

WORLD METEOROLOGICAL ORGANIZATION

COMMISSION FOR AERONAUTICAL METEOROLOGY

**FIFTH WMO VAAC "BEST PRACTICE" WORKSHOP
(VAAC BP/5)**

Tokyo, Japan

7-9 June 2017

FINAL REPORT



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GROUP PHOTO



[Not pictured: David Schneider]

1. WORKSHOP OPENING AND ATTENDANCE

1.1 Mr Makoto Saito, Director of the Volcanology Division of the Japan Meteorological Agency (JMA) opened the workshop and extended a warm welcome to all participants. Mr Greg Brock, Scientific Officer of the Aeronautical Meteorology Division, WMO, welcomed everyone on behalf of the WMO Secretary-General, Professor Petteri Taalas, and expressed thanks to the Japan Meteorological Agency for hosting the workshop and for the excellent arrangements provided. Mr Ian Lisk, vice-president of the WMO Commission for Aeronautical Meteorology (CAeM), provided a similarly warm welcome to all participants on behalf of the president of the CAeM, Mr Shun.

1.2 The workshop was also addressed during its opening by Mr Raul Romero, Technical Officer (Meteorology), International Civil Aviation Organization (ICAO) headquarters and by Mr Peter Lechner, Chair of the ICAO Meteorology Panel.

1.3 Mr Ian Lisk chaired the proceedings of the workshop assisted by Mr Brock and, as necessary, by Messrs Romero and Lechner.

1.4 Participants were advised that the workshop, consistent with the discussion at the previous workshop (VAAC BP/4 (2016) Final Report, 18.2 refers), was being conducted in two parts, namely:

- A two-day closed (*in-camera*) session on 7 and 8 June 2017 only involving managers and representatives of the nine volcanic ash advisory centres (VAACs), an expert from a State volcano observatory (via teleconference) and observers from Japan Meteorological Agency, followed by
- A one-day open session on 9 June 2017 additionally involving the International Air Transport Association (IATA), Rolls-Royce, other VAAC representatives and observers.

The full list of participants is provided in Annex 1 to this report.

2. AGENDA AND OBJECTIVES

2.1 The VAACs adopted a workshop agenda (in the form of an order of business) as given in Annex 2 to this report.

2.2 Consistent with VAAC BP workshops held since the fourth (final) meeting of ICAO's International Volcanic Ash Task Force (IVATF/4) in 2012, the VAACs were reminded that the objective of the workshops was to discuss improved processes to achieve service delivery harmonization amongst the nine VAACs and other concerned parties, such as State volcano observatories and meteorological watch offices, in the context of the requirements within International Airways Volcano Watch (IAVW).

2.3 In this connection, the VAACs, WMO and ICAO had agreed, in advance, that the scope of the VAAC BP/5 (2017) workshop should cover (in no particular order):

- Roles, responsibilities and programmatic coordination on volcanic ash issues across concerned WMO and ICAO expert groups;
- T+24 VAG trial update, including user feedback;
- Re-suspended volcanic ash;
- Discernible Ash, VAA/VAG consistency;
- VAAC collaboration tools;
- T+0 VAA/VAG confidence levels and supplementary volcanic ash products;
- Modelling and ESP database;
- Issues related to the application, dissemination and consistency of the VONA;
- Key Performance Indicators for VAACs; and
- Other volcanic ash-related items as necessary.

2.4 Participants were informed that the fifth meeting of the ICAO METP Working Group on Meteorological Operations Groups (WG-MOG/5) addressing the IAVW work stream and the third meeting of the ICAO METP Working Group on Meteorological Information and Service Development (WG-MISD/3) addressing the volcanic ash sulphur dioxide (VASD) work stream were convening in the week immediately following the workshop (specifically 12 to 14 June 2017) at the same location, and that the outcomes of many of the items to be addressed by the workshop were expected to feed as direct inputs to ICAO's due consideration process in that regard.

3. REVIEW OF THE FOLLOW-UP TO VAAC BP/4 (2016) OUTCOMES

3.1 It was recalled that the VAAC BP/4 (2016) workshop was held in Buenos Aires, Argentina from 25 to 27 April 2016 immediately prior to the second meeting of the ICAO METP WG-MOG (IAVW) at the same location (27 to 28 April 2016), and that the workshop had formulated sixteen outcomes (VW4-O-01 to VW4-O-16 inclusive).

3.2 A review of the VAAC BP/4 outcomes was conducted. It was noted that a majority of the outcomes had been addressed in the context of the previous WG-MOG/2 and upcoming WG-MOG/5 meetings and/or that they would be addressed in the context of the current workshop.

3.3 In respect of outcome VW4-O-01, it was recalled that a graphical representation of the relationships between the various WMO and ICAO bodies involved in volcanic ash had been developed and shared, wherein groups such as VAAC BP, VASAG, WG-MOG and WG-MISD were highlighted as key contributors to the progression of the IAVW at the present time. In respect of outcome VW4-O-02 and related to the aforementioned outcome, a brief overview of WMO programmes and expert teams/groups involved in volcanic ash was provided, including mention of an IPET-SUP¹ that had recently considered a volcanic ash algorithm inter-comparison/SCOPE nowcasting activity. In respect of outcome VW4-O-03 related to modelling, it was noted that this outcome was to be next addressed in 2018 (i.e. once every two years). In respect of outcome VW4-O-06 concerning backup arrangements, it was noted that was now business-as-usual activity amongst the VAACs. In respect of outcome VW4-O-14 concerning improvements to the ash encounters database, it was noted that feedback had been provided to DLR. In respect of outcome VW4-O-15 concerning guidance on jet engine impacts of volcanic ash, it was noted that this outcome had fed into the ICAO METP WG-MOG considerations.

Note: As a consequence of the foregoing, outcomes VW4-O-01, VW4-O-02, VW4-O-06, VW4-O-14 and VW4-O-15 were considered complete, while VW4-O-03 was left open.

3.4 The status of the follow-up to all sixteen VAAC BP/4 outcomes is presented in Annex 3.

3.5 In considering the previous and upcoming workshop deliberations and the relationship of much of the work with that of the WMO/IUGG Volcanic Ash Scientific Advisory Group (VASAG), it was acknowledged that it may be desirable to codify the VAAC best practice effort through terms of reference at some point to ensure continuity and avoid the risk of duplication.

4. VAAC COLLABORATION TOOLS AND IWXXM/XML DEVELOPMENTS

4.1 VAAC collaboration tools

4.1.1 It was recalled that, owing to (the then) limited available resources within the VAACs to develop and maintain a common website for exchanging model output and other relevant information amongst all the VAACs, outcome VW4-O-12 had called for an investigation into the use of social media-based platforms (such as Facebook, WhatsApp and others) as an

¹ Commission for Basic Systems (CBS) Open Programme Area Group on Integrated Observing Systems (OPAG-IOS) Inter-Programme Expert Team on Satellite Utilization and Products (IPET-SUP)

alternative approach. It was noted that this outcome was linked with ICAO METP WG-MOG/2 (IAVW) Action 2/5.

4.1.2 A progress report at VAAC BP/5 indicated that while some VAACs had expressed an interest and ability in using such social media platforms, other VAACs had no ability due to reasons that included the restricted or prohibited use of social media in the VAAC/office workplace. In addition, concerns had been expressed by some VAACs regarding a lack of time available for social media interactions amongst forecasters given their operational responsibilities when responding to a volcanic eruption and the presence of volcanic ash in the atmosphere as well as, in some instances, RSMC-related responsibilities.

4.1.3 During discussions, several VAACs expressed a continued desire to have some form of collaboration tool to facilitate exchange of operational information between VAACs and that early tools were starting to develop within a small number of VAACs, in particular to assist in the handover of responsibility between VAACs and as a way for one VAAC to ask for information or assistance (e.g. modelling of a volcanic eruption) from others during an individual VAAC's response to a volcanic event.

4.1.4 Following discussion, the VAACs agreed to formulate a consolidated set of functional needs that would enable the exchange of operational information and to develop a set of common principles that summarize these needs. Since individual applications, web sites, phone numbers or email addresses can change over time, documenting the needs of the VAACs in general terms would help ensure these needs are met as technology evolves. It was suggested that this information could perhaps be included in the Handbook on the IAVW at a future point in time.

4.1.5 A preliminary set of functional needs relating to a VAAC collaboration tool was developed during the workshop as follows (in no particular order):

- Secure access
- Real-time screen mirroring
- Text and image exchange via a message timeline
- Ability to import geo-referenced guidance layers
- Multi-user sessions with content control exchange between actors
- Interactive polygon drawing and image annotation
- Importing of XML VAA and SIGMET products
- Session archival
- Configurable alerting to trigger collaboration sessions for ongoing events
- Import dispersion modelling
- Fit-for-purpose approaches (scale of the approach consistent with scale of collaboration needed).
- An ash/no-ash report template.

4.1.6 It was agreed to finalize these functional needs and that the VAACs with existing or emerging capability should collaborate in the development of a suitable, single web-based platform (basic functionality to start as necessary). **Outcome VW5-O-01**

Note: As a consequence of the foregoing, outcome VW4-O-12 was considered complete.

4.2 IWXXM/XML developments

4.2.1 It was recalled that outcome VW4-O-10 had called on the WMO Secretariat to advise all VAACs about the publication of the draft IWXXM schema for the volcanic ash advisory (VAA) on the WMO website (WIS wiki) and for all VAACs to review and provide feedback on the draft IWXXM schema.

4.2.2 A progress report at VAAC BP/5 indicated that notification of the IWXXM schema and the related WMO website (<http://schemas.wmo.int/iwxxm/>) had been communicated as required. It was highlighted that problems had been identified during the implementation of IWXXM 2.0 such that the evolution in space and time of multiple volcanic ash clouds within a single SIGMET/AIRMET traditional alphanumeric code message could not be represented in

XML. It was noted that this problem had been resolved as part of IWXXM 2.1 released in March 2017 ([available here](#)).

4.2.3 The VAACs discussed matters that included the state of readiness of the VAACs to implement VAA conforming to the IWXXM schema, the feasibility and need to synchronize IWXXM implementation for the VAA across the VAACs (given the current and expected future requirements in ICAO Annex 3 – *Meteorological Service for International Air Navigation*²), and the need for a common repository to host/publish the data prior to and with the advent of system-wide information management (SWIM).

4.2.4 In this regard, it was noted that all VAACs were currently or were soon-to-be IWXXM capable but that clarification was required from ICAO METP WG-MIE and/or WMO CBS TT-AvXML on the differences between the current and next IWXXM versions (i.e. 2.1 and 3.0) and when next IWXXM version (3.0) would be available since these aspects would likely have a bearing on the implementation plans of each VAAC. **OUTCOME VW5-O-02** In addition, it was acknowledged that future user requirements in the context of the IAVW should be fulfilled only in IWXXM-compatible formats (rather than legacy formats such as abbreviated plain language and graphics). For the near term, however, the VAACs recognized that IWXXM-compliant VAA/VAG should be made available on the VAAC websites (to start) and extended AMHS (eventually). **OUTCOME VW5-O-03**

Note: As a consequence of the foregoing, outcome VW4-O-10 was considered complete.

5. VOLCANO MONITORING AND OBSERVING ISSUES

5.1 Volcano Observatory Notice for Aviation (VONA) and aviation colour codes issues

5.1.1 It was recalled that outcome VW4-O-09 had requested issues related to the application, dissemination and consistency of the volcano observatory notice for aviation (VONA) to be referred to the ICAO METP WG-MOG. It was noted that the issues had been referred as requested and had consequently led to the formulation of ICAO METP WG-MOG/2 (IAVW) Action 2/15 where a sub-team was to review the utility of the colour codes in volcanic ash products, especially with respect to situational awareness.

5.1.2 A progress report at VAAC BP/5 highlighted that there was a long history to this issue and that the volcano level of alert colour codes for aviation (“aviation colour codes”) were applied in multiple products, including the VONA, VAA/VAG and ASHTAM/NOTAM. It was acknowledged that there was the potential for confusion, inconsistency and/or duplication in both the supply and use of the aviation colour codes.

5.1.3 During discussion it was well recognized by the VAACs that the users (airlines, ANSPs and others) have a need for aviation colour code-type information, most especially but not only in the pre-eruption stage, but that its inclusion and occasional inconsistency across multiple products was undesirable given the foregoing remarks. It was also well recognized that the inclusion of the aviation colour code by VAACs on the VAA had long-preceded the development and its inclusion by State volcano observatories in the VONA.

5.1.4 Following discussion and in the context of ICAO Annex 3, the consensus of the VAACs was that it should be proposed to the ICAO METP WG-MOG/5 (IAVW) meeting that the aviation colour code be removed from the VAA template in order to avoid duplication and/or inconsistency with equivalent information likely to be available in the VONA and other messages and that, additionally and in parallel, it should be proposed that the VONA be elevated to the status of a recommended practice and (eventually) a standard as a means to heighten 1) the importance of the issuance of VONA by State volcano observatories and 2) its awareness amongst State regulatory/civil aviation authorities and other bodies such as the World Organization of Volcano Observatories (WOVO). **OUTCOME VW5-O-04**

² Reproduced as WMO-No. 49, Technical Regulations, Volume II.

Note: As a consequence of the foregoing, VW4-O-09 was considered complete.

5.2 Eruption source parameters

5.2.1 It was recalled that outcome VW4-O-08 concerned the completion in 2016, by all VAACs, of a questionnaire on the global eruption source parameter (ESP) database targeting dispersion modellers with a view to informing future work on the database.

5.2.2 It was appreciated that the follow-up to outcome VW4-O-08 had been completed.

5.3 Volcanic hazard monitoring and observing capabilities

5.3.1 It was recalled that outcome VW4-O-16 (which itself related to outcome VW3-O-01) concerned the enhancement and improved coordination of aircraft reports of volcanic ash, in-situ, remote sensing and volcano monitoring information availability and dissemination processes together with the development of associated best practice guidance. It was noted that this outcome was also subsequently related, in part, to the progress being made in response to ICAO METP WG-MOG/2 (IAVW) Action 2/10 on the reporting of 'no ash' by flight crew.

5.3.2 It was considered that, to the greatest extent, the advancement of the volcano monitoring and observing capabilities and the development of associated guidance would remain a recurrent (business-as-usual) activity in the context of the IAVW – be it addressed through the VAAC BP workshops, VASAG meeting or other relevant mechanism. The relationship between this issue and issues concerning VAA/VAG consistency (including 'Ash'/'No Ash' reporting, discernible ash, T+0 confidence and re-suspended ash) were noted.

5.3.3 Accordingly, it was agreed that outcome VW4-O-16 should remain open.

6. KEY PERFORMANCE INDICATORS

6.1 It was noted that key performance indicators (KPIs) had been a consideration of the ICAO METP WG-MOG/2 (IAVW) meeting which had consequently formulated Action 2/2 calling for the development of appropriate KPIs for the VAACs.

6.2 A progress report at VAAC BP/5 highlighted that while all VAACs were required to provide standardized VAA and VAG products in accordance with the requirements of ICAO Annex 3, KPIs currently tended to be local to each VAAC resulting in the potential for a non-uniform, non-harmonized approach across all VAACs.

6.3 Three main parameters had been considered in respect of seeking to establish uniform, harmonized VAAC KPIs – namely timeliness, accuracy and compliance. It was appreciated that each of these three parameters presented challenges in their own right when considered from a VAAC-wide perspective, be they due to, for example, delays or a complete absence in the notification that an eruption has occurred, cloud obscuration, little or no knowledge of the ESP, different types of VAA/VAG production software, etc. Notwithstanding such challenges, a preliminary set of VAAC KPIs was reviewed and then improved during the workshop, resulting in the following:

a) **Timeliness:** Following the collection of sufficient evidence of volcanic ash in the atmosphere within a VAAC area of responsibility:

- 1) the initial VAA/VAG is to be issued within 20 minutes on 95% of occasions; and
- 2) the first forecast VAA/VAG is to be issued within 75 minutes on 95% of occasions;

Note: This timeliness KPI represents the absolute minimum criteria for the VAACs. It is acknowledged that, locally, a VAAC may be able to provide the VAA/VAG in a more timely manner.

- b) **Accuracy:** Peer review of VAG/VAA issued by a VAAC is to be undertaken by another VAAC(s) through collaboration;

Note: This accuracy KPI would be fulfilled through peer review of recent case studies.

and,

- c) **Compliance:** Subsequent forecast VAA/VAG to be issued not later than the time stated in the 'Next advisory' element of the VAA/VAG until no further advisories.

6.4 The VAACs agreed that these proposed KPIs should be reported to the ICAO METP WG-MOG/5 (IAVW) meeting for consideration and that, subject to agreement by WG-MOG, the KPIs should be trialled by all VAACs. **OUTCOME VW5-O-05**

7. VAA/VAG CONSISTENCY

7.1 Reporting of 'Ash'/'No Ash'

7.1.1 It was noted that the reporting by flight crew of 'Ash'/'No Ash' had been a consideration of the ICAO METP WG-MOG/2 (IAVW) meeting which had consequently formulated Action 2/10 calling for an ad-hoc group to review ICAO documentation and consider the utility and ways of reporting 'no ash'. Consequently, the 'Ash'/'No Ash' issue was to be part of the ICAO METP WG-MOG/5 (IAVW) meeting.

7.1.2 In this connection, the workshop considered issues related to the reporting of 'Ash'/'No Ash'. The VAACs agreed that such reporting remained a potentially valuable source of evidence that could be used to validate/corroborate VAAC output. It was noted, however, that there was currently limited *actual* reporting of 'Ash'/'No Ash' by flight crew. It was further noted that progress in this area ensures a link with the definitions of discernible ash and visible ash as well as the development of the VAAC collaboration tools.

7.1.3 In considering ways and means to improve the level of 'Ash'/'No Ash' reporting without significantly compromising the use of resources, it was noted that during and subsequent to volcanic eruptions some VAACs already undertook direct liaison – often as simple as a telephone call – with contact points within ANSPs and airline operators to seek such information. It was noted that this often resulted in a positive outcome for all concerned and was not too onerous. The VAACs agreed these considerations should be reported to the ICAO METP WG-MOG/5 (IAVW) meeting. **OUTCOME VW5-O-06**

7.2 Discernible ash strength of evidence checklists

7.2.1 It was recalled that outcome VW4-O-11 (which itself related to outcome VW3-O-03) concerned the development of VAAC forecast best practice guidance material on agreed discernible ash techniques.

7.2.2 A progress report at VAAC BP/5 highlighted a potential approach in establishing commonly agreed discernible ash techniques based on 'strength of evidence' checklists. Two types of checklist were demonstrated:

- a) a conventional tick-box style checklist using a VAAC Darwin web form as an example;
- b) a graphical pyramid-style checklist using a VAAC Darwin and VAAC Tokyo concept example.

Case studies were used to describe how the checklists had been trialled during recent (May 2017) eruptions in Indonesia and Papua New Guinea together with an outline of the respective strengths and weaknesses of each technique.

7.2.3 During discussion, the VAACs agreed that the checklists methodology was a valuable tool when there is a lack of (or ambiguity in) volcanic ash evidence/reports and that, essentially as a QMS best practice, the use of such checklists would add credibility to and ensure better consistency of VAAC decisions and outputs. From a VAAC forecaster competency perspective, the availability and use of such checklists was seen as a positive development and one that could be applied to help most especially but not only forecasters who were new to the VAAC. In addition, the link with the VAAC collaboration tool (see 4.1) and satellite inter-comparison (see 7.3) were noted.

7.2.4 Following discussion, it was agreed that the VASAG should be informed of the discernible ash strength of evidence checklists to seek their expert advice in maturing the methodology. In addition, it was agreed to further trial and mature the checklists amongst the VAACs, taking into account the advice of VASAG as appropriate, in time for consideration at the next VAAC BP workshop. **OUTCOME VW5-O-07**

Note: As a consequence of the foregoing, VW4-O-11 was considered complete.

7.3 MTSAT-2 and Himawari-8 inter-comparison

7.3.1 As part of the effort to develop agreed techniques for discernible ash (see 7.2), the workshop considered an MTSAT-2 and Himawari-8 satellite inter-comparison presentation which provided an overview of the satellite systems, the time period and methodology used to conduct the inter-comparison, case studies, findings and future work.

7.3.2 The positive impacts of Himawari-8 over its predecessor (MTSAT-2) were highlighted. These included the improved detection of small eruptions and small areas of volcanic ash in the atmosphere as well as now being able to better identify volcanic ash under poor observing conditions such as meteorological cloud obscuration. It was also highlighted that distal areas of volcanic ash could now be detected and tracked for longer than had been the case with MTSAT-2. Side effects or consequences of the introduction of Himawari-8 were also highlighted. These included an appreciable increase in the operational workload (where forecasters were now having to monitor more satellite observations and new types of imagery and products), an increase in the issuance of VAA (in particular for relatively small eruptions) and challenges in ensuring consistency across the VAACs (for instance, analysis in advanced satellite techniques was inducing individual differences within the VAAC and the analysis of different satellites was occasionally resulting in larger differences among VAACs).

7.3.3 Accepting the positive impacts as well as the side effects/consequences of the introduction of Himawari-8 on VAAC operations, the VAACs were unanimous in their opinion that these developments – and others like them coming online such as GOES-16 (GOES-EAST) – were creating a paradigm shift in the information available to the VAACs and consequently to their operations and outputs.

7.3.4 Following discussion, it was agreed that, where feasible, a comparison between the old and new generation of satellite products should be conducted within each VAAC and that a comparison of the new generation of satellite products should be conducted across all VAACs. It was agreed to consider this matter further at the next VAAC BP workshop. **OUTCOME VW5-O-08**

7.3.5 It was noted that the enhancement of satellite analysis skills within each VAAC and the development of agreed techniques for discernible ash detection across all VAACs was linked with the foregoing strength of evidence checklist discussion (see 7.2). In addition, it was noted that the continued advancement of satellite capabilities, satellite-derived products and analysis techniques was linked with considerations by the VASAG.

7.4 Re-suspended ash

7.4.1 It was recalled that outcome VW4-O-04 concerned the need for clarification (from ICAO) on whether re-suspended ash needed to be described as 're-suspended' in the VAA/VAG. It was noted that this outcome was subsequently related to ICAO METP WG-MOG/2 (IAVW) Action 2/12 addressing the identification of changes needed to the VAA/VAG template as well as the SIGMET template used in ICAO Annex 3.

7.4.2 A progress report at VAAC BP/5 offered a reminder of what re-suspended ash is (i.e. previously deposited volcanic ash that is re-suspended due to strong winds and, although not common, can pose a significant hazard to aviation operations) as well as examples of recent VAAC experience handling re-suspended ash events in Iceland and the Kamchatka peninsula. In addition, the progress report illustrated the various aspects of ICAO Annex 3 that would need to be amended in order to enable re-suspended ash to be included in VAA/VAG and SIGMET for VA as well as the associated ICAO guidance material that would need to be updated.

7.4.3 During discussion, the VAACs agreed that VAA/VAG must be issued for re-suspended ash events wherever and whenever there is evidence that corroborates its existence. In this regard, the linkage with the discernible ash strength of evidence checklists discussion (7.2) was noted.

7.4.4 In the context of the existing template for VAA (Annex 3, Appendix 2, Table A2-1), the VAACs agreed that it should be proposed to the ICAO METP WG-MOG/5 (IAVW) meeting that some form of re-suspended ash indicator be introduced into Table A2-1 as follows:

- a) Eruption Details section – e.g. **ERUPTION DETAILS: NO ERUPTION. RE-SUSPENDED ASH**;
- b) Remarks section provided sufficient character space exists (e.g. **RMK: RE-SUSPENDED ASH**); and
- c) In respect of a) and b), that consideration be given to the continuity of these proposed changes with other elements of the VAA template (e.g. Summit elevation which is currently a mandatory nnnnM (or nnnnnFT) field with no other possible alternative). **OUTCOME VW5-O-09**

Post-script: The ICAO METP WG-MOG/5 (IAVW) meeting reviewed the above proposals and made further improvements such that a) and b) became "ERUPTION DETAILS: NO ERUPTION – RE-SUSPENDED VA" and "RMK: RE-SUSPENDED VA" respectively.

7.4.5 In the context of other parts of the VAA template, it was noted that, for example, the name and the location of the volcano can both already be indicated as "UNKNOWN", which would be highly beneficial in a VAA (and VAG) in those instances when it is not possible for a VAAC to determine the known source of the re-suspended ash.

Note: As a consequence of the foregoing, VW4-O-04 was considered complete.

7.5 T+0 confidence levels

7.5.1 It was recalled that outcome VW4-O-07 concerned the hosting of T+0 confidence guidance on the VAAC Darwin website (and referenced to all other VAAC websites). It was noted that this outcome was subsequently related to the progress being made in response to ICAO METP WG-MOG/2 (IAVW) Action 2/4 which was addressing a trial of the inclusion of T+0 confidence in the VAA/VAG.

7.5.2 A progress report at VAAC BP/5 highlighted that considerable progress had been made since the last workshop such that all VAACs were now in a position to express their confidence at T+0 in the remarks section of the VAA/VAG, in supplementary confidence products, or in

both forms. It was noted that the supplementary confidence products were graphical depictions of the confidence in the observation (T+0) polygon of volcanic ash cloud(s) used in the VAA/VAG.

7.5.3 In respect of guidance material, it was noted that only two VAACs had included guidance relating to the VAA/VAG T+0 confidence on their websites with a further one VAAC including guidance on their website relating to the referred supplementary confidence product. The progress report highlighted that there was a lack of harmonization in the descriptions being used to define high and low confidence across even just this small number of VAACs.

7.5.4 Notwithstanding the progress made since the last workshop (see 7.5.2), the VAACs agreed that the existing template for VAA (Annex 3, Appendix 2, Table A2-1) was a limiting factor in being able to adequately described the T+0 confidence and that it did not fully meet the perceived user requirement. Furthermore, since the introduction of a T+0 confidence assessment in the VAA/VAG, there had been very limited user feedback of a continuing need and a derived benefit of having confidence information supplied in the current form (i.e. as a remark of 'HIGH' or 'LOW' in the VAA/VAG).

7.5.5 Following discussion and with the support of the IATA representative, the VAACs agreed that it should be proposed to the ICAO METP WG-MOG/5 (IAVW) meeting that the inclusion of T+0 confidence in VAA/VAG should be discontinued while other options are explored such as the referred supplementary confidence products in graphical form.

OUTCOME VW5-O-10

Note: As a consequence of the foregoing, VW4-O-07 was considered complete.

7.6 MODEL VAG and MODEL SVA projections in Appendix 1 to Annex 3

7.6.1 It was noted that the MODEL VAG (volcanic ash advisory model chart) and MODEL SVA (SIGMET for volcanic ash model chart) projections used in Appendix 1 to ICAO Annex 3 had been a consideration of the ICAO METP WG-MOG/2 (IAVW) meeting which had formulated Action 2/7 tasking the VAACs in coordination with WMO to undertake a review of the projections used, in essence to ensure their consistency with the provisions that they support. In this connection, a progress report at VAAC BP/5 outlined the historical context to the issue, prevailing shortcomings with the MODEL VAG and MODEL SVA, principle considerations related to model charts in general, the result of consultations with all VAACs and potential solutions to resolve the issue.

7.6.2 Having considered a range of potential solutions to this issue and respecting the principle considerations, the VAACs agreed that it should be proposed to the ICAO METP WG-MOG/5 (IAVW) meeting that two new examples *each* should be developed for the MODEL VAG and MODEL SVA with a view to their potential future inclusion in ICAO Annex 3. **OUTCOME**

VW5-O-11 The workshop was pleased to note that VAAC Wellington was willing to assist WMO in this regard, subject to endorsement of the proposal by ICAO METP WG-MOG/5 (IAVW).

7.6.3 In connection with the foregoing, the VAACs appreciated that the graphical depiction of the volcanic ash advisory and SIGMET for volcanic ash was an issue that would, with time, probably be superseded by the transition to volcanic ash data or information in a SWIM context.

8. SUPPLEMENTARY VOLCANIC ASH PRODUCTS

8.1 T+24 VAG

8.1.1 It was recalled that outcome VW4-O-05 concerned the status of a trial on the provision, by VAACs, of T+24 VAG and the seeking of advice (from ICAO) on the next steps. It was noted that this outcome was subsequently related to ICAO METP WG-MOG/2 (IAVW) Action 2/9 which had tasked all VAACs in a position to do so to provide T+24 VAG as a

supplementary product on a trial basis on their respective websites whenever ash was expected to remain discernible beyond T+18 hours or when requested to do so by a user.

8.1.2 During discussion at VAAC BP/5 it was identified that most but not all VAACs had been producing a supplementary T+24 VAG trial product whenever the situation demanded but that such provision had been particularly onerous and resource intensive on the operational duties amongst all of the VAACs with capability. Indeed, without an appropriate cost recovery mechanism in place, all VAACs agreed that the continuation of the T+24 VAG trial was unsustainable.

8.1.3 Furthermore, since the initiation of the T+24 VAG trial there had been very limited user feedback of a continuing need and a derived benefit of having the product. In this regard, the IATA representative indicated that while some airline operators indicated they wanted the product for situational awareness, strategic planning, most considered the information too unreliable for operational use and were simply not using it for flight planning purposes.

8.1.4 Following discussion, and in particular respecting the absence of a cost recovery aspect as well as the future transition to volcanic ash data/information, the VAACs agreed that it should be proposed to the ICAO METP WG-MOG/5 (IAVW) meeting that the T+24 VAG trial be discontinued. **OUTCOME VW5-O-12**

Note: As a consequence of the foregoing, VW4-O-05 was considered complete.

8.2 Quantitative ash contamination products

8.2.1 It was recalled that outcome VW4-O-13 had called on the VAACs to collaborate in the development of proposals for future 'supplementary' volcanic ash charts, including T+0 VA evidence products, VA contamination level advisory products based on quantitative ash mass column loading thresholds as well as consideration of evolving safety management system (SMS) aspects. It was noted that this outcome was subsequently related, in part, to ICAO METP WG-MOG/2 (IAVW) Action 2/4 on T+0 confidence (see 7.5).

8.2.2 A progress report at VAAC BP/5 offered an overview of the latest research, technological and scientific developments in the detection, modelling and jet engine ingestion impacts of volcanic ash, with a view to informing a discussion on how supplementary information in the form of quantitative volcanic ash contamination forecasts should be used within the context of a globally harmonized volcanic ash safety risk assessment process. It was highlighted that the trialling during recent volcanic ash exercises in Europe (ICAO EUR/NAT VOLCEX) of column mass loading supplementary products (in addition to supplementary ash concentration charts) had been discontinued on the basis of negative user feedback.

8.2.3 Following discussion, the VAACs agreed that it should be proposed to the ICAO METP WG-MOG/5 (IAVW) meeting that the issue of volcanic ash concentration charts should be revisited in the context of the scientific and technological advances that have occurred since the eruption of Eyjafjallajökull in Iceland in 2010 as well as the recent (May 2017) public announcement by an original equipment manufacturer (Rolls-Royce) of the tolerability of certain Rolls-Royce engine types to volcanic ash ingestion (see 9 below).

OUTCOME VW5-O-13

Note: As a consequence of the foregoing, VW4-O-13 was considered complete.

8.3 Sulphur dioxide (SO₂)

8.3.1 Brief consideration was given at the workshop to the volcanic sulphur dioxide (SO₂) issue, which was going to be the main consideration of the ICAO METP WG-MISD/3 (VASD) meeting (see 2.4).

8.3.2 During discussion at VAAC BP/5 it was identified that most but not all VAACs currently have SO₂ detection, monitoring and/or prediction capabilities and that, where any capability

exists, this was in the research/non-operational area. It was agreed that this should be reported to the WG-MISD/3 (VASD) meeting together that an indication that the future establishment of an operational VAAC service for SO₂ based on a (yet to be determined) user requirement in ICAO Annex 3 would require additional VAAC resources to implement and therefore must be supported by appropriate cost recovery arrangements.

OUTCOME VW5-O-14

9. UPDATE ON VOLCANIC ASH IMPACTS ON JET ENGINES

9.1 Following on from discussions at the last workshop, a progress report was given at VAAC BP/5 by the Rolls-Royce representative regarding the susceptibility to volcanic ash of all Rolls-Royce Trent and RB211 engine marks (as at 24 May 2017) as well as the Rolls-Royce Position in respect of volcanic ash and aviation (as at 31 May 2017) based on the scientific and operational developments that have taken place since the eruption of Eyjafjallajökull in Iceland in 2010. In addition, an unclassified report commissioned by NATO and prepared by Rolls-Royce (March 2017) was also shared which detailed how operators can maximise airspace use during volcanic eruptions through the matching of engine durability against ash cloud occurrence.

9.2 All participants appreciated that the information provided by Rolls-Royce was both highly informative and important since it offered, effectively for the first time and in the public domain, an insight into the implications on certain engine types of the risks and consequences of exposure to volcanic ash, both from the perspective of the duration of the exposure and the quantitative concentration of the exposure.

9.3 It was considered by the VAACs that the issues identified in the Rolls-Royce progress report were of great significance in the context of the IAVW. It was appreciated that the issues identified would next be considered at the ICAO METP WG-MOG/5 (IAVW) meeting and other fora such as the VASAG.

10. WORKSHOP OUTCOMES AND NEXT STEPS

10.1 Formulation of the VAAC BP/5 (2017) outcomes

The outcomes of the VAAC BP/5 workshop are presented in Annex 4.

10.2 Inputs to ICAO METP WG-MOG/5 (IAVW) and WG-MISD/3 (VASD)

10.2.1 As alluded to at 2.4 above, it was recalled that many of the outcomes of the workshop were expected to be directly related to items to be addressed at the ICAO METP WG-MOG/5 (IAVW) and WG-MISD/3 (VASD) meetings (12 to 14 June 2017).

10.2.2 Upon the conclusion of the workshop it was noted that this was indeed the case, as illustrated by Annex 4.

10.3 Next steps including future workshops

10.3.1 In the context of the next workshop – namely VAAC BP/6 (2018) – it was appreciated that VAAC Wellington was currently willing to host the workshop in New Zealand in 2018, with a precise date and location to be determined. It was agreed that VAAC Wellington would work with the WMO Secretariat to confirm the offer (through the Permanent Representative of New Zealand with WMO) prior to making any necessary arrangements. **OUTCOME VW5-O-15**

10.3.2 In this connection, the VAACs considered that, if practicable, it could be mutually beneficial to convene the next or other future workshop in concert with a VASAG meeting (e.g. back-to-back, overlapping or in parallel). In addition, a preference was expressed that there should be sufficient time (3 months, say) between the convening of a VAAC BP and a WG-MOG (IAVW) in order to allow sufficient time to prepare consolidated VAAC positions and to avoid a risk of a duplication of issues.

10.3.3 In the context of other relevant events, the workshop was informed that the seventh meeting of the WMO/IUGG Volcanic Ash Scientific Advisory Group (VASAG/7) was expected to take place immediately following the IAVCEI 2017 Scientific Assembly in Portland, Oregon, United States in August 2017. It was noted that, amongst its many activities, the VASAG/7 was expected to make a recommendation on the timing and content of the next International Workshop on Volcanic Ash (IWVA/8). It was recalled that the IWVA events had typically been held once every 2 to 3 years with the most recent workshop (IWVA/7) in 2015. It was noted that, at present, an IWVA in 2018 was considered unlikely owing to the convening by WMO of the sixteenth session of the Commission for Aeronautical Meteorology and its Technical Conference (CAeM/16 and TECO).

10.3.4 Lastly, the workshop was informed that WMO was conducting an Aeronautical Meteorology Scientific Conference (AeroMetSci-2017) in Toulouse, France from 6 to 10 November 2017 and that an official announcement by WMO in this connection was to be expected soon.

11. CLOSURE OF THE MEETING

11.1 The workshop paid its respects to Mr Steve Albersheim (FAA/United States) who had sadly passed away on 8 June 2017 after a short but aggressive illness. Mr Albersheim had made a significant contribution to the advancement of the IAVW over the past decade and more and was known to many within the VAACs and the broader WMO and ICAO communities.

11.2 The workshop was informed of the imminent retirement of Mr Philippe Husson (VAAC Toulouse/France), Mr Nigel Gait (VAAC London/United Kingdom) and Mr Hans-Rudi Sonnabend (IATA) as well as the recent appointment by WMO of Ms Miriam Andrioli (VAAC Buenos Aires/Argentina). Participants thanked them all for their significant contributions to the VAAC BP process and the advancement of the IAVW in general over many years.

11.3 After the customary exchange of courtesies, the meeting concluded at 13:30 on Friday 9 June 2017.

AGENDA

WEDNESDAY 7 JUNE CLOSED SESSION*		THURSDAY 8 JUNE CLOSED SESSION*		FRIDAY 9 JUNE OPEN SESSION*	
0830	Registration	—	—	0830	Registration (new participants only)
0900	Welcome, opening remarks Objectives, working arrangements	0900	Recap of Day 1 and plan for Day 2	0900	Welcome to new participants Plan for Day 3
0915	Review of follow-up to VAAC BP/4 (2016) outcomes Roles, responsibilities and programmatic coordination [VW4-O-01, VW4-O-02] <i>WMO lead</i>	0915	VAA/VAG consistency including MTSAT-2 and Himawari-8 inter-comparison <i>VAAC Darwin and VAAC Tokyo lead</i>	0915	VAAC Discussions Outcomes 1 - VAA/VAG consistency including re-suspended ash and collaboration tools
1030	<i>Break</i>	1030	<i>Break</i>	1030	<i>Break</i>
1045	VAAC collaboration tools [VW4-O-12] and IWXXM/XML developments [VW4-O-10] <i>VAAC Montreal lead</i>	1045	VAA/VAG consistency continued including confidence levels and resuspended ash [VW4-O-11, VW4-O-07 and VW4-O-04] (<i>VAAC Darwin and VAAC Tokyo lead</i>) and model VAG and model SVA projections in Appendix 1 to Annex 3 (<i>WMO Lead</i>)	1045	VAAC BP/5 inputs to ICAO METP WG-MOG/5 <ul style="list-style-type: none"> • Confidence • T+24 • Aviation colour codes • Model VAG and SVA projections • KPIs • IWXXM developments
1215	Summary	1215	Summary	1215	Summary
1230	<i>Lunch</i>	1230	<i>Lunch</i>	1230	<i>Lunch</i>
1400	Volcano monitoring and observing issues [VW4-O-09, VW4-O-08 and VW4-O-16] <i>VAAC Anchorage lead</i>	1400	Supplementary volcanic ash products including T+24 charts [VW4-O-13 and VW4-O-05] <i>VAAC London lead</i>	1400	Volcanic Ash Impacts on Jet Engines Update <i>Rory Clarkson</i>
1530	<i>Break</i>	1530	<i>Break</i>	1500	<i>Break</i>
1545	Key Performance Indicators <i>VAAC London lead</i>	1545	Supplementary volcanic ash products continued, including for SO ₂	1530	VAAC Discussions Outcomes 2 - Supplementary volcanic ash products
1645	Summary	1645	Summary	1645	Summary
1700	Close of Day 1	1700	Close of Day 2	1700	Close of Day 3

* *Note.* — The first two days will be a closed session, limited only to members of the VAACs. Any Volcano Observatory staff in Tokyo will also be welcome to participate. The third day will be open to other concerned stakeholders such as members of the ICAO METP WG-MOG (IAVW), IATA and IFALPA. The workshop will be conducted mainly in the form of presentations and demonstrations by the VAACs. The meeting will be chaired by the WMO CAeM Vice-President with WMO and ICAO Secretariat in support.

LIST OF PARTICIPANTS

1. VAACs MANAGERS (or Representatives)

VAAC AFFILIATION	NAME	E-MAIL
BUENOS AIRES	CALLE, Ximena	xcalle@smn.gov.ar
DARWIN	CROZIER, Adele	adele.bear-crozier@bom.gov.au
MONTREAL	BENSIMON, Dov	dov.bensimon@ec.gc.ca
TOULOUSE	MASSON, Fabien	fabien.masson@meteo.fr
TOKYO	ITO, Kazuki	kazuki.ito@met.kishou.go.jp
WELLINGTON	ACETHORP, Paula	paula.acethorp@metSERVICE.com
LONDON	MUSCAT, Anton	anton.muscat@metoffice.gov.uk
ANCHORAGE	MOORE, Donald	donald.moore@noaa.gov
WASHINGTON	KIBLER, Jamie M.	jamie.kibler@noaa.gov

2. OTHERS PARTICIPANTS

AFFILIATION	NAME	E-MAIL
VAAC BUENOS AIRES	RIBERO, Claudia	cribero@smn.gov.ar
VAAC DARWIN	JANSONS, Emile	e.jansons@bom.gov.au
VAAC LONDON	GAIT, Nigel	nigel.gait@metoffice.gov.uk
VAAC TOKYO	IGARASHI, Yohko	y_igarashi@met.kishou.go.jp
VAAC TOKYO	SAKURAI, Toshiyuki	sakurai@met.kishou.go.jp
VAAC TOULOUSE	HUSSON, Philippe	philippe.husson@meteo.fr
VAAC TOULOUSE	SIMON, Patrick	patrick.simon@meteo.fr
CAeM Vice-Pres.	LISK, Ian	ian.lisk@metoffice.gov.uk
ICAO Secretariat	ROMERO, Raul	rromero@icao.int
ICAO METP Chair	LECHNER, Peter	lechnerp@caa.govt.nz
USGS*	SCHNEIDER, David	djschneider@usgs.gov

*Remote participation only

3. OBSERVERS

AFFILIATION	NAME	E-MAIL
METEOCHILE	GUTIÉRREZ CISTERNA, Reinaldo	rgutierrez@meteoChile.cl
IATA	RENNIE, Graham	grennie@qantas.au
JAPAN MET. AGENCY	RYUZAKI, Jun	jryuzaki@met.kishou.go.jp
ROLLS ROYCE	CLARKSON, Rory	rory.clarkson@rolls-royce.com
UNIVERSITY OF ICELAND	REICHARDT, Uta	utar@hi.is
Plus other staff of the Japan Meteorological Agency		

4. WMO SECRETARIAT

TITLE	NAME	E-MAIL
SO/AEM	BROCK, Greg	gbrock@wmo.int

STATUS UPDATE ON THE OUTCOMES OF THE FOURTH VOLCANIC ASH BEST PRACTICE WORKSHOP (VAAC BP/4) (2016)			
No.	Description	Lead	Status (as at VAAC BP/5)
<u>VW4-O-01</u>	Clarify roles and responsibilities of the different WMO, WMO/IUGG and ICAO VA groups and meetings in a schematic way.	WMO (first draft to be presented to VASAG in Nov 16)	COMPLETE
<u>VW4-O-02</u>	Improve the coordination with relevant WMO groups and programmes dealing with VA driven by VAAC needs, e.g. the WMO GAW programme including SDS-WAS.	WMO (Paper to VAAC BP 2017)	COMPLETE
<u>VW4-O-03</u>	Modelling - All VAACs in coordination with the relevant NWP provider(s), to further investigate and report on NWP errors/performance (taking into account region specific issues e.g. tropics) relevant to volcanic ash modeling and VAAC 'Ins and Outs' Modelling tables to be reviewed, updated and shared every 2-years (next update 2018).	VAAC London (Updated tables added to VAAC BP website by end of July 2016)	OPEN
<u>VW4-O-04</u>	Re-suspended ash - Seek clarification from ICAO METP WG-MOG on whether re-suspended ash needs to be described as re-suspended on VAA and VAG. Investigate how to establish links to the WMO SDS-WAC programme.	Lead: WMO (April 2016) VAAC-BP/5; 2017	COMPLETE
<u>VW4-O-05</u>	T+24 Trial - Report current status of T+24 Trial to ICAO METP WG-MOG and seek advice regarding further steps (including cost-recovery aspects); consider the need to include T+24 provision in Amd 78 to Annex 3 (2018).	WMO (May 2017)	COMPLETE
<u>VW4-O-06</u>	VAAC back-ups – All VAACs to annually review and if necessary update (email to Raul) Doc 9766 VAAC back-up table 4.3 and VAAC contact details with back-up arrangements then tested at least annually with OPMET databanks and MWOs feedback coordinated by VAACs rather than through the medium of a State letter.	VAAC Darwin (May 2017)	COMPLETE
<u>VW4-O-07</u>	T+0 Confidence - Guidance material on confidence levels to be hosted by VAAC Darwin and referenced to all other VAACs websites. In the meantime continue providing T+0 confidence level. Report to MOG for eventual inclusion of a provision in Annex 3 and templates. MET info for TBO concept to be considered in future development of confidence level info.	VAAC Darwin (May 2017)	COMPLETE
<u>VW4-O-08</u>	ESP Database - Questionnaire on the Global Eruption Source Parameter database targeting dispersion modelers to be completed by all VAACs to inform future work on the database.	All June 2016	COMPLETE

STATUS UPDATE ON THE OUTCOMES OF THE FOURTH VOLCANIC ASH BEST PRACTICE WORKSHOP (VAAC BP/4) (2016)			
No.	Description	Lead	Status (as at VAAC BP/5)
<u>VW4-O-09</u>	Issues related to application, dissemination and consistency of the VONA to be referred ICAO METP WG-MOG.	ICAO (May 2017)	COMPLETE
<u>VW4-O-10</u>	XML - WMO Secretariat to advise all VAACs about the publication of the draft VAA XML schema on the WIS Wiki website. All VAACs to look at the draft XML schema and provide feedback by the determined deadline.	WMO (June 2016)	COMPLETE
<u>VW4-O-11</u>	Discernible Ash and VAA VAG consistency – Based on VW3-O-03, VAAC Forecast Process Best Practice ‘guidance manual’ to be developed with ‘Discernible Ash Agreed techniques’ section duplicated in Volcanic Ash Handbook.	VAAC Darwin and VAAC Tokyo, MET-P WG-MOG paper in coordination with VASAG (2017)	COMPLETE
<u>VW4-O-12</u>	VAAC Collaboration Tools – Development of sustainable website not possible due to limited resources. Social media based options now being investigated and trialed based on development of common requirements specification.	VAAC Montreal, VAAC BP (2017)	COMPLETE
<u>VW4-O-13</u>	Supplementary Products - VAACs to collaborate on the development of proposals for future ‘supplementary’ volcanic ash charts including, T+0 VA ‘evidence’ products, VA contamination level advisory products based on quantitative ash mass column loading thresholds and consideration of evolving safety management system considerations.	VAAC London, VASAG paper (late November 2016) and MET-P WG-MISD 2017 papers.	COMPLETE
<u>VW4-O-14</u>	Encounter Database – All workshop participants to share any ideas on how to improve occurrence reporting with carsten.christmann@dlr.de .		COMPLETE
<u>VW4-O-15</u>	Jet engine volcanic ash damage impacts – Common understanding that jet engine damage impacts are a function of ash mass dosage and that Doc 9691chapter 4, list 4.2 should now be considered for updating.	ICAO in consultation with ICCAIA. METP WG-MOG paper (2017).	COMPLETE
<u>VW4-O-16</u>	Volcanic hazard monitoring and observing capabilities Volcanic ash AIREPS, in-situ, remote sensing and volcano monitoring information availability and dissemination processes need to be enhanced and better coordinated with associated guidance including operational application best practice updated/developed. (IAVWOPSG ref 7/23, 8/3, 8/21, 8/22) – METP WG-MOG paper	WMO. Routine VASAG updates submitted to MET-P WG-MOG meetings.	OPEN

OUTCOMES OF THE FIFTH VOLCANIC ASH BEST PRACTICE WORKSHOP (VAAC BP/5)			
No.	Description	Lead	Status at 20 June 2017
<u>VW5-O-01</u>	VAAC COLLABORATION TOOL 1) Finalize functional needs analysis for a VAAC collaboration tool; and 2) Upon completion of 1), VAACs with capability to collaborate in the development of a suitable, single web-based platform (basic functionality to start as necessary). Progress report to next workshop.	VAAC Montreal (Dov)	OPEN
<u>VW5-O-02</u>	IWXXM VERSIONS Seek clarification from ICAO METP WG-MIE and/or WMO CBS TT-AvXML on the differences between the current and next IWXXM versions (i.e. 2.1 and 3.0) and when the next IWXXM version (3.0) will be available.	VAAC Toulouse (Patrick)	COMPLETE – Email communication 14/6/17
<u>VW5-O-03</u>	IWXXM IMPLEMENTATION IWXXM-compliant VAA/VAG should be made available on the VAAC websites (to start) and extended AMHS (eventually). Progress report to next workshop.	VAAC Montreal (Dov)	OPEN
<u>VW5-O-04</u>	VONA AND AVIATION COLOUR CODES ISSUES Propose to the WG-MOG/5 (IAVW) meeting that the aviation colour code be removed from the VAA template and that the VONA be elevated to the status of a recommended practice and (eventually) a standard.	WMO (Greg/Ian)	COMPLETE – Addressed at WG-MOG/5 (IAVW)
<u>VW5-O-05</u>	KEY PERFORMANCE INDICATORS (KPIs) 1) Proposed KPIs should be reported to the ICAO METP WG-MOG/5 (IAVW) meeting for consideration; and 2) Upon completion of 1), the KPIs should be trialled by all VAACs. Progress report to next workshop.	VAAC London (Anton)	1) COMPLETE – Addressed at WG-MOG/5 (IAVW) 2) OPEN
<u>VW5-O-06</u>	'ASH'/'NO ASH' REPORTING Feed ideas to the ICAO METP WG-MOG/5 (IAVW) meeting on the ways and means to improve the level of 'Ash'/'No Ash' reporting without significantly compromising the use of resources.	VAAC Darwin (Emile)	COMPLETE – Addressed at WG-MOG/5 (IAVW)
<u>VW5-O-07</u>	DISCERNIBLE ASH AND STRENGTH OF EVIDENCE CHECKLISTS	1) WMO	OPEN

OUTCOMES OF THE FIFTH VOLCANIC ASH BEST PRACTICE WORKSHOP (VAAC BP/5)			
No.	Description	Lead	Status at 20 June 2017
	1) Inform VASAG of the discernible ash strength of evidence checklists to seek their expert advice in maturing the methodology; and 2) Further trial and mature the checklists amongst the VAACs, taking into account the advice of VASAG as appropriate. Progress report to next workshop.	(Greg/Ian) 2) VAAC Darwin (Adele) and VAAC Tokyo (Kazuki)	OPEN
<u>VW5-O-08</u>	SATELLITE INTER-COMPARISON Where feasible, 1) Conduct comparison between the old and new generation of satellite products within each VAAC; and 2) Conduct comparison of the new generation of satellite products across all VAACs. Progress report to next workshop.	VAAC Darwin (Adele) and VAAC Tokyo (Kazuki)	
<u>VW5-O-09</u>	RE-SUSPENDED ASH Propose to the ICAO METP WG-MOG/5 (IAVW) meeting that some form of re-suspended ash indicator be introduced into Annex 3, Appendix 2, Table A2-1.	VAAC Tokyo (Yohko)	COMPLETE – Addressed at WG-MOG/5 (IAVW)
<u>VW5-O-10</u>	T+0 CONFIDENCE Propose to the ICAO METP WG-MOG/5 (IAVW) meeting that the inclusion of T+0 confidence in VAA/VAG should be discontinued while other options are explored.	VAAC Darwin (Emile)	COMPLETE – Addressed at WG-MOG/5 (IAVW)
<u>VW5-O-11</u>	MODEL VAG AND MODEL SVA Propose to the ICAO METP WG-MOG/5 (IAVW) meeting that two new examples <i>each</i> should be developed for the MODEL VAG and MODEL SVA with a view to their potential future inclusion in ICAO Annex 3.	WMO (Greg)	COMPLETE – Addressed at WG-MOG/5 (IAVW)
<u>VW5-O-12</u>	T+24 VAG TRIAL Propose to the ICAO METP WG-MOG/5 (IAVW) meeting that the T+24 VAG trial be discontinued.	WMO (Greg)	COMPLETE – Addressed at WG-MOG/5 (IAVW)
<u>VW5-O-13</u>	SUPPLEMENTARY PRODUCTS – CONCENTRATION CHARTS	VAAC London	COMPLETE –

OUTCOMES OF THE FIFTH VOLCANIC ASH BEST PRACTICE WORKSHOP (VAAC BP/5)			
No.	Description	Lead	Status at 20 June 2017
	Propose to the ICAO METP WG-MOG/5 (IAVW) meeting that the issue of volcanic ash concentration charts should be revisited in the context of the scientific and technological advances since 2010 and the latest engine-type tolerability information.	(Anton)	Addressed at WG-MOG/5 (IAVW)
<u>VW5-O-14</u>	SO2 Report to the WG-MISD/3 (VASD) that: 1) most but not all VAACs currently have SO ₂ detection, monitoring and/or prediction capabilities and that, where any capability exists, this was in the research/non-operational area; and 2) the future establishment of an operational VAAC service for SO ₂ based on a (yet to be determined) user requirement in ICAO Annex 3 would require additional VAAC resources to implement and therefore must be supported by appropriate cost recovery arrangements.	WMO (Greg)	COMPLETE – Addressed at WG-MOG/5 (IAVW)
<u>VW5-O-15</u>	NEXT WORKSHOP VAAC Wellington to work with the WMO Secretariat to confirm the offer of hosting the VAAC BP/6 workshop in New Zealand in 2018.	VAAC Wellington (Paula)	OPEN