



International Civil Aviation Organization

**SIXTEENTH MEETING OF THE
COMMUNICATIONS/NAVIGATION/SURVEILLANCE AND
METEOROLOGY SUB-GROUP (CNS/MET SG/16) OF APANPIRG**

Bangkok, Thailand, 23 – 27 July 2012

Agenda Item 11: Meteorological advisories and warnings

4) review METWSG SIGMET advisory

REQUIREMENTS FOR REGIONAL WX SIGMET ADVISORY CENTER

(Presented by Japan)

SUMMARY

This paper presents the preparation for SIGMET advisory and discussion about the requirement of SIGMET advisory centre.

This paper relates to –

Strategic Objectives:

A: Safety - *Enhance global civil aviation safety*

C: Environmental Protection and Sustainable Development of Air Transport - *Foster harmonized and economically viable development of international civil aviation that does not unduly harm the environment*

Global Plan Initiatives:

GPI-19 Meteorological Systems

1. Introduction

1.1 The 2nd meeting of the Meteorological Warning Study Group (METWSG) which was held in May 2009 agreed the necessity to carry out a feasibility study of the provision of the SIGMET advisory information. For the purpose, the meeting pointed out the importance of numerical weather prediction and remote sensing data from satellite and so on.

1.2 Japan Meteorological Agency (hereafter JMA) has been operating global and regional numerical weather prediction models and developing some application products which supports to improve the issuance of SIGMET. JMA developed three indices (TB index, index of CB cloud and icing index).

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23/07/12

1.3 The TB index is a new turbulence forecast which can predict various kind of turbulence. The TB index is constructed by using multiple turbulence indices. The index for CB is a new index to forecast the amount and cloud top height of CB clouds derived diagnostically from NWP output. The icing index is a new index based on a result of the recent research in Japan. JMA presented those indices at the 13th meeting of communications, navigations and surveillance / meteorology sub-group (CNS/MET SG/13) of APANPIRG which was held in November 2010 (See attachment 1).

1.4 JMA also operates Geostationary Meteorological Satellite which is also useful for the advisory because it covers wide regions JMA is also developing an automatic detecting technique for thunderstorm by using the satellite observation and the global numerical prediction model. It is also useful to develop a new technique to enclose the TS region by simple polygon to reflect the product to the SIGMET. JMA presented above techniques at the conjoint session of the 10th meeting of ASIA/PAC OPMET Management Task Force of CNS/MET Sub-group of APANPIRG (OPMET/M TF/10) and the 2nd meeting of ASIA/PAC Meteorological Advisories and Warnings Implementation Task Force (METWARN/I TF/2) in April 2012 (See Attachment 2).

2. Discussion

2.1 Not only to improve the issuance of SIGMET but also to improve the content of the SIGMET is important. The utilization of products for the MWOs which have already issue SIGMET to add value to the existing SIGMET should be also considered in establishment of the SIGMET advisory centers.

2.2 In order to assist States to issue SIGMETs which has certain level of accuracy, advisory itself should also be required to be accurate. It is only achievable when highly accurate NWP output is available as background forecast data. Therefore, well-developed, accurate, and consistent NWP indices should be one of important requirements for future regional WX SIGMET Advisory Centers.

2.3 As the same as in the WAFC products, it should also be essential to conduct regular and comprehensive verification of such WX SIGMET Advisory. To assure that the advisories can help the States improve accuracy of its SIGMETs. In this context, to establish verification framework should be required to the future regional WX SIGMET Advisory Centers.

3. Conclusion

3.1 When establishing requirements to the Regional WX SIGMET Advisory Centers, the MET SG may consider adopting following draft decision.

Draft Decision 16/xx – Requirements for Regional WX SIGMET Center(s)

When considering requirements for future Regional WX SIGMET Centers, The MET SG is invited to

- a) consider capability of providing well-developed, highly accurate, and consistent NWP outputs as one of important requirements, and
- b) recognize necessity to establish verification framework for WX SIGMET Advisories to assure their effectiveness

4. Action by the Meeting

4.1 The meeting is invited to:

- a) note the information contained in this paper; and
- b) discuss any relevant matters as appropriate.
- c) consider the adoption of the related Decision.

Attachment 1

CNS/MET SG/13-IP/25
Agenda Item 10 (3)



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THIRTEENTH MEETING OF THE COMMUNICATIONS/NAVIGATION/SURVEILLANCE AND METEOROLOGY SUB-GROUP OF APANPIRG (CNS/MET SG/13)

Bangkok, Thailand, 20 – 24 July 2009

Agenda Item 10: ICAO advisory & warning systems:

3) review the status of implementation of SIGMET and warnings

INDICES OF SIGNIFICANT WEATHER FOR ISSUANCE OF SIGMET

(Presented by Japan)

SUMMARY

SIGMET issued by MWO is needed to be reliable and accurate. The Japan Meteorological Agency (JMA) operates some indices of significant weather for aviation, using outputs of numerical weather prediction (NWP), to provide useful information with forecasters of MWO for issuance of SIGMET. JMA has developed and improved the skill of the indices of icing, cumulonimbus clouds (CB), and turbulence. In this paper, brief outlines of these indices are shown.

This paper relates to

Strategic Objectives:

- A: Safety – Enhance global civil aviation safety
- D: Efficiency – Enhance the efficiency of aviation operations

Global Plan Initiatives:

- GPI-18 Aeronautical Information
- GPI-19 Meteorological Systems

1. Introduction

1.1 For the safety and efficiency of flight operation, it is demanded that SIGMET with high accuracy is provided by MWO. For issuance of SIGMET, observation and forecast data should be well provided to MWOs. Forecast data are necessary for expected occurrence or evolution of observed weather phenomena in SIGMET. Recently, forecast data for aviation use with high quality are derived from outputs of numerical weather prediction (NWP). The Japan Meteorological Agency (JMA) has developed some application products and grid point value (GPV) data of significant weather using NWP, and makes use of them operationally to forecast significant weather phenomena in Fukuoka FIR as an MWO. In this paper, brief outlines of the indices to forecast weather elements significant for en-route flight, i.e. of icing, cumulonimbus clouds (CB) and turbulence are shown. These indices will contribute to the improvement of the capabilities of MWOs to issue SIGMET.

2. Index of icing

2.1 JMA predicted icing mainly using -8 D method (Godske et al. 1957) and statistical

method that the upper air temperature in the situation causing icing is between 0 and -20 degrees C around Japan. But -8 D method is known that it is not applied in the case of temperature below -13 degrees C. In addition, the statistical method above is based on a study a few decades ago, and does not seem to be applicable to recent types of aircraft. Restudy on the situation of icing with increasing number of aircraft reports (PIREPs) and temperature and T-Td predicted by a recent NWP model (Mesoscale model, MSM) was done. It revealed that no small amount of icing occurred at the temperature below -20 degrees C (Kudo 2006). A function between frequency of icing and temperature, and that between frequency of icing and T-Td were derived respectively, and two were integrated into an index to predict the potential of icing (Kudo's icing index) (Kudo 2008). Figure 1(a) shows the 9 hour forecast of the potential of icing using Kudo's icing index (left) and -8 D method(right). In Figure 1(b), triangles indicate the reported points of moderate and severe icing at that valid time. Comparing these figures, it is found that moderate and severe icing occurred between FL180 and FL300 (horizontal lines) around 35°N (vertical line) in the cross section chart along 135°E (top of Fig. 1(a)), and it is clear that Kudo's icing index with a certain threshold predicts the height of icing more accurately than -8 D method does. Kudo's icing index came into operation for the assistance of issuance of SIGMET and domestic prognostic SIGWX charts in Dec. 2008.

3. Index of CB

3.1 JMA distributes the information on the forecast of CB around Japan by FAX chart and GPV data to aviation customers. The amount and the cloud top height of CB are calculated with outputs of NWP. JMA used the diagnostic method with precipitation and Showalter Stability Index (SSI) derived from NWP to forecast CB (Takada 1997) before. A new method to distinct deep convection considered as CB, was introduced in Mar. 2006 (Kudo 2005). It used the height and temperature of cloud top and cloud base by KF scheme for convective parameterization (Yamada 2003) in the outputs of NWP. The accuracy of the CB forecast has been improved by direct calculation of KF scheme and appropriate adjustment of parameters (Kudo 2007, 2009). Figure 2 shows the result of 12 hour forecast of CB areas in FAX chart. The latest method (a), applied in Mar. 2009, forecasts CB areas at sea (red circles), while previous one (b) does not. These areas match the observation of thunderstorms (c) detected by the Lightning Detection Network System (LIDEN), and of heavy rain (d) by the radar network of JMA.

4. Index of turbulence

4.1 JMA mainly uses the vertical wind shear, because of its accuracy (e.g. Kudo 2008), as an index of moderate or severe air turbulence among many indices. For further improvement, a new index to determine CAT using Turbulent Kinetic Energy (TKE) derived from NWP has developed, and an index of probability of CAT using TKE and other indices will come into operation in a near future.

5. Action by the meeting

5.1 The meeting is invited to note the issues presented above.

References

- Godske, C.L., T. Bergeron, J. Bjerknes, and R.C. Bundgaard, 1957: Dynamic Meteorology and Weather Forecast, 769-773.
- Kudo, A., 2005: Text for NWP-training, Japan Meteorological Agency, 38, 49-51 (in Japanese, Suuchiyohouka Kenshu Text).
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Takada, S., 1997: Technical Meeting for Aviation Weather Forecast, Japan Meteorological Agency, 123-126 (in Japanese, Koukuu-kishou-yohou-gijutsu-kentoukai).

Yamada, Y., 2003: Report of Numerical Prediction Division, Japan Meteorological Agency, 49, 77-88 (in Japanese, Suuchiyohouka Houkoku Bessatsu).

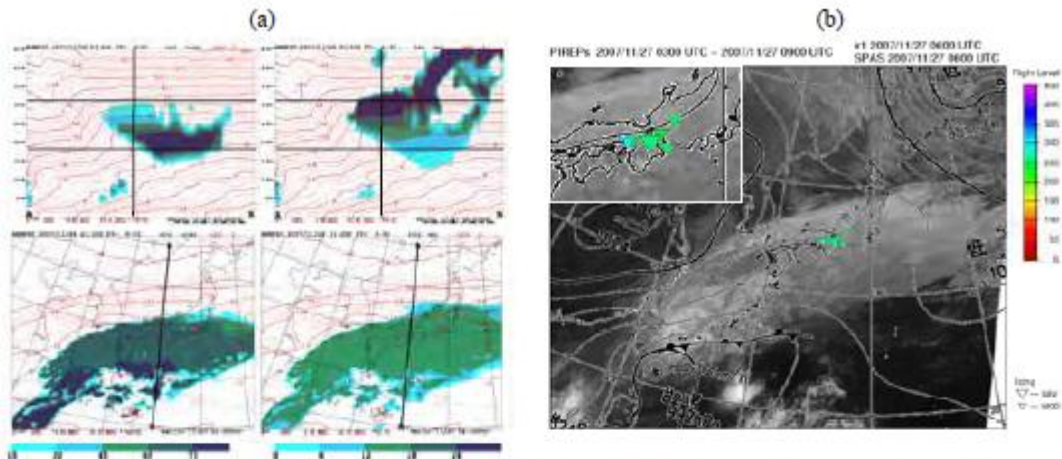


Figure 1 9 hour forecast of the potential of icing valid for 06 UTC on 27 November 2007 and observation at that time. (a) Kudo's icing index (left shaded), -8 D method (right) and temperature (red line). Cross section charts along 135°E (top) and plane charts of FL230 around Japan (bottom). (b) PIREPs of moderate and severe icing (green and blue colored triangles between FL180 and FL300) overlaid on satellite imagery.

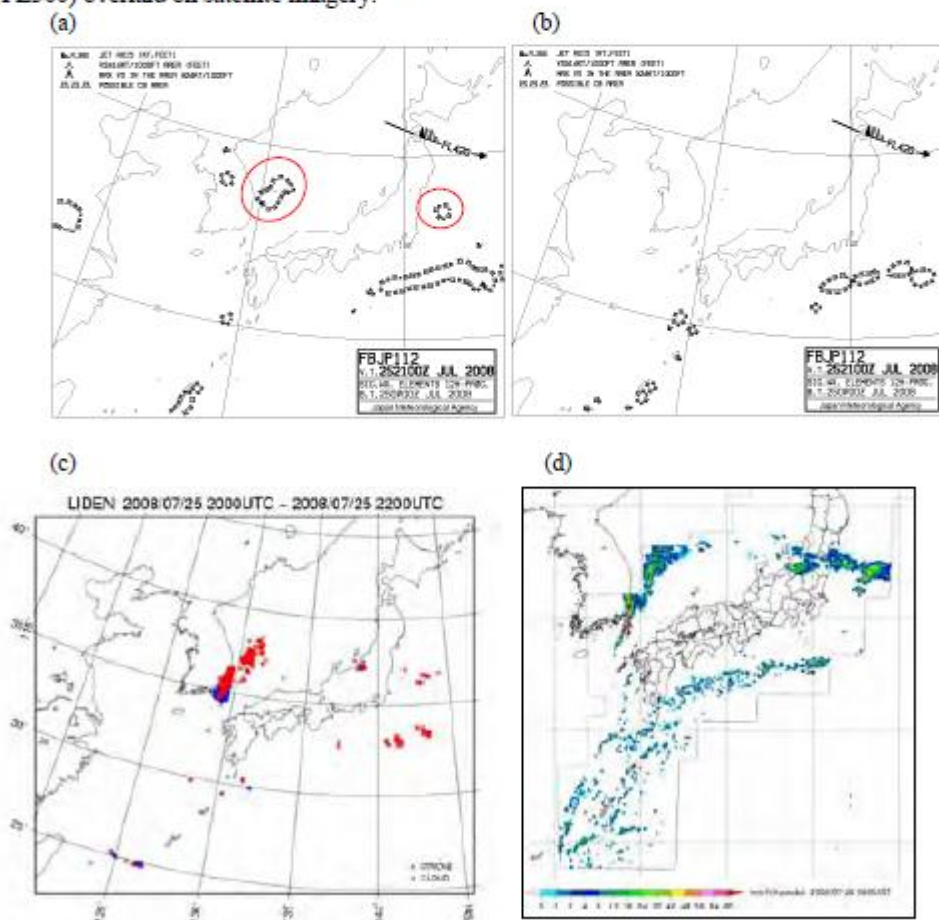


Figure 2 12 hour forecast of CB areas valid for 21 UTC on 25 July 2008. (a) improved method (b) previous method (c) TS observed by LIDEN from 20 to 22UTC. (d) radar echo intensity at 21 UTC.

Attachment 2

OPMET/M TF/10 – IP/6
Agenda Item Conjoint (b)
17/04/12



International Civil Aviation Organization

THE TENTH MEETING OF ASIA/PACIFIC OPMET MANAGEMENT TASK FORCE (OPMET/M TF/10)

Bangkok, Thailand, 17 – 19 April 2012

Agenda Item Conjoint b): **Regional Participation in SIGMET advisory trial**

PREPARATION FOR SIGMET ADVISORY AT JAPAN METEOROLOGICAL AGENCY

(Presented by Japan)

SUMMARY

This paper presents the preparation for SIGMET advisory at JMA.

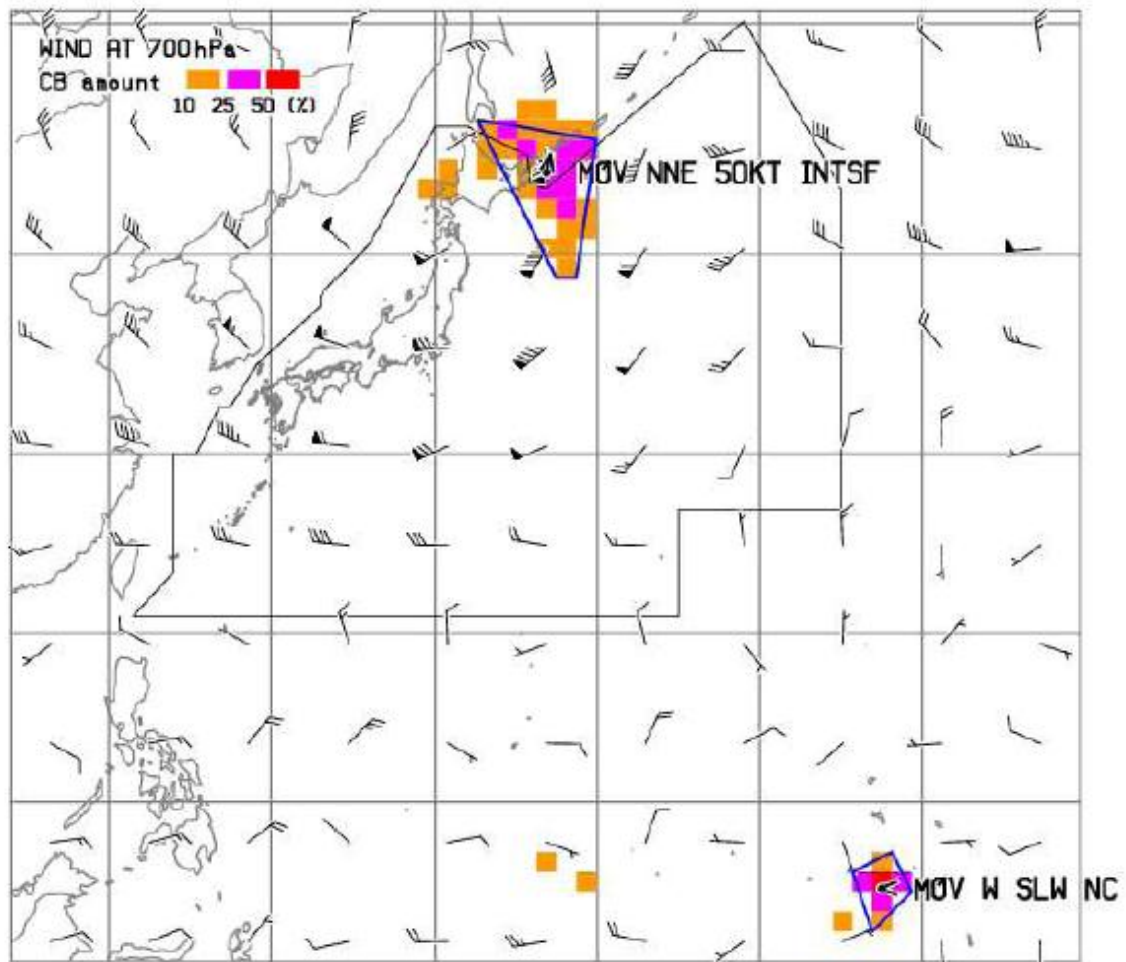
1. INTRODUCTION

1.1 The Meteorological Warnings Study Group (METWSG) has been discussing the feasibility of SIGMET advisory information. According to the summary of the discussion of METWSG/2, the aims of a feasibility study could be not only to improve the issuance of SIGMET but also to assess improvements and the level of added value. The Japan Meteorological Agency (hereafter JMA) develops a technique to improve the content of SIGMET.

2. DEVELOPMENT TO IMPROVE THE THUNDERSTORM SIGMET

2.1 Thunderstorm (hereafter TS) is one of the important phenomena and difficult to forecast. To improve the accuracy of the SIGMET for TS, JMA is developing an automatic detecting technique from the satellite observation and forecast by global numerical prediction model.

2.2 Figure 1 shows the sample of the detected TS region using the satellite observation. The colored cell means the amount of the CB in each cell. The blue line indicates the TS region. The direction and speed of the TS region is calculated using numerical weather prediction model. The information in picture format could be used easily by forecasters in MWO, though the format was not directly connected with the text format of SIGMET.



BASED ON CLOUD GRID INFORMATION AT 1600 UTC 3 APR 2012 AND GSM BASED AT 1200 UTC 3 APR 2012

Figure 1 Sample of the TS SIGMET information in graphical format
