TRMM Accomplishments and Applications

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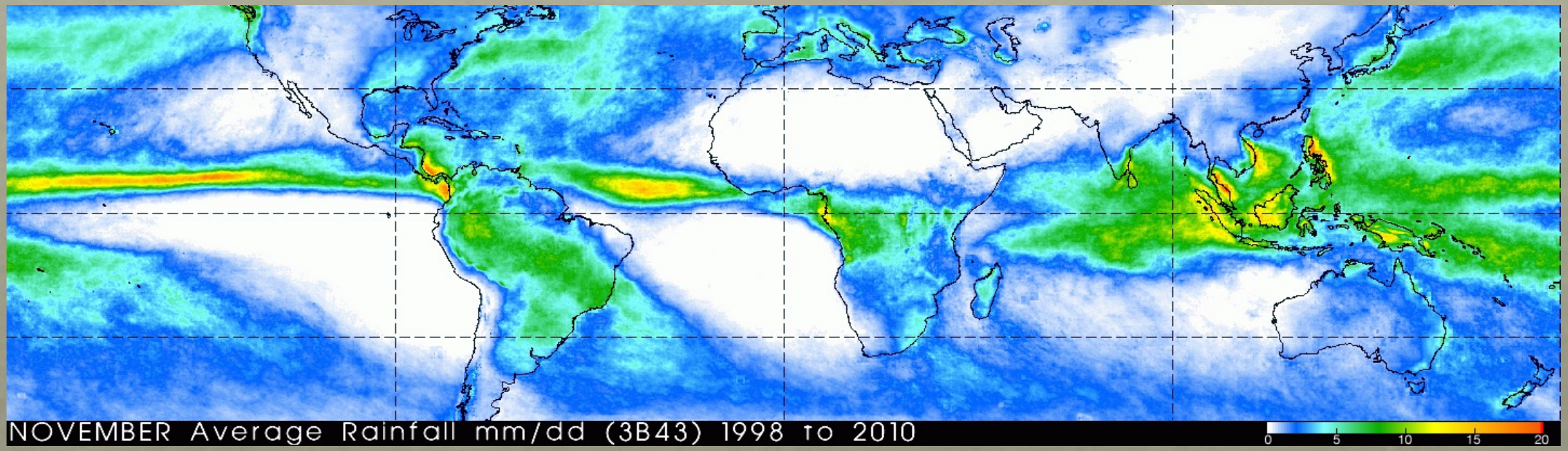
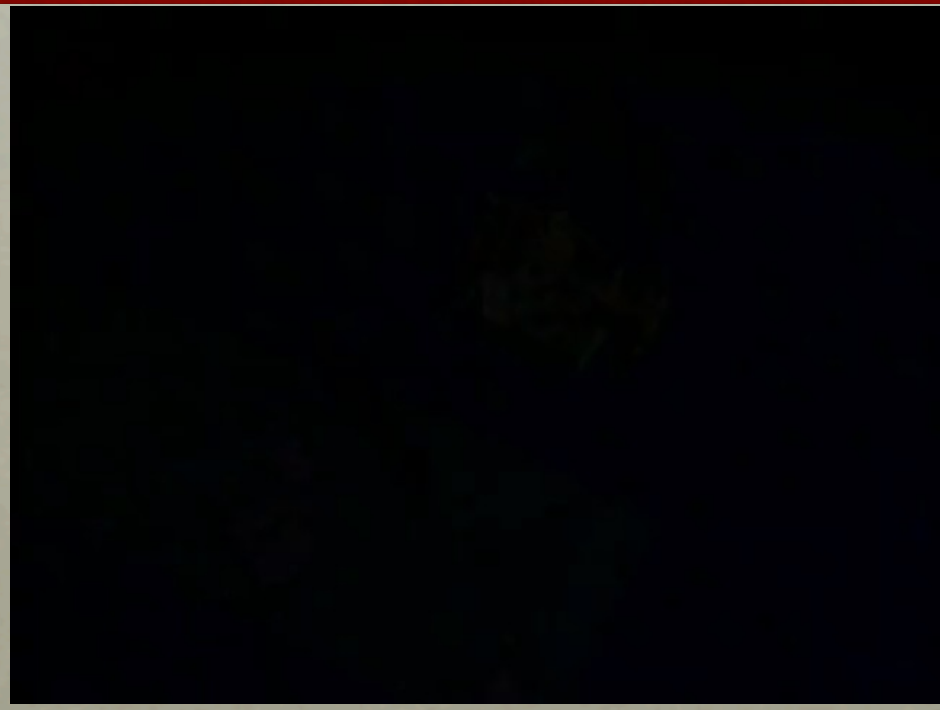


TRMM PAYLOAD

Joint NASA/JAXA mission launched in Nov. 1997
Instrument Payload:

- **TRMM Microwave Imager (TMI)**
- **Precipitation Radar (PR) [Japan]**
- **Lightning Imaging Sensor (LIS)**
- **Visible IR Scanner (VIRS)**
- **Clouds and Earth's Radiant Energy System (CERES)**



Original TRMM Goal: To produce rainfall estimates on 5x5° grids on monthly time scales

Accomplishment: High-quality rainfall estimates on 0.25x0.25° grids at 3-hourly time scales

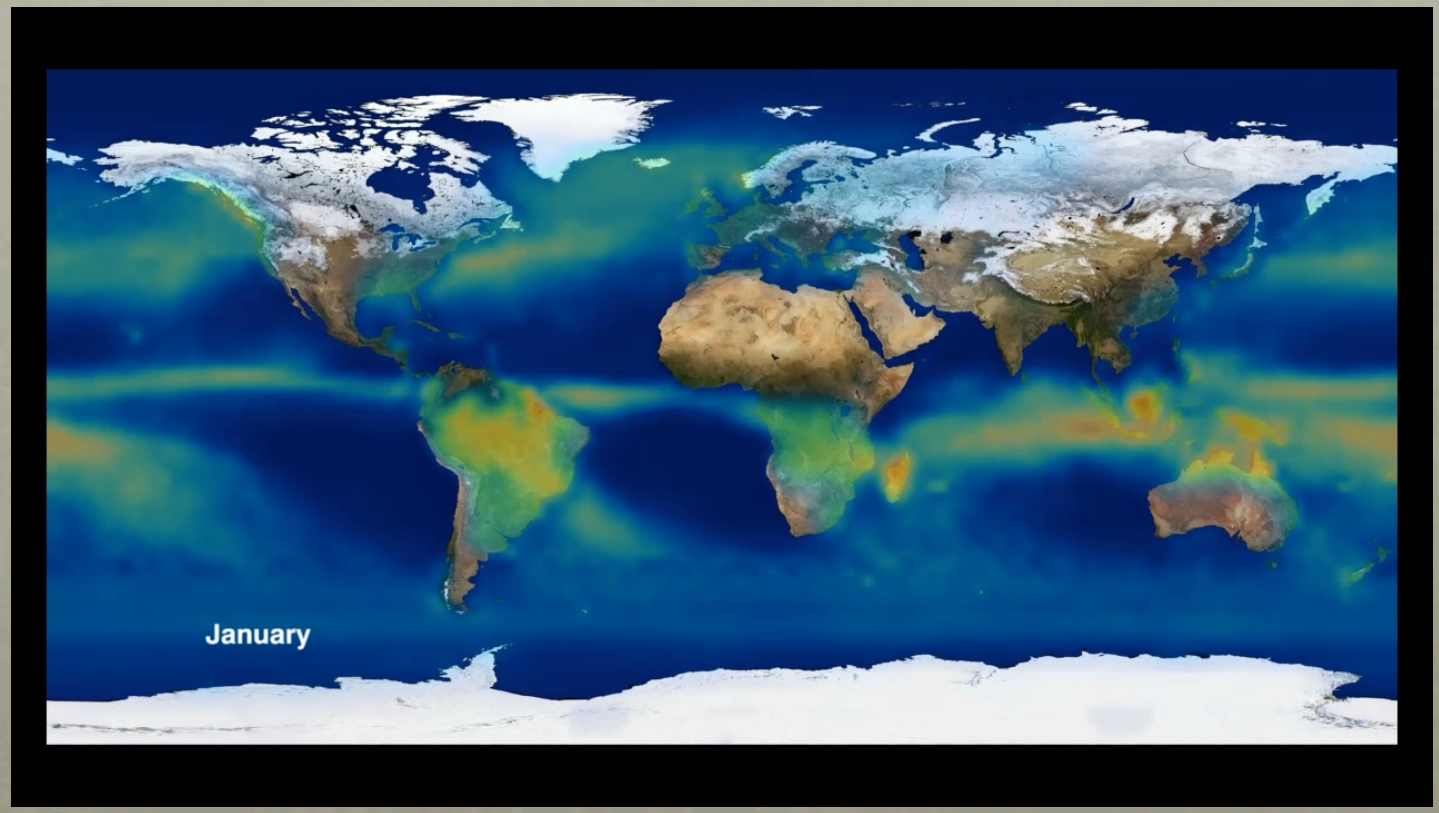
TRMM RAINFALL CLIMATOLOGY

Benchmark 17+ year climatology

Unique monitoring of interannual rainfall variations related to ENSO

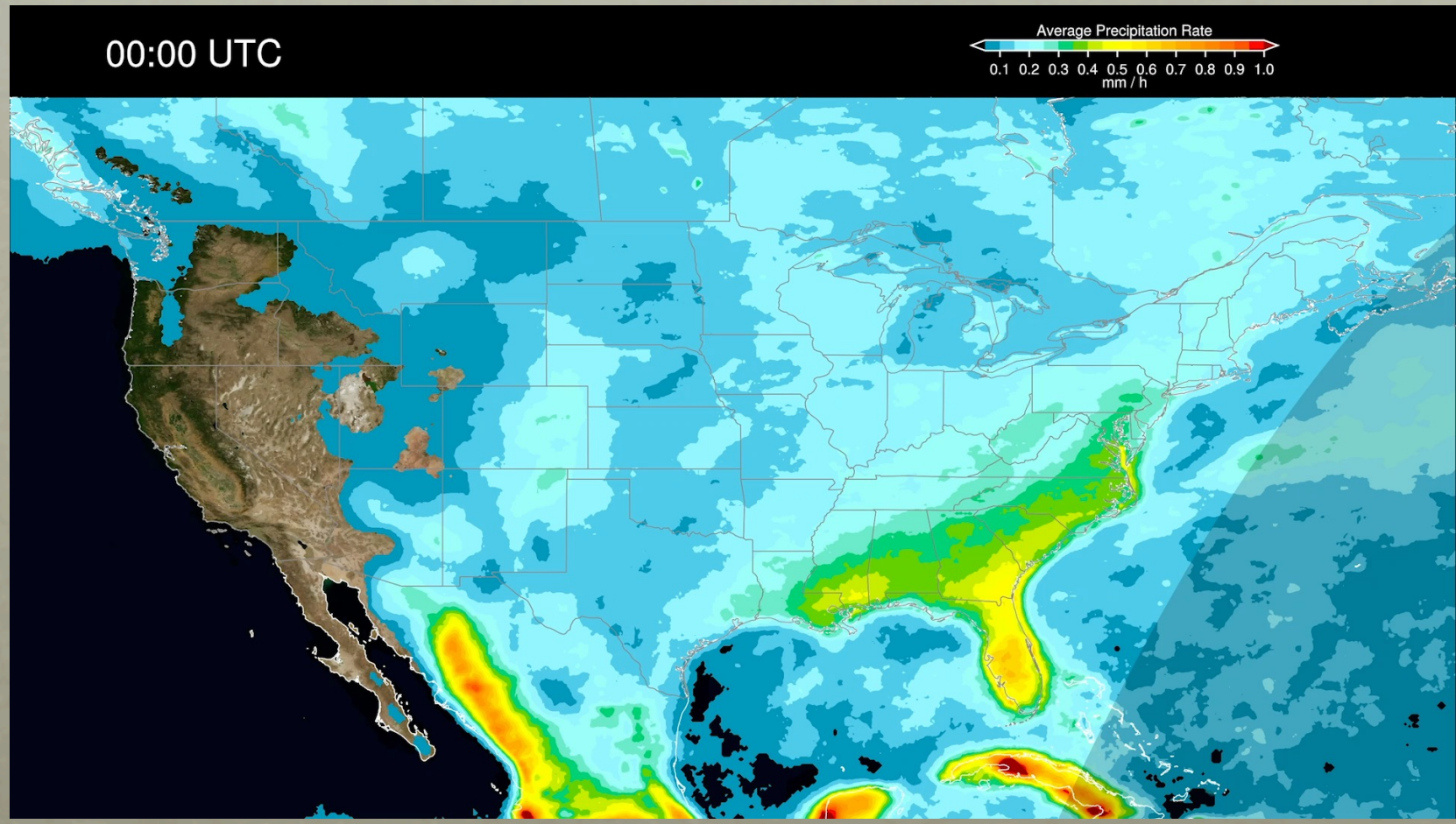
Comprehensive estimates of how rainfall is directly related to latent heat release (LHR)

Global Precipitation by Month



TRMM RAINFALL: DIURNAL CYCLE

- Low inclination (35˚), precessing orbit allows sampling of all local hours over several weeks
- Quantification of diurnal cycle of precipitation tropics wide
- Has also allowed focus on global, regional, and local scales

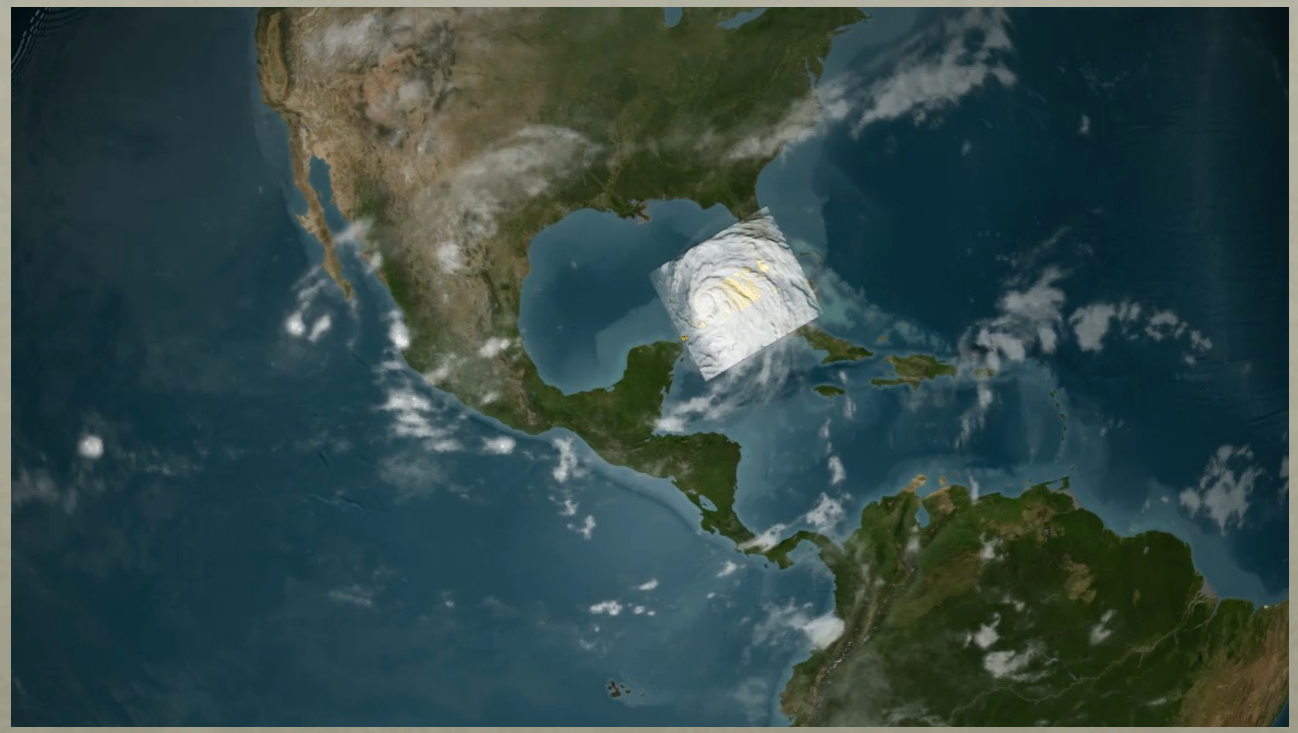


Precipitation shifted in time to common hour of day

TROPICAL CYCLONE SCIENCE

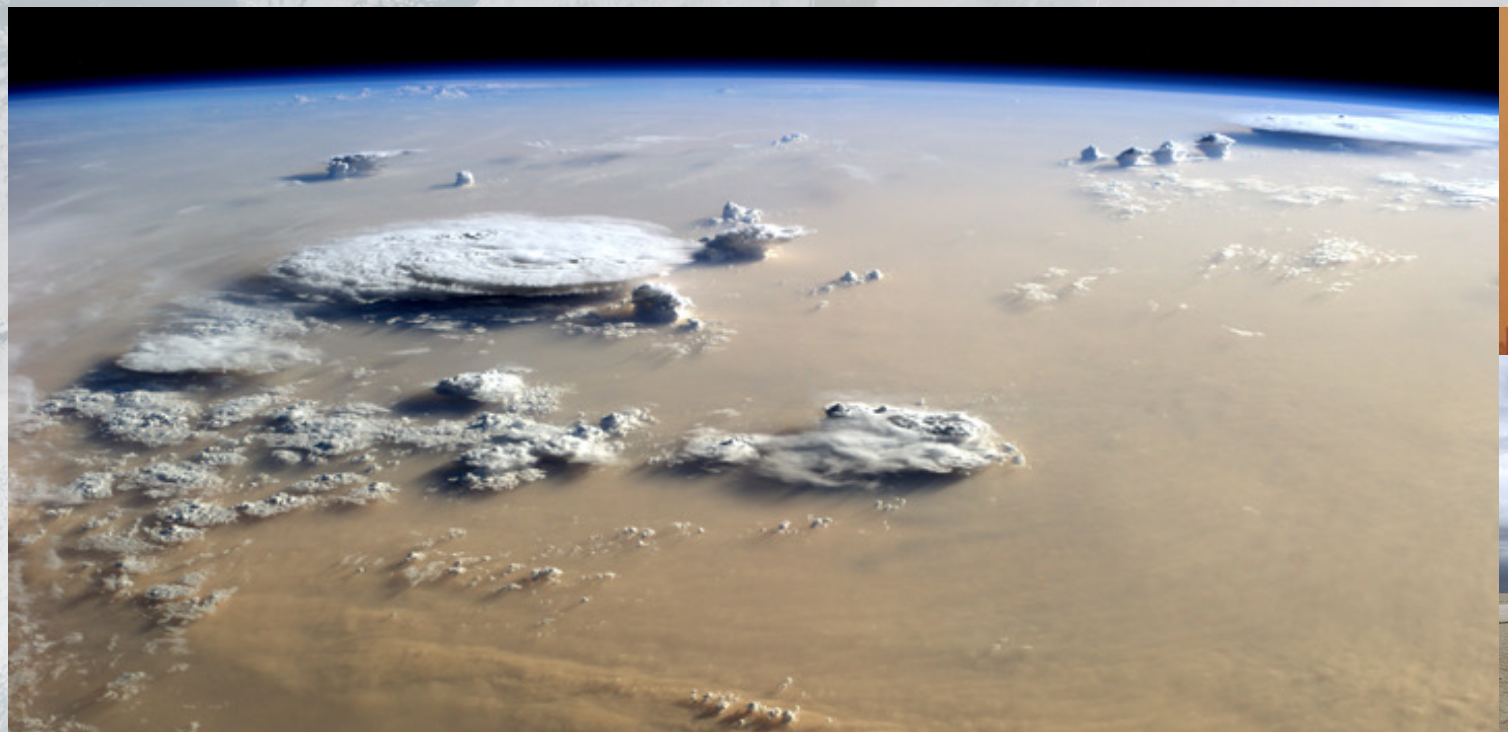
- ~500-600 Center fixes per year
- Rainfall climatologies in hurricanes
  - Radial distribution
  - Shear and motion induced asymmetries
  - Eyewall and rainband vertical structure and lightning
  - Precipitation feature database characteristics
- Improved SST estimates in storm wakes

TRMM VIRS and PR Radar For Hurricane Ike (2010)



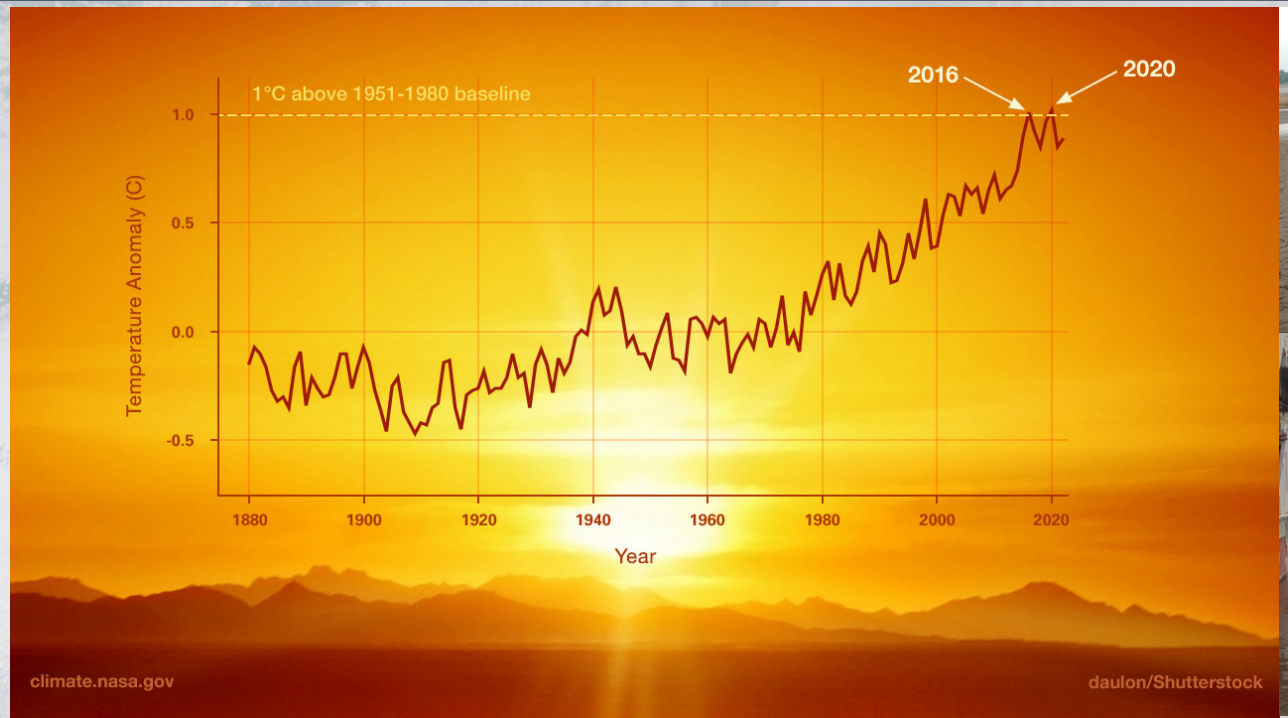
The Atmosphere Observing System (AOS)

- AOS is a new NASA mission that will deliver transformative space-based, airborne, and ground-based observations fundamental to understanding coupled aerosol-cloud-precipitation processes that profoundly impact weather, climate, and air quality



Why AOS?

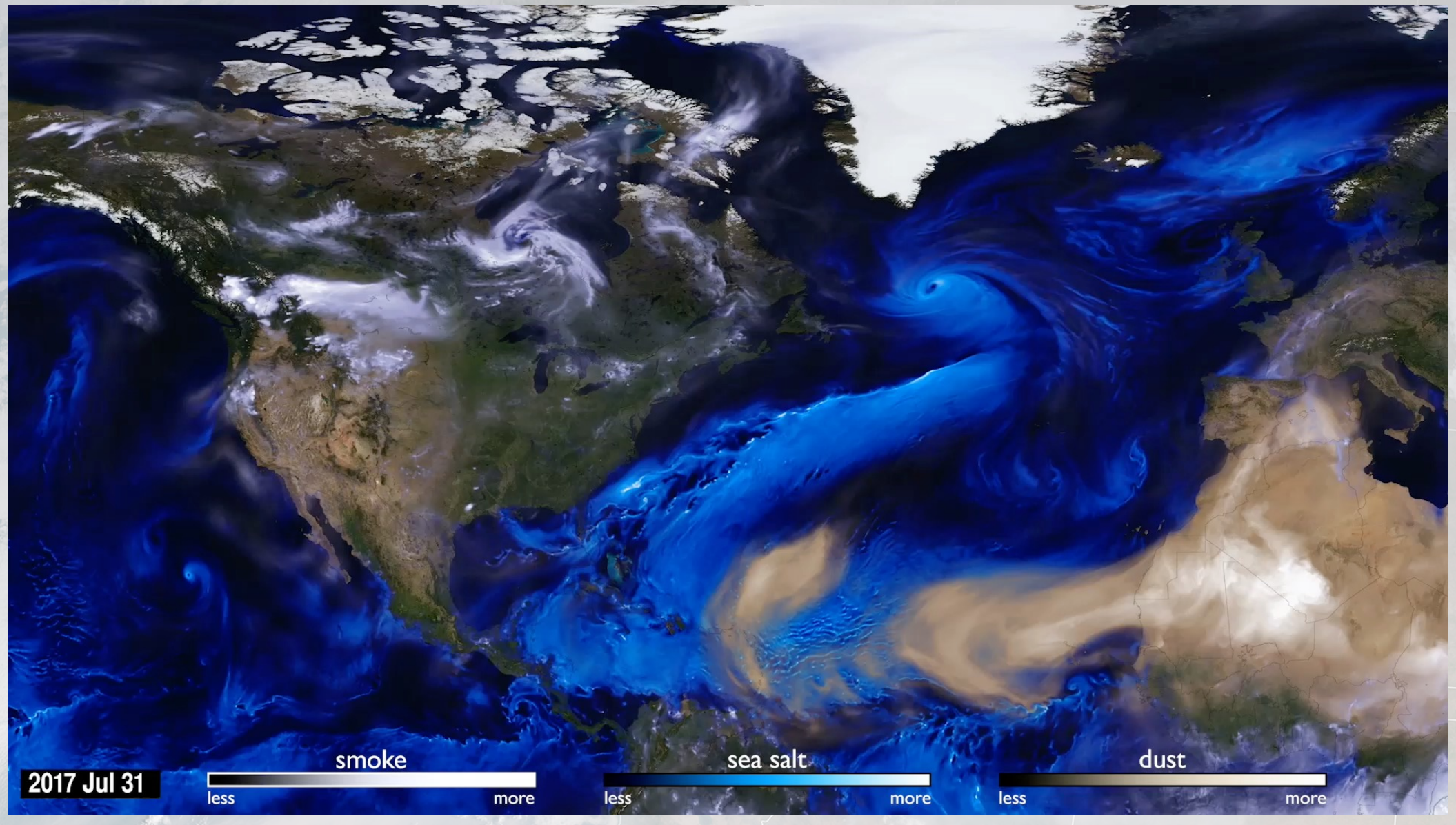
- Science themes: Climate sensitivity, convective storms, aerosols
- Aerosols and their interactions with clouds are key drivers of climate sensitivity
- Aerosols impact air quality, human health, aviation
- Nearly 7-fold increase in $Billion disasters over the last 40 years



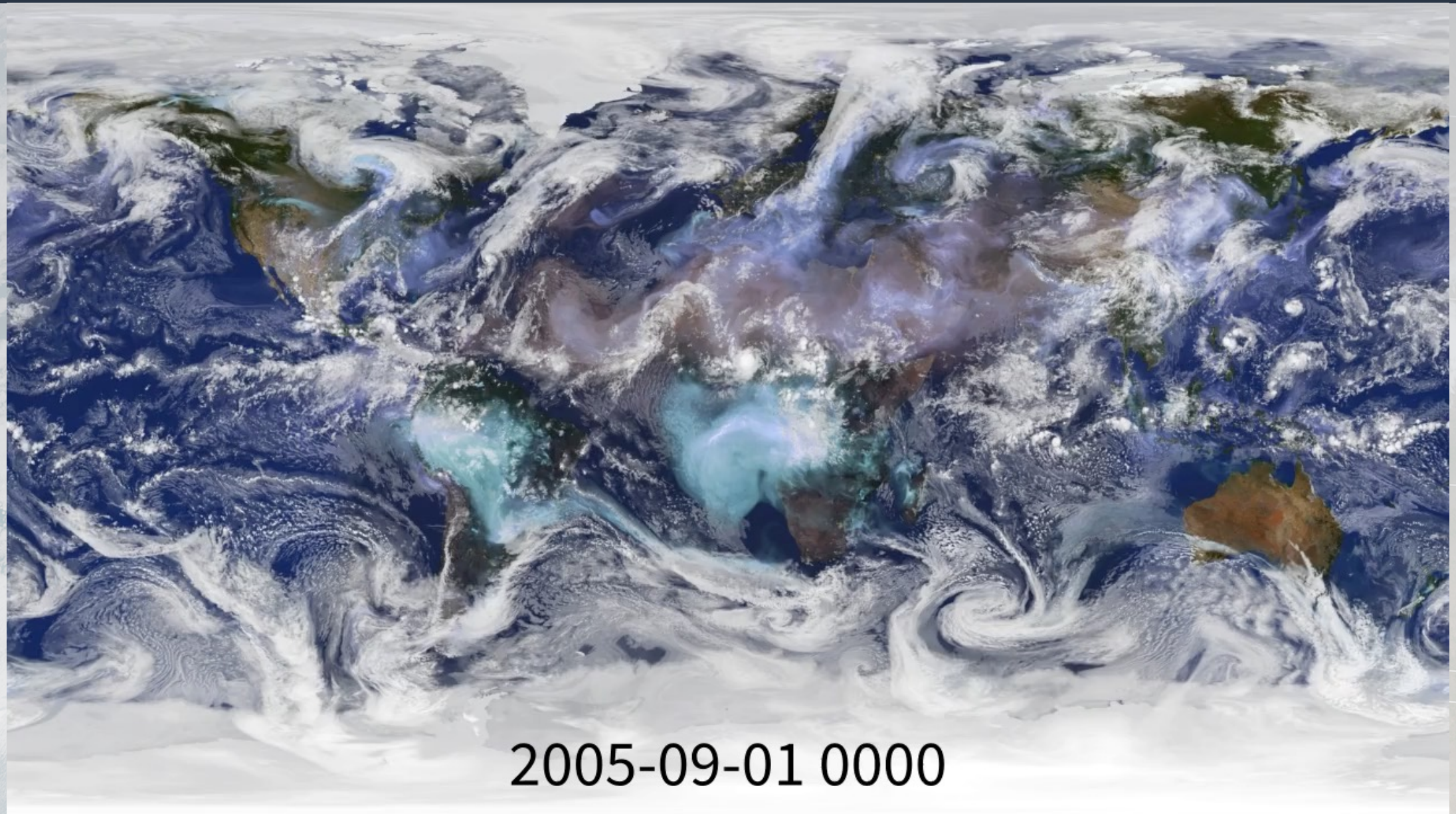
EARTH SYSTEM OBSERVATORY
AOS
ATMOSPHERE OBSERVING SYSTEM

Aerosol Distributions and Processes

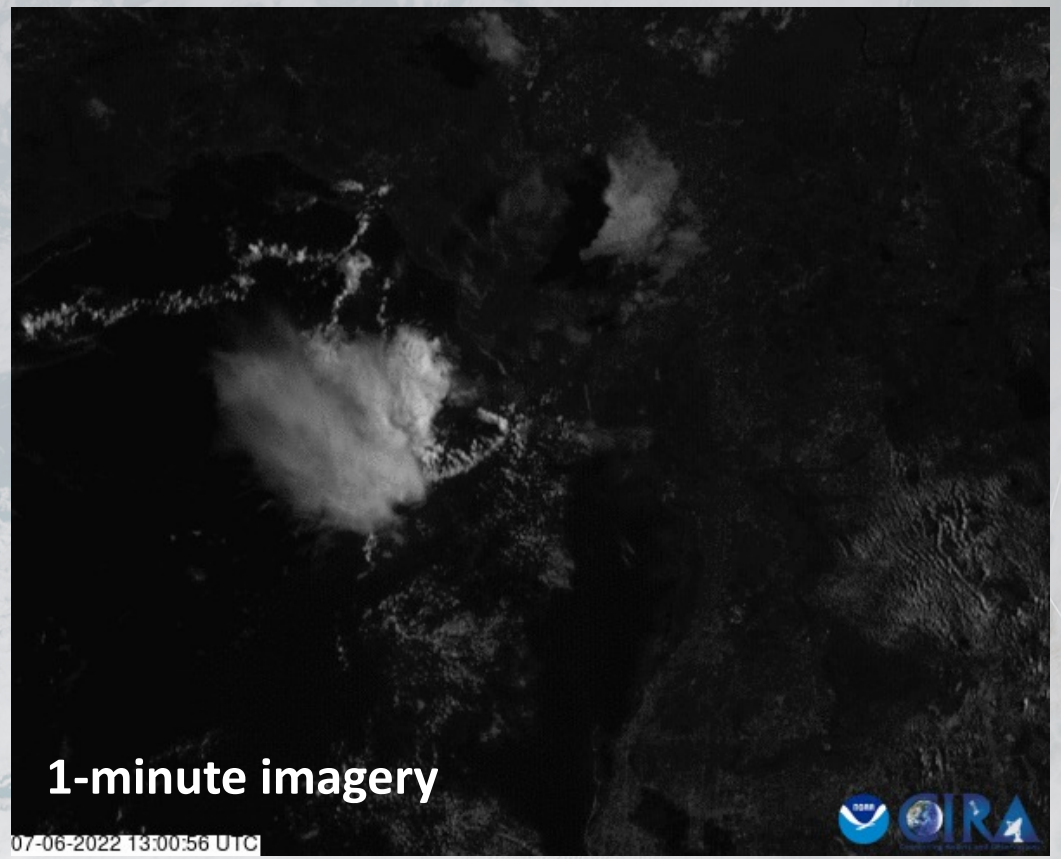
NASA

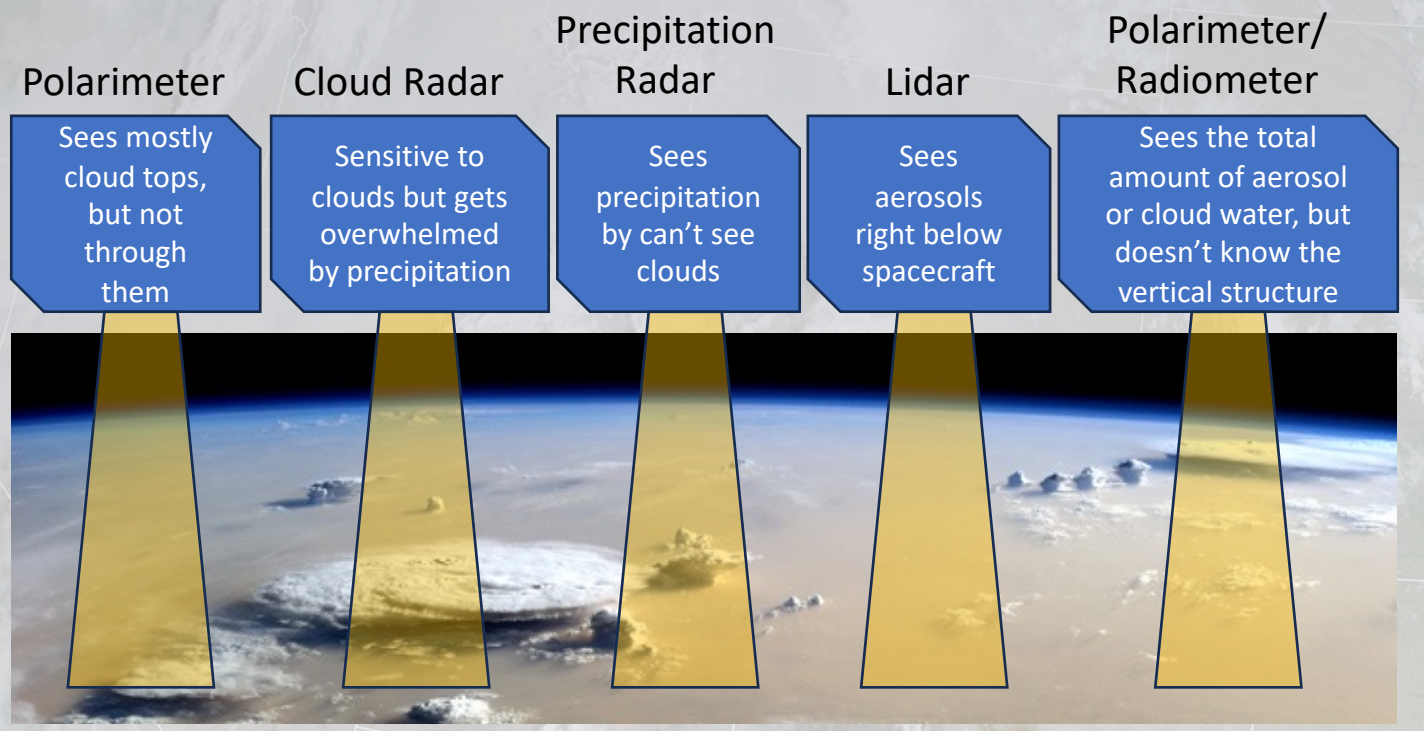


Aerosols and Clouds Coexist



Measurement Synergy Is Critical To AOS

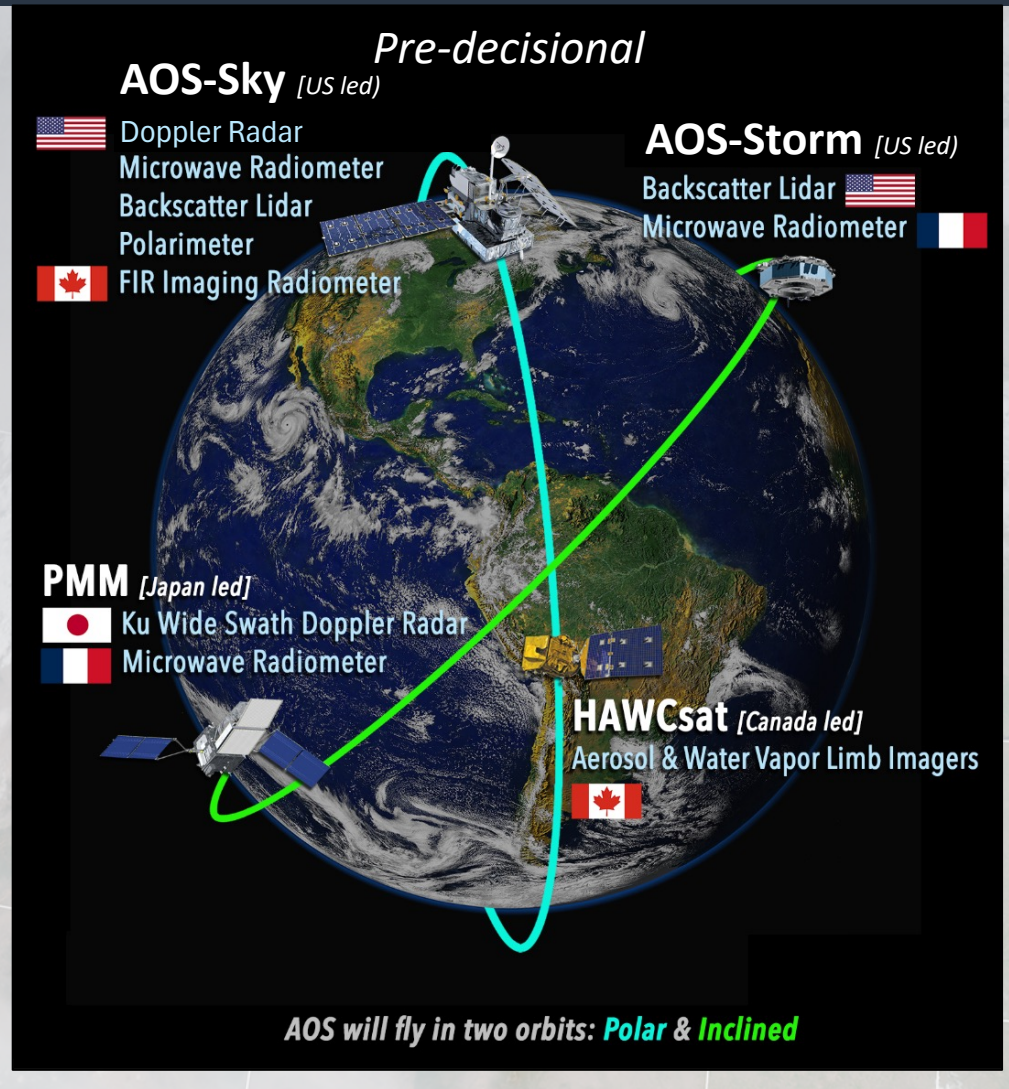




Coincident in time and space measurements needed because convective clouds occur on spatial scales of ~0.5-5 km, temporal scales of minutes

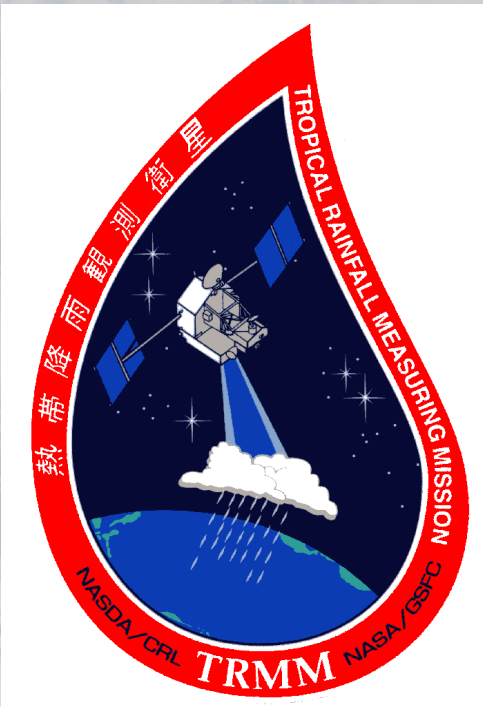
The AOS Mission

- Four satellites, 11 instruments, 3 international partners
- Delivers globally distributed measurements over a range of temporal scales
- AOS-Sky provide measurements central to understanding aerosol-cloud interactions for climate and aerosol studies
- Generous contributions from Japan and France enable observations of convective storms over varying times of day combined with NASA cloud/aerosol measurements



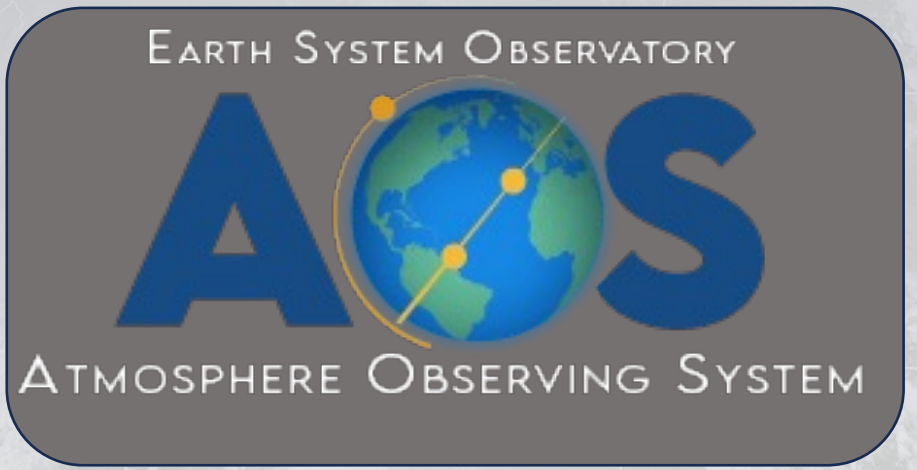
Graphic reflects initial architecture concept directed at KDP-A. Additional direction was provided to study architecture changes, which are still on-going.

Summary



- First precipitation radar in space
- Coupled precipitation, clouds, and lightning data
- Focus on the tropics
- 17 year lifetime

- More accurate dual-frequency radar
- Additional microwave channels, improved resolution
- Extension to mid latitudes
- Formal constellation
- Real-time data
- Potential 16+ year record



- Single frequency Doppler radars
- Coupled aerosol-cloud-precipitation measurements
- With TRMM & GPM, potential for 35+ years of precipitation measurement

Backup slides

AOS Science Themes

Climate sensitivity and feedbacks

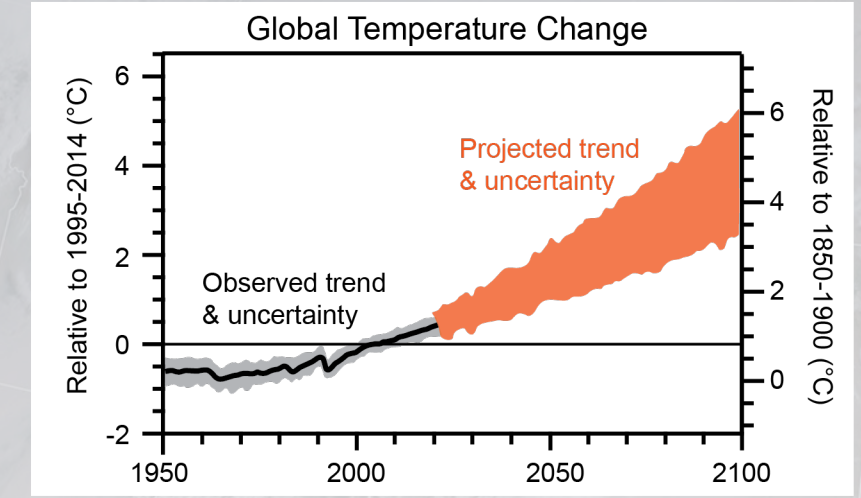
How can we reduce the uncertainty of predictions of the climate response to natural and man-made forcings?

Convective Storm Formation Processes

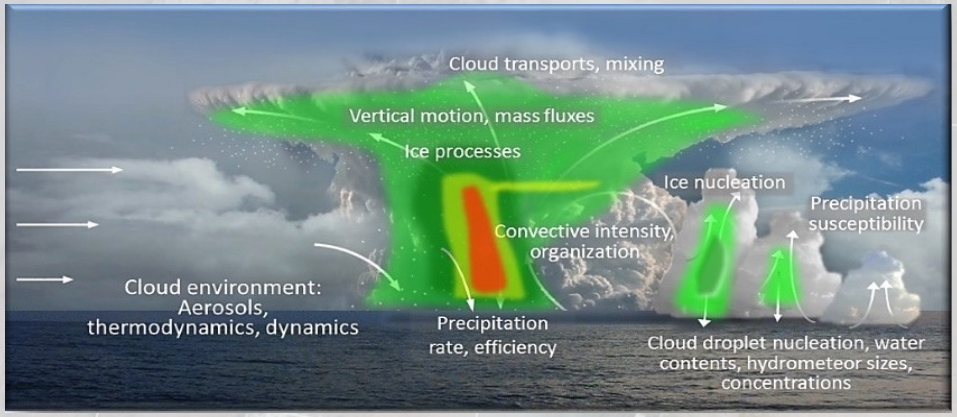
How do the cloud and precipitation properties of convective storms relate to storm dynamics?

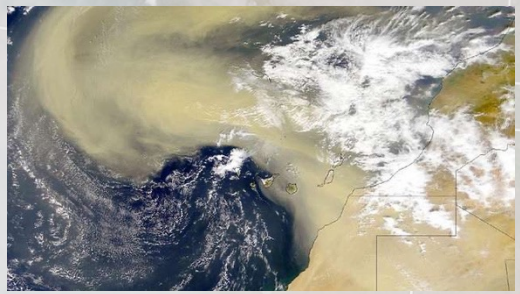
Aerosol processes and distributions

What processes determine the patterns and evolution of air pollutants and their adverse impacts on human health, agriculture, and ecosystems?



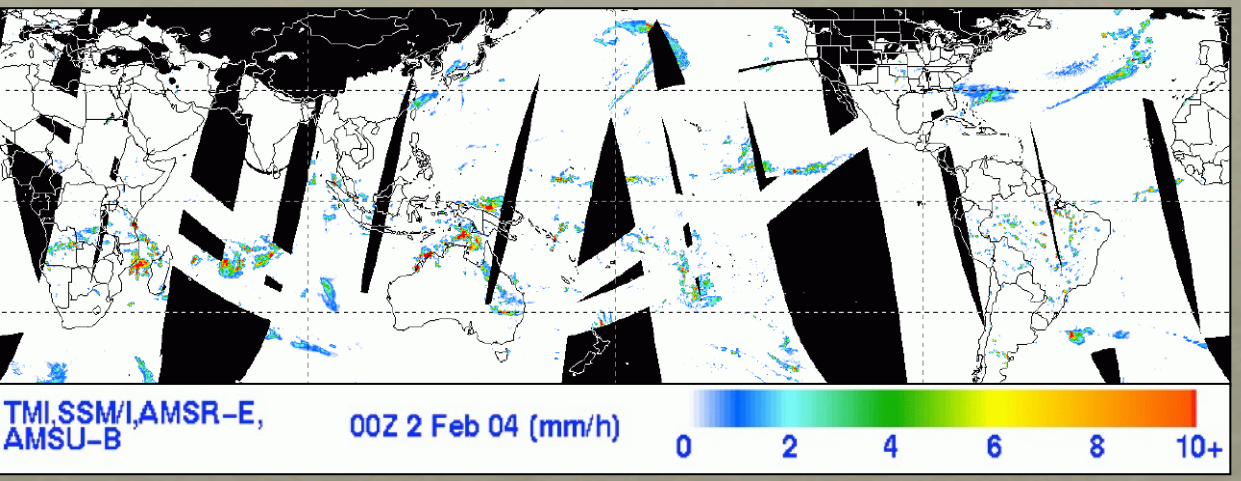
Adapted from the IPCC AR6 Report Chapter 4



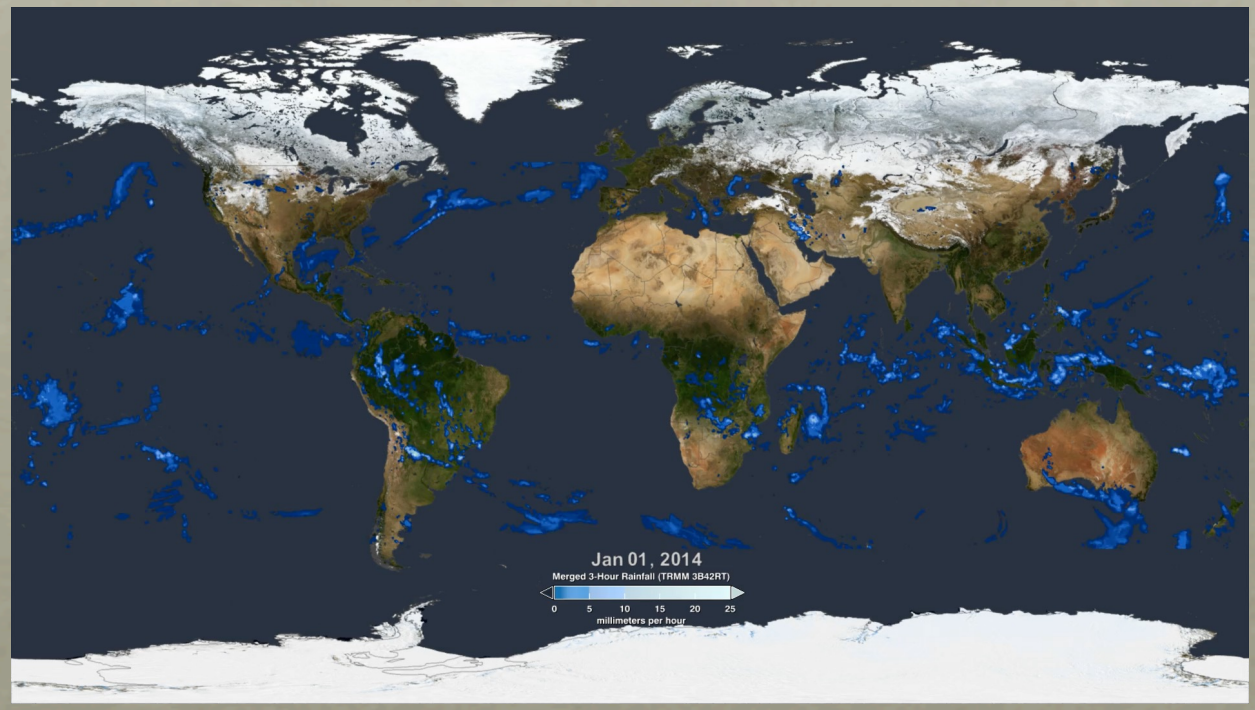


TRMM MULTI-SATELLITE PRECIPITATION ANALYSIS

Uses 3-hr window to combine passive microwave data (gaps filled with Geo-IR) calibrated by TRMM on a 0.25˚ grid



TRMM Multi-satellite Precipitation Analysis



AOS Schedule Relative to Program of Record

AOS will advance key measurements while also providing important continuity for TRMM, GPM, and other missions

Polar

CloudSat/CALIPSO

Possible extended mission

Italian Lidar

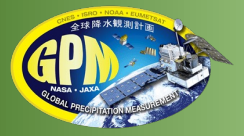
AOS-Sky + HAWCsat

Possible extended mission

CSA

End of GPM station keeping fuel

Inclined



GPM

INCUS

PMM

Possible extended mission

AOS-Storm

Possible extended mission

JAXA CNES