Geophysical Research Abstracts
Vol. 13, EGU2011-8672, 2011
EGU General Assembly 2011

Quasi-stationary zonal wave in total ozone distribution: long-term changes during Antarctic spring and summer

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To study the large-scale atmospheric waves in the Antarctic stratosphere the total ozone column has been considered as an indicator of wave propagation. Ozone asymmetry in latitude range 50-80S has been analysed using the satellite data during last 30 years (1979-2009). Data of TOMS/Nimbus-7, TOMS/Earth Probe and OMI/Aura have been treated. Corrected 8th version of the data has been used. Comparison of planetary wave characteristics for southern spring (September – November) and summer (December – February) period has been fulfilled. Longitudinal variations and spectral characteristics of the quasi-stationary waves in the two seasons have been compared. It is shown that quasi-stationary wave (QSW) minimum in ozone distribution has shifted during spring with a rate nearly 15 deg. per decade whereas its summer shift is unsteady and takes place at significantly lower amplitude levels. The longitudinal positions of the QSW minimum are located more westerly in summer (in the South America's and Pacific Ocean's sectors versus Atlantic one in spring). QSW maximum in ozone distribution did not experience a statistically reliable shift during both seasons. Parameters of the Fourier harmonics have been calculated. Impact of zonal harmonics with wave numbers 1-5 on the quasi-stationary wave shape has been studied. Change of harmonics' amplitude with zonal wave number has been studied. This dependence corresponds to power law. Amplitude decreasing with zonal number is slower for averaged amplitude of the total ozone disturbance comparative to the quasi-stationary distribution and for summer relative to spring. Long-term change analysis shows that the wave amplitude in ozone distribution was increasing when ozone depletion processes prevailed (1980s – early 1990s). After ozone hole stabilisation (from mid-1990s), systematic amplitude changes have not been observed. Latitude dependence of the quasi-stationary wave characteristics has been analysed. Tendencies in wave dynamics have been considered using also data for other atmospheric parameters from NCEP-NCAR reanalysis.