A Numerical Model for VHF Meteor Radar Systems

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The COBRA radar is a VHF (46MHz) meteor radar system that utilizes radio reflections from meteor trails to measure the winds in the mesosphere and lower thermosphere (MLT) region. We are creating a simulation of the COBRA system, which will be used to evaluate the sensitivity of the system to specific design parameters and understand how these changes affect the wind measurements made by the radar. The model will also be used to evaluate the meteor model which has been developed using high power large aperture (HPLA) radar systems. The simulation is statistically based and calculates several parameters for meteors simulated by a meteor ionization model developed by Janches [Janches, D., C. J. Heinselman, J.L. Chau, A. Chandran and R. Woodman, Journal of Geo. Phys. Research,Vol. 111, A07317, 2006].

The simulation is based on the classic bistatic meteor radar equation [McKinley, D.W.R. McGraw-Hill, Ch-9, 1961] which includes parameters specific to the radar such as the antenna pattern, geographic location of the transmitter and receiver, operating frequency, transmitted power and receiver noise figure. The meteor model simulates the ablation process and outputs electron line density versus altitude. The location of points along the trail and the electron line density enable the calculation of the total received power from each meteor and hence the signal to noise ratio (SNR). Meteors that exceed a predefined detection threshold SNR are tallied and simulation products that include the meteor detection rate, the detected meteor azimuth and elevation, and a SNR histogram can be generated. These results can then be used to evaluate the meteor system performance while varying different system parameters.

A discussion of our meteor model and technical approach will be presented. Additionally the resulting output will be compared with observations from the COBRA system currently operating at the South Pole. This comparison will be used to validate our approach and the underlying meteor model.