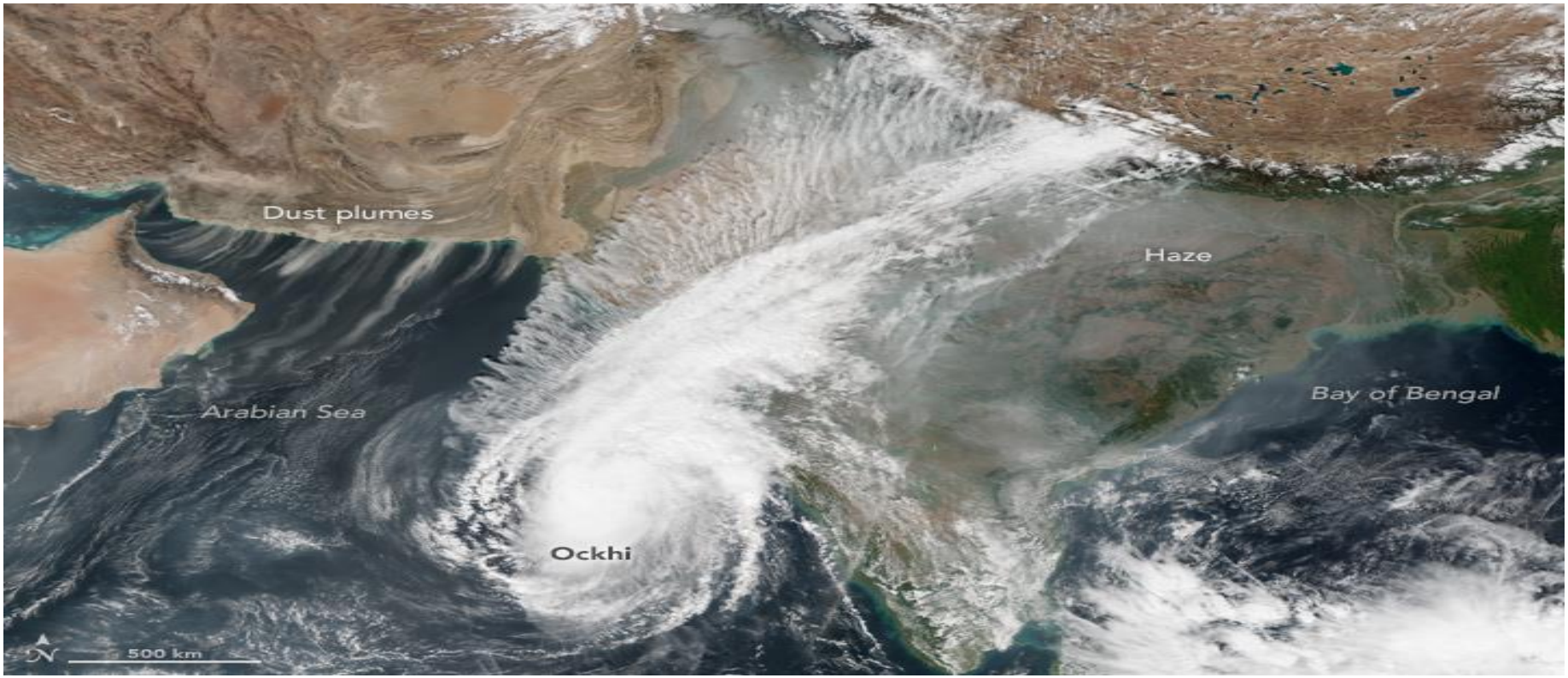
Karlsruhe Institute of Technology

Status and applications of the modelling system ICON-ART

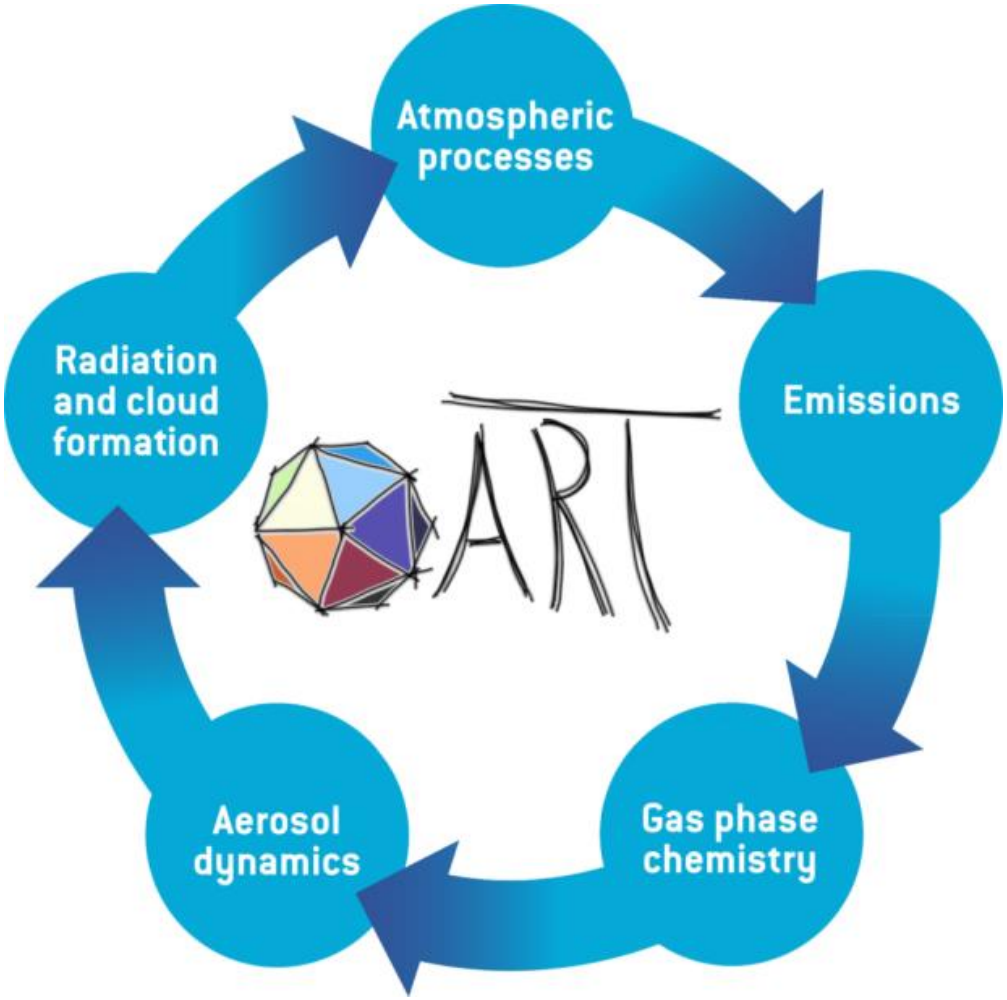
Institute of Meteorology and Climate Research, KIT, Karlsruhe

Bernhard Vogel and the ICON-ART developers

Aerosols and gaseous compounds



Aerosols and gaseous compounds



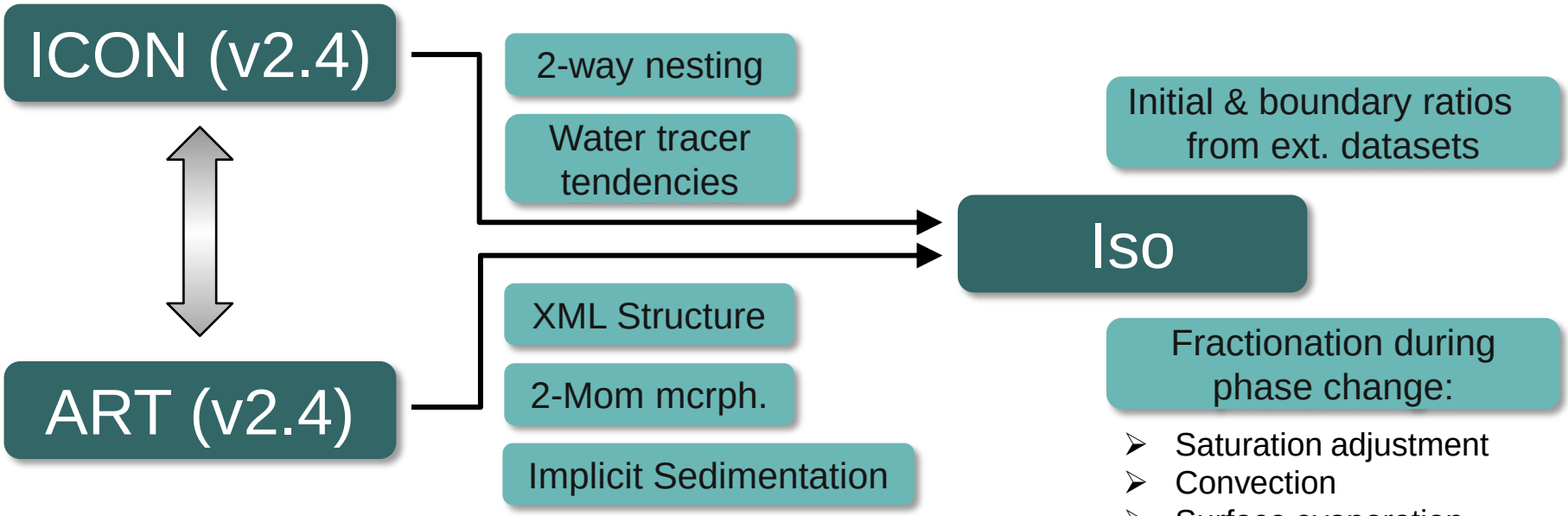
Rieger et al., 2016
Weimer et al., 2016
Gasch et al., 2017
Eckstein et al., 2018
Schroeter et al., 2018
Gruber et al., 2019
Hoshiaripour et al., 2019

Main topics at IMK

- **Process studies**
- **Relative importance for weather forecast**
- **Impact on climate**
- **Seamless in spatial and temporal scales**

ICON-ART-Iso – Current Status

Simulation of heavy water isotopologues HDO and $H_2{}^{18}O$ as diagnostic water tracer *(Eckstein et al., 2018 (GMD))*



Future plans:

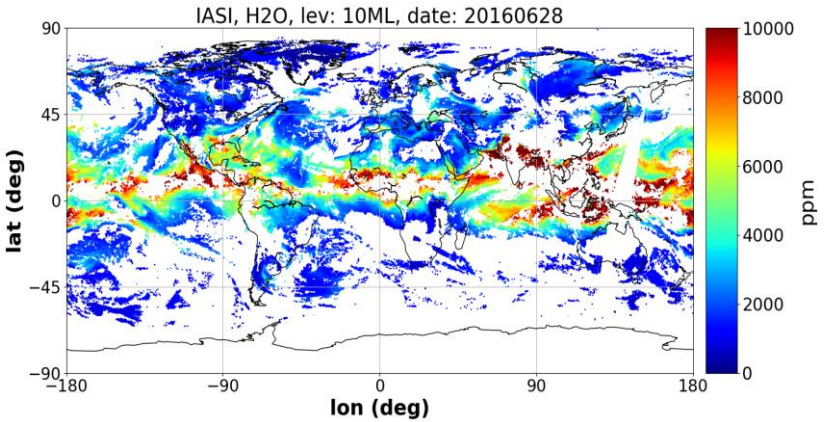
- Implementation of TERRAiso
- Convection permitting simulations

C. Diekmann

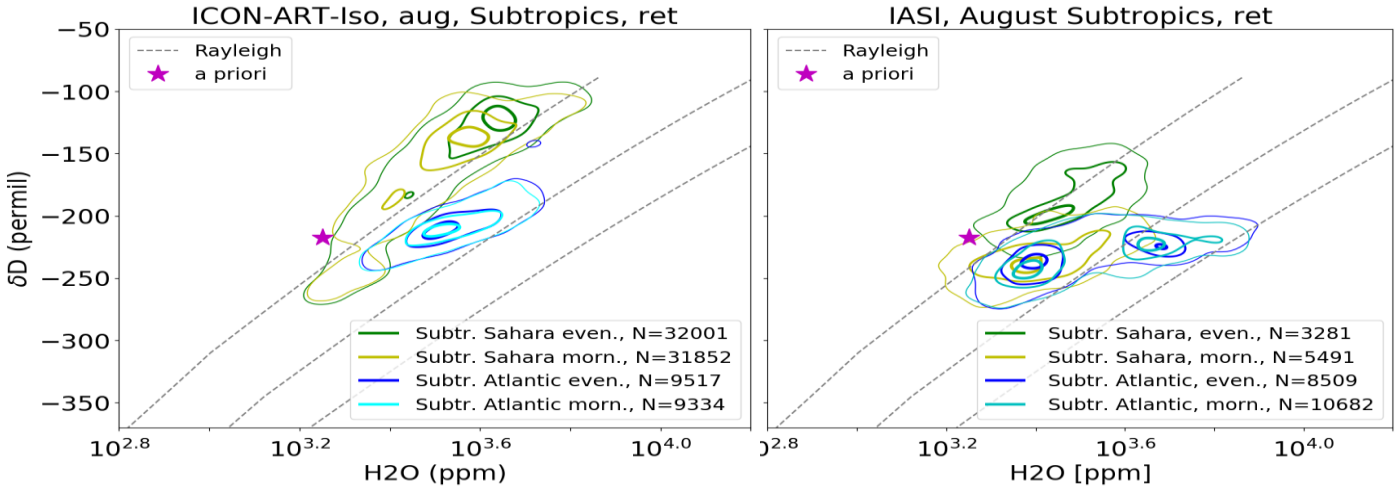
ICON-ART-Iso

MOTIV (*Moisture Transport pathways and Isotopologues in water Vapour*)

- Operational generation of satellite-based atmospheric water isotope retrievals from IASI spectra (2015-2018)
- Model vs. satellite analyses with focus on water processes during the West African Monsoon



***Left**: Model data, adapted to IASI sensitivities*
***Right**: Retrieved from IASI spectra*

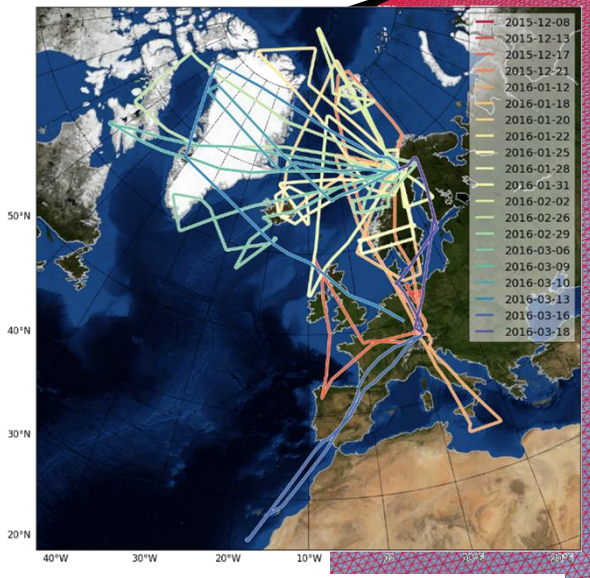


ICON-ART POLSTRACC simulation

Jennifer Schröter and the POLSTRACC team

POLSTRACC campaign setup
NH Winter 2015/2016
R2B6 global (40 km)
R2B7 Arctic nest (20 km)

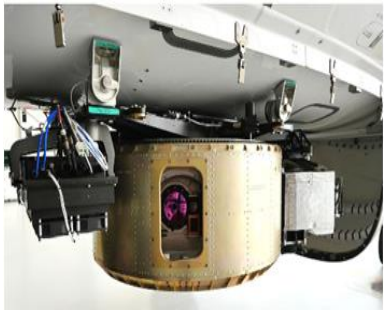
24h forecast mode - IFS initial states



Simulation with 22 tracers, including ozone (linearised scheme with cold tracer)

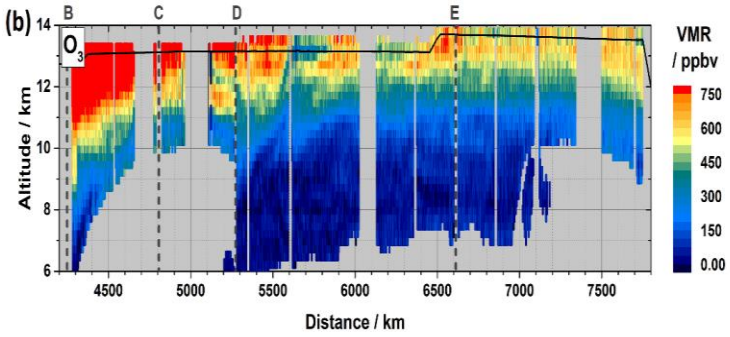
Example flight PGS14

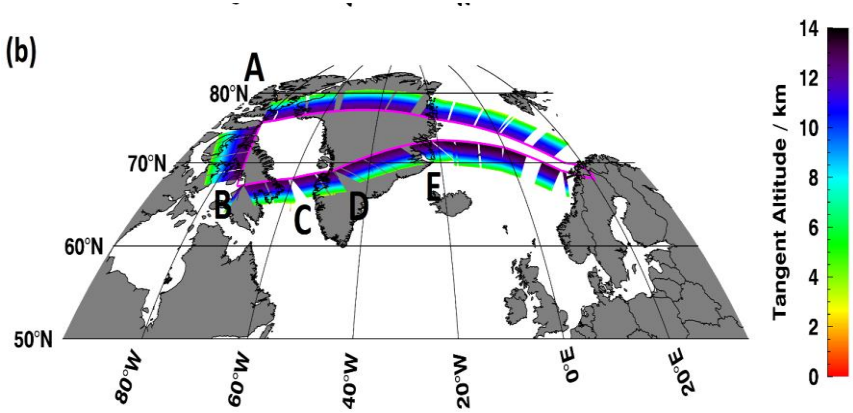
Jennifer Schröter and the POLSTRACC team

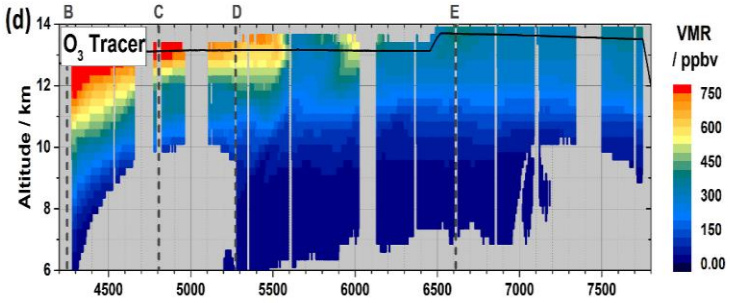


POLar **STRA**tosphere in a **C**hanging **Cl**imate

HALO aircraft mission coordinated by KIT





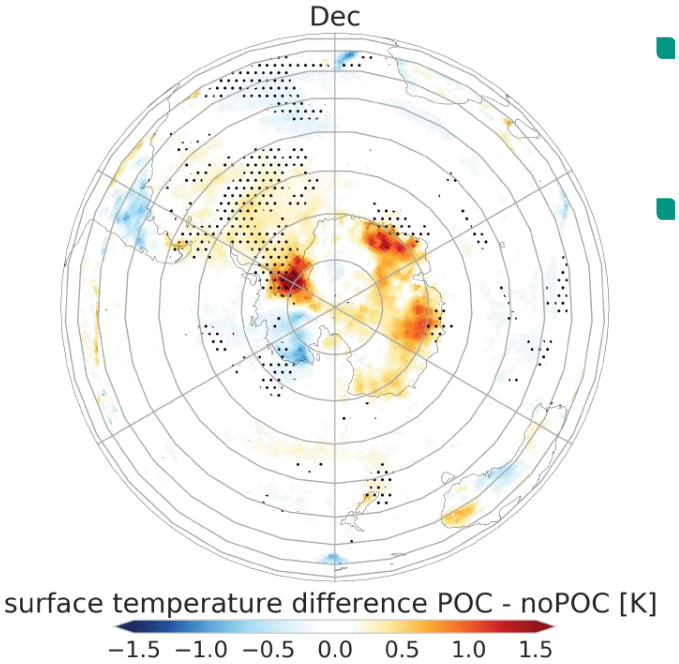


Preliminary results
ICON-ART integration by J.Schröter (KIT)
GLORIA results by W.Woiwode (KIT)

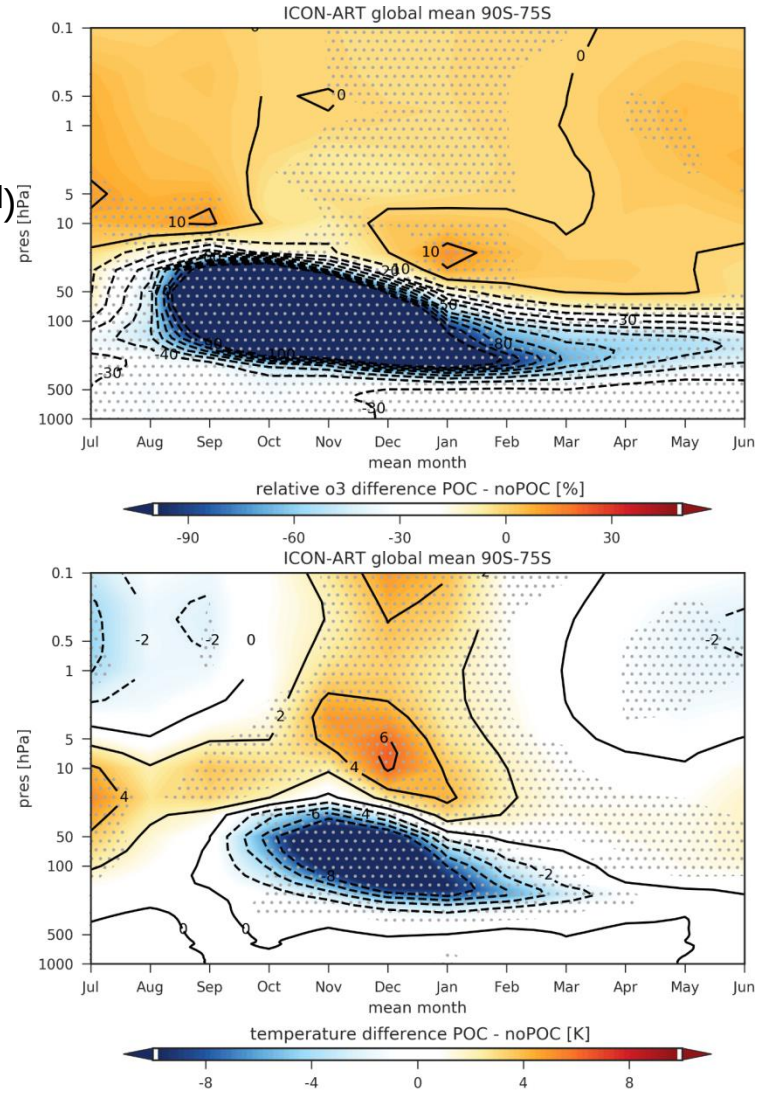
Stratospheric Impact on Surface Climate

Timeslice Experiment

- Climate configuration, 50 years of simulation
- Mean conditions 1998-2002: SST/SIC, GHG
- Free running linearized ozone scheme (based on LINOZ [1])
- Ozone initialized for year 2000
- Ozone is transported and has a radiative impact



- Experiment I: POC
  Polar ozone chemistry included
- Experiment II: noPOC
  Polar ozone chemistry neglected



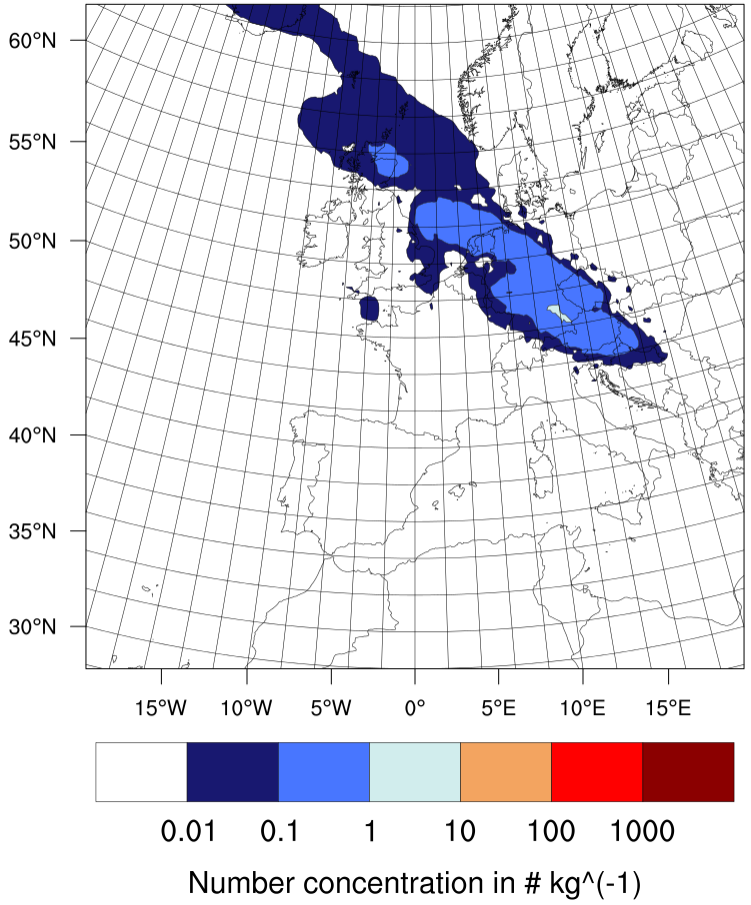
M. Braun, J. Schröter

Institute for Meteorology and Climate Research

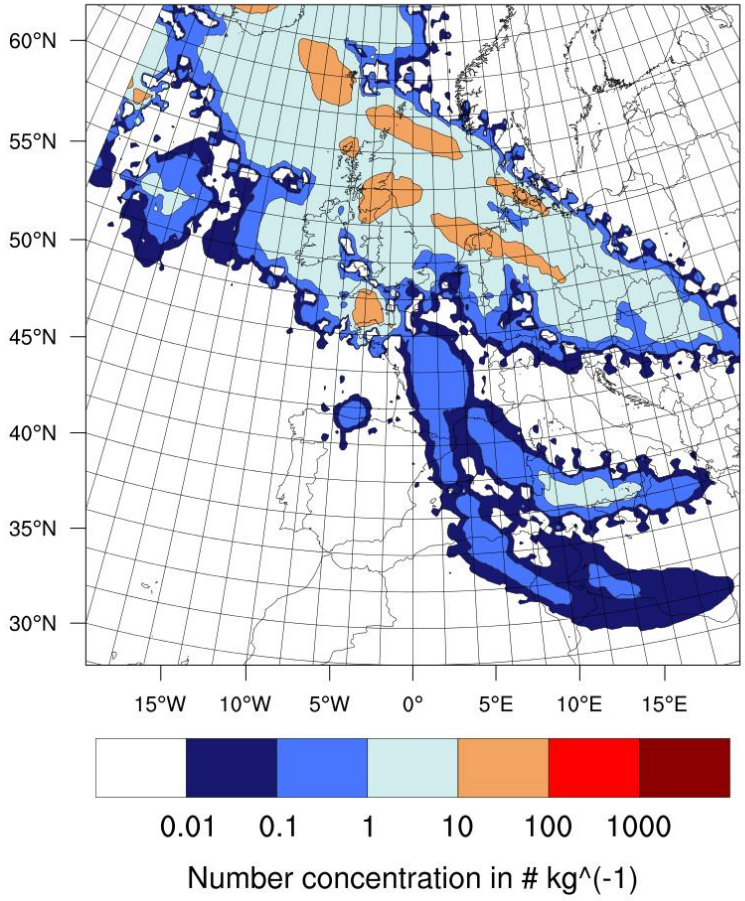
Biological particles

PolDACH

Contour plot - Pollen - Height: 8000 m



Contour plot - SPP - Height: 8000 m



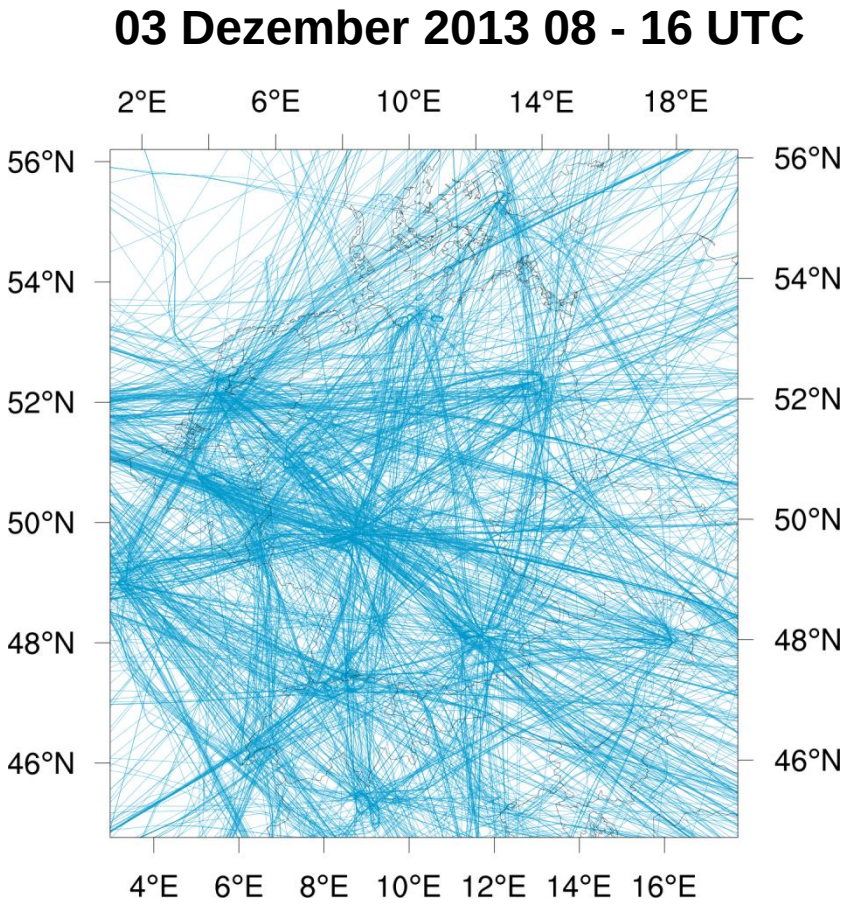
Sven Werchner

Institute for Meteorology and Climate Research

Contrails and solar energy production

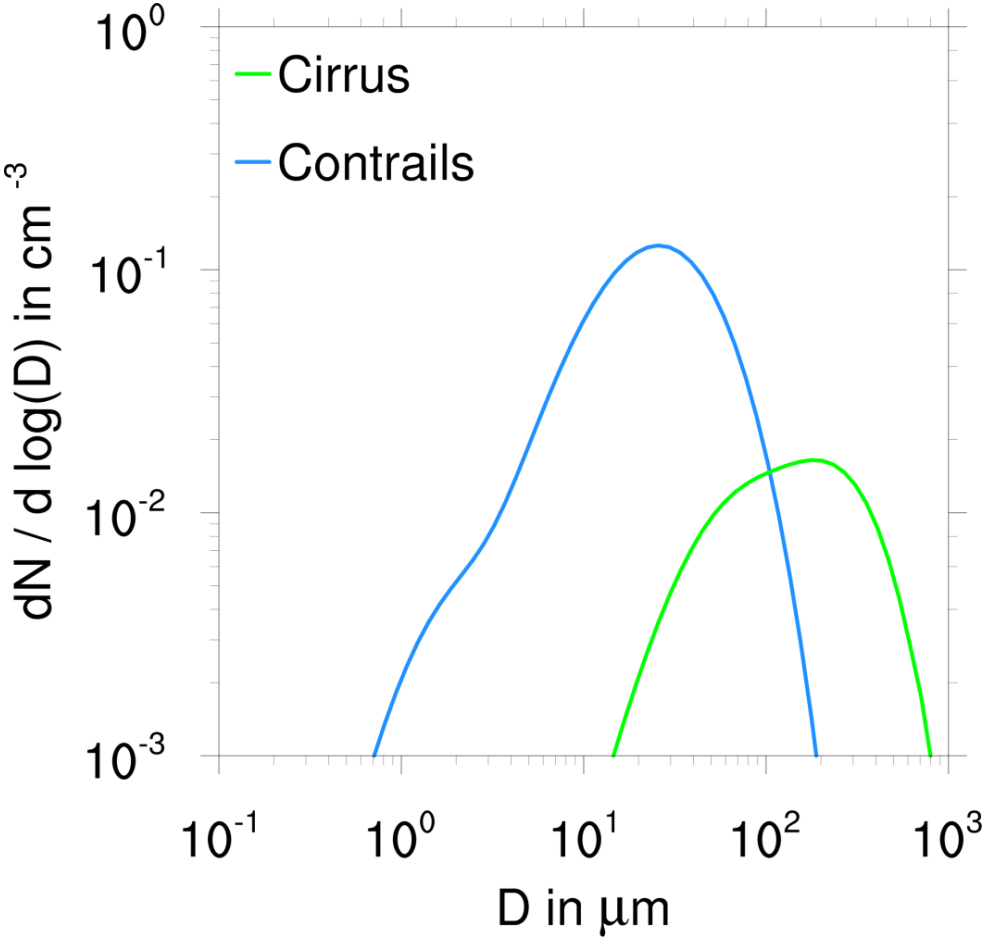
Impact of contrails on radiation

flightradar24.com, 2016.



Development in microphysics

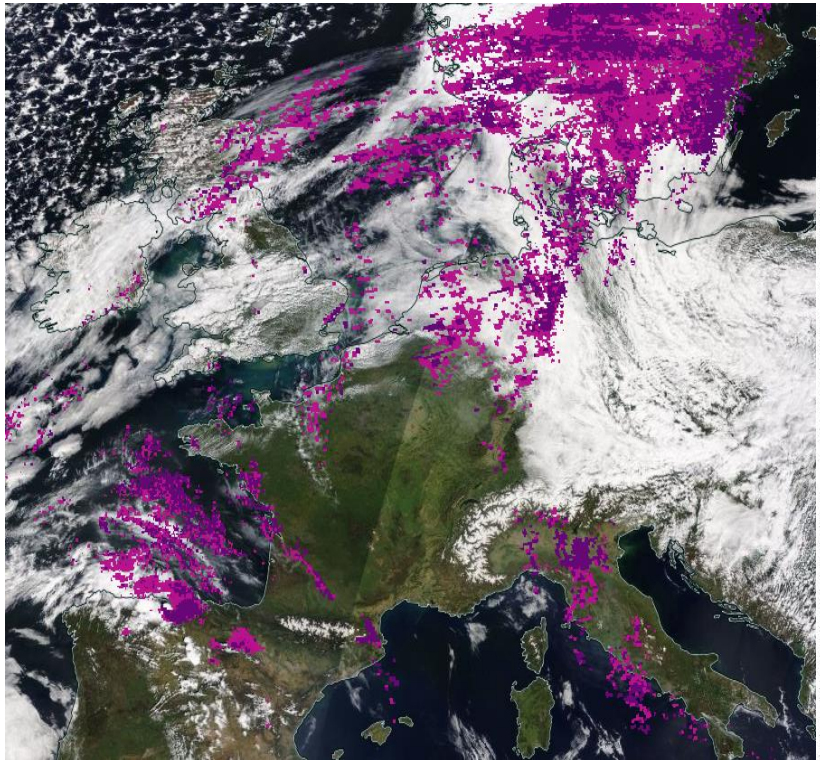
- 4 additional classes of hydrometeors (size, shape)

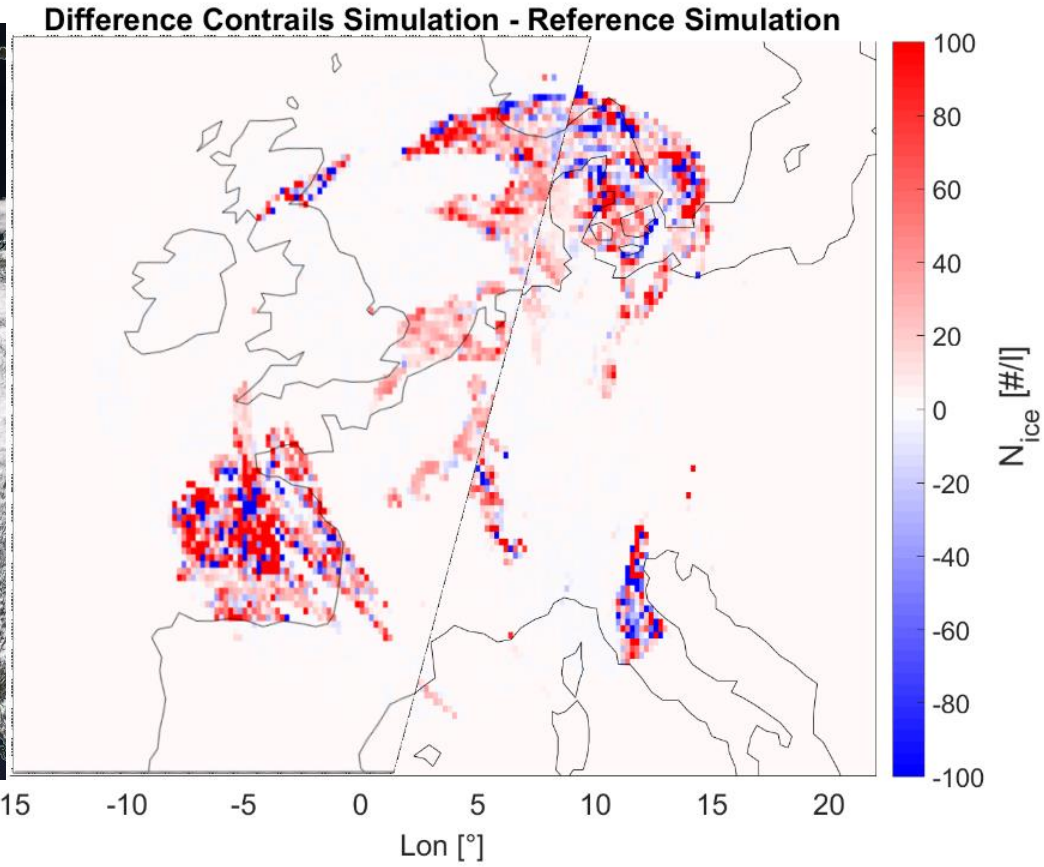


$$D(m) = a\, m^b; m = \frac{Q}{N}$$

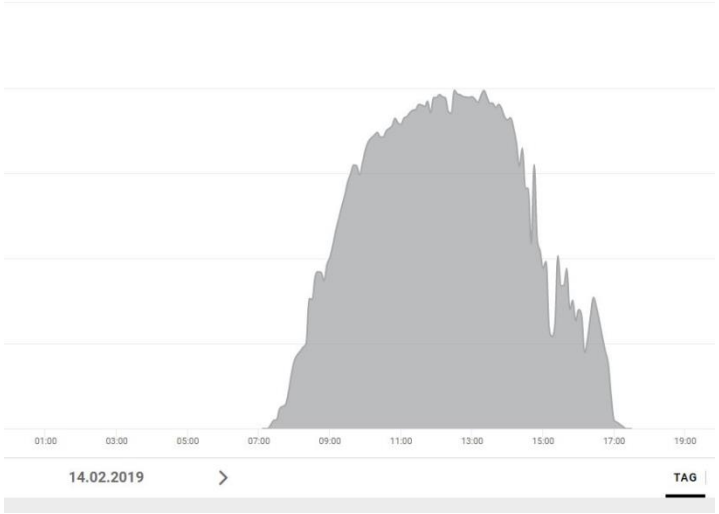
Gruber et al., 2018

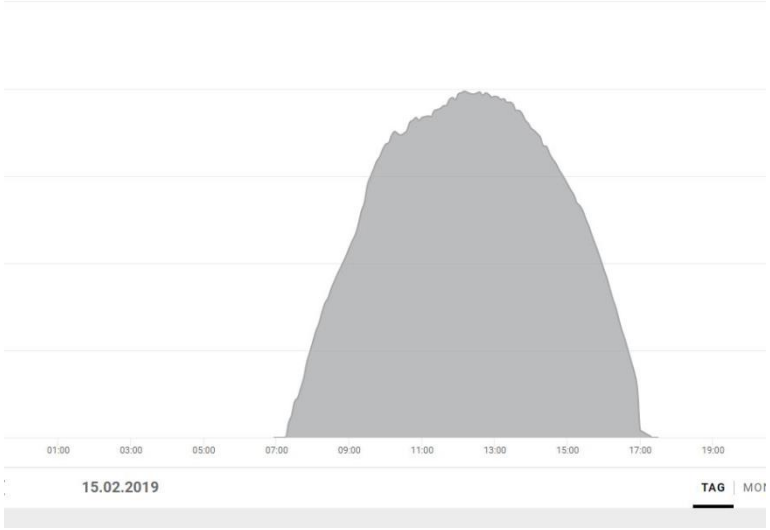
Ice particles produced by air traffic

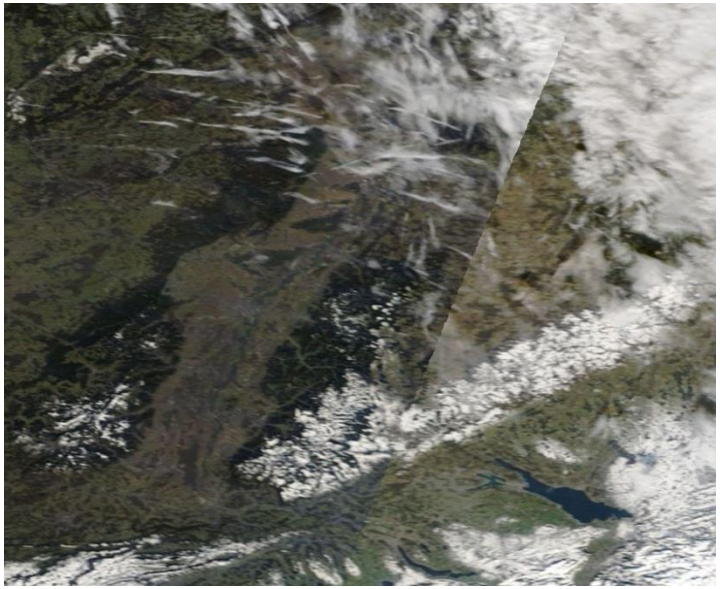




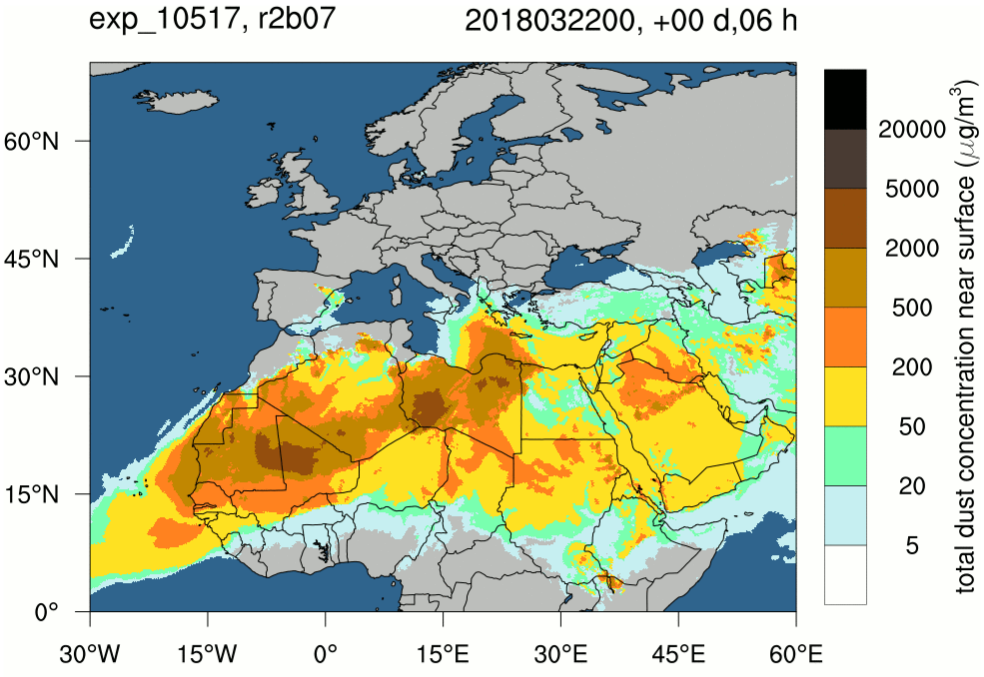
Impact on PV production (Crowd Science)







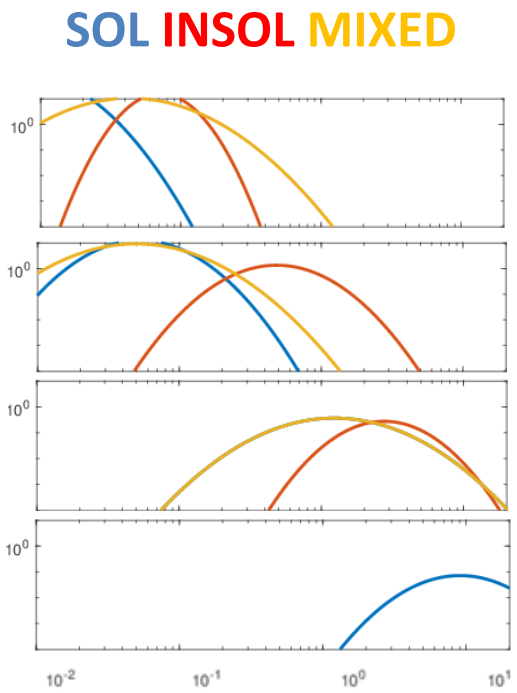
Atmospheric impact of Mineral Dust



V. Bachman, A. Steiner, J. Förstner

AERODYN, a new flexible aerosol scheme

- Coupling with the gas phase
- Flexible number of modes
- Flexible number of species
- Interaction with radiation and clouds
- Generic



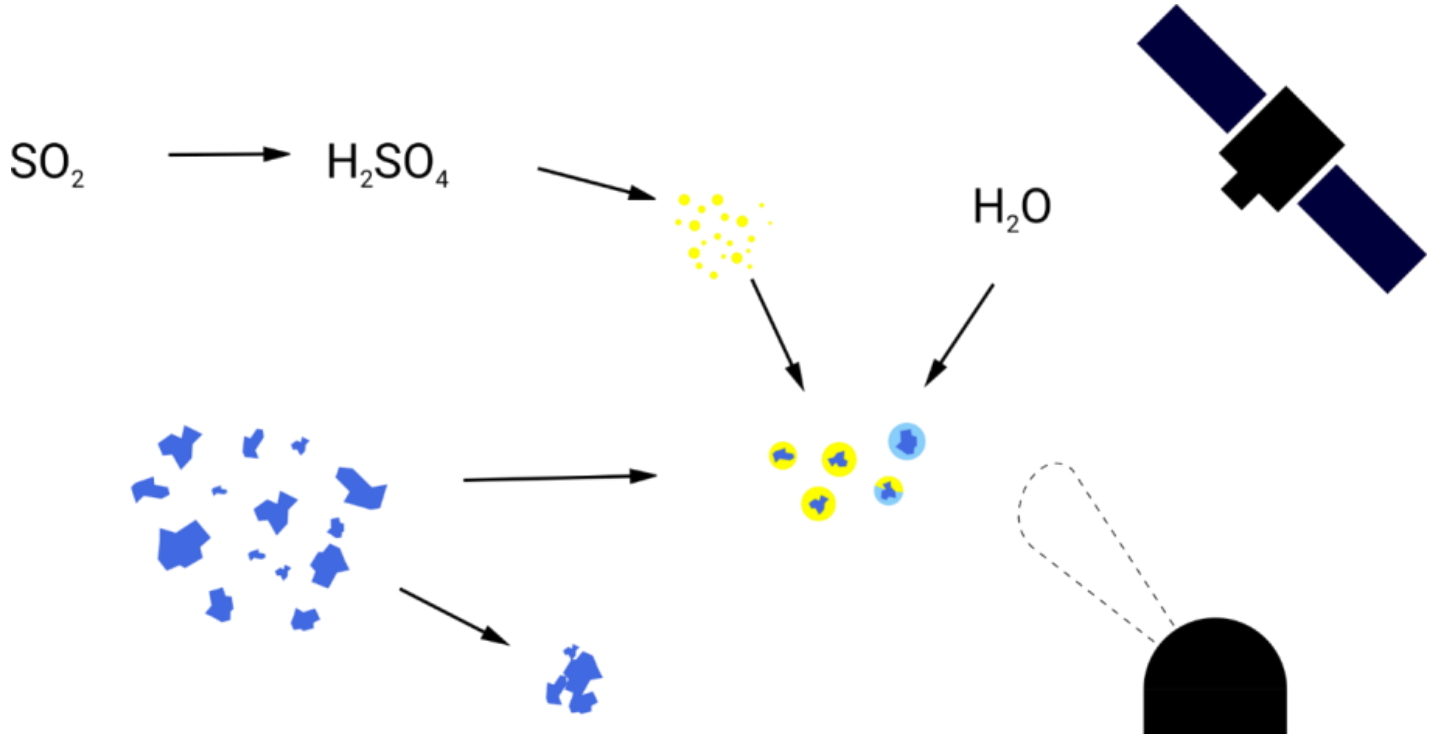
Contributions by:

Sascha Bierbauer, Simon Gruber, Ali Hoshyaripour, Lisa Muth, Lukas Muser, Anika Rohde, Jonas Straub, Heike Vogel, Sven Werchner, and many others

Improvement of volcanic ash forecast by data assimilation

Karlsruhe Institute of Technology

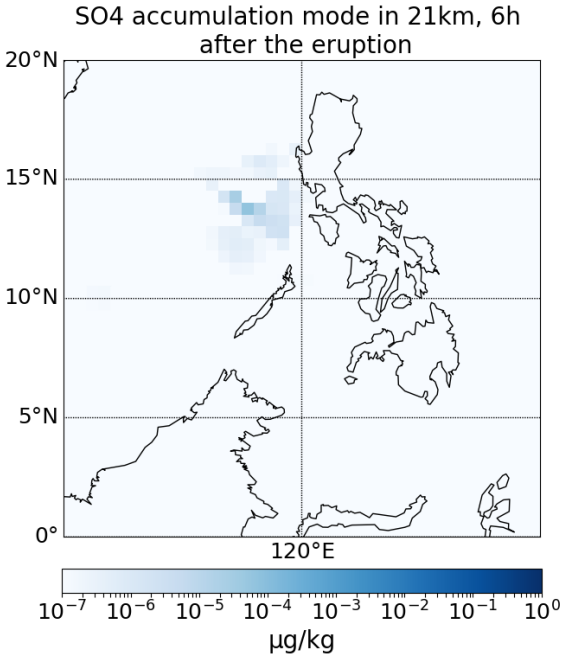
Deutscher Wetterdienst
Wetter und Klima aus einer Hand

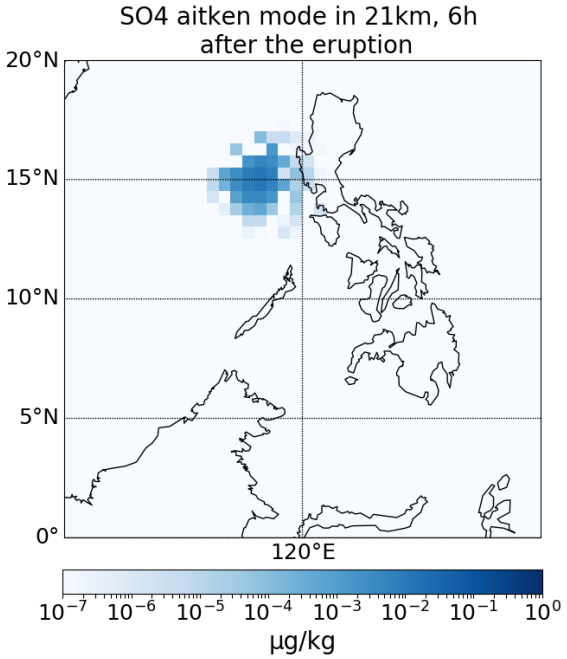


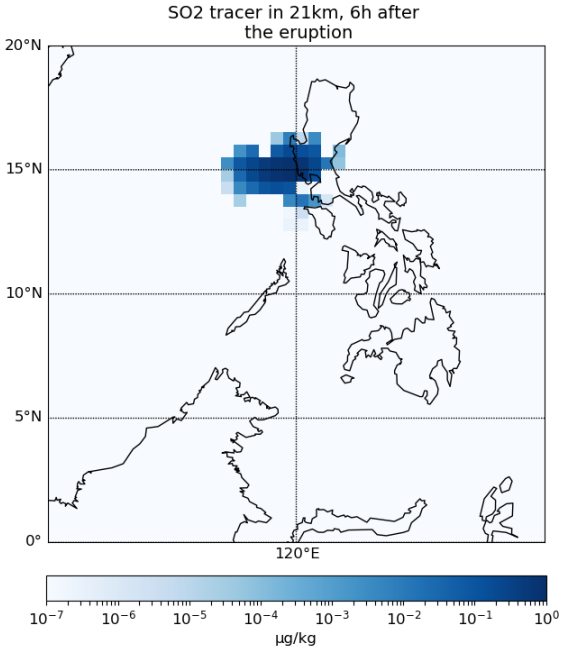
Lukas Muser

Institute for Meteorology and Climate Research

First AERODYN Pinatubo application







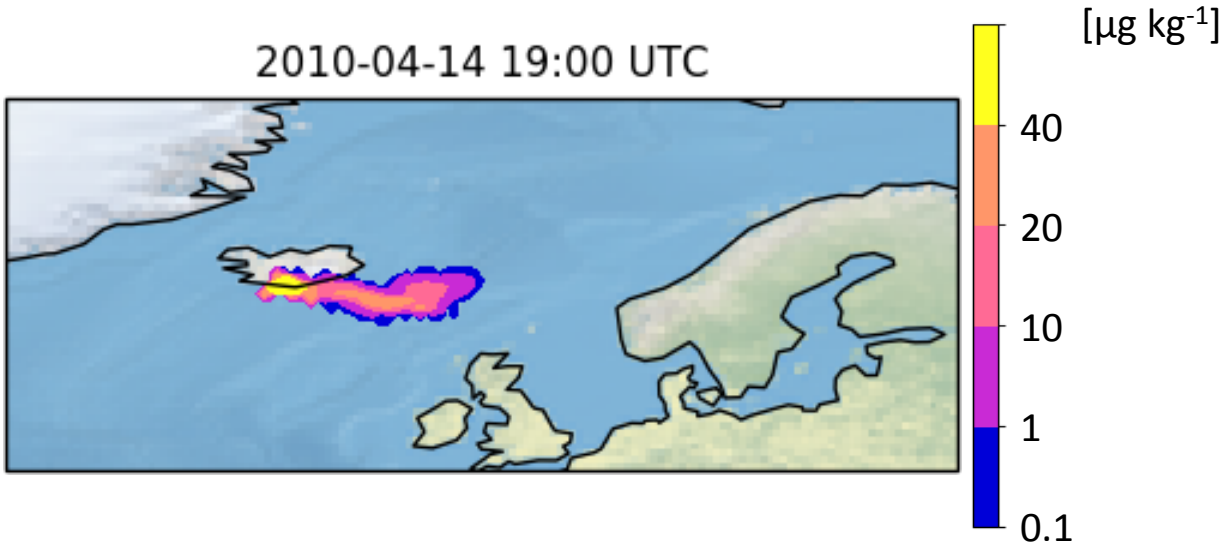
VOLIMPACT

Lisa Muth

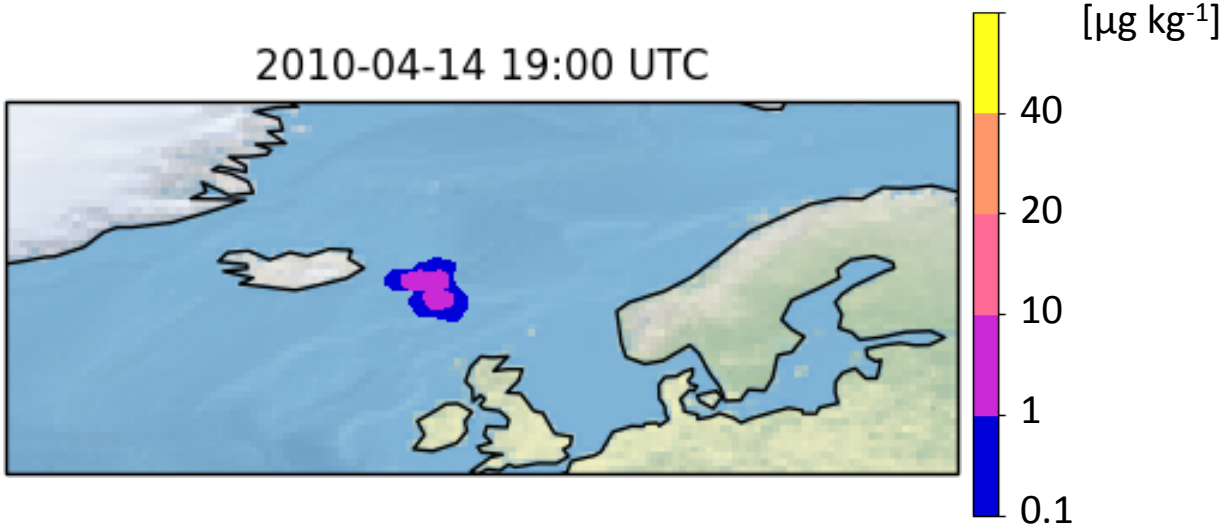
Institute for Meteorology and Climate Research

Mixing by condensation and coagulation

Volcanic Ash
in
insoluble accumulation
mode



Volcanic Ash
in
mixed accumulation
mode



ICON-ART Licensees

FU Berlin

TROPOS Leipzig

AWI Potsdam

University Mainz

Rosshydromet

Pukyong National University

Topics not addressed in this talk

Karlsruhe Institute of Technology

Climate engineering (Presentation by S. Gruber)

Methane budget (Poster by C. Scharun)

Aqua planet, sea salt, and clouds (Poster by C. Braun)

Operational dust forecast in South Korea (future project)