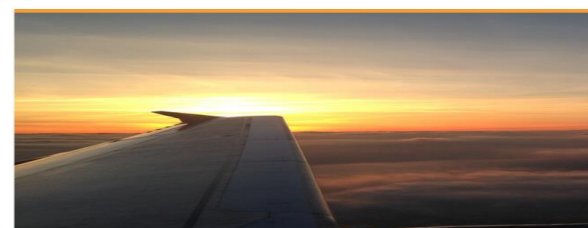




World Meteorological Organization

Weather • Climate • Water



Progress of Aviation Research Demonstration Project (AvRDP)

Peter PW Li
Hong Kong Observatory

2nd Joint CAeM ET/ASC ET/ISA Meeting

23 May 2017
WMO, Geneva

Objectives

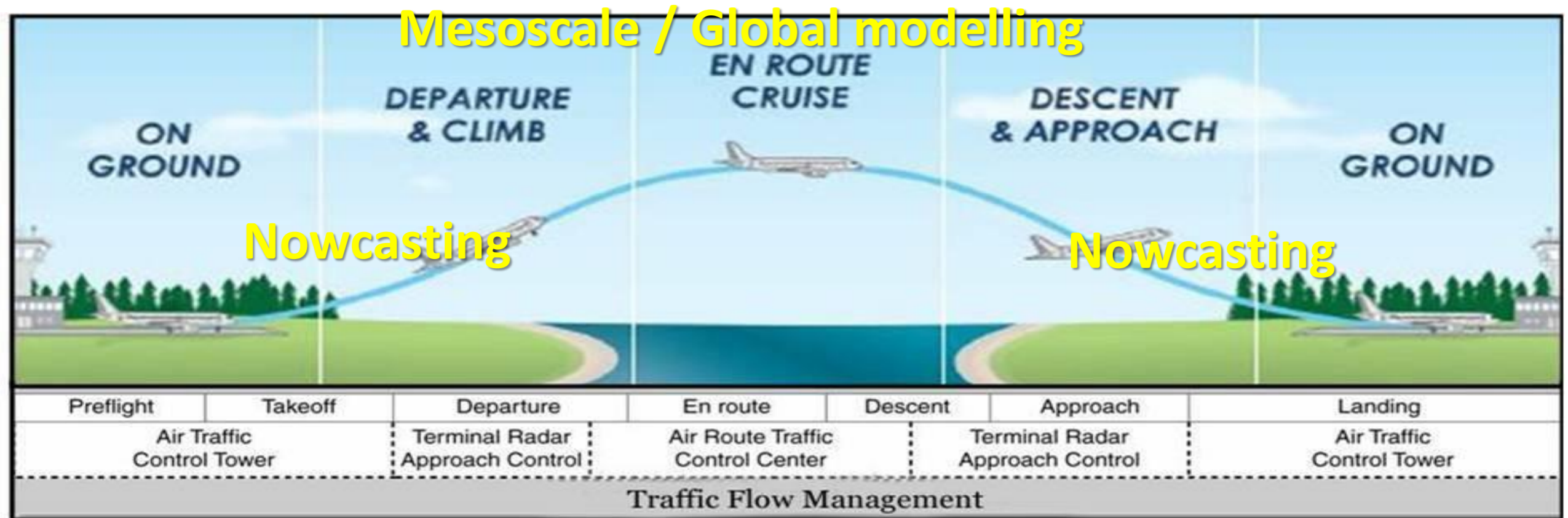
A joint effort between CAS and CAeM, in 4 years (2015-2018, may need to be extended subject to the discussion in AeroMetSci2017 and 3rd AvRDP SSC Meeting):

- 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.
- 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;
- 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*

Seamless Trajectory-Based Operation (TBO)

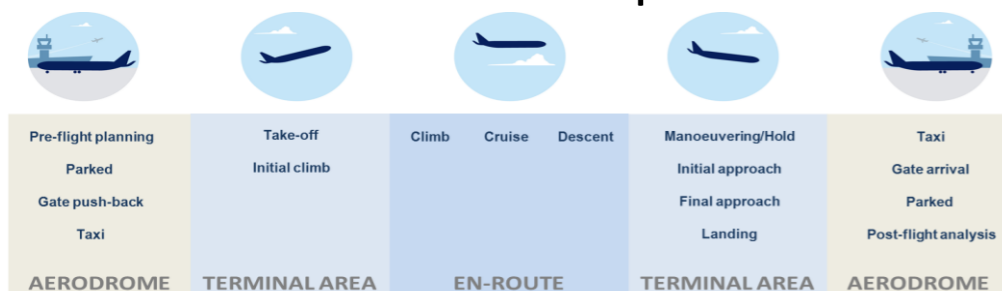
Seamless nowcasting -> mesoscale -> global scale -> mesoscale -> nowcasting scale







Terminal Control Area:
Location specific

En Route Phase:
Mainly supported by
global/regional
Multi-model Aviation
Weather Forecast
Centre (AWFC)

Terminal Control Area:
Location specific



Initial AvRDP Airports

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

Timeline

(2nd AvRDP SSC Meeting, Jul 2016)

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	1 st IOP for convective weather (over Airports in Northern Hemisphere)
Nov 2015 – Mar 2016	1 st IOP for winter weather, visibility and ceiling (over Airports in Northern Hemisphere)
Dec 2015 – Mar 2016	2 nd IOP for convective weather (Southern Hemisphere)
May 2016 - Jul 2016	3 rd IOP for convective weather (Northern Hemisphere)
Nov 2016 – Mar 2017	2 nd IOP for winter weather, visibility and ceiling (Northern Hemisphere)
May 2015 – July 2017	Nowcasting research including MET 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	2 nd 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) Aviation Research Project Science Conference (AvRDP Airports or Participants who started the IOP in late 2015 or later may choose to enter Phase II in late 2016)
Jul 2016 – Jun 2017	Research on MET-ATM impact translation
Mid/Fall 2017	2 nd AvRDP Workshop on MET-ATM integration Back-to-back with the Science Conference
Jul 2017 – Jun 2018+	Demonstration of MET-ATM impact
Mid/Fall 2017	WMO Inter-commission (CAS/CAeM/CBS) AeroMetSci-2017 Conference
Mid/Fall 2017+	Phase I (and Phase II?) to be expanded after the Conference?



Airport Progress

Airport	IOP completed	Phase I (MET capability)	Phase 2 (MET/ATM translation)	Data sharing (AvRDP Data Server)
HKG	IOP1 (summer 15) IOP2 (summer 16)	√ √	On going (IOP3 summer 2017)	√
CDG	IOP1 (winter 15/16) IOP2 (winter 16/17)	√ √	?	√
JNB	IOP1 (summer 16)	√	On going discussion with SAS	Not yet
SHA	IOP1 (summer 16-17)	√?	IOP2	Not yet
YYZ	IOP1 (winter 16/17)	√	On going discussion with NAVCAN	√
YFB	Preparing IOP1 (winter 17/18)			

Other on-going:

- Verification and Validation – develop metric
- Engaging ATM
- Engaging more research community
- Entertain more airports to enter Phase I (Singapore, Russia, Japan)
- Consider next Training Workshop
- Connection with AeroMetSci-2017 Conference

WSN16 (25 – 29 July 2016, Hong Kong)



<http://wsn16.hk> and <https://www.facebook.com/wsn16hk/>



Evening school



- **166 participants from all continents attended**
- **109 paper/posters**

Key messages from the aviation stakeholders (ATM and Air Pilot)

- ATM and airline need 0-6hr nowcasting, both for short haul and long haul flights for decision-making close to terminal
- Precise, reliable, graphical, frequent updated, uplink/downlink MET information
- TAF Text should be legendary. Need graphical weather info and uplink.
- Uncertainty estimation
- MET translation into Impact products/services (S2S)

2nd AvRDP SSC

(22 – 23 July 2016, Hong Kong)

- Next steps
 - To define the deliverables – current ATM impact product list, ATM desirables/requirements
 - To develop verification method and metric – beware of observation deficiency/quality/reliability
 - Uncertainty estimation
 - Minimum forecast accuracy (minima) – horizon dependent, product dependent
 - Phase II relationship with the Inter-commission Aviation Project

Phase II progress since then

- JNB – ATM expressed great interest in the expected arrival and departure rates product. Aiming March 2018
- SHA – TRACON up and running. Asking verification results
- HKA – Runway capacity reduction due to SigConv. “very useful” but need verification
- CDG – Link with SESAR ?
- YYZ – still need a way to connect NAVCAN

Translate MET information into ATM Impact. What Impact?

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

- Next Training Workshop
 - Focusing on MET-ATM – back-to-back with AeroMetSci-2017 Conference (need to reschedule to 2018 due to lack of funding)

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 Mesoscale modelling	Satellite-based nowcast
Radar-based nowcasting techniques	Seamless Nowcast & SESAR	Breakout discussions
Aviation Mesoscale Numerical Weather Prediction	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
- Next Training: closer to ATM operation, benefits in MET impact on ATM



Training Workshop highlight and conclusion

- 22 trainees out of 26 applicants and 5 lecturers attended the 3 day training workshop
- Nowcasting science, meososcale models, satellite-based nowcasting and hand-on training on running radar-based nowcasting systems were delivered
- Favourable comments received from the trainees
- Comments received from participants included the following:
 - Lectures on weather systems which are relevant to participants and closer to ATM operations
 - Clearer selection criteria of trainees
 - Lectures needed on benefit of MET info/services on ATM
- Next workshop is planned to be held in conjunction with Scientific Conference in 2017 (to be rescheduled due to WMO budget)

AvRDP SSC Membership

Name	Representation
Peter LI, Chair	HKO rep of CAeM
Erik BECKER to replace Estelle de CONING	SAWS rep of JNB
Janti REID	ECCC rep of YYZ & YFB
Stephanie DESBIOS to replace Jean-Louis BRENGUIER (retired)	MeteoFrance rep of CDG
Fengyun WANG	CAAC rep of SHA
Sharon LAU	HKO rep of HKG
Peter M. CHADWICK	CAD rep of HKG (ATM expert)
Baode CHEN	SMS rep of CMA
Cecilia MINER	NOAA rep of NextGen
Stefane BELAIR	ECCC rep of NMRWG
Paul JOE to be replaced by another NMRWG	rep of NMRWG
Barbara Brown to replace Marion MITTERMAIER	NCAR rep of JWGFVR
Dennis HART	EuroControl rep of SESAR (Phase II)
To be invited:	
Herbert PUEMPEL	Ex-WMO C/AeM and AustroControl

AvRDP Website (<https://avrpd.hko.gov.hk>)



Mission

The overall mission 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. For simplicity, nowcast or nowcasting hereafter refers to all techniques/systems including observation-based, expert system-based, human-machine interfaced and meso/microscale NWP or any combination thereof which can generate high resolution, rapidly updated forecasts for the next 0-6hr ahead. This definition of nowcast/nowcasting is in accordance with the definition/practice adopted in WWRP and the nowcasting community.

USE OF DATA FROM THIS SERVER

The datasets available on this server are provided for research purposes only. Before retrieving the data please read the terms and conditions below and acknowledge that you accept them.

Terms and Conditions on Use of the AvRDP datasets

1. All datasets on the World Weather Research Programme's (WWRP) Aviation Research and Demonstration Project (AvRDP) server are released as preliminary data to be used only with appropriate caution and for research purposes only in support of the project. Research is understood as any project organized by a university, scientific institute, meteorological office, or similar (private or institution), for non-commercial research purposes only. A necessary condition for the recognition of non-commercial purposes is that all the results obtained are openly available at delivery costs only, without any delay linked to commercial objectives, and that the research results themselves are submitted for open publication.
2. Although every care has been taken in preparing and testing the data, WMO cannot guarantee that the data are correct in all circumstances, neither does the WMO accept any liability whatsoever for any error or omission in the data, or for any loss or damage arising from its use.
3. These raw data have not been subjected to the WMO's aviation quality control or quality assurance procedures (ISO 9001:2008) and do not meet the criteria and standards of aviation meteorological service data.
4. The data have been produced by AvRDP partners (Appendix I) and are distributed with their consent.
5. Any person extracting data from this server will accept responsibility for informing all data users and owners of these conditions.
6. The World Meteorological Organization (WMO) grants permission to Users to download and copy the data contained in the server, subject to the terms and conditions outlined in this document, and also subject to more specific restrictions that may apply to some specific material/s. Users are prohibited from directly using the data (i.e., selling the data) for commercial purposes.
7. The WMO reserves its exclusive right in its sole discretion to alter, limit or discontinue access to the data or any Material/s in any respect. The WMO shall have no obligation to take the needs of any User into consideration in connection therewith. The WMO reserves the right to deny in its sole discretion any user access to this server or any portion thereof without notice.
8. Data must not be supplied as a whole or in part to any third party outside your organization.
9. Articles, papers or written scientific works of any form, based in whole or in part on AvRDP data, shall contain an acknowledgment of AvRDP.

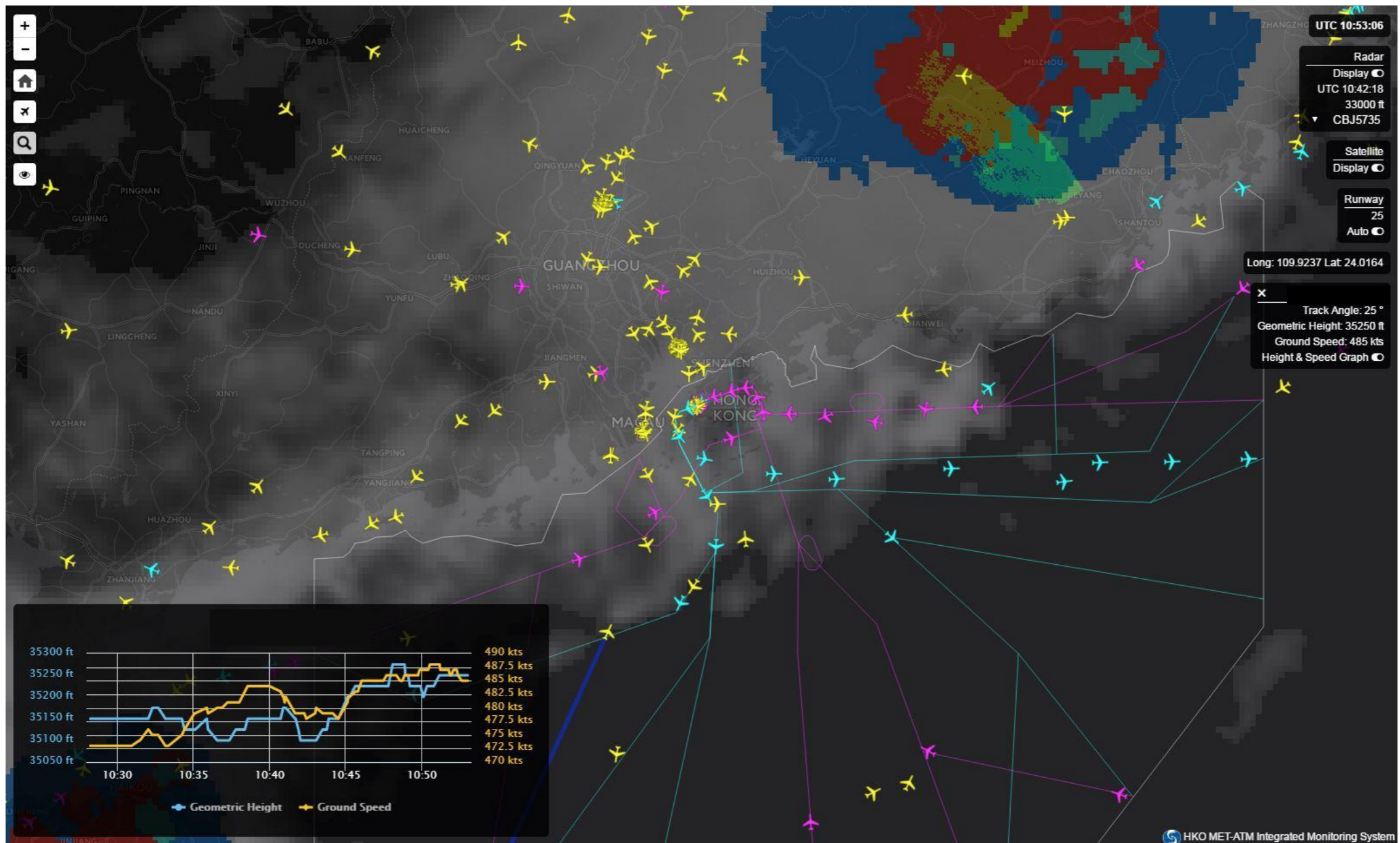
You need to register and then log in to accept this license.

Supplementary Info

HKG AvRDP IOP I, II data, including Airport Observations, Nowcasting facility, modelling facility and ATM data

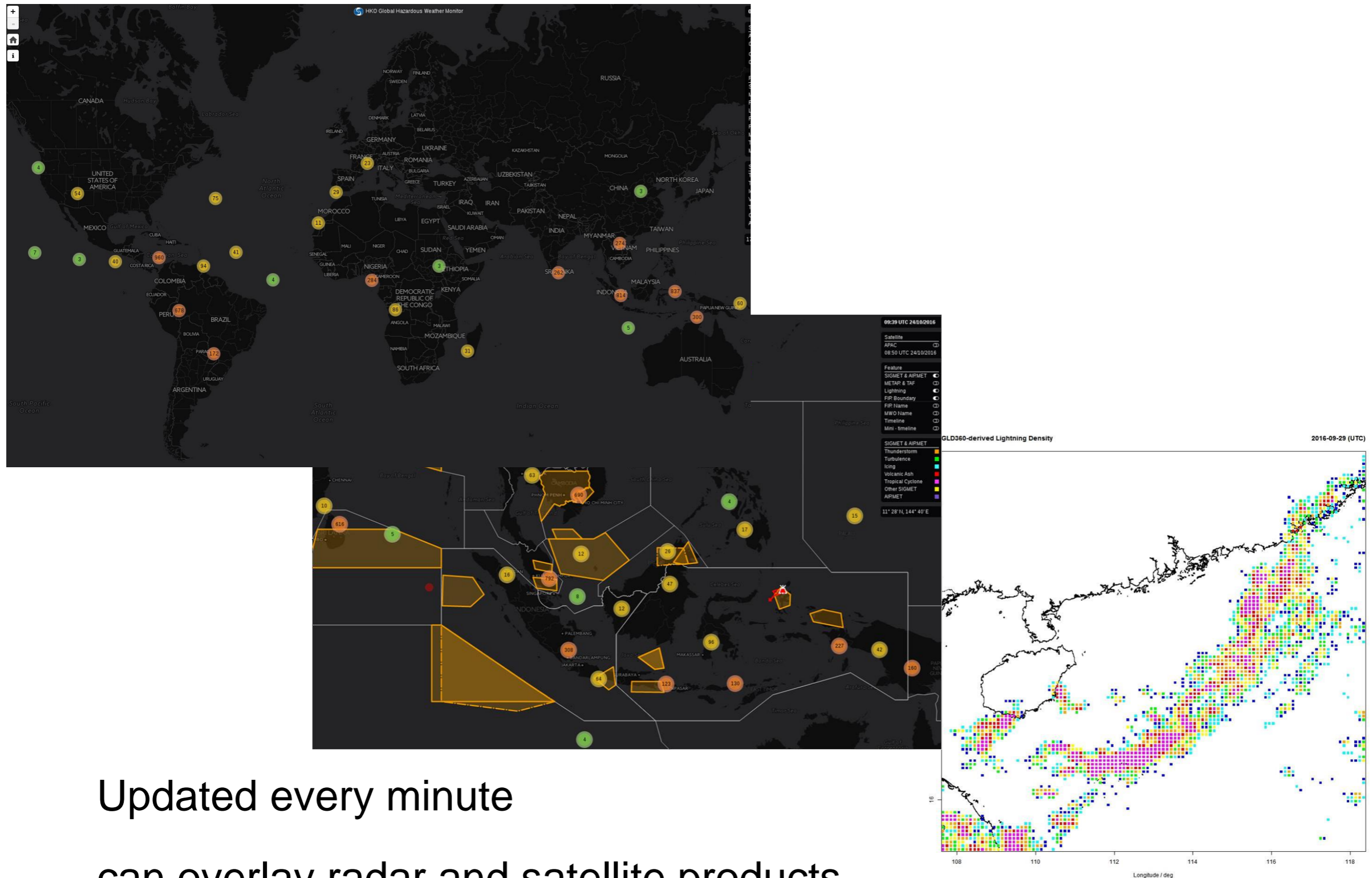
Airport	Observations										Nowcasting system and model	ATM data					
	Weather Radar (conventional or Doppler)	Geostationary Satellite	Wind profiler	LIDAR	Anemometer	Visibility sensor	AMDAR/ACARS data	Other observations	Global lightning (since mid 2016)	Nowcasting system	Micro/mesoscale NWP	Regional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

ADS-B collected (for Phase II)



ABS-B overlaid with weather radar and satellite

Global lightning (for Phase I, II and verification)

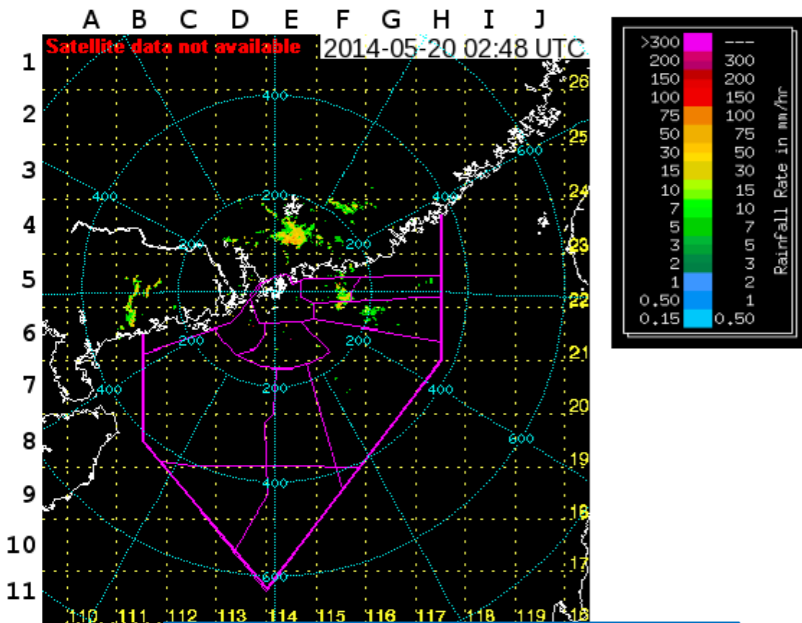
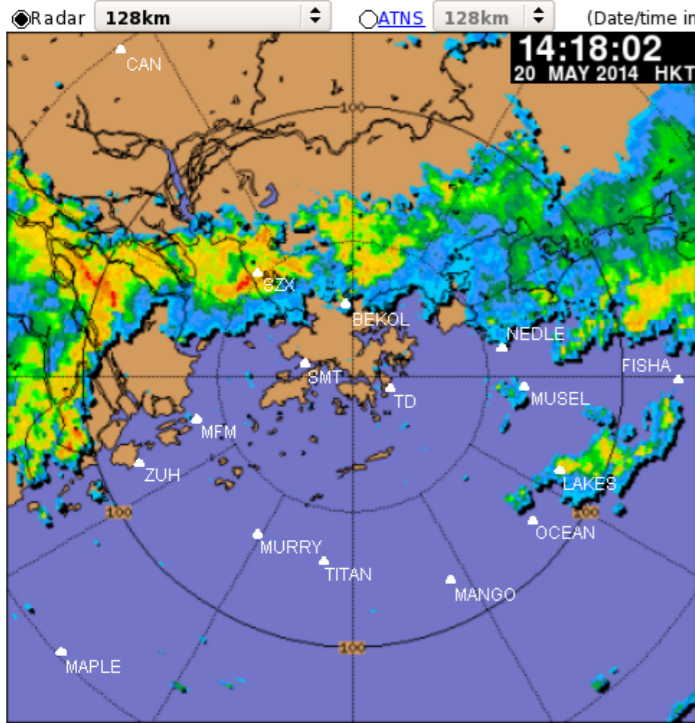


Updated every minute

can overlay radar and satellite products

From Nowcast to Airport Capacity (Phase II)

Weather radar reflectivity animation

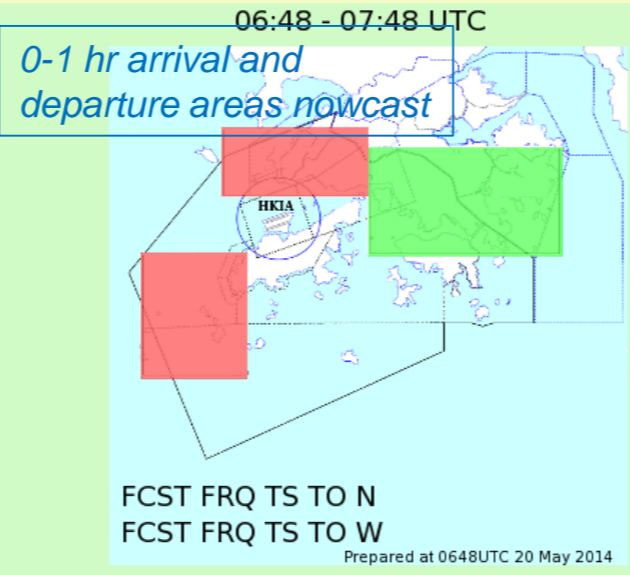


Weather radar overlaid on satellite imagery

Significant Convection Monitoring and Forecast (trial)



Forecast valid from 06 UTC 20 May 2014 to 18 UTC 20 May 2014



Forecast for HKIA

UTC	07	08	09	10	11	12	13	14	15
Overall	Yellow	Yellow	Green	Green	Green	Green	Green	Green	Green
07 Headwind	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey
25 Headwind	Yellow	Yellow	Green	Green	Green	Green	Green	Green	Green
Crosswind	Green	Green	Green	Green	Green	Green	Green	Green	Green
Visibility	Green	Green	Green	Green	Green	Green	Green	Green	Green
Ceiling	Green	Green	Green	Green	Green	Green	Green	Green	Green

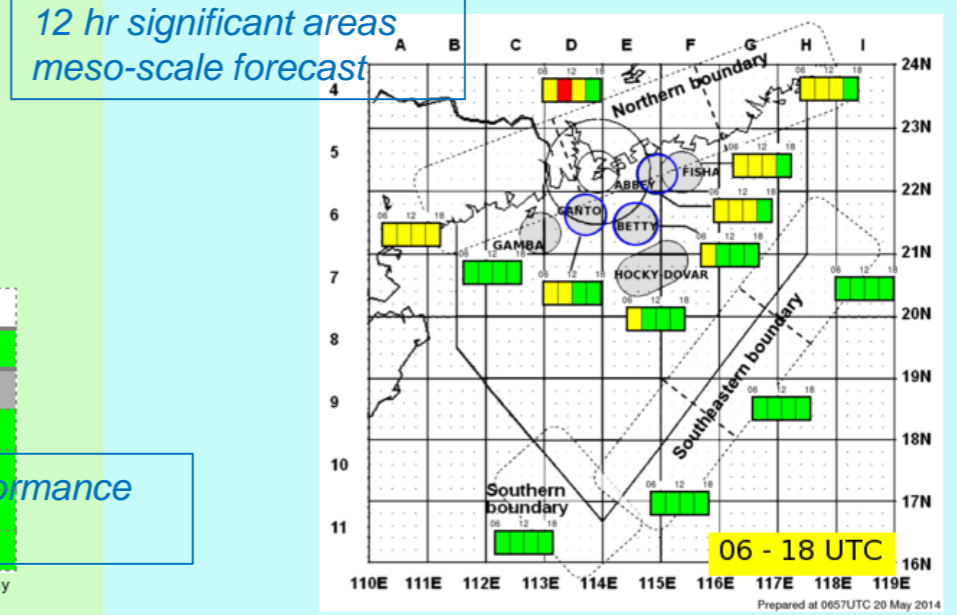
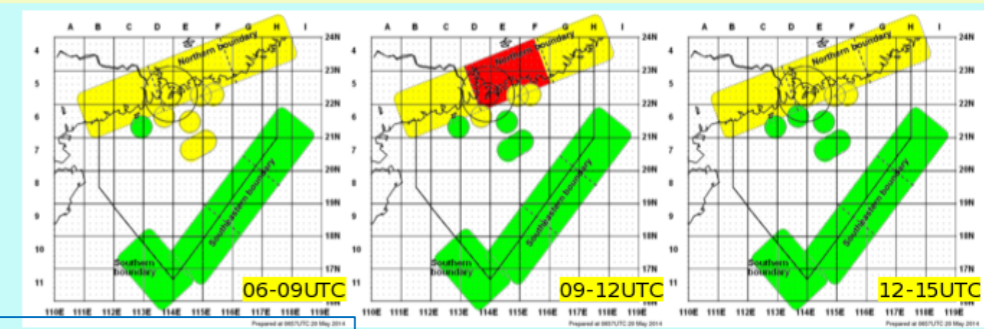
Prepared at 0632UTC 20 May

TS/CB forecast for adjacent areas

UTC	07-08	08-09	09-10	10-13
20nm of ARP	Red	Red	Yellow	Yellow
ABBEY	Yellow	Yellow	Green	Green
BETTY	Yellow	Yellow	Green	Green
CANTO	Yellow	Yellow	Green	Green

Prepared at 0657UTC

1-6 hr significant points nowcast



CAPACITY RELATED INFORMATION VHHH (FOR ARRIVALS)
 VALID: 200600 to 201600 UTC
 CAPACITY LEVEL: 2
 AIRPORT ACCEPTANCE RATE: 28 flights per hour
 EXPECTED DELAY: Up to 30 mins
 REASON: CB in vicinity of Aerodrome
 REMARK: Convective activities are expected to affect the holding areas and HKIA.
 Prepared at: 0523UTC 20 May 2014

Predicted Airport Arrival Rate based on convection nowcast and airport constraints

Airport Air Traffic Data (for Phase II)

Distribution of flights arriving in the next hour (approx.)

N: 42 HKT

MET-ATM Integrated Monitoring [Trial]

Capacity Forecast (for Arrivals)

Last update: 2015-03-29 22:06
 VALID: 300000 to 300800 UTC
 CAPACITY LEVEL: 1
 AIRPORT ACCEPTANCE RATE: 32 flights per hour
 EXPECTED DELAY: Up to 15 mins
 REASON: -
 REMARK: -

Traffic Interruption Related Messages from ATIS

Last Update: 04:04 UTC

HONG KONG ARRIVAL INFORMATION

A-TIME 0404
 A-RUNWAY 25R
 A-INFO-D2
 A-SUPPL1
 A-SUPPL2
 D-WXCHG

HONG KONG DEPARTURE INFORMATION

D-TIME 0404
 D-RUNWAY 25L
 D-SUPPL1

Traffic Interruption Related Messages from NOTAM

Last Update: 12:13 HK

VALID 2015-03-26 02:00
 FROM: UTC
 VALID TO: 2015-03-26 04:00
 UTC
 (ISSUED AT: 23 07:03 UTC)

Flow Restriction (from ATC Watch Manager)

Last Update: 2015-03-29 17:33

[Re: Traffic departing from Hong Kong via BEKOL destined for ZBAA expect delay]

To whom it may concern,

SW Route (CANTO)			S Route (BETTY)			E Route (ABBIEY)		
TAR	ELDT	RWY STAR	ELDT	RWY STAR	STAR	ELDT	RWY STAR	STAR
6B	0415	25 2B	0416	25 2A	0410	25 2B	0417	25 2B
6B	0422	25 2B	0421	25 2A	0413	25 2B		
6B	0432	07 3A	0426	25 2A	0417	25 2B		
6B			0441	2B	0424	25 2B		
6B			0441	2B	0425	25 2B		
6B			0454	2B				

Accumulated number of flights

Arrival 30 Mar 2015

Total: 11

Delay from 00:00 to 01:00 (HKT): 8, 2, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0

Update Time: 12:14

Accumulated number of flights

Departure 30 Mar 2015

Total: 16

Delay from 00:00 to 01:00 (HKT): 11, 3, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0

Update Time: 12:14

Past 1-hour number of arrived flights

30 Mar 2015

Legend: SIERA: 1, CANTO: 0, BETTY: 1, ABBEY: 1

Update Time: 12:14

[One-year Statistics](#)

Switch to Number of Flights in Past 30 Minutes

Past 1-hour number of flights

Arrival 30 Mar 2015

Update Time: 12:14

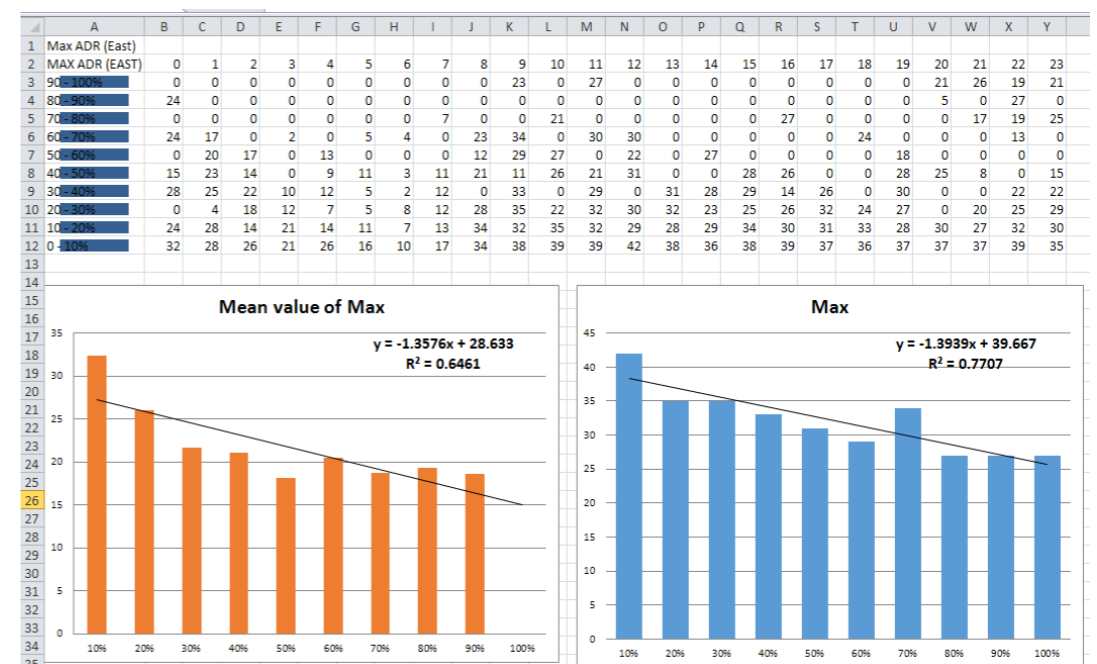
Past 1-hour number of flights

Departure 30 Mar 2015

Update Time: 12:14

HKG 3rd IOP (Phase II) for Convection in Northern Hemisphere (mid May – mid Sep 17)

- Phase II studies started:
 - Flight avoidance study using ADS-B
 - Hourly Airport Arrival Rate & Airport Departure Rate reduction due to the convective weather
 - Aircraft delay using Big Data technology
- Verification:
 - Collection of Global lightning data for convection verification
 - AAR/ADR reduction prediction validation



Winter IOP-1: YYZ Observations

... And more!

- Pyranometer
- Ultrasonic Winds
- Icing Detector
- Snow Depth
- Lightning Mapping Array

Many instruments collect and transmit at 1-minute frequency

CT25K
Ceilometer

POSS

FD12P

X-Band VPR

Jenoptik
Ceilometer

WXT520

Web Cameras

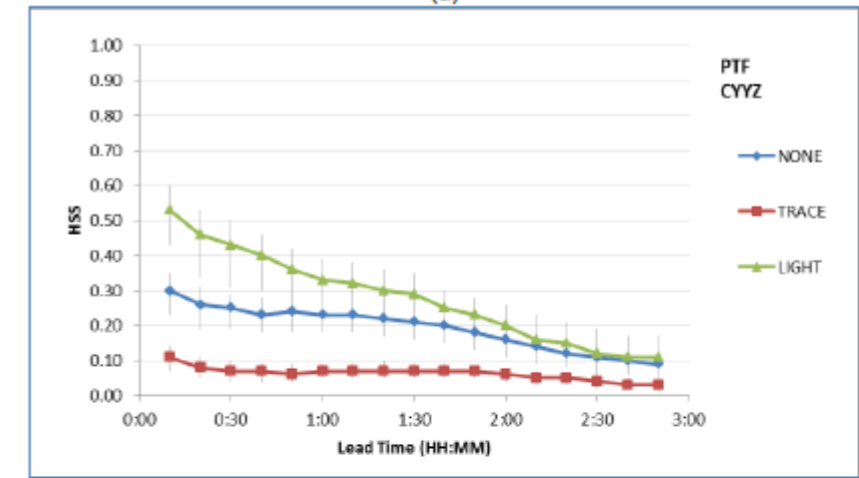
Observation-model blended NWC, including verification

System	Acronym	Type	Status	Variables verified in this work
GEM High Resolution Deterministic Prediction System (2.5km)	HRDPS	NWP	Experimental	T, RH, WS, WD
GEM Regional Deterministic Prediction System (10km)	RDPS	NWP	Operational, Research for CIG and VIS	T, RH, WS, WD, CIG, VIS
CARDS Point Forecast Integrated Nowcasting System	PTF	Radar-based	Operational	PR
Integrated Weighted Nowcasting (INTW)	INCS	Blended NWP & Observations	Operational	T, RH, WS, WD
Aviation Conditional Climatology	INTW	Blended NWP & Observations	Research	T, RH, WS, WD
	ACC, ACC-OBS	Climatology-based	Operational	CIG, VIS

Table 1: Summary of nowcasting systems and their forecasted variables that are verified in this work. Note that for the RDPS, CIG and VIS post-processing algorithms were evaluated in this report.

Nowcasting System	Availability	Format
HRDPS	November 3, 2015 - March 31, 2016	ASCII
RDPS	November 3, 2015 - March 31, 2016	ASCII
PTF	November 1, 2015 - March 31, 2016	ASCII
INCS	November 1, 2015 - March 31, 2016	ASCII
INTW	November 4, 2015 - March 31, 2016	ASCII
ACC	November 1, 2015 - March 31, 2016	ASCII
ACC-OBS	November 1, 2015 - March 31, 2016	ASCII

Table 3: Summary of nowcasting system availability during IOP-1 for CYYZ.



(b)

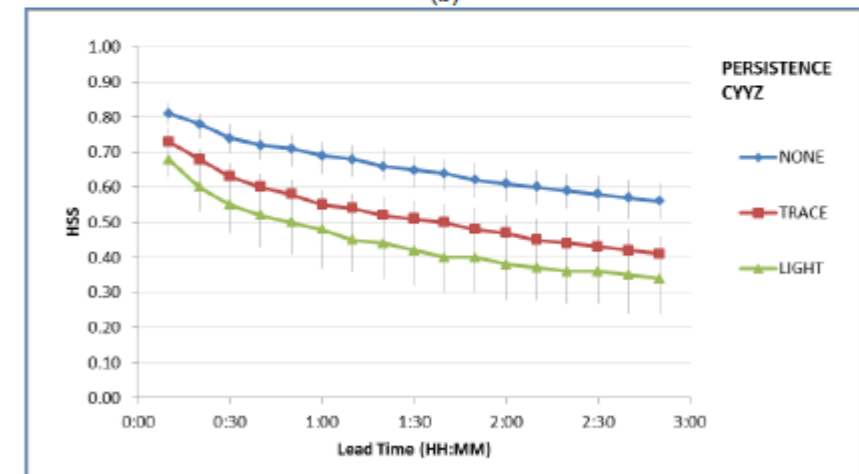
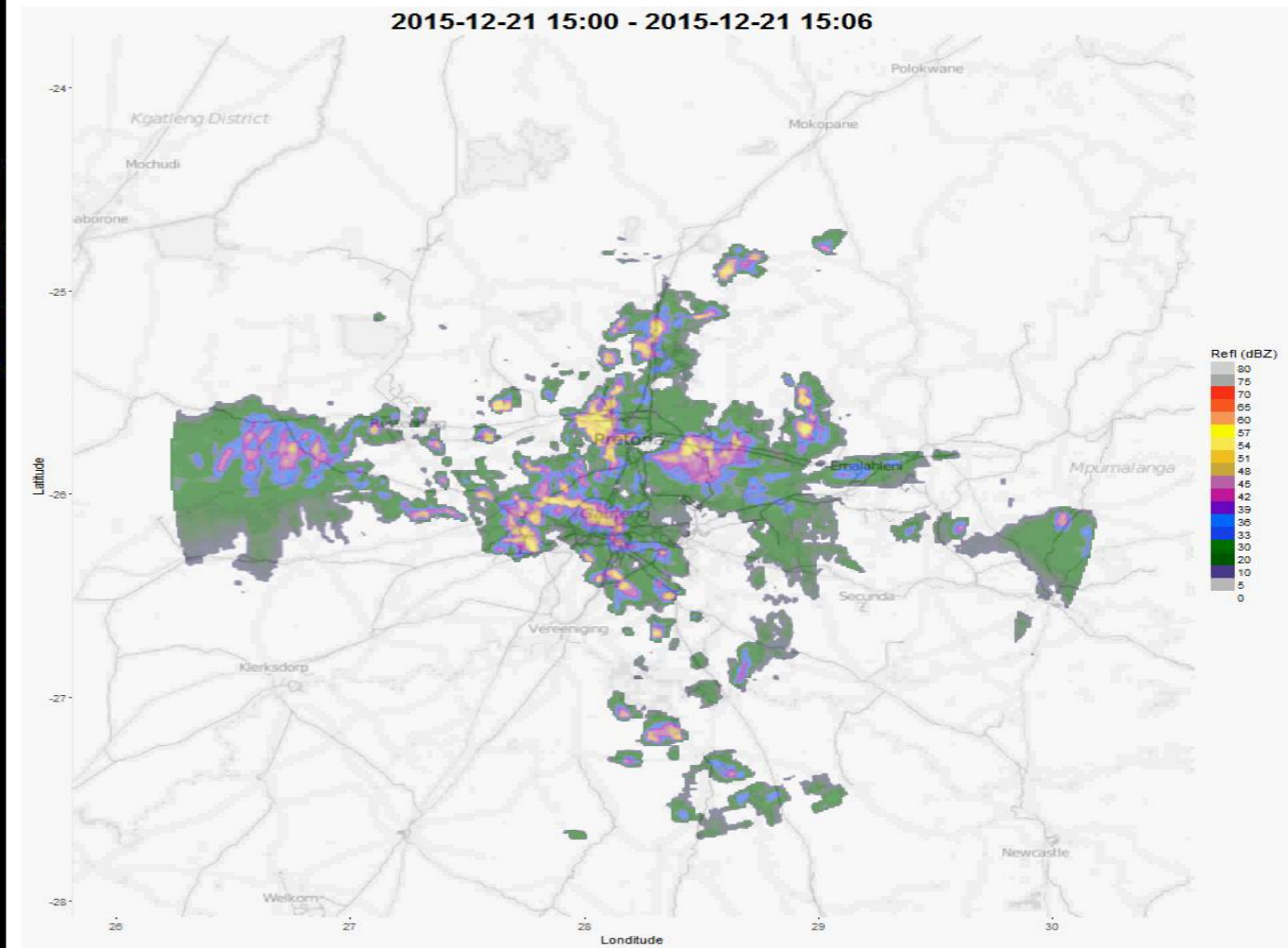
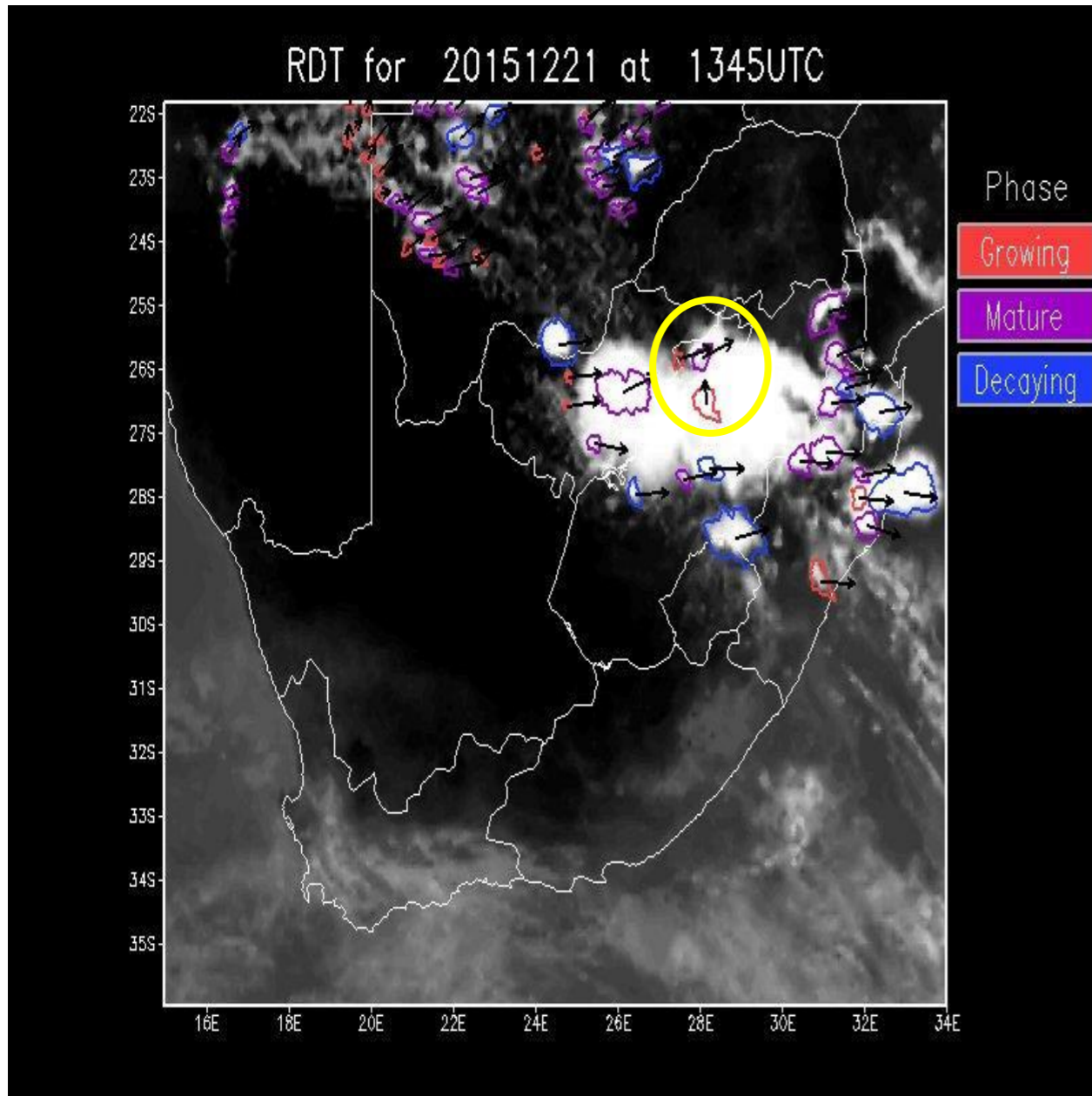


Figure 6: (a) HSS scores for the Point Forecast and (b) Persistence at CYYZ during IOP-1. Precipitation categories shown are none (blue), trace (red) and light (green). 95% confidence intervals are indicated by the vertical grey bars at each forecast lead time.

JNB Satellite-based NWC/SAF RDT radar-based NWC



Radar data assimilation -WRFDA

- A proposal was submitted for funding to investigate the possibility of running a high temporal (1hr) and spatial (~500m) model with assimilated radar data using WRFDA.
- The project will also introduce seamless based forecasting by attempting to increase lead-time skill by blending the model (WRFDA) with com-SWIRLS extrapolation forecasts.
- Unfortunately the proposal to secure funds to implement WRFDA at the South African Weather Service was not successful.
- The proposal will be resubmitted for funding in the beginning of July 2017. Due to the importance of the work other means of funding are also being investigated.

Mesoscale Modelling

- SAWS was able to successfully setup a convective scale model (300m) using the UK Met Office Unified Model

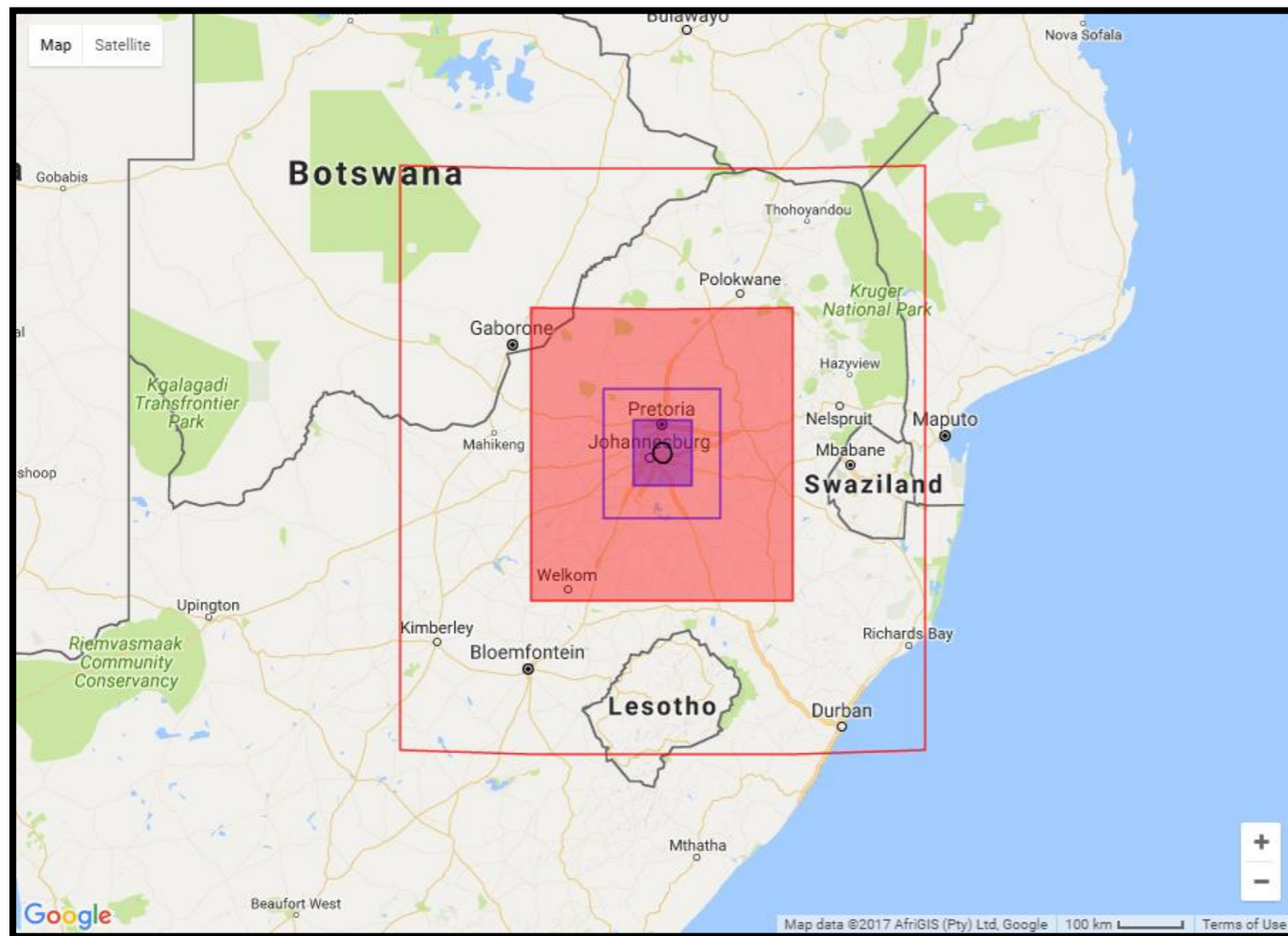
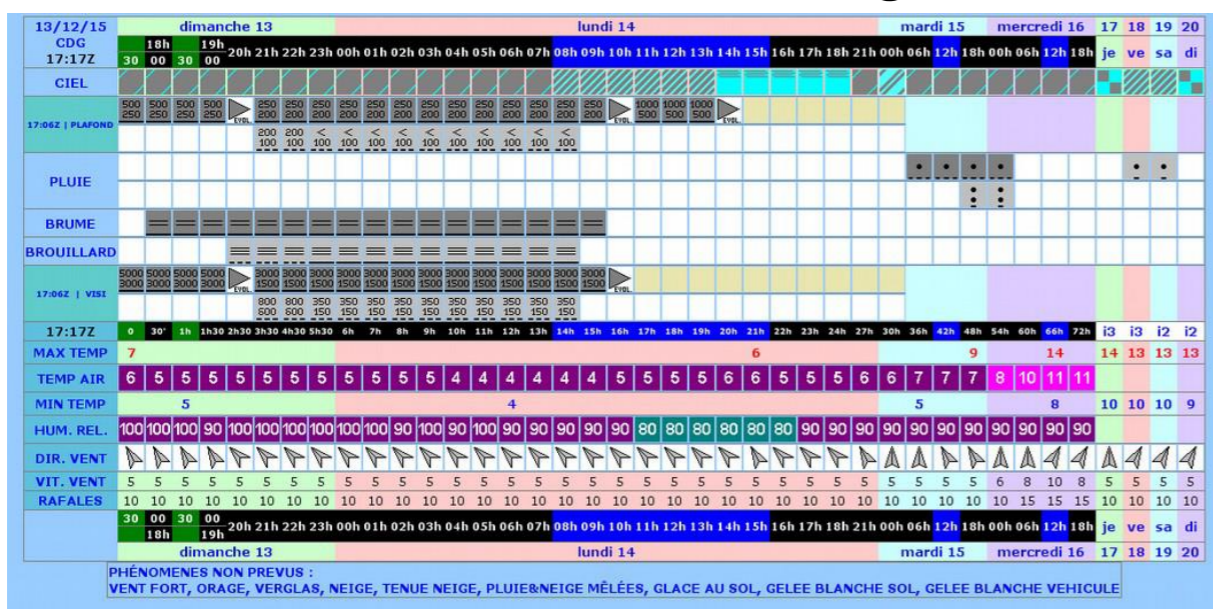


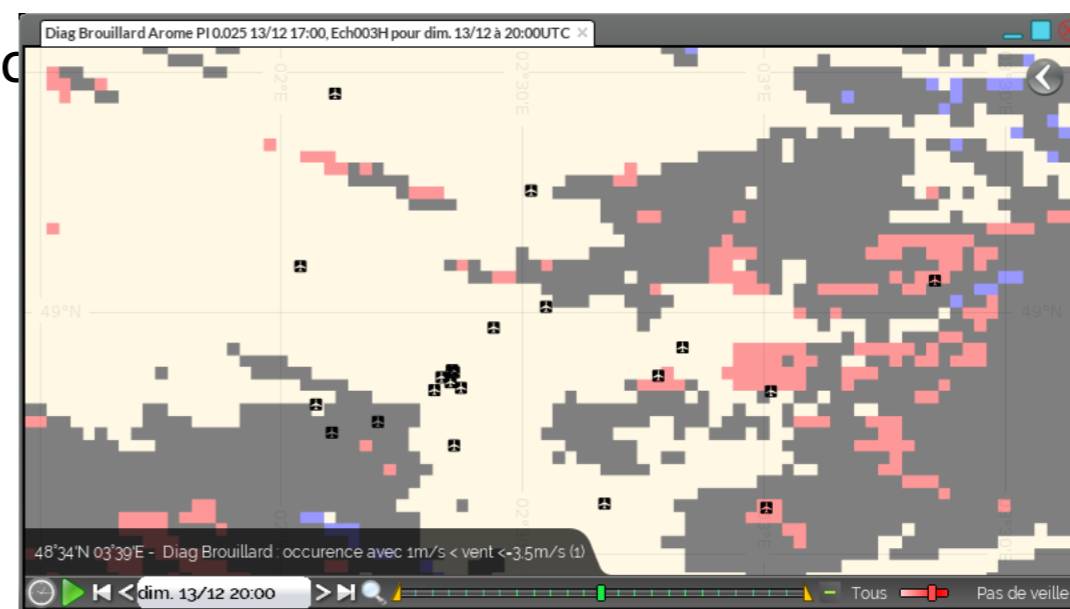
Image illustrates the model domain over the ORTIA aerodrome (Black circle)

CDG

- Collected a few winter weather, cloud ceiling and low visibility cases due to fog and stratus using the 1.3 km resolution, hourly updated, rapid output (15min), NWP Nowcasting system AROME-PI.
- A statistical model which determines on-ground aircraft icing probability has also been developed.
- PEIP to forecast the runway temperature in the [CDM@CDG](#) tool. It utilizes atmospheric data from the regional and high-resolution model AROME-France and ground data from a ground model, running every three hours forecasting up to 30 hours.
- A CDM@CDG tool has been developed for diagnostic and assessing the airport conditions for decision-making.



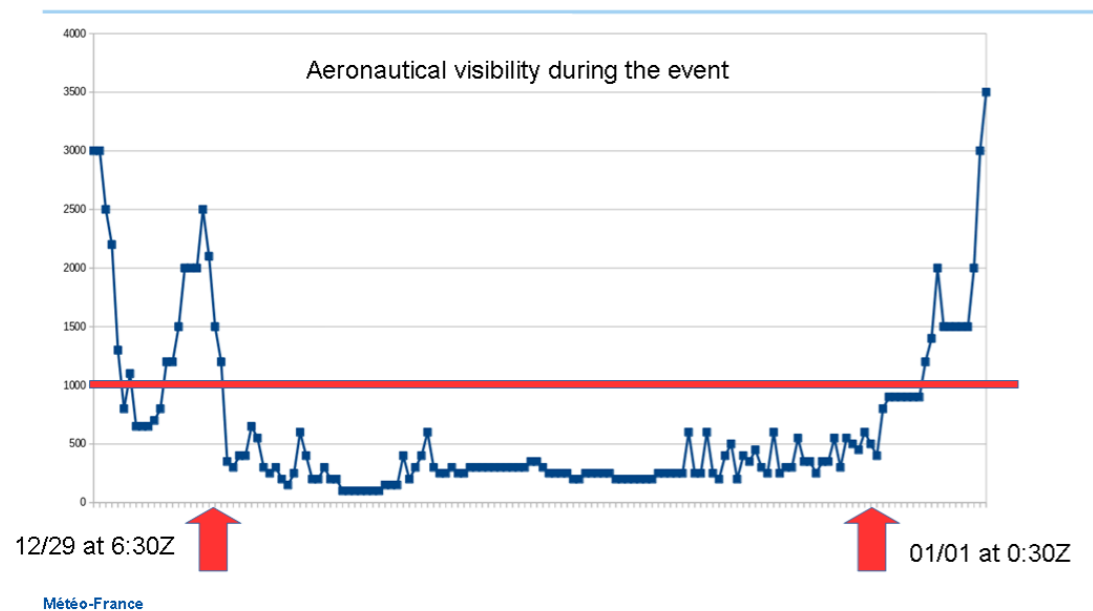
Weather predictions from CDM@CDG tool



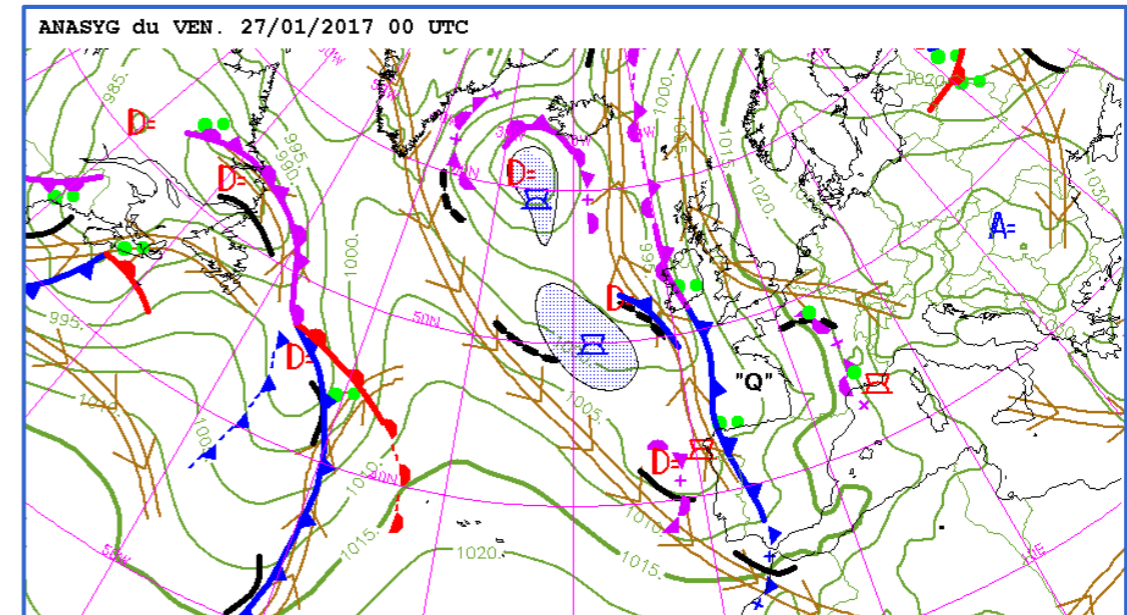
Fog prediction by AROME-PI

IOP2 Winter 16/17

Continuous and persistent fog + industrial snow



Low visibility (fog) case



Freezing rain case

Meteo-France's nowcast numerical model allowed the forecasters to anticipate this event.

SHA

Completed:

IOP Data

MET Data and ATM Data

NWP Models

STI-WARMS 9km

STI-WARR 3km

STI-WARR 1km (in the future)

On going:

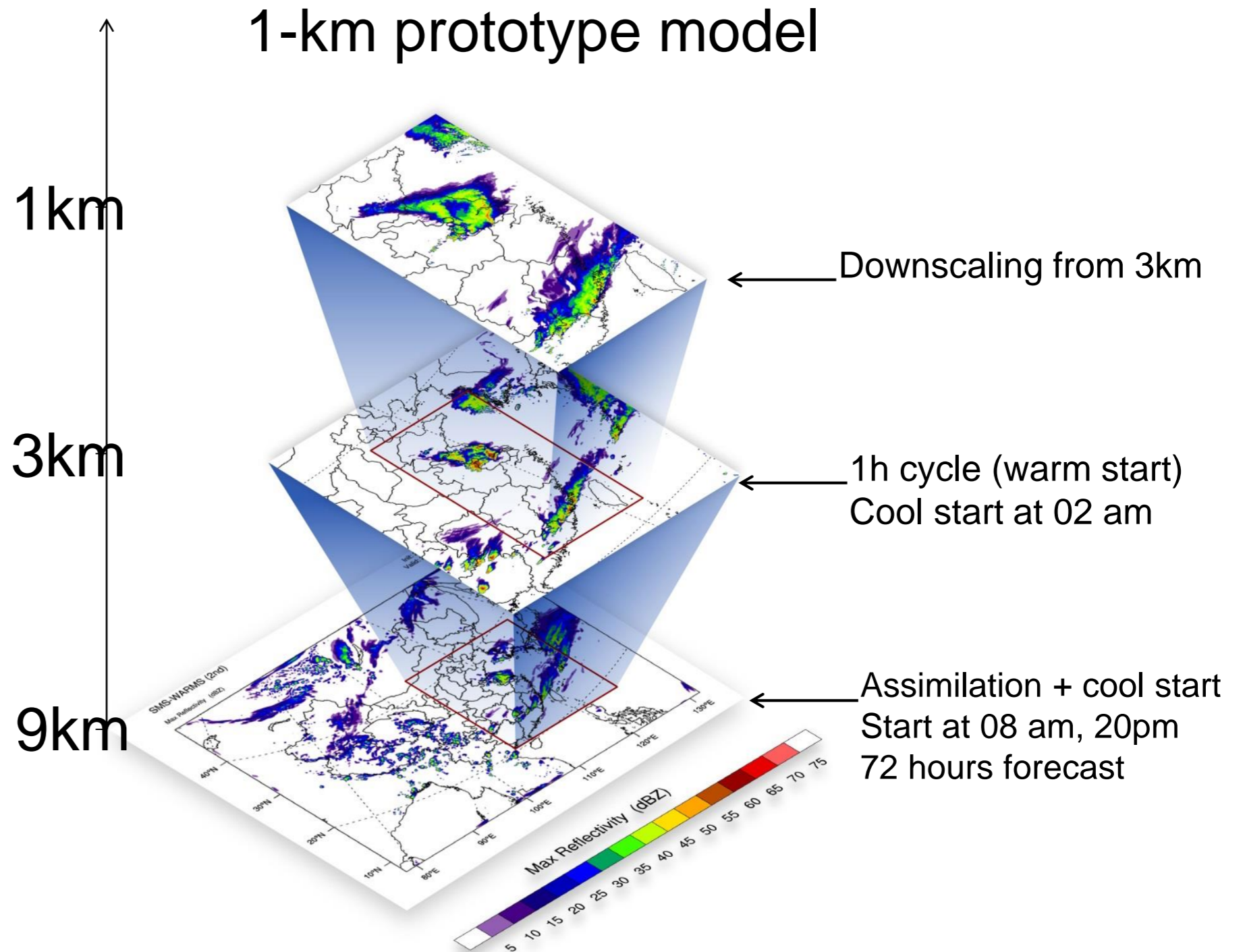
Nowcasting System

MET-ATM Impact

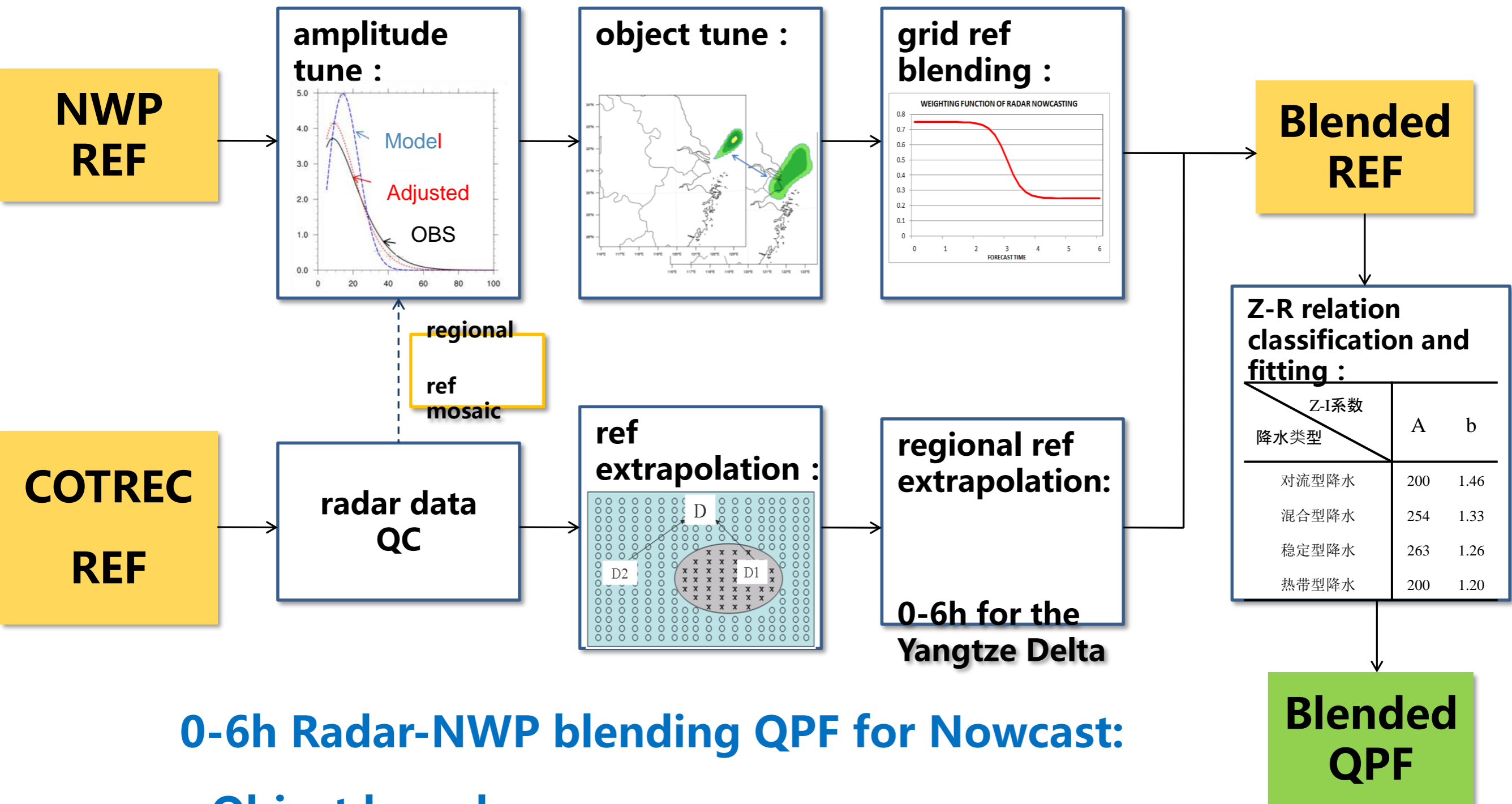
Translation

Products of Various Scales

Case Study



SHA Radar-based + NWP Blended Nowcast



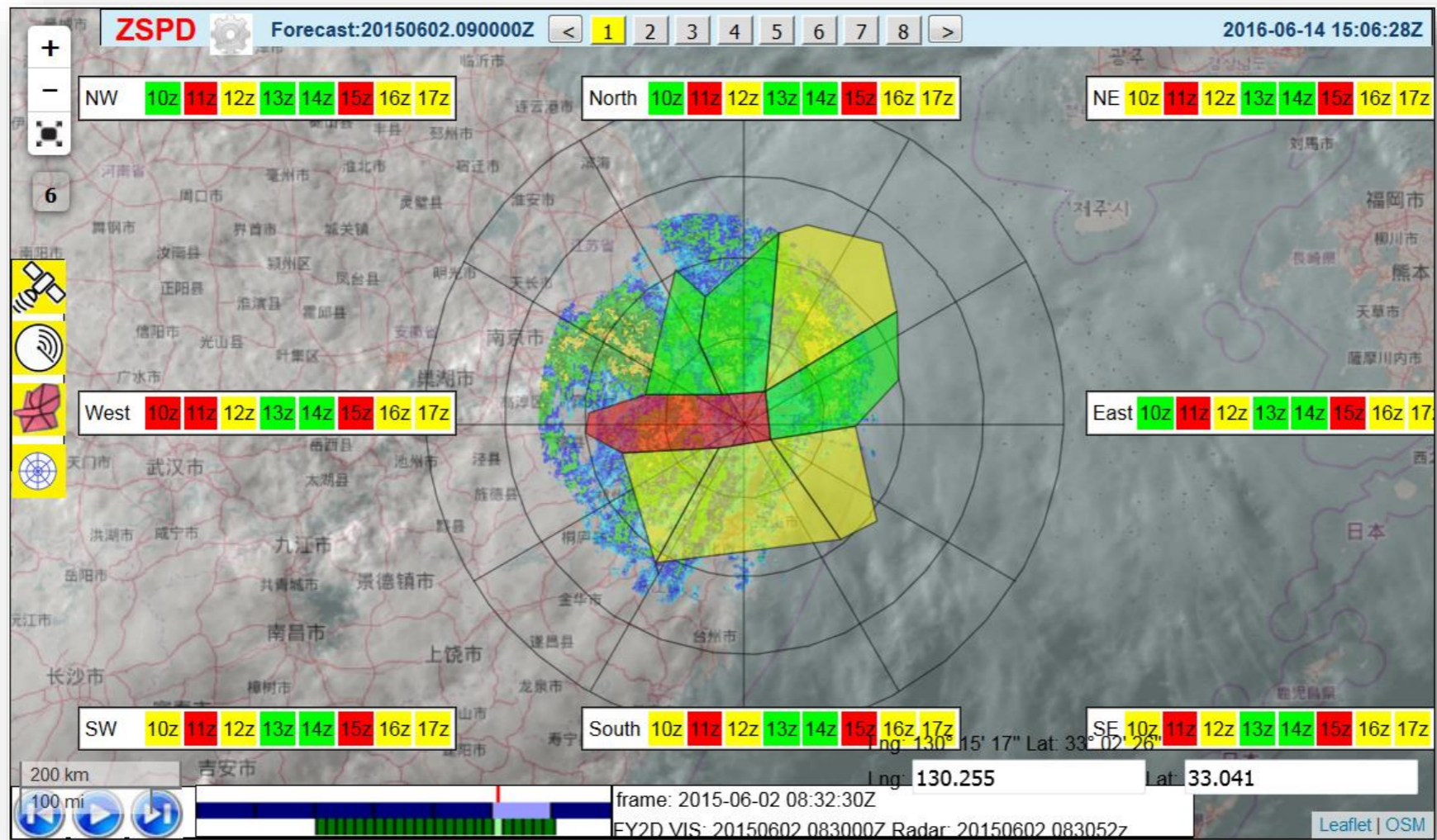
0-6h Radar-NWP blending QPF for Nowcast:

- Object based
- COTREC extrapolation
- 3km/10min/Yangtze Delta area

TRACON forecast for Approach

Forecast of weather impact timeline for TRACON (key route points)

Based on the eIAWS-R3R forecast results, this tool forecasts hourly weather impact up to 8 hours for selected TRACON of an airport.



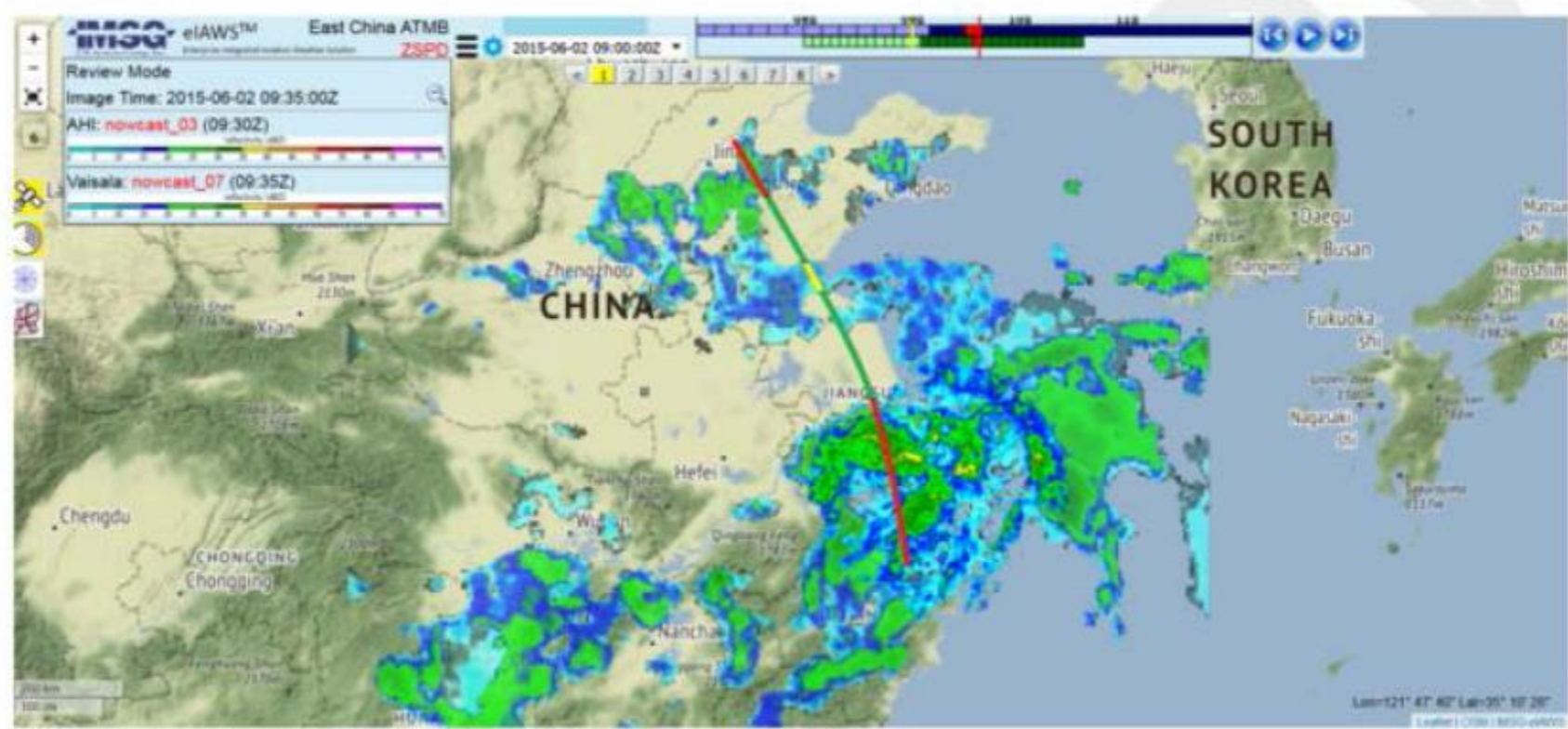
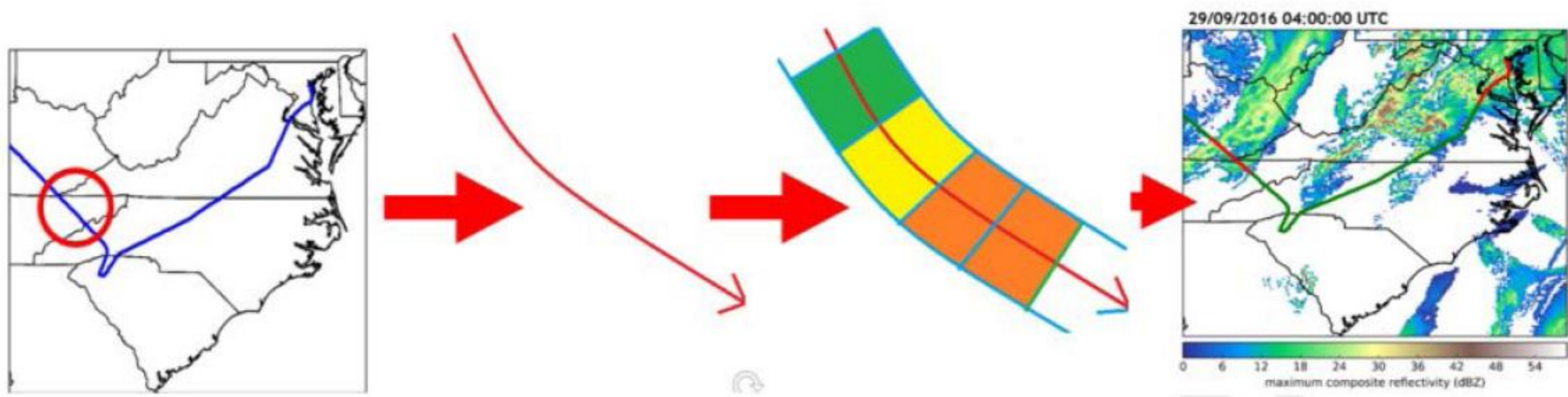
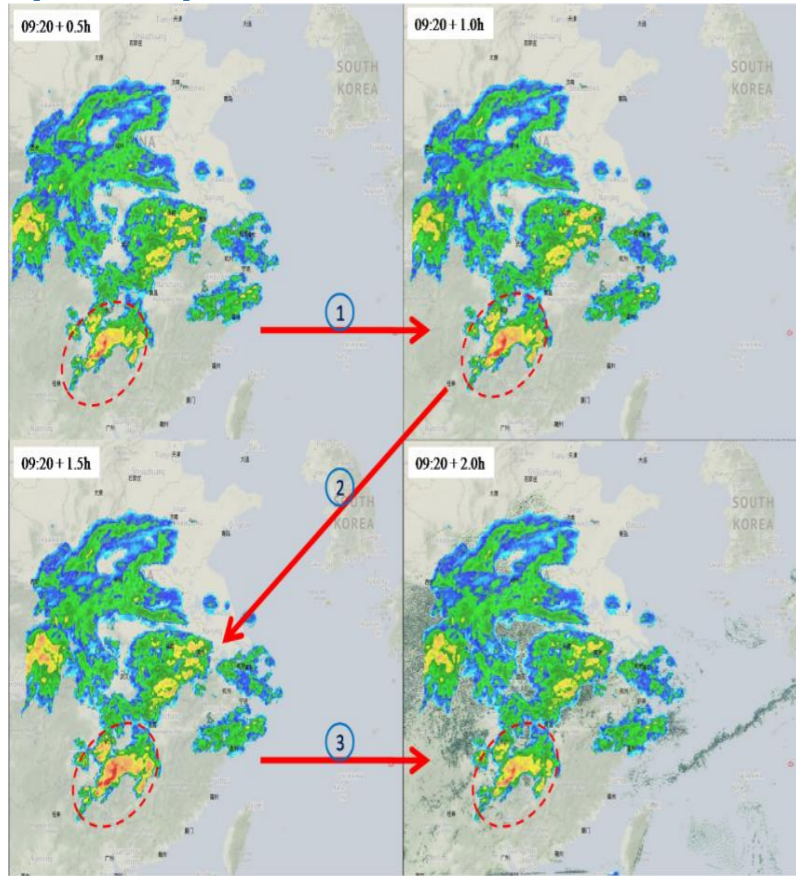


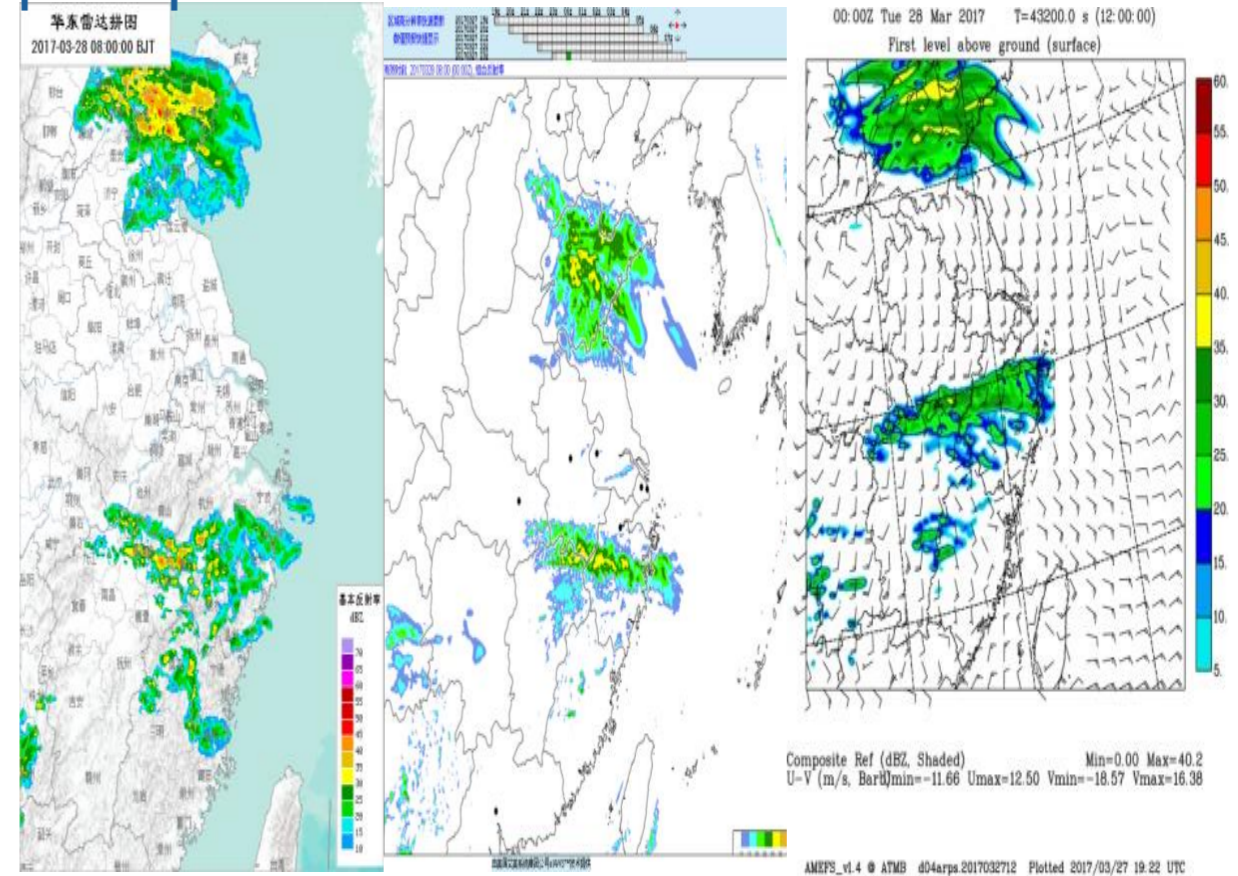
图 10. 航路可用性预报产品示意

30 Mar 2017 precip forecast



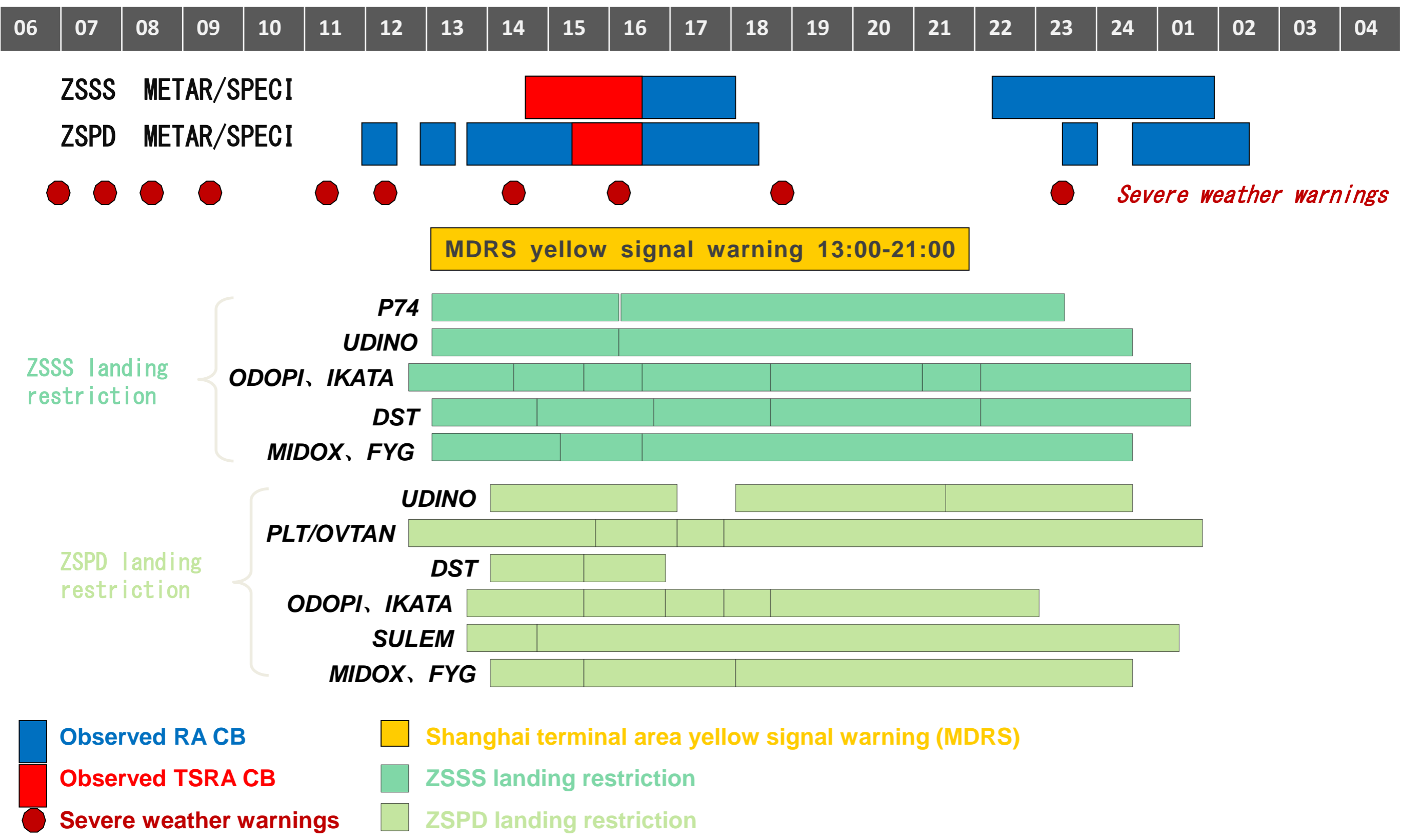
系统外推预报对**对流强度**变化具有敏感性，能够在强对流2小时左右的强盛期（天气影响最强阶段）做出合理的预报。

28 Mar 2017 precip forecast



系统数值模式预报基本能够很好的再现降水的分布范围，在天气系统的落区（位置）预报方面，较上一代预报系统（世博精细化数值预报系统、京沪穗中尺度数值预报系统）有**显著改进**。

SHA MET-ATM Impact Translation (Phase II)



█ Observed RA CB
█ Observed TSRA CB
● Severe weather warnings

█ Shanghai terminal area yellow signal warning (MDRS)
█ ZSSS landing restriction
█ ZSPD landing restriction

Questions