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# Using spatial variations of surface radiation to constrain the global temperature sensitivity

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Although climate models are able to simulate the effect of radiative changes on surface temperature there is a large model spread in the response to climate change which calls for observational constraints to improve model parameterizations and reduce the uncertainty for climate sensitivity. Here, we use the high information content of spatial variation in the surface radiation budget obtained by remote sensing and reanalysis to constrain how the surface energy partitioning responds to changes in surface radiation induced by climate change. Spatial variations can be derived on a time-average global field and ensures a climatological mean state thus reducing the impact of heat storage variations which would otherwise influence sensitivities. While it is well known that temperature is strongly affected by the partitioning into radiative and turbulent cooling, we show here that surface temperature will respond much more to changes in the longwave than to changes in shortwave radiation. By using spatial variations of remote sensing (CERES-EBAF) and reanalysis (ERA-Interim) products we obtain observational constraints, which disentangle the sensitivity of surface temperature to changes in net shortwave and downwelling longwave radiation. There is a remarkable agreement between the spatial sensitivity derived from present day observations and the sensitivity derived from global scale climate change simulations. We then show that this sensitivity allows to predict the equilibrium climate sensitivity of each model given its surface radiative changes. There is a large model spread of the sensitivity when we use spatial variations of climate model output, which is correlated to climate feedback. This suggests that climate models, which have a bias in the surface energy partitioning when compared to observations may have less realistic estimates for climate change.