Volcanoes and Aviation - Detection, Prediction and Expectation

Ian Lisk, Met Office
WMO Commission for Aeronautical Meteorology vice-president
1. Agreed ICAO IAVWOPSG-7 Outcomes

2. (To be) Agreed ‘discernible ash’ techniques…

3. European VAAC Collaboration

4. WEZARD EUVONET

5. International service delivery processes
‘Visible Ash’

...volcanic ash observed by the human eye

Encompasses a range of detection thresholds depending on:

- Day or night
- Eyesight and state of awareness of the observer
- Angle of the sun
- Orientation of the observer to the ash layer (above, within, underneath, side on)
- Thickness of the ash layer
- Other atmospheric contaminants e.g. haze, dust, water vapour
- Granularity of ash.
‘Discernible ash’

volcanic ash detected by: defined impacts on/in aircraft; or by agreed in-situ and/or remote sensing techniques

The VAACs will base their forecasts on the ‘…agreed in-situ and/or remote sensing techniques’ noting that:

• Satellite ash detection threshold is 0.2 mgm$^{-3}$ (+/- 0.15)

• Quantitative (particle size, mass column loading) estimates can be derived from multi-spectral satellite data available on MSG-SEVIRI and on some polar orbiting platforms

• Quantitative in-situ measurements (aircraft)

• Ceilometer and lidar ash detection thresholds are understood to be ≤0.03 mgm$^{-3}$

• Quantitative (particle size, ash concentration) estimates can be derived from multi-spectral lidar – sun photometer data
Other IAVWOPSG-7 Recommendations

- QMS implementation
- VAAC Forecaster competency Standards
- State Volcano Observatory capacity development
- VAAC responsibilities (obs, modelling, AIREPs, areas, harmonisation)
- Confidence levels and SRA products
- No agreement on S02 requirements
- Nuclear and Space Weather requirements

APPENDIX E

RECOMMENDATIONS FOR AIRCRAFT INSTRUMENTATION FOR CONDUCTING VOLCANIC ASH CLOUD SAMPLING

(Extracted from Appendix C of the Report of IVATF/4)

3.5 Volcanic ash advisory centres

3.5.1 A Contracting State, having accepted, by regional air navigation agreement, the responsibility for providing a VAAC within the framework of the international airways volcano watch, shall arrange for that centre to respond to a notification that a volcano has erupted, or is expected to erupt, or volcanic ash is reported in its area of responsibility, by arranging for that centre to:

a) monitor relevant geostationary and polar-orbiting satellite data and, where available, relevant ground-based and airborne data, to detect the existence and extent of volcanic ash in the atmosphere in the area concerned;

Note.— Relevant ground-based and airborne data includes data derived from Doppler weather radar, ceilometers, lidar and passive infrared sensors.
2. (To be) Agreed ‘discernible ash’ techniques ideas...

- IUGG/WMO Volcanic Ash Scientific Advisory Group (VASAG) led...

‘Low contamination’ ash envelope:
Model ash column loading output (0.2 $gm^{-2}$ as proxy for 0.2 $mgm^{-3}$) verified, validated and amended against sources of qualitative in-situ and remote sensing information & PIREPS (evidence of visible ash only)

‘Medium contamination’ ash envelope (SRA products only):
Model ash column loading output (2 $gm^{-2}$ as proxy for 2 $mgm^{-3}$) verified, validated and amended against available quantitative in-situ and remote sensing data & PIREPS (qualitative evidence of visible ash or impact as described in Doc 9974)

‘High contamination’ ash envelope (SRA products only):
Qualitative assessment of the contiguous eruptive plume and; model ash column loading output (4 $gm^{-2}$ as proxy for 4 $mgm^{-3}$) verified, validated and amended against available quantitative in-situ and remote sensing data & PIREPS (qualitative evidence of visible ash or impact as described in Doc 9974)
3. European VAAC Collaboration

- Meteo-France and Met Office workshops
- Ash mass column-based low, medium & high contamination contour lines
- Best practice use of NRT observations as available
- Low contamination envelope identical to VAG ‘VA’ envelope
- Risk-based proxy for mass concentrations
- Modelling, satellite and lidar science collaboration & coordination

Comment: No VA above FL350
4. EUVONET

VA Observing Technologies
- Satellite-based Instruments
- Airborne: Research and In-Service Aircraft probes; UAS; Aerosol Sonde
- Ground-based: Lidars; Ceilometers; Radar etc.

VA Data Policies
- Quality
- Storage & Archiving
- Access and Dissemination

Related Projects and Initiatives
- e.g. FUTUREVOLC, EPROFILE, METROLOGY

WEZARD Recommendations

EUVONET main work phases
- R&D to fill specific technological and geographical gaps in volcanic ash observations and applications.
- Development of “integrated” system: utilising technology synergies; data quality and requirements, storage and archiving, NRT access.
- Exercises and Pilot, involving end-user communities. Roadmap for future applications, operationalisation and links to other systems e.g. SESAR

EUVONET: Pre-Operational European Volcanic Ash Observing Network
5. International volcanic Ash service delivery process

FUNDING

<table>
<thead>
<tr>
<th>USERS/DECISION MAKERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agreed priorities &amp; accountabilities</td>
</tr>
<tr>
<td>Action &amp; educate</td>
</tr>
<tr>
<td>Evaluate, sustain and improve</td>
</tr>
</tbody>
</table>

AUTHORITATIVE VOICE

OBSERVATIONS

SCIENCE

Politics

Economics

Opportunism

Topicality

History

Media

Thank you….

ian.lisk@metoffice.gov.uk