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Subtropical influence on January 2009 major sudden stratospheric warming event: diagnostic analysis

Andrea Schneidereit (1), Dieter Peters (1), Christian Grams (2), Gabriel Wolf (3), Michael Riemer (3), Franziska Gierth (3), Julian Quinting (4,2), Julia Keller (5), and Olivia Martius (6)

(1) Leibniz-Institute of Atmospheric Physics, University of Rostock, Kühlungsborn, Germany (schneidereit@iap-kborn.de), (2) Institute for Atmospheric and Climate Science, ETH Zurich, Switzerland, (3) Institute for Atmospheric Physics, Johannes Gutenberg-University, Mainz, Germany, (4) Institute for Meteorology and Climate Research, Karlsruhe Institute of Technology, Karlsruhe, Germany, (5) German Weather Service (DWD), Offenbach, Germany, (6) Oeschger Centre for Climate Change Research and Institute of Geography, University of Bern, Bern, Switzerland

In January 2009 a major sudden stratospheric warming (MSSW) event occurred with the strongest NAM anomaly ever observed at 10 hPa. Also stratospheric Eliassen-Palm flux convergence and zonal mean eddy heat fluxes of ultra-long waves at 100 hPa layer were unusually strong in the mid-latitudes just before and after the onset of the MSSW. Beside internal interactions between the background flow and planetary waves and between planetary waves among themselves the subtropical tropospheric forcing of these enhanced heat fluxes is still an open question. This study investigates in more detail the dynamical reasons for the pronounced heat fluxes based on ERA-Interim re-analysis data.

Investigating the regional contributions of the eddy heat flux to the northern hemispheric zonal mean revealed a distinct spatial pattern with maxima in the Eastern Pacific/North America and the Eastern North Atlantic/ Europe in that period. The first region is related with an almost persistent tropospheric blocking high (BH) over the Gulf of Alaska dominating the upper-level flow and the second region with a weaker BH over Northern Europe. The evolution of the BH over the Gulf of Alaska can be explained by a chain of tropospheric weather events linked to and maintained by subtropical and tropical influences: MJO (phase 7-8) and the developing cold phase of ENSO (La Niña), which are in coherence over the Eastern Pacific favor enhanced subtropical baroclinicity. In turn extratropical cyclone activity increases and shifts more poleward associated with an increase of the frequency of warm conveyor belts (WCB). These WCBs support enhanced poleward directed eddy heat fluxes in Eastern Pacific/North-American region. The Eastern North Atlantic/European positive heat flux anomaly is associated with a blocking high over Scandinavia. This BH is maintained by an eastward propagating Rossby wave train, emanating from the block over the Gulf of Alaska. Eddy feedback processes support this high pressure system. The evolution of these links is examined in its importance for the forcing of the MSSW 2009.