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WORKING PAPER

INTERNATIONAL VOLCANIC ASH TASK FORCE (IVATF)

FOURTH MEETING

Montréal, 13 to 15 June 2012

Agenda Item 2: Report of the science sub-group (SCI SG)
2.4: Recommendations for increased meteorological data gathering and sharing during a volcanic event

IVATF TASK TF-SCI04.2 REPORT – PROVISION OF METEOROLOGICAL DATA TO THE VOLCANIC ASH ADVISORY CENTRES DURING A VOLCANIC EVENT

(Presented by the Rapporteur of the IVATF Science Sub-Group)

SUMMARY

Volcanic Ash Advisories, issued by Volcanic Ash Advisory Centres within the framework of ICAO's International Airways Volcano Watch and in accordance with Annex 3 – *Meteorological Service for International Air Navigation* provisions, are the result of complex forecasts of the expected volcanic ash content in any volume of air for up to 36 hours.

For these forecasts to be accurate and reliable, not only the volcanological data characterizing the eruption are required, but also a full set of atmospheric data including aerosol content and volcanic ash contamination, both to arrive at an initial situation and also for the verification and evaluation of the forecasts.

This verification and evaluation is needed to provide users a reliable estimate of the accuracy of the advisory and for the necessary continual improvement process of the forecasts.

This report is related to IVATF task TF-SCI04.2.

1. INTRODUCTION

1.1 Volcanic Ash Advisory Centres (VAAC) require a full set of atmospheric and volcanological data in order to fulfil their mandate of issuing Volcanic Ash Advisories (VAA). This

working paper concentrates on the atmospheric data (including existing ash and aerosol contamination) rather than on the eruption source data of the volcano. In the case of the VAAC being a global data processing centre with a forecast model suite covering the entire globe, the basic data set similar to that required by a World Area Forecast Centre (WAFC) is required, relying on the established WMO circuits (GTS, WIS). Where only a regional forecast model is available, boundary values for such a model are required from a global model. Of the atmospheric processes of high relevance to VAA, transport, diffusion and deposition of aerosols are predominant. For these processes detailed information on the 3-dimensional wind field, including processes of turbulent diffusion, divergence, deformation and shear are paramount. In particular, high resolution in the vertical is important in order to capture bifurcation points in forward trajectories

1.2 For tropospheric eruptions, dry and wet depositions of fine ash are important processes determining final, far-field contamination levels. Aggregation processes are likely to be influenced by turbulent processes, and wet deposition depends on convection and large-scale precipitation. The most effective deposition is by snowfall, so moisture, freezing level and atmospheric stability data in the initial conditions are required.

1.3 Primary and processed satellite data (e.g., brightness temperature differences) are required for automatic and human detection of existing ash contamination. Detection of sulphur dioxide and other gases indicative of eruptions is also mainly based on passive radiation measurements by standard meteorological satellites. High temporal resolution of geostationary data is key for the discrimination between free convection and eruption-triggered convection in tropical regions. All relevant data from existing meteorological satellites are made available through the normal WMO data exchange (GTS, WIS) to the VAAC.

1.4 Specialized data from active space-based sensors (e.g. LIDAR) are currently only available from Low Earth Orbiters, and non-operational dissemination channels in near-real time may be required to provide access to such data for the VAAC, typically using the public Internet (FTP, push- or-pull solutions)

1.5 The WMO Global Atmosphere Watch programme (GAW), which has been established to monitor the presence of atmospheric aerosols by means of space-based, ground based remote and in-situ sensing by specialized aircraft, has provided such data for volcanic eruptions to the VAAC under semi-operational conditions during recent eruptions.

2. DISCUSSION

2.1 In order to ensure the optimal flow of data for VA purposes, the following measures have been taken by WMO:

a) *Meteorological Satellites*: The Coordination Group on Meteorological Satellites at its recent session (CGMS-39) held at St. Petersburg, Russian Federation, in October 2011, was informed about the urgent need to retain and if possible increase the relevant IR channels and active sensors for VA purposes by WMO, supported by letter from the ICAO Secretariat; and

b) *Ground-Based Remote Sensing*: The WMO GAW programme, together with the GALION and European EARLINET LIDAR network, has reacted favourably to requests from the VA community to make every effort to provide mostly research-oriented data on

a quasi-operational basis to support the work of VAAC and national meteorological services with relevant atmospheric profile data of aerosols, in particular volcanic ash. A dedicated project undertaken by WMO in collaboration with Deutsche Wetterdienst has established an information system on ground-based LIDARs with near-real time access for a number of LIDAR sites, and undertook steps to study and enhance the usability of airport-located laser ceilometers for the detection of lower-and mid-tropospheric ash layers.

On-going projects to establish regional and national weather radar networks are continuing to improve our knowledge of real-time precipitation over populated areas, and satellite-derived estimates of convective precipitation over the oceans and over sparsely populated areas and in the developing world are helping to identify areas where aerosols and VA would be subject to wet depositions, affecting the forecasts for VA contamination. Ground-based weather radars, where located near volcanoes, also provide key information about eruption plume height, which is a key input to ash-dispersion models. In the far field, their capability to observe precipitation at all levels of the atmosphere can contribute to an improved estimate of wet deposition of ash. While the international exchange of fully 3-dimensional weather radar data in real-time currently is subject to technology challenges and issues of calibration and comparability, intermediate products such as radar-derived rainfall estimates could be exchanged in the short-medium term.

2.2 During the protracted eruption series at Eyjafjallajökull in April and May 2010, European meteorological services were requested to increase their radiosonde ascents to compensate for the shortfall of aircraft (AMDAR) providing atmospheric profile data during the temporary cessation of operations of large parts of Europe. This should be taken as an indication of the need for contingency plans for future protracted eruptions, where accurate analyses of wind fields will be needed to initialize VA transport and diffusion models possibly in absence of aircraft data.

2.3 The WMO Commission for Basic Systems Expert Team on the Evolution of the Global Observing System (ET-EGOS) is monitoring the degree to which currently available data are fulfilling the requirements of the different WMO programme areas, and the contribution for the aeronautical meteorology programme contains specific reference to the requirement for VA purposes in the form of a "Rolling review of requirements" with Statements of Guidance for the different application areas.

3. RECOMMENDATION

3.1 The importance of "conventional" meteorological data for atmospheric parameters of mass, wind, temperature, humidity at high vertical and horizontal resolution is recognized for the provision of VA-related forecasts and warnings, and the WMO Members and their National Meteorological Services currently are providing an adequate data set for global predictions, with gaps understood to exist in the tropics, the oceans and some land areas in the developing world. Contingency procedures should be worked out between ICAO and WMO for protracted severe VA events, when aircraft meteorological data (AMDAR, and similar) may become defective over affected areas.

3.2 Support for the on-going development of relevant passive and active sensors for remote sensing should be given to the operators of meteorological satellites through the Coordination Group on Meteorological Satellites, both in form of clearly specified requirements as well as in political and economic forms of support

3.3 Specialized aerosol data, currently being collected for the WMO Global Atmosphere Watch on a semi-operational basis need to be enhanced both in density, global availability and through the availability of appropriate metadata and accessibility. Quasi-operational availability during protracted volcanic eruption events will require a dedicated funding mechanism from either national or international disaster management funds and through appropriate cost recovery from aviation.

Recommendation 4/xx —

That, the IAVWOPSG, in close cooperation with the WMO and national or regional agencies operating observing platforms, be invited to progress the development of the Concept of Operations for the International Airways Volcano Watch (IAVW) that defines basic meteorological data requirements, data collection and exchange for aerosol data which are currently not exchanged through the WMO systems (GTS, WIS) on a real-time basis, and contingency plans for the availability of alternative data in case of wide-spread lack of aircraft data in ash-contaminated areas. This effort should include a review of the ICAO and WMO guidance on cost recovery for meteorological services to incorporate new data types and services.

4. ACTION BY THE IVATF

4.1 The IVATF is invited to:

a) note the information contained in this paper; and

b) decide on a recommendation for the task force's consideration.

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