Effect of Plasma Turbulence on the evolution of Specular Meteor Echoes

F. R. Galindo[1], J. V. Urbina[1], L. P. Dyrud[2] and J. Fentzke[2]

(1) Communications and Space, Sciences Laboratory, Pennsylvania State University, University Park, PA, USA

(2) OmniEarth, Inc. 2015. 251 18th Street South - Suite 650, Arlington VA 22202

Specular meteor echoes are signals back-scattered from expanding trails of ionized particles created during the passage of a meteoroid through the upper atmosphere, when a radar **k** vector points perpendicularly to the trajectory of the trail. These radar echoes are currently used to derive atmospheric parameters such as temperature, pressure, and drifts; under the assumption of non-turbulent diffusion rate. In this paper, we describe a numerical model of under-dense specular meteor echoes that includes for the first time the effect of plasma turbulence on its evolution. Our numerical method simulates both the trail at different stages and its corresponding received power. This numerical model can easily be expanded to include physical processes (e.g. differential ablation) that briefly affect the evolution of the specular meteor echo.

We present the analysis of a specular meteor echo that exhibit a double decay as a case study. Our simulations demonstrate that meteor events similar to this double decay can occur when time-scales to produce plasma turbulence in the trail is on the order of hundreds of milliseconds, or when plasma turbulence ceases rapidly. Furthermore, we report meteor simulation results in conjunction with specular meteors collected with Jicamarca All Sky Meteor Radar (JASMET). These simulations incorporate the studies of diffusion values, which are modeled by including/excluding the effect of the Earth's geomagnetic field and plasma turbulence. Upon examination of simulations and experimental data, our preliminary studies illustrate the significant effect that turbulence plays on the evolution of underdense specular meteor echoes. This result is particularly useful to infer more accurate mesospheric temperatures from trail diffusion rates and their usage for meteor scatter communication systems.