UP 4: Climate modelling

Time: Monday 14:00–14:45 Location: G 1.011

UP 4.1 Mon 14:00 G 1.011

An explanation for the different climate sensitivities of land and ocean surfaces based on the diurnal cycle — •Axel Kleidon and Maik Renner — Max-Planck-Institut für Biogeochemie, Jena

Observations and climate model simulations consistently show a higher climate sensitivity of land surfaces compared to ocean surfaces, with the cause for this difference being still unclear. Here we show that this difference in temperature sensitivity can be explained by the different means by which the diurnal variation in solar radiation is buffered. While ocean surfaces buffer the diurnal variations by heat storage changes below the surface, land surfaces buffer it mostly by heat storage changes above the surface in the lower atmosphere that are reflected in the diurnal growth of a convective boundary layer. Storage changes below the surface allow the ocean surface-atmosphere system to maintain turbulent fluxes over day and night, while the land surface-atmosphere system maintains turbulent fluxes only during the daytime hours when the surface is heated by absorption of solar radiation. This shorter duration of turbulent fluxes on land then results in a greater sensitivity of the land surface-atmosphere system to changes in the greenhouse forcing because nighttime temperatures are then shaped by radiative exchange only, which are more sensitive to changes in greenhouse forcing. We use a simple, analytic energy balance model of the surface-atmosphere system to show that predictions compare very well with observations and CMIP 5 climate model simulations.

Invited Talk UP 4.2 Mon 14:15 G 1.011

The response of the stratospheric circulation to climate change — •Hella Garny — DLR Oberpfaffenhofen

The role of the stratosphere in the climate system is increasingly being appreciated, and it is known that the circulation of the stratosphere can significantly influence surface climate and weather. The fate of the large-scale circulation of the stratosphere in a changing climate is a much discussed topic in the last years. Progress has been made on the understanding of the mechanisms of the general acceleration of the circulation in response to climate change as simulated by models. However, observational evidence on circulation changes is still not reconciled with model simulations and with our mechanistic understanding. The key open questions on large-scale circulation changes and their possible impacts on the climate system, that will be discussed during this talk, are: (1) Process understanding: How is tracer transport (that is detectable from observations) coupled to the wave-driven mean mass circulation, the residual circulation? (2) Reconcile observations, models and reanalysis: Is decadal-scale variability causing the differences between observational records and models? Were different processes acting during the recent past compared to the long-term climate record typically analysed in global models?