

EUNADICS-AV: Project on aviation hazards

Part I: Introduction and modeling approach

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Eruption of the Eyjafjallajökull volcano in Iceland

April 14:

- Increasing volcanic activity
- Explosive eruptions
- Ejection of fine ash

Ash was advected towards continental Europe

Major disruptions of the air traffic



Source: Patrick Nielsen

Motivation: Eruption of the Eyjafjallajökull volcano



Eruption:

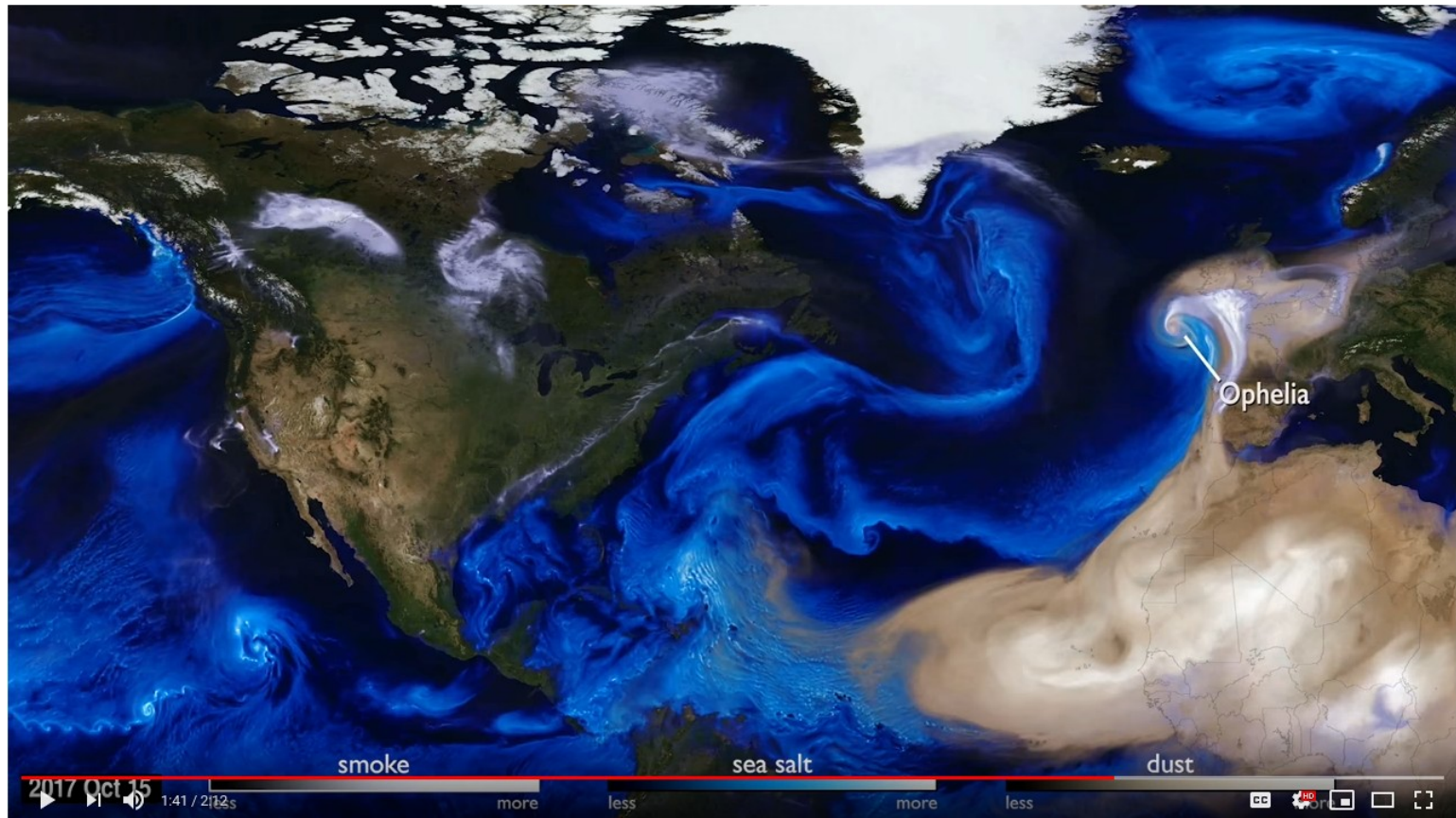
- was a relatively small but...
- ...the volcano's ash spread unusually far and stayed for long time in the atmosphere

Impact:

- over 100 000 flights were canceled from April 15 to 21, 2010
- 7 million passengers were affected
- 1.7 billion USD in lost revenue to airlines
- highest level of air travel disruption since World War 2

Motivation: Ophelia 2017

Saharan dust and Iberian wildfires: October 15, 2017





Saharan dust & Iberian wildfires:

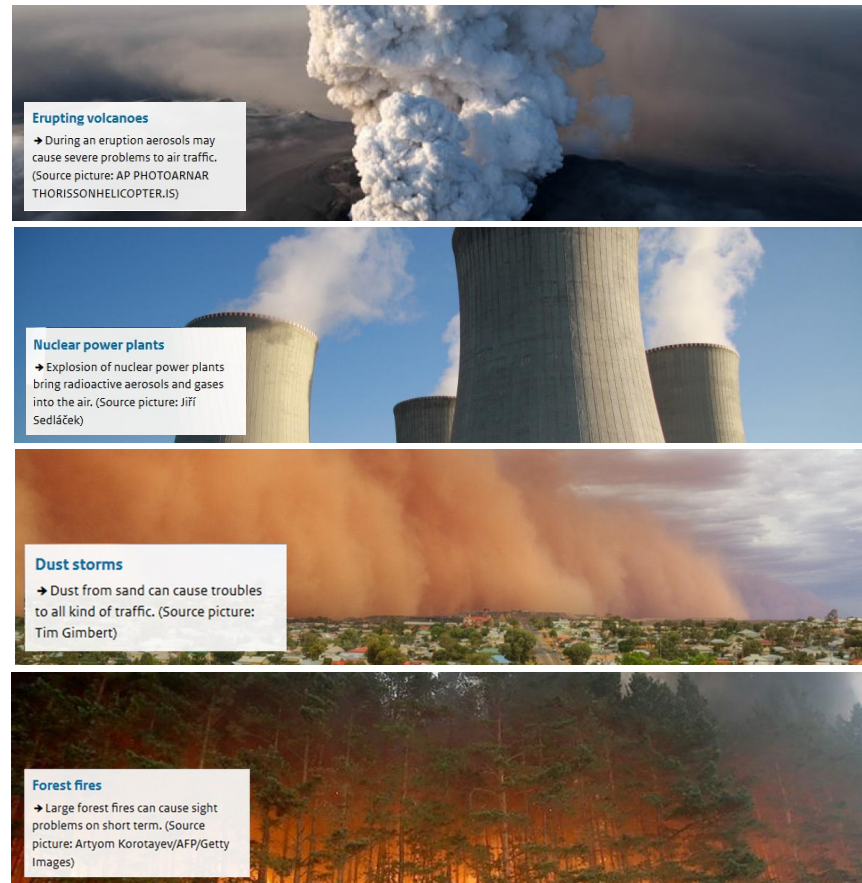
- Strong wind from the south in October 2017...
- ...debris from Iberian wildfires
- ...and Saharan dust
- Reddish sky across parts of England

Impact:

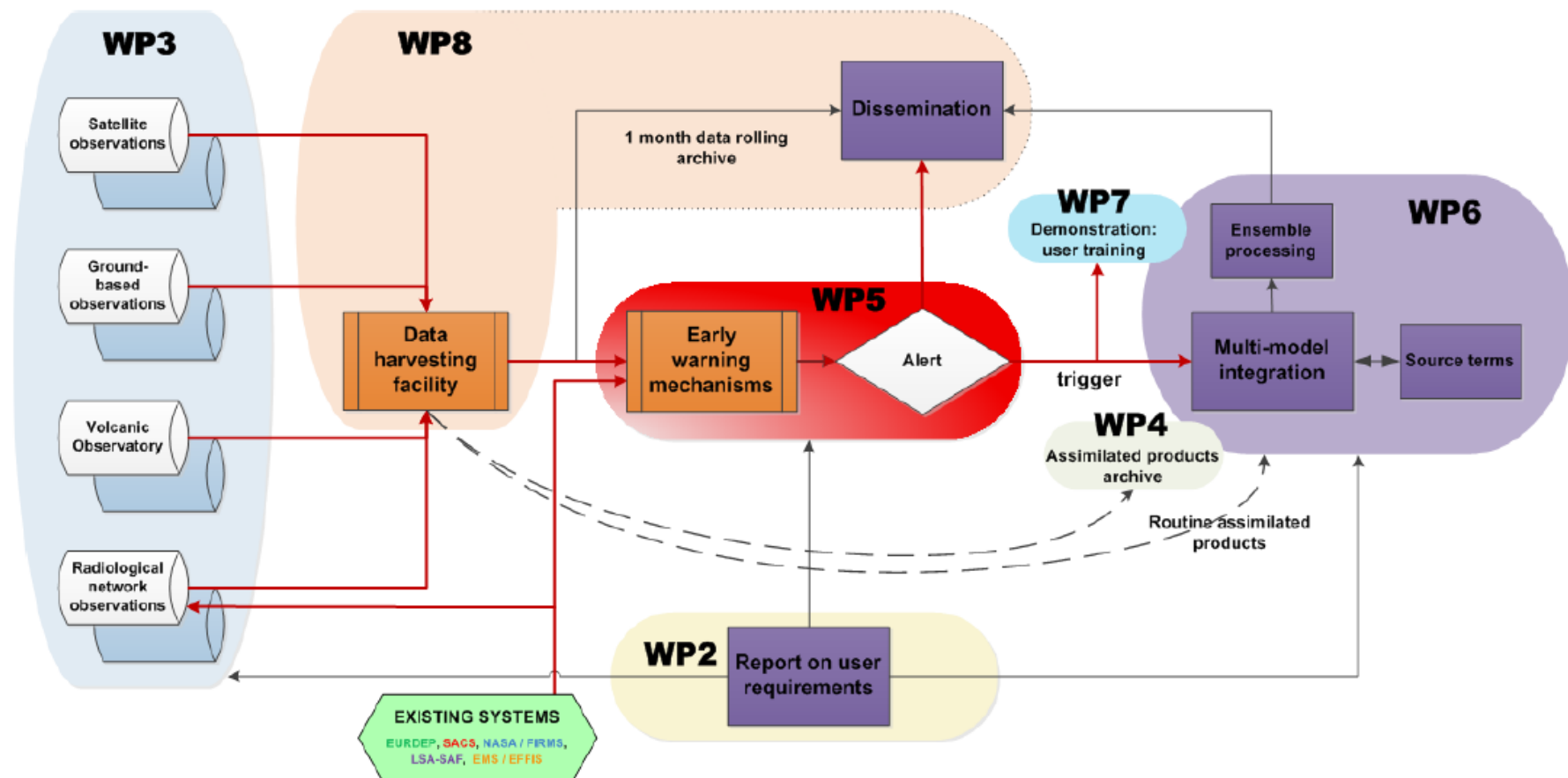
- Report of smoke smells on several flights
- A number of flights have been forced to land or divert
- Precautionary landings following smells in the cockpit of airplanes

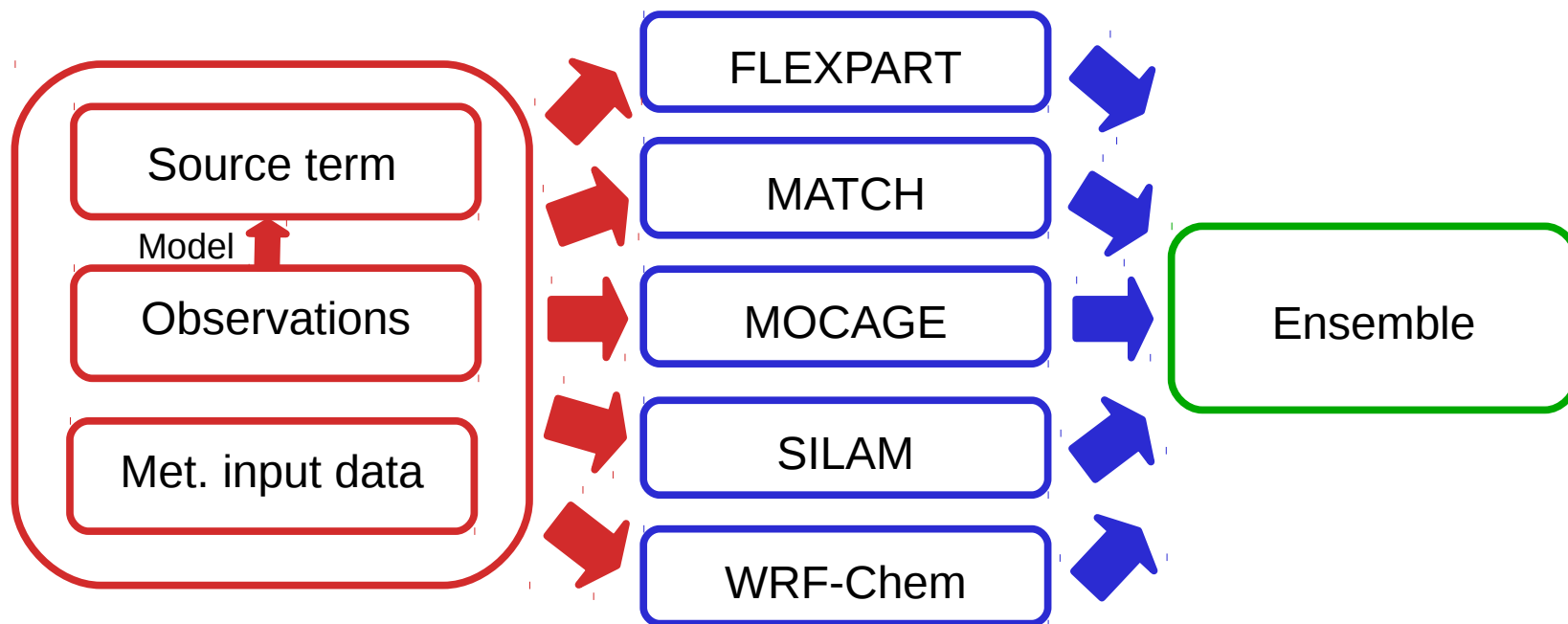
Key challenges:

- Rare events
- High uncertainty in source terms
- Sensitivity to dispersion model
- Availability and variety of observations
- Identification of key products that stakeholders would like to use



Processing chain





Multi-source multi-model ensemble to:

- assess the uncertainty of the analyses
- provide a probabilistic assessment of the hazard

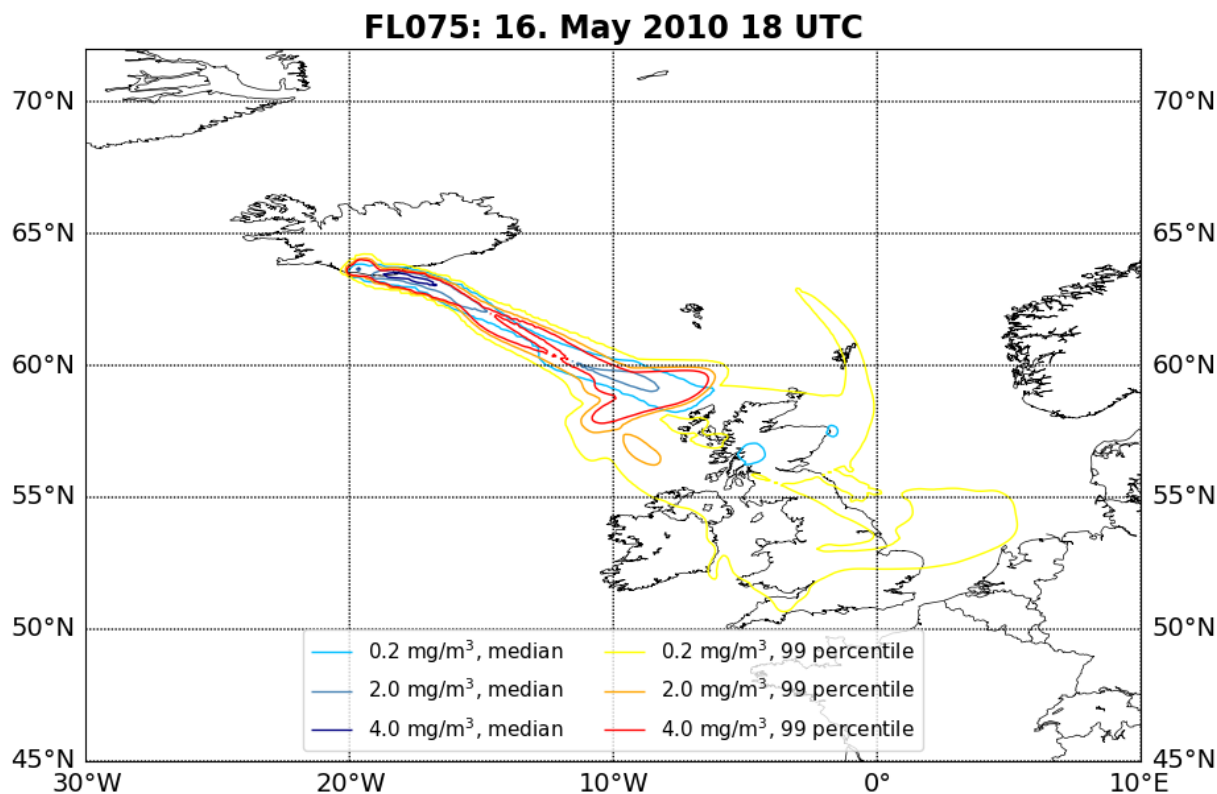
EUNADICS-AV: Multi-source multi-model ensemble

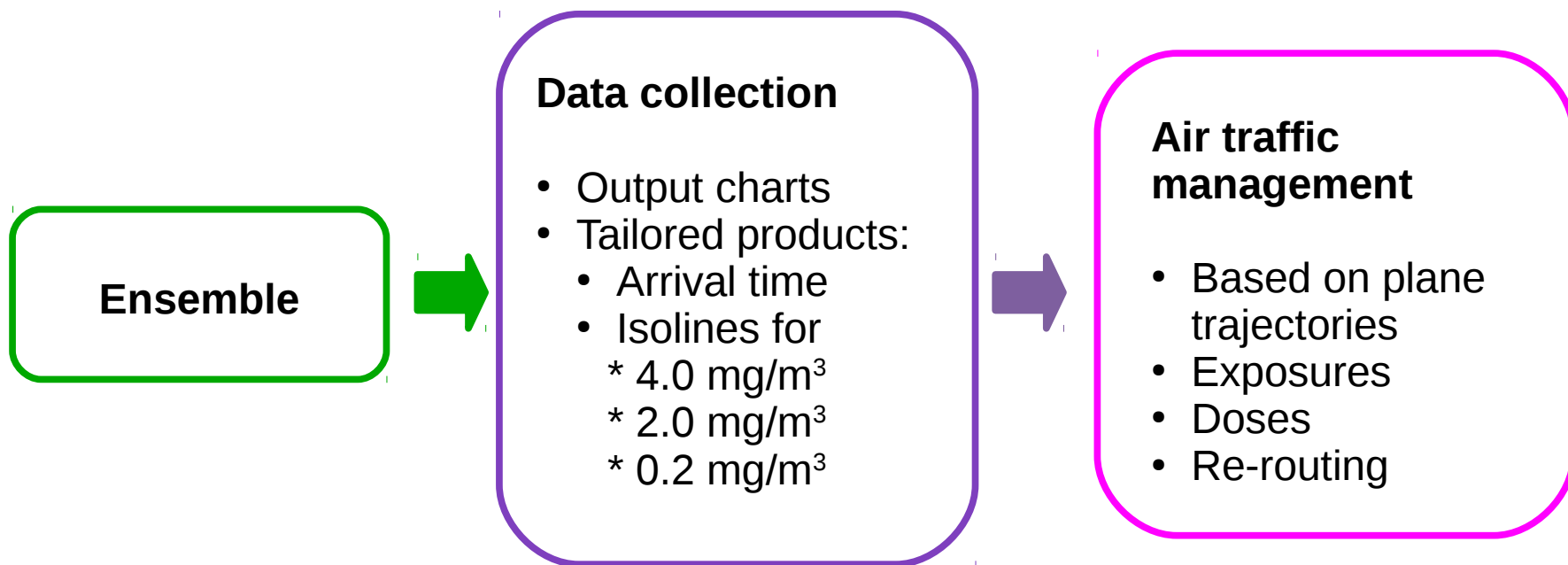


4D-Ensemble	Vertical Grid		Horizontal Grid	Scenarios
Aerosol concentrations <ul style="list-style-type: none"> Volcanic ash (<63 μm) Desert dust Forest fires 	Coarse vertical grid <ul style="list-style-type: none"> FL200 FL350 FL550 	Fine vertical grid <ul style="list-style-type: none"> FL50 FL100 FL150 FL200 FL250 FL300 FL350 FL400 FL450 FL500 FL550 FL600 FL650 	Global Domain: <ul style="list-style-type: none"> 1° x 1° resolution Extended EU domain: <ul style="list-style-type: none"> 0.1° x 0.1° resolution 	Ensemble of models Percentiles of <ul style="list-style-type: none"> 50 % 75 % 99 %
Gas concentrations <ul style="list-style-type: none"> SO₂ 				
Radionuclides Activity concentrations Deposited activity concentration				

Ensemble answer?

- consensus: mean / median of all models
- worst-case: maximum of all models
- uncertainty: difference, e.g., 75 % - 25 %







- Availability & use of real-time measurements in atmospheric dispersion modeling remains a critical issue
- Need more measurements, which can represent the hazard along the vertical (such as lidars, and also profiles from satellite sounders)
- Large differences in model output
 - Need to further reduce the uncertainties in models
 - Ensemble approach is needed to assess uncertainties
- Precise engine damage cost prediction is possible, allowing fully automated cost optimization through/around contaminated areas
- Huge potential cost savings, both in large-scale events and in day-to-day operations