Air travelers, astronomers stand to benefit from research on atmospheric turbulence

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Anyone who frequently travels by airplane has likely experienced clear-air turbulence. It's the kind of jarring turbulence that can quickly turn a smooth flight into a bumpy ride, often causing aircraft to drop anywhere from a few feet to thousands of feet within seconds.

A recently awarded $716,000 grant from the U.S. Air Force Office of Scientific Research will fund research by ASU professor Alex Mahalov aimed at reducing those anxious moments for air travelers.

Mahalov also will study another kind of atmospheric turbulence that poses problems for astronomers.

Optical turbulence results from the amplitude and phase fluctuations in electromagnetic waves propagating through the atmosphere, which is what causes stars to appear to "twinkle." It also is a major source of telescope image degradation, making it difficult for astronomers to get clear views into space.

Mahalov is a professor in the Department of Mathematics and Statistics in ASU's College of Liberal Arts and Science, with a joint appointment in the Department of Mechanical and Aerospace Engineering in the university's Ira A. Fulton School of Engineering.

Working in the engineering school's Center for Environmental Fluid Dynamics, Mahalov will use funding from the grant over a three-year period to improve techniques for identifying, forecasting and detecting

areas of clear-air turbulence and modeling of optical turbulence under extreme environmental conditions.

He will collaborate with experts at the National Center for Atmospheric Research in Boulder, Colo., on improving the ability of numerical codes to forecast clear-air turbulence, particularly in areas of mountainous terrain.

"Improved real-time predictability and forecasting of high-impact, clear-air turbulence events will minimize the potential for costly devastation to human life and loss of business assets," Mahalov says.

He also will work with astronomers at the observatories at Mauna Kea in Hawaii on using adaptive optics to reduce telescope image degradation caused by atmospheric optical turbulence.

Mahalov works with ASU's high-performance computing group on creating real-time, high-resolution environmental forecasts. When researchers study multi-scale dynamics over a relatively limited geographic area, he explains, they need to use high-resolution models to produce accurate predictions.

Mahalov will use the facilities of the engineering school's High Performance Computing Initiative to address complex research problems, from identifying the optical effects of the jet stream above astronomical observatories to understanding the effects of environmental transport on global and regional scales. Environmental transport involves the movement of chemical and particulate matter – such as ozone and other pollutants – as they are released into the atmosphere.

Mahalov has had almost 100 peer-reviewed research articles published. In 2004 he received a High Performance Computing Challenge grant from the Department of Defense High Performance Computing

Modernization Program. The project funded by the grant was the subject of a featured presentation at the annual conference of the International Society for Optical Engineering in San Jose, Calif., in January 2008.

Mahalov often collaborates with top scholars in his field from around the world, including those with the European Center for Medium Range Weather Forecasting in Reading, England and the Laboratoire de Meteorologie Dynamique at the University of Paris.

Source: Arizona State University