WORLD METEOROLOGICAL ORGANIZATION (2 February 2018)

Meeting Report & Action Items

THIRD MEETING
Aviation Research and Development Project (AvRDP)
Scientific Steering Committee (SSC)

Toulouse, France
6 and 7 November 2017

The Aviation Research Demonstration Project (AvRDP) is a WMO World Weather Research Programme (WWRP) Research and Development Project (RDP) which commenced in 2015 and aims to demonstrate the capability of nowcasting and mesoscale modelling techniques in support of the development of the next generation aviation initiative, namely, the Aviation System Block Upgrade (ASBU) under the new Global Aviation Navigation Plan(GANP). In 2016, EC-68 supported the transition of the AvRDP to an extended aviation meteorology research project.

MEETING REPORT

The meeting was held at the Météo France Centre International de Conférences, Toulouse, France, 6 and 7 November 2017, in conjunction with the 2017 WMO Aeronautical Meteorology Scientific Conference.

1. Welcome Remarks

The meeting started at 9 am, 6 November 2017. The Chief of WMO's World Weather Research Programme (Paolo Ruti) welcomed the participants to the meeting.

This was immediately followed with a welcome remark from the Chair of the AvRDP SSC (Petr Li) to all meeting participants most specially to representatives of new members of the project: (India, Japan, Russia and Singapore). The CAD representative of HKG and representative of ECCC were unable to attend in person but were arranged to participate remotely via teleconferencing (Peter Chadwick, Sharon Lau and Janti Reid). The list of meeting participants is given in **Annex 2.**

2. Adoption of Agenda and Working Arrangements

Brief introductions from meeting participants were made after which the agenda (**Annex 1**) was reviewed and then adopted after minor amendments were made. The working arrangements for the meeting were discussed.

3. Report from the WWRP Secretariat

The Senior Scientific Officer of WWRP (Nanette Lomarda) provided a brief summary of the decision of WMO's 68th Executive Council (Geneva, June 2016) endorsing the proposal to organize the 2017 WMO Aeronautical Meteorology Scientific Conference with the objective of identifying needs and planning the research activities during Blocks 1 and 2 of the Aviation System Block Upgrades (2018-2028). EC-68 also requested the Secretary General of WMO to provide support for the transition of the AvRDP to an extended aviation meteorology research project.

She also presented an overview of the WWRP Implementation plan for 2016-2023 and the role of the AvRDP in WWRP.

At the last meeting of the WWRP SSC (SSC-9, Geneva, October 2016) the following decisions/comments related to the AvRDP were noted:

- Need to align working group and project activities with WWRP Implementation Plan (i.e. with Action Areas)

- AvRDP Phase II challenges
    - how to get local ATM involved

- how the project will expand to other airports that had joined recently
- How AvRDP transforms into the WMO Inter-Commission Project (CAeM/CAS/CBS)

4. Review of minutes of last meeting

The Chair of the AvRDP SSC provided a summary of what had transpired at the last AvRDP SSC Meeting (AvRDP-2, Hong Kong, China, 22-23 July 2016).

5. AvRDP Status Reports

The representatives of the 5 airports presented updates on the activities of their respective airports highlighted below:

5.1 Progress Report and Plan of CDG

The representatives of CDG airport (Stephanie DESBOIS and Pauline JAUNET) provided some updates on the progress of their activities highlighted below:

NOTE: Of major concern to the airport (convection, strong winds, low ceilings, fog, winter weather)

- Reports of case studies of impacting met situations at CDG airport, during IOPs, that include met situation analysis, some verification results (MET only), some validation results when ATM input (data) is available

- Report on nowcasting numerical technologies/systems that include information on implementation and infrastructure to share Météo-France experience in this domain and to provide input for capacity building and training

High Priority (Building trust with ATM, users/stakeholders)

5.2 Progress Report and Plan of JNB (OR Tambo International Airport)

NOTE: Of major concern to the airport (fog and frost (early morning in winter)

The representative of JNB airport (Erik BECKER) provided the status update of AvRDP related activities at JNB airport. Highlights are enumerated below:

- *Improvement of Nowcasting and Very Short Range Forecasting to produce a seamless 0-6 hour forecast*
- *R& D working closely with the Aviation Weather Centre (AWC) to possibly improve and introduce new forecasting products*
- *AWC works closely with ATM authorities to translate forecasting products into impact-based products*

Future Plans:

- *Continue to develop and improve on the 0-6 hour forecast lead-time.*
- *Implement SWIRLS, include satellite data – Guidance from HKO – Assist SADC countries.*
- *Continue working towards UM and WRF high-res models.*
- *Include WRFDA for radar data assimilation.*

- *Research to continue on improving forecasts and development of impact based products*

- *AWC and ATM entities continue to establish new and build on current connections/relationships*

5.3 Progress Report and Plan of HKG

NOTE: Of major concern to the airport (convective systems)

The representative of HKG airport (Sharon LAU – WebEx and Peter LI) provided the status update of AvRDP related activities at HKG airport. Highlights are enumerated below:

PHASE II (Translate MET Information into ATM Impact)

HKG 3rd IOP for convection in Northern Hemisphere (May to Sep 2017)
(airport observations, global lightning, nowcasting and modelling facility, ATM data)

ATM Impact Parameter identified and being studied
(1) Airport capacity reduction with verification (preliminary)
(2) Airspace capacity (refining flight avoidance probability)
(3) Optimized flight trajectory

Future Plans:

- To focus on Phase II - Continue to collaborate with local ATM expert and other stakeholders on determining the ATM impact products
- Improve capacity reduction performance
- Complete the ADS-B Avoidance Study, including exploration of using local ATM simulator
- Complete the flying simulator Study and demonstrate improved sequencing and the possibility of quantifying the delay figures
- To collaborate with JWGFVR and local ATM on developing verification towards continuous improvement of MET products to ATM
- To arrange 2nd AvRDP Training Workshop focusing on MET-ATM impact

5.4 Progress Report and Plan of SHA

NOTE: Of major concern to the airport (Thunderstorms/low visibility/low ceiling and gale)

The representative of SHA airport (Zhong Feng ZHANG) provided the status update of AvRDP related activities at the airport. Highlights are enumerated below:

PHASE I (MET capacity research) May 2015 to July 2017

- IOP for convective weather
- NWP and Nowcasting Research
    - Developed an integrated aviation weather system
        - Updated the East China NWP to rapid refresh system (3km resolution, 1 hour update)
    - Developed the SHA terminal TRACON Area Nowcasting System (1km, 10 or 20 min update)

PHASE II (MET-ATM impacts research) July 2016 to June 2018

- Research on MET-ATM Impacts Translation
    - Developed a series of integrated tools to support ATM operation
        - Terminal Convective Weather Pre-Warning System (TCWPS)
        - CDM Support Tools
            - (Under development) design of a more comprehensive en-route forecasts (automatically match the departure time with flight number and then provide a display of en-route forecasts)

- Validation of MET-ATM Impacts

Future Plans:

- NWP and Nowcasting Assessment and Optimization
    - Accuracy, higher resolution, rapid refresh, capacity
- Research on the Integration of MET-ATM Information
    - MET-ATM Integration Capacity Prediction
- Validation of MET-ATM Impacts

5.5 ATM Impact Products

The representative of Hong Kong's CAD (Peter CHADWICK) provided the current needs for ATM Impact Products and challenges faced by the ATM sector. Main points for MET-ATM collaboration are enumerated below:

The need for ATM Impact Products are becoming more urgent:

- Traffic demand approaching/exceeding capacity at many major airports including HKG
- A large proportion of flight delays/cancellations experienced by passengers due to weather-related ATFM measures
- Industry and customers expect improvement in efficiency: The move towards more performance-based ATM - Target Level of Service
- No longer acceptable to anticipate poor weather conditions but not take action to efficiently manage impact to operations i.e. airborne holding delay must be kept within reasonable limits, departure queue length must be contained to limit unnecessary emissions

Airspace Management Issues

- Increasing complexity of Terminal Airspace structure
- Improved navigational accuracy allows tracks to be placed closer together to increase airspace capacity
- OK when conditions are good but impacted significantly when aircraft begin to deviate around wx
- Need to provide resilience in maintaining capacity under adverse conditions
- Ability to strategize – ATFM Daily Plan (ADP)

ATM Challenges

- Need to define specific operationally critical criteria….
- Can they be more generic rather than aerodrome/airspace specific?

Need to Widen the Scope

- Extending beyond Airport Arrival capacity
- Determination of Airport Departure Rate
    - At what rate can flights be released?
    - Particularly relevant to airports with A-CDM operations

    - Pre-Departure sequencing and Target Start Up Time important for Airline Ops decision making
- Requires Measurement and Impact of weather on departure "funnel"
- Impact of convective weather deviation on ATFM
    - Aircraft flying longer track miles
    - Unable to make good their allocated ATFM slots
    - Further exacerbates airborne delay
- Regional Impact Awareness
    - ATFM problems are no longer just locally generated
    - Regional weather phenomena can have significant impact to standard traffic flows and demand balance

5.6 Progress Report and Plan of YYZ and YFB (remote)

The representative of Canadian airports (Janti Reid – WebEx) provided the status update of AvRDP related activities at the two airports (CYYZ and CYFB). Highlights are enumerated below:

PHASE I (Note: updates for the period (2016-2017) are solely for data collection and provision

- Collect meteorological observations including surface, advanced remote sensing and NWP data
    - ✓ CYYZ Winter IOP-1 (2015-16)
    - ✓ CYYZ and CYFB Winter IOP-2 (2016-17)
- Provision of OBS and nowcasting data to AvRDP data server to share with project participants
    - ✓ CYYZ Winter IOP-1
    - ✓ CYYZ and CYFB Winter IOP-2 … Data transfer in progress …
- Execute nowcasting and model simulations over airports
    - ✓ CYYZ Winter IOP-1
    - ✓ Possible model simulations on a case-by-case basis (Stephane Belair)
- Conduct inter-comparison and verification of nowcasting systems
    - ✓ AvRDP CYYZ Summary Report (Sept 2016)

The NWP and nowcasting data sets that were collected during IOP-2 have all been uploaded to the AvRDP data server. The closest model point data have been extracted for the 2.5 km near operational HRDPS. The INCS was developed by MSC and had the following inputs: surface observations, radar, lightning, NWP, UMOS, algorithms including radar and lightning extrapolation routines (MAPLE). Outputs are side specific winds, precip/POP, visibility/obscuration, cloud and temperatures every hour for 12-hour forecast lead times. For the CARDS Point Forecast, precipitation nowcast is derived from the extrapolation of radar echoes whose motions are computed using cross correlation of CAPPI images. This was done only in 2016.

Key issues for the airports as identified by the Airport Manager are temperature, temperature gradients, fog and visibility.

Future Plans:

- CYYZ and CYFB supersites will continue to operate
- No plans yet to contribute to Phase II

6. Other International Projects

6.1 NextGen Update

NOTES:

- NOAA's Joint Planning and Development Office (JPDO) has closed
    - Completed its purpose of setting the vision for NextGen

  - New Interagency Program Office handles R&D coordination and interagency NextGen planning
- Next Gen has been dropped by NOAA from its weather program in favor of Science Applications and Integration

NOAA (NEXT GEN) Weather

- NOAA's "NextGen" Weather Program formulated to enable improvements to support the Federal NextGen initiative
  - Program divided into two main components:
    IT/Web Services:
    - Near-term deliverable to improve access and discoverability of NOAA data for aviation
    - Transferred to Integrated Dissemination Program (IDP) in FY14

    Science and Applications:
    - Longer-term research and development of applications to improve the accuracy and timeliness of aviation weather information

- Major thrusts
  - NextGen IT/Web Services
  - Digital Aviation Services/Enhanced Digital Services
  - INtegrated Support for Impacted air Traffic Environments (INSITE) tool
  - CL31/PBL ceilometer extension
  - TRACON Approach and Departure Gate Forecast
  - Aviation Forecast Verification Tool (AFVT)

ONGOING:

- NextGen continuing to make solid progress on several key activities
- Implementing state of the art dissemination technologies
- Enabling more accurate and timely forecasts of weather affecting the National Airspace System
- Developing additional NextGen capabilities which will help all NWS service areas

The meeting agreed that a closer cooperation between AvRDP and NextGen was beneficial.

7. **Discussions**

7.1 **Update on Progress of Phase I**

CDG

Data periods: November 1, 2015 - March 31, 2016
Data available for specific case studies:
- December 13, 2015
- January 20, 2016
- March 5, 2016

1st_IOP

FORECAST

-- AERONAUTICAL_MESSAGES (Weather warnings for Paris_CDG airport)
-- CDM_CDG (Display of the CDM@CDG tool utilized for the on-ground operations and by the ATM)
-- LVP (Low Visibility Procedures bulletins)
-- TAF

NOWCAST (Fog probability fields from the nowcast model AROME-PI and the on-ground icing model)

NWP (Snowfall fields from the regional model AROME-France)

OBSERVATIONS

-- DE_ICING (Number of de-icing operations performed at Paris-CDG during the 1st IOP)
-- METAR
-- W_CHARTS (Charts of weather fronts produced by Meteo-Franceâs forecasters)
-- RADAR (Radar pictures for March 4th and 5th 2016)

YYZ

--- NOWCAST
--- ACC (Aviation Conditional Climatology ceiling and visibility nowcasts)
--- ACC_OBS (Aviation Conditional Climatology using Observations ceiling and visibility nowcasts)
--- DFPD (Dew Frost Point Depression derived ceiling nowcasts using the RDPS)
--- INCS (Integrated Nowcasting System)
--- INTW (Integrated Weighted Nowcasting System)
--- PTF (CARDS Point Forecast)
--- RDPS_VIS (Visibility nowcasts using the RDPS)

--- NWP
--- HRDPS (GEM High Resolution Deterministic Prediction System)
--- RDPS (GEM Regional Deterministic Prediction System)

--- OBS

YYB

Data being uploaded to the AvRDP data server

HKG

1st IOP data manual:
https://avrdp.hko.gov.hk/documentation
2nd IOP contains additional data of:
ADS-B aircraft position ~400km about HKIA
Multi-layered radar CAPPI for studying aircraft response to convection
3rd IOP:
Weather and traffic data for departure/arrival rate study
Data opened for access
Data period: May 2017 – Sep 2017
6 Tropical cyclones cases, including ones with severe impact to airport operation
Plenty of significant convection cases:
22 AMBER rainstorm, 5 RED, and 1 BLACK
33 occasions with ATC declared capacity reduction
Weather
256km 3km CAPPI reflectivity at 6min interval
1 hour radar nowcasting at 6min intervals
ATM
ATIS information on runway usage
Aircraft position data from ADS-B at 20s resolution
Aircraft arrival/departure log

Hourly arrival rate estimate by ATC

These data type are being used for:

Departure (arrival) rate weather dependency (with update result)
Weather avoidance behaviour (in progress)
Flight rerouting (in collaboration with a university, also plan for ATC simulator)

More data to be uploaded to server in future

7.2 Update on Progress of Phase II

(please see individual reports of airports)

Issue: YYZ and YFB may not be able to implement Phase II because of local issues.

Due to the recently joined new airports and the need of longer time to discuss with ATM on translating MET data into ATM impacting products, the meeting decided to extend Phase II of the project to summer 2019.

7.3 **Issues identified and possible solutions**

On the issue of YYZ and YFB implementing Phase II

The meeting suggested to seek the advice of the Presidents of WMO and CAeM to help seek a resolution to the issue.

Engagement of Newly-joined Airports

The meeting proposed that newly engaged airports implement some activities related to Phase I and then proceed to Phase II of their respective project so as to be timely aligned with the other airports who had joined the project earlier on.

7.4 **Verification**

- It was proposed that verification activities be focused on convection
- The members were requested to provide comments on verification activities for the project
- It was agreed that a Guidance material for meteorologists on how to evaluate convection be prepared (Herbert PUEMPEL and Barbara BROWN agreed to coordinate on this activity.)

7.5 **Review of AvRDP activities in WWRP Implementation Plan (2016-2023)**

The members were requested to review the AvRDP activities incorporated in the 2016-2023 Implementation Plan of WWRP and send in their edits/comments to Peter Li as soon as possible.

7.6 **Future Actions/Plans**

7.6.1 **Reports/Plans of new members**

Each of the attending representatives of the new members of the AvRDP SSC gave an overview of their planned activities in support of the project. Highlights of each airport's planned activities are given below:

7.6.1.1 Japan

NOTE: Of major concern to the airport (low ceiling and convection)

Narita/Haneda Airport （Tokyo, Japan）

Plans for PHASE I and II activities:

- To generate hourly 0-9 hours, 2km resolution convection and other weather elements with 3DVAR over the Main Island of Japan nowcast;
- To generate 3hourly upto 39 hours, 5km resolution convection and other weather elements with 4DVAR over the Main Island of Japan forecast;
- To translate the above nowcast/forecast to provide ATC capacity (CAPA) forecast.

7.6.1.2 Russia

NOTE: Of major concern to the airport (low clouds and visibility, fog)

Pulkovo Airport (St. Petersburg, Russia)

Plans for PHASE 1 activities:

- To generate 0-4 hours visibility and ceiling nowcasts;
- To deliver nowcasts to the aviation weather forecasters in real time;
- To improve visibility and ceiling forecasts at aerodrome;
- To assess benefits of forecast improvement (verification).

7.6.1.3 Singapore

NOTE: Of major concern to the airport (tropical convective scale thunderstorms)

The project proposal attached to this meeting report outlines MSS' plan for demonstrating the concepts of AvRDP and applying them in forecasting thunderstorms that may affect air traffic operations at the Singapore Changi Airport.

7.6.1.4 India

NOTE: Of major concern to the airport (fog and thunderstorm)

The project plan attached to this meeting report outlines IMD's plan on improving Thunderstorm and Dust Storm monitoring and early warning system (summer 2018) and Fog Nowcasting (winter 2018-2019) at the IGI airport, New Delhi.

7.6.2 Drafting of Project Implementation Plan for (CBS/CAeM/CAS) Intercommission Aviation Research Project (2019)

The meeting decided that the drafting of a Project Implementation Plan for the (CBS/CAeM/CAS) Intercommission Aviation Research Project (2019) should start in 2018 for presentation to the next WMO Congress in spring 2019. It is expected that all AvRDP SSC members will be involved in the drafting of said plan. The detailed Plan will identify what will be done by whom, when and for which resources within what organization.

7.6.3 **Next AvRDP Training Workshop (October 2018)**

The meeting decided to organize a three-day training workshop in October 2018 (Venue TBD) It is envisaged that the workshop will focus on translation of Aviation Meteorology Information into Air Traffic Management impacting products.

7.6.4 **Next AvRDP SSC meeting (AvRDP-4)**

The meeting proposed that the next 2-day meeting of the AvRDP SSC be held after the next AvRDP Training Workshop (Tentative: October 2018; venue TBD)

8. **Recapitulation (including Action Items)**

LIST OF ACTIONS AND DECISIONS
Action 1: AvRDP members to provide comments/edits on AvRDP activities incorporated in the WWRP Implementation Plan (2016-2023)
Action 2: AvRDP to further strengthen cooperation/collaboration with NOAA's SAI
Action 3: The meeting suggested to seek the advice of the Presidents of WMO and CAeM to help seek a resolution to the YZZ and YFB issue.
Action 4: The AvRDP members to provide comments on verification activities for the project
Action 5: Herbert PUEMPEL and Barbara BROWN to coordinate on the preparation of a Guidance material for meteorologists on how to evaluate convection
Action 6: AvRDP SSC members with the support of the WWRP Secretariat to start drafting the Project Implementation Plan for the Intercommission Aviation Research Project
Action 7: WWRP to organize an AvRDP Training Workshop sometime in October 2018
Action 8: P Li to explore the possibility of organizing the next meeting and training workshop either in Hong Kong, China or Shanghai, China
Action 9: N Lomarda to upload all available presentations made during the meeting in the WWRP website by 10 November 2017

9. **Closing Remarks**

The representative of WWRP thanked the host, Mètèo-France, in particular Ms Stehhanie DESBOIS for hosting the meeting and for all the excellent logistical arrangements, Peter LI for chairing the meeting and for his months of hard work preparing for the meeting, and to all the meeting participants for their active participation and valuable contributions to the meeting.

The meeting closed at 19h55 on 7 November 2017.

Attendance

Name	**Organisation**
Alexander Solonin	IRAM Russia
Artem Korchagin	Aviamettelecom of Roshydromet, Russia
Barbara Brown	NCAR, USA
Chow Kwok Wah	Meteorological Service Singapore, Singapore
Dhipak Lalla	Air Traffic and Navigation Services
Dong Hai Wang	Sun Yat-Sen University, China
Dr. R. K Jenamani	IMD New Delhi, India
Erik Becker	South African Weather Services, South Africa
Eugeniy Millez	ATTPH Russia
Herbert Puempel	ET-ASC, CAeM, WMO
Juliya Naryshkina	Aviamettelecom of Roshydromet, Russia
Jun Ryuzaki	ET-ISA, CAeM, WMO, JMA, Japan
Larisa Nikitina	Aviamettelecom of Roshydromet
Matt Strahan	NOAA, NWS, USA
Nanette Lomarda, Secretariat	WWRP, WMO
Nikolai Bocharnikov	IRAM Russia
Pauline Jaunet	Meteo-France, France
Peter PW Li Chair	Hong Kong Observatory, Hong Kong, China
Rodney Potts	Bureau of Meteorology, Australia
Stephanie Desbios	Meteo-France, France
Stephen Quao	Aviation Met Inspector, Ghana Civil Aviation Authority, Ghana
Tatiana Bazlova	IRAM Russia
Xu Tang	WDS, WMO
Zhong Feng Zhang	Aviation Meteorological Center, ATMB, CAAC, China