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Infrasound Propagation during the 2009 Sudden Stratospheric Warming

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Sudden stratospheric warmings (SSWs) are the primary atmospheric variations, being the clearest and strongest prove of the dynamical coupling between the stratosphere and troposphere. The study of these events is important for our daily weather and climate, and for numerical modelling purposes. In this study, part of ARISE (Atmosphere Dynamics Research Infrastructure in Europe) project, infrasound observations during the 2009 major SSW are re-analysed to better understand the signature of warming. The spectral analysis of the beamformed signal indicates a narrow band of periodic, rather pulsing, signal with a centre frequency of 0.15–0.2 Hz, corresponding to micro-barom signals. Marine storm characteristics, such as movement and aging, can clearly be denoted in the infrasound signal. The influence of the warming is different for all 11 CTBTO arrays. Arrays I10CA, I18DK, I53US and I56US indicate a clear change in back-azimuth, from westerly to easterly signals, due to the change in direction of the zonal-mean flow. This effects corresponds very well with period of the warming, indicating the possibility of determining the onset and duration (offset) of the sudden stratospheric warming. Simulations are used to verify and understand each observation, in order to investigate which atmospheric information that can be extracted. The marine storm locations in both the Atlantic and Pacific Ocean are used as verification parameter. In a first stage the locations are determined by cross bearing the back-azimuth angle of the observed signals. In a second stage ray simulations from the array locations are used to improve the cross bearing positions. Both microbarom areas resulting from the cross bearing are compared with locations resulting from both the ECMWF dynamical ocean model as the Wavewatch III model.