

The DASI Zephyr project, being led by the University of Colorado Boulder, is developing a prototype meteor radar system designed to measure winds between 90 and 100km above the surface of the Earth. The project is supported under National Science Foundation grant #1933007.

Specifically, this project supported by the Geospace Facility's Distributed Arrays of Small Instruments (DASI) will utilize observations of meteors to measure the winds in the upper atmosphere. Tons of mass enters the atmosphere daily in the form of meteoroids. Observations of meteors with VHF radar can be used to infer properties of very high altitude winds in the atmosphere. Characterization of these winds is very important to understanding the dynamics of our atmosphere and how it responds to or creates space weather events, which can impact radio communications, for instance. This project is to develop and deploy a novel new technology for detecting meteors using a system of multiple antennas and multiple receivers. Typically, a transmit - receive system consists of a single transmitter and a single or multiple receivers. The novel innovation here is the ability to deploy low cost antenna. The data from the multiple in - multiple out (MIMO) system will measure 3D data in the very complex region of the atmosphere. This team is led by an early career scientist and includes mentoring for graduate and undergraduate students who will participate in outreach for deployment sites and participation in research.

Winds in the upper atmosphere, at the edge of space, are hard to measure routinely because in situ observations are limited to rocket flights (too high for aircraft and too low for stable satellites) and current remote sensing techniques only provide sparse, local estimates. Models for predicting the dynamics of the upper atmosphere often do not agree with each other or with actual observations because there are not enough measurements to inform and constrain model development. Just as investment in observational infrastructure has dramatically improved the prediction capabilities of lower atmospheric weather models, so too could the development and deployment of a continental-scale meteor radar network dramatically improve modeling and physics-based understanding of the upper atmosphere. The work will take the first step in developing such a large scale network by addressing the outstanding technical challenges which include system miniaturization, autonomous operation, low power draw, and cost-effective scaling for production. Testing and deployment will take place near the Rocky Mountains with a network consisting of three transmit array sites, one receive array site, and ten single-receiver sites providing observational coverage in a region spanning ~90,000 square kilometers. The work will encompass: hardware engineering, to optimize system design and produce a remote-deployable integrated receiver unit; software engineering, to create open source tools for radar operations, meteor detection and processing, and wind field estimation; and scientific analysis, to study the upper atmosphere in the Rocky Mountain region and measure the lower thermospheric wind field from a new mesoscale perspective.