MLS Scientific Publication

Scientific Themes: Atmospheric Dynamics, Satellite Observation

Mountain Waves in the Middle Atmosphere: Microwave Limb Sounder Observations and Analyses
Jonathan H. Jiang, Dong L. Wu, Stephen D. Eckermann, and Jun Ma, *Adv. Space Res.*, V32-5, 801-806, 2003.
Contacts: Jonathan.H.Jiang@jpl.nasa.gov, 1-818-354-7135; Stephen.Eckermann@nrl.navy.mil, 1-202-404-1299.

Summary

This paper summarizes recent progresses in MLS radiance variance analyses and some important aspects of the technique for detecting gravity waves in the middle atmosphere, especially those related to topography. Because of MLS's three dimensional "oval-shaped" weighting function, the sensitivity to gravity wave perturbations highly depends on wave propagation direction, instrument viewing angle, as well as horizontal and vertical wavelengths. Using recent mountain wave modeling simulations at Naval Research Laboratory (NRL), MLS measurements are proven to be one of the most valuable global gravity wave data for validating and constraining in gravity wave parameterizations.

This work is an introduction for future model-measurement comparison studies with the upcoming Earth Observation (EOS) MLS experiments and new generation climate and numerical weather forecast models, such as NRL-NOGAPS (http://uap-www.nrl.navy.mil/dynamics/html/nogaps.html). This work and future related research are aligned with NASA EOS science goals, to pursue improved understanding of atmospheric components where great uncertainties exist in predicting future climate change.

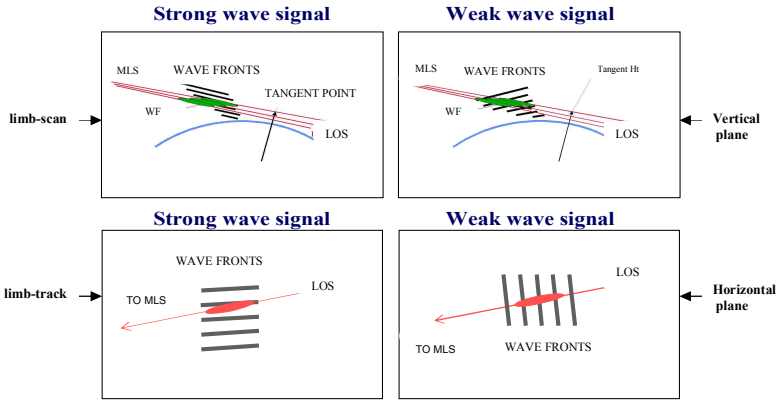

Figure 1

Figure 1: These diagrams illustrate some examples of MLS observing scenarios w.r.t. wave propagation directions. From the simulations with a 2D MLS weighting function (shown as oval-shape), we find that gravity wave variances are sensitive to the direction how waves are tilted vertically, as well as how the horizontal wave fronts are aligned up w.r.t. MLS LOS.

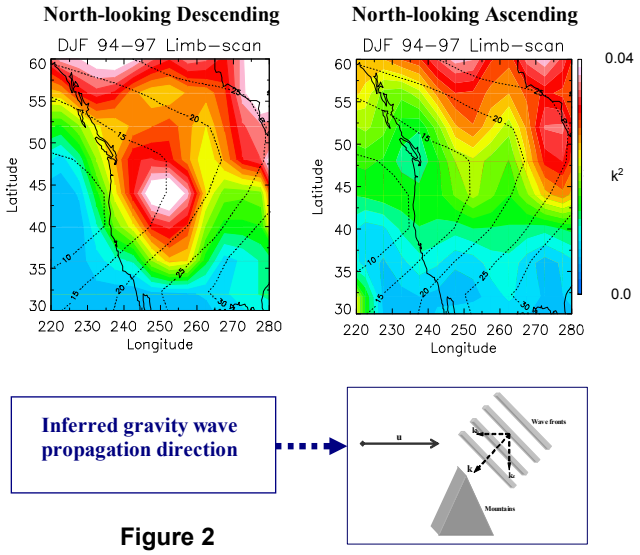

Figure 2

Figure 2: In the study of MLS gravity wave variances over the major mountain ridges in the Northern Hemisphere, we found that the variances are usually much higher when observed from north-looking descending (ND) observation orbits, and lower when observed from north-looking ascending (NA) orbits. In this example, the MLS gravity wave variance over the Rockies is substantially higher when measured from ND orbits than the variances measured from NA orbits. Since MLS line-of-sight (LOS) are pointing at slightly north of east direction at the Rockies latitudes when on the ND orbits, the scenario in Figure 2 implies that downward phase propagating wave fronts must be tilted westward (or slightly south of westward). In other words, the horizontal phase velocity is mostly westward.