Experiences from operational actions and recent research with respect to atmosperic disaster events

Alexander Hieden

ZAMG Customer Service
Department Environmental Meteorology
Emergency Response Modeling Group

EUNADICS-AV

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Outlook

- Introduction of the **Austrian Emergency Response System**
  - General Description
  - TAMOS
  - Products

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- Introduction of **EUNADICS-AV**
  - Current Situation
  - General Description
  - Data Assimilation / Ensemble

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Radiological Early Warning Network

- No NPPs in Austria, but 15 in range < 200km
- One of the world‘s densest monitoring networks
- Europe‘s first nationwide automatic radiation measurement system
- In continuous operation for more than 30 years
- Data transmission every 10 minutes

336 ODL-stations (ODL = ambient dose rate), 10 monitoring stations

Federal Ministry of Sustainability and Tourism BMNT

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Crisis Management Austria in case of radiological emergency

BM.I

Information on radiological event from IAEA, ECURIE or other

Assessment of hazards and counter measures

BMNT
Federal Ministry for Sustainability and Tourism

BMGF
Federal Ministry for Health and Women's Affairs

- **Atmospheric transport and dispersion modelling system** TAMOS
- **Weather bulletin**
- **Meteorological support** during all phases of emergency

- Estimation of release term
- Assessment of consequences and counter measures

All Units of the Austrian ERCC
Emergency Response Coordination Centers of federal states, districts and local communities

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Atmospheric transport and dispersion modelling system

global meteorological forecasts

ECMWF

Precipitation fields

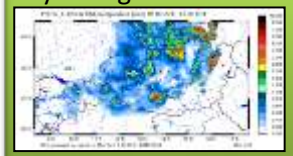
ALARO

regional

INCA

local

Hydrological



Meteorological

Specialised Forecasts

TAMOS

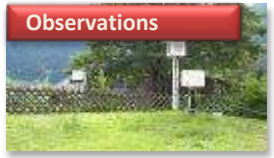
FLEXTRA trajectories

FLEXPART transport and dispersion modeling

forwards/backwards

federal institutions

Observations



Radar data

Topography

Satellite data

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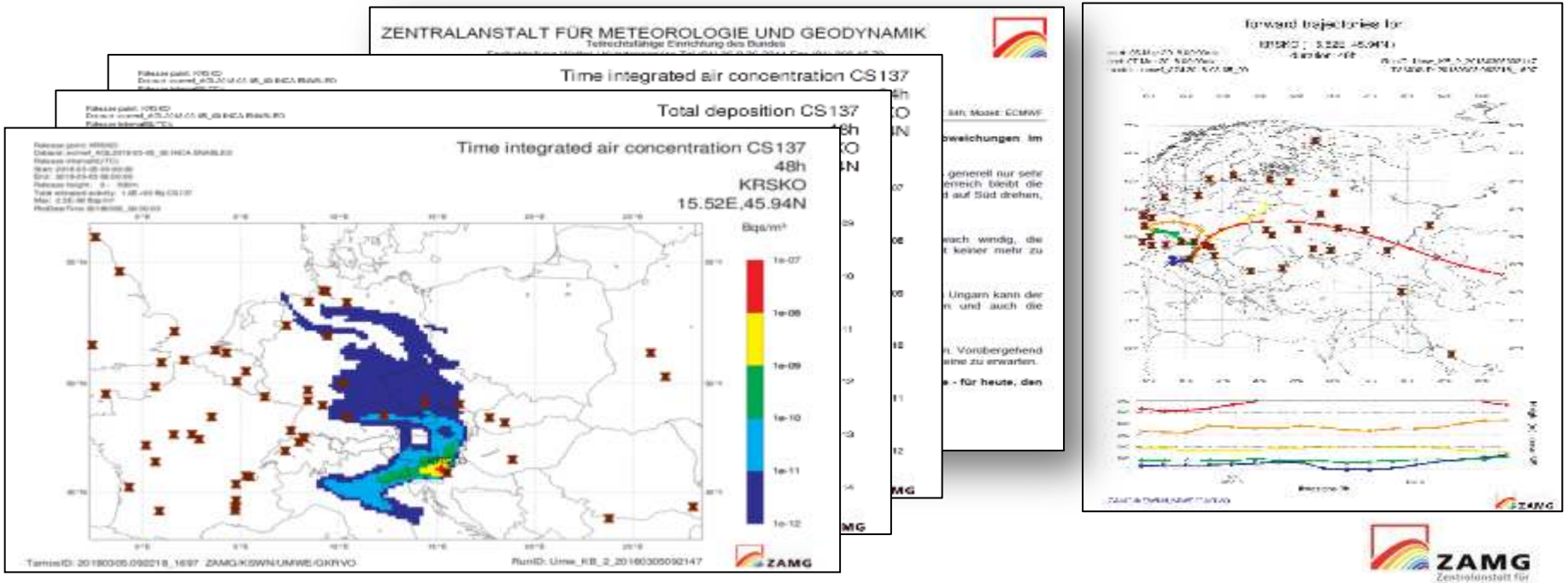
Products for the Austrian ERCC

- Graphical output of particle dispersion and trajectory modelling system
- „**Weather bulletin**“: information on forecast reliability, regional and local details
- WMO **RSMC** products



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EU Project EUNADICS-AV

Nuclear Accidents

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Sand Storms

*The project **EUNADICS-AV** undertakes to develop and test a unique system to provide **consistent and coherent information** to aviation authorities and airlines 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.*

Volcanic Eruptions

Forest Fires

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Disasters: Current Situation

Before 1990s

- Few data
- Inaccurate models
- Limited analysis capabilities

Today

- Many data
- Good models and analysis capabilities

… but there are still remaining issues !

- **Data** from different networks, partly research activities, are **not harmonized**
- **Inconsistencies** in data may **hamper** the analysis and cause inconsistencies in situation assessments
- **Lack of coordination** with regard to special crisis measurements
- Issues with data **availability** and distribution
- Models/analysis instruments are not optimized with regard to data flood during crisis
- Not all stakeholders performing forecasts have **access to high-quality analysis**

This gap in information availability & consistency needs to be closed!

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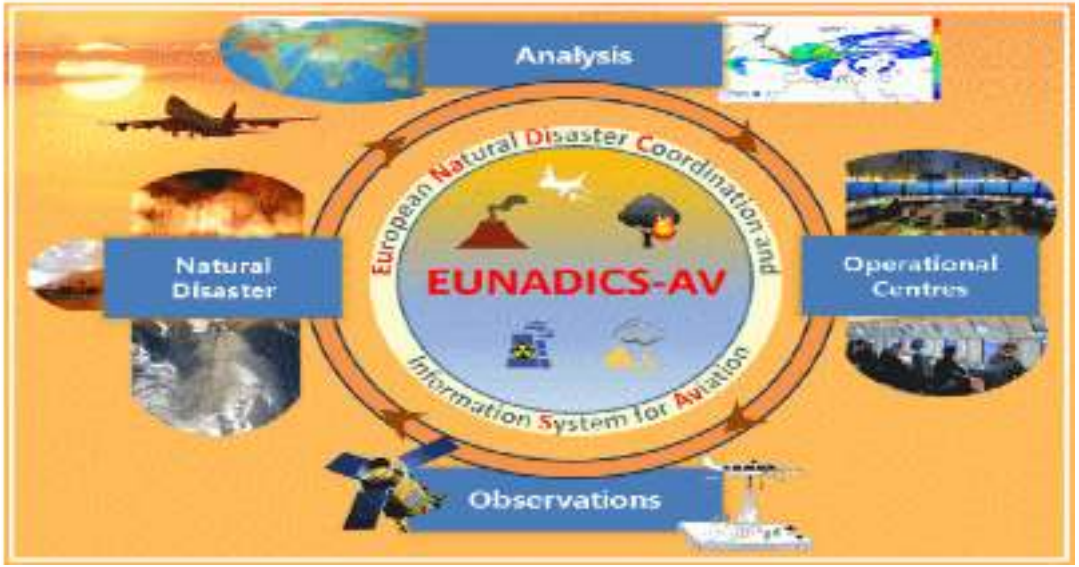
Coordination by ZAMG

- 21 participating organizations from 12 different countries
- National Weather Services
- Measurement & Data Specialists
- Model Developer
- Aviation Experts & Flight Plan Managers

Our solutions

- Combine and harmonize data from satellite, ground based and airborne observations
- Use state-of-the-art data assimilation and analysis systems
- Provide data and analysis products to all stakeholders through existing chanels (VAACS, RSMCs, Nat. Met. Services, Airlines)

EU Horizon 2020 (Grant No. 723986) 2016-2019



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Fulfilling User Requirements

User Requirements

- Provide **standardized interfaces** to external systems
- Make use of **existing dissemination channels**
- **Common data formats** and SWIM compatibility
- Information on **error margins**
- Provide **multiple scenario forecasts**
- Labeling of **information quality**
- Use of **trusted sources**
- Good horizontal resolution **(< 10 km)**, frequent update of information **(< 6 hrs)**
- Information displayed on maps at **different flight levels**

Our Challenges

- **Rare events for verification**
- **Diversity** and **availability** of **observations** to assimilate
- Estimation of **reliability** on input data
- **High uncertainties** in:
  - observations
  - source terms
  - Model / numerical computation
- **Model integration**:
  - FLEXPART, WRF-Chem (ZAMG)
  - MOCAGE (Meteo-France)
  - MATCH (SMHI)
  - SILAM (FMI)

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Reducing Uncertainties

Source term estimation

- Source-Receptor-Sensitives
- Satelite/Ground-Based Observations (if available)
- Scaling by an empiric **“a priori”** source estimation **[Mastin et al. 2009]**
- Analytic estimation

Ensemble

1. First Guess:
   Global FLEXPART-Run with *„operational“* ECMWF-Data
2. Create 5-6 representative ensemble members from (50) ECMWF perturbed forecasts
3. Variation of the First Guess by the repr. members

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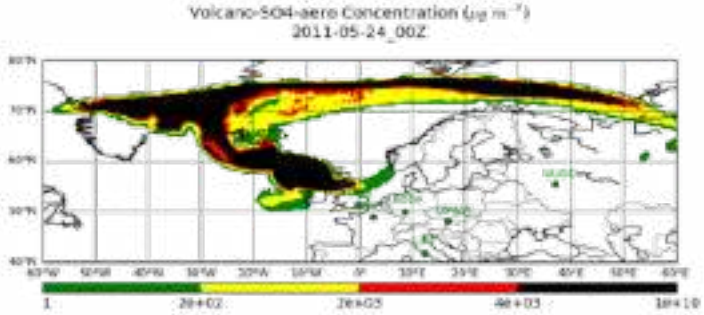
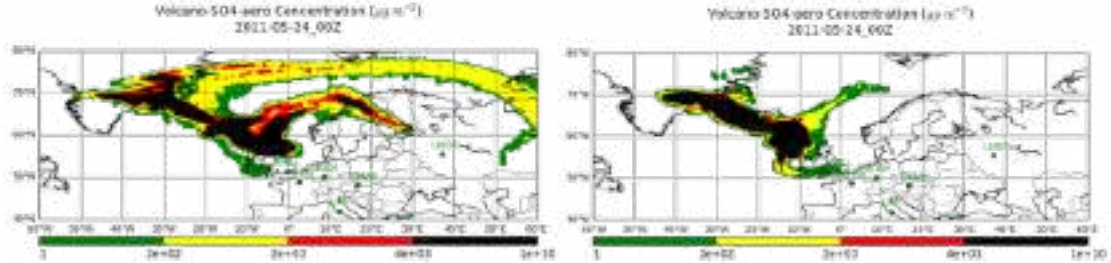
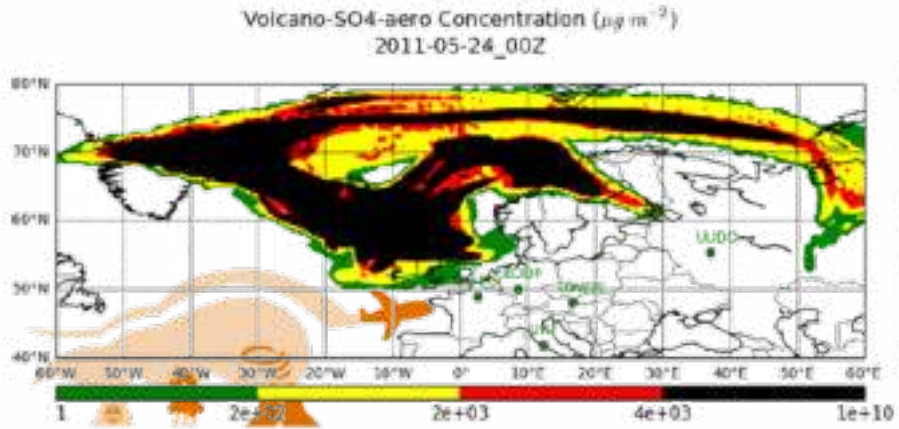
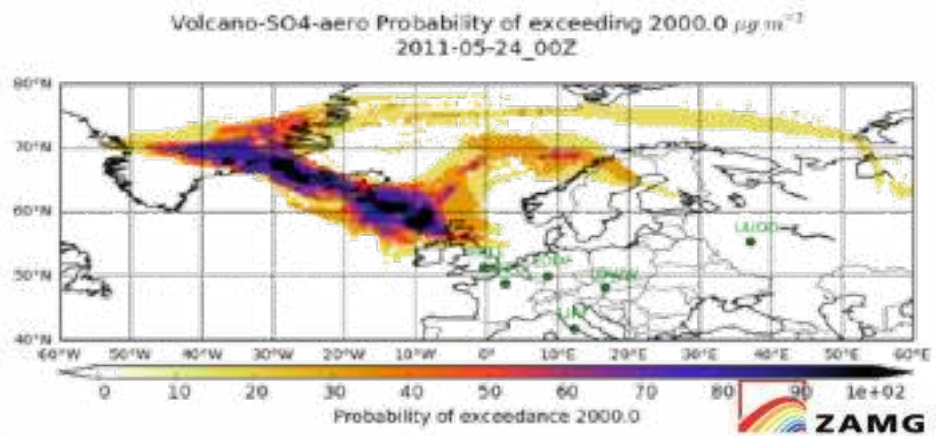
Example Results





Examples of Representative Members





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Literature (Selection)

- Arnold et al., 2004
- Stebel et al., 2004
- M.Meila 2007 Comparing clusterings – an information based distance
- Mastin et al., 2009
- Maurer et al., 2013
- Stohl et al., 2011 Uncertainties in the inverse modelling of sulphur dioxide eruption profiles, Geomagnetics, Natural Hazards and Risk, 2(3) 201-216
- R.Klonner (Master Thesis) 2013 Clustering ECMWF ENS ensemble predictions to optimise FLEXPART plume dispersion ensembles
- E.Moxnes (Master Thesis) 2013 Estimating the sulphur dioxide and ash emissions from the Grimsvötn 2011 volcanic eruption and simulating their transport across Northern Europe

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