

EUNADICS-AV: Lessons learnt

Barbara Scherllin-Pirscher and the EUNADICS-AV team

20 May 2021

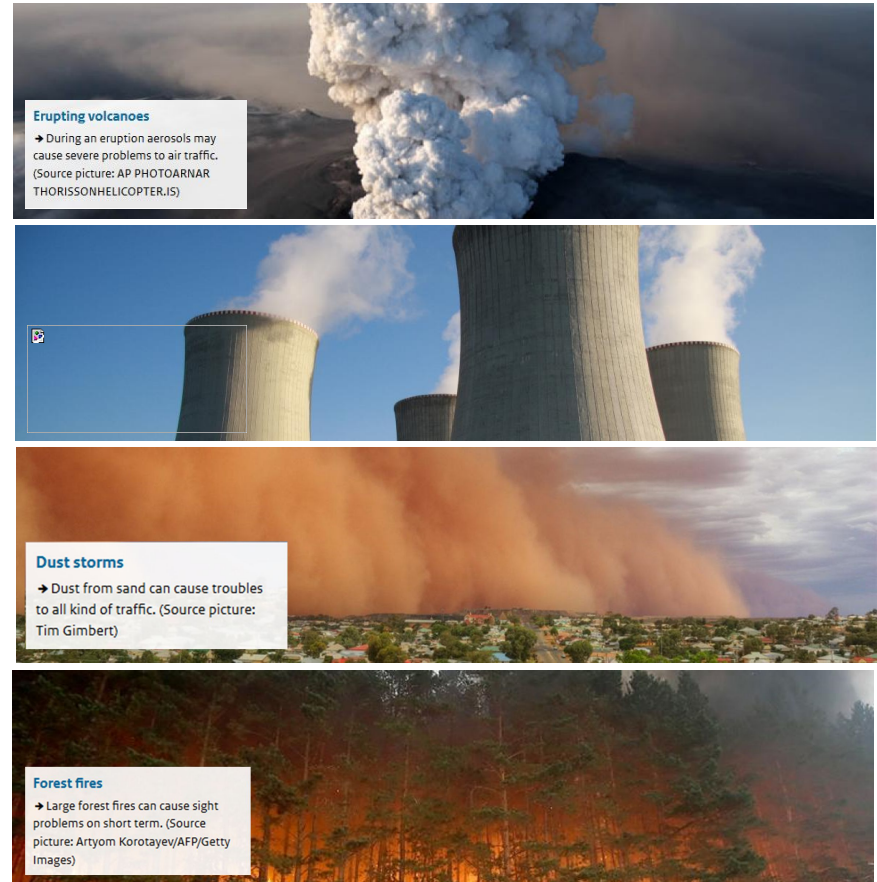
inDust User Workshop on Dust Products for Aviation



ZAMG
Zentralanstalt für
Meteorologie und
Geodynamik

Key challenges

- Rare events
- High uncertainty in source terms
- Sensitivity to dispersion models
- Availability and variety of observations
- Identification of key products for stakeholders



Problems in aviation

- Poor visibility
- Often associated with strong winds
- Mechanical problems
- Ice nucleation
- Disturbances in airport operations
 - Outside workers
 - Cleanup: remove sand/dust from runways and other critical areas
- Rerouting
- Cancellations of scheduled flights
- Maintenance costs

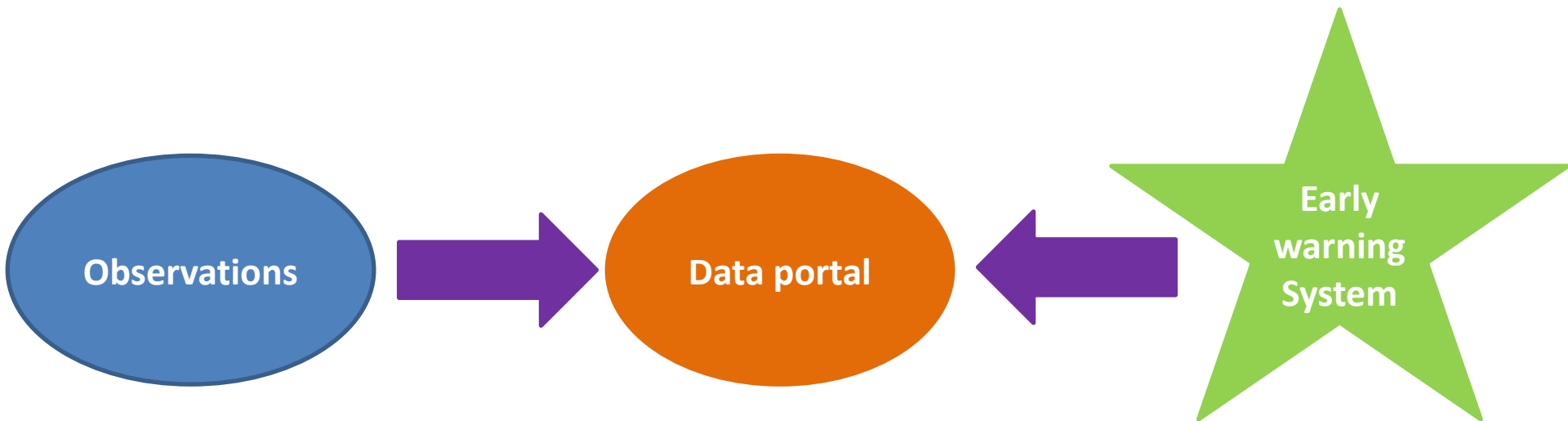


Source:

<https://www.dabangasudan.org/en/all-news/article/ha-boob-blankets-sudan-capital-shuts-down-airport>

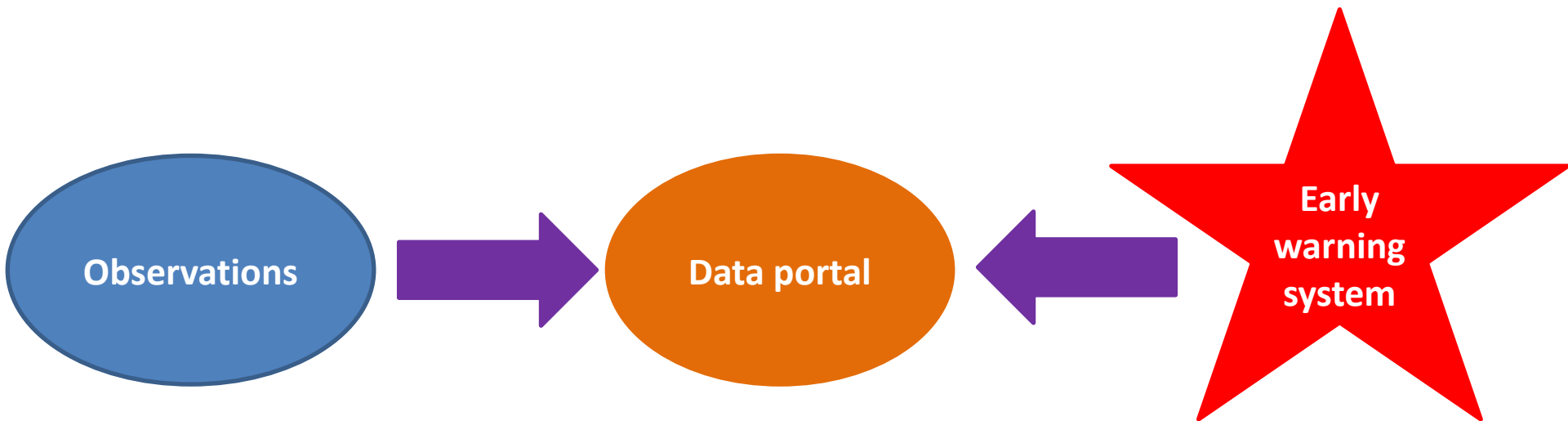
Monitoring, pre-alert phase

- **Observational infrastructure:** collection, tailoring, documentation, distribution of observational data
- **Early warning system:** Early warning messages and triggering of the EUNADICS-AV modelling chain based on observational data



Monitoring, pre-alert phase

- **Observational infrastructure:** collection, tailoring, documentation, distribution of observational data
- **Early warning system:** Early warning messages and triggering of the EUNADICS-AV modelling chain based on observational data



Early warning system triggers.....

- **Data integration and assimilation:**

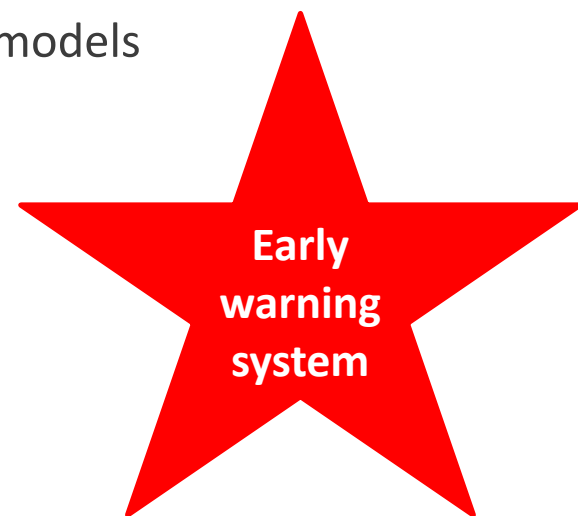
- Source-term estimates (location & strength) based on observations
- Assimilation of relevant observations into numerical models

- **Aviation product development and integration:**

- Collection of model data
- Computation of model ensemble
- Generation of output concentration charts
- Processing for air traffic management

- **Data and product delivery:**

- Distribution of relevant products and visualization of different data sets in a harmonized way
- Interface between EUNADICS-AV products and end users





Multi-model ensemble

- Probabilistic assessment of the hazard
- Percentiles of 50 %, 75 %, 99 %
- Uncertainty of the analyses

Products

- Output charts
 - FL grid
- Tailored products
 - Arrival time
 - Isolines for
 - * 4.0 mg/m³
 - * 2.0 mg/m³
 - * 0.2 mg/m³

Air traffic management

- Based on plane trajectories
- Exposures
- Doses
- Rerouting

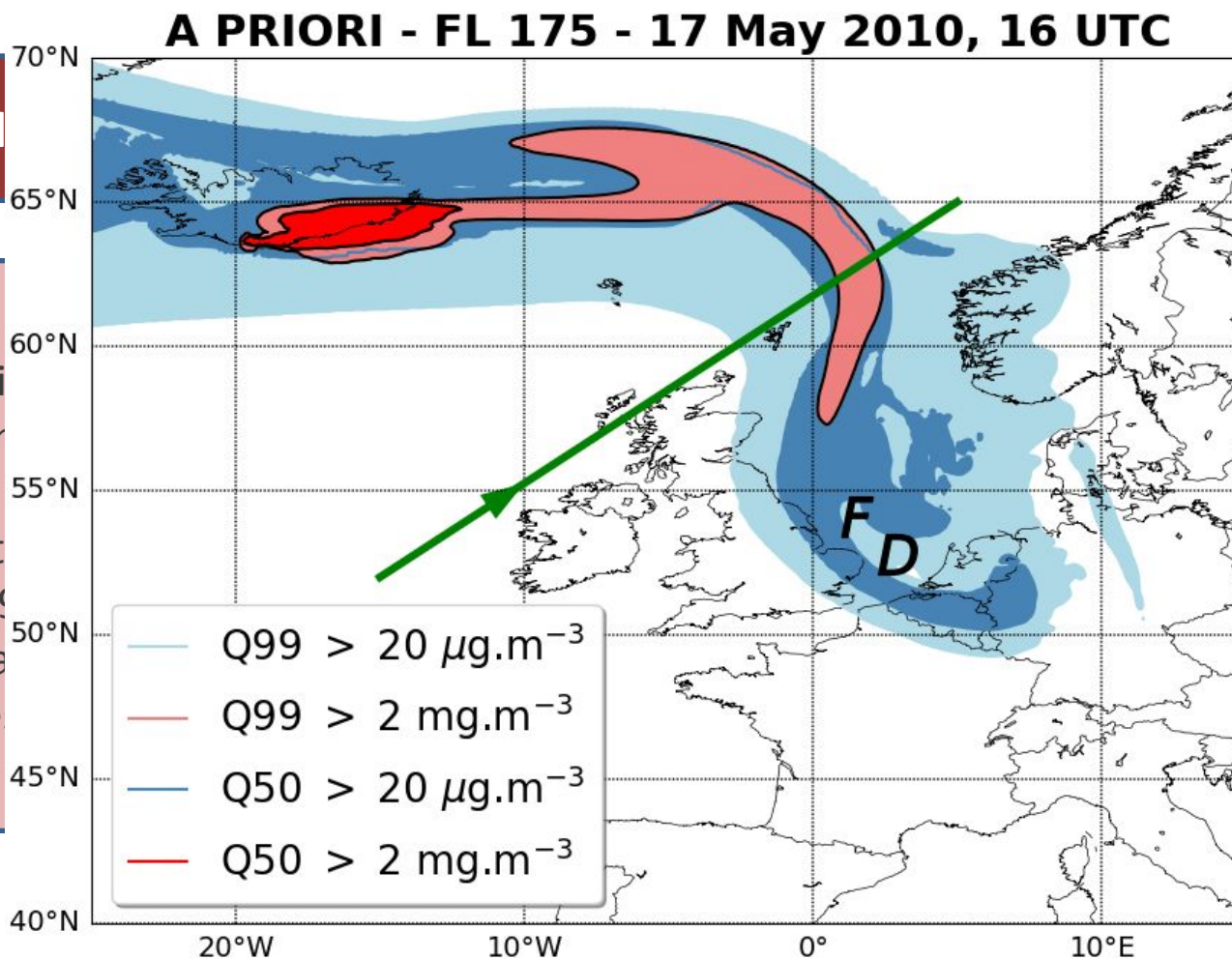
Model data flow

Multi-model

- Probabilistic assessment of hazard
- Percentiles 75 %, 95 %
- Uncertainty analysis

Management

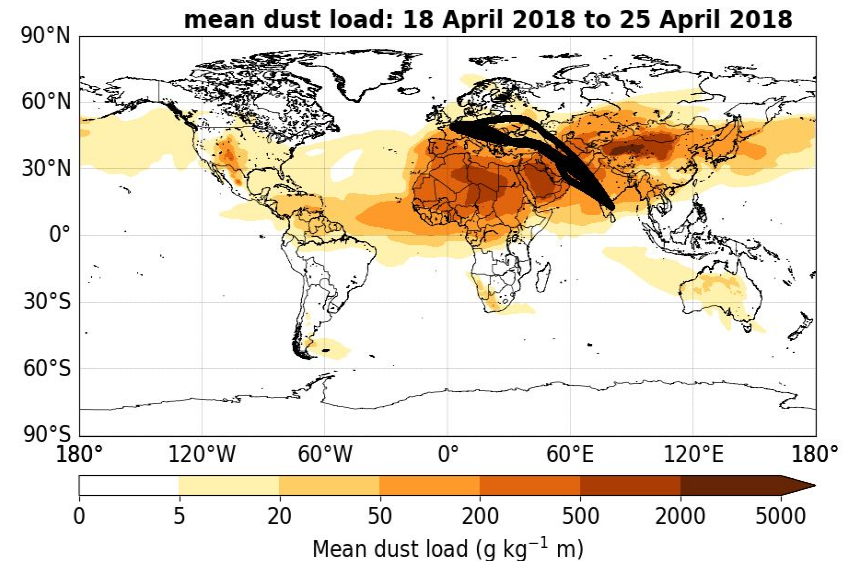
plane
es
s
g



Plu et al. (2021, NHESS, in discussion)

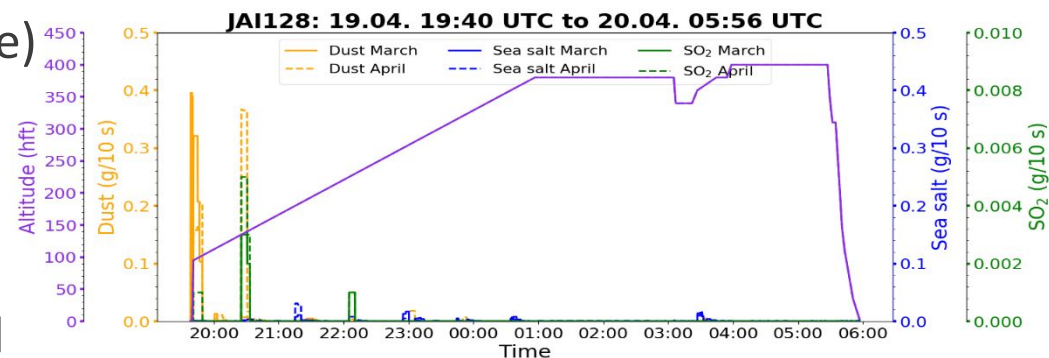
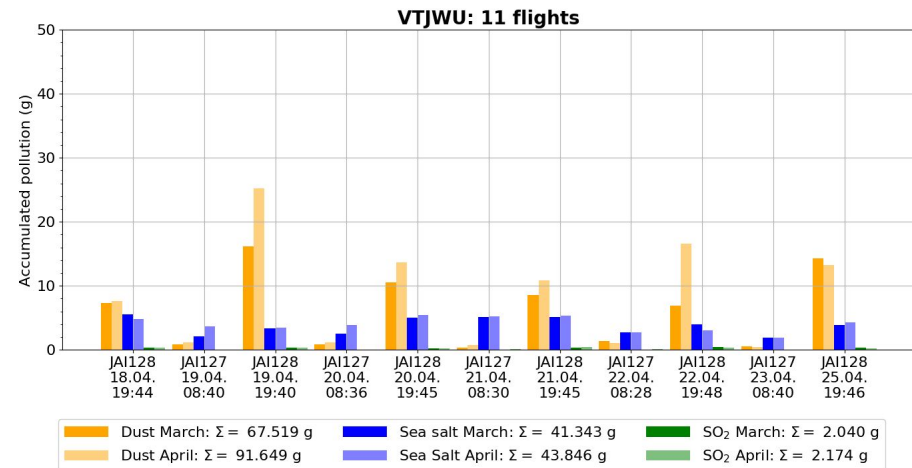
Maintenance costs

- Dust concentration on 13 flight levels in March & April 2018
- Flight traffic: 18 to 25 April 2018 (ECAC area, 9806 individual aircraft, 195802 flights)
- Accumulated dust mass of each engine based on March/April dust concentration
- High dust load for VTJWU (Airbus 330-300 with 2 engines; 11 flights; Paris ☐ ☐ Chennai)



Maintenance costs

- JAI 127: Paris ☐ Chennai
- JAI 128: Chennai ☐ Paris
- Highest dust load during:
 - takeoff in Chennai due to
 - high dust concentration and
 - high fuel consumption
- Highest dust load for flight JAI128 on 19 April 2018 (25 g per engine)
- Up to 5000 € loss
 - Assumption:
 - 1 kg dust per engine costs between 50 000 € and 100 000 €





Challenges:

- Critical issue: Availability and use of **real-time measurements in atmospheric dispersion modeling**
- Need for: **more measurements**, which can represent the hazard along the vertical (Lidars, profilers)
- Large **differences in model output**
 - Need to further reduce the uncertainties in models
 - Ensemble approach is needed to assess uncertainties



Benefits:

- **Established network** (scientist, aviation, military,...)
- **Harmonized data** in single environment
- **Interfaces** between observations – modeling – ATM
- Precise **engine damage cost prediction** is possible, allowing fully automated cost optimization through contaminated areas
- **Huge potential cost saving**, both in large-scale events and in day-to-day operations



Thank you for
your attention!