

COSMO-ART

Status - Development - Application

Aerosols and Climate Processes, Institute for Meteorology and Climate Research - Troposphere



Why aerosols in operational forecasts?

Accidental releases

Health issues

Visibility

Flight safety (including icing)

Renewable energy (radiation and icing)

Hydrology and high impact weather



**THE WORLD WEATHER
OPEN SCIENCE CONFERENCE**

The weather: what's the outlook?
16 to 21 August 2014
WELCOME

WWOSC 2014
MONTRÉAL, CANADA

**CONFÉRENCE SCIENTIFIQUE
PUBLIQUE MONDIALE SUR
LA MÉTÉOROLOGIE**

La météo : quel avenir?
16 au 21 août 2014
BIENVENUE

Co-organized by / Co-organisée par :



WMO OMM



ICSU



Environment
Canada



Environnement
Canada



National Research
Council Canada



Conseil national
de recherches Canada

http://library.wmo.int/pmb_ged/wmo_1156_en.pdf

**Symposium on
Coupled chemistry-
meteorology/climate modelling:
Status and relevance for numerical
weather prediction, air quality and
climate research.**

9-11 February 2015 at the World
Meteorological Organization (WMO), Geneva,
Switzerland

<http://eumetchem.info/>

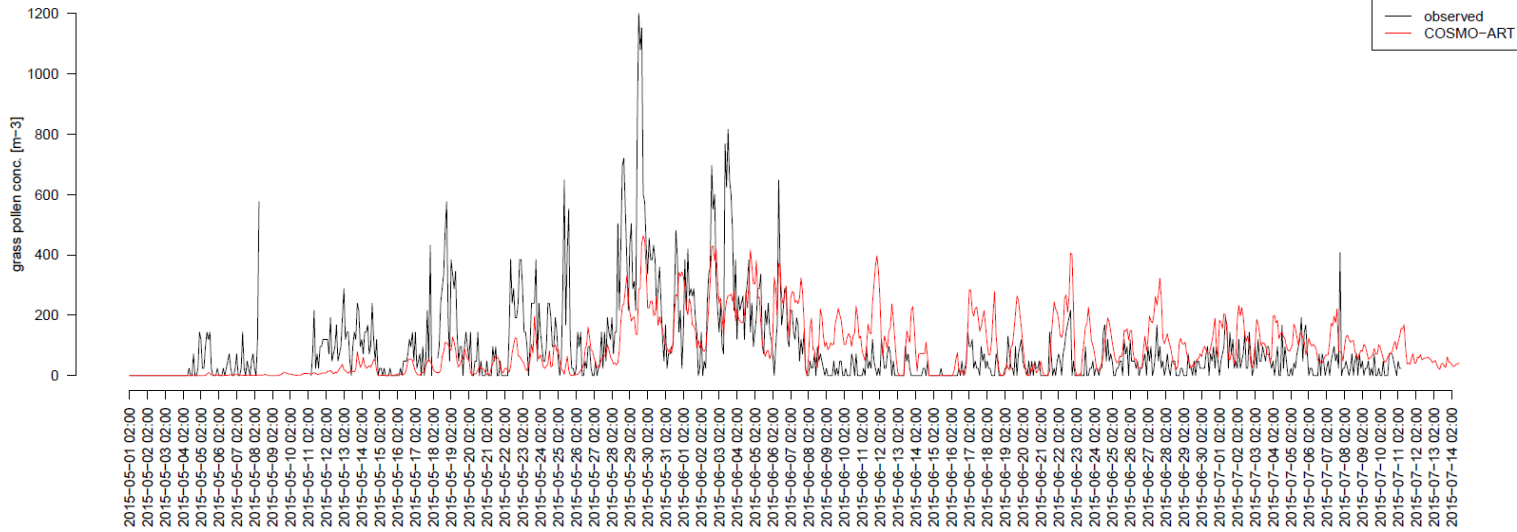




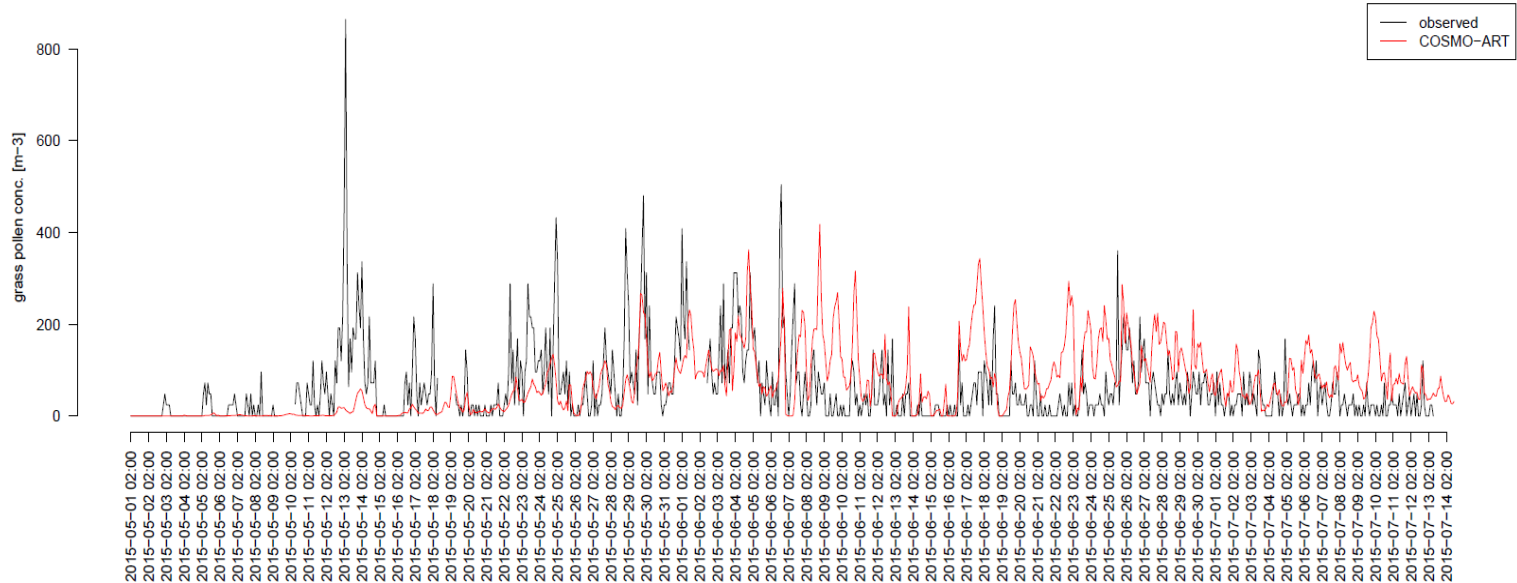
Gräserpollensaison 2015 (Basel, Lausanne)

A. Pauling

Station PBS 2-hourly data



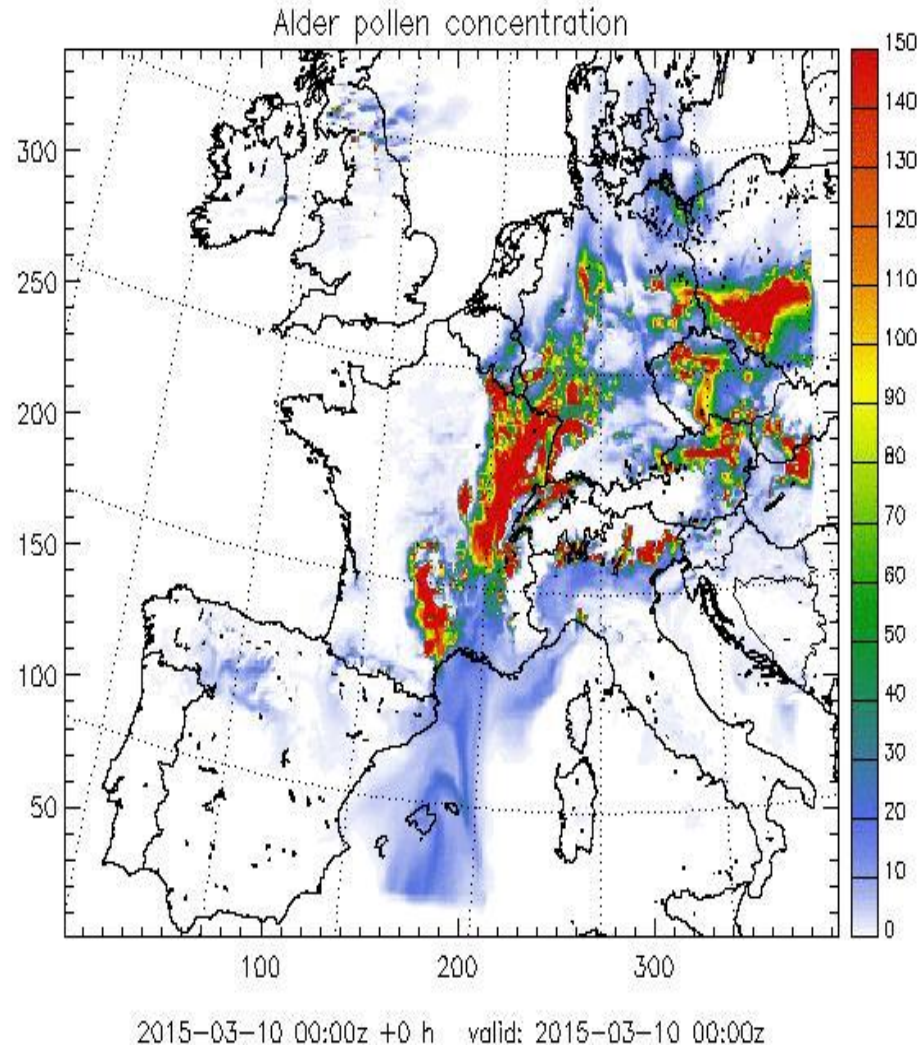
Station PLS 2-hourly data





Animation 10.3. – 15.3.2015

A. Pauling





Investigation of direct radiative effects of aerosols due to changes in domestic heating fuel

Orestis Speyer, Eleni Athanasopoulou, Evangelos Gerasopoulos,
Dominik Brunner, **Heike Vogel** and **Bernhard Vogel**

Institute of Environmental Research of Athens (IERSD/NOA), Greece; Institute of Materials Science and Technology (EMPA), Switzerland; Institute of Meteorology and Environmental Protection, National Observatory of Athens, Athens, Greece

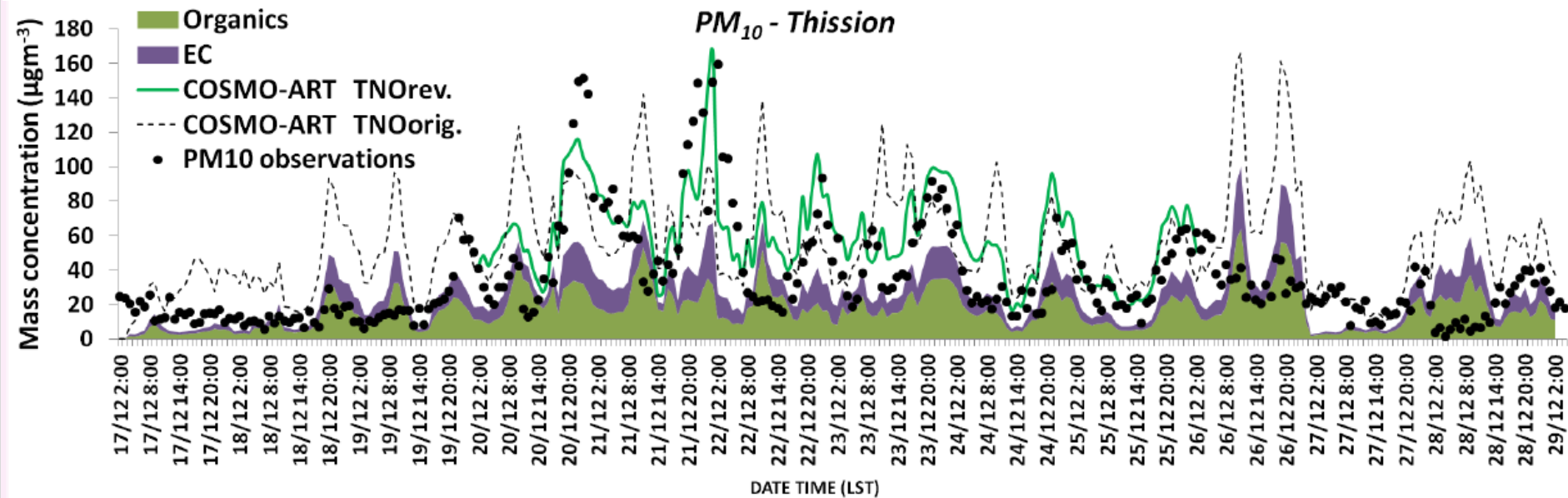
“Winter nighttime spikes of PM_{2.5} were up to **200-300 µg m⁻³** in Athens and Patras, Greece. Wood burning in fireplaces was responsible for these high levels by ca. **80-90%**”
Greek Newspaper ‘Ta Nea’, 2014

“Over the last 5 years the **increase** on the price of fuel oil was ca. **40-60%**”
Sarigiannis et al., 2014

Residents in southern Europe started burning **wood** as a primary form of **domestic heating**.
Borrego et al., 2010; Saffari et al., 2013; Paraskevopoulou et al., 2014



COSMO-ART vs. measurements



Dust above Israel

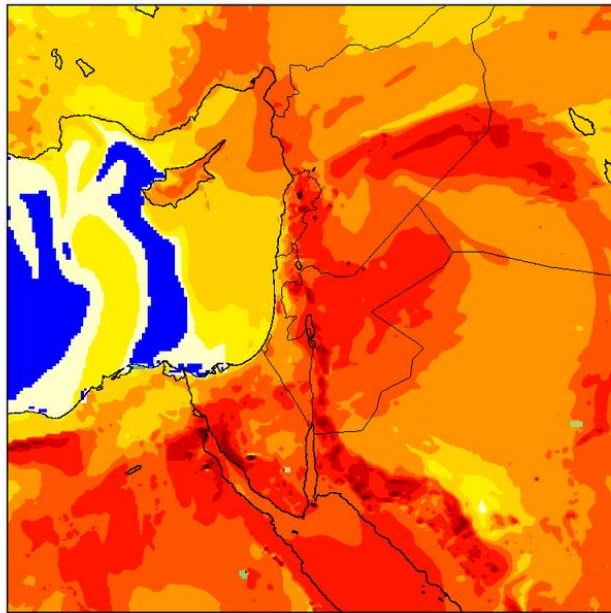
J. Förstner



8 Sept. 2015, 12 UTC

9 Sept. 2015, 12 UTC

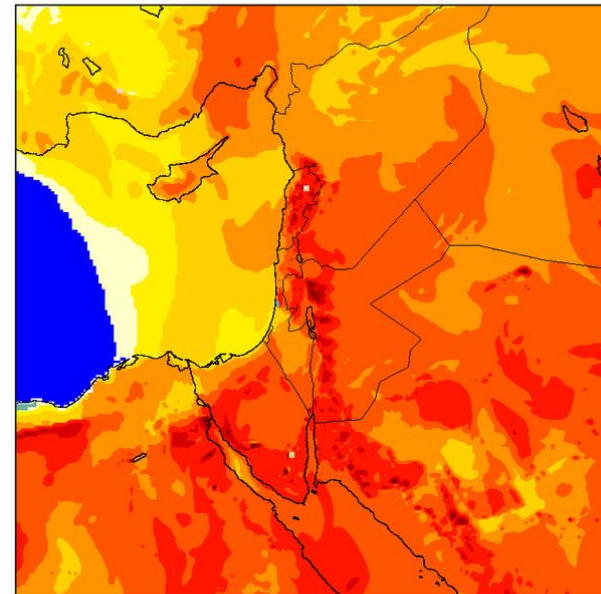
VSOILA+VSOILB+VSOILC [g m⁻³]



Mean: 6.35385 Min: 1.25e-06 Max: 3629.33 Var: 408.565



VSOILA+VSOILB+VSOILC [g m⁻³]

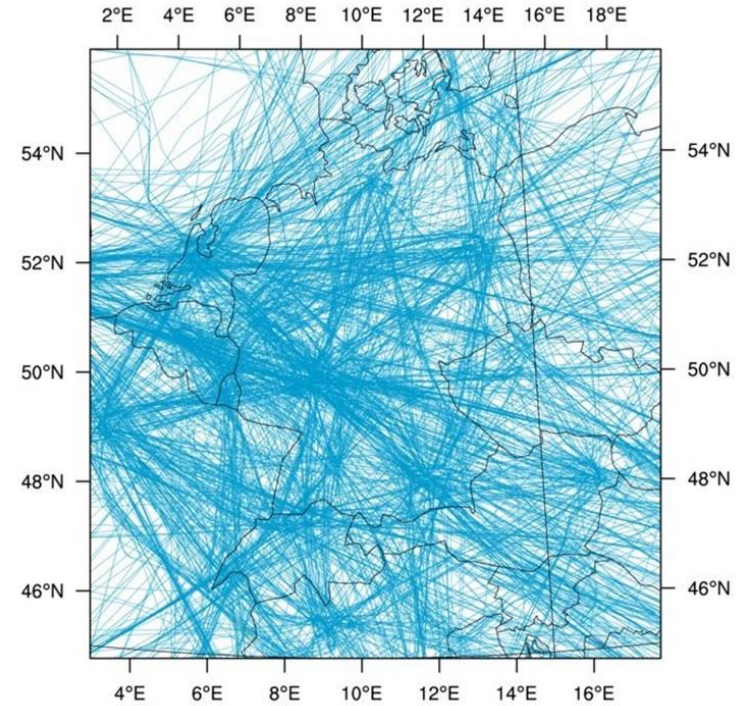


Mean: 5.70644 Min: 5e-07 Max: 272.238 Var: 37.2927



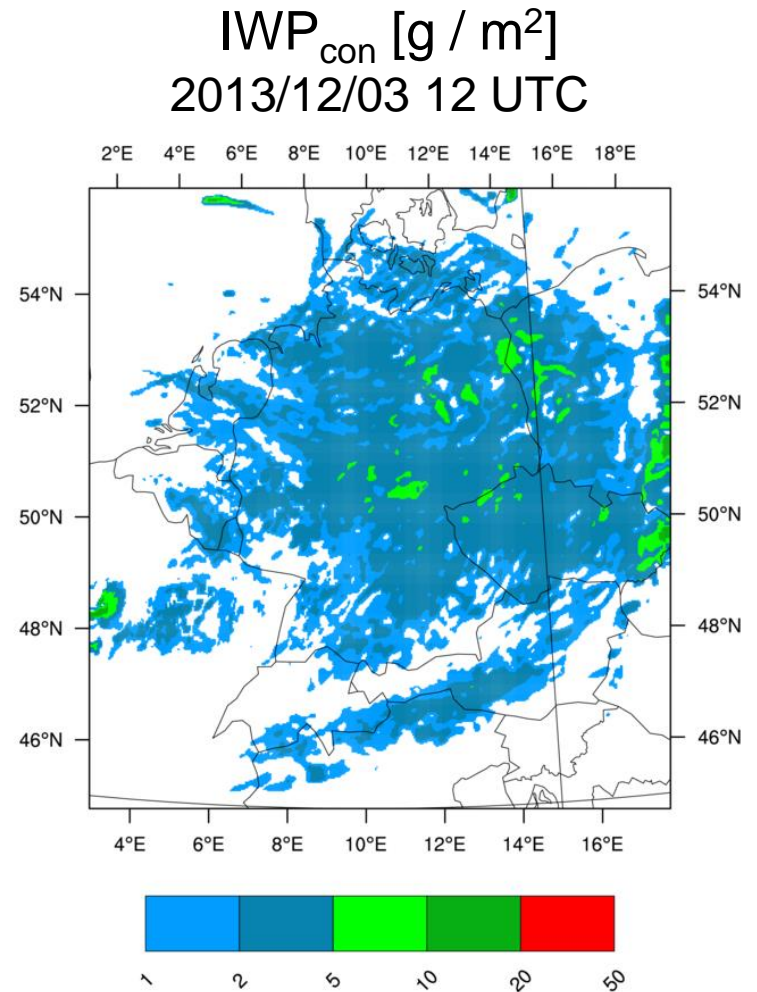
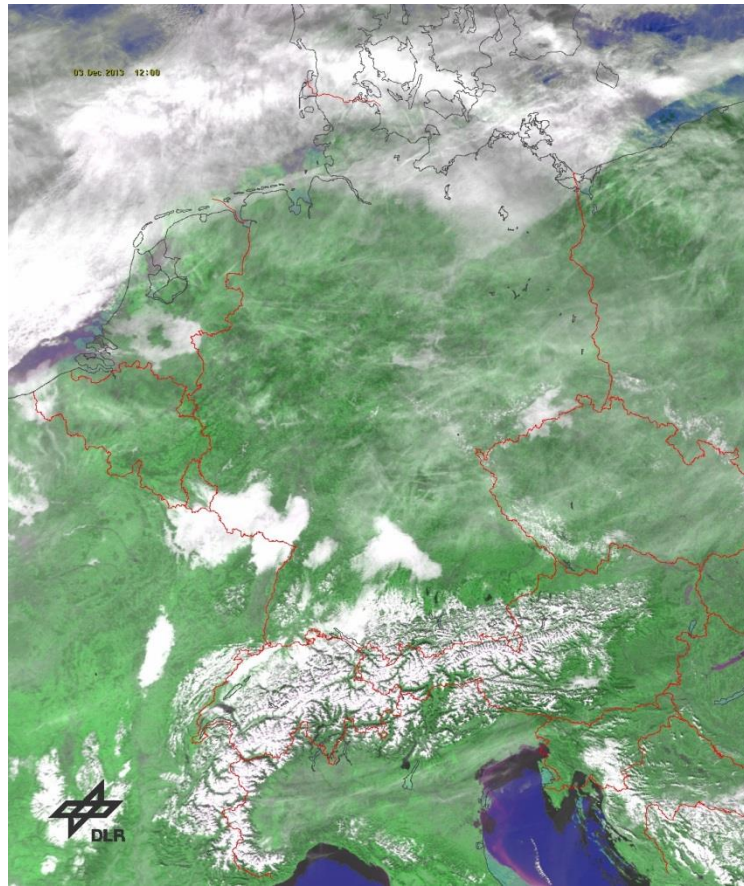
Contrails

Flight tracks, 2013/12/03 08-16 UTC



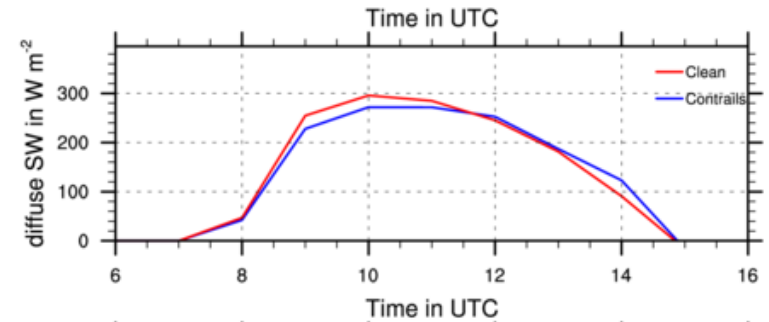
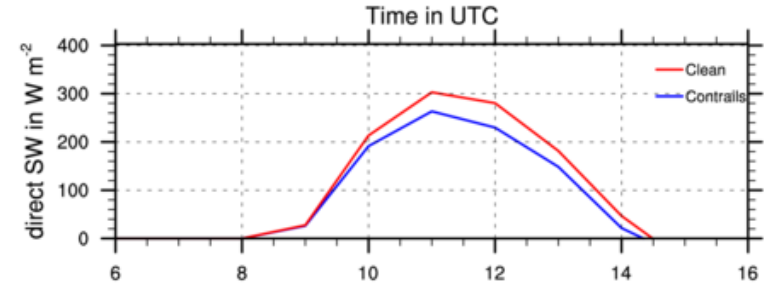
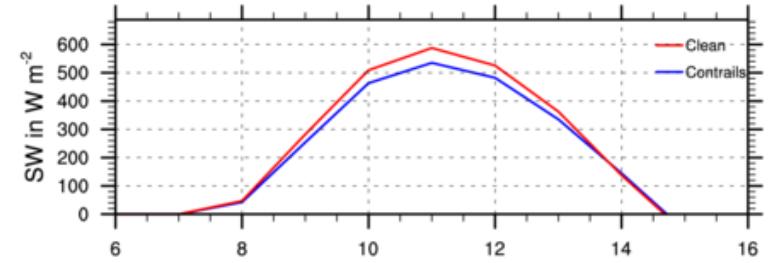
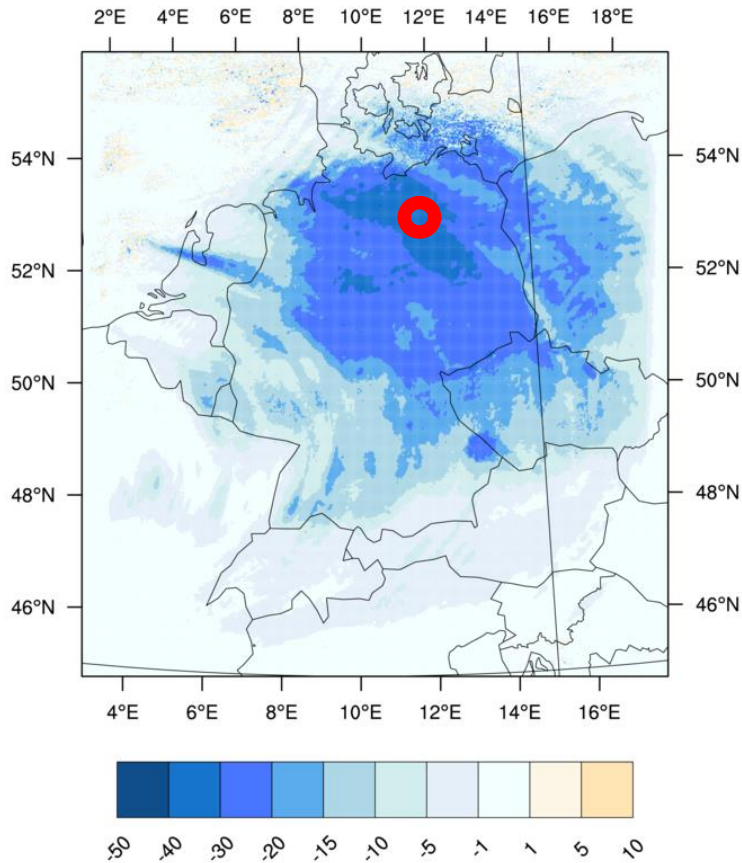
Helmholtz-Zentrum
Geesthacht



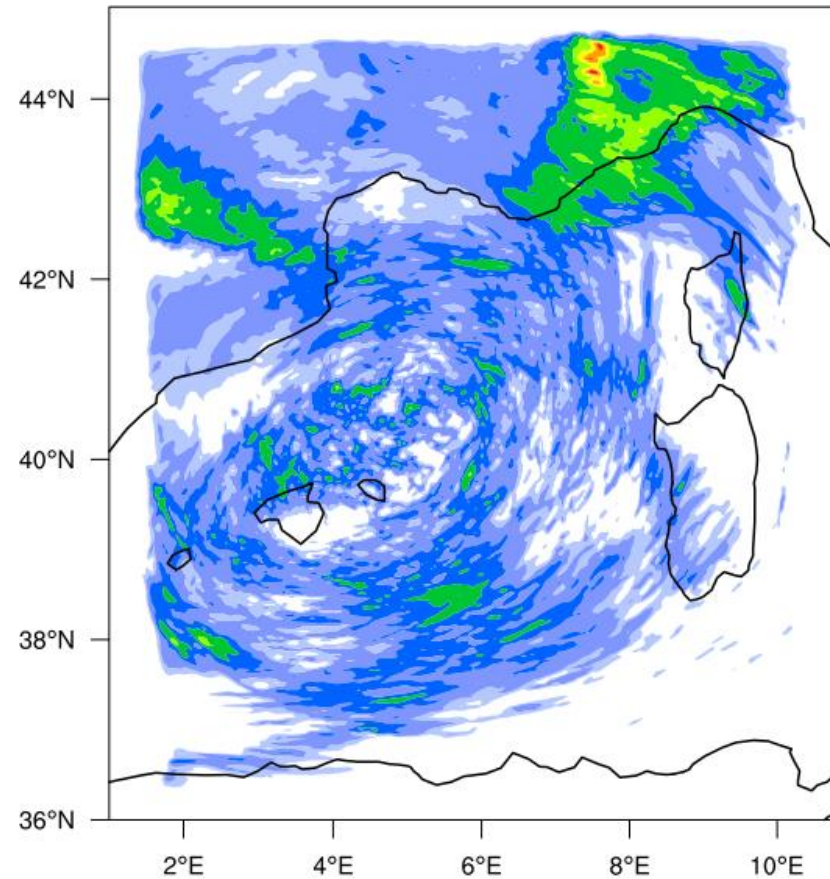
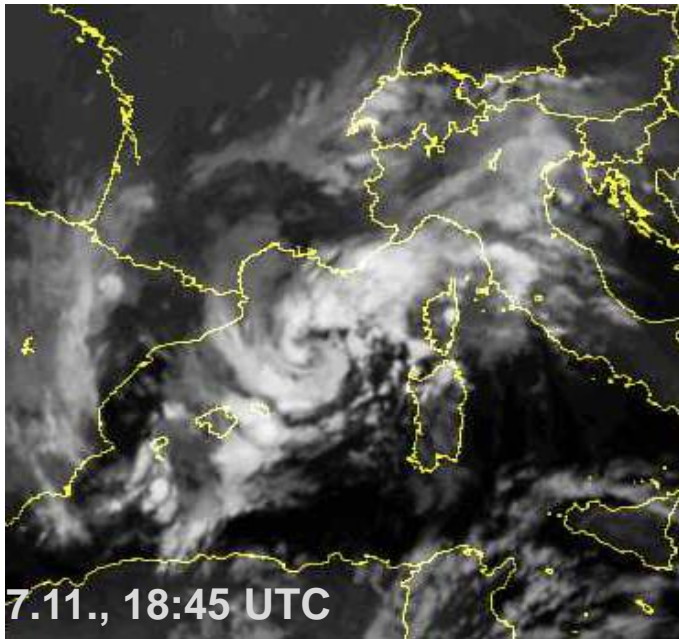


Changes of Incoming Solar Radiation, PV Power

Δ SW (diffuse and direct) [%]
2013/12/03 08 - 16 UTC

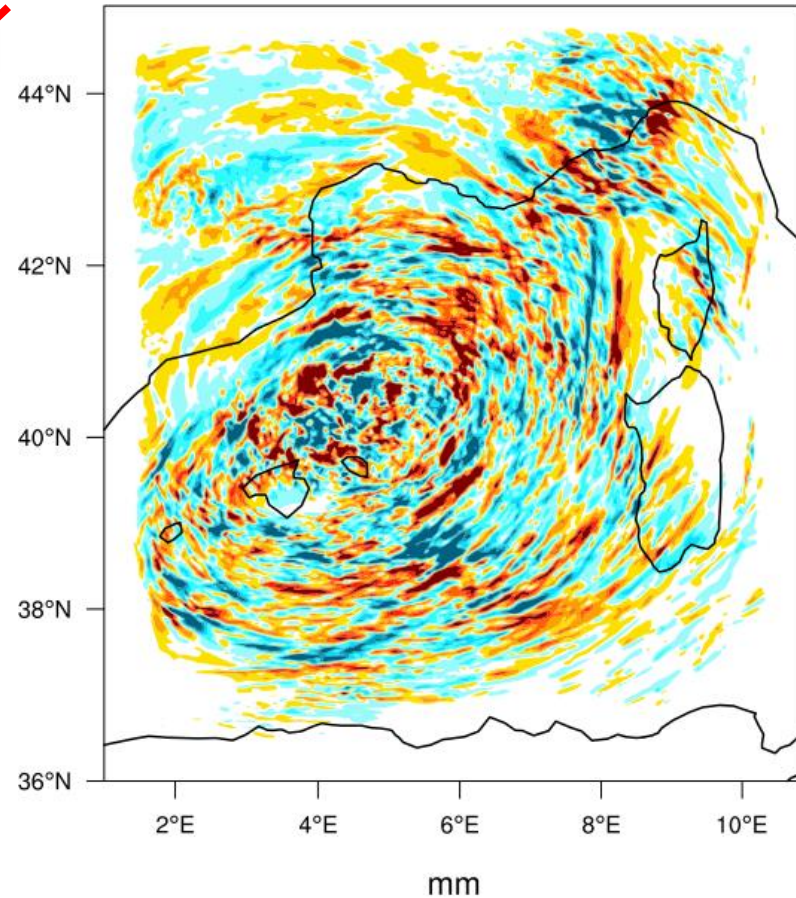
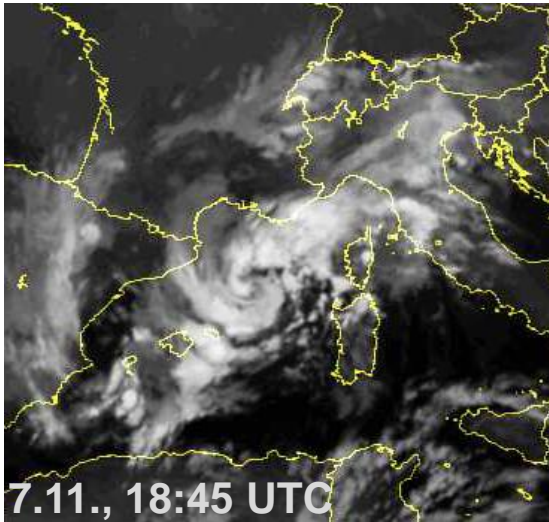
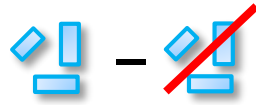


Feedback of a Medicane with sea salt

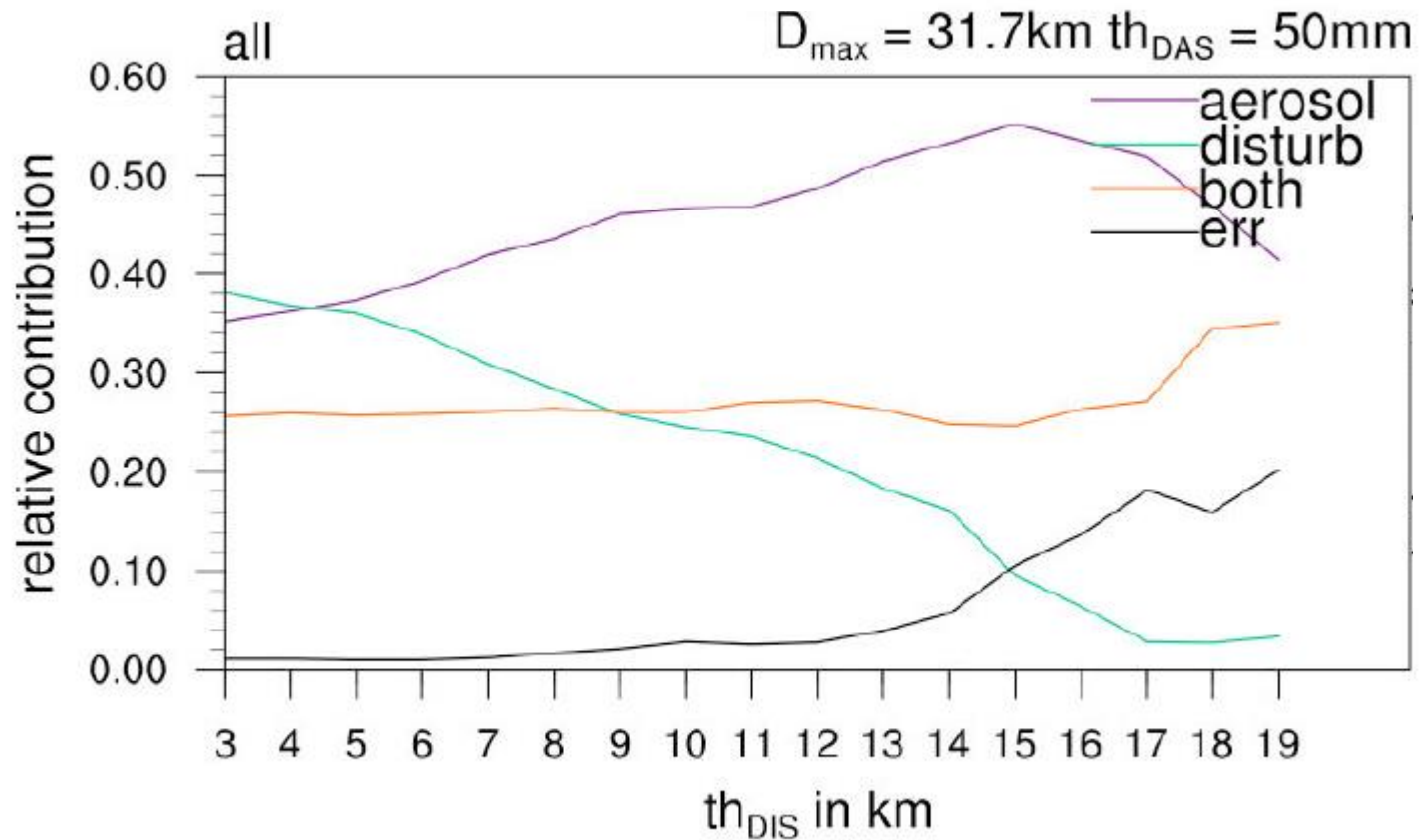


I. Kraut

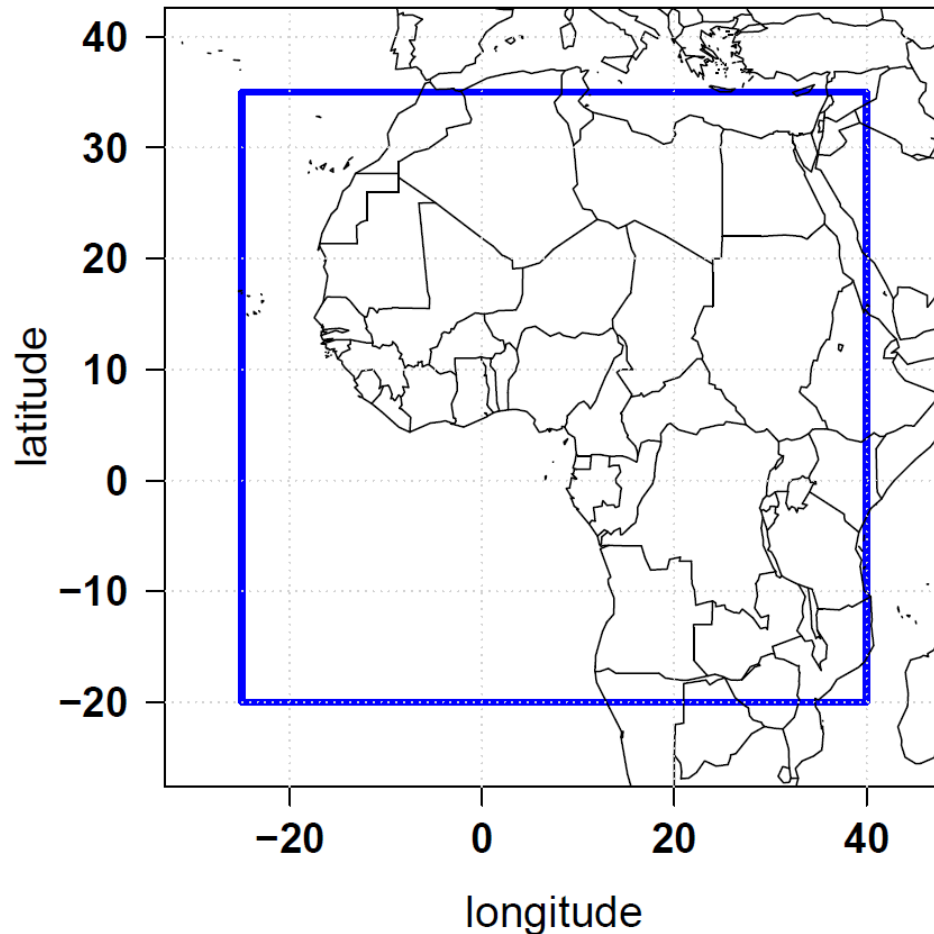
Sea salt effect on precipitation (6.-7.11.11)



Combination of DAS and factorial method



Simulation setup



Grid mesh size:
0.25° (~28 km)

Forecast time:
57h

Met. boundary conditions:
ICON DWD forecasts (R03B07)

Chemistry boundary conditions:
MOZART-4/GEOS-5

Fire emissions:
GFASv1.2 NRT

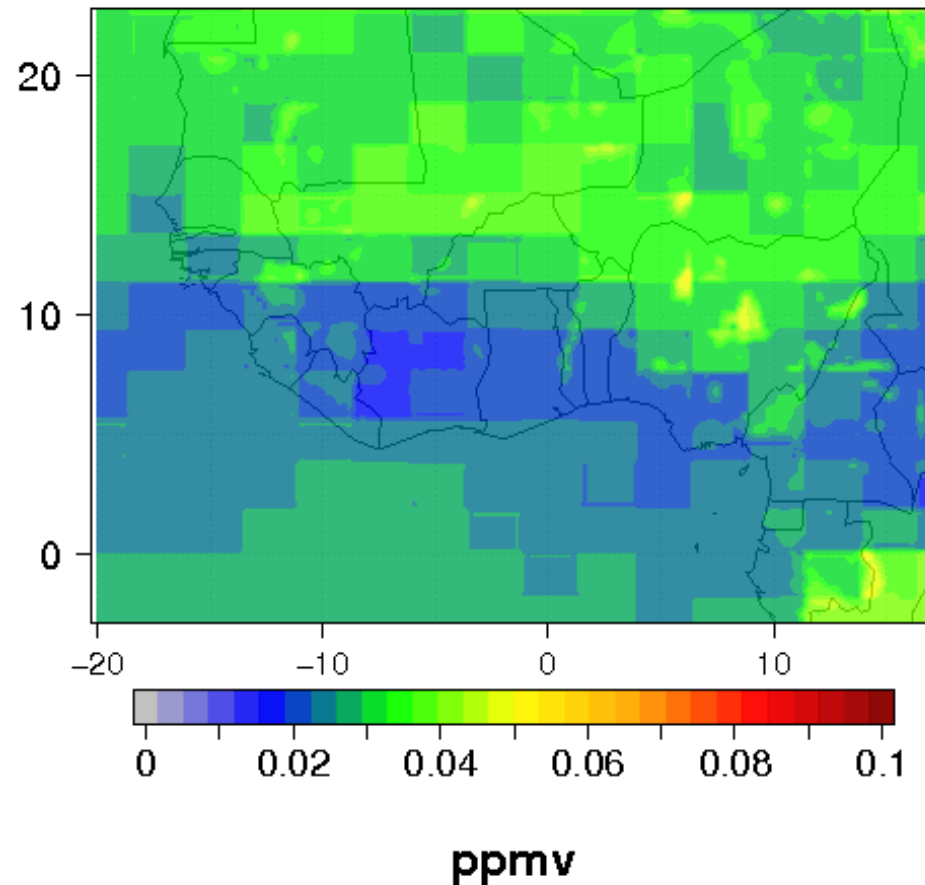
Anthropogenic emissions:
EDGAR HTAP_V2 2010

Chemistry/aerosol initialization:
with COSMO-ART from previous
simulation

Ozone (ppmv) in lowest model level

COSMO-ART simulation with 0.0446° (~5km) grid mesh size

OZONE – 01.06.2014 00 UTC

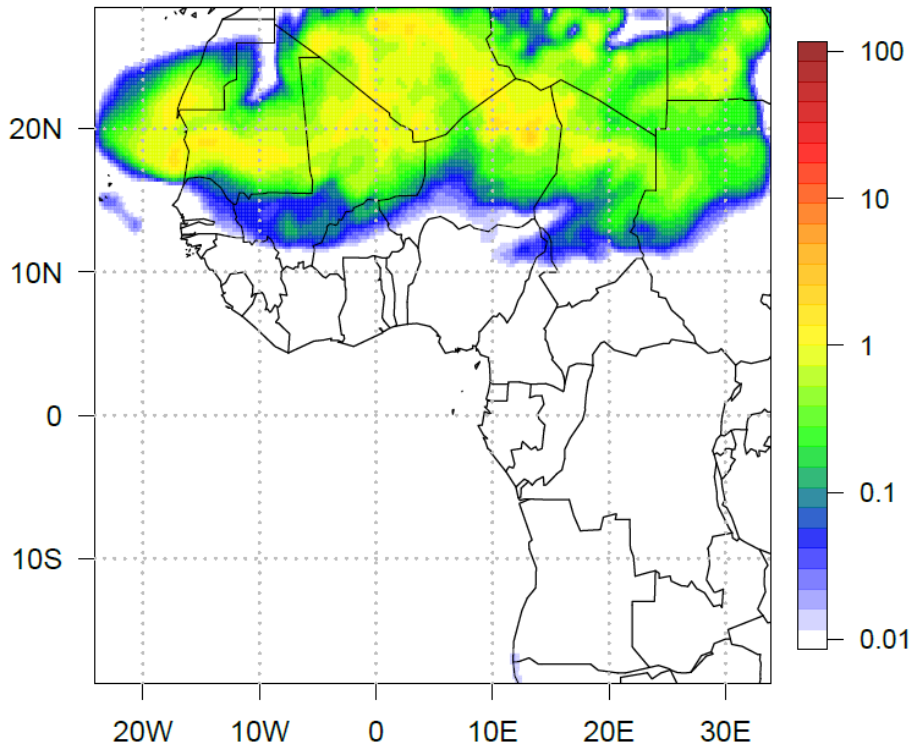


Forecast results: Mineral dust

Base time: Aug 1, 2015 (12 UTC), valid time: Aug 3, 2015 (12 UTC)

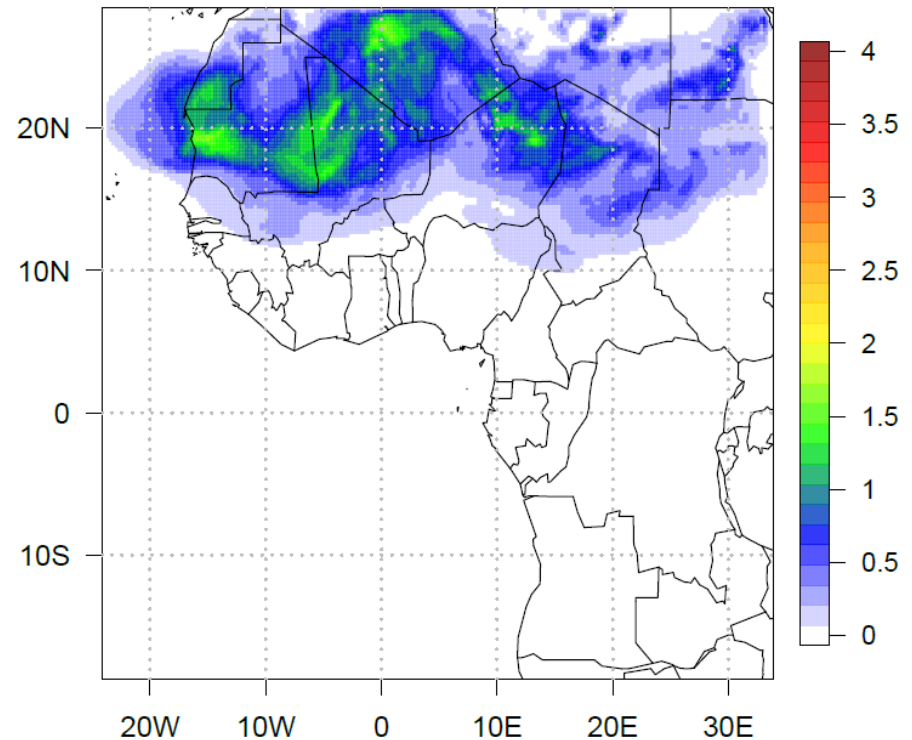
Mineral dust mass concentration (mg m^{-3})
at 850 hPa

Sunday 01 August 2015 12 UTC COSMO-ART Forecast t+48 VT: Tuesday 03 August 2015 12 UTC
Mineral Dust concentration (mg m^{-3}) at 850 hPa



Mineral dust AOD 550nm

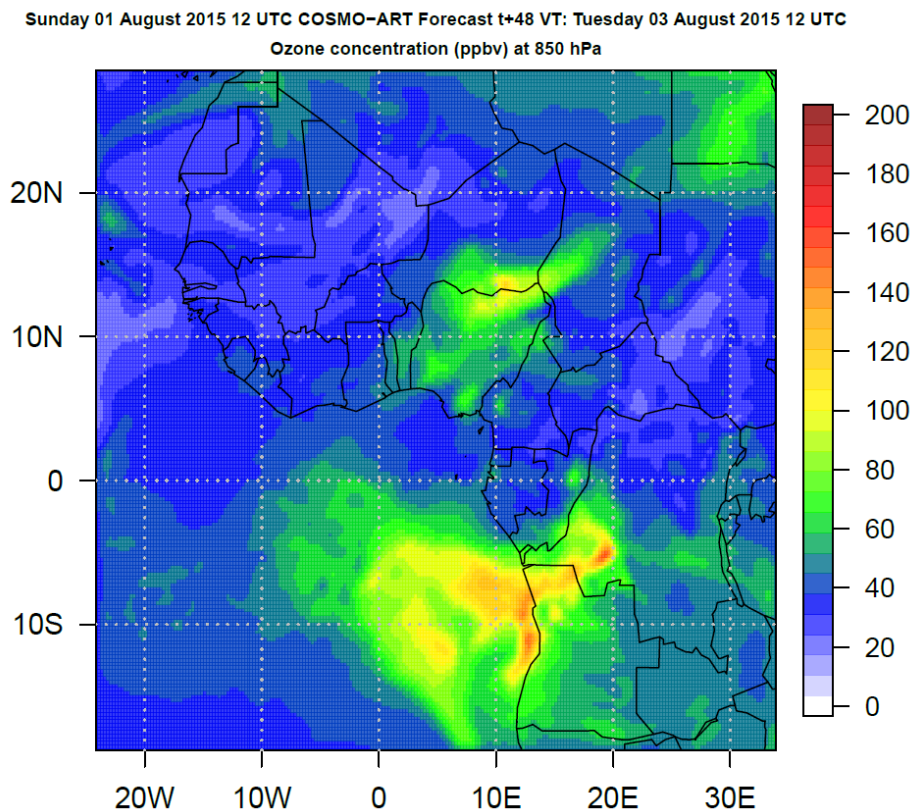
Sunday 01 August 2015 12 UTC COSMO-ART Forecast t+48 VT: Tuesday 03 August 2015 12 UTC
Mineral Dust AOD 550nm (-)



Forecast results: Ozone

Base time: Aug 1, 2015 (12 UTC), valid time: Aug 3, 2015 (12 UTC)

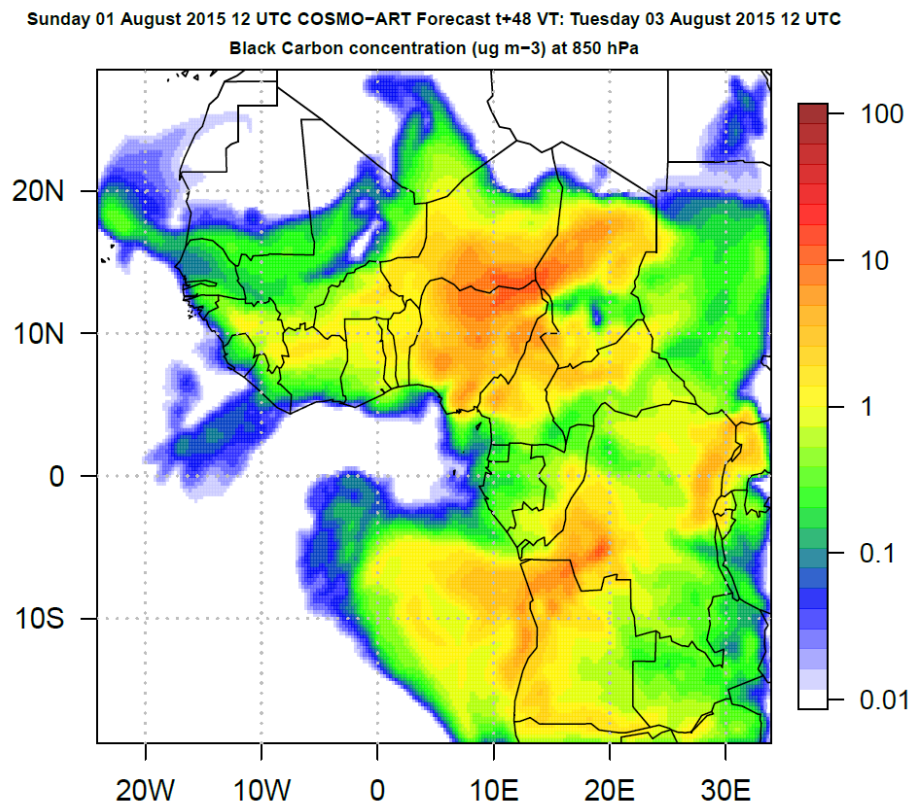
Ozone volume mixing ratio (ppbv) at 850 hPa



Forecast results: Black Carbon

Base time: Aug 1, 2015 (12 UTC), valid time: Aug 3, 2015 (12 UTC)

Black carbon mass concentration ($\mu\text{g m}^{-3}$) at 850 hPa



Status of ICON-ART



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³DWD

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Geosci. Model Dev., 8, 1659–1676, 2015
www.geosci-model-dev.net/8/1659/2015/
doi:10.5194/gmd-8-1659-2015
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Geoscientific
Model Development



Open Access

ICON–ART 1.0 – a new online-coupled model system from the global to regional scale

D. Rieger¹, M. Bangert¹, I. Bischoff-Gauss³, J. Förstner², K. Lundgren^{1,*}, D. Reinert², J. Schröter¹, H. Vogel¹, G. Zängl², R. Ruhnke¹, and B. Vogel¹

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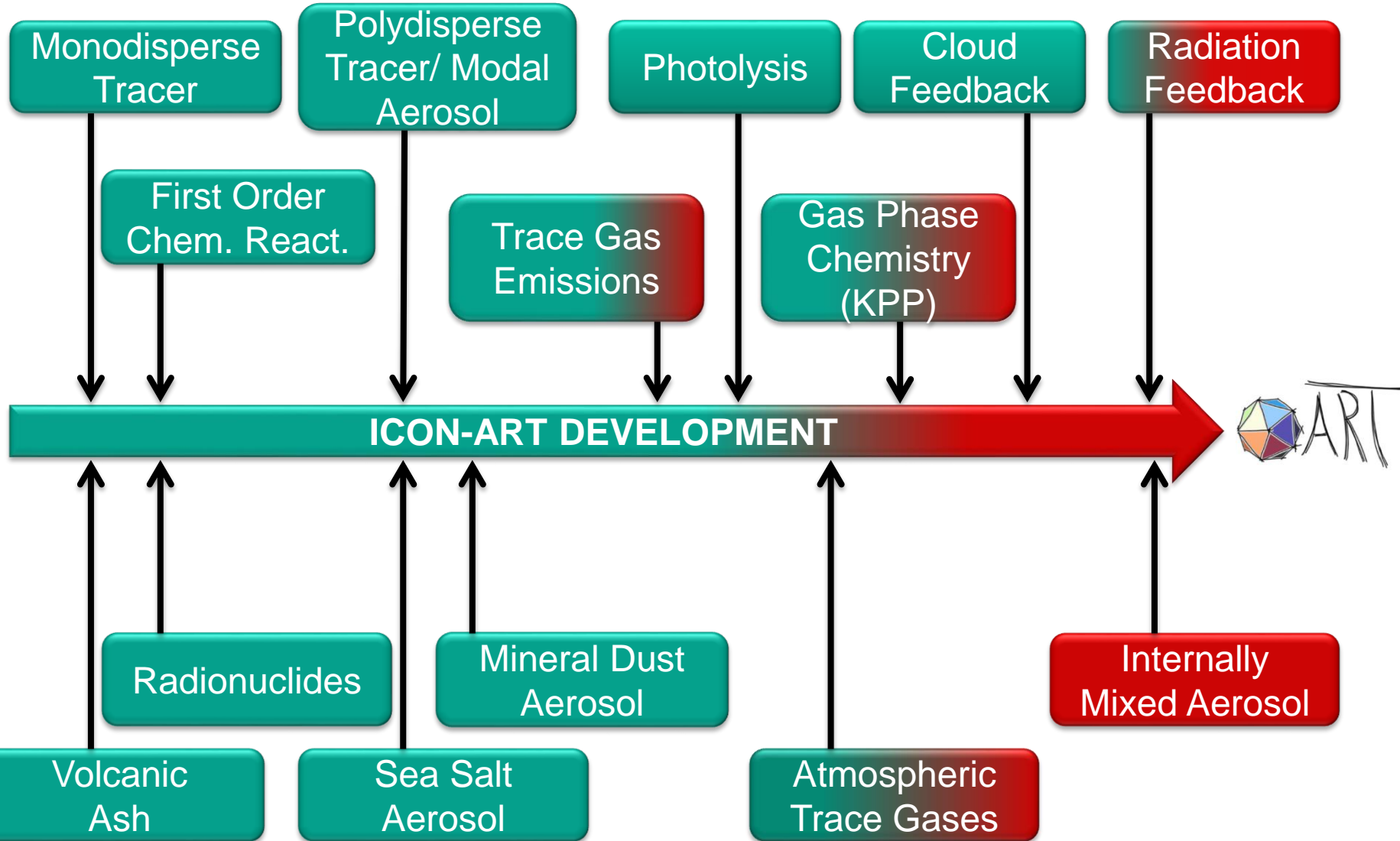
*now at: Deutscher Wetterdienst, Frankfurter Str. 135, 63067 Offenbach, Germany

Correspondence to: D. Rieger (daniel.rieger@kit.edu)

Received: 19 December 2014 – Published in Geosci. Model Dev. Discuss.: 27 January 2015

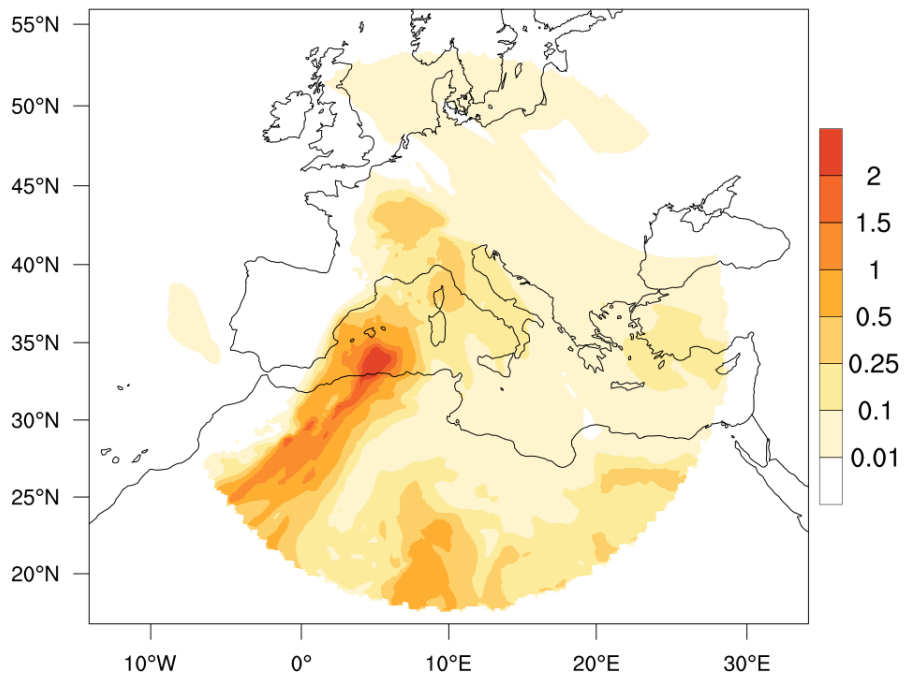
Revised: 21 April 2015 – Accepted: 7 May 2015 – Published: 4 June 2015

Development Status

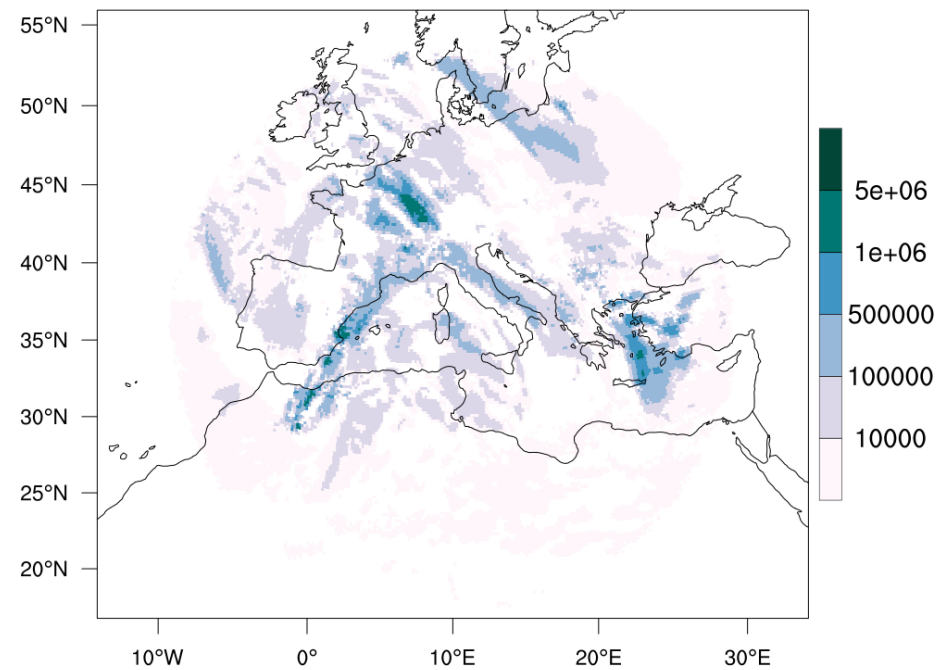


Aerosol-Cloud-Interactions: First Tests

Mineral Dust Aerosol Optical Depth 03 Apr 2014 00 UTC



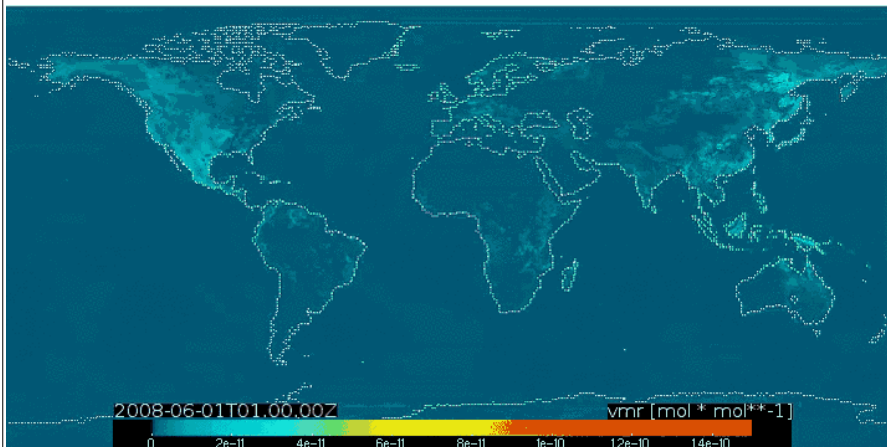
Vertically Integrated $n_{\text{nuc,het}}$ [# $\text{dm}^{-2} \text{h}^{-1}$] 03 Apr 2014 00 UTC



ICON-ART – Current Developments

- Emission data from the MEGAN-MACC project distributed via the Emission database: ECCAD (Emissions of atmospheric Compounds & Compilation of Ancillary Data)

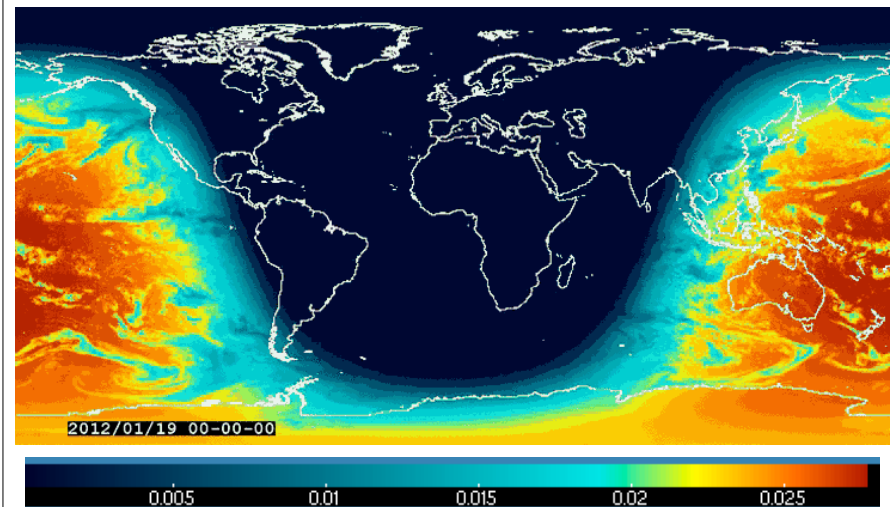
Acetone tracer with biogenic emissions of the project MEGAN-MACC at model level 84 (~500 m above surface)



M. Weimer, Master Thesis

- Photolysis rates are calculated with Fast-JX (Bian and Prather, J. Atmos. Chem., 2002)

Photolysis rate of NO₂ model level 88 (~100 m above surface)



J. Schröter, Ph.D. Thesis

Aerosols in operational forecasts

2013

Pollen grains:

health issues

Volcanic ash:

aviation

Mineral dust:

visibility

Vegetation fires:

health, aviation

Sea salt, mineral dust:

cloud formation

2018

Primary and secondary aerosols:

visibility, fog, icing, flooding, ...

