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Award Abstract # 2019947

Collaborative Research: Experiment of Sea Breeze Convection, Aerosols, Precipitation and Environment (ESCAPE)

NSF Org:	AGS Div Atmospheric & Geospace Sciences
Awardee:	COLORADO STATE UNIVERSITY
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Program Manager:	Nicholas Anderson nanderso@nsf.gov (703)292-4715 AGS Div Atmospheric & Geospace Sciences GEO Directorate For Geosciences
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History of Investigator:	Susan van den Heever (Principal Investigator) sue@atmos.colostate.edu
Awardee Sponsored Research Office:	Colorado State University 601 S HOWES ST FORT COLLINS CO US 80521-2807 (970)491-6355
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ABSTRACT

This award provides funding for an observational field experiment in the Houston, Texas area to study clouds and precipitation, and their dependence on environmental factors including small particulates known as aerosols. The Houston region represents a unique region of study, where isolated clouds and thunderstorms are common, there is a sea breeze due to the nearby Gulf of Mexico, and there are specific sources of aerosol due to urban and industrial emissions. The research team will deploy research aircraft, ground based radars, and a variety of other sensors to characterize the environment in and around growing clouds. The data will be analyzed and incorporated into numerical models to answer questions about the role of temperature, moisture, winds, and aerosols in the formation and development of clouds and precipitation. This research will help to improve high-resolution simulations of extreme or high-impact events in highly populated coastal regions. The research will also have wide relevance to climate models, where aerosol/cloud interactions are difficult to simulate. Early career researchers and students will gain experience in conducting observational research. Outreach activities will also provide opportunities for enhanced public awareness of thunderstorm and flooding hazards.

The Experiment of Sea Breeze Convection, Aerosols, Precipitation and Environment (ESCAPE) is planned for June and July 2021 in the Houston metropolitan area. ESCAPE will provide measurements that will be used symbiotically with high-resolution models to improve simulations of the lifecycle of isolated convective cells, including the effects of interactive aerosol, microphysical, and kinematic processes on observable cloud, precipitation, and electrification signatures. The research team plans to methodically advance observation-based understanding of fundamental convective cloud processes and aerosol impacts on these processes by deploying a host of instruments in a targeted geographic region. The main airborne platform would be the NSF/National Center for Atmospheric Research (NCAR) C-130 research aircraft with a wide range of cloud microphysical measurements. On the ground, the PIs would coordinate multiple radars, radiosondes, swarmsondes, and the Houston Lightning Mapping Array. The campaign will coordinate with the Department of Energy deployment of the Atmospheric Radiation Measurement mobile facility and make use of existing measurements of air quality in the Houston area. The observational data would be combined with modeling using WRF and RAMS to address the following science objectives: 1) Investigate the control of meteorology, dynamics, and mixing on aerosol indirect effects on the early growth stage of convective clouds, 2) Characterize the environment and physical processes leading to coastal convective initiation, 3) Determine how mature convective updraft microphysical and kinematic properties relate to those earlier in the cloud lifecycle, its initiation mechanism, and heterogeneities of its parent environment, 4) Quantify environmental thermodynamic and kinematic controls on convective lifecycle properties under different aerosol conditions, 5) Quantify how: a) cold pool properties and lifetimes vary as a function of precipitation amounts and precipitation size distributions, and how are these relationships modulated by the relative humidity, b) what is the impact of aerosol number concentration on cold pool depth and intensity, and c) how do different land-surface types determine the dissipation of cold pools, 6) Characterize how the lightning flash size and energy depends on the modification of the supercooled liquid water content, scale and volume of the mixed-phase updraft, and hydrometeor populations.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

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Marinescu, Peter J. and Kennedy, Patrick C. and Bell, Michael M. and Drager, Aryeh J. and Grant, Leah D. and Freeman, Sean W. and van den Heever, Susan C. "Updraft Vertical Velocity Observations and Uncertainties in High Plains Supercells Using Radiosondes and Radars" *Monthly Weather Review* , v.148 , 2020 https://doi.org/10.1175/MWR-D-20-0071.1 Citation Details

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