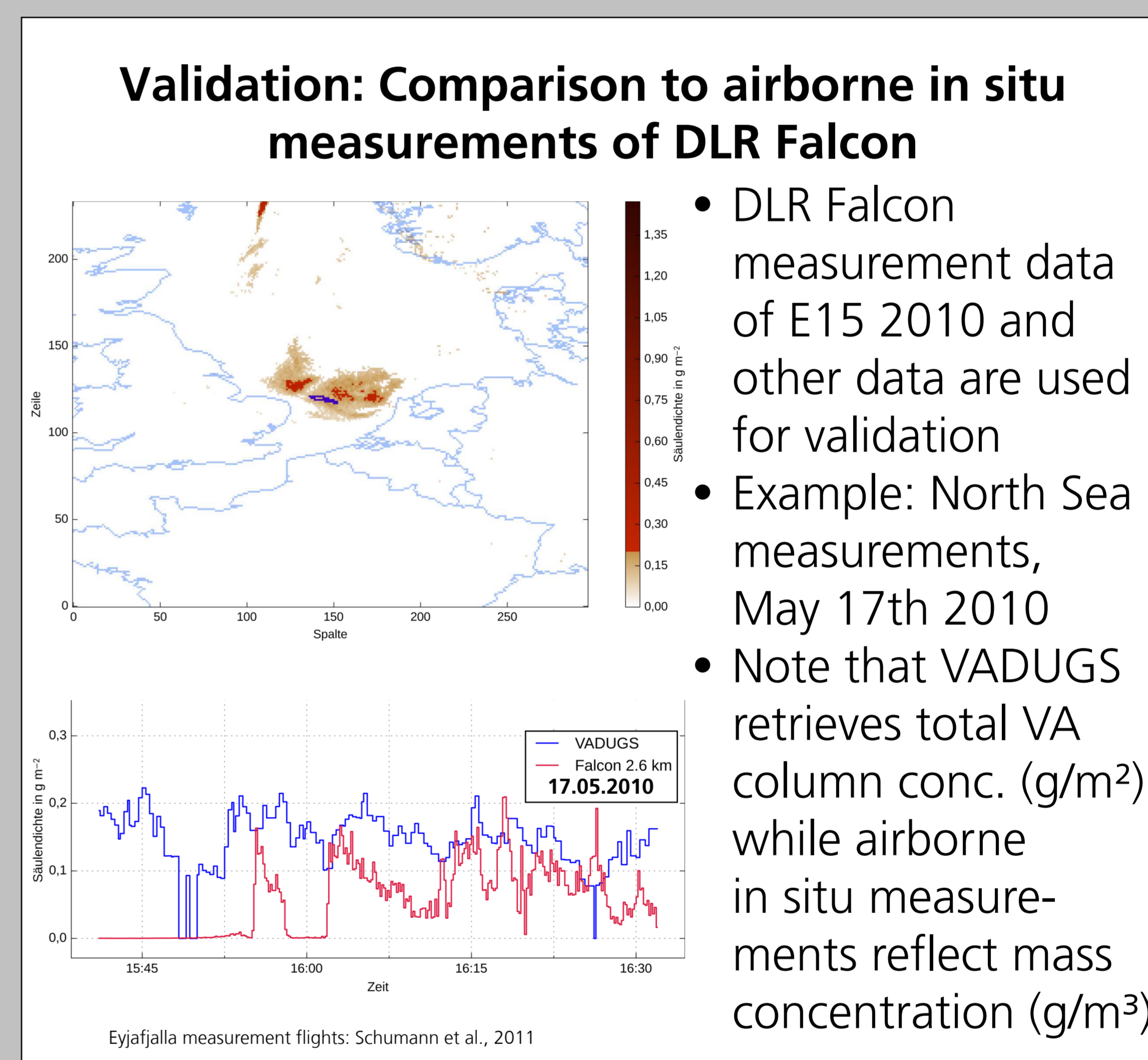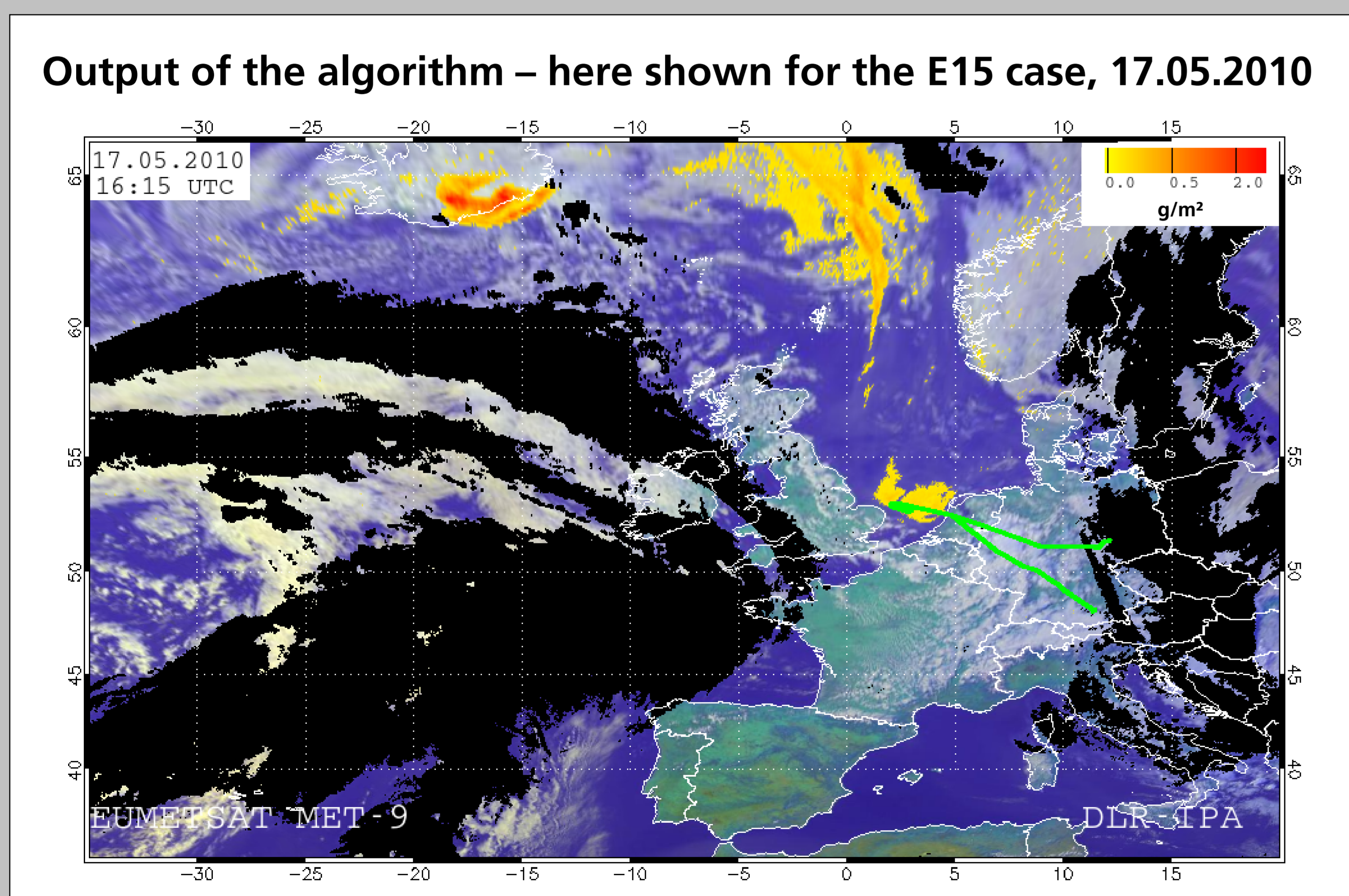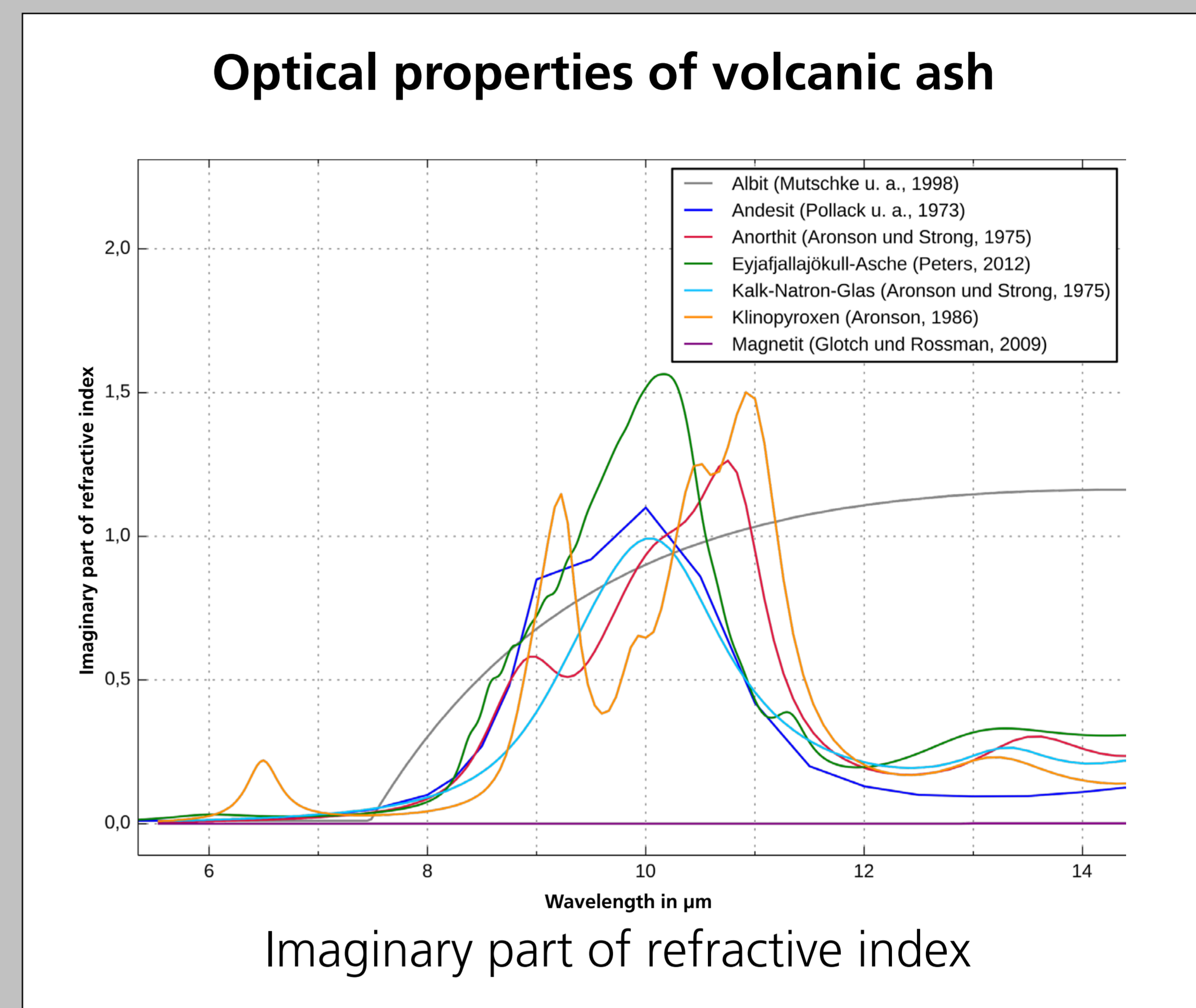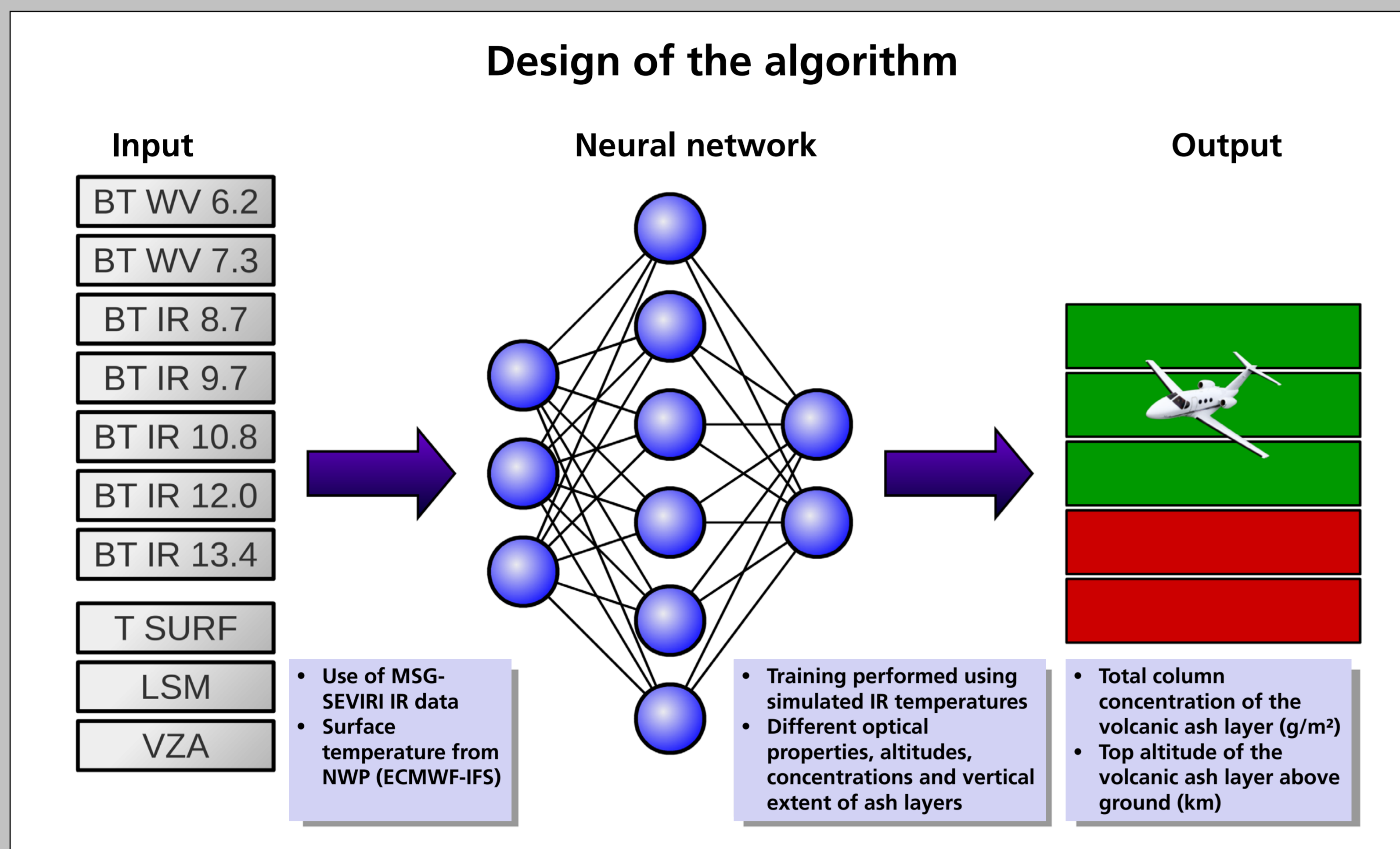# Detection of volcanic ash clouds in MSG-SEVIRI IR data based on an neural network approach and comparison with in situ measurement data of DLR-Falcon

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We present the current state of the VADUGS algorithm (Volcanic Ash Detection Utilizing Geostationary Satellites). The algorithm is based on a backpropagation neural network, trained by simulated brightness temperatures for the SEVIRI channels. The algorithm is designed to reveal information on the column mass concentration (g/m²) and top altitude of volcanic ash layers. Results are compared with in situ airborne measurements of volcanic ash concentrations performed during the E15 eruption period in 2010.

Design of the algorithm

Input
- BT WV 6.2
- BT WV 7.3
- BT IR 8.7
- BT IR 9.7
- BT IR 10.8
- BT IR 12.0
- BT IR 13.4
- T SURF
- LSM
- VZA

• Use of MSG-SEVIRI IR data
• Surface temperature from NWP (ECMWF-IFS)

Neural network

• Training performed using simulated IR temperatures
• Different optical properties, altitudes, concentrations and vertical extent of ash layers

Output

• Total column concentration of the volcanic ash layer (g/m²)
• Top altitude of the volcanic ash layer above ground (km)

Optical properties of volcanic ash

Albit (Mutschke u. a., 1998)
Andesit (Pollack u. a., 1973)
Anorthit (Aronson und Strong, 1975)
Eyjafjallajökull-Asche (Peters, 2012)
Kalk-Natron-Glas (Aronson and Strong, 1975)
Klinopyroxen (Aronson, 1986)
Magnetit (Glotch und Rossman, 2009)

Imaginary part of refractive index

Output of the algorithm – here shown for the E15 case, 17.05.2010

17.05.2010
16:15 UTC

0.0   0.5   2.0
g/m²

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Validation: Comparison to airborne in situ measurements of DLR Falcon

• DLR Falcon measurement data of E15 2010 and other data are used for validation
• Example: North Sea measurements, May 17th 2010
• Note that VADUGS retrieves total VA column conc. (g/m²) while airborne in situ measurements reflect mass concentration (g/m³)

VADUGS
Falcon 2.6 km
17.05.2010

Eyjafjalla measurement flights: Schumann et al., 2011

Results of the WMO Intercomparison: Examples

VADUGS vs. EUMOP

VADUGS vs. NOAA

Image: Richard Siddans, Rutherford Appleton Lab. // WMO

• Column concentration values: VADUGS is rather close to NOAA and gives a factor of ~5 smaller values than EUMOP
• General performance with respect to ash load looks promising; however, quality of VADUGS top altitude retrieval is dissatisfying in several cases

Towards operational use of VADUGS

➤ Within the project **TeFiS** (funded by the German Federal Ministry for Economic Affairs and Energy) we adapt the algorithm to specific requirements for operational use in the German Weather Service (DWD) facilities, in cooperation with German air traffic control (DFS), and the Lufthansa AG

➤ Beside improvements of the algorithm, special emphasis is given on user-friendly data formats, meeting the specific needs of DWD and users from the aviation sector

TeFiS
Technologie für Flugverkehrsmanagement in großen Strukturen

Gefördert durch:
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Deutsches Zentrum für Luft- und Raumfahrt e.V.

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http://www.dlr.de/ipa

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