# A new natural hazards data-base for volcanic ash and $SO_2$ from global satellite remote sensing measurements

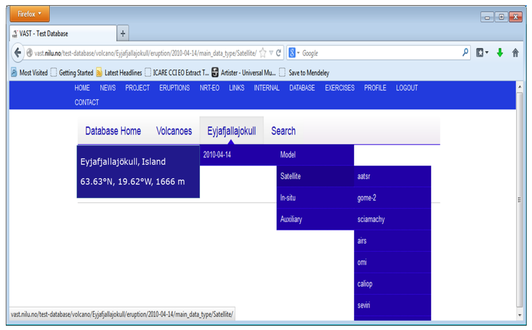
Kerstin Stebel (kst@nilu.no), Norwegian Institute for Air Research, Kjeller, Norway
Fred Prata, Norwegian Institute for Air Research and Nicarnica Aviation, Kjeller, Norway
Nicolas Theys, Belgian Institute for Space Aeronomy, Brussels, Belgium
Lucia Tampellini, Compagnia Generale Per lo Spazio SpA, Milano, Italia
Martijn Kamstra,S[&]T, Oslo, Norway
Claus Zehner, European Space Agency, ESRIN, Frascati, Italy and the VAST/SACS/SMASH teams

## Introduction

**Over the last few years there has been a recognition of the utility of satellite measurements to identify and track volcanic emissions that present a natural hazard to human populations. Mitigation of the volcanic hazard to life and the environment requires understanding of the properties of volcanic emissions, identifying the hazard in near real-time and being able to provide timely and accurate forecasts to affected areas. Amongst the many ways to measure volcanic emissions, satellite remote sensing is capable of providing global quantitative retrievals of important microphysical parameters such as ash mass loading, ash particle effective radius, infrared optical depth, $SO_2$ partial and total column abundance, plume altitude, aerosol optical depth and aerosol absorbing index.**

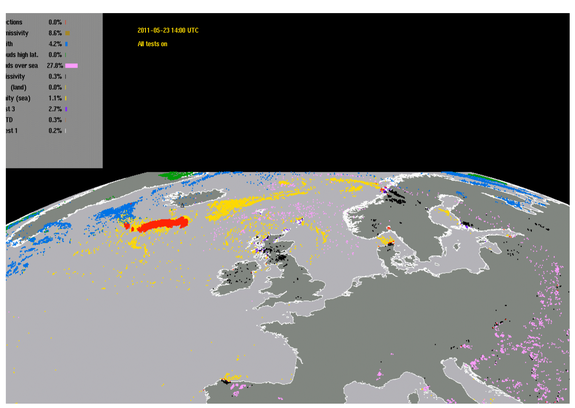
## VAST data-base

**The eruption of Eyjafjallajökull in April – May, 2010 led to increased research and measurement programs to better characterize properties of volcanic ash and the need to establish a data-base in which to store and access these data was confirmed. The European Space Agency (ESA) has recognized the importance of having a quality controlled data-base of satellite retrievals and has funded an activity called Volcanic Ash Strategic Initiative Team VAST (vast.nilu.no) to develop novel remote sensing retrieval schemes and a data-base, initially focused on several recent hazardous volcanic eruptions. In addtion, the data-base will host satellite and validation data sets provided from the ESA projects Support to Aviation Control Service SACS (sacs.aeronomie.be) and Study on an end-to-end system for volcanic ash plume monitoring and prediction SMASH. The VAST website and the data-base search interface is shown below.**


## Sattelite retrieval

**The data-base will contain satellite retrievals for the eruptions of Eyjafjallajökull, Grímsvötn, Puyhue-Cordon Caulle, Nabro, Merapi, Okmok, Kasatochi and Sarychev Peak. New retrievals and methods are being developed. As an example we show the new Cloud Identication (CID) scheme for SEVIRI ash detection (Prata, 2013). This is displayed in NRT for selected regions, see fred.nilu.no/sat. In addtion, we show an example for the SEVIRI ash retrieval for the Grímsvötn eruption in Iceland in May 2001.**


see Prata, A.J., Detecting and Retrieving Volcanic Ash from SEVIRI Measurements. ATBD, ESA-VAST document, NILU, 55 pp., May 2013

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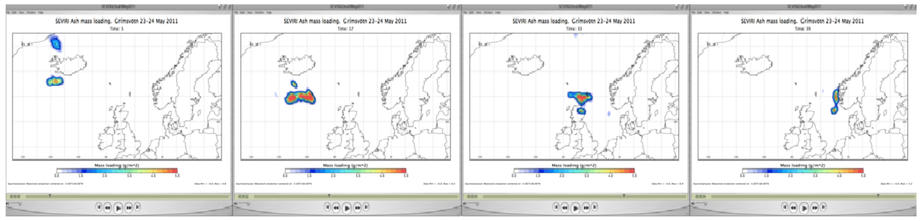
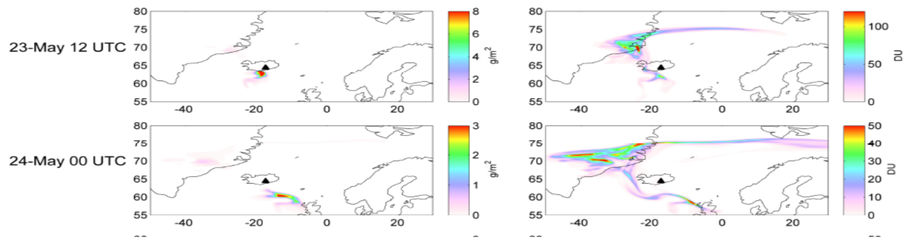


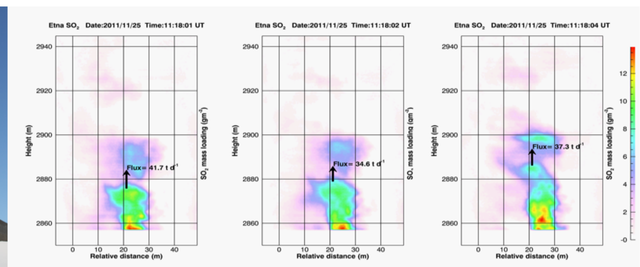

## Model data

**Dispersion model simulations are also being included in the data-base. Several atmospheric dispersion models (FLEXPART, SILAM and WRF-Chem) are used in VAST to simulate the dispersion of volcanic ash and $SO_2$ emitted during an eruption. Source terms and dispersion model results will be given. Model data for the Grímsvötn eruption are shown below(courtesy from N. Kristiansen, NILU).**



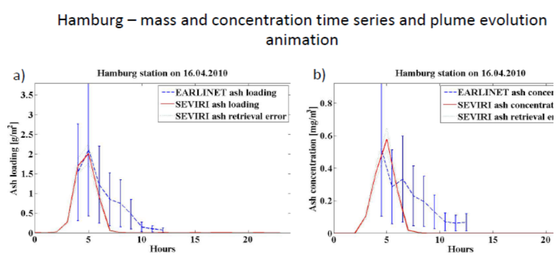

## Ground-based and other data-sets

**In time, data from conventional in situ sampling instruments, airborne and ground-based remote sensing platforms and other meta-data (bulk ash and gas properties, volcanic setting, volcanic eruption chronologies, potential impacts etc.) will be added. Here we show an example of ground-based UV camera observations of $SO_2$ fluxes at Mt. Etna. Gas flux measurements can be a means to diagnose future unrest.**




## Validation results and knowledge base

**Shown below are validation results for SEVIRI ash concentrations (courtesy from J. Bialek, NUIG) and an excerpt of an extensive bibliography.**




### Bibliography

#### Volcanic hazards to aviation

[1] S. Albersheim and M. Guffanti. The United States national volcanic ash operations plan for aviation. *Nat. Hazards*, 51(2):275–285, 2009. doi: 10.1007/s11069-008-9247-1.

[2] A.l. Bernard and W.I. Rose Jr. The injection of sulfuric acid aerosols in the stratosphere by the El Chichon volcano and its related hazards to the international air traffic. *Nat. Hazards*, 3(1):59–67, 1990.

[3] Vincent M Brannigan. Alice's adventures in volcano land: The use and abuse of expert knowledge in safety regulation. *Eur. J. Risk Reg.*, 1:107, 2010. ISSN 1867-299X.

[4] P. Brooker. Fear in a handful of dust: aviation and the Icelandic volcano. *Significance*, 7(3):112–115, 2010. ISSN 1740-9713. doi: 10.1111/j.1740-9713.2010.00436.x.

[5] T.J. Casadevall. The 1989–1990 eruption of Redoubt Volcano, Alaska: impacts on aircraft operations. *J. Volcanol. Geotherm. Res.*, 62(14):301 – 316, 1994. ISSN 0377-0273. doi: 10.1016/0377-0273(94)90038-8. The 1989-1990 Eruptions of Redoubt Volcano, Alaska.

[6] T.J. Casadevall, P.J. Delos Reyes, and D.J. Schneider. The 1991 Pinatubo eruptions and their effects on aircraft operations. In C.G. Newhall and R.S. Punongbayan, editors, *Fire and mud: eruptions and lahars of Mount Pinatubo, Philippines*, pages 625–636. Philippines Institute of Volcanology and Seismology, Quezon City; University

## Conclusion

**The data-base has the potential to provide the natural hazards community with a dynamic atmospheric volcanic hazards map and will be a valuable tool particularly for aviation.**