Geophysical Research Abstracts
Vol. 12, EGU2010-373, 2010
EGU General Assembly 2010

Gravity Wave Analysis with GPS Radio Occultation Data

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Atmospheric waves interconnect atmospheric layers. Gravity waves are mesoscale waves with horizontal wavelengths from 10-1000 km and therefore small in comparison to the resolution of climate models. For climate modelling a parametrization of gravity waves is incorporated. Required are global measurements of wave properties. This includes vertical and horizontal wave parameters as well as all possible sources and their temporal and spacial variability. GPS radio occultation (RO) measurements from CHAMP (2001-2008), GRACE and COSMIC (both since 2006) provide temperature data, used for gravity wave analysis. The combination of these unique datasets builds the basis of climatologies of gravity wave activity in tropospheric as well as in lower stratospheric regions (5 to 40 km altitude). Therefore temporal variability and regional differences of gravity wave activity are discussed. Additionally case studies are applied to neighbouring temperature profiles (small time and space differences) using the first months of the COSMIC dataset (high spatial and temporal resolution) to derive horizontal gravity wave parameters along the connecting line between the two adjacent profiles. Different regions, each representing either polar, mid or tropical latitudes, were chosen for these studies. RO temperature fluctuation profiles were analysed using a Morlet wavelet to determine the phase shift between both profiles. Finally, the horizontal wavenumber component in the direction defined by the two measurements is calculated as the ratio of the phase shift and the distance between them. Coherences of monitoring geometry (line-of-sight) and wave structures are discussed. The results of the studies were verified using the mesoscale Weather Research and Forecast (WRF) model. For the mid latitude case study a horizontal wavelength along the connecting line of approximately 370 km was derived from the RO measurements which is in very good agreement with the WRF results.