*International Civil Aviation Organization*

**INFORMATION PAPER**

**Eleventh Meeting of the Meteorological Services Working Group (MET/S WG/11)**

Virtual meeting, 24 to 26 March 2021

**Agenda Item 6: Guidance and education related to the provision of meteorological services**

# VAAC DARWIN MANAGEMENT REPORT

(Presented by Australia)

**SUMMARY**

This paper presents an IAVW Management Report for the VAAC Darwin area of responsibility covering the period 1 July 2020 to 31 January 2021. It provides an update on current VAAC Darwin activities, significant operational changes, training and development, collaboration and stakeholder engagement.

## 1. INTRODUCTION

1.1 The report is contained in Attachment 1. The discussion below contains a summarisation of key topics.

## 2. DISCUSSION

Key topics from the report in Attachment A

2.1 VAAC Darwin issued 1313 advisories in financial year 20/21 (Note: a financial year runs from 1 July to 30 June the following year). The most advisories were issued for Dukono and Semeru in Indonesia. There were fewer high impact eruptions during the financial year 20/21 compared to financial year 19/20.

2.2 The activity per volcano has been summarised in Figure 1 and 2 in Appendix A.

2.3 Mt Lewotolo erupted on 29th November in the Lesser Sunda Islands in Indonesia to 50,000ft. The ash quickly moved southeast towards Australian airspace. The ash dissipated quickly and satellite imagery showed no discernible ash; however, there was a strong lingering $SO_2$ signal that continued to move to the southeast and over central Australia.

2.4 The VAAC is creating new ways to train and assess forecasters' skills while they are gaining their competency. WMO will be looking at a review of the current VAAC competency framework with support from VAAC Darwin and VAAC Montreal to better align with AMF.

2.5 VAAC has transitioned to its new position in the Hazardous Weather Unit (HWU) under the new Melbourne Aviation Forecasting Centre (MAFC) in June 2020. The MAFC and VAAC Darwin

now have 18 VAAC competent staff who rotate around the 3 HWU desks which gives the service added resilience. The forecasters have been able to support each other as everyone knows the right procedures for volcanic ash.

2.6 The VAAC and MAFC have been adapting to the ever-changing situation with COVID-19 affecting Australia. From March until now, the team has been looking for ways to continue the services and transition to work from home with no interruption to services. The current situation has the team split up into three different areas (Melbourne Office levels 5 and 11, and home-based work) but the communication and collaboration between the forecasters has been impressive and the response to high level eruptions has been as timely as ever.

2.7 VAAC Darwin and VAAC Montreal are still progressing with their back-up support for VAAC Washington. Testing of dissemination to start this month and service expected to start in first quarter 2021. All VAACs will be aligning their back-up procedures due to previous issues with consistency and will now be notifying users with a message "*Issued by VAAC nnnnn on behalf of VAAC nnnnn"* in the VAA.

2.8 VAAC Darwin is producing Volcanic Ash Advisories (VAA) in IWXXM format using schema version 3.0. Further testing for minor bugs will be done in early 2021.

2.9 The Bureau has a new Dispersion Ensemble Prediction System (DEPS) which provides probabilistic forecasts for volcanic ash to help with more accurate advisories. This new tool helps move away from a deterministic approach, to better capture the uncertainties involved. DEPS will help with improved volcanic ash forecasts. It is also a step towards quantitative volcanic ash information such as ash concentration products or data as part of the international work from the ICAO Meteorology Panel (METP) Meteorological Information and Services Development (WG-MISD).

2.10 VAAC Collaboration has strengthened between VAACs Darwin and Wellington as they look to harmonise services. The two VAACs have been working on operational processes and procedures, comparison of ash dispersion models, comparison of advisory and forecast creation, daily check-ins, and back-up services and exercises. VAAC Darwin will look to expand collaboration efforts with VAAC Tokyo in a similar way in the near future.

2.11 VAACs Darwin and Wellington conducted a standalone volcanic ash exercise to support Solomon Islands with Air Navigation deficiency (AP-MET-23). The Solomon Islands FIR 'Honiara' is split between both VAACs so a volcano from each VAAC area of responsibility was used for the exercise. Progress report was provided to the MET-SG24 and both VAACs will continue to support Solomon Islands to remove the deficiency.

2.12 The METP WG-MOG-IAVW has been focusing on: key performance indicators to enhance consistency and accuracy of forecasts; elevation of the Volcano Observatory Notice for Aviation (VONA) status and discussions around aviation colour codes; and progression of the Roadmap and ConOps documentation. Elevation of the VONA has progressed and draft provisions to Annex 3 and PANS-MET are expected to be provided to the next METP meeting.

2.13 The ICAO METP Working Group on Meteorological Information and Services Development (WG-MISD) work stream for sulphur dioxide ($SO_2$) and volcanic ash (VASD) is focusing on the first look at a potential operating capability for $SO_2$ services and having an initial operating capability (IOC) for the delivery of probabilistic quantitative volcanic ash information services. Group is aiming to provide draft provisions to Annex 3 and PANS-MET to the next METP meeting for

quantitative volcanic ash. Further details on MOG and MISD activities are available in report provided to MET-SG24 (https://www.icao.int/APAC/Meetings/Pages/2020-MET-SG24.aspx).

2.14 The Volcanic Ash Exercises (VOLCEX) Steering Group has two exercises planned for each year. VOLCEX 20/02 was successfully conducted on 17 July 2020 in the Pacific region. The exercise had multiple aims and was conducted by VAAC Wellington, VAAC Darwin and VAAC Washington. During the exercise there was a back-up procedure test between VAAC Wellington and VAAC Darwin as well as coordinating with VAAC Washington as ash approached their boundary.

2.15 VAAC Darwin has contributed to other stakeholder engagement within the region as the international requirements will increase for training and coordination between VAACs and State Volcano Observatories.

## 3. ACTION BY THE MEETING

3.1 Note the information contained in this paper and refer to Attachment 1 for the full VAAC Darwin Management Report.

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**Attachment A**

## 1. INTRODUCTION

**1.1.** The Volcanic Ash Advisory Centre (VAAC) Darwin is responsible for monitoring the area from the Andaman Islands (India) eastwards to the Solomon Islands including the volcanically active Indonesian archipelago, Papua New Guinea and the southern Philippines. More than 150 active volcanoes lie within the area, some of which have given rise to the largest eruptions in human history. Areas within the region have poor communications and general infrastructure, incomplete volcanic monitoring and are characterised by moist tropical convection that makes remote sensing difficult for much of the year.

## 2. VAAC STATISTICS

| **VAAC** | **Period of reporting** | **Total number of Advisories** | **High Impact Events*** |
|---|---|---|---|
| Darwin | 1 July 2020 - 31 January 2021 | 1313 | Lewotolo 29 November 2020<br>Semeru 21 August 2020<br>30 November 2020<br>Sinabung 10 August 2020<br>14 August 2020 |

* Discernible or visible ash that is impacting or expected to impact aircraft cruising levels, international aerodromes, is of high media interest, or is deemed to be significant to aviation operations by a VAAC

2.1. A total of 1313 Volcanic Ash Advisories (VAA) and accompanying Volcanic Ash Graphics (VAG) have been issued for the Darwin area of responsibility this financial year (FY 20/21) thus far (Note: a financial year runs from 1 July to 30 June the following year).

2.2. Figure 1 shows the number of advisories issued by VAAC Darwin (reported by volcano) during FY 20/21. FY 20/21 has been a quiet period for high impact eruptions but has continued with low impact volcanic activity. In the VAAC Darwin area of responsibility (AOR), Mt Dukono, in northern Halmahera, Indonesia erupted almost continuously through this period with 719 advisories. Other volcanoes with sustained volcanic activity include Mt Semeru in Java, Indonesia with 192 advisories. Collectively, these two volcanoes were responsible for 70% of all advisories issued by VAAC Darwin for this period. The volcanoes which have had high impact eruptions include Mt Lewotolo in the Lesser Sunda Islands in Indonesia, Mt Semeru on Java in Indonesia and Mt Sinabung on Sumatra in Indonesia. In order to provide context, Figure 2 features the total number of advisories issued by VAAC Darwin (by FY) since 1993.

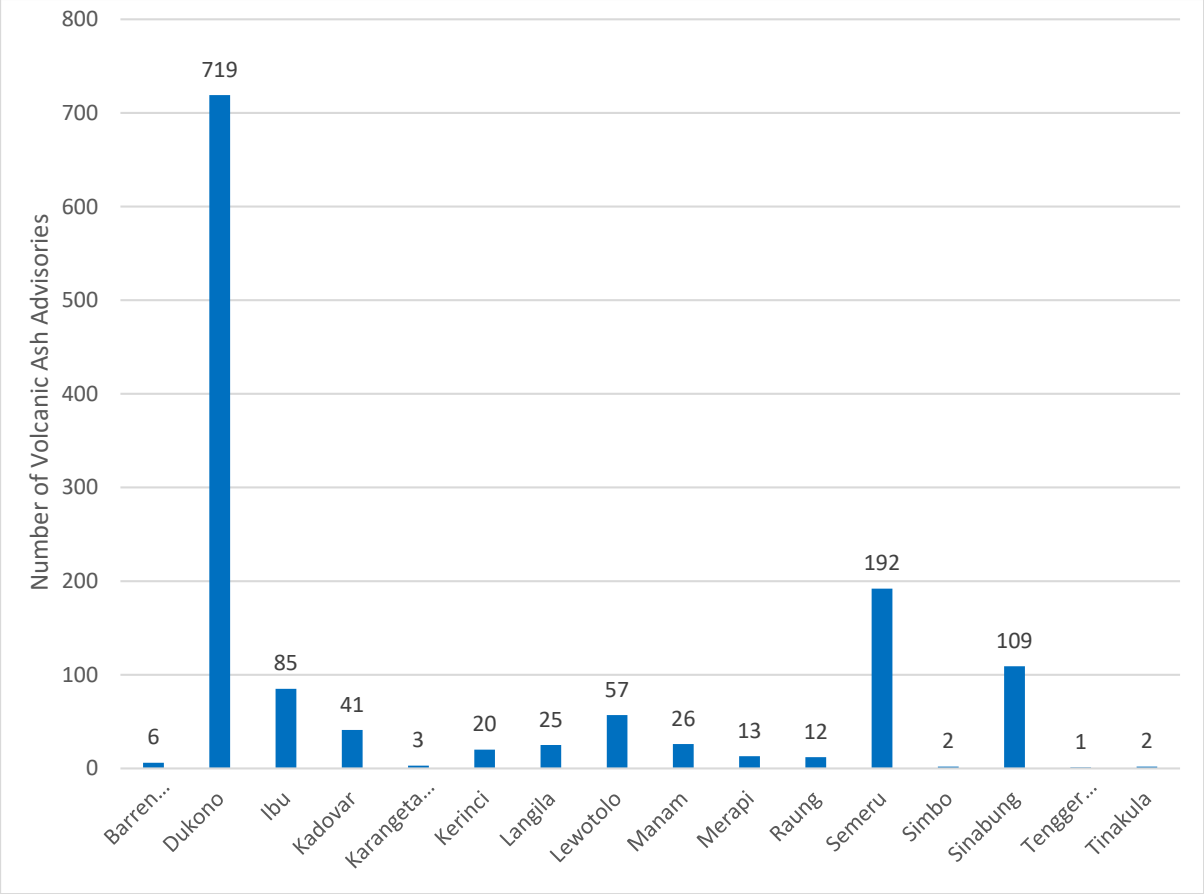


***Figure 1*** *- Advisories by volcano for the VAAC Darwin area of responsibility for FY 20/21**

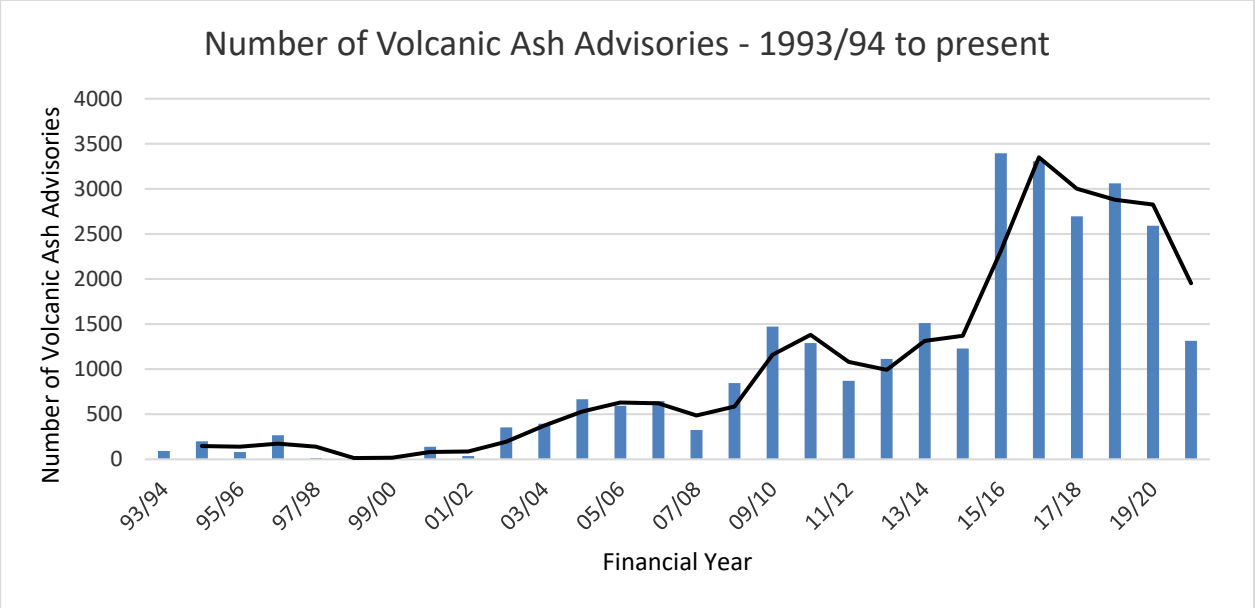


***Figure 2*** *- VAAC Darwin: Number of advisories for Financial Years 1993/94 - 2020/21* (period 1 July 2020– 31 January 2021)*

## 3. HIGH IMPACT ERUPTIONS

### 3.1. Lewotolo, Lesser Sunda Islands Indonesia 29 November 2020

3.1.1. Mt Lewotolo is in the Lesser Sunda Islands in Indonesia. From early November there was an increase in seismic activity and thermal anomalies appearing at the volcano. On 27th November, there was a VONA for continuous emission which was observed on satellite imagery and an advisory issued to 6,000ft. On the 29th November at 0150 UTC, Mt Lewotolo erupted with ash reaching -60 degrees Celsius or 50,000ft. Figure 3 shows the ground report from Indonesia by Centre of Volcanology and GeoHazard Mitigation (CVGHM) and the satellite imagery at 0400 UTC. Satellite imagery indicated that the high-level ash was drifting to the southeast and a low-level component to 18,000ft moving to the northwest.

3.1.2. The ash continued to move to the southeast towards Australia. The signal appeared to have a significant Sulphur Dioxide ($SO_2$) component as the ash signal dissipated. The ash moved into the Brisbane FIR and over Australia. The ash quickly separated from the $SO_2$ and dissipated leaving no trace of ash on satellite imagery. The $SO_2$ continued to move into central Australia and linger for a while longer. Figure 4 shows the strong $SO_2$ signature from the Mt Lewotolo eruption. The eruption appeared to have a large volcanic gas component than ash component.

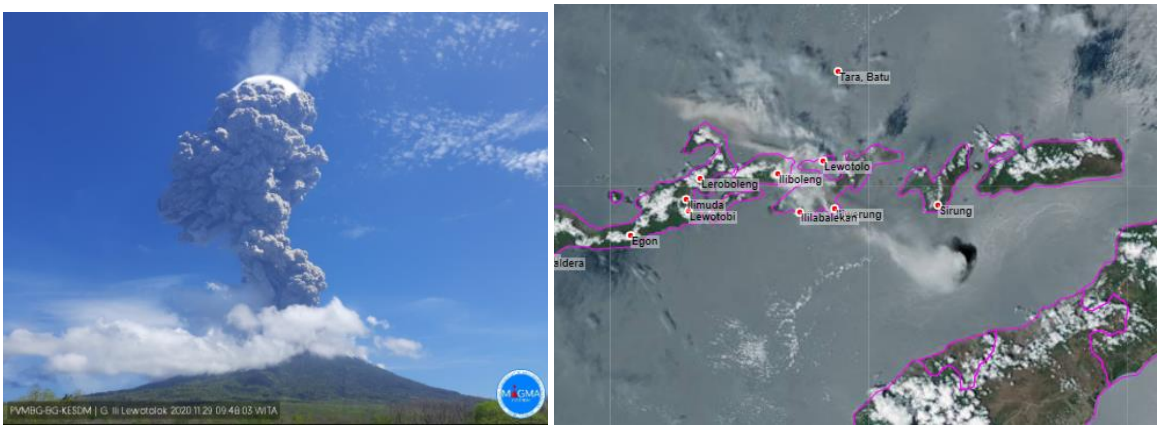


***Figure 3**. Mt Lewotolo eruption on 29 November 2020 in the Lesser Sunda Islands in Indonesia. The left image shows the ground report from CVGHM (courtesy of CVGHM) and the right image shows true colour visible Himawari-8 imagery at 04 UTC.*

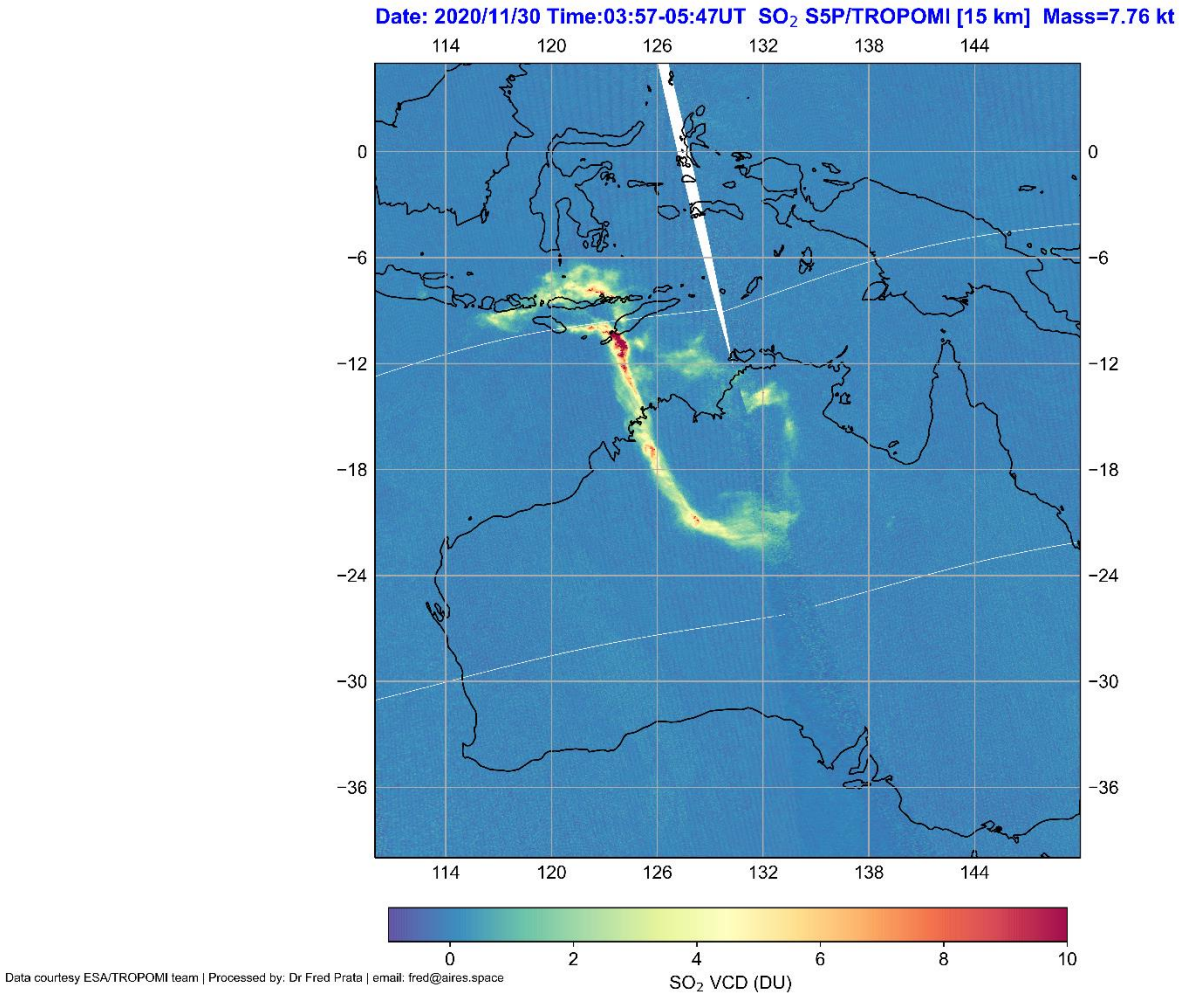


***Figure 4.** The $SO_2$ from the Lewotolo eruption on 29 November 2020. Shows the spread and strength of the $SO_2$ signal.*

### 3.2. Semeru, Java, Indonesia – 21st August and 30th November 2020

3.2.1. Mt Semeru on Java in Indonesia has had many eruptions throughout FY 20/21 so far with 192 advisories issued. Typically, the activity has been observed as low-level and discrete which can dissipate quickly.

3.2.2. On 21st August there was a VONA received for Mt Semeru via the VAAC Darwin e-mail account for an eruption to 25,000ft but the VONA didn't appear on the Indonesian Magma/VONA website. The forecaster issued an urgent initial while waiting for satellite imagery to arrive and confirm the activity. On satellite imagery the activity was observed to 12,000ft as small discreet puffs so the follow up advisory was downgraded.

3.2.3. On 30th November there was reported an eruption with landslides and possible ash rain. The webcam showed significant activity in the area. An urgent advisory was issued to 50,000ft which matched current observed activity on satellite imagery. The signature on satellite imagery was moving to the southwest. After one and a half hours, the high-level observation was reassessed as a thunderstorm which developed at the same time as the volcanic activity. An ash signal was observed on satellite imagery and an advisory was continued to 20,000ft to match the reassessment of activity.

### 3.3. Sinabung, Sumatra, Indonesia – 10 August 2020

3.3.1. On 10 August, there was an eruption observed on webcam and satellite imagery to 32,000ft. The ash quickly separated into two levels due to the wind profile above the volcano. The high-level component was moving to the west and the low-level component to 14,000ft was moving to the northeast (Figure 5). The eruption provided a clear and strong signal on satellite imagery allowing the forecaster to easily track the ash as it dissipated.

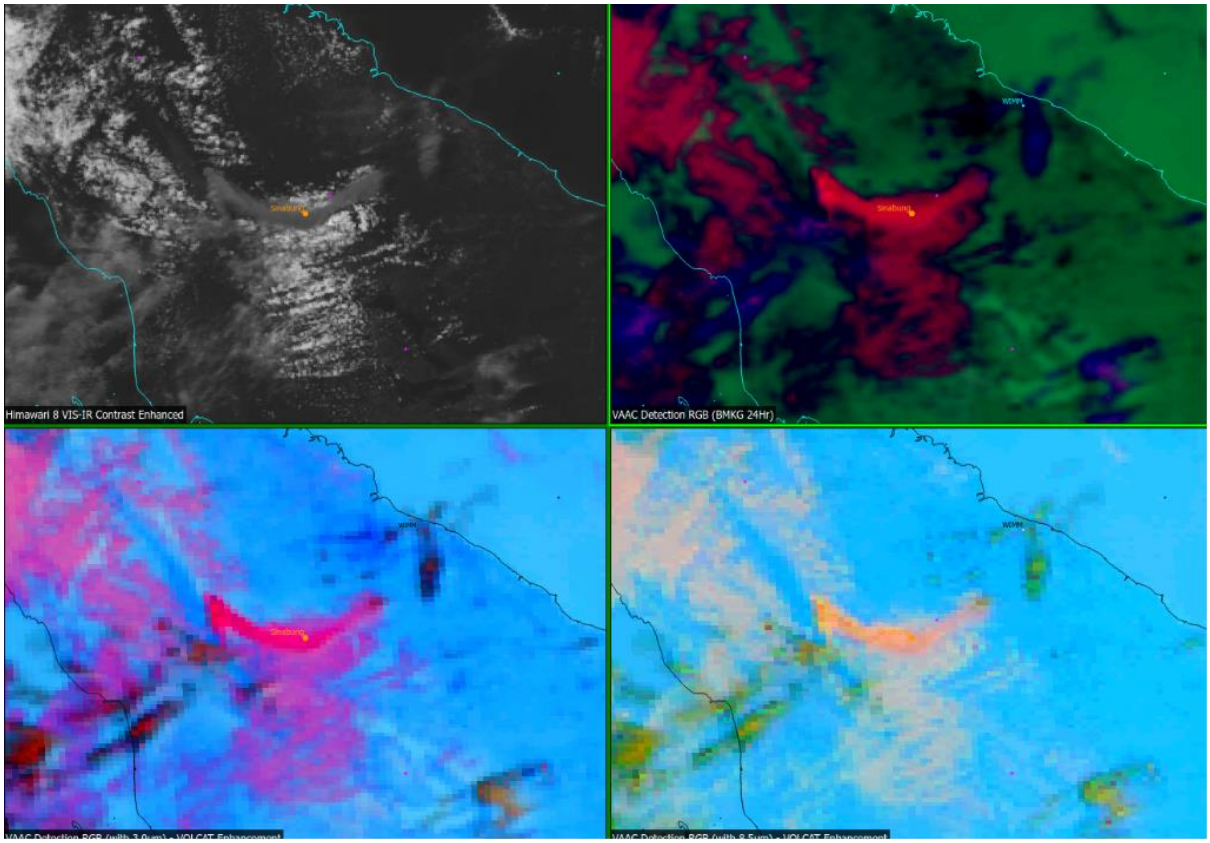


***Figure 5.*** *Himawair-8 imagery on 10 August for the eruption at Mt Sinabung. Top left is visible imagery, top right is RGB false colour image (bright red is volcanic ash), bottom left is RGB false colour image (bright pink is volcanic ash) and bottom right is RGB false colour image which highlights $SO_2$ as bright green.*

### 3.4. Merapi, Java, Indonesia – Many discrete minor eruptions

3.4.1. Mt Merapi on Java in Indonesia is one of the most highly monitored volcanoes in Indonesia. It is near Yogyakarta which is a densely populated area. The previous eruption in 2010 was devastating for the area and caused widespread evacuations as the eruptive activity continued for over a month.

3.4.2. In 2020, the ground alert level at Mt Merapi was raised to Siaga or Level 3. There has been increased seismic activity at the volcano and many minor eruptions, pyroclastic flows and lava from the volcano which are still occurring in January 2021. The latest assessment from CVGHM is that the volcanic activity level is still quite high. Merapi is closely monitored by ground authorities and the VAAC.

## 4. SIGNIFICANT OPERATIONAL CHANGES

### 4.1. VAAC Darwin transition to Hazardous Weather Unit

4.1.1. On 18th June 2020, VAAC Darwin moved from under the Bureau's National Operations Centre (BNOC) to its new home in the Hazardous Weather Unit (HWU) in the Melbourne Aviation Forecasting Centre (MAFC). All forecasters moving to HWU were required to have their VAAC competency (see section 4.2). Many months of work was conducted to guarantee that the software, technology and Melbourne servers were ready to accommodate the VAAC service to create a seamless transition and avoid service disruption.

4.1.2. The way the VAAC operates from a process point of view remains largely the same; the main change was the service transitioning to be under a new team with many of the staff moving across as well. However, there are a number of other benefits to the VAAC service that have come with this transition. The greater number of VAAC-competent meteorologists in the HWU compared to previously increases the VAAC's flexibility and resilience, particularly in high end events. Under the new HWU, all forecasters working in the section are VAAC-competent. Over time, quality of service is likely also to benefit from the increased ability of the VAAC forecaster on duty to consult and seek second opinion from experienced VAAC-competent colleagues also on-shift at the time. This extra support also increases capacity in the VAAC to be responsive to high-impact events by redirecting more resources to VAAC services more quickly.

4.1.3. Additionally, in the transition to the HWU, significant work was completed on systems resilience and redundancy.

### 4.2. COVID-19 response

4.2.1. From March 2020, the Bureau of Meteorology has been adapting to the COVID-19 outbreak. There was a great effort across the whole of the Bureau to make sure the service could continue uninterrupted. Forecasters were provided equipment to test working from home capabilities and internet connections.

4.2.2. Currently the forecasting team is split into three different areas: Operations Centre 1 in Melbourne Office level 11, Operations Centre 2 in Melbourne Office level 5, and work from home set-ups. With the use of MS Teams and other technologies, the three desks under HWU can keep in constant contact with each other to discuss activity and screen share as if they were both at the same desk. During high level events, the forecasters are working closely while (on occasion) in different locations to provide the same level of service as before COVID-19 – but with increased risk management around the threat of the pandemic itself.

4.2.3. There are many procedures around handover and coordination to make sure that the staff are kept safe during the current situation. This provides added comfort for the two teams still working from the office as well as knowing there is a lower risk to the service if any staff are exposed to COVID-19.

4.2.4. In 2021, the Bureau of Meteorology started a transition back to the office for staff who have been working at home due to minimal COVID numbers.

## 4.3. VAAC Darwin Competency Program

4.3.1. VAAC Darwin has implemented a competency and training program for VAAC forecasters in line with quality management obligations and recent advancements in volcanic ash detection, monitoring and forecasting (i.e. next generation geostationary satellites, automated alerts (VOLCAT)), as well as implementation of improved strategies for delivering aviation briefings which can be scaled up or down based on the impact of an event and to meet the evolving needs of industry.

4.3.2. VAAC Darwin currently has 18 VAAC competent staff members. This has significantly increased the number of competent technical staff available and able to respond to high impact volcanic ash events.

4.3.3. VAAC Darwin is developing in-house simulations and case studies to provide forecasters with a well-rounded training program so they can gain first-hand experience with many high impact eruptions.

4.3.4. The World Meteorological Organization (WMO) Expert Team on Education, Training and Competency (ET-ETC) will be updating the top- and/or second-level competencies for aeronautical meteorological personnel to accommodate the role of VAAC forecasters and VAACs Darwin and Montreal will be assisting with the process. We are hoping that with VAAC Darwin involvement we can have a consistent competency framework between all the VAACs. The review of top- and second level AMF is underway to incorporate volcanic ash.

## 4.4. VAAC Washington back-up

4.4.1. VAAC Darwin and VAAC Montreal are in consultation with VAAC Washington to continue working towards back-up support. VAAC Darwin are creating products for issuing VAAC Washington advisories, compiling important operational information such as contacts and AFTN addresses, working towards live dissemination tests once products and software are ready and preparing a Memorandum of Understanding for VAAC services between the two organisations.

4.4.2. VAAC Anchorage was included in the initial discussions for back-up but were not able to provide this service so now the back-up agreement is between VAAC Washington, VAAC Darwin and VAAC Montreal.

4.4.3. VAAC Darwin will back-up the area consisting of Central America, South America to 10°S, the Northwest Pacific which includes the Marianas Islands and sections west of Central and South America in the Eastern and Central Pacific (Figure 6, green area). VAAC Montreal will back-up the area consisting of the Continental US, Mexico, Caribbean, Eastern Atlantic and the Eastern and Central Pacific that includes Hawaii and west to 170°W. (Figure 6, yellow area). The service is expected to commence in first quarter of 2021.

4.4.4. Work is progressing towards these new back-up capabilities for VAAC Washington. VAACs Darwin and Washington are planning to issue some test VAAs soon and having

discussions between forecasters to start gaining background knowledge of the new back-up area.

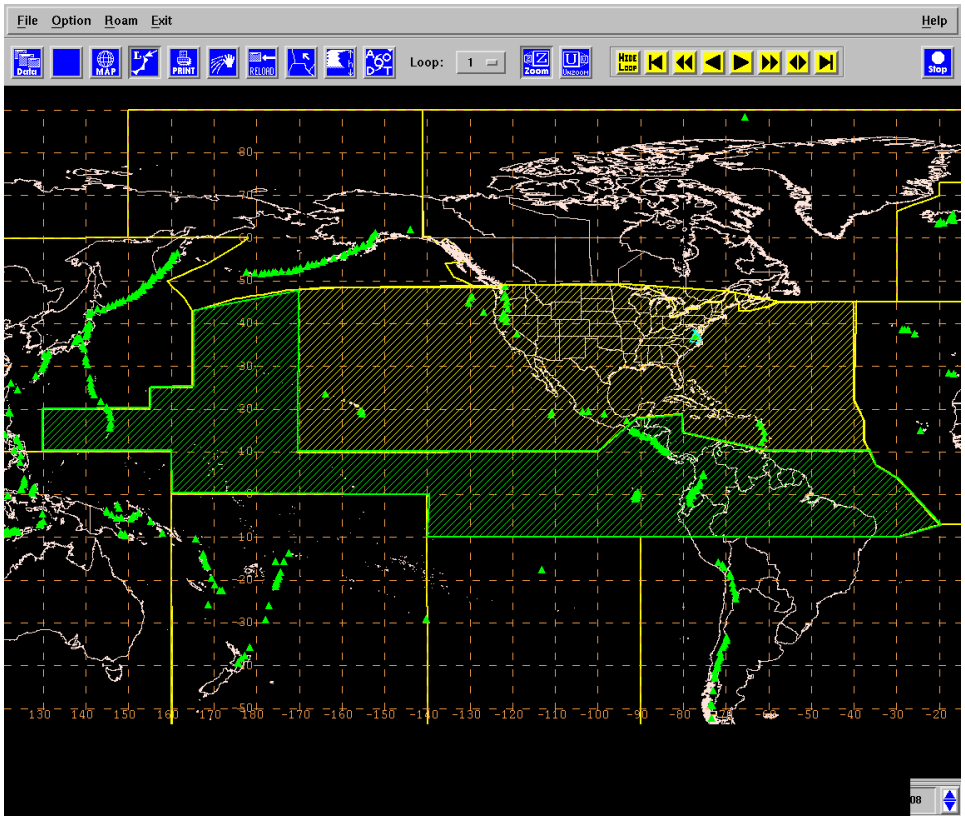


***Figure 6**. The VAAC Washington area split between VAAC Montreal and VAAC Darwin for back-up support.*

## 4.5. VAAC Back-up testing

4.5.1. After recent changes at the ICAO METP WG-MOG, there will be a minor update to the VAAC back-up headers. The meeting decided:

> *That VAACS, when acting in a back-up capacity to another VAAC:*
>
> *Shall use the same product and location ID in the bulletin header as used by the VAAC they are backing up (with header number ii as appropriate), and*
>
> *Shall add a comment in the remarks section of the VAA when providing back-up to notify users in the form of "Issued by VAAC nnnnn on behalf of VAAC nnnnn"*

4.5.2. These changes will make sure the back-up procedures are consistent between all VAACs and that end users know which VAAC has issued the product.

4.5.3. The VAACs are required to conduct back-up tests at least once a year. The back-up procedures had to be changed with VAAC Wellington. A back-up test was conducted on 18th December 2020 to test out those changes.

4.5.4. VAAC Darwin and VAAC Tokyo are reviewing and updating their operational back-up procedures before the next back-up test.

### 4.6. IWXXM

4.6.1. VAAC Darwin is producing Volcanic Ash Advisories (VAA) in IWXXM format using schema version 3.0. Further testing for minor bugs will be done early 2021.

### 4.7. Dispersion Ensemble Prediction System (DEPS)

4.7.1. The Australian Bureau of Meteorology transitioned its new dispersion model software which will give VAAC Darwin access to probabilistic forecasts for volcanic ash to help with more accurate forecasts in its advisories. The previous dispersion model capability was deterministic which provided a single output forecast for a volcanic eruption. The model could be run multiple times but didn't take into account the atmospheric uncertainties as well as the eruption uncertainties.

4.7.2. The new system DEPS provides a probabilistic output which takes 18 current Numerical Weather Prediction (NWP) models and the previous 18 NWP models to create a lagged ensemble of 36 members. The output shows a probabilistic view of how many of the ensemble members suggest there is in any volcanic ash in a section of air space. Having an ensemble approach accounts for more of the uncertainties associated with the dispersion model process so it highlights that uncertainty in the output. This allows the VAAC forecaster to process the data and incorporate it into their advisories. It also puts VAAC Darwin in a good position to provide input into the international work by METP WG-MISD that is happening around quantitative volcanic ash and the future of volcanic ash services.

## 5. VAAC COLLARBORATION

### 5.1. Volcanic ash evidence checklist

5.1.1. VAAC Darwin has been working on a volcanic ash evidence checklist to support VAAC operations for when to issue an advisory. Each VAAC issues a volcanic ash advisory when they have sufficient evidence that an eruption is imminent or underway. The evidence checklist is a way to visualise the information which will provide faster decisions and more timely advisories.

### 5.2. VAAC Wellington

5.2.1. VAAC Darwin and VAAC Wellington collaboration has been a major focus for the two VAACs to look at consistency and harmonisation of services. The VAACs have been considering coordination, quality, consistency, flexibility, and resilience. There are forecasters organising a number of activities which include looking into current capabilities

and comparing ash dispersion models, looking into ways to incorporate daily collaboration activities, comparison of advisory and forecast creation, and an updated evidence checklist to be useful for other VAACs.

5.2.2. We are having forecasters take on these responsibilities to further build up relationships between the two VAACs and to provide professional development for staff. We continue to work closely to organise, participate and review volcanic ash exercises to test out procedures and coordination.

5.2.3. VAAC Darwin and VAAC Wellington conducted a volcanic ash exercise to support Solomon Islands with Air Navigation deficiency (AP-MET-23). The Solomon Islands FIR 'Honiara' is split between both VAACs so a volcano from each VAAC area of responsibility was used for the exercise (figure 7). Both VAACs will continue to support Solomon Islands with follow up training and discussions about volcanic ash advisories and volcanic ash SIGMETs, offline tests for creating ICAO compliant SIGMETs and other standalone volcanic ash exercise.

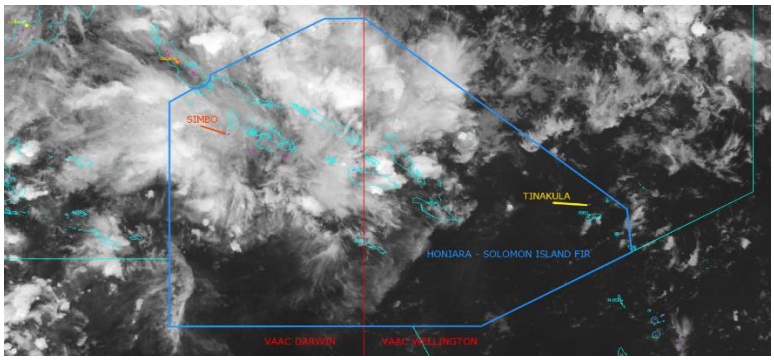


***Figure 7****. Map of the Honiara FIR, VAAC Darwin and VAAC Wellington Area of responsibility boundaries and Simbo and Tinakula volcanoes*

### 5.3. VAAC Tokyo Collaboration

5.3.1. VAAC Darwin and VAAC Tokyo are collaborating on a number of tasks to improve operational services and consistency between both centres. VAAC Tokyo have developed the JMA SIGMET Collaboration tool which will be expanded to include VAAC collaboration. The VAACs are looking to revise their back-up arrangements to continue future back-up tests.

5.3.2. Both VAACs are looking to incorporate the collaboration tool into back-up procedures as an easier way to communicate. We will begin trialling the collaboration tool for use with sharing forecast and dispersion runs for fictitious volcanic activity and real activity.

## 6. INTERNATIONAL STAKEHOLDER ENGAGEMENT

## 6.1. VAAC BP/VASAG

6.1.1. The combined VAAC Best Practice and VASAG was not held in 2020 but will be held in 2021. The group is looking at the information exchange for operational volcanic ash practices, which includes monitoring and forecasting, technology, back-up services, new developments and ICAO compliance. There are a number of key actions that came out of the meeting which involve all VAACs or specifically VAAC Darwin:

- WMO are reviewing top- and/or second level competencies for VAAC forecasters and VAAC Darwin will be heavily involved in the updates for consistent VAAC competencies.
- All VAACs are contributing to the International Volcanic Ash Workshop being organised by the VASAG and committee.
- The VASAG is preparing for the eighth International Workshop on Volcanic Ash (IWVA) that was scheduled to be held in October in Reykjavik, Iceland 2020. The last workshop was held in 2015. The workshop is a chance for operational and scientific groups to talk about volcanic ash and the future. Next steps – to prepare agenda and finalise the concept note for the workshop. Due to COVID and restriction on international travel by many countries, the group has decided to postpone the workshop to a tentative date of October 2022.
- Further VOLCAT development and dashboard for all automated alerts.
- All VAACs use evidence from different sources, but when do forecasters have enough information to issue a volcanic ash advisory? The group is looking at graphical representation of this information as a flow chart or pyramid of information to help forecasters make decisions. This will improve consistency between operations for each VAA.
- The VASAG finalised the $SO_2$ recommendations based on guidance from World Health Organization on the level of exposure to $SO_2$ for different scenarios to pass back to the WG-MISD-VASD.
- The group is looking at quantitatively based volcanic ash information services.
- WMO is looking at merging the VAAC BP and VASAG into one group.

## 6.2. ICAO Meteorological Panel Working Groups

6.2.1. The WG-MOG and WG-MISD meetings are expected to be held virtually in 2021 after the last meeting in 2019.

6.2.2. The WG-MOG is responsible for operational oversight in the global system for volcanic ash, namely the International Airways Volcano Watch (IAVW). The IAVW work stream is working on the Concept of Operations to identify user needs, determining shortfalls, refining concept of operations, and defining functional and performance

requirements for new information related to volcanic ash. The key action items for the WG-MOG include:

- Timeliness and accuracy key performance indicators to look at VAAC consistency, compliance and forecasts.
- Status of Volcano Observatory Notice for Aviation (VONA) and aviation colour codes.
- Progression towards quantitative volcanic ash information services as product or data.
- Looking towards the future with the roadmap for the Concept of Operations and IAVW.

6.2.3. The Volcanic Ash and Sulphur Dioxide (VASD) work stream of the WG-MISD is looking at the requirements of $SO_2$ reporting and the future of volcanic ash products including concentration charts and graphics. The MISD is looking at $SO_2$ for the provision of a new service based on user requirements and input from world health organisation with an ad-hoc group tasked with developing a provisional first look at a potential capability. The potential capability will be presented at the next MOG meeting in 2021.

6.2.4. The VASD has gathered requirements and developing the initial operating capability for a probabilistic quantitative volcanic ash service as well as updates for Annex 3 to incorporate the new service. The group is planning to provide draft provisions to Annex 3 and PANS-MET to the next METP meeting. The timeframe for quantitative volcanic ash is aiming for 2023 and 2026. All nine VAACs are heavily involved in developing these capabilities.

### 6.3. VOLCEX Steering Group

6.3.1. The VOLCEX steering group conducts volcanic ash exercises in the Asia Pacific region to maintain safety, regularity and efficiency of aviation during the event of a volcanic eruption.

6.3.2. VOLCEX 20/02 was conducted in South-west Pacific/Tonga by New Zealand. The exercise is planned to affect multiple FIRs that don't experience a lot of volcanic ash. The exercises included participation from VAACs Darwin, Washington and Wellington. The primary VAAC issuing products was VAAC Wellington. As a first in APAC VOLCEX, there was a VAAC back-up test conducted during the exercise. VAAC Darwin provided back-up to VAAC Wellington to provide users with an added layer to the exercise. The outcomes will be provided in the VOLCEX 20/02 report at the next VOLCEX-SG/7.

### 6.4. State Volcano Observatory engagement

6.4.1. Due to COVID, the State Volcano Observatory (SVO) engagement has slowed down since States have been responding to the pandemic. There has been outreach to States that have APAC Met deficiencies to see where the VAAC can provide support especially to deficiencies around volcanic ash services. VAAC Darwin will be supporting RVO with its

current work to provide volcanic activity information and remove its deficiency. VAAC Darwin has also supported MWO Solomon Islands to remove some air navigation deficiencies and continues to support them for issuing volcanic ash SIGMETs.

6.4.2. With the elevation of the VONA by the ICAO WG-MOG IAVW, there will be follow on education for SVOs and customers. The SVOs in each region were consulted about the changes to the VONA and provided feedback to the WG-MOG IAVW. Once the changes have been approved by the METP and are incorporated into Annex 3, the VAACs will need to help with education around the changes and continue the discussion with SVOs.