



# Investigation of Convective Updrafts

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### **INCUS GOAL**

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To understand why, when and where tropical convective storms form, and why only some storms produce extreme weather.

INCUS will provide the first ever tropics-wide observations of CMF

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Convective Mass Flux (CMF) = the vertical transport of air and water

## **Convective Mass Flux – Storm Scales**







#### Aerosols











# **INCUS Science Objectives**



### Objective 1: ENV $\rightarrow$ CMF

Determine the predominant environmental properties controlling CMF in tropical convective storms

### Objective 2: CMF $\rightarrow$ High Clouds

Determine the relationship between CMF and high anvil clouds

Objective 3: CMF  $\rightarrow$  Current and Future Weather

Assess the relationship between CMF and type and intens the weather produced

### **Objective 4: CMF in Models**

Evaluate these CMF observationally determined relationships in weather and climate models.









# Unique Time Differencing ( $\Delta t$ ) Approach





#### W of 15 m/s corresponds to ~1km/min

Rapidly sampling the cloud state in time provides information on the storm motion and hence CMF

Exploratorium.edu





van den Heever INCUS Kickoff Meeting 26 April 2022





### Does it work?



20

15

10

5

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-5

-10

-15

-20

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Dolan et al., 2023





# **INCUS Made Possible by Miniaturization**



**JPDRAFTS** CONVECTIVE ЦO **INVESTIGATION** 



radiometer







### **RainCube and TEMPEST-D implemented** as tech demos by NASA's ESTO

March 2018 | Volume 106 | Number 3 Proceedings of IEEE

SPECIAL ISSUE

**Small Satellites** 

Point of View: How Is the Networked Society Impacting Us? Scanning Our Past: Who Invented the Earliest Capacitor Bank ("Battery" of Leyden Jars)? It's Complicated

### **Deployable Antenna**





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## **INCUS Baseline Mission**

∆t=30secs

Blue Canyon Technologies X-SAT Venus commercial bus

> JPL cross-track scanning microwave radiometer (middle spacecraft only) (TEMPEST-D heritage; 165, 174, 178 and 181 ± 0.5 GHz)

JPL Ka-band radar with 5 beams (RainCube heritage)

- Applies a novel timedifferencing ( $\Delta t = 30, 90$ and 120 sec) approach
- Rapidly sample the same storm systems to provide evolution of CMF
- Radiometer provides high cloud and contextual information
- Duration: 2 years
- ~330,000 convective cores at 39°

Tendeg deployable Ka-band antenna

∆t=90secs

-light Direction

Colorado State University



Jet Propulsion Laboratory California Institute of Technology Inclination: 22.5 to 39°
Launch:~ August 2026

∆t=120secs