Karlsruhe Institute of Technology

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

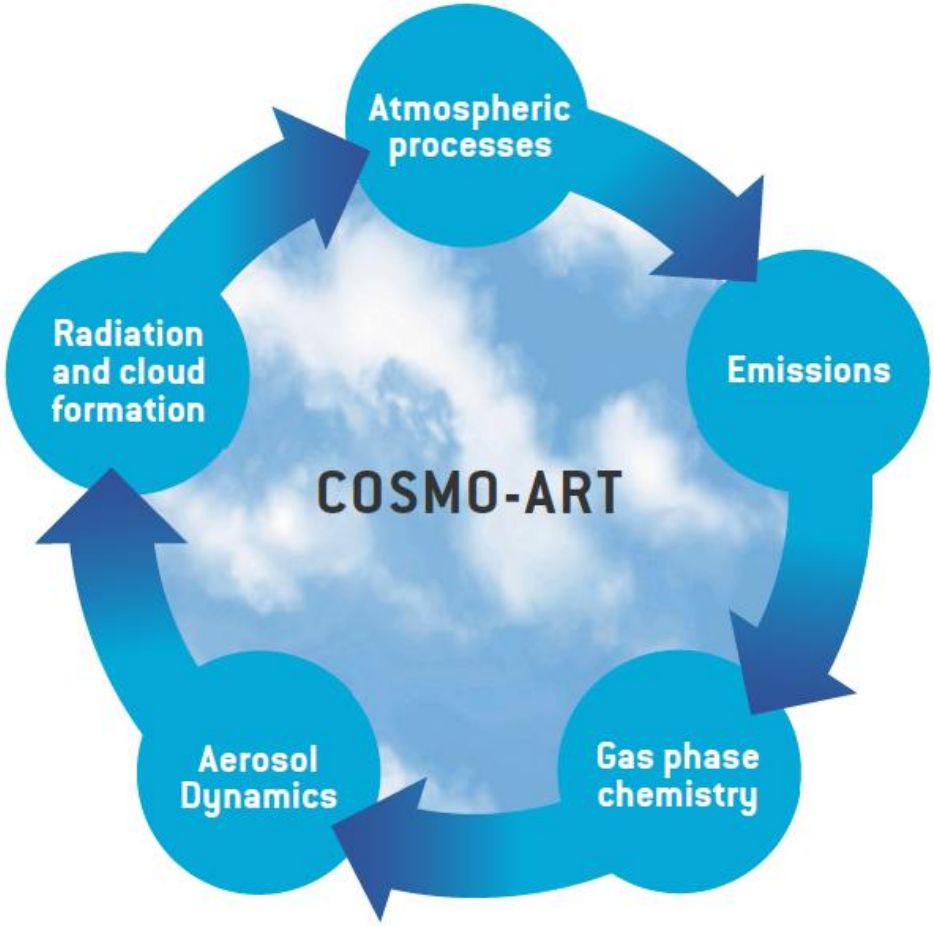
Flight safety (including icing)

Renewable energy (radiation and icing)

Hydrology and high impact weather

Climate

COSMO-ART: Aerosols and Reactive Trace gases



Vogel et al., 2009
Bangert et al., 2012
Rieger et al., 2014

The world outside of COSMO-ART

Participants	Case 1	Ca 2
CPTEC		
JMA	X	X
ECMWF	X	X
Météo-France/Met. Serv. Algeria	X	
ESRL/NOAA	X	X
NASA/Goddard	X	X
NCEP	X	X
Barcelona Super. Ctr.	X	

X = data not y

Participants	People Involved
CPTEC	Saulo Freitas, Mauricio Zarzur
JMA	Taichu Tanaka, Chiasi Muroi
ECMWF	Angela Benedetti, Samuel Remy, Jean-Noel Thepaut
Météo-France/Met. Serv. Algeria	Morad Mokhtari, Bouyssel Francois
ESRL/NOAA	Georg Grell
NASA/Goddard	Arlindo da Silva
NCEP	Sarah Lu, Yu-Tai Hou, Shrinivas Moorthi, and Fanglin Yang
Barcelona Super. Ctr.	Oriol Casellas

X = da

Upcoming Conference

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

COSMO-ART training courses

EUMETCHEM

Summer school

Aveiro, Portugal

D. Brunner, EMPA

Publications

Athanasopoulou, E., Rieger, D., Walter, C., Vogel, H., Karali, A., Hatzaki, M., Gerasopoulos, E., Vogel, B., Giannakopuolos, C., Gratsea, M., Roussos, A. (2014): Fire risk, atmospheric chemistry and radiative forcing assessment of wildfires in eastern Mediterranean, Atmospheric Environment 95, 113-125

Baklanov, A, et al., (2014): Online coupled regional meteorology chemistry models in Europe current status and prospects, Atmos. Chem. Phys., 14, 317-398

Rieger, D., Bangert, M., Kottmeier, C., Vogel, H., Vogel, B. (2014): Impact of aerosol on post-frontal convective clouds over Germany, Tellus, 66, 22528

Vogel, H., Förstner, J., Vogel, B., Hanisch, T., Mühl, B., Schättler, U., Schad, T. (2014): Time-lagged ensemble simulations of the dispersion of the Eyjafjallajökull plume over Europe with COSMO-ART, Atmos. Chem. Phys, 14, 7837-7845

Lundgren, K., B. Vogel, H. Vogel, and C. Kottmeier (2012), Direct radiative effects of sea salt for the Mediterranean Region at conditions of low to moderate wind speeds, *J. Geophys. Res.*, doi:10.1029/2012JD018629

Zink, K., Pauling, A., Rotach, W., Vogel, H., Kaufmann, P., Clot, B. (2013), EMPOL 1.0: a new parameterization of pollen emission in numerical weather prediction models, Geosci. Model Dev., 6, 1961-1975

Data assimilation activities for COSMO-ART

LIDAR forward operator (Uni Hohenheim)

Reconstructing source height from Sat observations

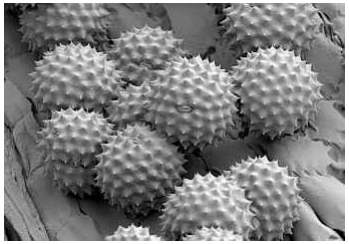
First ideas on data assimilation

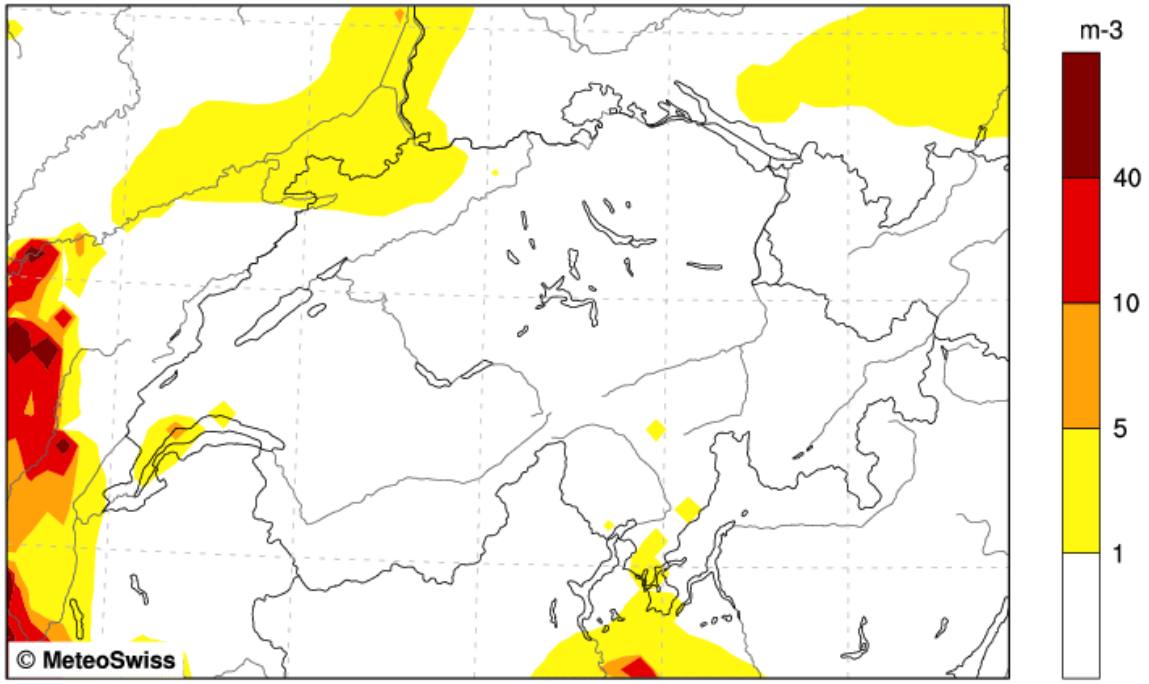
Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Operational forecast

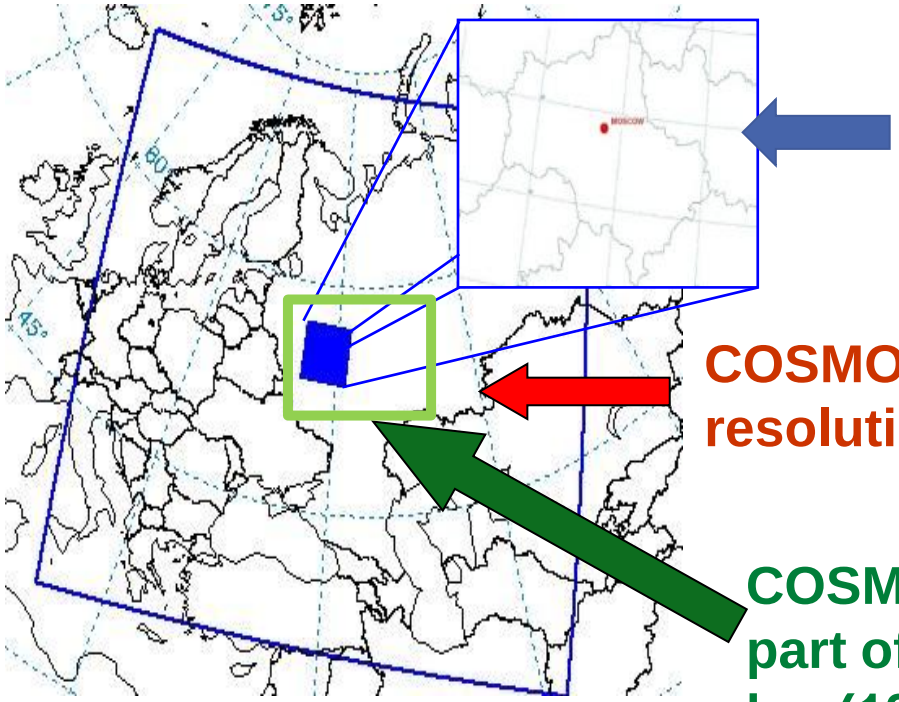
A. Pauling, K. Zink, P. Kaufmann

Karlsruhe Institute of Technology





Alexander Kirsanov, Anastasia Revokatova,
Gdaliy Rivin, Galina Surkova, Irina Kuznetsova,
Alexander Kislov

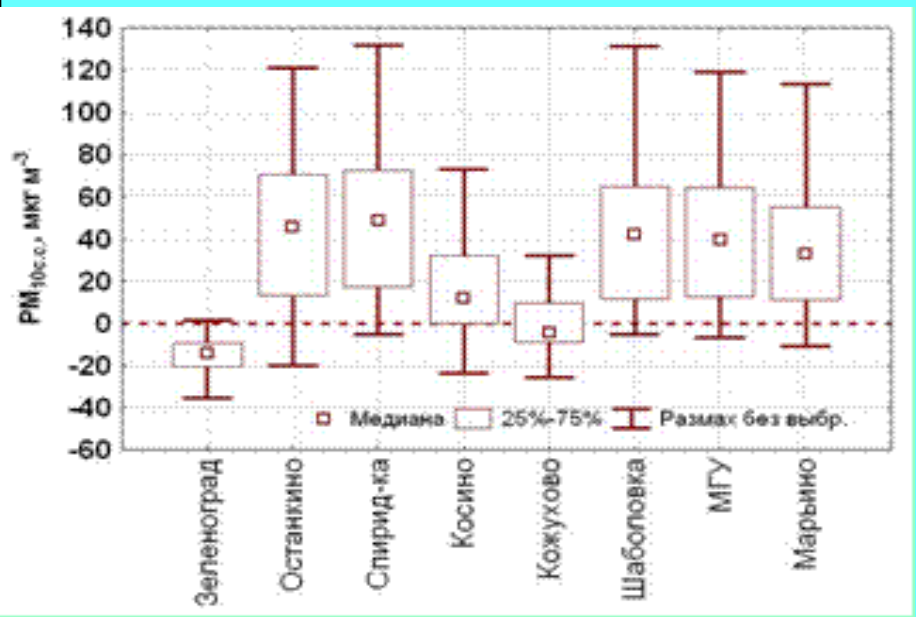


COSMO-ART, Moscow region spatial resolution 7x7 km (64x64 grid cells)

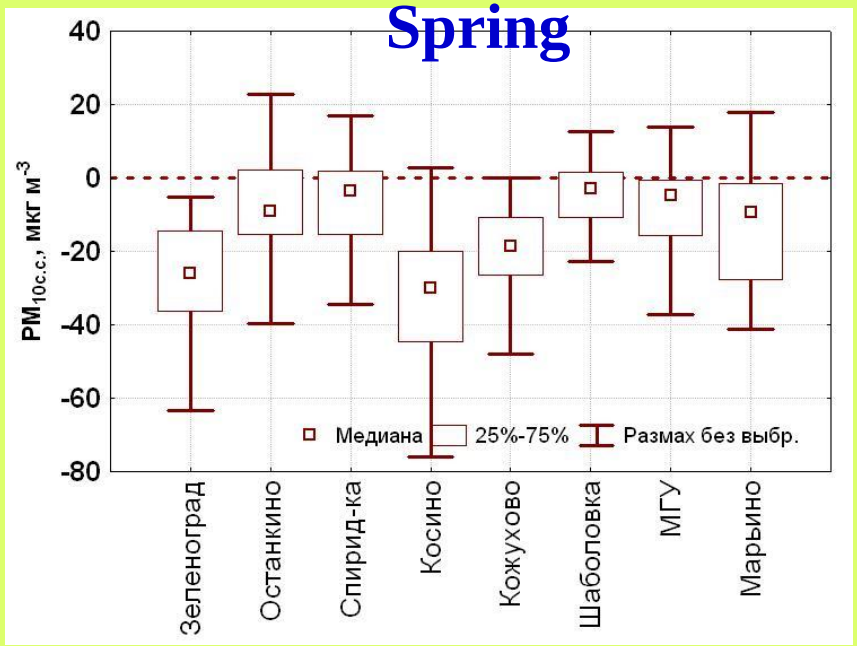
COSMO (RU) – European part of Russia resolution 7x7 km (700x620 grid cells)

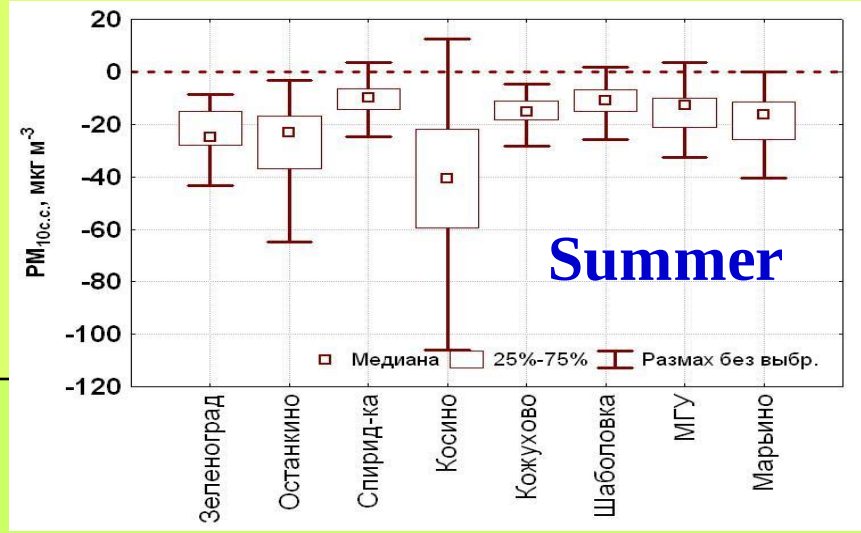
COSMO-ART, Central part of European part of Russia. Spatial resolution 7x7 km (135x150 grid cells). This domain used for Quaisi-operational 48-hours forecast

PM10. COSMO-Ru7-ART



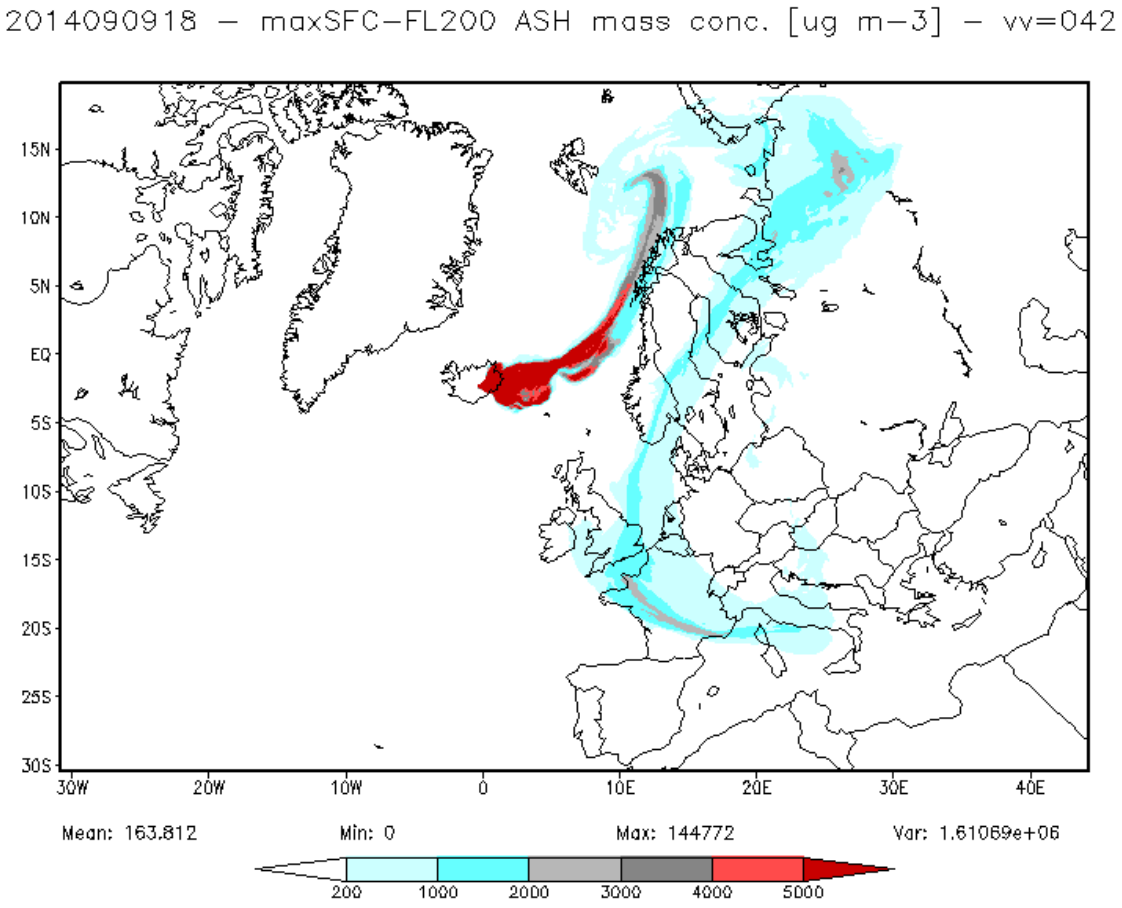
Winter: PM10 is overestimated





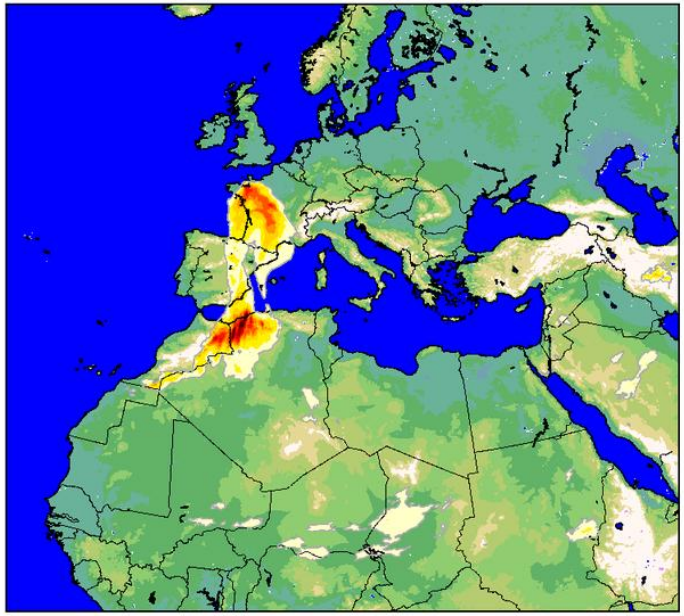
Warm period: PM10 **underestimated**

Jochen Förstner



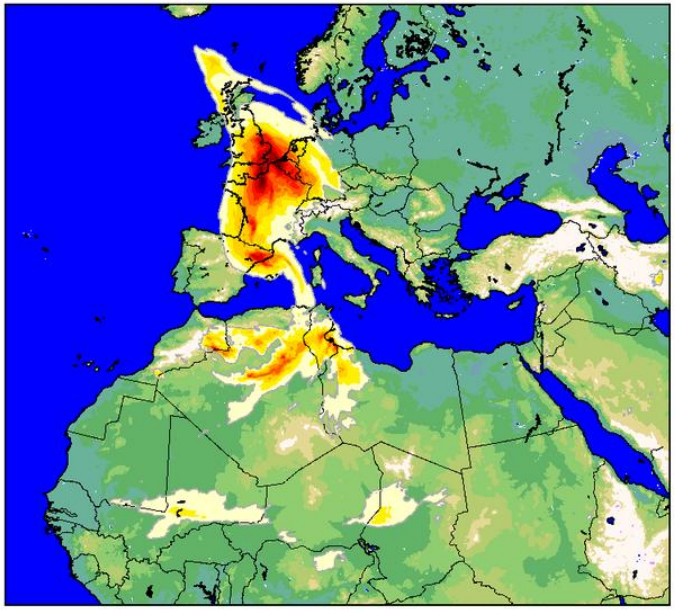
Simulated AOD

02.04.14 12 UTC



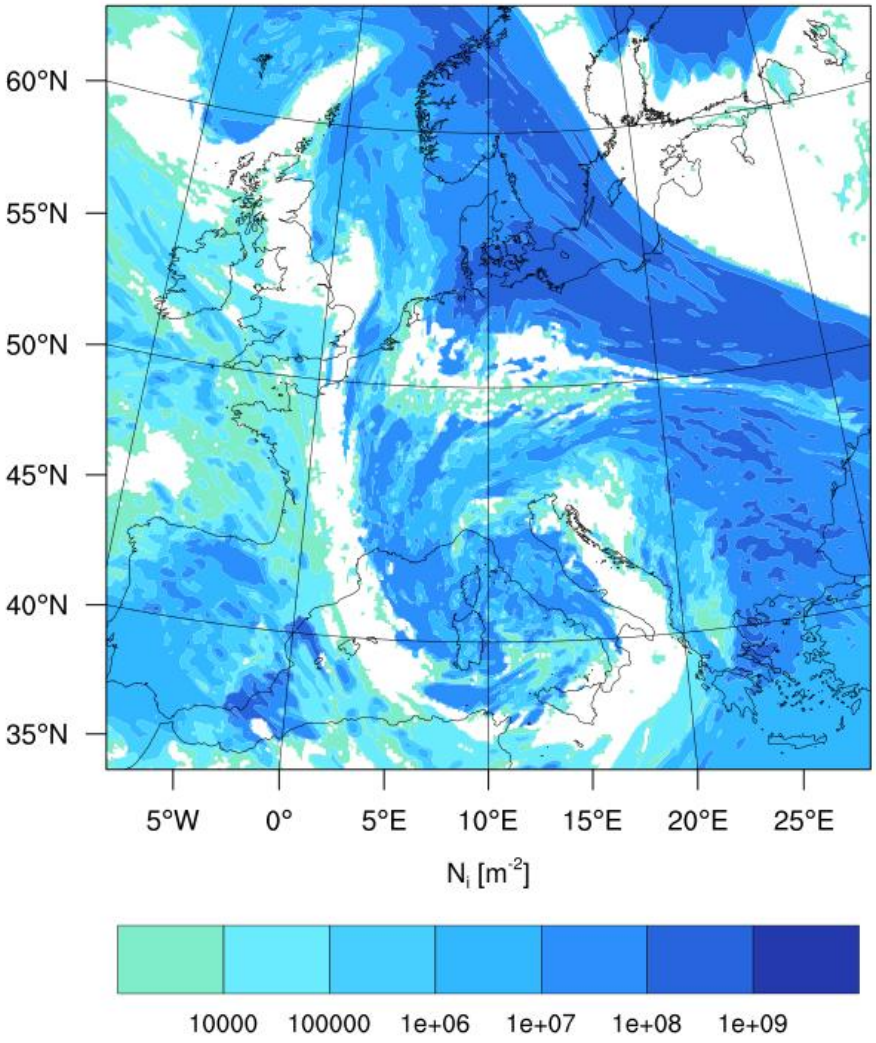
Mean: 0.0364828 Min: 0 Max: 2.51898 Var: 0.0109052

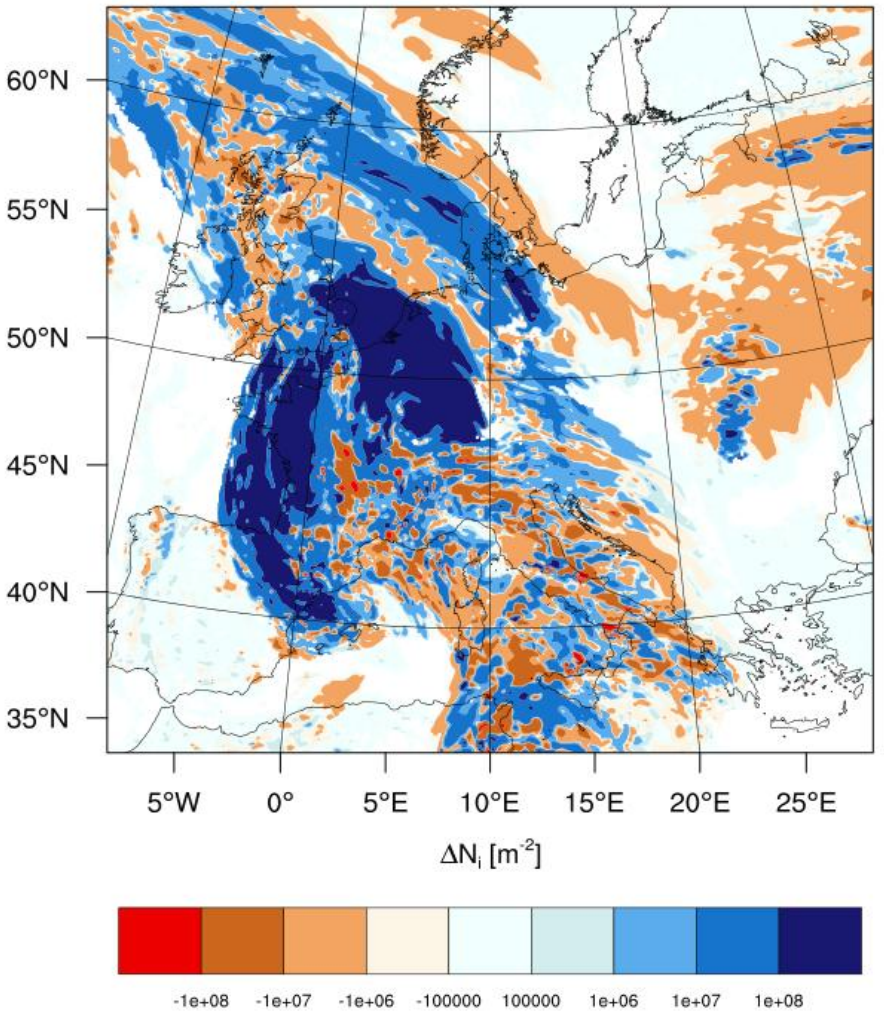
03.04.14 12 UTC



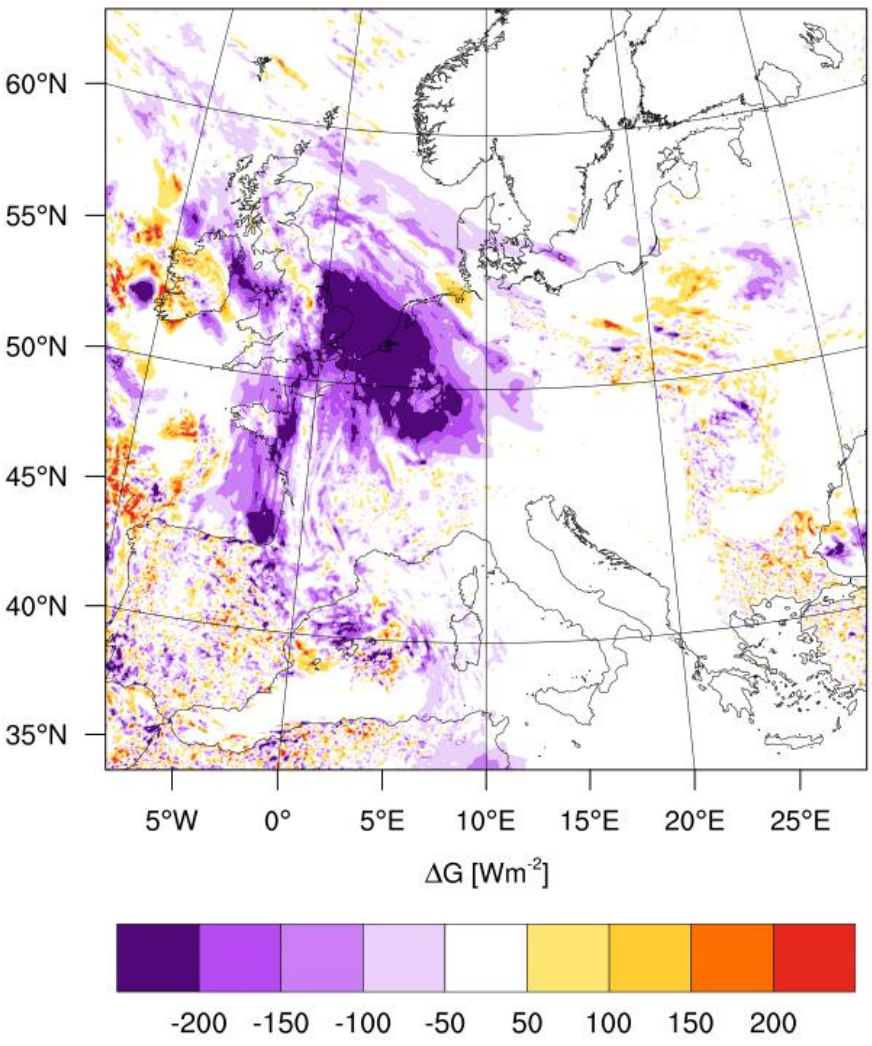
Mean: 0.0658172 Min: 0 Max: 1.95061 Var: 0.0273097

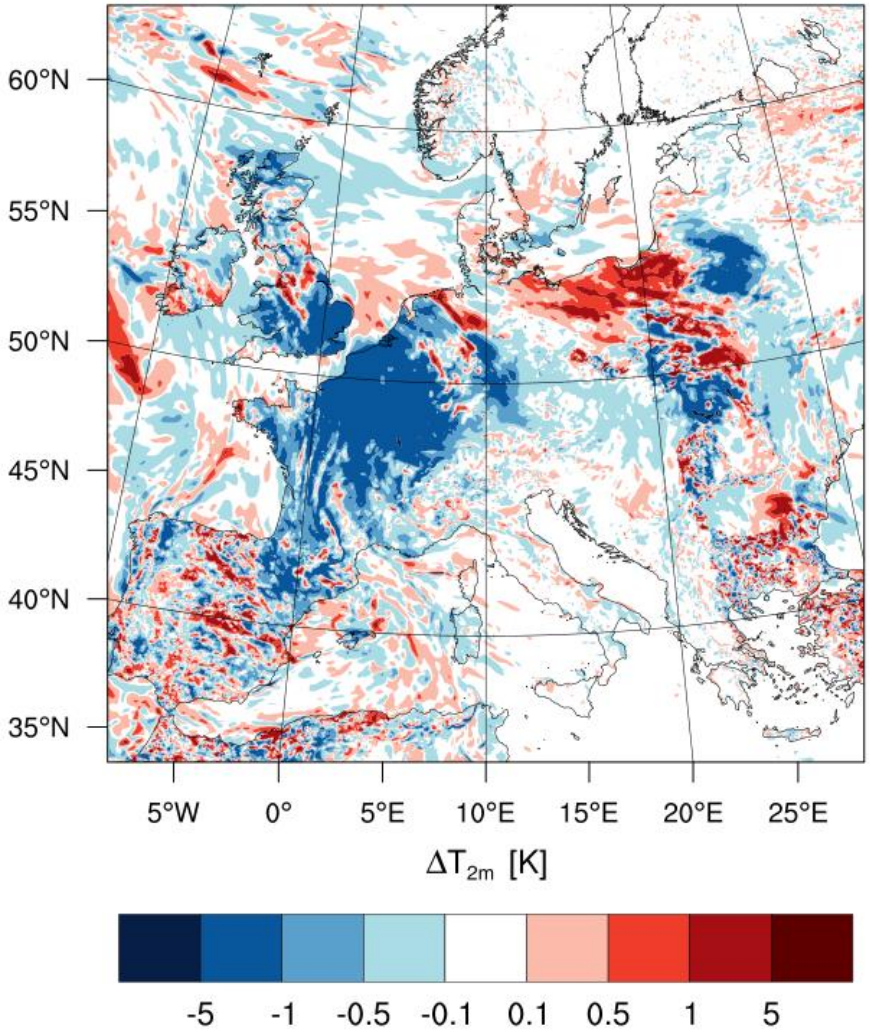
Changes in ice crystal number





Changes in radiation and temperature





Biomass Burning

Athanasopoulou et al. (2014)

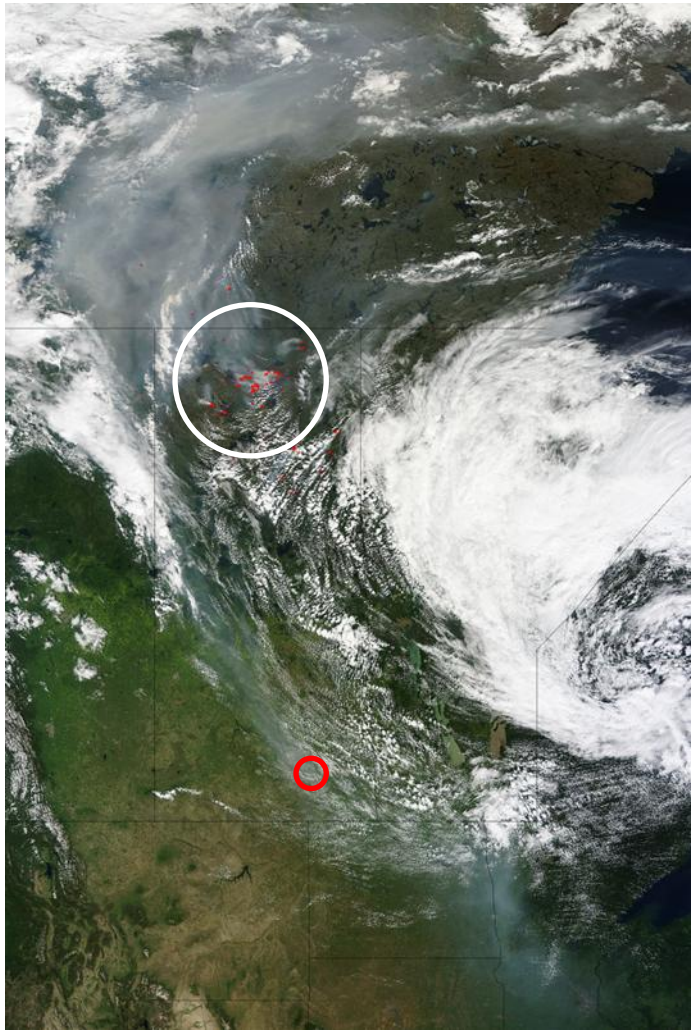
D. Rieger

Trentmann et al.(2002),
Freitas et al. (2006)

M.O. Andreae

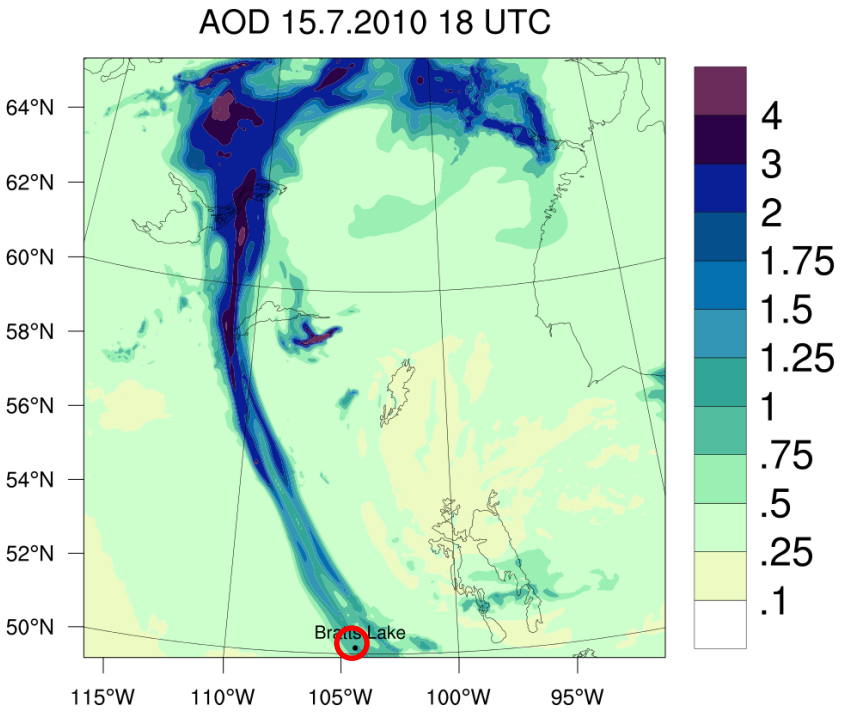
Horizontal Distribution

15.7.2010 17:55 UTC



LANCE Rapid Response MODIS Image Gallery, NASA

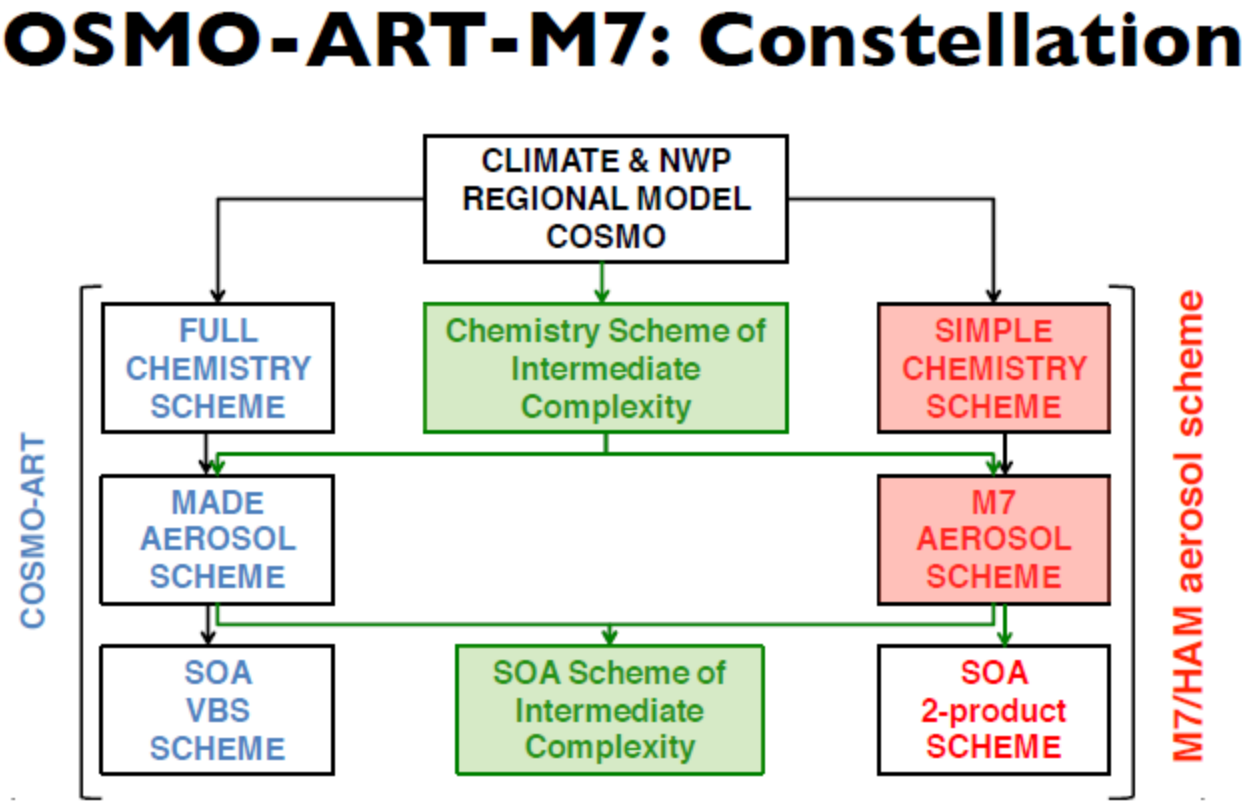
WW+SW scenario



O. Speyer, E. Athanasopoulou, E. Gerasopoulos,

(3) smog winter periods in Athens: 11/1 - 11/2/2013 & 15/12/2013 – 23/02/2014

COSMO-ART/M7


COSMO-ART-M7: Constellation
CLIMATE & NWP REGIONAL MODEL COSMO
FULL CHEMISTRY SCHEME
Chemistry Scheme of Intermediate Complexity
SIMPLE CHEMISTRY SCHEME
MADE AEROSOL SCHEME
M7 AEROSOL SCHEME
SOA VBS SCHEME
SOA Scheme of Intermediate Complexity
SOA 2-product SCHEME
COSMO-ART
M7/HAM aerosol scheme

Outlook

LM-ART will become available to COSMO members

as soon as possible.

Status of ICON-ART

Already realised:

Volcanic ash

Radioactive substances

Sea salt

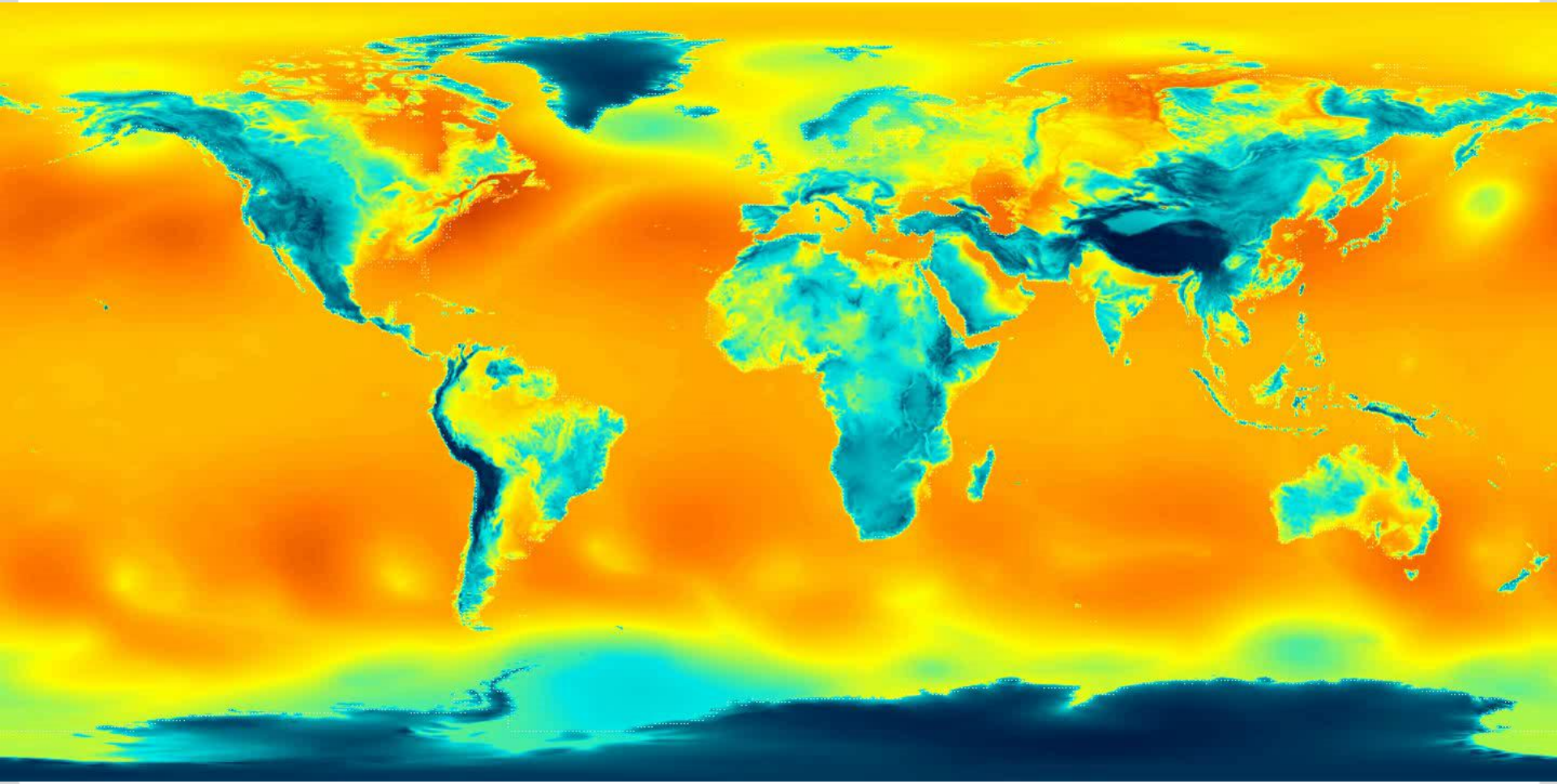
Simple halogen chemistry

(Mineral dust)

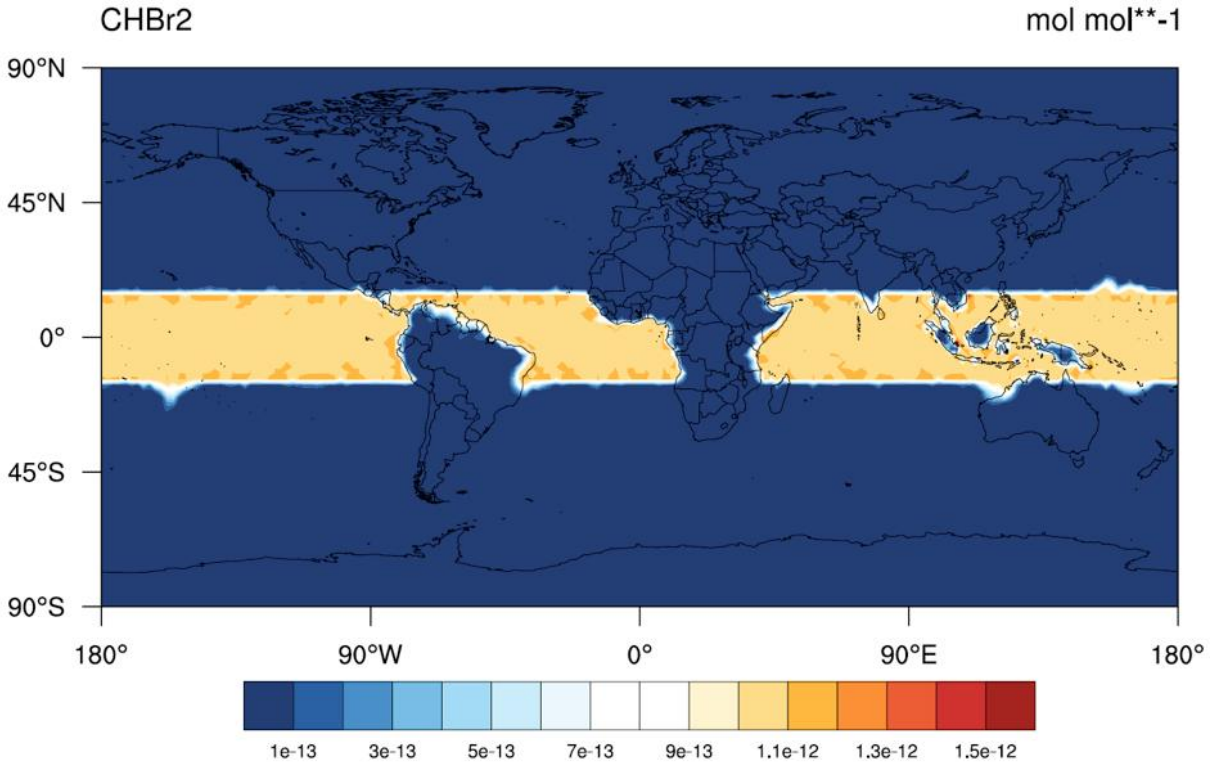
Super-Typhoon Hayhan

Roland Ruhke, Martin Köhler

(~13 km resolution), 05.11.2013 - 14.11.2013

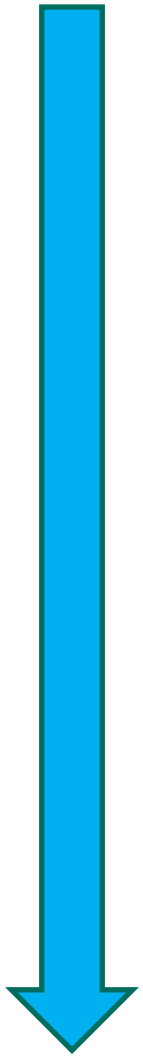


Prescribed boundary conditions for CH_2Br_2



CH_2Br_2 at 95 HPa

Aerosols in operational forecasts



Pollen grains: **health issues**

Volcanic ash: **aviation**

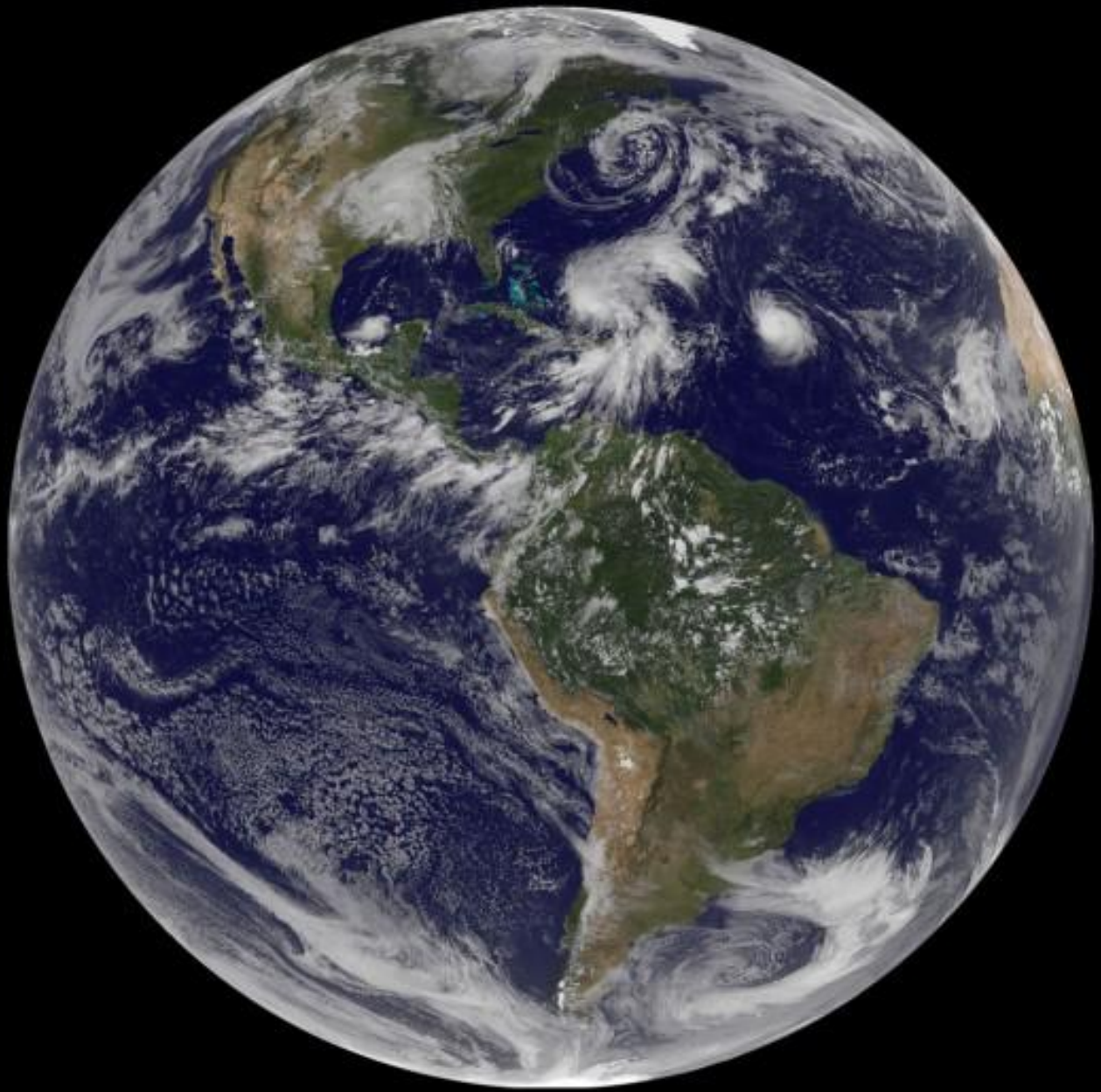
Mineral dust: **visibility**

Vegetation fires: **health, aviation**

Sea salt, mineral dust: **cloud formation**

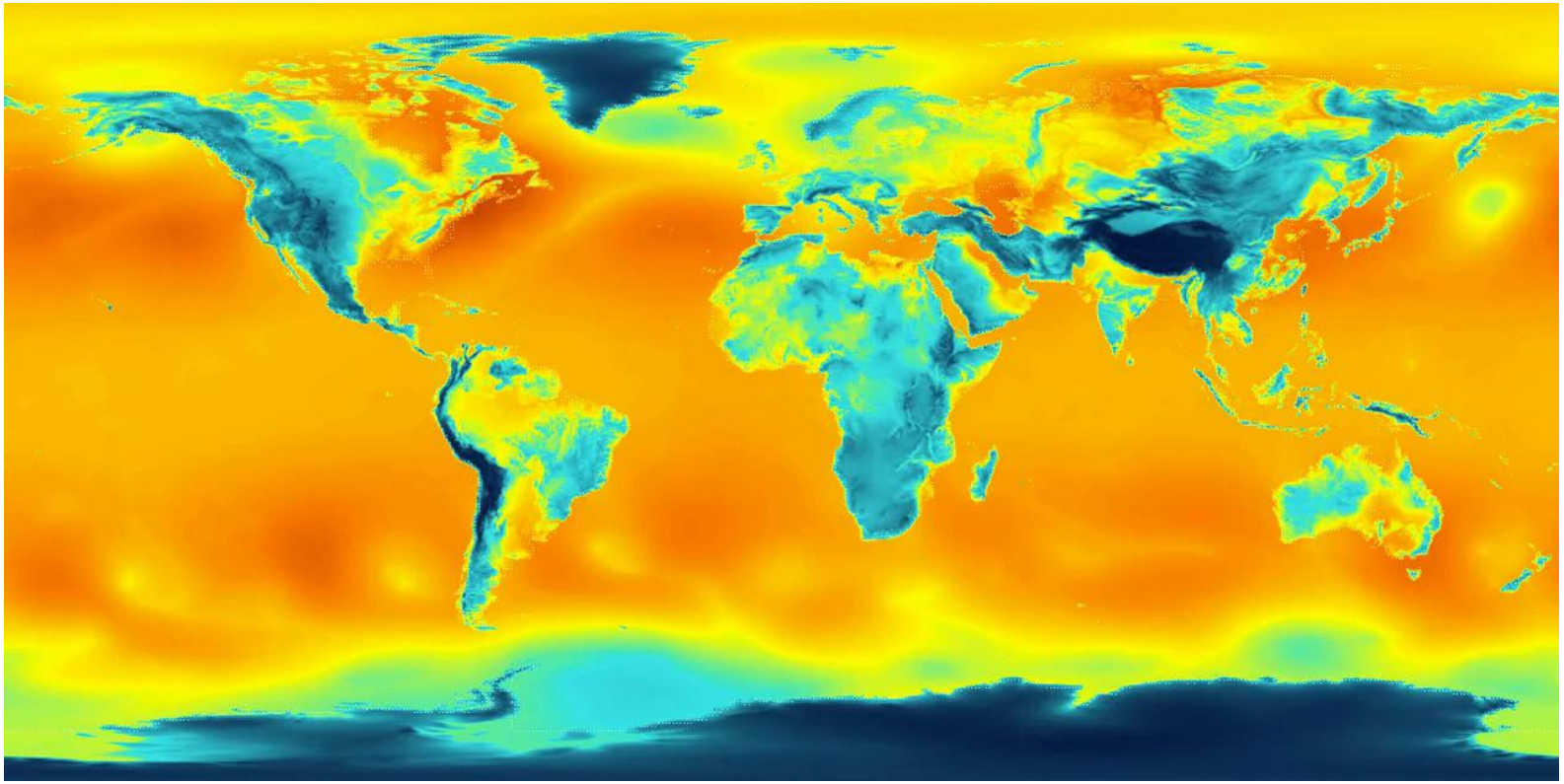
Primary and secondary aerosols:

visibility, fog, icing, flooding, …



But there is more…

- Super-Typhoon Hayhan
  R03B07 (~13 km resolution), 05.11.2013 - 14.11.2013, hourly output, level 46 (~110 hPa):
- Pressure in Pa at lowest model level



Acknowledgement:

We acknowledge COSMO

We appreciate the support in the development of COSMO-ART:

U. Schättler, M. Baldauf, A. Seifert, U. Blahak, J. Förstner, M. Raschendorfer

A. Pauling, K. Zink, P. Kaufmann, O. Fuhrer, A. Roche

D. Brunner, Ch. Knote

A. Revokatova

E. Athanasopoulou

New COSMO-ART users:

Helmholtz-Zentrum Geesthacht
Zentrum für Material- und Küstenforschung

NiMet
Nigerian Meteorological Agency

Sultanate Of Oman
Public Authority For Civil Aviation
D.G.of Meteorology & Air Navigation

Biomass burning aerosol over Canada

WW+SW scenario

Temperature Change in 2 m Height

WW+SW – WW