Error in wind measurements due to gravity wave activity in multi beam observation using VHF radar

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Atmospheric winds in the troposphere have been observed routinely for many years with MST radars using Doppler Beam Swinging (DBS) method. The best way to test for possible errors in wind estimates (when using DBS) is by doing comparisons with different techniques at the same place and time. The present study reveals that radar derived horizontal winds are underestimated due to gravity wave activity. For this study we made wind measurements using different beam combinations. The beam combinations include East, North, Zenith-Y (ENZy), West, South, Zenith-Y (WSZy), and East, West, North, South, Zenith-Y (EWNSZy). We have made comparisons of horizontal winds measured by Indian MST radar in the height range of 3.6 km to 20 km from January 2002 to December 2002 over Gadanki. Results have been obtained almost for every month of the year. From the comparisons it is concluded that in general, the 3-beam and 5-beam methods both provide reliable means for synoptic studies of neutral winds in the height range of 3.6 to 20 km. However, we do find that some parameters seem to be estimated with greater precision, in particular the measurement of zonal and meridional winds. We observed that error generated in measuring horizontal winds due to gravity waves is more when we use single oblique beam (lying in the same plane) in our computation instead of two oblique beams i.e. the error is more in measuring zonal and meridional winds by 3 beam combinations (ENZy & WSZy) than by 5 beams (EWNSZy). The former is likely to be due to atmospheric gravity wave activity. It is also observed that the error increases as height increases. The difference in zonal winds between two 3-beam combinations is maximum about 1.89 m/sec at 3.6-6 km and 3.26 m/sec at 18-20 km whereas it is about 0.93 m/sec at 3.6-6 km and 1.67 m/sec at 18-20 km between 5-beam and 3-beams. Similarly for meridional winds it is observed that the difference is maximum of about 1.83 m/sec in the height range of 3.6-6 km and 3.02 m/sec in the height range of 18-20 km for 3-beam combinations, and it is about 0.93 m/sec at 3.6-6 km and is 1.65 m/sec at 18-20 km between 5-beam & 3-beams. Thus it is seen that the error in the measurement of zonal and meridional velocities reduces substantially with 5-beam combination.