National Aeronautics and
Space Administration
NASA
EXPLORE EARTH
John Haynes, MS
Applied Sciences Program
Earth Science Division
Science Mission Directorate
ICES Biennial Meeting
December 3, 2019
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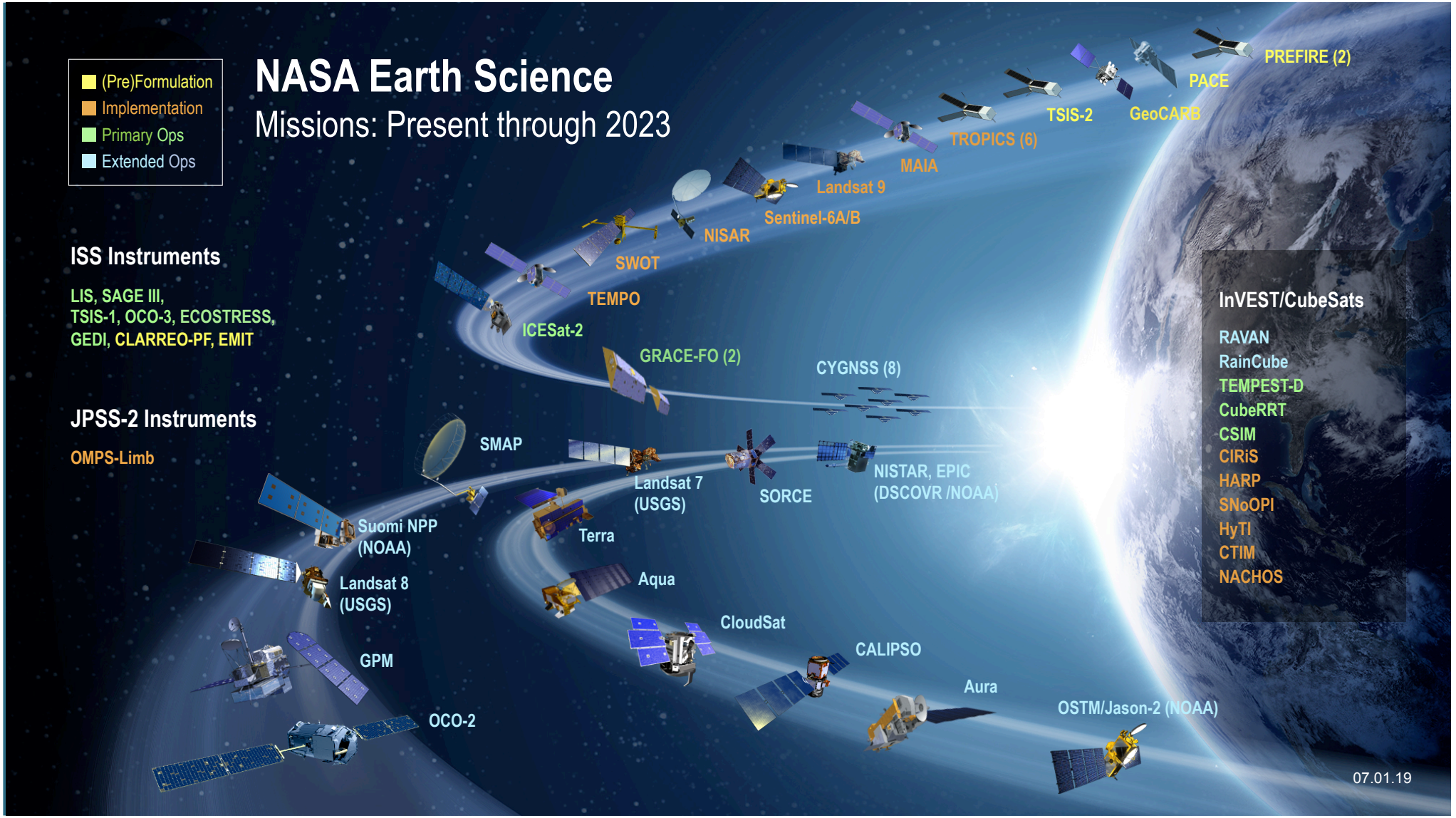
(Pre)Formulation
Implementation
Primary Ops
Extended Ops
NASA Earth Science
Missions: Present through 2023
ISS Instruments
LIS, SAGE III,
TSIS-1, OCO-3, ECOSTRESS,
GEDI, CLARREO-PF, EMIT
JPSS-2 Instruments
OMPS-Limb
PREFIRE (2)
PACE
GeoCARB
TSIS-2
TROPICS (6)
MAIA
Landsat 9
Sentinel-6A/B
NISAR
SWOT
TEMPO
ICESat-2
GRACE-FO (2)
CYGNSS (8)
SMAP
Landsat 7
(USGS)
SORCE
NISTAR, EPIC
(DSCOVR /NOAA)
Suomi NPP
(NOAA)
Terra
Aqua
Landsat 8
(USGS)
CloudSat
CALIPSO
GPM
Aura
OCO-2
OSTM/Jason-2 (NOAA)
InVEST/CubeSats
RAVAN
RainCube
TEMPEST-D
CubeRRT
CSIM
CIRiS
HARP
SNoOPI
HyTI
CTIM
NACHOS
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NASA Applied Sciences Program

Discovering and demonstrating innovative and practical uses of Earth observations in organizations' policy, business, and management decisions.

http://AppliedSciences.NASA.gov

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.

Applications Areas

Areas of Applications Emphasis

Health & Air Quality

Water Resources

Ecological Forecasting

Disasters

Agriculture / Food Security

Support opportunities in additional areas

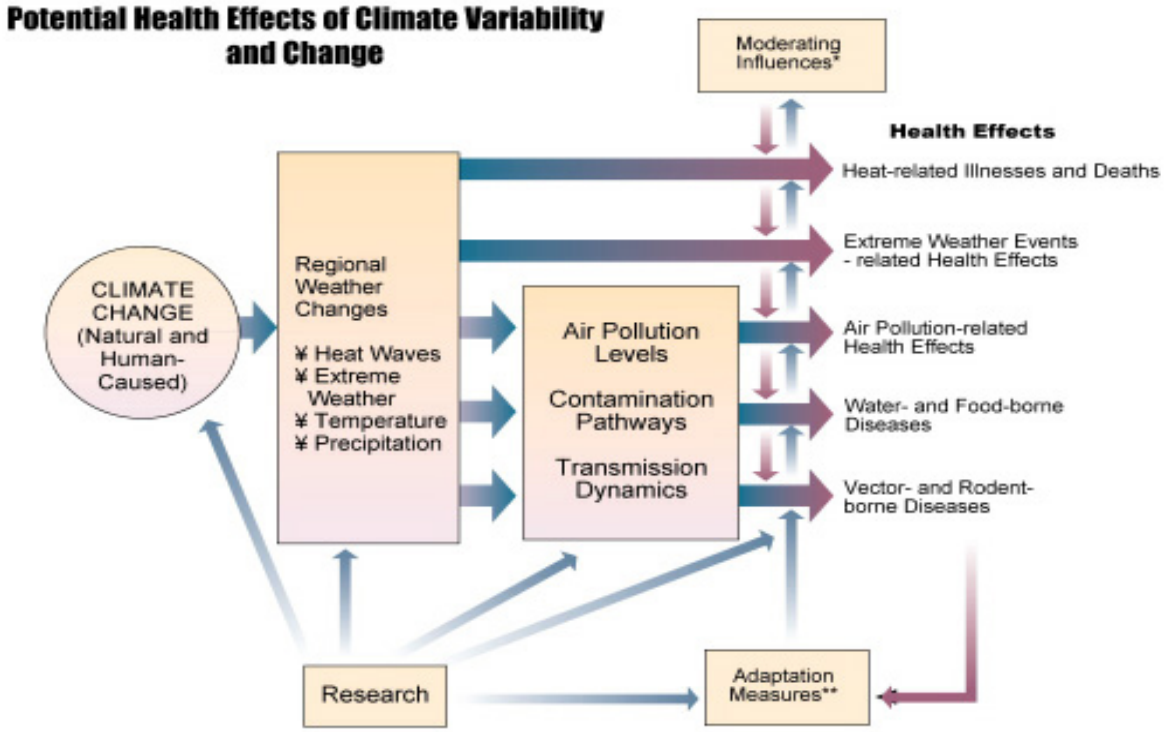
Energy

Urban Development

Transportation / Infrastructure

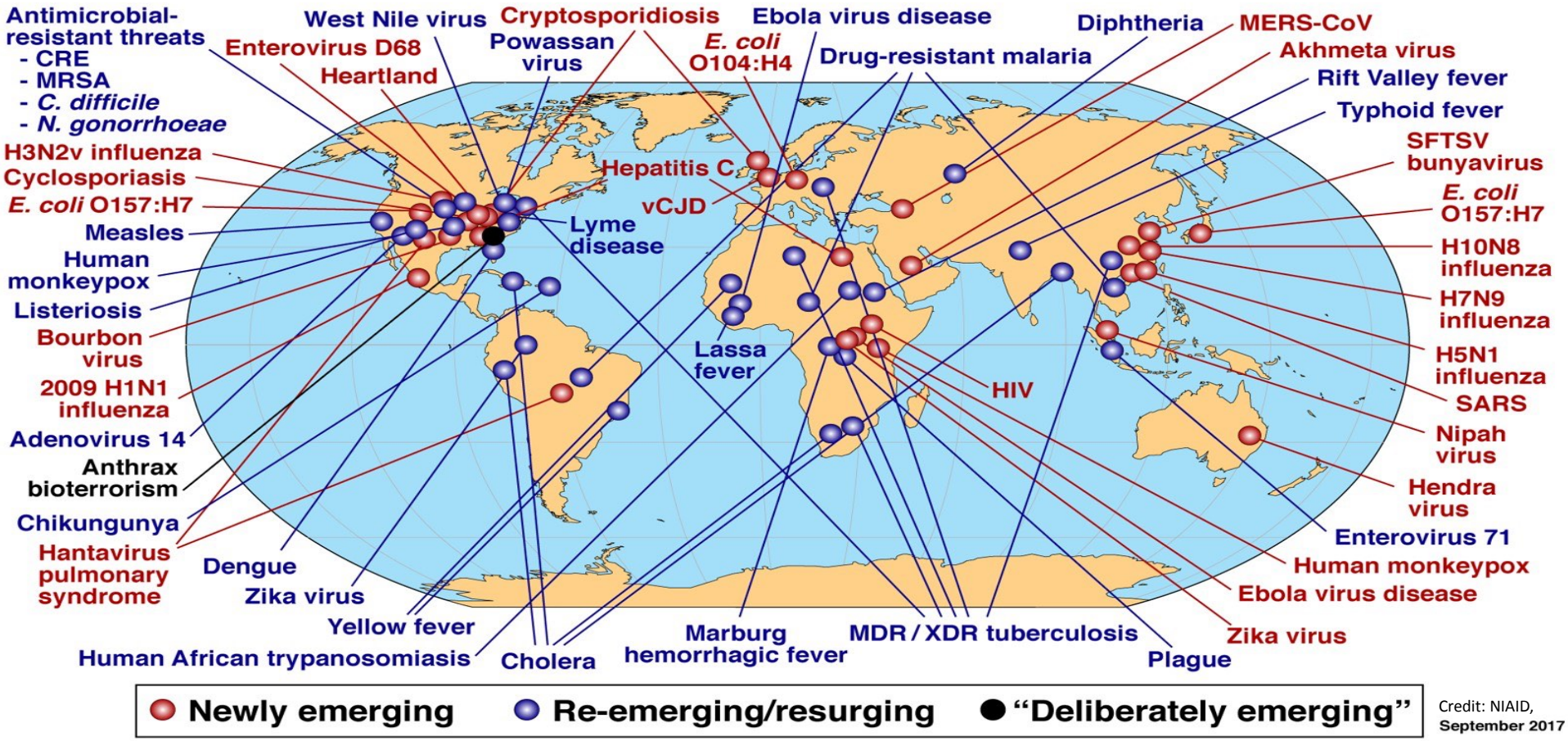
Climate & weather cross-cut all areas

Why Health & Air Quality?



Source: GEO, 2003

Global Examples of Emerging and Re-Emerging Infectious Diseases



Credit: NIAID, September 2017

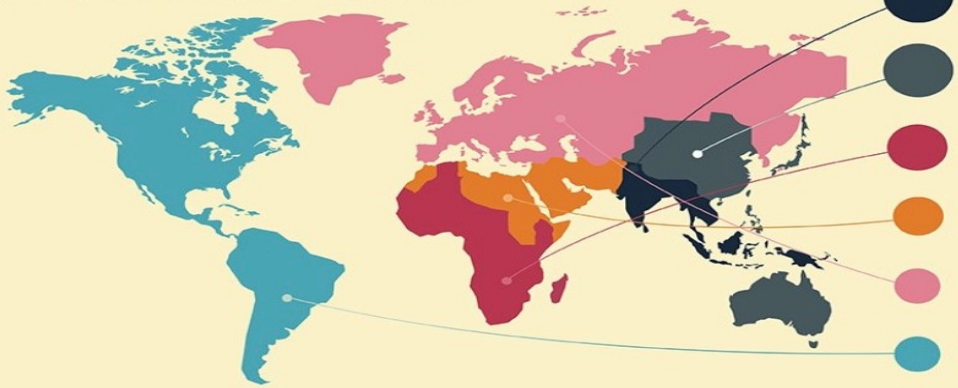
AIR POLLUTION – THE SILENT KILLER

Every year, around **7 MILLION DEATHS** are due to exposure from both outdoor and household air pollution.

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

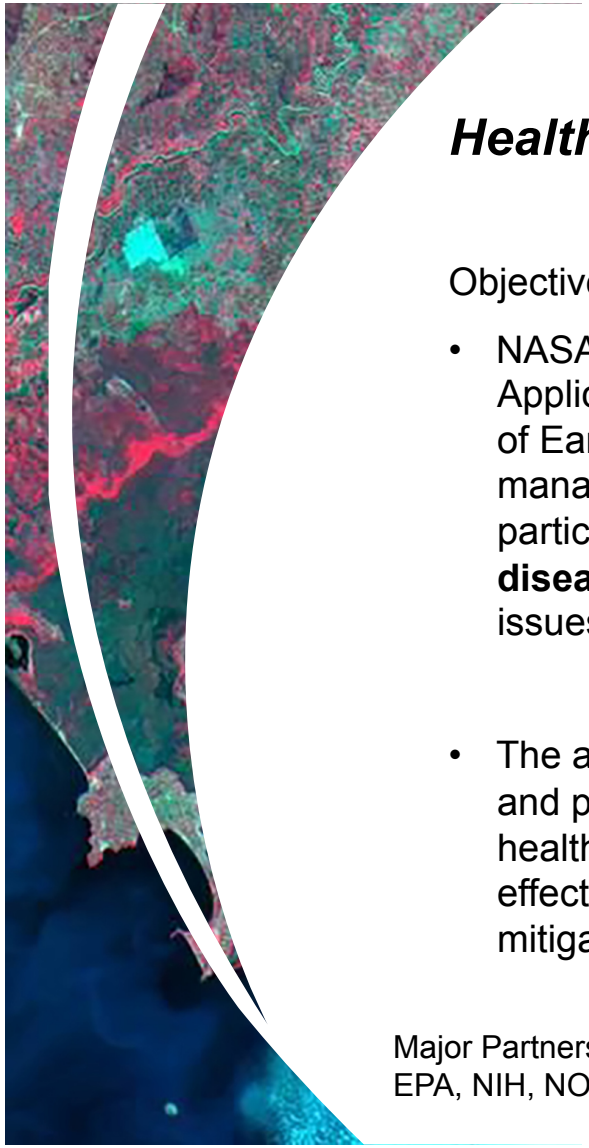
- **Stroke**
- **Heart disease**
- **Lung cancer, and both chronic and acute respiratory diseases, including asthma**

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



Health & Air Quality

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.

Major Partners include International (e.g., GEO, WHO, UNICEF, PAHO), Federal (e.g., CDC, EPA, NIH, NOAA), State (e.g., South Dakota, California, Texas), and Private sectors (AER, Inc.).

Enhanced Data-Driven Decision Support for Highly Invasive Vectors

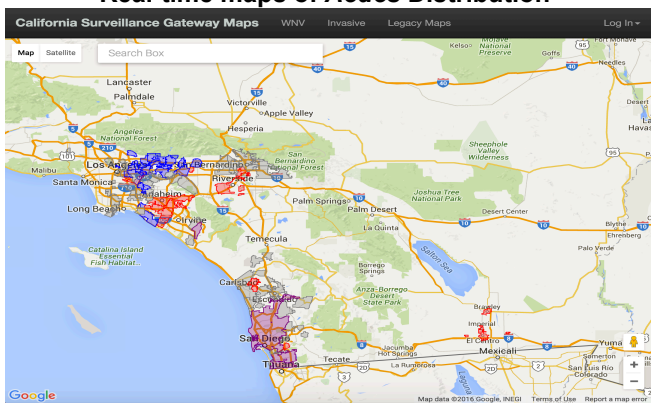
PI: Dr. Chris Barker, UC-Davis

CalSurv California Vectorborne Disease Surveillance Gateway

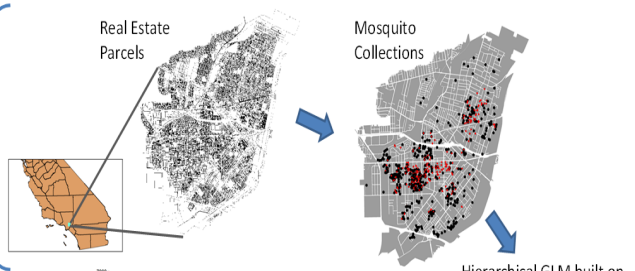
Purpose and Objective

The CalSurv Gateway was built originally as a decision-support system for West Nile virus. The NASA Health & Air Quality project focuses on decision support tools for controlling the invasive mosquitoes, Aedes aegypti and Aedes albopictus, and for estimating and mapping the risks for dengue, chikungunya, and Zika viruses. This slide shows new maps for end users that present real-time surveillance maps for the invasive mosquitoes, and our climate-based suitability estimates for *Aedes aegypti* in the U.S.

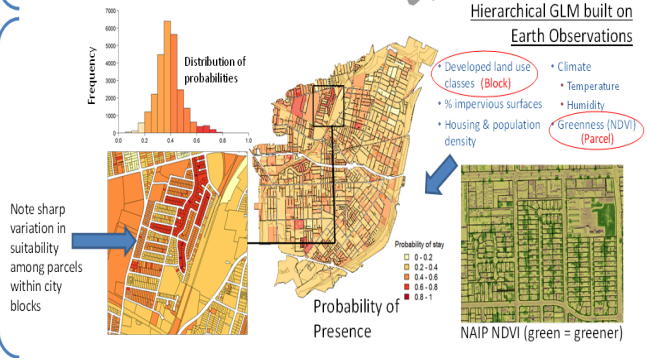
Real-time maps of *Aedes* Distribution



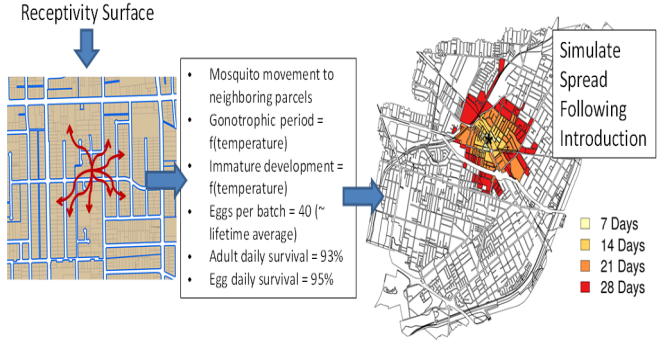
Mosquito Collection Data



Suitability estimates



Spread simulation

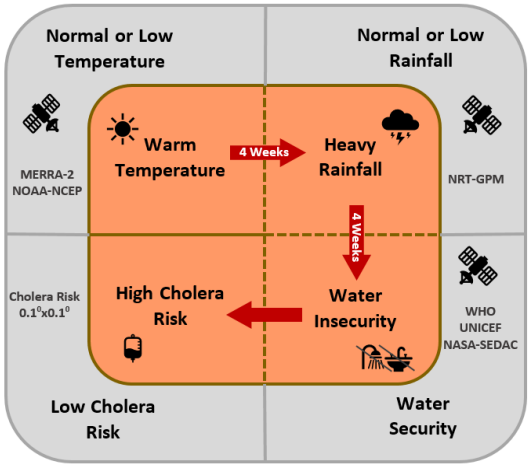


NASA Web Feature: https://www.nasa.gov/feature/nasa-helps-fight-the-mosquito-bite-coast-to-coast

A Multi-Sensor Remote Sensing Approach to Predict Cholera

PI: Dr. Antar Jutla, U. of Florida

Application of Earth observations for connecting large-scale hydro-climatological processes with cholera occurrence in epidemic regions.



Warm temperature= above climatological average temperature
Heavy rainfall= above climatological average precipitation
Water insecurity=lack of access to water and sanitation access
High cholera risk=probability of cholera greater than 50%

Simplified representation of the epidemic cholera algorithm that used GPM, MERRA-2, NOAA-NCEP and SEDAC data.

Types of Earth Observations used (depending on location)

Landsat: Land Use

MODIS/VIIRS: Surface Temperature, Ocean Color

TRMM/GPM: Precipitation

MERRA: Air Temperature

GRACE: Water Storage

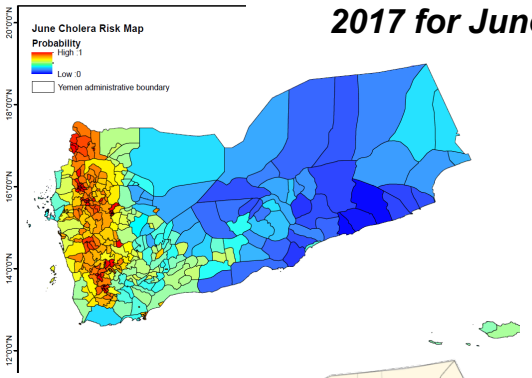
GPM: Precipitation

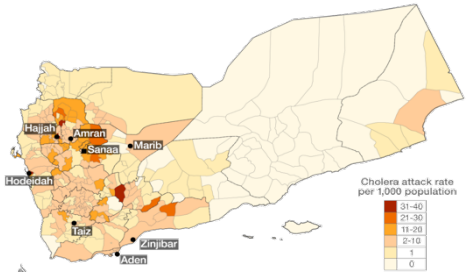
JASON: Sea Surface Height

AVHRR: Sea surface temperature

SRTM: Elevation

Risk estimated on 30.May. 2017 for June 2017





Reported cholera cases for June 2017 (Source: WHO)

NASA Web Feature: https://www.nasa.gov/press-release/nasa-investment-in-cholera-forecasts-helps-save-lives-in-yemen

Health and Air Quality Applied Sciences Team (HAQAST)

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)

Last Meeting: July 10-12, 2019, in Pasadena, CA
Stakeholder Webinars Planned for Winter 2020
Joint Workshop Planned with EPA for June 2020
https://haqast.org

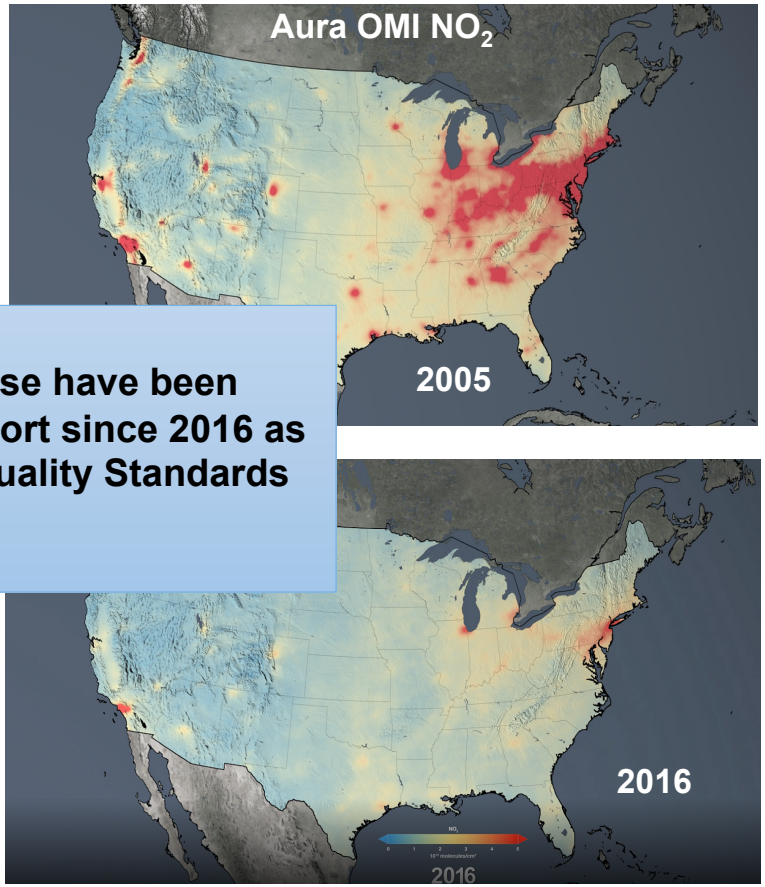
NASA *Aura* OMI Shows Air Quality Improved

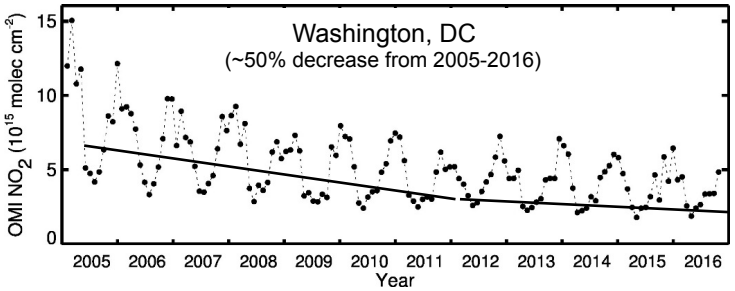
• Nitrogen dioxide (NO_2) is a pollutant that is unhealthy to breath and contributes to the formation of unhealthy levels of surface ozone pollution. It is primarily emitted from tailpipes and smokestacks.

• Aura Ozone Monitoring Instrument (OMI) NO_2 data sho
of the U.S. fro
due to toughe

• While OMI d
occurred from
changed less

Earth observations such as these have been included in the EPA Air Trends Report since 2016 as part of the National Ambient Air Quality Standards (NAAQS) chapter.





(above) Monthly-average OMI NO_2 data for the Washington DC Metro area (source: https://airquality.gsfc.nasa.gov)

(above) Annual-average OMI NO_2 data for the U.S. (source: https://svs.gsfc.nasa.gov/12094)

Applied Remote Sensing Training Program (ARSET)

POC: Ana. I. Prados, NASA-GSFC

Objectives

- Provide end-users with **professional technical workshops**
- Build long-term partnerships with communities and institutions in the public and private sectors.

Online and hands-on courses

- **Who:** policy makers, environmental managers, modelers and other professionals in the public and private sectors.

  Where: U.S and internationally
- **When**: throughout the year. Check websites.
- Do NOT require prior remote- sensing background.
- Presentations and hands-on guided computer exercises on how to access, interpret and use NASA satellite images for decision-support.

NASA ARSET Training for California Air Resources Board, Sacramento, CA

http://arset.gsfc.nasa.gov/

National Aeronautics and
Space Administration

Questions:

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http://AppliedSciences.NASA.gov