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Seasonal variability and tidal interactions of gravity waves in the Arctic and Antarctic mesosphere

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A new technique for observing gravity waves using meteor radar has been developed. The variance of the horizontal velocities of individual meteor echoes detected by the radar can be used as a proxy for gravity-wave activity. Gravity waves with periods from close to the Brunt-Vaisala period to ~ 2 hours can be detected and variances can be calculated on timescales as short as 2-hours between ~ 80 and 100 km. This technique is applied to data from two identical meteor radars based at conjugate geographical latitudes in Rothera, Antarctica (69 S) and ESRANGE, Arctic Sweden (69 N). The resulting variances are used to study polar-region gravity-wave activity. A climatological analysis reveals both annual and semi-annual components to the seasonal cycle. Significant inter-annual variability is also present. Monthly-mean profiles of variance with height show an interesting structure during summer when wave activity is limited below ~ 87 km but increases rapidly above. This is explained in terms of the height of the summer mesopause and the effect of the temperature profile on wave growth. Evidence of modulation of the gravity-wave field is also presented. Significant modulation at tidal periods (24 and 12 hours) is present at both Rothera and ESRANGE, particularly during the summer months.