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Regional predictability and the linearity of climate feedbacks

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At the global scale, feedback analysis is a powerful tool for constraining climate sensitivity by understanding uncertainty in the component pieces of model physics. Our focus here is to evaluate the extent to which this framework can be applied to the question of regional climate predictability. We have developed a clean and clear approach to address these challenges. We employ the GFDL AM2 model in aquaplanet mode, coupled to simple ocean mixed layer and sea ice schemes. Further, we explicitly calculate radiative kernels (necessary to diagnose the feedbacks) for this precise model set-up, thus removing much of the ambiguity in the feedback approximation. We find that linking regional predictability and individual climate feedbacks depends on the balance between local radiative feedbacks and meridional energy transport in response to changes in climate forcing. An important aspect of this energy budget is the linearity of the kernel-calculated feedbacks, which we evaluate. Spatial patterns of these factors can be related to the basic structure of atmospheric circulation, and our results highlight regional differences in the effect of feedbacks on the regional climate response.