An Overview of the WMO Joint CAS/CAeM Aviation Research Demonstration Project (AvRDP)

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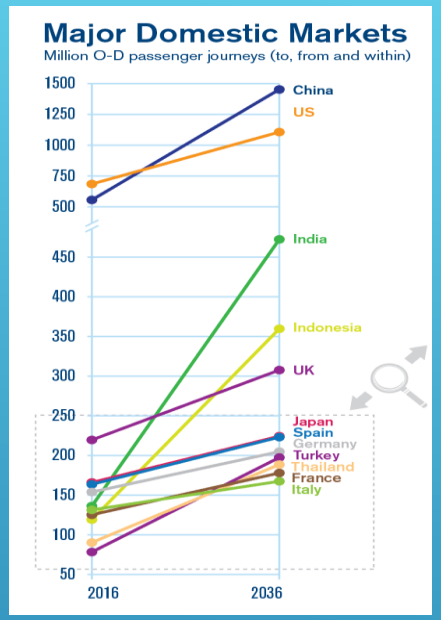
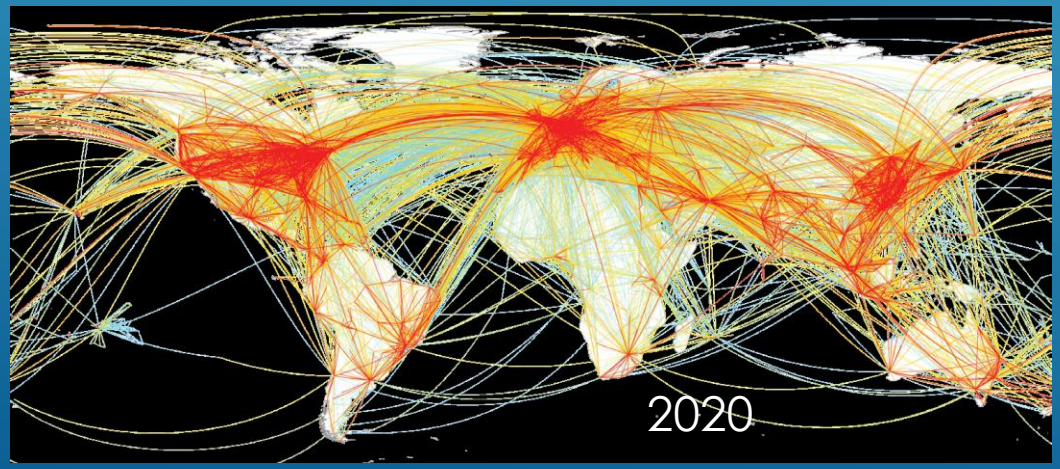
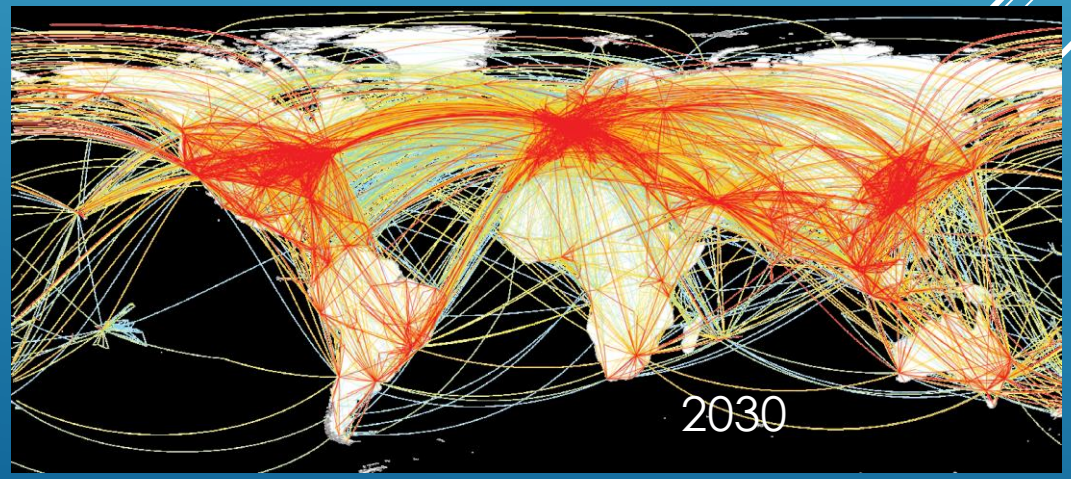
Chair, AvRDP Science Steering Committee

2nd AvRDP Training Workshop
Hong Kong, China
8-10 October 2018

AIR TRAFFIC WORLDWIDE HAS BEEN GROWING RAPIDLY



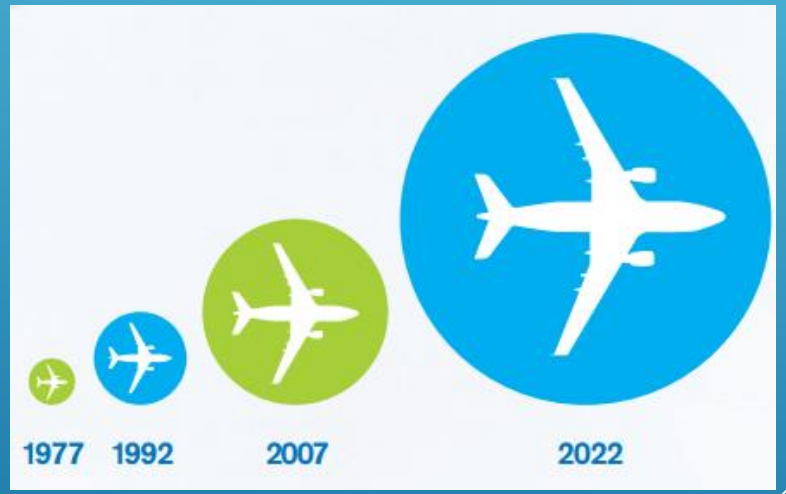




NEW ERA OF AVIATION INDUSTRY

- The new ICAO GANP/ASBU methodology aims at safe, sustained growth, increased efficiency and responsible environmental stewardship in the next 15 years and beyond.
- WMO Congress XVI recognized that these changes could pose significant challenges to WMO Members, as well as provide new opportunities.

WMO STRATEGIC PRIORITIES	
1.	Disaster risk reduction
2.	Global Framework for Climate Services
3.	WMO Integrated Global Observing System
4.	Aviation meteorological services
5.	Polar and high-mountain regions
6.	Capacity development
7.	Governance

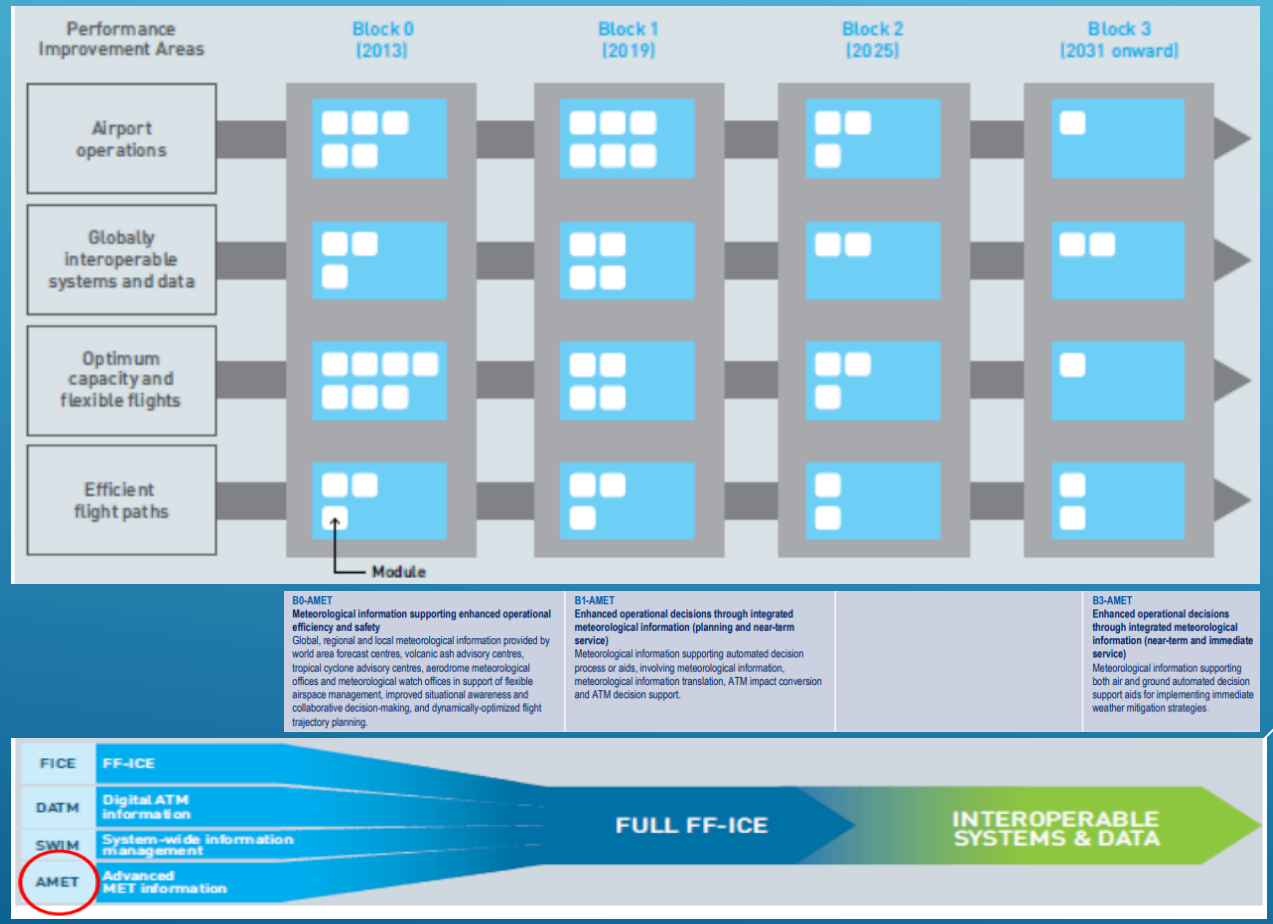


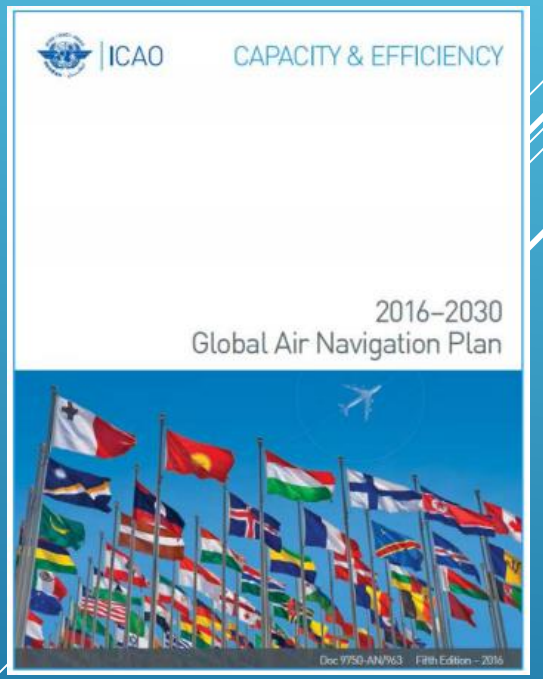
Congress XVI - Aviation meteorological services: One of the 7 priorities in 2016-2019, probably would also remain in the next Congress until 2023 or beyond

ICAO Global Air Navigation Plan (GANP)
MET developments as part of the Aviation System Block Upgrades (ASBU) methodology and timeline (15+yr strategic direction)

National Projects:

- *SESAR – Europe*
- *NextGen – USA*
- *CARATS – Japan*
- *SIRIUS – Brazil*
- *China*
- *Canada*
- *Etc.*





Advanced MET Information (AMET)

B1-AMET (& B2-AMET) FOCUSES ON MET-ATM INTEGRATION

To enable the reliable identification of solutions when forecast or observed meteorological conditions impact aerodromes, airspace or operations in general. Full ATM-Meteorology integration is needed to ensure that meteorological information is included in the logic of a decision process and the impact of the meteorological conditions on the operations are automatically derived, understood and taken into account. The supported decision time-horizons range from minutes, to several hours or days ahead of the ATM operation. This includes optimum flight profile planning and execution, and support to tactical in-flight avoidance of hazardous meteorological conditions (improved in-flight situational awareness) to typical near-term and planning (>20 minutes) type of decision making. This module promotes the establishment of standards for global exchange of the MET information closely aligned with other data domains and adhering to a single reference (ICAO-AIRM). It also promotes the further enhancement of meteorological information on various quality-of-service aspects including the accuracy and consistency of the data when used in inter-linked operational decision making processes.

Appreciating that the number of flights operating on cross-polar and trans-polar routes continues to steadily grow and recognizing that space weather affecting the earth's surface or atmosphere (such as solar radiation storms) pose a hazard to communications and navigation systems and may also pose a radiation risk to flight crew members and passengers, this module acknowledges the need for space weather information services in support of safe and efficient international air navigation.

This module builds, in particular, upon Module B0-AMET, which detailed a sub-set of all available meteorological information that can be used to support enhanced operational efficiency and safety.

Applicability

Applicable to traffic flow planning, and to all aircraft operations in all domains and flight phases, regardless of level of aircraft equipage.

- **Existing TAF is not sufficient, Terminal Area and Global MET information will be required**
- **MET Integration with ATM is required, focusing on the impact**
- **Standards on XLM are being developed for MET information exchange**

B1-AMET	Enhanced operational decisions through integrated meteorological information (planning and near-term service)

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Benefits

Capacity	Enables more precise estimates of expected capacity of a given airspace.
Efficiency	Reduces the number of deviations from user-preferred flight profiles. Decrease in the variability and numbers of ATM responses to a given meteorological situation, along with reduced contingency fuel carriage for the same meteorological situation.
Environment	Less fuel burn, and reduction of emissions due to fewer ground hold/delay actions and environmentally optimized routing.
Flexibility	Users have greater flexibility in selecting trajectories that best meet their needs, taking into account the observed and forecast meteorological conditions.
Predictability	More consistent evaluations of meteorological constraints, which in turn will allow users to plan trajectories that are more likely to be acceptable from the standpoint of the ANSP. Fewer reroutes and less variability in associated traffic management initiatives (TMIs) can be expected.
Safety	Increased situational awareness by pilots, AOCs and ANSPs, including enhanced safety through the avoidance of hazardous meteorological conditions. Reduced contingency fuel carriage for the same meteorological condition.

Cost

Current experience with utilization of ATM decision support tools, with basic meteorological input parameters to improve ATM decision making by stakeholders has proven to be positive in terms of producing consistent responses from both the ANSP and user community.

CAEM/ICAO CONJOINT MEETING
7-18 JULY 2014, MONTREAL, CANADA

Recommendation 2/10 —Development of meteorological service for the terminal area

That ICAO, in close coordination with WMO, be tasked to:

a) include meteorological service for the terminal area and other relevant operational requirements in Block 1 and subsequent blocks of the aviation system block upgrade methodology to highlight potential related impacts on air traffic flow in consideration of air traffic control and air traffic management (ATM);

b) develop ATM-tailored meteorological service for the terminal area to meet future ATM requirements identified by the *Global Air Navigation Plan* (Doc 9750) and reflect the appropriate functional and performance requirements in the relevant provisions, noting outcomes from ICAO expert groups on meteorology, ATM and flight operations.;

c) develop guidance on verification methodology toward the continuous improvement of meteorological information to ATM; and

d) integrate the information concerning meteorological service for the terminal area into the future system-wide information management environment underpinning the future globally interoperable ATM system.

ON-GOING PROGRAMMES IN SOME COUNTRIES/REGIONS

- Ongoing Air navigation improvement programmes undertaken by a number of ICAO Member States:
  SESAR in Europe; NextGen in the United States; CARATS in Japan; SIRIUS in Brazil, and others in Canada, China, India and The Russian Federation are consistent with the Block Upgrade framework
- How about WMO Members?

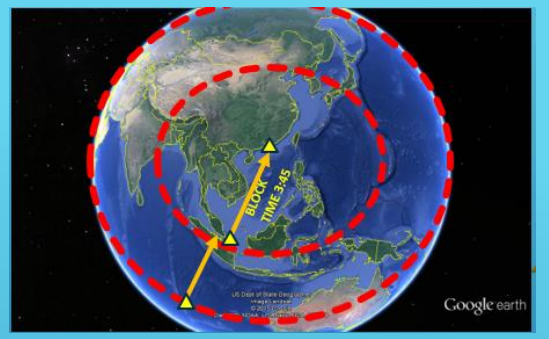
AVRDP OBJECTIVES

A joint effort between CAS and CAeM, in 4 years (2015-2019)

- **Phase I:** to conduct research in **nowcasting and mesoscale modelling** at a number of **international airports** located in Northern and Southern Hemisphere with a view to supporting the development of the **next generation aviation initiative**, the Aviation System Block Upgrade (**ASBU**) under the new Global Aviation Navigation Plan (GANP) of International Civil Aviation Organization (ICAO). Key concepts under ASBU are the development of seamless **Trajectory-Based-Operation (TBO**, or "gate-to-gate") and **Meteorological Services to ATM (MSTA)** near airport terminal area.
- **Phae II** to collaborate with the respective Air Traffic Management (ATM) to translate the Meteorological (MET) information into ATM Impact products so as to demonstrate the benefits of the MET information (nowcast and mesoscale modelling) in the aviation community;
- **Capacity Building** to help in capacity building via the knowledge gained in AvRDP other WMO Members who need to enhance their aviation MET services so as to meet the ASBU initiative.

* *Not just enhancing flight efficiency but also safety and environment-friendly by reducing fuel waste*

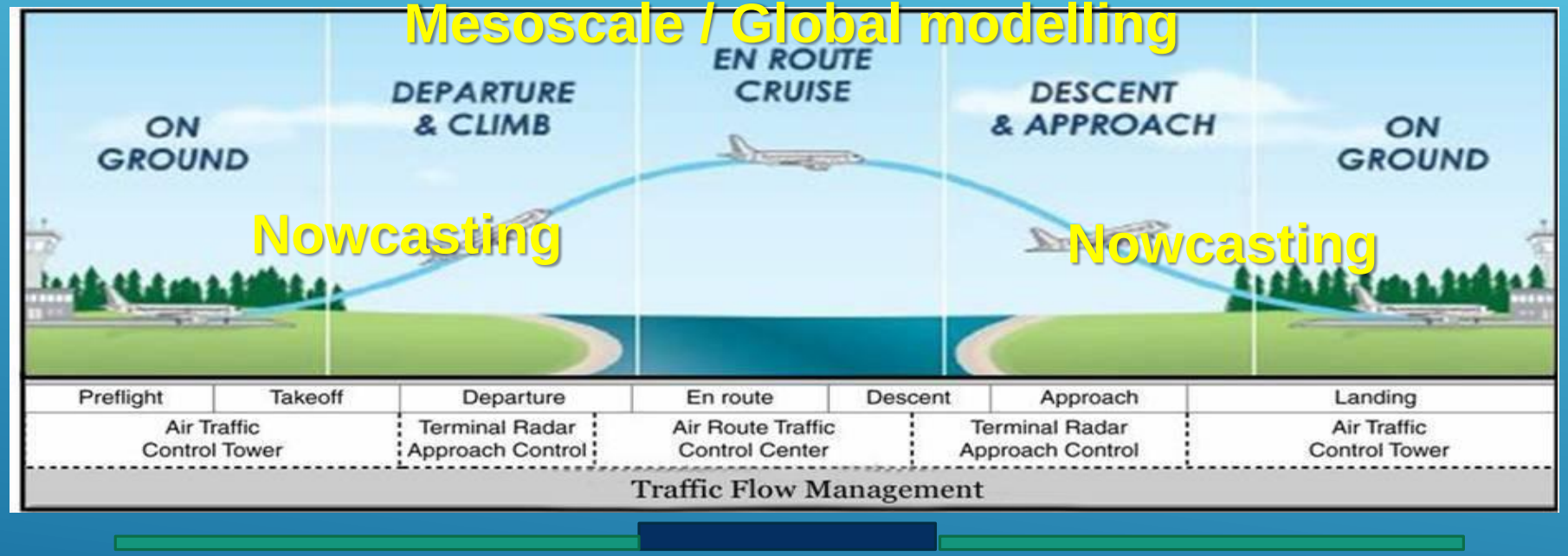
TRAJECTORY-BASED OPERATION (TBO)



~ 6 ours flight radius

- Seamless MET information, not bounded by FIR
- Trajectory-based operation; gate-to-gate info

Seamless nowcasting -> mesoscale -> global scale -> mesoscale -> nowcasting scale

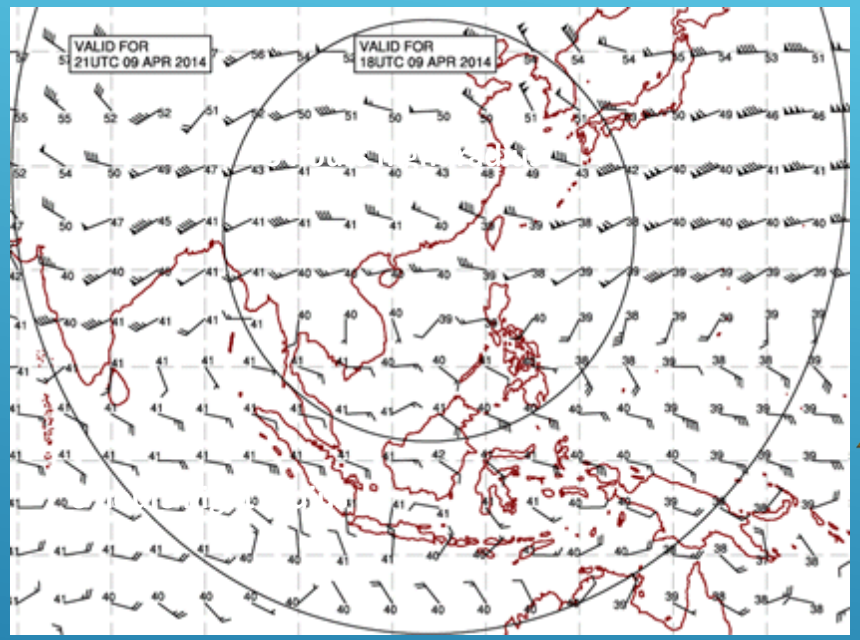


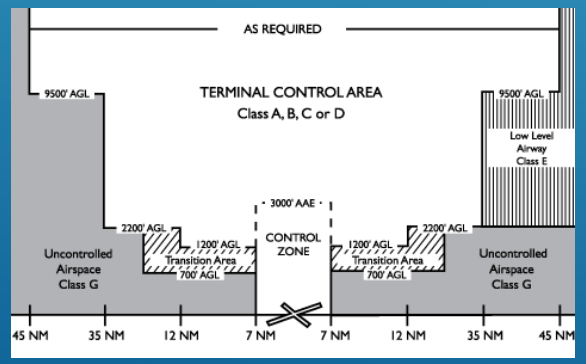
Terminal Control Area: Location specific

En Route Phase: Mainly supported by global model

Terminal Control Area: Location specific

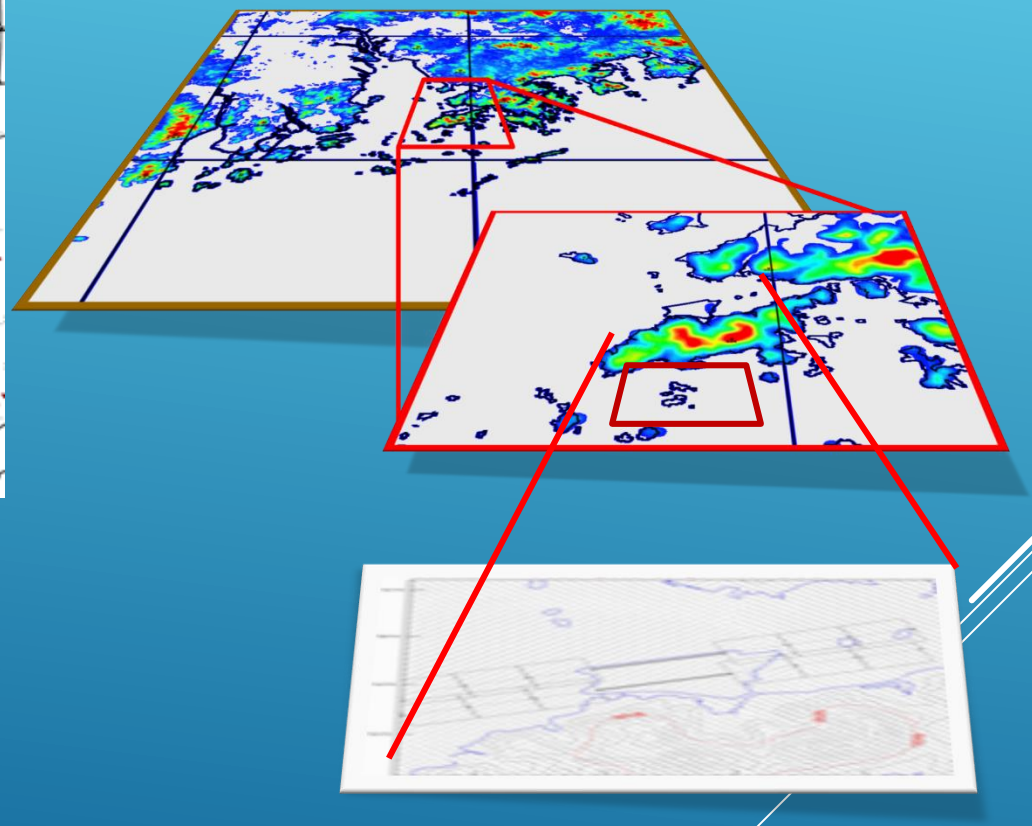
The closer to the Terminal Control Area / Aerodrome, the finer weather information required





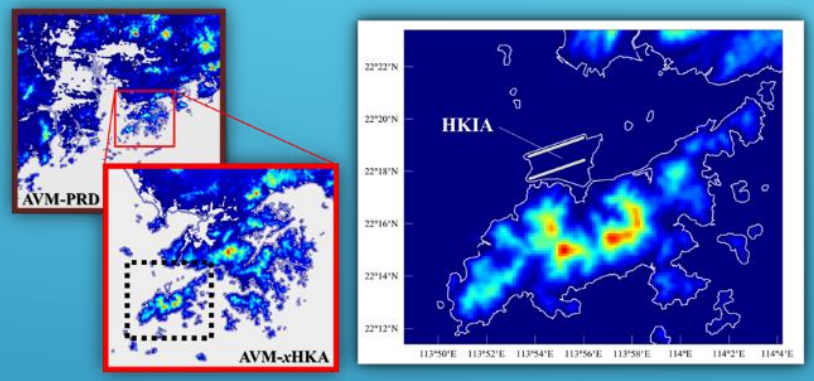
This is the area needs 0-6 hr nowcast

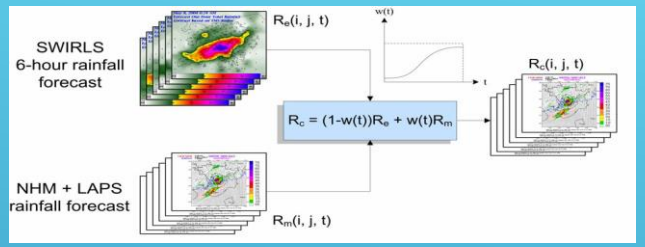
Meteorological Service for the Terminal Area (MSTA)



Spatial resolution Δx from 10's km to sub-km
Temporal resolution Δt from hours to minutes
Update frequency from hours to minutes

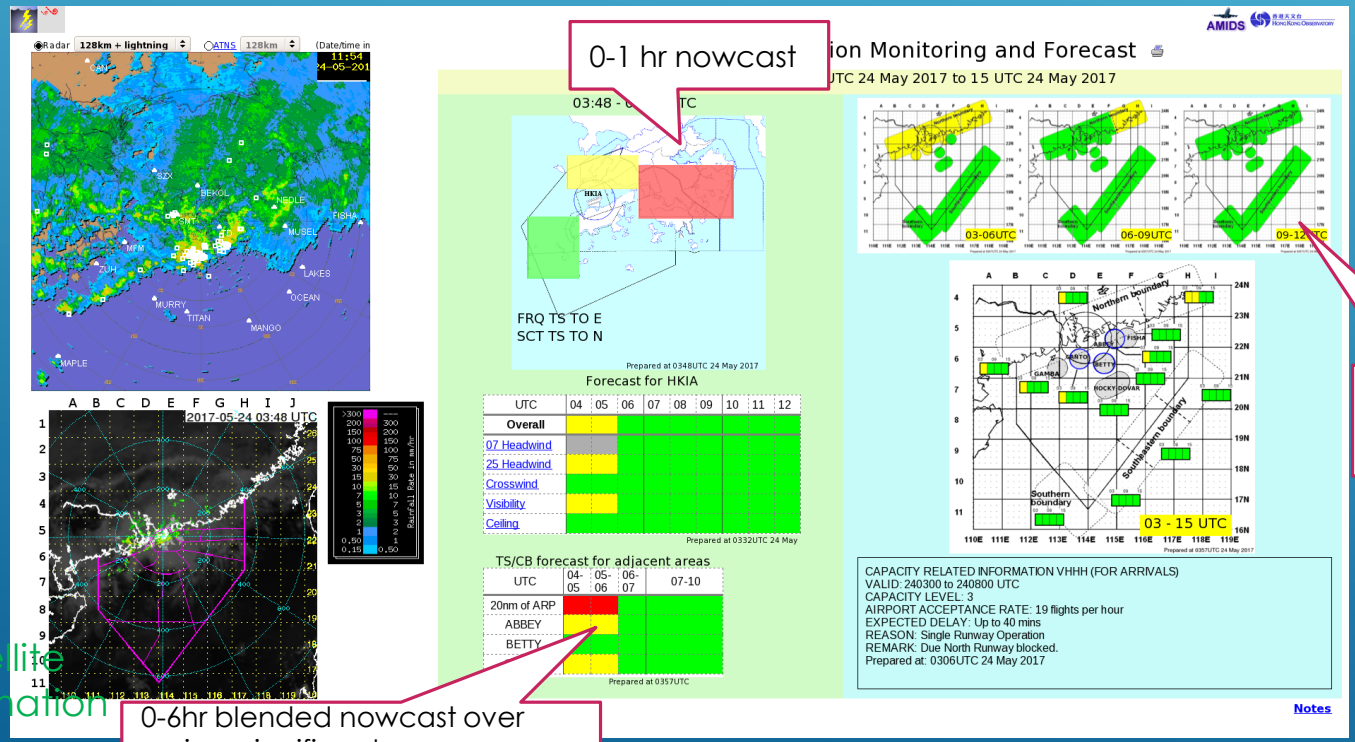
SEAMLESS NOWCAST AND MESOSCALE MODELLING





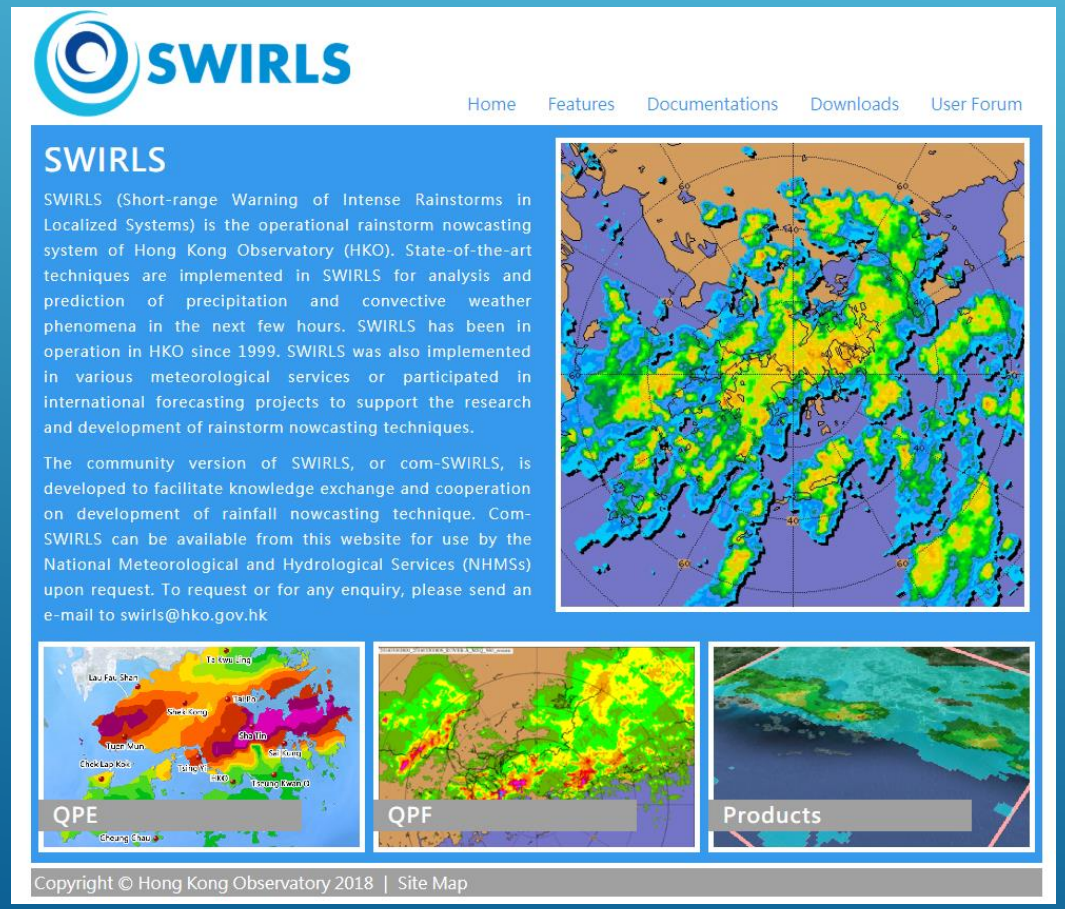
Blended nowcasting and non-hydrostatic model to forecast 0 to 6 hrs ahead

Weather radar overlaid with lightning



RADAR-BASED NOWCASTING SYSTEM – HKO COMMUNITY SWIRLS – STATE-OF-THE-ART

http://swirls.hko.gov.hk/index.html



Current users (operational):

- South Africa - SAWS
- India – IMD
- Malaysia - MMD

Implementing for operation:

- Vietnam – VMHA
- Philippines - PAGASA
- Myanmar - DMH
- China – SWPC of NMC

SATELLITE-BASED NOWCASTING

http://swirls.hko.gov.hk/rsmc/aviation.html

Hong Kong Observatory
RSMC on Nowcasting

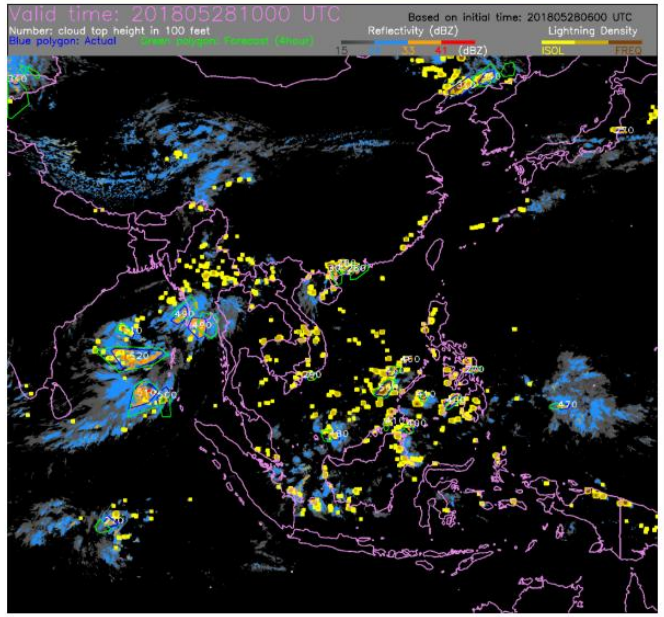
Home | Nowcasting Products | Com-SWIRLS | Research Development | Verification | Collaborations | Training

Aviation Nowcasting

- Real-time SigConv
- Real-time ICI
- ATNS
- ATLAS
- Back to top

Real-time SigConv (Significant Convection)

Significant convection present imminent threats to in-flight aircraft for the associated hazards of lightning, turbulence, icing, rain and hail...etc. Limited by the range and coverage of on-board weather radar, pilots may not have a complete picture of the distribution and short-term evolution of convective systems within their intended flight path. The product shown here uses multiple channels, high resolution meteorological satellite data and real-time global lightning data to automatically identify and nowcast the hazardous areas of significant convection for aircraft's avoidance. More details of the satellite-based algorithm can be found in the paper: Development of Satellite Reflectivity Retrieval Technique for Tropical Cyclone Rainfall Nowcasting.

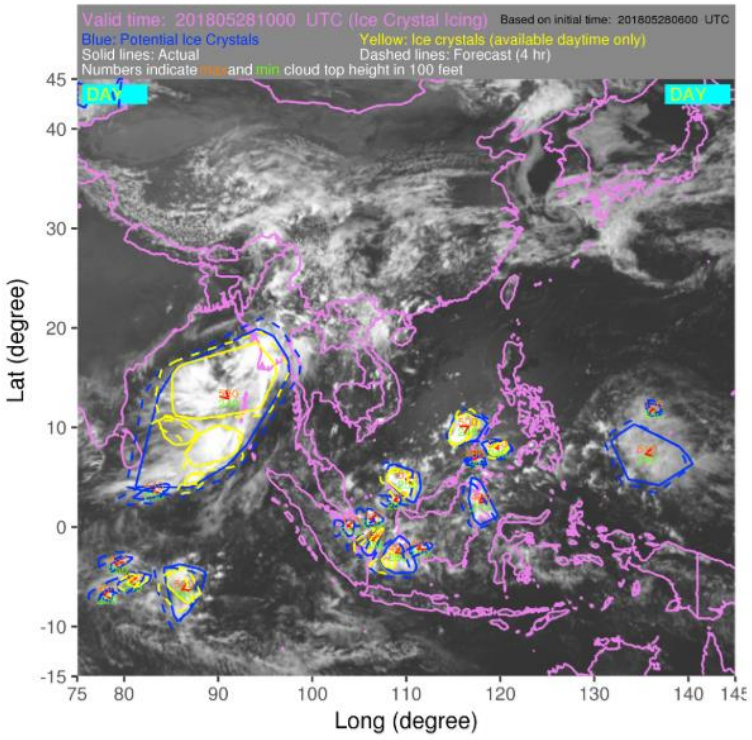


- Real-time SigConv
- Real-time ICI
- ATNS
- ATLAS
- Back to top

Real-time ICI (Ice Crystal Icing)

At the core of deep convection, small ice crystals may be thrown upward by the strong updrafts to very high altitude. As aircraft passing through regions of dense high altitude ice crystals, which might be undetected by aircraft radar, these small ice crystals may form a thin ice layer on the engine blades and cause the engine to lose power. This phenomenon is known as ice crystal icing (ICI) or engine icing. The product shown here uses multiple channel, high resolution meteorological satellite data to automatically detect and nowcast the hazardous areas which may have high potential of ICI for aircraft's avoidance.

Please refer to HKO News Bulletin for the Aviation Community http://www.weather.gov.hk/aviat/outreach/1024index038.htm for more details.



TIMELINE

Nov 2014	**Endorsement of the AvRDP proposal by WWRP SSC**
Nov 2014 – Feb 2015	Formation of AvRDP SSC and identification of AvRDP Participants
24 – 26 Jun 2015	Kick-off Meeting cum Science Meeting
May 2015 – July 2017	**Phase I – MET capacity research** (AvRDP Airports or Participants who need longer preparation time may choose to enter Phase I in late 2015 or after)
May 2015 - Oct 2015	1st IOP for convective weather (over Airports in Northern Hemisphere)
Nov 2015 – Mar 2016	1st IOP for winter weather, visibility and ceiling (over Airports in Northern Hemisphere)
Dec 2015 – Mar 2016	2nd IOP for convective weather (Southern Hemisphere)
May 2016 - Jul 2016	3rd IOP for convective weather (Northern Hemisphere)
Nov 2016 – Mar 2017	2nd IOP for winter weather, visibility and ceiling (Northern Hemisphere)
May 2015 – July 2017	Nowcasting research including MT verification on convective weather
Nov 2015 – July 2017	Nowcasting research including MET verification on winter weather, visibility and ceiling
20 - 22 Jul 2016	AvRDP Training Workshop on aviation nowcasting
22 – 23 Jul 2016	2nd SSC Meeting
25 – 29 Jul 2016	Preliminary Phase I results to be presented in WWRP Symposium on Nowcasting and Very-short-range Forecast
Jul 2016 – Jun 2018+	**Phase II – MET-ATM impact translation and validation** To be expanded after the WMO Intercommission (CAS/CAeM/CBS) AeroMetSci-2017 Conference (AvRDP Airports or Participants who started the IOP in late 2015 or later may choose to enter Phase II in late 2016)
Jul 2017 – Jun 2019	Research on MET-ATM impact translation
Jul 2017 – Jun 2019	Demonstration of MET-ATM impact
Fall 2017	Participate in the AeroMetSci-2017 Conference
Jan 2018 – Jun 2019	4 more airports joining the Project
Oct 2019	2nd AvRDP Training Workshop focusing on ATM-MET integration
Jul 2019	Concluding Meeting

6+4 AvRDP AIRPORTS

AvRDP Airport	Climatological regime	Weather elements to be studied in AvRDP
Charles de Gaulle Airport (CDG) 	Mid-latitude in Northern Hemisphere Location: Inland	Winter weather - snowfall, icing, low temperature Fog
Hong Kong International Airport (HKG) 	Subtropical in Northern Hemisphere Location: Surrounded by water Next to high mountain	Convection and Thunderstorm Low visibility and ceiling
O.R. Tambo International Airport (Johannesburg Airport) (JNB) 	Subtropical in Southern Hemisphere Location: Inland	Convection Fog
Shanghai Hongqiao Airport (SHA) 	Subtropical/mid-latitude in Northern Hemisphere Location: Inland not far away from River Estuary and East China Sea	Convective weather
Toronto Pearson International Airport (YYZ) and Iqaluit Airport (YFB)  	Mid-latitude in Northern Hemisphere Location: Inland but not far away from Lake High-latitude in Northern Hemisphere Location: On Frobisher Bay	Winter weather – snowfall, icing, precipitation type and amount, visibility, wind speed, direction shear, and gust, turbulence, and low ceilings Convective Weather Artic weather – Winds, blowing snow, fog, visibility, ceiling

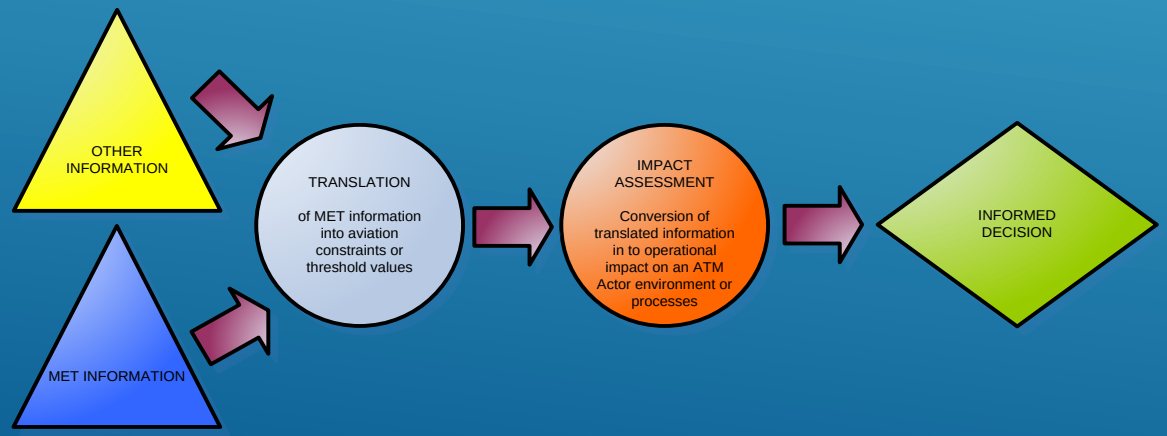
Changi Airport (SIN) 	Tropics 01°21'33.16" N103°59'21.5"E 2 Runways: 02/20 Location: Coastal	Convective Thunderstorm
Pulkovo Aiport (LED) 	Mid-latitude in Northern Hemisphere 59° 48' N 30° 15' E 2 Runways: 10/28 Location: Inland but between 2 Lake	Visibility and Cloud Ceiling
Indira Gandhi International Airport (IGI) 	Subtropic in Northern Hemisphere 28°34'07''N 77°06'44''E 3 Runways: 09/27 10/28 11/29 Location: Inland	Summer Convection Winter Fog/Low VIS
Tokyo Airport (Narita/Haneda Airport) 	Subtropic in Northern Hemisphere 35°45'55''N 140°23'08''E 2 Runways: 16/34 Near shore	Summer Convection A/P TS, Low VIS, Cloud ceiling winds ATC Sectors Convection Low level winds

AvRDP IOPs Collect and Share data, including Airport Observations, Nowcasting, modelling and ATM data

Airport	Observations									Nowcasting system and model			ATM data				
	Weather Radar (conventional or Doppler)	Geostationary Satellite	Wind profiler	LIDAR	Anemometer	Visibility sensor	AMDAR/ACARS data	Other observations	Global lightning	Nowcasting system	Micro/mesoscale NWP	Regional model	PIREP	Aircraft data (including QAR)	ATM capacity data	Air traffic data	ADS-B

TRANSLATION MET INFORMATION INTO ATM IMPACT

- Airport Capacity
- Airspace Capacity
- Arrival/Departure Delay
- Fuel consumption
- Aircraft de-icing, runway clearance, engine icing in freezing fog
- Lightning strike affecting ground ops.
- …



AvRDP AIRPORT STATUS

- Most participating airports have finished Phase I and moving on to Phase II
  - HKG – working on Phase II focusing on convection impact on airport capacity
  - CDG – completed Phase I and engaging with ATM to move forward to Phase II
  - SHA – jumped directly to Phase II
  - JNB – completed Phase I and engaging with ATM to move forward to Phase II
  - YYZ - completed Phase I and have difficulties to engage ATM to working on Phase II
  - YFB – working on Phase I (polar weather) but has no plan to work on Phase II
  - Paper presented during the AMET Sci-Conference 2017

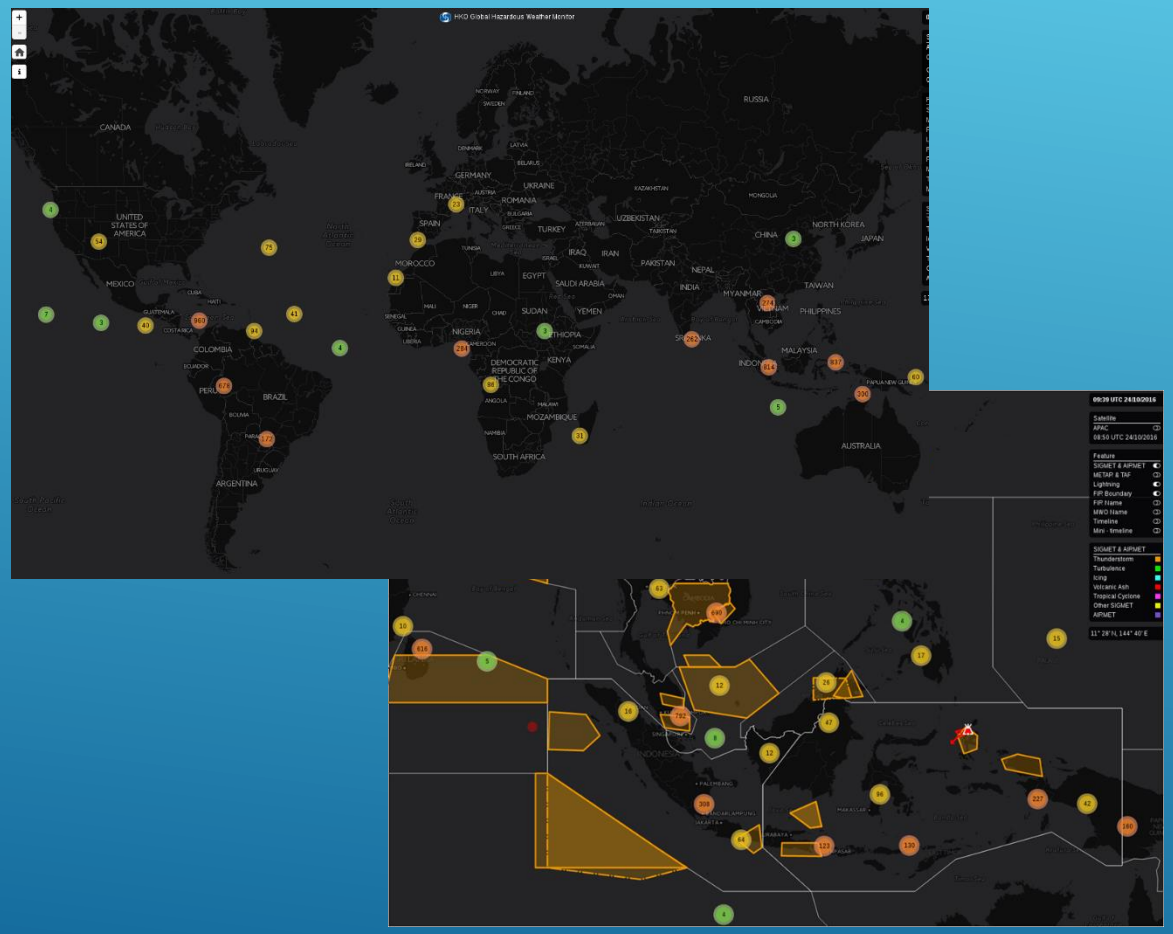
- 4 New Airports to participate
  - Russia Pulkovo Airport (LED) – focusing on low cloud and fog
  - Singapore Changi Airport (SIN) – focusing on lightning and tropical cyclone
  - Japan Narita Airport (NRT) – focusing on convection, low ceiling and winds
  - India New Delhi Airport (IGI) – focusing on convection and fog
  - Newly engaged airports will proceed to Phase II as early as possible to subsequently be timely aligned with the other airports who had joined the project earlier on.

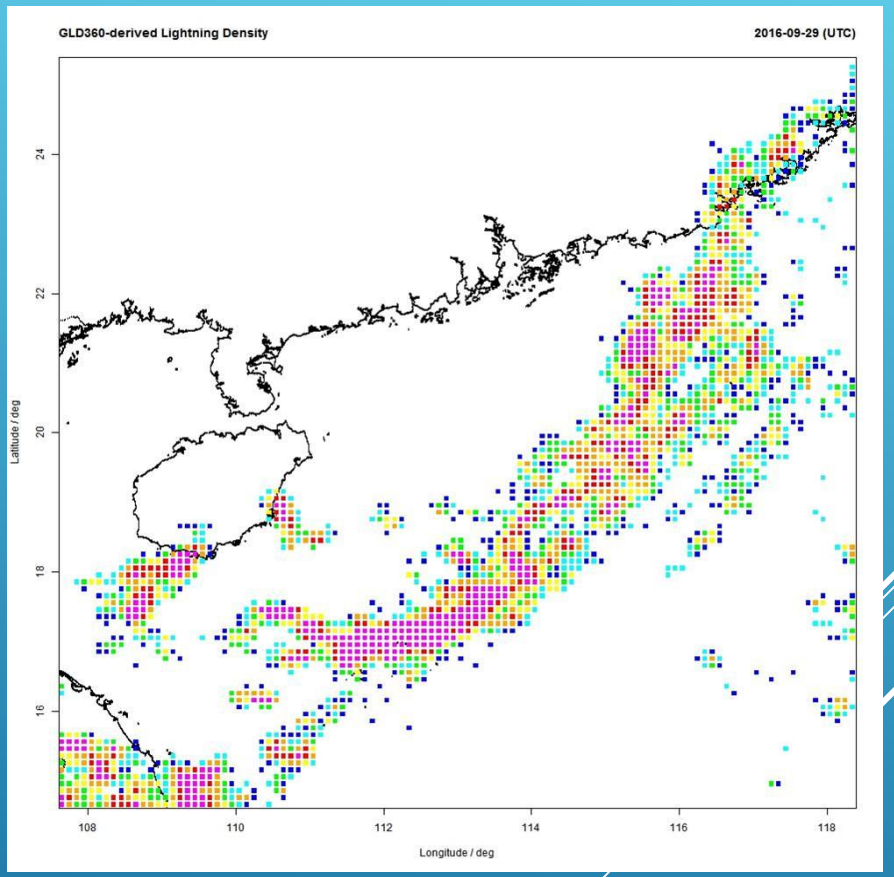
WMO EC-69 (2017) ON MET-ATM INTEGRATION

SPECIAL DIALOGUE ON THE FUTURE OF AERONAUTICAL METEOROLOGICAL SERVICES (11 May 2017)

- Instead of only trying to improve the accuracy of the forecast, the translation of the meteorological forecast elements, qualified with uncertainty and confidence information, into operational impacts, …
- and the communication of such information to users, … to improve their decision-making.
- Emphasis should be how to make the 'best decision', rather than simply to supply the 'best forecast'

GLOBAL LIGHTNING (FOR PHASE I, II AND VERIFICATION)



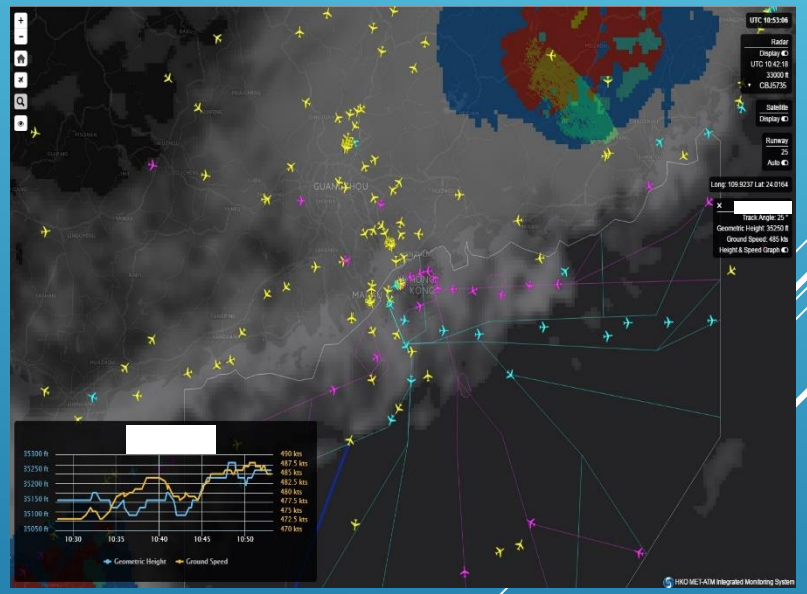


Updated every minute
Overlaid with radar and satellite products

HKO – FOCUSING ON ATM IMPACT STUDY

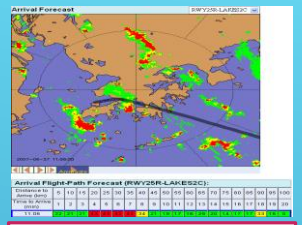
Collecting and studying ATM Impact based on Nowcasting facility, modelling facility and ATM data (HKG)

Airport	Observations									Nowcasting system and model			ATM data				
	Weather Radar (conventional or Doppler)	Geostationary Satellite	Wind profiler	LIDAR	Anemometer	Visibility sensor	AMDAR/ACARS data	Other observations	Global lightning (since mid 2016)	Nowcasting system	Micro/mesoscale NWP	Regional model	PIREP	Aircraft data (including QAR)	ATM capacity data	Air traffic data	ADS-B (since 2016)
HKG	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

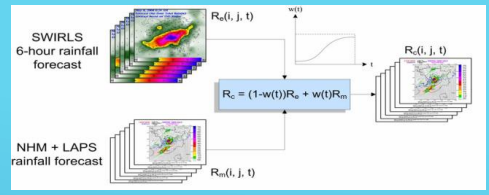


ADS-B (aircraft position) overlaid with weather radar and satellite

ATM Impact Parameter – Airport Capacity Notification -> ATFM Daily Plan (ADP)



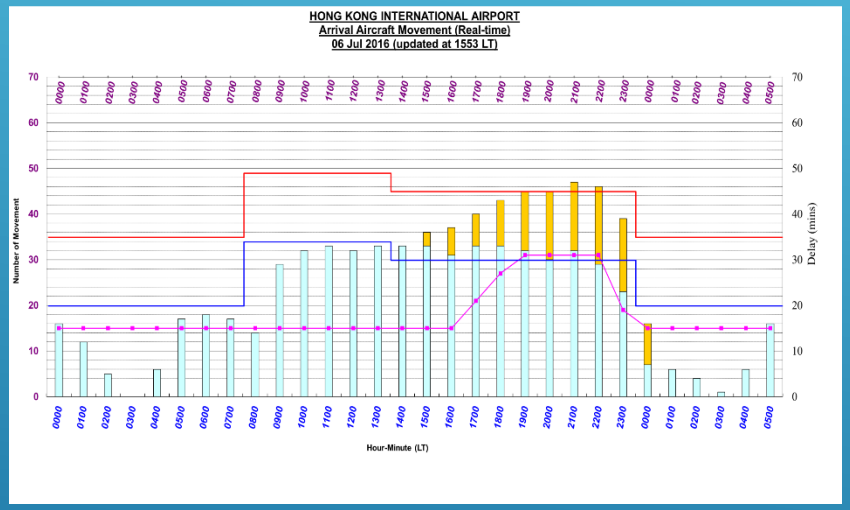
Flight/route specific convection nowcast

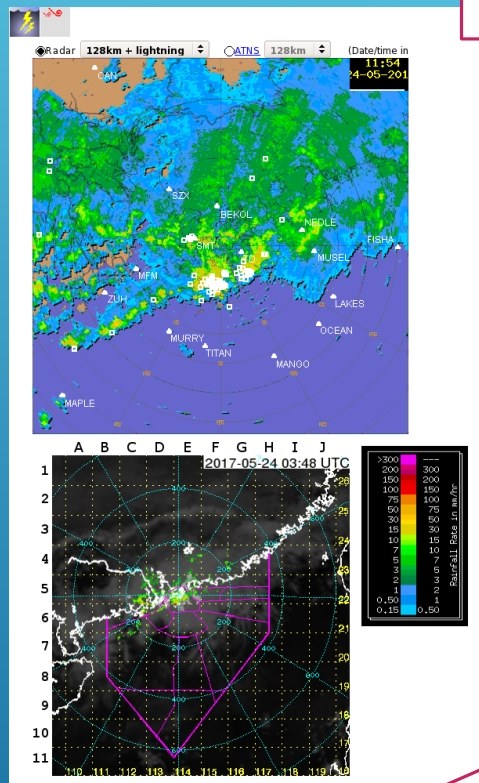


Blended nowcasting and non-hydrostatic model to forecast 0 to 6 hrs ahead

Weather radar overlaid with lightning

0-1 hr nowcast

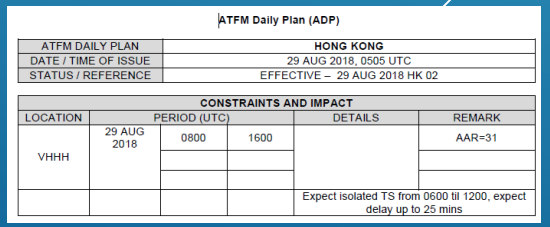




3 hrly forecasts based on global model

Satellite animation

0-6hr blended nowcast over various significant areas



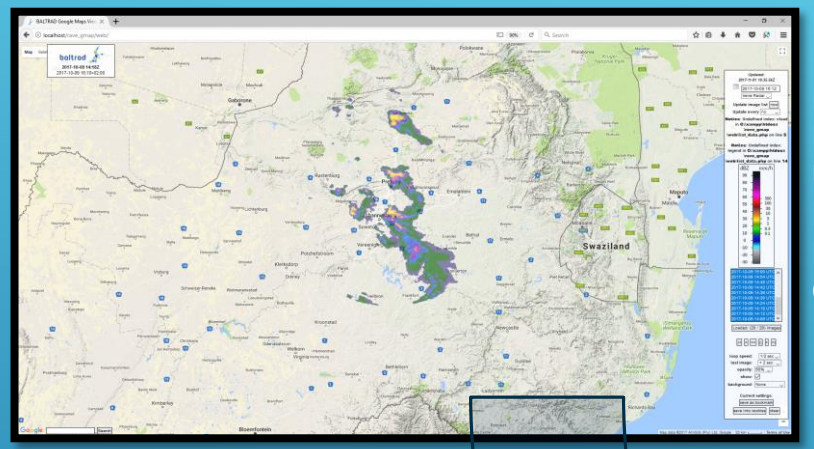
ATFM Daily Plan (ADP)

ATFM DAILY PLAN	HONG KONG
DATE / TIME OF ISSUE	29 AUG 2018, 0505 UTC
STATUS / REFERENCE	EFFECTIVE – 29 AUG 2018 HK 02

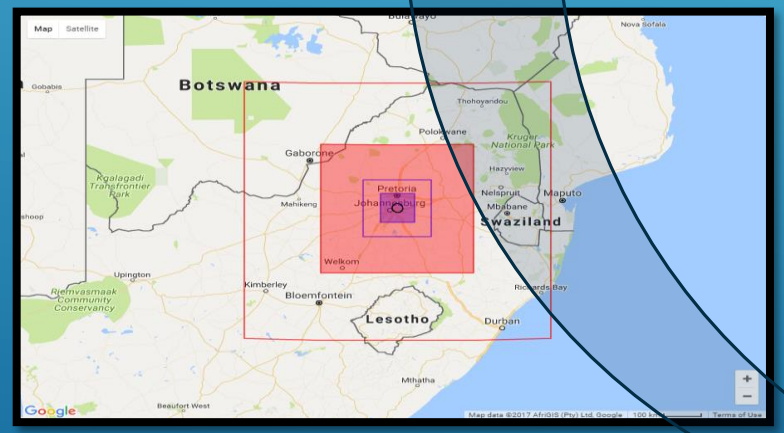
CONSTRAINTS AND IMPACT					
LOCATION	PERIOD (UTC)			DETAILS	REMARK
VHHH	29 AUG 2018	0800	1600		AAR=31
				Expect isolated TS from 0600 til 1200, expect delay up to 25 mins	

Airport Capacity Notification sent to regional airports

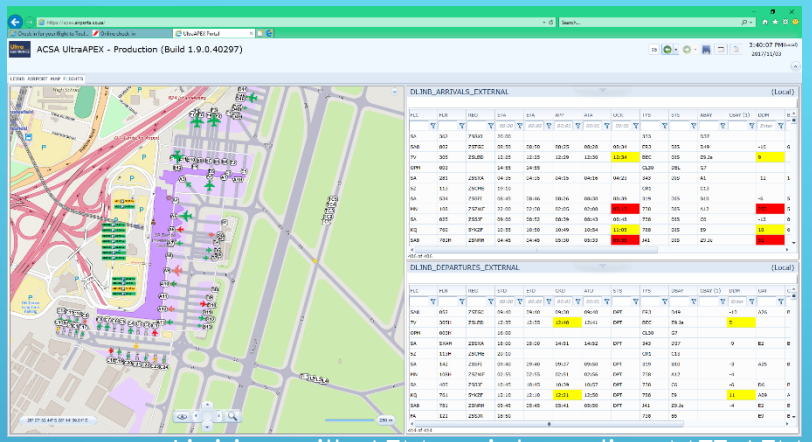
JNB (JOHANNESBURG AIRPORT)



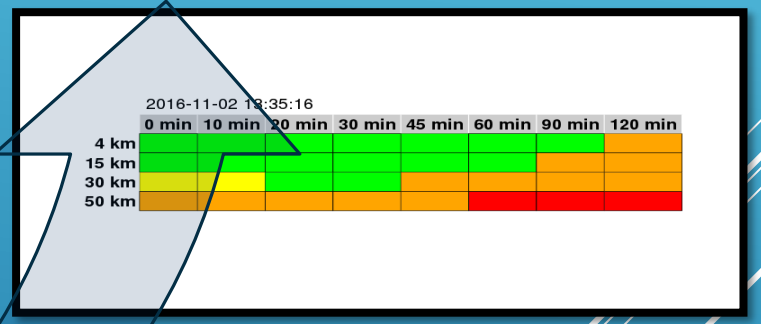
Radar-based Com-SWIRLS
Nowcasting system
Updates every 6 min
Lead-Time extrapolation = 2 Hour
Resolution = 1 km
Operational end of 2017

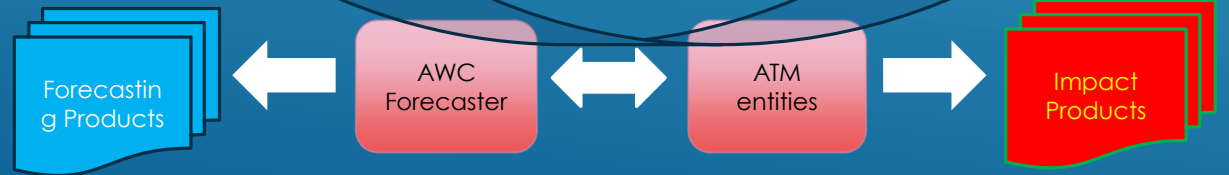


UKMO down to 300 m resolution
Storm moved over OR Tambo Int. Airport
Severe impact on airport operations



Liaising with ATM on integrating MET-ATM





Likelihood		Minimal	Minor	Significant	Severe
	High		2	6	10
	Medium		1	5	9
	Low			4	8
	Very Low			3	7
		Impact			

Risk Matrix Table

1ST AVRDP TRAINING WORKSHOP - AVIATION NOWCASTING CAPACITY BUILDING WORKSHOP (20 – 22 JULY 2016)

20 Jul (Wed)	21 Jul (Thu)	22 Jul (Fri)
Aviation Research Demonstration Project	Probabilistic Nowcast Meososcale modelling	Satellite-based nowcast
Radar-based nowcasting techniques	Seamless Nowcast & SESAR	Breakout discussions
Aviation Mesoscale Numerical Weather Predication	Low Visibility Nowcast	Nowcasting System: Community-SWIRLS (hands-on training)
Aviation Nowcasting System CAN-NOW	Winter Weather Nowcast	

22 trainees from 10 MWO/local Universities

EXPANSION OF AVRDP INTO AN INTER-COMMISSION (CAS/CAEM/CBS) AVIATION RESEARCH PROJECT EC-68 JUNE 2016 DECISION 6.1 (2)/1

- AGREES with WWRP SSC recommendation for expansion of AvRDP into an **Inter-Commission (CAS/CAeM/CBS) Aviation Research Project** (Research to Operation)

- REQUESTS Presidents of CAS/CAeM/CBS to
  - prepare a coordinated road map for the Project in support of future operational solutions for ATM for consideration by the PTC in 2017.

- ENDORSES the organization in 2017 a scientific event with the objective to identify needs and plan research activities during ASBU Block 1 & 2 (2018-2028)

- Research should be **in accordance with ASBU time blocks:**
  - AMET B0 (2013-2018) – use of existing MET/ATM capability
  - AMET B1 (2019-2024) – MET-ATM Integration
  - AMET B2 (2025-2030) - Aircraft data downlink/uplink
  - AMET B3 (2031 +) – Advanced Avionics research

- Research should be focused on the performance improvement areas:

  - Airport Operations
  - Globally Interoperable Systems and Data
  - Optimum Capacity and Flexible Flights
  - Efficient Flight Path

RESEARCH AREAS TO BE CONSIDERED

- **Improved observations, forecasting and warnin**gs
  - Enhanced 4-dimensional information for meteorological hazards, enhance global MET information, enhance high resolution MET information for airports and terminal areas
- **Integration, use cases, fitness for purpose and delivery**
  - Integrate MET information into ICAO System-Wide Information Management (SWIM), support Collaborative Decision Making (CDM), support Trajectory-Based Operations (TBO)
  - support different ATM decision horizons – from "immediate" (0-20 minutes) to several days ahead
- **Climate change impacts on aviation industry**
- R & D be of such a nature that developing countries can also benefit to enhance aviation safety in areas where highly sophisticated instruments and computer resources are not always available

WMO AERONAUTICAL METEOROLOG SCIENTIFIC CONFERENCE

WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

6-10 NOVEMBER 2017
TOULOUSE, FRANCE

WMO OMM
World Meteorological Organization
Organisation météorologique mondiale

Co-sponsored by:

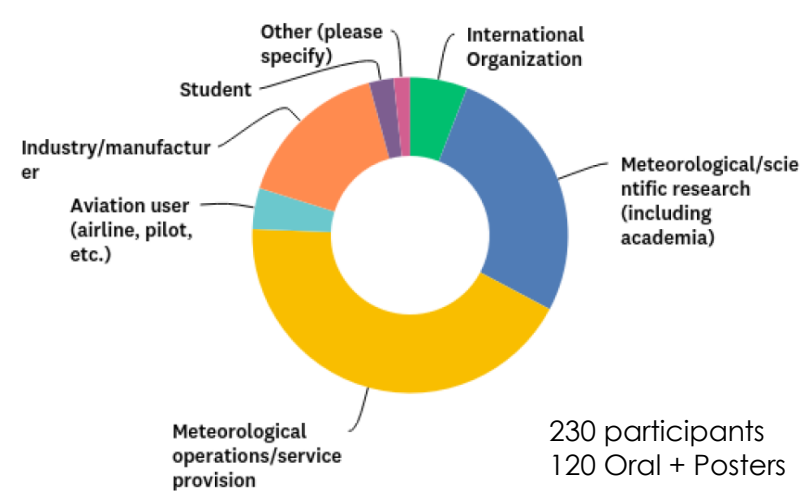
AIRBUS

Selex ES
A Finmeccanica Company

THALES

METEO FRANCE

THEME: "AVIATION, WEATHER AND CLIMATE: SCIENTIFIC RESEARCH AND DEVELOPMENT FOR FUTURE AERONAUTICAL METEOROLOGICAL SERVICES IN A CHANGING ATMOSPHERIC ENVIRONMENT" -



230 participants
120 Oral + Posters

https://public.wmo.int/en/media/press-release/aeromet-conference-focuses-aviation-safety-efficiency-and-environment

Key Area 1: Aeronautical Meteorology Science
• Ice crystal icing and airframe icing research
• Turbulence research
• Significant convection research
• Wake vortex detection and prediction
• Fog/low visibility research
• Space weather research
• Atmospheric aerosols and volcanic ash research
• Advances in observing methods and use of observations
• Seamless nowcast and numerical weather prediction, probabilistic forecast and statistical methods

Key Area 2: MET-ATM Integration
• In-cockpit and on-board MET capabilities
• Terminal area and impact-based forecast
• En-route hazards information systems
• Translation of MET information for impact and risk assessment
• Collaborative decision-making (CDM), air traffic flow management (ATFM) and network management
• Trajectory-based operations (TBO), flight planning and user-preferred routing
• Use of MET information for climate-optimized trajectories

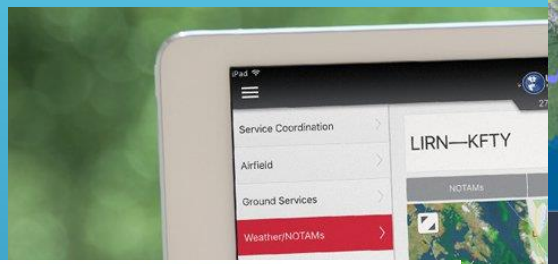
Key Area 3: Climate Change and Impact on Aviation
• Building awareness of potential impacts
• Jet stream position and intensity and related phenomena, such as CAT
• Extreme weather events and airports, changes to typical scenarios (storm surges, heat waves, visibility regimes, etc.)
• Re-evaluation of airframe/avionics resilience standards and certification
• Focus on downscaling of aviation impacts to regional and local scale

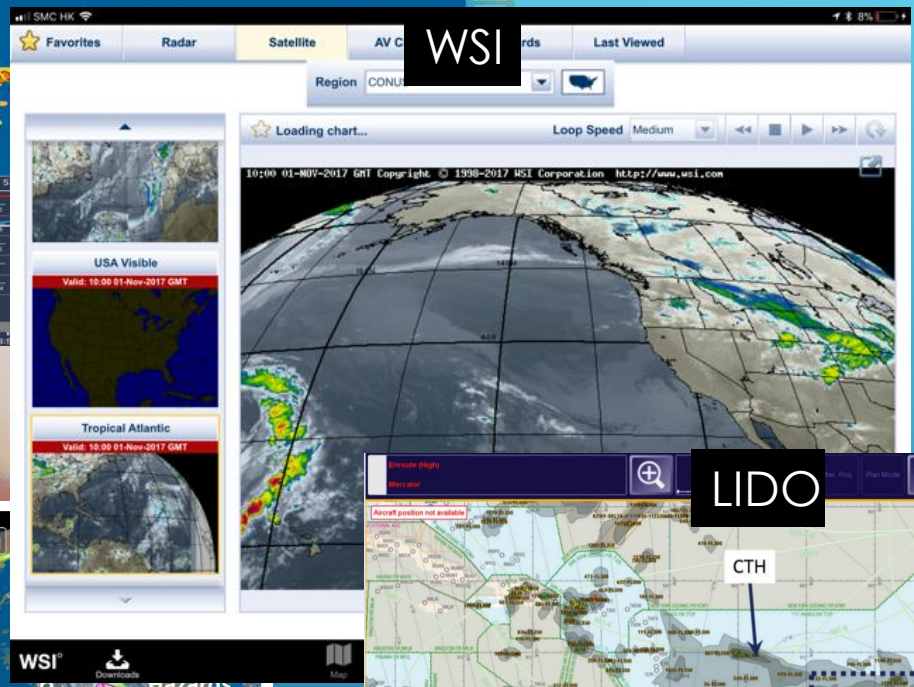
CONFERENCE STATEMENT

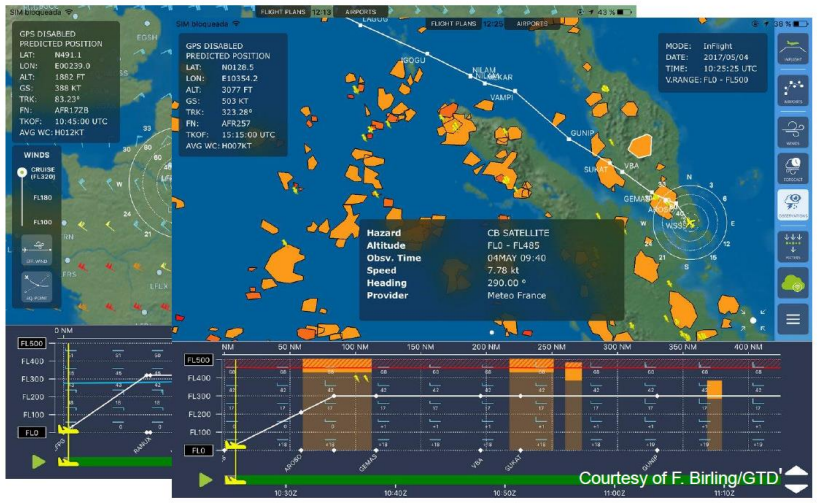
- Conference recognized the tremendous amount of ongoing cross-disciplined research in the field of Aeronautical Meteorology. This **collaborative scientific excellence** should be leveraged to enable the future global ATM system.
- The role of MET as a key enabler to aviation's vision for a globally interoperable, harmonized ATM system of the future that is safer, more efficient and more environmentally responsible will only be realized through the **accelerated transition of scientific research and technological advancement into operations** based on aviation users' needs, new and improved community partnerships, trust, transparency and openness.
- As the potential impacts of climate change and variability on aviation operations become better understood, the research community should continue to advance relevant science and **communicate in a style that is well understood by the user**.

Conference outcomes to be used to guide the Roadmap of the CAS/CAeM/CBS Inter-commission Aviation Research Project

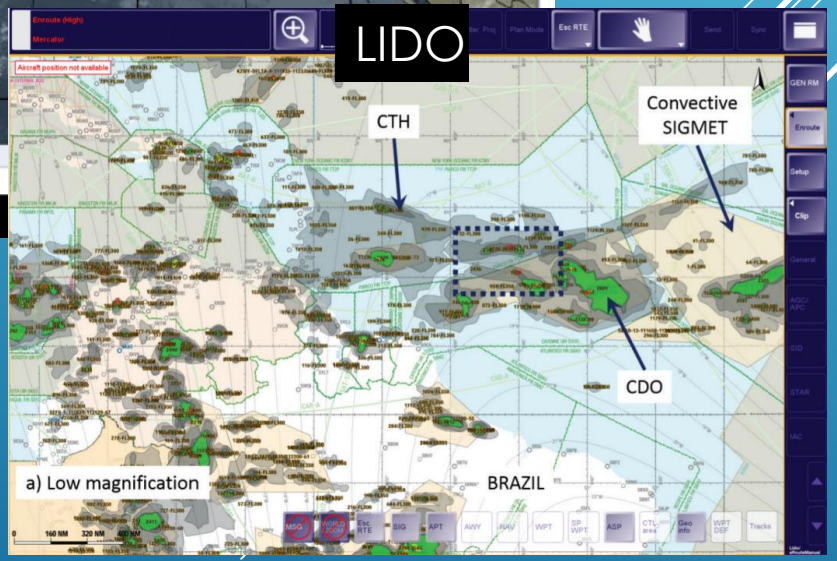
EFB, EFB, EFB …

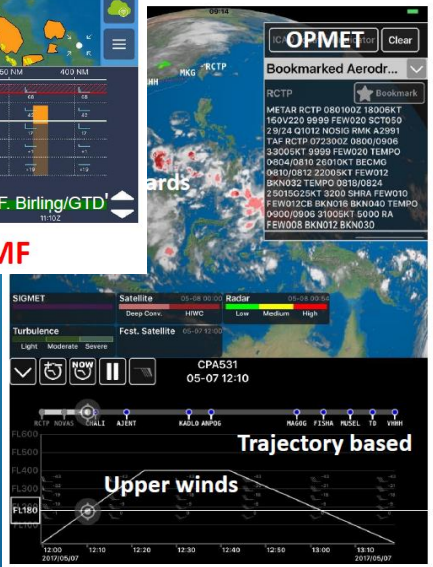


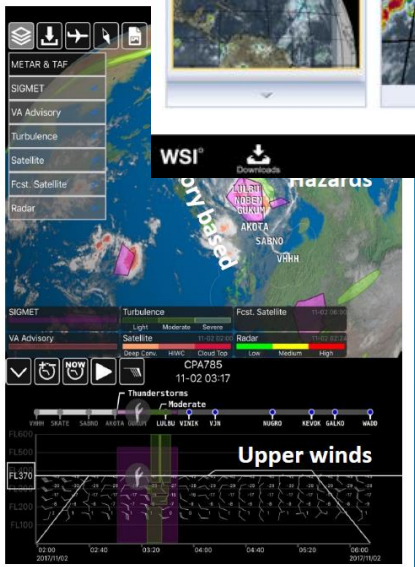




Partnership between AFR, GTD & MF



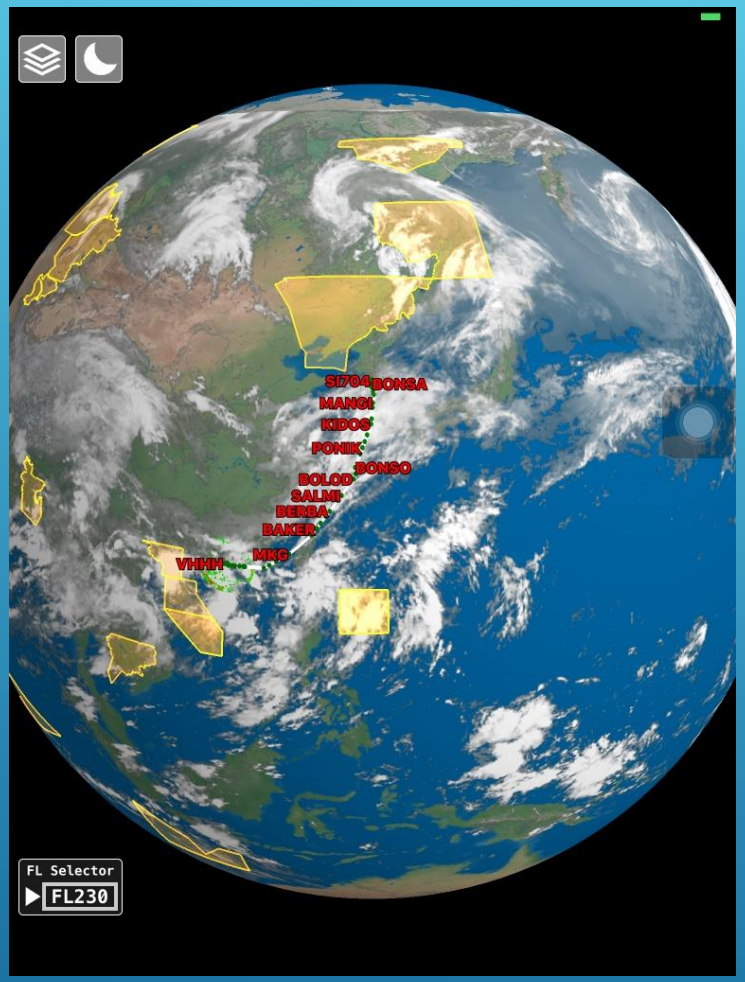


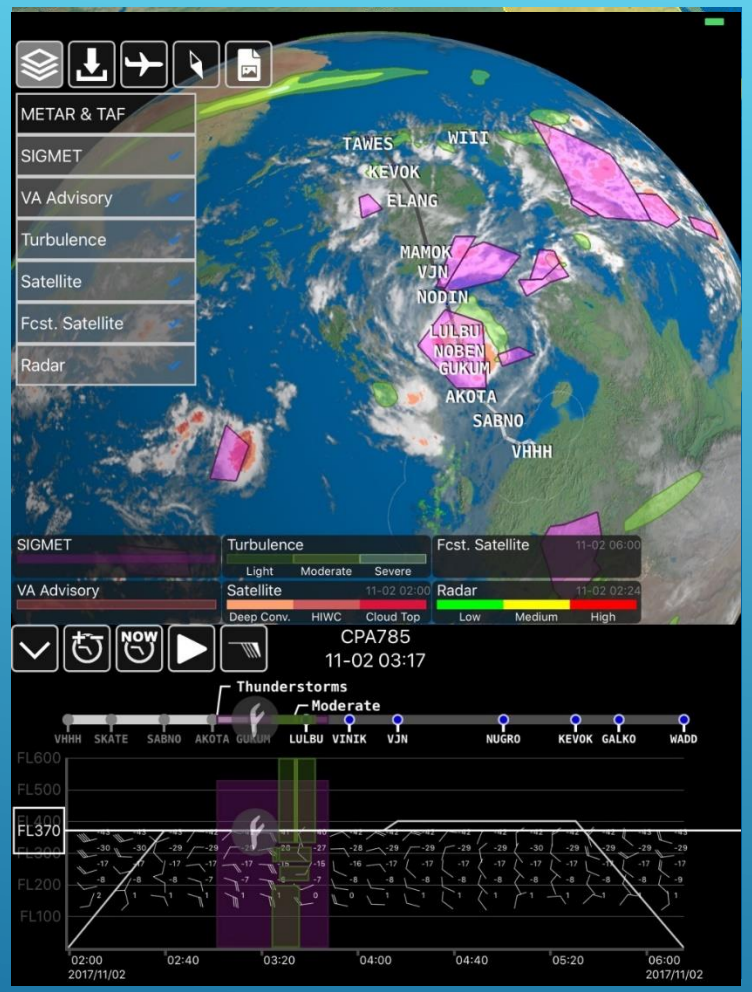


Partnership between CPA and HKO

EFB is the future direction!

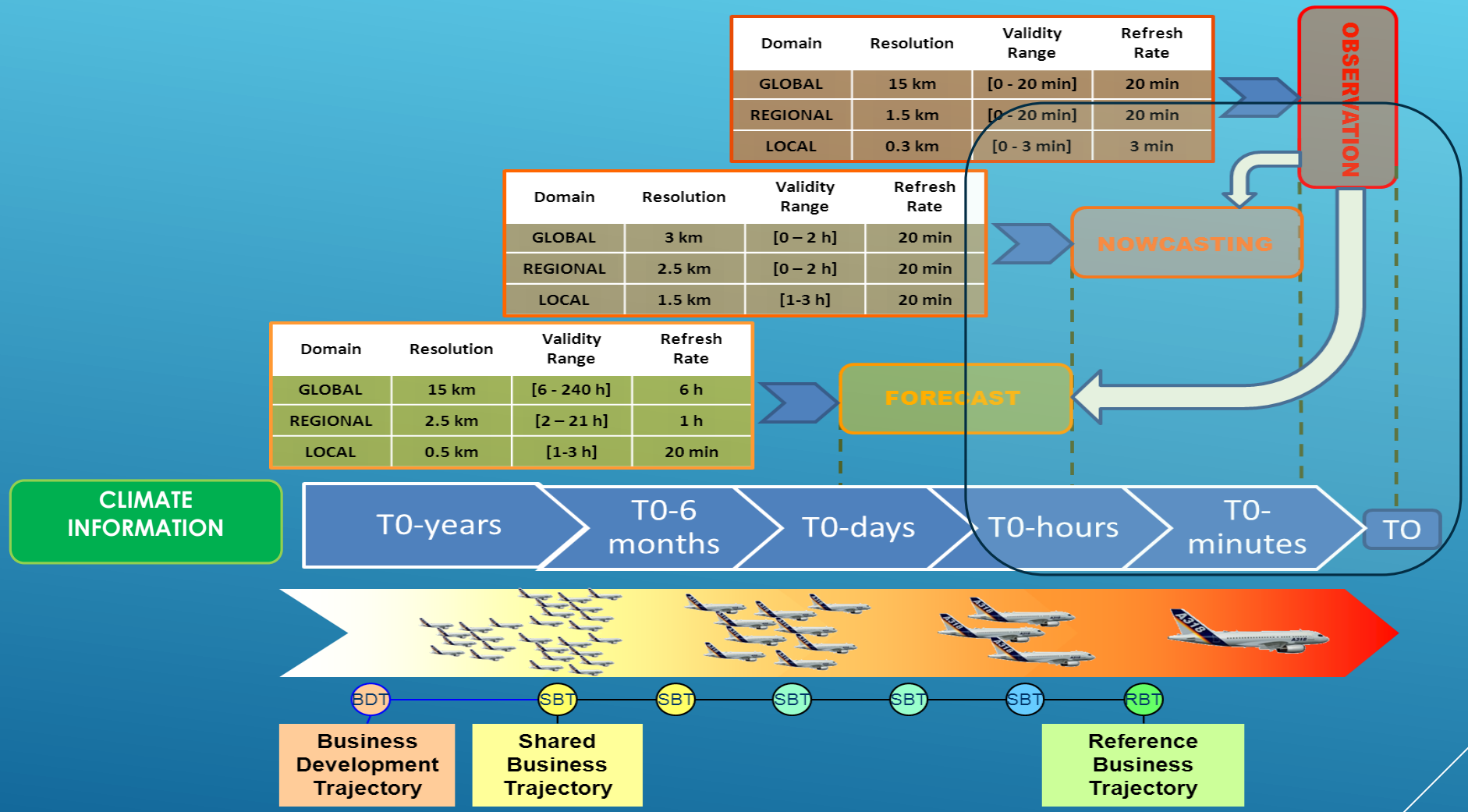
Ultimate TBO something like this?





- Seamlesssly combining MSTA with En-route Forecast (TBO)
- Uplinked weather information

DESIRABLE SEAMLESS MET INFORMATION



Current project

AvRDP Website (https://avrdp.hko.gov.hk)

AvRDP SSC Membership

Name	Representation
Peter LI, Chair	HKO rep of CAeM
Stephanie LANDMAN (replacing Erik BECKER)	SAWS rep of JNB
Janti REID	ECCC rep of YYZ & YFB
Stephanie DESBIOS	MeteoFrance rep of CDG
Fengyun WANG	CAAC rep of SHA
Sharon LAU	HKO rep of HKG
RK JENAMANI	IMD rep of IGI
Larisa NIKITINA	Roshydromet rep of LED
Jun RYUZAKI	JMA rep of NRT
Chui Wah YAP	MSS rep of SIN
Peter M. CHADWICK	CAD rep of HKG (ATM expert)
Baode CHEN	SMS rep of CMA
Matt Strahan	NOAA rep of NextGen
Stefane BELAIR	ECCC rep of NMRWG
Rep of NMRWG	rep of NMRWG
Barbara Brown	NCAR rep of JWGFVR
Herbert PUEPEL	Ex-WMO C/AeM and AustroControl

THANK YOU