Project: 979

Project title: Simulating the mineral dust cycle on glacial and interglacial timescales

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Project overview

Mineral dust aerosol emitted from dry and barren soils is a global player in the Earth system and a large contributor to the atmospheric aerosol burden. Dust impacts on the atmospheric dynamics, alters the Earth radiation budget, changes cloud properties, and influences the biogeochemical cycle in many ways.

Project objectives

The objective of this DKRZ project is, to (1) evaluate the current dust production model, (2) review the representation of glacigenic dust sources, a prominent dust source type at glacial-interglacial timescales, (3) to perform global, multi-annual simulations for different climatological set-ups.

Work achieved until 2016-10-31

Eventually aiming for an improved representation of the glacigenic dust sources in global models, we are applying a two-stage approach:

1. Driving an off-line dust emission module with atmosphere fields obtained from ECHAM simulations performed at different horizontal and vertical resolutions. This way, dust source properties can be adapted and tested with regard to their emission capacity at low computational cost.
2. Implementation of the revised dust emission scheme in ECHAM-HAM's dust module, which follows an approach similar to the off-line model. Results from ECHAM-HAM simulations will then be validated against observations.

So far, ECHAM runs were performed at different horizontal and vertical resolutions. The off-line dust model has been successfully driven with these simulations. As not much attention has been paid to the explicit representation of glacigenic dust sources in current dust emission models, we are now revisiting the dust scheme in particular with regard to soil type, soil texture, wind friction velocity threshold. To begin with, a case study benefitting from the 2007 Greenland field campaign has been set up.

In a next step, multi-annual simulations will be performed in order to capture the interannual variability as atmosphere and soil conditions both determining frequency and intensity of dust emission events may change from year to year. A first ECHAM-HAM run covering a 12-year period was performed.

Problems, issues and delays

The ECHAM simulations were planed complementary to meso-scale COSMO-MUSCAT simulations (performed at Leibniz Institute for Tropospheric Research (TROPOS), Leipzig). The idea behind this two-model approach is to build up a cascade of model simulations at grids with increasing horizontal (and vertical) resolution. Thereby, highest horizontal resolutions are covered by COSMO-MUSCAT, coarser resolutions by ECHAM. We started with COSMO-MUSCAT at highest resolution. However, difficulties regarding the topography at high grid resolutions occurred which caused some delays in preforming the simulations. Consequently, we have not performed all ECHAM simulations yet as planned and thus are a bit behind the schedule.