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The surface impact of stratospheric sudden warmings in a 1000 year control simulation: sensitivity to event definition and type

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Major sudden stratospheric warmings (SSWs) are characterised by large departures of the northern hemisphere winter-time circulation from climatology. Numerous studies have shown that on average these events impact on tropospheric weather patterns leading to a more negative North Atlantic Oscillation index; however, recent studies have suggested that the nature of this downward coupling may be sensitive to the type of SSW (vortex split or displacement). This study explores this issue using a 1000 year pre-industrial control simulation from the IPSL-CM5A-LR model taken from the CMIP5 archive. We identify SSW events using two distinct methods: the widely applied algorithm of Charlton and Polvani (2007) and a 2-D moments-based approach described by Seviour et al (2013). The long simulation offers a unique opportunity to analyse a very large sample of SSW events ($\sim$500).

We evaluate the relative timing and frequency of SSWs identified by the two methods and examine their impact on the tropospheric state. In contrast to other recent studies, we do not find a significant difference between the impact of split and displacement SSWs on the troposphere in this model. We analyse the evolution of the SSWs that are not consistently identified by the two algorithms, and examine whether they have a significant role in determining the overall impact of SSWs on the troposphere. The large number of warming events enables a comprehensive assessment of the noise that may be associated with analysing stratosphere-troposphere coupling in smaller sample sizes.