

*Health & AQ Applications as Part of the Aerosols & Cloud-Convection
Precipitation (A-CCP) Study*

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2017 NAS Decadal Survey

“shape science priorities and guide agency investments into the next decade”



2017 NAS Decadal Survey

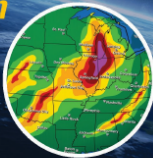
Both science and applied sciences were highlighted in the report.

THE IMPORTANCE OF EARTH INFORMATION

Earth-observing satellites provide critical information about our planet. This information supports a broad range of societal needs and enables the scientific discovery required to meet those needs, making us all healthier, safer, and more efficient.

HELPING PLAN OUR DAY

300 billion
weather forecasts
used by Americans
every year



100+ million
American adults use
internet-based
mapping services



Americans rely on sophisticated Earth information throughout their everyday lives, from weather forecasts to navigation applications in their cars. Satellites are the original sources of much of the data.

PROTECTING OUR HEALTH

6.5 million
premature deaths from
air pollution around the
world every year



Earth-observing satellites track the concentration of harmful pollutants across the country, providing air quality data for rural areas without ground-based monitoring systems and measuring the effects of air quality regulations.

50% of the world's population
is at risk from malaria.

Satellite observations of temperature, vegetation, and rainfall help predict the spread of mosquito-borne illnesses like malaria, Zika, and West Nile Virus.



KEEPING US SECURE

The estimated value of NASA and NOAA information services to the U.S. Navy's operational effectiveness is **\$2 billion** per year.

The U.S. Navy and other U.S. defense agencies partner with NASA and NOAA to use satellite data, to access operational services, and to leverage their scientific progress.



MITIGATING NATURAL DISASTERS

Extreme weather and fires have cost the federal government more than **\$350 billion** over the past decade.

Satellite measurements play a critical role in tracking the paths of hurricanes and wildfires so that we can warn populations at risk, assess the damages, and avoid future costs.



ENSURING RESOURCE AVAILABILITY

Advanced technology, including many types of Earth information, will unlock up to **\$1.6 trillion** in economic savings for energy generation and use by 2035.

Satellite observations can also help ensure water availability, which is particularly important to the 20% of the world now living in areas of water scarcity.



NASA Study Plans

NASA initiated four “study plans”, including A-CCP, based on the Decadal Survey recommendations.

*Two new NASA flight program elements: a committed group of observations termed *Designated*, along with a competed group termed *Earth System Explorer*.

Targeted Observable	Science/Applications Summary	Candidate Measurement Approach	Designated	Explorer	Incubation
Aerosols	Aerosol properties, aerosol vertical profiles, and cloud properties to understand their effects on climate and air quality	Backscatter lidar and multi-channel/multi-angle/polarization imaging radiometer flown together on the same platform	X		
Clouds, Convection, and Precipitation	Coupled cloud-precipitation state and dynamics for monitoring global hydrological cycle and understanding contributing processes including cloud feedback	Radar(s), with multi-frequency passive microwave and sub-mm radiometer	X		
Mass Change	Large-scale Earth dynamics measured by the changing mass distribution within and between the Earth's atmosphere, oceans, ground water, and ice sheets	Spacecraft ranging measurement of gravity anomaly	X		
Surface Biology and Geology	Earth surface geology and biology, ground/water temperature, snow reflectivity, active geologic processes, vegetation traits and algal biomass	Hyperspectral imagery in the visible and shortwave infrared, multi- or hyperspectral imagery in the thermal IR	X		
Surface Deformation and Change	Earth surface dynamics from earthquakes and landslides to ice sheets and permafrost	Interferometric Synthetic Aperture Radar (InSAR) with ionospheric correction	X		



National Aeronautics and Space Administration

Aerosols and Cloud-Convection Precipitation (A-CCP) Study

Draft Study Plan in response to Designated Observables Guidance for
Multi-Center Study Plans

An awe-inspiring, truly joint Center plan



Submitted by:

- Goddard Space Flight Center
- Langley Research Center
- Jet Propulsion Laboratory
- Marshall Space Flight Center
- Ames Research Center
- Glenn Research Center

What will A+CCP observe?

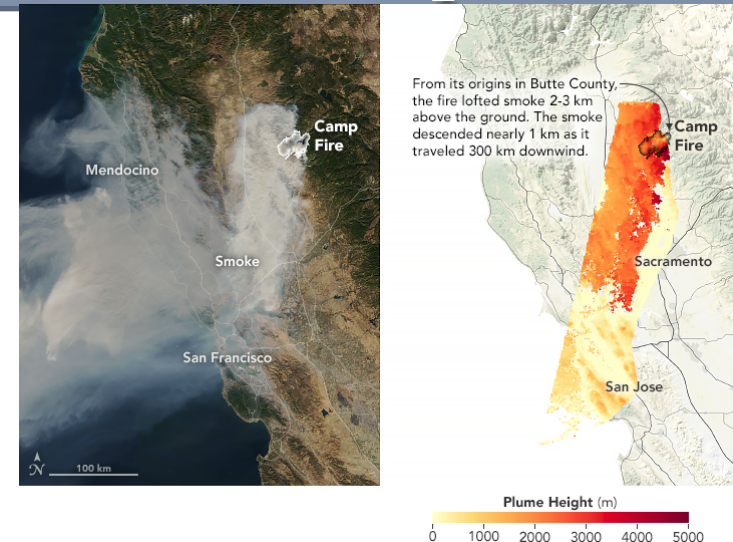
A-CCP is a **combined** Aerosols and CCP **process-oriented** Earth Observing System

- Payload may consist of:
 - a) **Active sensors** (lidars and radars) are the cornerstones of the payload, complemented by
 - b) Several **passive radiometers** (multi-angle, multi/hyper-spectral, with some polarized channels, from UV to sub-mm)
- Being a process-oriented mission, some of the instruments may have a **narrow swath** needed to provide **context** to the measurements (as opposed to wide swath needed for mapping)
- A-CCP is an Earth Observing System potentially consisting of
 - a) A space-based mission (payload, spacecraft, launch vehicle)
 - b) A fully integrated, **sustained sub-orbital component**
 - c) Models, data assimilation and synergistic algorithms needed to extract maximum benefits from the A-CCP measurements

Objective 6: Aerosol Attribution

Potential Enabled Application Example

- **AQ Forecasting & Decision-Making:** Observations of speciated aerosol enable initial conditions, plume tracking (e.g., volcanoes, forest fires), and estimation of emissions for AQ forecasting, as well as, for AQ decision-making, such as State Implementation Plan development and Exceptional Event support.
- **Relevant Geophysical Properties:** AOD, Aerosol Extinction Profiles, Aerosol Speciation, Aerosol layer height
- **Partners:** NOAA, EPA, state AQ agencies, National Forest Service, FAA, VAACs



A+CCP has the potential to provide more and better information to characterize the 3-D structure of speciated aerosols within the boundary layer and to quantify emission sources

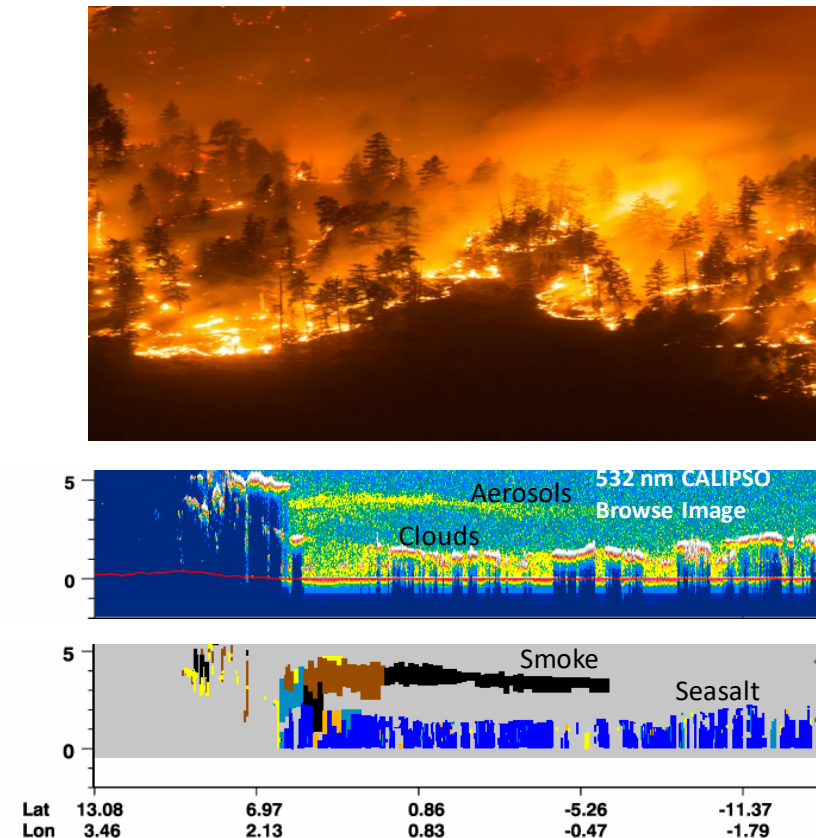


Objective 8: Absorbing Aerosols

Potential Enabled Application Example

- **Wildfire Operations & Management :**
Observations of the horizontal and vertical extent of absorbing aerosol enable estimation of the impact on air quality at the nose level of biomass burning and at larger scales, the impact on radiation of smoke aerosols above clouds
- **Relevant Geophysical Properties:** AOD, AAOD, Aerosol Extinction Profiles, Aerosol Speciation, Aerosol layer height,
- **Potential Partners:** EPA, NOAA, United States Forest Service, state agencies

A+CCP will enable measurements of absorbing aerosol, particularly smoke from wildfires and biomass burning that will allow more accurate estimates of plume injection heights and transport



CALIPSO images of aerosols above clouds and absorbing (smoke) and scattering (seasalt) aerosol subtypes

Stakeholder Community Input

- Tell us how you use aerosol satellite data and how you would like to see it improved.
 - If your interest is piqued, please contact us.
- NASA Weather and Air Quality Forecasting Applications Workshop (July 22-23, 2019)