An update on the NASA ACCP Study

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Recap:

- Aerosol, Cloud, Convection, and Precipitation (ACCP) is one of the key recommendations of the 2017 NASA Earth Sciences Decadal Survey
- More a program than a mission:
  - Multiple satellites, possibly in different orbits
  - Involves a significant suborbital component: ground-based, airborne campaigns
  - An integrated modeling component
- A three year study was initiated in fall 2018 involving a study team with > 50 members from NASA GSFC, JPL, LaRC, Marshall, and Ames
- Study team is exploring mission concepts, will identify three best candidate mission designs which fall within the cost cap
- Recommendations to be presented to NASA HQ in early 2021
- Launch anticipated in the 2030 timeframe

ACCP Aerosols and Clouds, Convection, and Precipitation Study

ACCP Science Goals

DS Science Question

C-2 (I-MI): Climate Feedback and Sensitivity.

W-4 (MI): Convective Storm Formation Processes.

W-5 (MI): Air Pollution Processes and Distribution.

DS Science Objectives

C-2a (MI) and C-2h. Reduce uncertainty in low and high cloud feedback and total aerosol radiative forcing.

W-4a (MI). Measure the vertical motion within deep convection to determine convective transport and redistribution of mass, moisture, momentum, and chemical species.

W-5a (MI). Improve the understanding of processes that determine air pollution distributions and aid estimation of global air pollution impacts on human health and ecosystems.

ACCP Science Goals

G1 Cloud Feedbacks
Reduce the uncertainty in low- and high-cloud climate feedbacks

[G2 Storm Dynamics]

G3 Cold Cloud and Precipitation
Improve understanding of cold cloud processes and associated precipitation and their coupling to the water and energy cycles

G5 Aerosol Impacts on Radiation
Reduce the uncertainty in Direct and Indirect aerosol-related radiative forcing of the climate system.

G2 Storm Dynamics
Improve our physical understanding and model representations of cloud, precipitation and dynamical processes within convective storms

G4 Aerosol Processes
Reduce uncertainty in key processes that link aerosols to weather, climate and air quality related impacts.

Progress since last year

- Constructed and examined 50+ architectures (ie: mission concepts)
- Refined science requirements
- Added SW (UV to SWIR) and LW (4-50um) radiometers to provide radiation measurements for core science
  - TOA constraints
  - Cloud properties (OD, Re, albedo)
- Architecture evaluation:
  - Radar/lidar: trade studies, technical risk analysis, cost estimation
  - Developed quantitative scoring to compare science benefit of architectures
    - Largely based on simulations of retrieval uncertainties
  - Analysis of launch options
- Currently about a dozen architectures under consideration for the final three
  - A spectrum of instruments from large (radar, lidar) down to cubesat-class passive sensors
  - Considering combinations of large/medium/smallsats

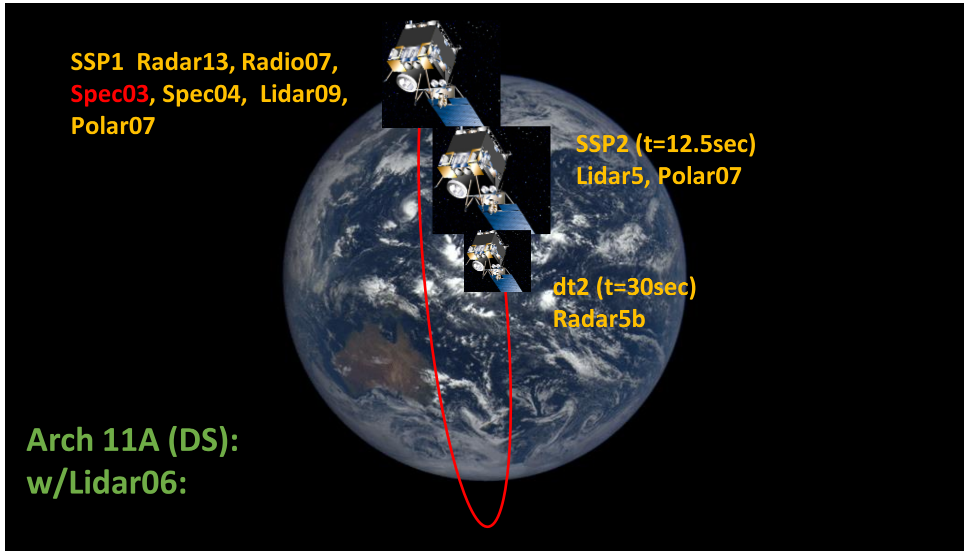
Architecture Studies:

- Now studying about a dozen appealing architectures, most built around a core payload:
    - HSRL (highly desired in polar orbit)
    - Multi-band, multi-angle polarimeter
    - Radar: two or three frequencies (W, Ka, Ku), with Doppler
    - SW, LW, and MicroWave radiometers/spectrometers
- Instruments placed on:
    - One or two large satellites
    - Or a mix of medium and small satellites
- Key trades:
    - Advanced lidar, advanced radar, or both?
    - Polar sun sync orbit vs low inclination orbit (diurnal coverage)
    - Data continuity (A-train, GPM)
    - Time-difference measurements for insight into cloud dynamics

Two architecture concepts:

11A

- Polar orbit with three satellites in formation
  - Core payload distributed between two MediumSats
  - SmallSat radar following at 30 sec delay to observe convective development



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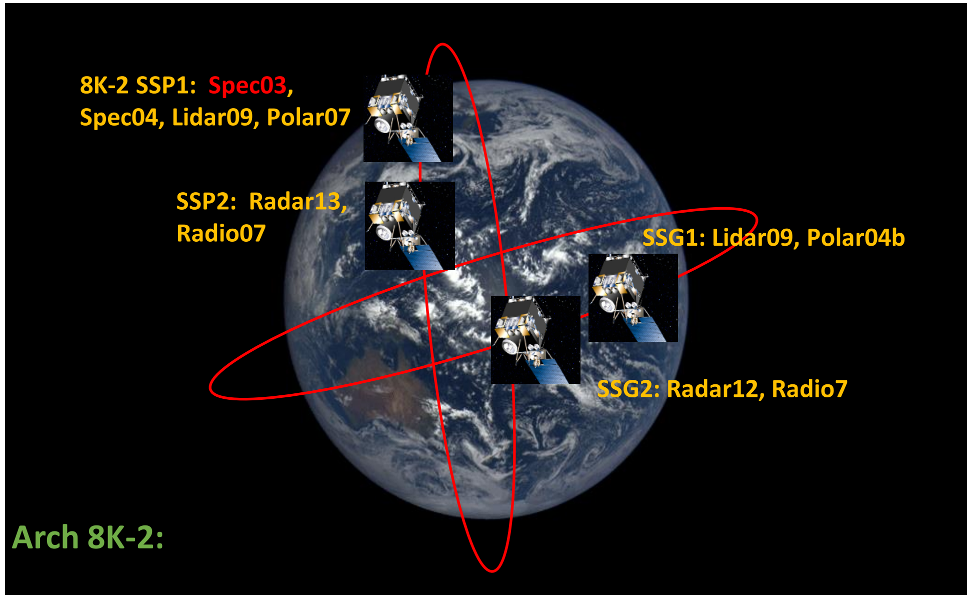
- Four satellites in two orbit planes:
  - Polar sun-sync orbit for continuity with A-train
  - Low inclination orbit for diurnal sampling



Upcoming Activities

FY 2021

- January – down select from a dozen to three architectures
  - Each architecture will have a different implementation strategy or science emphasis
  - Goal is to “make progress” in all objectives, but to be “transformative” in one or more objectives
- Hold Modeling and Sub-orbital workshops (probably virtual)
- Study team management will release more specific RFIs for instruments and spacecraft (to increase technical and cost confidence)
- Refine concepts and cost estimates
- Develop inputs for future AO or RFP (request for proposal)
- Submit final report to document results of study
  - Payload and mission concepts
  - Science to be addressed

FY 2022:

- Develop acquisition strategy (HQ)
- Conduct pre-Phase A study

Community Engagement Opportunities

- To follow ACCP activities and download materials relevant to study, check-out https://earth.gsfc.nasa.gov/missions/accp
- New, more interactive, web-site will be made publicly available in October

ACCP Working Groups—Working Groups are specialized units that collaborate with SALT, SIT, AIT, SCC, SET, VFT, and SMT. To contact/participate in any of the Working Groups, please contact the respective co-lead.

- ***Lidar Working Group--ROBERT E HOLZ reholz@ssec.wisc.edu***
- ***Radar Working Group--matthew.d.lebsock@jpl.nasa.gov***
- ***Radiation Working Group--wing.sze.lui@jpl.nasa.gov***
- ***Sub-Orbital Working Group (includes Calibration and Validation)--walt.petersen@nasa.gov; felix.c.seidel.caprez@jpl.nasa.gov***
- ***Modeling Working Group--Andrew Gettelman andrew@ucar.edu***
- ***Data Analysis & Forecast OSSE Planning--ARLINDO DA SILVA arlindo.m.dasilva@nasa.gov***
- ***Algorithm Working Group (will start in January 2021 after down-select to final 3 Architectures)***

ACCP Study Team—Changes In Yellow

Study Management Team (SMT)

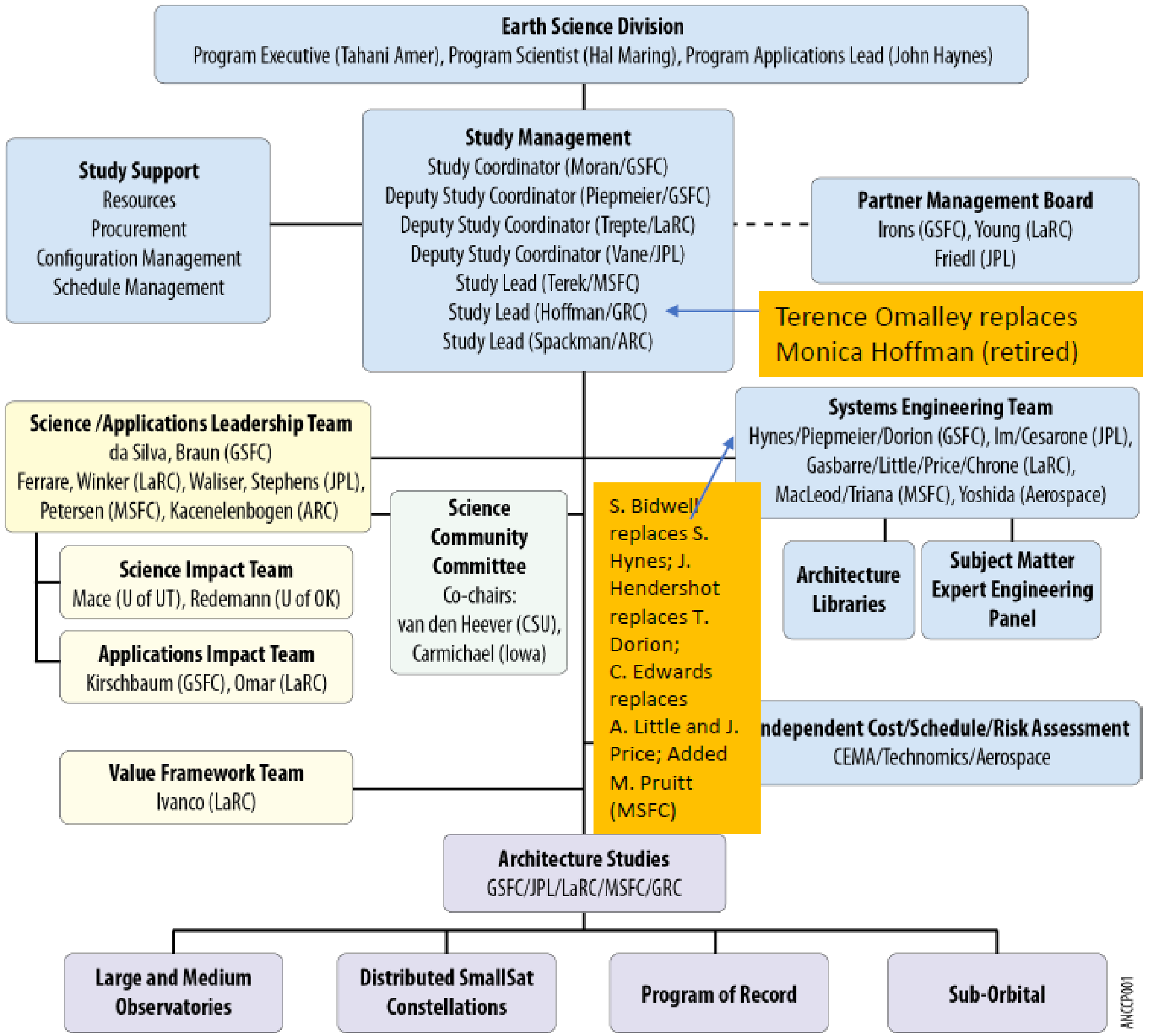
- Overall Leadership and Management of Study and Delivery of Study Report
- Community Engagement
- Assessment of Architectures
  - Cost Estimation & Validation
  - Programmatic Risk
  - Other Programmatic Factors

Science/Applications Leadership Team (SALT)

- Definition of Science & Applications Traceability Matrices
- Assessment of the Utility of the Geophysical Variables in Meeting Each Objective

Science & Applications Impact Teams (SIT and AIT)

- Assessing the Science & Applications Value of Architectures (Science Quality of Each Architecture wrt Meeting Geophysical Variables)



Science Community Committee

- Independent Assessment of SATM
- Independent Assessment of Science & Applications Benefit by Community of Users

Systems Engineering Team (SET)

- Definition of Architectures
- Assessment of Architectures
  - Technology Readiness
  - Technical Risk

Value Framework Team

- Development of Standard and Systematic Approach to Science, Applications, and Programmatic Evaluations of Architectures to facilitate Down-Select Decisions