Geophysical Research Abstracts,
Vol. 11, EGU2009-11347, 2009
EGU General Assembly 2009

Observed stratospheric downward reflection, and its relation to upward pulses of wave activity

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We examine the differences between observed stratospheric vertical wave reflection and wave absorption events, which differ in that the wave induced deceleration remains confined to upper levels in the former. The two types of events signify two types of stratospheric winter dynamics, associated with different downward coupling to the troposphere (Perlwitz and Harnik, 2004). Using time lag composites, we find that the main factor influencing which event will occur is the duration, in time, of the upward pulse of wave activity entering the stratosphere from the troposphere. Short pulses accelerate the flow at their trailing edge in the lower stratosphere while they decelerate it at upper levels, resulting in a vertical shear reversal, and corresponding downward reflection, while long pulses continue decelerating the vortex at progressively lower levels. The confinement of deceleration to upper levels for short wave forcing pulses is also found in an idealized model of an interaction between a planetary wave and the stratospheric vortex, though some aspects of the wave geometry evolution, and thus vertical reflection, are not captured realistically in the model. The results suggest the stratospheric influence on the type of wave interaction, in reality, is indirect - through a possible effect on the duration of upward wave fluxes through the tropopause.