METEOROLOGY PANEL

Concept of Operations for Volcanic Hazard Information for International Air Navigation in Support of the Global Air Navigation Plan and the Aviation System Block Upgrades

12 November 2018

Version 3.0

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0.1	15 April 2011	Internal draft. New Document.
0.2	06 May 2011	Initial draft. Presented to IAVW coordination group of IVATF.
0.3	13 July 2011	Initial draft. Presented to IVATF/2 (Working Paper 04).
0.4	08 February 2012	Revised draft. Complete rewrite based on comments received on initial draft.
0.4.1	10 February 2012	Minor revision. Minor edits. Presented to IAVW coordination group at IVATF/3.
1.0	14 December 2012	Draft version for IAVWOPSG/7. Format and structure changed to harmonize with other ConOps being developed. Considered and/or incorporated comments received in response to IAVWOPSG Memorandum 56.
1.1	12 November 2015	Based in part on the *Roadmap for International Airways Volcano Watch (IAVW) in Support of International Air Navigation*, 21 November 2013, version 1.0, ICAO Doc 10045 *Meteorology (MET) Divisional Meeting (2014)*, Appendix C. New format and structure changed.
1.2	11 December 2015	Minor revision based on comments received at MISD/VA/1.
2.0	29 April 2016	Complete revision.
2.1	8 August 2016	Minor revision per METP MISD Rapporteur. Included the phrase “Need for information” to the titles of sections 2.4 and 2.5. Added the word “thresholds” twice in section 5.3 for the short-term forecasts.
3.0	12 November 2018	Revisions to align with the 5th Edition of the GANP. Other revisions in response to the review and input of the METP WG-MOG IAVW Work Stream.

Table of Contents

1.0 Introduction.

This Concept of Operations (ConOps) document describes the **need for** and **use of** volcanic hazards information for operational decisions, in qualitative and quantitative terms, from the perspective of the end user and relevant to an operator's Safety Management System (SMS). This ConOps is not intended to describe **how** future volcanic hazard information is to be provided or by **whom** the future information is to be provided.

This ConOps supports the latest version of the - the *Roadmap for International Airways Volcano Watch (IAVW) in Support of International Air Navigation.* This ConOps is a living document that is intended to evolve as operational requirements evolves.

1.1 Information Identification

This ConOps presents the future use of volcanic hazard information for international air navigation in support of International Civil Aviation Organization (ICAO) Global Air Navigation Plan (GANP) and associated Aviation System Block Upgrades (ASBU). Specifically addressed are ASBU Blocks 1 and 2, in their respective timeframes of 2019-2024 and 2025-2030.

Performance Improvement Area 2 from the GANP calls for, inter alia, *enhanced operational decisions through integrated meteorological information*, with *meteorological information supporting automated decision processes or aids involving: meteorological information, meteorological translation, air traffic management (ATM) impact conversion and ATM decision-making support.*[1] This ConOps describes how improved information on the hazards from volcanoes will help meet the need called for in the GANP.

1.2 Information Overview

An aviation user must know if a hazard will affect their operation, and if so, what actions to take in order to mitigate the risk in accordance with SMS practices or procedures agreed to in any Contingency Plan.

A provider of aviation hazard information needs to determine if a hazard exists, or is expected to exist, in their area of responsibility. The provider compiles information about the hazard into format(s) that can be used by the aviation user. The provider makes available information about the hazard for users to access to mitigate the risk.

The hazard may vary depending on the user. For volcanoes, the hazards to aviation include:

- Volcano expected to erupt
- Erupting volcano
- Volcanic ash (either from an erupting volcano or resuspended from a previous/ancient eruption):
    - in the atmosphere, that is visible from an aircraft including discernible from remote sensing or *in-situ* observations
    - in the atmosphere greater than a specified threshold
    - on the runway/taxiway greater than a specified depth
- Sulphur dioxide (SO_2) and other hazardous gases greater than a specified threshold

[1] *Global Air Navigation Plan 2016-2030,* ICAO Doc 9750, Fifth Edition 2016

Note: Specified thresholds can vary depending on the user. For example, for ash and SO_2 it can be as simple as discernible from satellite, or it could be a defined metric, such as 2 milligrams per cubic meter, or some other value (per a user's SMS).

Depending on the user, quantitative and qualitative information on the hazard will vary. A user may not need to know every detail regarding the hazard, only the information pertaining to their operation. For example, a flight crew's need for detail and accuracy will be high for that portion of the hazard expected to affect the flight route including any revised routes due to critical engine out and depressurization.

Information overload can occur for the user if too much information is provided that is not relevant to the hazard affecting their operation. To avoid information overload, users must be able to obtain the appropriate information in a timely manner in order to successfully complete their evidence-based risk assessment and operate efficiently. If information from multiple sources is received, it is critical that what is provided is consistent and not conflicting.

1.3 References

The following documents are referenced in this ConOps

- ICAO Annex 3 - *Meteorological Service for International Air Navigation*
- ICAO Annex 15 – *Aeronautical Information Services*
- *Global Air Navigation Plan 2016-2030,* ICAO Doc 9750, Fifth Edition 2016, including:
    - *Aviation System Block Upgrades*, Appendix 2
- *Handbook on the International Airways Volcano Watch*, ICAO Doc 9766
- *Flight Safety and Volcanic Ash,* ICAO Doc 9974
- *Procedures for Air Navigation Services - Air Traffic Management,* ICAO Doc 4444
- *Roadmap for International Airways Volcano Watch (IAVW) in Support of International Air Navigation*, Version 3.0 (11 Dec 2017)

2.0 User Need Identification

Large volcanic events can impact multiple users over a wide geographic area. In addition, the collaborative nature of some aviation-decisions, in which multiple users in multiple Flight Information Regions (FIR) have input into decision-making, requires all of the users to have access to harmonized and consistent information on volcanic hazards. This information must be in a format that is usable by multiple aviation decision-makers, including decision support systems.

2.1 Operators

Operators are entities engaged in the conduct of domestic and international flights. Operators are responsible for the safe and efficient conduct of flight operations and a principal user of volcanic hazard information.

Typically, operators have two distinct functions: flight planning and flight operation. In larger operators, these are usually separate roles performed by different individuals. Smaller operators may combine these roles and require flight crew members to fulfill flight planning and flight operation functions.

2.1.1 Flight operations centres, dispatchers, and flight planners

Flight operations centres (FOCs), dispatchers, and flight planners are generally responsible for flight planning (e.g., route selection, required fuel). In some instances, these roles may also be responsible for en route deviations.

FOCs, dispatchers, and flight planners use volcano activity and ash cloud information to plan routes that allow flights to avoid or fly through airspace in which the risk of encountering ash is within the limits of the operator's SMS. The planned routes dictate the amount of fuel required to complete the flight to the intended destination.

To achieve maximum utility, this information needs to be available to FOCs, flight planners, and dispatchers in a format that can be ingested by decision support systems.

2.1.2 Flight crew members

Flight crew members, typically pilots, are responsible for safely conducting flight operations. For smaller operators, flight crew members may also fulfill the flight planning responsibilities.

Flight crew members use updated volcanic activity/ash information to make decisions regarding en route course changes and deviations. These decisions are based on both observations (reports of an eruption and the ash in the atmosphere) and forecasts of airspace likely to be affected by the eruption and/or ash cloud.

2.2 Air Traffic Service

Air Traffic Service (ATS) is a generic term referring to flight information service, alerting service, air traffic advisory service, and air traffic control service (area control service, approach control service, or aerodrome control service). The two components of ATS that most require volcanic event information are Air Traffic Management (ATM) and Air Traffic Control Service (ATCS).

2.2.1 Air Traffic Management

ATM, including Air Traffic Flow Management (ATFM), is a service established with the objective of contributing to a safe, orderly, and expeditious flow of air traffic by ensuring that air traffic control capacity is utilized to the maximum extent possible, and that the traffic volume is compatible with the capacities declared by the appropriate ATS authority.

ATM plans the flow of air traffic through airspace based on filed flight plans and known or forecast constraints, particular those caused by weather. ATM also identifies the flight tracks that will be used for trans-oceanic flights.

Enhanced forecasts of the impact of volcanic events on airspace will enable ATM to maximize the flow of aircraft through the airspace. In particular, ATM will use enhanced forecast information to begin planning aircraft flows through previously affected airspace in a timelier manner. Similar to the FOCs, flight planners, and dispatchers, ATM requires the enhanced forecast information in a format that can be ingested by decision support systems.

2.2.2 Air Traffic Control Service

ATCS is a service provided for the purpose of preventing collisions between aircraft and, on the maneuvering area, between aircraft and obstructions. ATCS also expedites and maintains the orderly flow of air traffic.

ATCS requires enhanced forecasts of the impacts of a volcano event to plan for the potential disruptions to air navigation. The enhanced forecast information will be used by ATCS to help manage requests for route deviations and altitude changes from aircraft that may be affected by volcanic eruption and/or ash cloud.

2.3 Civil Aviation Authorities

Civil Aviation Authorities (CAAs) are responsible for maintaining the safe operation of airspace through the promulgation of appropriate regulations, policies, and guidance. In order to ensure the safety of operators and the traveling public, as well as national security, CAA's have the authority to temporarily close airspace to specific types of flight operations or all operations.

Enhanced forecasts of airspace likely to be impacted by a volcanic eruption and/or ash cloud will be used by CAAs to proactively manage the airspace.

2.4 Need for Information on Volcanic Eruption and Ash Cloud

Users need to know the current and future state of a volcanic event, including both location and extent (vertical and horizontal) of an ash cloud. To improve efficiencies in air transportation during volcanic events, high-quality, timely and consistent volcanic hazard information is essential to mitigate the safety risk of aircraft encountering volcanic eruption and/or ash cloud.

The following is a set of high-level operational needs of aviation users:

- Determine the onset of a volcanic event (i.e., pre-eruption activity warning)
- Determine if an eruption and any associated volcanic ash is a hazard to international air navigation based on any agreed-upon quantitative threshold values
- Determine which aerodromes and airspace are impacted by the eruption and associated ash cloud
- Determine when the eruption has ended
- Determine when the volcanic ash cloud has dispersed below agreed-upon quantitative threshold values
- Ensure the information provided is globally consistent

2.5 Need for Information on Volcanic Gases

During volcanic eruptions, several toxic gases may be emitted in addition to ash; these include SO_2, hydrogen fluoride, and hydrogen sulphide amongst many others. Each of these gases has different atmospheric dispersion properties. Gas clouds may be found coincident or separate from ash clouds. Of these gases, SO_2 is of particular importance as it may be emitted in large quantities and potentially has significant health effects and could in time, impact the service life of certain aircraft components. The documented experience to date of in-flight encounters with sulphurous gases suggests that SO_2 has never been a significant immediate safety hazard to an aircraft or health hazard to its occupants.

ICAO's Meteorology Panel has been tasked to determine a clear meteorological/atmospheric chemistry requirement for a critical level of SO_2 in the atmosphere that would be observed (or forecast) that would pose a threat to aircraft systems, or after passing through the aircrafts ventilation system, could pose a health risk to the aircraft's occupants.

3.0 Current Capability Assessment

A detailed description of current service providers and their functions with respect to volcanic ash information can be found in ICAO's *Handbook on the International Airways Volcano Watch*, Doc 9766.

3.1 Volcanic Eruption and Ash Cloud

Currently volcanic ash forecasts are basic textual and graphical products derived and produced using the output from dispersion and transport models validated and amended against available volcanic ash observations. The two primary volcanic ash forecast products are the volcanic ash advisory (VAA) (and its corresponding graphical version [VAG]), and the SIGMET information message[2].

VAAs (and VAGs) are produced and issued by the nine Volcanic Ash Advisory Centers (VAAC), each with a defined geographical area of responsibility. VAACs are operated by an ICAO Contracting State and designated by ICAO regional air navigation agreement. The VAA/VAG provides an analysis of the ash cloud and a 6-, 12- and 18-hour forecast for the location of the ash cloud and associated flight levels that may be affected.

SIGMETs for a volcanic ash cloud are produced and issued by Meteorological Watch Offices (MWO), operated by ICAO Contracting States, based on the guidance provided by a VAAC. They are valid for up to six hours and describe the location and expected location of the ash cloud within the area of responsibility of the MWO, which is normally just one FIR.

Per ICAO Annex 3, SIGMETs are valid for only one FIR, whereas a VAA/VAG is not restricted to FIR boundaries and thus may cover multiple FIRs.

VAA/VAG and SIGMET provide a simple outline of the ash cloud (observed and forecast), which often is an over simplification due to format requirements (limited number of vertices/points). Also, base and top of the ash cloud are a simplification due to the format requirements and uncertainties in the model output. Temporal resolution of information in the VAA/VAG and SIGMET is six-hours, which is very coarse and may limit users' ability to determine the location of the hazard in various time frames (e.g., at two hours after issuance of a VAA/VAG and SIGMET). Per Annex 3 the aerial coverage of a SIGMET is limited to the FIR. Thus, an ash cloud impacting multiple FIRs will have multiple SIGMETs, each one only describing the ash cloud within their FIRs.

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[2] In accordance with ICAO Annex 3 – *Meteorological Service for International Air Navigation.*

3.1.3 Other Products

In addition to the SIGMET and VAA/VAG, other products may be issued for a volcanic eruption and/or ash cloud including Notice to Airman (NOTAM), ASHTAM[3], and Special Air Report (AIREP). NOTAMs and ASHTAMs are issued by State's International NOTAM Offices (NOF) and are described in ICAO Annex 15 – *Aeronautical Information Services*. Special AIREPs are pilot reports and are described in ICAO – Annex 3 - *Meteorological Service for International Air Navigation.*

A Volcano Observatory Notice for Aviation (VONA) is issued by some State volcano observatories on the state of the volcano. The VONA contains a four-level color code for quick reference to indicate the general level of threat of an eruption for a given volcano. The VONA allows the volcanologists to provide a succinct message on the state of volcano to MWO, VAAC, and NOF, which as noted above assists in the issuance of SIGMET, VAA and NOTAM respectively.

Each of these products is unique in format and content, but all (except for the VONA which describes the state of the volcano) provide information regarding the location of the volcanic ash but with varying degrees of quality and accuracy. The challenge is the need for consistency in their overall message.

3.2 Sulphur Dioxide (SO_2)

Of the products discussed in section 3.1 only the Special AIREP may currently be used for reporting the presence of SO_2. Investigations are ongoing with a view to determining a need and feasibility to expand the volcanic hazard information services to include other hazardous elements typically associated with volcanic eruptions, such as toxic gases. During volcanic eruptions, a number of toxic gases may be emitted in addition to ash; these include SO_2, hydrogen fluoride and hydrogen sulphide among many others. Each of these gases will originate in varying amounts, and possibly different heights, in the eruption column and will undergo varying chemical transformations (e.g. sulphur dioxide to sulphate), have different atmospheric dispersion properties. As previously stated gas clouds may or may not be found coincident with ash clouds. Of these gases, SO_2 is of particular importance, since it has potentially significant health effects, operational efficiency impacts on the airframe and avionics, and may be emitted in large quantities.

Compared to information on volcanic ash clouds, little information is currently provided to aviation on the presence of SO_2 in the atmosphere. The following is a list of current responsibilities and information:

- Guidance to pilots on the detection of sulphurous gases is provided in ICAO's *Handbook on the International Airways Volcano Watch,* Doc 9766

[3] An ASHTAM is a special case NOTAM for the status of a volcano as well as volcanic ash in the atmosphere.

- Pilots have the responsibility to report encounters with SO_2 from volcanic activity through the Volcanic Activity Report[4] (VAR), which is part of a Special Air Report (AIREP)
- Currently there are no provisions for SO_2 forecast information in ICAO Annex 3 – *Meteorological Service for International Air Navigation*
- SO_2 can be detected via remote sensing techniques from satellites
    - Information on the extent of SO_2 clouds is available from various national service providers[5]

4.0 Anticipated Change Identification (Shortfall Analysis)

In the future, enhanced forecasts will provide users with local, regional and globally consistent information on the potential impacts to aviation operations from volcanic events. This information will be used by FOCs, flight planners, dispatchers, and ATM to plan the most efficient flight routes and tracks while avoiding the potential impacts from volcanic events. Flight crews and ATCS will use this information to anticipate any likely route and altitude changes, as well as the potential impact on arrival and departure operations at airports.

To achieve this future operational environment, the following enhancements to volcanic event information are necessary:

- Improved forecasts of the potential impacts from a volcanic event to international air navigation.
- Development of forecasts on SO_2 clouds from volcanic eruptions.
- Improved forecasts of when specific areas of airspace will experience the impacts of a volcanic event.
- The use of probability information with decision support systems to assist improve traffic flow and provide improved temporal information
- Increased frequency of observations and forecasts when significant airports are impacted
- Information that is consistent across FIR boundaries.
- From the user perspective, a "single answer" about the impact of the volcanic event along an intended route of flight.
- Information disseminated in a format that is integrated into decision support systems.

5.0 Concept Definition

5.1 Objectives and Scope

The objective of this concept is to describe the information to be provided to improve the safety and efficiency of international air navigation during volcanic events.

[4] Detailed information on the VAR is contained in ICAO's *Procedures for Air Navigation Services - Air Traffic Management,* Doc 4444, Appendix 1.
[5] Such as the Support to Aviation Control Service SO_2 and Ash Notification System by the Belgian Institute for Space Aeronomy, http://sacs.aeronomie.be

Volcanic events can be on a local, regional and multi-regional scale, can impact both short and long-haul flight operations, and on rare occasions have a global impact on aviation users. Information on volcanic hazard information services must be consistent across all these scales. Thus, the scope of the information required to satisfy the needs described in this concept ranges from local to global.

5.2 Potential Benefits of New or Modified Information

The proposals for enhanced volcanic hazard information and services to be developed and implemented will provide users with volcanic hazard information that has greater confidence and utility – for example, probability, short-period and contamination threshold-based forecasts. Moving from a product-centric environment to information services environment will meet the future operational needs of aviation decision-makers. Also, decision support systems can use the probabilistic information to provide route and altitude selections based on user's acceptance thresholds based on their SMS. The integration of volcanic short-term forecasts combined with the use of probabilistic forecasts to address uncertainty, will lead to more effective and informed decision making and planning for air traffic operations.

The application of probabilistic forecasts will benefit high-density (congested) traffic areas the most, where decision makers can benefit from more than just a deterministic forecast. Also, decision support systems can use the probabilistic information to provide route and altitude selections based on user's acceptance thresholds.

5.3 Description of Change in Operational Decision Environment that Produces the Benefits

5.3.1 Improved representation of the volcanic hazard

By the ASBU Block 2 timeframe (2025 – 2030), it is foreseen that a high-resolution three-dimensional representation of the volcanic hazard, as a forecast, could be made available. This information would be made available via the System Wide Information Management (SWIM) system and extracted by the user. Volcanic hazard information providers would update the information at a high frequency, to provide a more realistic assessment of the location and extent of the hazard (e.g., volcanic ash cloud) and be used for tactical decision making by flight crew members and ATCS.

As the volcanic ash moves or changes, representation of the volcanic hazard would be updated at a temporal frequency that meets user needs and service provider capabilities. Improved remote sensing instrumentation and retrieval algorithms, volcano eruption source parameters (ESP) and *in situ* measurements of the airborne volcanic ash will be needed to ensure that the information provided meets the accuracy levels needed by decision-makers.

5.3.2 Use of probability in the provision of volcanic hazard forecasts

Current volcanic ash forecasts, such as the VAA/VAG, are deterministic forecasts. They are a yes/no forecast, with respect to the depiction of the airspace impacted by volcanic ash contamination.

Volcanic ash transport and dispersion models can produce an array of solutions (e.g., forecasts) by varying the model input. Changes in meteorological parameters and ESP will result in different forecast outputs that affect the four-dimensional shape (three-dimensional shape and change of shape with time) of the cloud. The purpose of a probabilistic forecast is to provide decision makers with an assessment of all the likelihoods of a weather parameter's risk of exceeding a defined magnitude/threshold. Probabilistic forecasts help multiple decision makers use the same weather information, applying their own operational constraints to determine risk to their operation.

5.3.3 Integration of volcanic hazard forecasts into decision support systems

One of the key elements in meteorological modules of the ASBUs is the integration of meteorological information into decision support systems. Future ATM decision support systems will need to directly incorporate volcanic hazard forecasts, allowing decision makers to determine the best response to the potential operational effects and minimize the level of traffic restrictions. This integration of volcanic hazard forecasts, combined with the use of probabilistic forecasts to address uncertainty, reduces the likelihood of misinterpretation by the user and thus reduces the effects of volcanic hazards on air traffic operations.

5.4 Operational Scenarios

Three kinds of operational scenarios are presented: 1) avoidance of the volcanic ash cloud, 2) planned flight into an ash cloud that has contamination thresholds below that which is acceptable to an operator's designated aircraft type and meets the operator's SMS, and 3) flight in areas of SO_2 from a volcanic eruption. Other scenarios exist but are not included in this document. The information for these scenarios is in the form of forecasts that are integrated into decision support systems.

5.4.1 Avoidance of the Volcanic Ash Cloud

In the avoidance scenario, high-resolution three-dimensional representation forecasts of the ash cloud provide users with a depiction of the perimeter of the lowest acceptable threshold of ash contamination, in a common exchange format that provides integration into decision making tools, as well as offers a graphical depiction of the information. As the volcanic ash moves or changes, the forecast is updated at a temporal frequency that meets user's needs and service provider's capabilities.

5.4.2 Flight into acceptable thresholds of ash contamination

For planned flight into acceptable thresholds of ash contamination, four-dimensional representations of volcanic ash cloud, including depictions of the acceptable thresholds of contamination in both deterministic and probabilistic terms, in a common exchange format that provides integration into decision support tools. Forecasts would be valid *x* hours and up to *y* days and would contain finer temporal resolution in the short-term time frame.

5.4.3 Flight in areas of SO_2 from a volcanic eruption

For planned flights in areas of SO_2, operators will apply observations and forecasts of SO_2, in accordance with their SMS, to either avoid the SO_2 cloud or transition the cloud.

It is desirable that with flights into the SO_2 cloud that appropriate instrumentation be available on the aircraft to report and record the levels of SO_2 encountered by the aircraft, including those levels entering the aircraft's cabin after transition through relevant aircraft systems.

5.4.4 Information for decision-makers

For the above scenarios, as well as others not described, it is important that all decision-makers have consistent and common information at the resolution necessary to make their necessary decisions. This includes spatial and temporal resolution as well as update frequency of the information.

Flight crew are likely to require the most detailed information under the aforementioned scenarios. Flight crew may benefit from high-resolution satellite imagery as long as proper training in their use is provided.

5.5 Assumptions and Constraints

5.5.1 Assumptions

The proposed concept contained herein is based on the following assumptions:

- High-resolution three-dimensional representation forecasts of the ash cloud and longer-term probabilistic forecasts will replace the need for today's SIGMETs (for volcanic ash cloud) and VAAs.
- High-resolution three-dimensional representation of the volcanic hazard are not a traditional alphanumeric coded product. This concept moves away from a product-centric environment to an information services environment.
- Probabilistic forecasts can be utilized by aviation decision makers.
- Probabilistic forecasts are best suited for users in congested airspace but can also beneficial for users in uncongested airspace.
- Operator decision makers will use these probabilities within their decision support systems to better determine the temporal impact of the ash.
- Aircrew and other decision makers will receive training on the application and use of probabilistic forecasts, as appropriate.
- Continuing user demand for phenomena-based information, rather than FIR-based information.
- Worldwide, improved remote sensing techniques and *in situ* measurements of the airborne volcanic ash (from ground-based, space-based or airborne-based observing platforms), volcano ESP, will be needed to provide short-term forecasts and forecasts that have a high level of accuracy and confidence.
- There are acceptable thresholds of ash that may be a maintenance concern for an aircraft but do not pose a safety hazard for aircraft.
- Acceptable thresholds of ash and SO_2 may vary based on the type of aircraft, system and engine requiring the development of index levels.
- The forecast providers are capable of providing the information at the required resolution and update frequency.
- The systems used by the decision-makers, including aircrew, be able to receive and process the information, including the display if required, at the required resolution and update frequency.
- That the provision of volcanic hazard information services should be reviewed by ICAO to ensure that the information is globally consistent as well as efficiently provided,

which may result in an adjustment of the number of VAAC providers required to provide this service.

5.5.2 Constraints

The following constraints may impede the implementation of the proposed concept:

- Determining the height of bases and tops of the ash cloud, as well as bases and tops of multiple layers is difficult.
- The critical quantity (contamination, mass loading, exposure) will need to be determined.
- Funding for these developments and improvements, which is state-specific, may not occur or be delayed.
- Regarding improved forecast information, unless new satellite imagery or another observation of the area of volcanic ash becomes available, an interpolation between two previously stated positions is the best estimate of the location of the volcanic ash cloud. Assuming more frequent observations become available, the service providers may not be capable, e.g., due to resources (e.g., staffing), to deliver frequent updates.
- The development, production and delivery of probabilistic forecasts for volcanic ash may not be possible or delayed for some or all service providers.

5.6 Operational Policies

Moving from a product-centric environment to an information services environment with integration into decision support systems require changes in policies for flight documentation as well as retention of information by the provider. Currently, products are artifacts that can easily be provided for flight documentation and then archived for future reference (e.g., accident investigation). With the implementation of probabilistic forecasts along with integration into decision support systems, the concept of flight documentation changes. A database of information will replace a folder with charts and text reports and messages. Policies relating to system storage capacity for data retention (archival) will need to be visited. This need could vary depending on a State's legal requirements.

It is expected that these issues will be addressed with the implementation of the SWIM concept, which is part of the GANP and associated ASBUs.

Appendix A. Glossary and Acronyms

A.1 Acronyms

Acronym	Term
AIREP	Air Report
ASBU	Aviation System Block Upgrades
ASHTAM	A special class of NOTAM
ATCS	Air Traffic Control Service
ATFM	Air Traffic Flow Management
ATM	Air Traffic Management
ATS	Air Traffic Service
CAA	Civil Aviation Authority
ConOps	Concept of Operations
ESP	Eruption Source Parameter
FIR	Flight Information Region
FOC	Flight Operations Center
GANP	Global Air Navigation Plan
IAVW	International Airways Volcano Watch
IAVWOPSG	International Airways Volcano Watch Operations Group
ICAO	International Civil Aviation Organization
IVATF	International Volcanic Ash Task Force
MWO	Meteorological Watch Office
NOF	International NOTAM Office
NOTAM	Notice to Airman
SIGMET	SIGMET information[6]
SMS	Safety Management System
SO_2	Sulphur Dioxide
SWIM	System Wide Information Management
VAA	Volcanic Ash Advisory
VAAC	Volcanic Ash Advisory Center
VAG	Graphical version of the VAA
VAR	Volcanic Activity Report
VONA	Volcano Observatory Notice for Aviation

A.2 Glossary

Not used for this document.

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[6] SIGMET information: Information issued by a meteorological watch office concerning the occurrence or expected occurrence of specified en-route weather and other phenomena in the atmosphere that may affect the safety of aircraft operations.