Development of MET Products for ATM in Hong Kong, China and Future Possibilities

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MET/ATM Co-ordination Seminar for Asia/Pacific Region, Bangkok, Thailand, 8 - 10 February 2006

**MET/ATM CO-ORDINATION SEMINAR FOR
ASIA/PACIFIC REGION**

Bangkok, Thailand, 8-10 February 2006

Discussion Topic 5:   Future requirements – MET component of the CNS/ATM systems

**DEVELOPMENT OF MET PRODUCTS FOR ATM
IN HONG KONG, CHINA AND FUTURE POSSIBILITIES**

(Presented by Hong Kong, China)

SUMMARY

MET products for ATM being developed in Hong Kong, China will be introduced. Taking into consideration recent developments in the Global Air Navigation Plan for CNS/ATM Systems in relation to IATA's ATM Implementation Roadmap, future potential MET products and possibilities will also be presented.

1.   INTRODUCTION

1.1   In Hong Kong, China, a programme of development of MET products for the new CNS/ATM system is closely coordinated between the Hong Kong Observatory (HKO), Hong Kong Civil Aviation Department (CAD), in particular the ATM service provider, and the end users (IATA, IFALPA and IFATCA). This paper introduces the MET products for ATM being developed this programme. Thoughts on future potential MET products and possibilities considering the recent developments in the Global Air Navigation Plan for CNS/ATM Systems (the "Global Plan") in relation to IATA's "ATM Implementation Roadmap – Short and Medium Term" (the "Industry Roadmap") will also be presented.

2.   CURRENT DEVELOPMENTS

2.1   The current programme of development of MET products for ATM includes:

(a)   **Terminal Meteorological forecast (TerMET)**

One of the planned new products being developed by HKO in consultation with ATM users is the "Terminal Meteorological Forecast (TerMET), which is a aerodrome forecast for wind, visibility, cloud, significant weather with reference to ATM operation thresholds. In particular, the forecast MET elements will be displayed in textual format with red colour highlighting those forecast figures reaching thresholds that would affect ATM operations. A sample product display is provided in Appendix I.

In line with the METATM Task Force's recommendation that the MET authorities/providers could consider supplementing ATM with MET information that could be provided with little development, especially utilizing readily available systems, TerMET will be generated basically from existing MET information and forecasts, including METAR, TREND forecast, forecast for take-off and TAF every hour. The algorithm to automatically generate a "first

guess" product from these reports and forecasts has been developed and is being tested and validated. The "first guess" will be quality-checked and modified by the Forecaster as necessary.

(b)   **MET information for arrival metering and sequencing**

A new arrival metering and sequencing system is being set up by CAD. This system will help ATM determine the sequence of arrival aircraft, the time when the aircraft could leave the relevant check points (e.g. the metering fix, holding point), and the estimated time of arrival. Since the wind aloft will have impact on the aircraft speed and hence the estimated time of arrival, short-range high-resolution wind forecasts in grid point format (Appendix II) will be provided to support the operation of the new system.

The necessary software is already in place to generate the wind forecasts from HKO's regional numerical weather prediction (NWP) model which can provide the forecasts at the required resolution.   It should be noted that in the current high fuel price operating environment, the availability of accurate descent winds in support of FMS descent profile management will also have significant benefits on fuel conservation and aviation efficiency.

(c)   **Nowcasting of thunderstorms for terminal area**

In mid-2005, HKO set up a lightning location network covering Hong Kong, China and its vicinity, in collaboration with the meteorological services of Mainland China and Macao, China. The network provides lightning information, including time, location, direction (i.e. cloud-to-cloud or cloud-to-ground) and polarity (i.e. positive or negative) within 140 km of HKIA. Real-time lightning location information has been made available to airline and CAD users via AMIDS.

Development of thunderstorm nowcasting products for the terminal area using the lightning location data and weather radar data has started. Two different approaches are being explored:

(i) using a technique known as TREC (Tracking Radar Echoes by Correlation), the correlation between lightning data and weather radar echo parameters (e.g. echo top, reflectivity at 3 km CAPPI, vertically integrated liquid (VIL)) has been made to estimate the probability of lightning in relation to the radar parameters in the following 1 hour. A sample display of the forecast is shown in Appendix III; and

(ii) the lightning data within contiguous regions are grouped together to identify active thunderstorms in the vicinity of HKIA. Forecast movement of these lightning regions is estimated using the TREC method. When a lightning region is forecast to hit HKIA, an alert would be generated. Sample display of the forecast is shown in Appendix IV.

3.   FUTURE POSSIBILITIES

3.1   Future potential MET products include:

(a)   **Wake vortex detection**

This future requirement is currently stated in the Global Plan (para. 8.13(f)) and highlighted by the IATA Roadmap (Section 7.5.11). While the Global Plan focuses on optimizing aircraft separation and runway capacity by using meteorological sensors coupled with expert systems to provide wake vortex reports and forecasts, the Industry Roadmap also points out the enhancement of the safety of aircraft operations by introduction of wake vortex detection

systems, or improved understanding of wake vortex transitory characteristics. The experience in Europe, U.S. and Japan was noted. Although there is no urgent need for wake vortex alerts for aircraft separation at HKIA based on current flight capacity Hong Kong, China will begin to study the issue.

Apart from the wake vortex detection approach, recent studies in Europe also suggest that the separation (in terms of distance) of approaching aircraft could be safely reduced in strong headwind conditions since wake vortex energy dissipates with time, not distance. Wind data downlink from aircraft, ground-based remote wind sensing instrumentation such as Doppler LIght Detection and Ranging (LIDAR), and high-resolution NWP models are available techniques to be explored to provide accurate headwind profile along the glide paths for the application.

(b)   **MET data downlink in support of ATM and dynamic aircraft routing**

Real-time and forecast wind fields derived from the wind information reported automatically from an aircraft may be used for applications in tactical decision-making for aircraft surveillance, air traffic flow management, and updating flight plans for flexible/dynamic aircraft routing. Currently, only ADS-C air-reports over oceanic regions on a limited scale and WMO air-reports are available. The possible use of ADS-B for automatic air-reporting is also being studied by ICAO in the ASIA/PAC Region. If found possible, the progressive aircraft equipage of ADS-B with automatic air-reporting capability will greatly enhance the provision of the required real-time wind fields for the above applications.

With the availability of automatic air-reports at higher frequency, more accurate wind profiles could be generated along the flight routes and in their vicinity for the above applications using these reports in combination with high-resolution NWP models. The wind forecasts for the arrival metering and sequencing discussed earlier could also be enhanced as a result.

(c)   **Sharing of MET information for Collaborative Decision Making (CDM)**

To achieve the ultimate goal of allowing each aircraft to fly its own optimized flight path, procedures supporting CDM should be developed. Sharing of MET information amongst other aeronautical information, so that all stakeholders have access to the same set of data for coordination and operational decision-making, is of fundamental importance.

Currently, sharing of WAFS global upper wind forecasts, downlink MET information, and reports and forecasts of hazardous weather with ATC and airline centralized operational control is stated in para. 8.13(c) of the Global Plan. In order to provide concise and pertinent information to all relevant users, including pilots, in support of CDM, it appears necessary to consider integration of the various MET information, possibly in the form of graphical products such as those being developed for uplinking to the cockpit. An example is the Integrated Terminal Weather System (ITWS) developed by the U.S., which integrates information from ground-based windshear detection system (the Terminal Doppler Weather Radar), weather radars, surface winds, lightning and nowcasting products as well as NWP forecasts.

4.   ACTION

4.1   The meeting is invited to note the information provided in this paper and exchange views on the subject.

## SAMPLE of Terminal Meteorological Forecast (TerMET)

TerMet
Hong Kong International Airport

Runway 07

Issue time: 05090410Z

	Present				
Time (UTC)	0400	0500	0600	0700	0800
Wind	220/16	220/16	220/16	210/15	210/15
TEMPO		VRB25	VRB25	--	--
Tailwind (kt)	14	14	14	11	11
TEMPO		--	--	--	--
Crosswind (kt)	+8	+8	+8	+10	+10
TEMPO		--	--	--	--
Prevailing Visibility	10km	10km	10km	8km	8km
TEMPO		1500m	1500m	3000m	3000m
Cloud ceiling	8000	8000	8000	8000	8000
TEMPO		4000	4000	4000	4000
Cloud base	600	600	600	600	600
TEMPO		400	400	400	400
SIGWX	SHRA	--	--	--	--
TEMPO		TSRA +SHRA	TSRA +SHRA	SHRA	SHRA

Criteria for highlighting the data in red

| Tailwind	exceeding 5 kts
Crosswind	exceeding 20 kts
Visibility	less than 5000m
Cloud Ceiling	1000 ft or below
Cloud Base	less than 1500 ft
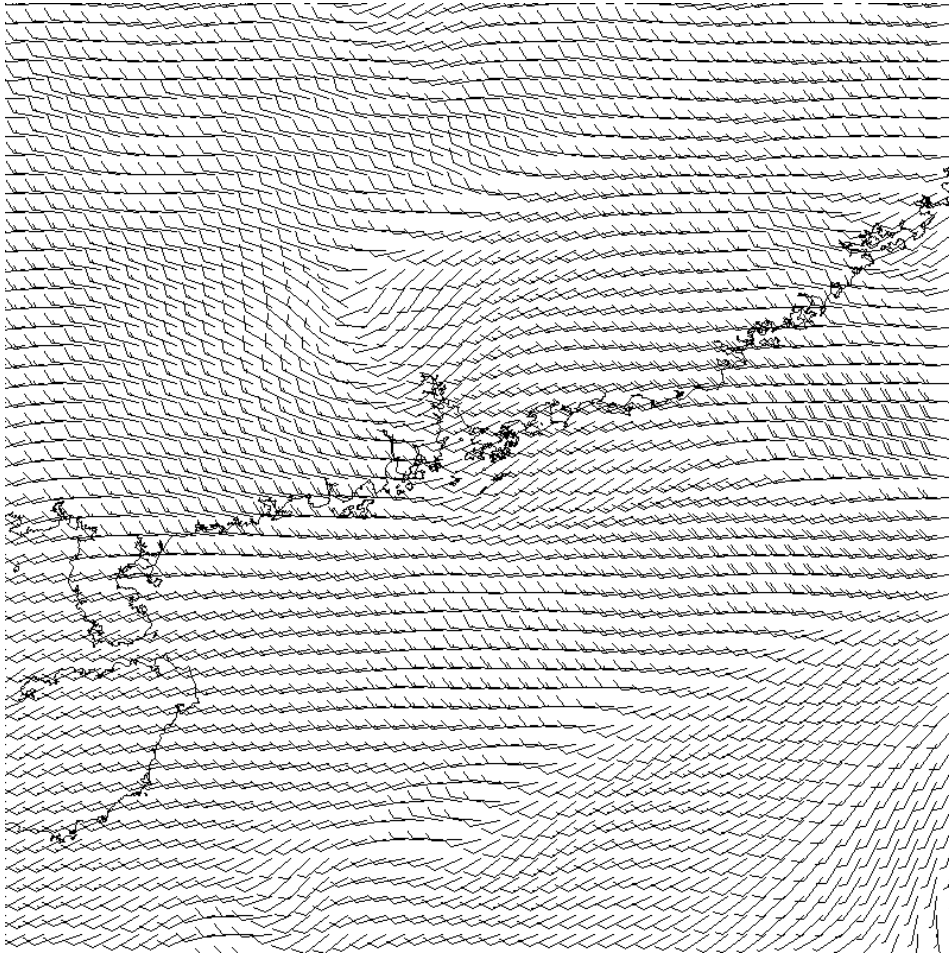
Sample wind forecast data (700 hPa level) for the Arrival Metering and Sequencing System

Scope of En-route Wind Forecast data

(a)	Area of coverage:	17.0-27.0N, 109.0-119.0E
(b)	Resolution:	0.2 degree
(c)	Forecast Wind:	Forecast vector wind U and V in m/s (U and V are the E-W and N-S wind components)
(d)	Update frequency:	8 times daily (available in about 4 hours after forecast base time at 0000, 0300, 0600, 0900, 1200, 1500, 1800 and 2100 UTC)
(e)	Forecast range:	4th to 12th hour after forecast base time
(f)	Output time step:	hourly
(g)	Levels (hPa):	200, 300, 400, 500, 600, 700, 800, 900 and 1000 hPa
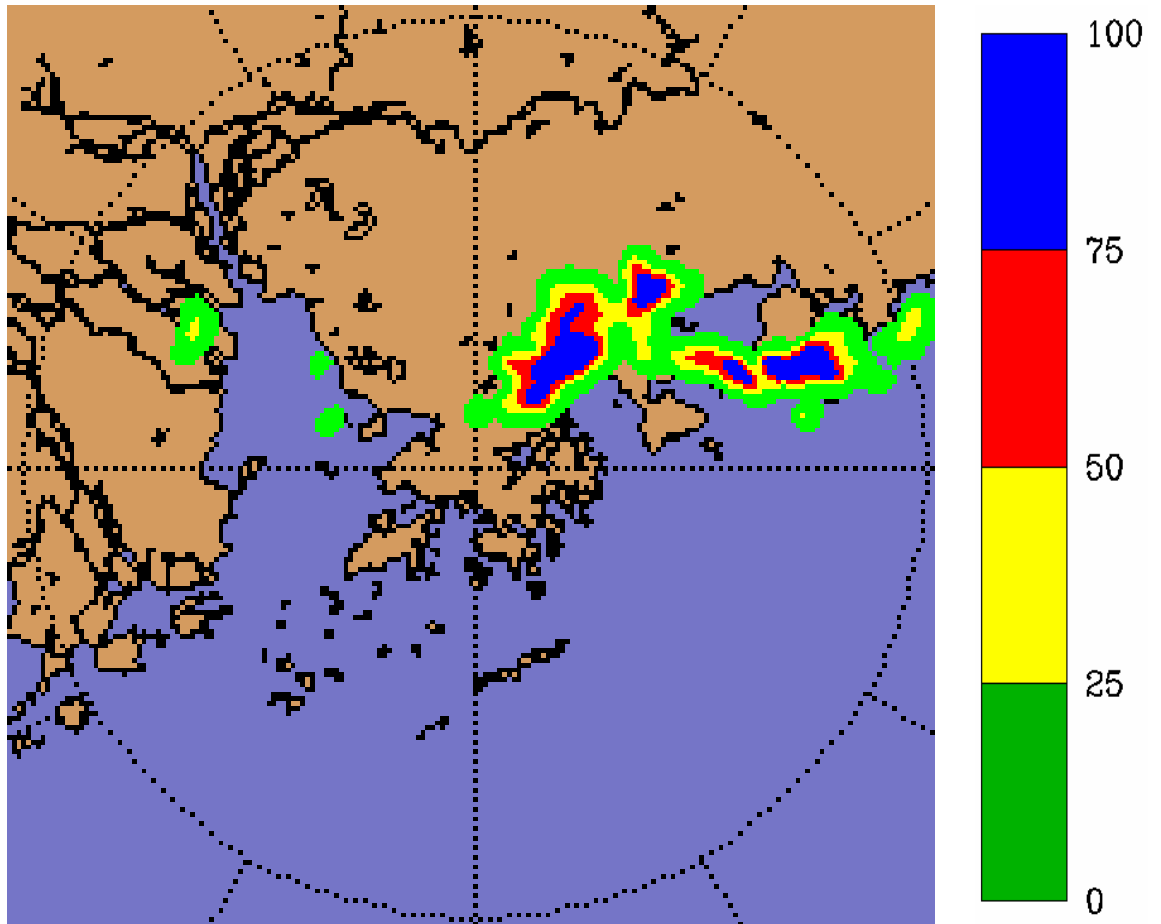
Sample 1-hour forecast probability of lightning (indicated by colours)
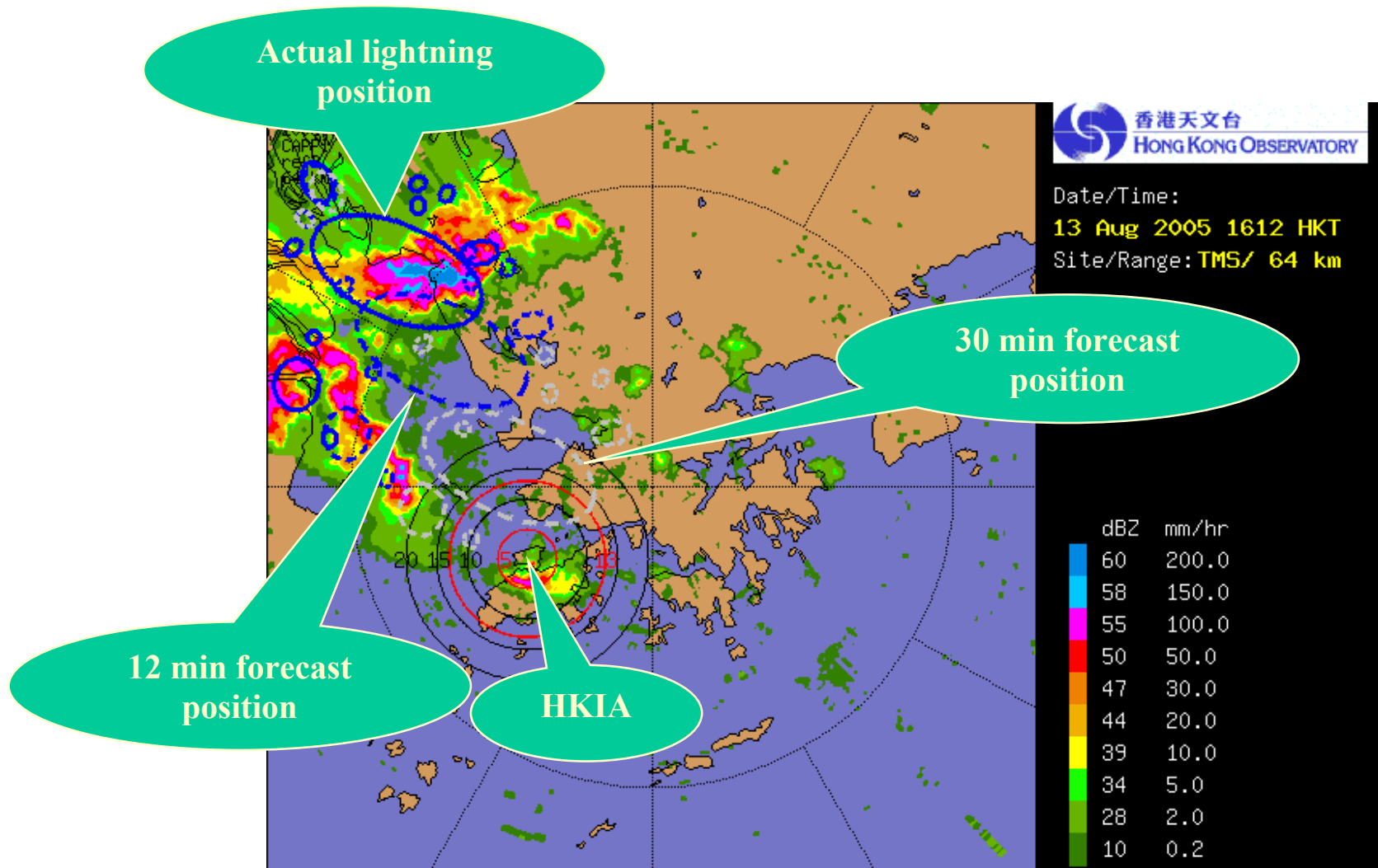
Sample forecast positions of lightning regions