MiKlip Pastlands: Optimum parameter and state estimation of the land and biosphere

The project will assess the importance of land surface components on decadal climate predictions. It will develop a land observation and diagnosis system to best initialize a seasonal to decadal climate prediction system. The land surface scheme used will be the JSBACH model of the coupled Earth System model of the Max-Planck Institute for Meteorology (MPI-M). The major scientific objectives are:

- Identify regions where the memory of the land surface has an impact on the climate and on which time scales (from seasons to decades) this impact is noticeable.
- Exploit the potential of new satellite observations (e.g. SMOS, SENTINEL-2) for Earth System research and an improved estimate of the land surface state.
- Assessing the impact of observational datasets and initialization procedures on seasonal to decadal climate predictions.
- Development and assessment of a combined optimum model and state estimation tool which can be used for the initialization of seasonal to decadal climate predictions.
- Evaluation of observation uncertainties on model initialization and prognostic skills.

The project aims at a comprehensive, combined state and parameter estimation of a climate model land surface scheme using simultaneously observations for different land surface variables. Focus is hereby given on a most realistic model parameter optimization at the model grid scale to improve the model predictive skills for seasonal to decadal predictions. A flexible observational framework will be built up that utilizes existing land surface observations obtained by remote sensing from satellites. Investigations will be based on the JSBACH land surface scheme, which is part of the MPI-M coupled ECHAM/MPI-OM/JSBACH Earth system model. Model predictive skills will be verified using coupled and uncoupled climate model simulations in hindcasting applications and independent observational data.

The variational state and parameter estimation for JSBACH will be carried out in offline mode, i.e. the model is driven with “observed” atmospheric forcing. The project nevertheless addresses the initialization for the coupled model by analyzing and correcting potential biases in the exchange fluxes with the atmosphere that may be caused by the offline approach. Variational assimilation has been demonstrated with great success for other components of the Earth system, in particular the ocean (Stammer et al., 2002). The development and operation of a variational assimilation system for JSBACH in offline mode already constitutes a scientific and technological challenge and is an important first step towards a variational initialization of the entire MiKlip-model. Currently, variational assimilation for coupled models is being explored, within the EU project THOR, for the Planet Simulator (Fräedrich et al., 2005) which is less complex than the MiKlip-model.

The foreseen research also contributes to the objectives of the Global Climate Observation System (GCOS) and the Coordinated Observations and Prediction of the Earth System (COPES) of the World Climate Research Program (WCRP) to investigate
potential and limits of the predictability of the climate system from seasonal to decadal scales.

References
