Forum on the "Assessment of volcanic ash threat: learning and considerations from the Eyjafjallajökull eruption"

Cities on Volcanoes 6, Tenerife, 4 June 2010

RATIONALE

The April-May 2010 Eyjafjallajökull eruption has had a tremendous unprecedented impact on civil aviation in Europe and beyond resulting in millions of Euros in economic loss and large social impact, especially during the 14-20 April week. The Organizing Committee of the COV6 meeting, held in Tenerife (Canary Islands, Spain) during 31 May-4 June 2010, scheduled an open Forum aimed at joining scientists and different actors attending the meeting that were directly or indirectly involved in the crisis. The idea was to stimulate an open discussion and to analyze the current strategy used for forecasting volcanic ash clouds and mitigating its effects on aviation.

This document lists the main issues raised and discussed during the development of the Forum. Although in general terms there was a broad consensus among participants, the items listed below do not represent any particular opinion nor are necessarily shared by all the attendees.

SUMMARY

1-. VAACs and atmospheric dispersion models

Volcanic Ash Advisory Centres (VAACs) are the official centres designed by the International Civil Aviation Organization (ICAO) as a part of the International Airways Volcano Watch (IAVW) to detect, monitor and forecast trajectories of volcanic ash plumes within their assigned airspace and to provide Volcanic Ash Advisories (VAA). VAACs make use of atmospheric dispersion models to forecast the evolution of volcanic ash clouds. Based on these models, VAACs issue every 6 hours both a VAA and graphical forecast charts that are used by aviation authorities to decide aircraft re-routing or the closure of the affected airspace.

- The important role played by the London VAAC during the crisis was recognized. The decisions taken can be justified on the basis of the guidelines available during the first days of the crisis. However, the crisis clearly highlighted the need of improvements in all directions (scientific, operational, industry, etc.) and that the strategy currently adopted to face large-extension ash clouds needs a revision.
- Questions were raised on the lack of homogeneity of models, each VAAC using a different model and even different input data (models used by VAACs were mainly

developed for different purposes than modelling volcanic ash clouds).

- Most models do not compute ash airborne concentration but only the "presence" or "absence" of ash. This "binary" strategy is justified in the context of the previous guidelines ("zero ash tolerance") but should be abandoned if a criterion for flight safety is definitively adopted. On the other hand, most models used by VAACs do not compute ash fallout. This is explained because their primary goal is to prevent encounters with in-flight jets. However, it was noticed that, in general, fallout forecast is also of interest to nearby airports and communities.
- Models do not consider some important effects such as ash aggregation, which is especially critical in the removal of fine ash. This can lead to an overestimation of the airborne ash mass (i.e. concentration) at large distances, i.e. where the ash cloud becomes finer-grained. Scientists that were sampling in Iceland during the eruption confirmed that aggregation phenomena did actually occurred.
- Finally, it was noticed the importance of a fluid communication between Volcano Observatories (VO) and VAACs during a crisis because VO are a key data provider. Accuracy of models strongly depends on the goodness of input parameters.

2-. Safe "ash concentration threshold"

Before the crisis, guidelines to determine the closure of airspace were based on the "zero ash tolerance" criterion. This criterion was successively relaxed during the crisis following several "monitoring flights" and because of the pressure of the airlines. From 17 May 2010 the limits used by the UK Civil Aviation Authority (CAA) are 4 mg/m^3 for the no fly zone, 2 mg/m^3 for the time-limited zone, and 0.2 mg/m^3 for the enhanced procedures zone.

- It was noticed that the establishment of quantitative criteria has been an old, continuous and reiterated demand of the scientific community to airlines and manufacture industry, the later occasions during the 4th IAVWOPSG meeting (Paris, 2008) and during the recent 5th International Workshop on Volcanic Ash (Chile, March 2010). However, the issue goes back much farther, to the beginning of aviation-ash working groups but proposals to take quantitative measurements (airborne LIDAR, for example) of plume concentrations were ignored 20 years ago because they were "too expensive".
- There was agreement in that, considering the present CAA limits and according to models (e.g. FALL3D simulations shown during the Forum), the impact of the same event today would be considerably minor, i.e. with a much more localized airspace closure both in time and space. This has been the key issue of this crisis.
- It was wondered on how the CAA obtained these values and if they have some scientific justification. Also, it was noted that values should not be independent on the chemical composition of ash and on the characteristics of each particular engine. It is clear that

much work is needed to end with a reasonable balance between risk (safety) and cost.

- Another issue is whether it makes sense to consider "a safe ash concentration" or would be better to consider instead a "critical ash dose" (i.e. a maximum total mass of ash that an engine can ingest). The later option considers not only the concentration but also the duration of the "exposure".

3-. Involvement of airlines and industry

- So far, industry has been very weakly involved. However, several companies performed survey flights and collected data. Some participants noted the scientific importance of these data, although it was noticed that private companies have often difficulties in sharing.

4-. Future strategy for ash cloud forecasting

- There was some debate and suggestions on how to improve ash cloud forecasting in the future.
- It was noticed that it is unviable for models to distinguish between 4 and 2 mg/m^3 because of the large uncertainties involved, especially from the volcanological point of view. The clearest example is the determination of the eruption rate (erupted mass) which influences model's results as a first order parameter but is subjected to large uncertainties (and oscillations).
- Suggestions for improvement of models included: i) increase of model resolution, ii) more realistic model physics (e.g. aggregation, sedimentation laws, fragmentation mechanism and resulting particle characteristics, etc), iii) use probabilistic and ensemble forecast (as done in meteorology) strategies to deal with the inherent uncertainties and the different modelling approaches. In the case of a probabilistic approach it may be necessary to consider a cost/benefit analysis to convert a probabilistic modelling strategy into a binary decision.