



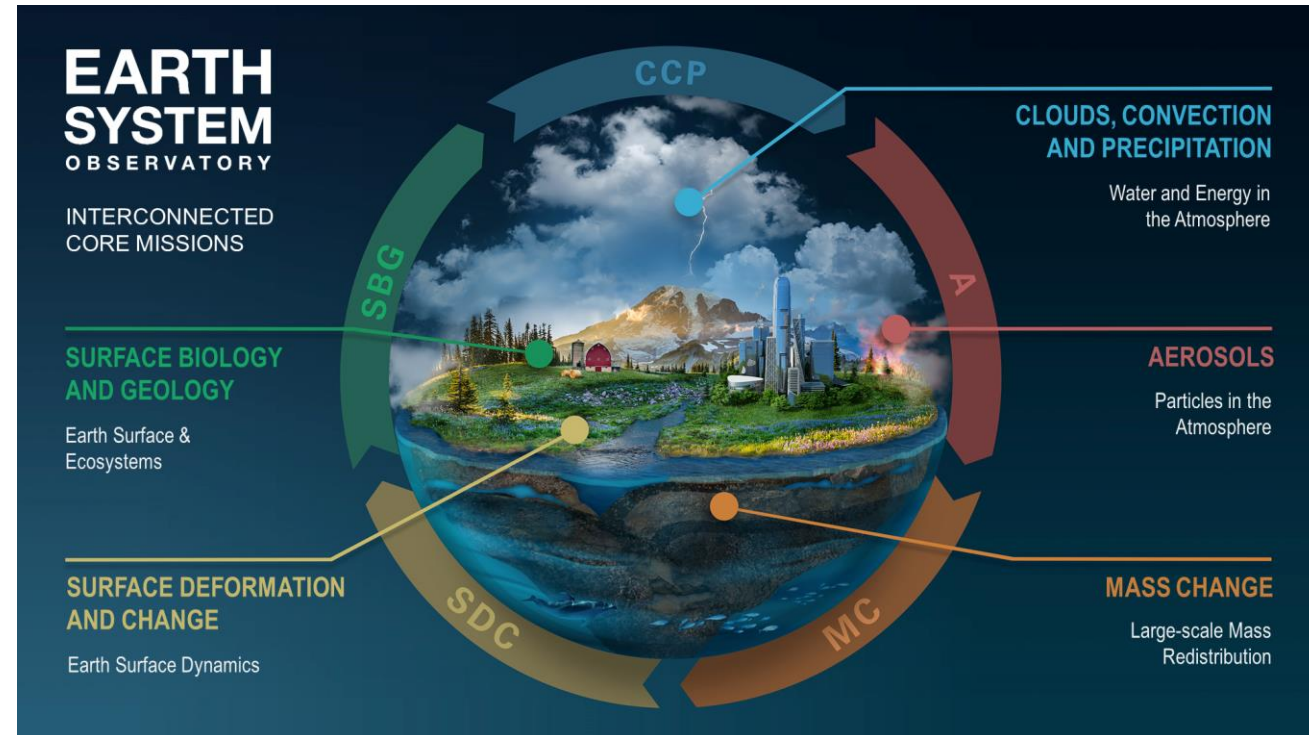
# From NASA's EOS to ESO: Advancing Applications of the Future Atmosphere Observing System (AOS) Mission

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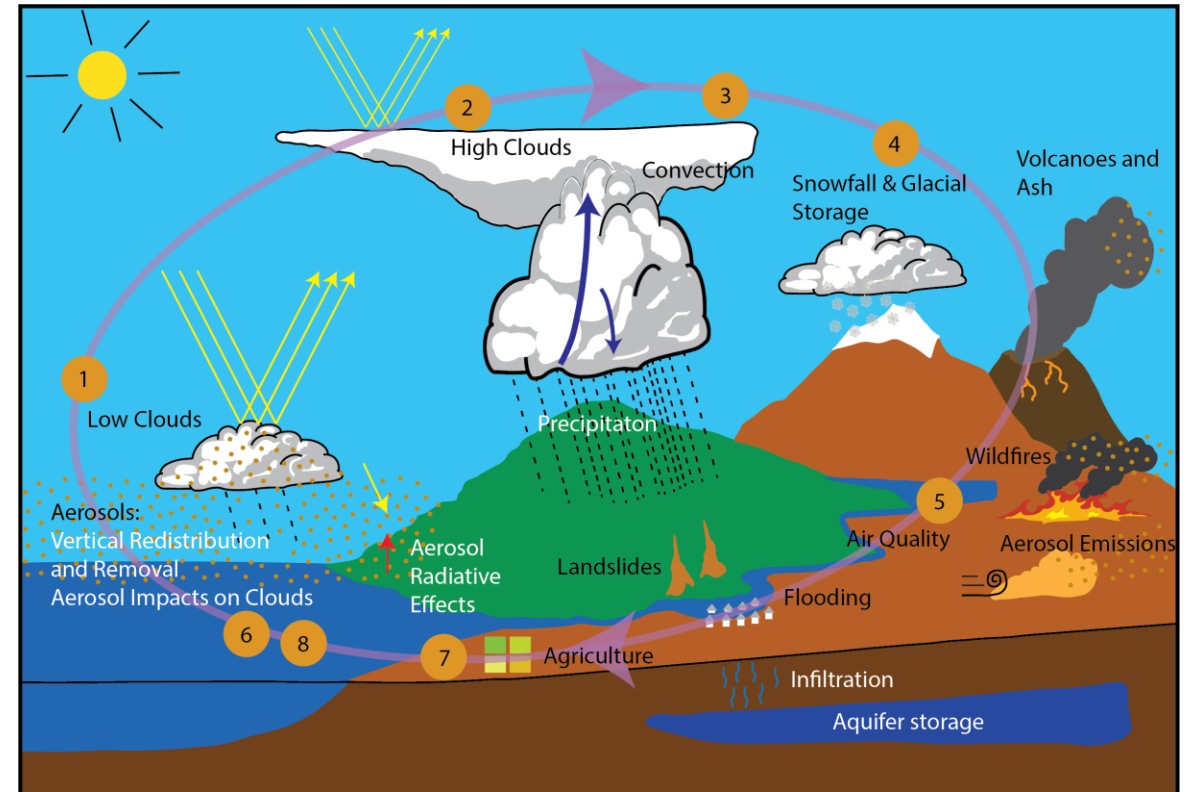
# What is AOS?

- The 2017 Decadal Survey recommended five "Designated Observables" which included one labeled "**Aerosol**" and another "**Cloud, Convection, and Precipitation**"
- October 2018 - A pre-formulation study team was assembled "**Aerosol, Cloud, Convection, and Precipitation (ACCP)**"
- In May 2021, a pre-Phase A study was authorized; to reflect the space, suborbital, modeling, and applications aspects of the observing system. ACCP was replaced by **Atmosphere Observing System (AOS)**, which is part of new **Earth System Observatory (ESO)** construct



# AOS Science Priorities and Questions

AOS addresses these priorities with an **observing system** that focuses on **connected** measurements addressing Decadal Survey themes of climate sensitivity, convection, and aerosol processes



## AOS Science Objectives

- |                                |  |
|--------------------------------|--|
| 1. Low cloud feedbacks         | 5. Aerosol attribution and air quality |
| 2. High cloud feedbacks        | 6. Aerosol redistribution and removal  |
| 3. Convective storm processes  | 7. Aerosol direct effect               |
| 4. Cold clouds & precipitation | 8. Aerosol indirect effect             |

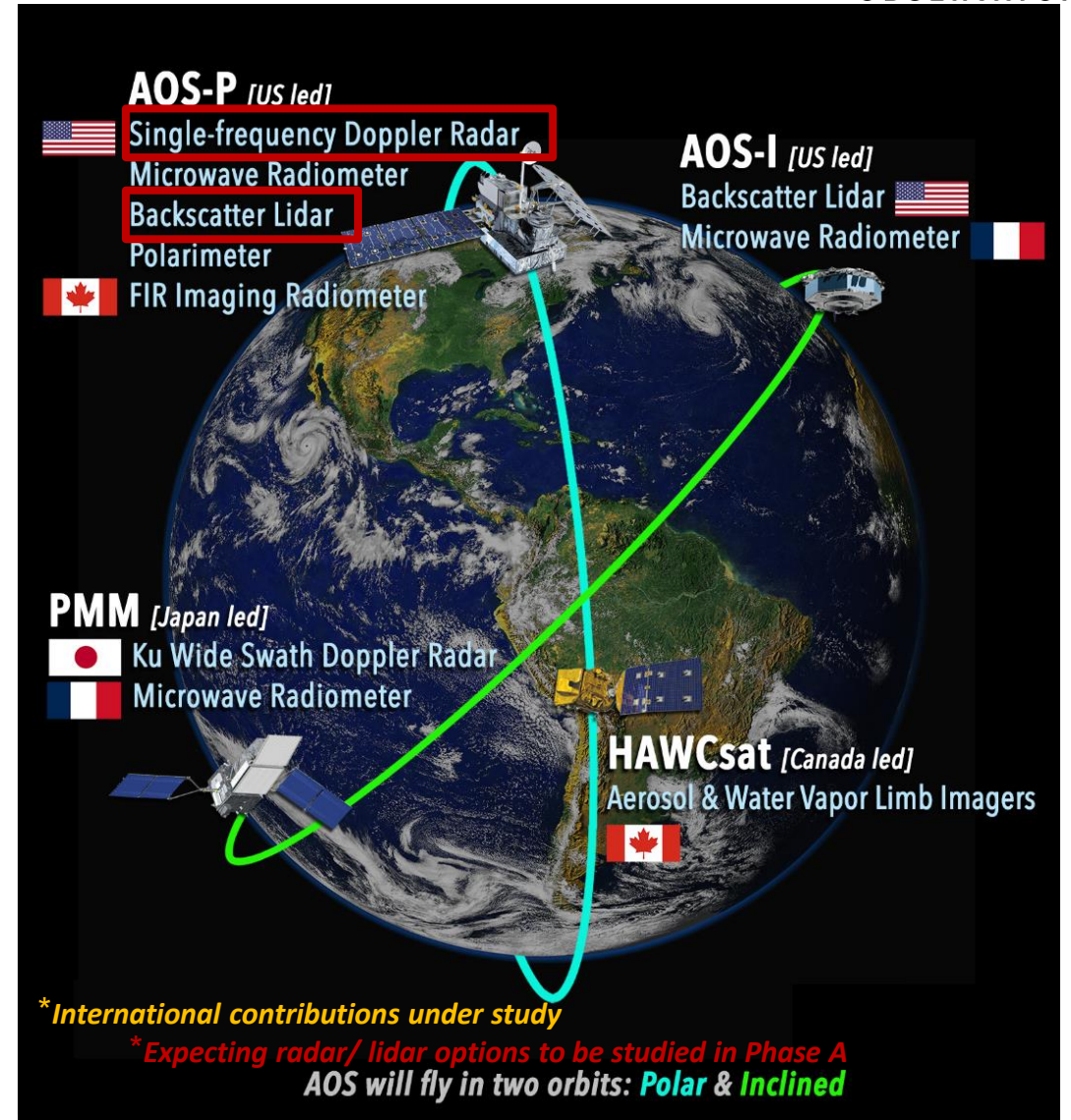


# The AOS Architecture

- Inclined (55°) orbit focused on weather (sub-daily) time scales with emphasis on convection, high clouds, and aerosol/PBL evolution
- Polar, sun-sync orbit focused on improved measurements for climate processes and sensor synergies
- Completed Mission Concept Review in May 2022
- Independent Review Board (IRB) Study\* (August – September 2022). To address cost and technical readiness risks
- Key Decision Point (KDP-A) review January 2023

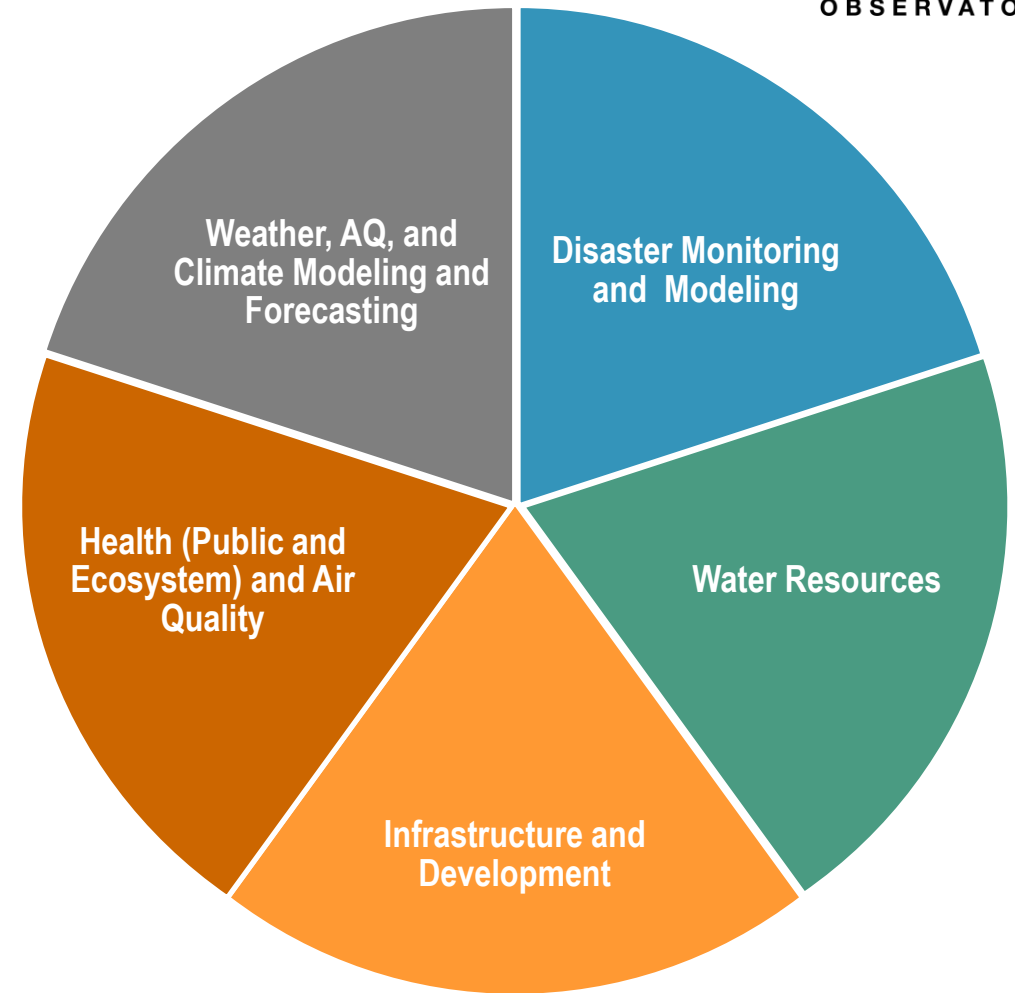
*Pre-Decisional-AOS is in Pre-Phase A and NASA makes no commitments on the final design of the mission or instruments*

**EARTH  
SYSTEM  
OBSERVATORY**



# AOS Applications

- The AOS Applications Team (AIT) is charged with **ensuring that applications are considered to the greatest extent possible** in mission design and implementation.
- **AOS will provide key information to support decision making at timescales from hours to decades**
  - enabling improved weather and air quality forecasting today
  - seasonal to sub-seasonal changes in the near future
  - societal challenges resulting from climate change in the decades to come



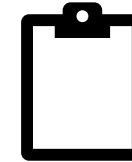


### ACCP Stakeholder Workshops

- Weather and Air Quality Modeling (7/2019)
- Transportation and Logistics (11/2020)
- Air Quality (3/2021)



### Interviews with Communities of Practice and Potential



### Surveys and Trainings

- Weather and AQ modeling community
- ARSET GPM training



### Science Conference Engagements

AGU, AMS, Community Forums, HAQAST Workshops, GPM Science Team, International Association of Wildland Fire, CALIPSO Science Team



### Community Assessment Report

Characterize 10 user communities that could benefit from AOS measurements

- Over 250 workshop attendees and surveys solicited
- Over 60 independent interviews
- Engagement with National/International agencies and the private sector



### Non-Traditional User Needs

Summary of new users and applications with a focus on private sector

# Program of Record: Applications

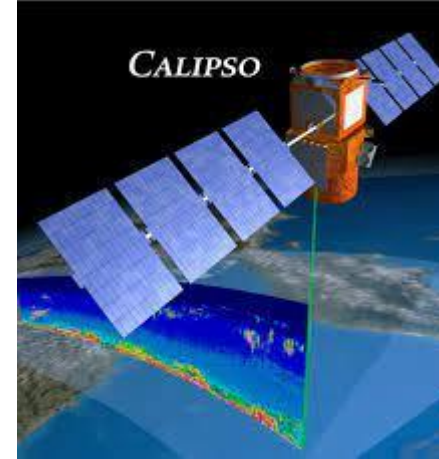
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SYSTEM  
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## GPM



Weather forecasting (Tropical Cyclones and Precipitation Events)  
NWP & Climate modeling  
Water resources & Agriculture  
Disasters  
Energy  
Public Health

## CALIPSO



Air Quality Forecasting  
Air Quality Modeling  
Air Quality Assessments  
Hazardous Plume Forecasting  
NWP Verification & Improvement

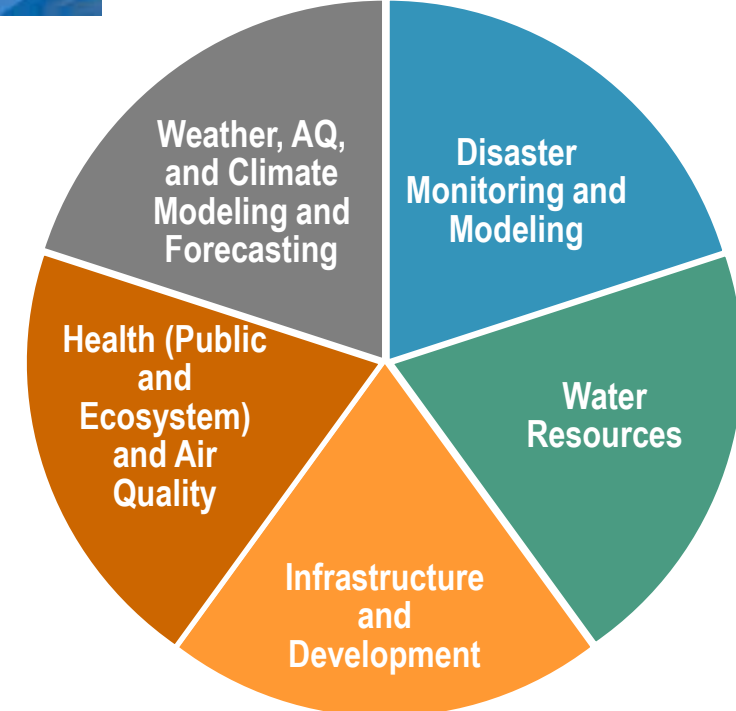
## AQUA & TERRA MODIS



Weather forecasting (Tropical Cyclones and Precipitation Events)  
NWP & Climate modeling  
Air Quality Forecasting  
Air Quality Modeling  
Air Quality Assessments  
Public Health

## SNPP & JPSS VIIRS

## AOS

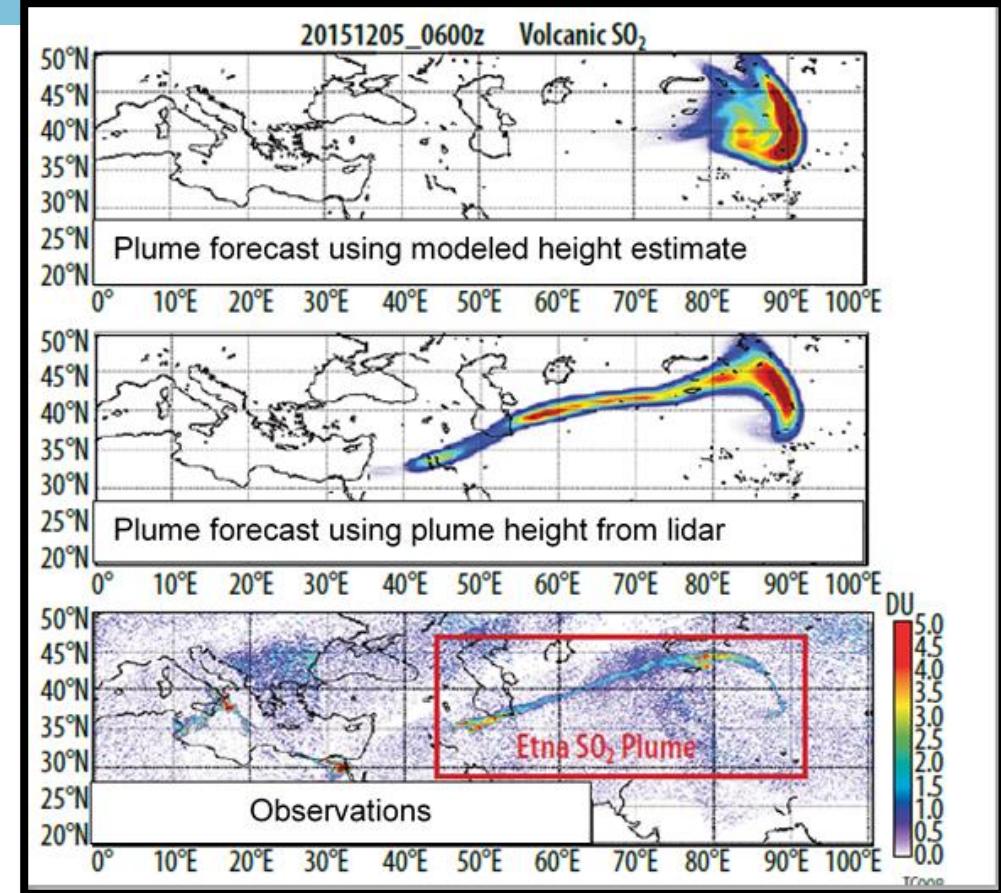




# Hazardous Plume Forecasting

What can we learn about this community of users?

- Require quantitative information
  - Plume height, thickness, mass
  - For volcanic plumes:  
Discrimination between ash, dust, and SO<sub>2</sub>
- Data needs:
  - < 3h latency is most useful
- Require readily ingestible and digestible information



Low latency observations of the vertical profile of aerosols, such as from lidar, are critical to providing accurate forecasts of plume transport. Figure adapted from Hughes et al. (2016).



# AOS Applications Seminar Series

## Monthly seminar to foster dialogue on:

- Opportunities to leverage AOS data products in stakeholder applications and research
- Existing gaps in data needs that may present future opportunities for ESO and AOS
- Engagement of communities to increase awareness of and participation in AOS
- Expand breadth of thematic areas covered in preparation for future activities, including Early Adopter Program

- High seminar attendance (~>70 participants)
- 10 seminars covering a wide range of topics



Applications Seminars: <https://aos.gsfc.nasa.gov/meetings.htm?id=sem>

# Seminars – What we’ve learned



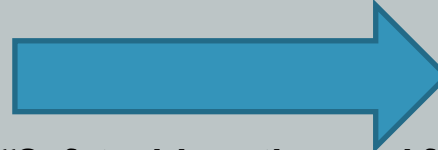
## Organizations Represented

FAA Advanced Weather Research Program  
United Airlines  
NOAA NWS Aviation Weather Center  
NOAA NESDIS/STAR  
NRL

## Applications

- Icing
- Turbulence
- Convective Weather
- Volcanic Plumes
- Wildfire smoke/pyroCBs

*“Data latency and  
operational  
availability is key”*



*“Safety drives the need for  
high quality products with  
long development times”*

## Societal Impacts

- Safety
- Avoiding Injuries
- Airport operations
- Flight Re-routing/Planning
- Avoiding rapidly developing hazards

## Important AOS Measurements

- Cloud top phase, temperature, and particle size are important for identifying supercooled water droplets for icing
- Cloud top height and upward motion for convective awareness

## Potential Benefits of AOS

- High-resolution, nadir observations are valuable for detail of phenomena
- Some value in a snapshot of a ‘signal’ especially for slow changing processes
- Rely on research community to understand the value, blend it with other sources

# Seminars – What we've learned



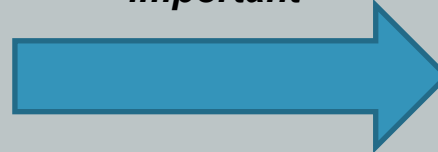
## Organizations Represented

UNICEF  
WESTAR  
Texas Commission on Environmental Quality

## Applications

- Climate and disaster risk policies, mitigation, adaptation
- Health vulnerability mapping
- Air quality modeling, monitoring, and forecasting
- Tracking wildfire smoke and dust
- Exceptional events and non-attainment

***"Data access and training on use is important"***



***"having data where surface monitors are lacking is informative"***

## Societal Impacts

- Exposure to climate and environmental hazards – cyclones, flooding, air pollution
- Increasing access to water
- Decreasing vector-borne disease
- Public air quality and smoke alerts
- Air quality episodes, regulatory significance

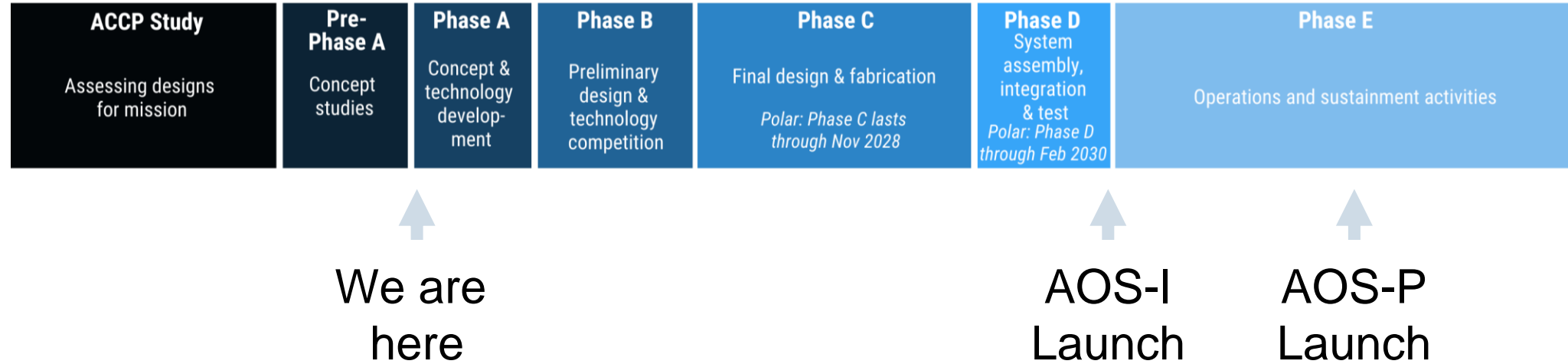
## Important AOS Measurements

- Precipitation to assess trends in environmental health hazards
- Aerosol optical depth to track wildfire smoke or dust
- PM2.5 to assess pollution and air quality standard attainment (non-attainment)

## Potential Benefits of AOS

- Informing climate and disaster vulnerability assessments and indices
- Assessing vertical gradients in pollution to link events to the 'human level' (surface)
- Analyzing air pollution events and non-attainment to inform health standards

# How can I get involved with AOS?



<https://aos.gsfc.nasa.gov/>

- Attend AOS events forums
  - AOS Application Seminars
  - Thematic Workshops
- Email applications coordinator [andrea.m.portier@nasa.gov](mailto:andrea.m.portier@nasa.gov) to get on our mailing list