A MULTI-MODEL SYSTEM TO ESTIMATE VOLCANIC, AEROSOLS AND NUCLEAR HAZARDS TO AVIATION (EUNADICS-AV)

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Context and purpose
The project EUNADICS-AV undertakes to develop and test a unique system to provide consistent and coherent information to aviation authorities, airlines and pilots in the event of a natural disaster affecting the airspace, which, if successful, would greatly enhance the resilience of one of the most critical infrastructures of the 21st century.

Challenges for modeling:
- Rare events,
- High uncertainty in source terms,
- Diversity of observations to assimilate,
- Availability of observations.

Model integration aims at:
- Assimilation of observations,
- Computation and integration of source terms,
- Developing prototype products useful to assess these hazards,
- Reducing uncertainty by assimilation,
- Assessing uncertainty using ensemble.

Four modelling systems are involved that have proven assimilator capability:
- MATCH (SMHI), Robertson et al, 1999
- MOCAGE (Météo-France), Sicil et al, 2016
- SILAM (FMI), Sofiev et al, 2015
- WRF-Chem (ZAMG), Grell et al, 2005, and FLEXPART (ZAMG), Stohl et al, 2005

Assimilation
The assimilation of observations produces an analysis, accurate model state (ie 3D concentrations of the pollutants). This analysis is as close as possible to the assimilated observations, under the assumption of prior information (error statistics).

Source-term inversion
Inverse modelling for source term reconstruction also uses observations to make an estimate of the strength, height and time-evolution of the emissions. This source term can be used to generate a 4D model output of the evolution of the hazardous plume.

Observations to integrate:
- AOD from satellites,
- Lidar and ceilometer aerosol profiles,
- SO2 satellite columns,
- VA satellite columns,
- PM in-situ,
- Nuclear in-situ.

Prototype
Model outputs delivered on the same grid:
- GLOBE at 1° or finer,
- EUROPE at 0.1°.

General dataflow (example for volcanic ash)

Multiple analyses
Multiple source terms

Prototype observations
ACD, lidar, in-situ PM

Quantities of 3D VA concentrations, per model

Source-term

Nuclear hazard - Arrival time of a plume

Some examples of model outputs (under development):

- Developing model integration and multi-model on several test case:
  - Eyjafjallajökull 2010,
  - Grimsvötn 2011,
  - Etna 2002,
  - Desert dust and forest fire events,
  - Nuclear fictitious arc real events.
  - Assessing the added-value of the system in an ATM software and protocol.

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References