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The Response of the Southern Hemispheric Eddy-Driven Jet to Future Changes in Shortwave Radiation in CMIP5

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A strong relationship is found between changes in the meridional gradient of top-of-atmosphere net downward shortwave radiation (TOA SW) and Southern Hemispheric jet shifts in 21st-century RCP8.5 climate simulations of CMIP5 coupled models. The relationship is such that models with increases in the meridional gradient of TOA SW around the Southern midlatitudes, and therefore increases in midlatitude baroclinicity, tend to produce a stronger poleward jet shift. The TOA SW changes are shown to be dominated by changes in cloud properties, with sea ice declines playing a secondary role.

We investigate the causal relationship between TOA SW changes and jet shifts by considering the SW and jet responses in simulations with a prescribed SST increase. In these simulations, in which changes in SW cannot affect baroclinicity due to the prescribed SSTs, larger jet shifts are not associated with a stronger SW anomaly dipole around the midlatitudes, as one would expect if jet shifts cause SW anomalies. Moreover, the SW changes are remarkably similar in both prescribed-SST and RCP8.5 experiments, even though the jet responses are very different. This implies that the inter-model spread in SW changes is mainly the cause, and not the result, of the spread in jet shifts with global warming.

Our results highlight the importance of reducing the uncertainty in cloud feedbacks in order to constrain future circulation changes.