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The wintertime two-day wave in the polar stratosphere, mesosphere and lower thermosphere

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Recent observations of the polar mesosphere have revealed that waves with periods near two days reach significant amplitudes in both summer and winter, which is in striking contrast to mid-latitude observations where two-day waves maximise in summer only. Here, data from a meteor radar at Esrange (68ºN, 21ºE) in the Arctic and data from the MLS instrument aboard the EOS Aura satellite are used to investigate the wintertime polar two-day wave in the stratosphere, mesosphere and lower thermosphere. The radar data reveals that mesospheric two-day wave activity measured by horizontal-wind variance has a semi-annual cycle with maxima in winter and summer and equinoctial minima. The MLS data reveal that the summertime wave in the mesosphere is dominated by the familiar westward-travelling zonal wavenumber three wave with significant westward wavenumber four present. This reaches largest amplitudes at mid-latitudes in the southern hemisphere. However, in the winter polar mesosphere, the wave appears to be an entirely different phenomenon. The analysis reveals it to be an eastward-travelling zonal wavenumber two, which is not seen during the summer. A proposed source for this eastward travelling wave in the mesosphere is that it has ascended from the wintertime polar stratosphere, and is likely generated by instabilities in the polar night jet.