Remote Sensing Wind Profiles Using Non-Specular Meteor Trail Measurements

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The principal method of obtaining high-resolution wind velocity profiles in the Lower Thermosphere - Mesosphere (LTM) region of the atmosphere has been to track a chemical trail released by a rocket. This has been done more than 400 times in the past 60 years and represents an enormous investment of time and money. This article describes a new method: tracking non-specular meteor echoes as they are blown by the neutral wind. This method may enable researchers to dynamically track wind profiles as they change over many hours.

This new method requires a sensitive radar with interferometric capability pointing nearly perpendicular to the geomagnetic field such as the primary 50MHz antenna array at the Jicamarca Radio Observatory (JRO). Using a sample of JRO data, we show that one can measure wind speeds and directions with an altitude resolution of a few hundred meters. We have been able to measure winds from 110km down to 93km in altitude. While no single meteor trail spans that large an altitude range, one can use many meteor trails seen over a ten minute period to build a profile extending nearly 20km in altitude. The measurements show zonal winds speeds reaching to 160m/s and sometimes changing speeds by as much as 100m/s over 6km altitude. The meridional winds are much slower, as expected. We validate our results by showing that meteor trail echoes occurring within a few minute of each other yield similar wind profiles. To further establish the reliability and accuracy of this new method, comparisons to wind profiles generated by other techniques should be made.