International Civil Aviation Organization
CAR/SAM Regional Planning and Implementation Group (GREPECAS)
Eleventh Meeting of the GREPECAS Aeronautical Meteorology Subgroup (AERMETSG/11)
Lima, Peru, 28 to 30 November 2011

Agenda Item 3: Review the status of implementation of the International Airways Volcano Watch (IAVW) in the CAR/SAM States

(Presented by the Secretariat)

SUMMARY

This working paper presents information on the progress of the International Airways Volcano Watch (IAVW), in accordance with the results of the Fifth and Sixth meetings of the IAVW Operations Group (IAVWOPSG/5 and IAVWOPSG/6), and the implementation status in CAR/SAM States.

References

- Report of the Fifth Meeting of the International Airways Volcano Watch Operations Group (IAVWOPSG/5), 15 to 19 March 2010, Lima, Peru.
- Report of the Sixth Meeting of the International Airways Volcano Watch Operations Group (IAVWOPSG/6), 19 to 23 September 2011, Dakar, Senegal.
- Report of the Fifteenth Meeting of the CAR/SAM Regional Planning and Iimplementation Group (GREPECAS/15), Rio de Janeiro, Brazil, 13 – 17 October 2008.

ICAO Strategic Objective:	*A – Safety* *C - Environmental Protection and Sustainable Development of Air Transport*

1. Introduction

1.1 The IAVWOPSG was established in response to Recommendation 1/22 of the Meteorology (MET) Divisional Meeting (2002), to ensure that the operation and development of the IAVW continue, in order to meet current and evolving operational requirements in a cost effective manner. The Group should also develop proposals for the development of the IAVW in order to ensure the seamless evolution of operational requirements, under ICAO procedures for the amendments to Annex 3.

1.2 ICAO Air Navigation Planning and Implementation Groups (PIRGs) should review the results of the IAVWOPSG meetings and identify any necessary follow-up action at regional level. Additionally, issues related to IAVW implementation raised by the PIRGs should be referred to the IAVWOPSG for consideration.

2. **Discussion**

Review the outcome of IAVWOPSG/5 and IAVWOPSG/6 meetings

2.1 The Fifth Meeting of the International Airways Volcano Watch Operations Group (IAVWOPSG/5) was carried out from 15 to 19 March 2010 in Lima, Peru. The Sixth Meeting was held in Dakar, Senegal, from 19 to 23 September 2011. The executive summaries are reproduced in **Appendix A** to this working paper. In addition, complete information regarding IAVWOPSG meetings can also be found at IAVWOSG website: http://www.icao.int/anb/iavwopsg, available in only English.

Review the status of implementation of IAVW

2.2 The Meeting shall recall that the Tenth Meeting of the GREPECAS Aeronautical Meteorology Subgroup (AERMETSG/10) approved Draft Conclusion 10/04, adopted by GREPECAS in its Sixteenth Meeting under Conclusion 16/09 - Guide on the International Airways Volcano Watch (IAVW).

2.3 In this regard, and as requested by the referred conclusion, the ICAO SAM Office prepared regional guidance in Spanish, to explain the contents of Doc 9766, *Handbook on the International Airways Volcano Watch (IAVW) — Operational Procedures and Contact List*, which is presented as **Appendix B**[1] to this working paper.

2.4 Considering the latest events on volcanic ash in the SAM Region which have affected several States, the Meeting could agree to formulate the following draft conclusion:

DRAFT
CONCLUSION 11/XX **DOC. 9766 - *HANDBOOK ON THE INTERNATIONAL AIRWAYS VOLCANO WATCH (IAVW) — OPERATIONAL PROCEDURES AND CONTACT LIST, IN SPANISH***

That, in order to support CAR/SAM States in IAVW implementation, ICAO be invited to consider the development of a Spanish version of Doc 9766 - Handbook on the International Airways Volcano Watch (IAVW), Operational Procedures and Contact List.

2.5 Based on the new GREPECAS methodology, the Meeting could consider a project for the implementation of international airways volcano watch (IAVW). One of the tasks to be developed by this project should be the review of the contingency plans for volcanic eruptions in the CAR and SAM Regions, as well as the tasks required for the implementation of IAVW and the issuance of volcanic ash related SIGMET.

3. **Action required**

3.1 The Subgroup is invited to:

a) consider the information presented in this working paper, as well as in Appendices A and B; and

b) agree on other actions as necessary.

[1] In the English version of this WP, Appendix B corresponds to Doc 9766.

APPENDIX A

FIFTH MEETING

IAVW OPERATIONS GROUP
(Lima, Peru, 15 to 19 March 2010)

EXECUTIVE SUMMARY

1 INTRODUCTION

1.1 The Fifth Meeting of the International Airways Volcano Watch Operations Group (IAVWOPSG/5), held at the ICAO South American Office (SAM) from 15 to 19 March 2010, was attended by eighteen experts from the eight volcanic ash advisory centre (VAAC) Provider States, the International Air Transport Association (IATA), the International Union of Geodesy and Geophysics (IUGG) and the World Meteorological Organization (WMO).

1.2 Mr P. Lechner, the Chairman of the IAVWOPSG, presided over the meeting throughout its duration. Mr. R. Romero, Technical Officer, Meteorology from ICAO Headquarters, Montréal, was Secretary of the meeting, assisted by Mrs. Nohora Arias, Regional Officer Meteorology from the South American Office.

2. FOLLOW-UP OF IAVWOPSG/4 CONCLUSIONS

2.1 Regarding the follow-up action of IAVWOPSG/4 Conclusions, the group noted that, except for Conclusions 4/23 and 4/24, action was considered to be complete on all the issues (Decision 5/1 refers).

3. REVIEW OF ICAO PROVISIONS RELATED TO IAVW

3.1 The group reviewed the IAVW-related regional procedures contained in the air navigation plan (ANP) facilities and services implementation document (FASID) which would render them compatible with Annex 3 — *Meteorological Service for International Air Navigation*. The amended procedures would be referred to the ICAO Regional Offices for processing (Conclusion 5/2 refers).

4 OPERATION OF THE IAVW

4.1 The group reviewed the management reports prepared by the VAAC Provider States, noted their content and expressed satisfaction with the scope of the information provided.

4.2 In order to improve the situational awareness of users of the IAVW, the group reviewed a proposal for the issuance of daily volcano status briefing information and agreed to pursue the development of further concepts around the coordination and provision of volcano situational awareness information (Conclusion 5/3 refers).

4.3 The group noted that, due to operational airline requirements, the area of responsibility of VAAC Wellington had been extended to the south to cover high latitudes and, to the east to meet the western edge of VAAC Buenos Aires. The group also took note of a proposal by Chile of supporting New Zealand in the coverage of the extended area. The group endorsed the extended area and agreed that VAAC Wellington be invited to formalize the extension of its area of responsibility (Conclusion 5/4 refers).

4.4 Concerning the operational procedures for the coordination and transfer of responsibility between volcanic ash advisory centres (VAACs) during volcanic ash events, the group addressed a proposal aimed to align the procedures established in Annex 3 and in the *Handbook on the International Airways Volcano Watch (IAVW) — Operational Procedures and Contact List* (Doc 9766) and, since the proposal would simplify the procedures, the group agreed to undertake a safety and communication issues assessment, after which Doc 9766 may need to be amended by the Secretariat (Conclusion 5/5 refers).

4.5 To ensure support of established procedures regarding notification on pre-eruption and/or volcanic eruptions by volcano observatories, the group agreed with the inclusion of the Volcano Observatory Notice to Aviation (VONA) in Doc 9766 and also on the need to continue the education process concerning its use by volcano observatories (Conclusion 5/6 refers).

4.6 In order to assist both the meteorological watch offices (MWOs) and VAACs to meet their obligations under the IAVW and to avoid unnecessary repetition of information in different documents, the group agreed to develop a proposal for amendment of Annex 3 to include a reference to the VONA (Conclusion 5/7 refers).

4.7 To improve the description and movement of the ash cloud in volcanic ash advisories, the group agreed to prepare a proposal of amendment of Table A2-1 of Annex 3 to allow the use of "estimation" and direction and speed of movement attached to the description of the observed ash cloud (Conclusion 5/8 refers).

4.8 The group agreed to pursue the development of appropriate guidance material clarifying the procedures to be followed by meteorological watch offices (MWOs) for the reporting of complex volcanic ash events in SIGMET messages (Conclusion 5/9 refers).

4.9 In order to assist the VAACs, the group agreed to the development of a common international volcano database, adapted to their needs, to be used by the VAACs (Conclusion 5/10 refers).

4.10 To support the issuance of special air reports related to the smell of sulphur, the group agreed to include appropriate guidance on procedures to be followed in the *Handbook on the International Airways Volcano Watch (IAVW) — Operational Procedures and Contact List* (Doc 9766) (Conclusion 5/11 refers).

4.11 Regarding the implementation of a central repository for the collection and distribution of the volcanic activity reports (Model VAR in the Procedures for Air Navigation Services-Air Traffic Management (Doc 4444)), the group agreed that work related to the establishment of such a facility be completed by VAAC Darwin (Conclusion 5/12 refers).

5 DEVELOPMENT OF THE IAVW

5.1 Regarding the Acoustic Surveillance for Hazardous Eruptions (ASHE) project in Ecuador, the group, concurring that there could be some potential use of this technology for the provision of near real-time notification of volcanic eruptions, agreed to express appreciation to the members of the project and that the work on the task was considered to be complete (Conclusion 5/13 refers). In a related issue concerning the use of infrasound data in support of the volcanic ash advisories centres (VAACs), the group agreed to develop and test a prototype notification system for the VAACs and to pursue collaborative work between VAACs and the Comprehensive Nuclear Test-Ban Treaty Organization (CTBTO).

5.2 To support the issuance of ASHTAM/NOTAM for volcanic ash deposit ion at the aerodromes, the group agreed with the development of appropriate guidance material for inclusion in the Doc 9766 (Conclusion 5/15 refers). In a related issu e the group agreed that the Secretariat prepare an alignment of the ASHTAM and NOTAM for volcanic ash formats and to develop a proposal for inclusion in Amendment 37 of Annex 15 –*Aeronautical Information Services* (Conclusion 5/16 refers).

5.3 The group agreed that with the com pletion of the classific ation matrix of eruption type, research on the work on the Eruption Source Para meters (ESP) was considered to be co mplete (Decision5/17 refers).

6 MATTERS RELATED TO THE MONITORING AND PROVISION OF WARNINGS TO AIRCRAFT OF RADIOACTIVE DEBRIS AND TOXIC CHEMICAL CLOUDS

6.1 The group reviewed and endorsed a d raft guidance material called *Manual on Space Weather Effects in Regard to International Air Navigation* and agreed to its inclusion on the International Airways Volcano Watch Operations Group (IAVWOPSG) website to improve understanding between the users community of the pr oducts regarding space weat her which could be used in support of operational decisions (Conclusion 5/ 10 refers). In a related issue, the group agreed in drafting operational requirements for Space Weather and preparing s uggested milestones for t he development a Spac e Weather service for international air navigation f or review by the next meeting in 2011(Conclusion 5/19 refers).

7 IMPROVED NOTIFICATION CONCERNING THE ACCIDENTAL RELEASE OF RADIOACTIVE MATERIAL INTO THE ATMOSPHERE

7.1 With regard to the procedures for the direct notification to the area control centres (ACCs) regarding the release of radioactive material in the at mosphere the gr oup agreed to develop a global database of aeronautical fixed t elecommunication network (AFTN) addresses which should be available online (Conclusion 5/22 refers). In a related issue, the group agreed t hat there is no need for th e time being to develop ad ditional provisions related to SIGMET f or radioactive clouds. (Decision 5/23 refers). With regard to guidance material, the gro up agreed to develop draft guidance on the issuance of SIGMET for radioactive cloud to a ssist meteorological watch offices (MWOs) in meeting their obligations under the International airways Volcano watch (IAVW) (Conclusion 5/24 refers).

8 FUTURE WORK PROGRAMME

8.1 Regarding the future work programme, the group reviewed the work programme and proposed additional changes based on the discussions under Agenda Item s 6, 8 and 9 (D ecision 5/20 refers). Additionally, the group agreed that a proposal be presented at the sixth meeting regarding issues on volcanic ash messages raised by the fifth-first Meeting of the European Air Navigation Planning Group (EANPG/51).

— END —

SIXTH MEETING

INTERNATIONAL AIRWAYS VOLCANO WATCH OPERATIONS GROUP (IAVWOPSG)

(Dakar, Senegal, 19 to 23 September 2011)

EXECUTIVE SUMMARY

1. INTRODUCTION

1.1 The Sixth Meeting of the International Airways Volcano Watch Operations Group (IAVWOPSG/6), held at the ICAO Western and Central African Office (WACAF) from 19 to 23 September 2011, was attended by thirty experts from seven volcanic ash advisory centre (VAAC) Provider States, the Comprehensive Nuclear Test-Ban Treaty Organization (CTBTO), the International Air Transport Association (IATA), the International Union of Geodesy and Geophysics (IUGG), the International Federation of Air Line Pilots' Associations (IFALPA) and the World Meteorological Organization (WMO).

1.2 Mr. Peter Lechner, the Chairman of the IAVWOPSG, presided over the meeting throughout its duration. Mr. Raul Romero, Technical Officer, Meteorology from ICAO Headquarters, Montréal, was Secretary of the meeting, assisted by Mr. Akoa Okossi, Regional Officer Meteorology from the Western and Central African Office and Mr. Vitalis Ahago, Regional Officer Meteorology from the Eastern and Southern African Office.

2. FOLLOW-UP OF IAVWOPSG/5 CONCLUSIONS

2.1 Regarding the follow-up action of IAVWOPSG/5 conclusions, the group noted that, except for Conclusions 4/23, 4/24 and 5/16 which had been overtaken by events, action was considered to be complete on all the issues (Decision 6/1 refers).

3. REVIEW OF ICAO PROVISIONS RELATED TO IAVW

3.1 The group reviewed the IAVW-related regional procedures contained in the Air Navigation Plan (ANP) and Facilities And Services Implementation Document (FASID) to render them compatible with Annex 3 — *Meteorological Service for International Air Navigation*. The amended procedures will be referred to the ICAO Regional Offices for processing (Conclusion 6/2 refers).

3.2 The group reviewed and endorsed a draft amendment to Annex 3 (Conclusions 6/3 and 6/4 refer) regarding:

a) the introduction of a reference to the Volcano Observatory Notice for Aviation;

b) an amendment to Table A2-1 — *Template for advisory message for volcanic ash*; and

c) the alignment of Appendix 1, Model SN (radioactive material and volcanic eruption symbols in WAFS forecasts and related requirements).

3.3 With regard to IAVW-related guidance material, the group agreed to amend the procedures for coordination and transfer of responsibility between VAACs included in the *Handbook on the International Airways Volcano Watch (IAVW) — Operational Procedures and Contact List* (Doc 9766) to add new possibilities for the issuance of volcanic ash advisories when a long lasting eruption impacts several VAACs' areas of responsibility (Conclusion 6/5 refers).

4. OPERATION OF THE IAVW

4.1 The group reviewed the management reports prepared by all the VAAC Provider States, noted their content and expressed satisfaction with the scope of the information provided.

4.2 In order to improve support to international aviation users, VAAC Buenos Aires was invited to ensure that the volcanic ash related information available at its public internet website is provided in the English language (Conclusion 6/6 refers).

4.3 In order to continue the work regarding improvement of the situational awareness of users of the IAVW, the group agreed that further development of daily volcano status briefing information and related concepts should be done in partnership with the International Volcanic Ash Task Force (IVATF) (Conclusion 6/7 refers).

4.4 Regarding the need to report on processes and methodologies used by each VAAC to provide information to airline operators and regulators regarding the way in which the VAACs operate and for staff at all VAACs to ensure better consistency in the products they issue, the group agreed to carry out further work in the development of a best practices guide, initially through a workshop comprising representatives from all the VAACs (Conclusion 6/8 refers), and to provide a detailed report on processes and methodologies (Conclusion 6/9 refers).

4.5 The group reviewed and endorsed a draft amendment to the *Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Clouds* (Doc 9691), Chapter 3 — *Observation/Detection and Forecasting Movement of Volcanic Ash in the Atmosphere* and Chapter 4 — *Effect of Volcanic Ash on Aircraft* stemming from the IVATF (Conclusion 6/10 refers).

4.6 Concerning the operational procedures for the coordination and transfer of responsibility between VAACs during large-scale volcanic ash events, the group agreed that fine-tuning of the role of the "lead VAAC" was necessary and also that its relationship with other VAACs should be clarified (Conclusion 6/11 refers).

4.7 Regarding the development of procedures on how to improve the sharing of information from WMO Member States (such as radar reports, satellite imagery and ground-based measurements) with volcano observatories in an effort to improve collaborative forecasting, the group agreed to invite WMO to support collaborative forecasting through enhanced information sharing (Conclusion 6/12 refers).

4.8 To improve collaborative decision making between VAACs and volcano observatories, the group agreed to amend the operational procedures for the dissemination of information on volcanic eruptions and associated volcanic ash clouds included in Part 4 of Doc 9766 (Conclusion 6/13 refers).

4.9 Regarding a list of recommendations developed by IATA related to the promotion of safe and efficient operations in or near airspace subject to volcanic ash contamination, the group agreed to pursue additional work to ensure that, in light of the IAVWOPSG and IVATF work programmes, each of

the matters raised is adequately covered or clearly allocated to an appropriate body (Conclusion 6/14 refers).

4.10 The group agreed to upgrade to a Standard the Recommended Practice for the monitoring, by selected State volcano observatories, of active or potentially active volcanoes which could affect international airways (Conclusion 6/15 refers).

4.11 Due to known implementation issues in the various ICAO Regions, the group agreed to invite ICAO to urgently consider the establishment of special implementation projects for all the ICAO Regions, but in particular for Asia, and Central and South America, to promote improvements in volcano observatory products for aviation and improvements in communications between volcano observatories and the aviation community (Conclusion 6/16 refers).

4.12 Regarding the detailed results of the investigation into flight planning information dissemination prepared by the IVATF, the group agreed to establish an ad-hoc working group to assess the findings (Conclusion 6/17 refers).

4.13 With regard to a proposal to modify the existing template for advisory messages for volcanic ash (Annex 3, Table A2-1 — *Template for advisory message for volcanic ash*) to allow each forecast time step to be self-contained within its own message bulletin, the group agreed to undertake further work to consider issues related to the composition and length of the advisory message for volcanic ash to improve its utility (Conclusion 6/18 refers).

4.14 To ensure consistency between the VAACs in their production of volcanic ash advisories, the group agreed to invite ICAO to generate a digital database of VAAC areas of responsibility and flight information regions (FIRs)(Conclusion 6/19 refers).

4.15 With regard to the need for standardization of an international volcano database to be used by the VAACs and the willingness of the Smithsonian Institution's Global Volcanism Program to produce such database adapted to VAAC needs, the group agreed that the members from Canada and IUGG will assist the Smithsonian Institution to finalize the database (Conclusion 6/20 refers).

4.16 Concerning the development of guidance material related to the reporting of complex volcanic ash events (multiple layers and/or more than one eruption within a FIR) in SIGMET, the group agreed to assess, inter alia, if the volcanic ash advisory/volcanic ash advisories in graphical format (VAA/VAG) could be used to replace the SIGMET for volcanic ash and the capability of the nine VAACs to provide global service in this regard (Conclusion 6/21 refers).

4.17 To facilitate the description of the observed and/or forecasted position of volcanic ash clouds in SIGMET messages, the group agreed to introduce the terms "ENTIRE FIR (or CTA)" and "NO VA EXP" in Annex 3, Table A6-1 — *Template for SIGMET and AIRMET messages and special air-reports (uplink)* (Conclusion 6/22 refers).

4.18 Concerning the need to improve the situational awareness (in terms of volcano monitoring and alerting methods) of impending volcanic eruptions, which was recognized to be of value for aviation risk management, the group agreed to invite IUGG to promote the use of the volcano observatory notice for aviation (VONA) and to produce a list of volcanoes which pose a threat to aviation and are unmonitored or inadequately monitored (Conclusion 6/23 refers).

4.19 The group agreed to consider closed the work related to the implementation, on a trial basis, of a central repository for collection of volcanic activity report (VAR), in view of the associated work being addressed by the IVATF (Conclusion 6/24 refers).

5. DEVELOPMENT OF THE IAVW

5.1 Concerning the use of inf rasound data in support of the VAACs, the group agreed to pursue the development and testing of a prototype real-time eruption notification system for the VAACs and to pursue the ongoing collaborative work between VAACs and the CTBTO (Conclusion 6/25 refers).

5.2 Agreeing with a list of seven reco mmendations made by the IVATF in the field of the volcanic ash science, the group decided to refer them as quickly as possible to the WMO-IUGG Volcanic Ash Scientific Advisory Group (VASAG) to allo w them to initiate appropriate follow-up action (Conclusion 6/26 refers).

5.3 To support engine testing, the group agreed that the preliminary guidance information on volcanic material for engine testing was mature and agreed to include it in Doc 9691(Conclusion 6/27 refers).

5.4 In an effort to reduce unc ertainty and to improve volcanic ash dispersion forecasts, the group agreed to invite the VAACs to take into account in their current practices the approaches suggested by the Wor kshop on Ash Dispersio n Forecasting and Aviat ion (Geneva, 18–20 October 2010) (Conclusion 6/28 refers).

6. IMPROVED NOTIFICATION CONCERNING THE ACCIDENTAL RELEASE OF RADIOACTIVE MATERIAL INTO THE ATMOSPHERE

6.1 With regard to the provision of inform ation on the release of radioactive material into the atmosphere, the group agr eed to establish an ad-hoc group to de velop a concept of operations for th e provision of such information, to rev iew Annex 3 provisions and related guidance material and to coordinate, in view of an evaluation of the role of regional specialized meteorological centres (RSMCs) in the provision of related guidance, with the WMO Commission for Basic Sy stems (CBS) Coordination Group on Nuclear Emergency Response Activities (Conclusion 6/29 refers).

6.2 In a related issue, the group reviewed the overall structure for the provision of information regarding the release of radioactive material into t he atmosphere, and agre ed to study alternative provisions for replacement of the SIGMET for radioactive cloud and to assess th e possibility of the provision of such information by centres with the necessary expertise (Conclusion 6/30 refers).

7. MATTERS RELATED TO THE ASSESSMENT OF THE NEED TO PROVIDE INFORMATION ON SOLAR RADIATION STORMS AND OTHER BIO-HAZARDS

7.1 The ad hoc working gr oup tasked to develop requirements for space weather proposed the development of a concept of operations to further promote the formulation of such requirements. After review of a proposed concept of operations, the group agreed: that IATA be invited to develop high-level requirements on space w eather; to include the draft user requirements and th e concept of operations on the IAVW w ebsite to obtain States' views; and to consolidate the replies and develo p a draft set of requirements for review by the next meeting in 2013 (Conclusion 6/31 refers).

8. FUTURE WORK PROGRAMME

8.1 Regarding the future work programme, the group reviewed the terms of reference and the work programme and proposed changes based on the discussions under Agenda Items 2 to 10 (Decision 6/32 refers).

9. OTHER BUSINESS

9.1 The group noted that the issue of re-suspended volcanic ash is becoming an issue that deserves further attention and therefore agreed to invite the VAAC Buenos Aires Provider State to report on its experience on the management of re-suspended ash during the 2011 Puyehue-Cordón Caulle eruption (Conclusion 6/33 refers).

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APPENDIX B

HANDBOOK ON THE

INTERNATIONAL AIRWAYS VOLCANO WATCH

(IAVW) - DOC 9766-AN/968

Doc 9766-AN/968

HANDBOOK ON THE INTERNATIONAL AIRWAYS VOLCANO WATCH (IAVW)

OPERATIONAL PROCEDURES AND CONTACT LIST

SECOND EDITION — 2004

Approved by the Secretary General and published under his authority

INTERNATIONAL CIVIL AVIATION ORGANIZATION

DOCUMENT CHANGE RECORD ON THE WEB
Parts 1 to 4

DATE	SECTION PAGES AFFECTED	
31.8.11	Part 4	Update to Table 4-3, VAA bulletin header
16.8.11	Part 4	Update to Table 4-2, VAAC contact numbers – Anchorage VAAC
8.2.11	Part 4	Update to Table 4-2, VAAC contact numbers – Wellington VAAC
9.12.10	Part 4	Updated page 4-7 added para 4..3.4; page 4.9, para 4.5.1, line 1, added "*volcano observatory* after *WMO*; para 4.5.1 a) added footnote no. 5; para 4.5.1 c) line 3, added "*using the PNG format*" after "*graphical format*" and deleted "*(in a position to do so*)"; page 4-10, added "*see Appendix E – VONA;* page 4-17, Table 4-2. updated VAAC Buenos Aires URL.
25.8.10	Part 4	Updated page 4-7, para 4.3.3 changed the word " ASHTAM" to "NOTAM", and "airport" to "aerodrome".
12.07.10	Part 2: Part 4:	Updated Wellington (New Zealand) area of responsibility text Replaced VAAC Map New paragraph 4.3.3
8.07.10	Part 4:	Replaced Appendix E with updated version Appendix F (new) was added
14.5.10	Part 2.	Change to Toulouse VAAC area of responsibility
14.4.10	Part 4:	VAAC Tokyo
26.11.09	Part 3:	Amendment to the URL address for New Zealand VAAC
25.9.09	Part 3: Part 4:	Amendment to the URL address for Buenos Aires VAAC URL address for the eruption source parameters for volcanoes of the world; and introduction of information regarding the availability of ESP
29.5.09	Part 4:	Guidance regarding the transmission of information to aviation by selected State observatories Update regarding the distribution (addresses) of ASHTAM/NOTAM for VA.
14.5.09	Part 4:	Introduction of new heading "4.7 Action to be taken by pilots in the event of entry into a SO_2 cloud" and "Table A4-3 – Volcanic ash advisory bulletin headers"
12.3.09	Part 4:	Update to Table 4-2. VAAC contact numbers
25.2.09	Parts 3 and 4: Part 4:	Amendment to the URL for Toulouse VAAC Introduction of new sub-paragraphs 4.5.1 h) recommended practice for "gradual" advisory cessation and 4.6 on standard format of the VA advisories and VA SIGMET used for test purposes

DATE	SECTION PAGES AFFECTED
15.12.08	Parts 3 and 4: New web page for VAAC Montreal
24.11.08	Part 4, pages 4-12 and 14: Update of VAAC Buenos Aires AFTN address
19.11.08	Part 2, page 2-10: Wellington Part 4, page 4-13: Indonesia
22.5.07	Part 4: Buenos Aires
5.11.07	Part 4: Buenos Aires
6.8.07	Part 2: Part 4: Introduction of changes resulting from the IAVWOPSG/3 Meeting Appendices:
30.7.07	Part 4: Update of AFTN addresses to be used for sending air-reports, SIGMETs and volcanic ash advisories to London WAFC and SADIS
16.6.07	Part 4: Updated volcano level of alert colour code
14.11.06	Part 4: Introduction of relevant aspects of the Hyogo framework
9.6.06	Part 2: Editorials Part 3: Update of VAAC Tokyo homepage Part 4: Editorials
2.5.06	Part 4: VAAC Tokyo
24.4.06	Part 2: New format – inclusion of location indicators for MWOs and ACCs Part 4: Deletion of WMO abbreviated headers for ASHTAM and NOTAMs, introduction of Appendix C on back-up procedures and update to VAACs London and Wellington
31.1.06	Part 2: VAACs areas of responsibility
28.11.05	Part 5: Ecuador , Panama
1.11.05	Part 5: Argentina, Chile, Paraguay
30.6.05	Part 5: El Salvador
25.4.05	Part 4: VAAC Buenos Aires Part 5: Peru
24.2.05	Part 4: Introduction of Appendix A — Sample letter of Agreement between the ATS, MET authorities and vulcanological authorities and procedures on the transmission of information related to aircraft encounters with volcanic ash (Former Appendix A renumber as B)
29.10.04	Part 4: Introduction of Appendix A on operational procedures for the coordination and transfer of responsibility between VAACs for volcanic ash events

DATE	SECTION PAGES AFFECTED
25.10.04	Part 4: AFTN address for ASHTAMs/NOTAMs
14.9.04	Part 3: VAAC Montreal
1.9.04	Part 2: VAAC Toulouse
16.8.04	Part 2: VAACs Anchorage, London and Toulouse
29.7.04	Part 2: VAACs Buenos Aires, Tokyo and Washington; Part 3, 3.3; Part 5: Canada, Russian Federation
19.4.04	Parts 3 and 4: VAACs London and Tokyo
3.3.04	Part 2: VAAC Toulouse; Part 5:Argentina
22.1.04	Parts 3 & 4: VAAC Tokyo

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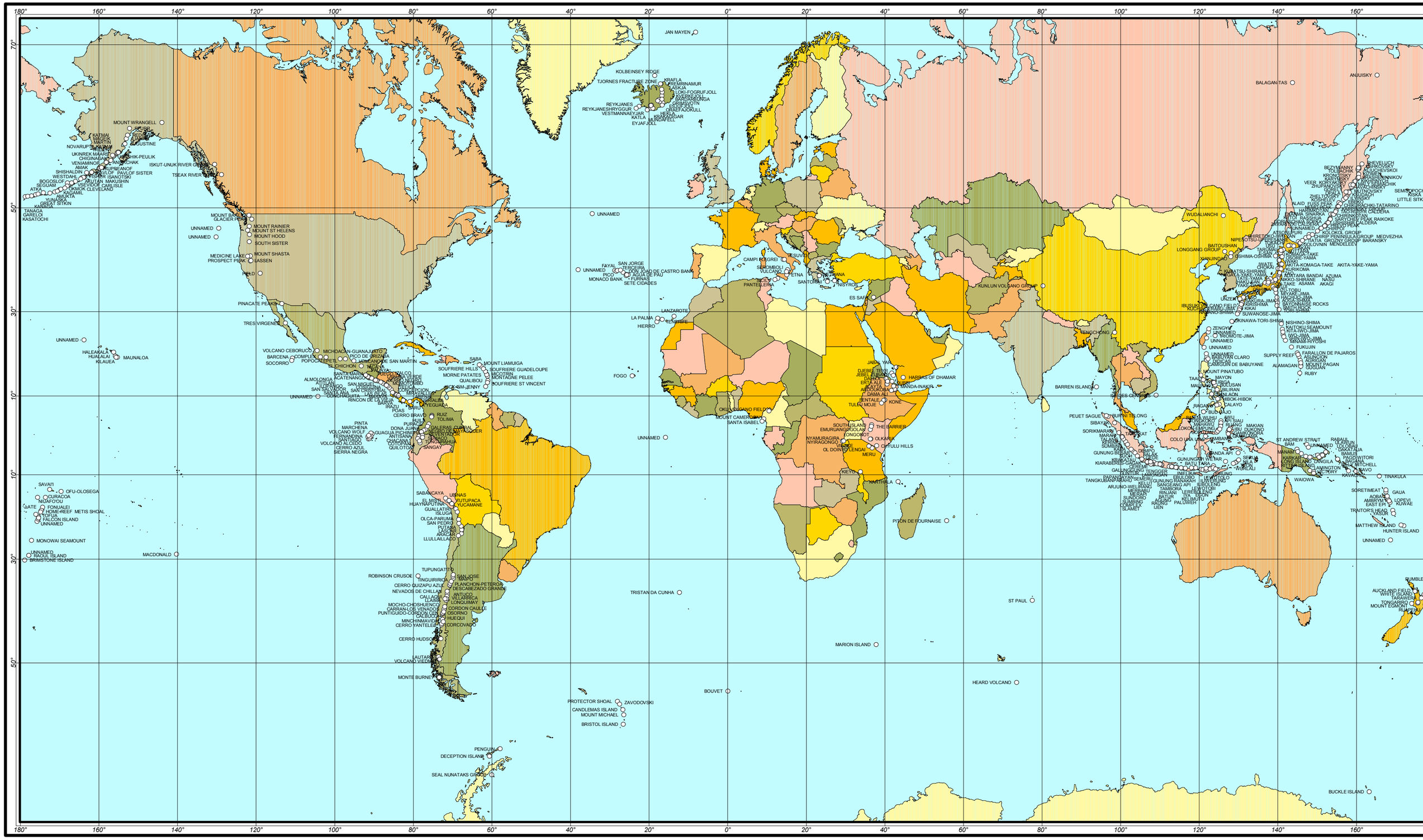
Part 1

VOLCANOES ACTIVE DURING THE LAST 10 000 YEARS



Volcanoes with Eruptions During the Last 10,000 Years
Prepared in 1995 by Roland Pool, Smithsonian Institution,
Global Volcanism Program, NHB MRC 119, Washington, DC 20560

VOLCANOES OF THE WORLD

3000 0 3000 Km

Mercator Projection

A 101x147 cm map, This Dynamic Planet, showing these volcanoes, earthquake epicenters, impact craters, plus tectonic and physiographic data is available from: US Geological Survey, Map Distribution Center, Box 25256, Federal Center, Denver, CO 800225 (800) USA-MAPS

Part 2

VOLCANIC ASH ADVISORY CENTRES (VAACs) DESIGNATED BY ICAO AND THEIR RESPONSIBILITIES

(Note. — VAACs maintain a 24-hour watch)

EXPLANATION OF THE TABLE

Column

1. Location of the volcanic ash advisory centre (VAAC).
2. ICAO location indicator of VAAC (for use in the WMO heading of advisory bulletin).
3. Area of responsibility for the preparation of advisory information on volcanic ash by the VAAC in Column 1.
4. MWOs to which the advisory information on volcanic ash should be sent.
5. ICAO location indicator of the MWOs in Column 4.
6. ACCs to which the advisory information on volcanic ash should be sent.
7. ICAO location indicator of the ACCs in Column 6.

VOLCANIC ASH ADVISORY CENTRE	***ICAO LOCATION INDICATOR***	***AREA OF RESPONSIBILITY***	***MWOs TO WHICH ADVISORY INFORMATION IS TO BE SENT***		***ACC TO WHICH ADVISORY INFORMATION IS TO BE SENT***	
			Name	***ICAO LOCATION INDICATOR***	***Name***	***ICAO LOCATION INDICATOR***
1	**2**	**3**	**4**	**5**	**6**	**7**
Anchorage (United States)	PAWU	Anchorage Oceanic Anchorage continental Anchorage Arctic and west to E150 north of N60	Anadyr	UHMA	Anadyr	UHMA
			Anchorage	PAWW	Anchorage	PAZA
			Chaybukha	UHMG	Chaybukha	UHMG
			Chersky	UESS	Chersky	UESS
			Chokurdakh	UESO	Chokurdakh	UESO
			Edmonton	CWEG	Edmonton	CZEG
			Fairbanks	PAWU	Fairbanks	PAFA
			Kansas City	KKCI	Boston Chicago Cleveland Denver Minneapolis New York Salt Lake Seattle Washington	KSBW KORD KZOB KZDV KZMP KZNY KZLC KZSE KZDC
			Mys Shmidta	UHMI	Mys Schmidta	UHMI
			Pevek	UHMP	Pevek	UHMP
			Seymchan	UHMS	Seymchan	UHMS
			Tiksi	UEST	Tiksi	UEST
			Tokyo	RJTD	Tokyo	RJTG
			Zyryanka	UESU	Zyryanka	UESU
Buenos Aires (Argentina)	SABM	South of S10 between W10 and W90	Amazònica	SBEG	Amazònico	SBAZ
			Antofagasta	SCFA	Antofagasta	SCFZ
			Asunción	SGAS	Asunción	SGFA
			Brasilia	SBBR	Brasilia	SBBS
			Buenos Aires (Aeroparque)	SABE	Ezeiza	SAEF/SAEU
			Comodoro Rivadavia	SAVC	Comodoro Rivadavia	SAVF/SAVU
			Córdoba	SACO	Córdoba	SACF/SACU
			Curitiba	SBCT	Curitiba	SBCW
			La Paz	SLLP	La Paz	SLLF
			Lima-Callao	SPIM	Lima	SPIM
			Mendoza	SAME	Mendoza	SAMF/SAMV
			Montevideo	SUMU	Montevideo	SUEO
			Puerto Montt	SCTE	Puerto Montt	SCTZ
			Punta Arenas	SCCI	Punta Arenas	SCCZ
			Recife	SBRF	Recife Atlantico	SBRE SBAO
			Resistencia	SARE	Resistencia	SARR/SAEU
			Santiago	SCEL	Santiago	SCEZ

VOLCANIC ASH ADVISORY CENTRE	***ICAO LOCATION INDICATOR***	***AREA OF RESPONSIBILITY***	***MWOs TO WHICH ADVISORY INFORMATION IS TO BE SENT***		***ACC TO WHICH ADVISORY INFORMATION IS TO BE SENT***	
			Name	***ICAO LOCATION INDICATOR***	***Name***	***ICAO LOCATION INDICATOR***
1	**2**	**3**	**4**	**5**	**6**	**7**
Darwin (Australia)	YPDM	Southward from N10 and from E100 to E160, and the Perth FIR between E100 and E75, Colombo FIR, and those parts of the Kuala Lumpur, Bangkok, Chennai, Yangon and Calcutta FIRs lying within N10 E100 to N20 E100 to N20 E82 to N10 E82 to N6 E78 to S2 E78 to S6 E75	Adelaide	YPRM	Adelaide	YPAD
			Bangkok	VTBD	Bangkok	VTBB
			Brisbane	YBRF	Brisbane Cairns	YBBN YBCS
			Chennai	VOMM	Chennai	VOMF
			Darwin	YDRM	Darwin	YPDN
			Gia Lam	VVGL	Hanoi Ho-Chi-Minh	VVNB VVTS
			Hobart	YMHF	Hobart	YMHB
			Honiara	AGGH	Honiara	AGGH
			Jakarta	WIII	Jakarta	WIIF
			Kota Kinabalu	WBKK	Kota Kinabalu	WBFC
			Kuala Lumpur	WMKK	Kuala Lumpur	WMFC
			Manila	RPLL	Manila	RPHI
			Melbourne	YMRF	Melbourne	YMMM
			Perth	YPRF	Perth	YPPH
			Port Moresby	AYPY	Port Moresby	AYPM
			Singapore	WSSS	Singapore	WSJC
			Sydney	YSRF	Sydney	YSSY
			Townsville	YBTL	Townsville	YBTL
			Ujung Pandang	WAAA	Ujung Pandang	WAAF
			Yangon	VYYV	Yangon	VYYF
London (United Kingdom)	EGRR	Bodø Oceanic, Reykjavik, Shanwick Oceanic, London, Scottish, Shannon	Amsterdam	EHDB	Amsterdam	EHAA
			Bodø	ENVN	Bodø Oceanic	ENOB
			Bordeaux	LFBD	Bordeau	LFBB
			Bremen	EDZM	Bremen	EDWW
			Brest	LFRN	Brest	LFRR
			Brussels	EBBR	Brussels	EBBU
			Edmonton	CWEG	Edmonton Gander	CZEG CZQX
			Exeter	EGTE	Exeter	EGTT
			København	EKMI	København	EKDK
			Lisboa	LPPT	Lisboa	LPPC
			London	EHHR	London Oslo Paris	EGTT ENOR LFFF
			Reykjavik	BIRK	Reykjavik Rovaniemi Scottish	BIRD EFPS EGPX
			Shannon	EINN	Shannon Stravanger	EISN ENSV
			Tromsø	ENVN	Tromso	ENTC
			Trondheim	ENVA	Trondheim	ENVA

VOLCANIC ASH ADVISORY CENTRE	***ICAO LOCATION INDICATOR***	***AREA OF RESPONSIBILITY***	***MWOs TO WHICH ADVISORY INFORMATION IS TO BE SENT***		***ACC TO WHICH ADVISORY INFORMATION IS TO BE SENT***	
			Name	***ICAO LOCATION INDICATOR***	***Name***	***ICAO LOCATION INDICATOR***
1	**2**	**3**	**4**	**5**	**6**	**7**
Montreal (Canada)	CWAO	Gander Oceanic Canadian Continental FIRs (including the Arctic Ocean) Reykjavik Søndre Strømfjord	Edmonton	CWEG	Edmonton Gander Moncton Montreal	CZEG CZQX CZQM CZUL
			Reykjavik	BIRK	Reykjavic	BIRD
			Søndrestrømfjord	BGSF	Søndrestrømfjord Toronto Vancouver Winnipeg	BGGL CZYZ CZVR CZWG
Tokyo (Japan)	RJTD	N60 to N10 – and from E90 to Oakland Oceanic and Anchorage Oceanic and Continental FIR boundaries	Bangkok	VTBD	Bangkok	VTBB
			Blagoveshchensk	UHBB	Blagoveshchensk	UHBB
			Beijing	ZBAA	Beijing Hohhot Taiyuan	ZBPE ZBHH ZBYN
			Bratsk	UIBB	Bratsk	UIBB
			Chita	UIAA	Chita	UIAA
			Gia Lam	VGLL	Hanoi Ho-Chi-Minh	VVNB VVTS
			Guanzhou	ZGGG	Guandzhou Changsha Guillin Nanning	ZGZU ZGCS ZGKL ZGNN
			Hong Kong	VHHH	Hong Kong	VHHH
			Incheon	RKSI	Incheon	RKRR
			Irkutsk	UIII	Irkutsk	UIII
			Khabarovsky	UHHH	Khabarovsky	UHHH
			Kirensk	UIKK	Kirensk	UIKK
			Kunming	SPPP	Kunming Chengdu Chongqing	ZPKM ZUDS ZUCK
			Lanzhou	ZLXY	Lanzhou Xi'an	ZLHW ZLSN
			Magadan	UHMM	Magadan	UHMM
			Magdagachi	UHBI	Magdagachi	UHBI
			Manila	RPLL	Manila	RPHI
			Nikolayevdsk-na-Amure	UHNN	Nikolayevdsk-na-Amure	UHNN
			Okha	UHSH	Okha	UHSH
			Okhotsk	UHOO	Okhotsk	UHOO
			Petropavlovsk-Kamchatsky	UHPP	Petropavlovsk-Kamchatsky	UHPP
			Phnom-Penh	VDPP	Phnom-Penh	VDPP
			Pyongyang	ZKYP	Pyongyang	ZKKK
			Sanya	ZJSY	Sanya	ZJSY
			Shanghai	ZSSS	Shanghai Hefei Jinan Nanchang Nanjing Qingdao	ZSHA ZSOF ZSTN ZSCN ZSNJ ZSQD

VOLCANIC ASH ADVISORY CENTRE	ICAO LOCATION INDICATOR	AREA OF RESPONSIBILITY	MWOs TO WHICH ADVISORY INFORMATION IS TO BE SENT		ACC TO WHICH ADVISORY INFORMATION IS TO BE SENT	
			Name	ICAO LOCATION INDICATOR	Name	ICAO LOCATION INDICATOR
1	2	3	4	5	6	7
					Xiamen	ZSAM
			Shenyang	ZYTX	Shenyang Dalian Hailar Harbin	ZYSH ZYTL ZBLA ZYHB
			Taibei	RCTP	Taibei	RCTP
			Tokyo	RJTD	Tokyo Fukuoka Naha Saporo	RJTG RJDG RORJ RJCG
			Ulan-Bator	ZMUB	Ulan-Bator	ZMUB
			Urumqi	ZWWW	Urumqi	ZWUQ
			Vladivostok	UHMM	Vladivostok	UHWW
			Wuhan	ZHHH	Wuhan	ZHWH
			Yuzhno-Sakhalinsk	UHSS	Yuzhno-Sakhalinsk	UHSS
Toulouse (France)	LFPW	Santa Maria Oceanic, AFI Region to S60, EUR Region west of E90 (except for London, Scottish and Shannon FIRs) and MID Region: south of N71, west of E90 ASIA Region (only Afghanistan)	Abu Dhabi	OMAA	Abu Dhabi	OMAA
			Accra	DGAA	Accra	DGAC
			Addis Ababa	HAAB	Addis Ababa	HAAA
			Aktau	UATE	Aralsk	UATA
			Aktyubinsk	UATT	Atyrau	UATG
			Alger	DAAG	Alger	DAAA
			Almaty	UAAA	Almaty	UAAA
			Amderma	ULDD	Amderma	ULDD
			Amilcar Cabral	GVAC	Amilcar Cabral/Sal	GVSC
			Amman	OJAC	Amman	OJAC
			Amsterdam	EHDB	Amsterdam	EHAA
			Ankara	LTAC	Ankara	LTAA
			Antananarivo	FMMI	Antananarivo	FMMM
			Arkhangelisk	ULAA	Arkhangelisk	ULAA
			Ashgabat	UTAA	Ashgabat	UTAA
			Asmara	HHAS	Asmara	HHAA
			Astana	UACC	Astana	UACC
			Astrakhan	URWA	Astrakhan	URWA
			Athinai	LGGG	Athinai	LGGG
			Atyrau	UATG	Aktau	UATE
			Baghdad	ORBB	Baghdad	ORBI
			Bahrain	OBBB	Bahrain	OBBI
			Baku	UBBB	Baku	UBBB
			Barcelona	LEBN	Barcelona	LECB
			Barnaul	UNBB	Barnaul	UNBB
			Beirut	OLBA	Beirut	OLBB
			Beograd	LYBE	Beograd	LYBA
			Bergen	ENVV	Bergen	ENTR
			Berlin	EDZB	Berlin	EDBB
			Beryozovo	USHB	Beryozovo	USHB

VOLCANIC ASH ADVISORY CENTRE	ICAO LOCATION INDICATOR	AREA OF RESPONSIBILITY	MWOs TO WHICH ADVISORY INFORMATION IS TO BE SENT		ACC TO WHICH ADVISORY INFORMATION IS TO BE SENT	
			Name	ICAO LOCATION INDICATOR	Name	ICAO LOCATION INDICATOR
1	2	3	4	5	6	7
			Bishkek	UAFM	Bishkek Osh	UAFM UAFO
			Bodo	ENVN	Bodø	ENOB
			Bordeaux	LFBD	Bordeaux	LFBB
			Bratislava	LZIB	Bratislava	LZBB
			Brazzaville	FCBB	Brazzaville	FCCC
			Bremen	EDZM	Bremen	EDWW
			Brest	LFRN	Brest	LFRR
			Brindisi	LIBR	Brindisi	LIBB
			Brussels	EBBR	Brussels	EBBU
			Bucuresti	LROM	Bucuresti	LRBB
			Budapest	LHBP	Budapest	LHBP
			Bujumbura	HBBA	Bujumbura	HBBA
			Cairo	HECA	Cairo	HECC
			Canarias	GCGC	Canarias	GCCC
			Casablanca	GMME	Casablanca	GMMM
			Chelyabinsk	USCC	Chelyabinsk	USCC
			Chennai	VOMM	Chennai (+Darwin)	VOMF
			Chisinau	LUKK	Chisinau	LUKK
			Dakar	GOOY	Dakar	GOOO
			Damascus	OSDI	Damascus	OSDI
			Dar-es-Salaam	HTDA	Dar-es-Salaam	HTDC
			De Bilt	EHDB	De Bilt	EHDB
			Delhi	VIDP	Delhi	VIDF
			Dhaka	VGZR	Dhaka (+Tokyo)	VGFR
			Dikson	UODD	Dikson	UODD
			Dushanbe	UTDD	Dushanbe	UTDD
			Dusseldof	EDZE	Dusseldorf	EDDL
			Entebbe	HUEN	Entebbe	HUEC
			Essen	EDZE	Frankfurt	EDYY
			Gaborone/SSK	FBSK	Gaborone	FBGR
			Geneva	LSZH	Geneva	LSAG
			Gran Canaria	GCLP	Gran Canaria	GCGC
			Hamburg	EDZH	Hamburg	EDMM
			Harare	FVHA	Harare	FVHA
			Helsinki	EFHK	Helsinki	EFIN
			Istanbul	LTBA	Istanbul	LTBB
			Jeddah	OEJN	Jeddah	OEJD
			Johannesburg	FAJS	Cape Town Johannesburg Johannesburg Oceanic	FACA FAJA FAJO
			Kabul	OAKB	Kabul	OAKX
			Kaliningrad	UMKK	Kaliningrad	UMKK

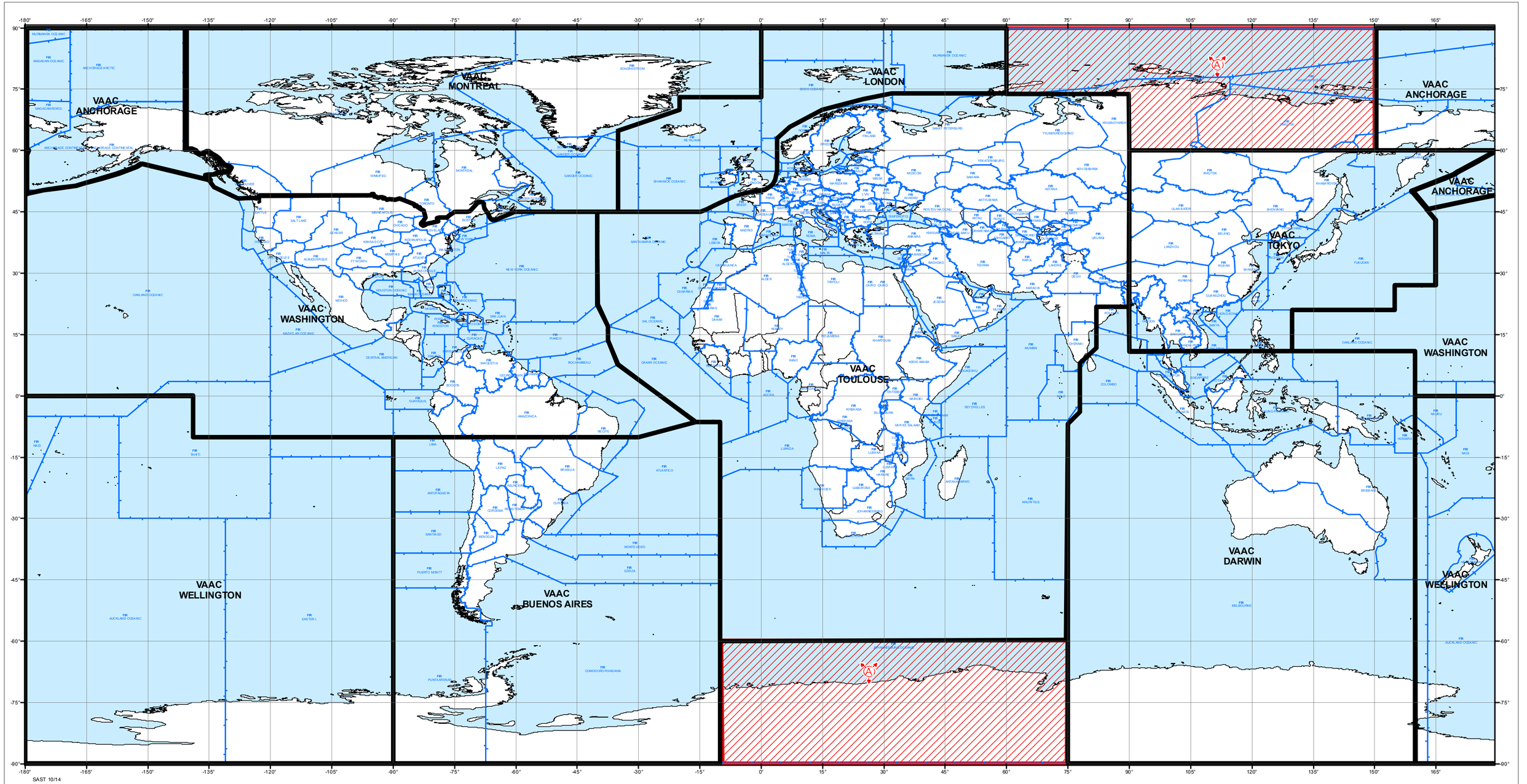
VOLCANIC ASH ADVISORY CENTRE	ICAO LOCATION INDICATOR	AREA OF RESPONSIBILITY	MWOs TO WHICH ADVISORY INFORMATION IS TO BE SENT		ACC TO WHICH ADVISORY INFORMATION IS TO BE SENT	
			Name	ICAO LOCATION INDICATOR	Name	ICAO LOCATION INDICATOR
1	2	3	4	5	6	7
			Kano	DNKN	Kano	DNKK
			Karachi	OPKC	Karachi	OPKR
			Kathmandu	VNKT	Kathmandu	VNSM
			Kazan	UWKD	Kazan	UWKD
			Khanty-Mansiysk	USHH	Khanty-Mansiysk	USHH
			Kharkiv	UKHV	Kharkiv	UKHH
			Khartoum	HSSS	Khartoum	HSSS
			Kigali	HRYR	Kigali	HRYR
			Kinshasa	FZAA	Kinshasa	FZAZ
			Kirov	USKK	Kirov	USKK
			København	EKMI	København	EKDK
			Kolkata	VECC	Kolkata (+Darwin)	VECF
			Kolpashevo	UNLL	Kolpashevo	UNLL
			Kostanay	UAUU	Kostanay	UAUU
			Kotlas	ULKK	Kotlas	ULKK
			Krasnoyarsk	UNKL	Krasnoyarsk (+Tokyo)	UNKL
			Kurgan	USUU	Kurgan	USUU
			Kuwait	OKBK	Kuwait	OKBK
			Kyiv	UKBB	Kyiv	UKBV
			Kyzylorda	UAOO	Kyzylorda	UAOO
			Lahore	OPLA	Lahore	OPLR
			Larnaka	LCLK	Nicosia	LCCC
			Lilongwe	FWLI	Lilongwe	FWLL
			Lisboa	LPPT	Lisboa	LPPC
			Ljubljana	LJLJ	Ljubljana	LJLA
			London	EGTE	London	EGTT
			Luanda	FNLU	Luanda	FNAN
			Lusaka	FLLS	Lusaka	FLFI
			L'viv	UKLL	L'viv	UKLL
			Madrid	LEMM	Madrid	LECM
			Mahe	FSIA	Seychelles	FSSS
			Male	VRMM	Male	VRMF
			Malmo	ESSA	Malmo	ESMM
			Malta	LMML	Malta	LMMM
			Mauritius	FIMP	Mauritius	FIMM
			Maputo	FQMA	Beira	FQBE
			Milano	LIMM	Milano	LIMM
			Minsk	UMMM	Minsk	UMMV
			Mogadishu	HCMM	Mogadishu	HCSM
			Monrovia	GLRB	Conakry	GUCY
			Moscow	UUWW	Moscow	UUWW
			Mumbai	VABB	Mumbai	VABF
			München	EDZW	München	EDMM

VOLCANIC ASH ADVISORY CENTRE	***ICAO LOCATION INDICATOR***	***AREA OF RESPONSIBILITY***	***MWOs TO WHICH ADVISORY INFORMATION IS TO BE SENT***		***ACC TO WHICH ADVISORY INFORMATION IS TO BE SENT***	
			Name	***ICAO LOCATION INDICATOR***	***Name***	***ICAO LOCATION INDICATOR***
1	**2**	**3**	**4**	**5**	**6**	**7**
			Murmansk	ULMM	Murmansk	ULMM
			Muscat	OOMM	Muscat	OOMS
			Mys- Kamenny	USDK	Mys-Kamenny	USDK
			N'Djamena	FTTJ	N'Djamena	FTTT
			Nairobi	HKJK	Nairobi	HKNA
			Niamey	DRRN	Niamey	DRRR
			Norilsk	UOOO	Norilsk	UOOO
			Novosibirsk	UNNT	Novosibirsk	UNNT
			Nukus	UTNN	Nukus	UTNN
			Odesa	UKOO	Odesa	UKOO
			Offenbach	EDZO	Offenbach	EDYY
			Ohrid	LWOH	Ohrid	LWSK
			Omsk	UNOO	Omsk	UNOO
			Orenburg	UWOO	Orenburg	UWOO
			Oslo	ENMI	Oslo	ENOS
			Palma de Mallorca	LEPA	Baleares	LECP
			Paris	LFPS	Paris	LFFF
			Pechora	UUYP	Pechora	UUYP
			Penza	UWPP	Penza	UWPP
			Perm	USPP	Perm	USPP
			Petrozavodsk	ULPB	Petrozavodsk	ULPP
			Praha	LKPR	Praha	LKAA
			Reims	LFML	Reims	LFEE
			Riga	EVRA	Riga	EVRR
			Rome	LIIB	Rome	LIRR
			Roberts	GLRB	Roberts	GLRB
			Rostov-na-donu	URRR	Rostov-na-donu	URRR
			Rovaniemi	EFRO	Rovaniemi	EFPS
			Salekhard	USDD	Salekhard	USDD
			Samara	UWWW	Samara	UWWW
			Samarkand	UTSS	Samarkand	UTSD
			Sana'a	OYSN	Sana'a	OYSC
			Sankt-Petersburg	ULLI	Sankt-Petersburg	ULLI
			Lisboa	LPPT	Santa Maria Oceanic	LPPO
			Sarajevo	LQSA	Sarajevo	LQSB
			Semipalatinsk	UASS	Semipalatinsk	UASS
			Seychelles	FSIA	Seychelles	FSSS
			Shymkent	UAII	Shymkent	UAII
			Surgut	USRR	Surgut	USRR
			Simferopol	UKFF	Simferopol	UKFF
			Skopje	LWSK	Skopje	LWSK
			Sofia	LBSF	Sofia	LBSR
			Stockholm	ESSA	Stockholm	??????

VOLCANIC ASH ADVISORY CENTRE	***ICAO LOCATION INDICATOR***	***AREA OF RESPONSIBILITY***	***MWOs TO WHICH ADVISORY INFORMATION IS TO BE SENT***		***ACC TO WHICH ADVISORY INFORMATION IS TO BE SENT***	
			Name	***ICAO LOCATION INDICATOR***	***Name***	***ICAO LOCATION INDICATOR***
1	**2**	**3**	**4**	**5**	**6**	**7**
			Syktyvkar	UUYY	Syktyvkar	UUYY
			Tallinn	EEMH	Tallinn	EETT
			Tarko-Sale	USDS	Tarko-Sale	USDS
			Tashkent	UTTT	Tashkent	UTTR
			Tehran	OIIX	Tehran	OIIX
			Tel Aviv	LLLL	Tel Aviv	LLTA
			Tbilisi	UGGG	Tbilisi	UGGG
			Tirana	LATI	Tirana	LAAA
			Toulouse	LFPW	Marseille	LFMM
			Tripoli	HLLT	Tripoli	HLLL
			Tromso	ENVN	Stavanger	ENSV
			Trondheim	ENVV	Trondheim	ENTR
			Tunis	DTTA	Tunis	DTTC
			Turukhansk	UOTT	Turukhansk	UOTT
			Tyumen	USTR	Tyumen	USTR
			Ufa	UWUU	Ufa	UWUU
			Uralsk	UARR	Uralsk	UARR
			Urumqi	ZWWW	Urumqi (+Tokyo)	ZWUQ
			Varna	LBWN	Varna	LBWR
			Velikie Luki	ULOL	Velikie Luki	ULOL
			Vilnius	EYVI	Vilnius	EYVL
			Volgograd	URWW	Volgograd	URWW
			Vologda	ULWW	Vologda	ULWW
			Vorkuta	UUYW	Vorkuta	UUYW
			Warszawa	EPWA	Warszawa	EPWW
			Wien	LOWW	Wien	LOVV
			Windhoek	FYWH	Windhoek	FYWH
			Yekaterinburg	USSS	Yekaterinburg	USSS
			Yeniseisk	UNII	Yeniseisk (+Tokyo)	UNII
			Yerevan	UDYZ	Yerevan	UDDD
			Zagreb	LDZA	Zagreb	LDZO
			Zhekazgan	UAKD	Zhekazgan	UAKD
			Zurich	LSZH	Zurich	LSAZ
Washington (United States)	KNES	New York Oceanic, Oakland Oceanic and United States continental FIRs, North of S10 W140	Amazònico	SBEG	Amazònica	SBAZ
			Caracas	SVMI	Maiquetia	SVZM
			Cayenne	SOCA	Rochambeau	SOOO
			Darwin	YDRM	Darwin	YPDN
			Edmonton	CWEG	Edmonton Gander	CZEG CZQX
			Guayaquil	SEGU	Guayaquil	SEGU
			Habana	MUHA	Habana	MUFH
			Honolulu	PHFO	Honolulu Oakland Guam	PHZH KZOA PGZU

VOLCANIC ASH ADVISORY CENTRE	*ICAO LOCATION INDICATOR*	*AREA OF RESPONSIBILITY*	*MWOs TO WHICH ADVISORY INFORMATION IS TO BE SENT*		*ACC TO WHICH ADVISORY INFORMATION IS TO BE SENT*	
			Name	*ICAO LOCATION INDICATOR*	*Name*	*ICAO LOCATION INDICATOR*
1	2	3	4	5	6	7
			Kansas City	KKCI	Houston Oceanic Miami Oceanic Nassau San Juan	KZHU KZMA MYNA TJZS
			Kingston	MKJP	Kingston	MKJK
			Lima-Callao	SPIM	Lima	SPIM
			México	MMMX	Mazatllán México	MMZT MMEX
			Panamá	MPTO	Panamá	MPZL
			Port-au-Prince	MTPP	Port-au-Prince	MTEG
			Port-of-Spain	TTPP	Piarco	TTZP
			Recife	SBRF	Recife Atlantico	SBRE SBAO
			Santa Fé de Bogotá	SKBO	Barranquilla Bogotá	SKEC SKED
			Santo Domingo	MDSD	Santo Domingo	MDCS
			Tegucigalpa	MHTG	Central American	MHTG
			Timehri	STCJ	Georgetown	SYGC
			Tokyo	RJTD	Tokyo	RJTG
			Willemstad	TNCC	Curacao	TNCF
			Zandery	SMJP	Paramaribo	SMPM
Wellington (New Zealand)	NZKL	Southward from the Equator and from E160 to W140, and Southward from S10 and from W140 to W90	Brisbane	YBRF	Brisbane	YBBB
			Honiara	AGGH	Honiara	AGGH
			Honolulu	PHFO	Honolulu	PHZH
			Melbourne	YMRF	Melbourne	YMMM
			Nadi	NFFN	Nadi	NFFF
			Tahiti	NTAA	Tahiti	NTTT
			Wellington	NZKL	Auckland Christchurch	NZZO NZZC

CURRENT STATUS OF ICAO VOLCANIC ASH ADVISORY CENTRES (VAAC) - AREAS OF RESPONSIBILITY
SITUATION ACTUELLE DES CENTRES OACI D'AVIS DE CENDRES VOLCANIQUES (VAAC) - ZONES DE RESPONSABILITÉ
ESTADO ACTUAL DE LOS CENTROS DE AVISOS DE CENIZAS VOLCÁNICAS (VAAC) DE LA OACI - ÁREAS DE RESPONSABILIDAD
СУЩЕСТВУЮЩЕЕ РАСПРЕДЕЛЕНИЕ КОНСУЛЬТАТИВНЫХ ЦЕНТРОВ ИКАО ИО ВУЛКАНИЧЕСКОМУ ПЕПЛУ (VAAC) - РАЙОНЫ ОТВЕТСТВЕННОСТИ



SAST 10/14

Part 3
USEFUL WEB SITES

Note.— These addresses are included for back-up information only, and it should be clearly understood that operational reliance on volcanic ash information obtained from web sites cannot be assured.

3.1 VOLCANIC ASH ADVISORY CENTRES

Anchorage: http://aawu.arh.noaa.gov/vaac.php
Buenos Aires: http://www. smm.gov.ar/?mod=vaac&id=1
Darwin: http://www.bo m.gov.au/info/vaac
London: http://www.m etoffice.gov.uk/aviation/vaac/index.html
Montreal: http://meteo.gc.ca/eer/vaac/index_e.html (English)
http://m eteo.gc.ca/eer/vaac/index_f.html (French)
Tokyo: http://www.j ma.go.jp/jma/jma-eng/jma-center/vaac/index.html
Toulouse: htttp://www.meteo.fr/vaac/
Washington: http://www.ssd.noaa.gov/VAAC/washington.html
Wellington: http://www.vaac.metservice.com

Note.— The homepage of each VAAC normally contains hyperlinks to the homepages of the other VAACs.

3.2 WORLDWIDE WEEKLY VOLCANIC ACTIVITY REPORTS

Smithsonian Institution: http://www.volcano.si.edu/gvp

United States Geological Survey: http://volcanoes.usgs.gov

Note.— These sites provide excellent up-to-date reports on active volcanoes.

3.3 OTHER SITES

Alaska Volcano Observatory:	http://www.avo.alaska.edu
Canadian Meteorological Centre:	http://www.msc-smc.ec.gc.ca/cmc/index_e.html
Caribbean Disaster Emergency Response Agency:	http://www.cdera.org
Global Volcanism Network Bulletin:	http://www.nmnh.si.edu/gvp/ http://www.osei.noaa.gov/TOMS/ http://toms.gsfc.nasa.gov http://www.geo.mtu.edu/~boris/ETNA_news.html
Institute of Volcanic Geology and Geochemistry FED RAS	http://www.kcs.iks.ru/ivgig/index.html
Kamchatkan Volcanic Eruption Response Team (KVERT)	htt://www.kcs.iks.ru/ivgig/kvert/index.html http://geopubs.wr.usgs.gov/fact-sheet/fs064-02/
Current information release from KVERT	http://www.avo.alaska.edu/avo4/updates/kvertweekly.htm
Michigan Technical University:	http://www.geo.mtu.edu/volcanoes
Puff Tracking Model	http://puff.images.alaska.edu/index.html
VAFTAD:	http://www.ssd.noaa.gov/VAAC/vaftad.html
WAFS Internet:	http://weather.noaa.gov/fax/wafsfax.shtml
World Organization of Volcano Observatories (WOVO)	http://wovo.org http://www.wovo.org/dir-contents.htm (contacts)
Preliminary spreadsheet of eruption source parameters for volcanoes of the world	http://pubs.usgs.gov/of/2009/1133/

Note.— Useful background information on volcanic ash and its impact on aviation may be found in the Manual on Volcanic Ash, Radioactive Material and Toxic Chemical Clouds *(Doc 9691). ICAO documents are available from the Document Sales Unit at sales_unit@icao.int.*

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Part 4
INTERNATIONAL AIRWAYS VOLCANO WATCH

OPERATIONAL PROCEDURES FOR THE DISSEMINATION OF INFORMATION ON VOLCANIC ERUPTIONS AND ASSOCIATED VOLCANIC ASH CLOUDS IN AREAS WHICH COULD AFFECT ROUTES USED BY INTERNATIONAL FLIGHTS, AND NECESSARY PRE-ERUPTION ARRANGEMENTS

4.1. PRE-ERUPTION PROCEDURES

4.1.1 In order to permit efficient application of the measures noted in 4.2, 4.3, 4.4 and 4.5, States responsible for flight information regions (FIRs) in which there are active or potentially active volcanoes in proximity to routes used by international flights should make arrangements to ensure that:

a) information on increasing volcanic activity, volcanic eruption or cessation thereof, or volcanic ash cloud in areas which could affect routes used by international flights, available from one or more observing sources, such as vulcanological, seismological, geological, meteorological, or the police/military networks and domestic aviation, is passed **immediately** to the area control centre/flight information centre (ACC/FIC) and the meteorological watch office (MWO) concerned;

b) appropriate channels of communication are established between such sources of observation (especially vulcanological observing stations) and the nearest ACC/FIC and MWO to ensure that, in the event of an eruption, the information reaches the ACC/FIC/MWO as speedily as possible;

c) access to information from available geostationary and polar-orbiting weather satellites and other sources, such as volcanic ash advisory centres (VAACs), is arranged through the national meteorological authority concerned in order to obtain, as far as practicable, information regarding the extent and trajectory of volcanic ash clouds (see 4.4.1 a));

d) access to vulcanological advice is made available to the ACC/FIC and MWO and, in the Provider States concerned, to the VAAC, including 24-hour telephone contact numbers at which a vulcanologist can be contacted in an emergency;

Note.— A convenient forum to explore ways and means to implement the foregoing measures is the National Disaster Committee or any similar consultative body.

e) the State international NOTAM office personnel are familiar with the issuance of ASHTAMs[1] (or NOTAMs for volcanic ash);

f) information, preferably supplemented by charts, concerning volcanoes in the FIRs for which the State is responsible should be included in the State aeronautical information publication in accordance with Annex 15, Appendix 1, Section ENR 5.3.1; and

g) ATM contingency arrangements in respect of volcanic ash are made and promulgated, as necessary, for air routes crossing FIRs for which the State is responsible, in coordination with adjacent FIRs.

4.1.2 Contracting States shall promulgate a requirement for pilots to make and transmit a special aircraft observation, in accordance with 5.5.1 g) and h) of Annex 3, in the event that pre-eruption volcanic activity or a volcanic eruption is observed or a cloud of volcanic ash is encountered or observed which may affect the safety of other aircraft operations, and to record a special air-report in accordance with of Annex 3, Chapter 5, 5.9. In addition, the International Air Transport Association (IATA), the International Federation of Air Line Pilots' Associations (IFALPA) and the International Council of Aircraft Owner and Pilot Associations (IAOPA) should bring this requirement to the attention of pilots and airline operating centres and highlight their significance for the IAVW and the importance of transmitting these observations in a timely manner.

Note.— Pre-eruption volcanic activity in this context means unusual and/or increasing volcanic activity which could presage a volcanic eruption.

4.1.3 It is essential that the foregoing arrangements be made in every State concerned and their efficacy continually maintained. In the case of volcanic ash, the hazard to jet transport aircraft is greatest within the first few hours following an eruption; hence speed of notification between all links in the chain of communication is critical. States may wish to consider drawing up letters of agreement between the parties involved, in particular, the civil aviation and meteorological authorities and the vulcanological agency, to record the agreed responsibilities of each party. Since Annex 3, paragraph 3..6 requires that selected State volcano observatories should send information about pre-eruption volcanic activity, a volcanic eruption and/or volcanic ash in the atmosphere to associated ACC, MWO and VAAC, the State concerned, may, if it so wishes, recover reasonable costs related to the transmission of such information.

1. The ASHTAM is a special series NOTAM specifically for volcanic activity.

4.1.4 In order to assist States in enhancing the coordination between the different States' authorities/agencies involved in the IAVW, at Appendix A is a sample letter of agreement covering the coordination and responsibilities between meteorological authorities, ATS authorities and vulcanological authorities for the provision and exchange of information relevant to volcanic ash.

Note. — In order to enhance stronger linkages, coherence and integration with States' disaster risk reduction units, Contracting States are encouraged to send back to States' volcano observatories any relevant information regarding volcanic ash to the extent and in a form agreed between the VAAC and the volcano observatory concerned. The sample letter of agreement could be used to document such agreements.

4.2 ACTION TO BE TAKEN BY THE ACC IN THE EVENT OF A VOLCANIC ERUPTION

In the event of significant pre-eruption volcanic activity, a volcanic eruption occurring or a volcanic ash cloud being reported in areas which could affect routes used by international flights, the ACC/FIC responsible for the FIR concerned, on receiving information of the occurrence, should take the following actions:

a) Pass this information **immediately** to aircraft in flight which could be affected by the volcanic ash cloud and advise ACCs in relevant adjacent FIRs. Issue an ASHTAM or a NOTAM through the State International Notam Office (NOF), in accordance with Annex 15, Chapter 5, giving details of the pre-eruption activity, volcanic eruption and ash cloud, including the name and geographical coordinates of the volcano, the date and time of the eruption, the flight levels and routes or portions of routes which could be affected and, as necessary, routes temporarily closed to air traffic. Include in the address list for ASHTAMs or NOTAMs concerning volcanic activity the associated MWO (see Part 2 of this document), all VAACs and the SADIS ISCS gateway at EGZZVANW.

Note 1.— In issuing an ASHTAM or a NOTAM concerning significant pre-eruption volcanic activity, or for volcanic eruptions ***not*** *producing ash plumes, it is recommended that the ASHTAM or NOTAM text include the following actual wording, as appropriate:*

"INCREASED VOLCANIC ACTIVITY REPORTED FOR VOLCANO (NAME AND LAT/LONG) AIRCRAFT ADVISED TO EXERCISE CAUTION UNTIL FURTHER NOTICE AND MAINTAIN WATCH FOR ASHTAM/NOTAM/ SIGMET FOR AREA".

or

"VOLCANO (NAME AND LAT/LONG) ERUPTED (DATE/TIME UTC) BUT NO ASH PLUME REPORTED, AIRCRAFT ADVISED TO AVOID FLYING WITHIN ... KM OF THE VOLCANO UNTIL FURTHER NOTICE, MAINTAIN WATCH FOR ASHTAM/NOTAM/SIGMET FOR AREA".

Use of such language in an ASHTAM or a NOTAM ensures that large volumes of airspace are not rendered unavailable to aircraft unnecessarily until such time as a volcanic ash plume/cloud is actually reported, or observed from satellite data.

Note 2.— In order to ensure speedy transmission of initial information to aircraft, the first ASHTAM or NOTAM issued may simply contain information that an eruption and/or ash cloud has been reported and the date/time and location. It is not necessary to await further detailed information; this may be included in subsequent ASHTAMs or NOTAMs as it becomes available.

Note 3.— A volcano level of alert colour code has been developed for aviation which may be used by some vulcanological agencies to report volcanic activity information to aviation. In those States where the colour code has been introduced by the vulcanological agency, it is useful to include the reported colour code in ASHTAMs or NOTAMs issued for volcanic activity. The aviation volcano level of alert colour code is:

Level of alert colour code	**Status of activity of volcano**
GREEN ALERT	Volcano is in normal, non-eruptive state. *or, after a change from a higher alert level*: Volcanic activity considered to have ceased, and volcano reverted to its normal, non-eruptive state.
YELLOW ALERT	Volcano is experiencing signs of elevated unrest above known background levels. *or, after a change from higher alert level*: Volcanic activity has decreased significantly but continues to be closely monitored for possible renewed increase.
ORANGE ALERT	Volcano is exhibiting heightened unrest with increased likelihood of eruption. *or,* Volcanic eruption is underway with no or minor ash emission *[specify ash-plume height if possible]*.
RED ALERT	Eruption is forecasted to be imminent with significant emission of ash into the atmosphere likely. *or,* Eruption is underway with significant emission of ash into the atmosphere *[specify ash-plume height if possible]*.

The colour code for the level of alert indicating the status of activity of the volcano and any change from a previous status of activity should be provided to the area control centre by the responsible vulcanological agency in the State concerned, e.g. "RED ALERT FOLLOWING YELLOW" OR "GREEN ALERT FOLLOWING ORANGE".

b) Activate contingency arrangements, including the implementation of alternative routes bypassing the area likely to be affected by the volcanic ash cloud, in coordination with ACCs and FICs responsible for adjacent FIRs.

c) Advise the associated MWO(s) and VAAC of the volcanic eruption and/or the existence of volcanic ash cloud (including the forwarding of all special air-reports in accordance with existing provisions in Annex 11, 4.2.3) and maintain continuous coordination with the MWO to ensure consistency in the issuance and content of ASHTAMs or NOTAMs and SIGMETs.

d) Cancel the ASHTAM or NOTAM as soon as it is considered that the volcano has reverted to its normal state and the airspace is not contaminated by volcanic ash.

4.3 ACTION TO BE TAKEN BY THE NOF IN THE EVENT OF A VOLCANIC ERUPTION

4.3.1 In the event of significant pre-eruption volcanic activity, a volcanic eruption occurring, or a volcanic ash cloud being reported in areas which could affect airspace in the FIRs of the State in which the Notam Office (NOF) is designated, the NOF should issue an ASHTAM (or a NOTAM for volcanic activity) based on information provided by the ACC responsible for the FIR concerned. The ASHTAM or NOTAM must be cancelled, in consultation with the ACC, as soon as it is considered that the airspace is not contaminated by volcanic ash. Include in the address list for ASHTAM or NOTAM concerning volcanic activity the associated MWO (see Part 2 of this document), all VAACs and the SADIS gateway at EGZZVANW. 4.3.2 In addition to addressing the ASHTAM (or NOTAM) to other NOFs for whom the information is of direct operational significance, the NOF should include in the address list the VAAC responsible for the FIRs concerned. The States responsible for FIRs in which there are active volcanoes and the AFTN switching centres designated to receive NOTAM or ASHTAM are listed in Table 4-1.

As an example:

An ASHTAM issued by the Tegucigalpa NOF would be sent to the VAAC Washington as follows:

ZCZC
GG KWBCYMYX
170630 MHTGYNYX
VAMH0001 MHTG 04170630

ASHTAM

A. CENTRAL AMERICAN FIR
B. 04170555
C. VOLCAN SAN CRISTOBAL.14004-02
D. 124211N0870024W
E. YELLOW ALERT
F. SFC/11000FT
G. E/SE
H. VOR/DME MGA A317 TUKOR CNL
I. VOR/DME MGA A317 TUKOR RTE AVBL. ALT RTE MGA VOR/DME A502 BERTA GABOS A317. VOR/DME/CAT/ABVL
J. INSTITUTO NACIONAL DE ESTUDIOS TERRITORIALES. DPTO. DE SISMOLOGÍA
K. GNE AVIATION CTN WIND 60KM/H E/SE FM VOLCANO

NNNN

A similar example, this time showing a NOTAM issued by Guayaquil NOF, would be sent to the VAAC Washington as follows, showing the four sections of the message:

1	ZCZC GG KWBCYMYX 151840 SEGUYNYX	USUAL AFTN HEADER ENVELOPE
2	A0623/00 NOTAMN Q) SEGU/QWWXX/IV/NBO/W/000 /250/0128S 07826W030 A) SEGU B) 0002151830 C) 0002171830 E) SIGNIFICANT VOLCANIC ACT TUNGURAHUA VA MOV W. AWY RESTRICTIONS AND ALT RTE NOTIFIED BY ATC	ACTUAL NOTAM

4	NNNN	USUAL AFTN ENDING ENVELOPE

4.3.3 In case of a need to issue a NOTAM regarding volcanic ash deposition at an aerodrome, the following guidelines are suggested:

a) in cases when a forecast of impending ash deposition is available, a NOTAM should be issued stating the time period when ash is expected to commence at an aerodrome;

b) a NOTAM should be issued when ash reaches an aerodrome or begins to accumulate on the ground at an aerodrome. The NOTAM should report if the aerodrome is still open for operation;

c) a new NOTAM should be issued every 4 hours while deposition is occurring or present in the air at the aerodrome, or more frequently as needed for occurrence of heavy ash deposition. If a friction test of runway surfaces has been made with a mu-meter, that value and the time it was made should be reported; and

d) a final NOTAM should be issued when clean-up activities are completed and operations have resumed.

4.3.4 Since volcanic ash deposition at an aerodrome is a phenomena which could prompt the issuance of an aerodrome warning, close coordination is recommended between each NOF and the aerodrome meteorological office(s), in its area of responsibility, concerning the issuance of such warnings.

4.4 ACTION TO BE TAKEN BY THE MWO IN THE EVENT OF A VOLCANIC ERUPTION

4.4.1 On receipt from the ACC/FIC of information concerning a volcanic eruption and/or the existence of a volcanic ash cloud, the MWO should take the following steps:

a) notify the VAAC designated to provide advice on volcanic ash trajectories for the FIR for which the State is responsible that a volcanic eruption and/or ash cloud has been reported, provide available relevant details and request advisory information on the extent and trajectory of volcanic ash. In particular, special air-reports of pre-eruption volcanic activity, a volcanic eruption, volcanic ash cloud or aircraft encounter with volcanic ash received by MWOs should be transmitted to their associated VAACs, to the WAFC London SADIS at the address specified in Appendix B, according to the region containing the area affected, the WAFC Washington at KWBCY MYX, and the Vienna International OPMET Data Bank at LOZZMMSS;

Note 1.— The area of responsibility of the VAACs and the MWOs to which

volcanic ash advisory information is to be sent are given in the ICAO regional air navigation plans and in Part 2 of this document.

Note 2.— The contact numbers that the MWOs should use to notify volcanic eruptions/volcanic ash cloud to the VAAC are given in Table 4-2.

b) as soon as practicable, advise the associated ACC/FIC whether or not the volcanic ash cloud is identifiable from satellite images/data and, if possible,

provide regular information based on advice received from the VAAC on the horizontal and vertical extent of the cloud and the trajectory of the cloud; and

c) issue a SIGMET message for volcanic ash for a validity period of 6 hours in alphanumerical message format and, if in a position to do so, in graphical format based on the advisory information provided by the VAAC concerned. Update SIGMET information at least every 6 hours. Include in the SIGMET address all VAACs (see 4.4.1 a)), the WAFC London at the address specified in Appendix B, according to the region containing the area affected, the WAFC Washington at KWBCYMYX, the Vienna International OPMET Data Bank at LOZZMMSS and the Regional OPMET Data Bank(s) responsible. Maintain continuous coordination with the associated ACC/FIC to ensure consistency in the issuance and content of SIGMETs, and ASHTAMs or NOTAMs. SIGMET messages for volcanic ash issued outside the EUR Region to be transmitted to the EUR Region should be addressed in accordance to the EUR FASID Table MET 2B as follows:

Source	**Responsible EUR Gateway and Address to be used**	
AFI	France	LFZZMAFI
MID	Austria	LOZZMMID
ASIA	UK	EGZZMASI
CAR	UK	EGZZMCAR
NAM	UK	EGZZMNAM
NAT	UK	EGZZMNAT
PAC	UK	EGZZMPAC
SAM	UK	EGZZMSAM

Note 1.— The associated ACC/FIC should automatically be on the address list for all SIGMETs issued by the MWO.

Note 2.— In order to ensure speedy transmission of initial information to aircraft, the first SIGMET issued may simply contain information that an ash cloud has been reported and the date/time and location. It is not necessary to await further detailed information before issuing the first SIGMET. Such information may be included in subsequent SIGMETs as it becomes available.

4.4.2 In the event that the MWO becomes aware of the occurrence of pre-eruption activity, a volcanic eruption or ash cloud from any source other than its associated ACC/FIC, that information should be passed **immediately** to the associated ACC/FIC. The procedures in 4.4.1 should then be followed, as necessary.

4.4.3 In the event that a meteorological office becomes aware of the occurrence of pre-eruption activity, a volcanic eruption or ash cloud from any source, the information should be passed **immediately** to its associated MWO for onward transmission to the ACC/FIC.

4.5 ACTION TO BE TAKEN BY VAACs IN THE EVENT OF A VOLCANIC ERUPTION

4.5.1 On receipt of information from an ACC, MWO, volcano observatory or any other source[2] that a volcanic eruption has been reported and/or a volcanic ash cloud has been observed in the FIR for which the MWO is responsible, the VAAC should:

a) initiate the volcanic ash computer trajectory/dispersion model in order to provide advisory information[3] on volcanic ash trajectories to the MWOs, ACCs and, to the extent possible, to the airlines[4] concerned;

b) review satellite images/data of the area for the time of the event to ascertain whether a volcanic ash cloud is identifiable and, if so, its extent;

c) prepare and issue advisory information on the extent and forecast trajectory of the volcanic ash cloud, in alphanumerical message format, as shown below, and, graphical format[5], (using the PNG format) for transmission to the MWOs, ACCs and, to the extent possible, to the airlines[3] concerned in the VAAC area of responsibility, to the WAFC London at the address specified in Appendix B, according to the region containing the area affected, the WAFC Washington at KWBCYMYX, the Vienna International OPMET Data Bank at LOZZMMSS and other VAACs. Advisory information on volcanic ash issued outside the

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2. When initial notification of the eruption is received from a source other than an ACC/MWO, this information should be passed **immediately** by telephone to the relevant ACC and/or MWO. Thereafter, the procedures in a) to g) should be followed.

3 On some occasions, the VA advisory could be the first information received byACC/FIC concerning hazardous conditions which may be encountered by an aircraft in flight. The VAAC has the option to issue a volcanic ash advisory without forecast as a first piece of information to quickly warn the ACC/FIC. The first advisory will, as soon as possible, be followed by a VA advisory with complete forecast information included.

4. Advisory information from VAACs is intended to assist MWOs in the preparation of the SIGMET. However, in order to provide airline operators with the earliest possible advance information on volcanic ash, an AFTN address (EGLLSITV) has been provided on the SITA network to which VAACs may send their advisories for onward distribution to airline operators by SITA. SIGMETs for volcanic ash will, of course, be disseminated in accordance with the relevant regional air navigation plan OPMET exchange tables.

5. Volcanic ash advisories in graphical format will be included on the London and Washington satellite broadcasts. An example of the graphical format is given in the Appendix 1 to Annex 3.

EUR Region to be transmitted to the EUR Region should be addressed in accordance with EUR FASID Table MET 2B (see 4.4.1 c).

The volcanic ash advisory message should contain the following information:

message type
— VOLCANIC ASH ADVISORY

issue time, date and name of issuing VAAC
— time (UTC), day/month/year; volcanic ash advisory centre issuing advisory

name of volcano and volcano reference number
— volcano name (if known) and reference number (International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI))

the State or area in which the volcano is located and the latitude/longitude
— name of State or area (e.g. oceanic) and latitude/longitude of volcano

source of information
— volcano agency (see Appendix E, volcano observatory notice for aviation (VONA) fomat) or special AIREP, etc.

details of eruption
— time (UTC), day/month/year of the eruption

details of ash cloud
— vertical extent in flight levels and horizontal extent in kilometres (nautical miles) and boundary of ash cloud in degrees and minutes

trajectory of ash cloud
— indication of direction and speed of movement of ash cloud at selected flight levels in broad descriptive terms

forecast movement of ash cloud
— forecast boundaries of ash cloud in degrees and minutes at selected flight levels for 6, 12 and 18 hours following time of issuance of advisory message

next advisory
— expected time of issuance of next advisory.

In order for the VAAC to initiate the monitoring of volcanic ash from satellite data and the forecast of volcanic ash trajectories, MWOs are expected to notify the relevant VAAC immediately on receipt of information that a volcanic eruption has occurred or volcanic ash has been observed in the FIR for which they are responsible in accordance with 4.4.1 a). In particular, any special air-reports of pre-eruption volcanic activity, a volcanic eruption or volcanic ash cloud, received by MWOs, should be transmitted without delay to the associated

VAAC and to other addresses in accordance with 4.4.1 a);

d) monitor subsequent satellite information to assist in tracking the movement of volcanic ash cloud;

e) continue to issue updated advisory information to MWOs, ACCs and airlines[6] concerned at least at 6-hour intervals, and preferably more frequently, until such time as it is considered that the volcanic ash cloud is no longer identifiable from satellite data, no further reports of volcanic ash are received from the area and no further eruptions of the volcano are reported;

Note. — If volcanic ash is not identifiable from satellite data and the VAAC has reasonable doubts about the existence of volcanic ash in the atmosphere, it should be indicated in the REMARKS section of the volcanic ash advisory.

f) maintain regular contact with other VAACs, as necessary, and the Smithsonian Institution Global Volcanism Network, in order to keep up to date on the activity status of volcanoes in the VAAC area of responsibility. In the specific case of reception of information regarding an aircraft encounter with volcanic ash (Annex 3, Chapter 5, 5.9 refers), the information should be sent to the Smithsonian Institution Global Volcanism Network and to ICAO in order to keep up to date the database for encounters between aircraft ash clouds (Doc 9691, Appendix I refers). To that end the following mail addresses should be used:

gvn@volcano.si.edu
iavwopsgsec@icao.int

g) in cases where volcanic ash cloud crosses the boundary between VAAC areas of responsibility, the first VAAC should retain responsibility for the issuance of advisories until such time as the handover of responsibility has been agreed between VAACs. Standardized operational procedures for the coordination and transfer of responsibility between VAACs for volcanic ash events are at Appendix C.

Note.— This means that, while the volcanic ash cloud straddles the common boundary, only one VAAC will issue advisories at any one time, and these advisories must be sent by each VAAC to MWOs and ACCs in their respective areas of responsibility.

VAACs should insert a note in their "last"/"first" advisory of the message and graphical series that the "handover"/"takeover" will take place at that

6. Advisory information from VAACs is intended to assist MWOs in the preparation of the SIGMET. However, in order to provide airline operators with the earliest possible advance information on volcanic ash, an AFTN address (EGLLSITV) has been provided on the SITA network to which VAACs may send their advisories for onward distribution to airline operators by SITA.

message/graphic number.

h) to facilitate VAACs' rapid access to volcanic ash advisories issued by other VAACs, Table 4.3 provides a listing of the WMO bulletin headers, for each product (volcanic ash in the advisory in the alphanumeric and graphical format, respectively) being used by the VAACs.

i) in the event of long-lived volcanic ash clouds no longer being identifiable on satellite imagery, the VAAC may choose to use the method of "gradual" advisory cessation by extrapolating forecast ash boundaries such that the previous 6-, 12- and 18-hour forecasts become the current analysis position in 6-and 12-hour forecasts respectively, with no ash boundary specified for the 18-hour forecast.

Note. — The above procedure (which is reducing the outlook period of 6 hours at each issue) should be applied unless remote sensing data or air-reports suggest there has been an error in the forecasts issued.

j) to provide rapid access to eruption source parameters (ESP) data for immediate use by forecasters in ash transport and dispersion models a preliminary spreadsheet of eruption source parameters of the world is available at http://www2.icao.int/en/anb/met-aim/met/iavsopsg/.

4.5.2 In the event of interruption of operation of one VAAC, its functions should be carried out by another VAAC or another meteorological centre, as designated by the VAAC Provider State concerned. The back up procedures agreed by the VAACs given in Appendix D should be applied in order to provide the VAAC services as needed.

4.5.3 For those VAACs which have not yet implemented a computer volcanic ash dispersion forecast model, on receipt of information from an MWO, or from any other source in its area of responsibility, that a volcano has erupted and/or volcanic ash cloud has been reported from the FIR for which the MWO is responsible, the VAAC should immediately contact the VAAC Washington at the following 24-hour contact numbers:

Tel.: +1 (301) 763-8444
Fax: +1 (301) 763-8333

to request initiation of the United States Volcanic Ash Forecast Transport and Dispersion (VAFTAD) model and the provision of the necessary trajectory forecasts. Alternatively, VAACs may interactively run a dispersion model via the Internet at the following web site: http://www.arl.noaa.gov/vaftad.html. This site also contains a number of model runs of hypothetical volcanic eruptions, generally of recently active volcanoes or those suspected to become active. If for any reason the VAAC Washington is unable to respond, or contact cannot be achieved, recourse should be made to the VAACs London, Montreal or Toulouse at the 24-hour contact numbers given in 4.4.1 to run their dispersion models.

4.6 ACTION TO BE TAKEN BY VAACs OR MWOs REGARDING VOLCANIC ASH TEST PROCEDURES

4.6.1 When a volcanic ash test/exercise is carried out to check the IAVW procedures, the following should be applied:

a) the VAAC concerned should issue a volcanic ash (VA) advisory test message highlighting that the advisory refers to a test message by using "VA TEST" or "VA EXERCISE" (followed by the name of the exercise if wished) in elements 9, 11 and 17 of the VA advisory message (Annex 3, Table A2-1 refers) as part of the element description. The VA advisory message will emphasize that the message refers to a test/exercise by repeating "VA TEST" or "VA EXERCISE" as many as practicable in element 17;

b) the MWO concerned should issue a volcanic ash SIGMET highlighting that the SIGMET refers to a test message by including "VA TEST" or "VA EXERCISE" (followed by the name of the exercise, if wished) in element "Phenomenon" of SIGMET message (Annex 3, Table A6-1 refers).

4.7 ACTION TO BE TAKEN BY PILOTS IN THE EVENT OF ENTRY INTO A $S0_2$ CLOUD

4.7.1 There is a possible association between volcanic ash and sulphur dioxide gas (SO_2). The following paragraphs provide guidance and recommended actions to be taken by pilots in the event of entering in a SO_2 cloud, with the understanding that they constitute only examples and do not necessary cover all the practices being applied by operators.

4.7.2 The presence of a sulfurous gas, (SO_2) at altitude is the result of volcanic activity. SO_2, best described as a sulfur odor similar to a struck match will only be detectable for a short period because of the olfactory fatigue resulting in lose of the ability to smell the odor of SO_2. Sensitivity to odors while in-flight is paramount to the safety of flight. "Electrical Smoke and Fire" and SO_2 are two odors that are described as somewhat similar requiring a means to verify which odor is present.

4.7.3 After determining there are no secondary indications that would result from and indicate an electrical fire, the crew should continue to determine the source of the odor. The first decision by the crew is to establish whether the odor is generated from inside or outside the air craft. In order for the crew to make this determination and confirm if the odor is transient or not, at the direction of the captain, a crew member should don an oxygen mask and breathe 100% oxygen for the period of time that results in a complete change of air within the cockpit.

4.7.4 The crew member should breathe 100% oxygen for the length of time determined in 4.7.3 to regain the ability to smell the SO_2. After the appropriate time period, the crew member should remove their oxygen mask and determine if the odor is still present. If the crew member affirms the continued presence of SO_2, it is recommended the captain report their findings to the controlling ATC facility and company dispatch as soon as practicable.

4.7.5 It is recommended the reporting pilot use the Volcanic Activity Report form (VAR) Section 1, Items 1-8. Following the submission of the VAR, the crew should remain vigilant for signs of inadvertent entry into a volcanic ash cloud. The crew should also request periodic updates of any volcanic activity along their route of flight from the controlling ATC facility and company dispatch.

Table 4-1. Addresses for NOFs to use to send ASHTAMs or NOTAMs on volcanic activity to their associated VAAC
(*4.3.2 refers)*

Argentina	– sent to SAZZMAMX EGZZVANW
Cameroon	– sent to LFPWYMYX EGZZVANW
Canada	– sent to CWAOYMYU EGZZVANW
Cape Verde	– sent to LFPWYMYX EGZZVANW
Chile	– sent to SAZZMAMX EGZZVANW
China	– sent to RJTDYMYX EGZZVANW
Colombia	– sent to KWBCYMYX EGZZVANW
Comoros	– sent to LFPWYMYX EGZZVANW
Costa Rica	– sent to KWBCYMYX EGZZVANW
Democratic Republic of the Congo	– sent to LFPWYMYX EGZZVANW
Ecuador	– sent to KWBCYMYX EGZZVANW
El Salvador	– sent to KWBCYMYX EGZZVANW
Eritrea	– sent to LFPWYMYX EGZZVANW
Ethiopia	– sent to LFPWYMYX EGZZVANW

France (Île de la Réunion)	– sent to LFPWYMYX EGZZVANW
French Antilles (France)	– sent to KWBCYMYX EGZZVANW
Greece	– sent to LFPWYMYX EGZZVANW
Guatemala	– sent to KWBCYMYX EGZZVANW
Guyana	– sent to KWBCYMYX EGZZVANW
Iceland	– sent to EGRRYMYX EGZZVANW
Indonesia	– sent to YPDMYMYX EGZZVANW
Italy	– sent to LFPWYMYX EGZZVANW
Japan	– sent to RJTDYMYX EGZZVANW
Kenya	– sent to LFPWYMYX EGZZVANW
Mexico	– sent to KWBCYMYX EGZZVANW
Montserrat (United Kingdom)	– sent to KWBCYMYX EGZZVANW
New Zealand	– sent to NZKLYMYX EGZZVANW
Nicaragua	– sent to KWBCYMYX EGZZVANW
Papua New Guinea	– sent to YPDMYMYX EGZZVANW

Peru	– sent to KWBCYMYX SAZZMAMX EGZZVANW
Philippines	– sent to RJTDYMYX YPDMYMYX EGZZVANW
Portugal	– sent to LFPWYMYX EGZZVANW
Russian Federation	– sent to KWBCYMYX RJTDYMYX EGZZVANW
Solomon Islands	– sent to NZKYMYX YPDMYMYX EGZZVANW
Spain	– sent to LFPWYMYX EGZZVANW
Trinidad and Tobago	– sent to KWBCYMYX EGZZVANW
Vanuatu	– sent to NZKYMYX EGZZVANW

Table 4-2. VAAC contact numbers
(4.4.1 a) refers)

Note.— E-mail addresses are provided as back-up. Telephone/fax numbers should always be used first.

VAAC Anchorage

Tel.:	Operational	+1 (907) 266-5110
	Administrative	+1 (907) 266-5116
Fax:		+1 (907) 266-5169
AFTN:		via KWBCYMYX
E-mail:	Operational	a-vaac@noaa.gov
	Administrative	Jeffrey.Osiensky@noaa.gov
		Eugene.M.Petrescu@noaa.gov
Homepage:		http://vaac.arh.noaa.gov
		http://aawu.arh.noaa.gov

VAAC Buenos Aires

Tel.:	Operational	+(54 11) 5167 6767, Ext. 18238/18233/18103
		+(54 11) 5167 6705
	Administrative	+(54 11) 5167 6767, Ext. 18235
		+(54 11) 5167 6707
Fax:		+(54 11) 5167 6709
AFTN:		SAZZMAMX
E-mail:	Operational	vmsr@smn.gov.ar
		bue.vaac@smn.gov.ar
		sovaacbue@smn.gov.ar
	Administrative	metaer@smn.gov.ar
		cbenitez@smn.gov.ar
Homepage:		http://www.smm.gov.ar mod=VAAC & id=1

VAAC Darwin

Tel.:	Operational	+61 (8) 8920 3830 (PABX) +61 (8) 8927 9189 (direct)
	Administrative	+61 (8) 8920 3867
Fax:		+61 (8) 8920 3829
AFTN:		YPDMYMYX
E-mail:	Operational	darwin.vaac@bom.gov.au
	Administrative	darwin.vaac.admin@bom.gov.au
Homepage:		http://www.bom.gov.au/info/vaac/

VAAC London

Tel.:	Operational	+44 1392 884167
	Administrative	+44 1392 886095
Fax:	Operational	+44 1392 884549
	Administrative	+44 1392 884549
AFTN:		EGZZVANW
E-mail:	Operational	vaac@metoffice.gov.uk
	Administrative	nigel.gait@metoffice.gov.uk
Homepage:		http://www.metoffice.gov.uk/aviation/vaac/index.html

VAAC Montreal

Tel.:	Operational	+1 (514) 421 4635
	Administrative	+1 (514) 421 4704
Fax:	Operational	+1 (514) 421 4639
	Administrative	+1 (514) 421 4679
AFTN:		CWAOYMYU
E-mail:	Operational	vaac@ec.gc.ca
	Administrative	rene.servranckx@ec.gc.ca dov.bensimon@ec.gc.ca
Homepage:		http://meteo.gc.ca/eer/vaac/index_e.html

VAAC Tokyo

Tel.:	Operational	+81 (3) 3212 6203
	Administrative	+81 (3) 3284 1749
Fax:		+81 (3) 3212 6446
AFTN:		RJTDYMYX
E-mail:	Operational	vaac@eqvol2.kishou.go.jp
	Administrative	vaac-adm@eqvol2.kishou.go.jp
Homepage:		http://ds.data.jma.go.jp/svd/vaac/data/index.html

VAAC Toulouse

Tel.:	Operational	+33 (5) 61 07 82 30 or 07 85 10
	Administrative	+33 (5) 61 07 82 37/82 39
Fax:	Operational	+33 (5) 61 07 82 54
	Administrative	+33 (5) 61 07 82 09
AFTN:		LFPWYMYX or LFPWYMCR
E-mail:	Operational	vaac@meteo.fr
	Administrative	philippe.husson@meteo.fr
Homepage:		http://www.meteo.fr/vaac/

VAAC Washington

Tel.:	Operational	+1 (301) 763-8444/8298
	Administrative	+1 (301) 763 8444
Fax:		+1 (301) 763 8333/8592
AFTN:		KWBCYMYX
E-mail:	Operational	w-vaac@noaa.gov
	Administrative	Grace.Swanson@noaa.gov
	Additional information	davida.streett@noaa.gov
Homepage:		http://www.ssd.noaa.gov/VAAC/

VAAC Wellington

Tel.:	Operational	+64 (4) 470 0816 (24/7 helpline)
	Administrative	+64 (4) 470 0731
Fax:		+64 (4) 470 0801
AFTN:		NZKLYMYX
E-mail:	Operational	vaac@metservice.com
	Administrative	marcel.roux@metservice. com
	Additional information	ray.thorpe@metservice.com
Homepage:		http://vaac.metservice.com

_____

Table 4-3. Volcanic ash advisory bulletin headers
(4.5.1 h) refers)

VAAC	Back-up VAAC	Bulletin Headers		Remarks
		VAA	VAG	
Anchorage		FVAK21 PAWU FVAK22 PAWU FVAK23 PAWU FVAK24 PAWU FVAK25 PAWU	PFXD21 PAWU PFXD22 PAWU PFXD23 PAWU PFXD24 PAWU PFXD25 PAWU	
	Washington			
Buenos Aires		FVAG01 SABM FVAG02 SABM FVAG03 SABM FVAG04 SABM FVAG05 SABM		
Darwin		FVAU01 ADRM FVAU02 ADRM FVAU03 ADRM FVAU04 ADRM FVAU05 ADRM FVAU06 ADRM	PFXD01 ADRM PFXD02 ADRM PFXD03 ADRM PFXD04 ADRM PFXD05 ADRM PFXD06 ADRM PFXD07 ADRM PFXD08 ADRM PFXD09 ADRM PFXD10 ADRM	
	Tokyo Wellington	FVFE01 RJTD FVPS01 NZKL		
London		FVXX01 EGRR FVXX02 EGRR FVXX03 EGRR	PFXD01 EGRR PFXD02 EGRR PFXD03 EGRR	
	Toulouse	FVXX05 EGRR	PFXD05 EGGR	
Montreal		FVCN01 CWAO to FVCN04 CWAO	PFXD01 CWAO PFXD02 CWAO	

VAAC	Back-up VAAC	Bulletin Headers		Remarks
		VAA	VAG	
	Washington	FVCN03 CWAO FVCN04 CWAO	PFXD03 CWAO PFXD04 CWAO	
Tokyo		FVFE01 RJTD	VAG available only at the VAAC website	
			QHVA10 RJTD QHVA15 RJTD	Graphical format chart of VA observation Graphical format chart of VA forecast
Toulouse		FVXX01 LFPW FVXX02 LFPW FVXX03 LFPW FVXX04 LFPW	PFXD01 LFPW to PFXD04 LFPW PFXD06 LFPW to PFXD09 LFPW	(T4 format) (png format) [where PFXDnn and PFXDnn+5 are the same VAG in T4 and png]
	London	FVXX05 EGRR	PFXD05 EGRR	(png format)
Washington		FVXX20 KNES FVXX21 KNES FVXX22 KNES FVXX23 KNES FVXX24 KNES FVXX25 KNES FVXX26 KNES FVXX27 KNES	PFXD20 KNES PFXD21 KNES PFXD22 KNES PFXD23 KNES PFXD24 KNES PFXD25 KNES PFXD26 KNES PFXD27 KNES	
Wellington		FVPS0 NZKL1	To be provided in due time	

APPENDIX A

Sample Letter of Agreement between the Air Traffic Services (ATS), Meteorological Authorities and Vulcanological Authorities

Directives for coordination between area control centres (ACCs), meteorological watch offices(MWOs) and vulcanological observatories and responsibility for the provision/exchange of information relevant to volcanic ash

Effective date:

1. OBJECTIVE

1.1 The objective of this Letter of Agreement between the [*ATS authority*][1], the [*meteorological authority*][2] and the [*vulcanological authority*][3] is to establish the directives for the necessary coordination between ATS units, meteorological watch offices and vulcanological observatories to ensure the provision of specific information on pre-eruption volcanic activity, volcanic eruptions and volcanic ash cloud required for civil (international and national) air navigation, in accordance with international agreements (see 1.4) and [national air navigation regulatory documents].

1.2 This Letter of Agreement provides guidelines on the responsibilities of ATS units, meteorological watch offices and vulcanological observatories in relation to the mutual exchange of information related to volcanic ash.

1.3 This Letter of Agreement is in accordance with the Standards and Recommended Practices and Procedures of ICAO, contained in Annex 3 — *Meteorological Service for International Air Navigation*, Annex 11 — *Air Traffic Services*, Annex 15 — *Aeronautical Information Services* and in the *Procedures for Air Navigation Services - Air Traffic Management* (PANS-ATM, Doc 4444), as well as the provisions contained in the relevant regional air navigation plan publications and in the aeronautical information publication of [*State*][4] (AIP-*[State*]). This Letter of Agreement is also based on the guidance material in the *Manual on Coordination between Air Traffic Services, Aeronautical Information Services* and *Aeronautical Meteorological Services* (Doc 9377), the *Aeronautical Information Services Manual* (Doc 8126) and the *Handbook on the International Airways Volcano Watch* (IAVW) — *Operational Procedures and Contact List* (Doc 9766).

1.4 This Letter of Agreement includes _____[5] Appendices, regarding detailed national directives and arrangements pertaining to the use of the aviation volcano colour code, the ASHTAM format, abbreviations, list of contact points and means of communication, stations/offices and contact numbers, etc.

2. REVISIONS

2.1 When, for special or unforeseen reasons, a significant change in the coordination between the three parties involved or the services mentioned in this Agreement becomes necessary, the respective officers-in-charge, through mutual agreement, may effect temporary changes or amendments, provided that these changes are not intended to last more than _____[6] days.

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1. Name of the ATS authority.
2. Name of the meteorological authority
3. Name of the vulcanological authority.
4. Name of the State concerned.
5. Number of appendices agreed upon by the three parties to the letter of Agreement,
6. Figure to be agreed locally: six days appears to be a suitable period.

2.2 Permanent revisions to the Letter of Agreement may be made by the authorities who approve and sign this Agreement. This LOA is to be reviewed annually. A complete cancellation of this Letter of Agreement may be made, in writing, by the parties to the agreement within a notice period of _____[7] days.

3. GENERAL

3.1 In order to contribute to the efficiency and safety of international air navigation in [*State*] the [*ATS authority*][1], the [*meteorological authority*][2] and the [*vulcanological authority*][3] will collaborate to ensure fast and efficient coordination to minimize the impact of the presence of volcanic ash in the atmosphere.

3.2 The *[MWOs][ACCs][volcanic ash advisory centres (VAACs) and selected volcano observatories*] concerned shall make suitable arrangements in order to facilitate vulcanological briefings as well as inter-agency consultations and to establish reliable communications to undertake an effective coordination.

4. RESPONSIBILITIES

4.1 Responsibilities of [*the meteorological authority]* and the meteorological watch offices

4.1.1 **General**

4.1.1.1 FASID Table MET 3C identifies the selected State volcano observatories which are to notify VAAC, MWOs and ACCs on volcanic pre-eruption , volcanic eruption and volcanic ash.

4.1.1.2 The [*meteorological authority*], through the [meteorological watch office (*MWO*)][8] included in the FASID Table MET 3C of [*ANP*][9], is responsible for issuing SIGMET(s) on volcanic ash, i.e. providing up-to-date information on existing and forecasted volcanic ash clouds, and forecasted trajectories at different flight levels based on the latest information received from vulcanological observatories or from the corresponding VAAC to those area control centres that need it in order to carry out their functions. The provision of any information related to volcanic activity and the presence of volcanic ash clouds in the atmosphere should be in accordance with the guidelines provided in the attachment to this Letter of Agreement.

4.2 Responsibilities of [*the ATS authority*] and area control centres (ACCs)

4.2.1 [*The MET Authority*], through the [*ACC*][10] included in the FASID Table MET 3C of [*ANP*], is responsible to provide up-to-date information on existing volcanic ash clouds and trajectory forecasts at different flight levels to pilots and airline operation centers..This information should be based on the latest information received from:

a) vulcanological observatories;

b) the associated VAAC; or

7. Figure to be agreed locally: 180 days appears to be a suitable period.

8. Name(s) of the meteorological watch office(s).

9. Title of corresponding ANP.

10. Name of the area control centre.

c) the associated MWO.

and passed immediately to aircraft in flight that could be affected by the volcanic ash, and to the adjacent ACCs.

4.2.2 The ACC should also issue an ASHTAM or NOTAM through the State International NOTAM Office (NOF) in accordance with Annex 15, Chapter 5, giving details of the pre-eruption activity, volcanic eruption and ash cloud, including name and geographical coordinates of the volcano, date and time of eruption, flight levels and routes affected and, if necessary, routes to be closed to air traffic. The provision of any information related to volcanic activity and the presence of volcanic ash clouds in the atmosphere should be in accordance with the guidelines provided in the attachment to this Letter of Agreement.

4.3 Responsibility of the vulcanological authority

4.3.1 [*The vulcanological observatory*] included in the FASID Table MET 3C of the[*ANP*] is responsible for the provision of up-to-date information on existing and forecasted volcanic activity and volcanic ash clouds based on the latest information received from direct or remote observation sources to the [*ACC*], the [*MWO*] and the [*VAAC*] concerned. The necessary vulcanological information will be supplied in accordance with the guidelines stipulated in the attachment to this Letter of Agreement.

4.3.2 The vulcanological information provided will, as far as possible, be in the format described in step 1 of the attachment in order to facilitate easy interpretation by ATS personnel.

5. ATS UNITS, MWOs AND VULCANOLOGICAL OBSERVATORIES COORDINATION MEETINGS

Regular and/or ad hoc coordination meetings between the chiefs of the ATS units, chiefs of meteorological watch offices and chiefs of vulcanological observatories, and other interested parties, aimed at improving the services provided to aircraft, will be convened as deemed necessary to ensure the safety of air navigation in accordance with the provisions as identified in 1.3.

6. COURSES FOR METEOROLOGISTS, AIR TRAFFIC CONTROLLERS AND VULCANOLOGISTS

6.1 Courses or on-the-job training for meteorological, ATS personnel and vulcanologists will be organized periodically with the objective of familiarizing personnel with the activities performed by the other services.

6.2 Periods and dates for these courses will be agreed by [*the ATS authority*], [*the meteorological authority*] and [*the vulcanological authority*] taking into account the availability of personnel and the necessary equipment.

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Attachment

GUIDELINES IN HANDLING VOLCANIC ACTIVITY RELATIVE TO AERONAUTICAL INFORMATION DISSEMINATION

(Complementary to Part 4 of the Handbook on the International Airways Volcano Watch (IAVW) — Operational Procedures and Contact List (Doc 9766)

STEP 1

1.1 **Action to be taken by the vulcanological observatory**

1.1.1 The vulcanological observatory shall immediately provide information on significant pre-eruption volcanic activity, volcanic eruptions or the presence of volcanic ash clouds to the relevant ACCs *[list the centres*], [*VAAC*] and the associated MWOs [*list the offices*]. The information provided should be in accordance with the format of the Volcano Observatory Notice for Aviation (VONA) given at Appendix E.

STEP 2

2.1 **Action to be taken by theACC**

2,1,1 The ACC concerned shall immediately pass the reported information to the aircraft in flight that could be affected by the volcanic ash cloud and to the relevant ACCs in the adjacent flight information regions (FIRs).

2.1.2 On the reception of special air-reports for volcanic ash by an ACC, the following action should be taken:

a) the information should be transmitted immediately to all aircraft concerned; and

b) the information should be forwarded to the associated MWO.

The special air reports for volcanic ash should be disseminated to aircraft for a period of 60 minutes after their issuance or until the issuance of a SIGMET from the associated MWO. The ACC shall verify that a SIGMET has been issued before discontinuing the transmission of the special air report.

2.1.3 The ACC concerned shall ensure that the content of the ASHTAM is consistent with any SIGMET issued for their FIR. Further, the ACC shall ensure that any ASHTAM or NOTAM issued follows the guidance of Annex 15.

2.1.4 The ACC concerned shall activate contingency arrangements, including implementation of alternative routes.

2.1.5 Transmit special air reports for volcanic ash received by voice communications and those received by data link communication to the associated MWO, and World Area Forecast Centres (WAFCs)London and Washington.

2.2 **Action to be taken by the MWO**

2.2.1 The MWO shall immediately forward special air-reports for volcanic ash received to its associated VAAC, WAFCs London and Washington and to the Washington, Brazilia, and Vienna International OPMET data bank.

2.2.2 The MWO shall ensure the reception of information from its associated VAAC on the extent and trajectory of volcanic ash.

2.2.3 The MWO shall immediately inform the ACC whether or not the volcanic ash cloud is identifiable from satellite images based on advice received from the VAAC.

2.2.4 The MWO shall issue SIGMETs in accordance with Annex 3 based on information received from the VAAC and/or vulcanological observatory and/or ACC. However, during critical conditions where an initial volcanic eruption already poses a danger to aviation, the MWO shall immediately provide to the ACC a trajectory forecast of volcanic ash based, inter alia, on the forecasts of numerical models used by the aeronautical MET service.

STEP 3

3.1 **Action to be taken by ACC**

3.1.1 The ACC shall submit a request for the promulgation of an ASHTAM/NOTAM for volcanic ash to its associated NOTAM Office (NOF)/ Aeronautical Information Service (AIS). The request shall contain the following:

a) date and time of volcanic activity or eruption, or presence of ash clouds;

b) name and number of the volcano (Smithsonian Tables);

c) coordinates (latitude/longitude expressed in whole degrees) of the volcano and/or the radial and distance of the volcano from a navigational aid (NAVAID);

d) aviation colour code for level of alert indicating volcanic activity, if available (Annex 15);

e) horizontal and vertical extent of volcanic ash cloud initially based on the special air report and subsequently based on the MWO, aeronautical MET service or VAAC report;

f) forecast direction of movement of the ash cloud at selected levels based on the advice from the MWO, the aeronautical MET service or the VAAC report;

g) air routes or portions of air routes and flight levels affected or expected to become affected;

h) closure of airspace, air routes or portions of air routes, and availability of alternate routes;

i) source of information (air report and or vulcanological observatory and/or MWO, aeronautical MET service and/or VAAC) indicating whether an eruption has actually occurred or ash cloud reported, or not; and

j) additional information.

Note.— Initially items a), b), c), and d) shall be disseminated immediately pending receipt of additional information from units concerned.

3.2 **Action to be taken by NOF/AIS**

3.2.1 The NOF shall promulgate an ASHTAM/NOTAM for volcanic activity based on information provided by the ACC and in accordance with ICAO format (see Annex 15, Appendices 3 and 6), and transmit to other NOFs for which the information is of direct operational significance.

3.2.2 The NOF shall compile a separate message to be transmitted, via AFTN, to [*the associated VAAC*] which shall be encapsulated within a dummy WMO abbreviated heading (see example in the *Handbook on the International Airways Volcano Watch (IAVW) — Operational Procedures and Contact List* (Doc 9766), Table 4-1). This enables

the receiving AFTN or MET switching centre to forward the ASHTAM/NOTAM for volcanic activity to the VAAC concerned on internal MET communications circuits.

Note. — Significant changes in the activity of the volcano shall be reported accordingly.

3.3 The ACC concerned shall, upon receipt of significant information relating to volcanic activity, request the NOF to revise or cancel the ASHTAM.

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APPENDIX B

AFTN ADDRESSES TO BE USED TO PROMULGATE SPECIAL AIR REPORTS, SIGMETs and VOLCANIC ASH ADVISORIES TO LONDON WAFC AND SADIS

Region	Address
EUR	EGZZWPXX
NAM	EGZZMNAM
NAT	EGZZMNAT
CAR	EGZZMCAR
SAM	EGZZMSAM
PAC	EGZZMPAC
ASIA	EGZZMASI
MID	EGZZMMID
AFI	EGZZMAFI

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APPENDIX C

OPERATIONAL PROCEDURES
FOR THE COORDINATION AND TRANSFER OF RESPONSIBILITY
BETWEEN VAACs
FOR VOLCANIC ASH EVENTS

1. As soon as one of the VAACs learns of an eruption (for a volcano erupting within 5º degrees latitude of the VAACs boundary) or when an ash cloud is expected to come within 5º (latitude) of the VAACs and/or FIR boundary, an information /coordination phone call will be made. The possibility of a hand-off will be discussed, if appropriate.

2 Hand-off of operational responsibility shall be coordinated by the lead VAAC with adjacent affected VAACs and MWOs when the ash cloud is not less than 5º (latitude) from a VAAC and/or FIR boundary. In the rare situation of large or persistent ash emissions, adjacent responsible VAACs, upon coordination, may agree to divide the operational forecast responsibility.

3 Once a hand-off has been decided, the last volcanic ash advisory issued by the lead VAAC before hand-off will include the following at the end of the message (in the REMARKS):

"THE RESPONSIBILITY FOR THIS ASH EVENT IS BEING TRANSFERRED TO VAAC **aaaa** THE NEXT ADVISORY WILL BE ISSUED BY VAAC **aaaa** BY **xxxx** UTC UNDER HEADER **bbbb**."

Where:
aaaa is the name of the VAAC taking over
bbbb is the bulletin header that will be used by the VAAC taking over (FVCN01 CWAO, FVXX21 KWBC, FVAK20 PANC, etc.)
xxxx is the time in UTC

Example:
"THE RESPONSIBILITY FOR THIS ASH EVENT IS BEING TRANSFERRED TO VAAC MONTREAL. THE NEXT ADVISORY WILL BE ISSUED BY VAAC MONTREAL BY 2200 UTC UNDER HEADER FVCN01 CWAO."

4. The first volcanic ash advisory issued by the VAAC that has taken over responsibility will include the following:

"VAAC **cccc** HAS TRANSFERRED RESPONSIBILITY OF THIS EVENT TO VAAC **dddd**. THIS ADVISORY UPDATES MESSAGE **eeee**."

Where:
cccc is the name of the VAAC which had the lead before the hand-off
dddd is the name of the VAAC which has taken over
eeee is the full bulletin header (e.g FVAK PANC 261200) of the last message issued by the VAAC which had the lead before the hand-off.

Example:
"VAAC ANCHORAGE HAS TRANSFERRED RESPONSIBILITY OF THIS EVENT TO VAAC MONTREAL. THIS ADVISORY UPDATES MESSAGE FVAK20 PANC 261200."

5. When the lead VAAC is issuing messages covering a portion of another VAAC's area of responsibility, or an ash cloud is approaching (within 5 degrees of latitude) the area of responsibility of a non-lead VAAC, the non-lead VAAC should issue a volcanic ash advisory directing the user to the correct product. The following wording is suggested:

"PLEASE SEE **ffff** ISSUED BY VAAC **gggg** WHICH DESCRIBES CONDITIONS OVER OR NEAR THE VAAC **hhhh** AREA OF RESPONSIBILITY."
Where:
ffff is the full bulletin header of the message issued by the lead VAAC
gggg is the name of the lead VAAC
hhhh is the name of the VAAC re-broadcasting the lead VAAC message

Example of rebroadcast message issued by VAAC Montreal:
PLEASE SEE FVAK20 PANC 121200 ISSUED BY VAAC ANCHORAGE WHICH DESCRIBES CONDITIONS OVER OR NEAR THE VAAC MONTREAL AREA OF RESPONSIBILITY"

6. For situations in which two or more distinct ash clouds would be present (different eruptions or one eruption for which the ash cloud has divided in two or more distinct parts), the "hand-off" only applies to the ash cloud approaching or crossing VAAC boundaries.

7. The ending of an advisory for a volcanic ash event shall be performed by the lead VAAC, upon coordination with the adjacent affected VAACs and MWOs.

8. Only the lead VAAC shall issue volcanic ash advisories in graphical format on ISCS or SADIS.

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APPENDIX D

BACK-UP PROCEDURES FOR VOLCANIC ASH ADVISORY CENTERS

The following guidelines on back-up procedures should be followed by VAACs:

a) a back-up site should be established;

b) back-up sites should have the full capability of the primary site, i.e. the ability to monitor ash dispersal, run atmospheric dispersion models, produce and distribute the volcanic ash advisory;

c) the back-up site should be chosen as to maximize efficiency, e.g. this will normally be at an alternative 24/7 production facility with pre-existing facilities for the VAAC capability;

d) back-up sites should maintain up-to-date contact lists as per the VAAC;

e) in the event of the back-up site becoming operational, volcanic ash advisories issued by the back-up VAAC will contain information giving the origin of the message; and

f) the back-up arrangements should be tested at least annually.

Editorial Note.— Most of the VAACs already have a nominated back-up site. This back-up site may be another meteorological centre in the same Contracting State or it may be another VAAC. Details about the back-up sites and their contact details together with examples will also be included in the Handbook (Doc 9766) by the Secretariat in due course.

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APPENDIX E

FORMAT OF VOLCANO OBSERVATORY NOTICE FOR AVIATION (VONA)

Explanation of the format of a Volcano Observatory Notice for Aviation (VONA) which is issued by a VO when a colour code changes (up or down) or within a colour-code level when an ash-producing event or other significant change in volcanic behaviour occurs.

(1) VOLCANO OBSERVATORY NOTICE FOR AVIATION--VONA

(2) Issued:	Universal (Z) date and time (YYYYMMDD/HHMMZ).
(3) Volcano:	Name and number (per Smithsonian database at http://www.volcano.si.edu/world/)
(4) Current Aviation Colour Code:	**GREEN, YELLOW, ORANGE, OR RED** in upper case bold font
(5) Previous Aviation Colour Code:	Lower case font, not bold
(6) Source:	Name of Volcano Observatory (volcanological agency)
(7) Notice Number:	Create unique number that includes year
(8) Volcano Location:	Latitude, longitude in NOTAM format (N or S deg min W or E deg min)
(9) Area:	Regional descriptor
(10) Summit Elevation:	nnnnn FT (nnnn M)
(11) Volcanic Activity Summary:	Concise statement that describes activity at the volcano. If known, specify time of onset and duration (local and UTC) of eruptive activity.
(12) Volcanic Cloud Height:	Best estimate of ash-cloud top in nnnnn FT (nnnn M) above summit or AMSL (specify which). Give source of height data (ground observer, pilot report, radar, etc.). "UNKNOWN" if no data available or "NO ASH CLOUD PRODUCED" if applicable.
(13) Other Volcanic Cloud information:	Brief summary of relevant cloud characteristics such as colour of cloud, shape of cloud, direction of movement, etc. Specify if cloud height is obscured or suspected to be higher than what can be observed clearly. "UNKNOWN" if no data

	available or “NO ASH CLOUD PRODUCED” if applicable.
(14) Remarks:	Optional; brief comments on related topics such as monitoring data, observatory actions, volcano’s previous activity, etc.
(15) Contacts:	Names, phone numbers (voice and fax), email addresses.
(16) Next Notice:	“A new VONA will be issued if conditions change significantly or the colour code is changes.” Indicate if final notice for an event. Include URL of Web site where latest volcanic information is posted.

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APPENDIX F

GUIDANCE TO PILOTS ON THE DETECTION OF SULPHUROUS GASES ON THE FLIGHT DECK

In the *Handbook on the International Airways Volcano Watch (IAVW) — Operational Procedures and Contact List* (Doc 9766) *replace* paragraph 4.7 by the following:

4.7.1 The following paragraphs provide explanatory material and guidance about recommended actions to be taken by Flight Crew in the event of smelling sulphur gases during flight, with the understanding that the guidance constitutes examples and does not necessarily cover all practices being applied by operators.

4.7.2 Volcanic eruptions emit various gases along with magma, including sulphur dioxide (SO_2) and hydrogen sulphide (H_2S). Volcanoes are the only sources of large quantities of sulphur gases at cruise altitudes, and both SO_2 and H_2S are detectable by smell. Thus, the smell of sulphur gases in the cockpit may indicate volcanic activity that has not yet been detected or reported and/or possible entry into an ash-bearing cloud. In some cases when sulphur gases are smelled, there may be little ash in the cloud owing to ash fallout during prior dispersion of the cloud, but Flight Crew do not have the means to determine directly that the cloud is non-hazardous and thus should seek to exit the cloud.

4.7.3 SO_2 is identifiable as the sharp, acrid odour of a freshly struck match. H_2S, also known as sewer gas, has the odour of rotten eggs. Sulphur gases may be detectable only for a short period of time because of 'olfactory fatigue' (temporary loss of the ability to smell a particular odour).

4.7.4 Inhalation of SO2, even at low concentrations (<5 ppm), can cause respiratory tract irritation especially in people with asthma and chronic obstructive pulmonary disease. When SO_2 gas combines with water in the atmosphere, a sulphate aerosol primarily composed of dilute sulphuric acid is formed. Flying through sulphuric acid aerosols has caused crazing of acrylic windows, fading of exterior paint, and accumulation of sulphate deposits in engines. SO_2 gas is colourless, but under certain conditions of reflection and refraction of sunlight, a sulphuric acid aerosol may be a visible atmospheric feature, such as a layer of haze of variable colour (brownish, yellowish, bluish, or whitish). Ash particles likely will be present in aerosol haze but possibly in minor or trace amounts.

4.7.5 "Electrical Smoke and Fire" and SO_2 are two odours described as somewhat similar. After determining there are no secondary indications that would result from and indicate an electrical fire, the Flight Crew must establish whether the sulphur odour is transient or not. This is best achieved by Flight Crew donning oxygen mask(s) and breathing 100% oxygen for the period of time that results in a complete change of air within the cockpit and also allows the sense of smell to be regained. After the appropriate time period, the Flight Crew should remove the oxygen mask and determine if the odour is still present.

4.7.6 If the Flight Crew affirms the continued presence of sulphur gas, the controlling Area Control Centre and Airline Operation Centres must be informed as soon as practicable to request information about any relevant volcanic activity and the whereabouts of possible volcanic clouds. It is recommended that the reporting pilot use the Volcanic Activity Report form (VAR) Section 1, Items 1-8, which is a Special AIREP. Upon landing the Flight Crew should complete VAR (items 9-16) and submit the VAR per the instruction on the VAR form to the Darwin VAAC.

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Part 5
INTERNATIONAL AIRWAYS VOLCANO WATCH CONTACT LIST

5.1 ALPHABETICAL LISTING

Antigua and Barbuda
Argentina
Australia
Bolivia
Brazil
Cameroon
Canada
Cape Verde
Chile
China
Colombia
Comoros
Costa Rica
Cuba
Democratic Republic of the Congo
Dominican Republic
Ecuador
El Salvador
Eritrea
Ethiopia
France
France (Île de la Réunion)
French Antilles
French Guiana (France)
Greece
Grenada
Guatemala
Guyana
Honduras
Iceland
Indonesia
Italy
Jamaica
Japan
Kenya
Mexico
Montserrat (United Kingdom)
Netherlands Antilles (Netherlands)
New Zealand
Nicaragua
Pakistan
Panama
Papua New Guinea
Paraguay
Peru
Philippines
Puerto Rico (United States)
Portugal
Russian Federation
Saint Kitts and Nevis
Saint Lucia
Saint Vincent and the Grenadines
Solomon Islands
Spain
Suriname
Trinidad and Tobago
United States
Uruguay
Vanuatu
Venezuela

5.2 LIST OF STATES BY ICAO REGION

AFI

Cameroon
Cape Verde
Comoros
Democratic Republic of the Congo
Eritrea
Ethiopia
France (Île de la Réunion)
Kenya

ASIA/PAC

Australia
China
Indonesia
Japan
New Zealand
Pakistan
Papua New Guinea
Philippines
Solomon Islands
Vanuatu

CAR/SAM

Antigua and Barbuda
Argentina
Bolivia
Brazil
Chile
Colombia
Costa Rica
Cuba
Dominican Republic
Ecuador
El Salvador
French Antilles (France)
French Guiana (France)
Grenada
Guatemala
Guyana
Honduras
Jamaica
Mexico
Montserrat (United Kingdom)
Netherlands Antilles (Netherlands)
Nicaragua
Panama
Paraguay
Peru
Puerto Rico (United States)
Trinidad and Tobago
Saint Kitts and Nevis
Saint Vincent and the Grenadines
Saint Lucia
Suriname
Uruguay
Venezuela

EUR

France
Greece
Italy
Portugal
Russian Federation
Spain

NAM/NAT

Canada
Iceland
United States

DOCUMENT CHANGE RECORD
Part 5

DATE	SECTION PAGES AFFECTED
9.12.10	Bolivia, Dominican Republic, Ecuador, Guyana, Honduras, Mexico, Netherlands Antilles and Panama – contact information updated
19.10.10	Cameroon – contact information updated
20.9.10	Brazil – contact information updated
12.7.10	Montserrat (United Kingdom) contact information updated
25.9.09	Update to Mexico
21.4.09	Update to Suriname
25.2.09	New entries: Cuba, Honduras, Jamaica and Puerto Rico (United States) Updates to: Dominican Republic, Mexico, Netherlands Antilles (Netherlands) and Trinidad and Tobago
16.12.08	New entry: Netherlands Antilles (Netherlands)
17.10.08	Update to Cameroon
8.9.08	New entry: Dominican Republic
26.8.08	Updates to: Cameroon, Cape Verde, Comoros, Dem. Rep. of Congo and CAR/SAM States
22.2.08	Portugal
5.11.07	Canada
16.4.07	Russian Federation
12.2.07	Guyana, Paraguay and Uruguay
4.12.06	Greece, Iceland, Italy, Portugal, Russian Federation and Spain
24.4.06	Canada and Peru
16.3.06	Kenya
3.3.06	Argentina, Brazil and Chile
28.11.05	Ecuador , Panama

1.11.05	Argentina, Chile, Paraguay
30.6.05	El Salvador
25.4.05	Peru

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FIR	SANTIAGO		
ACC		Tel.: AFTN: E-mail: Fax:	+56 (2) 767 2001 +56 (2) 436 3004 SCELZRZX cta.accu@dgac.cl cta_acol@dgac.cl +56 (2) 767 1636
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CHILE

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FIR	BARRANQUILLA		
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	Observatorio Sismológico y Vulcanológico de Arenal y Miravalles San José	Tel.: +506 257 4220 Fax: +506 695 5033
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	LONG VALLEY CALDERA		
	Long Valley Caldera Monitoring, USGS	Tel.: E-mail: Fax:	+1 (415) 329 4795 hill@andres.wr.usgs.gov +1 (415) 329 5163
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