Frequency spectra and vertical profiles of wind fluctuations in the summer Antarctic mesosphere revealed by MST radar observations

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Continuous observations of polar mesosphere summer echoes at heights from 81–93 km were performed using the first Mesosphere-Stratosphere-Troposphere/ Incoherent Scatter radar in the Antarctic over the three summer periods of 2013/14, 2014/15, and 2015/16. Power spectra of horizontal and vertical wind fluctuations, and momentum flux spectra in a wide frequency range from (8 min) $^{-1}$ to (20 d) $^{-1}$ were first estimated for the Antarctic summer mesosphere. The horizontal (vertical) wind power spectra obey a power law with an exponent of approximately −2 (−1) at frequencies higher than the inertial frequency of (13 h)$^{-1}$, and have isolated peaks at about 1 day and a half day. In addition, an isolated peak of a quasi-two-day period is observed in the horizontal wind spectra but is absent from the vertical wind spectra, which is consistent with the characteristics of a normal-mode Rossby-gravity wave. Zonal (meridional) momentum flux spectra are mainly positive (negative), and large fluxes are observed in a relatively low-frequency range from (1 day) $^{-1}$ to (1 h) $^{-1}$. A case study was performed to investigate vertical profiles of momentum fluxes associated with gravity waves and time-mean winds on and around January 3, 2015 when a minor stratospheric warming occurred in the Northern Hemisphere. A significant momentum flux convergence corresponding to an eastward acceleration of ~200 m s^{-1}day^{-1} was observed before the warming and became stronger after the warming when mean zonal wind weakened. The strong wave forcing roughly accorded with the Coriolis force of mean meridional winds.

Reference: Sato, K., M. Kohma, M. Tsutsumi, and T. Sato (2017), Frequency spectra and vertical profiles of wind fluctuations in the summer Antarctic mesosphere revealed by MST radar observations, J. Geophys. Res. Atmos., 122, 3-19,doi:10.1002/2016JD025834