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Southern Hemisphere Jet Position and Variability in the IPSL GCM at varying resolutions

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The Southern Hemisphere jet position and variability are studied using the IPSL GCM in a series of imposed-SST and coupled simulations at varying horizontal resolutions, with alternative increases in latitude an in longitude up to a doubling of the initial resolution. We look at the improvement of the model biases with resolution, as well as the relation between these biases and the model variability and response to CO_2 increase.

In summer (DJF), the climatology is close to a zonally-symmetric structure. The distribution of the daily jet latitude is shifting polewards for each increase in latitudinal resolution, reaching the observed latitude for the highest resolution. Other statistics describing the jet variability (variance and skewness of daily latitude distribution, mean speed of the jet, timescale of jet shifts and eddy variance) also converge towards the observed ones with increasing resolution and mean latitude.

In winter (JJA) departures from zonal symmetry are stronger. The model biases remain stronger than in summer, perhaps because of Tropical influence. They also tend to project on the dominant variability structure, the Southern Annular Mode or SAM. The simulated variability keeps however the observed relation with the mean state, except for the strongest biases. In the Indian Ocean, the SAM remains a shift of the jet around its mean latitude, albeit located equatorward of the observed one. In the Pacific Ocean, the SAM is a see-saw between two distinct positions of the jet. This split-jet is well reproduced in the simulations, but the equatorward branch is always two strong.

The simulated response to a CO_2 increase projects strongly on the SAM structure, both in summer and winter. The amplitude of the poleward shift in summer is found to depend both on the mean position of the jet, and on the persistence of its fluctuations.