Geophysical Research Abstracts
Vol. 16, EGU2014-5744, 2014
EGU General Assembly 2014


# Assessment of the Impact of Middle-Atmosphere Solar Tides on Gravity Waves in a *WKB* Gravity-Wave Model Based on Wave-Action Phase-Space Density

Bruno Ribstein (1), Ulrich Achatz (1), and Fabian Senf (2)

(1) Institut für Atmosphäre und Umwelt, Goethe-Universität, Frankfurt am Main, Germany (ribstein@iau.uni-frankfurt.de),
(2) Leibniz Institute for Tropospheric Research, Leipzig, Germany

**abstract**

Gravity waves (*GWs*) and solar tides (*STs*) are main constituents of the dynamical coupling between troposphere and mesosphere-lower-thermosphere (*MLT*). Via momentum deposition, *GWs* control to a large extent the mesospheric mean circulation. *STs* are large scale waves, mostly due to tropospheric and stratospheric diurnal heating processes, that modulate all dynamical fields in the mesosphere. *GWs* ant *STs* also interact strongly with each other.

Conventional GW parameterizations used to describe this interaction (e.g. [1]) neglect the time-dependence and horizontal gradients of the background flow, with fatal effects (e.g. [2]). We study here the propagation of *GWs* in a time-dependent middle-atmosphere background flow, using a new (caustics free) *WKB GW* model (ray tracer). The background flow is composed by a climatological mean and tidal fields extracted from a general circulation model (HAMMONIA, see [3]). In order to avoid caustics, inevitable in classic ray-tracer implementations, we implemented a new wave-action phase-space density conservation scheme [4, 5]. The scheme attaches to each ray a finite volume in the location & wavenumber phase-space. The location-wavenumber volume is conserved during the propagation, responding in shape to the local stretching and squeezing in wave-number space. From the propagation of *GWs* we evaluate the deposition of momentum and buoyancy. Rayleigh-friction and temperature-relaxation coefficients are also evaluated.

In this extension of the study by [2] it is shown, with an amplitude scheme more stable against numerical instabilities, due to the avoidance of caustics, that *STs* (and so the time dependence of the background flow) modulate the propagation of *GWs*. Via Rayleigh-friction and temperature-relaxation coefficients, we also quantify how the pseudo-momentum-, momentum-, and enthalpy-deposition of *GWs* can influence the amplitude and the phase structure of *STs*. Finally, we compare momentum and buoyancy fluxes from the propagation of GWs with results from a simple scale analysis of the problem. These explain the amplitudes obtained by the scheme quite well.

**Key words:** Middle-Atmosphere dynamics, Solar Tides, Gravity Waves, WKB model

## References :

[1] C. K. Meyer. *Gravity wave interactions with the diurnal propagating tide*. J. Geophys. Res., 104:4223–4239, 1999.

[2] F. Senf and U. Achatz. *On the impact of middle-atmosphere thermal tides on the propagation and dissipation of gravity waves*. J. Geophys. Res., 116:D24110, 2011.

[3] H. Schmidt, G. P. Brasseur, M. Charron, E. Manzini, M. A. Giorgetta, T. Diehl, V. I. Fomichev, D. Kinnison, D. Marsh, and S. Walters. *The hammonia chemistry climate model: Sensitivity of the mesopause region to the 11-year solar cycle and co(2) doubling*. J. Clim., 19:3903–3931, 2006.

[4] A. Hertzog, C. Souprayen, and A. Hauchecorne. *Eikonal simulations for the formation and the maintenance of atmospheric gravity wave spectra*. J. Geophys. Res., 107:D12, 2002.

[5] J. Muraschko, M. D. Fruman, U. Achatz, S. Hickel, and Y. Toledo. *On the application of wkb theory for the simulation of the weakly nonlinear dynamics of gravity waves*. Q. J. R. Meteorol. Soc., submitted, 2014.