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Evaluating feedback factors in a GCM: focus on clouds

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Climate change as the response to an external forcing is highly related to radiative feedback factors. Among those feedback factors the responses of cloud-related fields are of high relevance, as parameterizations of cloud processes in general circulation models (GCM) account for one of the biggest uncertainties in recent climate projections. Clouds affect radiation in the solar and terrestrial spectra and are sensitive to climate conditions. Discrepancies between different GCMs in simulated climate sensitivity are still mainly due to differences in their representation of clouds, related to uncertainties in the formulation of cloud processes.

Different feedback factors for cloud-related fields in the global circulation model ECHAM5 are estimated, using the partial radiative perturbation method. These estimates are calculated from all radiation-relevant output fields for climate sensitivity experiments with varied well-mixed greenhouse gases. A single-column radiation model based on the ECHAM5 radiation kernel is used to obtain different physical feedback factors, their impact on climate sensitivity and their spatial distribution. This method allows separating neatly the contribution of single feedbacks to the total change in radiative forcing.
The spatial distribution of feedback factors will be shown with special emphasis on cloud related processes. The results will be evaluated with observational data using skill scores to analyze short wave and long-wave radiative effects.