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TWELFTH AIR NAVIGATION CONFERENCE

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Agenda Item 4: Optimum capacity and efficiency − through global collaborative ATM
4.3: Enhanced operational decision-making through integrated meteorological information

METEOROLOGICAL INFORMATION IN AVIATION SYSTEM BLOCK UPGRADE MODULES

(Presented by China)

EXECUTIVE SUMMARY

The pilot project "Meteorological Service for the Terminal Area" now being showcased by the World Meteorological Organization (WMO) and the "SIGMET Advisory" being studied by the International Civil Aviation Organization (ICAO) should form the foundation for the future aviation system block upgrade (ASBU).

The proposed roadmap of the ASBU is generally in the right direction but a number of issues, including inter alia, the production of the single authoritative source of meteorological information, the transition of terminal area meteorological data and terminal area forecast, the conversion of meteorological information into ATM impact, human factor and implementation timetable have to be discussed further.

The participation of meteorological authorities and the cooperation between MET and ATM are crucial in the work related to the meteorological component of ASBU.

Action: The Conference is invited to note the conclusions in paragraph 3.

1. INTRODUCTION

1.1 The existing aviation meteorological services and products are crucial in maintaining safety and regularity in air navigation. With growing air traffic and further development of the aviation industry, the impact of adverse weather in the terminal area on its operation is becoming more serious. In recent years, to meet the needs of air navigation, various new aviation meteorological products have been

[1] English and Chinese translation provided by China.

developed by meteorological services to support the air navigation service providers (ANSP) and users. Amongst these, the Meteorological Service for the Terminal Area (MSTA) and SIGMET advisory are of utmost importance. The future transition of the existing and newly evolving meteorological products and the development of new meteorological products for integration into the next generation aviation system according to the aviation system block upgrade (ASBU) would require further discussion and decision by the aviation and meteorological communities.

1.2 The necessity for meteorological forecast for terminal area

1.2.1 There is a gap between the Terminal Aerodrome Forecast (TAF) and the en-route forecast in the existing aviation meteorological services to support international air navigation due to the lack of meteorological services tailored for the terminal area. Noting that weather forecast products for the terminal area would be highly effective in meeting the pressing need from ANSP and users, some States have promoted the concept of MSTA, conducted relevant researches, and developed some experimental products with a view to filling the gap between the TAF and en-route forecast and provide better meteorological services to support air navigation.

1.2.2 The existing technology and equipment, including inter alia, Doppler weather radar, lightning location system, AMDAR, numerical weather prediction (NWP) and associated algorithms have matured enough to make the provision of meteorological forecast for the terminal area possible.

1.3 Development in China and Hong Kong, China

1.3.1 China has commenced the provision of forecast and services for the terminal area and developed experimental products on wind field/wind gust, convective weather, turbulence and icing.

1.3.2 Hong Kong, China has developed experimental nowcast (0-1 hour), very short-term forecast (next 6 hours) and short-term forecast (next 12 hours) products for predicting the impact of convective weather on air traffic along the flight paths and holding areas. The impact to air traffic is categorized into three tiers, namely “low”, “medium” and “high”. In respect of nowcasting, Hong Kong, China has developed a system known as “Aviation Thunderstorm Nowcasting System” which forecasts the locations of thunderstorms in the next hour and is automatically updated every six minutes. On the very short-term and short-term forecast, Hong Kong, China has made available to Hong Kong ATM personnel a product known as “Significant Convection Monitoring and Forecast”. The Significant Convection Monitoring and Forecast is based on automatic forecast or that from forecasters through the use of combined man-machine forecast. It effectively fills the gap between the conventional weather forecasts provided and the meteorological information required for ATM. It facilitates the air traffic controllers to issue capacity forecast to neighbouring control areas and airlines. The capacity forecast is updated whenever necessary according to the latest situation to better manage the flow control.

1.4 The necessity for SIGMET advisory

1.4.1 At present, the availability and accuracy of SIGMET of some States and areas are very low. The ICAO Meteorological Warnings Study Group (METWSG), after three meetings to discuss the matter, had proposed to establish several SIGMET Advisory Centres around the globe for the issuance of SIGMET advisory information to provide guidance and assistance to meteorological watch offices (MWO) in issuing SIGMET on significant weather phenomena other than volcanic ash, radioactive release and tropical cyclone. A feasibility study was carried out to evaluate the effectiveness of SIGMET advisory in raising the quality of SIGMET issuance and serve as the basis for the establishment of regional SIGMET Advisory Centres. A three-month trial was carried out in 2011 with China, South Africa and France acting as the regional SIGMET Advisory Centre for the Asia Region, AFI-S and AFI-N respectively. The

trial showed that SIGMET advisories helped improve the issuance and accuracy of SIGMETs in the region. Results of the trial were summarized and reported.

2. DISCUSSION

2.1 Terminal area forecast

2.1.1 ICAO is requested to develop the standards of terminal area forecast, including technical aspects such as its content, format and valid time in Annex 3 — *Meteorological Service for International Air Navigation*" in collaboration with WMO.

2.1.2 The benefit of terminal area forecast services have been showcased on many occasions. A good example is the pilot project on MSTA by the WMO Commission for Aeronautical Meteorology (CAeM) Expert Team on Meteorological Services To ATM and Meteorological Information Exchange (ET-M&M) (http://www.ntf.weather.gov.hk/demo_projects/demo_projects.phtml). The project includes new terminal area forecast products operated or to be operated by Japan Meteorological Agency, Météo-France, National Oceanic and Atmospheric Administration of the United States of America, Meteorological Service of Canada, Bureau of Meteorological of Australia and Hong Kong Observatory. The aforementioned "Aviation Thunderstorm Nowcasting System" and "Significant Convection Monitoring and Forecast" in paragraph 1.2 developed by Hong Kong, China, were developed under this banner.

2.1.3 Implementation schedule: MSTA will be officially launched in the year 2017 (Block 1) subject to the approval by the Conjoint MET/AIM Divisional Meeting/CAeM Session to be held in 2014, followed by the inclusion of relevant standards in Annex 3.

2.2 SIGMET advisory

2.2.1 Development of the Standard on the issuance of the SIGMET advisory in textual and graphical format, including content, frequency and valid period is required for its operational use.

2.2.2 Standards on the establishment of SIGMET Advisory Centres should also be established. The Standard should detail the basic requirements of a SIGMET Advisory Centre, its geographical requirement, means for timely communication between users and feedback mechanism, and experience in disseminating SIGMET advisory, etc.

2.2.3 Implementation schedule: the proposed establishment of SIGMET Advisory Centre is subject to the approval by the Conjoint ICAO MET Divisional/WMO CAeM session to be held in 2014.

2.3 Meteorological support for future air navigation system

2.3.1 Though the proposed ASBU roadmap is generally moving in the right direction, a number of issues require further discussions. The following paragraphs bring up a few key issues for consideration.

Single Authoritative Source of Meteorological Information

2.3.2 The use of a single authoritative source of meteorological information to support ATM, ANSP and users in collaborative decision making (CDM) could enhance efficiency and is generally

supported. However, further discussion is required on how this single authoritative source of meteorological information is to be generated collaboratively.

2.3.3 According to the Convention on International Civil Aviation, each Contracting State shall determine the meteorological services which it will provide to meet the needs of the international air navigation within its own Flight Information Region (FIR) and contribute towards the safety, regularity and efficiency of international air navigation. This determination shall be made in accordance with the provisions in Annex 3 with due regard to regional air navigation agreements. As such, the provision of the meteorological information within the State's own FIR shall fall under its own prerogative.

2.3.4 Currently, to comply with ICAO Annex 3, each Contracting State has installed various monitoring and observing systems to provide continuous updated observations and support the issuance of warnings and forecasts. Despite the potential improvement in the accuracy, resolution and update frequency of global numerical weather prediction models in the future, they cannot replace the actual observations at the airport and forecasts from nowcasting systems. Furthermore, presently a number of States also operate a higher resolution regional numerical model to better utilize their own observations so as to enhance their warning and forecasting capability. Such local or regional observations and numerical model data may outperform the global models over their regions of interest and should continue to be deployed to support air navigation.

2.3.5 As the temporal and spatial resolutions as well as the updating frequencies of these local and regional data differ from those of the global numerical weather prediction models, ways to harmonize these local or regional meteorological data with the global numerical weather prediction model data into a single authoritative source of meteorological information - for instance, how to facilitate local, regional and global exchange of data, blending of these data into a seamless, coherent database for ANSP and users – is a big issue. The transition to integrated meteorological information will require not only an agreement to a global standard for meteorological information exchange but also collaborative effort from all States to continuously update such information and harmonize these data for use by all ANSP and users. There should be more in depth discussion for an early solution.

Transition from existing products to the prospective system

2.3.6 Although the conversion of meteorological information into ATM impact already exist in a more primitive form in the current terminal area forecasts, such information are mainly used for strategic planning only. In the new generation of aviation system as depicted by ABSU, it was planned that the meteorological information would be integrated with ATM decision-making systems and used for driving both strategic and tactical decisions for the avoidance of hazardous weather conditions. As meteorological information is mainly exchanged between systems, the role of air traffic controller and pilots in the strategic and tactical decision making process is unclear. As this would have great impact on the operation and thus the meteorological products required, the aviation community is advised to put forth a comprehensive plan as soon as possible so that the meteorological community can better respond. As discussed in WP/15, agreements are also necessary on what will constitute required meteorological information and graphical presentation of such information.

Conversion between meteorological information and thresholds for aerodrome and air space

2.3.7 The conversion of raw meteorological information into pre-defined ATM constraints and airspace or aerodrome threshold events is a very complex process. Furthermore, all meteorological data, in particular forecast products, has a certain degree of uncertainty. The longer the lead time, the larger is the uncertainty. In employing the aviation system, ANSPs and users should be fully aware of the potential

impact of the meteorological data and their associated uncertainty which are directly ingested into the system. Although studies on the ATM impact are being undertaken by a WMO Expert Team as well as some developed countries, as the same weather condition may result in very different impact for different aerodromes, the conversion should be tailored for each aerodrome by each State. It might not be suitable to standardize the meteorological information translation parameters and ATM impact conversion parameters as suggested in WP/15. This requires further study with participation from both air traffic controller and meteorological personnel. Otherwise, it could affect the future air traffic capacity.

Human Factor consideration

2.3.8 The prospective single authoritative source of meteorological information, with enormous data volume, will be mainly used for information exchange between systems. Moreover, in the final phase of implementation, the conversion between meteorological information into airspace and aerodrome constraints would be much more complex. It will be difficult to integrate these data and represent such information in simple products for reference by air traffic controllers and pilots. However, if the system and the users do not have a "common view" of the meteorological condition, this might easily lead to misunderstanding, aggregating the human factor considerations in the provision of such converted information to users.

Implementation schedule

2.3.9 Although the time schedules for ASBU mentioned in WP/15 are intended only to depict the initial readiness of the components needed for deployment, it should be recognized that certain technologies required for performing the upgrade are still lacking or immature. For instance, in respect of numerical weather prediction modelling, the forecasting capability of certain weather elements, such as turbulence intensity and significant convection are far from meeting the users' needs. There remain great challenges ahead. The experts who attended the World Weather Research Programme (WWRP) workshop of WMO held in the United States in 2011 generally agreed that this would not be easily solved in short term. Meanwhile, some pertinent meteorological equipment, such as equipment for measuring flight or slant visibility, has yet been developed.

2.3.10 In the future, the realization of globally interoperable, exchangeable meteorological information between the air traffic controllers on the ground and the pilots in the air shall impose a great demand on the ground-air data exchange. At present, the communications equipment and technology capable of meeting such functional requirement are still lacking, particularly over the oceans. Even if such equipment and technology are to be developed, it would still need a lengthy testing and implementation before they can be put in operational use. The schedules mentioned in WP/15 are hence too optimistic.

3. CONCLUSION

3.1 The existing relatively simple conventional meteorological products as defined in Annex 3 are not sufficient to meet the needs of ATM. WMO is promoting MSTA through its pilot project. China and Hong Kong, China have already developed a series of products with a view to providing meteorological supports to AOM, DCB, AO, TM and CM. The establishment of ATM decision thresholds is taking shape in these MSTA products. These MSTA products should form the bases of the prospective ASBU.

3.2 China has conducted some studies on the dissemination of SIGMET advisory information, especially on the format, content, frequency and valid period. During the SIGMET advisory trial in Asia conducted in 2011, the advisories were well received and were found to be fairly useful and provided good practical guidance but could be further improved on their performance and user friendliness.

3.3 The proposed roadmap of the ASBU is generally in the right direction but a number of issues, including inter alia, the production of the single authoritative source of meteorological information, the transition arrangement of terminal area meteorological data and terminal area forecast, the conversion of meteorological information into ATM impact, human factor and implementation timetable need to be discussed further.

3.4 Close collaboration between the meteorological authority and air traffic control authority is crucial in determining the operational and functional requirements, as well as the quantification of the assessment scheme. The participation of meteorological services in the development of the “conversion” tool, the integration of such information in the CDM tool and their assessment is also very important.

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