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The INCUS Mission

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The INvestigation of Convective UpdraftS (INCUS) is a recently selected NASA Earth Ventures Mission. The overarching goal of INCUS is to enhance our understanding of why, when and where tropical convective storms form, and why only some storms produce extreme weather. Life on Earth is bound to convective storms, from the fresh water they supply to the extreme weather they produce. Much of the vertical transport of water and air between Earth's surface and the upper troposphere is facilitated by convective storms. This vertical transport of water and air, referred to as convective mass flux (CMF), plays a critical role in the weather and climate system through its influence on storm intensity, precipitation rates, upper tropospheric moistening, high cloud feedbacks, and the large-scale circulation. Recent studies have also suggested that CMF may change with changing climates. In spite of the critical role of this vertical transport of water and air within the weather and climate system, much is not understood regarding the way in which various environmental factors govern this mass transport, nor the subsequent impacts of CMF on high clouds and extreme weather. Representation of CMF is also a major source of error in weather and climate models, thereby limiting our ability to predict convective storms and their associated feedbacks on weather through climate timescales.

INCUS is a NASA class-D mission. Three RainCube-heritage Ka-band 5-beam scanning radars that are compatible with SmallSat platforms comprise the mission. The satellite platforms will be 30 and 90 seconds apart. Each SmallSat will carry one radar system each, and the middle SmallSat will house a single TEMPEST-D-heritage cross-track-scanning passive microwave radiometer with four channels between 150 and 190 GHz. Through its novel measurements of time-differenced profiles of radar reflectivity, INCUS is the first systematic investigation of the rapidly evolving CMF within

tropical convective storms. The primary INCUS objectives are: (1) to determine the predominant environmental properties controlling CMF in tropical convective storms; (2) to determine the relationship between CMF and high anvil clouds; (3) to determine the relationship between CMF and the type and intensity of the extreme weather produced; and (4) to evaluate these relationships between CMF and environmental factors, high anvil clouds, and extreme weather within weather and climate models. The ground breaking observations of convective storms by INCUS are expected to significantly enhance our understanding and prediction of convective processes and extreme weather in current and future climates.

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