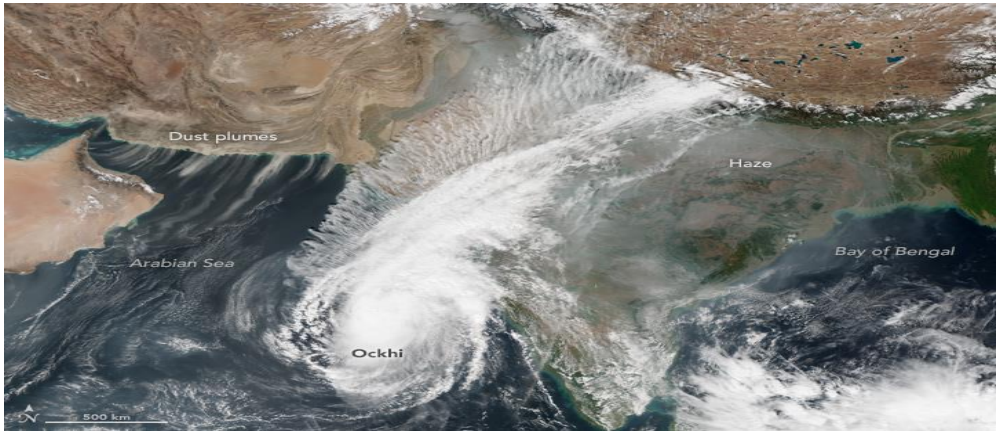
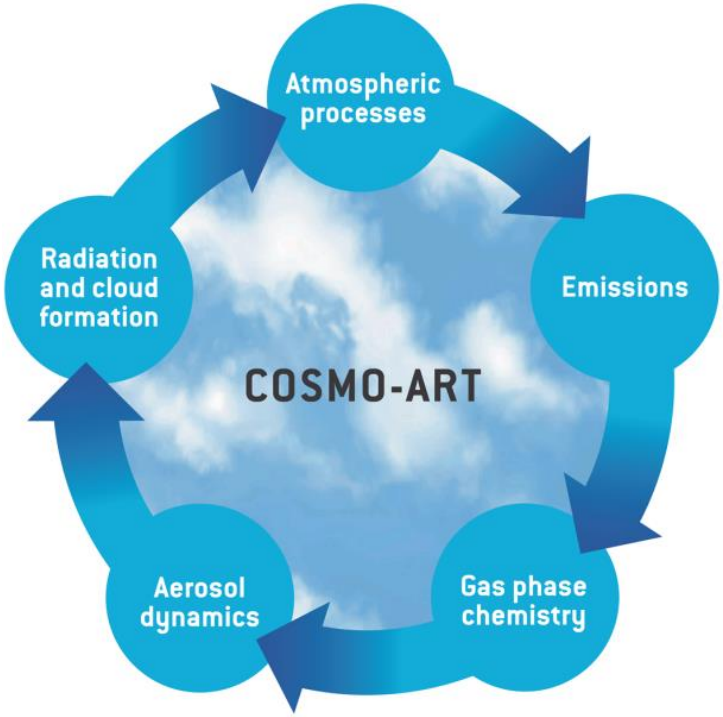
Karlsruhe Institute of Technology

Status of COSMO-ART & ICON-ART

Bernhard Vogel and ART developers and users



Applications of COSMO-ART



The study of urban aerosol component in the atmosphere of Moscow megacity based on measurements and COSMO-ART modelling

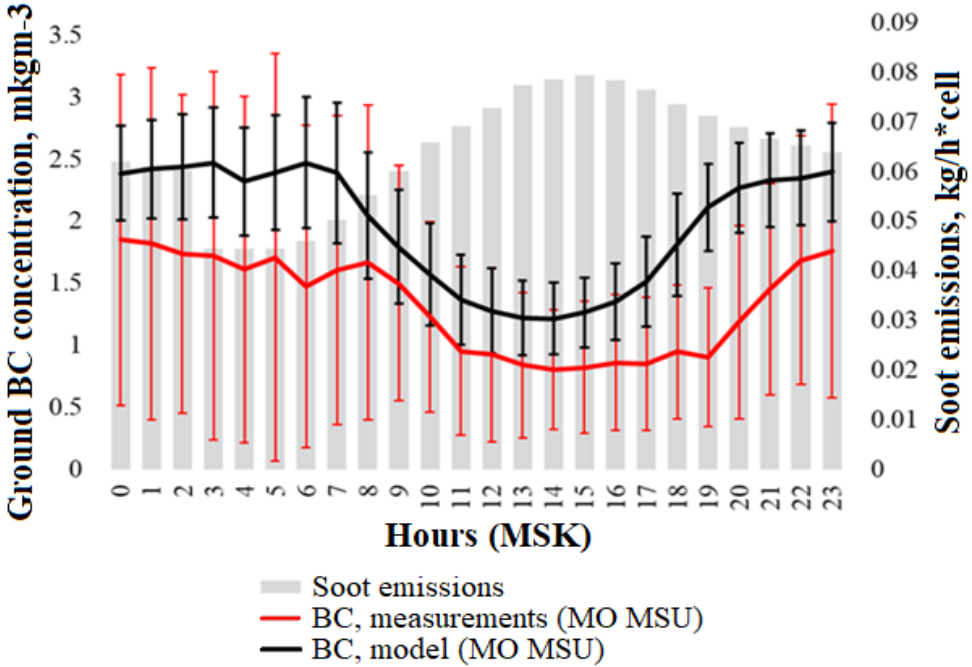
Nataly Chubarova[1], Elizaveta Androsova[1], Alexander Kirsanov[2], Bernhard Vogel[3],Heike Vogel[3], and Gdaly Rivin[1,2]

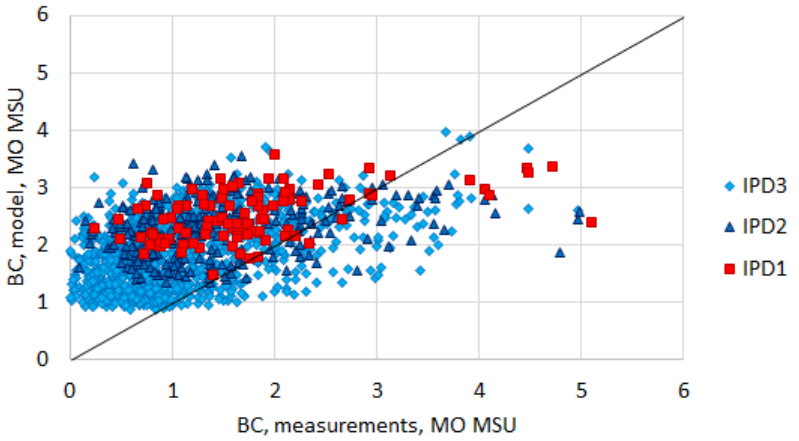
1 - Moscow State University, 119991, Moscow, Russian Federation (natalia.chubarova@gmail.com),

2 - Hydrometeorological Centre of Russia, 11-13, B. Predtechensky per., Moscow, 123242, Russia

3 - Karlsruhe Institute of Technology, Karlsruhe, Germany

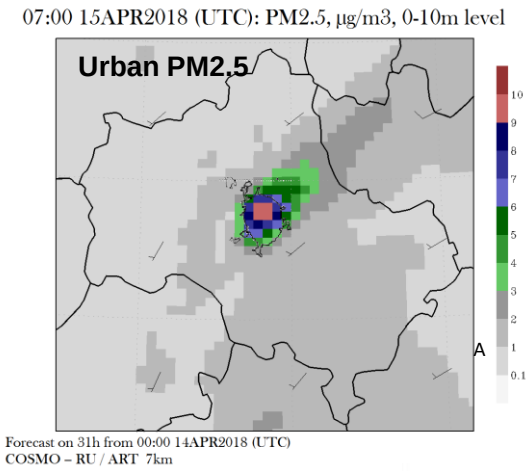
Black carbon aerosol: comparisons between model and measurements

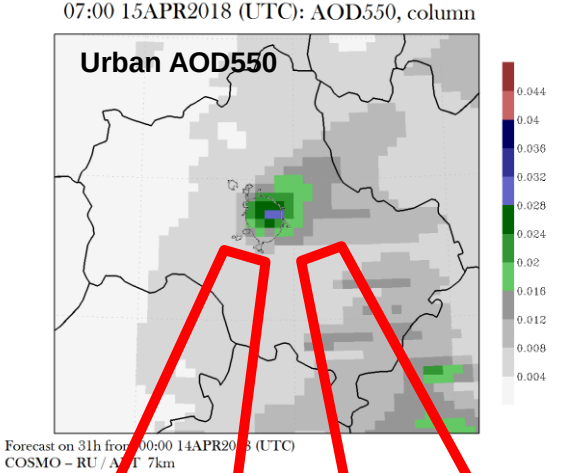


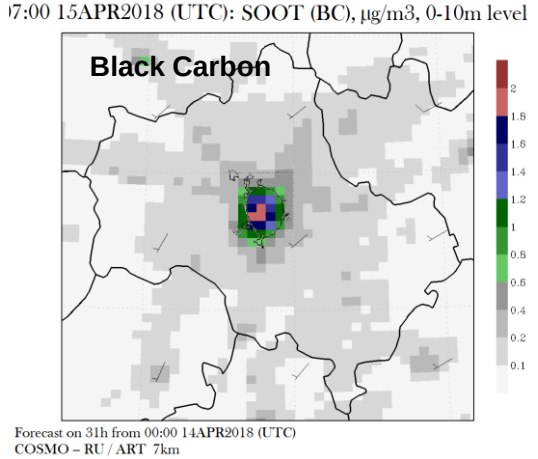


IPD1 – very stable atmosphere
IPD2 - intermediate
IPD3 – unstable atmosphere

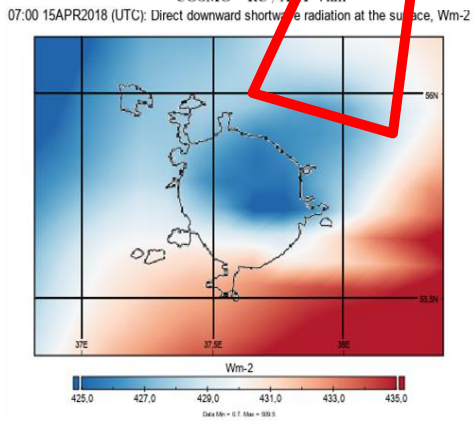
An example of radiative effect of Moscow urban aerosol for direct and diffuse irradince. 15/04/2018

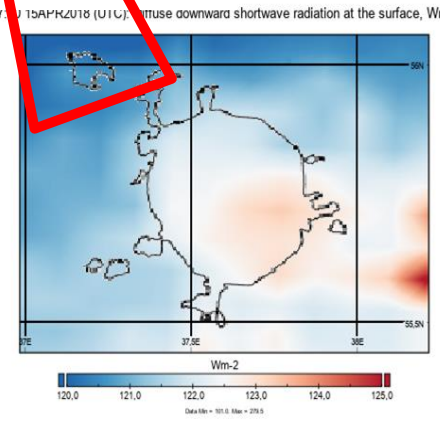






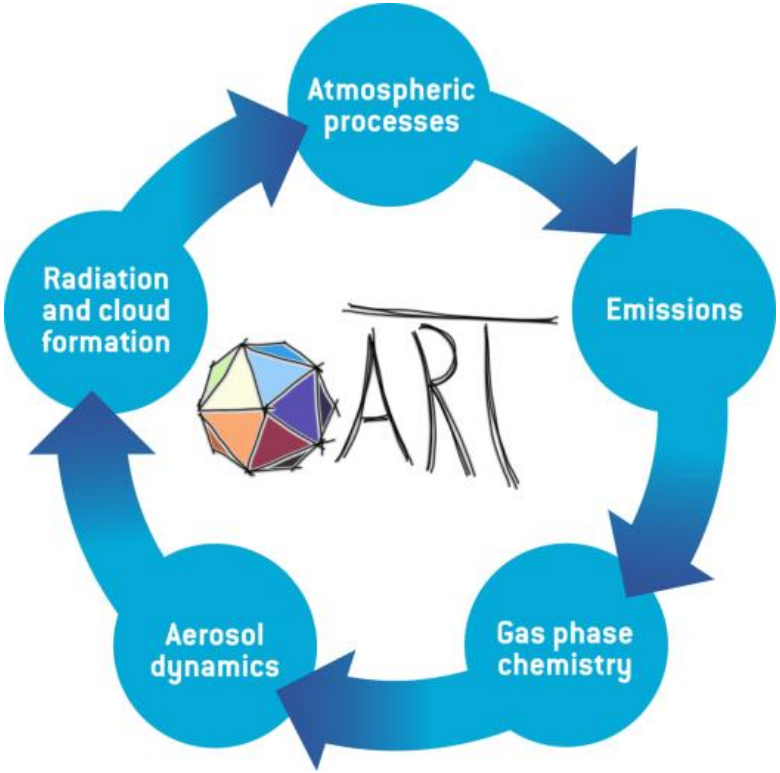
DIRECT IRRADIANCE





DIFFUSE IRRADIANCE

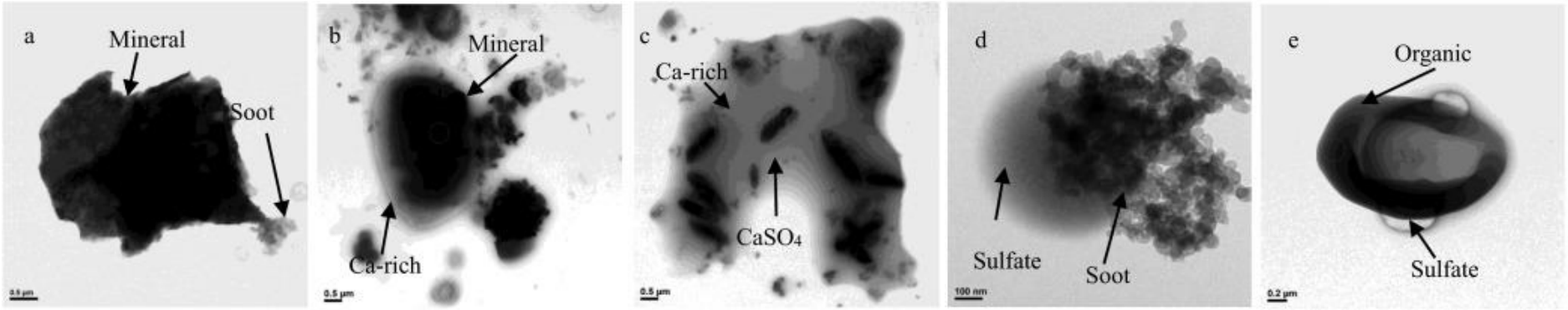
Developments and applications of ICON-ART



Representing the Optical Properties of Internally-Mixed Aerosols in Atmospheric Models using Artificial Neural Networks

Ali Hoshyaripour[1*], Lukas Muser, Lisa Muth, Heike Vogel and Bernhard Vogel

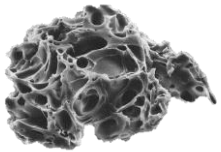
[1]Institute of Meteorology and Climate Research, Karlsruhe Institute of Technology, Germany
*ali.hoshyaripour@kit.edu



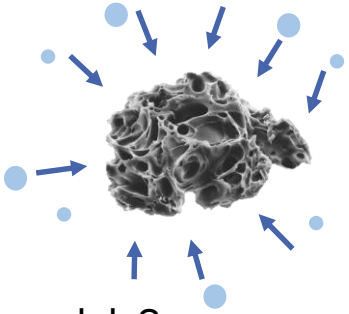
Source: Fan et al 2016

Effect of Aerosol Dynamics (AERODYN)

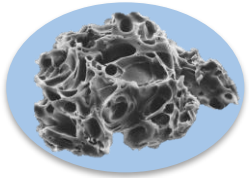
1) Fresh emitted particles



2) Condensation and coagulation

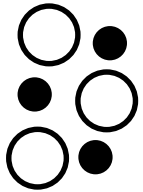


3) Coated/aged particles

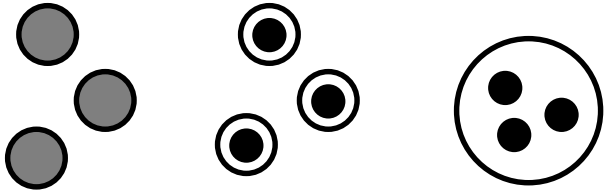


- How to treat the aged aerosols in models?

Ignored in externally mixed!



Considered (idealized) in internally mixed

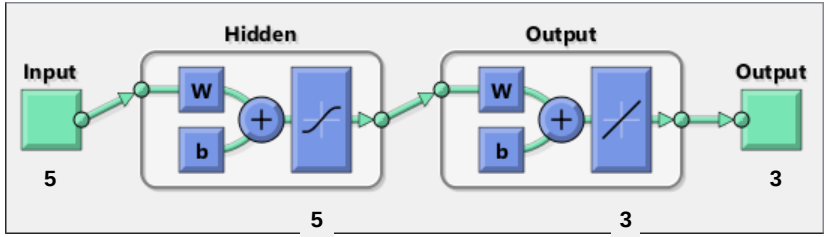


Volume-average Core-Shell Maxwell-Garnett

ANN development

- **Network architecture**
  - Two-layer feed-forward network with sigmoid hidden neurons and linear output neurons

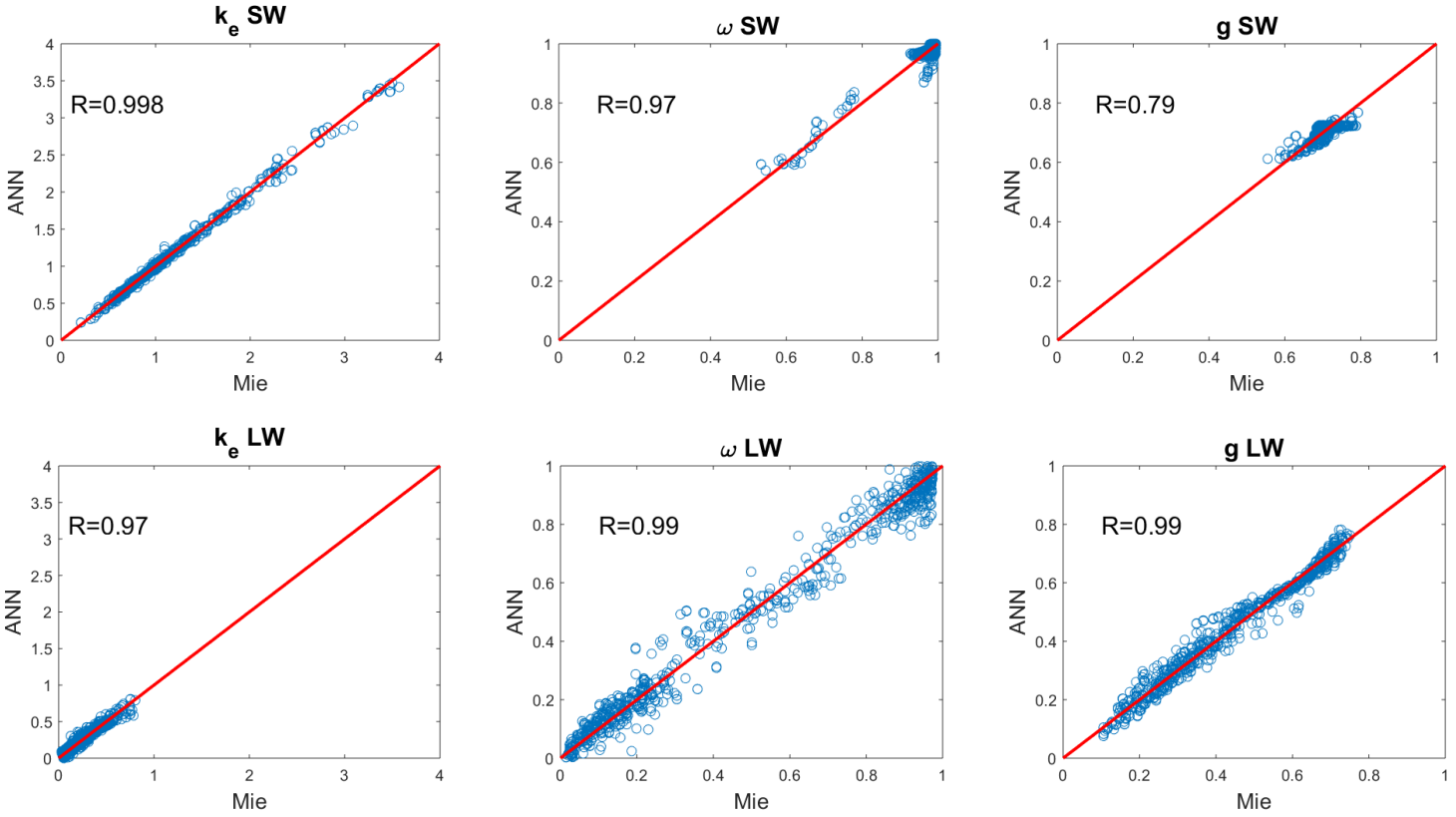
λ
D_c/D_t
D_t
n_s
k_s



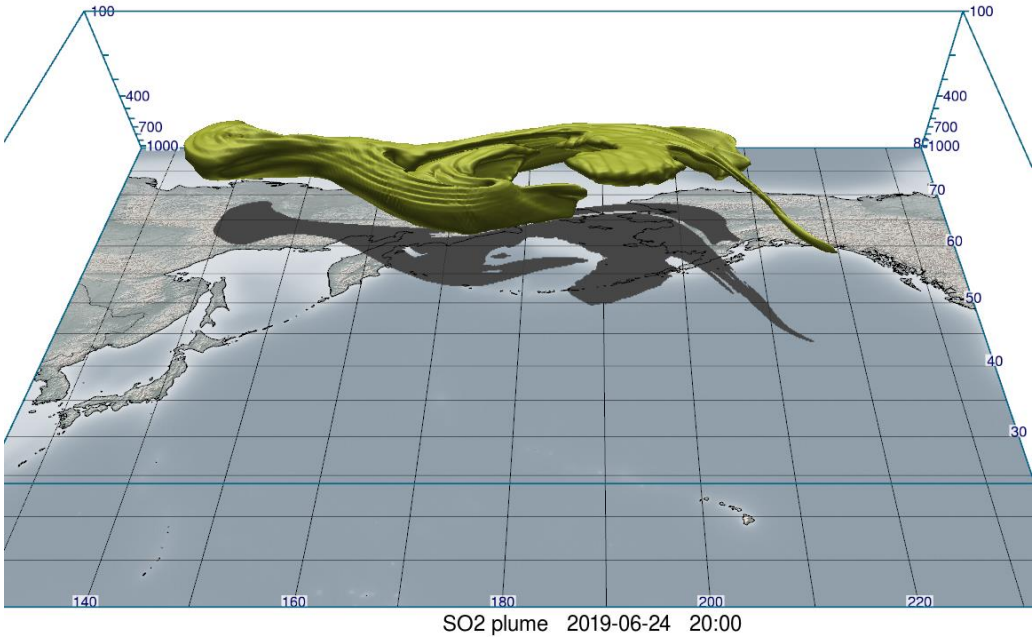
k_e
ω
g

- **Training algorithm:**
  - Data division: Random (70% for Training, 15% for validation, 15% for testing)
  - Training method: Levenberg-Marquardt
  - Performance: mean square error
  - Two networks are trained: one for SW and one for LW

An independent test for individual parameters

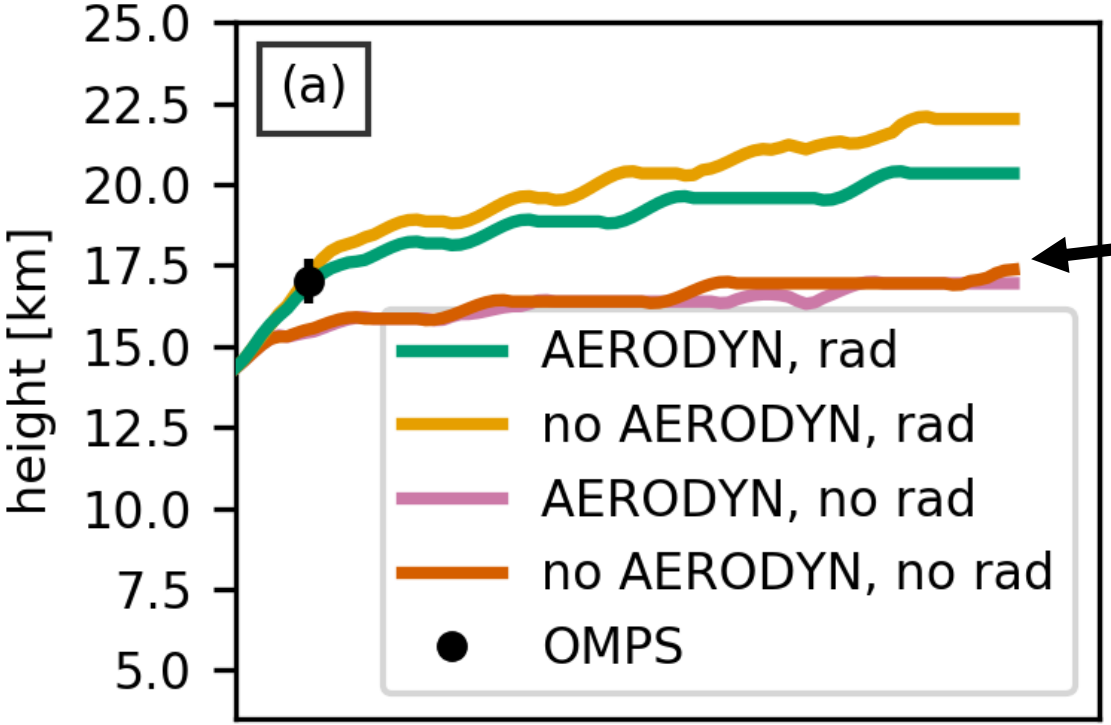


Raikoke eruption



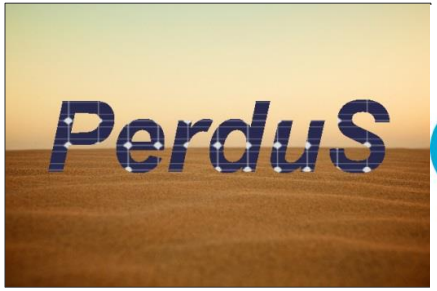
Lukas Muser,
ACPD, 2020

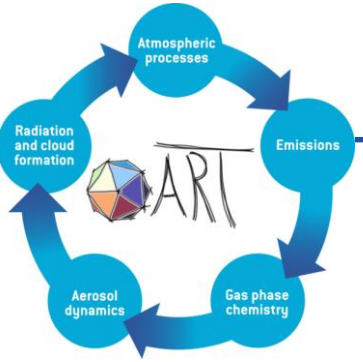
Applications of ICON-ART



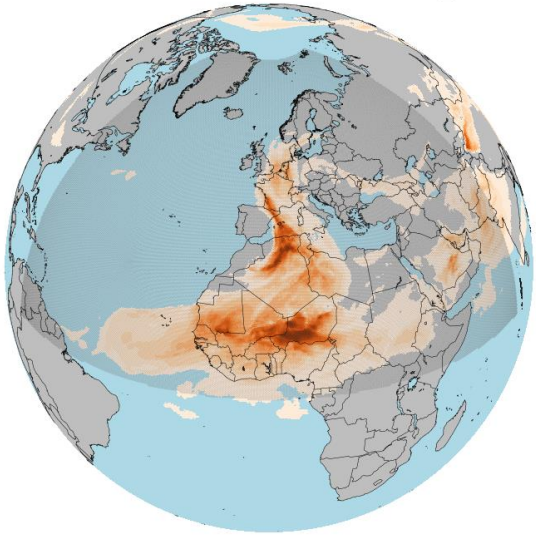
What VAACs are doing

Lukas Muser,
ACPD, 2020





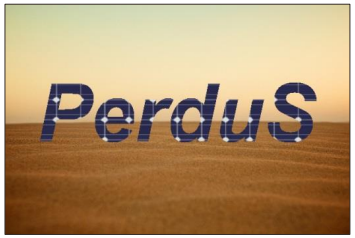
2018040800, vv: 003, ICON-ART, AOD_DUST



- Development of new analysis methods and model components related to mineral dust, e.g. optical properties for a mixture of non-spherical particles
- Quasi-operational global mineral dust forecasts using the system ICON-ART: twice a day for the next 7.5 days
- Daily preparation and provision of data (from monitoring networks and forecasts)
- Improved photovoltaic power forecasts for Germany during Saharan dust events

Motivation for PermaStrom from an NWP standpoint

PerduS – „lessons learned“



PermaStrom (since 05.2020)

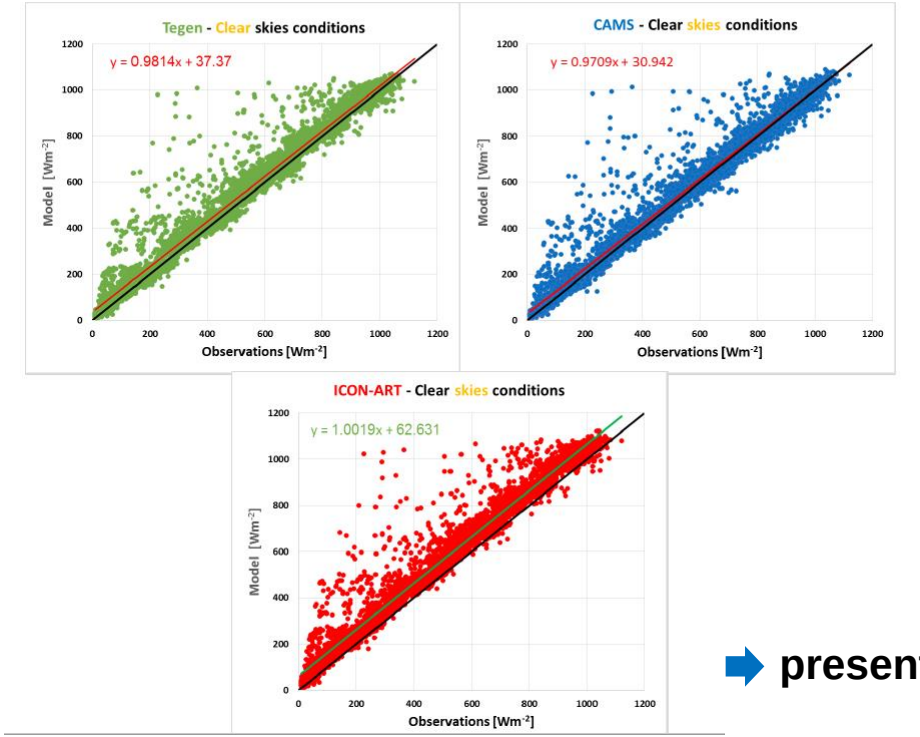
- Comparison of forecasts with observations is difficult
  - remaining aerosol climatologies
  - influence on clouds (not or only partly considered)
  - few measurement stations
- Forecast subject to uncertainties

- Extension:
- mineral dust, sea salt, vegetation fire
  - influence on radiation and clouds (direct, semi-direct and indirect effect)
  - extensive validation with modern observation systems (area-wide)
- Consideration of prediction uncertainty (deterministic and ensemble prediction)

Applications of ICON-ART mineral dust forecast

Karlsruhe Institute of Technology

Global radiation – model vs. Observations



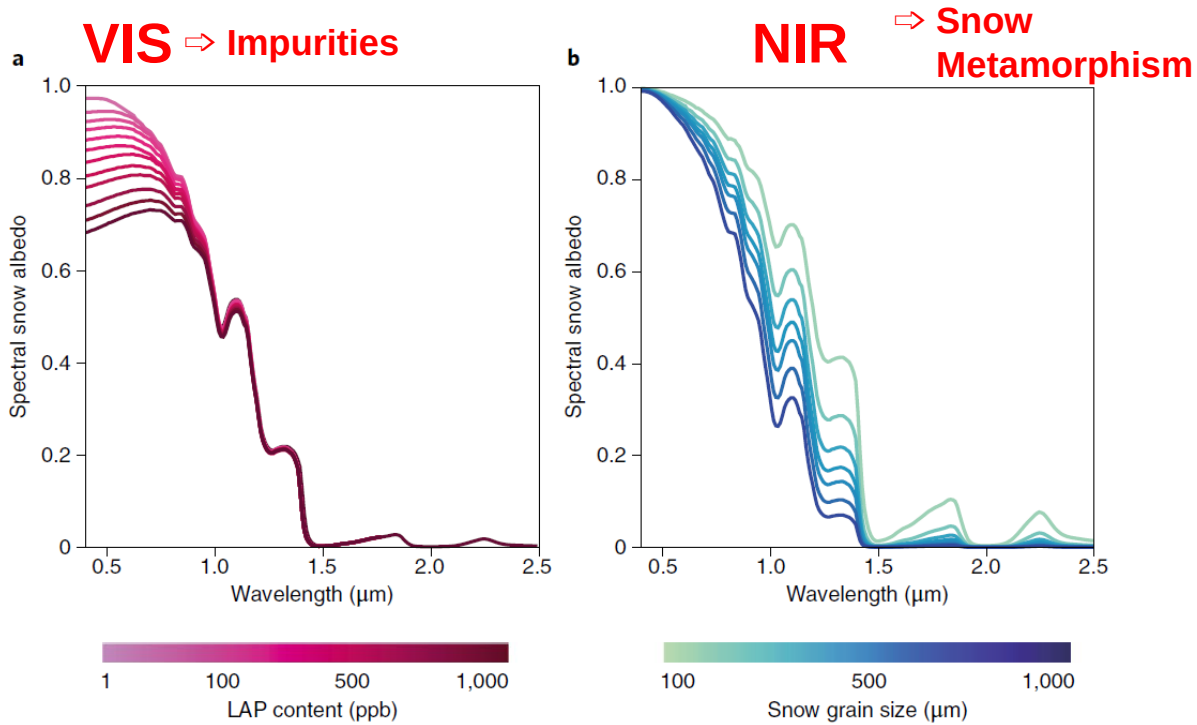
➡ **presentation Harel Muskatel**

Aerosols and their impact on snow albedo

Anika Rohde, S. Werchner, G. Hoshyaripour, H. Vogel, B. Vogel

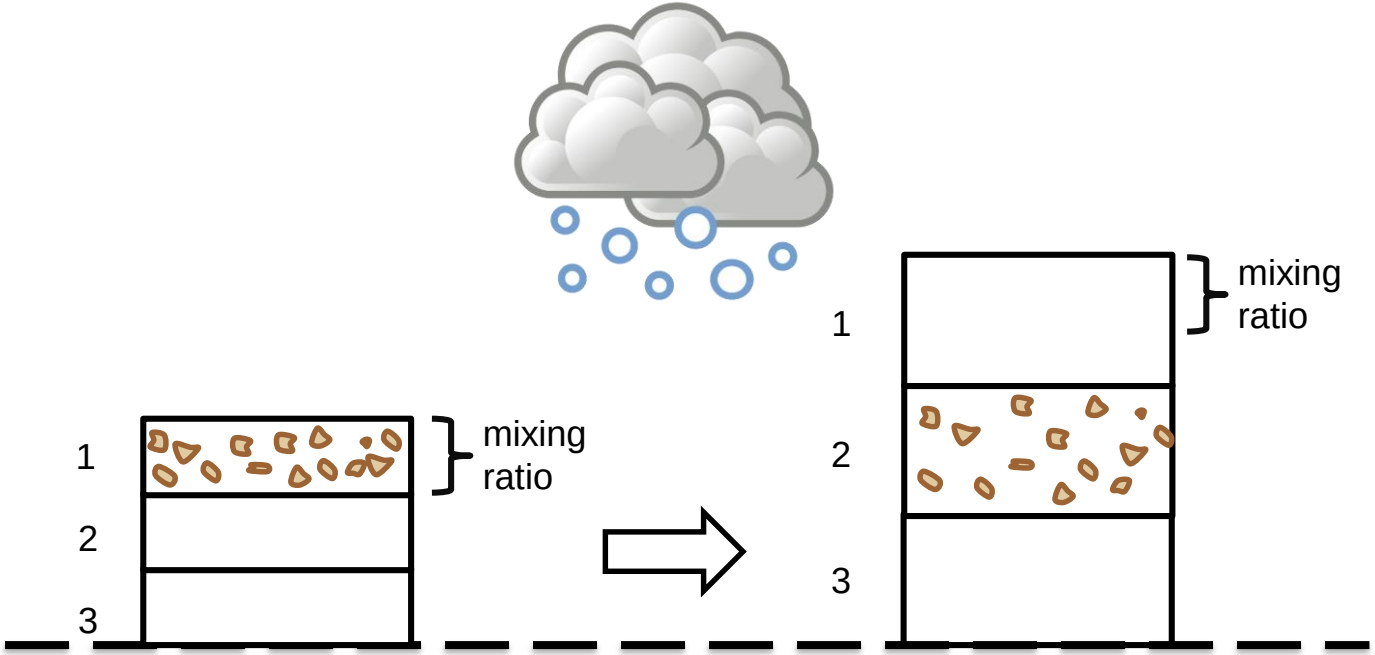
anika.rohde@kit.edu

The Snow Albedo

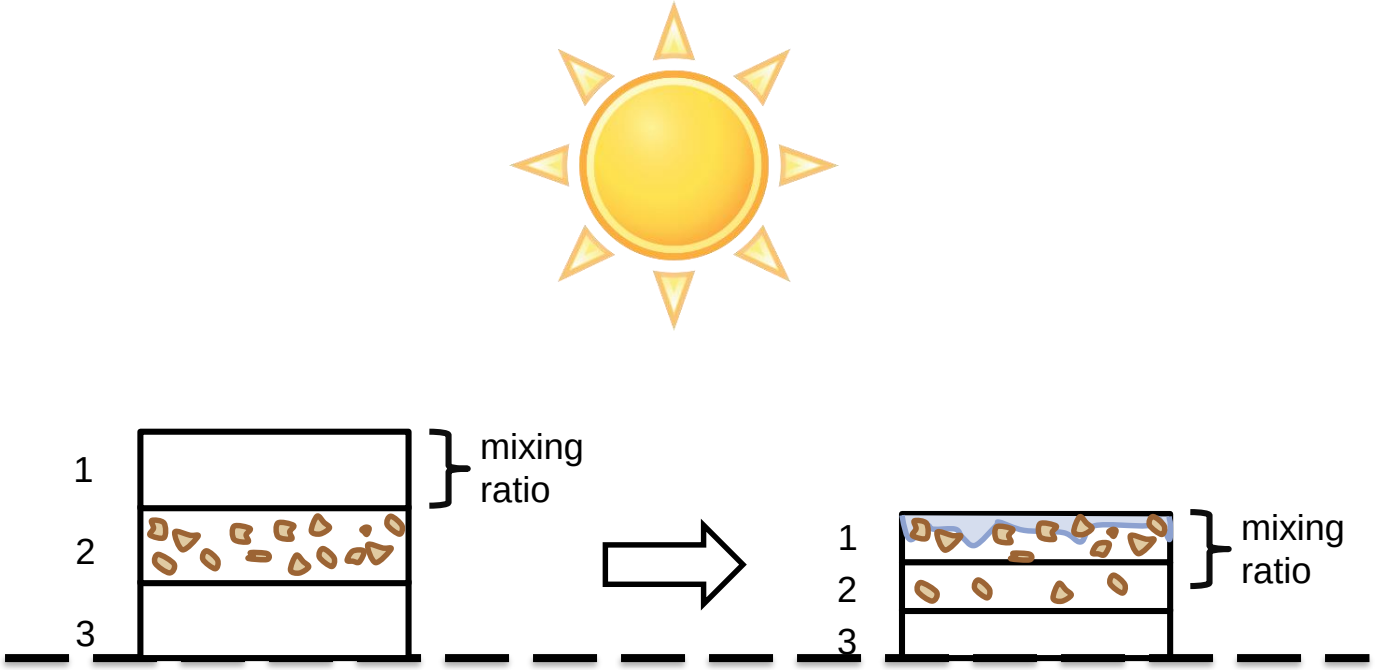


Skiles et al., 2018

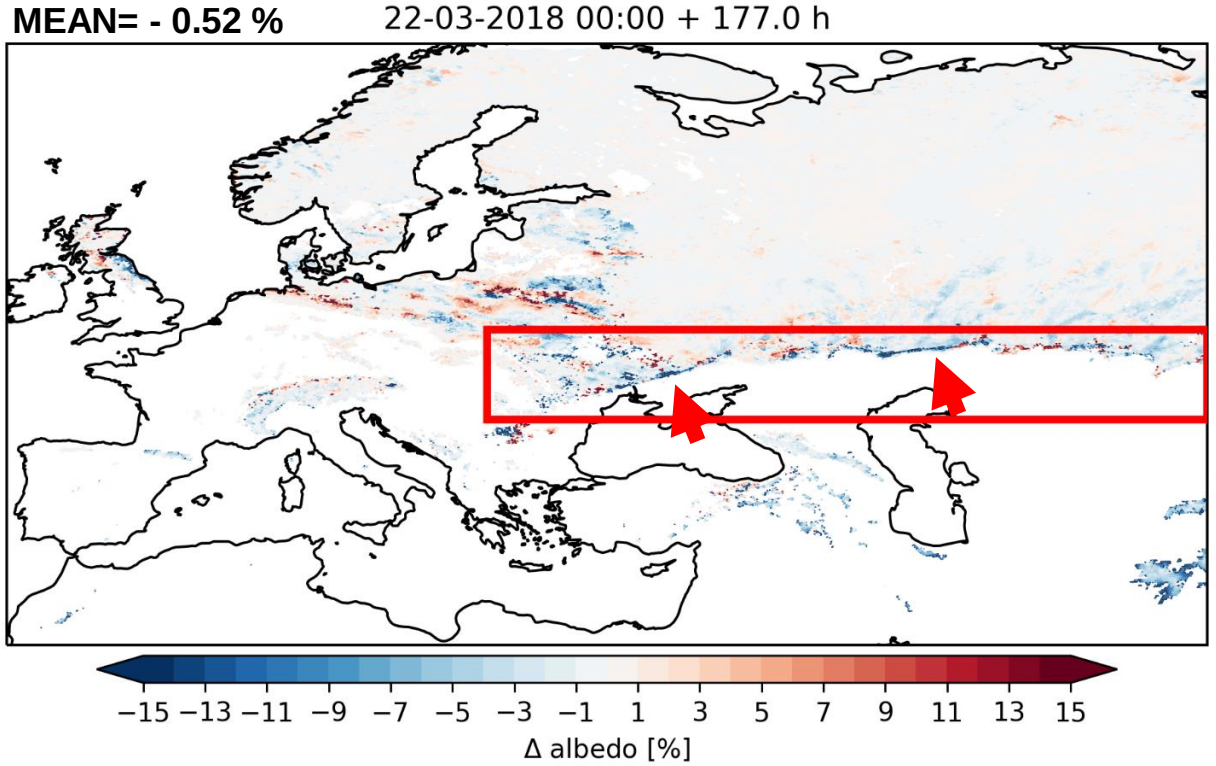
New Developments:
Shifting of Aerosols in Snow



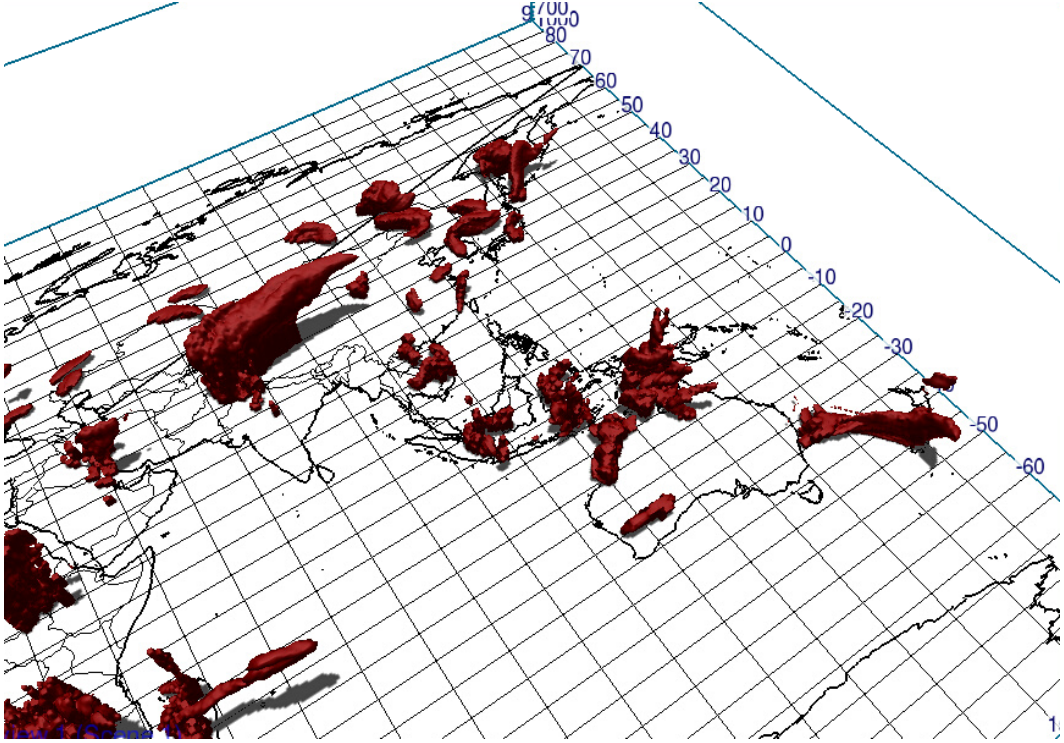
New Developments:
Shifting of Aerosols in Snow



Dust Event March 2018



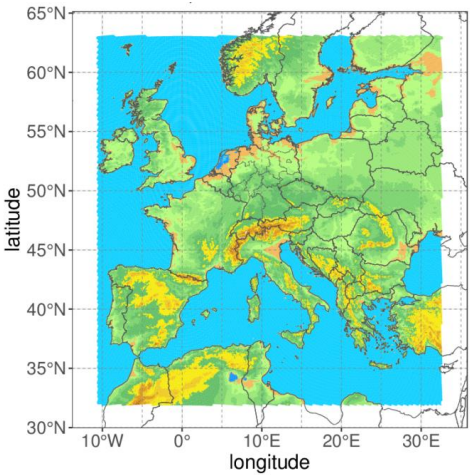
Biomass burning aerosol, 17.11.2019

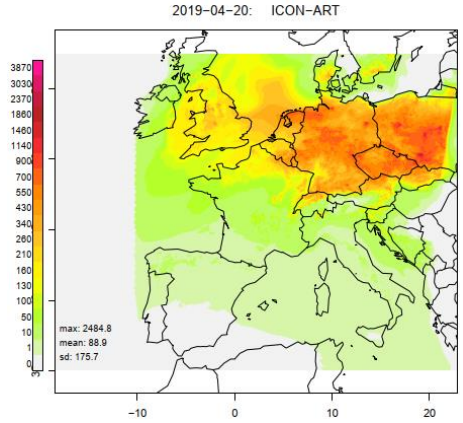


Lisa Muth

Forecast of Pollen with ICON-ART

- ICON-ART_LAM
  grid size 6.5 km, 60 levels
- 120h-lead time (00 UTC), analysis of
  ICON-EU, LBC of ICON global
- Daily mean pollen concentration on
  OpenData
- LBC for MeteoSwiss
- Pollen species: ALNU, BETU, POAC, AMBR
- Plan: **operationell Q1 / 2021**





ICON development partnership extended

„DWD and MPI-M have been working in close cooperation since 2004 on the development of the ICON Modelling Framework, which has been in use at DWD since 2015 for operational weather forecasting including data assimilation and at MPI-M for various research applications in the fields of climate simulation/projection and process studies.“

„The four contract partners **DWD**, **MPI-M**, **KIT**, and **DKRZ** combine their long-standing experience in the analysis and modeling of the Earth system in this cooperation for mutual benefit.“

If you want to have gas phase or aerosol processes included in ICON release versions, talk to us early!