

Ten-Year Climatological Features and Air Origin of Mid-latitude Double Tropopauses

XUE WU¹, DAREN LÜ¹

¹ *Key Laboratory for Atmosphere and Global Environment Observation, Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, China*

The 10-year climatological features related to mid-latitude double tropopause events (DTs) are examined using ERA-Interim data from 2003 to 2012. The analysis is based on tropopauses defined by lapse rate. Results show that DTs are permanent or semi-permanent in the mid-latitudes, and high DT frequency bands move poleward in winter and equatorward in summer, which is consistent with the seasonal movement of the subtropical jet. Based on our statistics, the second tropopause is found at about 100hPa in the subtropics and at slightly lower altitudes in sub-polar regions. The thickness between the first and second tropopause is smaller in the subtropics and increases with latitude. Next, the origin of air sandwiched between the first and second tropopause of DTs is studied with a revised version of the UK Universities Global Atmospheric Modelling Programme Offline Trajectory Code (Version 3) diabatic trajectory model. The results show that, in the lower or middle troposphere, air is transported into the DTs from lower latitudes, mainly in the tropics. The dominant source regions are mainly areas of deep convection and steep orography, e.g., the western Pacific and Himalayan Mountains, and they show strong seasonality following the seasonal shift of these strong upwelling regions.

Key words: double tropopause, trajectory model, stratosphere–troposphere exchange