

National Aeronautics and
Space Administration



Weather and Atmospheric Dynamics Focus Area, Research & Analysis, Earth Science Division, NASA Headquarters

Tsengdar Lee (Focus Area Lead),
Gail Skofronick-Jackson,
Aaron Piña

AGU Town Hall, December 2, 2020

NASA EARTH FLEET

OPERATING & FUTURE THROUGH 2023

SWOT (CNES)
SENTINEL-6 Michael Freilich/B (ESA)

TROPICS (6)

NISAR (ISRO)

TSIS-2

PREFIRE (2)

GLIMR

ISS INSTRUMENTS

EMIT

CLARREO-PF

GEDI

OCO-3

TSIS-1

ECOSTRESS

LIS

SAGE III

JPSS-2, 3 & 4 INSTRUMENTS

OMPS-Limb

LIBERA

09.23.20

Outline

- Who we are
- What we do
- Where we are going
- How to get involved

GEOCARB

MAIA

TEMPO

PACE (NSO)

ICESAT-2

GRACE-FO (2) (GFZ)

CYGNSS (8)

NISTAR, EPIC (DSCOVR/NOAA)

CLOUDSAT (CSA)

TERRA (JAXA, CSA)

AQUA (JAXA, AEB)

AURA (NSO, FMI, UKSA)

CALIPSO (CNES)

GPM (JAXA)

LANDSAT 7 (USGS)

LANDSAT 8 (USGS)

OCO-2

SMAP

SUOMI NPP (NOAA)

Weather Portfolio

Indirect Weather

INVEST/CUBESATS

RainCube

CSIM-FD

HARP

TEMPEST-D

CIRiS

CTIM

HyTI

SNoOPI

NACHOS

(PRE) FORMULATION ●

IMPLEMENTATION ●

PRIMARY OPS ●

EXTENDED OPS ●

Who are we in WADFA?



Tsengdar Lee

WADFA Lead Program scientist
Areas: Modeling and data
assimilation, computing,
information systems



Gail Skofronick-Jackson

Program Manager,
WADFA Program Scientist
for GPM, CYGNSS, and
AQUA/AIRS



Aaron Piña

AAAS Science and Tech. Policy Fellow,
WADFA Deputy Program Scientist

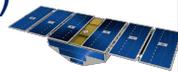


What We Do...



Flight (including Data Systems)

- Operating Missions: GPM, CYGNSS, Aqua (AIRS), LIS on ISS, RainCube, TEMPEST-D
- Future Missions: TROPICS, ACCP, PBL
- GPM's Precipitation Processing (data) System



Research & Analysis

- ROSES Research solicitations
- Modeling, Analysis, and Prediction (MAP) Program
- High-end Computing
- Field Campaigns: validation, process obs.
- Intra-R&A connections, mainly:
 - Atmospheric Composition
 - Water and Energy Cycle
 - Physical Oceanography



Interagency and International Interfaces

- ICAMS (previously OFCM)
- JCSDA
- ECMWF, ESA, JAXA
- CEOS, CGMS, GEO
- NOAA, DOE (ARM)



WADFA

Core Facility Assets

- MSFC/SPoRT
- GSFC/GMAO and NCCS
- Instrument Assets



Earth Science Technology Office

- In-space Validation of Earth Science Tech.
- Instrument Incubator Program
- Advanced Information Systems Tech: data systems, new observing strategy, and AI/ML
- Develops and demonstrates weather related technologies for future satellite and airborne missions



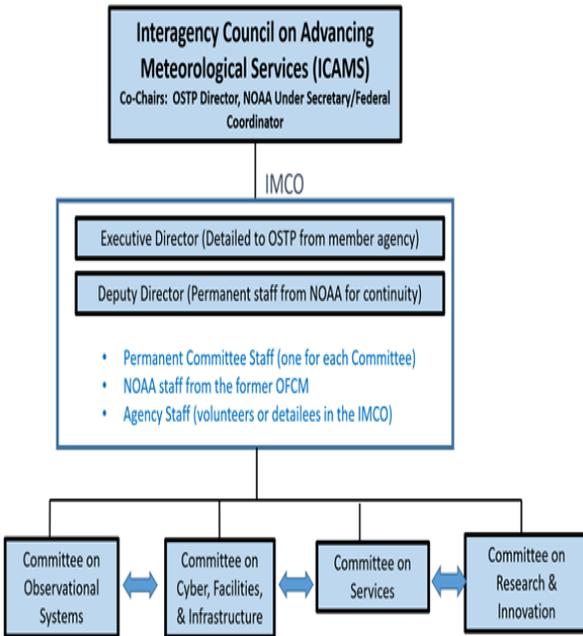
Applied Sciences

- SPoRT is heavily leveraged by the ASP's Disasters Area
- Exploring collaboration with ASP's Food Security and Agriculture Area
- Disaster Rapid Response
- ROSES and Flight funded activities



Interagency and International Interfaces

ICAMS as an interagency co-ordination entity

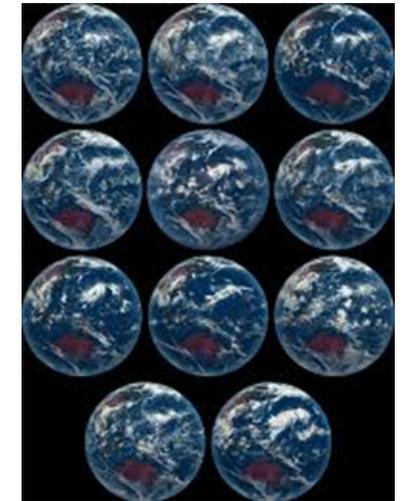


FV3 development coordination

 GMAO GEOS <ul style="list-style-type: none"> Data Assimilation Weather Prediction S2S Prediction Reanalysis Global Mesoscale 	 GFDL AM3 CM3 HiRAM <ul style="list-style-type: none"> Climate (IPCC) S2S Prediction Weather High-Resolution 	 EMC GFS GEFS SFS <ul style="list-style-type: none"> Operational DA Operational NWP S2S Prediction Reanalysis Future CAM and CAM Ensembles Hurricanes, Space Weather, WoF ... 	
 GISS modelE <ul style="list-style-type: none"> Climate (IPCC) Exo-planets 	 Harvard GEOS-Chem <ul style="list-style-type: none"> Chemical Transport Composition 	 ESRL NGGPS <ul style="list-style-type: none"> Real-time FV3-GFS Advanced Physics 	 NCAR CESM <ul style="list-style-type: none"> Climate (IPCC) Data Assimilation

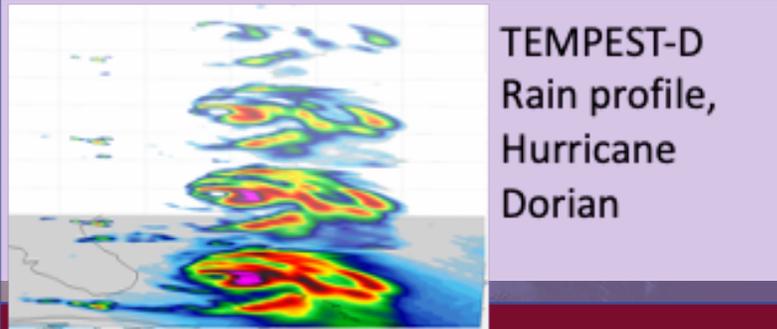
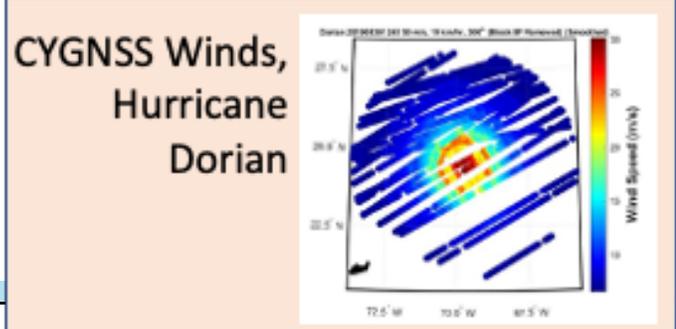
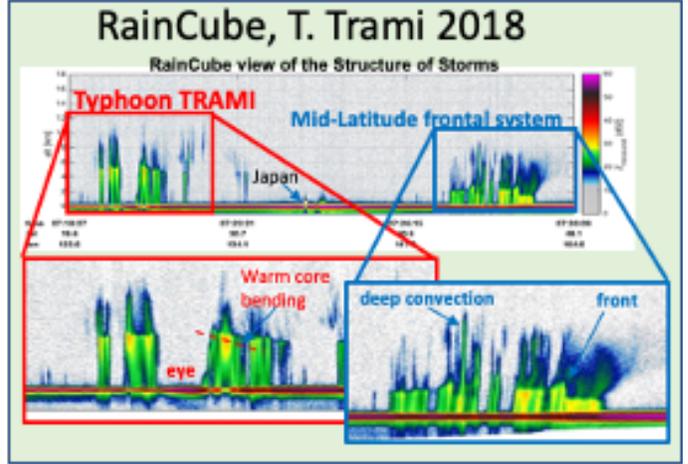
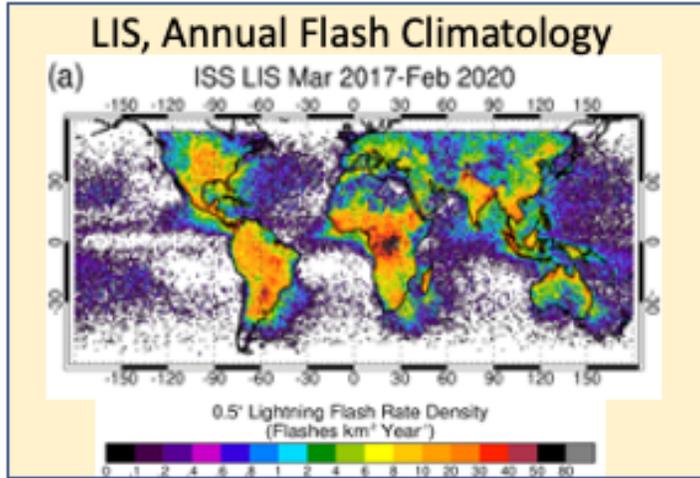
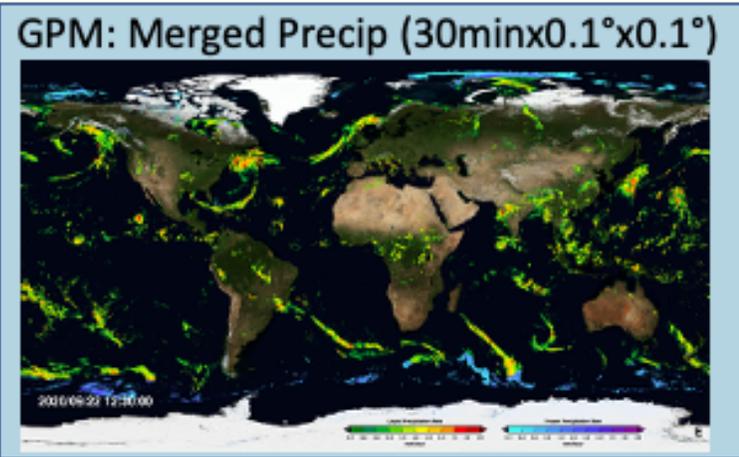
JCSDA
 Joint Center for Satellite Data Assimilation
 A multi-agency research center created to improve the use of satellite data for analyzing and predicting the weather, the ocean, the climate and the environment.
JEDI
 Data Assimilation

GPM Constellation



WADFA Satellite Flight Program Summary

- **Global Precipitation Measurement (GPM) Mission** (PS: S. Braun, gpm.nasa.gov, precipitation)
- **Aqua/AIRS instrument** (PS: C. Parkinson, aqua.nasa.gov/content/airs, atmospheric sounding)
- **Cyclone Global Navigation Satellite System (CYGNSS)** (PI: C. Ruf, www.nasa.gov/cygnss, 8 smallsats, winds & soil moisture)
- **Lightning Imaging Sensor (LIS) on the ISS** (PI: T. Lang, ghrc.nsstc.nasa.gov/lightning/overview_lis_instrument.html, lightning)
- **RainCube** (PI: E. Peral, www.jpl.nasa.gov/cubesat/missions/raincube.php, 6-unit cubesat, radar rain profiles)
- **TEMPEST-D** (PI: S. Reising, www.jpl.nasa.gov/cubesat/missions/tempest-d.php, 6-unit cubesat, precipitation/sounding)
- **TROPICS** (PI: W. Blackwell, tropics.ll.mit.edu, to be launched 2021-2022, six 3-unit cubesats, time resolved precipitation)



What we do

WADFA Satellite Flight – Earth Venture Activities and Opportunities

Mission	Mission Type	Release Date	Selection Date	Major Milestone
EVS-1 (EV-1) (AirMoss, ATTREX, CARVE, DISCOVER-AQ, HS3)	5 Suborbital Airborne Campaigns	2009	2010	Completed KDP-F
EVM-1 (CYGNSS)	Class D SmallSat Constellation	2011	2012	Launched Dec. 2016
EVI-1 (TEMPO)	Class C Geostationary Hosted Instrument	2011	2012	Delivered to storage Dec. 2018
EVI-2 (ECOSTRESS & GEDI)	Class C & Class D ISS-hosted Instruments	2013	2014	Launched June & Dec. 2018
EVS-2 (ACT-America, ATOM, NAAMES, ORACLES, OMG, CORAL)	6 Suborbital Airborne Campaigns	2013	2014	CORAL and NAAMES Completed KDP-F
EVI-3 (MAIA & TROPICS)	Class C LEO Hosted Instrument & Class D CubeSat Constellation	2015	2016	Delivery NLT 2021
EVM-2 (GeoCarb)	Class D Geostationary Hosted Instrument	2015	2016	Launch ~2021
EVI-4 (EMIT & PREFIRE)	Class C ISS-hosted Instrument & Class D Twin CubeSats	2016	2018	Delivery NLT 2021
EVS-3 (ACTIVATE, DCOTTS, IMPACTS, Delta-X, SMODE)	5 Suborbital Airborne Campaigns	2017	2018	Passed Initial Confirmation Review, 2 began deployments
EVI-5 (GLIMR)	Class C Geostationary Hosted Instrument	2018	2019	Delivery NLT 2024
EVC-1 (Libera)	Class C JPSS-Hosted Radiation Budget Instrument	2018	2020	Delivery NLT 2025
EVM-3 (NOI due 5 Jan 2021)	Full Orbital	2020	2021	Launch ~2025
EVI-6	Instrument Only	2021	2021	Delivery NLT 2026
EVS-4	Suborbital Airborne Campaigns	2022	2023	N/A
EVC-2	Continuity Measurements	2022	2023	Delivery NLT 2027
EVM-4	Full Orbital	2024	2025	Launch ~2029
EVI-7	Instrument Only	2023	2024	Delivery NLT 2028
EVC-3	Continuity Measurements	2025	2026	Delivery NLT 2030
EVS-5	Suborbital Airborne Campaigns	2026	2027	N/A

EVS
Sustained sub-orbital investigations (~4 years)

EVM
Complete, self-contained, small missions (~4 years)

EVI
Full function, facility-class instruments Missions of Opportunity (MoO) (~3 years)

EVC
Complete missions or hosted instruments targeting “continuity” measurements (~3 years)

Open solicitation - In Review

Completed solicitation

Earth Science Technology Office (ESTO)

ESTO manages, on average, 120 active technology development projects. Most are funded through the primary program lines below. Over 800 projects have completed since 1998.

Advanced Technology Initiatives: **ACT** and InVEST

Advanced Component Technologies (ACT)
Critical components and subsystems for advanced instruments and observing systems



12 projects awarded in 2018
ACT-20 Solicitation under review
ACT-22 Solicitation planned for FY'22

In-Space Validation of Earth Science Technologies (InVEST)
On-orbit technology validation and risk reduction for small instruments and instrument systems.



Four projects selected in FY18
Solicitations planned in FY21 and FY24
Average selection rate: 18.3%

Instrument Incubator Program (IIP)

Earth remote sensing instrument development from concept through breadboard and demonstration

17 projects awarded in FY17
19 Projects awarded in FY'20
Solicitations planned in FY21, FY23, and FY25



Advanced Information Systems Technology (AIST)

Innovative on-orbit and ground capabilities for communication, processing, and management of remotely sensed data and the efficient generation of data products

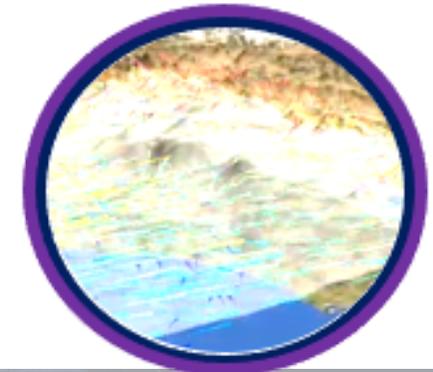
22 projects awarded in FY17
22 projects awarded in FY19
Solicitations planned in FY21, FY23, and FY25



Decadal Incubation

Maturation of observing systems, instrument technology, and measurement concepts for Planetary Boundary Layer and Surface Topography and Vegetation observables through technology development, modeling/system design, analysis activities, and small-scale pilot demonstrations

Solicitations planned in FY19 and FY21



Research & Analysis: ROSES Research Solicitations

- Register for an NSPIRES account to receive updates
- www.nspires.nasaprs.com (or Google “NASA NSPIRES”)

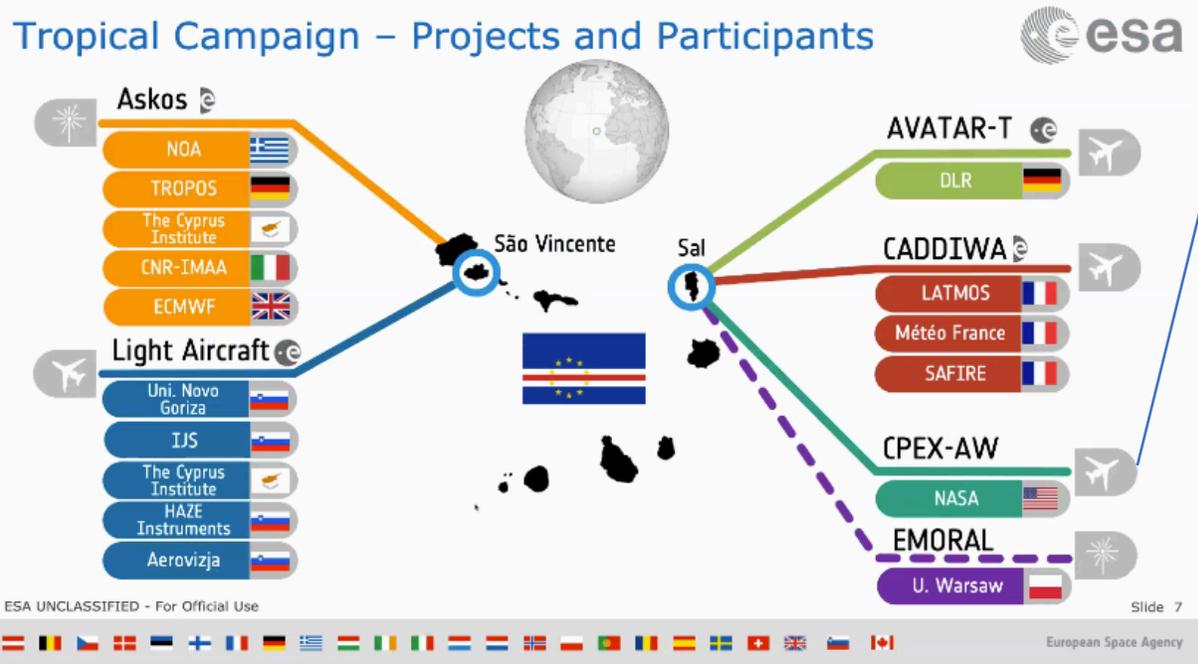
ROSES Year	Solicitation Short Title	# Yrs of \$
2017	Making Earth System Data Records for Use in Research Environments (MEaSURES)	5
2019	Interdisciplinary Science (IDS) - Urban Hydrometeorology - Life Cycle of Snow	3
2019	Weather and Atmospheric Dynamics	3
2019	PBL Incubation Study Team	1
2019	Earth Science Research from Operational Geostationary Satellite Systems (Joint w/ NOAA NESDIS)	3
2019	Global Navigation Satellite System Research	3
2019	Remote Sensing Theory	4
2020	FINESST (Graduate Student funding; 3 years funding solicited every year)	3
2020	Modeling, Analysis, and Prediction (MAP) (proposals were due July 2020)	4
2020	New Investigator Program (NIP)	3
2020	CYGNSS Science Team (proposals were due Nov 6, 2020)	3
2021	Precipitation Measurement Missions (expected to be due June 2021)	3
2021	TASNPP: Terra, Aqua, Suomi, NPP (due February and March 2021)	3

Research & Analysis: CPEX-AW Field Campaign **(COVID PENDING!)**

Overarching goal of the Tropical Campaign is to Calibrate/Validate ESA's Aeolus satellite wind obs.

• **NASA's Contribution: Convective Processes Experiment- Aerosols & Winds (CPEX-AW)**

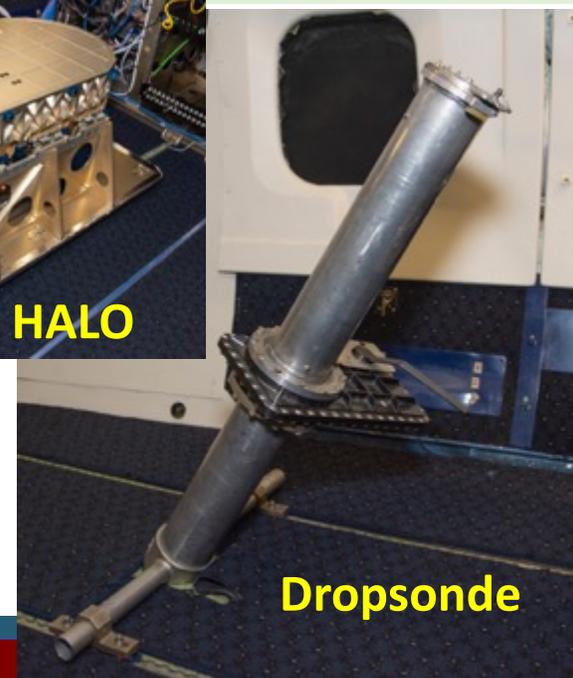
- **Confirmed Instruments on NASA's DC-8 Aircraft:**
- **DAWN:** (Doppler Aerosol WiND lidar)
- **HALO:** (High Altitude Lidar Observatory)
- **Dropsondes**
- **APR-3:** (Airborne Precipitation & Cloud Radar 3rd Gen.)
- **HAMSR:** (High Altitude Monolithic Microwave integrated Circuit (MMIC) Sounding Radiometer)



HALO



DAWN



Dropsonde

- **Location: Cabo Verde;**
- **NASA's DC-8 will have ~125 hours for research flights;**
- **Dates: NASA ~1 July -15 Aug 2021 (ESA overlap early July)**
- **Hoping to get NOAA G-IV aircraft to participate with research hours**

What we do

Research & Analysis: Intra-R&A Connections

Atmospheric Composition

Research on Earth's atmosphere, including its chemical and physical properties, Earth's energy budget, and air quality. WADFA contributes the state estimation of the atmosphere.

Carbon Cycle & Ecosystems

detects, explains, and predicts changes in Earth's ecosystems, biogeochemical cycles, biodiversity, and land cover. WADFA contributes hydrometeorology data.

Weather and Atmospheric Dynamics

Researches the dynamics of the atmosphere to improve our understanding of the fundamental processes that drive weather.

Climate Variability and Change

measures and models Earth's dynamic systems and how they change over time. WADFA focuses on short-term and fast processes.

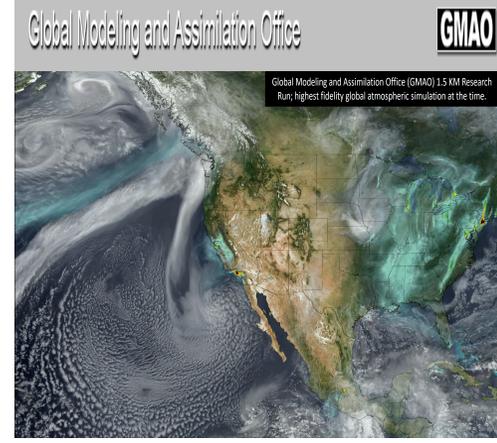
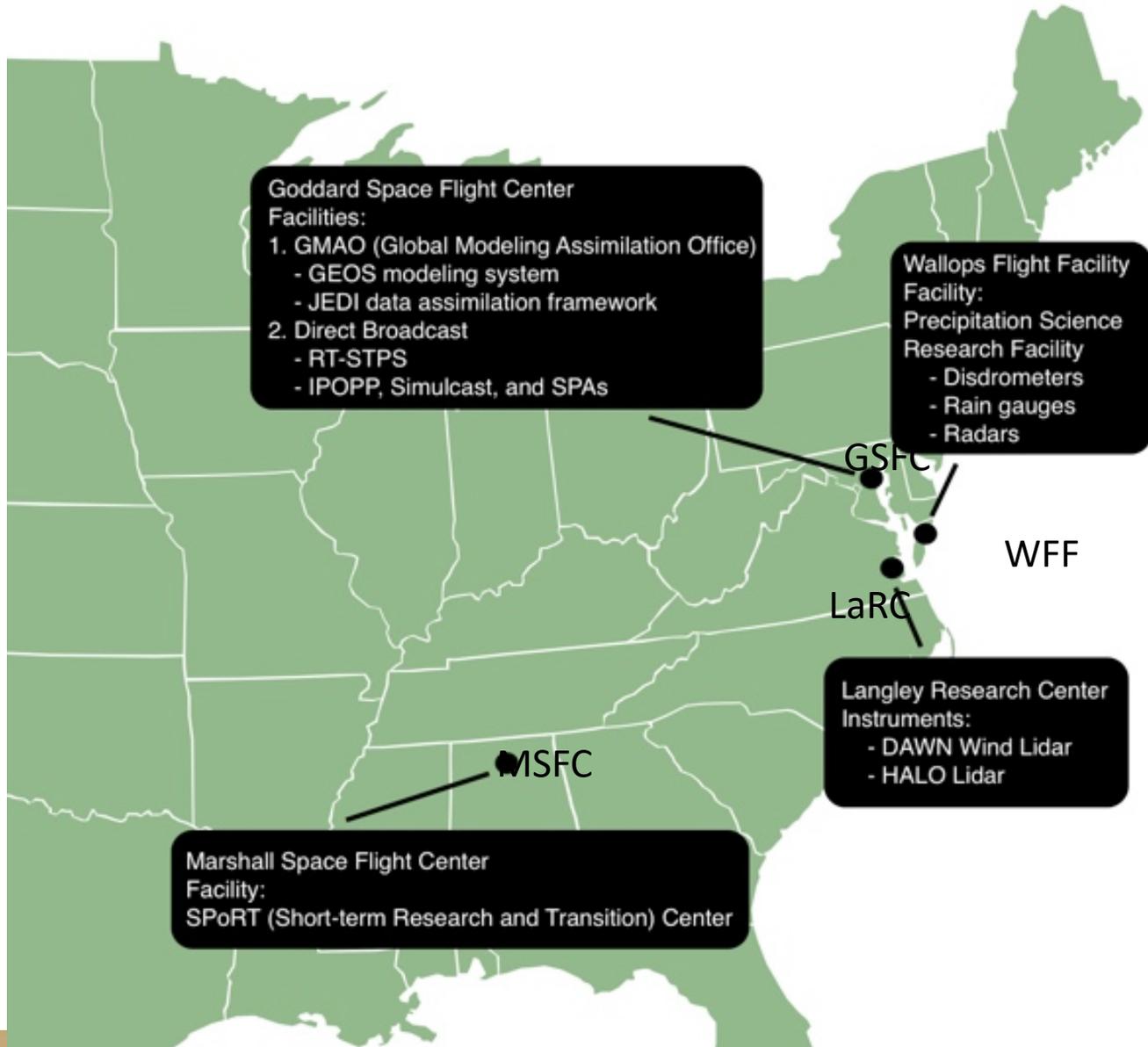
Water & Energy Cycle

focused and crosscutting research to improve our understanding of the global water cycle. WADFA focuses on short-term and extreme events.

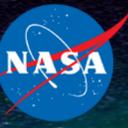
Earth's Surface and Interior

supports research and analysis of solid-Earth processes from crust to core. WADFA contributes the precipitation and water loading impacts on Earth's crust.

Core Facility and Instrument Assets in WADFA



What we do



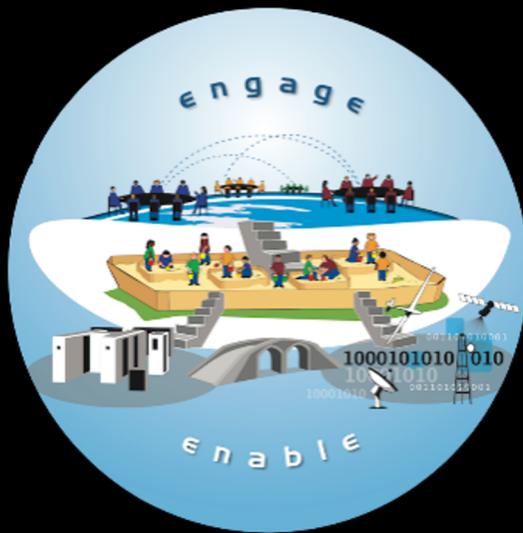
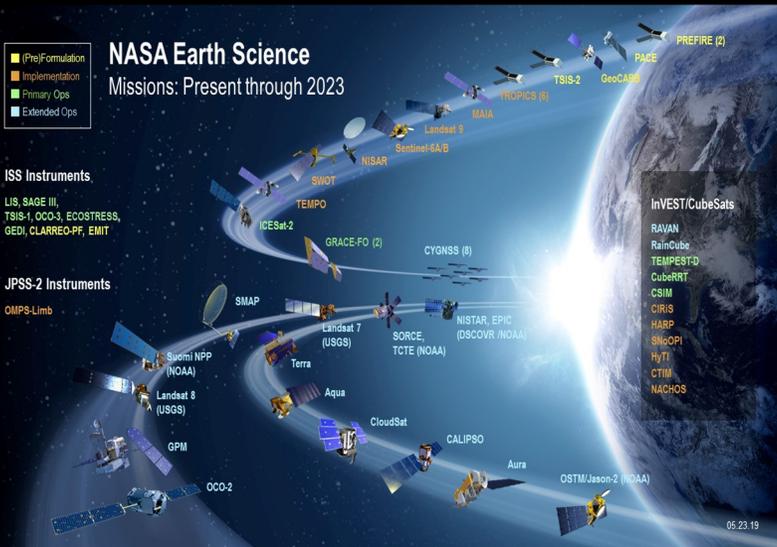
NASA Earth Exchange (NEX)

Ames Research Center, Moffett Field, CA

nex.nasa.gov

www.nasa.gov

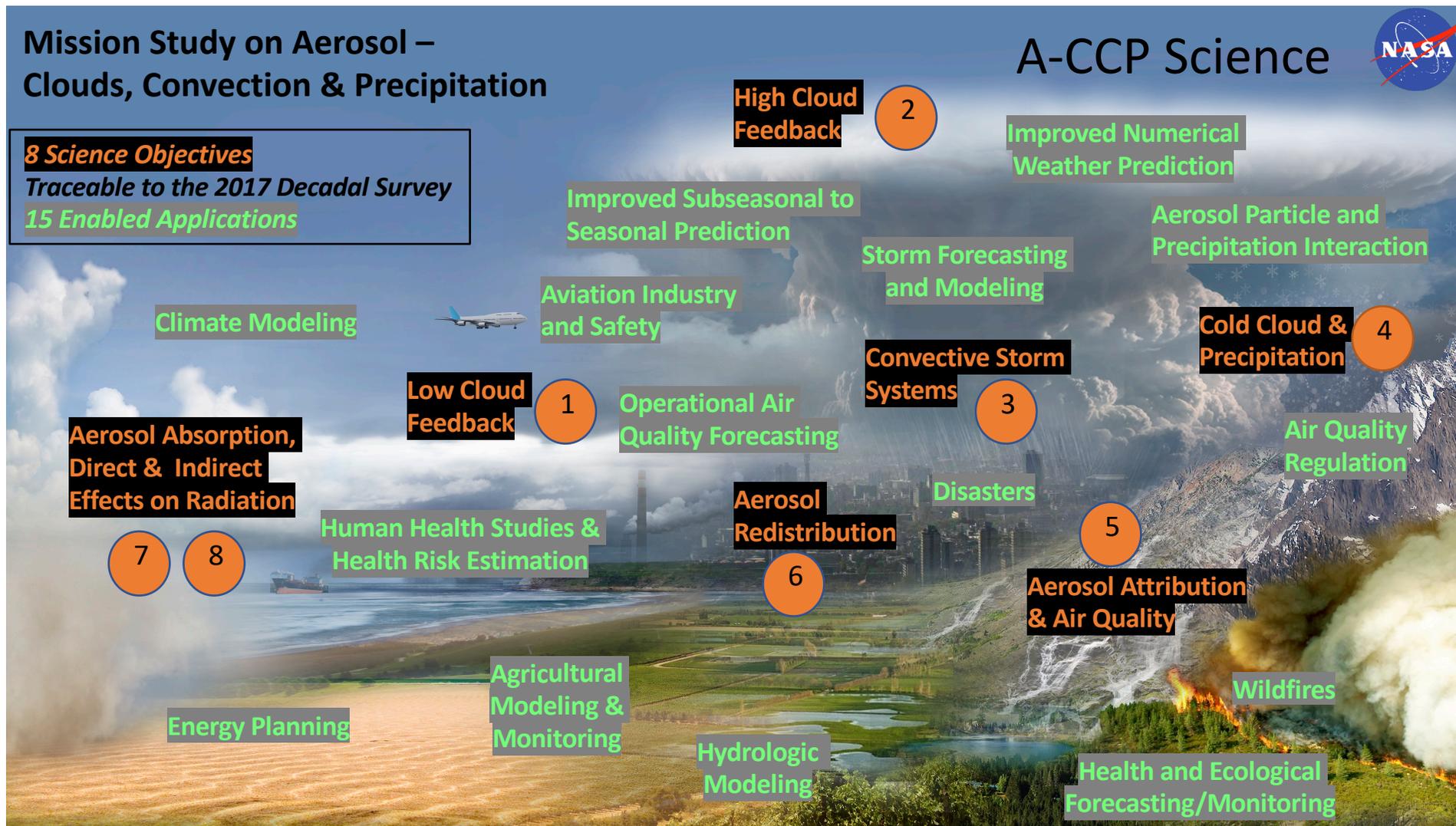
NEX is virtual collaborative that brings scientists together in a knowledge-based social network and provides the necessary tools, computing power, and access to massive data to accelerate research, innovation and provide transparency.



Massive data from multiple missions

Scalable & diverse computing architectures

Decadal Survey updates: A-CCP Science and Applications



Almost all the Science Objectives and Enabled Applications are related to Weather and Atmospheric Dynamics

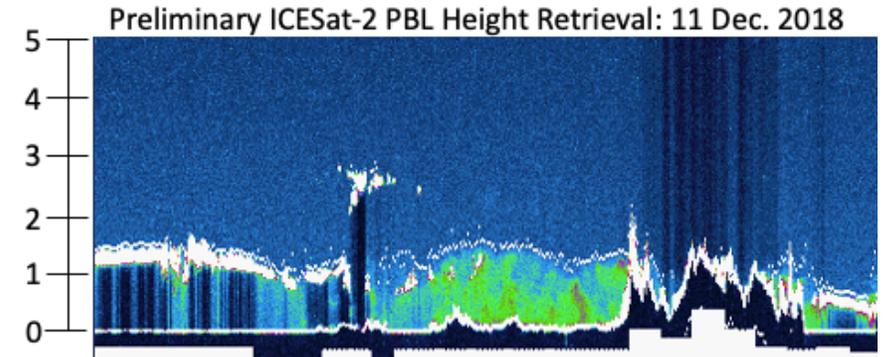
Decadal Survey updates: A-CCP

- 2-4 December 2020 Final Internal Architecture Evaluation Review
- December 2020 TBS Architecture Review with Earth Science Community Members
- December 2020 TBS Center Level Workshops/Reviews Instruments and Final 3 Architectures
- 11 January 2020 ACCP Community Forum
- 27-28 January 2020 ACCP Down Select Meeting with HQ



Decadal Survey updates: PBL

- ROSES Solicitation Proposals due 2019
- PBL Study team selected and announced November 2019
- PBL Townhall at AGU December 2019
- Weekly Study Team meetings + bi-weekly HQ tag-ups (virtual)
- Identified subgroups for science question theme areas
 - PBL and Extreme Weather / Convection
 - PBL and Clouds
 - PBL and Surface Interaction
 - PBL Vertical Mixing and Atmospheric Composition
- Outlined SATM
- Outlined white paper structure (writing assignments started)
- Interim report August 2020 to NASA HQ
- PBL Website being developed
- May 19-21, 2020 PBL Community Workshop (Virtual)
- Future: ROSES solicitation for FY22 funding

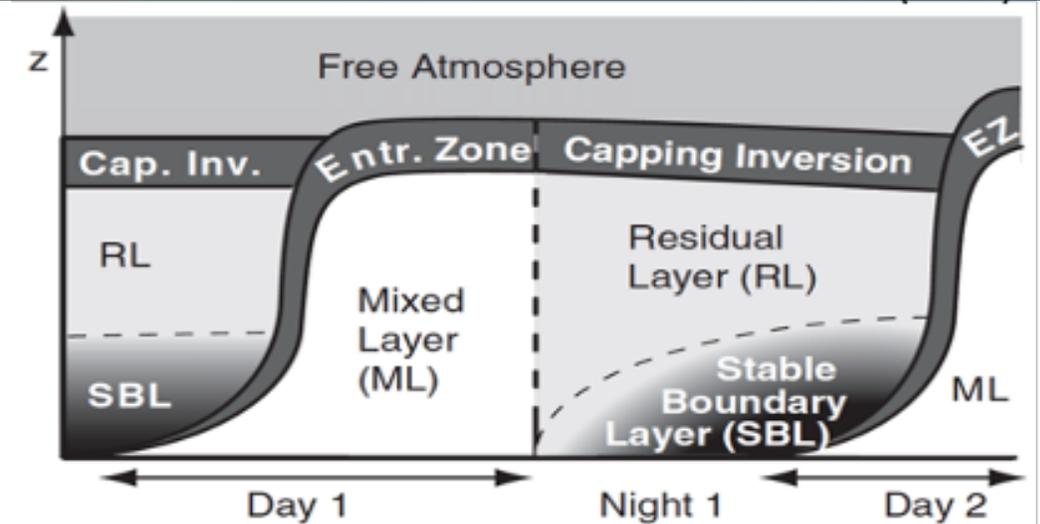


PBL INCUBATION: A WHITE PAPER OUTLINE

1. MOTIVATION
2. DECADAL SURVEY
3. WORKSHOP
4. PBL SCIENCE
5. PBL APPLICATIONS
6. PBL MODELING AND DATA-ASSIMILATION
7. PROGRAM OF RECORD
8. TECHNOLOGY
9. NASA OPPORTUNITIES
10. SATM
11. SUMMARY OF FINDINGS

Decadal Survey updates: PBL

- **Community Engagement**
 - **Community Workshop, May 19, 20, 25, 26, 2020**; average 200 attendees each session
 - High-latitude PBL & PBL and Deep Convection,
 - Land and Surface Interaction & Ocean and Sea Interaction,
 - Applications & Weather, Climate Models, and Data Assim.
 - Passive & Active PBL sensing, & In-situ and Suborbital
 - **October 13, 2020: PBL Technology Survey released**
 - ~50 responses so far
 - Submit entries ASAP to pbl-study-input@lists.nasa.gov
- **Schedule**
 - **September 11, 2020**: Draft delivered to HASA HQ (50 pages)
 - **November 2020**: Revisions incorporating HQ feedback due
 - **January 2021**: White Paper Due
 - **Ongoing**: PBL Augmentation Activities
 - **Summer 2021**: Joint Atmospheric Dynamics, Winds, and PBL Field Campaign planned (<https://espo.nasa.gov/cpex-aw/>)
 - **PBL Activity Proposal Solicitation(s)**: 3-9 months after White Paper released to the public
- **Key Preliminary Findings: Architecture with specific platforms (orbital and suborbital) to optimally address PBL needs**



Selected PBL Study Team

Science Lead	– Joao Teixeira (JPL)
Technology Co-Lead	– Jeff Piepmeier (GSFC)
Tech. Deputy Co-Lead	– Amin Nehrir (LaRC)
Chi Ao	JPL
Shuyi Chen	University of Washington
Carol Anne Clayson	Woods Hole Oceanographic Inst.
Ann Fridlind	NASA GISS
Matthew Lebsock	JPL
Will McCarty	NASA GSFC/GMAO
Haydee Salmun	Hunter College CUNY
Joe Santanello	NASA GSFC
Dave Turner	NOAA
Zhien Wang	University of Colorado, LASP
Xubin Zeng	University of Arizona

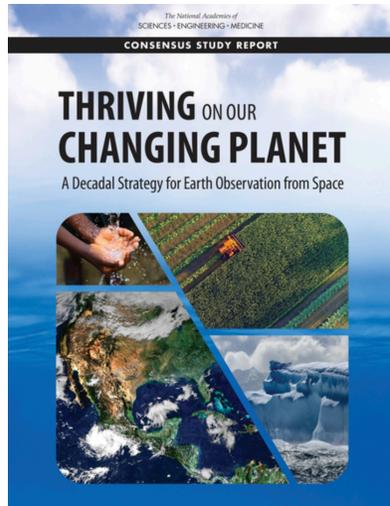
Weather and Atmospheric Dynamics Focus Area Strategy

Purpose: Develop a detailed strategy based on the other plans that will prioritize and guide WADFA research investments

Proposed schedule:

May – Nov '20	Dec '20	Jan '21	Feb '21	Mar '21	April '21	Summer '21
Organize pillars of WADFA strategy and RFI						
	RFI to WADFA R&D community					
			RFIs due			
		Synthesis of RFIs				
				WADFA R&D community workshop		
					NASA HQ synthesis and prioritization	
						WADFA strategy roll-out

Guiding documents:



Public Law 115–25
115th Congress

An Act

To improve the National Oceanic and Atmospheric Administration's weather research through a focused program of investment on affordable and attainable advances in observational, computing, and modeling capabilities to support substantial improvement in weather forecasting and prediction of high impact weather events, to expand commercial opportunities for the provision of weather data, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE; TABLE OF CONTENTS.

(a) SHORT TITLE.—This Act may be cited as the "Weather Research and Forecasting Innovation Act of 2017".

OSTP FTAC: Predictability and prediction especially for extreme hydrological events

Earth Science Division Diversity Commitments

Goal

Building a diverse, equitable, inclusive, and accessible environment for marginalized communities within the Earth science community.

The Work Ahead

- ESD established a Diversity and Inclusion Task Force to identify the most effective and impactful actions that can be directly undertaken within and specifically benefit the Earth science community.
- Collect and analyze current data and metrics to understand community baselines and what specific actions are most effective
- Champion Dual Anonymous Peer Review and other measures to address perceived bias in NASA ESD's panel review process.
- Further expand upon current footprint with STEM partnerships and increase participation with Historically Black Colleges and Universities and other Minority Serving Institutions.
- Highlight and amplify the accomplishments of NASA's scientists and researchers to encourage a more diverse generation of STEM professionals.

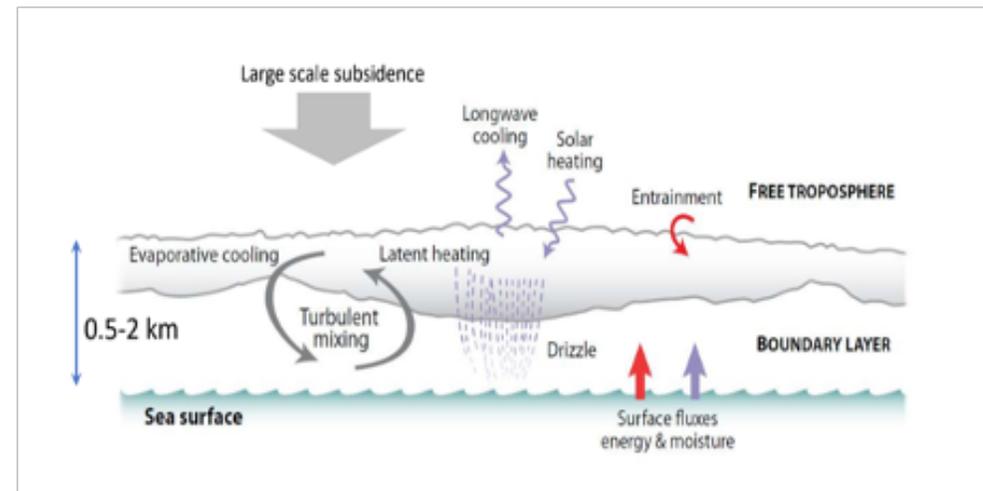
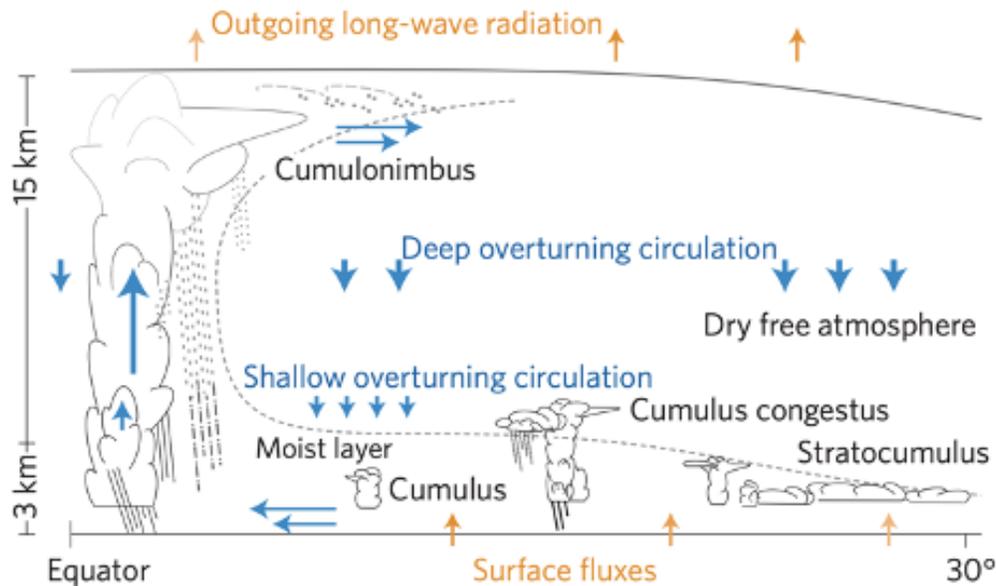
Areas of Potential Engagement with WADFA

- Register for an NSPIRES account to receive updates
- www.nspires.nasaprs.com (or Google “NASA NSPIRES”)

Expected Release	Solicitation Title	# Yrs of \$
Fall 2020	TASNPP: Terra, Aqua, Suomi, NPP (due February/March 2021)	3
Fall 2020 – Annual release	FINESST (graduate student funding) (due February 4, 2021)	1-3
Fall 2020 – Annual release	NASA Postdoc Program (www.npp.usra.com) (due March 1, 2021)	1-3
February 2021	Precipitation Measurement Missions (expected to be due June 2021)	3
2022	Interdisciplinary Science (IDS) - Topics TBD	3
2022	Weather and Atmospheric Dynamics	3
2022	PBL Incubation	3
2022	Earth Science Research from Operational Geostationary Satellite Systems (Joint w/ NOAA NESDIS)	3
2022	Global Navigation Satellite System Research	3
2023	New Investigator Program (Ph.D. + 6 years)	3
2023	CYGNSS Science Team (proposals were due Nov 6, 2020)	3
Ongoing	Rapid Response and Novel Research in Earth Science	1
Ongoing	Internships (high school, undergrad, and grad students) - Spring, Summer, and Fall www.intern.nasa.gov (Applications for Summer 2021 are due March 5, 2021)	10 weeks

Areas of Potential Engagement with WADFA

- Opportunities through other NASA programs—Research and Analysis focus areas, Applied Science Program, Earth Science Technology Office
- Attend a proposal writing workshop (e.g. AGU2020—Thursday, 17 December at 11 AM EST)
- Panel reviews
- Community meetings
- Collaborate with NASA Centers to learn about relevance to NASA missions and research



Questions?

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