

# Storm Penetrating Aircraft: A National Facility

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## Overview

This white paper is being submitted in response to “**Theme 2:** Opportunities lost due to the lack of enabling technologies or resources”. A storm-penetrating aircraft is critical atmospheric research infrastructure needed to better understand extreme weather when the world is facing possible changes in severe weather character, frequency, and geographic patterns due to climate change. The storm-penetrating aircraft is a vital scientific tool to advance our knowledge of the physical, chemical, and electrical processes associated with convective storms.

## Science Drivers

A storm-penetrating manned aircraft is the only reliable way to obtain in situ measurements of thunderstorm turbulence, 3-dimensional wind fields, hail/graupel characteristics, complete hydrometeor size distributions, aerosol concentrations and their physical and chemical characteristics, trace gases, and storm electrification and lightning. Along with storm core measurements, the inflow and outflow regions are sampled to observe thermodynamic properties using inlets suitable for removing cloud particles, allowing the budgets of water vapor, aerosols, or trace gases to be closed. In addition to being used to directly address key research problems such measurements also provide calibration information for remote sensing platforms (e.g. surface-based and satellite-based radars, lidars, and spectrometers).

The coupling of the dynamic/microphysics of storms to the environment and storm's lifecycle is very important for understanding the storm's life cycle. The “holy grail” for storm convection is the physics of processes in the storm core, which cannot be sampled adequately without a storm-penetrating aircraft to provide in-situ observations.

To summarize, the scientific motivations for this platform are:

- Measurements in strong convection will provide calibration information for remote sensing platforms (e.g., ground-based dual-polarization radars and satellite-based retrievals to improve precipitation estimates)

- A storm penetrating aircraft will significantly advance our knowledge by obtaining measurements in storm cores of strong convection.
- Storm inflow and outflow regions need to be sampled by the same aircraft, allowing the budget of water vapor, aerosols, or trace gases to be closed.
- The Aerosol and Cloud, Convection and Precipitation (ACCP) Decadal Survey observing system team is currently examining sub-orbital facilities that augment satellite orbital science. One of their science objectives is the coupling of the dynamics/microphysics of storms to the environment and storm's lifecycle.

### **Multi-Organizational Team Structure**

A storm-penetrating aircraft will be a highly specialized research platform and it will be expensive to set up and maintain. The research projects in which it would be used by an agency might be less frequent than for a more general purpose aircraft. Therefore, it would make sense for multiple agencies involved in atmospheric research such as NSF, NASA, NOAA, and DOE, to share in its use and support. The aircraft could be operated by the research aviation component of one of these agencies on behalf of all agencies, or perhaps an independent contractor could operate it on behalf of all agencies as part of a consortium involving University partners.