Plasma turbulence associated with the creation of an artificial dust layer in the earth’s ionosphere is investigated. The Charged Aerosol Release Experiment (CARE) aims to understand the mechanisms for enhanced radar scatter from plasma irregularities embedded in dusty plasmas in space. The plasma irregularities embedded in artificial dusty plasma in space may shed light on understanding the mechanism for enhanced radar scatter in the natural dust layers in the earth’s mesosphere (NLCs and PMSEs) and also contribute to addressing possible effects of combustion products in rocket and shuttle exhaust in the upper atmosphere as well.

A variety of plasma irregularities and instabilities can be generated in such active experiments. Computational models are described to study plasma irregularities in artificially created dusty space plasmas, which may lead to radar echoes. Possible instabilities, in the magnetized dusty plasma, are the shear-driven and streaming instability near the lower hybrid frequency generated by dust streaming perpendicular to the background geomagnetic field. The magnetic field effect on such lower hybrid instabilities are investigated by a model including the ratio of electron plasma frequency and electron gyro frequency. The dust acoustic (DA) instability and ion acoustic (IA) instabilities in unmagnetized plasmas are also investigated by a model using a Boltzmann electron assumption. Such acoustic type instabilities may be due to the dust and ion streaming along the geomagnetic field. The frequency range and wavelength in a nonlinear saturated state are also estimated for applications to active sounding rocket experiments. These computational models have the advantage of following nonlinear wave-particle effects, which may help designing future experiment.