



MAIA

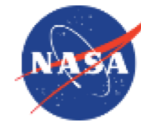
Associating particulate air pollution with human health



Multi-Angle Imager for Aerosols status update

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10 July 2019

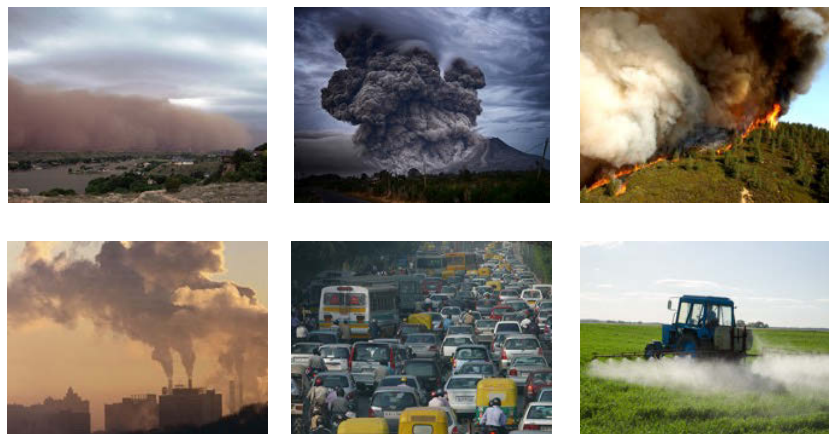
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Government sponsorship acknowledged.

Motivation

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Airborne particulate matter (PM) has been associated with many adverse health outcomes.

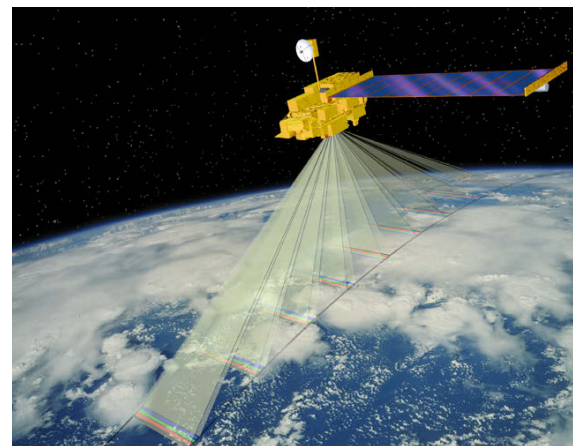
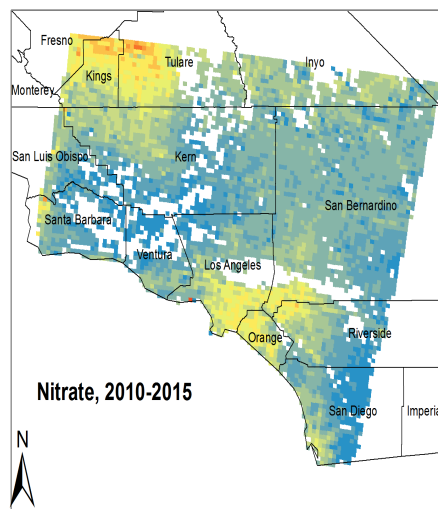
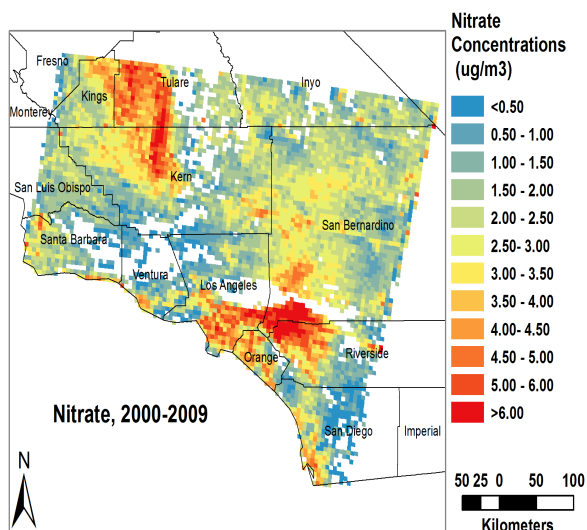
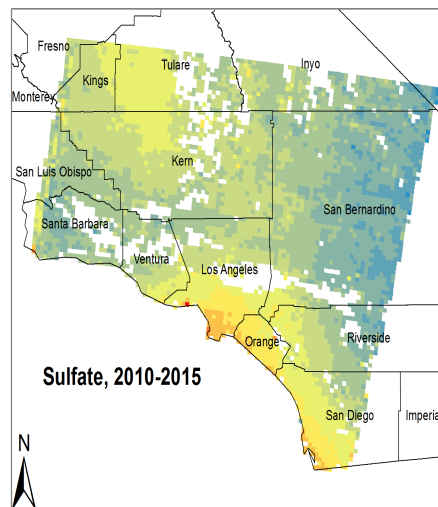
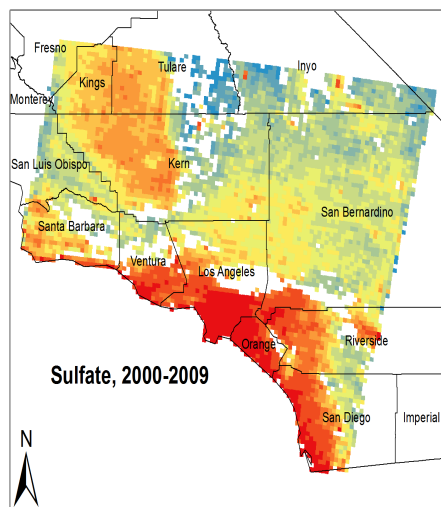
The relative toxicity of different PM types—mixtures of particles with different sizes, shapes, and compositions—is not well understood.



Satellites offer the opportunity to map PM exposure, especially where surface monitors are sparse, pollution levels are high, and health effects have not been well studied.

Speciated PM_{2.5} mapping with MISR (on Terra)

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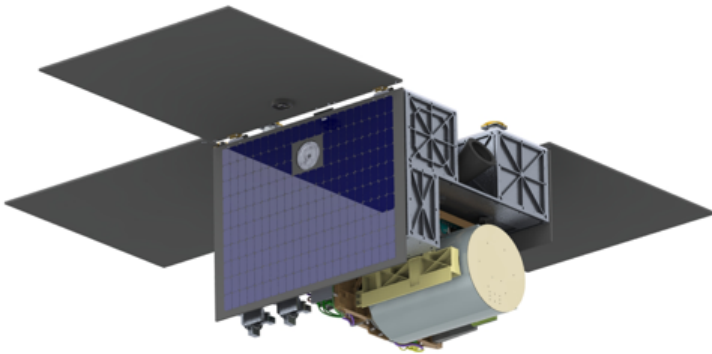
Multi-year means of
predicted sulfate and
nitrate PM_{2.5}
concentrations

Meng et al. (2018)
Collaboration between
Emory University, CARB,
and JPL

From MISR to MAIA

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- MAIA is part of NASA's Earth Venture Instrument program.



The MAIA instrument will fly aboard the General Atomics Orbital Test Bed (OTB)-2 spacecraft

Launch: Mid-2022 (to be confirmed)

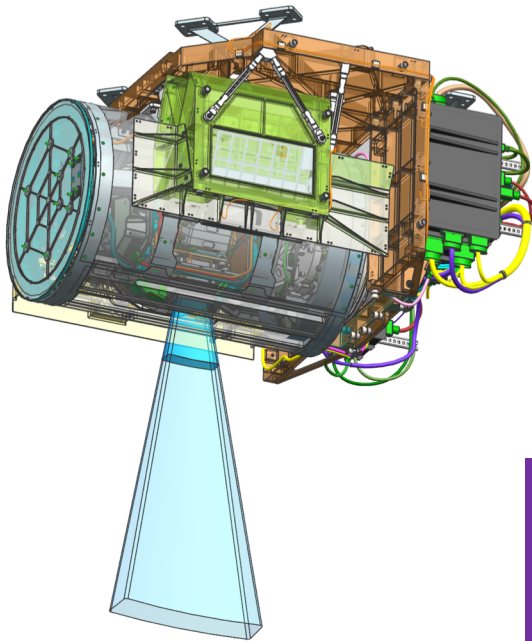
Baseline orbit

- Sun-synchronous, 740-km altitude
- 10:30 am equator-crossing time

Baseline mission duration = 3 years

MAIA instrument provides multiangular, multispectral, polarimetric imagery

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MAIA builds on MISR, MODIS, OMI, and POLDER heritage

The satellite instrument contains a pushbroom multispectral/ polarimetric camera on a 2-axis gimbal

Along-track (scan) axis provides multiangle imagery ($\pm 70^\circ$ at Earth)

Cross-track (pan) axis enables >3 revisits/week per target

Band (nm)	365	387	415	442	550	645	749	762.5	866	945	1040	1610	1885	2125
Polarimetric				X		X					X			

Aerosol absorption

Fine particles
cloud screening

Water vapor

Coarse particles,
cirrus

MAIA will observe discrete, globally distributed target areas

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- **Primary Target Areas (PTAs):** epidemiological studies
- **Secondary Target Areas (STAs):** air quality/climate studies or other applications
- **Calibration/Validation Target Areas (CVTAs):** instrument calibration and product validation



Primary Target Areas

- USA-LosAngeles
- USA-Atlanta
- USA-Boston
- ESP-Barcelona
- ITA-Rome
- ZAF-Johannesburg
- ISR-TelAviv
- ETH-AddisAbaba
- IND-Delhi
- CHN-Beijing
- TWN-Taipei

Secondary Target Areas

- USA-Hilo
- PAC-OceanStCu
- USA-SanFrancisco
- USA-Phoenix
- USA-Denver
- MEX-MexicoCity
- CAN-Toronto
- PER-Lima
- CHL-Santiago
- BRA-SãoPaulo
- SEN-Dakar
- ATL-OceanStCu
- NGA-Lagos
- ZAF-CapeTown
- SRB-Belgrade
- KWT-KuwaitCity
- IND-Chennai
- BGD-Dhaka
- VNM-Hanoi
- MNG-Ulaanbaatar
- KOR-Seoul
- AUS-Sydney

Calibration/Validation Target Areas

- USA-RailroadValley
- LBY-Libya4
- NAM-Gobabeb

Typical target size:
300 km x 400 km

Importance of surface monitors

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- MAIA relies on PM surface monitor measurements to “calibrate” the relationships between satellite aerosol properties and near-surface PM concentrations
- Existing monitors will be used where available; MAIA project is deploying monitors where needed
 - Major effort involving many domestic and international partnerships
 - Networks (CSN/IMPROVE, SPARTAN, others)
 - Universities and technical institutes
 - International governmental agencies
 - USAID and US State Department
 - Other potential collaborations, e.g., UNICEF

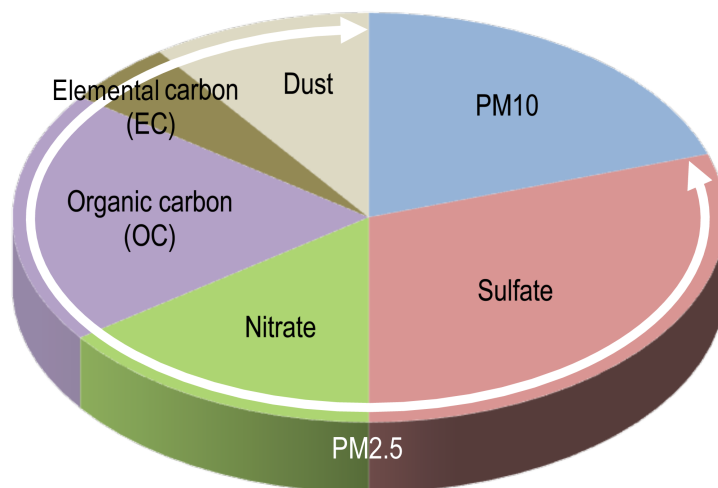
Standard data products

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Level	Description	Spatial/temporal grid
1	Calibrated, Earth-projected radiance and linear polarization imagery	250 m/overpass days
2	Cloud-screened total and fractional aerosol particle properties	1 km/overpass days
	24-hr averaged concentrations of PM10, PM2.5, and speciated PM2.5	1 km/overpass days
4	Gap-filled total and speciated PM	1 km/daily

To be archived and distributed at the NASA Atmospheric Science Data Center

PM constituents mapped by MAIA



Planned health investigations in the PTAs

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PTA	Acute effects	Subchronic effects	Chronic effects
Southern Calif.		Birth outcomes	Cause-specific mortality
Georgia	Respiratory morbidity		
New England	Mortality, heart attack, stroke, pneumonia	Birth outcomes	Mortality, heart attack, stroke, pneumonia
Spain			Mortality, primary care outcomes physical/mental health outcomes
Italy	Cause-specific mortality, disease-specific hospital admissions		Cause-specific mortality, disease-specific hospital admissions
South Africa	Cause-specific mortality		
Israel	Mortality, heart attack, stroke, pneumonia	Birth outcomes	Mortality, heart attack, stroke, pneumonia
Taiwan		Pregnancy complications, birth outcomes	COPD, heart disease
Ethiopia		Preeclampsia, birth outcomes, childhood mortality/morbidity	Respiratory disease, cognition
China	Cardiovascular disease		
India	Mortality, cardiovascular/ respir. disease		Cardiovascular biomarkers

Health data are privacy protected and not part of MAIA's standard data products.

MAIA Science Team

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Principal Investigator

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Co-Investigators: Instrument Characterization

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Russell Chipman	Univ. of Arizona
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Veljko Jovanovic	JPL
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Co-Investigators: Aerosol Remote Sensing, CTM Modeling, Validation

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Feng Xu	JPL
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Co-Investigators: PM Exposure, Epidemiology

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