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Numerical simulation of the 2013 stratospheric sudden warming by a mesoscale meteorological model

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The major 2013 Stratospheric Sudden Warming was followed in the troposphere by cold air outbreaks over Western Europe from January 12 to 25. In the stratosphere, the polar vortex started moving towards Russia at the end of December 2012 and split on January 7. The vortex splitting was accompanied by an anticyclonic circulation above north Atlantic and Norwegian Sea. The meteorological situation in the troposphere from January 10 to 25 was characterized by a blocking ridge over eastern Atlantic and an anticyclonic cell over Norwegian Sea. This regime was associated to northerly and easterly flows over Western Europe that led to cold air outbreaks. For this event, WRF simulations (Weather, Research and Forecasting) are performed in a domain covering the northern Hemisphere with a resolution of 60 km and extending vertically from surface to 250 Pa. The model is nudged towards ECMWF meteorological analyses (91 levels) over a period extending from 1 to 5 January only, in order to leave the stratosphere-troposphere as unconstrained as possible. In this case, the model is able to approximately reproduce weather forecasts in the troposphere from January 5 to 15. Sensitivity experiments are performed consisting in perturbing the initial conditions on January 5 by adding a warm source in the stratosphere. Numerical results indicate that the Atlantic ridge is reinforced, which results in lower surface temperatures over Western Europe. This work has been performed as part of the european project ARISE.