Volcanic Ash and Aviation

Knowledge exchange for effective hazard mitigation

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MOTIVATION

Volcanic ash in the atmosphere poses a threat to both commercial and military aircraft operations. Since Eyjafjallajökull in 2010, there have been some major changes in policy regarding flying in volcanic ash. Additionally, the scientific community have enhanced the research effort into the problem and have made significant progress in monitoring and forecasting, as well as improving the understanding of the effects of ash on aircraft. Much of this new knowledge is not yet incorporated into policy or being applied operationally.

AIMS

This work is part of a NERC Knowledge Exchange Fellowship on volcanic ash and aviation aims to achieve the following:

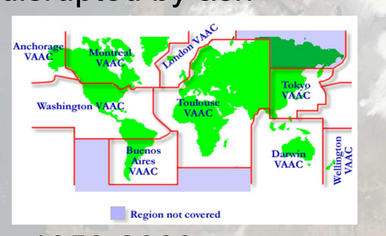
- To identify scientific research which could assist the aviation industry in managing volcanic ash hazards
- To determine current practices in the aviation community and identify areas where new research could be beneficial
- To facilitate and encourage interaction between industry, policy and academia

HISTORY

1950s Ash 1st recognised as an aviation hazard

1980s Commercial flights disrupted by ash

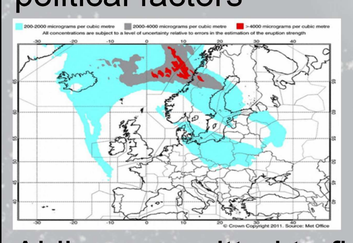
1990s Volcanic Ash Advisory Centres "Avoid All Ash"



2000s > 94 ash encounters 1953-2009.

2010s Eyjafjallajokull eruption

2mg/m^3 "safe" limit - based on safety & political factors



New thresholds: <2, 2 - 4 & >4 mg/m^3

Airlines permitted to fly with Safety Case

2013 "Avoid Visible/Discernable Ash" policy debate

2014 JSA144 flies into ash cloud despite VAAs

2017 OEMs suggest move to ash dosages

STAKEHOLDER PERCEPTIONS

Stakeholder meetings and interviews have identified the key issues as perceived by industry stakeholders.

BRITISH AIRWAYS · Rolls-Royce · Aer Lingus · easyJet · DGAC Dirección General de Aeronáutica Civil · [dstl] · Department for Transport · Civil Aviation Authority

Commercial Operators
Military Operators
Policy Makers
Airports
Airspace Managers

Safety

- Engine failure or other critical damage
- Operational delays in military operations

Reputation

Brand damage could result from:

- Perceived risk taking
- A damaging incident involving volcanic ash

Economic

- Aircraft maintenance
- Cancellations, delays, diversions
- Knock-on effects e.g. supply chain, tourism

Logistical

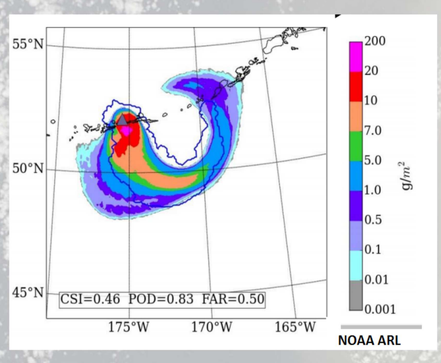
- Personnel & equipment displaced
- Route planning and management of airspace

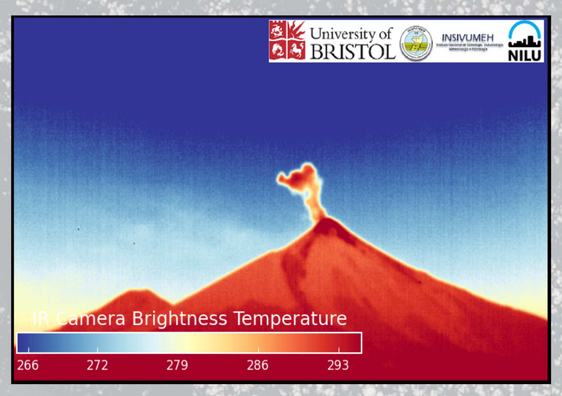
APPLICATION OF RESEARCH SCIENCE

MODELLING & OBSERVATION

Training in the use of freely available tools such as the online HYSPLIT model will enable better management of airspace close to active volcanoes where other data are limited.

Right: Hysplit ash prediction for Kasatochi, 2008. Credit: NOAA, 2015





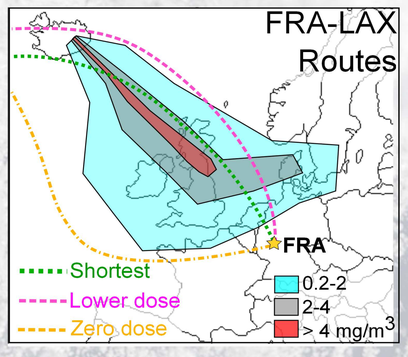
Volcanoes in remote and developing countries are often poorly monitored which makes eruption detection difficult and limits the accuracy of dispersion models. The development of new sensors for automatic imaging and detection will help mitigate the risk from such volcanoes.

Above: IR cameras at volcanoes such as Fuego, Guatemala, can provide much needed information on plume direction and composition.

ASH DOSAGE

Work by Rolls Royce assimilating ash and sand encounters has led to the development of the DEvAC chart. Results indicate that ash dosage is a more appropriate metric for engine tolerance to ash. The University of Reading are developing an ash dosage calculation tool that can be used to trade-off expected dosage (concentration x time) with additional fuel costs.

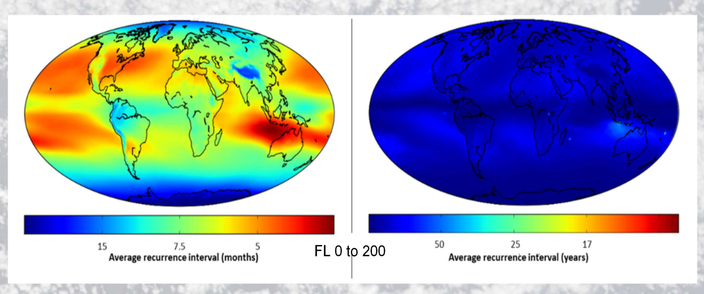
By working closely with airlines, methods of applying such a tool in practice will be developed.



PROBABILITY OF ENCOUTER

Computation of probability of ash in the atmosphere can facilitate flight planning at short notice and facilitate calculation of risk. Completion of a global database by the University of Bristol will provide useful information for both commercial and military flight operations.

Average recurrence intervals for any ash (L) and ash >2mg/m2 (R) in the lower ~6km of the atmosphere. From Jenkins et al. 2015.



FUTURE WORK

- Continue to develop links between researchers and the aviation industry community to identify further applications of ongoing research science
- Investigate how science can address the question of uncertainty in models for dosage calculation and the potential of in-flight ash sensors
- Review research regarding SO_2 as an aviation hazard for application to policy

REFERENCES

Jenkins et al., 2015. Mapping airborne volcanic ash hazard at the global scale, unpublished report.

Stunder B. et al., 2015. HYSPLIT volcanic ash dispersion modeling R&D, NOAA NWS NCEP operations, and transfer to operations. WMO 7th International Volcanic Ash Workshop Presentation.