ATMOSPHERE
Observing System

National Aeronautics and Space Administration

EARTH SYSTEM OBSERVATORY

Overview of the Earth System Observatory—Atmosphere Observing System (AOS)

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AOS Current Status

Current concept achieves Aerosol and CCP science

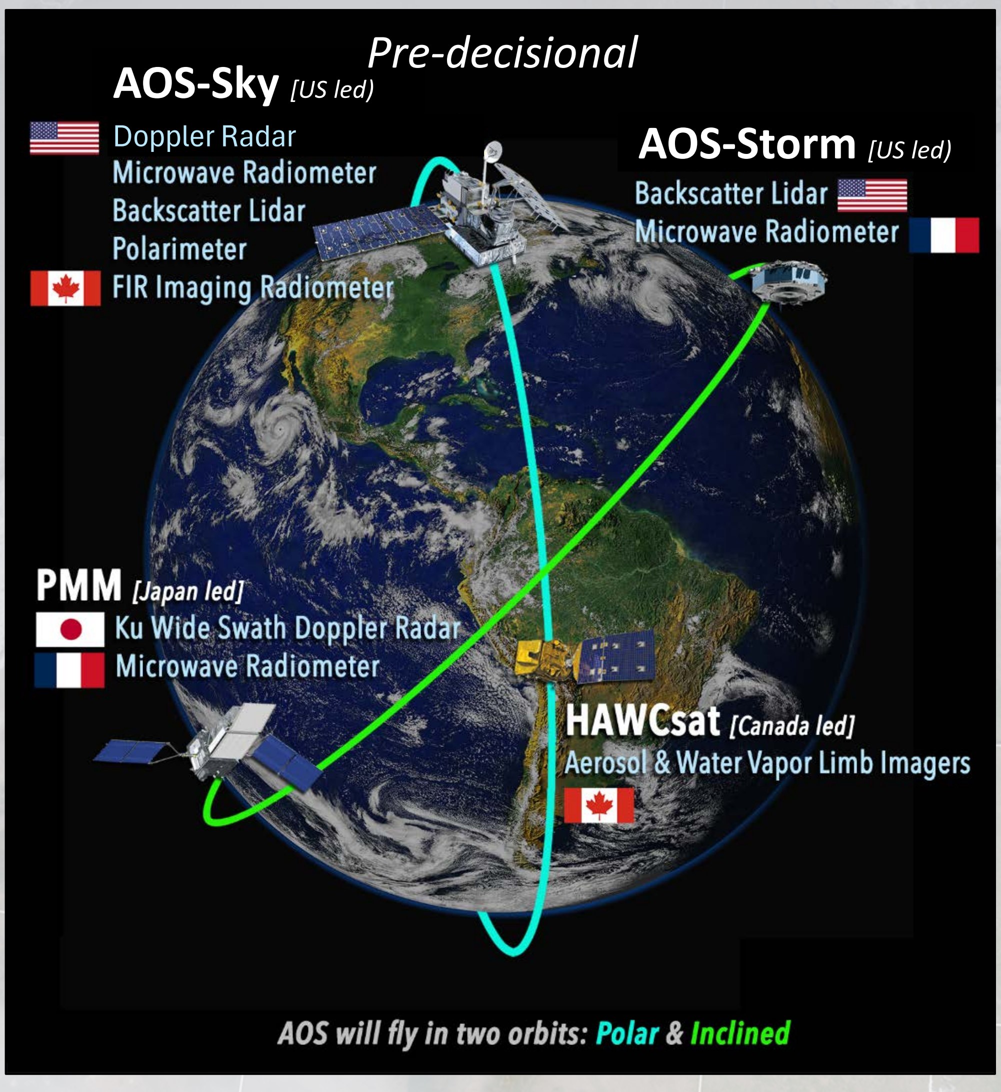
- Delivers globally distributed measurements over a range of temporal scales
- Complemented by sub-orbital element (e.g., science & cal/val)

AOS-Sky satellite represents Decadal Survey Minimum candidate architecture

- Expecting to pursue Pre-formulation study with ASI on a lidar separate from AOS-Sky
- CSA HAWCsat adds information on aerosol and moisture profiles

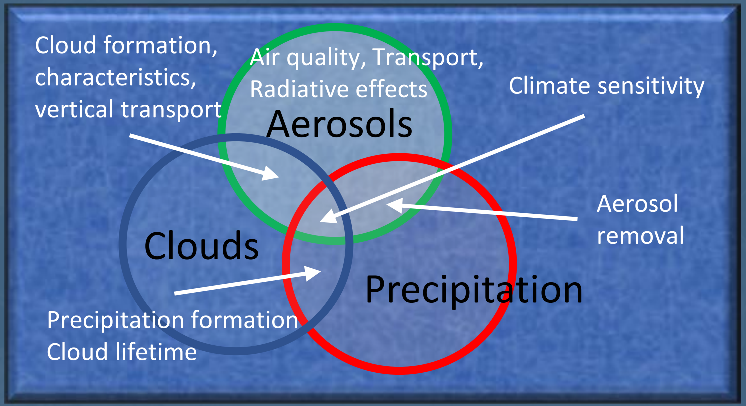
Generous contributions from JAXA and CNES enable critical science over varying times of day

- Addresses DS stated importance of diurnally varying measurements for CCP
- Provides continuity with TRMM/GPM with Doppler capability and new time-differenced radiometer measurements
- U.S. backscatter lidar adds aerosol and cloud detection as well as PBL height information

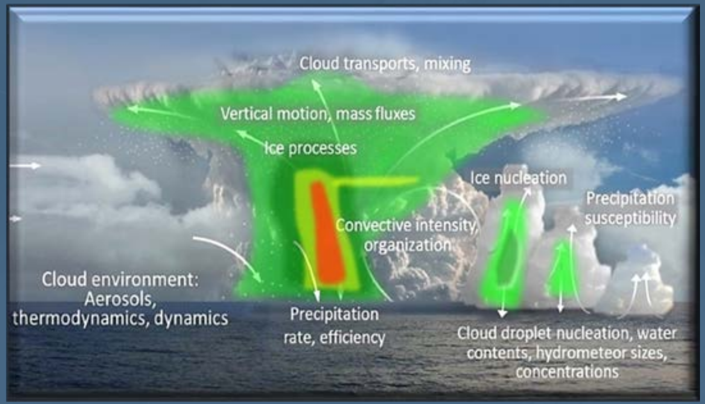


Graphic reflects initial architecture concept directed at KDP-A. Additional direction was provided to study architecture changes, which are still on-going.

AOS's Focus on Three DS Themes



1. CLIMATE: How can we improve our ability to predict local and regional climate response to natural and anthropogenic forcings and reduce the uncertainty in global climate sensitivity?



2. CONVECTION: Why do convective storms, heavy precipitation, and clouds occur exactly when and where they do? How do microphysical properties relate to storm dynamics?

3. AEROSOLS: What processes determine the spatio-temporal structure of important air pollutants and their concomitant adverse impacts on human health, agriculture, and ecosystems?

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Relationship Between DS And AOS Science Objectives and Geophysical Variables

Most Important DS Objectives

Climate:

C-2a. Reduce uncertainty in low and high cloud feedback by a factor of 2.

C-2h. Reduce total aerosol radiative forcing uncertainty by a factor of 2.

Convection:

W-4a. Measure the vertical motion within deep convection and heavy precipitation rates

W-2a: Larger range environmental predictions

Aerosols:

W-5a. Improve the understanding of the processes that determine air pollution distributions …

W-2a: Larger range environmental predictions

Related AOS Science Objectives

O1. Low clouds

O2. High clouds

O4. Cold cloud and precipitation processes

O7. Aerosol direct effect and absorption

O8. Aerosol indirect effects

O3. Convective storms, including dynamics

O5. Aerosol attribution and air quality

O6. Aerosol, Removal, Redistribution and Processing

Key AOS Geophysical Variables

- • • Cloud profiles
- • • Cloud optical depth
- • • Cloud droplet effective radius
- • Cloud ice particle size
- • • Cloud liquid water path
- • • Ice water path
- • • • Precipitation profiles/rate
- • • In-precipitation vertical air motions
- • • In-cloud vertical air motion
- • • • Aerosol extinction profile
- • • • Aerosol-cloud feature mask
- • • • Aerosol optical depth
- • • Aerosol absorption properties
- • • Aerosol fine-mode effect radius

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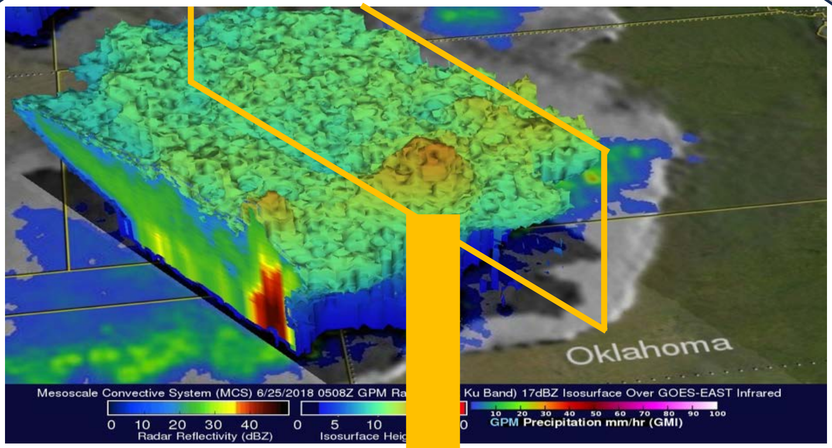
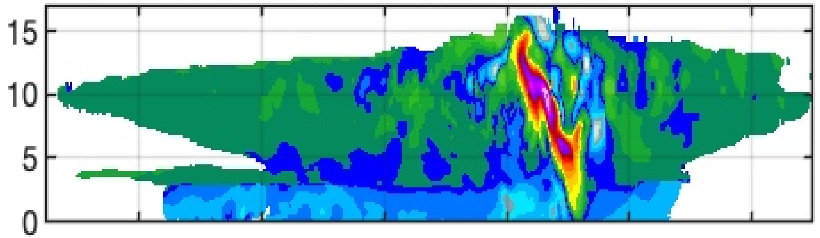
A Visual View of AOS-Storm Measurements

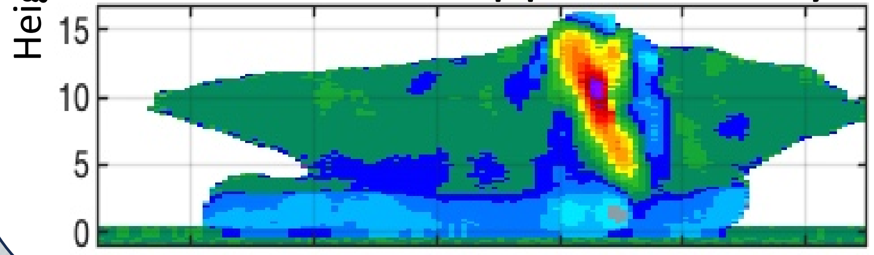
JAXA Wide Swath Ku Doppler Radar



Model "Truth"

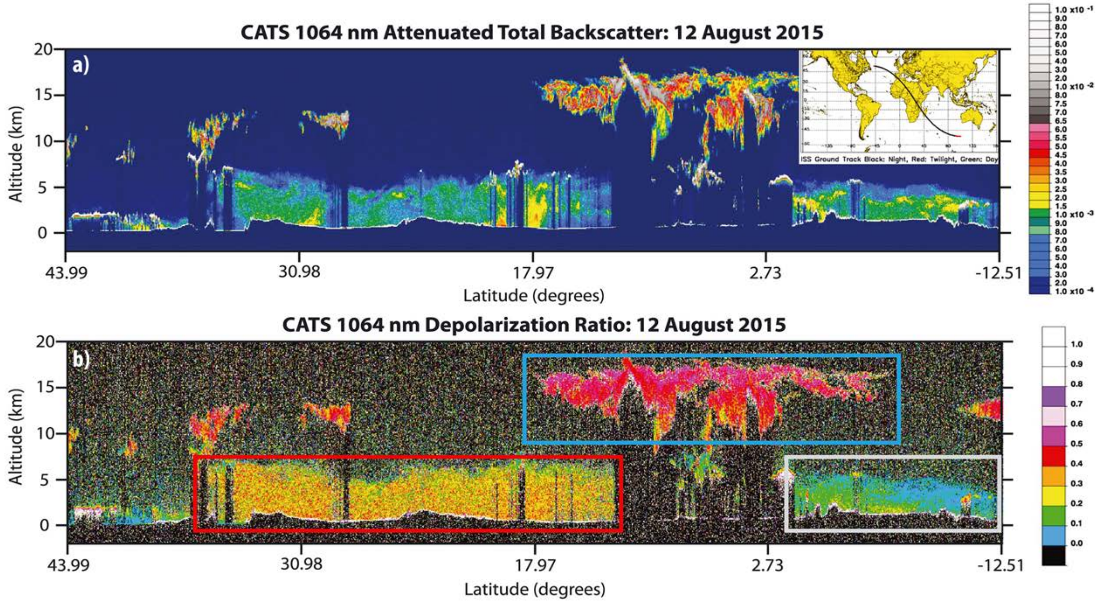


Simulated Ku Doppler Velocity

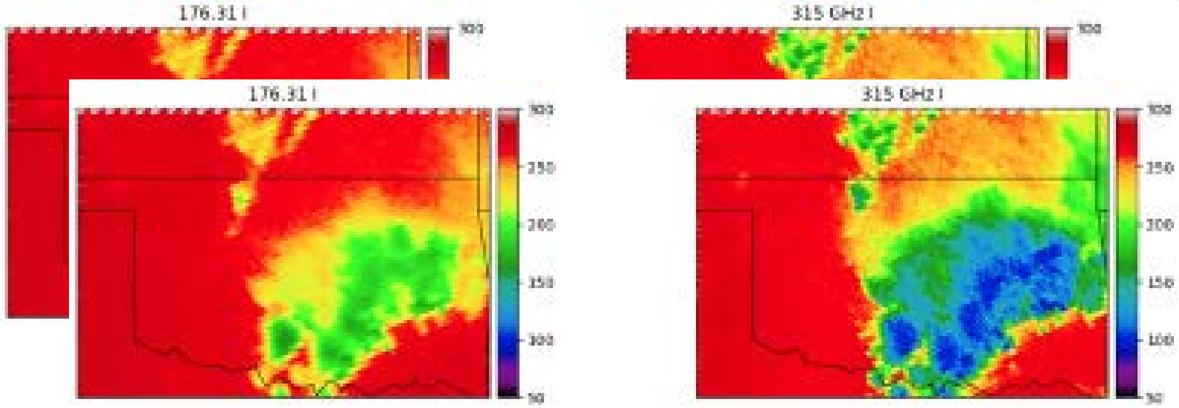


Courtesy Pavlos Kollias

532-, 1064-nm Backscatter Lidar



CNES Microwave Radiometers (89, 183, 325 GHz)



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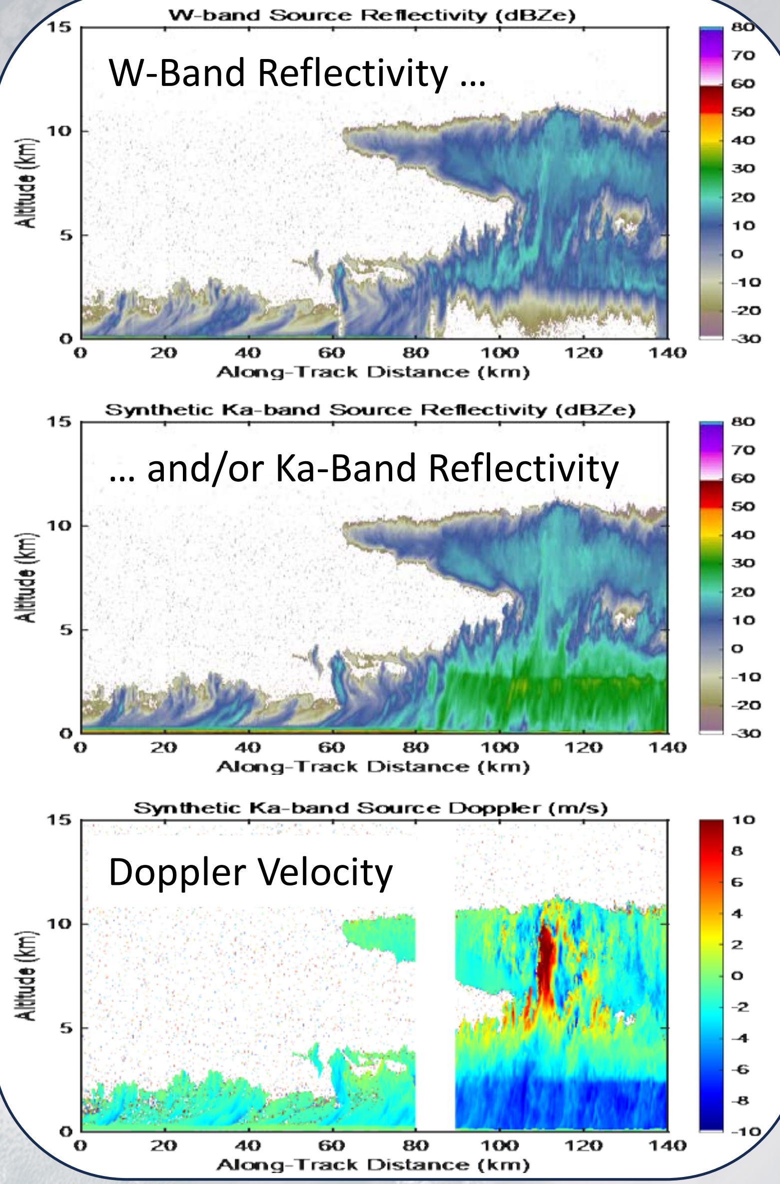
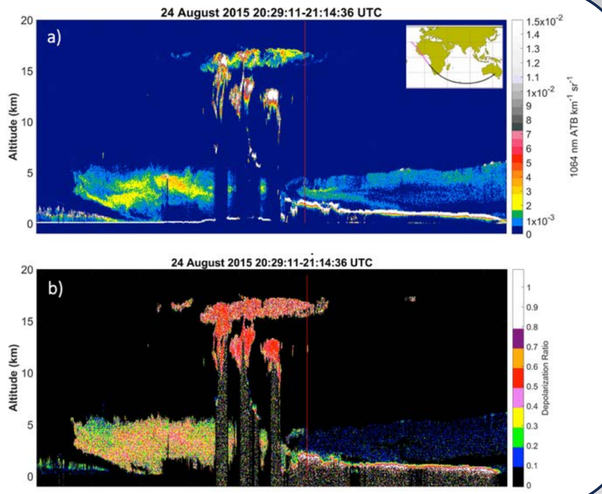
A Visual View of AOS-Sky Measurements

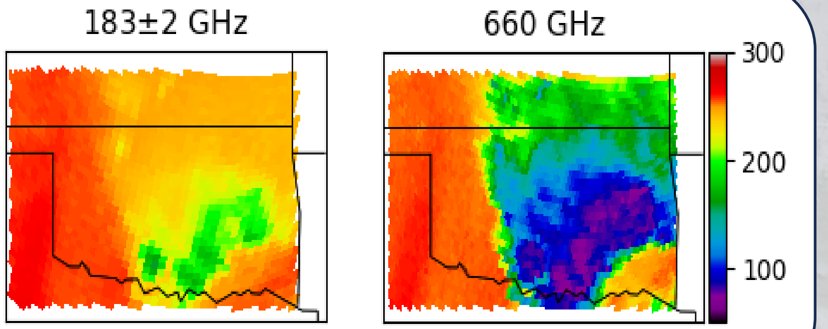
Single-Frequency Doppler Radar



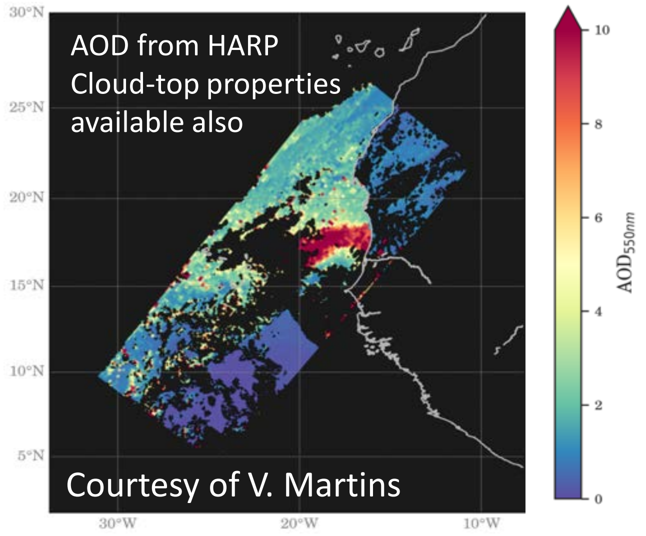
532-, 1064-nm Backscatter Lidar



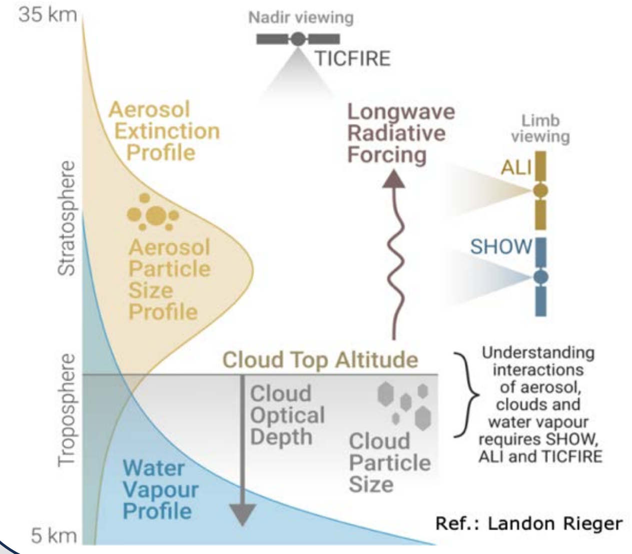
Microwave Radiometer: 89-700 GHz



Multi-angle Polarimeter



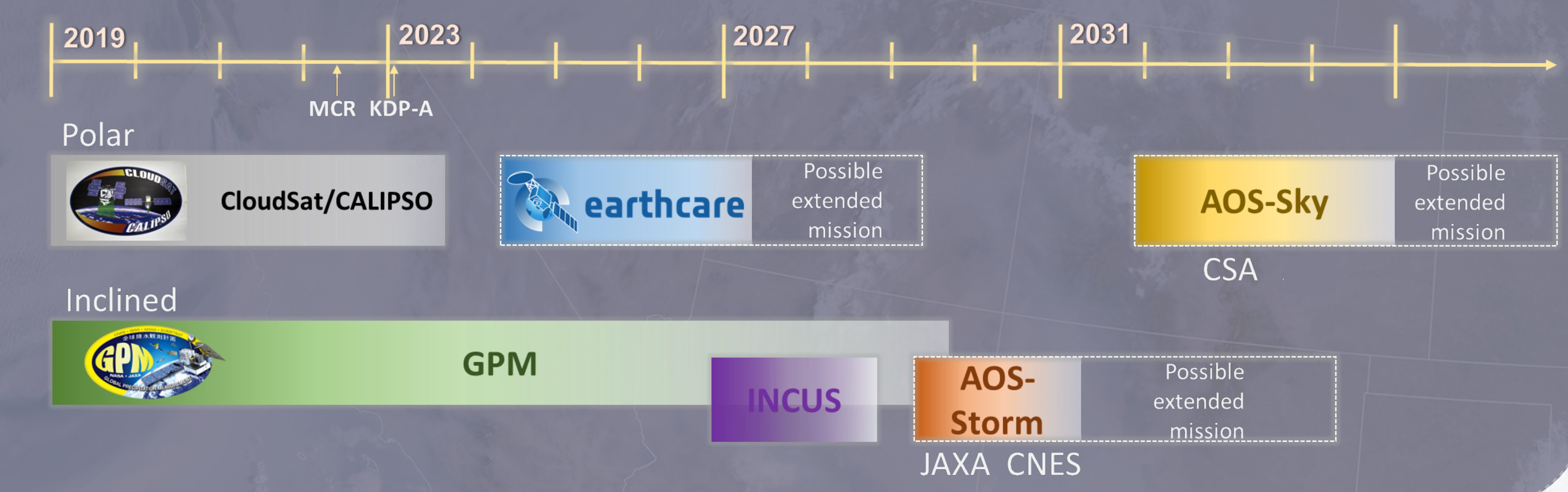
CSA LWIR-FIR Radiometer (4-73 μm), Aerosol/Moisture Limb Sounding



The Urgency and Timing of AOS

- We are feeling the **impacts from climate change <u>now</u>**
    - o Temperature extremes, Fires & Air Quality impacts, too little and too much precipitation
    - o Extreme storms – increasing in intensity and $$
- Planet may reach **1.5°C warming in a decade but projections have considerable uncertainty**
    - o Need improved observations to constrain models and improve scenario modeling

Key elements of the Earth-observing system of satellites related to atmospheric measurements are **coming to an end in the very near future.**



Summary

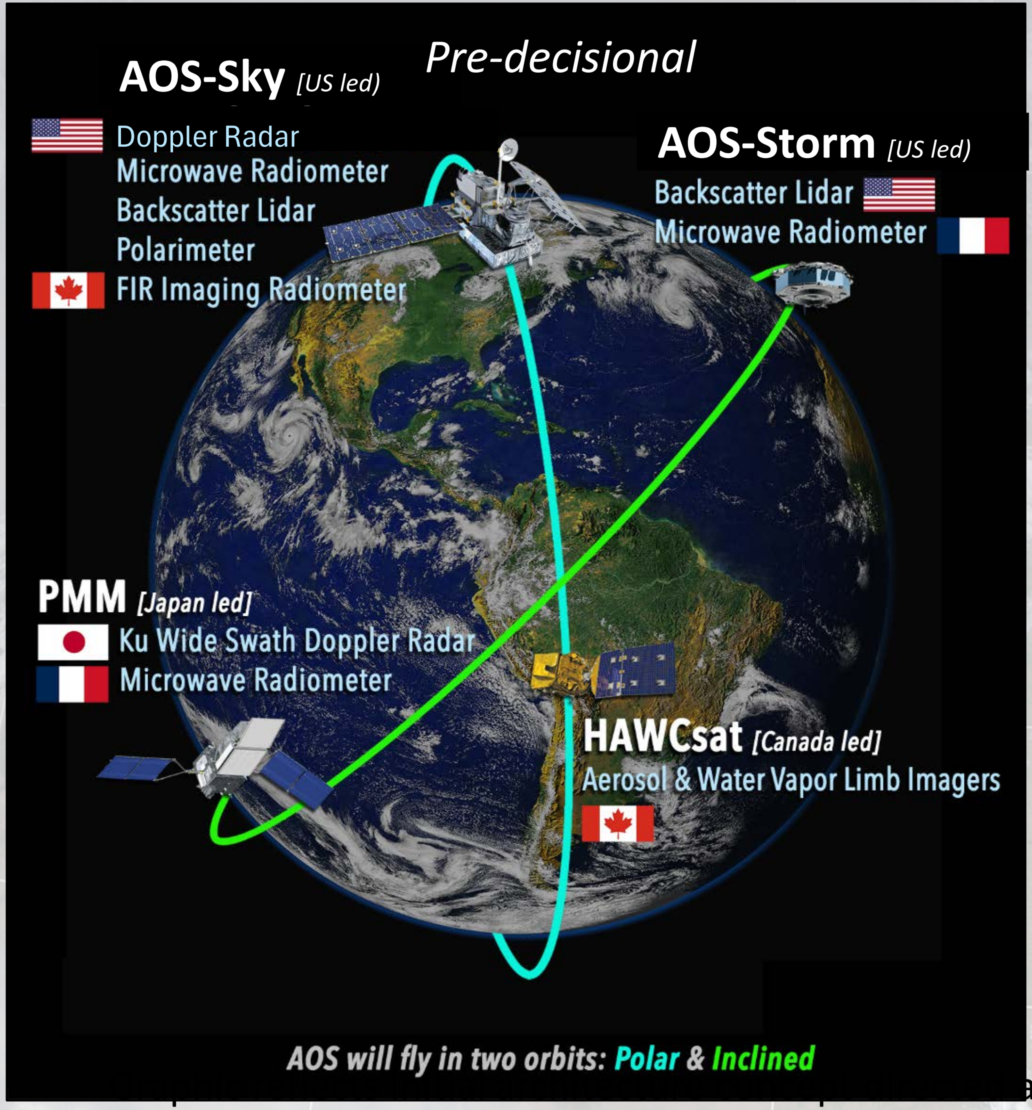
- AOS is two projects focused on coupled aerosol-cloud-precipitation processes
- AOS-Storm proceeding as planned per Mission Confirmation Review
- Exploring trades for AOS-Sky
  - Potential partnership with ASI on polar lidar
  - Current trade studies underway for radar
  - Additional trades may be necessary in near term due to budget profile uncertainty

AOS-Storm- Class C

- NLT March 2029 launch
- 407-430 km orbit, 55° inclination
- 1-2-yr mission life, 3 yrs of consumables

AOS-Sky- Class C

- NET December 2031 launch
- 450 km orbit, sun-sync-13:30 LTAN
- 3-yr mission life, 5 yrs of consumables



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