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Sudden Stratospheric Warmings and Blockings in the IPSLCM5 Coupled Model

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The relation between Sudden Stratospheric Warmings (SSWs) and blocking events is analyzed in the multi-centennial pre-industrial simulation done with the IPSL coupled model for CMIP5. First, we verify that the model produces realistic SSWs and blockings, with a tendency to overestimate the frequency of blocking events over the western pacific, and to simulate too few wintertime Euro-Atlantic blocks. Second, we also establish that the model reproduces robust relations between the blockings and the SSW. More specifically, we found that during the 40 days that surround SSW there always exists a place in the troposphere where the blocking frequency is significantly affected. We also analyze the regional location of the blocking frequency changes and found that there is an enhanced blocking frequency over Eurasia before the SSWs and that this region of enhanced blockings shifts to the west over the Atlantic as the SSWs evolves and then decline. Over the Eastern Pacific, the blockings are reduced almost all along during the SSW and there is no longitudinal shift of these regions during the SSW life cycle.

The length of the dataset used also permits to establish results which significance could not be established with shorter ones. For instance, we show that the blockings after the SSWs have shorter duration and shorter horizontal scales than before. Also, we establish that these differences are not due to an aliasing of the annual cycle of the blockings, a real problem since the dates before SSW are almost always in early winter while does after are often in late winter or early spring.

We have also systematically verified that our results are consistent with the two pictures that (i) blockings produce planetary scale anomalies that can force vertically propagating Rossby waves and then SSWs when the waves break and (ii) SSWs affect the blocking in returns, for instance via the effect they have on the North Atlantic Oscillation (NAO). Nevertheless, these two pictures are somehow contradictory since enhanced blockings after SSWs should also results in large scale Rossby waves forcings. We argue that the longitudinal shift of the Eurasian blocks tends to weaken the planetary wave forcing since it shifts anomalous anticyclonic patterns over the Atlantic trough hence reducing the planetary waves forcing.