MATCH MODELLING CAPABILITIES FOR EUNADICS-AV

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BACKGROUND

SMHI is contributing to EUNADICS-AV through data assimilation of observations and forecast modelling (WP4 and WP6).

The main component of the contribution goes through the MATCH modelling system that consist of:

- Eulerian transport model for volcanic ash, trace species and radioactive nuclides
- 3Dvar and 4Dvar assimilation methods

In this poster we describe work done related to the Grimsvotn eruption in May 2011, the Ru-106 incidence in 2017 and an example of a nuclear explosion.

RESULTS

Grimsvotn eruption 2011

The Icelandic volcano eruption at Grimsvotn took place in the 21st of May 2011. Major traffic disruption during 22-25 of May.

In the figure below IMO plume-top estimates are shown from radars at Keflavik and Klaustur (Petersen et al. 2012a, 2012b).

SO\textsubscript{2} source term retrieved from radar observations

Given information on observed plume heights we use the proposed source estimate by Mastin et al (2009) exponential on the plume height (km):

\[ Q \sim H^{0.5} \]

The Figure on the left shows the SO\textsubscript{2} emissions retrieved from the radar observations total column (upper) and vertical distribution (lower).

PM10 content is 3 % of the total emission and the SO\textsubscript{2} content is 5 % of the PM10 emission.

SO\textsubscript{2} source term retrieved by assimilation of OMI SO\textsubscript{2} columns

Simplified data assimilation has been performed by a single backward gradient calculation of the OMI observations given the observation operator. The source estimate in the Figure below was retrieved.

CONCLUSIONS

The MATCH model was applied to three different case studies that can trigger aviation disruption: (i) volcanic eruptions, (ii) nuclear accident and (iii) nuclear bomb blast.

Grimsvotn eruption 2011

The model was used using the data assimilation procedures included and the observation operators needed. The results can be used on flight levels. Despite quite different source terms the results with and without data assimilation for this case mostly is a matter of magnitude.

Ru-106 release in September 2017

The anthropogenic radionuclide Ru-106 was detected in most of European countries in early October 2018.

The Figures below shows backtracing by running the adjoint transport model from a reduced set of observations in Scandinavia and central Europe (IRSN 2018) at two dates, the 27th and 29th of September 2017.

Nuclear explosion and upper air gamma doses

The release from a nuclear bomb device is described as a set of aerosols clouds distributed over ten (10) bins with the aerosol radius ranging from 2.2 to 360 µm. The nuclear composition is taken from Kraus & Foster (2014) modified by STUK.

The activities for the various bins are calculated applying a particle distribution mechanism based on log-normal size distributions for the different segments in the cloud, following Harvey et al. (1993), to the 76 nuclides and noble gases.

Vertical extension and aerosol size distribution

Model cloud from 1 kT nuclear explosion corresponding to a total emission of 2 x 10\textsuperscript{16} Bq.

Cross section of a radioactive cloud (d-131) from a 1 kT hypothetical explosion showing the potential to provide information of radiation for cruising aircrafts.

REFERENCES


The research leading to these results has received funding from the European Union’s Horizon 2020 Research and Innovation Programme, under Grant Agreement no 723986.