Montréal, 7 to 18 July 2014

Agenda Item 2: Improving the safety and efficiency of international air navigation through enhanced meteorological service provision

2.2: Enhanced integrated meteorological information to support strategic, pre-tactical and tactical operational decision-making from 2018 (including ASBU Module B1-AMET)

IMPROVEMENT OF AERONAUTICAL METEOROLOGICAL INFORMATION THROUGH COLLABORATIVE INFORMATION SHARING AMONG STAKEHOLDERS

(Presented by Japan)

SUMMARY

This paper highlights the effectiveness of information sharing among stakeholders for the improvement of aeronautical meteorological services. The Japan Meteorological Agency (JMA) has built up a large body of aircraft observation data and a significant collection of pilot reports with the help of the Japan Civil Aviation Bureau (JCAB) and various airlines, and uses this information in the development of prediction and detection technology for significant weather phenomena and the improvement of its weather information. Aircraft observation is also the only way to collect data for use in verifying information on significant weather phenomena such as turbulence, and is fundamental for improving the accuracy of such information. In this context, regional sharing of aircraft observation data is seen as important for the successful operation of regional hazardous weather advisory centers (RHWACs). Action by the meeting is in paragraph 7.

1. INTRODUCTION

1.1 Since April 2003, the Japan Meteorological Agency (JMA) has collected observation data from aircraft operated by All Nippon Airways (ANA) and Japan Airlines (JAL). These data are globally distributed under the WMO AMDAR Programme via GTS (WMO’s Global Telecommunication System). Around 18,970 reports (3,440 from ANA and 15,530 from JAL) are collected from 220 aircraft each day over Japan’s FIR (Fukuoka FIR) via a VHF data link.

1.2 The Japan Civil Aviation Bureau (JCAB) also established the C-PIREP (Common PIREP) system in 2002 to support the collection and sharing of pilot reports from participating airlines among JCAB, JMA and the relevant airlines in a common format. The range of benefits brought by the system includes its incorporation of information on even minimal turbulence, which allows users to identify areas where there is a risk of encountering severe turbulence. The number of participating airlines has grown to 18, and around 2,200 C-PIREP data sets are reported daily.
1.3 JMA collects a range of aircraft observation data via VHF communication and pilot reports through the C-PIREP system with the help of JCAB and the above airlines. It uses this plentiful information in the development of prediction and detection technology for significant weather phenomena, the provision of detailed aeronautical meteorological information to users, and the verification of weather data.

2. DEVELOPMENT OF HIGH-LEVEL PREDICTION AND DETECTION TECHNOLOGY USING AIRCRAFT OBSERVATION DATA

Development of numerical weather prediction products for aviation operators

2.1 JMA operates highly precise numerical weather prediction (NWP) models such as the Global Spectral Model (GSM), the Meso Scale Model (MSM) and the Local Forecast Model (LFM). It develops various NWP products for aviation operators using data from these models and aircraft observation data including C-PIREP output. Examples are the turbulence index (TBindex), the cumulonimbus index (index for CB) and the icing index (icing index), which support the creation and provision of SIGMET messages and forecast charts for significant weather events.

2.2 The TBindex is used to predict turbulence generated by various weather conditions. It forecasts the potential for general turbulence types including those from mountain waves, the bottom of middle clouds and Kelvin-Helmholtz instability.

![Figure 1. TBindex](image)

2.3 The index for CB includes information on diagnostically calculated quantities and the altitude of cumulonimbus cloud tops.
2.4 The icing index is a diagnostic predictive product developed from statistical analysis of past aircraft observation data.

2.5 The sharing of C-PIREP and other types of aircraft observation data is fundamental for the development and verification of such effective indices.

**Development of automatic detection technology for thunderstorm areas**

2.6 JMA has also developed technology to automatically detect thunderstorm (TS) areas from geostationary meteorological satellite (MTSAT-2) observation data and NWP data.

2.7 The accuracy of automatic TS area detection has been improved by the acquisition of aircraft observation data and C-PIREP data.
2.8 In the second half of 2014, JMA also plans to launch a next-generation geostationary meteorological satellite (Himawari-8). The unit features more observation bands and higher temporal/spatial resolution than its predecessor, and is expected to support the development of technology for thunderstorm area detection with higher levels of definition and precision.

![Figure 4. NWP-based automatic TS detection product](image_url)

3. IMPROVEMENT OF METEOROLOGICAL INFORMATION USING AIRCRAFT OBSERVATION DATA

3.1 JMA utilizes aircraft observation data obtained from airlines to provide various types of meteorological information as outlined below.

3.1.1 Hourly Analysis (Figure 5): This information showing three-dimensional distribution of wind, temperature and vertical wind shear is automatically created every hour. It helps users to understand jet stream positions and wind speeds around the jet stream core, and supports the identification of possible areas of moderate or severe turbulence.
3.1.2 Domestic SIGWX OBS Charts (UBJP) (Figure 6): This graphical information representing significant weather conditions within domestic airspace is overlaid onto satellite images (IR), aircraft observation data such as C-PIREP information, radar echo intensity data, lighting observation data and typhoon charts, and is automatically created every hour. Aircraft observation reports received in the past hour detailing higher-than-moderate turbulence, icing or lightning are also included.

3.1.3 Domestic SIGWX Analysis Charts (ABJP) (Figure 7): This graphical information is overlaid onto data showing UBJP, jet stream axes and areas of significant weather events, and includes
forecaster comments on significant weather conditions that may affect aircraft operations. It is created six times a day (00, 03, 06, 09, 12, 21 UTC) by forecasters.

3.1.4 Domestic SIGWX Prognostic Charts (FBJP) (Figure 8): This graphical forecast information shows nine-hour projections for lightning, turbulence, significant weather events, volcanic eruptions, atmospheric pressure, cloud forms and isothermal lines in map form, and includes forecaster comments on significant weather conditions that may affect aircraft operations. It is created four times a day (00, 06, 12, 18 UTC) by forecasters.
3.1.5 Low-level SIGWX Prognostic Charts (Figure 9): This graphical forecast information supports safe and efficient flight for aircraft flying at low altitudes. It includes data on cloud, visibility, precipitation areas, lightning areas, isotherm position (0 degrees Celsius) and vertical profiles of wind over major aerodromes. It is automatically created eight times a day (00, 03, 06, 09, 12, 15, 18, 21 UTC).

![Low-level SIGWX Prognostic Chart](image)

Figure 9. Low-level SIGWX Prognostic Chart (0300 UTC on 9 Feb. 2014)

3.2 The above information is provided online to airlines and other aviation operators, and is used for safe and efficient flight management.

4. OTHER COLLABORATIVE WORK

4.1 JMA verifies various types of weather information using aircraft observation data and reports, works to improve the accuracy of NWP output and develops weather analysis technology.

4.2 JMA also holds regular study meetings with major Japanese airlines to support the analysis and discussion of past significant weather events. This creates mutual benefits in the enhancement of operational skills, helping JMA to improve the accuracy of its meteorological information and enabling airlines to use this information more effectively.

5. REGIONAL SHARING OF AIRCRAFT OBSERVATION DATA

5.1 The development of the prediction and detection technology described above is expected to be very useful in the future provision of accurate information on significant weather events under the regional hazardous weather advisory framework. Regional sharing of aircraft observation data is viewed as fundamental in facilitating region-based meteorological information provision.
5.2 Aircraft observation is also the only way to obtain data for use in the verification of en-route forecast products such as the TBindex. The regional sharing of aircraft observation data is expected to be useful in maintaining and improving the accuracy of such forecasts through verification.

6. CONCLUSION

6.1 Collaborative information sharing with ANSPs and airlines as exemplified by the C-PIREP system is seen as essential for the advancement of future aviation weather services.

6.2 JMA collects extensive aircraft observation data and turbulence information with the help of JCAB and various airlines, and uses this information in the development of prediction and detection technology for significant weather phenomena and the improvement of its meteorological information.

6.3 Regional sharing of aircraft observation data is seen as important for the operation of the regional hazardous weather advisory center (RHWAC) framework.

6.4 Aircraft observation is the only way to obtain data for use in the verification of en-route forecasts such as turbulence projections. Through verification, forecast accuracy can be improved.

7. ACTION BY THE MEETING

7.1 The meeting is invited to note the information contained in this paper.

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