Estimation and Attribution of the Temperature Variances in the Stratosphere

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Introduction

Planetary scales are the dominant form of the stratospheric disturbances. Theoretical studies explain the features of the vertical propagation of planetary Rossby waves from the troposphere into the stratosphere (Charney and Raman, 1963; Dickinson, 1968). The refraction in the meridional and the damping by critical layer absorption of the waves result in the wave forcing on the zonal circulation (Charney, 1969; Matsuno, 1970). The Brewer-Dobson circulation is also controlled by the change in the meridional transport of tracer gases in the stratosphere and influenced by the wave forcing (Haynes et al., 1991; Holton et al., 1995). Recent simulation studies using general circulation models (GCMs) all predict intensification in the BDC under the global warming in climate due to the increase in greenhouse gases (Buchau, 1987; Garcia and Randel, 2008).

The general circulation in the stratosphere exhibits the diurnal and semidiurnal tides that are most prominent in the mesosphere and lower thermosphere. The general features of the stratospheric diurnal tides are estimated by Wallace and Tadé (1974) using long records of 2- and 4- daily rawinsonde data of winds at various stations. They note that the diurnal tide at 30-hpa (24 km) exhibits large wind speed but only oscillate with period of 12 hours. The vertical propagation, which is in agreement with the calculation of Linsenberg and Hartmann, 2005; Formichev et al., 2006; Oleson et al., 2006; Garcia and Randel, 2008.

Travelling planetary Rossby waves in the stratosphere, their spatial structure and phase speeds of these waves are determined by the resonance properties of the atmosphere, and are also reported in the researches using ground based measurements and satellite observations, e.g. the observations (Charney and Raman, 1963; Hauchecorne et al., 2006; Offerman et al., 1987) Bittner et al., 2006). The data products of the most updated version 1.07 and of Level 2A data-set can provide the measurements of temperature, pressure, density and the concentration of several kind of trace gases of the atmosphere from the upper troposphere to stratosphere.

The data SABERTIMED temperatures collected during 2002 to 2008 are used to estimate the variances of temperature (Temp-VARs) that in turn represent the contributions of the non-tropical amplitudes. The data products of the most updated version 1.07 and of Level 2A data-set can provide the measurements of temperature, pressure, density and the concentration of several kind of trace gases of the atmosphere from the upper troposphere to stratosphere.

T-SDEVs (K) vs latitude and height in eight meridians

All the meridians show considerable resemblance in the latitude-height features of the Temp-SDEVs, which suggests that these features feature the same amplitude and phase in the vertical was carried out by the ratio of the tidal Temp-VARs to the Temp-SDEVs. During late-winter, the high latitudes in both hemispheres exhibit most square contributions, which suggests the predominance of travelling planetary Rossby waves.

Figure 6 shows, for example, the annual cycle of 2003 the latitude-height cross section of Temp-SDEVs. During late-winter, the high latitudes in both hemispheres exhibit most square contributions, which suggests the predominance of travelling planetary Rossby waves.

Tidal contribution to Temp-SDEV

The tidal contribution to Temp-SDEV can be obtained by the ratio of the tidal Temp-VARS to the Temp-SDEVs. The Left column in Fig. 5 shows the annual cycle of diurnal Transient contributions to the tidal Temp-SDEVs in the total Temp-SDEVs (shading for the ratio (%) for migrating semidiurnal tide).

In the spring hemisphere, the migrating tidal Temp-VARs at sub-tropical latitudes at height range 40-60 km, contributes most square contributions, which also seen in midsummer hemisphere at latitudes ranging from subtropics to polar region in 40-90 km range.

In all the seasons, the tidal contributions are always seen in the polar lower stratosphere. Migrating semiannual contributes significant temperature variances during autumn season in the middle stratosphere at high latitudes.