Project: **1070**

Project title: **PerduS**

Principal investigator: **Bernhard Vogel**

Report period: **2018-01-01 to 2018-12-31**

As explained in the proposal, PerduS experiments on Mistral are separated in three groups. The progress in each group is outlined below.

Dust-Radiation Interactions:
Mineral dust is a key player in the Earth system that affects the weather and climate through absorbing and scattering the radiation. Such effects strongly depend on the optical properties of the particles that are in turn, affected by the particle shape. For simplicity, dust particles are usually assumed spherical. But this assumption can lead to large errors in modelling and remote sensing applications. This study investigates the impact of dust particle shape on its direct radiative effect in a next-generation atmospheric modelling system ICON-ART (ICOsahedral Nonhydrostatic with Aerosols and Reactive Trace gases) to verify if accounting for non-sphericity enhances the model-observation agreement. Two sets of numerical experiments are conducted by changing the optical shape of the particles: one assuming spherical particles (SPH) and the other one assuming a mixture of 35 randomly oriented tri-axial ellipsoids (NSP). The simulations are compared to MISR, AERONET and CALIPSO observations (with focus on North Africa). The results show that consideration of particle non-sphericity increases the dust AOD at 550 nm by up to 28% and leads to slight enhancement of the agreement between modelled and measured AOD. However, the model performance varies significantly when focusing on specific regions in North Africa. These differences stem from the uncertainties as associated with particle size distribution and emission mechanisms in the modelling experiments. Regarding the attenuated backscatter, the simulated profile assuming non-sphericity differs by a factor of 10 from the experiment assuming spherical dust, and is in a significantly better agreement with the CALIPSO observations (figure 1).

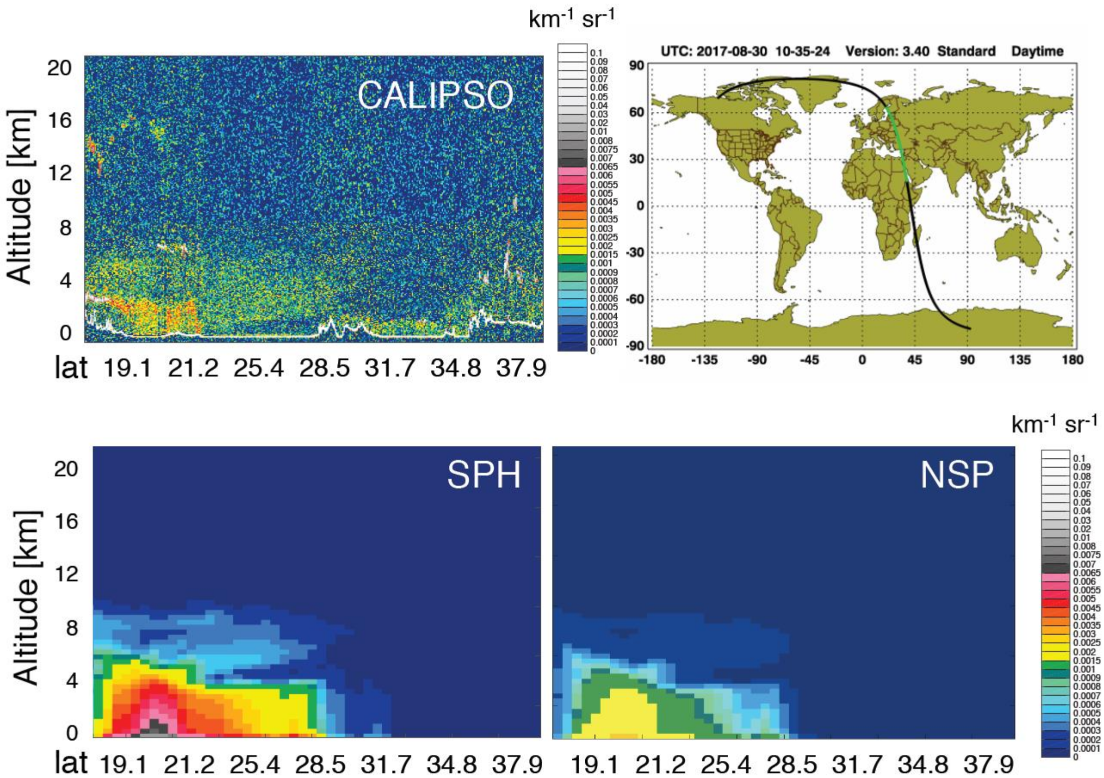

Figure 1: ABS (at 1064 nm) profiles on 30 August 2017 from CALIPSO (top) and modeling experiments (bottom)

The results are submitted as a manuscript (Hoshyaripour et al 2018) to the Journal of

Geophysical Research and is currently under revision. Future work will focus on the effects of particle size distribution on life cycle and radiative effects of dust particles.

Parameterization of convective dust emission

Convective systems usually create severe dust storms in arid and semi-arid regions. To develop the parameterization of this emission mechanism in global simulations, we need to first run convective-resolving simulations. The initial tests have been done to find the appropriate model configuration for multiple nests. These runs serve as a basis for future simulations and the CPU time estimations for the DKRZ proposal.

Mixing of dust with other aerosols:

As explained in the proposal text, a part of PerduS focuses on the direct and indirect effects of dust particles as a component of internally mixed aerosols (natural and anthropogenic). This means that chemical reactions eventually alter the chemical composition of dust particles and thus, their optical properties. To realize the aerosol aging and dynamics in ICON-ART, several simulations have been conducted in year 2018. These general developments lay the ground for next simulations that connects the chemical composition to optical properties of internally mixed aerosols.

A summary of the resources consumption in the last year is given in the table below.

Resource	Granted	Consumed
Mistral CPU time (Node hours)	8000	18925
Lustre work (GiB)	7500	1899
HPSS arch (GB)	10000	-
HPSS doku (GB)	1000	-

References:

Hoshyaripour, G., et al. (2018) Accounting for Particle Non-Sphericity in a Dust Forecast System: Impacts on Model-Observation Comparison. Journal of Geophysical Research (in revision)