Horizontal Wavelength of Gravity Waves in the Lower Atmosphere Measured by the SOUSY Svalbard Radar

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Height profiles of the vertical atmospheric motion are analyzed to obtain the vertical phase and group velocities of the atmospheric gravity wave motion by the technique of phase and group velocity tracing. Then the horizontal wave vector component along the direction of the mean wind is obtained by the gravity wave dispersion relation, and the angle $|\theta|$ between the horizontal wave vector and the mean wind velocity is obtained by the polarization relation. The data were taken during the period between March 30 and April 24 in 2000 using the SOUSY Svalbard Radar. The altitude range of measurement is between 2.4 km and 14.25 km. Most of the wave packets (about 75%) in the Range-Time-Intensity (RTI) plots of velocity show that the vertical phase and group velocities are in the opposite direction (Type 1 wave packets). The rest (about 25%) are shorter lasting wave packets showing that the vertical phase and group velocities are in the same direction (Type 2 wave packets). By horizontal wave vector analysis we have found no wave packet moving against the background wind. Statistical analysis of the angle $|\theta|$, which is the angle between the horizontal wave vector and the background wind velocity vector, reveals a trend, namely that the percentage of wave packets monotonically decreases with the angle $|\theta|$.

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I. INTRODUCTION

Very-High-Frequency Mesosphere-Stratosphere-Troposphere radars (VHF MST radars) have been intensively used for the study of atmospheric dynamics. They are particularly useful for observations of atmospheric gravity waves, which were shown in some of the early radar experiments [1–4]. Such case studies, as well as extensive statistical analyses, have proven essential for understanding the properties of these waves, such as their spectra [5] and their momentum deposition into the mean wind [6–8]. Gravity wave features were measured with radar, rocket, and satellite during the CADRE/MALTED campaign at equatorial latitudes in Peru [9, 10]. These latter radar observations were done so far in the middle and lower latitudes, but there had also been a few analyses of high polar latitude of gravity waves observed by radar [11] and detected in operational radiosonde data [12]. These observations were in the troposphere, stratosphere, and mesosphere. In this paper we investigate MST VHF radar observations of gravity waves in the troposphere and lower stratosphere at high polar latitudes which were done with the SOUSY Svalbard Radar [13].

Atmospheric gravity waves in the linear regime are characterized by a special relation

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