Session: C28 Poster: W41A

The effect of orographic waves on Antarctic Polar Stratospheric Cloud (PSC) occurrence and composition

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The first seasonal analysis of the relationship between mesoscale orographic gravity-wave activity and polar stratospheric cloud (PSC) composition occurrence around the whole of Antarctica is presented, for austral winter 2007. Gravity-wave variances are derived from temperature measurements made with the Constellation Observing System for Meteorology, Ionosphere and Climate (COSMIC) Global Positioning System Radio Occultation (GPS-RO) satellites. Data from the Cloud-Aerosol LIdar with Orthogonal Polarization (CALIOP) instrument onboard the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) satellite are used to determine the PSC composition class distribution and spatial volume. The results show intermittent large wave activity above the Antarctic Peninsula which is co-incident with large volumes of water ice PSCs. These ice PSC volumes advect downstream, where increases in nitric acid trihydrate (NAT) PSC volumes occur, supporting the mountain wave seeding hypothesis throughout winter. We calculate the approximate amount of PSCs attributable to these orographic gravity waves. While we show that planetary waves are the major determinant of PSC presence at temperatures close to the NAT formation threshold, we also demonstrate the important role of mesoscale, intermittent orographic gravity-wave activity in accounting for the composition and distribution of PSCs around Antarctica.