September 14, 2015

LAOF Request Coordinator/LAOF Program Manager
NCAR and National Science Foundation

Dear Dr. Baeuerle and Dr. Avallone,

This is a letter of intent for a Lower Atmosphere Observing Facilities request that is anticipated to fall in the “small project” category. The requested details are outlined below:

**Project name:** Microphysical Response to Mixing Experiment (MICRO-MIX)

**PI:** Raymond A. Shaw (Michigan Technological University); Jorgen Jensen and Jeff Stith from NCAR are strongly interested and will be requested as mission/flight scientists.

**Summary of the scientific goals of the project:** Optical properties and precipitation efficiency of atmospheric clouds are largely determined by turbulent mixing with their environment. When cloud liquid water is reduced upon mixing, droplets may evaporate uniformly across the population (homogeneous mixing), or in the other extreme, a subset of droplets may evaporate completely leaving the remaining drops unaffected (inhomogeneous mixing). The type of mixing has important implications for the development of the few, large cloud drops required to initiate the collision-coalescence process. We propose to investigate both the entrainment of environmental air into small cumulus clouds and the microphysical response to that entrainment. The focus will be on warm clouds, in which ice processes are not active, and precipitation development is governed by collision and coalescence of cloud droplets. The project will benefit from several new observational capabilities: cloud radar and lidar for remote characterization of overall cloud structure and entrainment rate, and the Holographic Detector for Clouds (HOLODEC), which can visualize the spatial structure and droplet size distribution at the smallest turbulent scales. This allows the microphysical response to entrainment and mixing with clear air to be observed at scales relevant to the collision-coalescence process. First measurements from HOLODEC show that turbulent clouds sampled in strongly continental regions
are inhomogeneous, with sharp transitions between cloud and clear air properties persisting to dissipative scales (< 1 cm). The local droplet size distribution is observed to fluctuate strongly in number density but with a nearly unchanging mean droplet diameter. This project will be aimed at sampling warm cumulus clouds in environments ranging from strongly maritime to continental, where air external to the cloud ranges from very humid (small thermodynamic contrast) to very dry (large thermodynamic contrast), in order to investigate the microphysical response across this range of conditions.

**Project location:** Gulf Coast (access to both maritime and continental small cumulus clouds with active warm rain process); Exact location to be determined, but New Orleans to the panhandle of Florida are suggested as ideal, allowing access to maritime clouds over Florida and the Gulf of Mexico, as well as continental clouds with drier environments in the Oklahoma to Tennessee region, and conditions in between.

**Start and end dates of the field project:** 3 weeks within June-August 2017 (summer convection with warm-rain conditions)

**Facilities to be requested:** NCAR GV, HCR, HSRL (C130 with WCL and WCR as possible substitute); state variables (high rate temperature and vapor, MTP) and microphysical/hydrometeor properties (King, PVM, CDP, 2DC, HOLODEC)

**Number of proposals:** 1

**Expected involvement of other funding agencies:** None

**Name of NSF Program Officer:** TBD (Dr. Chungu Lu is the Program Officer for the current NSF project supporting holographic studies of cloud processes)

I will look forward to receiving feedback after your evaluation. If further information or clarification is required, my email address is rashaw@mtu.edu and my office phone number is 906-487-1961.

Sincerely,

Raymond A. Shaw
Professor of Physics
Director, Atmospheric Sciences Program