

# VolcATS

## Volcanic ash impact on the Air Transportation System

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Knowledge for Tomorrow



# VolcATS – idea and goals



1. **Detection + short-term forecasting of ash-free and ash-contaminated regions based on satellite data,**

Analysing the value of „**visible ash**“ by radiative transfer calculations

2. **In-situ SO<sub>2</sub> and particle sensor development for airliners**

3. Development of **ATM-procedures** for a fast response of the **air transportation system on volcanic ash in airspace**

4. Impact of volcanic ash on **aircraft (engines, sensors),** definition of **standardized artificial volcanic ash**

## **DLR-wide project:**

- Institute of Atmospheric Physics  
[Incl. Meteorological Institute Munich (MIM/LMU)]
- Institute of Flight Guidance
- Institute of Air Transportation Systems
- Institute of Aerodynamics and Flow Technology
- Institute of Flight Systems
- Institute of Material Research

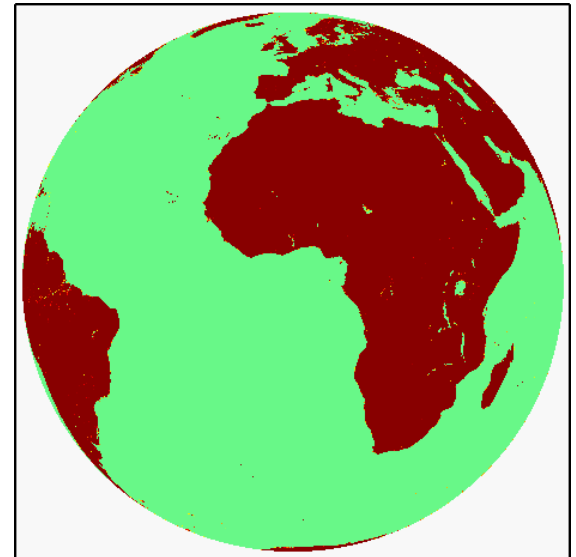


# VolcATS – idea and goals

**Algorithm for ash detection** is based on **SEVIRI**

aboard **Meteosat**, since:

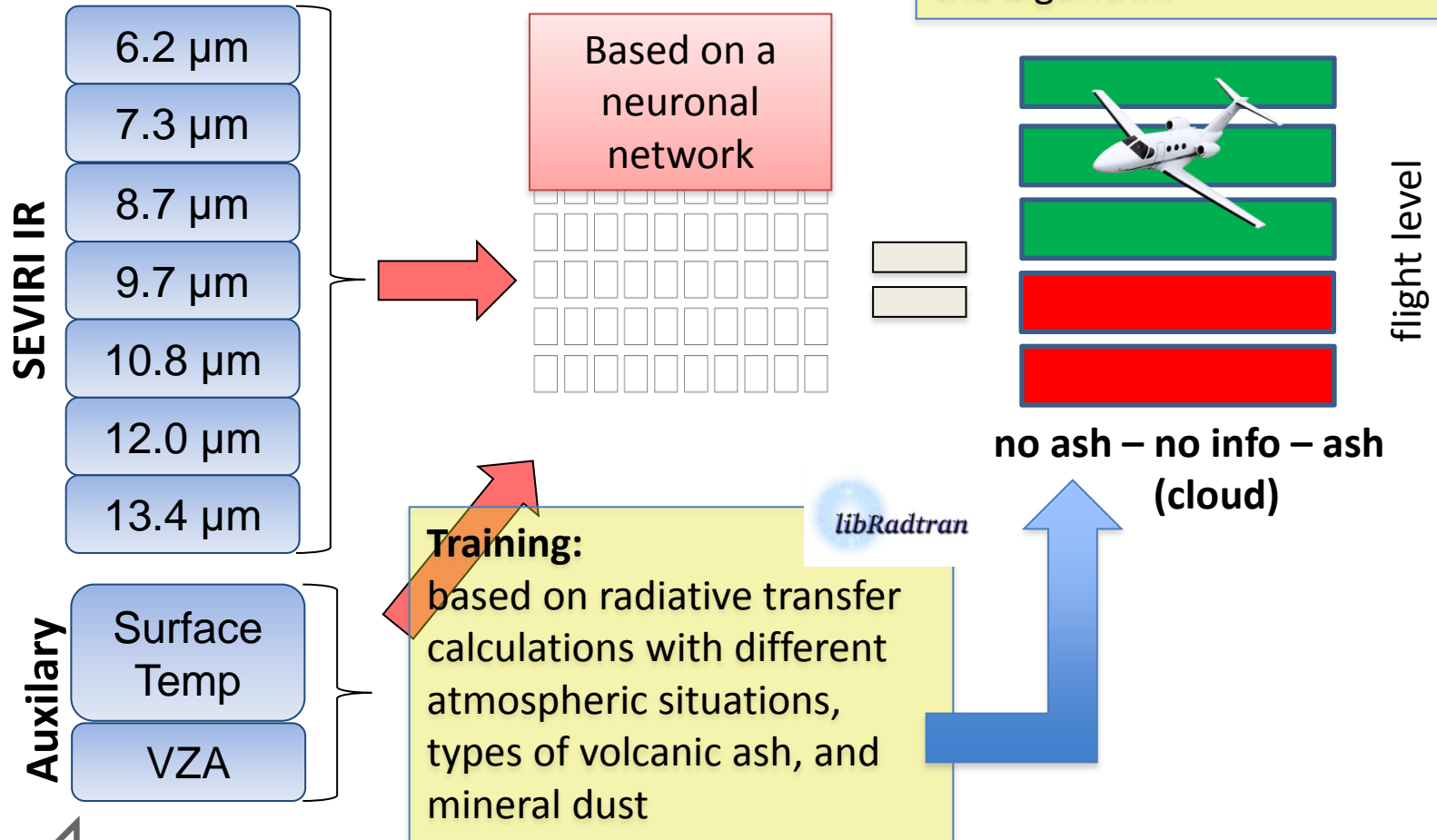
- High temporal and spatial resolution
- 7 channels located in the thermal infrared allow day/night observations
- Operational and high / fast data availability
- Existing expertise in DLR/IPA
- Sensitivity of SEVIRI measurements on VA already proven
- HIMAWARI-8 (2014) and GOES-R (2016) 2 additional SEVIRI-like instruments will be in geostationary orbits  
→ almost global coverage



# VADUGS

## Volcanic Ash Detection Utilizing Geostationary Satellites

Highly sensitive **cirrus cloud retrieval** (COCS) supports the algorithm

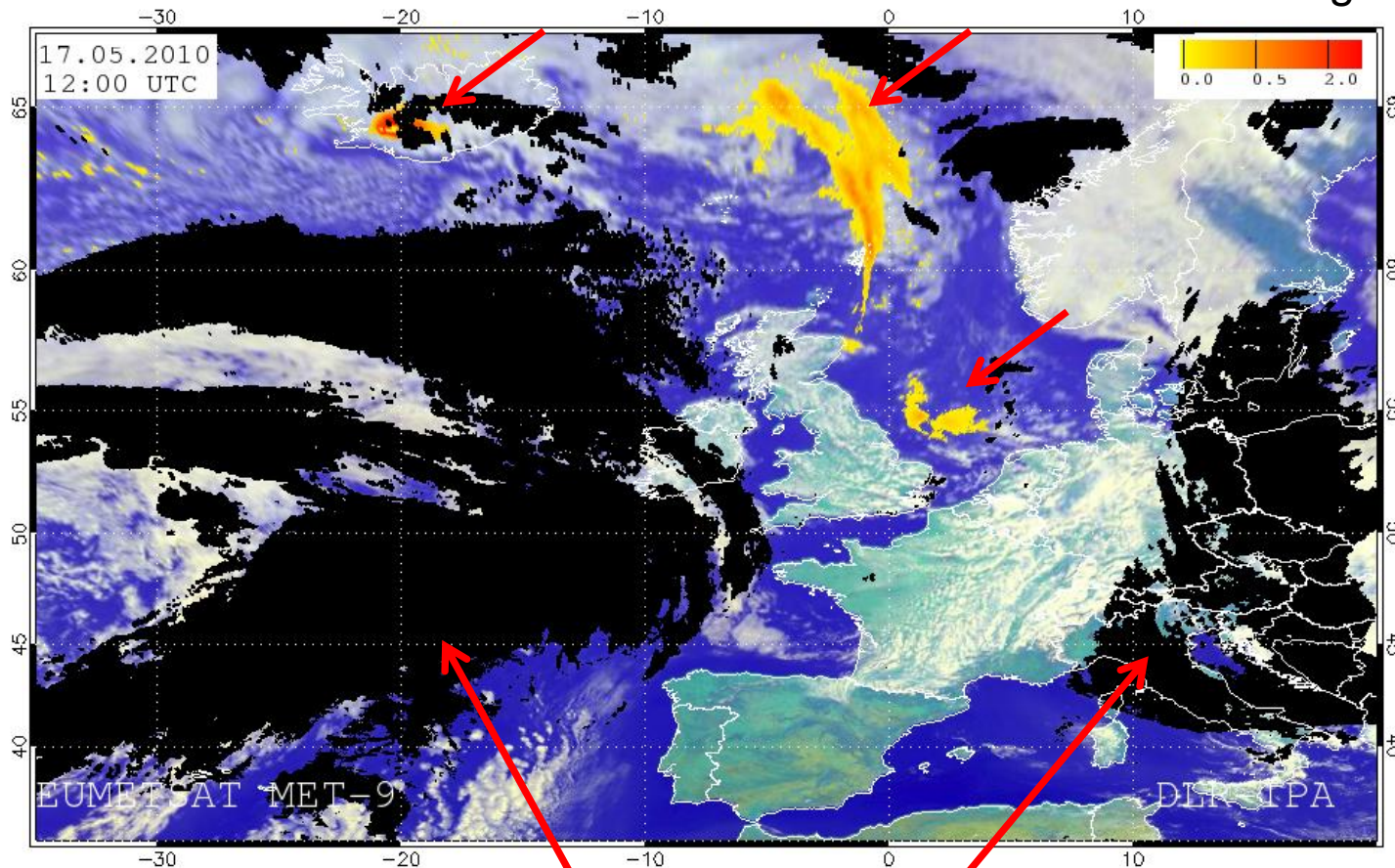


# VADUGS + COCS on 17th May 2010

Volcanic ash  
column concentration

Cirrus

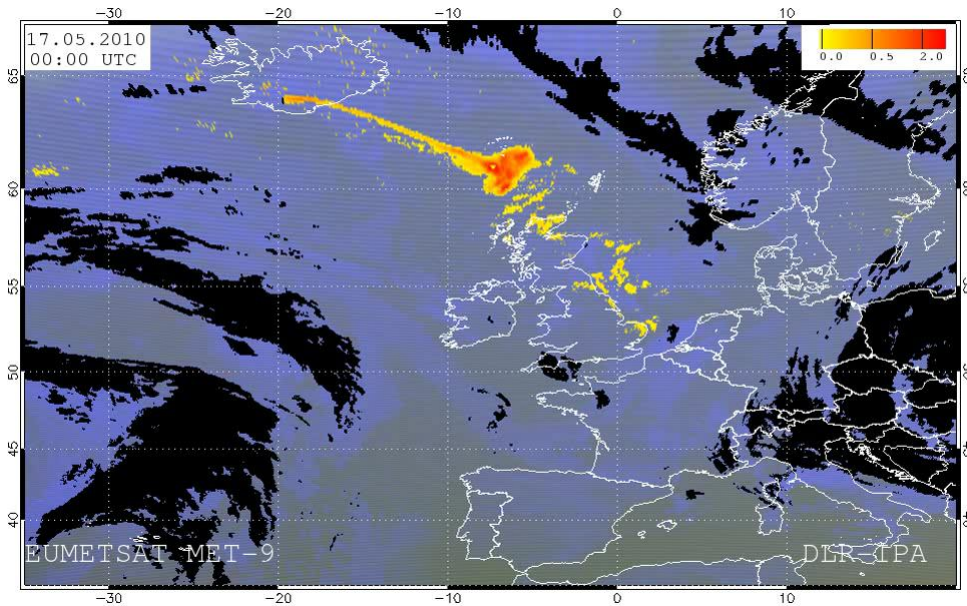
in  $10^{-3} \text{ kg/m}^2$



**Cirrus clouds**



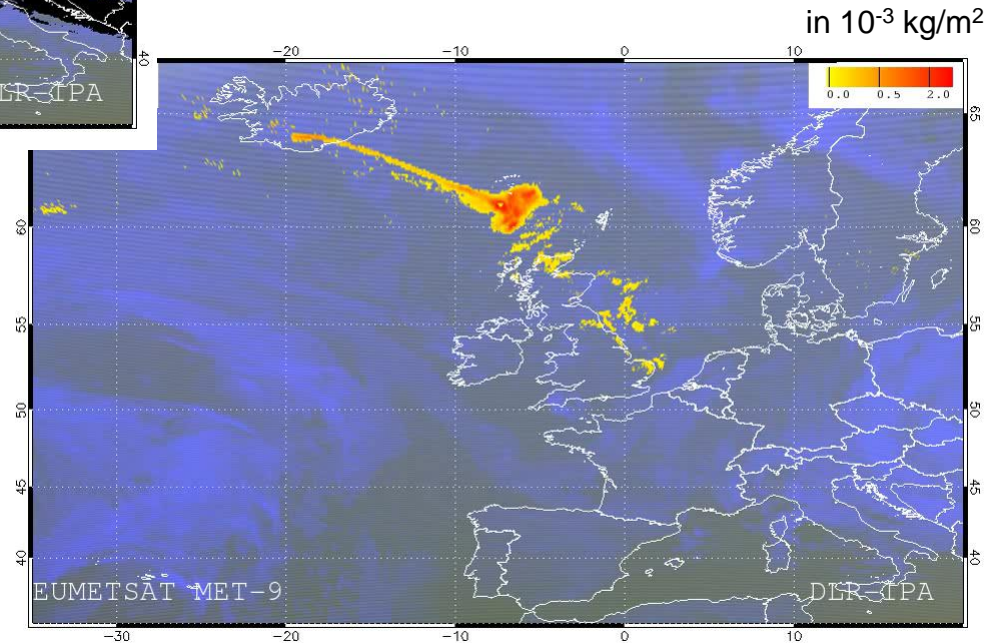
# VADUGS + COCS on 17th May 2010



in  $10^{-3} \text{ kg/m}^2$

Sensitive to ash with a volume concentration of  $100 \mu\text{g} / \text{m}^3$

volume concentrations have to be estimated assuming vertical distribution of ash, depth of ash layer, etc.



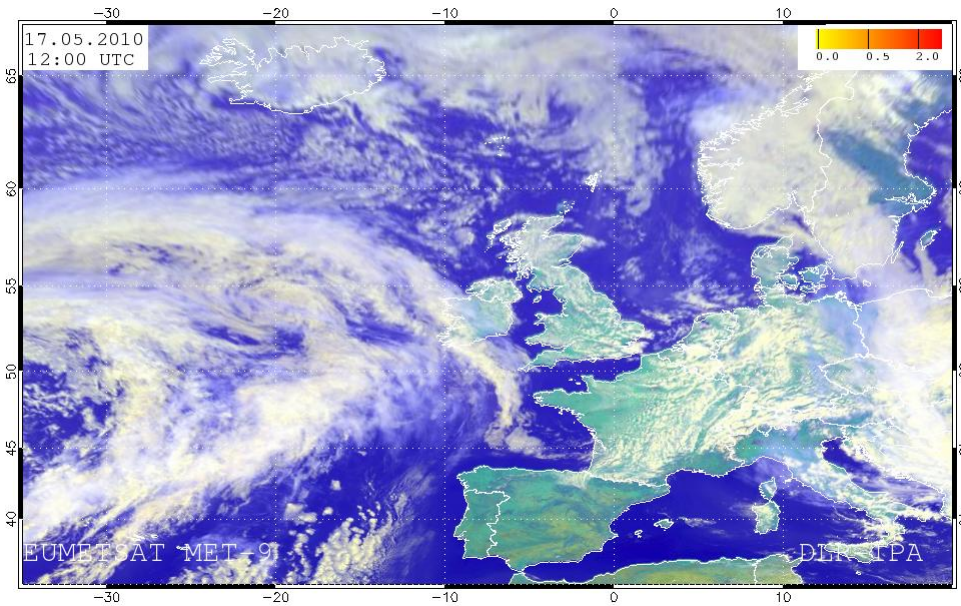
in  $10^{-3} \text{ kg/m}^2$

Currently derives **column concentrations of ash**

here: trained with spectral properties of ash of the Eyjafjalla-Eruption in 2010



# VADUGS + COCS on 17th May 2010



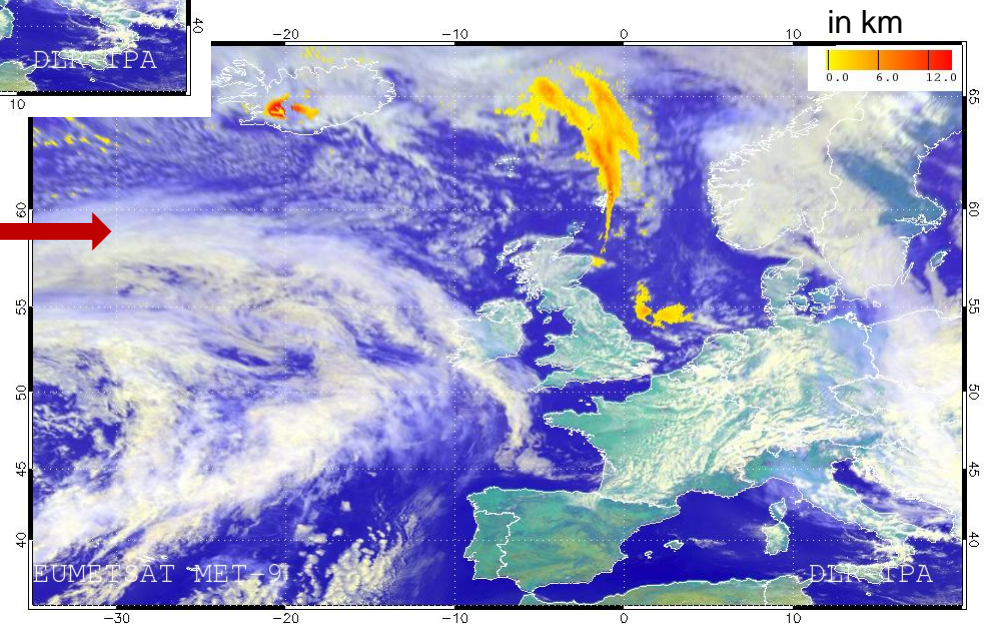
in  $10^{-3} \text{ kg/m}^2$

Sensitive to ash with a volume concentration of  $100 \mu\text{g} / \text{m}^3$

**Top altitude of ash layer**



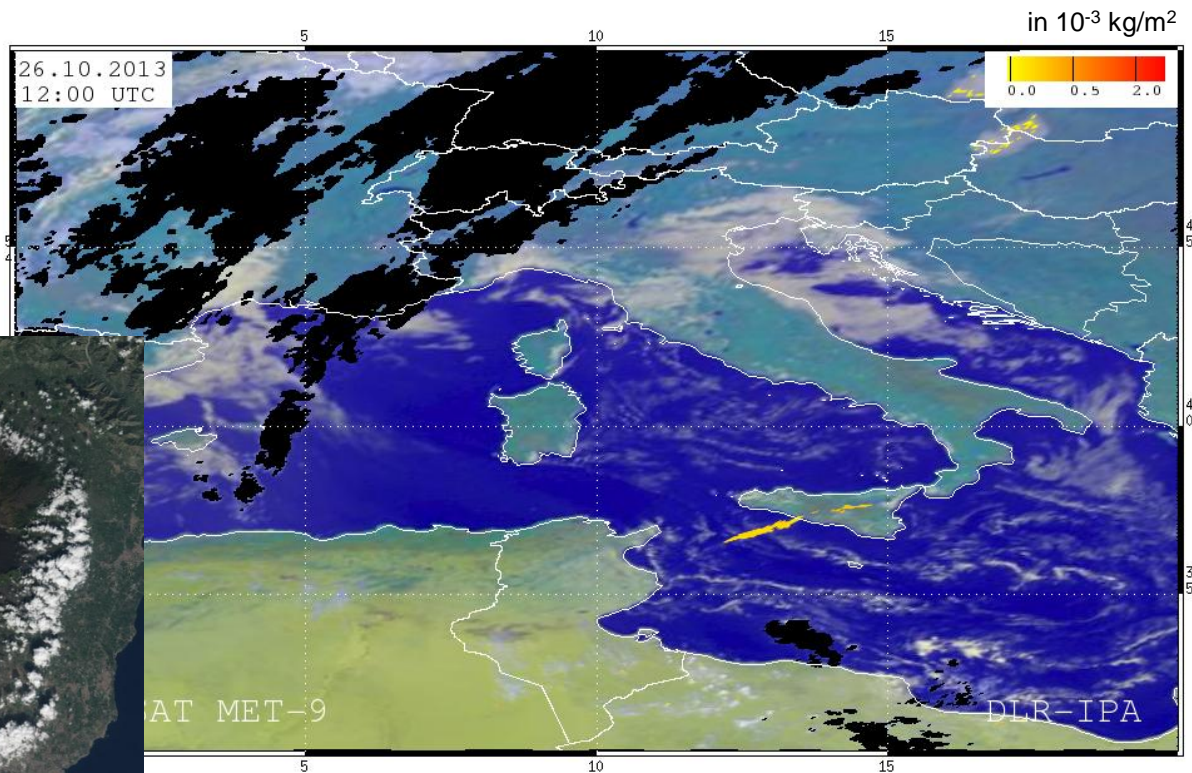
here: trained with ash of the Eyjafjalla-Eruption in 2010



# VADUGS + COCS, October 2013

## Etna eruption

©B. Behncke (volcanologist at the Osservatorio Etneo)



©NASA, Landsat-8





# Requirements for mini-sensors for in-service aircraft

- compact, robust, and light-weight design (few kg)
- low power consumption
- small sensitivity drift with time
- detection limit suitable for volcanic cloud measurements
- high time resolution (few seconds)
- no or quantifiable cross-sensitivities
- large maintenance intervalls (> 6 months)
- acceptable market prize



# Conclusions

- DLR's activities during the Eyjafjalla eruption formed the bases for the VolcATS project.
- VolcATS meets many needs of aviation industries (from engine simulations over in-flight sensors to spaceborne ash detection and forecasting)
- Work on sensors continues
- Satellite retrieval still needs to be further improved and extended
- Planned and partly already agreed cooperations with German Flight Control and German Weather Service on „bringing VADUGS + COCS in operational service“.
- On-going airborne validation and measurement activities (volcanic ash and mineral dust)

