Earth Observations Applied to a Changing World: NASA Health and Air Quality Applications

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NASA Earth Science Missions: Present through 2023

ISS Instruments
LIS, SAGE III, TSIS-1, OCO-3, ECOSTRESS, GEDI, CLARREO-PF, EMIT

JPSS-2 Instruments
OMPS-Limb

(Pre)Formulation
Implementation
Primary Ops
Extended Ops
Discovering and demonstrating innovative and practical uses of Earth observations in organizations’ policy, business, and management decisions.

Applications
Prove-out, develop, and transition applications ideas for sustained uses of Earth obs. in decision making.

Capacity Building
Build skills and capabilities in US and developing countries to access Earth observations to benefit society.

Mission Planning
Identify applications early in mission lifecycle and integrate end-user needs in mission design and development.

http://AppliedSciences.NASA.gov
Applications Areas

Emphasis in Applications Areas

Health & Air Quality
Water Resources
Ecological Forecasting

Disasters
Agriculture / Food Security

Support opportunities in additional areas

Energy
Urban Development
Transportation / Infrastructure

Climate & weather cross-cut all areas
Why Health & Air Quality?

Potential Health Effects of Climate Variability and Change

- CLIMATE CHANGE (Natural and Human-Caused)
  - Regional Weather Changes
    - Heat Waves
    - Extreme Weather
    - Temperature
    - Precipitation

- Air Pollution Levels
- Contamination Pathways
- Transmission Dynamics

Moderating Influences

Health Effects
- Heat-related Illnesses and Deaths
- Extreme Weather Events-related Health Effects
- Air Pollution-related Health Effects
- Water- and Food-borne Diseases
- Vector- and Rodent-borne Diseases

Research

Adaptation Measures

Source: GEO, 2003
Air pollution is a major environmental risk to health. By reducing air pollution levels, countries can reduce:

- Stroke
- Heart disease
- Lung cancer, and both chronic and acute respiratory diseases, including asthma

Every year, around 7 million deaths are due to exposure from both outdoor and household air pollution.

Regional estimates according to WHO regional groupings:

- Over 2 million in South-East Asia Region
- Over 2 million in Western Pacific Region
- Nearly 1 million in Africa Region
- About 500,000 deaths in Eastern Mediterranean Region
- About 500,000 deaths in European Region
- More than 300,000 in the Region of the Americas

Clean Air for Health

#AirPollution

World Health Organization
Observations of the Paradise wildfire in California from MODIS and ICESat-2 on November 11-12, 2018. The Paradise wildfire was the deadliest wildfire in the US in 100 years, with at least 85 victims.
Objectives:

- NASA’s Health & Air Quality Applications Area supports the use of Earth observations in air quality management and public health, particularly regarding infectious disease and environmental health issues.

- The area addresses issues of toxic and pathogenic exposure and health-related hazards and their effects for risk characterization and mitigation.

- The area promotes uses of Earth observing data and models regarding implementation of air quality standards, policy, and regulations for economic and human welfare.

- The Health & Air Quality Applications Area also addresses effects of climate change on public health and air quality to support managers and policy makers in their planning and preparations.
Cholera Prediction Model

Epidemic Cholera
- Sporadic outbreak
- Usually occurs following floods or inundation of large landscapes
- Warm temperatures may increase growth of bacteria in aquatic bodies.

Mixed-mode Cholera
- Usually two seasonal peaks
- One peak related to seawater intrusion; Second peak associated with widespread inundation
- Specific to Bengal Delta region

Endemic Cholera
- Cholera persists throughout year in coastal regions
- Seawater Intrusion from coasts to inland
- Cholera outbreaks occur during low river flow season

Satellites data and products
- LANDSAT: Land Use, NDVI
- MODIS/ MERIS: Surface Temperature, Ocean Color
- SWOT*: River Discharge
- SMAP*: Soil Moisture
- GRACE: Water Storage, River Discharge
- TRMM/GPM*: Precipitation
- TOPEX/JASON: Sea Surface Height
- AVHRR: Sea surface temperature

* denotes utility for future missions

PI: Antar Jutla, West Virginia U.
Smoke Health Impact Assessment (HIA) Forecaster
Jeff Pierce (Colorado State University)

Background Research
• Used NASA MODIS AOD, surface measurements, and model concentrations to estimate smoke exposure for past fires

Respiratory Outcomes

- Combined with health data to determine associated health effects of smoke exposure

Product
https://rgan.atmos.colostate.edu/smoke_forecaster/

- Apply those health associations to smoke forecasts to forecast health impacts of smoke exposure
- Allows communities and health providers to understand potential health risks and prepare for burden on health resources during smoke events

Ongoing Product Development
• Communications researchers at CSU are testing the usefulness and messaging of this product with the Colorado Department of Public Health and the Environment (CDPHE)
Based on NLDAS/MODIS temperature observations and admission data for heat stress at NY clinics, it was found that illness occurred at temperatures lower than original NWS advisory criteria; subsequently the NWS changed the heat advisory threshold from 100 to 95°F for four offices that cover New York and surrounding regions.

Maximum air temperature across New York State estimated using temperature data products from the NASA-sponsored North American Land Data Assimilation System (NLDAS).

Local specific indicators, messaging, and reports are available through the New York Department of Health and Environmental Public Health Tracking at:


[https://www.health.ny.gov/environmental/weather/profiles/index.htm](https://www.health.ny.gov/environmental/weather/profiles/index.htm)
Connecting NASA Data and Tools with Health and Air Quality Stakeholders

Tracey Holloway - Team Lead (University of Wisconsin-Madison)
Bryan Duncan (NASA Goddard Space Flight Center)
Arlene Fiore (Columbia University)
Minghui Diao (San Jose St. University)
Daven Henze (University of Colorado, Boulder)
Jeremy Hess (University of Washington, Seattle)
Yang Liu (Emory University)
Jessica Neu (NASA Jet Propulsion Laboratory)
Susan O’Neill (USDA Forest Service)
Ted Russell (Georgia Tech)
Daniel Tong (George Mason University)
Jason West (University of North Carolina, Chapel Hill)
Mark Zondlo (Princeton University)

Next Meeting: July 10-12, 2019, in Pasadena, CA!
https://haqast.org
Facilitating the Integration and Adoption of Satellite Products for Decision Support during Wildland Fire Smoke Episodes: Susan O’Neill (USFS)

NASA remotely-sensed products help inform the public about smoke impacts from wildfires.

*When smoke from wildfires blankets a region, people want to know: When will the smoke clear? Can my child play outside? Do we cancel the football game? NASA science is being used to support these important decisions affecting our daily life, health and safety.*

How: Including remotely-sensed data/products in tools/information used by smoke forecasters deployed with Incident Management Teams and Health/AQ Agencies.

- Smoke Outlooks (One-page smoke forecasts): [https://wildlandfiresmoke.net/outlooks/](https://wildlandfiresmoke.net/outlooks/)
- Smoke Forecasting System Improvements (MODIS, VIIRS, GOES, CATS, CALIPSO, MISR, TROPOMI)
- Web-tool: GOES-16 fire detection viewer, custom time profile generator and smoke modeling

Training
- Online video “The Basics of Satellite Data For Smoke and Fire”
- In-class: Annual Land Manager Smoke Trainings, Annual Air Resource Advisor Training

PI: USDA Forest Service, PNW Research Station. Close collaboration with the Wildland Fire Air Quality Response Program (WFAQRP).

Collaborators/Contributors: University of Washington, UC Davis, National Park Service, University of Wisconsin, NOAA, NASA Disasters Team, Mazama Science
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