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Coherent gravity wave occurrence rates in paired satellite observations

A. J. McDonald
University of Canterbury, Physics and Astronomy, Christchurch, New Zealand (adrian.mcdonald@canterbury.ac.nz)

Previous studies have deduced the horizontal wavelength and absolute momentum flux of gravity waves from two or more adjacent satellite profiles by assuming that these profiles belong to the same sinusoidal wave. However, the assumption that both profiles relate to the same sinusoidal wave is obviously sometimes violated in regions where multiple waves exist or where no waves exist. This presentation describes a statistical methodology to identify pairs of profiles from satellite observations which contain the same gravity wave. This methodology relies on comparing the magnitude of the cross S-transform derived from normalized profile pairs with Monte Carlo simulations to identify coherent wave structures in both profiles.

This technique also allows the percentage of paired observations which contain the same wave packet to be derived at a given significance level. Application of this technique to COSMIC/FORMOSAT3 data shows that the occurrence of coherent waves varies strongly as a function of latitude and season. The latitudinal pattern is shown to potentially be linked to the larger horizontal wavelengths of gravity waves observed at the equator and the likely corresponding change in the size of wave packets which increases the likelihood of two equally-spaced profiles observing the same wave. Other possibilities include greater intermittency in the gravity wave sources at mid-latitudes and differences in the observed wave field due to critical level filtering beneath the observation range. Using the dense sampling geometry provided by the COSMIC/FORMOSAT3 constellation we also examine how horizontal separations between profiles impacts the occurrence of coherent waves in profile pairs.