Geophysical Research Abstracts
Vol. 17, EGU2015-6361, 2015
EGU General Assembly 2015

A blocking view of the stratosphere-troposphere coupling

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Dynamical influence from the stratosphere is known to play a role in shaping the wintertime tropospheric circulation patterns. Observations suggest that this influence is strongest following weak and strong polar vortex events, termed sudden stratospheric warmings (SSWs) and vortex intensification (VI) events, respectively. In this work, stratosphere-troposphere coupling is studied through the modulation by extreme vortex events of the Northern Hemispheric tropospheric blocking frequency and eddy-driven jet displacements. This is done using three reanalysis data sets and the Centro Euro-Mediterraneo sui Cambiamenti Climatici Climate Model with a resolved Stratosphere (CMCC-CMS) coupled model control run. Reanalysis results suggest the existence of distinct patterns of blocking activity following extreme vortex events. Over the Atlantic basin, SSWs are shown to lead by about 20–50 days the occurrence of increased/reduced blocking frequency on the poleward/equatorward side of the Atlantic jet stream. Anomalies of the opposite sense, with poleward reduction and equatorward enhancement of the blocking frequency, occur following VI events. The response over the Pacific sector is less clear. Compared to reanalyses, CMCC-CMS shows a similar but weaker response, especially over the Atlantic: a possible explanation is identified in the different structure of the polar vortex and weaker wind shear anomalies with respect to reanalysis. We finally highlight that patterns identified following vortex extremes show similarities with the Northern Annular Mode over the Atlantic but not over the Pacific. This suggests that the stratosphere-troposphere coupling is more a regional than annular feature.