A GCM study of orographic gravity waves over Antarctica excited by katabatic winds

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In this study we simulate orographic gravity waves (OGWs) over Antarctica using a T213L250 general circulation model (GCM). The GCM has a fine vertical resolution of 300 m throughout the middle atmosphere. The simulation was conducted for a period of one year, with results mainly discussed for the period 21-28 June. The OGWs are excited by katabatic winds that travel down surface slopes of the Antarctic ice sheet. A strong eastward katabatic wind blows over the west coast of the Ross Sea at the time of approaching synoptic-scale upper tropospheric westerly jets. A quasi-stationary OGW is excited above the coast and propagates upward into the mesosphere. The OGW appears episodically during the Antarctic winter and spring; its amplitude and vertical wavelength are controlled by the eastward katabatic wind.

Dissipation of OGWs within the middle atmosphere results in a localized deceleration of westerly winds of greater than $-30\ \mathrm{m\,s^{-1}\,day^{-1}}$; this in turn modifies horizontal circulation in the polar vortex. Large-scale vertical mixing occurs within the mesosphere associated with wave breaking. Large temperature fluctuations associated with the OGWs affect the formation or suppression of polar stratospheric clouds in the lower stratosphere. Katabatic wind excitation is the most powerful source of gravity waves over Antarctica during the winter solstice period.