MLS-Scientific Publication

Scientific Themes: Atmospheric Dynamics, Modeling

UARS MLS Observation of Mountain Waves over the Andes. Jonathan H. Jiang, Dong L. Wu, and Stephen D. Eckermann, *J. Geophys. Res.*, **107**, 10.1029/2002JD002091, 2002.

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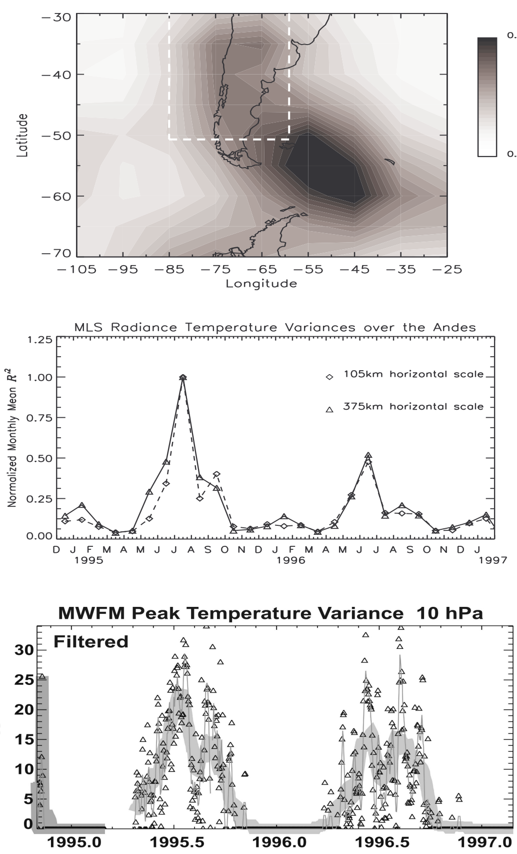
Summary

Mountain waves are internal atmospheric gravity waves generated by vertically-displaced air that flows over mountains. The deposition of momentum flux from the breaking of such mountain waves makes significant contributions to the general circulation in the upper atmosphere. Thus, inclusion of mountain wave effects in general circulation models can potentially improve the accuracy of numerical climate prediction and weather forecasts. This study presents the radiance variances, extracted from the measurements made by the Microwave Limb Sounder (MLS) aboard the Upper Atmosphere Research Satellite (UARS), that show seasonal and inter-annual behavior of mountain wave activity in the stratosphere over the Andes. Using the MLS data and a mountain wave model, the paper also investigates how the background winds and surface climate conditions may play a role in modifying mountain wave generation and propagation into the stratosphere. The MLS observations can provide the climate-modeling community important and needed information in quantifying interactions between the topography and background winds.

This work enhances our understanding of orographically excited gravity waves in the middle atmosphere, which can benefit society by possibly helping improve accuracy of climate models and weather forecasts.

Figure (a) shows a map of the MLS radiance variances at 48 km altitude averaged between May-September 1995. It illustrates for the first time the unique orographic impact of the Andes on atmospheric dynamical processes in the stratosphere. The region highlighted by the white dashed curve is the "Andes region" that we focus on in this study. The maximum variance over the Drake passage between the southern tip of South America and Antarctica probably resulted from the downstream penetration of waves into the vortex winds, is the subject of further modeling studies. Figure (b) shows the monthly mean MLS radiance temperature variances averaged between 33-53 km over the Andes region. We found the variances are significantly larger in southern hemispheric winter when the winds in the troposphere and stratosphere over the Andes are both westerly and mountain wave critical levels (zero-wind-lines) are absent. This annual variation of MLS radiance variance agrees well with data from radiosondes and output from the Naval Research Laboratory (NRL) Mountain Wave Forecast Model (MWFM) shown in Figure (c). In addition, we found the amplitude of the radiance variances seems to correlate well with the intensity of surface wind upstream of the Andes, which is also related to the meridional temperature gradient in the region. This suggests that a climate anomaly event such as El Niño may play an important role in modulating the mountain wave generation and the wave intensity reaching the stratosphere, an idea that the mountain wave model also lends some support to. Horizontal scale analysis suggests that mountain waves over the Andes have two preferential wavelengths at 110 and ~400 km.



(a)

(b)

(c)

Figures: (a) and (b) UARS MLS observed radiance temperature variances over the Andes; (c) NRL MWFM simulated air temperature variances over the same region.