WSN16

WMO WWRP 4th International Symposium on Nowcasting and Very-short-range Forecast 2016

25-29 July 2016, Hong Kong

WSN16 臨近預報

ABSTRACT BOOK

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25 July 2016 (Monday)

Plenary Session

Presentation Date: 25 Jul 2016
Presentation Time: 11:00-11:30
Session Name: M1 (LT1) Plenary Session
Speaker Name: Brian GOLDING

Reducing the cost of disasters: Opportunities and challenges for Nowcasting

The Sendai framework is a year old. It commits the world to reducing the cost of disasters, whether human, economic or environmental, including through better knowledge of weather-related hazards and its application in warning systems. Our science is ready. Recent advances in numerical weather prediction enable us to predict the weather at the scale of the hazard beyond the very short period for which feature extrapolation is useful. Nevertheless, many challenges remain, not least in observing the hazards themselves. In my talk, I will identify some of the key technologies that offer pathways to delivering the Sendai goal. It is the aim of the WMO HIWeather project to direct research towards accelerating progress in these and other areas so as to develop operational capabilities of benefit to all countries.

Presentation Date: 25 Jul 2016
Presentation Time: 11:30-12:00
Session Name: M1 (LT1) Plenary Session
Speaker Name: Rita D. ROBERTS

Status and Challenges in Nowcasting High Impact Weather

In the first published book on nowcasting, Browning (1982) described the great need for timely, location-specific predictions of high impact weather that are of particular importance to commercial and general aviation for planning and routing air traffic, to the public for outdoor sporting events, and to the construction industry, power utilities and ground transportation organizations that conduct much of their work outdoors. Significant progress has been made over the past few decades with the advent of high speed computers and physical understanding of meteorological processes. This presentation will touch on the status in nowcasting high impact weather, highlight challenges in predicting specific types of weather events, and discuss promising technologies and techniques for the future.

Presentation Date: 25 Jul 2016
Presentation Time: 12:00-12:30
Session Name: M1 (LT1) Plenary Session
Speaker Name: Dr. Herbert PUEMPEL

Nowcasting, Transition and Mesoscale modeling requirements in next generation air navigation service provision

In modern, high density air traffic management there is ample evidence that adverse weather is responsible for a significant, if not dominant proportion of delays and demand-capacity imbalances. New air traffic management systems, aligned with the ICAO Global ATM Operations Concept and based on performance principles, are recognizing the need for MET information in a cooperative environment, in particular for Trajectory Based Operations and Airport Throughput.

Detailed requirements, however, will depend on the different use cases for ATM units ranging from Ground and Tower Control units to continent-wide Network Managers, and have to be seen in the context of a SWIM environment, where different types of aeronautical and MET information are shared between all relevant stakeholders. Consequently, Key Performance Indicators for MET information are a highly complex issue and need to be developed in close cooperation with the ATM and stakeholder units, as only the appropriate use of impact-converted MET information holds the potential of a positive impact on the performance of the air transport system.

The range in required lead times, consistency, accuracy and relevance of observed and predicted parameters, phenomena and state variables determine to a large extent the optimal source of information. These range from highly accurate in-situ data such as winds, temperatures and humidity to now-casts of severe convective storms, icing and turbulence.

Numerical weather prediction models are increasingly capable of explicitly predicting many basic parameters, but for the most disruptive and essentially stochastic phenomena such as severe convection seamless forecasting needs to reflect the increasingly probabilistic nature of the phenomena, building on techniques of ensemble prediction techniques. Their ability to be reliably calibrated in terms of event probability and risk of parameters exceeding user-defined threshold values will determine their value for air space performance improvement by permitting reliable mitigating actions in the presence of disruptive weather.

The relative merits of probabilistic forecasts for individual use cases needs to be determined with the partners of ATM and Airports and end users. New approaches may also be needed for specialized observing systems to improve our understanding of complex interactions between the different scales and forcing mechanisms of the atmospheric processes affecting aviation.

Oral Presentation

Presentation Date: 25 July 2016
Presentation Time: 13:40 -14:00
Session Name: M2A (LT1) Parallel
Session S1: Forecasting of high impact weather in very-short-range
Author/Co-author Name: Gyuwon LEE, Soorok RYU
Speaker Name: GyuWon LEE

Rainfall Nowcasting using Burgers' equation

Weather radar plays an important role in allowing quantitative nowcasts of rainfall. The most nowcasts of surface precipitation pattern using radar are generated by algorithms based on the advection of rain field. In this work, we propose an advection diffusion equation based nowcasting rainfall model with moving motion vectors. The diffusion term in this equation smooths the forecasting images for lead time and results in the increasing of some skill scores. Motion vectors are updated at each time by solving a system of two dimensional (2D) Burgers' equations. The procedure has the following steps. First, the initial motion vector field of precipitations approximated by variational echo tracking (VET) algorithm. Second, the time dependent advection or advection diffusion equation is solved alone or with 2D Burgers' equation. Then forecasts are approximated at each time step by solving these equations. Lastly, some verification results are compared with the Lagrangian extrapolation scheme (MAPLE). The high-resolution forecasts from all methods are evaluated for lead times of 2.5 min-3h against the rain intensity observations for 6 rainfall events over 250 x 250 km area in south-eastern Korea. To observe the effects of diffusion term and moving motion vectors (obtained from Burgers' equation), the methods are classified into 4 types according to the types of equations: advection equation (Type 1), advection equation with Burgers' equation (Type 2), advection diffusion equation (Type 3), and advection diffusion equation with Burgers' equation (Type 4). The forecasts from the Type 1 method were very similar as the ones of MAPLE. Whereas the other models (Type 2-4) clearly have better skill scores and correlations compared to MAPLE up to lead time of 3h on average.

Presentation Date: 25 July 2016
Presentation Time: 14:00 -14:20
Session Name: M2A (LT1) Parallel
Session S1: Forecasting of high impact weather in very-short-range
Author/Co-author Name: Kanghui ZHOU, Yongguang ZHENG
Speaker Name: Kanghui ZHOU

Thunderstorm identification, tracking and nowcasting using lightning data

Lightning almost always accompanies convective storms in whose whole lives, so lightning activity could reflect the development of storms effectively. The national lightning detection network has been steadily worked for many years, making it possible to get the lightning location data instantly all over China. Because the lightning data transfers fast, it has a better performance in real time than radar and satellite data, which would be highly valuable in convective system monitoring. As a result, it was widely used in monitoring the convective systems.

A new method for flash cells identification, tracking and nowcasting was proposed. The Cloud-to-Ground lightning location data all over China was applied in this method. First, a new cluster algorithm, clustering by fast search and find of density peaks, was utilized to recognize the flash cells by cluster the flashes. Time and area distribution characteristics of flashes were used in identification. Second, tracking the moving path of cells by the Kalman filter, in which process the cell spit and merge were considered. Finally, based on the previous path, the linear moving path would be predicted in next 60 minutes by the Kalman filter.

The lightning location data in 2013 was processed by this method. Doppler radar data was applied to evaluate its performance, which proved its effectiveness on identification and tracking for flash cells, including the splits and merges. One case was analyzed in detail, showing lightning only appear in deep convective systems which usually accompanied with severe weather. It also has a nowcasting ability as better as TITAN (Thunderstorm Identification, Tracking, Analysis and Nowcasting) for thunderstorm in 60 minutes, even better in some aspects. The POD and CSI decreased dramatically with time. The POD of nowcasting for 10 minutes was about 0.7, while it was about 0.6 and 0.2 for 30 minutes and 60 minutes respectively. The corresponding CSI were 0.44, 035 and 0.2. Conversely, the FAR increased rapidly from about 0.4(10 minutes) to 0.7(60 minutes). All of those showing that the linear prediction is reliable in short time. This method could be applied to monitor and nowcasting the thunderstorm all over China effectively in real-time, assisting weather forecasters in severe weather nowcasting in 60 minutes. Furthermore, it was found that flashes disappeared in advance obviously in the dissipation stage of storms, which would be an indicator in predicting the end of convective systems.

Presentation Date: 25 July 2016
Presentation Time: 14:20 -14:40
Session Name: M2A (LT1) Parallel
Session S1: Forecasting of high impact weather in very-short-range
Author/Co-author Name: Bernard ALILONU
Speaker Name: Bernard ALILONU

Thunderstorm Forecasting in Very-Short-Range OVER ABUJA

Tremendous improvement in the accuracy of forecasts and warnings of thunderstorms and associated weather phenomena issued daily from the Nigerian Meteorological Agency's Central Forecast office (CFO) and forecast offices located at the nation's international airports has been achieved through the use of satellite imageries to monitor the evolution and movement of storms. Storms move from east to west across the West African sub region. However, observations have shown that not all storms that originate in the east eventually reach their expected destinations in the west. The CFO disseminates these daily forecasts as well as updates of expected adverse weather events through the national television and radio stations while aviation warnings issued at the airport forecast offices are disseminated through the control tower and other communication channels at the airports.

This paper aims at further improving the accuracy of very-short-range forecast of thunderstorms over Abuja through a combination of Satellite, NWP and Synoptic forecasting techniques. It examines the role of teleconnections between the mid-latitude troughs, thermal lows over the Sahara and thunderstorm occurrence over Abuja.

Daily analysis and diagnosis of real-time Europe-Africa surface synoptic charts and T-Φ gram plots for Abuja for the 2015 summer season (April-October) have been done. Also analyzed are daily satellite imageries and model NWP charts obtained from the "PUMA" synergy equipment in the CFO.

Also in this study, some of the disasters associated with thunderstorms and associated weather phenomena over Nigeria are highlighted while efforts are made to identify some of the socio-economic benefits of very- short-range forecasts.

Presentation Date: 25 July 2016
Presentation Time: 14:40 -15:00
Session Name: M2A (LT1) Parallel
Session S1: Forecasting of high impact weather in very-short-range
Author/Co-author Name: Shu-Yan TANG
Speaker Name: Ping CHEUNG

A simple 1D numerical model for operational nowcasting of sea breeze at the Hong Kong International Airport

The Hong Kong Observatory has been using a one-dimensional numerical model to predict occurrence and onset hour of sea breeze at the Hong Kong International Airport. The model is conceptually based on Bjerknes Circulation Theorem, with the modelled baroclinic circulation iteratively driven by land-sea differential in air temperatures in the zonal direction, where temperatures in modelled time are stepwise computed using theoretical solar radiation modified by forecast cloud cover subject to theories of heat transfer. Due to its ultra-simplicity, each of its run consumes very little computer resources and completes almost immediately. The model is run half-hourly, with the latest weather actuals, including background wind and air temperatures over land and sea, serving as inputs. Its output provides useful guidance for forecasters in making operational nowcasts. The model achieved average accuracies around 78% and 76%, respectively, in predicting whether sea breeze would occur or not, and the onset hour of sea breeze at the airport within a tolerance of one hour.

Presentation Date: 25 July 2016
Presentation Time: 15:00 -15:20
Session Name: M2A (LT1) Parallel
Session S1: Forecasting of high impact weather in very-short-range
Author/Co-author Name: Peiris T.M.N.
Speaker Name: Peiris T.M.N.

Instability Indices and forecasting Mesoscale Thunderstorms for BIA Airport

Sri Lanka is a maritime country and is affected by severe thunderstorms and mesoscale systems, which is a major hazard for aviation. Due to very high humidity, mean temperature of more than 250C, which is the characteristics of this region and unstable atmosphere, lead to thunderstorms especially during the two inter monsoon periods (March – April and October – November) and breaking periods of NE monsoon which effect to the SW part of Sri Lanka.

Studying the mesoscale convective system (MCS) over Sri Lanka (SL) using satellite data (Geostationary Kalpana data and MODIS data) with Model output data (GFS reanalysis data) and finding the thresholds for atmospheric stability is useful and essential for now-casting purposes in the aviation activities.

Atmospheric stability plays an important role during convective activity. At present the atmospheric stability is computed from radiosonde ascends over SL region, which has only one upper air station at the Colombo main meteorological office which is operated twice a week. To overcome this lacuna in sounding, satellite derived stability parameters with NWP data is useful, since it has better spatial and temporal coverage. This will help to predict severe weather such as thunderstorm more accurately at least three or four hour before the actual event.

During this study, data are chosen in the year 2015 based on the severe weather reports prepared by Meteorological Office in the International Airport at Katunayake.

Presentation Date: 25 July 2016
Presentation Time: 13:40 -14:00
Session Name: M2B (LT2) Parallel Session S2: New observational instruments
Author/Co-author Name: Steven GOODMAN, Daniel LINDSEY, Timothy SCHMIT
Speaker Name: Steven GOODMAN

GOES-R Rapid Refresh Imagery Capabilities for Nowcasting High Impact Weather

The next generation of GOES, the GOES-R series, with planned launch in late 2016 offers improved spacecraft and instrument technology to provide more accurate, detailed and timely detection of high impact environmental phenomena, and at the same time significant opportunities and challenges in quickly creating, updating, and disseminating data and products in near real-time to produce more accurate forecasts and warnings. The Advanced Baseline Imager (ABI) will provide three times more spectral information, four times the spatial resolution, and more than five times faster temporal coverage than the current system with rapid scan imagery of severe storms, tropical cyclones, volcanic eruptions, and fires potentially as often as every thirty seconds in mesoscale mode and at least every 5 min or 15 min (as opposed to the 7.5, 15 or 30 min data from today's imager). Additional advancements over current GOES capabilities include continuous total lightning detection and mapping of in-cloud and cloud-to-ground flashes from the Geostationary Lightning Mapper (GLM) with only twenty second latency or less, and increased dynamic range, resolution, and sensitivity imaging solar activity. The total lightning is very useful for identifying hazardous and severe thunderstorms, monitoring storm intensification and tracking evolution. Used in tandem with radar, satellite, and surface observations, total lightning data has great potential to increase lead time for severe storm warnings and improve public safety. The space weather instruments provide more detailed observations of coronal mass ejection, solar flares, and energetic particles to produce more accurate forecasts and warnings of solar storms that impact aviation, navigation, power transmission, and more. The data from the ABI, GLM and space weather instruments will have a wide-range of uses and multiple societal benefits in areas such as severe weather, energy, transportation, and commerce. This presentation will highlight the new capabilities that GOES-R will provide using recent examples of simulated and other proxy imagery.

Presentation Date: 25 July 2016
Presentation Time: 14:00 -14:20
Session Name: M2B (LT2) Parallel
Session S2: New observational instruments
Author/Co-author Name: Nicolas GAUSSIAT, Clotilde AUGROS, Daniel IDZIOREK, Jean-Marc MOISSELIN
Speaker Name: Nicolas GAUSSIAT

A radar network and products to better detect and forecast severe weather in France.

Météo France weather radars are critical components of the French observing network for monitoring and forecasting severe weather events. Volume reflectivity and Doppler observations, from the metropolitan radars are assimilated into the high resolution model AROME and its dedicated version for nowcasting AROME-PI, to improve the short and long range forecasts (Montmerle, 2009, Wattrelot, 2014). A maximum reflectivity, QPE and a wind-shear composite products, produced every 5' at the spatial resolution of 1km² (Figueras, 2013, Augros 2013) are used by downstream nowcasting applications to produce heavy rainfall warnings (APIC), deep convection product for aviation (ASPOC) and a storms and squall lines tracking objects (OPIC) for forecasters.

In response to a constant need for a better coverage of the lower part of the atmosphere, the number of French radars has increased from 13 in 1995 to 31 in 2015, and with the recent addition of 4 X band radars in the Alps, the 3 wavelengths, S, C and X are now being used in the network. All the radars are Doppler and operated with a triple PRT scheme that allows velocity measurements up to maximum range. Dual polarisation has become the standard with dualpol parameters Zdr, Rohv, Phidp being produced by 25 metropolitan radars and 1 overseas' radar. The densification of the network and the operational use of dual polarisation have greatly contributed to improve the quality of the composites and of the QPE products in particular.

In this paper, we will give an overview of the most recent operational implementations that include: the wind-shear composite product, the new dual-pol processing chain that uses KDP and operates at all three frequencies to deliver improved rain rates and hydrometeors types, the new spatialized gauge adjustment procedure to improve further QPE at intermediate (80-150km) and long ranges (>150km). Then, we will examine how the different improvements brought to the radar network and products are carried through to the nowcasting applications to produce better warnings and short-term forecasts of severe weather.

Clotilde Augros, Pierre Tabary, Adrien Anquez, Jean-Marc Moisselin, Pascal Brovelli, and Olivier Bousquet, 2013: Development of a Nationwide, Low-Level Wind Shear Mosaic in France. Wea. Forecasting, 28, 1241–1260.

Jordi Figueras i Ventura and Pierre Tabary, 2013: The New French Operational Polarimetric Radar Rainfall Rate Product. J. Appl. Meteor. Climatol., 52, 1817–1835.

Thibaut Montmerle and Claudia Faccani, 2009: Mesoscale Assimilation of Radial Velocities from Doppler Radars in a Preoperational Framework. Mon. Wea. Rev., 137, 1939–1953.

Wattrelot, E., O. Caumont, et J.-F. Mahfouf, 2014 : Operational implementation of the 1D+3DVar assimilation method of radar reflectivity data in the AROME model. Monthly Weather Review, 142, 1852–1873

Presentation Date: 25 July 2016
Presentation Time: 14:20 -14:40
Session Name: M2B (LT2) Parallel
Session S2: New observational instruments
Author/Co-author Name: Clifford MASS, Luke MADAUS, Conor MCNICHOLAS
Speaker Name: Clifford MASS

One Billion Observing Sites Around the World: Will Smartphone Pressures Revolutionize Nowcasting?

Many popular smartphones have pressure sensors with reasonable accuracy for absolute pressure (~+-2hPa) and pressure change (~+-.1hPa). By the end of 2016, it is estimated that nearly one billion smartphones with pressure sensors will be in use around the world. The essential question is whether such a huge number of surface pressures can be used to substantially improve model initializations and short-term forecasts. Could smartphone pressure greatly improve nowcasting?

This talk will begin by describing the characteristics of smartphone pressure sensors and show the observation distributions from an initial attempt at collection. A series of data assimilation and forecast experiments will be described, using the WRF mesoscale model and the DART data assimilation framework, in which both pressure and pressure change from smartphones are applied.

The talk will end by examining the problem of collecting smartphone pressures and the potential of large numbers of such pressures in countries with a less dense conventional observational network.

Presentation Date: 25 July 2016
Presentation Time: 14:40 -15:00
Session Name: M2B (LT2) Parallel
Session S2: New observational instruments
Author/Co-author Name: Volker WULFMEYER, Andreas BEHRENDT
Speaker Name: Volker WULFMEYER

Why is thermodynamic profiling essential for improving the performance of nowcasting systems?

Unfortunately, significant gaps exist in the observation of lower tropospheric water-vapor (WV) and temperature (T) profiles, which in the following are called thermodynamic (TD) profiles. Still to date, the structure of the lower troposphere from the surface layer, to the atmospheric boundary layer (ABL) to the lower troposphere must be considered as "terra incognita".

Corresponding observations are essential for improving our understanding of the Earth system with respect to radiative transfer, land-atmosphere feedback, convection initiation, and data assimilation (DA) including numerical weather prediction (NWP) for nowcasting and very-short-range forecasting.

We demonstrate that thermodynamic profilers will have a substantial positive impact on the skill of weather forecast models, if these are capable of providing not only integrated information but also gradients of the TD profiles in the stable or unstable atmospheric surface layer close to the ground, in the mixed layer, in the interfacial layer, and the lower troposphere. Furthermore, 3-dimensional scanning capabilities and their synergy with radar observations are beneficial.

We analyze whether current and future passive and active remote sensing systems resolve these gradients including passive infrared and microwave spectroscopy, the global navigation satellite system, as well as WV Raman lidar (WVRL), T rotational Raman lidar (TRRL), and WV differential absorption lidar (WVDIAL).

It is demonstrated that only active remote sensing has the capability to resolve WV and T gradients up to the lower troposphere and provides even 2- to 3-dimensional measurements with highest accuracy, which can be considered as bias-free for DA applications. In combination with their very short latency and their nearly instantaneous provision of error covariance matrices as well as their suitability for operation in networks over land and the oceans, e.g. on buoys, make them very suitable for NWP for nowcasting and very-short-range forecasting. In this connection, it should be considered that radar DA alone will suffer from substantial imbalances in the model system until the gap of consistent information of the TD pre-convective environment and the environment of convective systems is closed by a well-designed synergy with clear-air TD and wind observing systems.

Consequently, active TD profiling systems are very promising options for the set up and operation of networks for process studies, model verification, and DA. The latter is confirmed by impact studies using WV lidar systems and, to our knowledge for the first time, the assimilation of TRRL data in a mesoscale model using a 3DVAR in combination with a 3-h rapid update cycle. In this study, it is shown that the assimilation of temperature profiles does not only reduce the temperature bias and rms but also corrects the ABL depth and the strength of the temperature inversion. The impact region covered a domain of several 100 km. For a suitable, future mesoscale network design, three ingredients are considered particularly important: 1) The intensification of the development of commercially available, active TD profiler systems, 2) the design of synergetic lidar and radar networks, and 3) the performance of dedicated observing system simulation experiments.

Presentation Date: 25 July 2016
Presentation Time: 15:00 -15:20
Session Name: M2B (LT2) Parallel
Session S2: New observational instruments
Author/Co-author Name: Xavier CALBET, Miguel Angel MARTINEZ
Speaker Name: Xavier CALBET

Future Nowcasting SAF products for the Meteosat Third Generation Infrared Sounder (MTG-IRS)

The NWC SAF is preparing its products for the upcoming geostationary hyperspectral infrared sounder, MTG-IRS, with a planned launch not before 2021. It will deliver some 2000 infrared channels from geostationary orbit with spectral resolution of 0.625 cm -1 and a spatial resolution of 4 km at nadir and a repeat cycle of around 1 hour (30 minutes over the LAC-4 region which includes Europe). From these measurements it is possible to obtain profiles of temperature and humidity with a vertical resolution of about 1 km, 2km and an accuracy of 1 K, 15% respectively. This instrument will therefore provide meteorological information with an unprecedented temporal resolution and high vertical and spatial resolution of temperature and humidity, most likely becoming a fundamental tool for Nowcasting.

The set of products that the NWC SAF is preparing for MTG-IRS are:

- qIRS: quick IRS products. These will be fast processing linear combinations of channels which could serve many purposes such as:

  - Rough profiles of temperature and water vapor, together with their corresponding instability indices.
  - Future innovative RGB composites collecting information from various channels or physical properties.
  - Radiances or brightness temperatures from selected channels and simple operations (difference, maximum, etc).
  - Highlight of some physical property such as: detection of inversions, humidity layers, ozone, etc.
  - The tool is flexible enough such that it can be utilized for any other application a particular user may find useful.

- sSHAI_ES: sounding Satellite Humidity And Instability from EUMETSAT Secretariat. EUMETSAT Secretariat will provide profiles of temperature and humidity derived from an optimal estimation algorithm for clear scenes. The NWC SAF will use these as inputs to derive humidity and instability products, and also joining and re-projecting of the data onto a user defined region.

- sSHAI: sounding Satellite And Instability. The NWC SAF will derive profiles of temperature and humidity for clear and cloudy scenes using a fast non-linear regression algorithm. These will be provided to the user together with humidity products and instability indices, and also joining and re-projecting of the data onto a user defined region.

Presentation Date: 25 July 2016
Presentation Time: 15:50 -16:10
Session Name: M3A (LT1) Parallel
Session S1: Forecasting of high impact weather in very-short-range
Author/Co-author Name: Benedikt BICA, Ingo MEIROLD-MAUTNER, Alexander KANN, Yong WANG
Speaker Name: Benedikt BICA

Enhanced use of Radar and Satellite data within the INCA Analysis and Nowcasting System

In its standard version, the INCA analysis and nowcasting system provides objective estimates of precipitation fields by using rain gauge data along with radar data as background information. The nowcasting is based on motion vector fields which are derived from correlations between patterns in previous analyses. These patterns provide information for a kinematic extrapolation over the first few hours of lead time.

In recent experiments the potential benefit of satellite derived precipitation products was investigated. In a first step, and in accordance with the requirements of nowcasting, the CRR (NWCSAF), H03 (HSAF) and HE (NOAA) products were selected as possible candidates in a satellite based nowcasting system, where the analysis is computed from a weighted mean of station and satellite precipitation, with weights taken from a logistic function. The validation was carried out by comparing the satellite-based analysis fields against existing INCA precipitation analyses.

Generally, a systematic underestimation of satellite derived precipitation was observed. Resulting from the produced statistics and scores, the H03 product from HSAF was selected as the most promising candidate for accurate satellite based analysis and nowcasting.

A validation was carried out by using both standard error statistics and object oriented verification measures. Analyses were compared to radar based INCA fields as well as to NWP forecasts that would be available in an operational setting (i.e., with a time lag of a several hours). In comparison to raw satellite-derived precipitation, the analyses showed a superior performance, and the analyses also outperformed NWP forecasts within lead times up to around one hour. At longer lead times, the results deteriorate and drop below the scores obtained from different operationally available NWPs. In addition, sensitivity studies were carried out to investigate the influence of station density on analysis and nowcast quality. It turned out that a substantial reduction of stations does decrease the performance, but nevertheless the results still show a better performance at analysis time than what is obtained from NWP's.

In further experiments, means of improving the nowcasting performance were investigated, as by nature, motion vector-based short range forecasts cannot account for changes in shape and intensity of precipitation structures which occur especially in convective situations. For this purpose, cell-tracking vectors from the radar-based, object-oriented A-TNT system were used as additional information in INCA, as A-TNT also provides data on cell development. The cell tracking vectors were superimposed over the conventional motion vectors wherever applicable and thus applied modifications to the original extrapolation. Objective evaluations using the SAL verification method and standard scores clearly showed improvements in the nowcasting range.

The presentation will summarize the results from the experiments and it will identify further steps towards a refinement of the methodology and adaptations for operational use.

Presentation Date: 25 July 2016
Presentation Time: 16:10 -16:30
Session Name: M3A (LT1) Parallel
Session S1: Forecasting of high impact weather in very-short-range
Author/Co-author Name: Anthony REA, Stephan BOJINSKI, Alexander BAKLANOV
Speaker Name: Alexander BAKLANOV

SCOPE-Nowcasting – Introduction, Overview and Next Steps

An update on the Sustained Coordinated Processing of Environmental Satellite Data for Nowcasting (SCOPE-Nowcasting) initiative is provided. SCOPE-Nowcasting aims at ensuring continuous and sustained provision of consistent, well-characterized satellite products for nowcasting and severe weather risk reduction.

The four pilot projects of the Sustained Coordinated Processing of Environmental Satellite Data for Nowcasting (SCOPE-Nowcasting) initiative have made steady progress since their inception in 2013:

Pilot Project 1: Basic satellite imagery for Severe Weather Forecasting Demonstration Project (SWFDP) focus regions in Asia and South-West Pacific, including RGBs from Himawari-8, with key focus on consistent and agreed products across satellites from multiple operators

Pilot Project 2: Intercomparison of satellite-based volcanic ash retrieval algorithms, to inform operationalization of such algorithms for aviation services and ICAO

Pilot Project 3: Blended global satellite rainfall product for nowcasting and severe weather risk reduction using webmapping services

Pilot Project 4: Sand and dust monitoring in Asia using different data sources, exchange of ground-based validation data, and intercomparison of JMA and CMA algorithms

A meeting of the SCOPE-Nowcasting Steering Group is envisaged for early 2017.

Presentation Date: 25 July 2016
Presentation Time: 16:30 -16:50
Session Name: M3A (LT1) Parallel
Session S1: Forecasting of high impact weather in very-short-range
Author/Co-author Name: Kazuo SAITO, Tsuyoshi NAKATANI, Ryohei MISUMI, Yoshinori SHOJI, Hiromu SEKO, Naoko SEINO
Speaker Name: Kazuo SAITO

Tokyo Metropolitan Area Convection Study for Extreme Weather Resilient Cities (TOMACS): Lessons and outcome

An unprecedented dense observation campaign and relevant modeling and societal studies have been conducted since April 2010 by the National Research Institute for Earth Science and Disaster Prevention (NIED), Meteorological Research Institute (MRI), and more than 25 national institutions and universities in Japan that target local high impact weather (LHIW) in the Tokyo metropolitan area. The objectives of the project, the Tokyo Metropolitan Area Convection Study for Extreme Weather Resilient Cities (TOMACS; Nakatani et al. 2013, 2015), include the 1) elucidation of the mechanism of LHIW in urban areas (e.g., local torrential rain, flash flood, strong wind, lightening), 2) improvement of nowcasting and forecasting techniques of LHIW, and 3) the implementation of high resolution weather information to end-users through social experiments.

TOMACS science plan was endorsed in 2013 as an international Research and Development Project (RDP) of the World Weather Research Programme (WWRP) of the World Meteorological Organization (WMO) with international partners including Environment Canada (Canada), Bureau of Meteorology (Australia), Sao Paulo University (Brazil), University of Hohenheim (Germany), Pukyong National University (Korea), University ParisEst (France), National Center for Atmospheric Research (USA) and Colorado State University (USA). So far, three international workshops of the RDP TOMACS were held in 2013, 2014, and 2016. In the presentation, studies in TOMACS are reviewed, and the lessons and outcome obtained by the project are presented.

References:

Nakatani, T., Y. Shoji, R. Misumi, K. Saito, N. Seino, H. Seko, Y. Fujiyoshi and I. Nakamura, 2013: WWRP RDP Science Plan: Tokyo Metropolitan Area Convection Study for Extreme Weather Resilient Cities (TOMACS). WWRP report for Joint Scientific Committee, 26pp.

(available online at http://www.wmo.int/pages/prog/arep/wwrp/new/documents/Doc4_6_TOMACS_RDP_proposal_20130704)

Nakatani, T., R. Misumi, Y. Shoji, K. Saito, H. Seko, N. Seino, S. Suzuki, Y. Shusse, T. Maesaka, and H. Sugawara, 2015: Tokyo Metropolitan Area Convection Study for extreme weather resilient cities. Bull. Amer. Meteor. Soc., 96, 123-126.

Presentation Date: 25 July 2016
Presentation Time: 16:50 -17:10
Session Name: M3A (LT1) Parallel
Session S1: Forecasting of high impact weather in very-short-range
Author/Co-author Name: Jean-Marc MOISSELIN, Frédéric AUTONÈS
Speaker Name: Jean-Marc MOISSELIN

Convection Products of SAFNWC

The general objective of the SAFNWC (Satellite application Facility on support to Nowcasting and Very-short-range Forecasting) is to provide operational services to ensure the optimum use of meteorological satellite data in Nowcasting by targeted users. The SAFNWC is responsible for the development, maintenance and support of appropriate SW Packages. Two convection products are developed by Météo-France in the framework of SAFNWC: Convection Initiation (CI) and Rapidly Developing Thunderstorm (RDT). Both are applicable to geostationary satellites.

CI is a new SAFNWC product. It will provide the probability for a cloudy pixel to become a thunderstorm. The product will be released in summer 2016. Accordingly to literature, three categories of criteria have been defined to assess the thunderstorm development probability: cloud-top, cloud-growth, cloud-glaciation. In order to evaluate trends on each pixel, a displacement fields has been developed taking into account NWP 850 hPa winds, HRW SAFNWC product and displacement of warm cloudy cells. CI is tuned and validated thanks to RDT, lightning data and ground radar data.

The RDT is an older SAFNWC product. It provides in object-mode information about significant convective systems. Various attributes describe the convective system: cloud-top temperature and height, overshooting tops, morphological attributes, microphysics, etc. The product uses the satellite brightness temperature of various channels and optional data like NWP data, lightning data and other SAFNWC products. RDT is tuned and validated thanks to lightning data. The last version delivered to users is the v2013 and the next one will be the v2016: this new version will include a nowcast of convective systems (up to one hour). Météo-France operates the RDT on various domains covering the tropical and mid-latitude regions and the RDT is involved in various research projects.

CI and RDT will soon enter in a new phase of development with the CDOP3 (2017-2022), and will be prepared to be ready for the next Eumetsat generation of geostationary satellites.

Presentation Date: 25 July 2016
Presentation Time: 15:50 -16:10
Session Name: M3B (LT2) Parallel
Session S11: Special Session - CAS/CAeM Aviation Research Demonstration Project (AvRDP)
Author/Co-author Name: Ping-wah LI, Ping CHEUNG
Speaker Name: Ping-wah LI

Update of the Aviation Research Demonstration Project (AvRDP) Phase I and Short Brief to the Hong Kong IOP

The goal of the AvRDP is to, through international collaboration, develop, demonstrate and quantify the benefits of end-to-end nowcasting aviation weather services for the terminal area focused on high impact weather. The AvRDP will focus on nowcasting aviation weather, including the respective uncertainty/confidence estimation, over the Terminal Control Area for the next 0-6hr. The project is divided into two phases, Phase I - MET capacity research, and Phase II - MET-ATM impact translation and validation. After the project kicked off in June 2015, Hong Kong started its Intense Operation Period and data collection was completed in September 2015 for the convection season. The paper first provides an update on the latest progress of the project. It then gives a brief account on the Hong Kong IOP, including introduction of the dataset, some verification results and preliminary findings.

Presentation Date: 25 July 2016
Presentation Time: 16:30 -16:50
Session Name: M3B (LT2) Parallel
Session S11: Special Session - CAS/CAeM Aviation Research Demonstration Project (AvRDP)
Author/Co-author Name: Anupam KUMAR
Speaker Name: Anupam KUMAR

Did Weather play a key role for the crash of Air Asia Flight QZ 8501? A Review !

Aviation has an intimate relationship with weather. In Aviation the term 'Weather' is used not only to mean "What's happening now?" but also to "What's going to happen during my flight?" Based on these understanding the pilot will decide either to continue or cancel his flight. For pilots "Thunderstorms' are one of the most hazardous conditions, they encounter. All Thunderstorms can produce severe turbulence, icing, low level wind shear, low ceilings and visibilities, hail and lightning. In Aviation 'Turbulence' is considered to be one of the most unexpected aviation hazards by the pilots to fly through and also one of the most difficult hazards to forecast by the meteorologists. 'Aircraft icing' is another important aviation weather hazard that occurs when super cooled water freezes on impact with any part of the external structure of an aircraft during flight. Many aircraft accidents and incidents have been attributed to aircraft icing. Therefore, it's extremely important that pilots understand the dangers of aircraft icing. Even if an airplane is equipped and certified to operate in known icing conditions, there are limitations.

This study reviews the weather condition over the Java Sea where the Air Asia flight QZ8501 along with 162 passengers including aircrews on board suddenly disappeared from the radar monitor in early morning on 28th December 2014. The flight was just half way on its two hour flight to Singapore from Surabaya when it suddenly lost its contact with the Air Traffic Control. There are many theories that were immediately put across by aviation experts soon after the sudden disappearance of Air Asia flight. In one of the recent accident in June 2009, the Air France flight 447 (Airbus A330) crashed as the pilots were confused by faulty air-speed data after key sensors were covered with iced. For the Air Asia disaster, the final report was released by Ministry of Transportation, Indonesia that concluded that weather was not factor to the accident. So with these information's, "have we reached to a logical conclusion that weather did not contribute for the crash of Air Asia flight?" Or still we need to look on some finer details of weather situations that may have considered to contribute and cause the aircraft to encounter multiple challenges at higher altitude that finally reduced drastically its performance where it entered a stall and could never recover.

A detailed investigation has been performed using the dynamical modelling approach using a very high resolution "Weather Research & Forecasting Model" and a high resolution Reanalysis Data from ECMWF to model the weather on 28th Dec 2014 over Java Sea near the flight route of Air Asia. The aircraft pilot made his last contact to ATC at FL 320 at location S 3.3708 and E109.6911 "to avoid weather and requested for possibility of higher level". This leads to a couple of important questions which will be discussed in this study.

Presentation Date: 25 July 2016
Presentation Time: 16:50 -17:10
Session Name: M3B (LT2) Parallel
Session S11: Special Session - CAS/CAeM Aviation Research Demonstration Project (AvRDP)
Author/Co-author Name: K.K. HON
Speaker Name: K.K. HON

The Aviation Model – sub-km short-term forecasting at the Hong Kong International Airport

Situated on an artificial island surrounded by complex geography, the Hong Kong International Airport (HKIA), one of the busiest in the world, is susceptible to a wide range of meso-/micro-scale meteorological phenomena capable of impacting on aviation operations, which are often unresolvable by global models and challenging even to regional meso-scale models.

In support of fine-scale short-term forecasts at HKIA, the Hong Kong Observatory has begun real-time implementation of the Aviation Model (AVM) since late 2014. The AVM is a sub-kilometre analysis and prediction system based on the WRF (Weather Research and Forecast) model, providing hourly-updated forecasts up to 6 – 9 hours ahead for the Pearl River Delta region at a horizontal resolution of 600 m and for the immediate vicinity of HKIA down to 200 m. This paper presents the performance and application of the AVM in aviation-impact weather scenarios, including sea breeze occurrence, terrain-induced windshear and turbulence, and high temperatures. Challenges and opportunities in fine-resolution urban-scale modelling will also be discussed.

Presentation Date: 25 July 2016
Presentation Time: 17:10 -17:30
Session Name: M3B (LT2) Parallel
Session S11: Special Session - CAS/CAeM Aviation Research Demonstration Project (AvRDP)
Author/Co-author Name: Rajendra Kumar JENAMANI
Speaker Name: Rajendra Kumar JENAMANI

Bad Weather and Aircraft accidents- Global vis-à-vis Indian scenario

It is of great significance to identify and clarify the circumstances and the causes of any aircraft accident which will help to avoid any similar accident in the future. Besides attribution of various aircraft accident to avionic causes, bad weather remains as another prime cause for accident of many aircrafts and helicopters over India. But there is hardly any study in this regard in India using their long period data. When organization like USA based National Transportation Safety Board (NTSB), the Geneva-based Aircraft Crashes Record Office (ACRO) and some other researchers have analyzed factor-wise causes of aircraft accident in percentage using their long period data including percentage of aircraft accident due to various weather types e.g. low visibility/ceiling, wind shear, squalls etc., this is the high time when similar attempt is needed for India for their cumulative assessment and recommending better mitigation measures and regulations. In the present study, available studies and statistics in NTSB, ACRO etc., have been reviewed from the context of severe weather as major factors or cause of the aircraft accident followed by similar attempt for Indian region using data of annual aircraft accident report of 1992-2008 of Director General Civil Aviation (DGCA) of India.

Results show out of total aircraft accident, weather related accidents are 21% in India comparable to 22% in USA while it is 26-32% over the globe. Year-wise weather-related accidents though shows overall declined for respective domain, but not their ratio to total accidents. When these weather related aircraft accidents in India categorised among various types of aviation weather hazardous, it shows a highest 16% due to winds from gust, updraft and downdraft, another 16% due to low visibility and ceiling and 12% due to CB and Thunderstorms while for about 40%, nothing specific weather type had been mentioned in their DGCA accident Reports besides “bad weather”. In USA, it also shows the highest of 48% due to wind conditions followed by 20.5% as low visibility and ceiling as found for India. Since most private aircrafts including helicopter have many safety limitations, they are more likely accident prone compared to bigger aircrafts especially during bad weather. Hence we also carried out a study to validate this hypothesis. It shows out of all weather related accidents of various types in India, a highest of 56% as private type followed by 24 % as training type. We have also discussed how efficient use of newly available technology in Met Services may help to mitigate them to some extent.

Presentation Date: 25 July 2016
Presentation Time: 17:30 -17:50
Session Name: M3B (LT2) Parallel
Session S11: Special Session - CAS/CAeM Aviation Research Demonstration Project (AvRDP)
Author/Co-author Name: Rajendra Kumar JENAMANI,
Speaker Name: Rajendra Kumar JENAMANI

Thunderstorms, Dust storms and intense rainfall Monitoring and Nowcasting at Delhi(IGIA) during 2010-2015 using DWR, Satellite and surface Meso-scale observing system of four AWS and eighteen number of RVR

IGI Airport Delhi, normally experiences about 60 thunderstorms (TS) per annum (as per data of 1995-2014) with lowest of 22 in 2002 and highest of 105 in 2010. Out of all these, on an average, 16 are associated with squalls and Dust storms while it may be as low as 2 in 2014 and as high as 27 in 1997. Their occurrences has strong seasonal behavior with most of 89% occurred in Pre monsoon and monsoon covering March-Sept. They regularly have affected operation severely and following are some dates when it was worst:

May 2008 had most dates severe TS due to which ever highest number 70 flight diverted were diverted from IGIA in one month for storm season

Squall of 21 August 2009: A portion of the new domestic terminal building was damaged
21 May 2011: Ever big CB cell covered the airport 100km around, no flights pears down/up through for 2-hours during 1030PM till 1230AM :A total of 32- flights diverted
25 May 2011: Faridabad aircraft accident was due to a severe storm observed during 2200-2300 IST
6 June 2013: A day of four times change in wind direction, two wind peak of 25 and 35 kts and RWY closing 1115-1200UTC-24 Flights diverted
30 May 2014: at 0454PM of 30 May 2014 and lasted about 25-min with very strong winds up to 69kts, blinding the airport to dark with vis 200m, diverting 24 flights, damaging four parking aircraft. It was 2nd worst strom to hit IGIA. Last time, on 6 June 2006, a strong squall was hit IGI Airport when wind was reached to 74kt(138kmph) and this one remain all time record since data stored from 1995 for Palam airport.
2 Aug 2014: No Rain at IGI, 12 flight diverted as the CB was at flight path at IITD and NODIA side during 1100 to 1330IST (There was around 37.6mm rainfall at Safdarjung, 19mm at Lodi road, 3mm at Ridge, 14.3mm at Ayanagar, 3.2mm at Hindon and traces at Palam till 5.30pm)
13 June 2015: 16 flight diverted as season's worst Dust storm/Thunderstorm hit at 1459IST with wind of 51kts(95KMPH).
On 7th Aug: 2015 7 flights diverted by intense rain with TS during evening of 0715pm to 0800pm when around 40.2 mm rain was realized. Wind was of 30kt a
World's second-best airport, Delhi airport flooded on
16 June 2013: 117.8mm at 1300IST -1730 IST at IGI Airport with 30mm at City airport
15 Sept 2011: 115.6MM at IGIA 1435-1545 IST with City 35.0mm

In the present study, we have used data from DWR, Satellite and surface data from 4 AWS/18 RVR of IGIA to find checklists for their nowcast at 1-3 hours in advance. With airport has 42 sqkm and three RWY having 4 AWS and 18 RVR at various locations for each RWYs, we have used timings of DWR max Z and max Z of highest reflectivity and peak of surface winds and lowest RVR at respective location of the airport for major squall dates to determine the timing of gust front/dust storm those had affected respective RWY ends. We also have determined the time taken by each guest front/dust storm to travel from one end of airport from data of AWS/RVR located nearest to it, at RWY ends using their data. We have determined checklists for nowcast using same cases by considering maximum reflectivity. Nowcasting method from two cases of intense rainfall over Delhi are also discussed.

Poster Batch A

Poster ID: A01
Author/Co-author Name: Moudi Pascal IGRI, Roméo Stève TANESSONG,Derbetini Apollinaire VONDOU, Francois MKANKAM KAMGA, Jagabandhu PANDA
Speaker Name: Moudi Pascal IGRI

Added-Value of 3DVAR Data Assimilation in The Simulation of High Impact Weather Over Western and Central Africa

This study aims at evaluating the ability of a Numerical Weather Prediction (NWP) model to capture the spatial distribution and the magnitude of rainfall during 3 recent intense events (15-17 June 2011, 23-25 August and 04-06 September 2012) observed over Western and Central Africa, as well as the associated atmospheric and near surface conditions. For each event, two numerical experiments are performed using the Weather Research and Forecasting (WRF) regional model without (CNTL) and with (DA) data assimilation. Simulations are initialized with the Global Forecasting System (GFS) data.

The analyses are updated with the three dimensional variational (3DVAR) technique using prep-bufr and radiance observational data in a time window of ±3 hours. The potential added value of data assimilation is addressed by comparing meteorological variables such as relative humidity, zonal and meridional wind components, 2 m temperature and rainfall with the European Center for Medium Range Weather Forecasting Reanalysis (ERA-I) and the Tropical Rainfall Measuring Mission (TRMM) satellite-derived rainfall product datasets.

WRF accurately simulates the spatio-temporal propagation and the zonally extended structure of rainfall, as well as of relative humidity, 2 m temperature and horizontal wind components. DA exhibits different biases, root mean square error and spatial correlation leading to mixed results in terms of outperforming CNTL. Results indicated that there is an increment in control variables implying an added value from 3DVAR to the initial and boundary conditions. Rainfall forecasts were improved by 15-25%. Simulations outputs were also used for producing Terminal Aerodrome Forecasts (TAF).

Uncertainties in the simulation of intense events in the study domain were noticed, but improvement resulting from DA was limited due to lack of assimilated data in this region.

Poster ID: A02
Author/Co-author Name: Aldana Denisse ARRUTI GAMALDI, Aldana ARRUTI, Juan RUIZ, Paola SALIO
Speaker Name: Cynthia MATSUDO

Preliminary evaluation of a short range precipitation forecast system

In Southern South America, there are several regions where weather conditions are able to generate storms that might reach severe characteristics. It is for this reason that it is of great importance to advance in the development of very short term forecast (nowcasting). A forecast able to provide detailed information about the location and intensity of convective cells capable of producing severe phenomena is needed. Moreover, the implementation of such techniques is an even more ambitious goal given as they are not operationally implemented in our country yet.

In the present work it is proposed to develop and evaluate a very short-term model forecast based on extrapolation techniques of the reflectivity field. Assuming that the precipitating systems on time scales associated to nowcasting (1-6 hours) can be described from the movement seen in previous successive images, a semi- Lagrangian advective extrapolation method field reflectivity was implemented. This method is based on determining displacement vectors between successive fields using various techniques. In addition, it was studied the quality dependence of the forecast reflectivity at very short term on different similarity measures used in the calculation of the movement field and its post-processing. It was found that the proposed extrapolation technique presents a good performance once precipitation systems are already developed, but shows poor performance when systems present both strong growth and intensification rates.

The range of motion of the convective system was possible to adequately capture in spatial scales of the order of 100 km, but when trying to represent smaller scale components no good results were obtained. Evaluating the performance of the forecast and the time of its calculation, the best results were obtained by using the mean squared error as a measure of similarity, quality control of the displacement vectors based on detecting local extremes and a time interval of 10 minutes between reflectivity images.

Poster ID: A03
Author/Co-author Name: Leonardo CALVETTI, Rafael INOUYE, Cesar BENETI, Réverton NEUNDORF, Bianca MASKE, Dirceu HERDIES, Luis Gustavo GONÇALVES, Fábio DINIZ, Tiago NORONHA
Speaker Name: Leonardo CALVETTI

Measurements and Numerical Simulations of Wind Gusts on High-Power Transmission Towers

Since high-power transmission towers has been systematically blown down by wind gust during strong storms, sonic anemometers were installed in four towers in the west of Parana State, southern Brazil, to investigate the dynamic characteristics of these winds and their relationship with the storms. In three towers, sonic anemometers were installed in three levels, 10m, 20m and 30m. In another tower it was installed an additional sensor at 44m. The towers were located within a 60km radius distance of the dual-polarization S-band weather radar operated by the Meteorological System of Parana State (Simepar). High-resolution simulations (3 km) using WRF/NCAR MARS (Model Rapid Assimilation of Simepar) and 3DVAR data assimilation of radar reflectivity and radial velocity were performed for strong and moderate convection events. The assimilation module of MARS runs under a rapid updated cycle with radar data input every 15 minutes. Lateral boundary conditions were updated every hour using a 9km-grid WRF model named CAR, from the Center for Weather Forecasting and Climate Research of the National Institute for Spatial Research of Brazil (Cptec/Inpe). CAR is a WRF-based model that runs with GFS lateral boundary conditions and with an assimilation of satellite radiances, surface data and sounding observations in South America.

The investigation shows that in some events, it was possible to verify a qualitative association between weak reflectivity signals and moderate (10 to 15 ms-1) gust measurements. High wind peaks (20 – 27 ms-1) were correlated with strong long-lived squall lines and severe convection associated with cold fronts. Although supercells have been observed in the region, they were not registered in any occurrence over the campaign area. Another interesting result found in the campaign was that during events with strong gusts (greater than 15 ms-1) the vertical structure of the wind becomes linear, probably due to the propagation of the gust fronts. Therefore, while the average wind profile has a exponential shape, during the storms the profile shift to linear with similar values from the 10m up to 44m level.

The model has proven to be a useful tool to simulate the storms, but it cannot properly solve the observed intensity of the wind gusts. Better results were found increasing the horizontal resolution (up to 1km), vertical resolution (up to 60 levels) and time-step (up to 30s). Even with an assimilation cycle, the simulations showed a high-dependency with the position of the phenomena in the GFS initial conditions, indicating that if the analysis cycle does not indicate a correct location of a cold front or small troughs, the WRF cannot correct the position. The results of this research will be presented in this conference.

Poster ID: A04
Author/Co-author Name: Alena TROJAKOVA, Antonin BUCANEK, Patrik BENACEK
Speaker Name: Alena TROJAKOVA

New nowcasting frame-work in ALADIN/CHMI

Considerable progress has been made recently in use of numerical weather prediction (NWP) for nowcasting. Adapted mesoscale NWP system have shown a capability to outperform classical weather forecast for nowcasting ranges (0-6h) thanks to the use of more recent observations. Particularly high-resolution wind information is essential for formation of small horizontal scale features and deep vertical structure in extra-tropics. Therefore, modern air traffic surveillance systems (Mode-S) have received substantial attention due to its capability to provide high resolution observation of temperature and wind, e.g. Mode-S EHS (de Haan, 2011) and Mode-S MRAR (Strajnar, 2012).

We shall present an assessment of quality of new aircraft Mode-S observations available in the airspace of the Czech Republic. The state-of-the-art NWP system ALADIN operationally used at Czech Hydrometeorological Institute (ALADIN/CHMI) is used to evaluate impact of the Mode-S observations on forecast. We have also explored a potential of new Mode-S aircraft observations in a nowcasting context via near real time high resolution diagnostic analyses of upper-air wind and temperature. Diagnostic analyses aim to provide self-consistent diagnostic, which can help to identify regions where severe weather events could appear. Diagnostic analyses can be seen as nowcasting for period of 0 hour and the system can be eventually extended by very short time forecast to comply with the whole nowcasting ranges. A combination of recent observations with latest first guess given by the operational NWP model ALADIN/CHMI is used to produce the diagnostic analyses. Atmospheric fields are analysed using the 3D-Var method and near-surface parameters by OI method. The system relies on the NWP ALADIN system and like that it can assimilate not only aircraft observations, but also other conventional and remote sensing data. We will present the first results and the set-up of this new nowcasting frame-work, based on adaptation of the operational ALADIN/CHMI setting.

Poster ID: A05
Author/Co-author Name: Diego SOUZA, Rafael LE MASSON DE SOUZA, Rayana ARAÚJO
Speaker Name: Diego SOUZA

Study of flash floods over some parts of Brazil using precipitation index

In Brazil, the main phenomena related to natural disasters are derived from the Earth's external dynamics such as floods and flash floods, landslides and storms, where the flash flood phenomenon causes the second highest number of victims, totaling more than 32% of deaths. Floods and flash floods are natural events often triggered by storms or long period of rains, usually associated with rising volume of rainfall on the watershed, leading the river to exceed its maximum. Whereas the occurrence of natural disasters in Brazil is increasing in recent years, the use of more accurate tools to aid in the monitoring of extreme hydrological events it becomes necessary, aiming to decrease the number of human and material losses. In this context, this paper aims to implement an early warning and monitoring system related to extreme precipitation values and hydrological processes. So, initially were studied flood events in the states of São Paulo and Paraná, aimed de determination of the characteristics of rainfall and atmosphere. Later it was used an indicator of precipitation based on the climatology, which indicates warning points on the drainage network related to extreme precipitation, which are obtained by remote sensing sources, for example, radar and satellite, and numerical weather prediction data of short and very short term. The results indicated that most of the flood events over the study area was related to rainfall of deep convection. The use of precipitation indicators also helped the monitoring and the early warning, showing this to be an excellent tool for applications related to flash floods.

Poster ID: A06
Author/Co-author Name: Lan TAO, Jianhua DAI, Min SUN
Speaker Name: Lan TAO

Simulated Downburst Model Design for Aviation Airborne Radar

Wind shear caused by downburst has great threat on the aircraft taking off and landing, and may cause disastrous consequences. Based on the downburst empirical model and evolution process, combined with the actual observation data, the module of the downburst model was designed, which can generate three-dimensional wind field and reflectivity distribution field of downburst mature period, outbreak period and dissipation stage in every minute. The F factor was adopted to test downburst model data set , and the data set were provided for the test of aviation airborne radar wind resistance ability and warning threshold research for various types of aircraft.

Poster ID: A07
Author/Co-author Name: Lesley ALLISON, Lesley ALLISON, Marion MITTERMAIER, Chris VERNON, Katie NORMAN
Speaker Name: Robert SCOVELL

Quantifying the effect of radar observational uncertainty on the verification of kilometre-scale NWP precipitation forecasts using the Fractions Skill Score

When performing forecast verification, the observed values are commonly treated as "truth", and differences between the forecast and observed fields are generally attributed to model error. However, observational uncertainty can be large, particularly in complexly-derived fields such as the Quantitative Precipitation Estimates (QPE) from radar. In this study, we make use of a new radar ensemble product that has been developed for the UK radar network, which accounts for the effects of random errors in the vertical profile of reflectivity (VPR) on the QPE derivation, yielding an ensemble of estimated rainfall rates. We use this radar ensemble in the precipitation verification of the operational Met Office UKV model, which provides deterministic forecasts for the UK at 1.5 km resolution. With this spatial resolution, the UKV is able to provide precipitation forecasts that are deemed more realistic (particularly in the intensity and spatial characteristics of convective precipitation) than lower resolution models. However, traditional verification metrics tend to penalise high-resolution models for failing to exactly match the observed rainfall at the (inherently unpredictable) grid scale. For this reason we use the Fractions Skill Score (FSS), which is a verification metric that assesses the fractional coverage of precipitation at a variety of spatial scales, giving a better assessment of the true quality of forecasts. The range in FSS (rFSS) across the radar ensemble varies with the spatial scale and accumulation threshold considered, but early estimates indicate that it may be ~10% of the traditional “single radar field” score, and substantially larger at high accumulation thresholds. This evidence suggests that the (usually unaccounted for) effect of radar observational uncertainty on NWP verification metrics can be relatively large, and should be taken into account when assessing the relative performance of forecasts from different modelling systems, especially when using absolute accumulation thresholds.

Poster ID: A09
Author/Co-author Name: Dixiang XIAO, Nini TU, Shengxiu QI
Speaker Name: DiXiang XIAO

Diagnosis Analysis and Numerical Experiments of a Rainstorm Case along the Longmen Mountain

To research the forming and developing mechanisms of the rainstorm event along the mountain in western Sichuan Basin and the influences of the topographic and the initial temperature and humidity condition for rainfall intensity and region, diagnostic analysis and numerical experiments were performed for a rainstorm process which occurred on 17 to 18 August 2012 along the Longmenshan depended on conventional observation data, FY2E TBB data and southwest regional numerical model products(WRF-RUC). It was shown that: The mesoscale convective system was accompanied with the high energy, high wet and instability regions. The convection developing was closely related to the evolution of low-level east winds. Before the rainstorm occurring, the wind speed convergence and topographic lifting increasing in western Basin with low-level east winds increasing, which was the dynamical mechanism of the vertical ascending movement strong developing. The rainstorm regions moved west when the topography was altered. The decrease of initial temperature and humidity condition would greatly decrease the rainfall intensity. Without surface heat flux, the rainfall intensity weakened too.

Poster ID: A10
Author/Co-author Name: Kang LAN, Rui SHI, Diixiang XIAO, Weihua LIU
Speaker Name: Kang LAN

Analysis of an extreme gale in Sichuan Basin

Using multivariate observation data, the paper analyzes the April 4, 2015 in the evening at night gale weather process occurred in Sichuan Basin. Analysis pointed out that the background conditions of this gale weather is the cold advection in the upper air, ground cold air and early high temperature. The disparity of characteristics in ambient field could result in the different feature of gale. In the west of basin, the energy is weak, stratification is stable and the gas water column is low. The different temperatures of air pressure gradient to form gradient winds. The Velocity chart shows, in the near of radar, the characteristic of low elevation radial velocity high value and high elevation bull's eye. The Middle East energy increased, gas is not stable, and the whole layer of water vapor content is higher than the west. The ground cold air and high altitude cold advection trigger the formation of thunderstorms. There are hollow dry layer, large temperature lapse rate and coupling of high-low jet area in northeast of the basin, these provide good conditions for the formation of a squall line. The interaction of the Mesocyclone circulation, v-front inflow and rear inflow form bow echo.it has much higher reflectivity, liquid water content and the typical structure of hailstorm than ordinary thunderstorm. The whereabouts of continuous high reflectivity factor makes the downdraft enhancement, to bring ground wet downburst wind, and the precipitation drag effect further increases the wind strength.

Poster ID: A11
Author/Co-author Name: Mengjuan LIU, Shun LIU
Speaker Name: Mengjuan LIU

Evaluation of Wind Profiler Network Data in Shanghai

The horizontal wind observations from seven boundary layer profilers in Shanghai were evaluated by analysis data from the NCEP Global Data Assimilation System (GDAS) during June, 2014. Since the intensive observations from rawinsonde in Shanghai had not been assimilated by GDAS, these data were used to evaluate NCEP's analysis data. The results shows that both bias and RMSE between rawinsonde observations and NCEP data were small, which indicates that NCEP's analysis data are accurate enough to evaluate the quality of profiler data in Shanghai. Then the profiler observations are further compared with NCEP's analysis data, bias and RMSE are -0.14m/s and 2.72m/s for wind speed, -4.28°for wind direction over all heights for the entire month, respectively. The comparison shows that data quality of wind profiler in Shanghai is close to that of rawinsonde. Wind profiler observations in the network are reliable and can be used in operation or research.

Poster ID: A12
Author/Co-author Name: Yuhuan LI, Yu ZHANG, HanBin ZHANG
Speaker Name: Yuhuan LI

The Study of Sensitive Areas in A High Impact Weather in Beijing Based on A Regional Ensemble Forecast System

With the rapid development of national economy and urbanization, the negative impact of high impact weather (HIW) events on the safety of civil traffic, economy, is getting more and more critical. For high impact weather (HIW) events, adaptive mobile observation instruments can improve the forecast accuracy effectively. The ensemble transformation based sensitivity (ETS) method (Zhangyu, 2016) is used to identify sensitive areas for a rainfall case in Beijing in this study.

A regional ensemble forecast system (REPS) is used to identify the sensitive areas. The REPS of 20 forecasts with horizontal grid increments (grid numbers) of 6km (274×209) is employed in this study. The ICs for the control is the same as BJ-RUC 3km domain assimilated conventional observation、sounding data、GPS、aircraft data and automatic weather station data in Beijing. Both the initial conditions (ICs) and lateral boundary conditions (LBCs) perturbations are derived from Global Ensemble

Forecast System (GEFS). The ICs of the REPS are derived by the ICs perturbations and the control forecast ICs, which take account of both the large and small scales information.

Based on the REFS, the ETS calculates the sensitivity (gradient) of forecast error variance reduction in terms of analysis error variance reduction which is the first order approximation of the original perturbation ET method and reduces computational cost, and produce a similar data sensitive region as the ET method(YU ZHANG,2016). The rainfall day is associated with a low vortex that developed over northwestern China during 1-2 August 2015. The initial time of the regional ensemble forecasts is 0000UTC 1 August 2015. The verification area is covered from 114°E to 120°E and 37°N to 42°N. The estimation targeting observation area is the whole domain (105°E -120°E,35°N -45°N). The variables selected for the dry energy norm are the temperature and horizontal wind components at the 850,500 and 200hpa pressure levels. The verification time is 0000UTC 2 August, there are four adaptive time for the adaptive observations,-0h,-06h,-12h,-18h.The negative hours in adaptive time indicated the number of hours ahead of the verification time, correspondingly. The normalized signals of the sensitive regions are provided in this study. For this heavy rainfall case the sensitive signal shows that the sensitive areas are distributed around the trough (500hPa) which have existed at 24 hours ahead of the verification time and located in south – central of the Inner Mongolia; as the targeting time approached to verification time, the signal approached the verification area; the data impact experiment will be conducted to evaluate the contribution of this sensitive areas ;If we could identify these sensitive areas effectively, could help predict important weather phenomena on various temporal and spatial scales. So the study of sensitive areas in HIW based on REFS is useful to the observations network strategies.

Poster ID: A13
Author/Co-author Name: Zhigang CHU, Z. H. WANG, Hong GAO
Speaker Name: Zhigang CHU

Correction for GuangDong Radars Reflectivity Based on GPM/DPR Data

Due to calibration errors, CINRAD (China New Generation Weather Radar) ground-based weather radars (GR) reflectivity was often biased. In order to solve this problem, a new method is proposed by comparison of GR and GPM/DPR data to correct GuangDong GRs reflectivity. There were six steps to deal with the differences of electromagnetic wave frequency, particle scattering, path attenuation, observation space and the effects of non-uniform beam filling, ground clutter. From DPR and GR's geo-match data, a group of the best available subset was selected to calculate the bias of GR reflectivity. Finally, validations were performed based on GuangDong GRs data.

26 July 2016 (Tuesday)

Plenary Session

Presentation Date: 26 Jul 2016
Presentation Time: 09:00-09:30
Session Name: F1 (LT1) Plenary Session
Speaker Name: Peter Ping-wah LI

Overview of the Joint WMO Aviation Research Demonstration Project

The global air transportation will undergo significant upgrade in the next 15 year or beyond under the ICAO new Global Aviation Navigation Plan. To achieve this, aviation weather services will need to be enhanced. In particular the nowcasting and mesoscale modelling services near the terminal area of an airport will need to be upgraded to support the tactical and pre-tactical stage of the aircraft trajectory. In this connection, WMO Commission of Atmospheric Science and Commission of Aeronautical Meteorology jointly take forward an Aviation Research Demonstration Project (AvRDP) in 2015-2018 with a view to demonstrating the capability of nowcasting and mesoscale modelling techniques and providing a 'fast-track' transfer of the research results into operational applications to facilitate the national meteorological services under WMO to enhance their aviation weather services to provide sustainable high-quality services to support the safety, efficiency and regularity of air traffic management worldwide.

The objectives of the AvRDP are (i) to conduct research in nowcasting and mesoscale modelling at a few selected international airports to demonstrate the Meteorological (MET) capabilities in particular the nowcasting aspect; (ii) to collaborate with the respective Air Traffic Management (ATM) to demonstrate the benefits of the MET information to ATM; (iii) to transfer the knowledge gained in AvRDP to other WMO Members who need to enhance their aviation MET services. To study different high impact weather at different locale with different climatological conditions, several airports at different continents participate in the Project, namely, Charles de Gaulle Airport, Johannesburg Airport, Hong Kong International Airport, Iqaluit Airport, Shanghai Hongqiao Airport and Toronto Airport initially. The AvRDP is conducted in 2 phases. Phase I is conducted from summer 2015 till summer 2017 focusing mainly on the science aspect. This will be followed by Phase II which will focus on the translation of MET into ATM impact study. It is obvious that close collaboration between the MET and ATM community would be required for successful outcomes. The experience precipitated from AvRDP could serve as the basis for defining the ATM-tailored MET service for the terminal area to meet future ATM requirements and shared with other Members through technology transfer.

Presentation Date: 26 Jul 2016
Presentation Time: 09:30-10:00
Session Name: T1 (LT1) Plenary Session
Speaker Name: George A. ISAAC

Latest Nowcasting Technology for Aviation

Weather forecasting for short times, or the Nowcasting scale of less than 6 hours, is very important for airport operations and safety. Most incidents or accidents occur on take off or landing at airports. Most delays or operational disruptions occur at the airport itself and these are often weather related. However, routinely produced Terminal Aviation Forecasts are very limited in their uses for reducing safety hazards or economic impacts at airports. New methods of transmitting important weather information to airline dispatchers, airport operators, pilots, ground crews, and the travelling public are necessary. National Weather Services typically do not produce products that address important airport concerns. For example, it is necessary to have accurate visibility, ceiling, precipitation amount and type, winds, wind shear, and lightning forecasts at high time resolution. Many Nowcasting systems operate best when combined with good observations, which can be in-situ or remotely sensed. The existing weather conditions at the airport and their associated forecasts should be transmitted to users quickly. Those users are often not weather experts so the information must be clear and tailored to specific requirements. It is advantageous to have a skilled forecaster available to interpret the data/forecasts, especially in complex or high impact situations. These systems can be expensive so it is necessary to provide an economic or safety justification.

The above points will be illustrated using work mainly done in Canada. It is very important to verify forecasts so that the user has an appreciation of their limitations. Some variables, like visibility, require observations made with high time resolution. Observations also need quality control and careful attention. For example, radar nowcasts can use out-of-date algorithms to produce quantitative precipitation forecasts. Forecasts based on persistence can be very valuable and outperform more sophisticated approaches. Newer technologies, using both in-situ and remotely sensed observations and high resolution models, show promise for improving forecasts at airports.

Presentation Date: 26 Jul 2016
Presentation Time: 10:00-10:30
Session Name: T1 (LT1) Plenary Session
Speaker Name: Xiaoling ZHANG

0-12H VSR forecasting and nowcasting review and plan in CMA

0-12 h very-short-range (VSR) forecasting and nowcasting techniques are big challenges for China Meteorological Administration (CMA) to develop seamless weather forecasting from minutes to weeks. Recent years, the real time analysis technique based on the various observation data, the severe weather nowcasting by extrapolation and convective-allowing models have been progressing as optimization of the observation systems.

The Local Analysis Prediction System (LAPS) and its update version, Space-Time Multiscale Analysis System (STMAS) from NOAA, have been used in some local forecasting offices. The sounding, surface station, radar, satellite, wind profile, GPS-MET data were assimilated in the systems. The four-dimensional Variational Doppler Radar Analysis System (VDRAS), imported from NCAR by Beijing Meteorological Bureau, supports real time analysis products with 3 km horizontal direction, 375 m vertical direction and 12 minutes time resolution.

The severe convective weather discrimination, track and extrapolation techniques based on the radar, satellite, automatic observation station data have been integrated into the Severe Weather Automatic Nowcast System (SWAN). SWAN developed by National Meteorological Center (NMC) and some provincial branches. It can support many monitoring and nowcasting products to all the local forecasters. However, some provinces have their own nowcasting systems such as BJ-ANC in Beijing City, GRAPES-SWIFT in Guangdong province and MYNOS in Hubei province.

The valid forecasting time for severe convective weather is rarely more than two hours for most of the extrapolation-based nowcasting systems because convective initiation is the insuperable barrier. 2-12 h short-range forecasting relies on the convective-allowing models. The WRF models from Beijing and Shanghai can simulate meso β-γ scale convective system, while the GRAPES_MESO from National Numerical Prediction Center can simulate mesoα-β scale convective system. Based on the high resolution non-hydrostatic model output, NMC developed some very-short-range forecast techniques such as neighborhood strong echo and rainstorm probability forecast, time-lagged hourly QPF, ingredient-based severe convective weather probability forecast.

To realize the seamless weather forecasting from minutes to weeks, CMA focuses on developing the following techniques and systems in the next five years plan: convective-allowing model based on the data assimilation especially the radar simulation, application in new remote sensor data especially the dual polarization radar and FY-4 satellite data, rapid update assimilation and analysis system and SWAN with higher ability on small-scale severe convective weather monitoring and 2-6h forecasting. NMC will mainly develop meso-scale model application techniques such as high frequency calibration of the echo and quantity precipitation forecast, severe convective weather super ensemble forecast based on the excellent models from research branches of CMA and universities, severe convective weather category and intensity forecasting by transforming the severe weather discrimination technique from based on the radar data into based on the convective-allowing model output.

Presentation Date: 26 Jul 2016
Presentation Time: 14:10-14:40
Session Name: T3 (LT1) Plenary Session
Speaker Name: Yong WANG

Seamless ensemble prediction for civil protection: from week to minutes

Severe weather (thunderstorms, floods, storms, etc.) is responsible for many natural disasters which may cause significant economic damages and even loss of life. Accurate and reliable weather forecasts are essential for an improved preparedness and an enhanced awareness in the warning chain to protect citizens, environment and property in case of severe storms. In Frame of an EU Project (PROFORCE) led by ZAMG, an innovative seamless probabilistic forecasting system has been built and integrated in the decision making and preparative actions in the civil protection. This system provides weather forecast and the corresponding forecast uncertainties from week ahead to minutes (nowcasting) in a seamless way.

In the talk, the ensemble forecast systems including regional ensemble, convection permitting ensemble and ensemble nowcasting will be briefly introduced, and case studies on severe storms and its integration in the civil protection agencies will be shown to demonstrate the capability of the seamless forecast System.

Presentation Date: 26 Jul 2016
Presentation Time: 14:40-15:10
Session Name: T3 (LT1) Plenary Session
Speaker Name: Estelle DE CONING

AvRDP/Nowcasting in Africa

The lack of available observation data systems such as surface and upper air observations and radar systems in many developing countries around the world provide a challenge to the nowcasting of severe weather events. Ideally, radar systems form an integral part of nowcasting due to regular update of observations such as storm location, intensity and movement. The acquisition and maintenance of these excellent data sources are, however, not always an option or feasible. Over the African continent, data sources are diminishing and the available data are not necessarily meeting the World Meteorological Organization (WMO) standards of good quality control. Despite these limitations, warnings of severe weather still have to be issued in order to save lives and property.

The WMO Commission for Basic Systems (CBS) group initiated the so-called Severe Weather Forecasting Demonstration Projects (SWFDP). These projects – several of which are over the globe – identified the challenge for SWFDPs as "the need for very-short-range forecasting tools, to address especially the rapid onset of localized severe thunderstorms which can produce heavy precipitation and strong wind, given the absence of adequate real-time observational networks, especially weather radar coverage" (WMO, 2012). The usefulness of geostationary satellite based products was recognized and recommended for use in nowcasting practices in data sparse regions.

When the European Meteosat Second Generation (MSG) geostationary satellite was launched, experts in Europe were tasked to develop applications for various purposes using the 12 channels provided by the satellite. Eight so-called Satellite Application Facilities (SAF) were established, each with their own focus. For the nowcasting purpose, various products were developed – two of these are the Rapidly Developing Thunderstorms (RDT) product and the Convective Rainfall Rate (CRR). The RDT uses data from the geostationary MSG satellite and NWP data to provide information on clouds related to significant convective systems. The CRR uses MSG and NWP data to calculate the rain rate of convective (and associated stratiform) cloud systems. Both of these products can play a key role in nowcasting practices in data sparse regions since they rely only on easily accessible data sources. Other satellite based products have also been developed to provide information on atmospheric instability, which can help to improve lead time for the nowcasting of convection. Examples of these products and their usefulness over the southern African region will be shown in this presentation. With the availability of radar and lightning networks in South Africa, it was also possible to do a quantitative validation of these tools, to prove their value for other data sparse regions. The SWFDP in southern Africa has provided good evidence that NWP and satellite based tools can go a long way to improve resilience for adverse weather conditions in the African region. Without using expensive software, the data and/or images are made available through the Regional Specialized Meteorological Centre (RSMC) website, which makes it easy to access for all users.

Presentation Date: 26 Jul 2016
Presentation Time: 15:10-15:40
Session Name: T3 (LT1) Plenary Session
Speaker Name: Cynthia Mariana MATSUDO

South America Nowcasting

Central and northern Argentina is frequently affected by strong deep convection that is associated with High Impact Weather Events (HIWEs) as heavy rain episodes, landslides, and widespread reports of severe surface winds and hail. A large portion of large mesoscale convective systems (MCSs) in subtropical South America initiates and reach their mature stage over Northern and Central Argentina. Zipser et al. (2006) found that the world's most intense thunderstorms occur in this region according with Tropical Rainfall Measurement Mission.

In order to improve forecast accuracy of these HIWEs, different nowcasting initiatives are being carried out in the context of the project "ALERT.AR". In recent years the number of collaborations between the Meteorological Service of Argentina and the local academic community has been increasing, leading to a collaborative development of nowcasting tools, derived from high resolution numerical forecasts, radar information data quality, tracking of convective systems identified by radar and satellite observations, objective identification of hail with radar data, short range forecasts at storm scale using high resolution data assimilation and numerical weather prediction. Most of these nowcasting tools, tested in case studies, are still at a research stage and being evaluated for their operational implementation. Multiple testbeds between developers and forecasters have been implemented to evaluate and improve new tools in order to transfer research activities to operations. A rather unique aspect of ALERT.AR and our nowcasting development efforts is the inclusion of the social aspects of communication and coproduction of products together with those that take action based on these forecasts.

An international field campaign, RELAMPAGOCACTI, will be performed in Central Argentina during the warm season 20182019. Data provided by this experiment will be particularly useful for nowcasting tools evaluation and tuning. A Forecast Research Demonstration Project has been proposed to WMO/WWRP and has been supported by the SSC to improve local Latin American knowledge about nowcasting techniques and tools during this unique observational opportunity.

Oral Presentation

Presentation Date: 26 July 2016
Presentation Time: 11:20 -11:40
Session Name: T2A (LT1) Parallel
Session S1: Forecasting of high impact weather in very-short-range
Author/Co-author Name: Wai Kin WONG, Xing Jian SHI, Dit Yan YEUNG, Wang Chun WOO
Speaker Name: Wai Kin WONG

A deep-learning method for precipitation nowcasting

This paper presents a novel technique of precipitation nowcasting using the machine learning approach. The precipitation nowcasting is formulated as a spatiotemporal sequence forecast of radar reflectivity using the convolutional long short-term memory (ConvLSTM) network. Compared to another deep-learning approach, namely the fully connected LSTM (FC-LSTM), the convolutional structures in ConvLSTM contribute favourably in capturing the spatiotemporal correlations of radar sequences. Experiments and verification of quantitative precipitation forecast (QPF) using several years of data reveal that ConvLSTM outperforms FC-LSTM as well as the operational radar-based QPF using optical flow echo-tracking and semi-Lagrangian advection method. Extension of the framework of ConvLSTM to consider the uncertainty in forecasting the spatiotemporal sequence of radar QPF, as well as merging with other sources of meteorological data such as NWP model to improve the performance of QPF and to predict other high impact weather processes will also be discussed.

Presentation Date: 26 July 2016
Presentation Time: 11:40 -12:00
Session Name: T2A (LT1) Parallel
Session S1: Forecasting of high impact weather in very-short-range
Author/Co-author Name: Tim BÖHME
Speaker Name: Tim BÖHME

Use of improved remote sensing data for a better nowcasting of severe weather events

The German national weather service (DWD) uses observational data of modern remote sensing radar and lightning networks but also high resolution satellite data in order to improve nowcasting. The data basis is enlarged by NWP model (COSMO) output. As in mid-latitude regions weather is characterised both by severe summer events, e.g. heavy thunderstorms, and also severe winter events, e.g. heavy snowfall and black ice, nowcasting is integrating data of a wide range of warning algorithms.

The status of the currently used instruments will be presented. The focus will be put on the C-band radar network, as radar data are available in very high spatial resolution. Temporal resolution of radar data is also increased since in 2012 a new radar scan strategy was introduced. Between 2010 and 2015, DWD replaced single-pole Doppler radars by dual-pole Doppler radars and thus polarimetric data are now available, too. The main progress is an increase in data quality and additional information of the precipitation phase by introducing a hydrometeor classification algorithm. By this, an improved quantitative precipitation estimation is also possible.

The individual nowcasting data are merged into one final nowcasting algorithm which finally shows one warning class for one locality at one time. The data are visualized and distributed on different platforms to a wide range of users.

The contribution will show some examples of nowcasting algorithms output of severe weather events. In addition, the current developments in the field of nowcasting will be presented.

Presentation Date: 26 July 2016
Presentation Time: 12:00 -12:20
Session Name: T2A (LT1) Parallel
Session S1: Forecasting of high impact weather in very-short-range
Author/Co-author Name: Wen YAO, YiJun ZHANG, Qing MENG, WeiTao LV
Speaker Name: Wen YAO

Research on Lightning Nowcasting and Warning System and Its Evaluation Experiment

The Lightning Nowcasting and Warning System (CAMS_LNWS) was developed by the Laboratory of Lightning Physics and Protection Engineering (LiP&P), Chinese Academy of Meteorological Sciences (CAMS).The system proposed a lightning characteristic diagnose and nowcasting scheme in typical region, and adopted a multi-data, multi-parameter and multi-algorithm lightning nowcasting method. CAMS_LNWS integrated observation data from radar, satellite, lightning detection system, ground electric instrument and sounding instrument with synoptic pattern forecasting products and 2-D charge-discharge model, and employed algorithms of region recognition, region tracing, extrapolation and decision tree algorithms. The CAMS_LNWS supplied products of Lightning Occurrence Probability, Moving Trend of Lightning Activity Area and Lightning Occurrence Probability of Key Area automatically. Designed in modular structure, the system had plenty parameter interfaces and human-machine interaction function, and could be applied and promoted to a variety of occasions and areas.

The CAMS_LNWS works 24 hours every day and renew the warning products every 15 min automatically. Warning products are published via China Meteorological Administration (CMA) website, which can realize 0-1 hours, 1 × 1 km radius of lightning nowcasting, and provide rapid response to meteorological information sharing by internet.

In order to improve forecasting and diagnosing techniques and establish a quick-response operational system for lightning warning service., we evaluate the accuracy of the warning products by adopting three evaluation index, Probability of Detection (POD), Fault Alarm Rate (FAR) and Threat Score (Ts) , through comparing the warning results with lightning locating results. The result shows that CAMS_LNWS has favorable forecasting ability for regional lightning activity, which will provide lightning service information of high-quality, high spatial and temporal resolution.

CAMS_LNWS provide meteorological support services for public services, such as Olympic Games 2008，National Day 2009, World Expo 2010 Shanghai. And it also applies to the professional users, like Power, Traffic, Telecom, Combustible and explosive area and so on.

In the future, we will carry out in-depth studies to reveal the evolution characteristics of lightning activity and further improve the regional lightning nowcasting index and algorithm. We will also consider coupling of charge-discharge model of thunderclouds with meso-scale model to promote our scientific understanding of lightning activities with different micro-physical and dynamical processes in cloud. A 0~6 hour numerical forecasting method for lightning activity will be developed.

Presentation Date: 26 July 2016
Presentation Time: 12:20 -12:40
Session Name: T2A (LT1) Parallel
Session S1: Forecasting of high impact weather in very-short-range
Author/Co-author Name: Clifford MASS, Jeff BAARS
Speaker Name: Clifford MASS

Nowcasting Systems Developed for the City of Seattle

Based on the need to prepare for major floods, snowstorms, and wind-induced power outages, the city of Seattle has supported the development and use of nowcasting information. This presentation will describe three nowcasting systems created for Seattle by the University of Washington: RainWatch, WindWatch, and SnowWatch.

RainWatch takes full-resolution NWS radar imagery (precipitation estimates) and calibrates it using rain gauge data. These estimates are used to produce integrated precipitation amounts (e.g., 1 hr, 6 hr, 24 hr) and 1-h precipitation extrapolation. When precipitation exceeds set thresholds email warnings are sent to City of Seattle staff, as well as being available on a dedicated web site. RainWatch also makes available University of Washington WRF mesoscale model forecasts and short-term forecasts from the NOAA/NWS HRRR predictions system.

WindWatch provides warnings to Seattle City Light staff based on observed winds or high-resolution forecasts from the University of Washington WRF model, Seattle NWS forecast staff, or the NOAA/NWS HRRR system.

SnowWatch shows current surface air and roadway temperatures and warns when freezing is possible or occurring. Snow forecasts from the UW WRF model, the Seattle NWS forecast office, or the HRRR model are integrated into the system.

The talk will describe these systems and their substantial impact in saving lives, enhancing preparation for severe events, and reducing the economic impacts of local severe weather.

Presentation Date: 26 July 2016
Presentation Time: 11:20 -11:40
Session Name: T2B (LT2) Parallel
Session S11: Special Session - CAS/CAeM Aviation Research Demonstration Project (AvRDP)
Author/Co-author Name: Martin STEINHEIMER, Carlos GONZAGA-LOPEZ, Christian KERN, Martin MAYR, Markus KERSCHBAUM, Carl-Herbert ROKITANSKY
Speaker Name: Martin STEINHEIMER

Air traffic management and weather: the potential of an integrated approach

Wind and adverse/severe weather have a significant impact on air traffic management (ATM). Various performance figures related to safety, capacity, cost-efficiency and environmental impact have to be considered and optimized. ATM decisions currently rely on strictly deterministic information, while it would be more reasonable to use a probabilistic approach to account for the intrinsic uncertainty of the meteorological (MET) information. Preliminary results of the ongoing project MET4LOWW aiming at reconciling the uncertainty of weather and strictly deterministic ATM procedures in a holistic ATM/MET approach for optimal arrival and departure management will be presented.

The impact of weather on airport approach and departure is evaluated using basic Arrival/Departure Manager ideas. This includes avoidance of weather objects (e.g. thunderstorms) by aircraft and studying how wind impacts on airport and airspace capacity. The quantitative assessment is based on ATM key performance indicators (KPI) derived from fast time air traffic simulations. In addition, the simulated traffic is qualitatively assessed by air traffic controllers. Based on this analysis the ATM/MET procedures will be optimized.

To carry out the simulations, standard instrument arrival and departure procedures at Vienna airport and handling of wind and weather objects are integrated in the ATM/ATC simulator NAVSIM used by University of Salzburg. Realistic avoidance algorithms for weather objects (e.g. thunderstorms) and the accurate simulation of the impact of wind on aircraft on final approach are key prerequisites to reveal derived impact on landing capacity and on traffic-flow and -complexity in upstream air traffic control sectors.

With the air-traffic simulation approach, the potential of integrated ATM/MET procedures can be evaluated from different perspectives. The benefit of improved weather information can be identified by sensitivity studies of weather impact on KPIs. The required accuracy of weather forecasts in terms of temporal/spatial resolution as well as forecasted thresholds can be assessed. The use of probabilistic weather information to improve ATM efficiency on average, while maintaining safety levels in each individual case, can be investigated.

The simulation results are expected to help to tailor weather information to the specific needs of ATM, both in deterministic form for current ATM procedures and in probabilistic form for future ATM procedures where weather information should be an integral part.

The better integration of weather information into the operational ATM-system will ultimately improve the overall air traffic safety and efficiency.

Presentation Date: 26 July 2016
Presentation Time: 11:40 -12:00
Session Name: T2B (LT2) Parallel
Session S11: Special Session - CAS/CAeM Aviation Research Demonstration Project (AvRDP)
Author/Co-author Name: Estelle DE CONING, Craig POWELL, Jacques STRYDOM
Speaker Name: Estelle DE CONING

Nowcasting for aviation purposes in South Africa – a case study : Part1 – Satellite and radar based tools

In an effort to improve nowcasting for aviation applications, the WMO has initiated a research and development project which started in 2015 – called AvRDP. High density airports in different parts of the world were selected to take part in the initial phase where nowcasting techniques will be investigated and tested by means of various case studies. Oliver Tambo International Airport (ORTIA) in Johannesburg, South Africa, is one of the participating airports in this project. Nowcasting techniques related to convection will be investigated at this airport.

On 21 December 2015, more than one thunderstorm affected ORTIA and these storms resulted in many flight delays and cancellations due to heavy rainfall, hail and wind gusts of up to 50 knots. The more intense of the two storms passed over ORTIA at 4pm, a very busy time at the airport. Rain showers from this storm were intense, which diminished the visibility to about 1500m at time and small hail was also reported during this storm.

Although there are many radar systems in South Africa, the entire country is not covered by radars and thus gaps exist not only between some radars, but also in some parts of the country. Nowcasting techniques usually rely heavily on radar observations, but in data sparse regions – such as large parts of the African continent – satellite and Numerical Weather Prediction (NWP) blended products are utilized for nowcasting on convection. The Nowcasting Satellite Application Facility (based in Spain) has made various products available for the purpose of nowcasting. Their software has been operational in South Africa since 2013 and the use of the Rapidly Developing Thunderstorms and Convective Rainfall Rate products have been validated using observations over South Africa. Both these products are very useful for nowcasting.

In this presentation, the case of 21 December 2015 will be analysed to demonstrate the nowcasting tools which are available in South Africa. This will include the radar based (where available) as well as the satellite based tools. For the sake of the AvRDP, efforts are also underway to implement the SWIRLS nowcasting system from Hong Kong Observatory (HKO) in research mode in South Africa. More information on the results from this study will be presented in PART 2 of this topic.

Presentation Date: 26 July 2016
Presentation Time: 12:00 -12:20
Session Name: T2B (LT2) Parallel
Session S11: Special Session - CAS/CAeM Aviation Research Demonstration Project (AvRDP)
Author/Co-author Name: Erik BECKER
Speaker Name: Erik BECKER

Nowcasting for aviation purposes in South Africa – a case study : Part2 Evaluating the HKO's SWIRLS over OR Tambo International Airport

The South African Weather Service (SAWS) has recently installed and verified the community version of SWIRLS (Short-range Warning of Intense Rainstorms in Localized Systems), or com-SWIRLS. This was done after the conclusion of the WMO VCP workshop on Rainfall Nowcasting held in December 2015 at the Hong Kong Observatory (HKO), in Hong Kong. The successful implementation of com-SWIRLS will play an important role within the WMO AvRDP project. The project aims at improving nowcasting techniques for aviation applications and OR Tambo International airport (ORTIA) in Johannesburg, South Africa, was selected as a participating airport.

This presentation follows on from PART 1 where the 21st of December 2015 was analysed using existing nowcasting techniques within SAWS. The focus is here shifted to SAWS's Quantitative Precipitation Estimation (QPE) processes and specifically com-SWIRLS performance in terms of radar precipitation forecasts. Both will be analysed and tested to determine if any value could have been added to the current nowcasting techniques on the mentioned case date.

Over the past few years SAWS has invested a lot of time and money on improving their radar based applications. The SAWS radar network was upgraded with 10 new Gematronik Meteor 600S S-band radars during 2010-2012, bringing the network total to 14 radars. Since then, collaboration with various partners resulted in implementing various support software such as calibration monitoring software developed by the Dutch Weather Service, KNMI (Holleman, et al., 2010), which allows for monitoring antenna alignment and radar performance. Another software implemented is SCOUT radar processing software, developed by Hydro & Meteo in Germany which handles Quality Control (QC) processes to filter none precipitating echoes from the raw radar data. The existing SAWS QPE algorithm was also updated to include the latest techniques in precipitation estimation such as making use of precipitation classification with dual Z-R relationships, and the use of Optical Flow vectors to smooth temporal biases within accumulations. It is hoped the successful implementation of com-SWIRLS will further increase SAWS's nowcasting capabilities and in return also assist other developing countries in Africa.

Presentation Date: 26 July 2016
Presentation Time: 12:20 -12:40
Session Name: T2B (LT2) Parallel
Session S11: Special Session - CAS/CAeM Aviation Research Demonstration Project (AvRDP)
Author/Co-author Name: Janti REID, Robert CRAWFORD, Bjarne HANSEN, Laura HUANG, Paul JOE, David SILLS
Speaker Name: Janti REID

AvRDP: First Results from Toronto Pearson International Airport

The mission of the Aviation Research Demonstration Project (AvRDP) is to develop, demonstrate and quantify the benefits of high-impact weather nowcasting in the terminal area for the 0-6 hour time frame. Phase 1 of the project (2015-2017) focuses on meteorological nowcasting capabilities at selected host airports with an emphasis on nowcasting system demonstration and verification. This is expected to lead into later Phase 2 objectives such as the development and assessment of relevant nowcast products and their impact on air traffic management.

The Environment and Climate Change Canada (ECCC) contribution to AvRDP is a cold-season nowcasting demonstration at a high-density, northern hemisphere airport, namely Toronto Pearson International Airport (CYYZ; 43° 40′ 36″ N, 79° 37′ 50″ W). During the winter 2015-2016 intensive operation period (IOP), detailed observations and nowcasts were collected at Pearson to study wintertime weather hazards such as heavy snowfall, significant icing, freezing precipitation type, along with other aviation-pertinent parameters including ceiling, visibility and winds. ECCC demonstrated a variety of point-based nowcasting methodologies including a climatology-based system, a radar-based system, and a blended NWP-observation system. The airport observational site is furnished with a suite of instrumentation including an icing detector, multi-view camera system, vertically pointing X-band radar, visibility meter, multiple ceilometers and a surface weather station with temperature, relative humidity and wind sampled at WMO standard heights. The site also hosts a number of precipitation sensors including weighing gauge-type instruments and optical and radar-based systems. These will be used for nowcasting comparison and verification. Additionally the site data set is augmented by high time resolution NWP output from the Canadian 10-km Regional and 2.5-km High Resolution Deterministic Prediction Systems (RDPS, HRDPS). This talk describes first-cut results from the winter IOP, specifically the verification of the aforementioned nowcast systems, and a discussion of the respective strengths and weaknesses of each system.

A further ECCC contribution is a cold-season nowcasting demonstration at Iqaluit Airport (CYFB; 63°45' 23" N, 68°33' 21" W) in winter 2016-2017 which will provide a unique look into prediction capabilities in the Arctic. An update on the status of observational instrumentation at this site will also be given.

Presentation Date: 26 July 2016
Presentation Time: 12:40 -13:00
Session Name: T2B (LT2) Parallel
Session S11: Special Session - CAS/CAeM Aviation Research Demonstration Project (AvRDP)
Author/Co-author Name: Rajendra Kumar JENAMANI
Speaker Name: Rajendra Kumar JENAMANI

Development of an Integrated Fog Information System for Delhi (IGI Airport) and its Performance during 2008-2016 with special emphasis on its eighteen numbers of RVR meso-scale and INSAT 3-D based Fog monitoring and Empirical- NWP based Fog models

Indira Gandhi International Airport (IGIA) located at New Delhi, has been the India's pride since its modernization started in 2006 by PPP mode. It has now a new RWY, new Terminal and a new ATC-Tower and those are respectively of India's longest RWY, biggest terminal and of highest ATC height and thus it has already created its new history in world of aviation. Meteorologically, being it is of high CAT-IIIB dense fog occurrences in each winter with zero visibility prevailing for 10-16 hours covering total 5-15 days in many winters, two RWYs out of its three RWYs are well equipped with CAT-IIIB compliances. Being,The season of 1998-99 and 2014-15, are extreme fog seasons in history with as high as 37 days with 285 hours of dense fog of vis<200m and of 29 days and 174 hours observed respectively. it has very high RWY-Wise fog variability in terms of its intensity and duration, IMD has equipped it with eighteen RVR systems since 2014-15 -a highest in any airport in the world working at 24X7. With INSAT-3D has both day and night time fog microphysics detection capacity at 1-km resolution complimenting RVR, it as the most sophisticated meso-scale fog monitoring system in the world.

To manage the fog related disruption at IGIA Delhi effective, Met office at IGIA has implemented a FDP-Fog and collaborated with other country's premier institution like with IAF, CAS- IID, CAOS IISC, Bangalore, IIT Roorki, IIT Kanpur, IIT Madras, IIITM Pune and JNU, CMMACS CSIR Bangalore, NCMRWF, SAC- Ahmadabad, JNCASR, Bangalore, ICMOD Kathmandu, during 2008-2016 and implemented an integrated Fog information system which includes:

a)Fog micro-climatological information system developed based on hourly vis data of 1981-2016 for IGIA that has been updated time to time and has all detail aspects of past fog- micro information to help airlines

b) Real time fog monitoring at RWY through eighteen RVR-a highest at any airport in the world , and provide all RVR values in live through websites

c) Fog nowcasting and forecasting using improved Satellite fog detection scheme, better observational facilities like AWS, RVR and utility of DWR to look at clouds, new empirical fog models and using MOS from WRF models(Jenamani, 2009, 2015, Goswami and Tyagi, 2007)

d)SMS-Web based and Live RVR based Dissemination System for instantaneous transmission of fog early warnings to users all around the world on fog features at IGIA.

In this paper, we have reviewed all Indigenous available method (IMD Empirical fog models, CMMACS dynamical fog model and IAF Fog model used in FDP- FOG for Delhi implemented in 2008-2012 and performance of these fog models including the skill of real time fog forecast. We have also discussed Check lists of nowcast and Forecasts methods further developed in 2012-2016. We have assessed skill of Real time Fog Forecast and its success in 2008-16 in terms of significant reduction of diversion and further new challenges we foresee to further improve this system.

27 July 2016 (Wednesday)

Plenary Session

Presentation Date: 27 Jul 2016
Presentation Time: 09:00-09:30
Session Name: W1 (LT1) Plenary Session
Speaker Name: Steven J. GOODMAN

Latest Satellite Applications to Nowcasting

The new generation of geostationary environmental satellites provides greatly enhanced capability beyond that of the existing global constellation that rings the planet. New and improved technology will better enable the detection of high impact weather and environmental phenomena such as fires, volcanic eruptions, typhoons, and damaging severe local storms, resulting in more timely and accurate forecasts, nowcasts, and warnings. The advancements in cloud and moisture imagery include a factor of three increases in spectral channels, a factor of four increase in spatial resolution, and a factor or five or greater refresh rate. Additionally, some of the new satellites include a new capability for total lightning detection (cloud and cloud-to-ground flashes), which will aid in forecasting severe storms and convective weather impacts on aviation safety and efficiency. The latest satellite applications and integrated decision aids using the imagery, lightning, radar, and numerical models along with pre-operational product demonstrations conducted with forecasters will be discussed.

Presentation Date: 27 July 2016
Presentation Time: 09:30 -10:00
Session Name: W1 (LT1) Plenary Session
Author/Co-author Name: Pilar RÍPODAS
Speaker Name: Pilar RÍPODAS

The Nowcasting SAF: satellite derived products on support to Nowcasting. Challenges and opportunities of the new era of EUMETSAT satellites

The Nowcasting SAF is part of the EUMETSAT SAF Network, who´s objective is the generation of satellite derived products to ensure the optimal use of the EUMETSAT satellite data. In particular the objective of the Nowcasting SAF (NWC SAF) is the generation of satellite derived products with a direct application to Nowcasting.

Nowcasting comprises the detailed description of the current weather along with forecasts obtained by extrapolation for a period of 0 to a few hours ahead. The latest observational data, including radar and satellite allows the forecaster to analyze the small-scale features present in a small area and make an accurate forecast for the following few hours.

The Nowcasting SAF develops and maintains software packages that generate satellite derived products with a direct application to Nowcasting from Meteosat Second Generation (MSG) data and the Joint Polar System (JPS, EUMETSAT and NOAA agreement) data. The software is distributed freely to registered users of the meteorological community and is used for Nowcasting and as a development and research tool.

In the presentation the current NWC SAF products as well as the new coming NWC SAF products to be delivered after summer 2016, will be presented.

NWC SAF (current and coming) products include:
- Cloud products (cloud mask, cloud type, cloud top temperature and high and cloud microphysics)
- Precipitation products (precipitation likelihood, convective rainfall rate)
- Clear air precipitable water and instability indices
- High resolution winds
- Convection products: Rapid development Thunderstorms tracking and Convection iniciation
- Extrapolation Imagery
- Recognition of Meteorological features

In the coming years EUMETSAT will launch the first satellites of a new era of meteorological satellites: Meteosat Third Generation (MTG) and EUMETSAT Polar system Second Generation (EPS-SG).
Upgraded sensors and new sensors on board of MTG and EPS-SG satellites will bring the opportunity to improve current NWC SAF products and the development of new NWC SAF products. The highest spatial and temporal resolution of MTG respect to MSG will definitively improve detection and analysis of small-scale features in the satellite images increasing the Nowcasting capabilities of the NWC SAF products.

The main features of the new EUMETSAT programs and its implication for Nowcasting and the NWC SAF will be presented.

JMA and NOAA new era geostationary satellites (Himawari and GOES-R) have similar capabilities to MTG. The NWC SAF plans to adapt some of its products to Himawari and GOES-R data. This responds to a demand of some NWC SAF users but also serve as a first step towards the adaptation of the NWC SAF products to MTG.

Presentation Date: 27 Jul 2016
Presentation Time: 10:00-10:30
Session Name: W1 (LT1) Plenary Session
Speaker Name: Hiroshi SUZUE

Himawari-8 current applications and future development

The Japan Meteorological Agency (JMA) began operation of Himawari-8, which is the new-generation geostationary meteorological satellite, on 7 July 2015. In 2016, JMA is planning to launch Himawari-9 as a backup of Himawari-8. These satellites carry the Advanced Himawari Imager (AHI), whose observation performance is significantly improved over that of the predecessor MTSAT-series satellites. The AHI has 16 observation bands, and its spatial resolution is 0.5 or 1 km for visible and near-infrared bands and 2 km for infrared bands. Furthermore, the AHI scans the Full Disk every 10 minutes, and the Japan Area and Target Area every 2.5 minutes. These high-resolution and high-frequency observations are useful to monitor and analyze severe weather phenomena.

Several products using Himawari-8/AHI observation data have been operational at the Meteorological Satellite Center (MSC) of JMA. For example, there are High-resolution Cloud Analysis Information, CSRs and AMVs. Rapidly Developing Cumulus Area (RDCA) product is also one of these products. The purpose of RDCA product is to detect rapidly developing convective cloud earlier than radar for safety of aviation operation. This product had been operated only in the day time using 1 visible band and 2 infrared bands data of MTSAT-1R rapid scan observation, but now it has been operated all day using 1visible band and 6 infrared bands data of AHI Japan Area observation. JMA is also planning the development of domain extension of RDCA product using AHI Full Disk observation data and a new algorithm to detect RDCA with higher accuracy.

Oral Presentation

Presentation Date: 27 July 2016
Presentation Time: 11:00 -11:20
Session Name: W2A (LT1) Parallel
Session S1: Forecasting of high impact weather in very-short-range
Author/Co-author Name: Rita ROBERTS, James WILSON, Daniel MEGENHARDT, Jenny SUN, David Gochis, Amanda ANDERSON
Speaker Name: Rita ROBERTS

A real-time hydrometeorology research testbed for heavy rainfall and streamflow prediction

There have been increasing demands for accurate hydrological prediction, as urban flooding resulting from heavy rainfall and other high-impact weather has resulted in significant societal and economical costs. Thanks to the improved observation networks, advancement of computer technology, and scientific and technological development of data assimilation, the past decade has seen improvement in quantitative precipitation forecasts (QPF) and streamflow predictions. The ultimate improvement in rainfall and streamflow prediction that can truly benefit society requires a fully coupled, seamless, end-to-end system that consists of high-resolution, quantitative precipitation estimation (QPE) observations, state-of-the-art QPF modeling systems with radar data assimilation, high-resolution, location-specific quantitative precipitation nowcasts (QPN), and advanced hydrological modeling. This paper describes an experimental fully-integrated, hydrometeorology-based, heavy rainfall and streamflow prediction testbed developed by NCAR's Short Term Explicit Prediction (STEP) research program that was run in real-time during the summers of 2014 and 2015 over the Rocky Mountain Front Range region. This region was chosen because of its high frequency in flash flood occurrence, the existence of three operational NEXRAD radars, dense surface stations and rain gauges, streamflow gauges, and NCAR's S-Pol research radars.

This fully-integrated system includes 1) quality-controlled, radar-based QPE derived from (NOAA's MRMS and NCAR's dual-polarization hybrid algorithms) and rain gauge QPE, 2) QPF from state-of-the art WRF 3DVar models with (and without) radar data assimilation and with frequent 1 and 3 h update cycles, 3) radar echo extrapolation (TITAN) and precipitation accumulation nowcasts (QPN) from 10 min – 1 h from the heuristic-based AutoNowcaster/Trident system, 4) high resolution 4-D winds and buoyancy analyses from VDRAS, 5) streamflow prediction on a spatially-continuous 100m resolution grid from the WRF-Hydro coupled atmosphere and hydrology model, and 6) a near real-time performance evaluation of the above components using Model Evaluation Tools (MET) and the Method for Object-Based Diagnostic Evaluation (MODE) tool.

Examples of the real-time performance of this system for selected heavy rainfall (>1 inch per hour) events from 2014 and 2015 will be presented. Results show there is still much room for improvement in providing location-specific and time-specific prediction of heavy rainfall, flash floods and peak streamflow and providing useful products for the end-user.

Presentation Date: 27 July 2016
Presentation Time: 11:20 -11:40
Session Name: W2A (LT1) Parallel
Session S1: Forecasting of high impact weather in very-short-range
Author/Co-author Name: Joon-Woo ROH, Young-Joon KIM, Jae-Sik MIN
Speaker Name: Joon-Woo ROH

Analysis and Numerical Simulation using ASAPS for the Localized Heavy Precipitation Event in South Korea on 16 August 2015

Localized heavy rainfall, which is a typical severe weather phenomenon in Korea, tends to be increased in terms of the intensity and the frequency in recent years. Especially, the frequency of warm-season torrential rainfall events more than 30 mm/h precipitation has increased threefold in Seoul, a metropolitan city in South Korea, in recent 30 years. Urban localized heavy precipitations occur in the very small spatial and temporal scales in contrast to other heavy precipitation systems such as synoptic scale situation such as a frontal system in the Korean Peninsula. Localized heavy rainfall events in South Korea generally arise from mesoscale convective systems embedded in these synoptic scale disturbances along the Changma front, or from convective instabilities resulting from unstable air masses over the Korean Peninsula.

Accurate prediction of precipitation is one of the most difficult and significant tasks in weather forecasting. In order to improve very short forecasting of severe weather phenomena like frequent localized heavy precipitation events in the metropolitan area, Advanced Storm-scale Analysis and Prediction System (ASAPS) was developed by National Institute of Meteorological Sciences, Korea Meteorological Administration (KMA). ASAPS is designed for 1km resolution and 30 minute intervals for targeting in the local area obtaining Seoul metropolitan area and is provided with background fields through Korea Local Analysis and Prediction System, which is a kind of the KMA operating numerical models. The observation data for 1km analysis field of ASAPS are the regular observed data, which are AWS, RADAR, satellite, METAR, which is a format for reporting weather information, AMeDAS, lightning, wind profiler, and so on. In addition to, AMDAR data, which are observed through flight, and GTS data are included.

In order to investigate a localized heavy precipitation system in Seoul metropolitan area, analysis and numerical experiment based on ASAPS were performed for a typical event in 16 August 2015. This case is described to a structure of cold pool produced with a short-wave trough from the northwest and high moist and warm air by a thermal low from the southwest of the Korean Peninsula. ASAPS experiment showed a reasonable performance. The ASAPS simulations of the closer initiation times performed better in aspect to the intensity and the location of precipitation. Primary physical structures related to the localized heavy precipitation with the diagnostic fields, which are storm relative helicity, updraft helicity, and instantaneous contraction rates, and so on, were investigated based on the ASAPS results of convective scale resolution.

[Acknowledgement: This work was funded by the Weather Information Service Engine Program of the Korea Meteorological Administration under Grant KMIPA-2012-0001-1.]

Presentation Date: 27 July 2016
Presentation Time: 11:40 -12:00
Session Name: W2A (LT1) Parallel
Session S1: Forecasting of high impact weather in very-short-range
Author/Co-author Name: Yan-Chun CHAN, Wai-kin WONG
Speaker Name: Yan-Chun CHAN

Numerical simulation of a prolonged rainstorm in Hong Kong on 22 July 2015

In the vicinity of the westerly trough axis, coupling with certain unstable conditions such as active southwesterlies, there were prolonged heavy precipitation and squally thunderstorms over Hong Kong on 22 July 2015. More than 150 millimetres of rainfall fell in the urban areas with cloud to ground lightning exceeding 1000 strokes over the territory from early morning to afternoon. Flooding and fallen trees occurred in many places, and waterspout was even reported. The Hong Kong Observatory issued the Amber Rainstorm Warning in the early morning that lasted for nearly 12 hours, the longest record in the past decade.

The first part of this presentation will discuss the observations from the automatic weather stations, upper air sounding, wind profilers, radars and satellites to investigate the causes of significant convection during the rain episode. The performance of global and mesoscale numerical weather prediction (NWP) models in capturing the associated synoptic and mesoscale systems will also be illustrated. Through a review of mesoscale analysis technique, application and verification of NWP model products, it is envisaged to obtain useful guidance or rule of thumb in forecasting similar significant weather phenomena.

To understand the mesoscale and local-scale processes leading to prolonged significant convection, results of high-resolution numerical simulations using WRF (Weather Research and Forecasting) model will be discussed. The overall spatial distribution of the forecast rainfall is found to be sensitive to the resolution of radar observations in the 3-dimensional variational (3DVAR) data assimilation. Sensitivity experiments were conducted using single-moment (WSM-6) and double-moment (WDM-6) cloud microphysics together with non-local boundary layer schemes. Impact of local terrain on the location of convective developments was also investigated. The results suggested that the WRF single-moment microphysics (WSM-6) with the Asymmetric Convective Model version 2 (ACM-2) better captured the dynamic and moisture transport over the coastal region that produced a more realistic rainfall forecast.

Presentation Date: 27 July 2016
Presentation Time: 12:00 -12:20
Session Name: W2A (LT1) Parallel
Session S1: Forecasting of high impact weather in very-short-range
Author/Co-author Name: Biyan CHEN, Zhizhao LIU, Wai-kin WONG, Wang-chun WOO
Speaker Name: Biyan CHEN

Observing Water Vapor Variability during Heavy Precipitation Events in Hong Kong by GPS Tomography

Atmospheric water vapor has a strong influence on the evolution of heavy precipitation events due to the huge latent heat associated with the phase change process of water. Heavy precipitation can result in many natural disasters in increasingly populated urban centers, particularly in developing countries. Thus the monitoring of water vapor variation is very important for detecting and monitoring the occurrence and progress of heavy precipitations.

We focus on the use of Global Positioning System (GPS) tomography to investigate the water vapor variations associated with the evolutions of heavy precipitation events. Using GPS observations, the wet refractivity field was constructed at a temporal resolution of 30 min for two heavy rain events that occurred in Hong Kong on 22 July 2010 and 30 March 2014, respectively. Both events recorded hourly rainfall exceeding 50 mm/hour. The total zenith wet delay (ZWD) over the Hong Kong Observatory (HKO) synoptic station was derived from the tomographic results. ZWDs at five altitude layers (<1 km, 1~2 km, 2~3 km, 3~5 km and >5 km) were calculated to characterize the water vapor variations during the heavy rains.

We showed that the ZWD plays a very positive role in observing the evolution of heavy rain events. ZWD generally increased before the heavy precipitation and decreased quickly with the heavy rain pouring. We found that the total ZWD in both events exceeded 400 mm prior to the commencement of heavy rain. The water vapor above 3 km in altitude showed much larger variations during the heavy rain events though it accounts for only 10~25% of the total water vapor in Hong Kong. The remarkable water vapor fluctuations in the vertical layers, especially above 3 km, could be seen as precursors to heavy precipitations. We also observed that if the total ZWD continued to increase during a rainfall, heavier precipitation was likely to occur. Observation data from weather radar and wind profiler were also used to validate the water vapor variabilities observed from the GPS tomography. The findings positively demonstrated that the potential of GPS water vapor tomography technique in detecting and monitoring heavy rain events.

Presentation Date: 27 July 2016
Presentation Time: 12:20 -12:40
Session Name: W2A (LT1) Parallel
Session S1: Forecasting of high impact weather in very-short-range
Author/Co-author Name: Anupam KUMAR, Edmond LO, Adam SWITZER
Speaker Name: Anupam KUMAR

High Resolution Numerical Modelling of a distinct extreme weather event, 'Cold Surges' near the Hong Kong region

Climate change is considered to be the single greatest challenge confronting the Asia-Pacific region, and its more than 4 billion people. One of the most severe threats to these regions arises from a most distinct extreme weather event known as "Cold Surges". Very few literatures have focused on the occurrences of cold surges during winter monsoon near coastal regions of South China Sea. These cold surges create widespread outbreaks of cold continental air characterized by strong northeasterly winds, sharp temperature drops and increased surface pressure. In the winter season, Hong Kong is strongly influenced by the East Asian winter monsoon. Cold Surges occur yearly in and around the Hong Kong region during this winter monsoon season. These surges often cause heavy rainfall and floods in southern Thailand and cause strong convective activity over South China Sea. They are also considered to strengthen cyclonic disturbances north of Borneo coast. The interaction of cold surges and tropical warm water leads to the formation of "cold surge vortex". Such vortices can result in heavy precipitation events in the coastal South China Sea region even without reaching the intensity of a Tropical Cyclone. Since these events are associated with acute temperature drop they impose immediate adverse effect on human health and also sudden death. Thus such an extreme event is a big challenge to model for the purpose of weather forecasting.

The present study reviews the modeling performance of the three cold surge events during the year 2008, 2009 and 2016 near the Hong Kong region. Among these, one of the most devastating Cold surge event that occurred in southeast China was in the year 2008. This resulted in 4 billion US dollar economic losses, damage of 11867 kilo hectares of Agricultural crops and imposed adverse effect on human life and killed as many as 129 people. In 2016, under the influence of such Cold Surge event, the Hong Kong Observatory recorded a minimum temperature of 3.1 degrees on January 24, 2016. This is considered to be the coldest weather in the past 59 years of the record and the coldest day since 1957.

The study aims to model these events in a finer detail using the high resolution Reanalyzed data, Satellite based remote sensed wind data and a very high resolution Numerical Modelling approach. In past Cold surges has been studied mostly using the observational meteorological data for this region. To the best of the author's knowledge, such cold surge events near the Hong Kong region has never been examined previously at a fine resolution, i.e. combining fine resolution Reanalysis Data from ECMWF, high resolution Advanced Scatterometer Data Products (ASCAT) comprising wind data and very high resolution Weather Research & Forecast (WRF) model.

Presentation Date: 27 July 2016
Presentation Time: 11:00 -11:20
Session Name: W2B (LT2) Parallel
Session S4: Integration of nowcast and mesoscale NWP
Author/Co-author Name: Ping CHEUNG
Speaker Name: Ping CHEUNG

Blending of Multi-Sensing Nowcasting System and NWP Output to Improve Aviation Significant Convection Forecast

Nowcasting system of the Hong Kong Observatory is based on the radar reflectivity data from local Doppler weather radars. Due to the limited spatial coverage of local radars, the most usable prediction is often confined to the first couple of hours within 200 km from the radar location. For aviation nowcast which demands for longer lead time and wider spatial coverage, these limitations makes the local radar based systems inadequate for the purpose. The Observatory has used satellite infrared and visible channel data together with radar network mosaic to generate multi-sensing, wide-area nowcasting products. In a recent study, a blending algorithm is applied to this new nowcasting system and NWP output to produce significant convection forecast for the key areas within the Hong Kong air space. This paper introduces the blending algorithm, highlights the choice of forecast parameters and thresholds. The performance of the blended forecast will also be evaluated.

Presentation Date: 27 July 2016
Presentation Time: 11:20 -11:40
Session Name: W2B (LT2) Parallel Session S4: Integration of nowcast and mesoscale NWP
Author/Co-author Name: Min CHEN, Conglan CHENG, Mingxuan CHEN, Feng GAO, Lingye SONG, Yong WANG
Speaker Name: Min CHEN

An Integrated Rapid Multi-Scale Analysis and Prediction System (RMAPS-IN) and its Preliminary Performance Evaluation

An integrated rapid multi-scale analysis and prediction system (abbreviated as RMAPS-IN) has been constructed in Beijing Meteorology Bureau (BMB), China. With the Integrated Nowcasting through Comprehensive Analysis (INCA) System as the prototype, RMAPS-IN system is designed as a seamless integration of the short-term numerical forecasts (0-12hr), nowcasting (0-2hr) and real-time radar and AWS observations.

Specifically, a series of local analysis and nowcasting techniques have been integrated as well. The local real-time wind and perturbative temperature generated by the assimilation of local Doppler radars using 4DVAR technique are utilized as the background against which, the integrated analysis of AWS observations are performed. A local topography-dependent algorithm for AWS precipitation interpolation is also developed to enhance the capability of describing the small-scale topography-precipitation characteristics in the complex terrain area. For the precipitation nowcasting, a QPF extrapolated scheme with the blended Lagrangian and TITAN storm-tracking algorithm is constructed.

The preliminary evaluation for the analysis and forecasting results show that RMAPS-IN system is capable of providing high-quality, 10-min updated surface and upper-air analysis and 0-12hr forecasts with 1-km horizontal resolution. From the scores of the conventional and precipitation verifications, RMAPS-IN does demonstrate its superiority to nearly all of other operational NWP and nowcasting systems in BMB.

Presentation Date: 27 July 2016
Presentation Time: 11:40 -12:00
Session Name: W2B (LT2) Parallel
Session S4: Integration of nowcast and mesoscale NWP
Author/Co-author Name: Jean-Marc MOISSELIN, Joel HOFFMAN, Nicolas MERLET
Speaker Name: Jean-Marc MOISSELIN

Nowcasting with a dedicated mesoscale model and with a radar-NWP fusion technique

Radar and satellite observations are fundamental for nowcasting and several techniques have been developed to produce very short term forecast from them, like advection techniques. Unfortunately, the quality of the results decreases rapidly when range increases and, on average, it is not reasonable to consider these forecasts beyond one hour range.

Besides this, numerical models have regularly improved their performances and resolution. Now, Météo-France operates the Arome model, a 1-km resolution model for short-range weather forecasting. It is able to reproduce explicitly the large convective cells and the past progresses on spin-up allow the use of the outputs for the very short range forecasts.

This model is now running in a nowcasting configuration called Arome-NWC. It is operated every hour, with a very short cut-off of 10 minutes and it is available to forecasters at time H+35' with 15 minutes resolution of outputs and a maximum forecast range of +6 hours. The very high rate of production makes difficult a systematic use of the outputs. Therefore a dedicated web-dashboard helps the forecasters: for a selection of parameters, it shows different colours corresponding to different levels of warning and helps to look at the forecasts only when useful. For a given date, several forecasts started from different initial dates are available. Then the forecaster gains access to different solutions given by the model for this date.

Downstream the model, a smart extrapolation system is under construction. This so-called "radar-NWP fusion system" consists of using together the radar rainfall extrapolated with classical Lagrangian techniques up to one hour forecast and the fields produced by Arome-NWC to reach a 3-hour extrapolation. The process starts with a pairing step between observed rain patterns and NWP rain patterns. Then the observed rainfalls are extrapolated, at the beginning mainly with a traditional Lagrangian technique and gradually more and more with patterns and properties found in model fields. Since it is possible to produce such extrapolations from several consecutive radar images (1 every 5 min) and from 2 or 3 model runs, for a given date one gets in the end several extrapolations, which can be considered as an ensemble of several forecasts overlapping on a 3-hour timeslot. Based on this ensemble, the last step consists in the production of a 3-hour probabilistic forecast of rain.

This process still needs to be tuned and validated. It aims at a realistic rain forecast covering the next 3 hours.

Presentation Date: 27 July 2016
Presentation Time: 12:00 -12:20
Session Name: W2B (LT2) Parallel
Session S4: Integration of nowcast and mesoscale NWP
Author/Co-author Name: Sijin ZHANG, Xiang-Yu HUANG, Bruce MACPHERSON, Martin MCMILLAN
Speaker Name: Sijin ZHANG

Improving very short range precipitation forecasting over a tropical region

An advanced precipitation forecasting system is under developing in Singapore for providing the high quality precipitation forecasting over 0-12 hours. In this system, an hourly cycle scheme, which is blended with a traditional extrapolation based nowcasting approach, is applied over an extensive range covering Singapore, South of Malaysia and East of Sumatra. The hourly cycle scheme is set up based on the Unified Model (UM) at 1.5 km and a hybrid radar data assimilation system (DA). In the DA system, radial winds are assimilated using 3D-Var/4D-Var while the radar derived rain rates are incorporated into the model with Latent Heat Nudging (LHN) every 15 minutes. A 1 hour nowcast is applied to increase the nudging window and therefore prolong the effects of initialization. A blending scheme is applied to merge the extrapolation based nowcasting with Numerical Weather Prediction (NWP) after the lead time of 1 hour. The weight of NWP increases from zero to one at the lead time of 6 hours, while the contribution of nowcasting decreases. After 6 hours, precipitation forecasts are fully provided by the NWP model.

Both the initial subjective and objective evaluations show the robustness of this system compared to the downscaler alone, however, considering the characteristics of the high impact weather system in a tropical region, the effective period of this system is various and long term verifications are required before the operational use of the system.

Presentation Date: 27 July 2016
Presentation Time: 12:20 -12:40
Session Name: W2B (LT2) Parallel Session S4: Integration of nowcast and mesoscale NWP
Author/Co-author Name: Yali WU, Dehui CHEN
Speaker Name: Yali WU

On use of LHN method to assimilate the intensified surface precipitations for GRAPES_Meso model initialization

The quantitative precipitation forecast (QPF) in very-short range (0-12 hours) has been investigated in this paper by using a convective-scale (3km) GRAPES_Meso model. At first, a latent heat nudging (LHN) assimilation scheme to ingest the hourly intensified surface precipitation data was set up to enhance the initialization of GRAPES_Meso integration. And then based on the LHN scheme, a convective-scale prediction system was built up in considering the initial "triggering" uncertainties by means of multi-scale initial analysis (MSIA), such as the three-dimensional variational data assimilation (3DVAR), the traditional LHN method (VAR0LHN3), the cycling LHN method (CYCLING), the warm LHN assimilation method with no cycles (warm_LHN), the spatial filtering (SS) and the temporal filtering (DFI) LHN methods. Furthermore, the probability matching (PM) method was used to generate the QPF in very-short range by combining the precipitation forecasts of the five runs. The experiments for one month were carried out to validate the MSIA and PM method for QPF in very-short range.

The numerical simulation results showed that: (1) in comparison with the control run, the warm_LHN and CYCLING runs could generate the smaller-scale initial moist increments and was better for reducing the spin-up time and triggering the convection in a very-short time; (2) the DFI runs could generate the initial analysis fields with relatively larger-scale initial increments and trigger the weaker convections at the beginning time (0-3h) of integration, but enhance them at latter time (6-12h); (3) by combining the six runs with different convection triggering features, the PM method could significantly improve the QPF in very-short range in comparison to any single run. Therefore, the QPF with a small size of combining members proposed here is quite prospective in operation for its lower computation cost and better performance.

Presentation Date: 27 July 2016
Presentation Time: 12:40 -13:00
Session Name: W2B (LT2) Parallel Session S4: Integration of nowcast and mesoscale NWP
Author/Co-author Name: Wai Kin WONG
Speaker Name: Wai Kin WONG

Merging radar nowcast with convection-permitting, rapidly-updated NWP model for significant convection forecast

In supporting forecasts of heavy rain and significant convection, nowcasting techniques are often used to provide robust and rapidly-updated guidance on identifying the evolution of mesoscale convective storms. To improve the forecast skill of heavy rain and thunderstorms, methodologies to incorporate the growth and dissipation of convective storms via merging with mesoscale NWP models have been developed. This presentation discusses an experimental blending method to provide seamless integrated significant convection nowcast for the next 6 hours, by combining radar-based nowcast with the simulated reflectivity from the operational convection-permitting, hourly-updated Non-Hydrostatic Model (NHM) forecast with horizontal resolution at 2 km. The impact of data assimilation of radar reflectivity data on model quantitative precipitation forecast will be discussed. This will be followed by an illustration of the methodology to blend radar nowcast of precipitation, reflectivity or related storm parameters, and study of how the blended forecasts perform in several convective weather events that brought widespread heavy rain to Hong Kong or that caused adverse impact to aviation traffic. Verification of model forecast of simulated reflectivity in different horizontal and intensity scales will be shown. The verification results are also utilized to devise a probabilistic representation of significant convection potential by merging the model forecast at different initial times with the radar extrapolation, or the ensemble nowcast by perturbing the radar echo motion.

Poster Batch B

Poster ID: B01

Author/Co-author Name: Eder P. VENDRASCO, Gustavo G. G. DE GONÇALVES, Eduardo G. KHAMIS, Luiz F. SAPUCCI, Lucas A.AVANÇO, Liviany P. VIANA, Vivian B. MACHADO, Thiago S. BISCARO, João G. Z. DE MATTOS, Camila C. FERREIRA
Speaker Name: Eder P. VENDRASCO

Preliminary Results of the CPTEC's Regional Modeling System with Rapid Update Cycle in support to the Olympic Games in Rio de Janeiro

The Center for Weather Forecast and Climate Studies (CPTEC) from the Brazilian National Institute for Space Research (INPE) has started on July, 2015 its rapid update cycle (RUC) in experimental mode over South America. This system is intended to be used as both operational regional tool for high impact weather as well as in support to the Olympic Games that will take place in the city of Rio de Janeiro during August and September of 2016. The modeling suite, named Regional Modeling System (RMS), comprises nested domains with resolution of 9 km, 3 km and 1 km over South America, southeastern Brazil and Rio the Janeiro regions, respectively. A 3DVar data assimilation scheme based on the Gridpoint Statistical Interpolation (GSI) system has been implemented in the larger (9 km) domain using full observation system, including conventional, satellite radiances and GPS data. Furthermore, radar data assimilation has been implemented in the 1 km domain in order to capture the convective scale atmospheric features using the Weather Research and Forecasting Data Assimilation system (WRFDA). The 1 km domain is covered by 3 radars that provide reflectivity and radial velocity data to be assimilated. This work aims to assess the preliminary results from this CPTEC RMS/RUC and the value of radar information over the Rio de Janeiro in preparation to the Olympic Games. Additionally, the impact of conventional and satellite data over the South America is also investigated.

Poster ID: B02
Author/Co-author Name: Joon-Bum JEE, Young-Joon KIM
Speaker Name: Joon-Bum JEE

Application of Radiative Transfer Model for Topographical Effect in the ASAPS Model on Seoul Metropolitan Area

Solar radiation model calculate numerical method for the process of reaching the Earth's surface while released from the Sun that solar radiation is attenuated by absorption gases, aerosol and cloud passes through the atmosphere. Recently, solar radiation model adapted in complex area such as non-homogeneous surface, mountain, and urban morphologies how to calculate the solar energy is shielded by buildings and mountains. Zo et al (2014) calculate the topographic effect from a high-resolution digital elevation model based on solar radiation distribution.

In this study, we calculated the coefficients to calculate the effect of complex surface using a high-resolution DEM (digital elevation model) data and apply it to the New Goddard radiative transfer scheme (Chou and Suarez, 1999; Chou and Suarez, 2001) in WRF model (Skamarock et al., 2008) and applying a numerical simulation in real states and analyzing the changes in weather variables.

ASAPS (Advanced Storm-scale Analysis and Prediction System) is simulated for very short range forecast on Seoul metropolitan area based on KLAPS (Korea Local Analysis and Prediction System, Ha et al., 2011) from KMA. This system configured three parts that make a background field (SUF5), analysis field (SU01; Albers et al, 1996) with observation and high resolution forecast filed (SUF1).

In order to calculate the radiation reaching complex surface adopted the Lai et al (2010) method. The scaling factor (Kappa and Chi) for topographic effect in radiative transfer model is calculated using DEM data. Scaling factor for topographic effect retrieved from DEM data with 30 m resolution provided by the NSI (National Survey Institute) in South Korea. Kappa is a shield or shadow of direct radiation that configured 1296 layers with zenith angle (2.5˚ interval) and azimuth of the sun (2.5˚ interval). Chi is a all-sky (diffuse) radiation applied to the sky view factor.

And topographic effect adopted in New Goddard radiative transfer scheme in ASAPS model. ASAPS model simulate with ASAPS_control (without topographic effect) and ASAPS_topo (with topographic effect). Clear and partly cloudy sky condition select from July 22 to July 24, 2015. ASAPS model is composed of two nested domains with 5km and 1km.

It is more effective application of topographic effect in ASAPS model. Solar radiation on the surface is improved in ASAPS model with improving the resolution and topographic effect. While predicted temperature and wind field were changed with change of solar radiation with topographic effect, but precipitation is not changed.

Therefore, numerical model reflected the topographic effect with the actual surface characteristics, but the simulation of weather phenomena is not changes by the Earth's surface.

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Poster ID: B03
Author/Co-author Name: Na HE, Jisong SUN, Ke LIU, Xiaonong LIAO
Speaker Name: Na HE

Comparison of Dynamic Characteristics in Two Phases of Torrential Rainfall in Beijing on 21 July 2012

Different characters occurred in two phases of Torrential rainfall on 21 July 2012 in Beijing. Analysis showed that warm sector convective systems effect when 10:00-18:00 on July 21,and frontal systems effect from 19:00 on July 21 to 4:00 on July 22.The comparative analyses on their dynamical structure, the trigger mechanism, the maintenance mechanism and the structure of Moist potential vorticity (MPV) showed that: the convergence intensity, rising velocity and water vapor flux divergence in warm sector convective systems were weaker than in frontal convective systems, however, heavy rainfall distribution was more uneven. The total precipitation of frontal convective systems was more than that of warm sector convective systems, and the precipitation was relatively evenly distributed. The comparative analyses which the trigger mechanism and the maintenance mechanism of the two phases showed that due to the special terrain in North China triggered warm sector convection，and convectively unstable caused by strong warm and wet advection conveyance in middle and lower troposphere maintained the convection. Frontal uplift triggered frontal precipitation, and frontal conditional symmetric instability mechanism maintained the frontal convective. The comparative analyses of the two phases MPV verified their difference of convective nature. The analysis of MPV1 implied that warm convective systems exhibited characteristics of convectively unstable, and frontal convective systems exhibited the characteristics of interaction between the northwest air current and the southeast air current which tilt with height. The analysis of MPV2 implied that the maintenance of warm sector convective systems was associated with enhanced low-level vertical shear, and frontal convective systems was associated with high-level jets and low-level jets interaction and the frontal zone caused the physical processes of θse gradient enhancement.

Poster ID: B04
Author/Co-author Name: Jidong GAO, Chenghao FU, Yunheng WANG, Darrel KINGFIELD, Kristin CALHOUN, Chris KARSTENS, Travis SMITH, Gerry CREAGER, Lou WICKER, Jack KAIN
Speaker Name: Jidong GAO

A Realtime Weather-Adaptive Hybrid 3DVAR Analysis System with Automatic Storm Positioning and On-demand Capability

A real-time, weather-adaptive hybrid three-dimensional ensemble variational data assimilation (3DEnVAR) system has been developed recently for NOAA supported Warn-on-Forecast project (WoF). This system incorporates available ensemble forecasts, radar, and traditional observations within an analysis domain that has potential for severe weather, including tornadoes, hails and strong damage winds. The goal of this work is to provide physically-consistent gridded data produced by the system to forecasters to help make their warning decisions in a timely manner. Usually, in a hybrid system, the ensemble information is provided by an ensemble Kalman filter data assimilation system (EnKF). However, the 3DEnVAR system linked with EnKF is computationally very expensive. In this study, we use short-range ensemble forecasting (SREF) at the NCEP to provide ensemble information for the 3DEnVAR system. SREF may provide good information about mesoscale environmental uncertainty or variability. By doing this, the overall computational cost should not be significantly increased over the original 3DVAR system (Gao et al. 2013; Smith et al. 2014, Calhoun etal. 2014) because no ensemble forecasts are needed. The system keeps the fine features of original 3DVAR system. For example, it has the ability to automatically detect and analyze severe local hazardous weather events and the analysis can also be performed with on-demand capability in which end-users (e.g., forecasters or scientists) set up the location of the analysis domain in real time based on the current weather situation. The analysis product may help forecasters identify strong circulations imbedded in thunderstorms so that the accuracy of warnings for hazardous weather threats may be improved. The performance of the system during the 2015 Hazardous Weather Testbed Spring Experiment will be reported during the symposium.

Calhoun, K., M., T. M. Smith, D. M. Kingfield, J. Gao, and D. J. Stenrud, 2014: Forecaster Use and Evaluation of realtime 3DVAR analyses during Severe Thunderstorm and Tornado Warning Operations in the Hazardous Weather Testbed. Wea. Forecasting 29, 601-613.

Gao, J., T. M. Smith, D. J. Stensrud, C. Fu, K. Calhoun, K. L. Manross, J. Brogden, V. Lakshmanan, Y. Wang, K. W. Thomas, K. Brewster, and M. Xue, 2013: A realtime weather-adaptive 3DVAR analysis system for severe weather detections and warnings with automatic storm positioning capability. Wea. Forecasting, 28, 727-745.

Smith, T. M., J. Gao, K. M. Calhoun, D. J. Stensrud, K. L. Manross, K. L. Ortega, C. Fu, D. M. Kingfield, K. L. Elmore, V. Lakshmanan, and C. Riedel, 2014: Performance of a real-time 3DVAR analysis system in the Hazardous Weather Testbed. Wea. Forecasting, 29, 63-77.

Poster ID: B05
Author/Co-author Name: Cesar BENETI, Leonardo CALVETTI, Jorge BONATO, Renan SELUZNIAK, Tiago BURIOL, Tulipa SILVA, Camila OLIVEIRA, Rute FERREIRA, Dirceu HERDIES
Speaker Name: Cesar BENETI

Radar Nowcasting in Southern Brazil - An Open Source Approach in an Operational Environment

In less than 5 years, in Brazil we increased our radar coverage, from 23 single polarization weather radars to 15 more new dual polarization radars, mainly S-Band, with a concentration in the southern region, an area prone to severe weather, mostly related to Mesoscale Convective Systems. Weather radars in the south of Brazil play an important role in quantitative precipitation estimation and severe weather monitoring and forecasting. The major economical activity in this region is agro-industry and energy production, responsible for more than 35% of hydro-power energy generation used in the country, directly dependent on precipitation distribution, water availability and severe storms impacts.

In the past decade, the technology of polarimetric weather radars has been available to several meteorological operational centers throughout the world. The available information generated have, in many cases, increased more than five times, but we are still learning how to select the necessary information in real-time to apply in nowcasting activities.

Traditionally, data visualization systems in meteorology maintained some standard user interfaces and features that have persisted for many years. Designers and developers of such systems have given little attention to issues relating to the interface, especially with regard to usability and new tools to interact and explore the data visually.

A more efficient user interface allows the analyst to focus on research data to gain a better understanding of the phenomenon and thus be able to make decisions and reach to conclusions more quickly and effectively.

In this work we used Python language and packages to develop an application for visualization and analysis of radar data, focused on ease of use and speed of system response to user requests, in order to provide an effective means of exploitation and visual analysis of the data.

A radar conversion library in C and Python, mainly, was developed in order to read and/or convert data from several formats, process data with quality control and prepare the information to be used in applications such as nowcasting with blended data (e.g. lightning and radar) and weather radar data assimilation (reflectivity and radial velocity) in a mesoscale model (WRF/NCAR) with rapid update assimilation cycle. The Python ARM Radar Toolkit (Py-ART) library is used for data input and processing, and Unidata's Thematic Real-time Environmental Distributed Data Services (THREDDS) is used for data dissemination. Analysis of storm properties and nowcasting is performed using the Thunderstorm Identification, Tracking, Analysis, and Nowcasting (TITAN) algorithms.

The main idea of our application is to obtain several radar products from a set of data available locally, interacting directly on a visual representation that serves as a basis for the interaction. In this way, the user can focus on the analysis of the data much faster and naturally, without the need to convert in advance the data through several processes before being able to view a specific variable or product. This work presents our experience in polarimetric weather radar data visualization and usage within an operational environment for nowcasting severe weather.

Poster ID: B06
Author/Co-author Name: Wang-Chun WOO, Wai-Kin WONG
Speaker Name: Wang-Chun WOO

Progressive Verification of Rainstorm Warnings

Meteorological services around the world operate rainstorm warning systems to alert the public of the threat of rainstorms and to remind the public to take precautions to protect lives and properties. Verification is crucial to understanding the performances of rainstorm warnings and supporting tools. Through identifying relatively ineffective warnings and their causes, research efforts can be directed to the most promising areas for improvement.

Traditional binary verification methods delineate warnings as hits, misses, or false alarms. While intuitive and simple to use, this type of verification is limited in a number of ways. Firstly, the lead time of a rainstorm warning is rarely accounted for, resulting in late warnings classified as hits. Secondly, warnings that only marginally fail to reach pre-defined thresholds are strictly classified as false alarms, indistinguishable from genuine failures.

This presentation introduces the concept of progressive verification. Ideally, a rainstorm warning should be issued when the weather is still clement and well before heavy rain turns up. Progressive verification is designed to account for three factors, namely severity of rainstorm, intensification of rainstorm and timeliness of rainstorm warnings. Each rainstorm warning is assessed based on the three factors to come up an overall score. A progressive verification scheme was on trial at the Hong Kong Observatory in 2015. The results of the trial are summarized in this presentation.

Poster ID: B07
Author/Co-author Name: Lei LEI, Jisong SUN, Bailin WANG, Jian ZENG
Speaker Name: Lei LEI

Study On the Multi-cell organizational Process of squall line and Meso-scale Characteristics in Beijing Area

(Introduction) Because of the location and the special topography in Beijing, disaster caused by convective thunderstorm happened in what time and places are not easily forecasted and early warning. Two samples of squall line have attracted our attention, one was on June 16th in 2014, and another was on August 7 in 2015. Although the paths and moving directions were not the same, thunderstorm cells all experienced new-borned, merged, strengthened in the local places and when the multi-cells clusters of the upstream moving into and highly organized, squall line formed quickly. In the process of two cases, swath damaging winds (more than 10.8m/s), hails disasters (the diameter over 4cm) and heavy rain (more than 70mm per hour) were observed.

(Purpose) This paper attempts to analyze how the squall line formatted in the complicated multi-cells organizational processes, different synoptic backgrounds, the meso-scale characteristics and dynamics mechanisms. And show some advanced forecast technology we used now.

(Method and data) In this study, we used Sounding data, AWS (Auto Weather Station) data in great density, Doppler Radar, TBB (the temperature of Black Body) with FY2E-satellite, VDRAS (Variational Doppler Radar Assimilation System) data, and ERA Interim daily-analysis data(0.125°*0.125°).

(Conclusions) By analyzing the advanced observational and analysis technology, squall line could formatted in both strong and weak forces of the synoptic background in summer of Beijing. In the earlier complicated process, isolated cloud clusters generated and extincted in the plain area. New multi-cells were emerging between relatively independent deep convection thunderstorms and merged to “the old” to be strengthened, then formed the initial organizational linear convections system. The mature thunderstorm cells within the linear convection system were kind of continental convection clusters, the center more than 50 dbz vertically stretched over 12km, and TBB were below -45℃. The thunderstorm cell is closely associated with a local enhancement of cold pool and then strong meso-scale frontal zone and outflow in the low levels strengthened. The interaction of the outflow among adjacent clusters, and the formatted strong convergence between the outflow and the environment flow are the main formation mechanism of the earlier evolutional linear convection system. When the upstream thunderstorms move down to the North-china plain from the northwest or northeast mountains, they rapidly merge and consolidate with the local multi-cells under favorable conditions, such as very high CAPE, large vertical wind shear mainly in the low level, upward motion area in front of the hill and so on, eventually a highly organized squall line with the bowing structure and meso-β-scale characteristics formed. And nowadays in Beijing, development on meso-scale NWP (BJ-RUC), ensemble prediction, and the integration of nowcasting and NWP model system RMAPS-IN (Rapid update Multi-scale Analysis and Prediction System-INCA in Beijing) provide advanced convective weather forecast methods in less than 12 hours.

Poster ID: B08
Author/Co-author Name: Augusto PEREIRA FILHO, Leonardo CALVETTI,Mírian Costa PINTO, Laércio MANFREDINI, Fabiano alves de lima, Amarílio Carvalho PINTO, Carlos MORIBE, Felipe VEMADO, Ivon Silva JÚNIOR, Frederico FUNARI, Aliton OLIVEIRA, José ROJAS, Leonardo GILLY
Speaker Name: Leonardo CALVETTI

A Hydrometeorological Forecast System For Hydroelectric Power Generation In Brazil

Hydroelectric power plants produce about 70% of the all electricity in Brazil (70 GW). The most important power plants are in Southern (e.g., ITAIPU) and Southeastern (e.g., CESP) Brazil. Recent droughts (2013-2015) and major floods (2009-2012) have prompted the industry to the importance of improving the monitoring and the forecasting of water reservoir levels to optimize its multiuse in face of such a significant climate extremes on a daily bases. According to the Brazilian Water Resources Law, each watershed and its reservoirs have to supply water for agriculture, urban water consumption, navigation, recreation and many other conflicting objectives with hydroelectric power generation. This work describes an integrated QPE, QPF and streamflow forecasting system (HFS) applied to hydroelectric power generation management in South Eastern Brazil. This RDP was approved by “Agência Nacional de Energia Elétrica (ANEEL)” and sponsored by “Companhia Energética de São Paulo (CESP)”. The HFS is composed of a QPE system based on rain gauge AWS networks and satellite rainfall estimation both rainfall databases integrated by a Statistical Objective Analysis Schemes (SOAS), a QPF system based on the ARPS model with rainfall forecast up to 5 days in advance, and a hydrological forecast system (SMAP). Each component of the HFS was verified with available datasets between 2011 and 2015 with usual statistical metrics such as RMSE, CSI and others. Streamflow forecasts results for a total of 27 watersheds with and without the HFS indicate a very significant improvement on reservoir water inflow forecasts and better resulting water management. The improvements are related to better rainfall accumulation analysis given that the rain gauge networks are sparse and the satellite rainfall estimation is negatively biased in general, and better rainfall forecast with adjusted soil moisture measurements and the ARPS system initiation at 12-km and 2-km resolutions over South America.

Poster ID: B09
Author/Co-author Name: Rute FERREIRA, Dirceu HERDIES, Eder VENDRASCO, Cesar BENETI, Thiago BISCARO
Speaker Name: Dr. Dirceu Luis HERDIES

Evaluating The Mesoscale Convective Systems Using Radar Data Assimilation

Mesoscale Convective Systems (MCS) are responsible for severe storms in southern Brazil and can cause a lot of damage due to the large amount of precipitation in just a few hours. Usually, MCS are responsible for strong winds, lightning, storms, and even hail. The study of these systems through atmospheric modeling is required to improve the understanding and predictability of MCS. The goal of this work is using radar data assimilation to study two cases of MCS observed in 2014. Simulations were performed assimilating reflectivity and radial velocity data from three radars, Cascavel, Teixeira Soares (Parana, Brazil) and Asuncion (Paraguay) among other conventional data from the Global Telecommunication System (GTS). The atmospheric model and the assimilation system used are the WRF Data Assimilation (WRFDA) 3D-Var. The radial velocity was directly assimilated, while the reflectivity was converted to rainwater mixing ratio before the assimilation process using an exponential relationship. The spin up consists of ten 6-h cycles assimilating conventional data plus four 1-h cycles assimilating radar data. After the assimilation process, a 6-h forecast was carried out. The forecasted precipitations with and without assimilation were evaluated by comparing them against the combination with Tropical Rainfall Measuring Mission (TRMM) Multi-satellite Precipitation Analysis (TMPA) product 3B42 Real Time and rain gauge data. The new data analysis generated by assimilation showed the impact of radar data assimilation in all atmospheric levels represented by the model. The use of spin up for model initialization demonstrated its importance in correctly predicting the location of rainfall. An improvement of the forecast was observed when radar data were assimilated, showing the importance of improving the initial condition by assimilating high-resolution data into the model. The results show the importance of radar data to improve rainfall warnings related to MCS, thus reducing economic and life losses caused by severe storms.

Poster ID: B10
Author/Co-author Name: Min SUN, Ming HU
Speaker Name: Min SUN

Nowcasting and Shot-term Heavy Rain Forecast of Typhoon Fitow (2013) using GSI with Radar Radial Wind Assimilation

The main purpose of this paper is to investigate the impact of Doppler radar radial wind data assimilation on the short-term forecast (0-6h) of a heavy rainfall event which occurred on 8th October 2013. Radar radial wind observations from both radars in Shanghai are directly assimilated by the Gridpoint Statistical Interpolation (GSI) 3-Dimensional Variational (3DVar) assimilation system. A single U-component wind observation assimilation test is conducted in order to adjust the horizontal and vertical length scale of the increment response. Results of the single observation test show that when using GSI to assimilate radar radial wind data, the horizontal influence scale should be tuned to small values. The 'super-observation' technique is performed in order to reduce partially redundant actual data which is caused by the high spatial and temporal resolution of radar data. And the reasonability of this technique is assessed by tuning 'super-observation' parameters. The assimilation of low-level radar radial wind data has a positive impact on the short-term forecast, although the vertical components of air motion and the precipitation fall speeds are not considered in the radar radial wind observation operator in GSI 3DVar system. Assimilating radar radial wind observations can produce more reasonable wind analyses, compared with the wind fields retrieved from the dual-Doppler radar observations, at the model initial time than those from the control experiment without data assimilation. More local information are added to the background fields after assimilating radar radial wind observations, such as wind convergence and moisture flux divergence in heavy rain areas. Results also show that 3DVar assimilation of radar radial wind data is shown to improve the prediction of the rainband structure and rainfall amount especially within the first 3 hours. Consequently, an improved Equitable Threat Score (ETS) of the short-term composite reflectivity forecast is obtained when verified against radar reflectivity observations. Finally, five experiments using different 12min rapid update cycle times are conducted. The ETS of those experiments shows that rapid update cycle can't always improve the results, especially in the first one hour, because it needs time to adjust all the fields to achieve the balance.

Poster ID: B11
Author/Co-author Name: Yudan GU,
Speaker Name: Yudan GU

Study on the threshold of heavy rainfall in Shanghai

Based on hourly waterlogging data from 110 alarm and hourly rain data from weather stations in several obvious heavy rain processes in Shanghai during 2012-2015, the temporal and spatial dynamic evolution relationships between the amount of rain and the number of waterlogging alarm were analyzed and waterlogging threshold indicators caused from heavy rain were established in Shanghai. Results indicate that the waterlogging threshold is 30-40 mm per hour in Shanghai, and waterlogging disasters will increase significantly when the rain intensity reaches 50 mm per hour or more. The severity of waterlogging is not only related to the rain intensity, but also associated with the length of the rain duration and rain area. When rain with an intensity of 10-20 mm per hour has lasted for over 3 hours, and more than one fourth of the whole city surface has rained, the number of waterlogging will increase sharply once the rain enhances later. Waterlogging alarm relative to the occurrence of heavy rain has a lag of about 1-2 hours. Population density, underlying surface conditions and the degree of human daily activities are also associated with the amount of waterlogging alarm in Shanghai.

Poster ID: B12
Author/Co-author Name: Yudan GU,
Speaker Name: Yudan GU

Analysis of lightning distribution and lightning disaster characteristics in Shanghai

The characteristics of cloud-to-ground (CG) lightning distribution in Shanghai are analyzed by using the lightning data from Shanghai lightning location system from 2009 to 2014. It is found that the lightning flashes occur more frequently from June to September and from 6~9,11~12 and 15~16 in a day. CG lightning focused on the range of 0~10kA accounts for 50% of the total amount. Negative flashes are larger than positive flashes. Lightning activities in Shanghai have two high densities area. And one is in north of Pudong, central urban areas and south of Songjiang. The other is in Baoshan, Jiading and North of Qingpu. The average density of CG flash in these areas is 4 ~ 7/km2.a. According to the data, lightning disasters in Shanghai are mainly occurred between 14:00 and 20:00. The mainly lightning hazard-affected bodies were electric power facilities, suburban houses and outdoor signal lamp.

28 July 2016 (Thursday)

Plenary Session

Presentation Date: 28 Jul 2016
Presentation Time: 09:00-09:30
Session Name: H1 (LT1) Plenary Session
Speaker Name: Wai Kin WONG

Mesoscale Modelling in Nowcasting

In this presentation, a review on the advancement in fine-resolution numerical weather prediction (NWP) model, data assimilation and ensemble prediction system (EPS) to improve the analysis and simulation of convective precipitation systems, mesoscale and local-scale weather processes will be discussed. High-density surface automatic weather observations and remote sensing instruments contribute to improved quality of inputs to the NWP model analysis in capturing the mesoscale or local-scale weather processes. Model analysis and forecast running in rapidly-update cycle become increasingly indispensable to support the situational-awareness of forecasters in monitoring high-impact weather and decision-making processes on impact to socio-economic activities. With the use of fine-resolution NWP model, prediction of significant convective weather in very-short-range can be enhanced through the improved initial condition and considering the model errors due to uncertainties in analysis or physical processes. Moreover, the fine-resolution NWP model forecasts and possible scenarios obtained through time-lagged approach or running an ensemble prediction system can be used to blend with the radar-based extrapolation that extend the forecasting skill of heavy precipitation, significant convections and related high-impact weather phenomena. Numerical forecasts of several significant weather events in Hong Kong and south China coastal areas during springtime to summer monsoon season will be exemplified to highlight the challenges in forecast of high-impact weather events. A framework of multiscale prediction approach to underpin seamless integration of nowcasting, fine-resolution NWP, ensemble forecast and related model post-processing methods in nowcasting and very-short-range forecasts of rainstorms and aviation applications will also be discussed.

Presentation Date: 28 Jul 2016
Presentation Time: 09:30-10:00
Session Name: H1 (LT1) Plenary Session
Speaker Name: Peter CHADWICK

AvRDP - Air Traffic Management Expectation

While major airports normally declare their seasonal runway capacities for the purposes of airline scheduling, Air Traffic Services need to be able to make a dynamic determination of runway capacity on an hour to hour/day to day basis for the purposes of efficient air traffic management.

As the growth of air traffic has escalated exponentially worldwide, many of these airports are now operating very close to capacity, even in good weather conditions. Even a small reduction in capacity can cause a demand/capacity imbalance, which rapidly creates a backlog of traffic in the air and on the ground, requiring Air Traffic Flow Management (ATFM) measures to be imposed, often without the desired advance notification.

Historically, Air Traffic Controllers made reference to Aerodrome Forecasts and applied their local knowledge and experience to estimate the operational impact and broadly determine the runway capacity in the next few hours, so that ATFM measures could be implemented with some advance notice if necessary.

More recently, the recognition that significant weather in the Terminal airspace, within about 80 nautical miles and encompassing the normal arrival sequencing and holding areas and initial departure tracks, can have a quantifiable impact on the ability for ATC to deliver flights to and from the runways, has led to the need for forecasting services that can assist with the prediction of capacity impact within these areas.

The AvRDP provides the forum for MET and ATM to collaborate internationally, with the focus on nowcasting aviation weather, including the respective uncertainty/confidence estimation, over the Terminal Control Area for the next 0-6 hours.

Our expectation is that the Project can demonstrate the ability of nowcasting to provide tailored information, in new formats and in various Terminal airspace designs and configurations, to support ATM in the determination of airport and airspace capacity with the required lead time to enable more efficient operations and fulfil the requirements of the ICAO ASBUs.

Presentation Date: 28 Jul 2016
Presentation Time: 10:00-10:30
Session Name: H1 (LT1) Plenary Session
Speaker Name: Jonathan REBBECK

Airline expectation from future MET support

Challenging weather conditions are an everyday event for the airlines. The priority is safety of the aircraft, the crew and passengers and severe weather within congested airspace becomes an increasing threat. Whether the threat is turbulence, windshear, convective activity or other phenomena accurate short term, consistent forecasting and reporting plays a vital role enabling both strategic flight planning and in-flight tactical decision making which can have a significant effect on both safety and efficiency.

Critical operational decisions are made based on TAF and enroute forecasts including fuel uplift, re routes and diversions. This presentation will focus on the potential of short term forecasting and the communication with airlines that will result in enhanced safety and efficiency.

Oral Presentation

Presentation Date: 28 July 2016
Presentation Time: 11:20 -11:40
Session Name: H2A (LT1) Parallel
Session S3: Advances on mesoscale NWP model, data assimilation, ensemble prediction
Author/Co-author Name: Dongyan MAO, Yuanyuan ZHENG, Yerong FENG, Bo YANG, Feng HAN, Feng XUE, Hongyan WANG, Yufa WAN, Yongguang ZHENG, Sehng HU, Fuyou TIAN
Speaker Name: Dongyan MAO

SWAN – The Operational System for Nowcasting and Very-short Range Forecast in CMA

Severe Weather Automatic Nowcasting System (SWAN) is a system owned by China with proprietary intellectual property rights, which was first proposed by China Meteorological Administration in 2008, and was eventually developed by the cooperation among National Meteorological Center, Guangdong Meteorological Bureau, Wuhan Storm Office and other local meteorological departments and research institutions. As an operational system, it has played an active and important role for the severe convective weather nowcasting and warning. Till now SWAN has been updated to V2.0.

Considering the features of nowcasting operation in China, based on MICAPS platform, independent convective weather monitoring and nowcasting system was developed. 3 main functions were realized in SWAN, including the real-time weather monitoring, nowcasting and very-short range forecast, and warning issuance.

For the monitoring, based on radar and high-density auto-station data, the system can fulfill the real-time monitoring for the basic meteorological elements (temperature, rainfall, wind, et al) and the radar reflectivity. Moreover, some analysis can be realized through the system, such as the temporal variation for different elements, the cross section for the radar reflectivity for different points, and the statistic information for an area that the users may focus on. More importantly, considering the high-temporal and special data, SWAN can alarm automatically for the severe weather with the observation more than the threshold that was set in the system. In recent years, the techniques of hail identification and 3-D wind retrieval from radar data are developed and are very useful for the operation.

For nowcasting and very-short range forecast, the forecasters can get the 0-6h forecast products. Besides the classical TITAN technique for extrapolation, the nowcasting and NWP blending technique is being developed in recent years. By using the dynamic adjusting of Z-I relationship and the optical flow method, the QPF forecast accuracy for 0-2h could be improved. Moreover, by using Fourier Transform and Weibull Distribution the NWP products could be effectively rectified.

For the warning issurance, the system can produce 14 kinds of warning signals for different disastrous weather, such as rainstorm, hail, et al, and disseminate the warnings to different media.

Presentation Date: 28 July 2016
Presentation Time: 11:40 -12:00
Session Name: H2A (LT1) Parallel
Session S3: Advances on mesoscale NWP model, data assimilation, ensemble prediction
Author/Co-author Name: Rajasree VPM, Amit P KESARKAR, Jyoti N BHATE, Umakanth UPPARA, Vikas SINGH
Speaker Name: Rajasree VPM

A comparitive study on the genesis of North Indian Ocean cyclone Madi (2013) and Atlantic Ocean cyclone Florence (2006)

A study has been carried out to understand the tropical cyclone formation over the North Indian Ocean (NIO) and the Atlantic Ocean (AO). The genesis sequence of two cyclones viz. Madi (NIO) and Florence (AO) are compared by generating high resolution (6km) reanalysis using three dimensional variational data assimilation technique (3DVAR) and Weather Research and Forecasting (WRF) model. For the 3DVAR experiment, observations from NCEP Automated Data Processing (ADP) global upper air and surface data which include radiosondes, pilot balloons, aircraft, and satellite radiances from the Advanced Microwave Sounding Unit A (AMSU A), AMSU B, Atmospheric Infrared Sounder (AIRS) and Microwave Humidity Sounder (MHS) with default quality control settings have been used. Before analysing the genesis sequence of these cyclones the model outputs are verified against observations. It has been found that the simulated variables are well matching with the observations. The created analysis is used to trace the tropical depression backward in time using a moisture variable and it has been found that the parent disturbance associated with both the cyclones are westward moving in nature. Pouch regions associated with the parent disturbance is identified in the analysis as a region of enhanced moisture. It is found that in the case of NIO cyclone Madi, dry air intrusion is not a dominant detrimental factor for the genesis whereas the dry air intrusion delays the intensification of the AO cyclone Florence. The pouch region associated with the parent disturbance of Madi cyclone plays a more important role in the vorticity upscale cascade than in preventing dry air intrusion. The intensification of Madi cyclone from depression to tropical cyclone strength is found to be very quick compared to the Florence cyclone. The intensification of Florence cyclone is delayed due to the presence of a relative dry layer of air in the genesis environment. This is basically attributed to the dust outbreaks associated with Saharan Air Layer. However, the pouch region associated with the parent disturbance protects the pre-Florence disturbance from all kinds of environmental deformations and Florence intensifies into cyclonic strength at a later stage.

Presentation Date: 28 July 2016
Presentation Time: 12:00 -12:20
Session Name: H2A (LT1) Parallel
Session S3: Advances on mesoscale NWP model, data assimilation, ensemble prediction
Author/Co-author Name: Jose A. GARCIA-MOYA, Alfons CALLADO, Pau ESCRIBA, Carlos SANTOS
Speaker Name: Jose A. GARCIA-MOYA

gSREPS The New Mesoscale Multimodel Ensemble Prediction System in Spain

Forecasting severe weather events is a key object for National Meteorological Services around the World. In Spain convective precipitation events, very high-resolution cyclones at the Mediterranean ("medicanes") and gale winds are the most dangerous meteorological high impact weather events. Due to the large amount of processes involved in those events and their non-linearity, a probabilistic approach is required. Ensemble prediction systems are a feasible framework and the most useful tool to improve such forecasts. However, resolution also matters, because the effect of soil characteristics and orography, as well as the impact of explicitly resolve some physical processes may become very important in the location and intensity of the event. The Spanish Meteorological Agency (AEMET) has a long tradition in developing and operating ensemble prediction systems based in the multimodel approach. The next generation of EPS will be set at convection permitting scale. The system, called gamma-SREPS (gSREPS) will run at 2.5 km resolution and it will use the multimodel approach as well. Two different versions of the European model Harmonie and another two of the WRF model (ARW and NMM) will run with boundary conditions from five different global deterministic models (ECMWF, GFS, CMC, JMA and Arpege). The SPPT scheme will be use to model Physics errors while LETKF will produce proper perturbations at the initial state. The new system will run in daily experimental mode from January 2016 and will become operational after summer. In this presentation, we will show the main results that we have got during the development phase and the objective verification of the first steps of operations. We also show the probabilistic products specially developed to improve the use of ensembles in the Nowcasting operational tasks in AEMET.

Presentation Date: 28 July 2016
Presentation Time: 12:20 -12:40
Session Name: H2A (LT1) Parallel
Session S3: Advances on mesoscale NWP model, data assimilation, ensemble prediction
Author/Co-author Name: Jidong GAO, Chenghao FU, David STENSRUD, Jack KAIN
Speaker Name: Jidong GAO

OSSEs Stormscale Radar Data Assimilation with an Ensemble of 3DVAR system

In this study, an ensemble of data assimilation method named as En3DA has been developed which consists of an ensemble of 3DEnVAR assimilations and forecasts which differ from each other member by perturbing initial conditions and/or perturbing observations. The method is applied to the assimilation of simulated radar data for a supercell storm. It is shown that the flow-dependent ensemble covariances derived from the En3DA method is effective in producing quality analysis. Most important features of the simulated storm including low-level cold pool and mid-level mesocyclone are well analyzed. Several groups of sensitivity experiments are conducted to test the robust of the method. The first group of sensitivity experiments demonstrates that incorporating mass continuity equation as a weak constraint into the En3DA algorithm can improve the quality of the analysis when radial velocity observations contain large errors. In the second group of experiments, we examine the sensitivity of the analysis to microphysics scheme. It is found that the analysis results are quite sensitivity to different microphysics schemes. For this reason, ensemble forecasts with multiple microphysics schemes could be used to reduce uncertainty related to model physics errors. Four sensitivity experiments show that assimilating reflectivity can reduce spin-up time, but has a small positive impact on the quality of analysis for wind fields. The experiment with the threshold 15 dBZ provides the best analysis.

Presentation Date: 28 July 2016
Presentation Time: 11:20 -11:40
Session Name: H2B (LT2) Parallel Session S8: Verification and Validation
Author/Co-author Name: Robert SCOVELL,
Speaker Name: Robert SCOVELL

Validation of a 3D Radar Mosaic using STEPS

The Short Term Ensemble Prediction System (STEPS), developed jointly at the Met Office and the Bureau of Meteorology, provides Ensemble Nowcast products at up to six hours lead time, primarily for use in hydrological models. A central feature of STEPS is the spectral decomposition of two-dimensional rainfall rate analyses into a cascade of scales. This allows blending of Numerical Weather Prediction (NWP) forecasts, extrapolated radar analyses and stochastic noise. The latter being used where there is a loss of predictability at the shorter length scales with lead time.

A three-dimensional (3D) gridded radar reflectivity retrieval algorithm has been developed recently at Met Office and Météo-France that ingests reflectivity Plan Position Indicator (PPI) scan data from the British and French radar networks to provide a 3D radar mosaic. Motivated by a need to quantitatively evaluate and tune its performance, a method is described that uses the STEPS stochastic noise generator to create purely synthetic gridded log-scale reflectivity fields in 3D (two horizontal plus geometric height) matching the statistics of selected 3D mosaics of real data, assumed approximately normally distributed. By applying a forward operation on the synthetic reflectivity, simulated PPI scans are created which can be ingested into a candidate 3D retrieval algorithm, allowing it to be compared quantitatively with other candidates.

The method has been extended into four dimensions (4D; adding time) by the use of an Auto-Regressive Lag-2 (AR2) model, allowing a time series of a network of radar PPI scans to be simulated using the forward operation at each time step. This facilitates the study of retrieval errors due the temporal sampling characteristics of the radar network.

Presentation Date: 28 July 2016
Presentation Time: 11:40 -12:00
Session Name: H2B (LT2) Parallel
Session S8: Verification and Validation
Author/Co-author Name: Dominique BRUNET, David SILLS, Norbert DRIEDGER, Emma HUNG, Dominique BRUNET
Speaker Name: Janti REID

On the Verification of Thunderstorm MetObjects During the 2015 Toronto Games

To improve its severe weather alerting service, Environment and Climate Change Canada is proposing to move from a static regional warning system to a more customizable, timely and precise paradigm that captures ‘end-to-end’ decision making – from observations / model guidance to forecasters to end clients. This would be accomplished via simplified representations of weather features called MetObjects. Several novel MetObject techniques were developed and tested during a 'Next Generation' Forecasting, Nowcasting and Alerting Demonstration Project undertaken for the 2015 Pan / ParaPan Am Games in Toronto. Enhanced, high-resolution observational and Numerical Weather Prediction (NWP) datasets from the Games periods provided unique guidance for prediction, while operational and experimental lightning networks provided verification data.

In this talk, we will describe the demonstration and illustrate our efforts to verify thunderstorm MetObject forecasts and nowcasts. Specifically, we present our verification results for MetObjects that were either (i) derived from storm tracking algorithms, (ii) automatically extracted from post-processed numerical forecasts (first-guess fields) or (iii) produced by a weather forecaster. We discuss various classical and modern verification measures that were used to assess the quality of forecasts and nowcasts. Finally, we show how use of calibrated ensemble thunderstorm forecasts can result in high-quality first-guess fields and improve forecast accuracy.

Presentation Date: 28 July 2016
Presentation Time: 12:00 -12:20
Session Name: H2B (LT2) Parallel
Session S8: Verification and Validation
Author/Co-author Name: Bin ZHAO
Speaker Name: Bin ZHAO

Intercomparison of spatial verification for landing typhoon precipitation forecast

Based on UPDRAFT (Understanding and PreDiction of Rainfall Associated with landfalling Tropical cyclones) project, a landing typhoon case is selected to evaluate the precipitation forecast. Some spatial verification methods such as MODE (Method for Object-based Diagnostic Evaluation), FSS (Fractions Skill Score) is used to measure the spatial accuracy of precipitation forecast. MODE gives a helpful scheme to compare forecasts of precipitation objects to the observation. It produces a method of defining rain area for the purpose of verifying precipitation and the precipitation objects are defined in both forecasts and observations based on a convolution and thresholding procedure. The matching ability has a stong dependence on object size and is interpreted as the influence of relatively predictable synoptic-scale systems. FSS is used to determine the scale at which an acceptable level of skill is reached and this spatial-scale analysis is more popular for monitoring high-resolution precipitation forecast.

A high-resolution (5km) grid precipitation observation combined with gauges, satellite and radar datasets are used as rainfall estimation products and high-resolution (9km) simulated by GRAPES_MESO model is carried out research to compare the difference between spatial verification method and standard dichotomous method. It shows that a comprehensive evaluation scheme should be made to combine the standard verification method and spatial techniques applied to verification of precipitation, we can obtain more detailed analysis conclusion of the spatial distribution and forecast scale besides traditional skill scores.

Presentation Date: 28 July 2016
Presentation Time: 12:20 -12:40
Session Name: H2B (LT2) Parallel Session S8: Verification and Validation
Author/Co-author Name: Thomas BLACKMORE, Roger SAUNDERS, Simon KEOGH
Speaker Name: Thomas BLACKMORE

Simulated satellite imagery: verifying NWP model analyses and short range forecasts against satellite observations.

Simulating satellite imagery from numerical weather prediction (NWP) model fields is a way of interpreting the model analyses and forecasts by presenting them as if they were a satellite image. Plotting simulated values as an image in the same projection as observed satellite imagery allows a direct comparison between the two.

The imagery is created using a fast radiative transfer model, RTTOV-11, to calculate a top of atmosphere brightness temperature or reflectance from NWP model surface parameters and profiles of pressure, temperature, humidity and cloud properties from every NWP model grid-point. These simulated images provide an integrated view of the model temperature and moisture fields.

Currently simulated imagery is produced for a number of geostationary imagers, including those on Meteosat and GOES-East from the Met Office Global Unified Model. Water vapour, IR window and visible channels can all be simulated. The simulated imagery can also be produced for convective scale models and ensemble members.

These images are generated in real time and are used by forecasters at the U.K. Met Office. They are compared to real satellite images to quickly verify the model analyses and short range forecasts or where real imagery is not yet available to provide a forecast satellite image to help interpret what the weather situation will be. The ability to directly compare these simulated images with the satellite observations helps the forecasters to assess their confidence in the model predictions.

Simulated imagery can also be generated from experimental versions of the NWP models. This allows research scientists to see how novel model changes and upgrades affect the moisture and cloud compared to the current operational model and observed satellite imagery. This can provide useful guidance as to whether the proposed change has improved the model fields for both analyses and forecasts by matching the satellite images more closely. Examples of all the applications will be demonstrated.

Presentation Date: 28 July 2016
Presentation Time: 14:00 -14:20
Session Name: H3A (LT1) Parallel
Session S3: Advances on mesoscale NWP model, data assimilation, ensemble prediction
Author/Co-author Name: Fanyou KONG, Ming XUE, Youngsun JUNG, Keith BREWSTER
Speaker Name: Fanyou KONG

A Cycled EnKF and Storm-Scale Ensemble Forecasting Experiment

A newly implemented realtime EnKF based WRF ensemble forecasting system has been tested during the NOAA Hazardous Weather Testbed Spring Forecasting Experiment. The system includes a one hour EnKF cycling at 15 min interval from 2300 UTC to 0000 UTC following a 5-h 40-member ensemble forecast initiated from 1800 UTC over the continental United States (CONUS) domain, and a 12-member ensemble forecasts from 0000 UTC at a convection-allowing resolution at 3-km grid spacing. The 40-member ensemble background for EnKF is configured with initial perturbations and mixed physics options to provide input for EnKF analysis. Each member uses WSM6 microphysics with different parameter settings. All members also include initial random perturbations with recursive filtering of 20 km horizontal correlations scales, with relatively small perturbations (0.5K for potential temperature and 5% for relative humidity). Cycled EnKF analysis, with radar data and other conventional data, is performed from 23 to 00 UTC every 15 min over the CONUS domain. A 12-member ensemble forecast (60h) follows using the final EnKF analyses at 0000 UTC. The EnKF based storm-scale ensemble forecasts (SSEF) are compared with a 3DVAR based forecast set to evaluate its strength and weakness in terms of quantitative precipitation forecasting in a probabilistic framework.

Presentation Date: 28 July 2016
Presentation Time: 14:20 -14:40
Session Name: H3A (LT1) Parallel
Session S3: Advances on mesoscale NWP model, data assimilation, ensemble prediction
Author/Co-author Name: Wai Kin WONG
Speaker Name: Wai Kin WONG

Simulation of significant convective weather processes using fine-resolution NWP model

To forecast high impact weather phenomena, such as summer monsoonal heavy rain and localized convective development in Hong Kong and southern China, more accurate representations of cloud microphysics, planetary boundary layer process and terrain effect using a fine-resolution NWP model with data assimilation of high-density observations have become increasingly important. This presentation outlines an experimental fine-resolution modelling system based on the Weather Research and Forecast Model (WRF-ARW) running at 600 m that covers Hong Kong and the Pearl River Delta region. Model forecasts of heavy rain and severe convective weather phenomena such as intense wind gust associated with monsoon troughs and outer spiral rain bands of tropical cyclone will be discussed. Effects of various model cloud microphysical process in the forecasts of precipitation, growth and decay of convective systems will be illustrated. It is found that the commonly used single and double-moment schemes produced a reasonable simulation of rainfall. The double-moment schemes with prognostic number concentration of hydrometeors generally produce a better spatial structure of simulated reflectivity consistent with the radar imagery. However, considerable differences are noticed in the forecast of timing of initiation and intensity changes of convective cells. Ensemble prediction by employing multi-physics approach and including the initial error uncertainties, to generate a range of possible events may help in local and fine resolution forecasts, as well as in exemplifying various scenarios to weather forecasters or the public.

Presentation Date: 28 July 2016
Presentation Time: 14:40 -15:00
Session Name: H3A (LT1) Parallel
Session S3: Advances on mesoscale NWP model, data assimilation, ensemble prediction
Author/Co-author Name: Rajasree VPM, Amit P Kesarkar, Jyoti N BHATE, Umakanth UPPARA, Vikas SINGH
Speaker Name: Rajasree VPM

Genesis of tropical cyclone Madi (2013): Appraisal of recent understanding

The present study aims to examine the recent understanding of cyclogenesis by analysing the genesis sequence of formation of a very severe cyclonic storm Madi (6-13 December 2013) occurred over Bay of Bengal (BoB). We have generated high resolution (6km) reanalysis using three dimensional variational data assimilation technique (3DVAR) and Weather Research and Forecasting (WRF) model. We have analysed the genesis sequence using concepts in marsupial theory and other theories. The developed reanalysis is found useful for tracking the movement of westward moving parent disturbance from 15 days prior to genesis; identifying developed pouch region in Lagrangian frame of reference; understanding the evolution of pouch and inside convection and for the study of intensification inside pouch region. Large scale priming of environment agrees with the hypotheses of marsupial theory of tropical cyclogenesis. The analysis of vertical structure of convective towers inside the pouch region shows the increase in diabatic heating and lower level convergence a day or two prior to genesis of Madi and sudden rise in vorticity was observed about 12 hours prior to genesis. The analysis of both simulated precipitation and TRMM observations shows the isolated patches of convective precipitation attributed to presence of convective towers within the pouch. The region of heavy precipitations was observed concentrated near to center of pouch especially close to the genesis time. The analysis of presence of deep convection within the pouch region indicates that processes of their intensification within pouch region closely follows bottom to top mechanism.

Presentation Date: 28 July 2016
Presentation Time: 15:00 -15:20
Session Name: H3A (LT1) Parallel
Session S3: Advances on mesoscale NWP model, data assimilation, ensemble prediction
Author/Co-author Name: Yuan JIANG, Liping HUANG
Speaker Name: Yuan JIANG

Radar data quality control, national radar network mosaic and its application with cloud analysis in GRAPES_CR

To satisfy the high quality standard required by radar data assimilation, a radar data quality control system for CINRAD (Chinese New Generation Weather Radar System) /SA/SB/CB was set up to solve radar quality issues, such as ground clutter, electromagnetic interference and test pattern. Above quality control process goes through in a certain sequence and follows certain rules to prepare the data free of contamination or almost so for assimilation. Then three-dimension radar mosaic grid data can be ready by a national network three-dimension mosaic scheme with all CINRAD/SA/SB/CB data after quality control for high-resolution model.

Radar data assimilation is crucial for the regional model development recently. Assimilating the high temporal and spatial resolution of radar data satisfies the increasing requirements for more accurate and rapid update short-term forecast & nowcasting of the severe high impact weather, which occurred more frequently in recent years in China. Therefore, a GRAPES (Global/Regional Assimilation and Prediction System) _CR (Convection-Resolving), which uses the cloud analysis scheme as the initialization scheme, has been developed at NWPC (Numerical Weather Prediction Center) recently.

So far, this radar quality control & network mosaic system has been stable online running in NWPC since June 2015. The radar QC module is proved to be efficient as it solves the radar quality issues mentioned above, such as TP, EMI and AP clutter. The performance of this radar three-dimension mosaic data is demonstrated by application in cloud-analysis scheme of GRAPES_CR. The case study shows that the cloud analysis with radar data had a significant positive impact on the short-term precipitation forecast (from 1 hour until to 12 hours of range), especially for heavy precipitation center position and intensity forecast. TS score of one-month experiment also shows positive effect in precipitation forecast, especially in 0-6h forecast. Other departments in CMA already show their interests in the radar data quality control performance and the results of this three-dimension mosaic data applied with cloud analysis in GRAPES_CR.

Presentation Date: 28 July 2016
Presentation Time: 14:00 -14:20
Session Name: H3B (LT2) Parallel
Session S5: Urban meteorology
Author/Co-author Name: Stephane BELAIR, Sylvie LEROYER
Speaker Name: STEPHANE BELAIR

The Canadian Urban km and subkm-scale numerical weather prediction System

A Sub-kilometer atmospheric modeling system including urban processes with grid-spacings of 1 and 0.25 km is currently being developed at the Meteorological Service of Canada (MSC) in order to provide more accurate weather forecasts at the city scale. This system has been tested and evaluated over a few cities (Vancouver, Toronto, Montreal, and Tokyo) for a certain range of meteorological events. Most notably, a real-time version has been implemented over the Greater Toronto Area (GTA) in the context of the 2015 Pan American and Parapan Games, providing forecasts for an entire year.

In the Canadian urban modeling system, surface physical processes are represented with the Town Energy Balance (TEB) scheme for built-up covers and with the Interactions between the Surface, Biosphere, and Atmosphere (ISBA) land surface scheme for natural covers. Cloud microphysics is based on a double moment 6 category scheme, and the effect of subgrid-scale atmospheric turbulence is obtained with a modified one-dimensional TKE-based scheme.

At the symposium, results for summertime events over Toronto and Tokyo will be presented. For Toronto, the role of a lake breeze from Ontario lake during an episode of intense heat will be discussed. For Tokyo, the impact of urban surfaces on an intense precipitation event will be presented. In all the cases examined, the 250-m urban system was shown to provide guidance substantially better than what is currently available operationally at MSC (i.e., with 2.5-km grid spacing and no urban scheme). A possible extension of the new NWP system to nowcasting applications will soon be examined, as well as its use in the context of the Aviation Research Demonstration Project (AvRDP).

Presentation Date: 28 July 2016
Presentation Time: 14:20 -14:40
Session Name: H3B (LT2) Parallel
Session S5: Urban meteorology
Author/Co-author Name: Paul JOE
Speaker Name: Stephane Belair

The Environment Canada Pan Am Science Showcase for Severe Weather, Air Quality and Health Nowcasting in an Urban Environment

The Pan Am and Para-Pan Am Games of 2015 was held in Toronto. A science showcase project was conducted to consolidate milestones and showcase several internal research and development programs and including new observational technology, high resolution modeling, air quality and health initiatives in an urban environment. Toronto is located on the north shore of Lake Ontario and the lake breeze is a critical feature affecting urban scale weather - it initiates convection and thunderstorms, it acts as a plume for the vertical transport of pollutants and it is related to heat stress. The observation technology included 55 compact weather stations with black globe sensors, air quality fixed and mobile measurements, Doppler lidars (fixed and mobile), two supersites, mobile vehicles and a lightning mapping array. High resolution NWP modeling (250 m), AQ modeling (2.5 km), not only focused on traditional weather parameters but also on health indices for use by public health authorities. Data from this project is being prepared to be released to the international community.

Presentation Date: 28 July 2016
Presentation Time: 14:40 -15:00
Session Name: H3B (LT2) Parallel
Session S10: WMO/WWRP Nowcasting- Mesoscale FDP/RDP
Author/Co-author Name: Alexander Kann KANN, Yong WANG, Ingo MEIROLD-MAUTNER, Benedikt BICA
Speaker Name: Benedikt BICA

EUMETNET ASIST: A joint initiative on European-wide nowcasting

Nowcasting systems are typically developed at weather services based on the needs by end users who rely on forecasts with very high spatial and temporal resolution for relatively short lead times (around +6h). Amongst these end users are public authorities responsible for civil protection, hydrology, aviation or traffic. This setting caused the development of application specific nowcasting systems which are often tuned to regional and local specificities and provide only a limited set of parameters (most commonly precipitation and wind). An exchange of know-how, experiences, methods and methodologies between developers and users of different systems does not occur systematically. For this reason the European Economic Interest Group (EIG) EUMETNET proposed – besides the already existing cooperation programmes for observation and NWP – to establish a European cooperation project on nowcasting.

In 2013 the EUMETNET Nowcasting Activity was installed which incorporated 23 European meteorological services. Among the main goals of this preparatory activity was the compilation of nowcasting systems currently used by the members, exploration of possibilities for common developments and the preparation of a nowcasting and very short range forecasting cooperation. The latter cooperation started in 2015 (ASIST – Application oriented analySIS and very short range forecasT environment) and is targeted at coordinating (1) nowcasting developments, (2) NWP and observation, (3) verification and training and (4) application and user aspect. Besides the traditional observation based nowcasting, ASIST will also cover the very short range forecasting, which increasingly involves NWP models. The coordinated approach to face the challenges in nowcasting (as provided in ASIST) will demonstrate the importance of transregional efforts to provide forecasts and warnings from high impact weather.

In this presentation the coordinating member of both projects (Nowcasting Activity and ASIST) will give an overview of the results of the Nowcasting Activity as well as the planned and already running activities of ASIST.

Presentation Date: 28 July 2016
Presentation Time: 15:00 -15:20
Session Name: H3B (LT2) Parallel Session S10: WMO/WWRP Nowcasting- Mesoscale FDP/RDP
Author/Co-author Name: Brian GOLDING
Speaker Name: Brian GOLDING

Weather warnings: HIWeather and the science needed for future resilience

Advances in meteorological science in the last decade have made it possible to nowcast many weather-related hazards with useful precision and accuracy. As a result, the potential value of weather warnings in reducing hazard impacts has grown enormously. At the same time, it has become evident that there remain many obstacles to achieving the promised benefits. The 10-year WMO/WWRP HIWeather project aims to address these obstacles through promoting research, facilitating collaboration and building capacity. In my talk, I will review the warnings process, from observations through modelling to product generation and delivery, illustrating the advances that have been achieved, highlighting those aspects identified HIWeather as research gaps, and looking forward to nowcasting systems of the future.

Presentation Date: 28 July 2016
Presentation Time: 15:20 -15:40
Session Name: H3B (LT2) Parallel Session S10: WMO/WWRP Nowcasting- Mesoscale FDP/RDP
Author/Co-author Name: Sangwon JOO
Speaker Name: Sangwon JOO

Introduction to the ICE-POP 2018

The 23rd Olympic Winter and the 13th Paralympic Winter Games will be held in Pyeong-Chang, Korea, February 9-25 / March 9-18, 2018. It is a great opportunity to improve our understanding of local scale and severe weather over complex terrain and the capability of high-resolution (convective scale) numerical weather prediction at the time of winter games.

KMA (Korea Meteorological Administration) and NIMS (National Institute for Meteorological Sciences) have a responsibility to provide weather information for the management of games and the safety of the public and launch the ICE-POP 2018 for RDP/FDP in 2015. The goals of PC-2018 FDP/RDP is to demonstration of a nowcasting and very-short-range forecasting system to support the winter Olympic Games and to improve our understanding on severe weather (orographic precipitation and snow, visibility, rapid wind change and gusts, snow falls caused by mountain and coastal effect) over complex terrain

In this presentation, the current progress of the ICE-POP will be presented including the intensive observation experiments held from January to February 2016, and support of test-bed event. Plans for the high resolution NWP development and designed observation campaign will be presented.

29 July 2016 (Friday)

Plenary Session

Presentation Date: 29 Jul 2016
Presentation Time: 09:00-09:30
Session Name: F1 (LT1) Plenary Session
Speaker Name: Barbara BROWN

Verification of nowcasting, with some focus on aviation

Forecast evaluation has been an important – and often controversial – topic in meteorology practically since the first weather forecasts were issued more than 100 years ago. While many verification methodologies have persisted through much of this history, the last few decades have seen a renaissance in the development of new approaches, as well as greater understanding of capabilities that have existed since the early days of forecasting. Verification and evaluation for nowcasts – and particularly nowcasts and short-range forecasts of aviation weather conditions – have consistently been associated with numerous special issues, including the extremeness of the weather conditions, the use of remotely sensed data, and the importance of user-relevant approaches. This talk will consider new developments in forecast evaluation – and the verification community – in recent years. Special focus will be given to new spatial methods, method for extreme event forecasts, and user-relevant approaches in the context of nowcasts and aviation weather nowcasts and forecasts.

Presentation Date: 29 Jul 2016
Presentation Time: 09:30-10:00
Session Name: F1 (LT1) Plenary Session
Speaker Name: Kazuo SAITO

Seamless nowcasting and modeling

A research on ultrahigh resolution mesoscale numerical weather prediction with the High Performance Computing of the K-computer is introduced. This research was conducted as one of the five fields of the MEXT-funded national research project on supercomputing in Japan, the HPCI Strategic Programs for Innovative Research (SPIRE). Following three subjects were performed to show the feasibility of precise prediction of local high impact weather phenomena using HPC: 1) Development of cloud resolving 4-dimensional data assimilation systems, 2) Development and validation of a cloud resolving ensemble analysis and forecast system, and 3) Basic research with very high resolution atmospheric models.

In the presentation, development of high resolution data assimilation systems in the project is introduced, and examples of high-resolution and super high-resolution data assimilation/ensemble experiments for seamless prediction of mesoscale high impact weathers (torrential rains, tropical cyclones, and tornados) are shown with their visualization.

Presentation Date: 29 Jul 2016
Presentation Time: 10:00-10:30
Session Name: F1 (LT1) Plenary Session
Speaker Name: Alexander Baklanov

Urban Meteorology and GURME overview

Accelerating growth of urban populations, especially in developing countries, has become a driving force of human development. Crowded cities are centres of creativity and economic progress, but polluted air, flooding and other climate impacts, means they also face major weather, climate and environment-related challenges. Increasingly dense, complex and interdependent urban systems leave cities vulnerable: a single extreme event can lead to a broad breakdown of a city's infrastructure through domino effects. The World Meteorological Organization (WMO) recognizes that rapid urbanization necessitates new types of services which make the best use of science and technology and considers this challenge as one of the main priorities for the meteorological community. Such Integrated Urban Weather, Environment and Climate Services (IUWECS) should assist cities in facing hazards such as storm surge, flooding, heat waves, and air pollution episodes, especially in changing climates (Grimmond et al., 2014). The aim is to build urban services that meet the special needs of cities through a combination of dense observation networks, high-resolution forecasts, multi-hazard early warning systems, and climate services for reducing emissions, that will enable the building of resilient, thriving sustainable cities that promote the Sustainable Development Goals. A number of recent international studies have been initiated to explore these issues.

More than 10 years ago WMO established the Global Atmosphere Watch (GAW) Urban Research Meteorology and Environment (GURME) project (http://mce2.org/wmogurme/) which provides an important research contribution to the integrated urban meteorology and air quality services. GURME pilot projects serve as examples for development of air quality capacity in cities moving from research to operational activities and further to products and services and their dissemination. One example is the SAFAR project (Beig et al., 2015) where urban weather and air quality services were developed for New Delhi for the Commonwealth Games 2010, and consequently implemented for continuous use. Subsequently this system has been implemented in Pune, and will be implemented in 4 other Indian cities.
Additionally to GURME WMO provides several other urban related activities contributing to the IUWECS concept. In particular the WMO World Weather Research Programme (WWRP) launched a new High Impact Weather Project (HIW) in 2016 to promote cooperative international research to achieve a dramatic increase in resilience to high impact weather worldwide. This involves both improving forecasts for timescales of minutes to two weeks and enhancing their communication and utility in social, economic and environmental applications (Jones and Golding, 2014).
The presentation provides a brief overview of recent WMO GURME and other research activities in urban meteorology and air pollution, describes the novel concept of urban integrated weather, climate and environment related services and highlights research needs for their realisation.

References:
Beig, G. et al., 2015: System of Air Quality Forecasting and Research (SAFAR – India). WMO GAW Report No. 217.
Grimmond, S. et al, 2014: Towards integrated urban weather, environment and climate services. *WMO Bulletin* **63 (1)** 10-14.
Jones, S. and B. Golding, 2014: A research activity on High Impact Weather within the World Weather Research Programme. WMO, WWRP, Geneva, December 2014, 87p.

Oral Presentation

Presentation Date: 29 July 2016
Presentation Time: 11:00 – 11:20
Session Name: F2A (LT1) Parallel Session S3: Advances on mesoscale NWP model, data assimilation, ensemble prediction
Author/Co-author Name: Peter STEINLE, Susan RENNIE, Yi XIAO, Alan SEED, Aurora BELL
Speaker Name: Peter STEINLE

A Real Time Forecast Trial using Convective NWP in Australia

The Bureau of Meteorology developed a high resolution numerical weather prediction (NWP) system that assimilated radar data as well as the standard set of observations. This prototype system was used in real time forecasting trial during the Australian spring of 2014 over Sydney and eastern New South Wales. Overall, forecasters were very impressed by the change from the currently operational 4km downscaling predictions to a 1.5km fully assimilating system. While the 1.5km system provided significant advantages, the experiment also raised a number of interesting research questions.

The move from convection parametrization to explicit modelling of convection provides much more realistic structure to the predicted rainfall fields. This clearly provided an improvement in the timing and evolution of convective systems. However, calibrating the system to provide more realistic rainfall amounts becomes much more complicated

The use of a mesoscale assimilation system not only reduces spin-up, but also allows for more frequent forecasts, reducing the latency between analysis of observations and the forecast being available. Again there are challenges, this time regarding the low density of the observation network over land relative to the model grid, as well as the best approach for analysing data at these small scales. The observation density problem was partially addressed by the assimilation of Doppler radial winds – however these still have important limitations

Despite a number of issues the new NWP system performed well. This talk will cover some of the successes of the system, and some of the improvements that are under way prior to operational implementation in 2017.

Presentation Date: 29 July 2016
Presentation Time: 11:40 – 12:00
Session Name: F2A (LT1) Parallel Session S3: Advances on mesoscale NWP model, data assimilation, ensemble prediction
Author/Co-author Name: Kosuke ITO
Speaker Name: Kosuke ITO

Mesoscale hybrid data assimilation system based on JMA nonhydrostatic model

This presentation discusses the benefits of using a hybrid ensemble Kalman filter and four-dimensional variational (4D-Var) data assimilation (DA) system rather than a 4D-Var system employing the National Meteorological Center (NMC)-method (4D-Var-Bnmc) to predict severe weather events. An adjoint-based 4D-Var system is employed with a background error covariance matrix B constructed from the NMC method and perturbations in a local ensemble transform Kalman filter (LETKF) system. Both systems are based on the Japan Meteorological Agency's nonhydrostatic model. To reduce the sampling noise, three types of implementation (the spatial localization, spectral localization, and neighboring ensemble approaches) were tested. The assimilation of a pseudo-single-observation of sea-level pressure located at a tropical cyclone (TC) center yielded analysis increments physically consistent with what is expected of a mature TC in the hybrid systems at the beginning of the assimilation window, whereas analogous experiments performed using the 4D-Var-Bnmc were not. At the end, the structures of the increments became similar to each other among 4D-Var-based methodologies, while the analysis increment by the 4D-Var-Bnmc system was broad in the horizontal direction. Realistic DA experiments showed that all the hybrid systems provided initial conditions that yielded more accurate TC intensity and track forecasts than those achievable by the 4D-Var-Bnmc system. They are statistically significant improvements based on 62 forecasts. The hybrid systems also yielded some statistically significant improvements in forecasting a local heavy rainfall event for the forecast time of 0-6 h in terms of fraction skill scores when a 160 km × 160 km window size was used based on 104 forecasts. Overall skill of the hybrid systems is relatively insensitive to the choice of implementation. More details are found in Ito et al. (2016, submitted to MWR)

Presentation Date: 29 July 2016
Presentation Time: 12:00 – 12:20
Session Name: F2A (LT1) Parallel Session S3: Advances on mesoscale NWP model, data assimilation, ensemble prediction
Author/Co-author Name: K.K. HON
Speaker Name: K.K. HON

Experiments on meso-scale ensemble forecasting of severe weather over the South China coastal areas

Accurate forecasting of high-impact weather events such as tropical cyclones (TC) and severe convection is often limited by a combination of intrinsic and practical predictability. Ensemble prediction probes the evolution of flow-dependent uncertainties through integrating a collection of perturbed initial and boundary conditions, generating in the process a series of possible future weather scenarios on which an assessment of the likelihood of different weather events could be based.

This paper examines the feasibility of an experimental configuration of meso-scale EPS based on dynamical down-scaling of the NCEP GEFS using the WRF (Weather Forecast and Research) model, and evaluates its performance and application in a number of recent high-impact weather cases over the South China coastal areas, focusing in particular on TC passage and rainstorms.

Presentation Date: 29 July 2016
Presentation Time: 11:00 – 11:20
Session Name: F2B (LT2) Parallel
Session S7: Applications of nowcasting of severe weather in public weather ervices, transportation, public utilities
Author/Co-author Name: Yongguang ZHENG, Fuyou TIAN, Zhiyong MENG, Ming XUE, Dan YAO, Lanqiang BAI, Xiaoxia ZHOU, Xu MAO, Mingjun WANG
Speaker Name: Yongguang ZHENG

Survey and Multi-Scale Characteristics of Wind Damage Caused by Convective Storms in the Surrounding Area of the Capsizing Accident of the Cruise Ship "Dongfangzhixing"

The extraordinarily serious capsizing accident of the cruise ship, named Dongfangzhixing (Eastern Star), occurred at around 9:30 p.m., on June 1, 2015, in the Jianli (Hubei Province) section of the Yangtze River. Based on the results of the wind damage survey with satellite and radar data analyses, this paper presents that the high wind damage was caused by downbursts over the area surrounding the event occurring site at around 21:00–21:40, June 1, with the most intense Beaufort scale more than level 12, and the characteristics of discontinuous and multiscale spatial distribution and very small spatiotemporal scale of the most severe wind damage. The wind damage over the northern land part of the surrounding area (Shunxingcun, Laotai Deep Water Wharf, Sitaicun, Xingouzi) affected by one mesocyclone is more significant than the southern land part behind the gust front and microbursts. It is determined that one likely tornado occurred at Laotai Deep Water Wharf, and the wind damage at other sites was apparently caused by microbursts based on the radar data and damage survey. The flows in the convective storm causing wind damage have obvious multiscale characteristics, and a number of microburst swathes simultaneously occurred at the woods of Sitaicun located in the northern part of the surrounding area, with alternate spatial distribution of divergence and convergence, displaying a feature of the complicated atmospheric motion in the convective storm. Although mesovortices occur within a microburst, the horizontal scale of convergence within the microburst found in this wind damage survey is only tens of meters and far less than the several-kilometer horizontal scale of bookend vortices or mesovortices within a bow echo.

Presentation Date: 29 July 2016
Presentation Time: 11:20 – 11:40
Session Name: F2B (LT2) Parallel Session S7: Applications of nowcasting of severe weather in public weather ervices, transportation, public utilities
Author/Co-author Name: Mwayi Martin RICKY
Speaker Name: Mwayi Martin RICKY

Application Of Nowcasting Severe Weather In Public Weather Service, Transportation And Public Utilities In Uganda

It is vital that weather forecasters should consider severe weather information from a collection of observational data, satellite data, Radar information, and Synoptic analysis and NWP models. This will enable warning information accurate and effectively relayed to the public weather services (PWS), Transportation and public utilities in Uganda.

Applications of Now-casting of severe weather in Uganda in various sections public weather services (PWS), Transportation and public utilities has been more effective due to the section of SWFDP through severe weather video conference by Skype.

In this paper we describe the various warnings and forecasts (Now- casting severe weather forecasts) issued in Uganda, their applications in PWS, Transportation, public utilities and disaster response team in Uganda. Methods of generating Now-casting severe weather forecasts with its disseminated and we conclude by pointing out the several of the limitations involved. Key words: SWFDP, SEVERE WEATHER, NWP, Now -casting and PWS.

Presentation Date: 29 July 2016
Presentation Time: 11:40 – 12:00
Session Name: F2B (LT2) Parallel
Session S7: Applications of nowcasting of severe weather in public weather services, transportation, public utilities
Author/Co-author Name: Xiaofeng WANG, Xiaofeng HE, Shudong WANG, Lei FENG, Yanhong HAN
Speaker Name: Xiaofeng WANG

Applications of INCA nowcasting model in PMSC, CMA

INCA (integration and nowcasting through comprehensive analysis) was originally developed by ZAMG, Austria, and introduced to Public Meteorological Service Center, China Meteorological Center (PMSC, CMA) in 2014 for nowcasting use. In PMSC, INCA has been experimentally implemented, localized, and verified in its performance.

INCA is conducted in two regions of China, Henan Province and Jiangnan Area. In both regions, radar data and observations at more than 5000 surface stations are used. This set of data, which is updated every hour, contains radar quantitative precipitation estimation (QPE), surface precipitation from rain gauge, 10-meter wind fields, two-meter temperature, two-meter dew-point temperature, ground temperature, and some station geographical data. Moreover, numerical weather prediction (NWP) outputs, updated twice a day, are also integrated into INCA, including 3D wind fields, 3D temperature, 3D dew-point temperature, 10-meter wind fields, two-meter temperature, two-meter dew-point temperature, ground temperature, and other ancillary data. Variables are forecasted every hour and up to 24 hours long. After integrations of all useful observations and NWP data, nowcasting in INCA, up to 12 hours, is generated, including 10-meter wind fields, two-meter temperature, two-meter relative humidity, ground temperature, and surface precipitation. And temporal and spatial resolution is one kilometer and one kilometer, respectively. Blending of nowcasting and NWP data starts at Lead Hour 2 and ends at Lead Hour 6.

After accumulating nowcasting outputs of several months long, some simple verifications by calculating MAE (mean absolute error) are conducted, to check the performance of INCA in PMSC. In both regions, observational data at about 130 stations are selected to verify INCA nowcasting. When calculating MAE, the grid with its longitude and latitude nearest to its corresponding station is picked up. After averaging absolute errors spatially and temporally, we get some results. For all variables (relative humidity, 2m temperature, ground temperature, 10m wind speed, 10m wind direction, and surface precipitation), INCA shows an excellent performance in its analyzing ability. For instance, MAE of relative humidity and 2m temperature are just 1% and 0.2 degree Celsius, respectively. With lead hour going forward, MAE gradually increases until it reaches the level of MAE for NWP (which is almost constant in all lead hours) at the sixth lead hour, where blending of nowcasting and NWP data ends up. But there are also some exceptions. For wind directions, MAE grows up abruptly in the initial two hours, and exceeds MAE of NWP afterward. Besides temperature, humidity, and wind, we also validate precipitation by using TS scoring. For light rain, the TS score for analysis looks good, but it drops significantly in the following lead hours. For moderate and heavy rains, TS score falls more abruptly in the initial few lead hours.

However, we can still come to the conclusion that INCA can well nowcast 10m wind force, surface temperature, 2m temperature and humidity. As for wind direction and surface precipitation, we need to localize INCA further.

Presentation Date: 29 July 2016
Presentation Time: 12:00 – 12:20
Session Name: F2B (LT2) Parallel
Session S7: Applications of nowcasting of severe weather in public weather ervices, transportation, public utilities
Author/Co-author Name: Rajendra Kumar JENAMANI
Speaker Name: RAJENDRA KUMAR JENAMANI

Identification of Critical Features of various Fog formation Processes across Indo-Gangetic plain with special emphasis upon Delhi Fog events and Method of development lead predictors/Checklists for their nowcasting/forecasting

During each winter, Indo-Gangetic plain suffers a lot from frequent spells of occurrences of high duration dense fog and smog events at both moso-scale as well as large-scale. Study of fog layer across Indo-Gangetic plains(IGP) using satellite shows complexities of such fog events lies with its sudden development and its fast spreading to cover most parts of this great plain. The present study aims at identification of various critical Features of various Fog formation Processes across IGP and hence to filter possible lead predictors with special emphasis upon Delhi Fog events. We first consider large-scale fog over IGP region to find what are all ingredients who may readily conditioning up, to trigger such fog formation processes. This study finds: IGP perennially owns all fog forming parameters as mentioned below briefly fitting to the system in each winter while Western disturbances(WD) only helps for temporary respite:

- Highly favorable from geography of the region
- Land type and Land use, land surface processes
- Moisture sources and Moistening (Rivers, canals, Irrigations, easterly/southwesterly winds)
- A Very low Topography and alignment of this great plains
- A Perfect source and System to bring sharp temp changes and alternate warmer/colder winds with adj Himalayas ice Covers in coherent with WD activities
- A Fog ridge line passing though Lahore, Amritsar, Delhi, Lucknow and Varanasi
- With light winds from both side.
- A large-scale subsidence from top and semi- permanent inversion of to 1-2km
- A layer of High pollutants from following prospective using all available data

Hence IGP perennially owns major fog forming parameters from geo-graphical and geo-morphological prospective for fog in each winter. We also have studied Major severe fog Event –wise features of IGP using data for 1981-2015 for Delhi Fog and we all special characterizes of fog formation process for Delhi and adj IGP region in case fog is a radiation fog events which mainly occurs in Nov and Feb, matches to those already studied earlier. In case the event as Advection Fog, and it is for longer duration of longer spells with synoptic or large-scale, then we find it mainly occurs in Mid Dec to Mid Feb. Followings are some interesting findings of checklists for forecast of advection fog in the region:

- It starts over smaller area and due to all those perennial fog triggering conditions and spreads/spill over.
- It is well detected in Satellite and advects to other parts
- Trigger on its own if light surface wind prevails say 4-5-days in Dec and Jan along IGP and no WD for longer period(Self triggering)
- It forms ahead of WD: when warm easterly/southwest moist air moves over cold surface(BOB or Arabian Sea) created by approach of remotely active/locally active WD
- It forms at rear sector of WD: Sometimes it forms when, cold wind blow over warm and moist surface
- It also forms when eastern disturbances or easterly wave or cyclone from Southeast India cause rain over eastern parts of the country

Presentation Date: 29 July 2016
Presentation Time: 13:30 – 13:50
Session Name: F3A (LT1) Parallel
Session S6: Transfer of the science on nowcasting and very-short-range forecasting to services
Author/Co-author Name: Kamaljit RAY, L S RATHORE
Speaker Name: Kamaljit RAY

Operational Nowcast Services of India Meteorological Department

Nowcasting is based on the ability of the forecaster to assimilate great quantities of weather data, conceptualize a model that encompasses the structure and evolution of the phenomenon and extrapolate this in time. Nowcasts require high resolution of spatial and temporal meteorological data to detect and predict the occurrence of an event. Since the early 1960s, techniques for nowcasting convective precipitation have been developed by extrapolating radar echoes. Nowcasting in India has benefited from major developments in observational meteorology and computer-based interactive data processing and display systems in India Meteorological Department. In view of the recent improvement in monitoring and forecasting, due to introduction of digital and image information at 10 minutes interval from a network of 18 Doppler Weather Radars, a dense automatic weather station (AWS) network, half hourly satellite observations from INSAT-3D satellites, better analysis tools at forecaster's workstation, availability of computational and communication capabilities, India Meteorological Department, implemented web based nowcasting of thunderstorms, squalls and hailstorms in 2013. The skill and experience of the forecaster, continuous monitoring, his familiarity with the regional weather and meticulous attention to details contribute largely in timely forecasts and warning of thunderstorms.

Considering the importance and reliability of DWR based information for nowcast of thunderstorm and associated weather, in the first phase, major stations/cities which come under the coverage of DWR were included for nowcasting of convective weather. A total of 150 stations within 200 Km radius of various Doppler Weather Radars were selected and the nowcast is uploaded at every 3 hourly interval on a web-based Nowcast Page. These nowcasts are primarily made by forecasters at various Meteorological Centres and Regional Meteorological Centres of India Meteorological Department. The verification of Nowcasts for the year 2013 and 2014 indicates an average all India POD (Probability of detection) as between 0.6 and 0.8 and FAR (False Alarm rate) less than 0.4.

The dissemination of these forecasts to the users is a challenge, considering the short lead time and perishable nature of the generated information. Therefore to support early decision making by users, automatic dissemination of warnings to farmers through SMS alerts were launched through M-Kisan Portal of Ministry of Agriculture, in May 2015 ,to provide localised Extreme Weather Warnings to around 1 crore registered farmers . These Nowcast alerts are very useful to alert the farmer community about the occurrence of the adverse weather. The paper discusses the operational Nowcast services in India and their verification in detail.

Presentation Date: 29 July 2016
Presentation Time: 13:50 – 14:10
Session Name: F3A (LT1) Parallel
Session S6: Transfer of the science on nowcasting and very-short-range forecasting to services
Author/Co-author Name: Todd HUTCHINSON, Steven HONEY, Joseph KOVAL, Cathryn MEYER, Peter NEILLEY
Speaker Name: Todd HUTCHINSON

0-6 hour Weather Forecast Guidance at The Weather Company

As part of The Weather Company's Forecast On Demand system (Neilley et al., 2015), 0-6 hour forecasts are derived from a combination of 1) extrapolated radar-based nowcasts, 2) rapid-update convective-allowing regional NWP forecasts, 3) Global NWP forecasts, 4) surface observations and 5) government issued weather warnings. Forecasts of precipitation (intensity, probability and type) and other sensible weather parameters (e.g. , temperature, cloud cover, wind speed) are rapidly updated to provide forecasts to 6 hours. In areas where radar data is available (including North America and Europe), forecasts are updated every 5-15 minutes. In other areas, forecasts are updated at the frequency of available NWP forecasts (at present time, hourly).

Nowcasts of precipitation rate are derived from rapid-update mosaics of radar reflectivity that are cleaned of echoes from non-hydrometeor sources through automated and manual means. Precipitation motion vectors, calculated by cross-correlating subsequent radar mosaics, are used to extrapolate radar echoes forward in time to generate forecasts of precipitation rate.

NWP forecasts are run at convective-allowing scales (4 km) each hour over North America and Europe and at coarser resolution (13 km) globally every 6 hours. These forecasts drive precipitation forecasts in the latter half of the 0-6 hour period and over the entire 0-6 hour period where radar data is unavailable. The NWP forecasts are temporally blended with the radar-based nowcasts to provide deterministic forecasts of precipitation rate throughout the 0-6 hour period. The temporal blending varies from favoring extrapolated radar forecasts early to favoring NWP forecasts later in the period. The weighting is dynamically adjusted based on local atmospheric instability to favor an earlier transition towards NWP forecasts when the atmosphere is more convectively unstable.

Probabilities of precipitation (POP) are calculated by deriving POP independently from the radar-based nowcasts and NWP forecasts, then temporally blending the POP in the same way as the precipitation rate is blended. POP is calculated from both the radar-based nowcasts and the NWP forecasts at each forecast time by spatially analyzing the forecast precipitation rate within a radius of influence of the forecast point. NWP-based POP is further refined by weighted averaging of POP forecasts with common valid times from subsequent NWP cycles within the previous 9 hours (i.e., time-lagged ensemble).

In order to provide a complete forecast of sensible weather, the NWP forecasts also provide temperature, dew point, wind speed and direction, cloud cover, visibility and precipitation type. To assure consistency with observations and to provide increased skill, forecasts of temperature, dew point, cloud cover and wind are corrected by subtracting an error value that decays from the total error at the observation time to nil several hours into the forecast. Precipitation type is calculated from NWP-based thermodynamic profile of the atmosphere that are refined using surface observations of precipitation type, temperature and dew point.

Finally, government issued severe weather warnings are used to augment the 0-6 hour forecasts to assure that the near-term forecasts are consistent with critical warning information, and to include qualifiers (such as "severe") in worded 0-6 hour forecasts.

Presentation Date: 29 July 2016
Presentation Time: 14:10-14:30
Session Name: F3A (LT1) Parallel
Session S6: Transfer of the science on nowcasting and very-short-range forecasting to services
Author/Co-author Name: Wai Kin WONG, Tsz Lo CHENG, Wang Chun WOO
Speaker Name: Wai Kin WONG

Community version of SWIRLS nowcasting system

Hong Kong Observatory (HKO) started the development and operation of the SWIRLS (Short-range Warning of Intense Rainstorms in Localized Systems) rainstorm nowcasting system in 1997. SWIRLS provides real-time rainfall analysis, severe convective weather phenomena assessment, tracking and prediction of precipitation over Hong Kong for the next 6-9 hours. Besides supporting the rainstorm warning services in HKO, SWIRLS products are used in the precipitation nowcasting services that seamlessly integrate with the automatic location-specific digital weather forecast for the public.

In recent years, SWIRLS has been adopted for use in various international forecast demonstration projects such as the 2008 Beijing Olympics, 2010 Shanghai World EXPO and 2010 Commonwealth Games in New Delhi. SWIRLS has also be transferred to several meteorological services around the world for research development and building up of the capacity in nowcasting rainstorm and severe convective weather processes. With a view to promoting the knowledge exchange of radar nowcasting techniques, a community version of SWIRLS, or Com-SWIRLS in short, has been developed recently and made available to registered users. This presentation will outline the overall system design and its software modules of quantitative precipitation estimation (QPE) and quantitative precipitation forecast (QPF). Applications of Com-SWIRLS, e.g. in supporting the WMO/WWRP Aviation Research and Development Project (AvRDP), will also be discussed.

Presentation Date: 29 July 2016
Presentation Time: 13:30-13:50
Session Name: F3B (LT2) Parallel
Session S7: Applications of nowcasting of severe weather in public weather services, transportation, public utilities
Author/Co-author Name: Abubakar KALEMA
Speaker Name: ABUBAKAR KALEMA

Fog Nowcasting And Its Influence On Aviation Operations At Entebbe International Airport-Uganda

In this research, the influence of fog nowcasting on aviation operations, aircraft landing and takeoff in particular has been studied. The overall objective of this study was to determine the influence of fog nowcasting on aviation operations at Entebbe International Airport. This has been achieved by analyzing visibility, wind, and relative humidity both historical and current datasets which are key meteorological parameters that contribute to simple fog nowcasting algorithm development and then a relationship was established between fog nowcasting and aircraft delays at Entebbe International Airport (EIA).

Entebbe International Airport (IATA: EBB, ICAO: HUEN) is the principal international airport of Uganda. The airport is located near Entebbe town, on the shores of Lake Victoria, and about 41 km (25 miles) by road, southwest of the central business district of Kampala, the largest and capital of Uganda.

The meteorological datasets of visibility and wind data were acquired from Uganda National Meteorological Authority (UNMA), relative humidity from NCEP/ NCAR, and delayed flights information from Civil Aviation Authority (CAA). These were analyzed statistically using time series analysis, Regression Analysis based methods and Pearson product-moment correlation coefficient methods in order to establish the statistical relationships between fog nowcasting and aviation operations at EIA.

One of the findings of this study, the fog nowcasting algorithm indicated that, the northerly winds from inland dominate the winds that prevail 6 hours before fog formation. EIA topography is a valley with northern parts gradually sloping into this valley. These northerly winds into the airport valley contributes to the creation of a temperature gradient which is a key contributing factor to the formation of radiation fog, that is experienced at EIA.

The results indicated that the time of maximum fog occurrence at EIA is between 0400Z-0500Z (0700-0800AM local time). Results also indicate that Fog days in the DJF season are expected to increase in future and consequently, flight delays due to fog are also expected to increase at EIA as shown in the trend analysis with r2 significance of 47%. There's a significant decrease of 0.63% of aircrafts delays by the application of this fog nowcasting algorithm model in flight schedule at EIA.

Finally, this study will help policy makers (for example government, CAA and UNMA) in improving their understanding of the influence of fog on aviation. Therefore, the results can be used by planning authorities in cost cutting through impact reduction from fog occurrences.

Presentation Date: 29 July 2016
Presentation Time: 13:50 – 14:10
Session Name: F3B (LT2) Parallel
Session S7: Applications of nowcasting of severe weather in public weather services, transportation, public utilities
Author/Co-author Name: Christian SCHIEFER, Sebastian KAUCZOK, Andre WEIPERT
Speaker Name: Christian SCHIEFER

A smart system framework enabling an innovative weather awareness system for airports and beyond

Since more than a quarter-century, an annual growing of air traffic is observed and a break off this tendency is currently not foreseeable in the near future. Thus airports are in charge to handle more and more traffic in a safe manner wherein most of them are operating on capacity limit anyhow. Thereby airport capacity is prone to any unplanned occurrence and will directly drop even in case of any imprecise airport planning forecast.

The influence of weather on airport capacity is uncontested one of the major issue. Weather causes delays, re-routing and cancelations of flights or can lead to enlarge the separation in case of low visibility and is furthermore a serious safety issue for aviation.

Inside the SESAR program (Single European Sky ATM Research) which is the European version of a global effort in research and development to implement the International Civil Aviation Organizations (ICAO) Global Air Navigation Plan (GANP), Selex ES developed a system solution for improving the situational awareness of weather hazards for the airport. Meteorological (MET) requirements from different airport stakeholders were used to build a system framework which connects, processes and visualizes all available sources of MET data relevant to the airport and its surrounding aerodrome. In this process it makes use of the synergies between the different sources e.g. of remote or in-situ sensing systems by means of data fusion and translates the outcome for specific operational needs. The system features a high degree of flexibility in terms of MET input sources and serves a user friendly and highly configurable display tool based on state of the art Data Distribution Service (DDS) and conventional web browser technology which makes it easily customizable to a versatile of MET applications.

The talk will describe the system itself, the service capability to provide MET observations, nowcast and forecast of Wind, Convection, Visibility, Winter-Weather and standard MET data in a coherent display for one of the most demanding environments, the airport.

Presentation Date: 29 July 2016
Presentation Time: 14:10 – 14:30
Session Name: F3B (LT2) Parallel
Session S7: Applications of nowcasting of severe weather in public weather services, transportation, public utilities
Author/Co-author Name: Rajendra Kumar JENAMANI
Speaker Name: Rajendra Kumar JENAMANI

Analysis of Impact of severe Thunderstorms, Intense rains and dense Fog on Power sectors, Aviation, Railway, Highways of India and Adoptions of Customized Nowcast systems to reduce their loss

When north India was reeling under extremely heat and high humidity conditions in 15-19 May, 2011, it was utilizing a power supply of very high amount to meet for all cooling systems and irrigation for agriculture in the region. As per record from Northern India load dispatch center, it shows the evening peak (2000 hrs) demand met in Northern Region on 20th May 2011 was 32941 MW. The total energy consumption in Northern Region on 19 May 2011 and 20 May 2011 was 772.4 MU and 753 MU respectively. All in sudden, thunderstorm and rains swept across large parts of Northern Region during the night after 2300IST of 20th (and early morning hours of 21st and 22nd May 2011. The drop in temperature resulted in drastic reduction in the weather beating and agricultural loads. The sudden un-anticipated fall in 1200-1800UTC temp by 10-15degC from 19-20 to subsequent to 20-21 and 21-22 May with similar humidity variation, resulted unused power called load crashed, but generated as was expected to be in demand over the region and thus was a huge losses to power sector. The load crash was also experienced on three consecutive days during morning hours of 20th, 21st and 22nd May 2011 as this sector had no formal system of getting any nowcast . However, then, with better collaboration and discussion with this author followed with then formal collaboration of IMD with Power company such losses have been reduced. The present study discusses the 3-h temp and RH data DWR, Satellite data of 19-22 May 2016 to conclude how subsequent storm events could have nowcasted for hind cast mode. to analyze its effective use by concern power sector to stop such losses.

Dense Fog on Power sectors: Northern Region power system has witnessed several incidents of multiple transmission lines outage during 2008-2010 due to transient faults caused under dense fog conditions in the region. This phenomenon has aggravated in recent years and can be attributed to all around increase in pollution level. These trappings have the potential to cause blackout / brownout in large parts of the grid for several hours. The cases we have discussed are fog event of 6-7 March which was biggest blackout for most north India due to fog layer and high pollutions and 2nd Jan 2010 which have resulted into partial blackout in Northern Regional grid. The present paper also brings in depth analysis of such link and how a customize fog nowcast has helped this sectors.

We have also discussed series of cases studies through description of actual severe fog and storm and heavy rains event using meso-scale and regional data about their severe impact on aviation e.g. case of 16 June 2013: 117.8mm at 1300IST -1730 IST at IGI Airport with 30mm at City airport which has caused huge terminal flooding and the greatest fog impact and chaos that IGIA airport has experienced on 5-6 night Jan 2014 when 55 flights were diverted.

Presentation Date: 29 July 2016
Presentation Time: 14:30 – 14:50
Session Name: F3B (LT2) Parallel
Session S7: Applications of nowcasting of severe weather in public weather services, transportation, public utilities
Author/Co-author Name: Rajendra Kumar JENAMANI
Speaker Name: Rajendra Kumar JENAMANI

An Objective method for Nowcasting and Very Short range Forecasting of Squalls over Delhi using Stability Indices and other Upper air parameters (2001-2012)

Abstract: IGI Airport Palam Delhi has its most favorable period of storm occurrences is April to June when 75% of total annual squalls (139 out of 184) were formed. It further shows the most favorable timing of their occurrences on a day is 1200UTC-1800UTC when more than half of these also reported and at this same timing of the day, most reaches to very high intensity levels when stability indices from evening ascent of 1200UTC of the day are made available for forecasters. Hence, it will be more appropriate if one also investigates use of stability indices of 1200UTC, if any for nowcasting or very short range forecasting(VSRF) of Thunder squalls(TS) those occur at following evening and night. In the present study, an attempt has been made to investigate utility of upper air data of 1200UTC or 0000UTC in nowcasting and VSRF of TS depending upon timing of their occurrences in a particular validity period of such forecast/nowcast. For VSRF of TS, the period of validity aimed is 1200-2400 and 0000-12000UTC while for Nowcasting, it aimed to cover at span of 6-hours each e.g. 0000-0600UTC with four times a day. We have used method of finding a most favorable range or thresholds values, if any, for each of these index and parameters with respect to each VSRF or nowcast timings. For this, we have collected indices of each occurrence date of TS at Palam in the past, but based upon its 1200 or 0000 UTC ascent depending upon TS occurred at following night or day period respectively on that date. Accordingly, we then grouped values of each index and parameters of TS dates, as per timing of require forecast period and carried out a frequency analysis vis-à-vis various ranges of each indices. We have used indices derived for about 184 days of TS recorded at IGIA during the 12-year period covering 2001-2012. We have plotted probability of TS occurrences vis-a-vis each range of an index for each forecast/nowcast period by suitable dividing number of TS observed at one of the range of an index to total occurrences TS occurred during that period in the past for that index to find whether it follows normal distribution or highly biased to a particular index range.

Results shows emerging of most favourable range as -3 to 3°C, 30-45°C, 30-40°C, 40-50°C, -5 to 5°C and 200-400 from pre-defined single class size which is also modal class in the frequency distribution for stability indices corresponding to Showlter, K-index, vertical total, cross total, lifted index and SWEAT index with, 0-500 and -200 to 0 for Bulk Richardson number and CINE based upon 1200UTC ascent with probability of TS occurrences in the ensuing 12-hours of night reaches upto 0.42, 0.63, 0.63, 0.51, 0.50, 0.52, 0.86 and 0.85 respectively But, CAPE as predictor of VSRF or nowcast has been found to be of limited use at Delhi in view of absence of any suitable range of prominent modal class.

WSN16 Participant List

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Kalema ABUBAKAR	Uganda National Meteorological Authority
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