Three-dimensional satellite observations of gravity waves around the southern wintertime polar vortex: separating contributions from orographic and non-orographic sources

Neil HINDLEY [1], Corwin WRIGHT [1], Tracy MOFFAT-GRIFFIN [2], Lars HOFFMANN [3],
M Joan ALEXANDER [4], Nicholas J. MITCHELL [1]

[1] *University of Bath, Bath, UK*
[2] *British Antarctic Survey, Cambridge, UK*
[3] *Forchungszentrum Jülich, Jülich, Germany*
4 Northwest Research Associates, Boulder, CO, USA

Gravity waves are key drivers of the atmospheric circulation. However, accurately representing them in General Circulation Models (GCMs) has proved very difficult, as large parts of the gravity wave spectrum are at scales that are near or below the resolution of even modern GCMs. Furthermore, many fine-scale source mechanisms can prove difficult to accurately simulate in a computationally efficient manner. At latitudes near 60S, the inadequate representation of gravity waves in GCMs has been linked to the long-standing "cold-pole problem", where the southern stratospheric polar vortex breaks up too late in spring, with global implications. Progress in solving this problem has been limited due to a historical lack of 3D observations of gravity waves that can be used to test simulated wave fields produced by the GCMs. One key question here is the relative contributions of waves from orographic and non-orographic wave sources in the intense and persistent belt of gravity wave activity at 60S during austral winter. Do orographic waves from the Southern Andes and Antarctic Peninsula become detached and travel out over the ocean before breaking? Do non-orographic waves from storms travel in from other latitudes? Do other wave sources travel into the jet from sources to the north and/or south? Or are these waves all generated by in situ processes around the vortex edge? Here, as part of the DRAGON-WEX project, we use new 3-D measurements from NASA AIRS/Aqua and a novel 3-D analysis method to try to answer these questions. We investigate wave sources, amplitudes, momentum fluxes, group and phase speeds. Then, by comparison with reanalysis winds and storm-track datasets, we use our directional wave measurements to try to disentangle the relative contributions of orographic and non-orographic waves to the 'missing' momentum budget in this region.

Key words: gravity waves, dynamics, remote sensing, spectral analysis, storms