Session: C33 Poster: W234B

Using the radiative kernel technique to evaluate physical climate feedbacks in CMIP5 models

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The radiative kernel technique is a fast, standardized method to determine the strengths of the physical feedbacks (water vapor, lapse rate, surface albedo, and clouds) in general circulation models (GCMs). Differences in these feedbacks among models explain much of the difference in models' climate sensitivities. The technique can also be applied to satellite and reanalysis data. For example, we have demonstrated that the kernel technique can reproduce the radiative effects of the feedback variables on clear-sky top of atmosphere (TOA) fluxes in the ERA-Interim reanalysis data set. Other studies have shown the usefulness of this technique with satellite data. While we do not expect GCMs to reproduce the exact observed feedback behavior, we can compare trends and statistics (e.g., average year-to-year variations of TOA fluxes) to evaluate the manifestation of each feedback in the CMIP5 archive. We will also consider the sensitivity of the feedback calculations to the choice of radiative kernel (which depends on the specific GCM and base state used to create the kernel). By identifying regions or situations that correspond to the largest discrepancies among models or between models and observations, future work can focus on refining the models in those regions, as well as improving observations where they will be most effective at reducing uncertainties in modeled feedbacks.