# An Overview of NASA TROPICS Applications and Early Adopter Activities

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## NASA Science Mission Directorate
## Earth Science Division
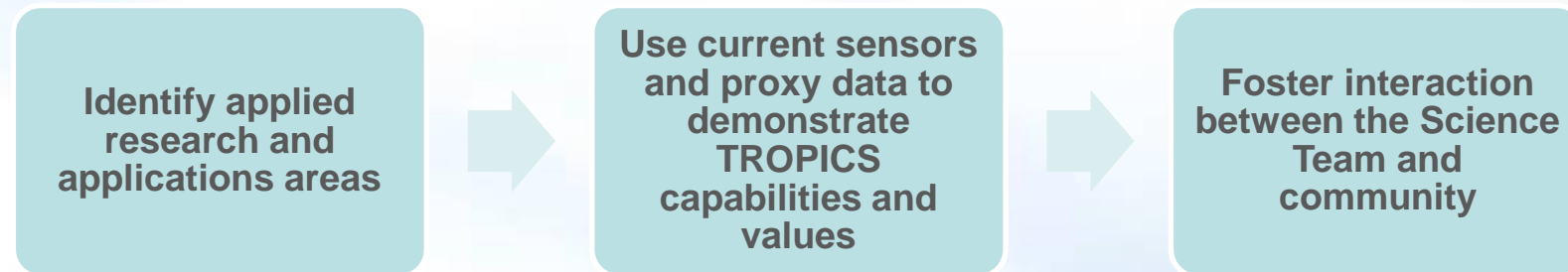## Applied Sciences Program

- **Earth Venture Instrument proposal selection by NASA to measure tropical cyclone structure and demonstrate SmallSat technology**

- **Design**

  - 6 CubeSats with 12-channel passive microwave radiometer (MicroMAS-2)

  - Provide rapid-refresh observations of temperature and moisture soundings and precipitation over the tropics with <60 minute revisit time

  - Meet requirements for temporal refresh needed to study storm evolution with ability to see into clouds
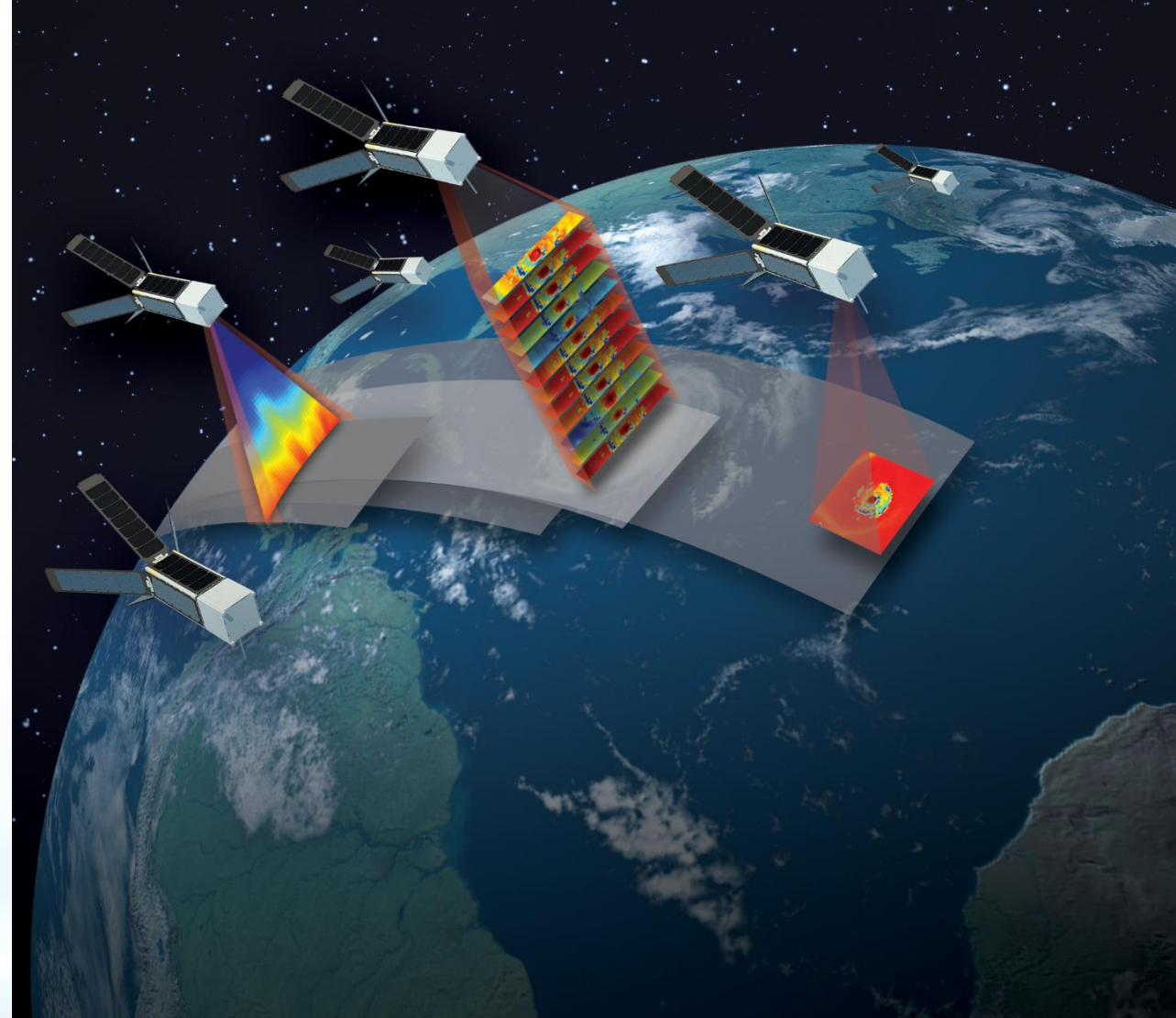


*TROPICS = Time-Resolved Observations of Precipitation structure and storm Intensity with a Constellation of Smallsats*

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- **What is an Early Adopter:** *Groups or individuals who have an interest in utilizing TROPICS data*

- **Goal:** *Build capacity to accelerate the integration of TROPICS in research and application quickly after launch*

- **Objectives:**

| Identify applied research and applications areas | → | Use current sensors and proxy data to demonstrate TROPICS capabilities and values | → | Foster interaction between the Science Team and community |
|---|---|---|---|---|

- **Value:** *identify advantages and limitations that can be exploited or addressed prior to launch*

National Aeronautics and
Space Administration

NASA/CP—2017–219705

**First Time-Resolved Observations
of Precipitation Structure and Storm Intensity
With a Constellation of SmallSats (TROPICS)
Mission Applications Workshop
Summary Report**

University of Miami Rosenthal School of Marine
and Atmospheric Studies (RSMAS) Auditorium

Sponsored by
NASA Earth Science Division Applied Science Program

Hosted by the Cooperative Institute for Marine
and Atmospheric Studies (CIMAS),
University of Miami, Miami, Florida

May 8–10, 2017

- **Meeting Objectives**
  - Introduce a broad community of potential end-users to the expected value of TROPICS by reviewing mission specifications and status
  - Review TROPICS data applications through presentations and breakout discussions
  - Provide a forum for applied researchers and operational decision makers to share insight into how observations from TROPICS can be used in their organizations and challenges to their application
  - Begin establishment of a user community that can be used to highlight potential TROPICS applications and accelerate post-launch applications
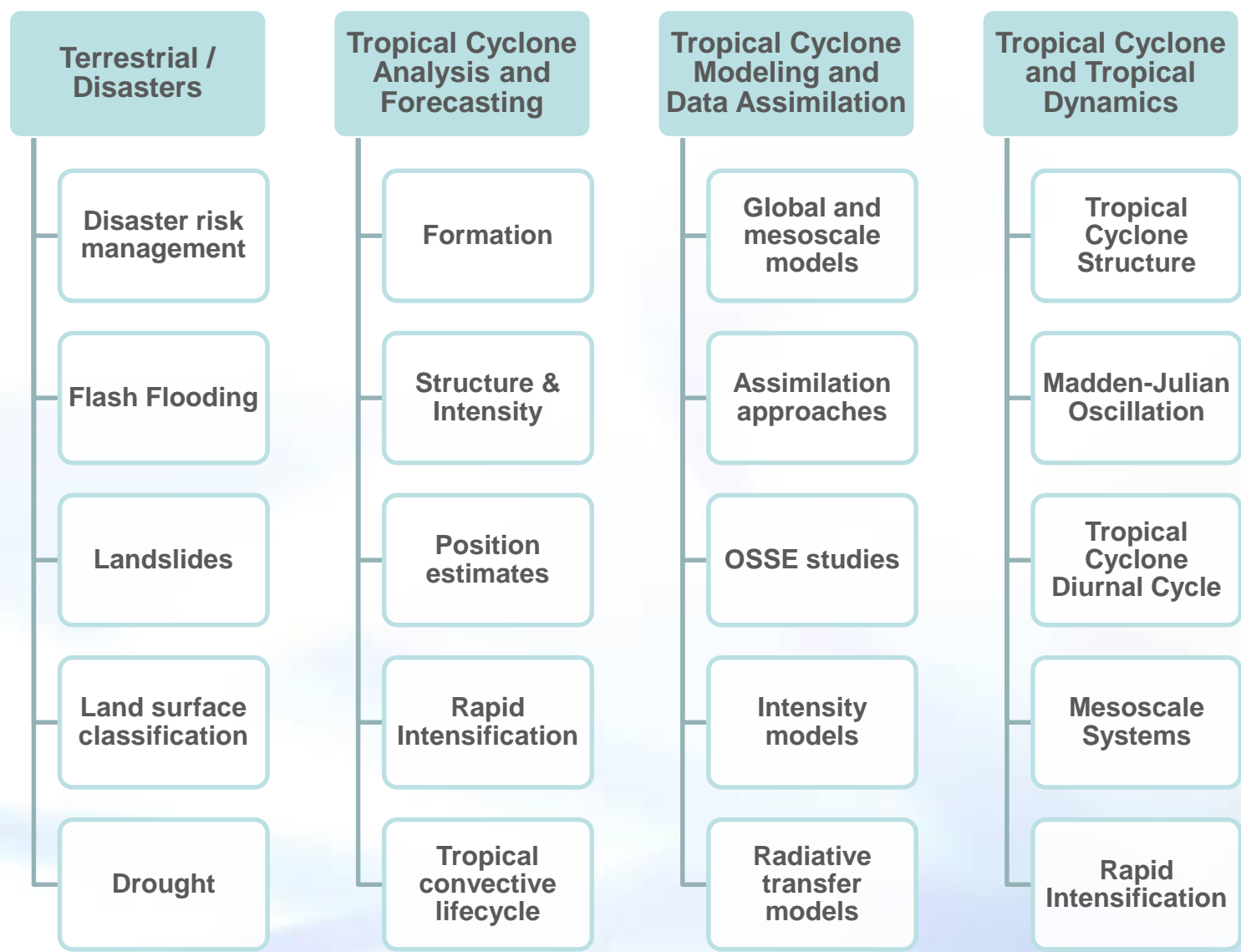  - Hard copy of the report available upon request (see me at the meeting) or go to Workshop website: http://tropics.ccs.miami.edu/workshop-summary/
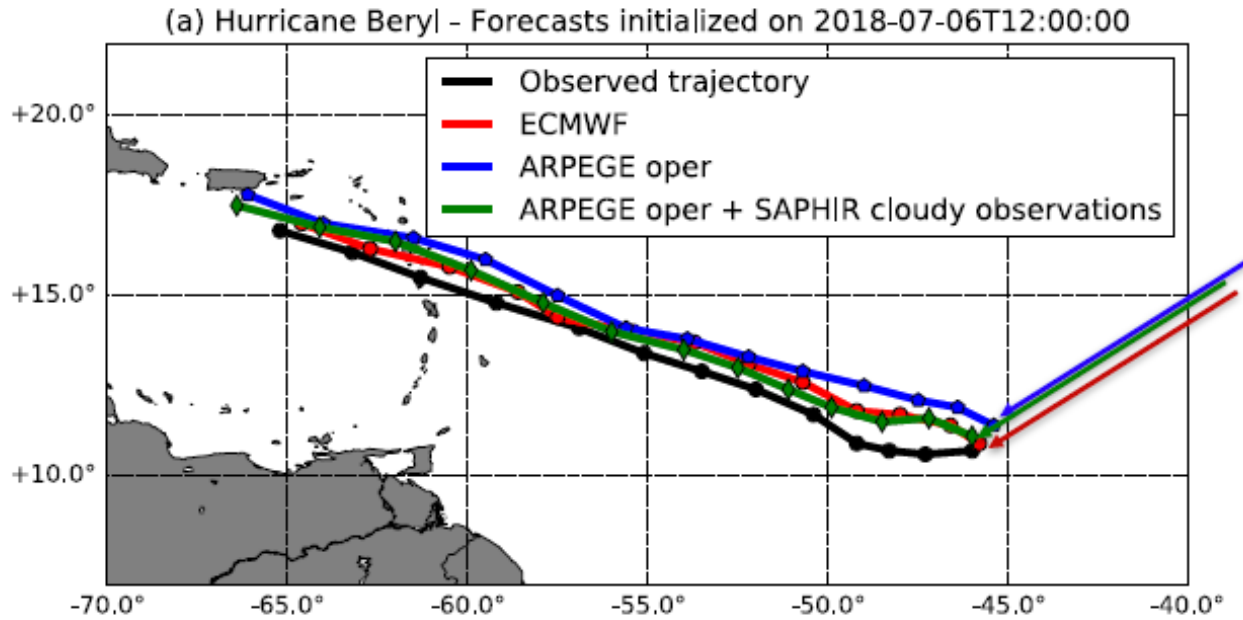
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- **Four application areas were identified and reported on**
  - Terrestrial:  high-temporal resolution precipitation data can supplement tropical regions that lack ground-based radar coverage
  - TC Analysis and Nowcasting:  providing mission observations and imagery to operational hurricane forecasters who rely on satellite data to diagnose storm structure
  - TC Modeling and Data Assimilation:  increased temporal frequency when used with 4DVAR techniques may aid in improving intensity forecasts
  - Tropical Dynamics:  applied research to determine convective extremes and trends in precipitation and severe storms not resolved well enough with current temporal frequency of observations
- **End-users want temporal refresh of 30 – 60 minutes to address research and forecasting challenges related to tropical cyclones; more than 3 hours doesn't add to current datasets**
- **Most users want data latency of < 1 hour; > 3 hours makes data difficult to use for operations**
- **Mission data need to be provided in data formats compatible with user modeling and decision support systems**

# Application Focus Areas

| Terrestrial / Disasters | Tropical Cyclone Analysis and Forecasting | Tropical Cyclone Modeling and Data Assimilation | Tropical Cyclone and Tropical Dynamics |
|---|---|---|---|
| Disaster risk management | Formation | Global and mesoscale models | Tropical Cyclone Structure |
| Flash Flooding | Structure & Intensity | Assimilation approaches | Madden-Julian Oscillation |
| Landslides | Position estimates | OSSE studies | Tropical Cyclone Diurnal Cycle |
| Land surface classification | Rapid Intensification | Intensity models | Mesoscale Systems |
| Drought | Tropical convective lifecycle | Radiative transfer models | Rapid Intensification |

(a) Hurricane Beryl - Forecasts initialized on 2018-07-06T12:00:00

Legend:
- Observed trajectory
- ECMWF
- ARPEGE oper
- ARPEGE oper + SAPHIR cloudy observations

Meteo France developed a data assimilation method for Megha-Tropiques SAPHIR and plan to follow the method to assimilate TROPICS observations
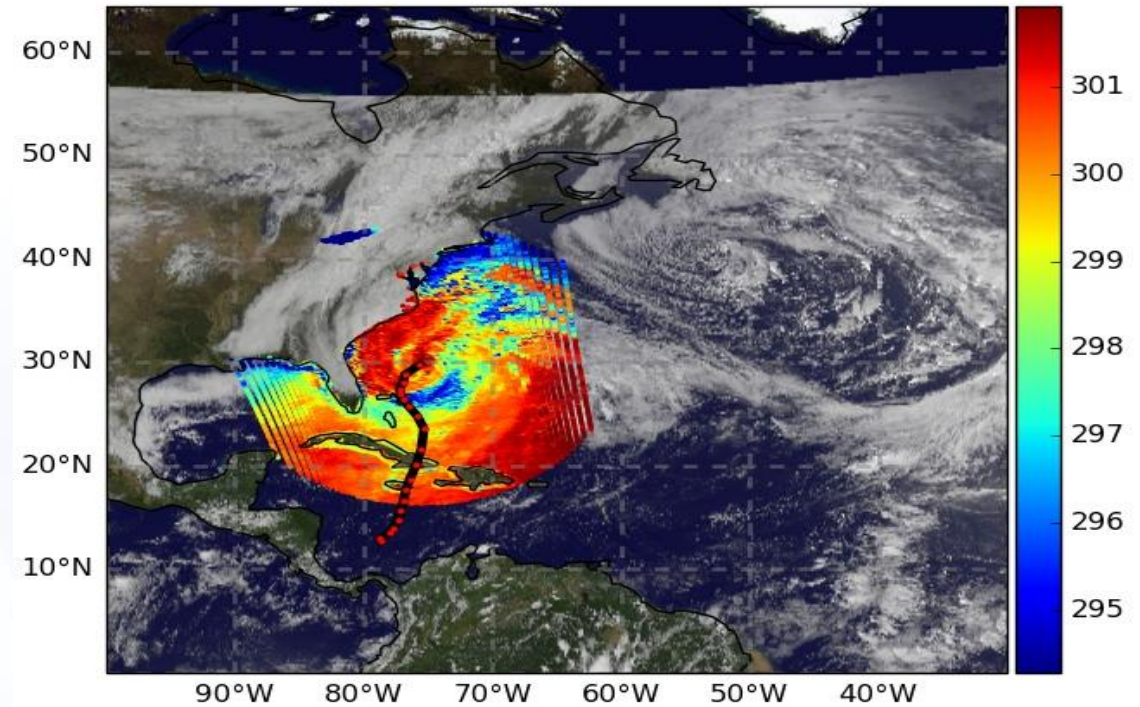
Use ATMS to develop a Bayesian Monte Carlo Integration technique to retrieve atmospheric varaibles and assimilate in GSI+GEOS system
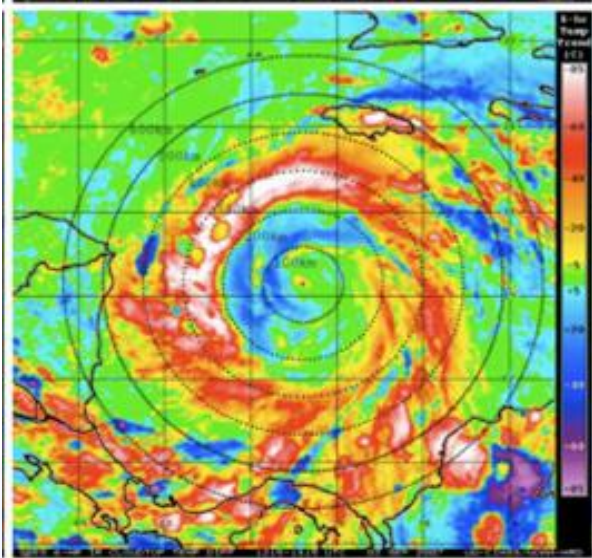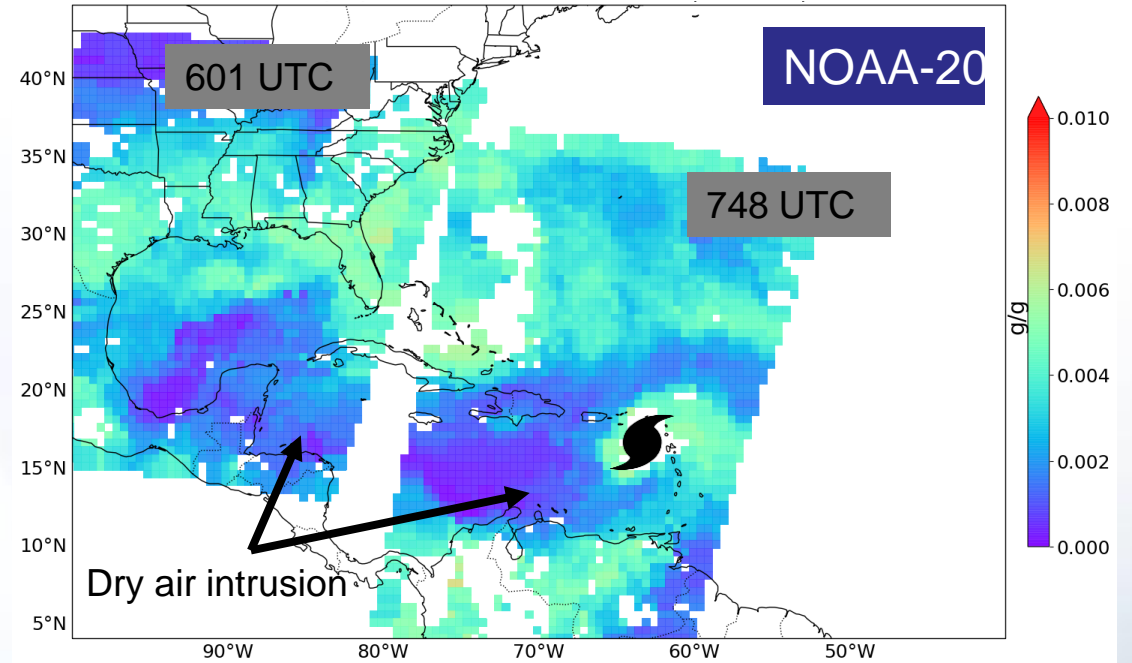
Assessing the ability of the HNR proxy data to resolve the Tropical cyclone Diurnal Cycle
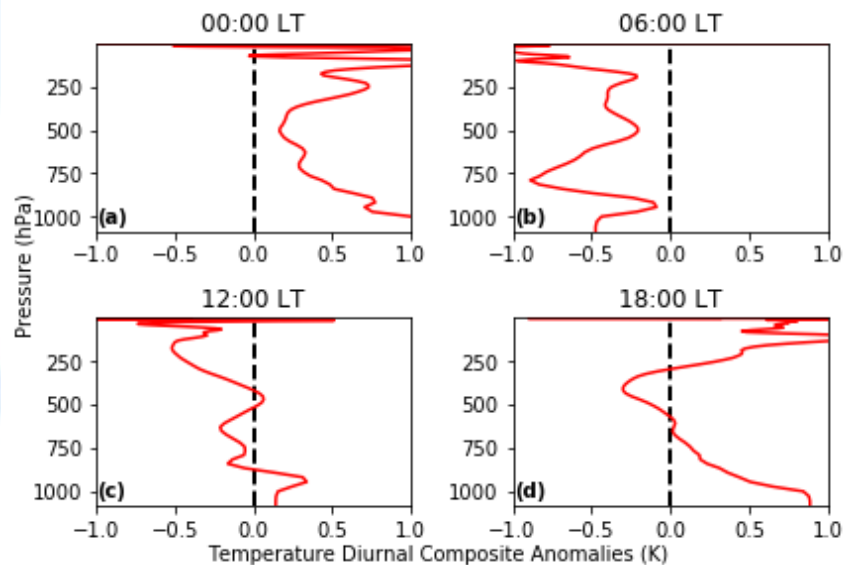
NUCAPS 596 mb water vapor



Use of real-time NOAA-20 CrIS/ATMS profiles to support hurricane field campaigns during Dorian as a demonstration of a future TROPICS application

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- **Goal of proxy data is to accelerate the use of mission data in operational/decision-making environments**

- **Proxy data are being developed using modeled data from a Hurricane Nature Run and the FY-3C satellite**

  – Simulated datasets that match the spatial, temporal, and spectral frequency of planned satellite architecture

  – Plan to make data available in multiple data formats for easier, earlier integration

- **Science Team recently released a version consistent with post-launch format**



20050730-061459 SV6 183 GHz
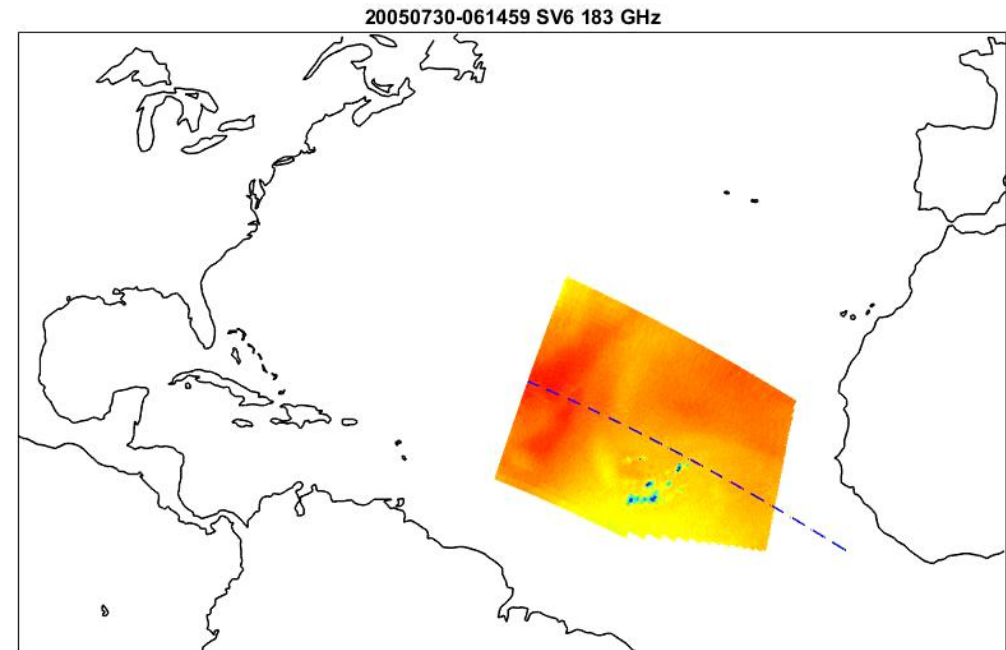
*simulated TROPICS data derived from the Hurricane Nature Run*

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Proxy data is currently available here: https://www.nsstc.uah.edu/tropics/get_involved.html

But will be moved to a new site by Feb. 1 2020 https://weather.msfc.nasa.gov/tropics/products_proxy.html

# Get Involved

- **2nd TROPICS Applications Workshop 19-20 February 2020**
  http://tropics.ccs.miami.edu/


- **We would love to learn more about how your group uses satellite data to study or make decisions regarding tropical weather or climate**

  - Become an EA!

  - Subscribe to our TROPICS Applications Mailing List

  - Participate in quarterly calls

  - Check out the proxy dataset


- **Contact me at emily.b.berndt@nasa.gov if you have any questions or would like to get involved**


- **Our new website will be launched soon: https://weather.msfc.nasa.gov/tropics/**