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High-Resolution Temperature Mapping of Mesospheric Gravity Waves and Breaking Events

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This presentation highlights new research capabilities and recent results using a novel infra-red imaging system operating at high-latitudes at the ALOMAR Arctic Observatory, Norway (69°N), and at Amundsen-Scott South Pole Station, Antarctica (90°S). The Advanced Mesospheric Temperature Mapper (AMTM) is a high-performance digital imaging system that measures selected emission lines in the mesospheric OH (3,1) band (at $\sim$1.55 μm) to create high-quality intensity and temperature maps of a broad spectrum of gravity waves at the $\sim$87 km level (with periods ranging from several minutes to many hours). The temperature data are obtained with an unprecedented spatial ($\sim$0.5 km) and temporal (typically 30 sec) resolution over a large 120° field of view enabling detailed studies of gravity wave propagation and breaking events in the Mesosphere and Lower Thermosphere (MLT) region, even in the presence of strong aurora and moonlight. New results include high-resolution wintertime studies of continuous (24-hr) gravity wave activity and spectral evolution, and first evidence of gravity wave "self-acceleration" in the MLT region using coordinated lidar and radar measurements. These results are complemented by very high resolution ($\sim$4 sec) gravity wave observations using a third AMTM developed for airborne measurements on the National Science Foundation (NSF) Gulfstream V aircraft as part of the DEEPWAVE program. This mission was successfully conducted from New Zealand during the Austral winter, June-July 2014, and obtained spectacular new data on mesospheric mountain waves, including large amplitude breaking events associated with variable orographic forcing over the Southern Alps.