

Position details

Master thesis at Climate and Environmental Physics

Topic: Sources of Sea Salt Aerosol recorded in Antarctic Ice Cores using Reanalysis Data

Ice cores in Antarctica represent a unique archive to reconstruct past climate back to 800'000 years. Apart from the composition of the past atmosphere (preserved in air bubbles), ice cores also preserve past atmospheric aerosols, such as sea salt, which either originates from the ocean or the sea ice. Variations in such aerosols recorded in ice cores rely on the source strength, atmospheric transport and deposition processes.

The topic of this master thesis will focus on the aerosol sodium recorded in ice cores over Antarctica from an atmospheric circulation perspective. Three ice core sites, representative for different areas in Antarctica, will be selected and back trajectories will be calculated to assess the source region and its strength variability as well as the processes along the trajectory to the ice core site affecting the aerosol concentration of an air parcel. To obtain the back trajectories two reanalysis products shall be used and compared, the ERAinterim data set (Dee et al. 2010) and the MERRA-2 reanalysis data set (Bosilovich et al., 2015). This is necessary as reanalysis data sets are still not perfectly constrained over Antarctica due to sparse observational data.

With the back trajectories at hand the following research question will be addressed:

1. What are the differences between the two reanalyses for the three different regions over Antarctica?
2. Which processes (source region, atmospheric transport, deposition) are most relevant for the signal recorded at the three ice core sites?

Project tasks and time frame

- Get familiar with the computer system (Linux/Windows), the reanalysis data, the back trajectory tool HySPLIT and the atmospheric processes and modes relevant for Antarctica (1. to 2. month).
- Apply to and test HySPLIT on one selected site on Antarctica using ERAinterim data (3. to 4. month).
- Calculate trajectories for 3 representative sites on Antarctica using both reanalysis data sets (5. to 6. month).
- Investigate the differences between the reanalysis data sets and start writing the first chapters of the thesis, e.g., methods and data chapters (7. to 8. month).
- Assess from which source regions the aerosols originate and which processes are relevant at the deposition site (9. to 10. month)
- Finalize thesis, in particular interpret the results and compare the findings with existing literature (11. to 12. month)

References:

Bosilovich, M., R. Lucchesi, and M. Suarez (2015), MERRA-2: File Specification. GMAO Office Note 9 (Version1.0), 73 pp.

Dee, D. P., and Coauthors, 2011: The ERA-Interim reanalysis: configuration and performance of the data assimilation system. *Quarterly Journal of the Royal Meteorological Society*, 137: 553–597. doi:10.1002/qj.828.

Wilmes, S. B., C. C. Raible, T. F. Stocker, 2012: Climate variability of the mid- and highlatitudes of the Southern Hemisphere in ensemble simulations from 1500 to 2000 AD. *Climate of the Past*, 8, 373-390.

Further information:

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