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Gravity Wave Activities in the Upper Mesosphere at King Sejong Station, Antarctica (62.22°S, 58.78°W) and Their Correlation with the Jet Stream in the Lower Atmosphere

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Gravity wave (GW) activities in the upper mesosphere (80–100 km) and their correlation with the jet stream in the lower atmosphere (troposphere and stratosphere) are investigated. Wind variances observed by the very high frequency (VHF) meteor radar at King Sejong Station (KSS), Antarctica (62.22°S, 58.78°W) are used as proxies for the GW activities in the upper mesosphere. A new meteor-variance technique, which removes large-scale wind components with ground-based periods larger than 4.5 hour directly from each meteor echo, is used to calculate the wind variances induced by the small-scale GWs. Among the large-scale wind components, the magnitude of the semidiurnal tide is the largest except for January when the 2-day waves are dominant. The GW activities over an 8-year period (2007–2014) show a clear semi-annual variation with solsticial maxima and equinoctial minima. To analyze the relation between the lower atmospheric jet stream and the GW activities in the upper mesosphere, the residual of the nonlinear balance equation (RNBE) is used as a diagnostic of the jet/front GWs and compared with the GW activities in the mesosphere. The RNBE is calculated in the lower atmosphere using the ERA-Interim reanalysis dataset. The RNBE in the stratosphere significantly correlate with the GW activities in the upper mesosphere during spring and autumn. Although wintertime RNBE in the stratosphere is largest, no significant correlation between GW activities in the stratosphere and the upper mesosphere is found due to the critical-level filtering and the Doppler shifting by the strong polar night jet during winter. Sources of the observed GWs in the upper mesosphere at KSS will be investigated further by backward integration of a 3-dimensional GW ray-tracing model.