Geophysical Research Abstracts
Vol. 18, EGU2016-15816, 2016
EGU General Assembly 2016

'The plunger hypothesis' - predicting the tropospheric impact of extreme stratospheric events

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The coupling of events in the polar stratosphere to those in the polar troposphere is not currently understood. Extreme events in the stratosphere have been identified to have a lasting influence on the tropospheric circulation below for a period of up to 60 days. As such understanding the downward propagation of stratospheric circulation anomalies would be beneficial to surface forecasting.

In this work we use the new 'plunger hypothesis', that mass fluxes into and out of the polar region compress the polar column of air - in a manner similar to a plunger - and cause pressure and temperature anomalies. We demonstrate how a quasigeostrophic assumption within this hypothesis allows for the prediction of mass fluxes across the boundary to the polar region given the pressure distribution at the boundary. This then allows for a prediction of how a given stratospheric event such as a sudden stratospheric warming (SSW) or a strong vortex event influences the polar troposphere.

The performance of this hypothesis is tested; its usefulness in improving surface forecasts, its accuracy in response to stratospheric events, and its ability to predict downward propagation of Arctic Oscillation (AO) index in the aftermath of extreme stratospheric events. The link between this work and the PV inversion formulation of stratosphere-troposphere coupling is discussed.

This work forms part of a three and a half year PhD project.