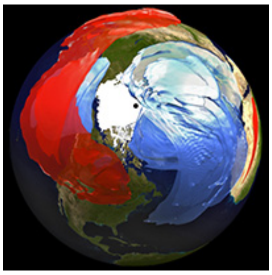

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3-D Stratospheric Gravity-Wave Charatceristics in a Multi-Year Climatology over the Southern Hemisphere from 3-D Satellite Observations and Spectral Analyses.

Stratospheric Gravity-Wave Charatceristics in a Multi-Year Climatology over the Southern Hemisphere from 3-D Satellite Observations and Spectral Analyses.

Neil P. Hindley, Corwin J. Wright, Lars Hoffmann, Nicholas J. Mitchell

Atmospheric gravity waves play a key role in the coupling of different layers of the Earth's atmosphere, acting as crucial drivers of the atmospheric circulation through deposition of energy and momentum. However, nearly all Global Circulation Models (GCMs) seriously under-represent the momentum fluxes of gravity waves in the southern hemisphere during winter, particularly at latitudes around 60S. There is thus a need for observational measurements of gravity-wave fluxes near 60S to constrain the momentum budget of GCMs, thereby reducing biases and improving predictability. However, such measurements are notoriously difficult, because they require 3-D observations of wave properties if the fluxes are to be estimated without using significant limiting assumptions. In this study we apply a 3-D Stockwell transform (3DST) method to specialised 3-D satellite measurements of gravity waves from NASA's AIRS/Aqua instrument. We present a multi-year climatology of spatially-localised gravity-wave amplitudes, wavelengths, directions of propagation and directional momentum fluxes in the stratosphere for the entire southern hemisphere. Our results reveal hot-spots of increased monthly-mean momentum fluxes over sources such as the mountains of the southern Andes, the Antarctic Peninsula and eastern coastline and small mountainous islands in the Southern Ocean, as well as a large 'belt' of increased flux over the Southern Ocean. We then use statistical methods to characterise the short-timescale (less than a month) and long-timescale (interannual) variability of these sources. Our results suggest that interannual variability is dominated by changes in short-timescale variability. This implies that the accurate representation the short-timescale gravity-wave intermittency in models is key to developing realistic simulated momentum budgets over longer timescales. We also present further evidence of a widespread convergence of gravity-wave flux towards latitudes around 60S from sources to the north and south. We show that this convergence is a regular and persistent feature that occurs each year, and could help to account for some of the under-represented flux in GCMs at these latitudes.

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