

International Civil Aviation

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Organization

WORKING PAPER

## MEETING OF THE METEOROLOGY PANEL (METP) METEOROLOGICAL OPERATIONS GROUP (MOG)

### SECOND MEETING

Buenos Aires, Argentina, 27 to 28 April 2016

# Agenda Item 4: MOG WORK PLAN AND ACTIVITIES4.1: Progress Report: Activity 3.14

### MAP PROJECTIONS USED FOR DISPLAYING VOLCANIC ASH FORECASTS: UPDATE OF MODEL VAG AND MODEL SVA OF APPENDIX 1 TO ANNEX 3

(Rapporteur United Kingdom)

This Working Paper proposes updates to the Model VAG and Model SVA in Appendix 1 to Annex 3 – *Meteorological Service for International Air Navigation* 

### 1. INTRODUCTION

1.1 The group will recall that at the eighth meeting of the IAVWOPSG<sup>1</sup> attention was drawn to potential errors introduced by representing areas affected by volcanic ash (or any feature) on map projections other than the projection on which the forecast was originally prepared.

<sup>&</sup>lt;sup>1</sup> IAWVOPSG/8, 17 to 20 February 2014, Melbourne, Australia. IAVWOPSG has now been disbanded.

1.2 During the consideration of this matter, it was identified that the MODEL VAG and MODEL SVA graphics were not consistent with the projection (Mercator) specified in ICAO Annex  $3^2$ .

### 2 **DISCUSSION**

## 2.1 Proposal to update Model VAG and Model SVA contained in Appendix 1 to Annex 3

2.2 It was identified that the Model VAG and Model SVA in Appendix 1 to Annex 3 could be misleading in their representations of straight sided polygons on polar stereographic projections. This being the case since footnotes for SIGMET and VAA indicate that the lines used to join vertices defining areas of volcanic ash contamination should be straight lines on a Mercator projection or a straight line between two points which crosses lines of longitude at a constant angle. Noting that the current examples are straight lines on what appear to be stereographic projections then there is an inconsistency – a straight line in one projection cannot be a straight line in other projections. It was therefore proposed that examples that are consistent with ICAO Annex 3 guidelines be produced.

2.3 In actuality, this does not mean the 'graphics' need to be Mercator projection. However, if another projection is used, the 'straight lines' that would apply to Mercator should be adjusted accordingly (invariably resulting in curved lines between the vertices). **Appendix A** (from the IAVWOPSG/8 Working Paper) is included as an example of the distortion that results from different map projections.

2.4 As a consequence, the group formulated IAVWOPSG 8/16 - Update of Model VAG and Model SVA of Appendix 1 to Annex 3;

## Conclusion 8/16 —Update of Model VAG and Model SVA of Appendix 1 to Annex 3

That, an ad-hoc group consisting of the France, Japan, New Zealand, United Kingdom (Rapporteur), United States, IATA and WMO be tasked to:

a) further progress work on updating the Model VAG and Model SVA contained in Appendix 1 to Annex 3 – *Meteorological Service for International Air Navigation* taking into account the need for consistency with the requirement that the volcanic ash advisory and SIGMET for volcanic ash are based upon accepted map projections, and;

b) report back to the IAVWOPSG/ $9^3$  meeting.

<sup>&</sup>lt;sup>2</sup> Footnote 2 to Table A2-1 and Footnote 25 to Table A6-1 (ICAO Amendment 76) both state "A straight line between two points drawn on a map in the Mercator projection or a straight line between two points which crosses lines of longitude at a constant angle."

- 2.4.1 IAVWOPSG8/16 has been carried forward as WG-MOG Activity 3.14. The requirement is straightforward and requests that updated examples of Model VAG and Model SVA should be used to replace the existing graphics.
- 2.4.2 The group may note that the transition to IWXXM and its use of XML/GML geospatial conventions should permit greater flexibility in originating and visualizing such phenomenon since information regarding the projection on which the polygons were generated can be included. This would then permit the originator to specify the original projection (rather than relying on a footnote in Annex 3), and the end user could then choose to display in any projection they wished applying the necessary corrections.

### 3 CONCLUSION

3.1 Notwithstanding the transition to IWXXM, for as long as VAA and VAG continue in their current form, it is recommended that the Model VAG and Model SVA contained in Appendix 1 to Annex 3 be updated to be consistent with current requirements regarding projections.

3.2 At time of submission, it had not been possible to obtain updates to the original MODEL VAG and MODEL SVA examples, and in light of this, London VAAC offers two MODEL VAG examples in **Appendix B**. London VAAC would be pleased to develop these examples further for inclusion in Amendment 78 of ICAO Annex 3.

3.3 The group is therefore invited to formulate the following draft Conclusion;

## Recommendation 2/xx —Update of Model VAG and Model SVA of Appendix 1 to Annex 3

That, the VAACs be invited to provide updated example MODEL VAG and MODEL SVA graphics to WMO for inclusion in Amendment 78 of ICAO Annex 3.

Note 1:- It is proposed that two VAACs volunteer to provide the updated examples to WMO;

Note 2:- The examples should be finalized by 20 July 2016, for final submission to the METP for inclusion in Amendment 78 to ICAO Annex 3

3.4 Further, it is recommended that appropriate guidance be provided, perhaps in ICAO Documents such as Doc 8896 – *Manual on Aeronautical Meteorological Practice* to remind users that appropriate corrections are applied to VAA and VA SIGMET messages when displaying on map projections that differ from the projection used for the creation of the message.

<sup>&</sup>lt;sup>3</sup> This is factually correct as a record of the IAVWOPSG/8 meeting. Of course, IAVWOPSG has been dissolved, and there was no subsequent IAVWOPSG/9 meeting.

3.5 A generic proposal for such advice is suggested:

'Users are to be aware of the importance of ensuring that visualizations of hazardous areas from a list of coordinate (such as those provided in Volcanic Ash Advisory and SIGMET) are consistent with the original projection from which the information is derived. If alternative projects are used when visualizing such data, appropriate corrections to bounding lines will be required'

3.6 The group may wish to consider if such guidance is appropriate, and in what manner users should be informed. The group is therefore invited to formulate the following draft Recommendation;

## Recommendation 2/xx — Guidance for users displaying Volcanic Ash Advisory and Volcanic Ash SIGMET information

That, ICAO consider including guidance within relevant ICAO documents (such as Doc 8896 – *Manual on Aeronautical Meteorological Practice*) advising users to apply appropriate corrections to traditional alphanumeric code forms of VAA and VA SIGMET messages when displaying on map projections that differ from the projection used for the creation of the original forecast.

#### 4 ACTION BY THE IAVWOPSG

#### 4.1 The METP-WG/MOG Volcanic Ash Work Stream is invited to:

a) note the information in this Study Note; and

b) decide on the draft recommendations proposed for the group's consideration

#### **APPENDIX** A

Ilustration of the effects of distortion due to joining vertices of a polygon (triangle in this case) by straight lines on different projections.

#### Example 1.

3 coordinates: 60N 000W, 40N 030E, 40N 030W. When the same points are joined by straight lines on two different map projections the areas affected are not the same – in a) the northern half of Spain is identified as being affected, in b) it is completely clear! Which is correct? According to footnote 2 of Table A2-1 (Annex 3) it would be a).



Figure 1: See Example 1 text for description.

To correctly represent the area defined by a) in the example above on a Polar Stereographic projection it would need to be described by the red dashed lines in figure 2b (below). This should therefore illustrate that you cannot simply join coordinates by straight lines on different map projections and obtain the same result.



Figure 2: See explanatory text for description.

#### **APPENDIX B**

Example MODEL VAGs illustrating how the dependence upon map projection effects the shape of the polygons (indeed any shape) defined in the equivalent VAA. It is proposed that updated MODEL VAGs and SVAs provide equivalent, yet consistent examples, in Mercator and Polar Stereographic projections to make the importance of application of corrections evident to originators and users.



Example MODEL VAG using a Mercator Projection, as per the specification for VAA.



Example MODEL VAG using a Polar Stereographic Projection yet remaining consistent with the equivalent VAA (Mercator). Note the curvature of lines joining the vertices of the polygon – particularly evident where distance between vertices is large.

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