



Contribution ID: 65

Type: **Oral presentation**

## What influences the timing of Sudden Stratospheric Warmings?

*Tuesday, 19 November 2019 16:00 (30 minutes)*

Extreme stratospheric polar events, in the form of Sudden Stratospheric Warmings (SSWs), have been shown to impact weather at the surface in the Northern Hemisphere, so an ability to accurately forecast them would improve forecast skill. Many studies have shown that statistical skill can be gained from knowledge of the QBO, ENSO and solar cycle phase but in rather general terms, telling us only if one is likely to occur sometime during the winter. Current seasonal forecast models are unable to forecast the timing of warming events, even though they are initialised e.g. with the correct phase of the QBO. In this study we examine factors that influence the timing of SSWs. We use 2 years as case studies, one with a displaced vortex (2005/6) and one with a split vortex (2008/9). The Met Office Unified Model is initialised with observations in early winter and then run with imposed observed sea surface temperatures. Various experiments are performed in which different regions of the atmosphere are nudged towards reality, with the main diagnostic being the timing of the simulated SSW and depth to which it extends. We find, perhaps not surprisingly, that the correct initialised QBO plus nudging throughout the troposphere alone is insufficient to accurately forecast the timing or depth of the SSW. Further experiments highlight the importance of achieving a good simulation of the upper equatorial stratosphere.

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**Session Classification:** Session 3 (cont.) : Polar vortex : predictability and downward influence

**Track Classification:** Workshop: Stratospheric predictability and impact on the troposphere