



**MET PANEL (METP)
MET OPERATIONS GROUP (MOG)
VOLCANIC ASH (VA)**

SECOND MEETING

Buenos Aires, Argentina, 27 to 28 April 2016

Agenda Item 4 : Activities 3.3, 3.4 and 3.16

Volcanic Ash Confidence Assessment

(Presented by Australia)

SUMMARY

This paper provides an update on Activities 3.3, 3.4 and 3.16.

1. INTRODUCTION

1.1 At the 7th meeting of the International Airways Volcano Watch Operations Group (IAVWOPSG/7), 18 to 22 March 2013, Bangkok, discussions were held around ways in which confidence in the position of volcanic ash could be expressed.

1.2 In order to progress this work, Conclusions 7/19 and 7/20 were formulated:

7/19 That an ad-hoc working group consisting of members from all the VAAC Provider States, with Canada as Rapporteur, and WMO be tasked to:

- a) define the details concerning the inclusion of confidence in VAA/VAG and possible roll-out strategies to support implementation;
- b) decide where information and guidance material for VAACs and users will be made available; and
- c) provide the final material to the Secretary by October 2013 for inclusion in appropriate ICAO manuals (Doc 9691 and/or Doc 9766) and posting on the IAVWOPSG website, if necessary.

7/20 That an ad-hoc working group consisting of members from all the VAAC Provider States, with Australia as Rapporteur, IATA and WMO, be tasked to:

- a) determine the scientific limitations for assigning confidence to volcanic ash analysis and forecasts;
- b) determine an appropriate product(s) based on the outcomes of
- a) that will help inform users safety risk assessments; and
- c) report progress to the IAVWOPSG/8 meeting

1.3 At the 8th meeting of the International Airways Volcano Watch Operations Group (IAVWOPSG/7), 17 to 20 February 2014, Melbourne), progress against conclusions 7/19 and 7/20 was reviewed and the Meeting agreed that conclusions 7/19 and 7/20 would remain active; additionally, the group agreed to conclusion 8/19.

8/19 That all VAAC Provider States, with New Zealand (VAAC Wellington) as Rapporteur, in coordination with IATA and IFALPA, be invited to:

- a) undertake a collaborative operational trial of the provision of confidence information in the remarks section of VA advisories, and
- b) report progress and experience to the IAVWOPSG/9 Meeting

Note.— It is expected that the confidence information will reflect the principles of best practices as presented by VAAC Darwin at IAVWOPSG/8.

1.4 The meeting will also recall the following definitions agreed to by the IAVWOPSG/8 meeting:

High confidence - Strong observational evidence of volcanic ash and high confidence in model(s) prediction resulting in low forecast uncertainty

Low confidence - Weak observational evidence of volcanic ash and/or low confidence in model(s) prediction resulting in high forecast uncertainty

1.5 Given the dissolution of the IAVWOPSG since that time, this topic is now pursued within the framework of the Meteorology Operations Group.

2. DISCUSSION

2.1 The subject of expressing forecast confidence in volcanic ash advisories has been a recurring theme of the VAAC Best Practices discussions in February 2012 (Montreal), June 2012 (Montreal), February 2014 (Melbourne), June 2015 (London) and November 2015 (Anchorage).

2.2 At the Anchorage 2015 meeting, consensus was reached amongst VAAC managers and VAAC representatives on the following outcomes:

2.2.1 Confidence level of high or low for T+ 00 hour will be included in the remarks section of the VAA and VAG.

2.2.2 Two possible statement examples were offered:

CONFIDENCE FOR T0 IS HIGH (or LOW)

CONFIDENCE IN OBS VA PSN IS HIGH (or LOW)

2.2.3 The confidence statement may also include the reasoning behind the confidence level assignment, at the discretion of the VAAC forecaster, e.g. VA clearly apparent in satellite imagery.

2.3 A survey of VAA issued in the period Jan 2016 – April 2016 indicates the following status regarding the provision of confidence information in the remarks section:

Status	VAAC
Consistently including confidence assessment in VAA	Montreal, Toulouse
Occasionally including confidence assessment in VAA	Darwin
Not yet including confidence assessment in VAA	Tokyo, Washington, Anchorage, Wellington, Buenos Aires
Insufficient data to assess	London

2.4 In response to demand from aircraft operators and regulators, several VAACs and Meteorological Watch Offices (MWOs) have begun, or are preparing, to issue volcanic ash risk assessment support products to supplement the information contained within the VAA/VAG.

2.5 **Attachment 1** includes an example pre-advisory evidence product generated by VAAC Darwin and scheduled for routine external dissemination commencing June 2016.

2.6 **Attachment 2** includes an example post-advisory forecast verification product generated by VAAC Darwin and scheduled for routine external dissemination commencing July 2016.

2.7 **Attachment 3** includes an example post-advisory confidence assessment product generated by VAAC Darwin and scheduled for routine external dissemination commencing June 2016.

2.8 **Attachment 4** includes an example annotated satellite product generated by the UK Met Office.

2.9 **Attachment 5** includes an example annotated satellite product generated by the Indonesian Agency for Meteorological, Climatological and Geophysics (BMKG) and routinely disseminated during Indonesian volcanic ash events.

2.10 The proliferation of risk assessment support products, including confidence assessments and strength of evidence assessments, is encouraging; however, there is considerable potential for new unregulated products to confuse decision makers if adequate training is not provided. Furthermore, the availability of more visually appealing guidance from sources other than VAACs is likely to result in contradictory volcanic ash assessments and/or a reduced role for the VAA and VAG in the volcanic ash risk assessment process.

2.11 Decision makers within the aviation industry have clearly demonstrated a requirement for information beyond what is able to be conveyed by the VAA and VAG products. In order for VAACs to maintain relevance there is an urgent need for VAAC provider states to work in a coordinated fashion to satisfy user requirements with regards to the volcanic ash risk assessment process.

3. CONCLUSION

3.1 In view of the foregoing, the group is invited to discuss the provision of volcanic ash confidence information and decide whether or not work on conclusions 7/19, 7/20 and 8/19 should still be pursued and reported back to the next meeting of the MOG.

4. ACTION BY THE MEETING

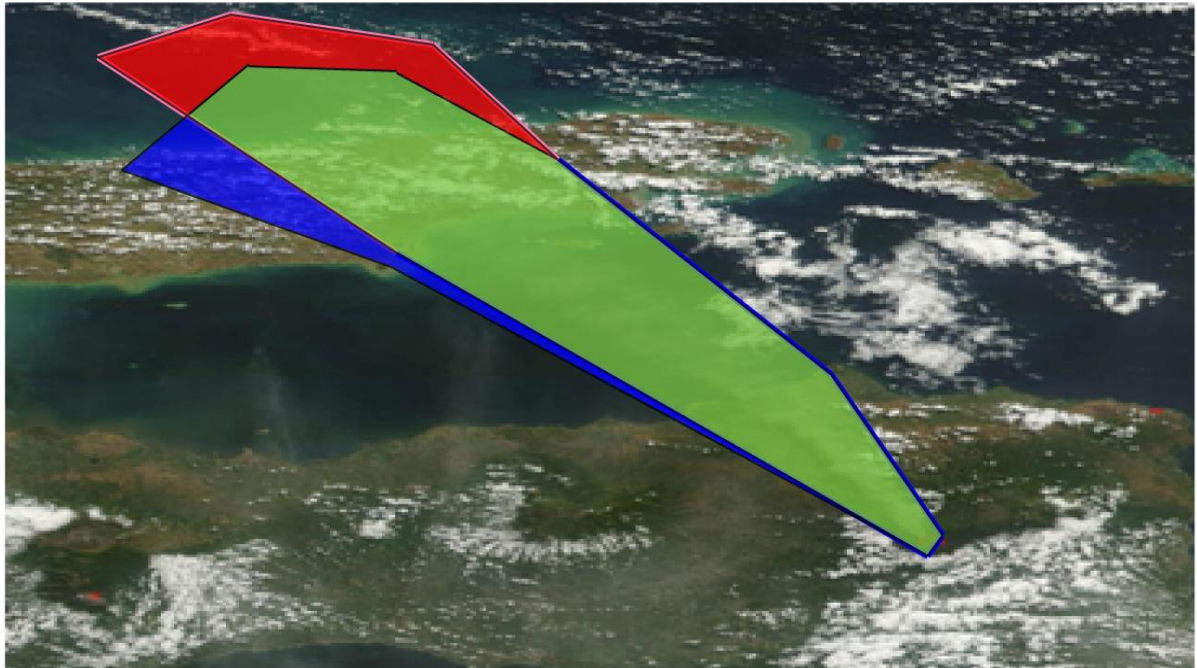
4.1 The meeting is invited to:

- a) note the information contained in this Study Note; and
- b) agree whether or not conclusions 7/19, 7/20 and 8/19 remain valid.

ATTACHMENT 1: Example Evidence Checklist

Evidence Quality	Volcano <input type="text" value="Ulawun"/>	
Remote Sensing Evidence		
Weak	Anomalously rapid cloud development above a known volcano	<input type="checkbox"/>
Weak	Convective development, that is asynchronous with the regional convective cycle, above a known volcano	<input type="checkbox"/>
Moderate	Stationary, persistent (>1 hr) overshooting cloud top embedded within meteorological cloud above a known volcano	<input type="checkbox"/>
Moderate	Hot spot at a known volcano	<input type="checkbox"/>
Moderate	Anomalous lightning activity above a known volcano	<input type="checkbox"/>
Weak	Low altitude SO2 signal with a back trajectory intersecting a known volcano	<input type="checkbox"/>
Moderate	High altitude SO2 signal with a back trajectory intersecting a known volcano	<input type="checkbox"/>
Strong	Grey or brown discolored clouds in true color imagery emanating from a known volcano	<input type="checkbox"/>
Strong	Cloud with a significant reverse absorption signal emanating from a known volcano	<input type="checkbox"/>
Strong	Anomalous linear or wedge shaped cloud emanating from a known volcano	<input type="checkbox"/>
Strong	Convective cloud like development in a stable air-mass above a known volcano	<input type="checkbox"/>
Airborne Evidence		
Weak	Pilot report of a sulfurous smell from a location downwind of a known volcano	<input type="checkbox"/>
Weak	Pilot report of visible ash from a location downwind of a known volcano	<input type="checkbox"/>
Moderate	Pilot report of a volcanic eruption from a known volcano	<input type="checkbox"/>
Strong	Pilot report of identified volcanic ash airframe impacts	<input type="checkbox"/>
Ground Based Evidence		
Strong	Web-cam image of a buoyant non-white volcanic plume emanating from a known volcano	<input type="checkbox"/>
Strong	State Volcano Observatory report of an ash generating eruption	<input type="checkbox"/>
Weak	ASHTAM/NOTAM/SIGMET indicating an eruption at a known volcano	<input type="checkbox"/>
Weak	Unofficial media report of an eruption from a known volcano	<input type="checkbox"/>
Moderate	Official media report of an eruption from a known volcano	<input type="checkbox"/>
Weak	Geophysical report indicating volcanic activity at a known volcano	<input type="checkbox"/>
Moderate	Ground lidar observation of a significant aerosol cloud emanating from a known volcano	<input type="checkbox"/>
Moderate	Ground radar observation of a plume emanating from a known volcano	<input type="checkbox"/>
Conceptual Evidence		
Weak	Volcano is currently on ACC Orange	<input type="checkbox"/>
Moderate	Volcano is currently on ACC Red	<input type="checkbox"/>
Strong	SVO advice that an eruption from the volcano is immanent	<input type="checkbox"/>
Strength of Evidence <input type="text" value=""/> <input type="button" value="↕"/>		
Sufficient	The balance of evidence suggests that an ash producing eruption has occurred	
Insufficient	Insufficient evidence to suggest that an ash producing eruption has occurred	

ATTACHMENT 2: Example Verification Product



Volcano: Raung **Issued:** 0300Z 31/07/2015 **VAAC:** Darwin



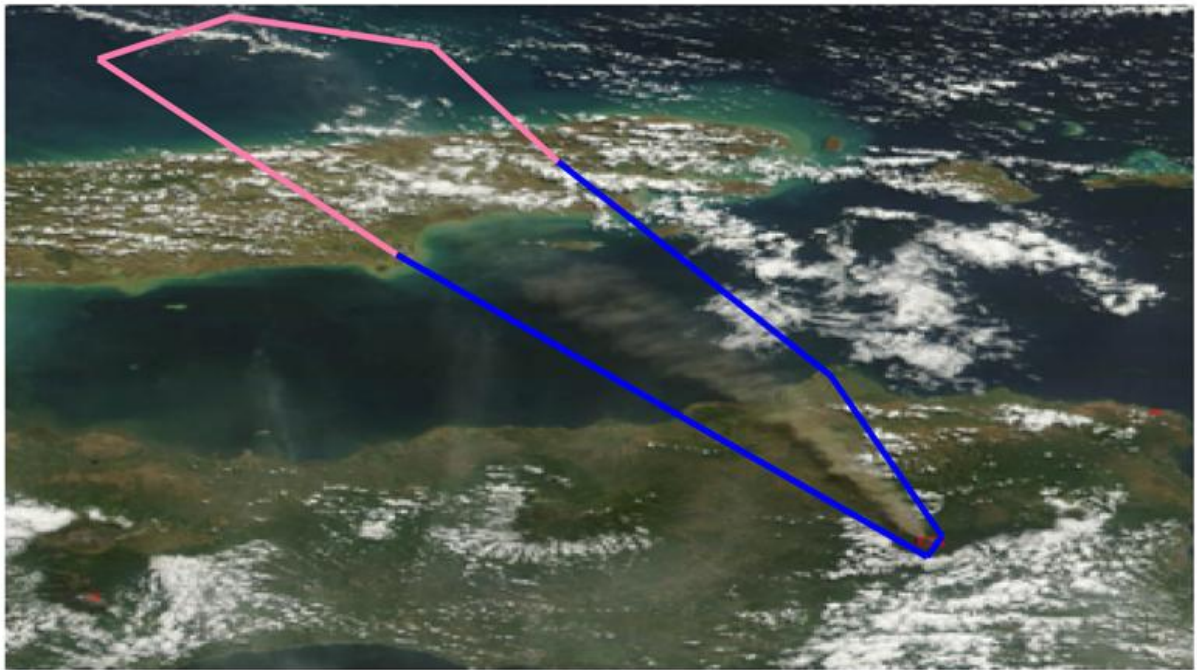
Ash observed but
not previously forecast



Ash observed and
previously forecast



Ash previously forecast
but not observed



Volcano: Raung **Issued:** 0300Z 31/07/2015 **VAAC:** Darwin Low Confidence High Confidence

Notes:

A sustained, low intensity eruption is continuing at the volcano Raung. Ash is continuing to be erupted to a maximum height of 17 000 ft and prevailing winds are expected to remain southeasterly for the next 24 hours. The ash boundary is clearly discernible in visible imagery extending to 45 nm northwest; however uncertainty increases beyond 45 nm as the plume becomes more diffuse. Ash is not currently discernible beyond 60 nm from the volcano.



1530 UTC 12 April 2016 Annotated Satellite Image

Issued 1530 UTC on 12 April 2016 - EXERCISE EXERCISE EXERCISE

EEEN41 MSG Dust RGB 12/04/2016 1500 UTC

EXERCISE VOLCICE

HIGH CONFIDENCE-

IMO Radar and ground ob confirms
initial plume height FL460 (14km)

LOW CONFIDENCE-

PIREP near FL300 reporting ash but
not discernible on current imagery
and wind directions do not support
ash transport in this direction

HIGH CONFIDENCE-

VA visible in RGB imagery.

EXERCISE EXERCISE EXERCISE EXERCISE

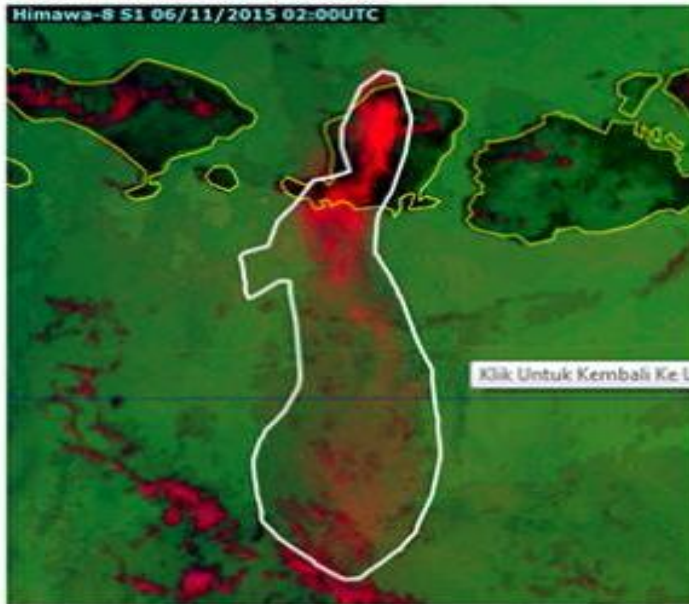
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ATTACHMENT 5: Example Annotated Satellite Product



Gambar 1. RGB Citra Satelit Cuaca Himawari BMKG Gn. Rinjani 06 November 2015 Pkl. 09.00 WIB

Himawa-8 S1 06/11/2015 02:00UTC



Pergerakan Debu
Vulkanik:
Selatan

Klik Untuk Kembali Ke Ukuran Kecil.

