Title: NASA Center for Advanced Measurements in Extreme Environments
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Summary: NASA routinely pushes the boundaries of current measurement and modelling technology, often conducting research in harsh or extreme environments, and even in the challenging conditions produced when travelling at hypersonic speeds. Climate change has already increased extreme environmental conditions—such as polar warming, and sea ice reduction—and the likelihood and severity of extreme weather events—like hurricanes, floods, and severe weather. It is imperative that appropriate measurement technologies be developed for these challenging settings to understand the physical nature of these extreme environments, and to improve our ability to predict their behavior through simulations. These advanced measurement techniques may also lead to breakthroughs in data acquisition for the similarly extreme environments experienced by extra-terrestrial surfaces during atmospheric entry. By leveraging recent advances in measurement technology, it is possible to develop novel diagnostic techniques that will drive discovery and improve our ability to operate in extreme environments across a wide range of measurement scales. These measurements will in turn provide a rich source of validation data for the development of physics-based numerical models enabling a robust predictive modeling and simulation capability.

The overall goal of this proposed Center is to develop a diverse workforce in earth system sciences, remote sensing technologies, computational fluid dynamics, and experimental fluid mechanics in support of NASA's Science, Aeronautics, and Space Technology Mission Directorates. This Center is a partnership of two minority serving institutions (MSI) (UTSA and the Alamo Colleges at San Antonio), two non-MSI universities (the University of Colorado Boulder and University of California Los Angeles), three NASA centers (GSFC, JPL, and LaRC), and additional partners. This multi-institutional partnership will provide the breadth of resources necessary to enable multidisciplinary education and research, combining the unique strengths of each partner into a Center that will vastly exceed the sum of the individual contributions. The proposed educational program extends from K-12 through postdoctoral training and will include recruitment, mentoring, course development, and research training. The five educational goals are: (i) form highly-skilled diverse professionals in STEM disciplines that support NASA's mission; (ii) develop an integrated education and research program in measurements, modelling, and data fusion supporting NASA's future workforce needs; (iii) increase the interest of underrepresented minority (URM) undergraduate students in graduate STEM education; (iv) implement a K-12 teacher workshop and outreach program with the purpose of inspiring URM students in pursuing STEM careers, and (v) increase the research capacity at UTSA in areas related to NASA research priorities.

The Center will promote collaborative, multidisciplinary research incorporating the development of measurement and modelling and data-fusion technologies for extreme environments. The five research focus areas are: (F1) Polar Sea Ice and Sea Level Rise, (F2) Gulf of Mexico and Polar Oceans, (F3) Atmospheric Science and Extreme Events, (F4) Aerodynamics, and (F5) Modeling, Simulation, and Big Data. The four research goals are: (i) characterize changes in polar sea ice and ice sheets, especially areas undergoing rapid change; (ii) improve our understanding of extreme atmospheric and oceanic processes with data-driven models using improved measurement techniques; (iii) develop new data assimilation and modeling methods and algorithms to combine multisensory measurements for resolving turbulent fluxes across a variety of surfaces (atmosphere-ocean; ice-ocean; atmosphere-ice) and flow scale regimes; and (iv) execute a synergistic experimental and computational effort to develop improved turbulence models with applicability over a range of flow scale regimes.