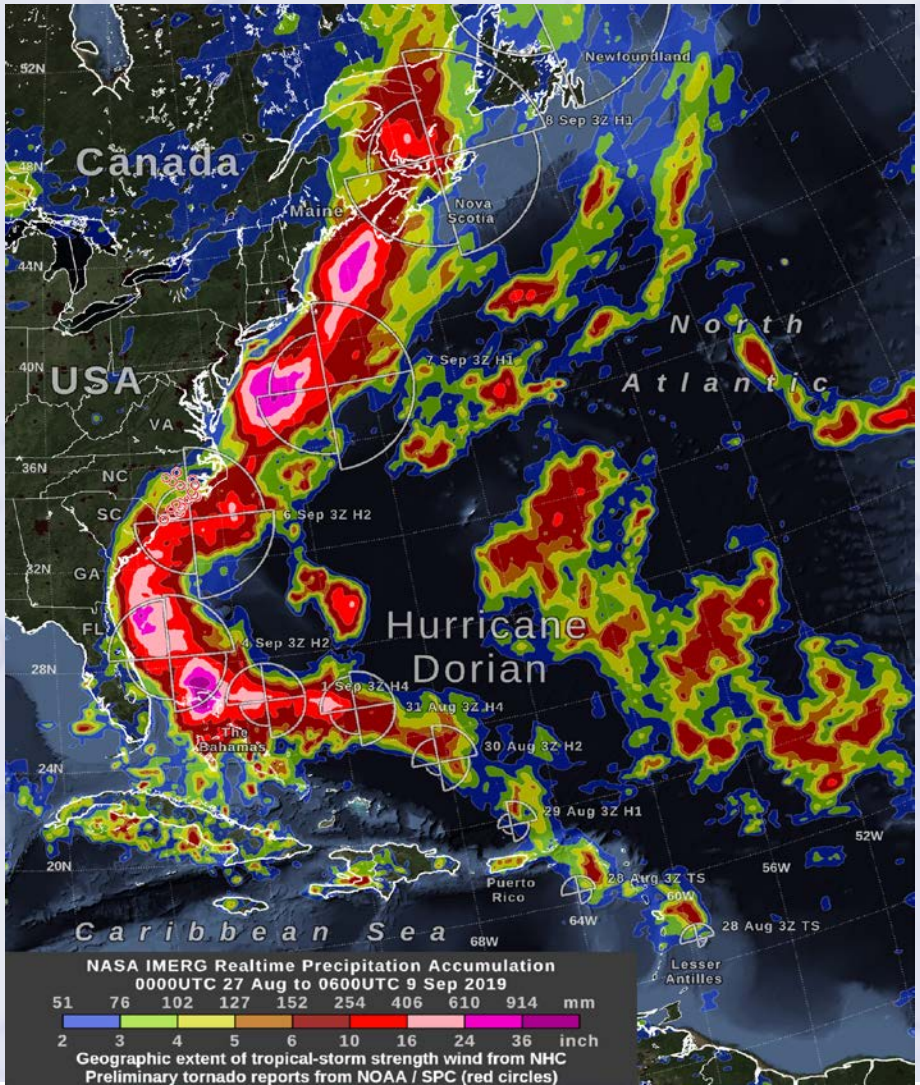
Status of Current and Future NASA Precipitation-Related Missions



Scott Braun
GPM/TROPICS Project Scientist
ACCP Science & Applications Leadership Team

NASA Goddard Space Flight Center

Joint PI Meeting of JAXA Earth Observation Missions
January 22, 2019

Presentation Outline

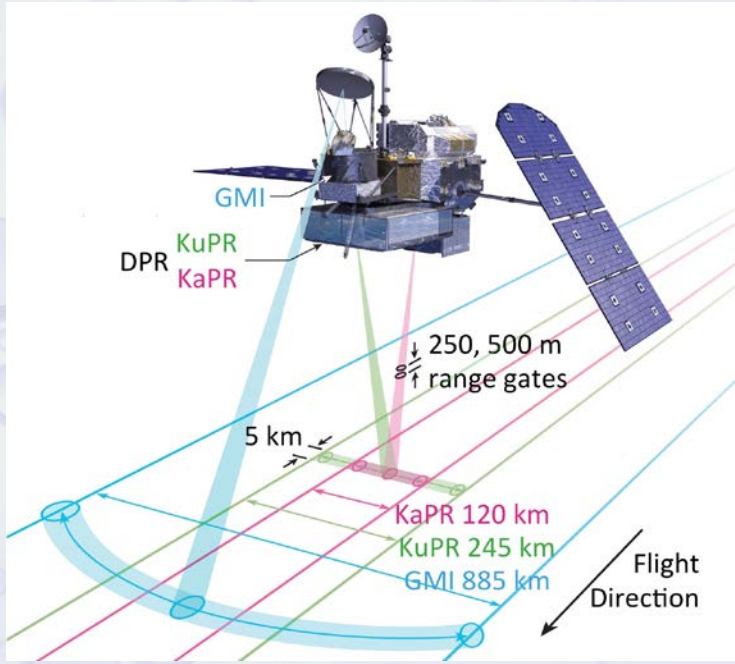
Status of precipitation missions including

- GPM
- TROPICS
- RainCube/TEMPEST-D
- IMPACTS
- Aerosols, Clouds, Convection, and Precipitation (ACCP) Decadal Survey Observing System study

The GPM Core Observatory

GPM Core Observatory:

- Launched: Feb. 27, 2014
- 6 years of operations, with fuel to last to ~2033
- All systems operating nominally



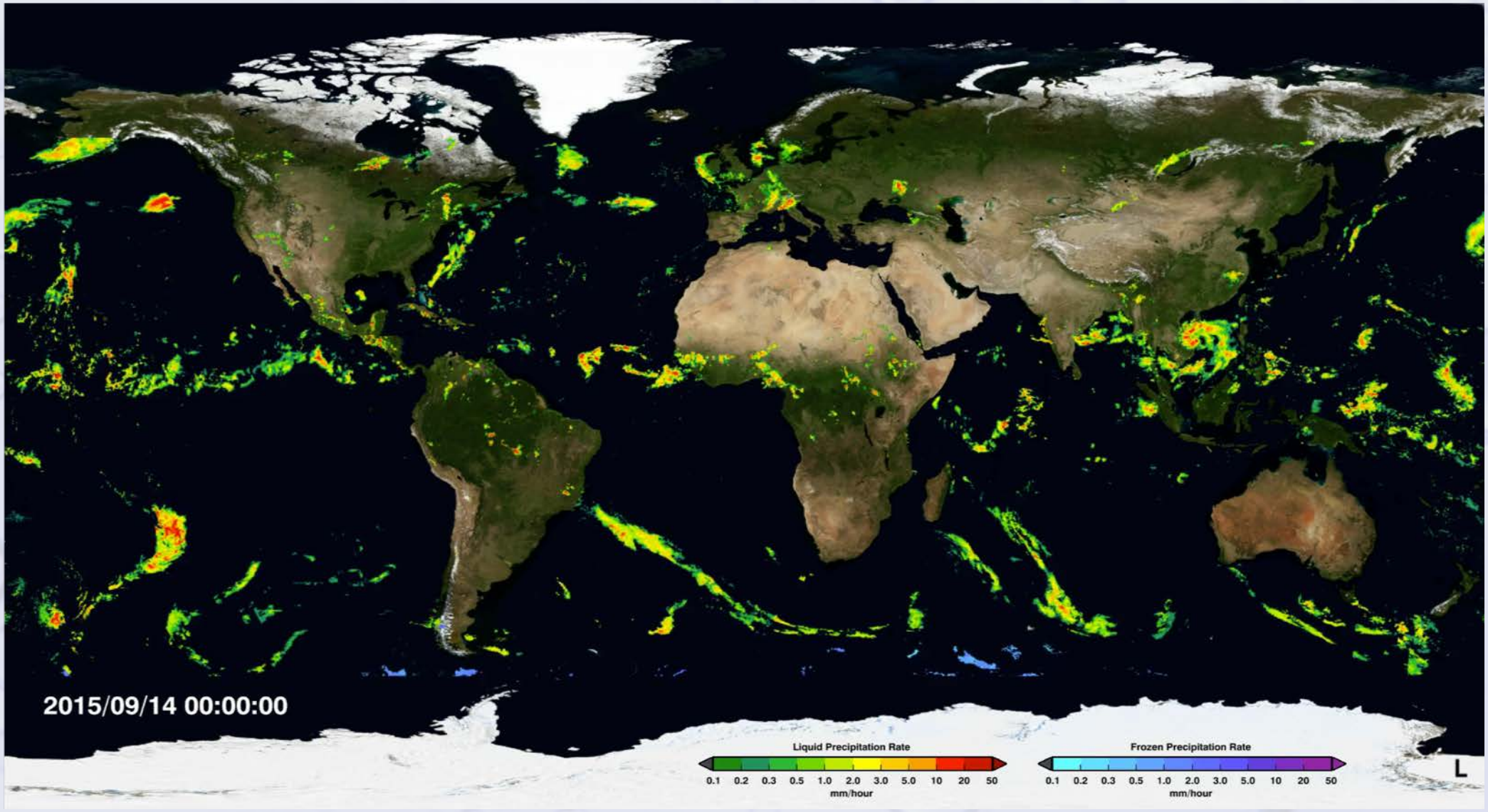
GPM Microwave Imager (GMI) 13 Channels, (Provided by NASA)

- Passive radiometer with excellent calibration
- 10VH, 19VH, 23, 36VH, 89VH, 166VH, 183±3, ±7
- Provides measurements of precipitation (rain and snow) intensity and distribution over 885 km swath
- High spatial resolution (down to ~5km footprints)

Dual-frequency Precipitation Radar (DPR), (Provided by JAXA)

- KuPR similar to TRMM, KaPR added for GPM
- Provides 3D measurements of precipitation structure, precipitation particle size distribution
- High spatial resolution (5km horiz.; 250m vertical)

IMERG Spans TRMM and GPM Eras



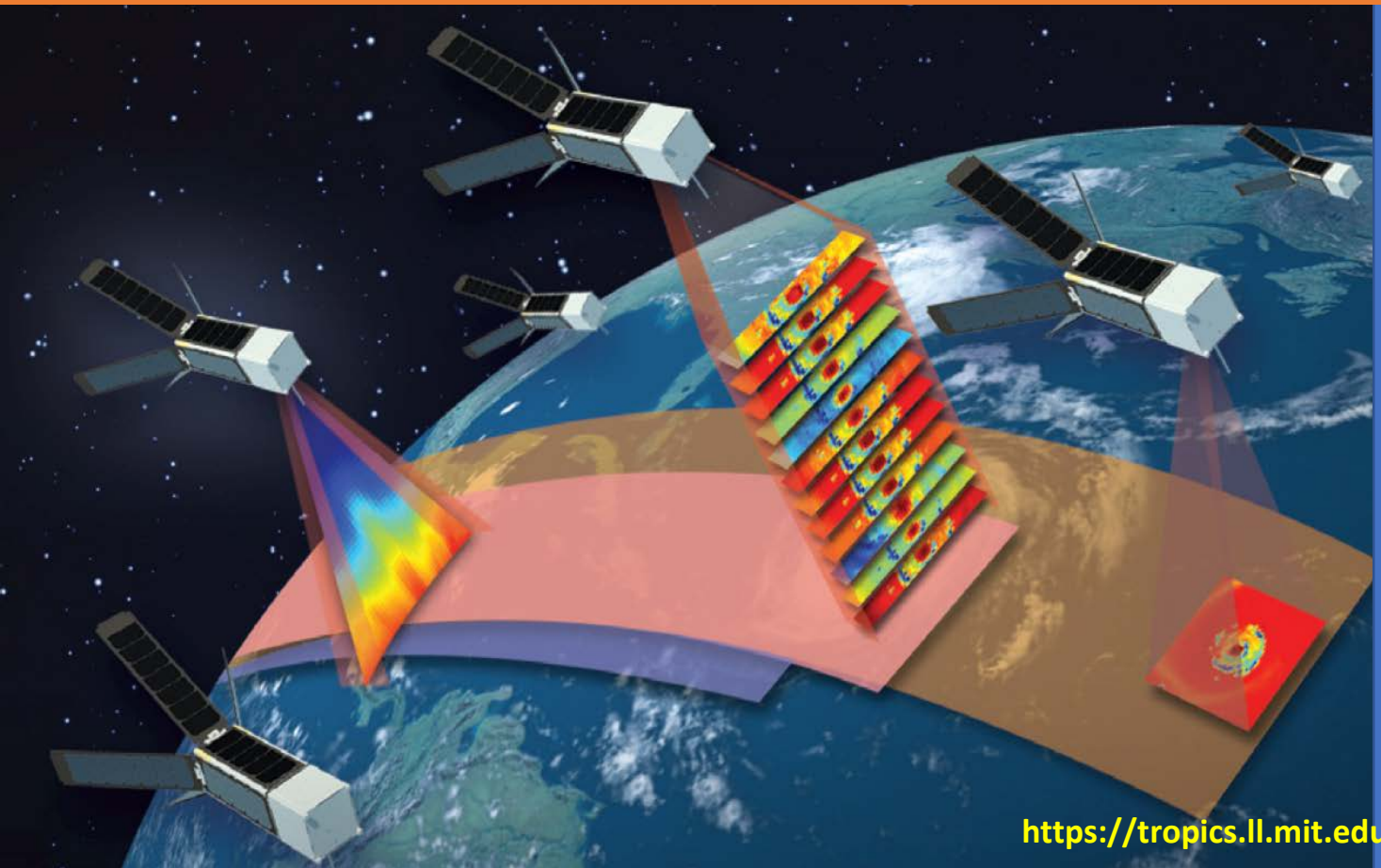
Time-Resolved Observations of Precipitation structure and storm Intensity with a Constellation of Smallsats

MIT Lincoln Laboratory (proposing organization)

William J. Blackwell, Principal Investigator, Scott Braun (NASA GSFC), Project Scientist

Science Team Members:

Ralph Bennartz, Vanderbilt U.; Chris Velden, U. Wisc.; Robert Rogers, Robert Atlas, Frank Marks, Jason Dunion, NOAA/HRD; Mark DeMaria, NOAA/NHC;



https://tropics.ll.mit.edu

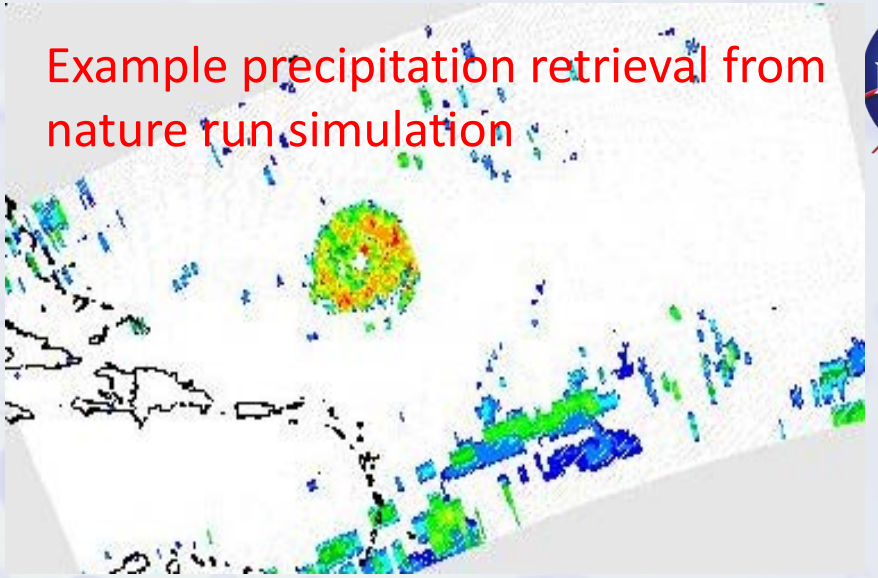
Science Objectives

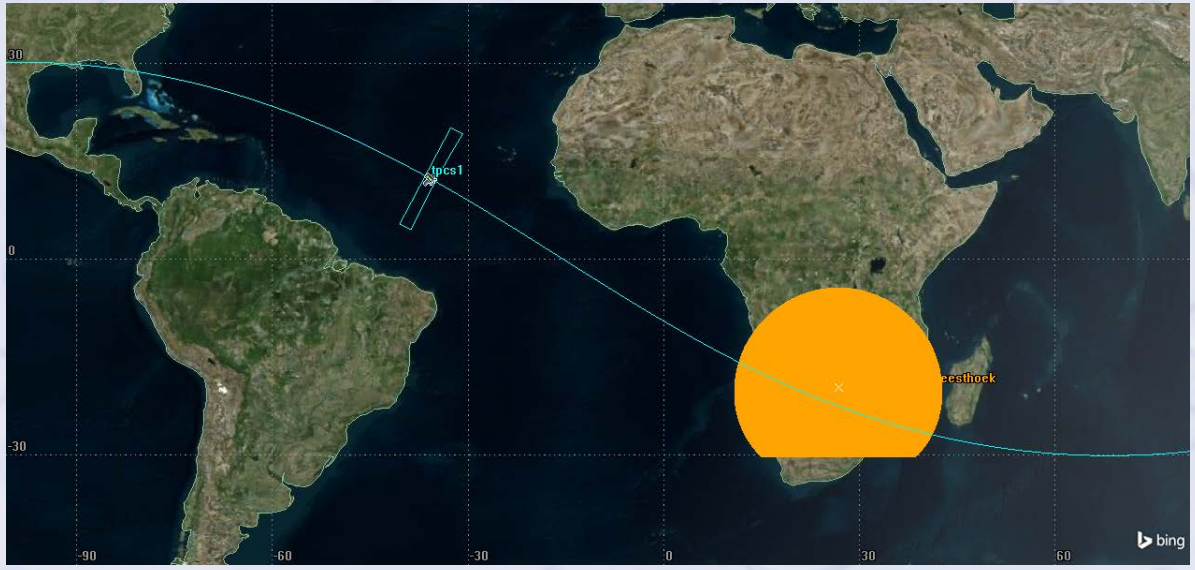
- Precipitation, warm core, and intensity co-evolution
- Role of convective bursts
- Impacts of dry air
- Impact on numerical/statistical models

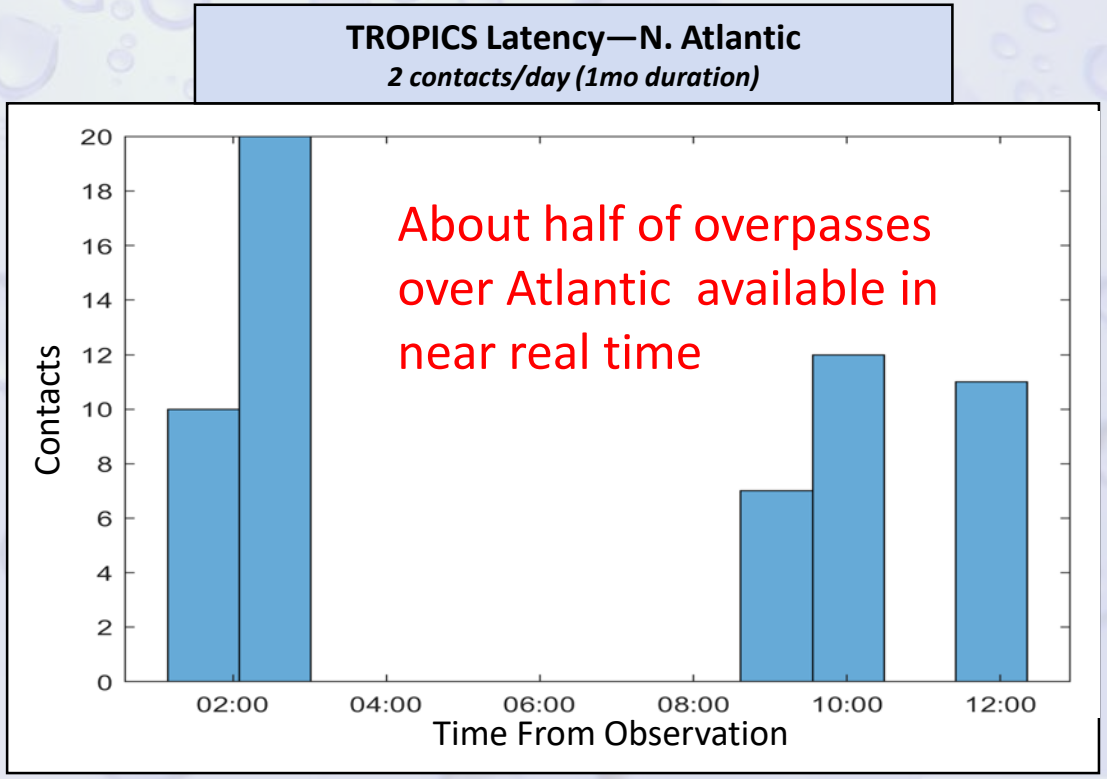
TROPICS Products

Data Products:

- Calibrated brightness temperatures
- Retrieved temperature/humidity profiles
- Precipitation rate/scattering index
- Storm intensity estimates

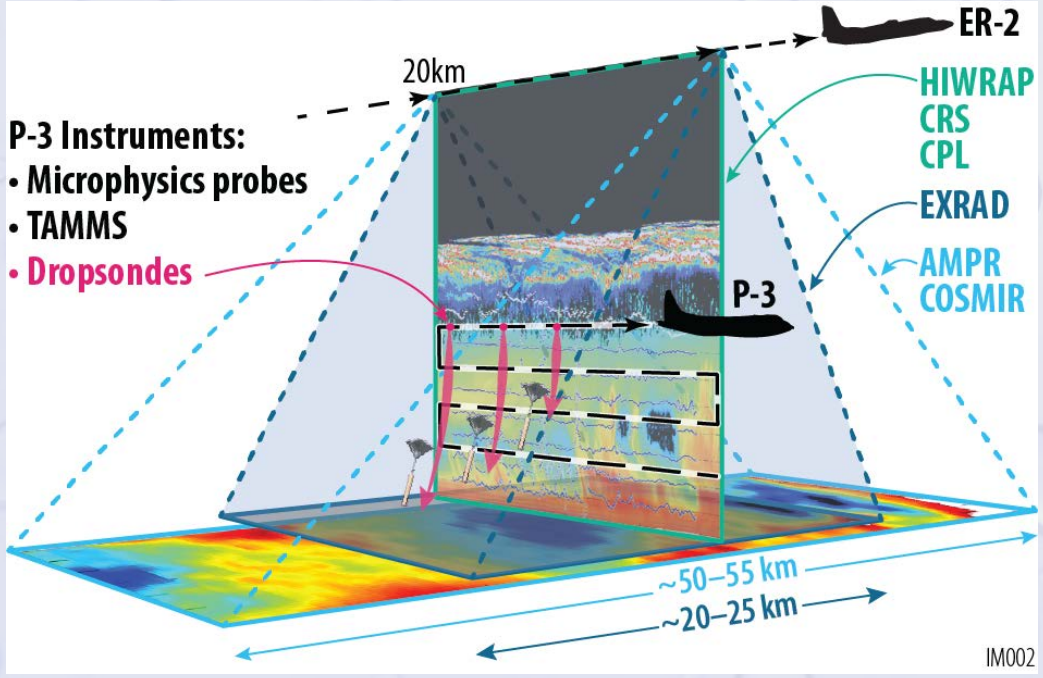


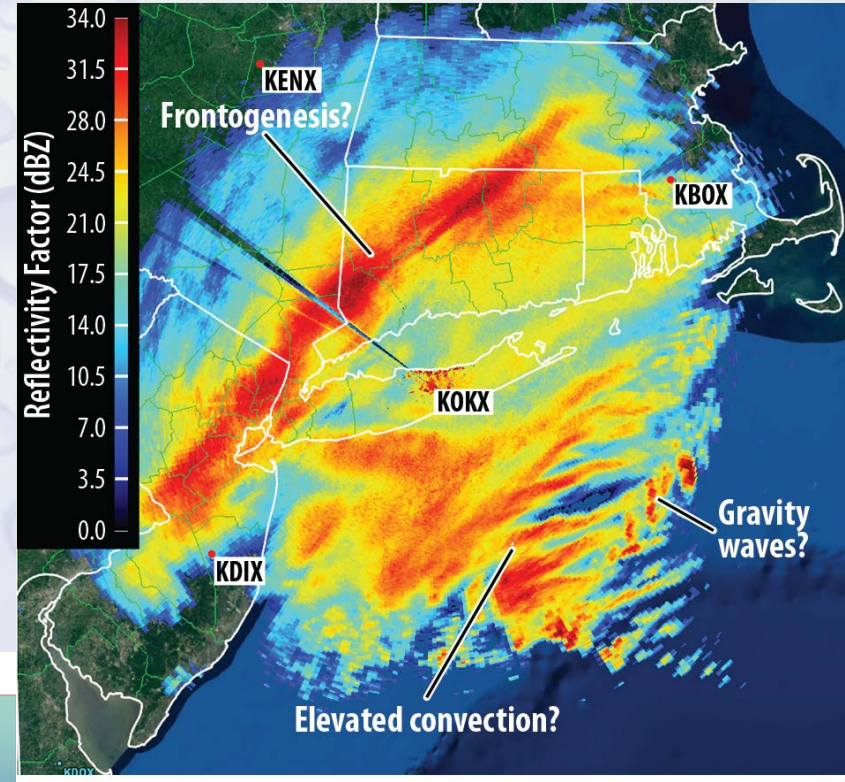




Investigation of Microphysics and Precipitation for Atlantic Coast-Threatening Snowstorms (IMPACTS)

- PI Lynn McMurdie, University of Washington
- GSFC leadership: G. Heymsfield, J. Yorks, S. Braun





IMPACTS Objectives

1. **CHARACTERIZE** the spatial and temporal scales and structures of snow bands in Northeast US winter storms
2. **UNDERSTAND** the dynamical and microphysical processes that produce the observed structures
3. **APPLY** this understanding of the structures and underlying processes to improve remote sensing and modeling of snow

IM055

Thriving on Our Changing Planet

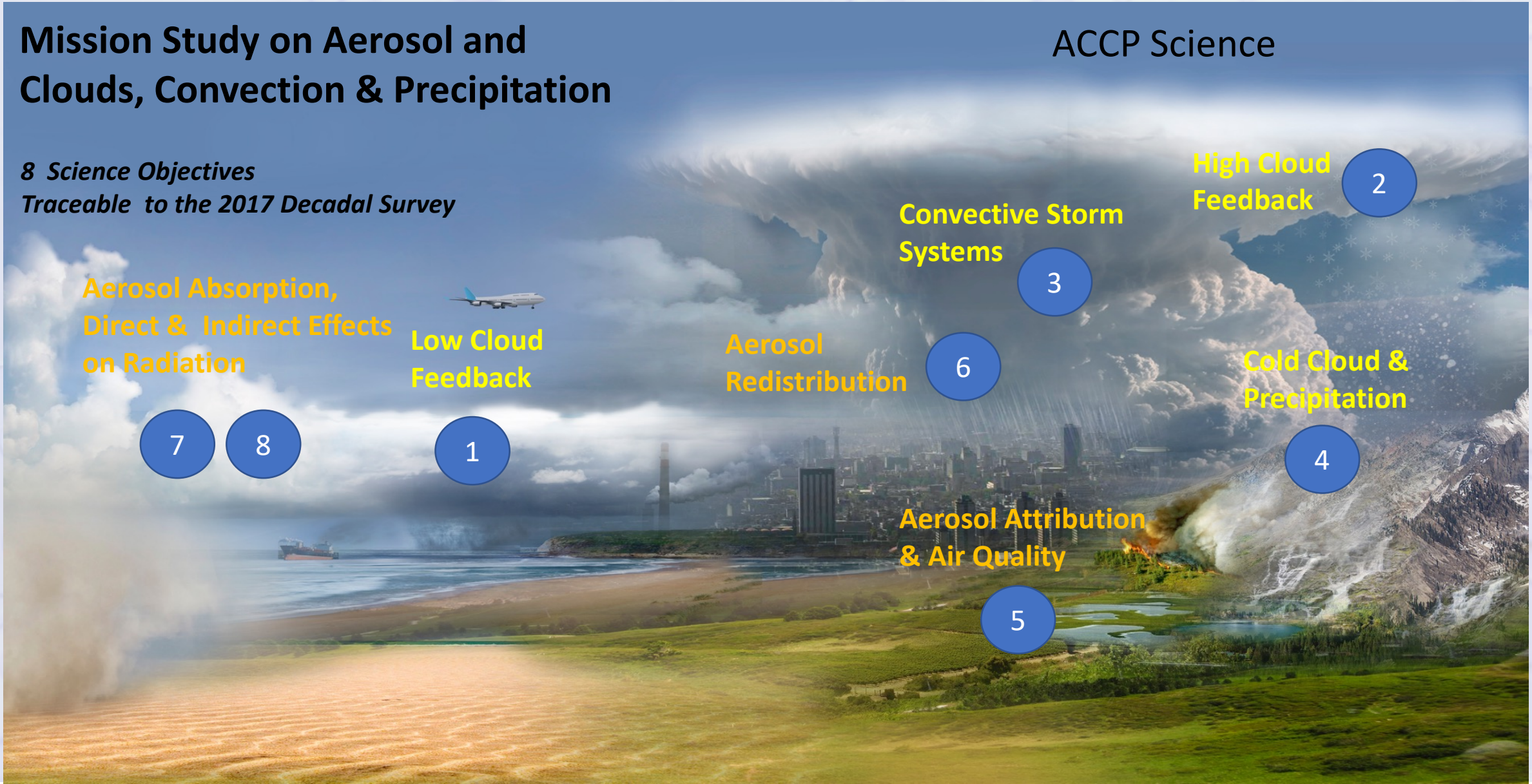
A Decadal Strategy for Earth Observation from Space

	Aerosols	Clouds, Convection, and Precipitation
Observable Priorities	Aerosol properties, aerosol vertical profiles, and cloud properties to understand their effects on climate and air quality	Coupled cloud-precipitation state and dynamics for monitoring global hydrological cycle and understanding contributing processes including cloud feedback
Desired Observables	Backscatter lidar and multichannel, multi-angle/polarization imaging radiometer	Radar(s), with multi-frequency passive microwave and sub-mm radiometer

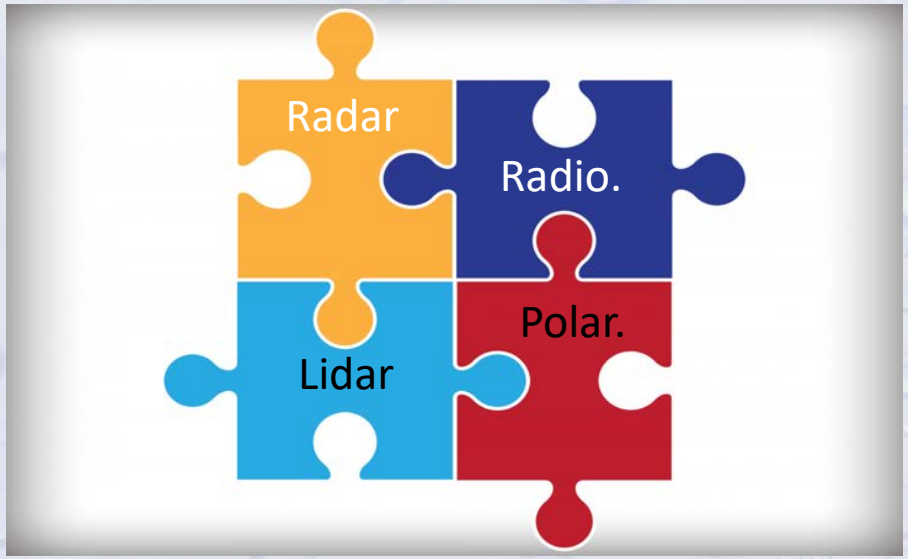
#EarthDecadal

The National Academies of SCIENCES ENGINEERING MEDICINE

ACCP Science Objectives



ACCP Architecture Studies



Architecture Components:

- Instruments
- Spacecraft buses
- Ground systems
- Launch vehicles
- Mission operations
- Suborbital observations/GV
- Science team

Generated ~32 high-level architectures including

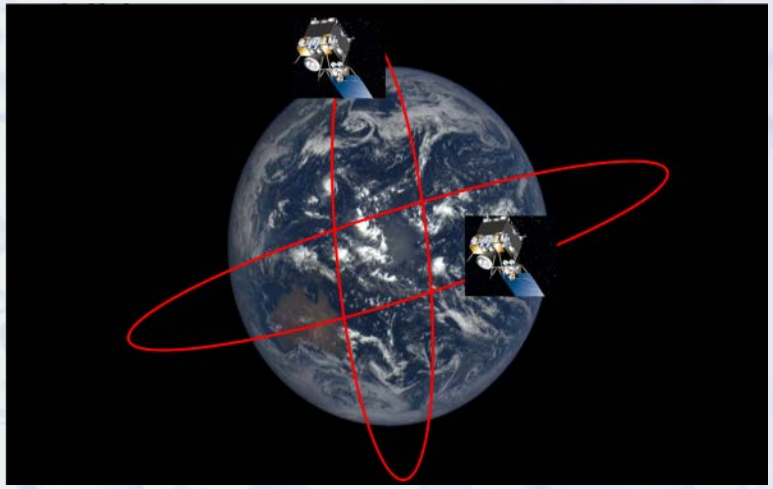
- Single- and dual- medium-to-large satellites
- Smallsat (<180 kg) systems
- Hybrid small/large satellite systems
- Constellations of cubesats
- Impacts of international contributions

Team Consensus on Desired Capabilities

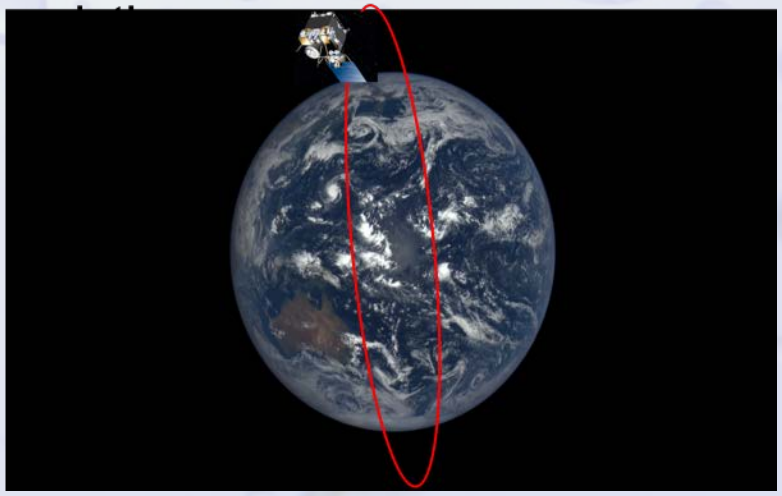
Highly desired capabilities:

- Radars, with W/Ka or W/Ku bands, with Doppler
- Microwave radiometers, frequencies ranging from ~89 to 883 GHz
- Lidars, HSRL at one frequency
- Multi-spectral, multi-angle polarimeters
- Complementary sensors

Inclined orbit



Polar orbit



Summary

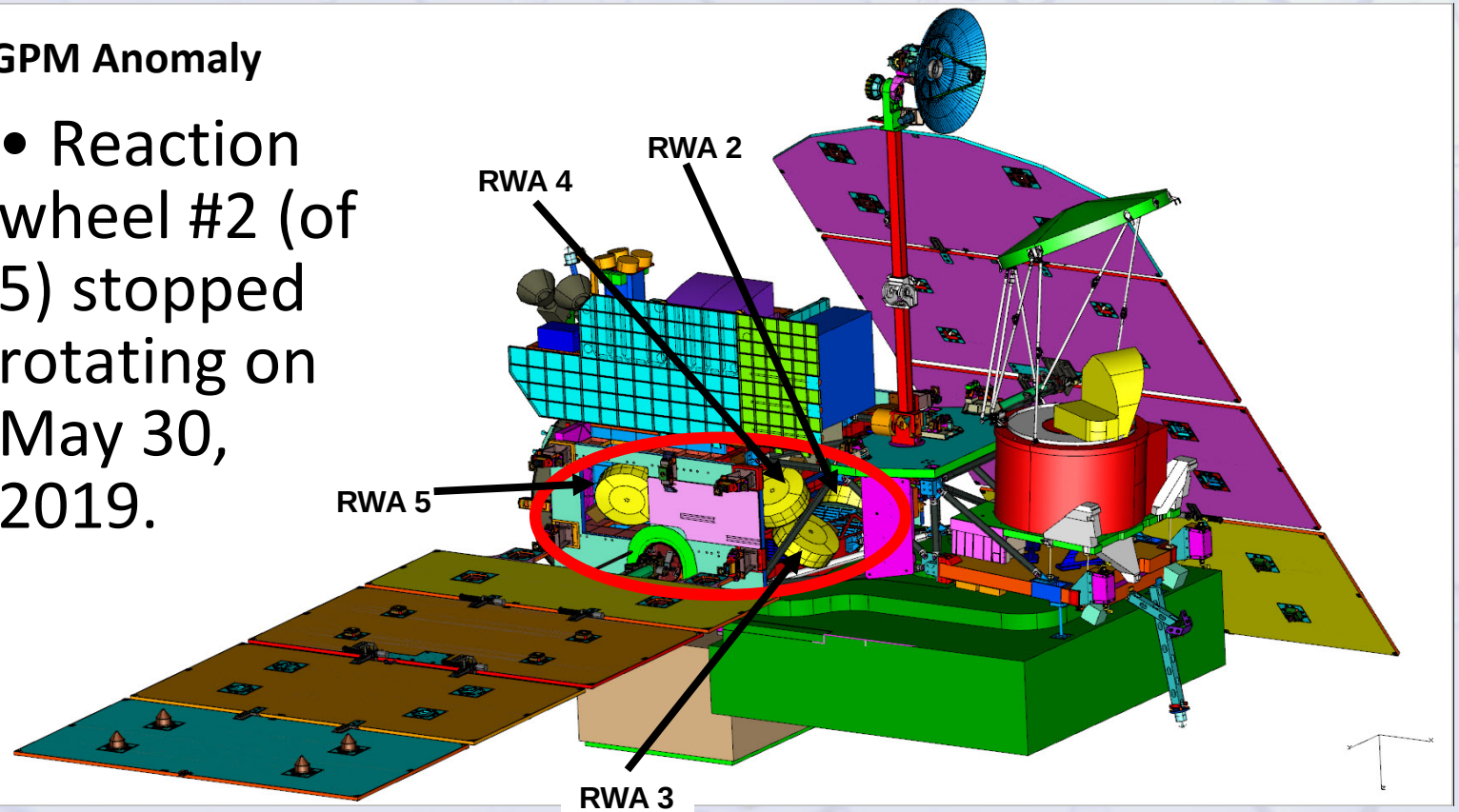
- GPM operating nominally after ~6 years
- TROPICS to provide high-revisit-rate observations in the Tropics, expected to launch ~2022-2023
- TEMPEST-D/RainCube demonstrate the capabilities of smallsat solutions
- ACCP exploring architectures for combined aerosol, cloud, and precipitation measurements, earliest possible launch likely in 2029

Mission Status

Spacecraft and instrument status: All systems are fully functional
Algorithm status: V05 (radiometers), V06 (radar, combined, IMERG, LH), next reprocessing ~2021

GPM Anomaly

- Reaction wheel #2 (of 5) stopped rotating on May 30, 2019.



Possible causes:

- Increased drag in ball bearings
- Resistive short in ceramic capacitor
- Short circuit in +5V logic device
- FOD in gap between rotor and stationary part of reaction wheel