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Influence of mountains on the Arctic Oscillation: evidences in the General Circulation Model LMDz

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Recent papers (Lott Robertson and Ghil 2004, Lott and D'Andrea 2005) have suggested that a dynamical link exists between the mountain torque and the Arctic Oscillation (AO) at periodicities near and below 30–days. Those links essentially occur because the AO is associated with a redistribution of mass from the polar regions to the midlatitudes hence giving a substantial contribution to the mass term of the Atmospheric Angular Momentum (AAM). As these results were essentially deduced from reanalysis data, we confirm them here by using a 30 years simulation done with the General Circulation Model LMDz. In particular, we verify that in the model also, the changes in mass AAM occuring during intra-seasonnal variations of the AO are in good part driven by the mountain torque. In this respect, the model LMDz has the great advantage to close the AAM budget near exactly, which is not the case of the NCEP reanalysis data. As the Antarctic Oscillation (AAO) is also associated with a redistribution of mass from the polar regions to the midlatitudes, its contribution to the AAM budget is also presented. As there are much less mountains in the southern hemisphere, we show that in the model as well as in the reanalysis, the changes in mass AAM during intra-seasonnal variations of the AAO are in good part equilibrated by changes of opposite sign in wind AAM.

The main interest of these results is that the mountain torque drives the changes in AAM, so it can sometimes participate actively to changes of the AO, the former being associated with substantial mass AAM: the relationship is not purely passive, it has a small but significant predictive interest.