Geophysical Research Abstracts
Vol. 20, EGU2018-6592-1, 2018
EGU General Assembly 2018

Radiative effect of clouds on the global warming response of the North Atlantic, North Pacific and Southern Hemisphere eddy-driven jet streams

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We investigate the role of cloud-radiative interactions for the response of the extratropical circulation to global warming using the atmospheric component of the ICOsahedral Non-hydrostatic model ICON. The model is run with the physics package used for numerical weather prediction. Sea surface temperatures (SSTs) are prescribed to isolate the role of atmospheric cloud-radiative effects. We perform two sets of simulations. In the first set, global warming is mimicked by increasing SSTs uniformly by 4K. In the second set, global warming is mimicked by increasing SSTs by a pattern derived from the ensemble average of CMIP5 coupled climate models. We apply the cloud locking method to differentiate between the role of the SST increase and the role of atmospheric cloud-radiative interactions. We find that the effect of cloud-radiative interactions on the zonal wind at 850 hPa is largely zonally symmetric. The annual-mean eddy-driven jet streams show a poleward shift and strengthening in the North Atlantic, North Pacific and Southern Hemisphere. The effect of cloud-radiative interactions explains about half of the total jet strengthening and poleward shift for the North Atlantic and about one-fourth to one-third for the Southern Hemisphere. In the North Pacific, cloud-radiative interactions explain more than half of the poleward jet shift. The role of cloud-radiative interactions on the response of the zonal wind, the jet position and jet strength is largely independent of the underlying SST forcing. Our results emphasize the importance of cloud-radiative interactions for future changes in the extratropical circulation.