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Investigating mid-latitude stratospheric wind variations, using the zonal-mean momentum equation

A. J. Haklander (1,2)

P. C. Siegmund (2)

H. M. Kelder (1,2)

(1) Department of Applied Physics, Eindhoven University of Technology (TUE), Eindhoven, The Netherlands

(2) Royal Netherlands Meteorological Institute (KNMI), De Bilt, The Netherlands
A.J.Haklander@knmi.nl / Fax: +31-(0)30-2210407 / Phone: +31-(0)30-2206228

The day-to-day variability of the zonal-mean zonal wind ($\bar{u}$) at mid-latitudes is investigated between 1000 and 0.l hPa, using ECMWF forecast data. To better understand this variability, the different terms of the Eulerian Mean (EM) zonal momentum equation are analyzed. Since the EM formulation often fails to isolate the contribution by eddies from that by the mean meridional circulation, the analysis is also applied using the Transformed Eulerian Mean (TEM) equation. In the EM formulation, day-to-day $\bar{u}$ accelerations generally coincide with variations in both the meridional Coriolis and eddy momentum flux divergence terms. However, no distinct mechanism for the observed $\bar{u}$ tendencies can be identified. If the TEM formulation is used instead, it is found that variations in the Eliassen-Palm (EP) flux divergence exhibit a strong and direct connection with variations in the $\bar{u}$ tendency throughout the stratosphere. Whereas the EM Coriolis term is positively correlated with $\partial\bar{u}/\partial t$ in the stratosphere, the TEM Coriolis term acts to oppose $\partial\bar{u}/\partial t$ variations caused by the EP-flux divergence term. On average, the eddy forcing due to the daily variability of the EP-flux divergence is about 2 times stronger than the observed daily $\bar{u}$ accelerations between 50 and 0.5 hPa. It is the eddy-induced TEM meridional circulation that acts to damp this forcing. In the second part of our investigation, an attempt is made to explain the observed downward propagation of low-frequency $\partial\bar{u}/\partial t$ variations in the stratosphere. The results suggest that the interaction between gravity waves and the basic flow likely

plays a role in causing the observed downward propagation of low-frequency $\partial\bar{u}/\partial t$ variations.