INTERNATIONAL CIVIL AVIATION ORGANIZATION
ASIA AND PACIFIC OFFICE

REPORT OF

FIRST MEETING OF THE ASIA/PACIFIC METEOROLOGY/ AIR TRAFFIC MANAGEMENT TASK FORCE (MET/ATM TF/1)

Bangkok, Thailand
2- 4 December 2009

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I. Introduction

i) The First Meeting of the Meteorology/Air Traffic Management Task Force (MET/ATM TF/1) of Communications/Navigation/Surveillance and Meteorology (CNS/MET) Sub-group of Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG) was held in Bangkok, Thailand from 2 - 4 December 2009.

II. Attendance

i) Fifty representatives from 18 States and 2 International Organizations, and ICAO participated in the meeting. The list of attendees is provided in **Appendix A** to this Report.

III. Opening of the Meeting

i) Mr. Christopher Keohan, ICAO Regional Officer, Meteorology and Secretariat welcomed the delegates to the first meeting of the MET/ATM task force in the Asia/Pacific Region. The meeting was apprised that global requirements of MET products for ATM are currently being developed by ICAO AMOFSG where the products themselves are being developed by the WMO Expert Team. A brief overview of the upcoming meeting was stated in that the following issues would be discussed: a status of the New Terminal Forecast (NTF) product, States' MET/ATM developments, sub-regional coordination arrangements that address larger scale events such as volcanic ash, tropical cyclones and squall lines, and a reevaluation of the Terms of Reference at the beginning and end of the meeting. Actions developed by the meeting and their associated progress will be reported to the CNS/MET SG. Any global interests on implementation issues would be presented to APANPIRG which would invite ICAO to consider, which may call on the assistance of AMOFSG.

IV. Officers and Secretariat

i) Mr. Peter Dunda, Manager Major Airport Weather Services - Australian Bureau of Meteorology, was elected chair of the meeting.

ii) Mr. Christopher F. Keohan, Regional Officer, MET and Mr. Kyotaro Harano, ATM Officer, of ICAO Regional Office Bangkok, acted as the Secretaries of the meeting.

V. Organization, Working Arrangement, Language and Documentation

i) The working language was English inclusive of all documentation and this report.

ii) A list of Working Papers and Information Papers presented at the meeting is in **Appendix B** to this Report.

Agenda Item 1: a) Adoption of provisional agenda and working arrangements for the meeting

The meeting adopted the provisional agenda as detailed in **Appendix C** to this Report.

b) Review of the TORs and composition of group

The meeting reviewed the TORs and decided with the recommendation of the Secretariat that this be reviewed after the delivery WP/8 and WP/14.

Operational requirements and rules of governance

1.1 The meeting noted the progress of functional and performance requirements generated for NextGen and the need for harmony amongst global MET requirements for ATM that take into consideration NextGen and SESAR requirements. Emphasis was placed on monitoring the progress of requirements (spatial and temporal resolution, data latency, data refresh rate, reliability (availability) and integrity for 2025 in draft form) as shown in **Appendix D** of MET products. A viewpoint of how MET data could be provided in the future was presented to the meeting. That is, MET data would be available for the MET Service Provider to utilize in a manner effective to the State and thus displays would be determined by the State. State adaptation of MET data could be documented in the Regional Air Navigation Plan (Basic ANP and FASID). Furthermore, consideration to Least Developed Countries (LDCs) is necessary and would likely have to obtain MET products through vendors in due time. The State would be responsible for verifying ICAO requirements are met. Lastly, the meeting noted the importance of considering the needs of General Aviation in having access to the new MET products under development.

1.2 With these perspectives, the meeting agreed to review the TORs at the beginning of the meeting and then again at the end of the meeting. The meeting provided input to the TORs which is given in **Appendix E** where the additional terms of reference are highlighted in yellow and deleted items denoted with a red-strike. The meeting was aware of the method of changing TORs of a task force in that the supporting sub group decides on the changes and formulated the following action to be delivered in a summary report by the MET/ATM TF chairperson to the CNS/MET SG.

APAC MET/ATM TF Action 1/1 – Update of TORs

That, the updated MET/ATM TF TORs as in the **Appendix E** be considered by the CNS/MET SG/14 meeting through a Decision.

Agenda Item 2: a) Outcomes and recommendations of the ASIA/PAC MET/ATM Coordination Seminar 2006

2.1 The meeting reviewed a summary and the outcomes and recommendations of the ASIA/PAC MET/ATM Coordination Seminar held in Bangkok, Thailand from 8-10 February 2006. A summary of the seminar report is given in **Appendix F** to this Report.

b) Results of Regional Survey on ATM Requirements for MET 2008 and follow-up actions

2.2 The meeting reviewed the results of the Regional Survey on ATM Requirements for MET 2008 and follow-up actions, which are provided in **Appendix G** to this Report. One of the follow-up actions, follow-up with non-responding States, was considered important by the meeting in that often the States that do not respond are less developed and their input essential in MET/ATM coordination particularly given the relatively small FIRs in parts of the Region, which results in interdependency. The meeting also noted that many States that do not traditionally respond to ICAO Regional Office inquiries (State letters, SIGMET test invitations, surveys) have recently been more responsive and if this trend continues, a more accurate assessment of regional concerns of MET products for ATM is expected.

2.3 With reference to the traditional suite of MET products (visibility, surface wind/gust and thunderstorm) being the most valuable to ATM (from survey result), the meeting noted that in the future environment of NetCentric data, these products in their current form may be provided by different means and formats (from meeting discussion).

2.4 The meeting also noted the value of providing automated services that were, as far as practicable, equal to that of an observer. The final point being that automation needs continued improvement to meet operational needs. The meeting also noted that the commercialization of meteorological organizations and automation of systems must take into account the needs of general aviation.

c) Development of New Terminal Forecast by WMO in coordination with ICAO

2.5 The meeting was apprised of the progress that has been made by the WMO Expert Team on the development of the New Terminal Forecast (NTF). The development of NTF for aerodromes with high traffic density (threshold to be determined) is to provide ATM/ATC and operations a forecast of convection, wind information, low ceilings/visibility and winter weather for a wider terminal area out to 150 nm from the aerodrome that encompasses corner points and fixes that is not currently provided in Annex 3.

2.6 The development of the NTF products is under the jurisdiction of the WMO Expert Team in coordination with ICAO which will develop ATM requirements (weather parameters, spatial and temporal scales, applicable locations, desirable accuracy and resolution) via the AMOFSG with significant overlap via an adhoc group. The example prototype NTF graphic in **Appendix H** shows an example of how the extraction of the NetCentric data oriented nature or other information can be visualized in support of ATM. The graphic derived from currently well known displays such as TDWR and ITWS is intended for the sharing of mutual information between MET, ATM, airlines and operators in making collaborative ATM decisions. While seeing the long term trend to data oriented NetCentric weather exchange models, the ET is convinced that at least for a considerable transition period, the need to assure full information for and cooperation by human operators will require the continued provision of graphical and tabular information.

2.7 The prototype NTF is located at the web address, http://www.ntf.weather.gov.hk (username: metatmtf_ntf, contact Sandy Song for password) in order to obtain user feedback. The users in the meeting were asked by a member of the WMO Expert Team to provide feedback on the prototype NTF graphic. The prototype products and display were based on identified international product and display commonalities (nowcasting and probabilistic forecast, graphical/tabular form, lead time more than 2 hours, weather briefing in plane language, collaborative decision making products) by the WMO ET.

2.8 The meeting also discussed the concept of user requirements not being fulfilled by existing MET capabilities due to scientific and technological constraints. It is believed; however, that this gap will narrow based on more observations of the current state of the atmosphere and improved modeling. Nevertheless, as MET capabilities improve; ATM requirements will likely become more stringent and the need for continual improvement of MET products as well as the coordination between MET and ATM to better understand the user requirements and the scientific and technological constraints is crucial. The meeting also noted that there is a variance of uses of MET products amongst airlines.

2.9 The meeting also noted the timeline of possible delivery of the convection, wind and winter weather NTF products in 2013 contingent on decisions made at the WMO CAeM session/ICAO MET Divisional Meeting. A gradual transition of the product is expected. Consideration for additional products of low-level wind shear and turbulence, icing in the terminal area, runway condition forecasts (based on precipitation type intensity), wake turbulence forecast, noise abatement and air quality forecast, and probability forecasts of convection, wind, ceiling and visibility are expected tentatively from 2015 to 2018.

d) MET component of ATFM Survey 2010

2.10 The meeting reviewed the MET component of the ATFM Survey 2010 in **Appendix I** and agreed that changes to the survey not possible in that it is traced to APANPIRG Conclusion 20/13. Nevertheless, the survey is expected to be conducted in the first half of 2010 and results will be reviewed before assessing the need for another survey. Consideration of sharing information on survey development and results with other regions was also noted by the meeting.

Agenda Item 3: a) States' coordination arrangements between MET and ATM

MET/ATM Coordination in Australia

3.1 The meeting noted that the Australian Bureau of Meteorology (ABoM) and Airservices Australia (Airservices) maintain an agreement under which meteorological services are provided by the Bureau directly to Airservices operational units. That is, the MET unit located in the Airservices National Operations Centre (NOC) in Canberra provides MET information to support FIR operations and the MET unit located in Sydney provides MET information to support terminal operations.

3.2 The functions of the NOC meteorological support unit (NOCMET) are to provide services and MET products tailored for ATM operations built upon standard meteorological products. These specialized services include advice and briefings to Airservices, airlines and airport operators on weather impacts to operations at the aerodromes and en-route. In addition, support is given to the Crisis Management Centre, air traffic management plans, training of ATM for MET and MET for ATM, and real-time MET inquiries.

3.3 The functions of the ABoM Sydney Airport Meteorological Unit (SAMU) at the Sydney Airport Control Unit (TCU) include providing MET information for ATC to support airspace management and issue aerodrome forecasts and warnings for Sydney and the vicinity. MET information and services used includes, trend forecast, aerodrome forecast, airport weather briefing, code grey, aerodrome and wind shear warnings (product details given in section 3b).

3.4 The MET unit in two air traffic facilities in Australia has proven fruitful in delivering more operational based products and services by understanding ATM operations.

Japanese coordination arrangements between MET and ATM

3.5 The meeting learned of the Japanese coordination arrangements between MET and ATM. In particular, the coordination steps in establishing the Air Traffic Meteorology Center (ATMetC) to support Air Traffic Management Center (ATMC) of the Japan Civil Aviation Bureau (JCAB) was discussed. ATMetC was launched to satisfy MET support for ATM considering existing coordination in the FAA such as physical proximity of MET in the ATM unit. In the ATMetC establishment process, Japan visited the FAA and observed the MET support to ATM in 2003. Upon return, JMA determined impacts of weather phenomena to ATM and determined needs of ATM such as forecasts for CB in high air traffic density areas with a two hour lead time. Subsequently, ATM tailored products and briefings were developed (more detail in section 3b). A training and exercise period of 5 months commenced at the new Fukuoka ATMC. The following coordination arrangements were implemented: face to face briefings twice per day, sharing of MET and ATM information on large screens, ATM-tailored MET products (ATMet Categorized Forecast with 1 hour update and ATMet summary every 3 hours). Continued collaboration includes arrangements on exchanging MET information for ATM and vice versa. In order to improve products, operations and collaborative decision making, ATMC provides weather delay data to determine dependency of weather impacts to air traffic flow with an emphasis on large scale events. Several meetings between MET and ATM during the year and mutual training of each other's disciplines facilitate this process.

3.6 Future ATM systems are being planned with the establishment of the Collaborative Actions for Renovation of Air Traffic Systems (CARATS) which utilizes perspectives of a wide range of stakeholders. The experience gained by Japan will undoubtedly support a component of the DGCA/46 Kansai Statement which is to establish a future global ATM in the Asia/Pacific Region in support to the Seamless Sky in Asia/Pacific.

b) States' current and planned MET support to ATM

Japanese MET support to ATM

3.7 The meeting noted that the ATMetC had been established in October 2005 for the purpose of supporting the ATMC of JCAB. The ATMetC services for the advanced Collaborative Decision Making (CDM) included providing ATMC two types of ATM-tailored forecasts: ATMet Category Forecast and ATMet Summary. The ATMet Category Forecast is a 4-rank probability of occurrence of impacts on air traffic flow within each Air Traffic Control sectors and major airports. The time series forecast for 6 hours is essentially updated every hour and displayed in graphic and tabular forms, the latter being used by ATM officers and the former by airlines. This probabilistic product is based on the ATM Signficant Weather Index discussed in detail in IP/3. In short, this index is forecast data for five elements derived from numerical models. The elements include max and mean precipitation in an hour in a sector, ratio of areal coverage of 16mm/hr precipitation to a sector, ratio of areal CB height (utilizing a height threshold) and the ratio of areas whose wetness exceeds a threshold ($T\text{-}T_d > 3C$) to the area of the sector. Thresholds applied to the graphics of the indices are related to the probability of air traffic flow impacts. The index is evolving based on continued MET and ATM evaluation.

3.8 ATMet summary is a summary of weather information (significant weather forecasted, numerical weather prediction, radar graphic, forecaster comments, text of impacts on air traffic, and time series forecasts) every 3 hours valid for up to 6 hours. The products provided were shared through CDM amongst ATMC, ATMetC and the Ministry of Defense in order to make collaborative air traffic management decisions. As a trial, an improvement to the shared knowledge process included video conferences with ATMC, ATMetC, ATC Centers, and two Japanese airline operation control centers. The result of the conferences was an ATM Operations Plan (OP) issued by ATMC that included capacity constraints due to weather impacts, which were available to other stakeholders not mentioned. Increasing membership of CDM and holding extraordinary meetings that produced extraordinary Ops would be considered for the future. The meeting noted that the OP issued by ATMC was available to authorized users, which could be obtained upon request from the Civil Aviation Bureau.

3.9 The meeting addressed the use of sector impacts by the airlines in that an increase in efficiency is expected in a scenario a sector has a high weather impact and ATC/ATM and the airlines utilize the same display of information. Therefore, a gain in efficiency results from shared situational awareness.

MET/ATM Products in Australia

3.10 The meeting was briefed on MET products that facilitate ATM planning at the major aerodromes in Australia. Products include: airport ground staff warnings of thunderstorm events, detailed weather briefings and MET information displayed in graphic, web-based representations. In particular, the Automated Thunderstorm Alert Service (ATSAS) produces thunderstorm position, forecast and associated lightning observations. An alert system provides the user warning when a thunderstorm is present or approaching within a certain range of the airport (time of arrival is displayed on a graph). Airport weather briefings expand on the information contained in the TAF and include operational impacts for events (thunderstorm, fog, below special alternate minima) that have a less than 30% probability of occurrence is termed "code grey", which particularly improves long-haul operations arriving to Australia and provides ATM operations preparedness for various scenarios.

3.11 The graphical airport briefing display contains traditional Annex 3 MET elements such as TAF, TTF, METAR, SPECI etc.., but also contains airport weather briefings, runway cross and tail winds and graphical indication of significant weather at aerodromes, whose benefits are shared information, single point of access, added information (i.e. cross and tail wind information) needed for effective operations. Future developments include improving the accuracy and display of convection with a focus on eastern Australia, providing probabilistic forecasts of fog, thunderstorms and below Special Alternate Minima conditions in tabular form will assist the utilization by ATM and preparing for the exchange of MET data via XML.

Thunderstorm nowcasting in support of ATM in Hong Kong, China

3.12 The meeting was apprised of the latest developments with regards to aviation thunderstorm nowcasting products in support to ATM and airline users in Hong Kong, China. Recent developments included utilizing technology derived nowcasting techniques used for the Beijing Olympics in 2008. Specifically, technology from the Short-range Warnings of Intense Rainstorm in Localized System (SWIRLS) was tailored for aviation based on user feedback of the prototype system at Hong Kong International Airport (HKIA). In addition to the 1-hour forecast of radar reflectivity at specific altitudes within 120 km of HKIA, current and forecast elements of cloud-top heights, vertically integrated liquid water, and reflectivity were superimposed on Google Map / Geographical Information System (GIS) that included the option of displaying way-points and obtain readings of the meteorological elements described at any particular point. A trial website had been developed for evaluation by users and was expected to become operational in mid-2010. To address storm growth and dissipation, utilizing nowcasting information with high-resolution numerical weather prediction (NWP) products might be considered. In the future, nowcasting products might be up-linked to the cockpit and adapted to specific flight routes relevant to the user.

Weather briefings for ATFM in Hong Kong, China

3.13 To facilitate planning and operational decision-making with ATC, airlines and the airport community, the Hong Kong Observatory provides weather briefings for ATFM on tropical cyclone impacts to airport operations. The meeting noted that weather alert (for example significant cross-wind or turbulence) that often result from TC impacts are issued to the airlines and ATC. Separate announcement are issued to the public to inform them to check airlines on delays or cancellations in order to reduce unnecessary human traffic at the airport. The usefulness of these briefings resulted in extension of briefings to cover routine weather situation (twice per day with regards to significant convection events and provides information on potential holding areas for arriving flights and impacts to the FIR boundaries). Significant air traffic delays due to weather are also reexamined at workshops in order to improve communication between MET and ATM. Convective forecasts and supplementary information (OPMET data, radar, nowcasting and convective cloud identification products, and satellite) that potentially impacts ATM is provided on a dedicated webpage called “Weather Summary for ATFM” which will form part of a common graphical weather display shared by ATM and MET in trial weather briefings expected to commence in early 2010.

3.14 The impacts to the Hong Kong FIR airspace and adjacent FIRs will become increasingly interdependent as air traffic increases. Coordination with adjacent FIRs is essential for a successful optimization of regional capacity. To facilitate this regional coordination, Hong Kong, China is taking the following measures: 1) developing extended forecasts of tropical cyclones of up to 24 to 48 hours ahead (http://adrr.weather.gov.hk/) (in coordination with WMO), 2) investigating the development of a sub regional radar/convective composite by utilizing shared information amongst adjacent FIRs, and 3) exploring ways to improve the accuracy of convective information utilizing radar, satellite, and NWPs.

3.15 Sub-regional products will require consideration to bi-lateral or multi-lateral agreements amongst States for the sharing of information. The development of the NTF by the ET could be an example of information that could be shared between States.

Aviation Meteorological Information Service Using Mobile Phones in Korea

3.16 The meeting noted that the Korea Aviation Meteorological Agency (KAMA) developed the Aviation Meteorological Information Service System Using Mobile Phone for providing meteorological information to low-level flights and has been operating since late 2008. KAMA acknowledged the user need of MET information for low-level en-route flights where the public Internet was not most suitable. To obtain the latest information a set of keys ('131' and a function key) is entered. The homepage will be made into English and with access to 12 Aerodrome Meteorological Observation Systems (AMOS) which will have an approximate 2 minute lag time from real time.

3.17 The meeting noted that cell phone signal problems were not a major issue in the Republic of Korea and that the use of cell phones provides more access to aviation weather. The meeting also noted that Hong Kong, China is investigating the use of the I-Phone for access to aviation weather.

Operational Improvement in Case that Large Scale Route Changes are Required for Several Days Such as Volcanic Eruption

3.18 Air traffic flow disruptions were associated with a volcanic eruption of Mt. Sarychev in Russia on June 12, 2009. Specifically, aviation operations were disrupted in the Northern Pacific (NOPAC) airspace for a 10 day period due to the ash location, which was in the path of all 5 ATS routes between Anchorage and Japan. Operational impacts included several aircraft that had to return to their departure aerodromes in Japan and the U.S. due to the lack of information provided by operations which resulted in fuel shortfalls for the necessary flight path deviations around the ash. In addition, many aircraft deviated around the volcanic ash cloud adding to the overall flight time and fuel expended. Operations could be improved by coordination and sharing of ATM strategies amongst States. Coordination and sharing of ash and ATM information is necessary for operations when formulating fuel needs. Relaxing the Russian airspace prohibition for NOPAC deviations and city pair restrictions of Pacific Organized Track System (PACOTS) is necessary for use of alternate aerodromes.

3.19 These suggested improvements were presented at the Informal Pacific ATC Co-ordinating Group (IPACG) meeting. The FAA and Japan Civil Aviation Bureau (JCAB) discussed ways to improve their operations for large scale events that disrupt air traffic flow and details provided in the attachment to IP/4 which reveals further progress in resolving the said issues is needed. In response to the circumstance, JMA considers enhancing communications with JCAB including attendance to the next IPACG meeting.

Agenda Item 4: Review guidance material related to MET and ATM coordination arrangements and consider including information about ATM-tailored MET products developed by the States in the region

4.1 The meeting reviewed the status of guidance material of MET and ATM coordination arrangements, which as recalled, the 2008 survey results submitted to ICAO did not warrant an update to Doc 9377, *Manual on Coordination between Air Traffic Services, Aeronautical Information Services and Aeronautical Meteorological Services*.

4.2 However, based on the information provided by JMA in steps taken in establishing a MET service for ATM in section 3a, the meeting agreed to the following action.

APAC MET/ATM TF Action 1/2 – establishment of a MET unit in ATM

That Japan consider presenting its implementation of ATMetC as an example of coordination between MET and ATM at CNS/MET SG/14 for possible use by States in the Region as a model.

4.3 The meeting reviewed the report by the Chairman of the METATM TF given in Appendix 24 to the CNS/MET SG/7 final report. This report is cited to have some initial guidance to the States on the development of tailor-made products to support ATM. Note that section 4 provides a table attached to this report as **Appendix J** that summarizes MET information that is provided by a number of Asia/Pacific States in support of ATM which includes additional MET supplementary information not included in Annex 3 requirements.

4.4 The meeting further noted differences of wind direction orientation and reporting amongst ICAO documents (Annex 3, PANS-ATM). The meeting displayed varied viewpoints on the orientation of wind at the aerodrome such as the use of GNS is oriented true. The meeting also noted that costs associated with this type of change to the airspace system (drafting charts, documentation, runway numbering) would be substantial to many States and that many States conduct business cases and risk assessment (although Safety Management Systems does not currently apply to Annex 3). The meeting realized that risk assessment in acquiring or changing aviation related systems is different than Quality Management System which relates to the continued validation of products delivered.

4.5 The meeting noted this issue is of interest, but proposed changes are out of the scope of the meeting. In addition, the meeting was reminded of the CNS/MET SG/13 final report which addressed the magnetic/true issue. That is, “The meeting recalled that all runway oriented information was in magnetic because the runway orientation was given in magnetic and that METAR and TAF represent conditions at and around the aerodrome, not only at the runway, explaining why they are in degrees true while the ATS display of wind is in degrees magnetic. In this context, it was noted that in the replies to the State letter related to draft Amendment 75 to Annex 3 the need for guidance related to the responsibility of the conversion from the true to magnetic wind speed had been raised and that it could be expected that the Secretariat would issue this guidance in time for the applicability of Amendment 75. Since the meeting considered that current ICAO Annex provisions were clear and need not be amended, the development of this guidance would sufficiently address the responsibility issue raised by China.”

4.6 With regards to visibility discrepancies, the meeting noted the importance of accurate visibility reporting to operations. The meeting was informed that prevailing visibility in METAR is a result of IATA preferring a representative visibility for the aerodrome for flight planning purposes (i.e. alternate aerodromes).

4.7 The meeting also discussed the definition of aerodrome covering an area of 8 KM is not suitable for large aerodromes; however, the New Terminal Forecast will provide information for the area outside the current definition. In addition, APANPIRG Conclusion 19/50, Issues related to TAF code, includes “providing explicit definition of the geographical area that the TAF covers with consistency between this definition for the TAF and METAR” which was forwarded to ICAO in the last quarter of 2008. ICAO called upon the AMOFSG to address this issue. Proposals made through AMOFSG in 2011 would be considered in Amendment 76 to Annex 3 (2013).

4.8 The meeting discussed the concept of ATIS containing aerodrome information and meteorological information in that the MET information is subject to frequent changes due to the dynamic nature of MET information when conditions change rapidly. The varying update rates of operational and MET information could be separated with the use of two separate delivery services. One service for MET information issued by MET and with the other for operational information use governed by ATC. The meeting noted that no operational requirements have been defined for a new MET information service. In addition, these conceptual changes could be brought forth to the respective sub group for consideration and through APANPIRG, which would invite ICAO for further consideration.

Agenda Item 5: Planning for the MET/ATM Coordination Seminar in 2010

5.1 The meeting was pleased to be informed that JMA considers offering to host the MET/ATM Seminar in the fourth quarter of 2010 in Japan. One main advantage for conducting the seminar in Japan included an operational view of MET/ATM coordination. Dates of the Seminar will be given during the first several months of the year. In addition, it was deemed most practical to have a one or two day meeting of the task force members after the Seminar.

APAC MET/ATM TF Action 1/3 – establish steering group for Seminar planning

That the ICAO RO Secretariat, Australia, Japan, Hong Kong, China, and United States (and other interested States) form the steering group committee for the planning of the 2010 MET/ATM TF Seminar.

Agenda Item 6: Future Work Programme

6.1 The meeting noted that three actions had been developed by the MET/ATM TF/1 meeting. Reporting of the status of these actions is expected at the CNS/MET SG/14 meeting. The meeting also noted the Seminar and task force meeting planning in Agenda Item 5.

Agenda Item 7: Any other business

7.1 The meeting was invited to provide input on the prototype NTF, in particular, a preliminary response to a questionnaire the WMO ET member sent to the group. Responses from several States and IFATCA included a positive response to the development of the NTF and its potential use to ATM. Also, a common theme in the responses included the need for accurate and timely information. In addition, the meeting noted that a 1-2 hour lead time for convective activity would be useful for operations at busy aerodromes. Operational benefit from the vertical cross section along a given flight path was noted by the meeting. Lastly, the meeting was reminded that the AMOFSG is tasked to develop requirements regarding NTF products and States in the ASIA/PAC Region encouraged to provide input (i.e. through questionnaire) that would facilitate the development of requirements.

-END-

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International Civil Aviation Organization

**FIRST MEETING ASIA/PAC METEOROLOGY/
AIR TRAFFIC MANAGEMENT TASK FORCE (MET/ATM TF/1)**

Bangkok, Thailand, 2 − 4 December 2009

LIST OF WORKING AND INFORMATION PAPERS

WP No.	Agenda Item	Subject	Presented by
WP/1	-	Provisional Agenda	Secretariat
WP/2	1b)	Review of MET/ATM TF Terms of Reference and Composition of Group	Secretariat
WP/3	2 b)	Review Results of Regional Survey on a ATM Requirement for MET 2008	Secretariat
WP/4	2 d)	Review MET Composition of ATFM Survey 2010	Secretariat
WP/5	4	Review Status of MET/ATM Guidance Material	Secretariat
WP/6	7	AIS Update from the First Meeting of ICAO AIS-AIM Study Group and the Fourth Meeting of Asia/Pacific AIS-AIM Implementation Task Force	Secretariat
WP/7	2a)	Review Outcomes from the ASIA/PAC MET/ATM Coordination Seminar	Secretariat
WP/8	3b)	Operational Requirements and Rules of Governance	USA
WP/9	2c)	Progress on Development of New Terminal Forecast	Hong Kong, China
WP/10	3b)	Development of MET Products and Services for ATM and ATFM	Hong Kong, China
WP/11	3a)	Japanese Coordination Arrangements between MET and ATM	Japan
WP/12	3b)	Japanese Current and Planned MET Support to ATM	Japan
WP/13	4	ATM and MET Coordination	IFATCA
WP/14	1b)	ATM and MET Co-ordination	IATA
WP/15	3b)	Aviation Meteorological Information Service Using Mobile Phones in Korea	Republic of Korea

IP/ No.	Agenda Item	Subject	Presented by
IP/1		Meeting Bulletin	
IP/2	7	Review APANPIRG/20 MET Outcomes	Secretariat
IP/3	3b)	ATM Significant Weather Index	Japan
IP/4	3a)	MET/ATM Coordination in Australia	Australia
IP/5	7	Volcanic Ash Impact on ATC and Aircraft Operation	Japan
IP/6	3b)	MET/ATM Products in Australia	Australia

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International Civil Aviation Organization

**FIRST MEETING OF ASIA/PAC METEOROLOGY/
AIR TRAFFIC MANAGEMENT TASK FORCE (MET/ATM TF/1)**

Bangkok, Thailand, 2 - 4 December 2009

PROVISIONAL AGENDA

Agenda Item 1:

a) Adoption of provisional agenda and working arrangements for the meeting

b) Review of the TORs and composition of group

Agenda Item 2: Review:

a) Outcomes and recommendations of the ASIA/PAC MET/ATM Coordination Seminar 2006

b) Results of Regional Survey on ATM Requirements for MET 2008 and follow-up actions

c) Development of New Terminal Forecast by WMO in coordination with ICAO

d) MET component of ATFM Survey 2010

Agenda Item 3: Review:

a) States' coordination arrangements between MET and ATM

b) States' current and planned MET support to ATM

Agenda Item 4: Review guidance material related to MET and ATM coordination arrangements and consider including information about ATM-tailored MET products developed by the States in the region

Agenda Item 5: Planning for the MET/ATM Coordination Seminar in 2010

Agenda Item 6: Future Work Programme

Agenda Item 7: Any other business

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DRAFT FUNCTIONAL AND PERFORMANCE REQUIREMENTS FOR NEXTGEN (2025)

Table N-2a Increment	Super-Density Terminal Airspace		Designated En Route Terminal Airspace and En Route Airspace		Designated Global Terminal Airspace and Global Airspace
FORECAST	Convection	Other Wx	Convection	Other Wx	
0 to 15 mins	1 min	15 min	15 min		
> 15 mins to 45 mins	5 min				
> 45 mins to 2 hours	10 min			1 hour	
> 2 hours to 4 hours	15 min		1 hour		
> 4 hours to 60 hours	1 hour	1 hour			
> 60 hours to 14 days	3 hours				6 hours
> 14 days to 90 days	12 hours				

Table N-2b Production Timelines (Temporal Resolution)	Super-Density Terminal Airspace		Designated En Route Terminal Airspace and				Designated Global Terminal Airspace and Global	
			Convection		Other Wx			
FORECAST	Production Rate	Latency	Production Rate	Latency	Production Rate	Latency	Production Rate	Latency
0 to 2 hours	5 min	2.5 min	10 min	5 min	30 min	15 min	3 Hours	90 min
> 2 hours to 4 hours	10 min	5 min	30 min	15 min				
> 4 hours to 10 hours	30 min	15 min	60 min	30 min	60 min	30 min		
> 10 hours to 24 hours	1 hour	30 min	3 hours	90 min	3 hours	90 min		
> 24 hours to 5 days	3 hours	90 min			6 hours	3 hours	6 hours	3 hours
> 5 days to 14 days	6 hours	3 hours	6 hours	3 hours				
> 14 days to 90 days	Monthly	One Day	Monthly	One Day	Monthly	One Day	Monthly	One Day

Table N-2c Horizontal Resolution	Super-Density Terminal Airspace	Designated En Route Terminal Airspace and En Route Airspace	Designated Global Terminal Airspace and Global Airspace
Convection	1/2 km	1 km	10 km
All Other		4 km	

Table N-2d Vertical Resolution	Super-Density Terminal Airspace	Designated En Route Terminal Airspace and En Route Airspace	Designated Global Terminal Airspace and Global Airspace
Top of NAS to 5,000 ft	500 ft	500 ft	
4,900 ft to Surface	100 ft		

Table N-2e Forecast Accuracy - Begin / End Times	Application	Super- Density Terminal Airspace		Designated En Route Terminal Airspace and En Route Airspace		Designated Global Terminal Airspace and Global Airspace
		Convection	Other Wx	Convection	Other Wx	
0 to 15 mins	ATM	± 2.5 min	± 5 min	± 15 min		
> 15 mins to 45 mins						
> 45 mins to 2 hours						
> 2 hours to 4 hours		± 5 min				
> 4 hours to 10 hours		± 15 min	± 15 min			
> 10 hours to 24 hours	Next Day Plan	± 30 min				± 1 hour
> 24 hours to 60 hours	AOC Plan					
> 60 hours to 14 days	NAS Outlook	± 1 hour				± 3 hours
> 14 days to 90 days		± 12 Hours				

Table N-2f Forecast Accuracy - Bases / Tops	Super-Density Terminal Airspace	Designated En Route Terminal Airspace and En Route	Designated Global Terminal Airspace and Global Airspace
0 to 2 hours		250 ft	
5,000 ft - Top of NAS	250 ft		
Surface to 4,900 ft	50 ft		
> 2 hours to 4 hours			
5,000 ft - Top of NAS	250 ft		
Surface to 4,900 ft	50 ft		
> 4 hours to 10 hours		500 ft	
5,000 ft - Top of NAS	500 ft		
Surface to 4,900 ft	100 ft		
> 10 hours to 24 hours			
5,000 ft - Top of NAS	500 ft		
Surface to 4,900 ft	100 ft		
> 24 hours to 60 hours		1,000 ft	
5,000 ft - Top of NAS	1,000 ft		
Surface to 4,900 ft	150 ft		
> 60 hours to 14 days		1,500 ft	
5,000 ft - Top of NAS	1,500 ft		
Surface to 4,900 ft	250 ft		
> 14 days to 90 days (Surface to Top of NAS)	3,000 ft		

Table N-2g Forecast Accuracy - Location (Lat/Long)	Super-Density Terminal Airspace	Designated En Route Terminal Airspace and En Route Airspace		Designated Global Terminal Airspace and Global Airspace
		Convection	Other Wx	
0 to 15 mins	1/4 km	1/2 km	2 km	5 km
> 15 mins to 45 mins				
> 45 mins to 2 hours				
> 2 hours to 4 hours		1 km		
> 4 hours to 10 hours	1/2 km	2 km	2 km	
> 10 hours to 24 hours				
> 24 hours to 60 hours	1 km			
> 60 hours to 14 days	2 km	4 km		8 km
> 14 days to 90 days	12 km			

Table N-2h Forecast Skill Verification	Super-Density Terminal Airspace	Designated En Route Terminal Airspace and En Route Airspace	Designated Global Terminal Airspace and Global Airspace
0 to 15 mins	95%	92%	88%
> 15 mins to 45 mins			
> 45 mins to 2 hours	92%		
> 2 hours to 4 hours	90%	88%	
> 4 hours to 10 hours	88%	85%	82%
> 10 hours to 24 hours	85%	82%	80%
> 24 hours to 60 hours	75%	75%	75%
> 60 hours to 14 days	60%	60%	60%
> 14 days to 90 days	55%		

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**TERMS OF REFERENCE OF
THE ASIA/PAC MET/ATM TASK FORCE (PROPOSED)**

TERMS OF REFERENCE

a) Evaluate the current and future requirements for MET in support of ATM (includes ATFM) in the ASIA/PAC Region and update Regional Air Navigation Plan accordingly and provide guidance material to assist States to develop MET services to meet these requirements.

b) Assess aviation meteorological services, systems and architecture in the region and how they can integrate weather information into decision support tools.

c) Investigate sub-regional exchange of MET information and associated agreements that facilitate ATM operations particularly over busy routes that overlap different FIRs.

d) Promote ~~communication~~ coordination between MET and ATM communities in the ASIA/PAC Region to enhance the level of understanding of MET requirements and capabilities in support of ATM.

e) Report to the CNS/MET Sub-group of APANPIRG for further co-ordination through the ICAO Secretariat with other relevant bodies.

~~Monitor the emerging capabilities and developments of MET and as necessary update regional plans for the implementation of MET services and facilities.~~

MEMBERSHIP

Australia (Chair), China, Hong Kong, China, Japan, New Zealand, United States, IATA

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REPORT ON

ASIA/PAC MET/ATM COORDINATION SEMINAR

Bangkok, Thailand 8 - 10 February 2006

1. GENERAL

1.1 Purpose of the seminar

1.1.1 The Seminar was organized by the ICAO Regional Office, Bangkok, as a follow-up of APANPIRG Conclusion 14/45, *Fostering of exchanges between MET and ATM*. The purpose of the seminar was to provide a forum for exchange of information on the current and future requirements for meteorological services (MET) in support of air traffic management (ATM).

1.1.2 The seminar was also aimed at furthering the development of the MET component of the Regional Plan for the New CNS/ATM. In this regard, developments of new MET products in the Asia/Pacific States to meet the emerging ATM requirements were to be reviewed and discussed.

1.2 Attendance

1.2.1 The Seminar was attended by 50 participants from 16 Asia/Pacific States, the Russian Federation, the United Kingdom, the United States, and IATA. The participant from Hong Kong, China acted also as WMO observer.

1.2.2 The ATM and MET sections of the ICAO Regional Office provided secretarial support to the seminar. Mr. Ted Williams, Bureau of Meteorology, Australia, who is Chairman of the MET/ATM Task Force of the CNS/MET Sub-group of APANPIRG, chaired the seminar.

1.2.3 A list of participants is in Attachment A to the report.

1.3 Programme of the seminar

1.3.1 A copy of the seminar programme is given in Attachment B.

2. REPORT ON ACTIVITIES

2.1 Participants were welcomed by Mr. Shaukat Ali, Deputy Regional Director. Mr. Ali outlined the trends in the aviation development in the Asia/Pacific region, which were marked by a stable growth, higher than for the rest of the world. He emphasized that the fast growing aviation activity in the region required adequate air traffic management and underscored in this regard that the coordination between MET and ATM was essential. This coordination had several levels – national, regional and global; improving the mutual understanding of requirements and capabilities through dialogue, such as this seminar, was of crucial importance for both ATM and MET communities. Mr. Ali wished the participants successful work and pleasant stay in Bangkok.

2.2 It was informed that the previous regional event on a similar subject was held 20 years ago; it was the *First ASIA/PAC/MID Seminar on Co-ordination Between Air Traffic Services and Aeronautical Meteorological Services* held in April 1986. The participants felt that in order to enhance the coordination between the MET and ATM communities, more frequent seminars/workshops should be organized in the future.

2.3 The seminar was carried out as a series of presentations and discussion sessions on the five discussion topics included in the seminar programme. The presentations and discussions covered different aspects of the coordination between ATM and MET, as follows:

2.3.1 **Discussion Topics 1 and 2**

Organization of Air Traffic Management (ATM) and Meteorological Services (MET)

- *Authorities and Providers*
- *Current and proposed organizational frameworks and consultative mechanisms*
- *ICAO SARPs and guidance material*

2.3.1.1 The ICAO provisions and guidance relating to the MET and ATM coordination arrangements were discussed. Participants were provided with excerpts of relevant material from various Annexes and documents. While MET and ATM experts were generally familiar with Annexes and documents relevant to their areas of expertise, they were not necessarily aware of provisions contained in Annexes and documents which did not relate to their disciplines. In this regard, the Manual on Coordination between Air Traffic Services, Aeronautical Information Services and Aeronautical Meteorological Services (Doc 9377) was recognized as highly valuable in drawing together the disparate components of the various regulatory documentation.

2.3.1.2 It was explained that air traffic management (ATM) included several components, as follows: air traffic services (ATS), airspace management and air traffic flow management (ATFM). It was noted in this regard that the current Annex 3 provisions referred only to one of these components, ATS. However, the other components of ATM were also “weather dependant” and would require specific meteorological services. The group felt that further effort should be undertaken to study these requirements at national and regional level.

2.3.1.3 A number of States presented information on the organization and structure of both ATM and MET services demonstrating a range of frameworks which can work effectively within ICAO provisions. The discussion of different arrangements and structures for service provision was very informative.

2.3.1.4 The seminar noted the trend towards the establishment of specialized MET units in support of ATM flow and airspace management. The importance of basic training of both MET in ATM and ATM in MET was discussed.

2.3.1.5 ATM/MET consultative mechanisms in various States were also discussed. The ICAO safety audit process was cited as motivating several States to formalize coordination arrangements between ATM and MET. One State informed the seminar of problems due to a State policy of not allowing formal agreements within the same government department; the issue of formalizing arrangements was eventually overcome through an exchange of letters. To

facilitate the establishment of formal arrangements between MET and ATM providers, the sample letter of agreement contained in Doc 9377 was presented in some detail.

2.3.2 **Discussion Topic 3**

Meteorological impacts on ATM and MET information required for ATFM

2.3.2.1 The seminar was interested to hear the high impact of meteorological phenomena on ATFM with several States providing detailed presentations of procedures and products developed to mitigate the impacts. These procedures generally employed a collaborative decision making (CDM) approach involving MET, ATM and airlines. It was noted that information required for ATFM was often not available from the suite of traditional OPMET data; examples were presented where changes to cloud base well above operational minima could half the aircraft acceptance rate at an airport. Various MET/ATM decision support tools and procedures dealing with incorporating MET into the ATFM process were presented. The group was informed that some States were focusing on developing tactical decision aids where forecast weather elements were translated to ATC impacts.

2.3.2.2 The seminar was informed of the impact of turbulence and mountain waves on RVSM and related guidance in ICAO Doc 9574 (*Manual on Implementation of a 300 m (1 000 ft) Vertical Separation Minimum Between FL 290 and FL 410 Inclusive*). Discussion revealed that the WAFC London recently conducted a workshop on turbulence and icing to improve the accuracy of WAFS forecasts of these phenomena. The MET participants felt that there was also potential to develop forecasts indicating the potential of wake turbulence at altitude to be used by ATM and that access to information on large deviations from the regional monitoring agencies would assist with analysis of the issue.

2.3.2.3 Meteorological impacts causing “large-scale weather deviations” (LSWD) from the planned air routes were discussed. Asia/Pacific Region is often influenced by tropical cyclones and volcanic ash clouds, which are among the most important phenomena causing LSWD. The importance of providing the ATM units with forecasts and advisories of these phenomena were emphasized.

2.3.2.4 The group was interested to hear of developments to VA graphics and procedures emanating from the IAVWOPSG. A presentation demonstrating the complex interactions between vulcanological, meteorological and ATC organizations required to provide a VA watch and warning service was also presented. The need for formal arrangements at national and regional level, as well as for developing national ATM contingency plans was stressed.

2.3.3 **Discussion Topic 4**

Use of meteorological information by ATM.

2.3.3.1 The group discussed inherent uncertainties and limitations in forecasting meteorological parameters. The group noted the greatly improved ability to forecast broad scale weather features through computer modeling in recent years and the move to forecast to higher spatial and temporal resolutions.

2.3.3.2 The use of categorical forecasts contained in traditional MET products was discussed and it was recognized that ATM were interested in alternative scenarios and

probabilities which could be incorporated in their planning process. Examples of the use of MET information by ATM, including alternative scenarios, were presented and discussed.

2.3.3.3 Forecast verification was briefly discussed with the group noting that scientific verification is in many cases not relevant to users and that verification should be focused on providing meaningful performance information to a range of users.

2.3.4 **Discussion Topic 5**

Future requirements – MET component of CNS/ATM System

2.3.4.1 A range of current and future ATM systems and initiatives were presented with the focus on their requirement for meteorological input. The seminar was pleased to note that the need for meteorological input had generally been recognized at the planning stage. It was realized that very complex advanced system, such as the New Generation Air Transport System in the USA (NGATS 2025), would apply weather-assimilated decision making, and that the implementation of such systems would require optimization of the global aviation weather services.

2.3.4.2 A number of MET products and services tailored specifically for ATM were presented by a number of States: Australia, Hong Kong, China, Japan, the USA, Republic of Korea. While many of these relied on sophisticated software, the meeting noted that in less complex organizational structures requirements could be met through elaborative briefing services, some of which had been developed as a result of collocating forecasters with ATM operational decision makers.

2.3.4.3 The meeting noted the tendency of developing decision supporting ATM-tailored products, in which the meteorological information is transformed into risk assessment information. Also, the participants widely supported the transition from alphanumeric to graphical products which were more informative and easier to interpret for the ATM users.

3. OUTCOMES AND RECOMMENDTAIONS

3.1 The presentations were recorded on CD-ROM and made distributed to the participants.

3.2 The participants expressed a general opinion that the seminar was very useful and fulfilled its goals, as formulated by APANPIRG.

3.3 The seminar formulated recommendations for consideration by the ATM/AIS/SAR/15 meeting (June, 2006) and CNS/MET SG/10 meeting (July 2006), as follows:

- Study further the ATM requirements and establish a set of general requirements for MET services/products (a regional survey to be carried out by the MET/ATM task Force);

- Update Chapter 11, Meteorology, of the regional plan for CNS/ATM systems and include information about ATM-tailored MET products developed by the States in the region (as presented at the seminar);
  - *Note: The update of Chapter 11 to be done after the adoption of the new Global ANP*
- Encourage the CNS/MET SG to discuss the need for developing provisions related to MET services in support to ATM;
- Stress the importance of weather information as a key factor in the future air navigation systems;
- Encourage more frequent exchanges between MET and ATM in a similar format (seminar or workshop) with a periodicity of 3 to 4 years;
- Express strong support to the development of graphical MET products tailored to ATM requirements;
- Improve the coordination between CNS/MET SG and ATM/AIS/SAR SG on issues related to the provision of meteorological services for air traffic management (present a working paper on the seminar outcomes to both meetings in 2006)

ATTACHMENTS:

A: List of Participants
B: Seminar Programme

RESULTS OF REGIONAL SURVEY ON ATM REQUIREMENTS FOR MET

Table 1 - Deficiencies and Suggested Improvements

Deficiencies and suggested improvements		
MET element	**Number of States providing comment**	**Summary of comments:**
Surface Wind:	4	2 min average preferred Move to digital sensors desired Improved presentation desired (no further details given) Forecast confidence/alternative scenarios would be beneficial Longer lead times Reliability of equipment Forecast accuracy Lack of ATM specific information
Surface Wind Gusts	2	Required for individual runways (assume forecasts) Reliability of equipment, Forecast accuracy Improved presentation desired (no further details given) Lack of ATM specific information
Visibility	4	Multiple visibilities (manual, automated, sector, threshold etc) require simplification Concerns with location of observing site ATM thresholds should be reflected by forecasts Reliability of equipment Forecast accuracy Improved presentation desired (no further details given) Lack of ATM specific information
RVR	3	Accuracy/Observing equipment limitations Improved presentation Lack of ATM specific information

Deficiencies and suggested improvements		
MET element	**Number of States providing comment**	**Summary of comments:**
Vertical Visibility	1	Concerns with location of observing site
Significant weather TS	5	Greater lead time desirable Real- time display requested Lack of spatial/temporal resolution forecast and observed Weather radar overlays, lightning network and satellite information desirable Integration of Met into ATC decision support tools suggested. Graphical displays focussed on ATM specific requirements desired Development of warning on significant weather customised to particular sectors should be considered
Significant weather SN	2	Greater lead time desirable Weather radar overlays requested
Significant weather RA	1	Integration of Met into ATC decision support tools suggested. Graphical displays focussed on ATM specific requirements desired Development of warning on significant weather customised to particular sectors should be considered
Cloud base/amount	4	Concerns with location of observing site and accuracy and reliability of equipment Greater use of satellite imagery (training required) would be beneficial ATM thresholds should be reflected by forecasts Presentation/display could be improved. Should include current and short term forecasts and emphasise ATM thresholds
Turbulence (Terminal)	2	Variation between forecast and observed (accuracy) Integration of Met into ATC decision support tools suggested Graphical displays focussed on ATM specific requirements desired Development of warning on significant weather customised to particular sectors should be considered
Wake Turbulence/Vortex information	3	Forecast values requested

Deficiencies and suggested improvements		
MET element	**Number of States providing comment**	**Summary of comments:**
Turbulence (Enroute)	2	Accuracy limitations Integration of Met into ATC decision support tools suggested. Graphical displays focussed on ATM specific requirements desired Development of warning on significant weather customised to particular sectors should be considered
Upper Winds	1	Integration of wind information into ATC tools would allow more efficient use of information
Icing	1	Presentation needs improving
Wind shear	3	Accuracy/Variation between forecast and observed Observed only - forecast information would be beneficial
TC	0	
VA	0	
TAF	1	Accurate short term information required - concerns over use of long term TAF

Table 2 - MET support in addition to Annex 3 products

Advice on Terminal Weather available to ATM Authority	**Advice on En-route Weather available to ATM Authority**
Phone consult/briefing, tailored elaborative briefing products	Weather radar access
Audio/visual consult/briefing, weather radar/satellite displays	Plain language adverse weather summary product, weather radar/satellite displays
Local routine reports, graphical display of forecast elements	Daily briefings
Daily briefings	Web based products
Microburst alarm, wind profiler, Weather radar, lightning warning system	Elaborative phone briefing
Elaborative phone briefing	Radar, Satellite, web access, in-person briefing
text based products, web access, and in-person and telephone briefing services	Web access to AIS/MET
Weather radar and AWOS, wind shear alert systems, graphical lightning display, web access to AIS/MET	
Phone consult/briefing	

Table 3 - Decision Support Tools

Brief Description of Current Tools	**Tools Under Development**
Tailored information for capacity planning, mid level sigwx charts, graphical area QNH product	Radar/lightning TS monitoring display, Satellite with radar and lightning overlay, Graphical TAF monitoring web display
Graphical display of forecast elements, wind shear alert system	Nowcasting system under development
ATM/MET facility to enable information sharing and collaborative decision making	Incorporation of SIGMET and weather radar into ATC display
Real time METAR display in TWR	
AWOS, LLWAS, and limited MET tool for en-route	
Development of MET data display underway	

Table 4 - Comments

Improved awareness of ATC and pilot requirements by aviation forecasters (would be beneficial)
MET observer/forecaster information could be more aviation focussed, potential for more tailoring of MET, reliability of equipment important
It is important Met and ATM have a mutual understanding of MET information and its application to ATC and flight safety

Figure 1
Count of MET Elements Causing Biggest Impact/Greatest Concern

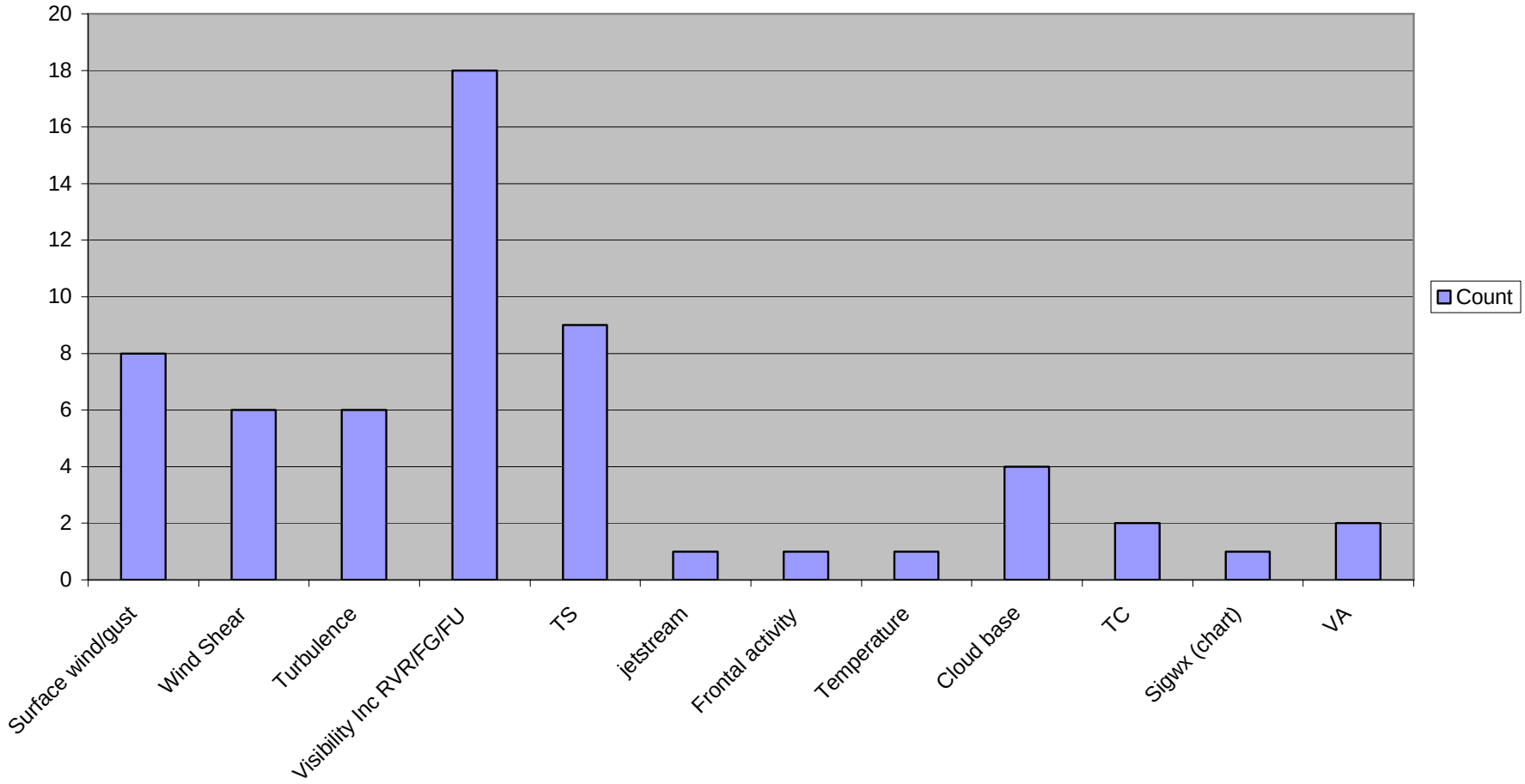
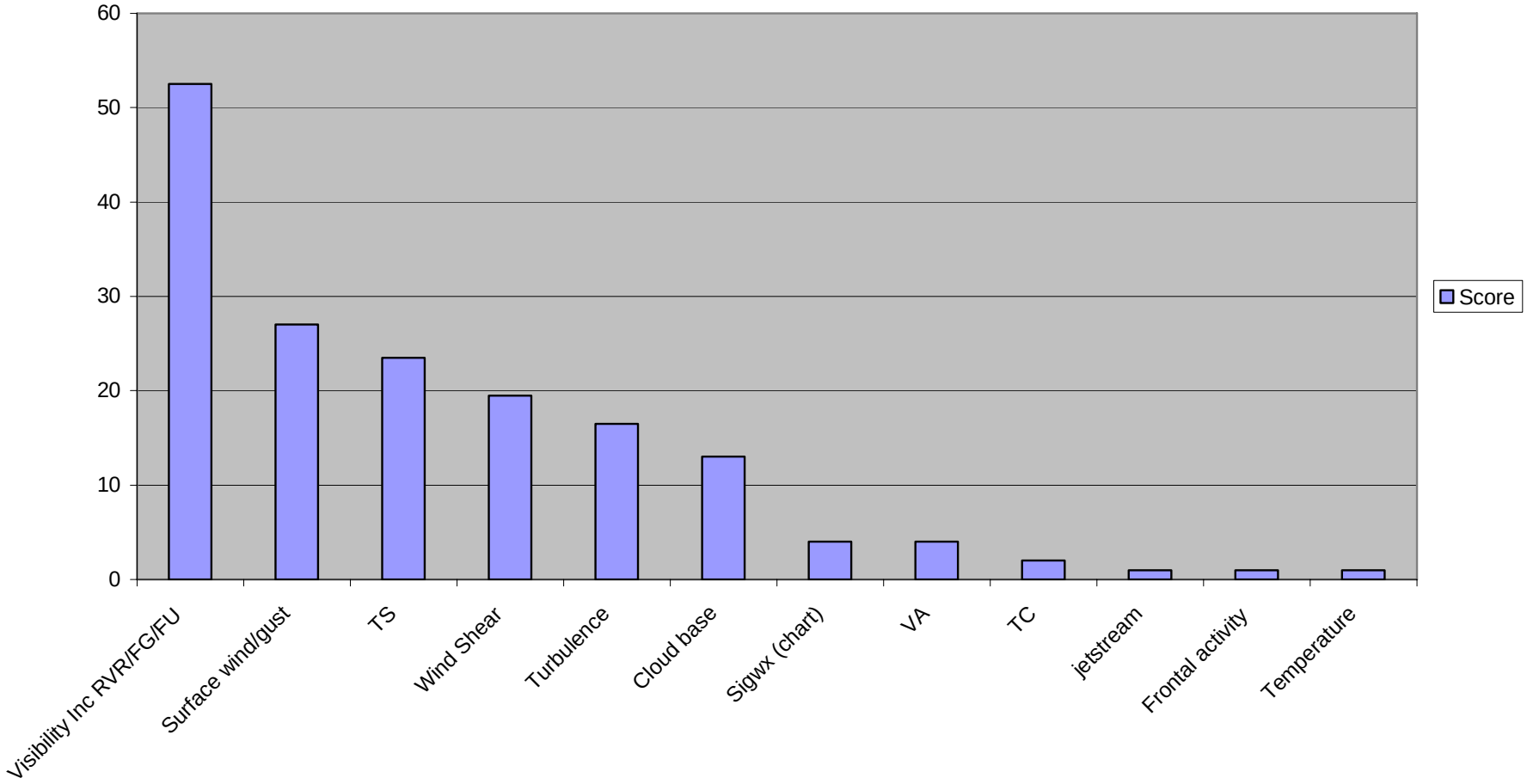


Figure 2
Ranking of MET Elements Causing Biggest Impact/Greatest Concern (after weighting)



Figures for NTF Graphic Prototype

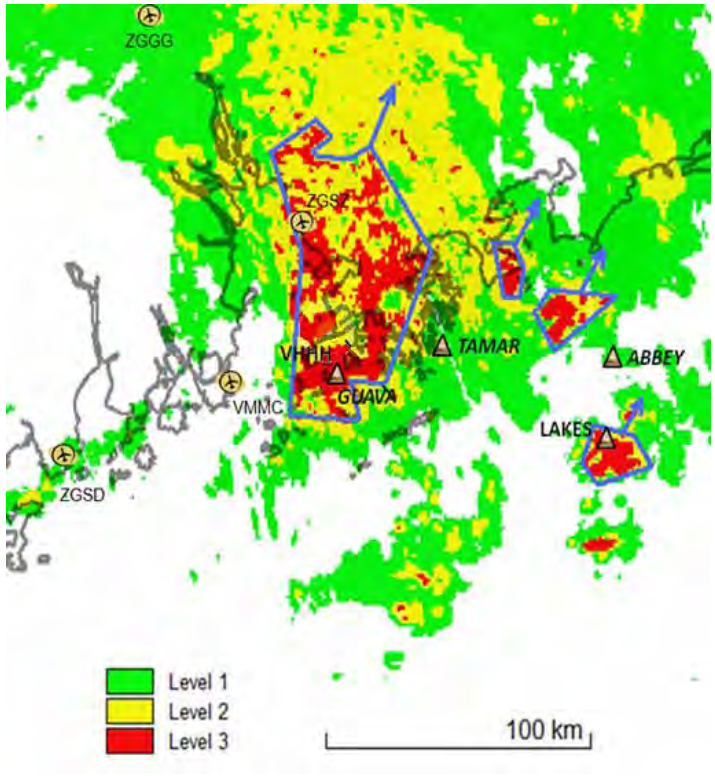


Figure 1a. Potential NTF Convective Nowcast

Area of Interest *(Note A)* \ Forecast Time (UTC) *(Note B)*	HHMM	HHMM + X	HHMM + 2X	...	HHMM + 1 hour
VHHH					
GUAVA					
TAMAR					
ABBEY					
LAKES					

Note A: Area of Interest (AOI), e.g. waypoint, airport, flight path, arr/dep corridors.
Note B: 5-6 minute interval, depend on radar capability

Figure 1b. Potential Convective Time series

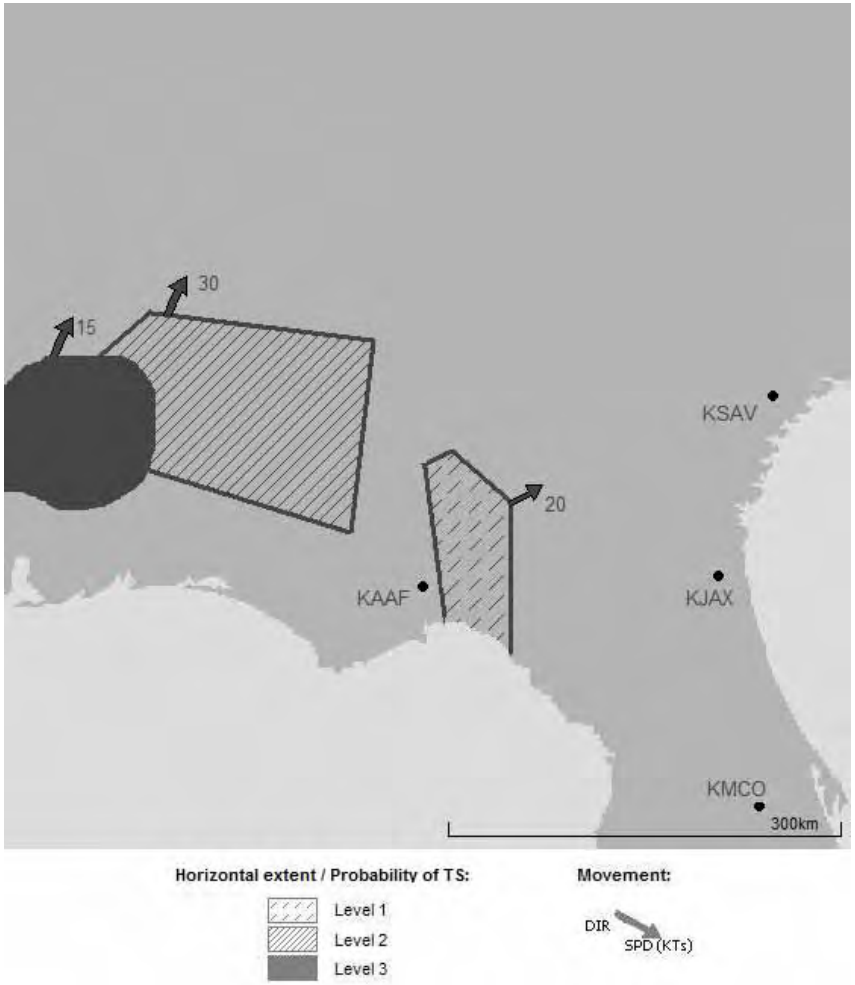


Figure 2a. Potential Convective Short-term Forecast

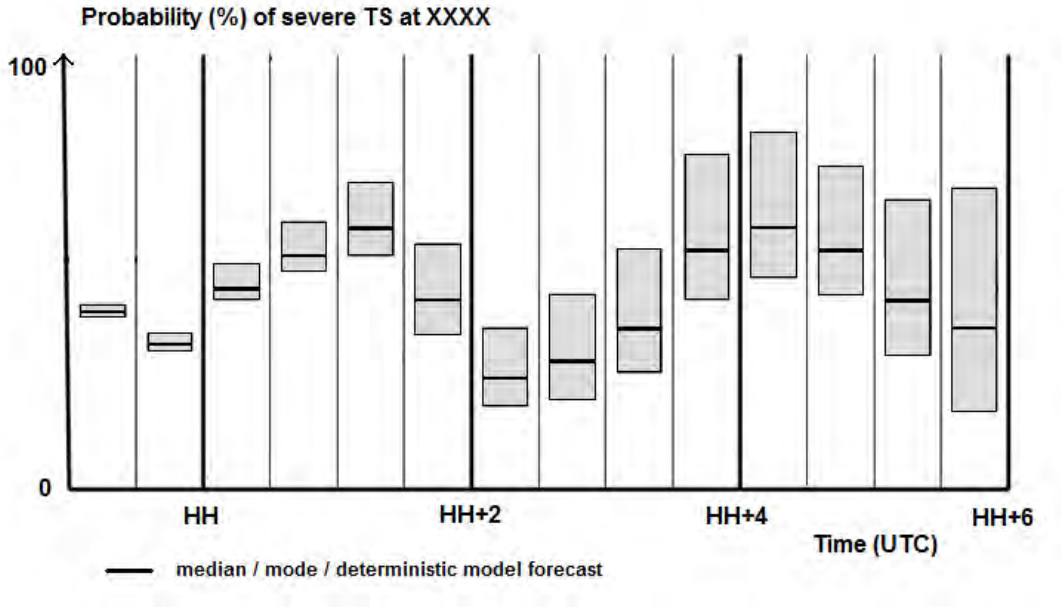


Figure 2b. Potential Convective Probability

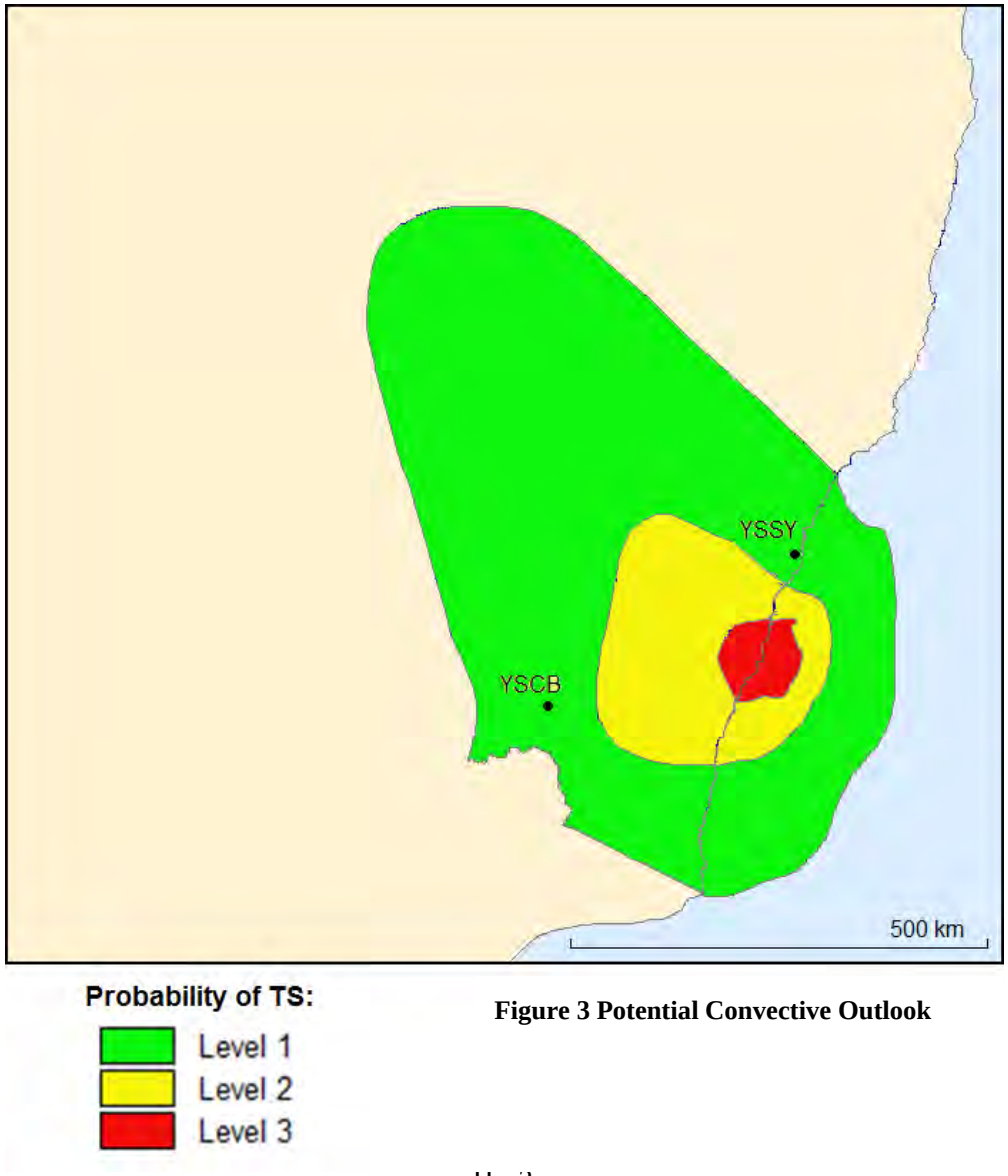


Figure 3 Potential Convective Outlook

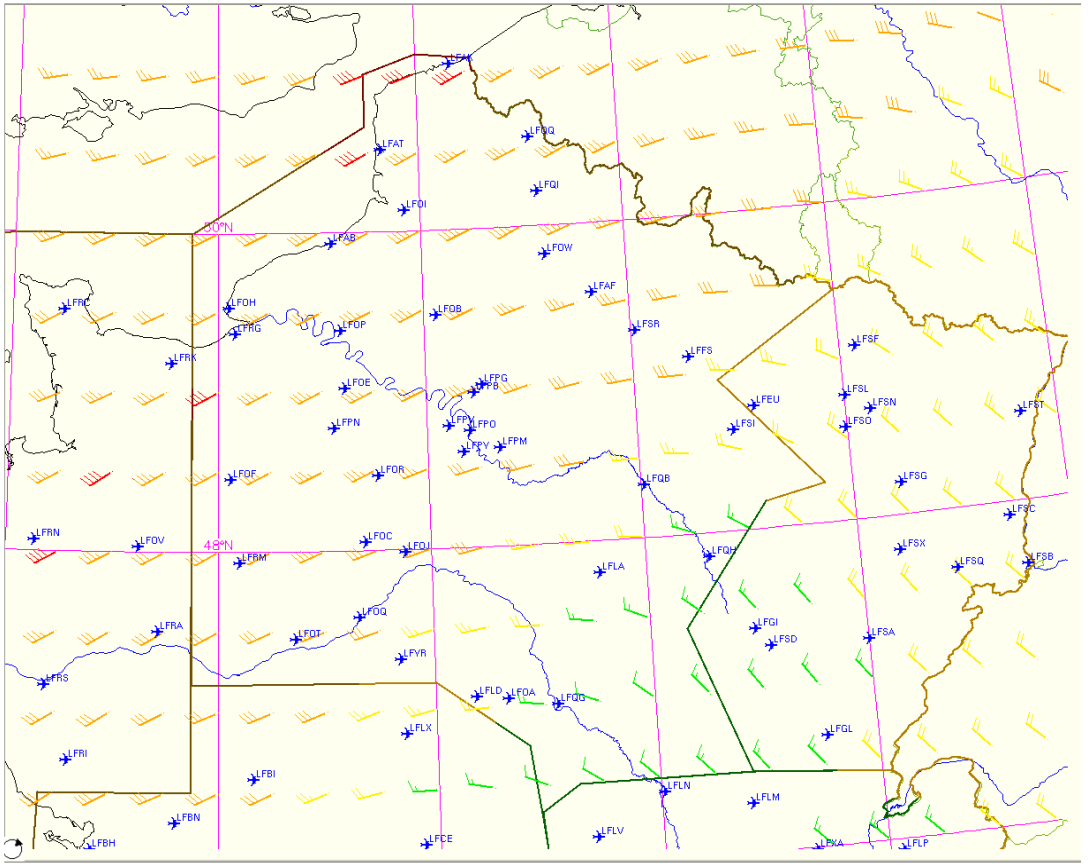


Figure 4. Example of gridded short term wind forecast (STWF) product (different colour representing different wind speed threshold)

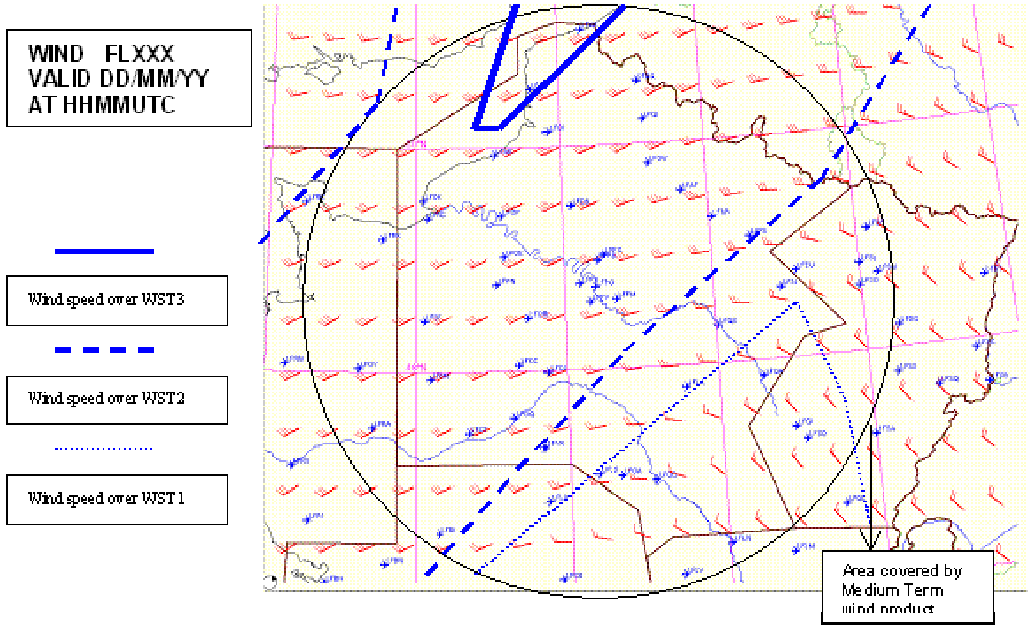


Figure 5. Example of gridded medium term wind forecast (MTWF) product.

Layer 1: gridded data (wind barbs)
Layer 2: Polygon representing forecast area of wind speed reaching certain threshold (objects).
Dotted line: wind speed over wind speed threshold (WST) 1. Dashed line: wind speed over WST 2. Plain line: wind speed over WST3

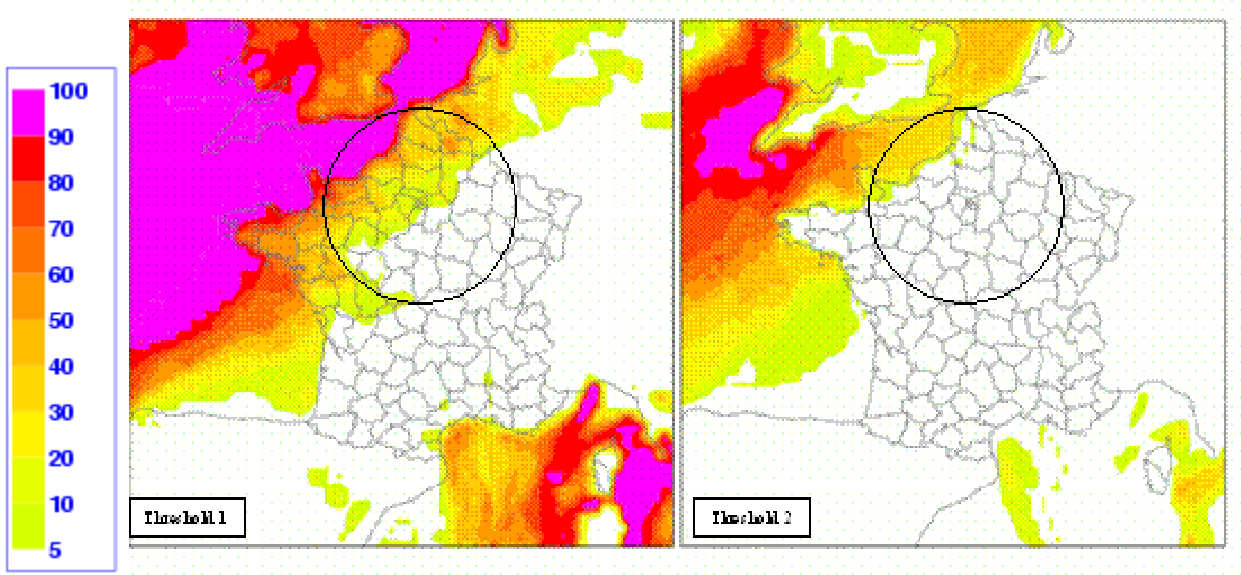


Figure 6. Examples of gridded probabilistic forecast of wind speed over certain threshold (TBD) 10 levels of probability: see legend

Area Of Interest (see 1) /Forecast time	HHMM +1hour	HHMM +2hours	---	HHMM+6hours	HHMM +9hours	---	HHMM+21hours	HHMM+24hours
LFPG airport	26KT 280°	28KT 290°	---	22KT 280°	20KT 300°	---	15KT 320°	15KT 330°
Way point 1	28KT 280°	30KT 290°	---	25KT 300°	20KT 300°	---	15KT 320°	15KT 330°
Way point 2	28KT 280°	30KT 290°	---	25KT 280°	20KT 300°	---	12KT 320°	12KT 330°
Corridor A	15KT 220°	20KT 260°	---	28KT 280°	20KT 300°	---	15KT 300°	15KT 330°
Coriddor B	20KT 270°	---	---	30KT 280°	20KT 300°	---	15KT 320°	15KT 330°
LFPB airport	26KT 280°	28KT 290°	---	22KT 280°	20KT 300°	---	15KT 320°	15KT 330°

Figure 7. Sample tabular form to present time series of wind forecast + probability of wind speed reaching certain threshold (e.g. 25KT)

5 levels of probability:

<20%	> 20%	> 40%	> 60%	>80%

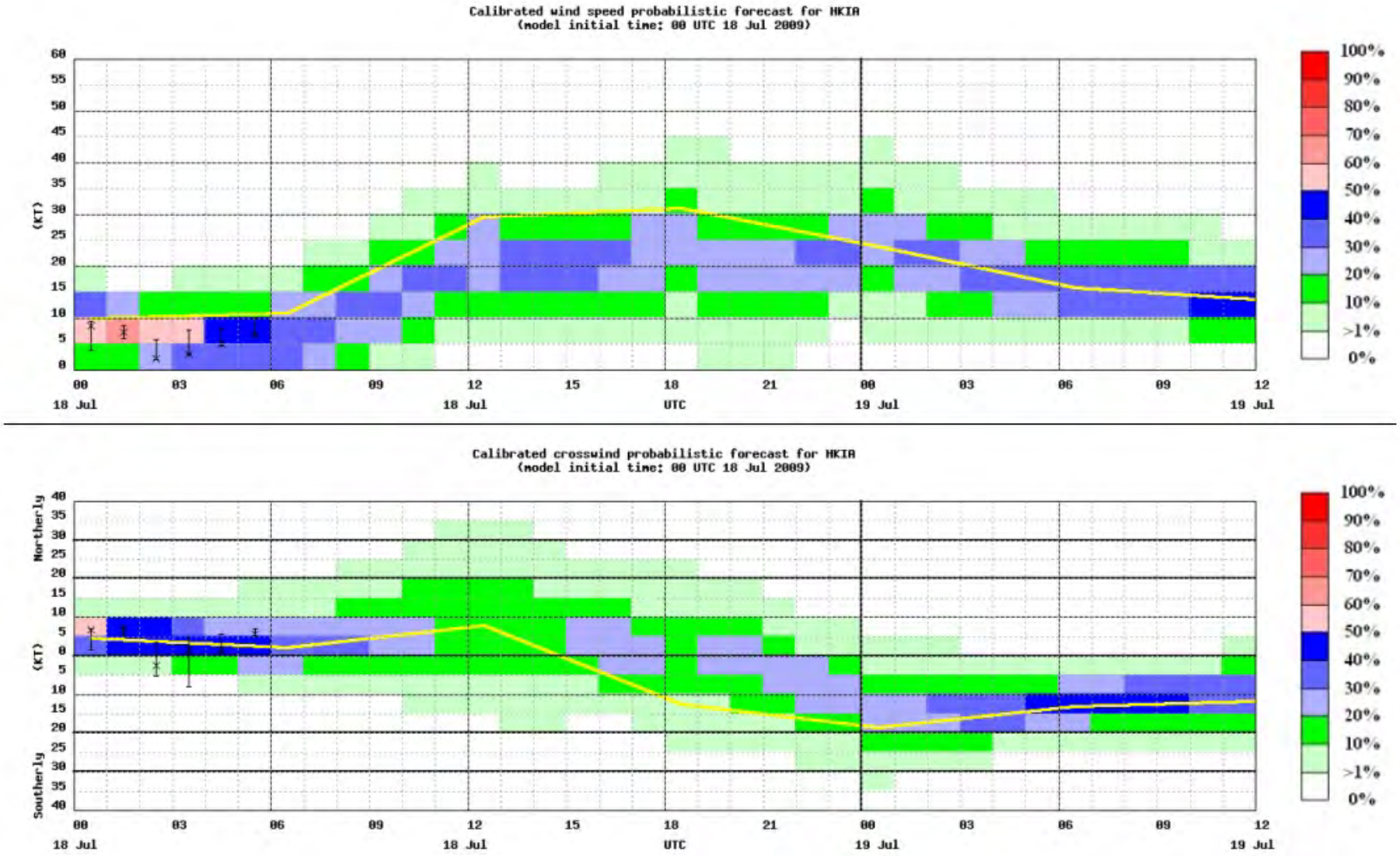


Figure 8. Example of time series deterministic and probabilistic forecast of surface wind (top) and crosswind (bottom) for one aerodrome 10 levels of probability: see legend

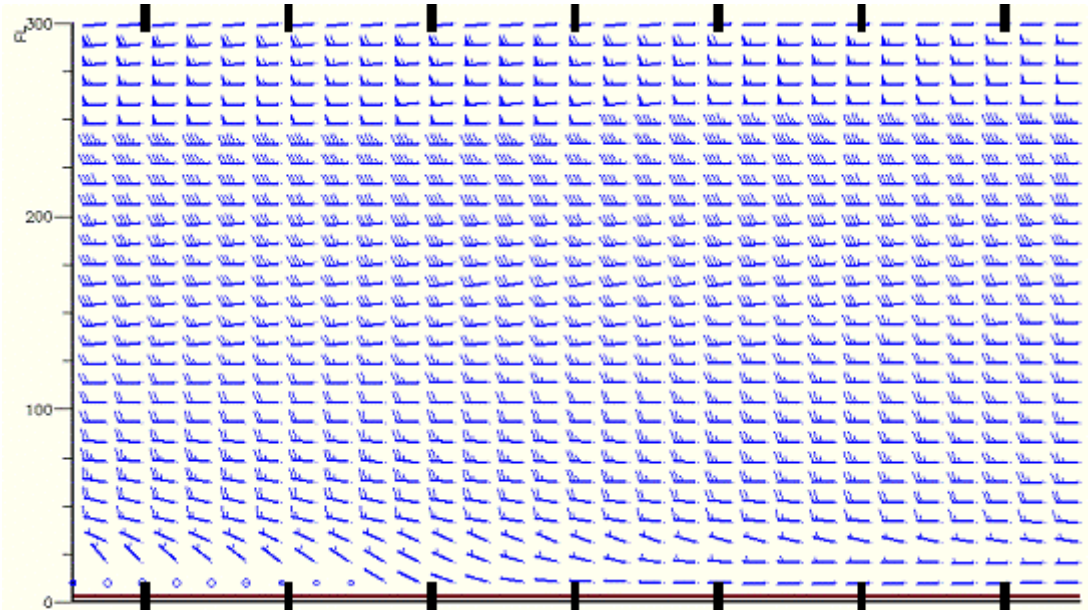


Figure 9a. Example of fixed time wind profiles along approach path resolved in head/tail wind

XXXX = ICAO airport indicator

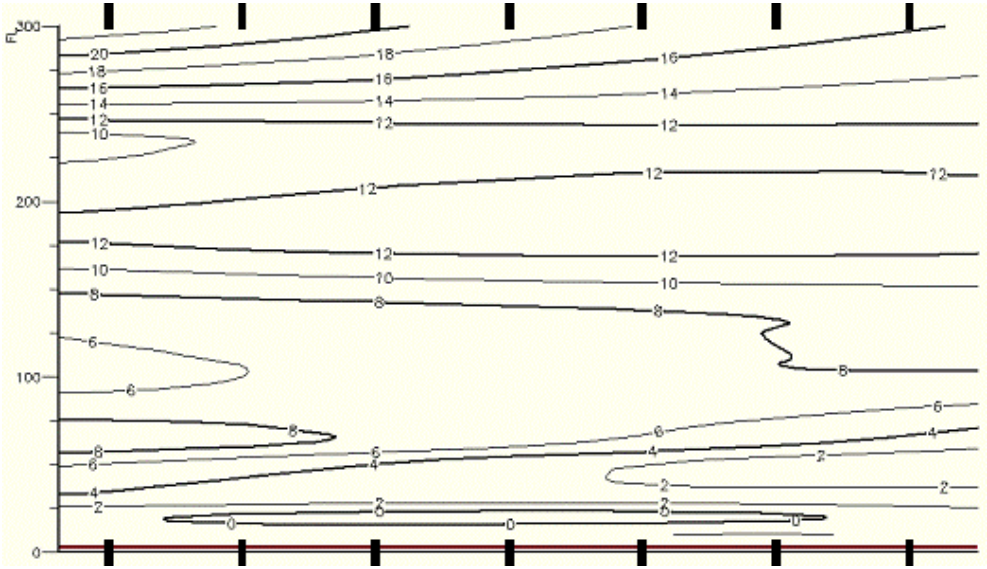


Figure 9b. Example of fixed time wind profiles along runway orientation resolved in crosswind. Runways are east-west oriented. Southerly crosswind intensities are positive, northerly ones are negative.

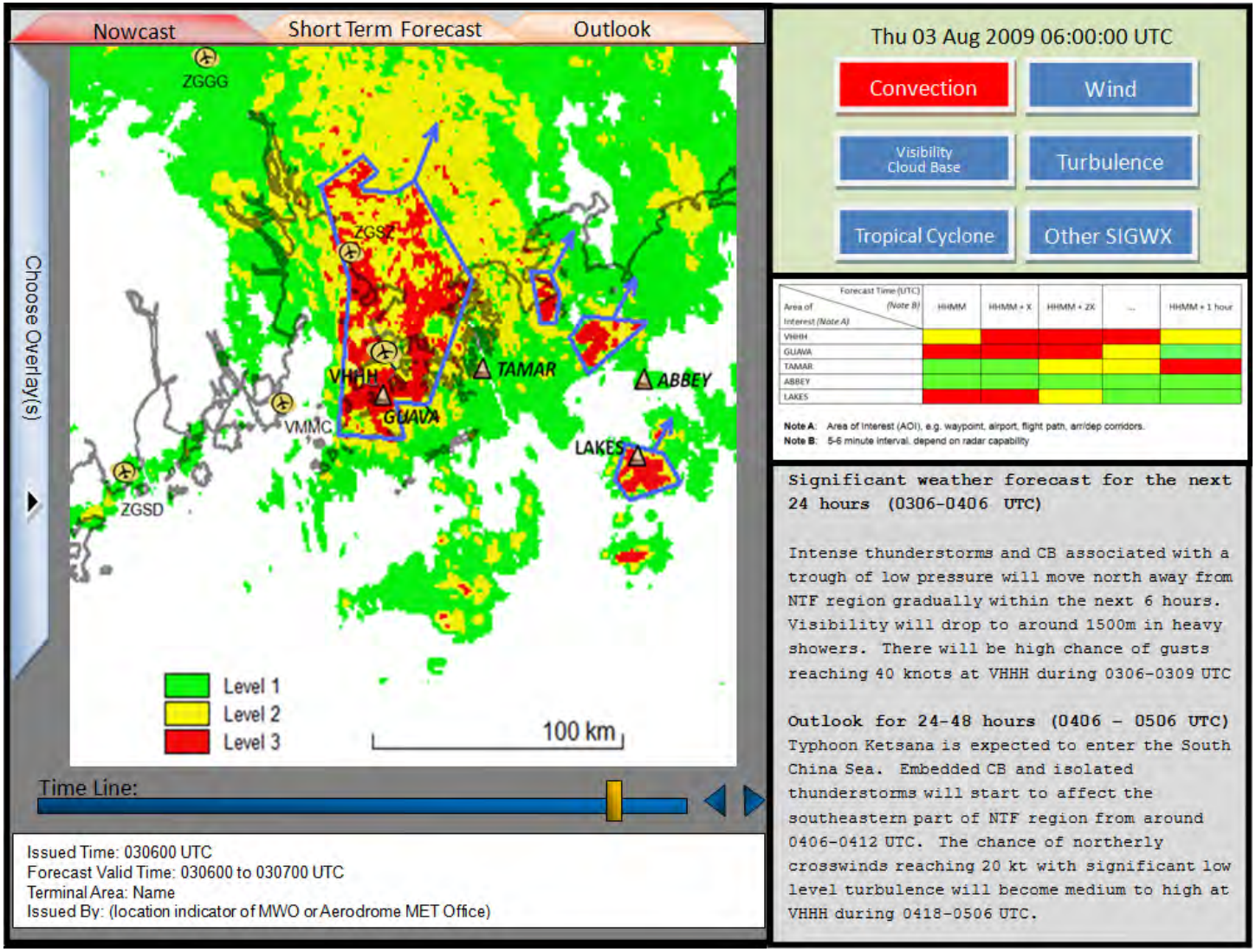


Figure 10. Example of NTF User Interface

Element	**Desirable overall specification**	**Template**						**Examples**
		Nowcast based on weather radar data (0-1 hour)			**Short term convective forecast (STCF) (up to 6 hours) / Convective outlook (CO) (6 hours up to a few days ahead))**			
Convection forecast	Resolution	Horizontal: 500 m or less Vertical: 2D Temporal: 6 minutes interval or less			Horizontal: 2 km or less for up to 6 hours 20 km or less for 6 hours up to a few days ahead Vertical: 2D Temporal: hourly interval or less for up to 6 hours 3-hourly interval or less for 6 hours up to 2 days ahead			
	Update frequency	As soon as weather radar data is available (typically 6-10 minutes)			Every 3 hours or less			
	Geographical range (subject to local arrangement)	Typically within 100 km of the aerodrome			STCF: Typically within 300 km of the aerodrome CO: Typically within 300 km of the aerodrome			
	Desirable content specification	**Description**	**Format**	**Colour**	**Description**	**format**	**Colour**	
Convection forecast	Forecast position/ probability of thunderstorms	Layer 1 Gridded forecast: intensity of TS / probability of TS	Gridded data	Layer 1 At least 3 levels (optional up to 5 levels, grayscale as standard, with option to have color-code : green/yellow/red)	Layer 1 Gridded forecast : horizontal extent (coverage) / probability of TS Forecast snapshot valid at certain time or probability of TS normalized over a period of time	Gridded data	Layer 1 At least 3 levels (optional up to 5 levels, greyscale as standard, with option to have color-code : green/yellow/red)	Nowcast Fig. 1a STCF Fig. 2a
	Forecast position/ probability of	Layer 2 Polygon representing	Object	Greyscale with option of colour-code (blue)	STCF and CO : Layer 2 Polygon representing	Object	Same as above	Nowcast Fig.1a

	thunderstorms	forecast area / probability of TS reaching certain threshold		(hollow/filled)	horizontal extent (coverage) / probability of TS reaching certain threshold			STCF Fig.2a CO Fig.3
	Forecast movement	Layer 3 For layer 2 (polygon) : Arrow : - Pointer : direction of movement - Length of arrow to indicate speed; or speed in XX knots indicated at the end of pointer	Object	blue	STCF: For layer 2 (polygon) : Arrow : - Pointer : direction of movement - Length of arrow to indicate speed; or speed in XX knots indicated at the end of pointer	Object	Grayscale (monochrome) with option of colour-code (blue)	Nowcast Fig.1a STCF Fig.2a
	Time series product	Time series TS forecast for user-specified Area of Interest (AOI) Left column AOI (e.g. waypoint, airport, flight path, arr/dep corridors) Row : probability/intensity of TS forecast at AOI with time step of 6 minutes or less	Tabular	Same as that for layer 1.	STCF: Time series of probability of TS) at AOI with time step of half hour or less CO : Time series of probability of TS) at AOI with time step of one hour	Time series	NA	Nowcast Fig.1b STCF Fig.2b

Textual information on graphical display	Textual information	Actual time (HHMM in UTC) Message issued time : issued at DDHHMM (UTC) forecast valid time (DDHHMM in UTC) – valid at DDHHMM or valid from DDHHMM to DDHHMM Location indicator of Terminal Area/FIR Location indicator of Aerodrome MET Office/MWO originating the product Name of Terminal Area/FIR Legend : meaning of colour code	Follow Annex 3 convention where applicable Terminal Area (names/location indicator -- TBD)

Element	Desirable overall specification	Template						Comments
		Short term wind forecast (STWF) (up to 6 hours)			**Medium term wind forecast (MTWF) (6 – 24 hours, up to 2 days)**			
Wind forecast	Resolution	Horizontal: 0,025° (~2 km) or less Vertical: Each available FL between FL530 and SFC Increased vertical resolution below 3000ft (optional) Temporal: hourly interval or less			Horizontal: 0,5° (less than 2°) for 6-24 hours up to 2 days ahead Vertical: Each available FL between FL530 and SFC Temporal: 3-hourly interval for 6 –24 hours, 6 hours up to 2 days ahead			
	Update frequency	Numerical model update frequency (every 6 hours or less)			Numerical model update frequency (every 6 hours or less)			
	Geographical range	Typically within 50NM/100 km of the aerodrome			Typically within 150NM/300 km of the aerodrome			Subject to local arrangement
	Desirable content specification	**Description**	**Format**	**Displaying specification**	**Description**	**Format**	**Displaying specification**	**Examples**
Wind forecast	Forecast speed and direction of wind	Layer 1 : 4D gridded forecast: Speed and direction (wind barbs)	Gridded data	Wind speed thresholds : several sizes of wind barb if monochrome or colors for wind barb (e.g. green/yellow/amber/red)	Layer 1 : 4D gridded forecast: Speed and direction (wind barbs)	Gridded data	Wind speed thresholds : several sizes of wind barb if monochrome or colors for wind barb (e.g. green/yellow/amber/red)	STWF Fig. 4
	Forecast speed and direction of wind	Layer 2 : Polygon representing forecast area of wind speed reaching certain threshold + Textual information Could be superimposed with Layer 1	Object	Blue (light blue if dark background) 3 types of line (plain, dashed, dotted)	Layer 2 : Polygon representing forecast area of wind speed reaching certain threshold + Textual information	Object	Blue (light blue if dark background) 3 types of line (plain, dashed, dotted)	MTWF Fig. 5

	Wind speed probabilistic forecast	4D gridded forecast: probabilities of wind speed over certain threshold	Gridded data	Less than 10 levels of probability of wind speed over certain threshold	4D gridded forecast: probabilities of wind speed over certain threshold	Gridded data	Less than 10 levels of probability of wind speed over certain threshold	Fig. 6
	Time series product	Time series surface and/or low-level wind forecast for user-specified Area of Interest (AOI) : Left column : Area Of Interest (e.g. waypoint, airport, flight path, arr/dep corridors) Row : Time series of wind speed and direction forecast + probability of wind* speed <u>reaching certain threshold</u>, at AOI with time step of one hour	Tabular	Wind speed and direction : textual information Probability : less than 10 levels , colour-coded	Time series high level wind forecast for user-specified Area of Interest (AOI) : Left column Area Of Interest (e.g. waypoint, airport, flight path, arr/dep corridors) Row : Time series of wind speed and direction forecast + probability of wind* speed <u>reaching certain threshold</u>, at AOI with time step of three hours for 6-24 hours, 6 hours up to 2 days.	Tabular	Wind speed and direction : textual information Probability : 5 levels , colour-coded	Fig. 7 (with 5 levels of probability) * Time series forecast could also produced for crosswind speed reaching certain threshold
	Time series product	Time series surface and/or low-level wind forecast for one aerodrome : deterministic and probabilistic forecast of wind speed *(and direction if needed)*, with a one hour time step Horizontal axis : time step Vertical axis : wind** speed in KT	Graphical	Deterministic forecast : line *(or wind barb)* Probability : 5 levels , colour-coded	Time series high level wind forecast for one aerodrome : Deterministic and probabilistic forecast of wind speed with time step of three hours for 6-24 hours, 6 hours up to 2 days. Horizontal axis : time step Vertical axis : wind** speed in KT	Graphical	Deterministic forecast : line (or wind barb) Probability : 5 levels , colour-coded	Fig. 8 ** Time series crosswind forecast could also be part of the wind product

	Fixed time wind profiles along approach path	Forecast wind information resolved in crosswind/head- and tail- wind in relation to approach path and runway orientation, at several time steps	Graphical	Wind barbs for head- and tail- wind ; intensity (+/-) for crosswind	Forecast wind information resolved in crosswind/head- and tail- wind in relation to approach path and runway orientation, at several time steps	Graphical	Wind barbs for head- and tail- wind ; intensity (+/-) for crosswind	Fig. 9
Textual information on graphical display	Textual information	Actual time (HHMM in UTC) Message issued time : issued at DDHHMM (UTC) Forecast valid time (DDHHMM in UTC) – valid at DDHHMM or valid from DDHHMM to DDHHMM Location indicator of Terminal Area/FIR Location indicator of Aerodrome MET Office/MWO originating the product Name of Terminal Area/FIR Legend : meaning of color code						Follow Annex 3 convention where applicable Terminal Area (names/location indicator -- TBD)

ASIA/PACIFIC REGION
AIR TRAFFIC FLOW MANAGEMENT (ATFM) SURVEY

1. General

1.1 The objective of this survey is to obtain information in order to learn about the current status of ATFM in Asia/Pacific States and Organizations with respect to:

a) The methods for estimating airport and ATC capacity;
b) ATFM procedures for the following phases:
   - Airport strategic
   - Airport tactical
   - Airspace strategic
   - Airspace tactical
c) Existing and planned equipment/infrastructure capable of supporting ATFM collaborative decision making (CDM), display and analysis; and
d) related matters included meteorology, AIS and map aspects related to ATFM provision.

1.2 This information will beneficial in enabling APANPIRG to fulfil its overall planning and harmonizing objectives. Accordingly, APANPIRG/20 (September 2009) adopted Conclusion 20/13 calling for the conduct of a regional ATFM survey during 2010

1.3 Mark with an "X" the corresponding answer. Please include your comments, if you deem pertinent. If necessary, use additional sheets. As applicable, send copies of requested electronic documents to the ICAO Asia/Pacific Regional Office icao_apac@bangkok.icao.int

1.4 Effective coordination with the relevant stakeholders should be made by the entity responsible for collating inputs for that State (i.e. ensure that a copy of this questionnaire has been sent to the State's MET Authority as components of this survey depend on MET input and coordination with your MET Authority in obtaining input for the relevant sections of the survey maybe necessary).

2. Airport Capacity

2.1 Does your administration (and/or State) currently have a method, whether basic or complex, for calculating airport capacity? If yes, please send an electronic copy of the methodology to icao_apac@bangkok.icao.int

☐ YES ☐ NO

2.2 If yes, please provide any available airport capacity data for your main airports in the following table. Please note that for this table:

Total Capacity = Airport Acceptance Rate (AAR) + Airport Departure Rate (ADR).

Airport Name	Runway configuration	Airport Acceptance Rate (AAR) VFR	MVFR	IFR	Airport Departure Rate (ADR)	Total Capacity

Table 1

Comments

_____

_____

_____

3. En-route Sector Capacity

3.1 Does your administration (and/or State) currently have a method, whether basic or complex, for calculating enroute sector capacity? If yes, please send an electronic copy of the methodology to icao_apac@bangkok.icao.int

☐ YES ☐ NO

3.2 If yes, please provide any available airport capacity data for your main airports in the following table. Under the "Time Increments" column, please indicate if the sector capacity is computed by 15-minute increments, 60-minute increments, or some other increment.

ACC	Sector Name	Sector Altitudes	Sector Capacity	Time Increments

Table 2

Comments

_____

_____

_____

4. Procedures for Phases of ATFM

4.1 Does your administration (and/or State) currently have procedures/arrangements in place to support the following phases of ATFM?

a) Airport Strategic

☐ YES ☐ NO

b) Airport Tactical

☐ YES ☐ NO

c) Airspace Strategic

☐ YES ☐ NO

d) Airspace Tactical

☐ YES ☐ NO

Comments

_____

_____

_____

5. Flow Management Data Processing and Display

5.1 Does your administration (and/or State) have a system to receive, process, and display flight plan data (FPL, RPL, etc.)?

☐ YES ☐ NO

5.2 Does your administration (and/or State) have a database that includes airspace information (for example, ACC boundary coordinates, sector boundary coordinates, NAVAIDS, airways, special use airspace) and airport information (for example, runway and taxiway layout, ramp layout, parking gate information)?

☐ YES ☐ NO

5.3 Does your administration (and/or State) have an electronic ATFM system that displays airborne traffic?

☐ YES ☐ NO

5.4 Does your administration (and/or State) have a communication system that allows automated or manual exchange of messages to support ATFM decision making (for example, SLOT assignment messages, SLOT adjustment messages, delay reporting messages, alternate route messages)?

☐ YES ☐ NO

5.5 Does your administration (and/or State) have a system to monitor and display the airport acceptance rates (AAR) at the main airports?

☐ YES ☐ NO

5.6 Does your administration (and/or State) have a system to monitor and display enroute sector capacity?

☐ YES ☐ NO

5.7 Does your administration (and/or State) have a system to monitor and display the mix of aircraft using the airspace or airports?

☐ YES ☐ NO

6. Surveillance Systems for ATFM Support

6.1 In the following table, list the type of surveillance systems in use in your administration's (and/or State's) airspace structure.

ACC Surveillance System	TMA Surveillance System	Other Surveillance System

Table 3

7. AIS/Map for ATFM Support

7.1 On the following lines, list the AIS and map databases that your administration (and/or State) has available to support ATFM.

7.2 Are they available in an electronic format?

☐ YES ☐ NO

7.3 What is the routine AIS database update cycle?

☐ 28-DAY UPDATE ☐ 56-DAY UPDATE ☐ OTHER

8. <u>Meteorological Information</u>

8.1 Provide the specific meteorological products and/or websites that your administration (and/or State) has available to support ATFM by checking the appropriate box.

☐TAF; ☐Trend; ☐METAR; ☐Local Report;

☐Real-time Sensor Data (e.g. RVR); ☐Weather Radar; ☐Satellite Imagery;

☐Surface Analysis Charts; ☐Surface Prognosis Charts; ☐SIGWX Chart;

☐Wind/temperature forecast Charts; ☐GRIB data (wind & temperature forecasts);

☐SIGMET; ☐Aerodrome warnings, wind shear warnings and alerts;

☐VA/TC Advisories; ☐Weather Briefing; ☐Others (please elaborate):

8.2 List the MET products your facility considers operationally valuable (in order of most importance) to AFTM.

8.3 List the MET products your facility considers operationally insignificant (in order of least importance) to AFTM.

8.4 Does your facility use automated processes of gridded data?

8.5 If no to 8.4, does your facility plan to implement automated processes of gridded data (if yes, please indicated approximate date)?

9. Data for Historical and Statistical Analysis

9.1 On the following lines, list the type of databases (i.e. aircraft position data from ADS-B/radar, OPMET data, weather radar data…) your administration (and/or State) maintains to support the analysis of air traffic operations and meteorological activities.

10. Communications capabilities for Collaborative Decision Making in ATFM

10.1 List the types of communication systems (i.e. AFTN, Internet, dedicated data link, video/tele-conferencing…) your operational units already have or could straightforwardly have with:

(a) other centralized ATFM organizations

(b) other ATS units and/or Flight Management Units

(c) operators and airspace users

(d) airport authorities

(e) meteorological authorities and/or aeronautical MET services

□ tick box if AFTM has a specialized meteorological support service

(f) aeronautical information services

(g) the transmission of radar and ADS data to the ATFM center

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MET PRODUCTS FOR ATM (2003)

Product/Information/Service	ATM Use*	Usual Source	Format/Delivery
1. OPMET – TAF/Landing Forecasts	A, B	Local Met office**	Text - web, AFTN, FTP
2. OPMET – Winds/Temps	A	WAFS	Grib
3. Winds/Temp	A	Local Models	Graphical - web
4. Tropical Cyclone Advisories/Volcanic Ash Advisories	A	TCAC/VAAC	Text – web, AFTN, FTP , fax
5. TC/VA information - Enhanced (graphical/extended/more detailed)	A	Local met office/TCAC	In-Person Briefing, verbal, text, graphical – web, fax, in person, telephone.
6. SIGMET/AIRMET	A, B, C	Various	Text, graphical – AFTN, FTP, web
7. Routine Tailored Briefing products***	A	Local met office	Text, verbal/graphical – web, FTP, fax, telephone
8. Ad hoc briefings	A	Local met office	Verbal, in-person – phone, in-person
9. Met presence in ATS Unit	A, B, C, D	Local met office	Verbal, graphical - In-person
10. OPMET – METAR/SPECI	B	Local met office	Text - web, FTP, AFTN
11. Current/recent surface conditions	B	Local met office	Text, graphical – web, FTP, dedicated displays
12. Weather Radar	B	Local met office	Graphical – web, local area network
13. Derived radar thunderstorm nowcasts	B, C	Local met office	Graphical – web, local area network
14. Satellite cloud imagery	B, C	Local met office	Graphical - web
15. Aircraft/Pilot reports	B, C	Aircraft	Text, graphical – AFTN, FTP, web
16. SIGWX – High	C	WAFS	Graphical - web
17. Medium	C	Local/regional	Graphical - web/fax
18. Icing Charts	C	Local model	Graphical - web, FTP
19. Extended range forecasts	D	Local met office	In-Person Briefing, verbal, text, graphical – In-person, telephone, fax, web, FTP.
20. Climatological information	D	Various	Graphical, text – web, mail.

*A – Capacity/flow management, B – Terminal/Airport ATC, C – En-route ATC, D – Airspace organisation and management

** The expression “local met office” is used to represent a meteorological office responsible for the provision of MET for a given location or airspace.

***Tailored briefing products refer to a number of products providing MET related to critical thresholds relevant to ATC operations.