EGU2020-9905
https://doi.org/10.5194/egusphere-egu2020-9905
EGU General Assembly 2020
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Alleviation of an arctic sea ice bias in a coupled model through modifications of the subgrid scale orographic parameterization

Guillaume Gastineau[1], **Francois Lott**[2], Juliette Mignot[1], and Frederic Hourdin[3]
[1]Sorbonne University, IPSL, LOCEAN, Paris, France (guillaume.gastineau@locean-ipsl.upmc.fr)
[2]PSL research University, LMD, Ecole Normale Supérieure, Paris, France
[3]Sorbonne University, IPSL, LMD, Paris, France

In the IPSL-CM6A-LR model, the subgrid scale orography (SSO) parameterization imposes at low level a blocked flow drag opposed to the local flow and a lift that is perpendicular to the local flow. We suggest that their tuning impacts of the Arctic sea ice coverage and the large scale oceanic circulation in climate models. In forced atmospheric mode, increasing the blocking and reducing the lift leads to an equatorward shift of the Northern Hemisphere subtropical jet, and a reduction of the mid latitude eddy-driven jet. It improves the simulated variability, with a reduced storm-track, and increased blocking frequency over Greenland and Scandinavia. Second, it contributes to cool the polar low-troposphere in winter. We show that the reduction in eddy activity yields a reduction of the poleward heat fluxes in the low troposphere of the mid-latitudes and polar regions. Transformed Eulerian Mean diagnostics also show that there is a reduction of the low-level eddy-driven subsidence in the polar region consistent with the simulated cooling. The changes are amplified in the coupled model, as the eddy-driven jet shift further south. The low-troposphere polar cooling is further amplified by the temperature and albedo feedbacks in link with the Arctic sea-ice. This corrects the warm winter bias and the lack of sea-ice that were present over the Arctic without changing the SSO parameters. This also impacts the ocean, with an equatorward shift of the Northern Hemisphere oceanic gyre, and a weakening of the AMOC.