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Annual, semi-annual and ter-annual variations of gravity wave momentum flux in 13 years of SABER data

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In this study, the variations at different time scales such as the annual cycle, the semiannual oscillation (SAO), the ter-annual cycle (about four monthly) and the quasi-biennial oscillation (QBO) in zonal mean GW amplitudes and GW momentum flux (GWMF) have been investigated using satellite observations from 2002-2014 and combining ECMWF high resolution data with the GORGRAT model. The global distribution (patterns) of spectral amplitudes of GW momentum flux in stratosphere and mesosphere (from 30 km to 90 km) show that the annual cycle is the most predominant variation, and then are SAO, ter-annual cycle and QBO. For annual components, two relatively isolated amplitude maxima appear in each hemisphere: a subtropical maximum is associated with convective sources in summer, a mid and high latitude maximum is associated with the polar vortex in winter. In the subtropics, GWs propagate upward obliquely to the higher latitudes. The winter maximum in the southern hemisphere has larger momentum flux than that one in the northern hemisphere. While on the SH the phase (i.e. time corresponding to the maximum GWMF) continuously descends with the maximum in July in the upper mesosphere and in September in the lower stratosphere, on the northern hemisphere, the phase has no visible altitude dependence with a maximum in December. For semiannual variations, in the MLT (70-80 km) region, there is an obvious enhancement of spectral amplitude at equatorial latitudes which relate to the dissipation of convectively forced GWs. The SAO in absolute momentum flux and the annual cycle in zonal momentum flux indicated that the variations at mid-latitudes (about from 30°-40°) are not a SAO signals but rather an annual cycle when the direction of GWMF is considered. The ter-annual cycle may be related to the duration of active convection in subtropical latitudes (from June to Sep. in north hemisphere) Indications for QBO are found latitude extension to mid-latitudes in stratosphere of both hemispheres and equatorial mesopause. Using these four dominant components of time scales and performing sinusoidal fits of GWMF we find that the patterns also at high latitudes are consistent with the range of 50°S to 50°N continuously covered by SABER.