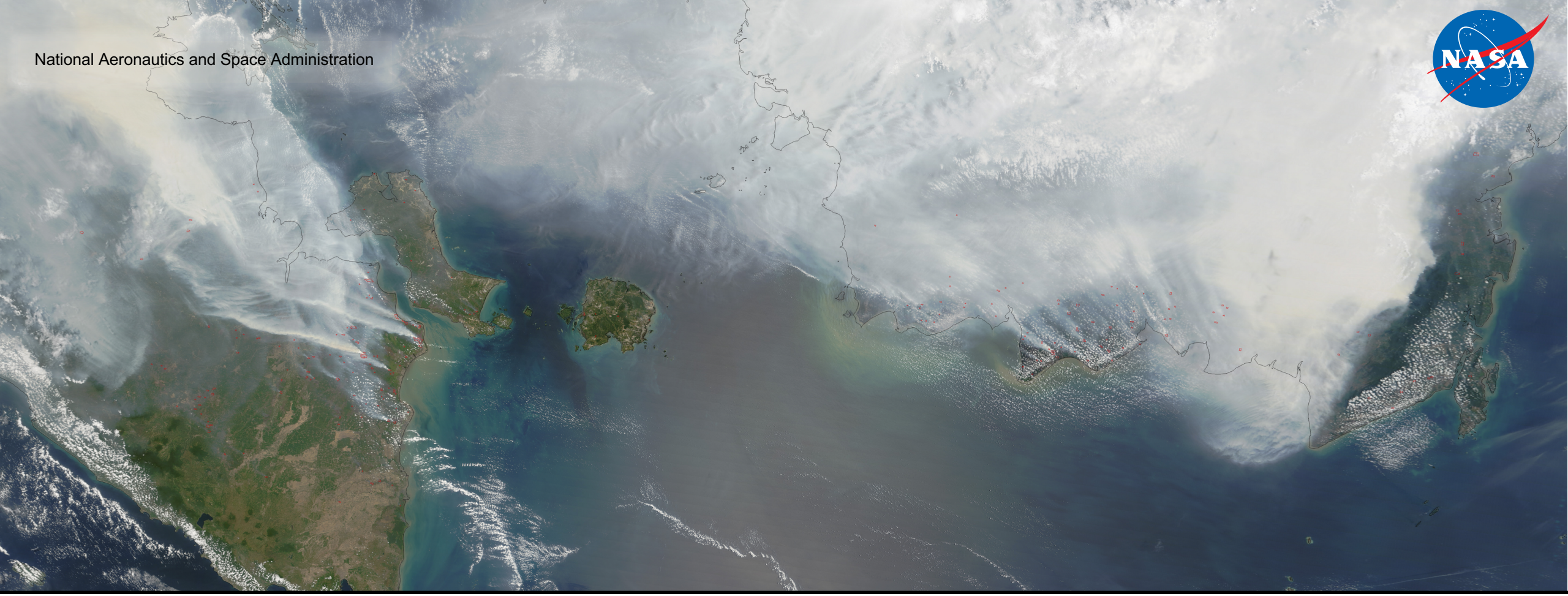
National Aeronautics and Space Administration



NASA Applied Remote Sensing Training (ARSET) Program Overview

Pawan Gupta, Melanie Follette-Cook, and Bryan Duncan

NASA Remote Sensing for Air Quality Applications, March 20-23, 2018, Jakarta, Indonesia

NASA's Applied Remote Sensing Training Program (ARSET)

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

- Empowering the global community through remote sensing training
- Part of NASA's Applied Sciences Capacity Building Program
- Goal: increase the use of Earth Science in decision-making through training for:
  - policy makers
  - environmental managers
  - other professionals in the public and private sector
- Trainings offered focusing on applications in:

Disasters
9 Trainings

Eco
12 Trainings

Health & Air Quality
52 Trainings

Water Resources
20 Trainings

ARSET Training Levels

Advanced Training, *Level 2*
- Online and in-person
- Requires Level 1 training or equivalent knowledge
- More in-depth or focused topics

Beginning Training, *Level 1*
- Online and in-person
- Requires Level 0 training or equivalent knowledge
- Specific applications

Fundamentals Training, *Level 0*
- Online only
- Assumes no prior knowledge of remote sensing

ARSET Training Levels

Advanced Training, *Level 2*
- Advanced Webinar: Using NASA Remote Sensing for Flood Monitoring and Management

Beginning Training, *Level 1*
- NASA Remote Sensing Observations for Flood Management

Fundamentals Training, *Level 0*
- Fundamentals of Remote Sensing
- Satellites, Sensors, and Earth Systems Models for Water Resource Management

ARSET Training Impacts: Health & Air Quality (2008-2016)

Total ARSET Participants (2009-2017): 13,042

Health & Air Quality Participants 2,978

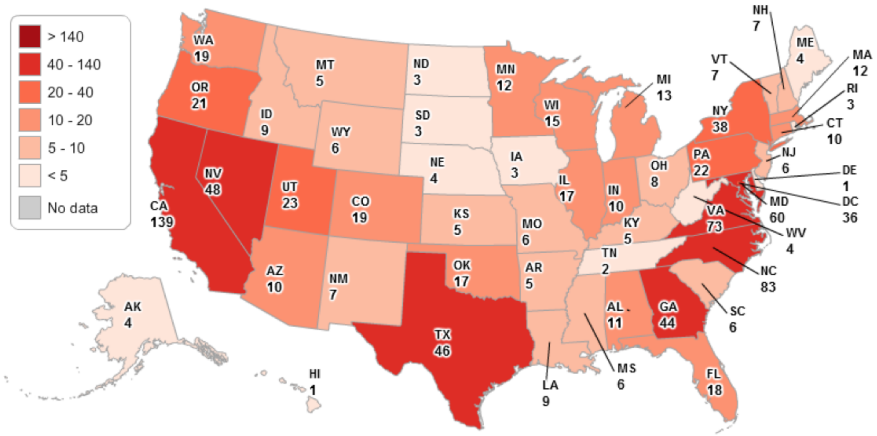
17 online trainings

75 countries

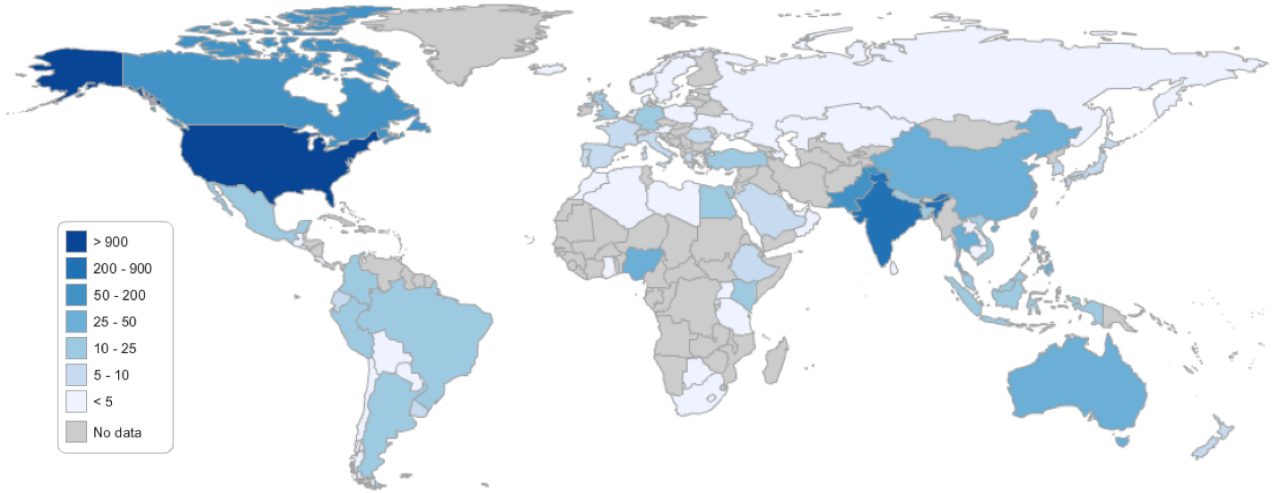
38 in-person trainings

836 organizations

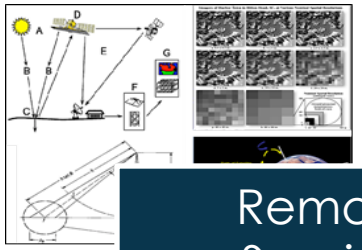
US Health & Air Quality Participants



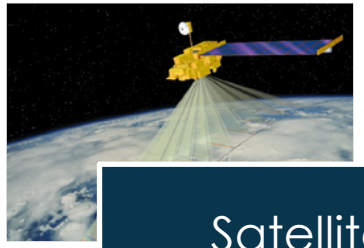
Global Health & Air Quality Participants



ARSET Air Quality Trainings

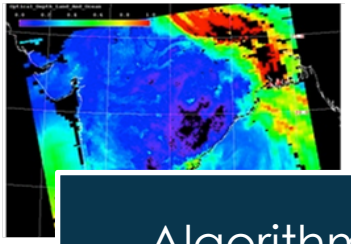


Remote Sensing

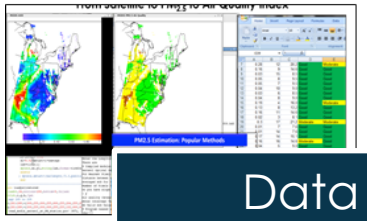


Satellites

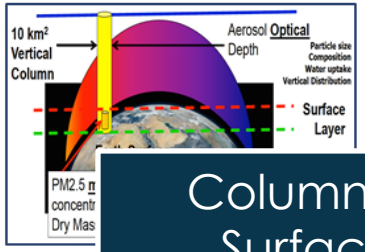
Imagery



Algorithms

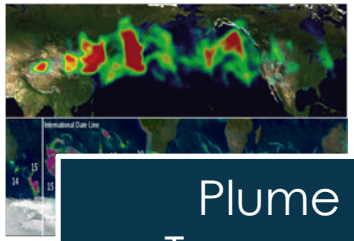


Data & Tools

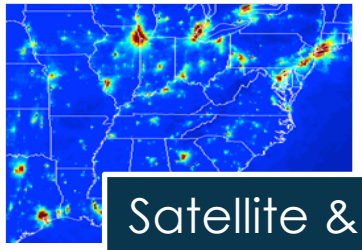


Column to Surface

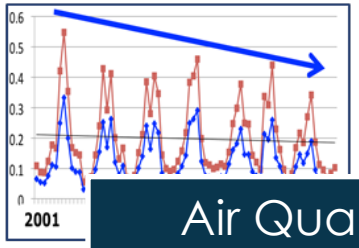
Dust & Smoke



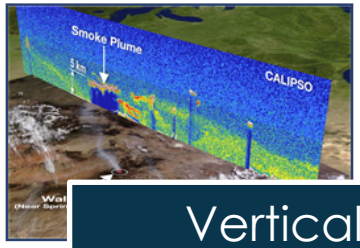
Plume Transport



Satellite & Model Comparison



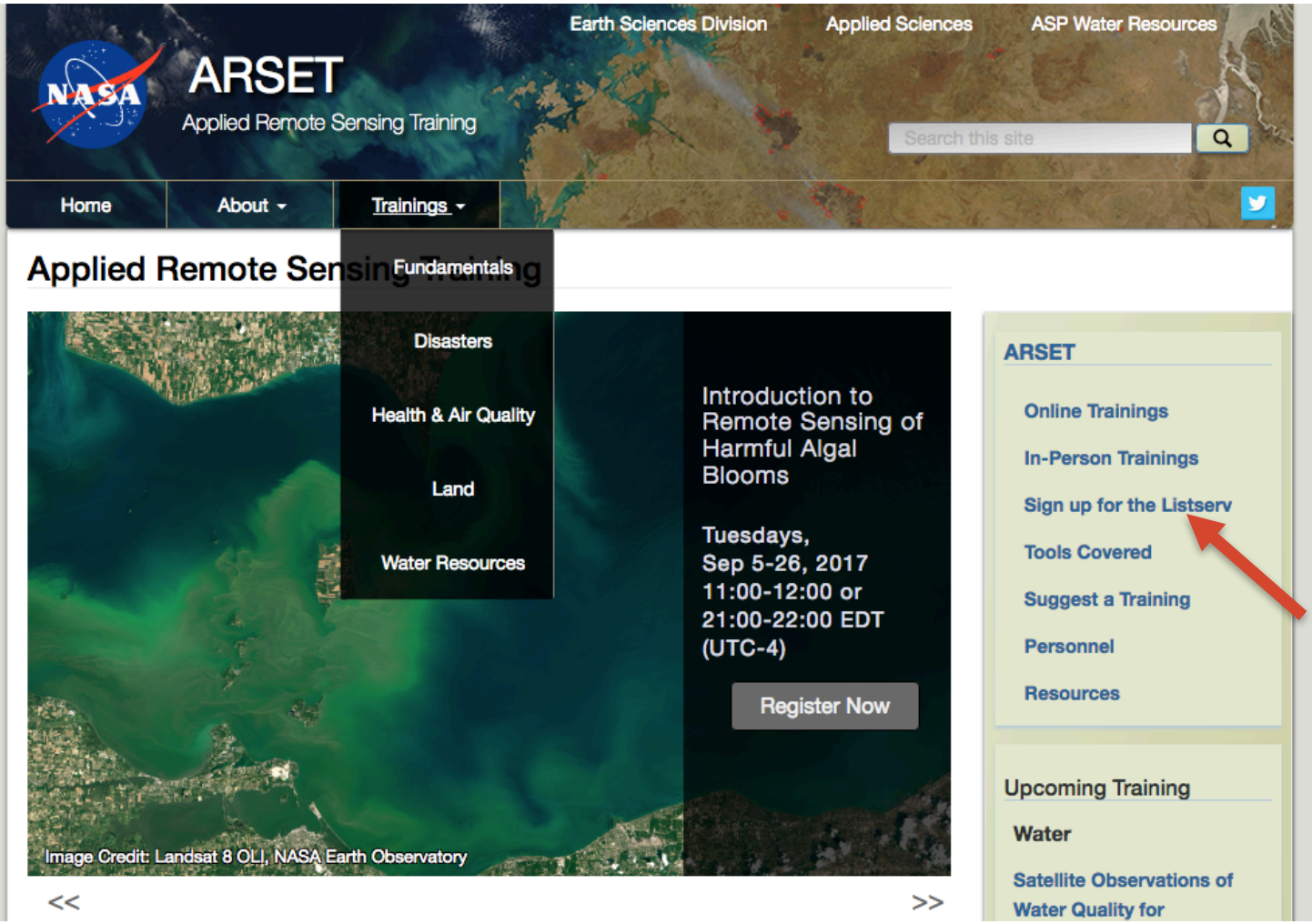
Air Quality Trends



Vertical Profiles

Learn More About ARSET

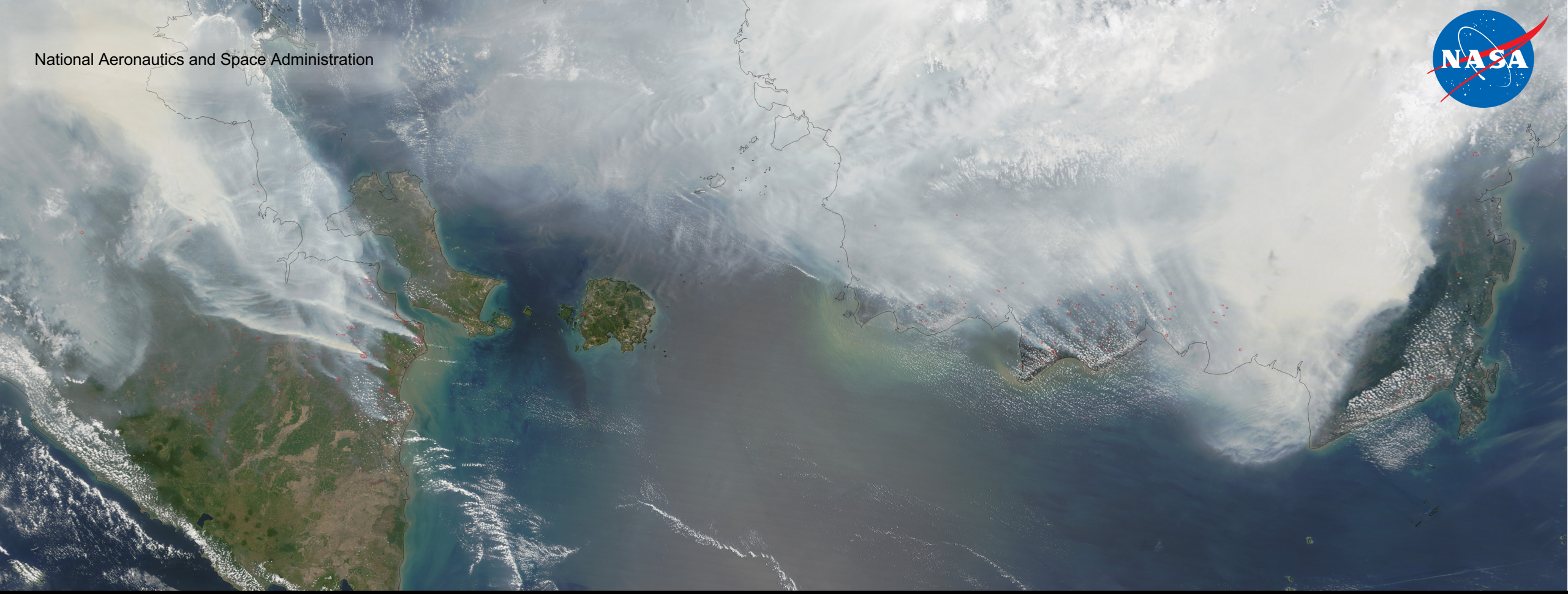
http://arset.gsfc.nasa.gov/



Training Outline

- **Day 1**
  - Introduction
  - Remote Sensing
  - Image Access & Interpretation
  - Data Formats
  - Aerosol Observations
  - Aerosol Data
- **Day 2**
  - Aerosol Products
  - Aerosol Data Validation
  - Reading and Mapping Aerosol data
  - PM2.5 Estimations
  - PM2.5 Data Sets
  - PM2.5 Applications
- **Day 3**
  - Fire Detection
  - Trace Gas Remote Sensing
  - NO_2 & SO_2 Data Access and Analysis
  - Aerosol vertical profile
  - Volcanic Eruptions
  - Reanalysis Data Sets
  - Geostationary Observations
  - Future Missions
- **Day 4**
  - Case study Analysis and Presentations

National Aeronautics and Space Administration



Overview of Satellite Capabilities for Air Quality Monitoring

Satellite Remote Sensing of Air Quality, March 20-23, 2018, Jakarta, Indonesia

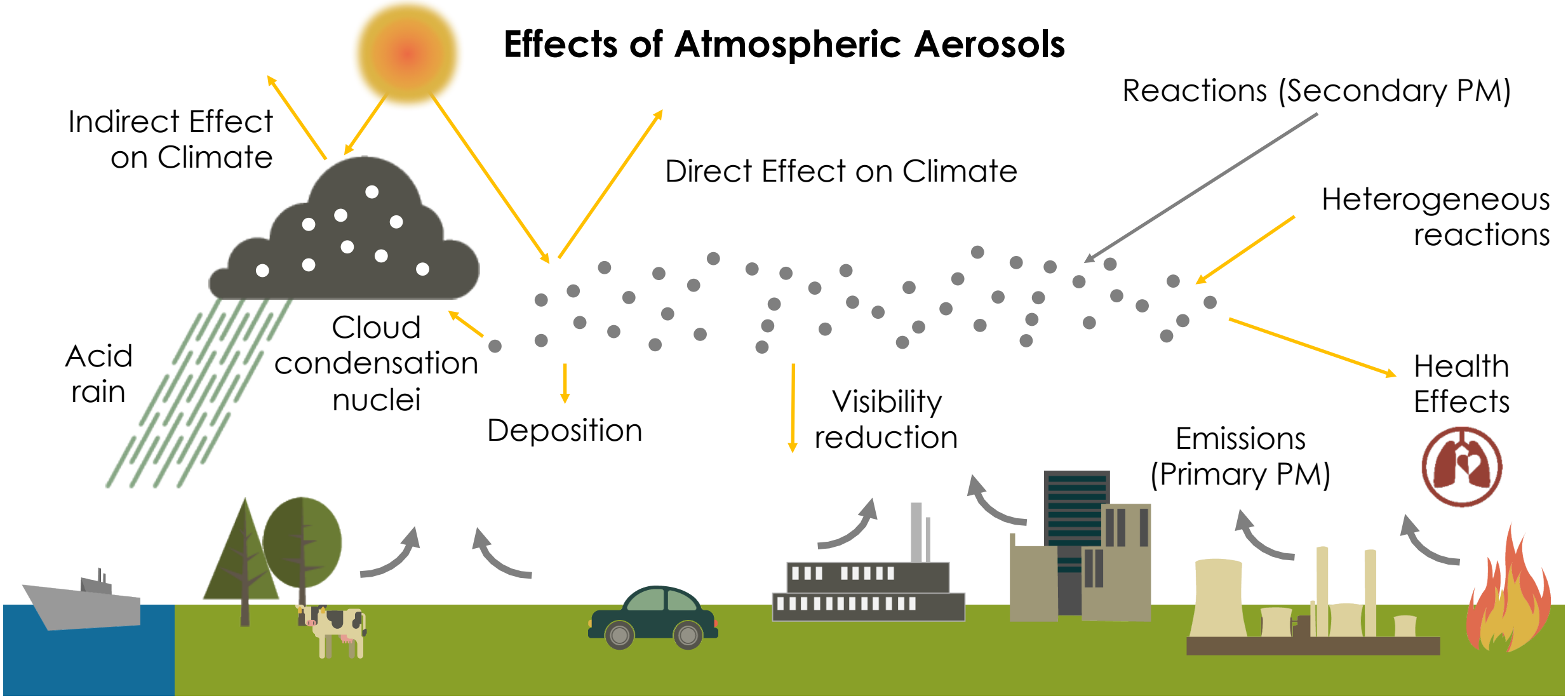
Pawan Gupta, and Melanie F. Cook

Learning Objectives

By the end of this presentation, you will be able to:

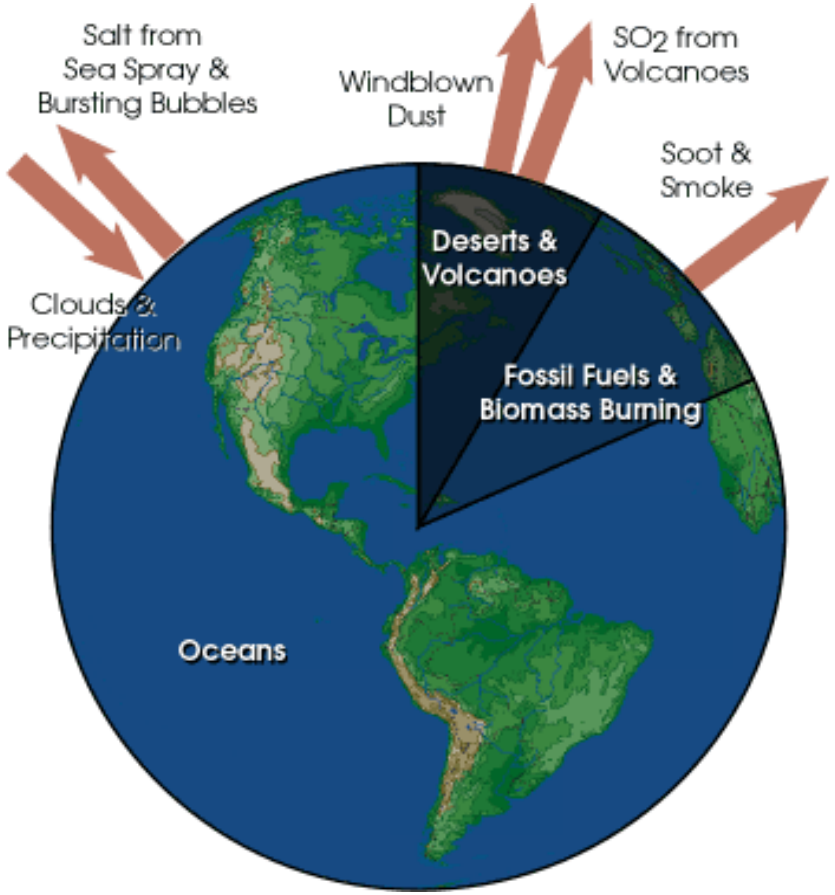
- Describe existing satellite capabilities for global air quality monitoring
- Identify various air quality monitoring applications

Motivation: Tiny, but Potent

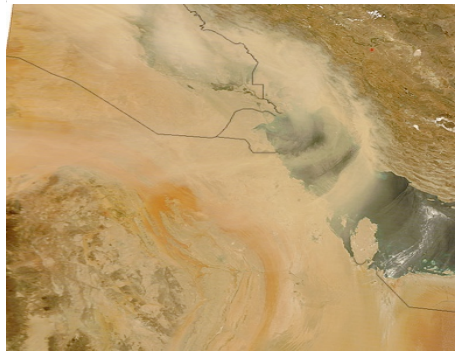


Pollution Sources

Atmospheric aerosols are highly variable in space and time



Dust

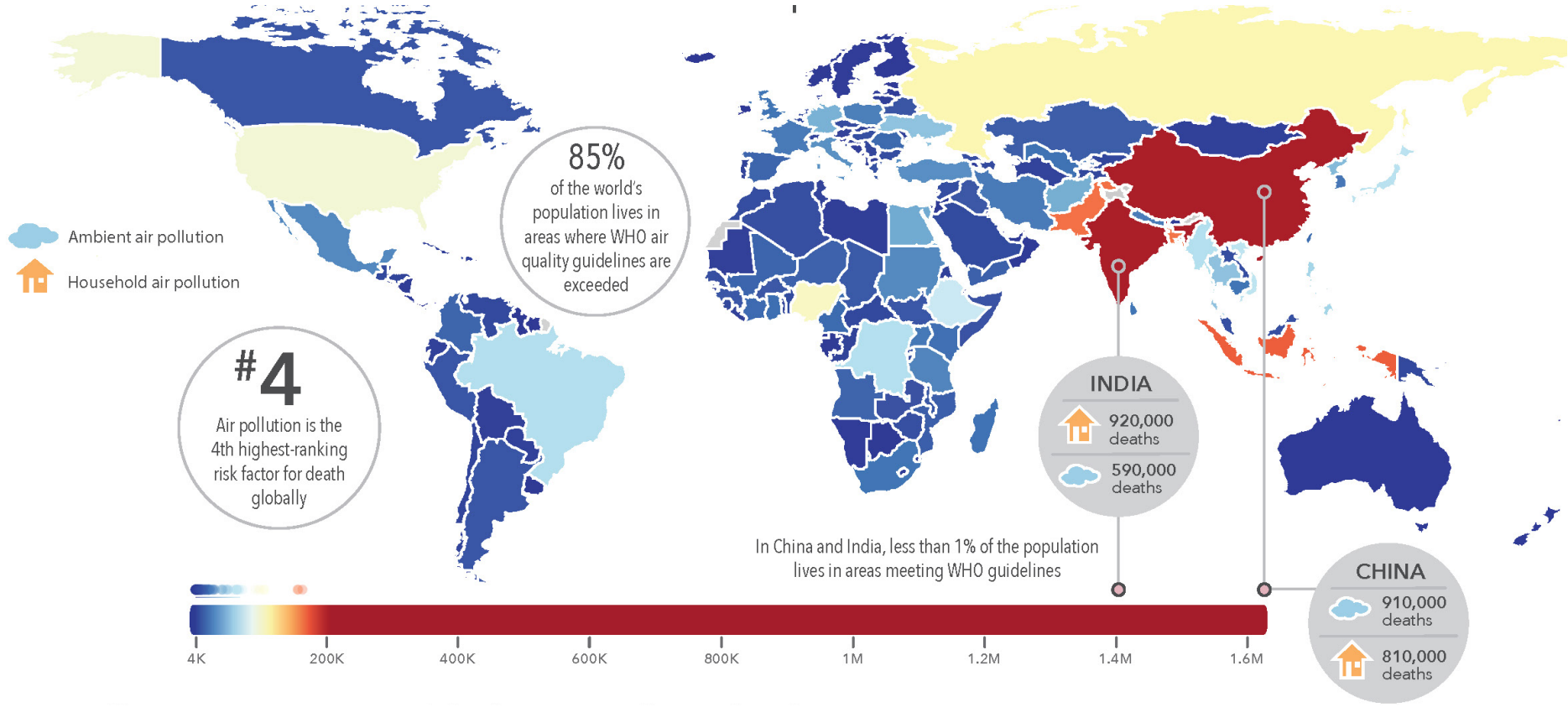


Fossil Fuels & Biomass Burning

Volcanoes

Soot & Smoke

Global Burden of Air Pollution



- Air pollution was responsible for 5.5 million deaths in 2013
- Satellite data can help quantify the impact on human health

Image Credit: http://thelancet.com/gbd/2013

UN Sustainable Development Goals (SDGs)

Transforming Our World: The 2030 Agenda for Sustainable Development

- A plan of action for people, planet, and prosperity
- All countries and all stakeholders, acting in collaborative partnership, will implement this plan
- 17 SDGs and 169 targets under this agenda
- Balance the three dimensions of sustainable development:
  – economic, social, and environmental

Text adapted from "Transforming our world: the 2030 Agenda for Sustainable Development"

Traditional Air Quality Monitoring

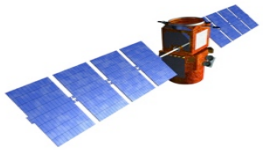
www.aqicn.org

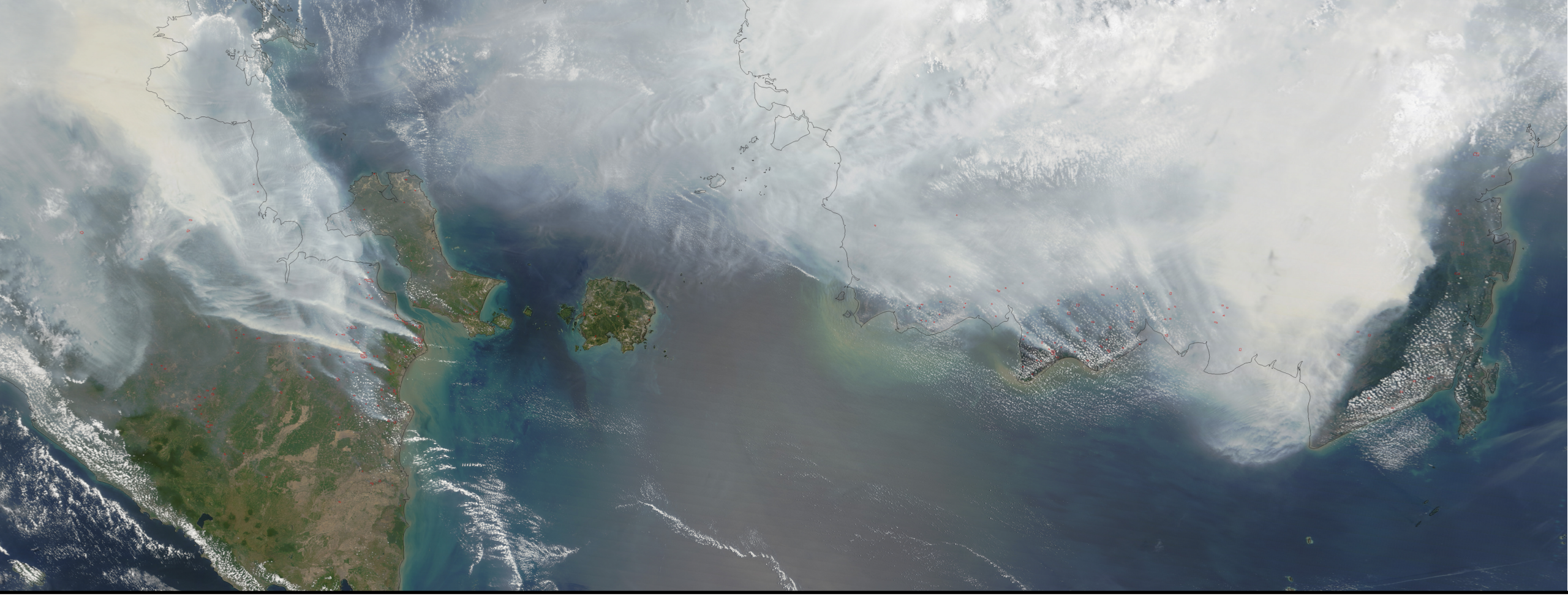
Air Pollution Monitoring

Ground Measurements

Air & Space Observations

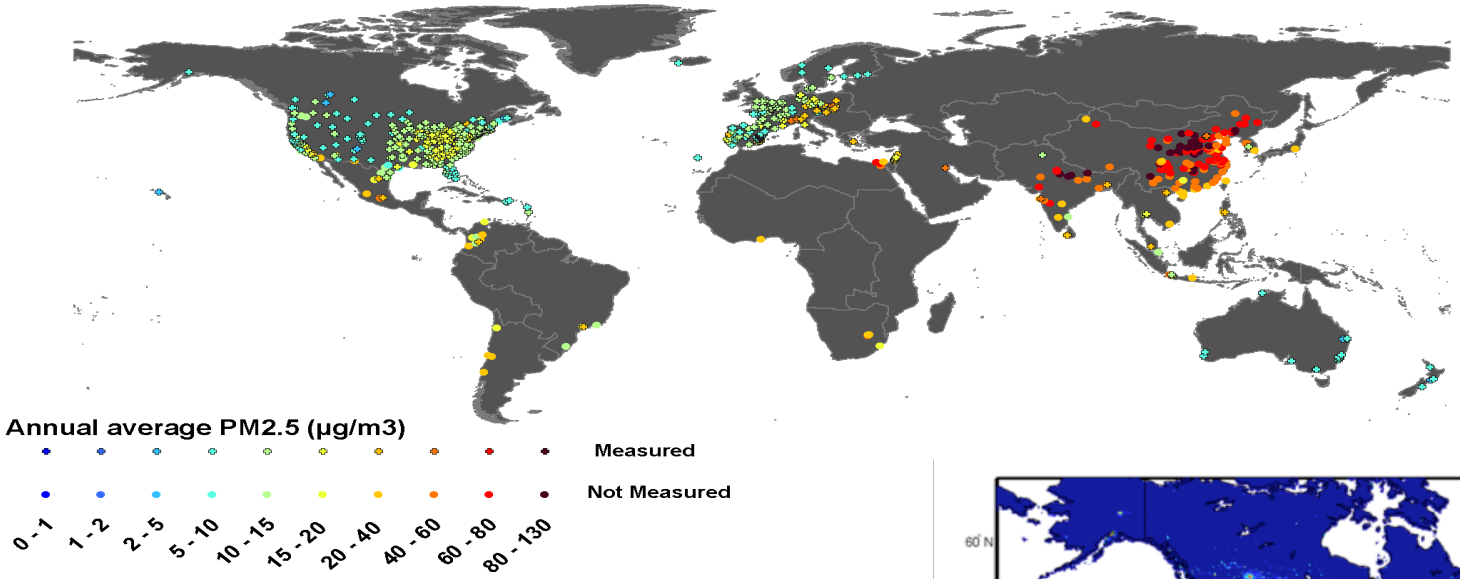
Models





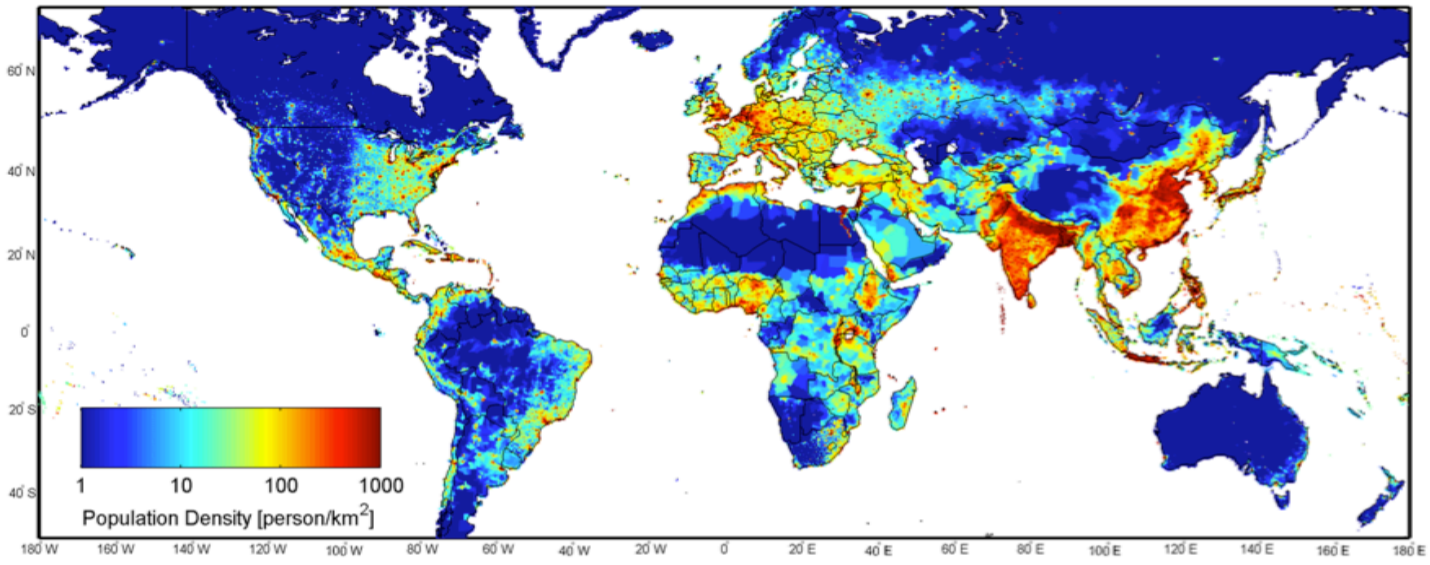
Why use satellite data?

Global Status of $PM_{2.5}$ Monitoring



Ground Sensor Network

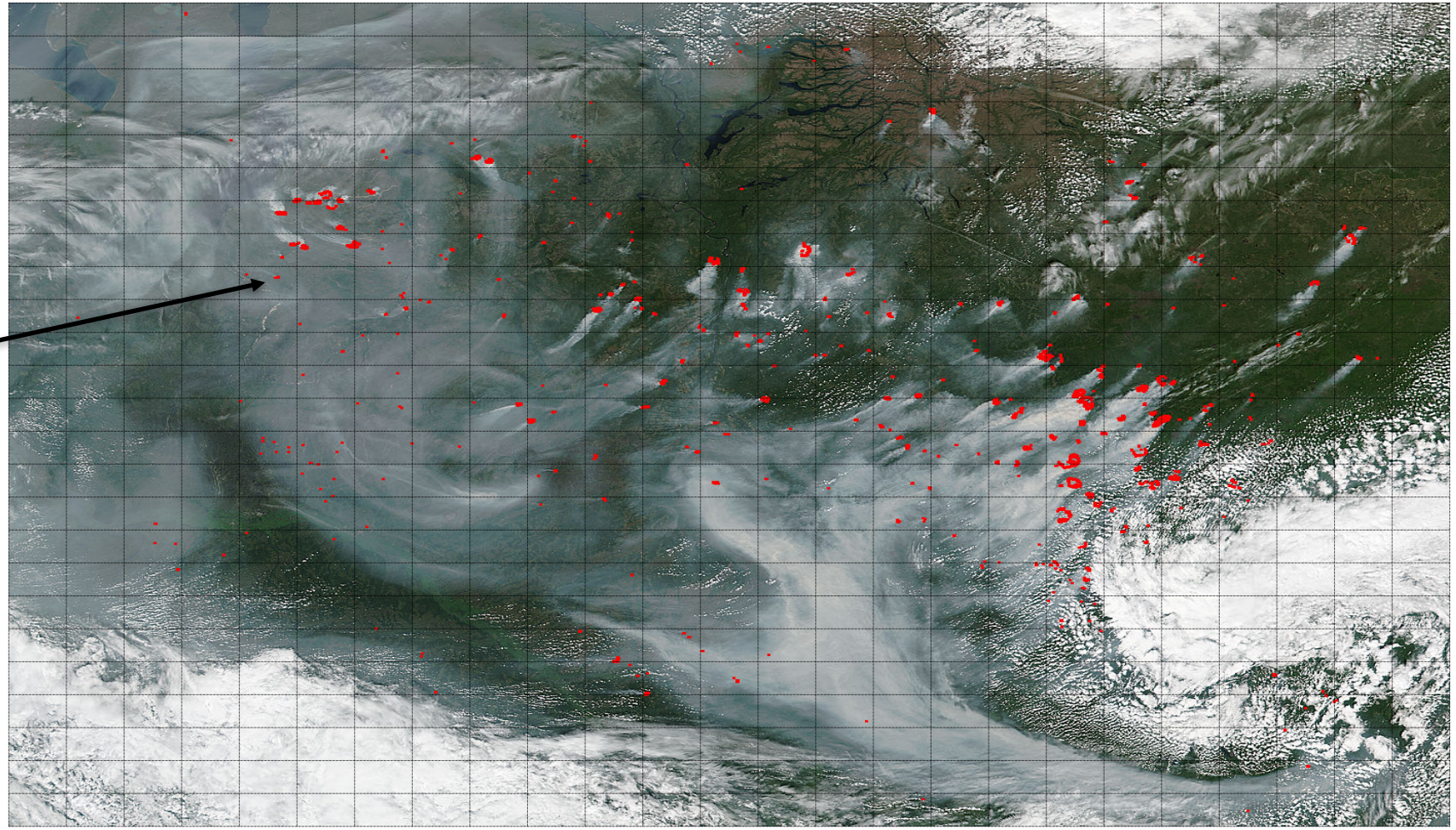
Population Density



“A Picture is Worth a Thousand Words”

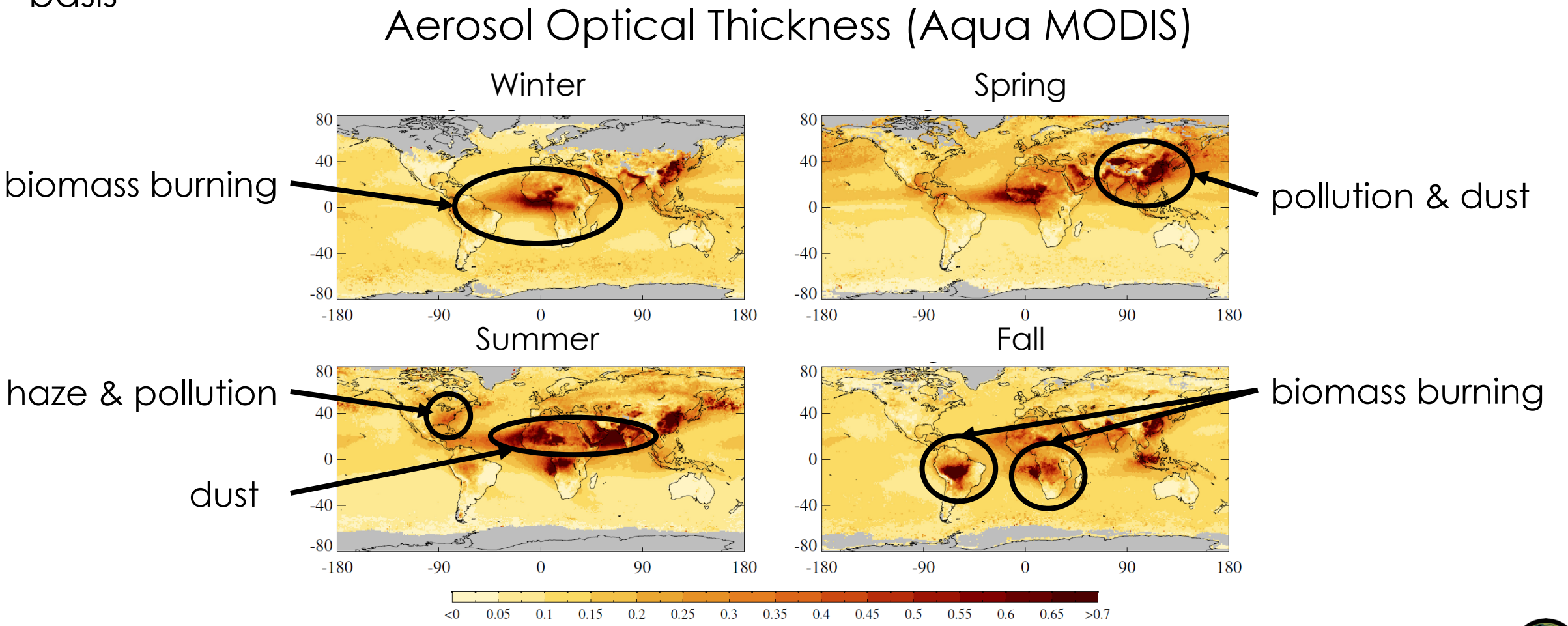
A satellite picture is worth ~~a~~ **millions of data points**

A geo-physical number



Aerosols from Satellites

- Several satellites provide state-of-the-art aerosol measurements globally, on a daily basis



Nitrogen Dioxide (NO_2)

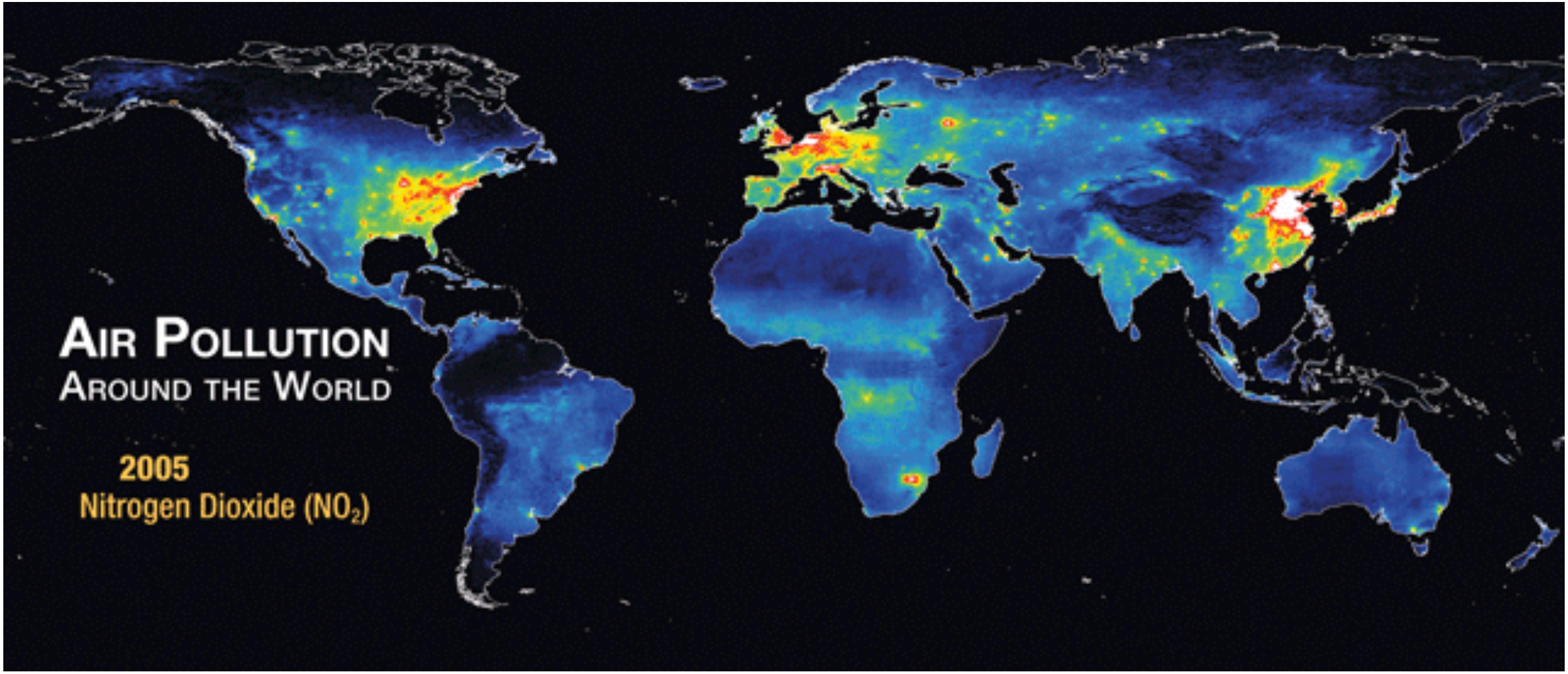


Image Source: https://aura.gsfc.nasa.gov/images/NASA_NO2_Global_FRONT.gif

Sulphur Dioxide (SO_2) – OMI - 2017

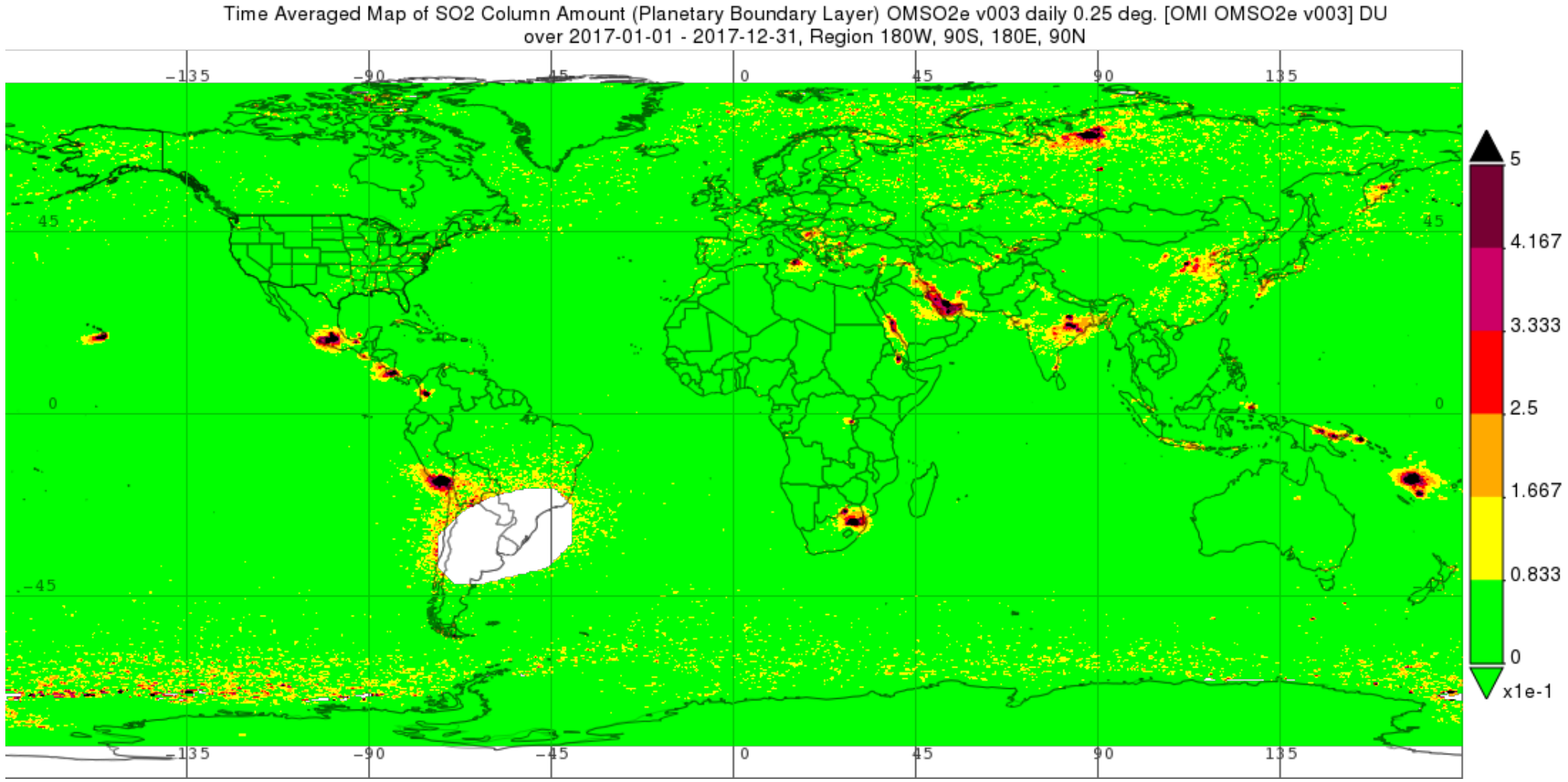
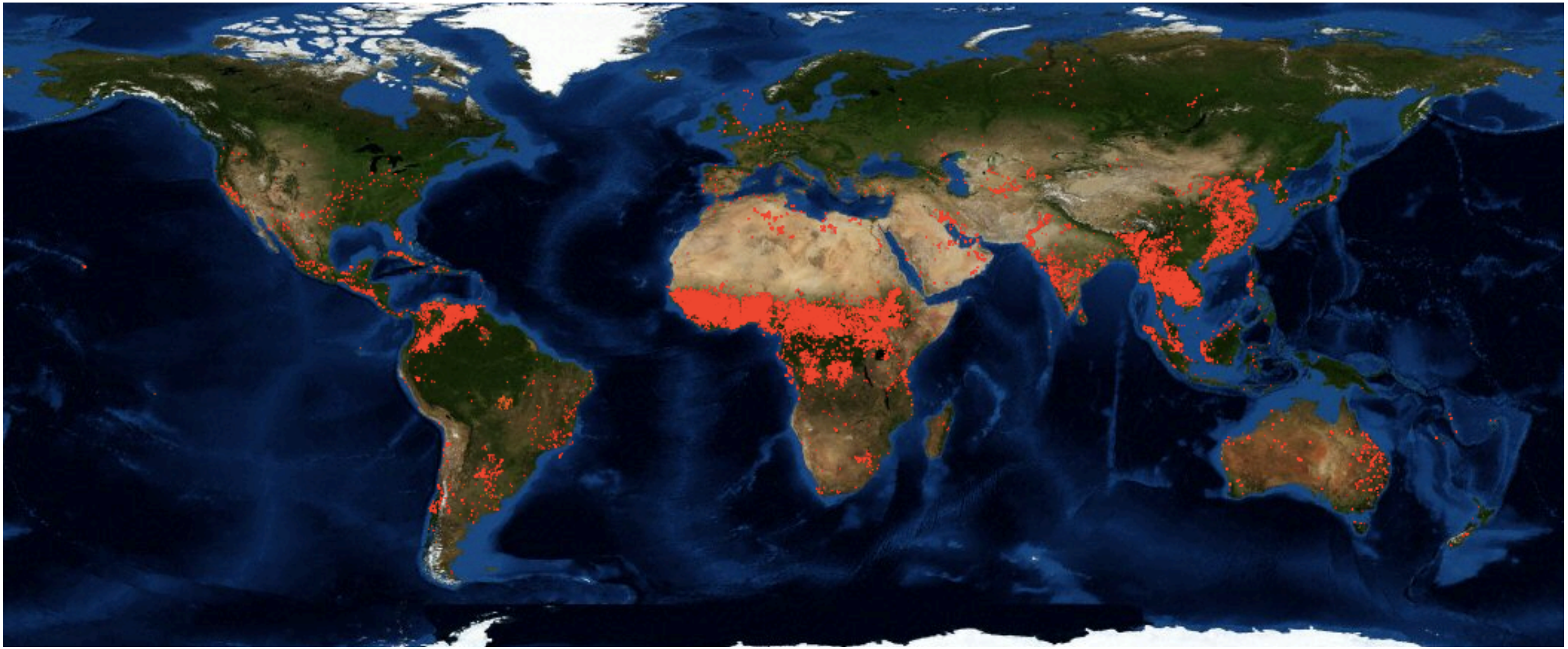


Image Credit: https://giovanni.gsfc.nasa.gov/

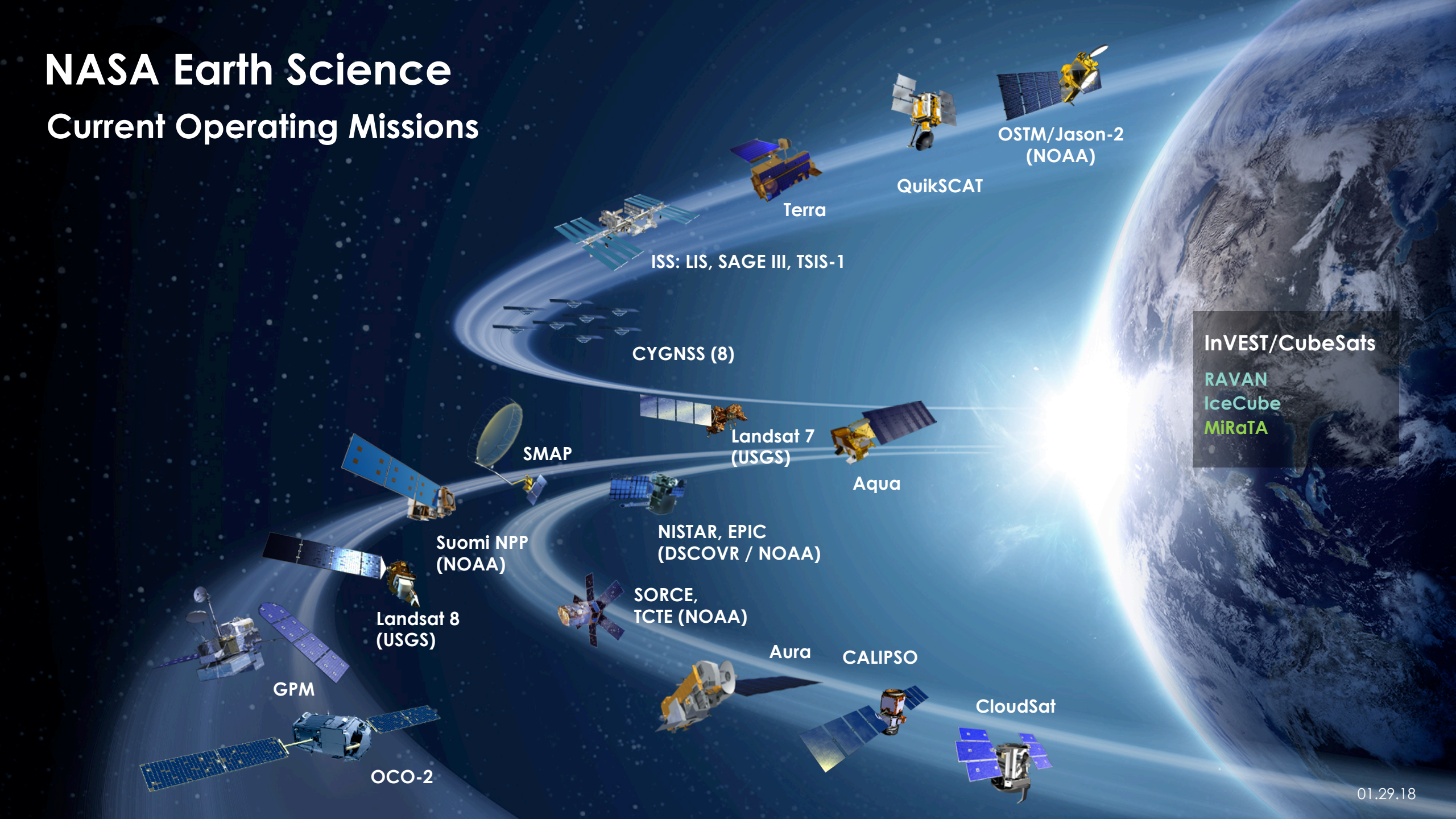
Active Fire Mapping – February 13, 2018



https://firms.modaps.eosdis.nasa.gov/

NASA Earth Science

Current Operating Missions



01.29.18

NASA Earth Science

Missions: Present Through 2023

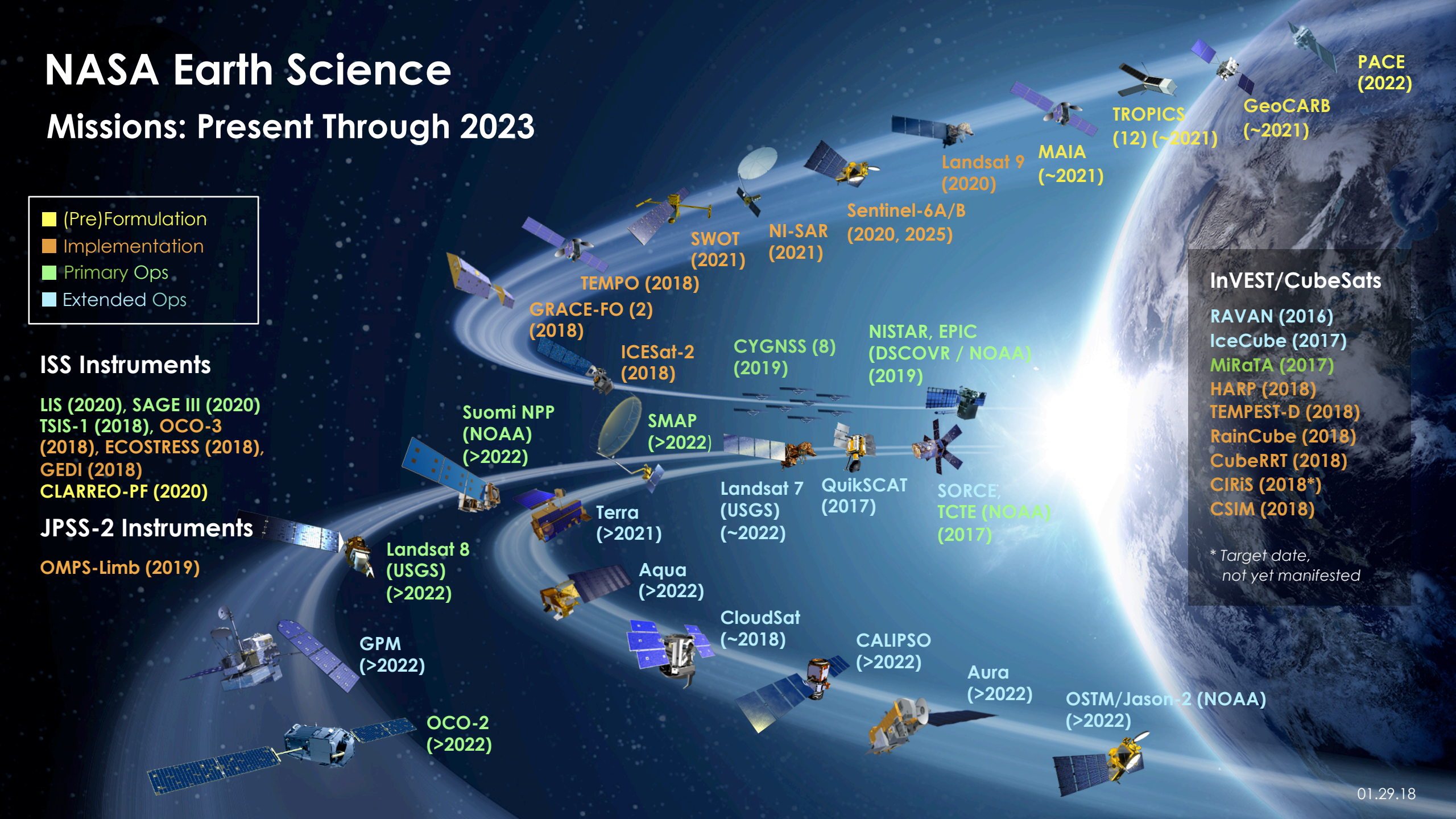
- (Pre)Formulation
- Implementation
- Primary Ops
- Extended Ops

ISS Instruments

LIS (2020), SAGE III (2020)
TSIS-1 (2018), OCO-3 (2018), ECOSTRESS (2018), GEDI (2018)
CLARREO-PF (2020)

JPSS-2 Instruments

OMPS-Limb (2019)

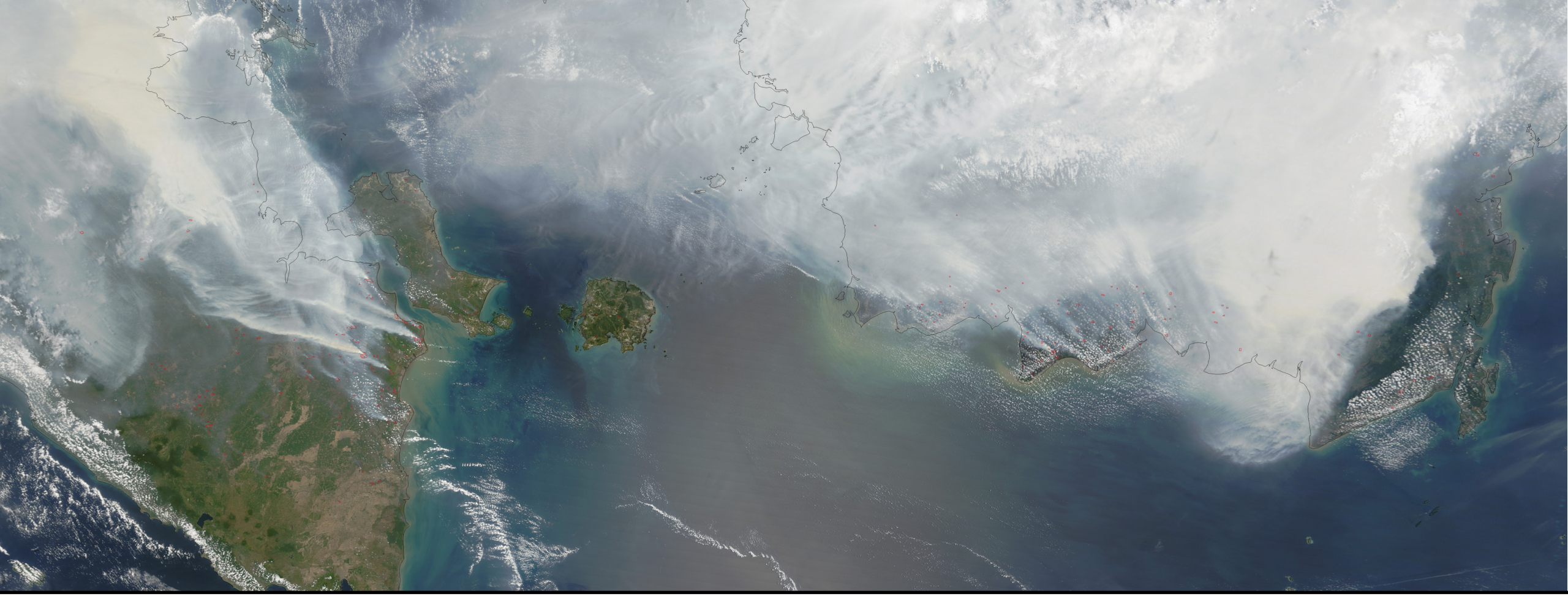


InVEST/CubeSats

RAVAN (2016)
IceCube (2017)
MiRaTA (2017)
HARP (2018)
TEMPEST-D (2018)
RainCube (2018)
CubeRRT (2018)
CIRiS (2018*)
CSIM (2018)

** Target date, not yet manifested*

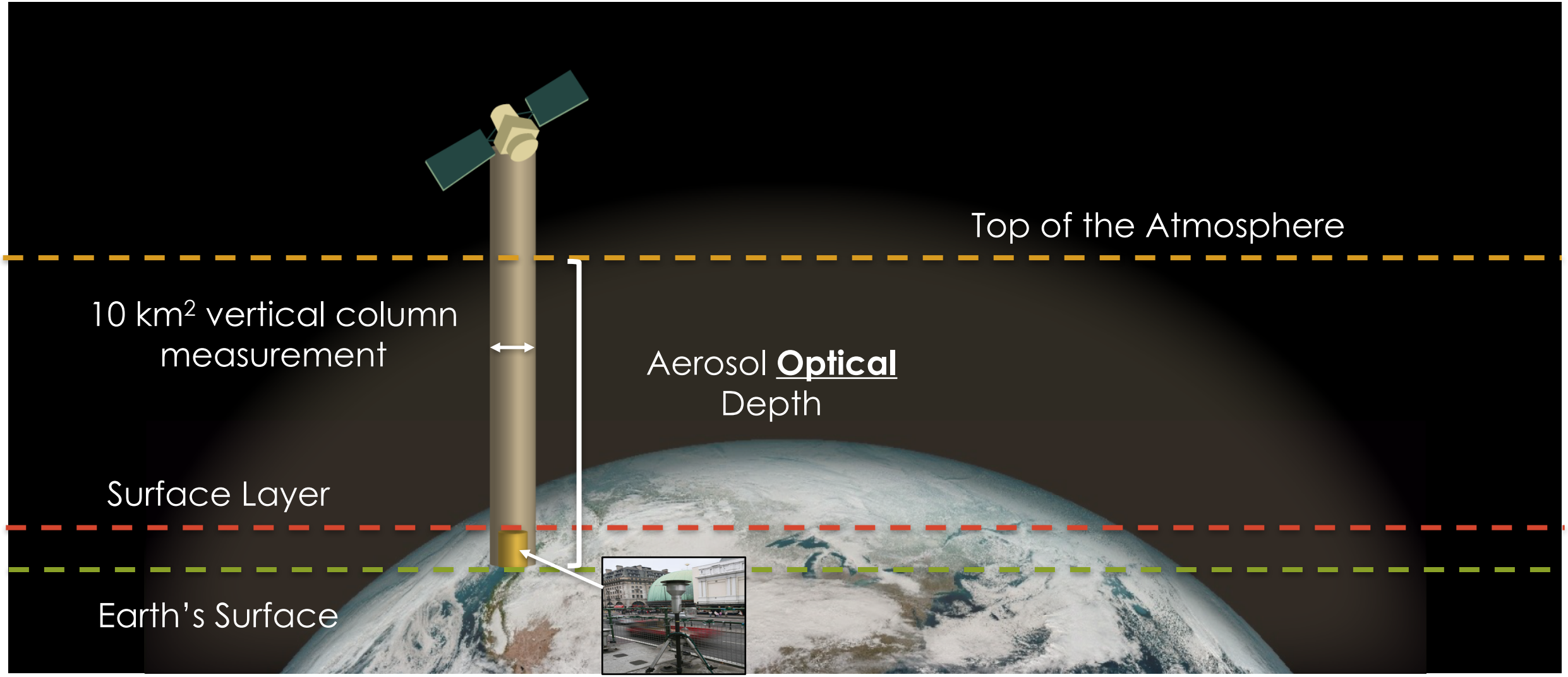
01.29.18



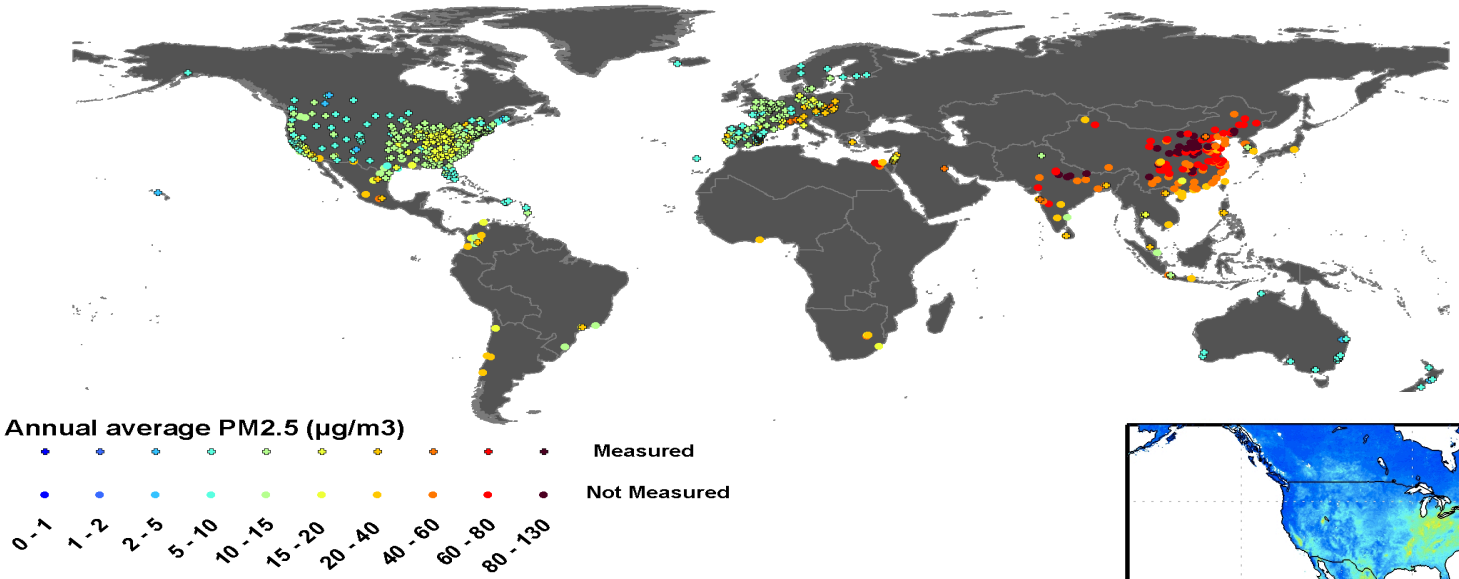
Air Quality Applications

Satellite vs. Ground Observation

Satellite vs. Ground Observation

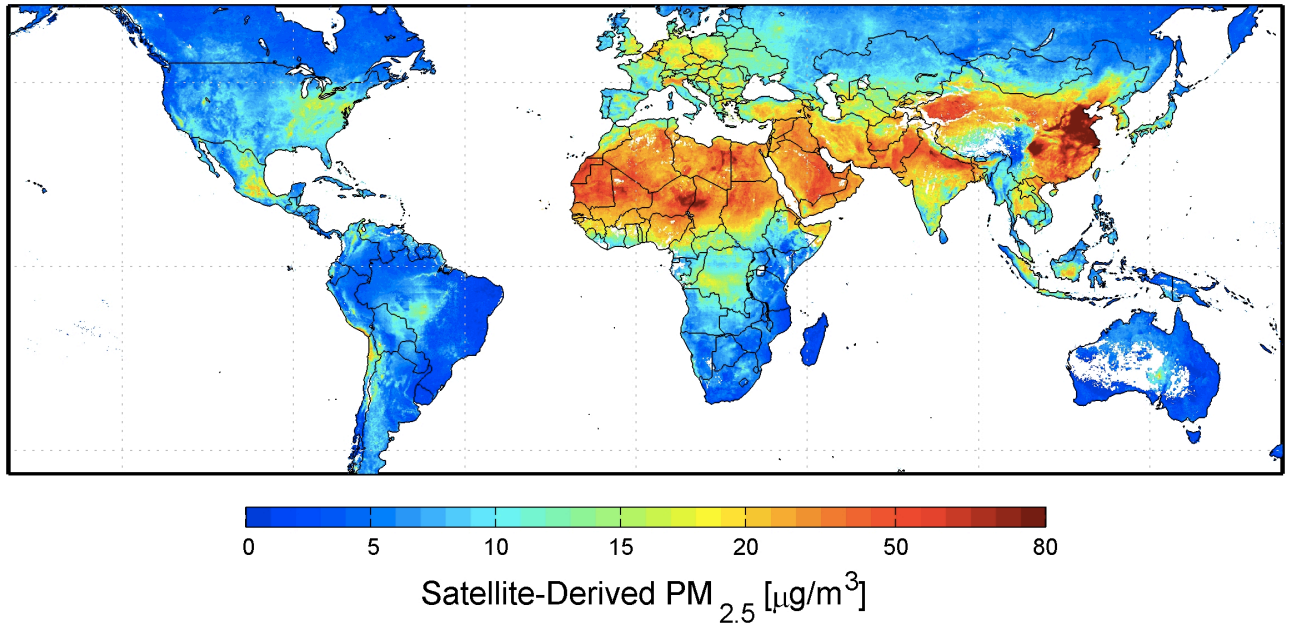


Global Status of PM2.5 Monitoring



Ground Sensor Network

Satellite Estimated $PM_{2.5}$

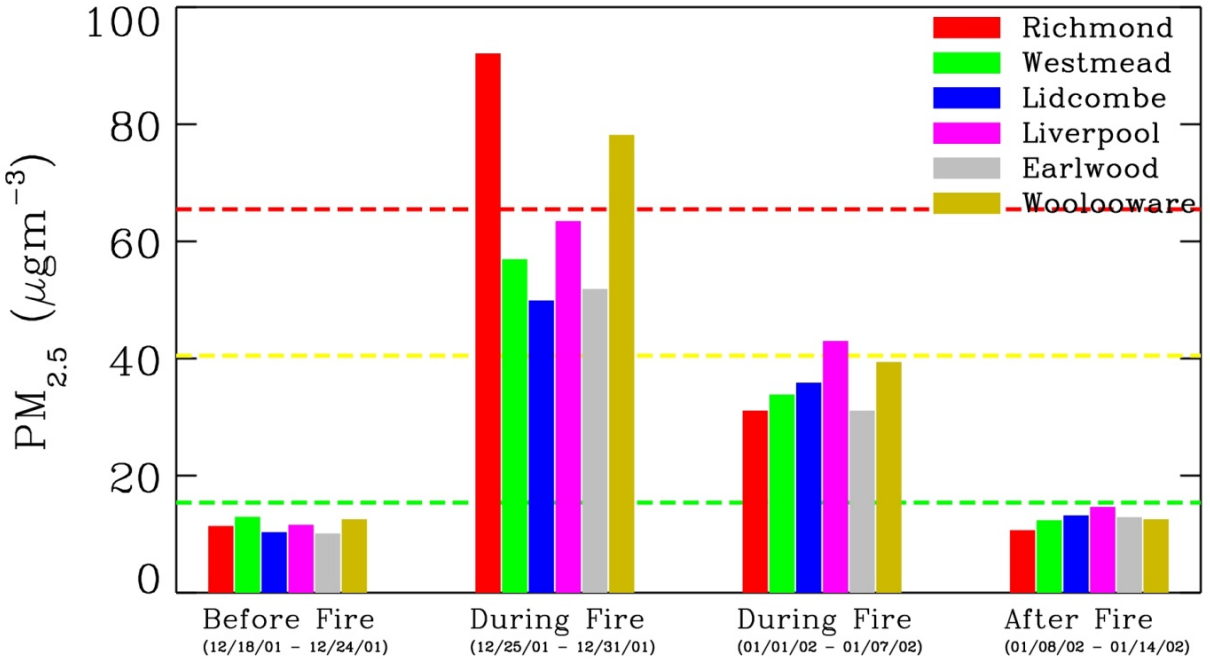


Credit: van Donkelaar et al., 2010

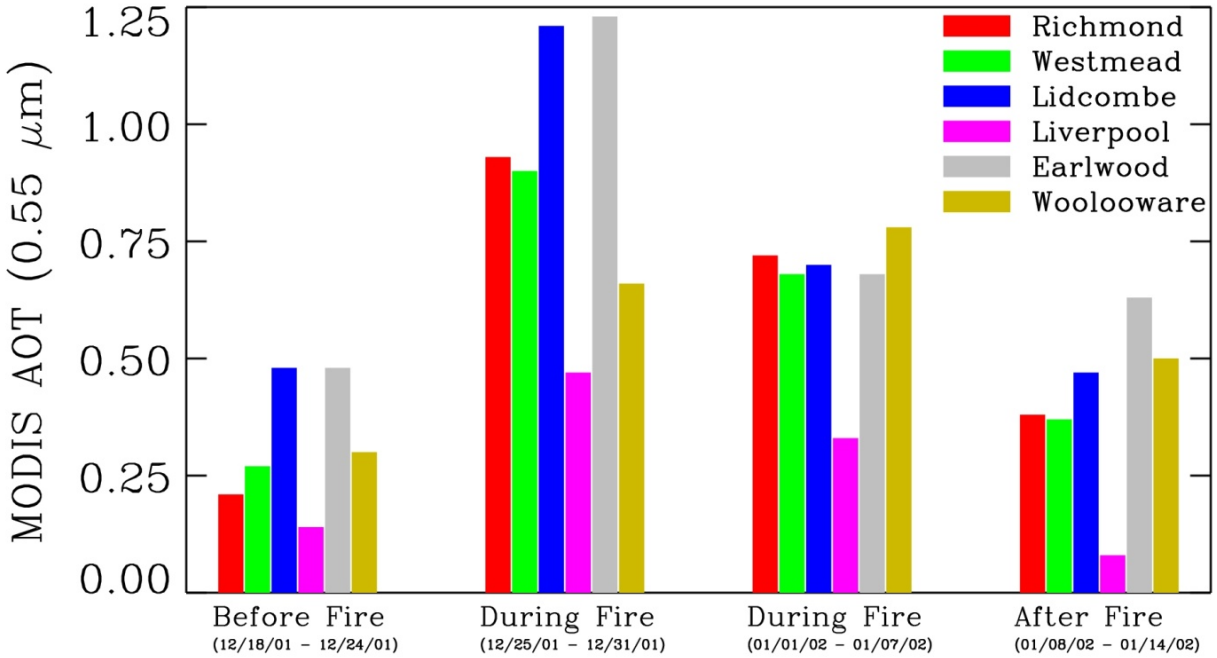
Application of Satellite Observations

Bushfires in Sydney, Australia

Surface $PM_{2.5}$



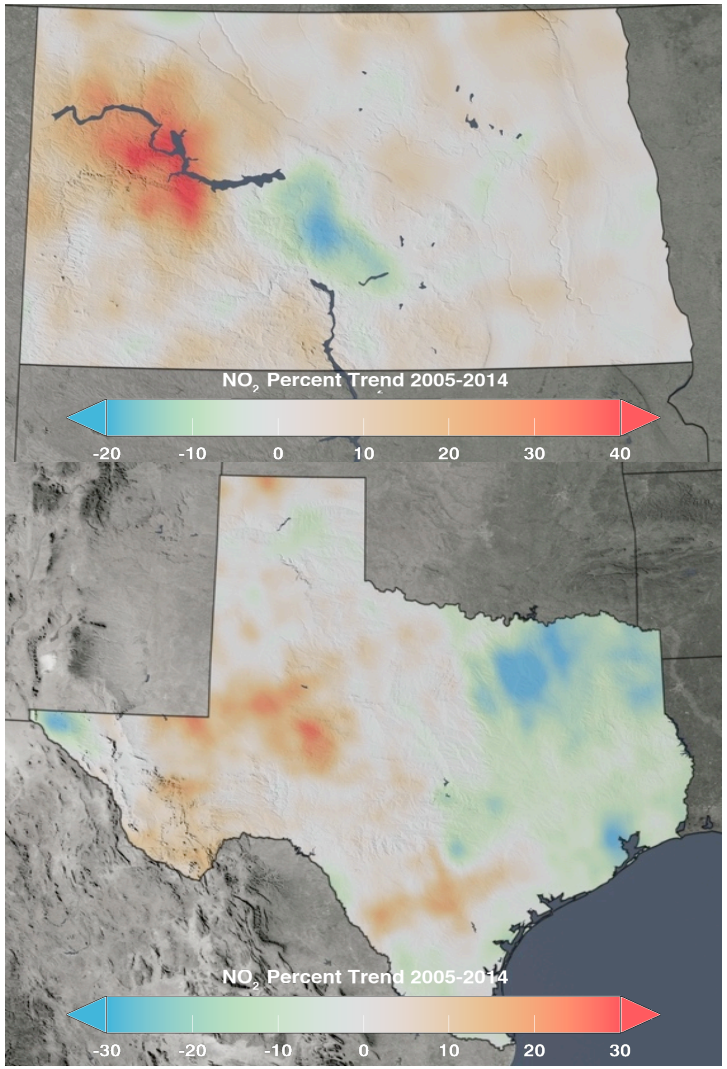
AOD from Satellites



Credit: Gupta and Christopher, 2007

OMI Detects NO_2 Increases from ONG Activities

2005 - 2014

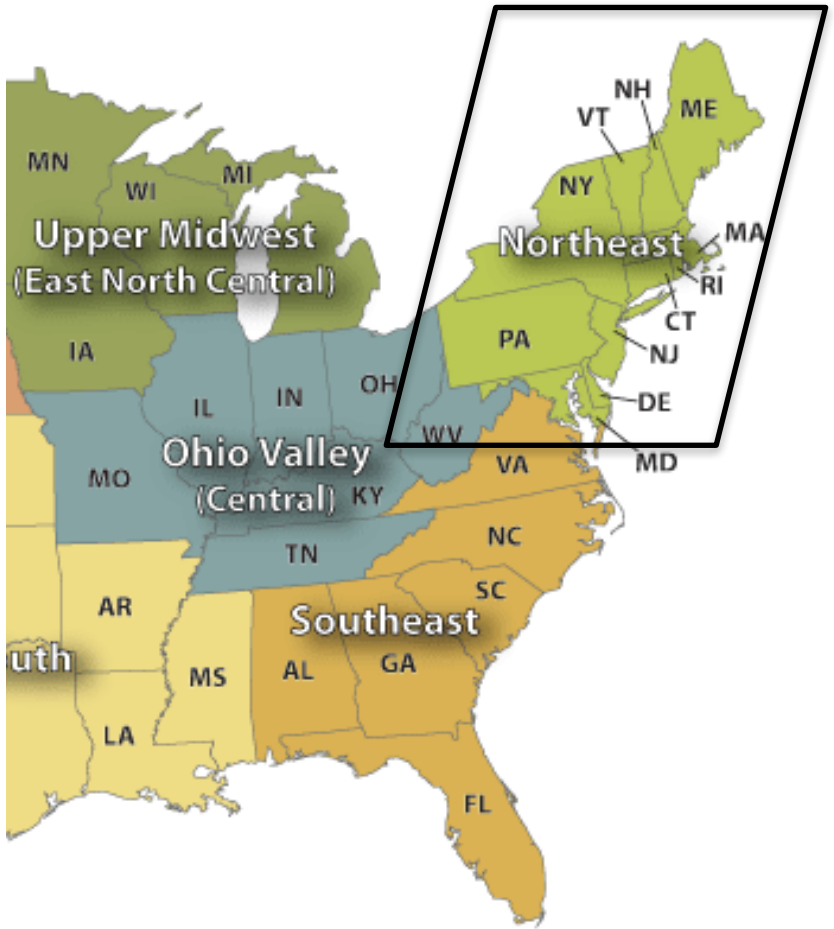


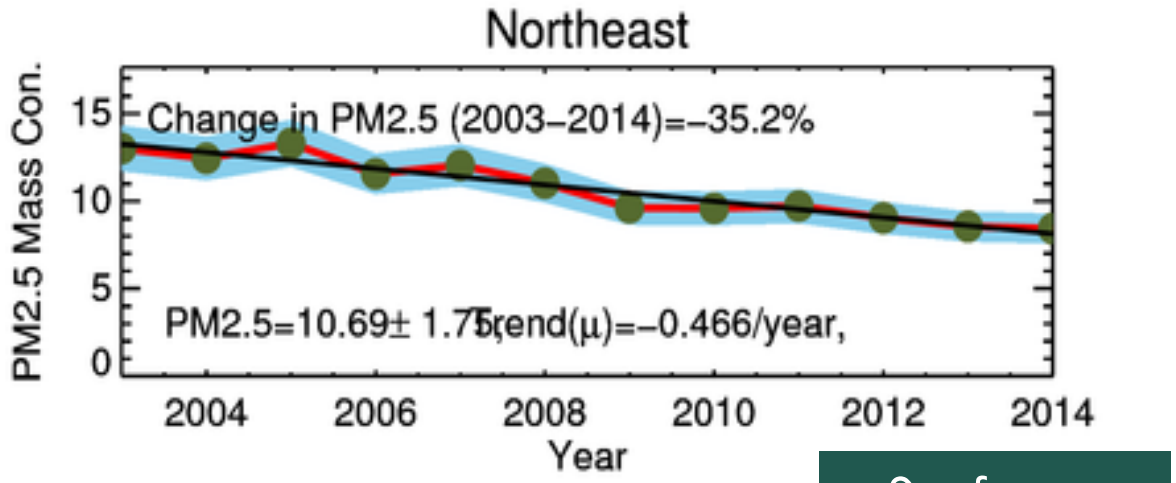
North Dakota

Suomi NPP VIIRS Lights at Night

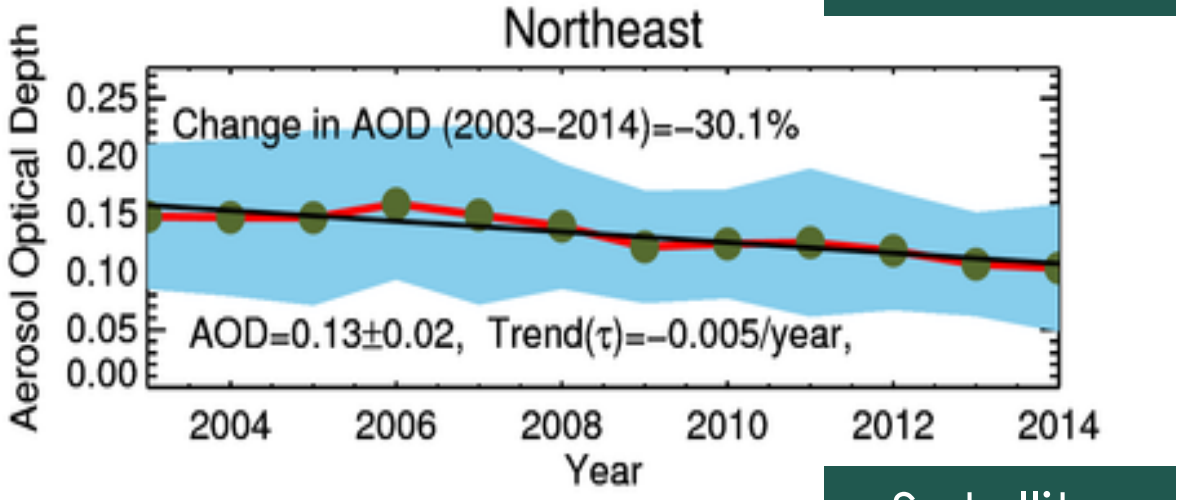
Texas

Measurements: Surface vs. Satellite





Surface

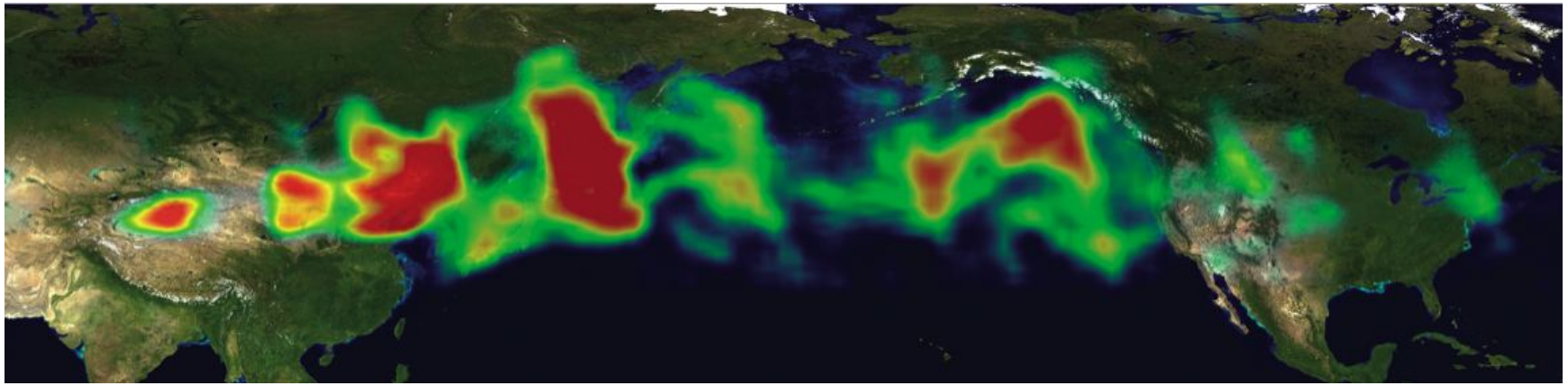


Satellite

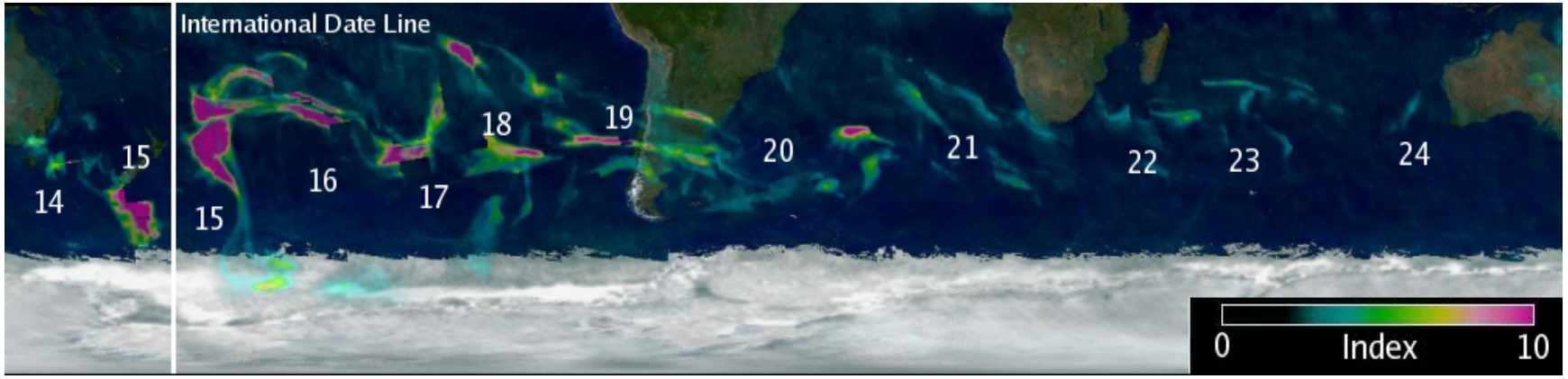
Map Credit: U.S. Climate Regions, NOAA; Time Series Credit: Gupta

Long Range Transport

Dust from Mongolian Deserts Reaches the U.S.



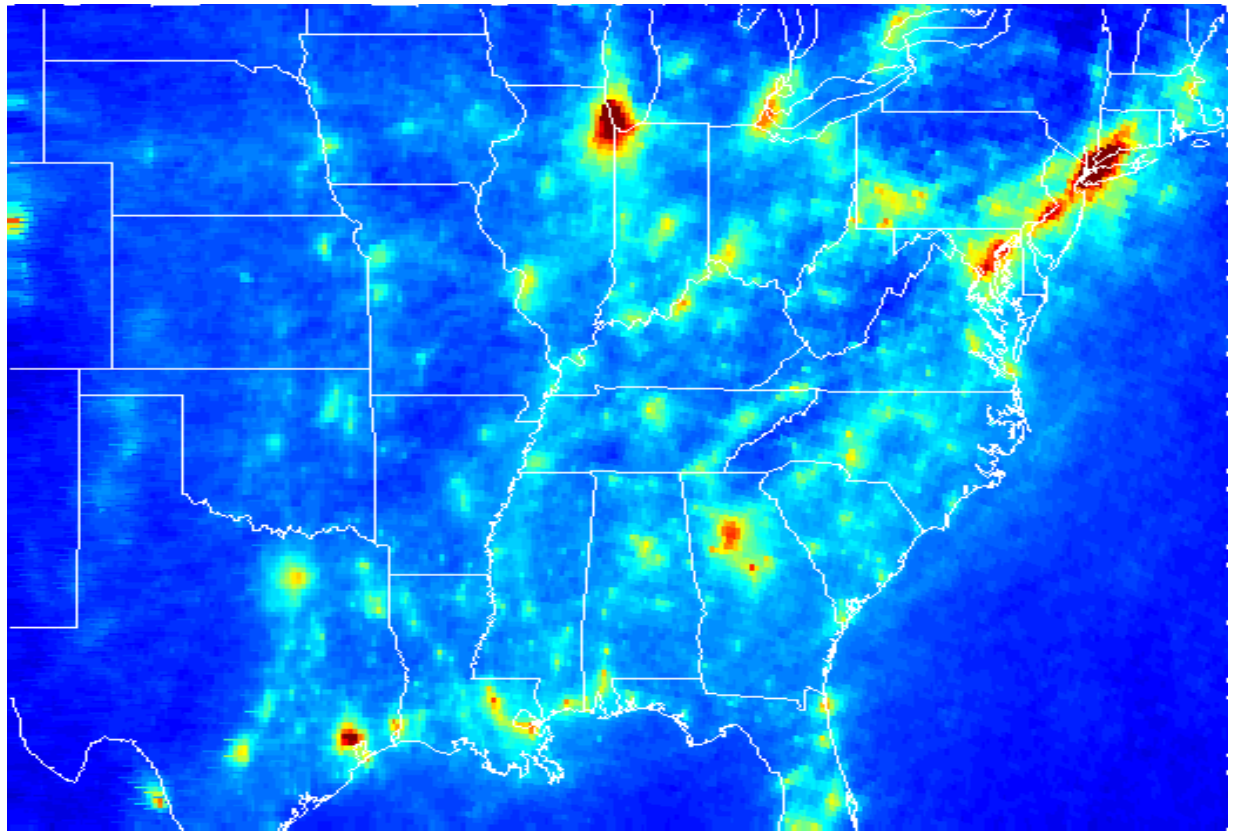
Smoke Travels Around the World in 11 Days

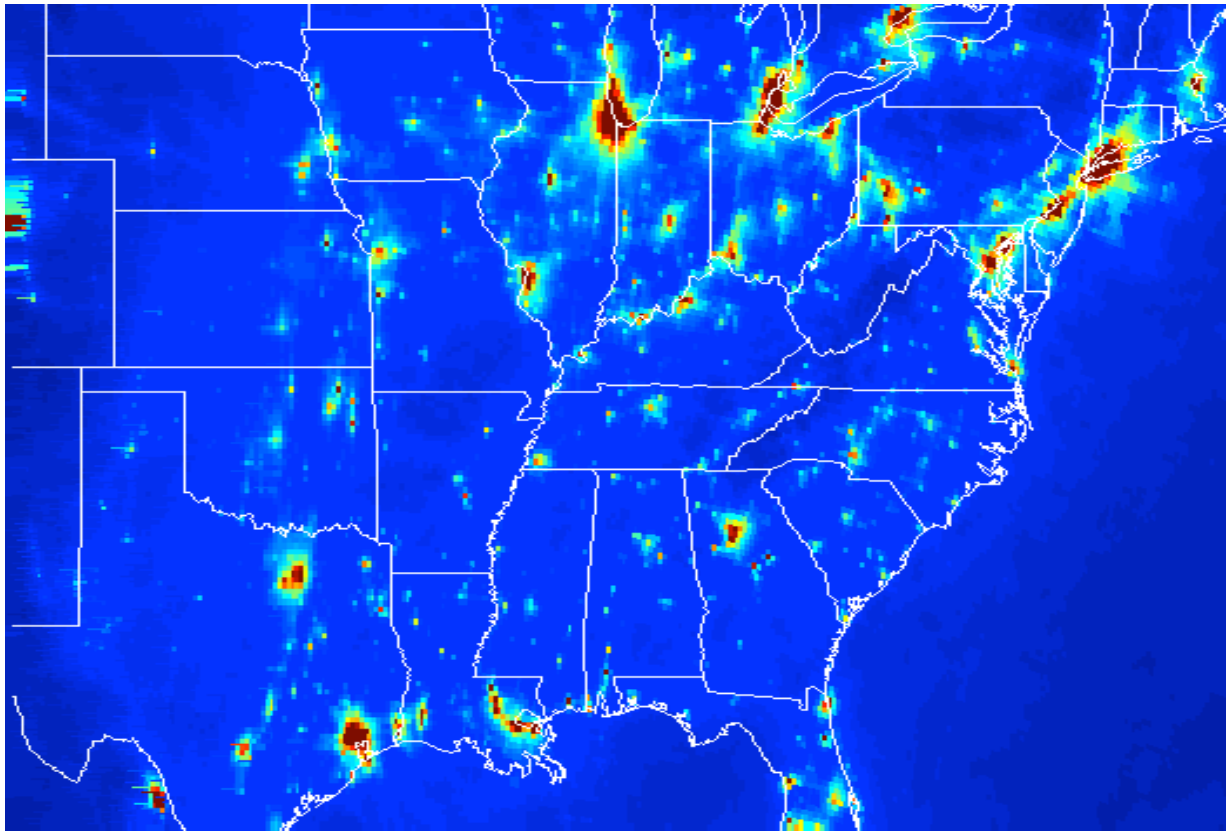


Model-Satellite Inter-Comparison

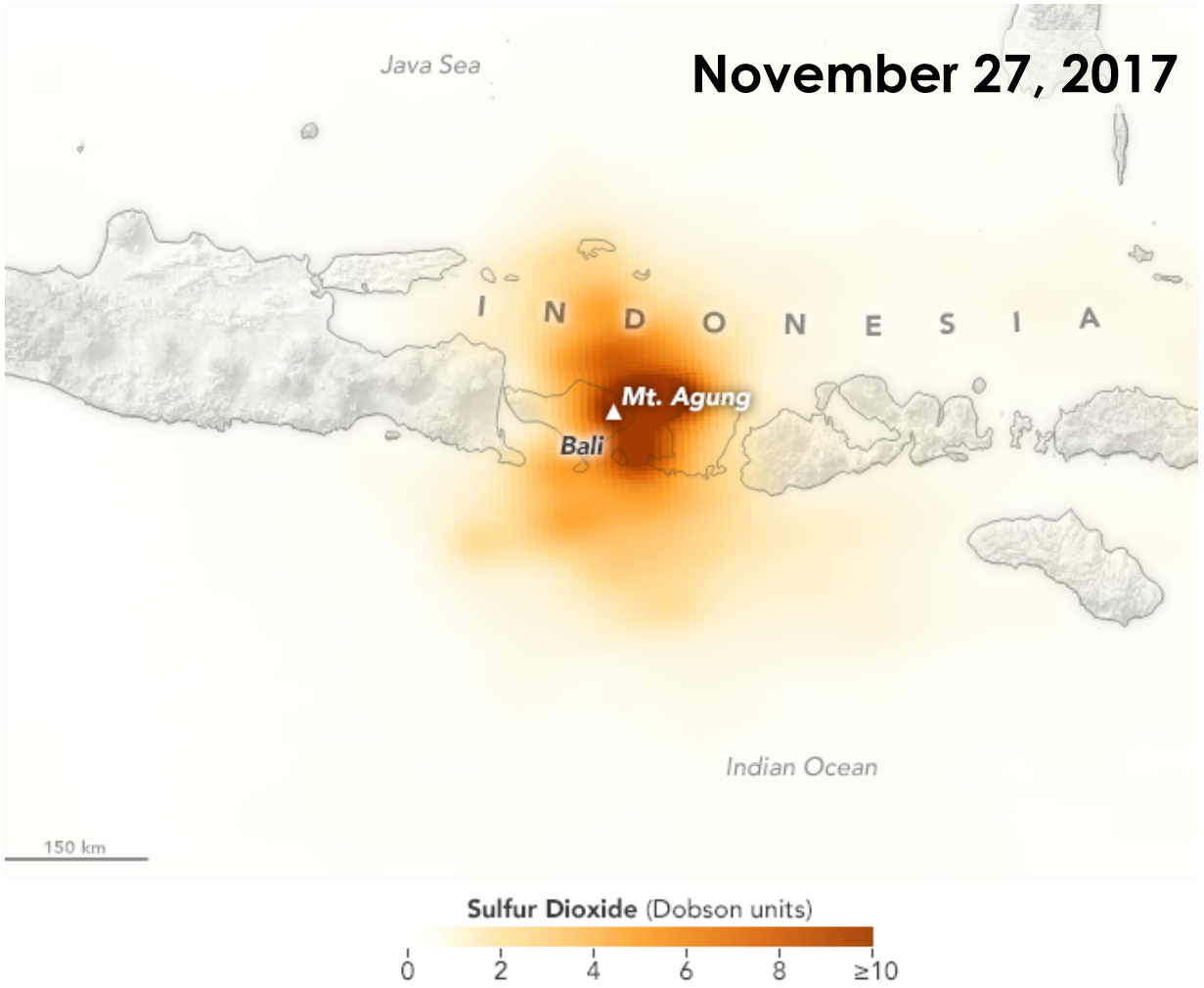
CMAQ Model NO2

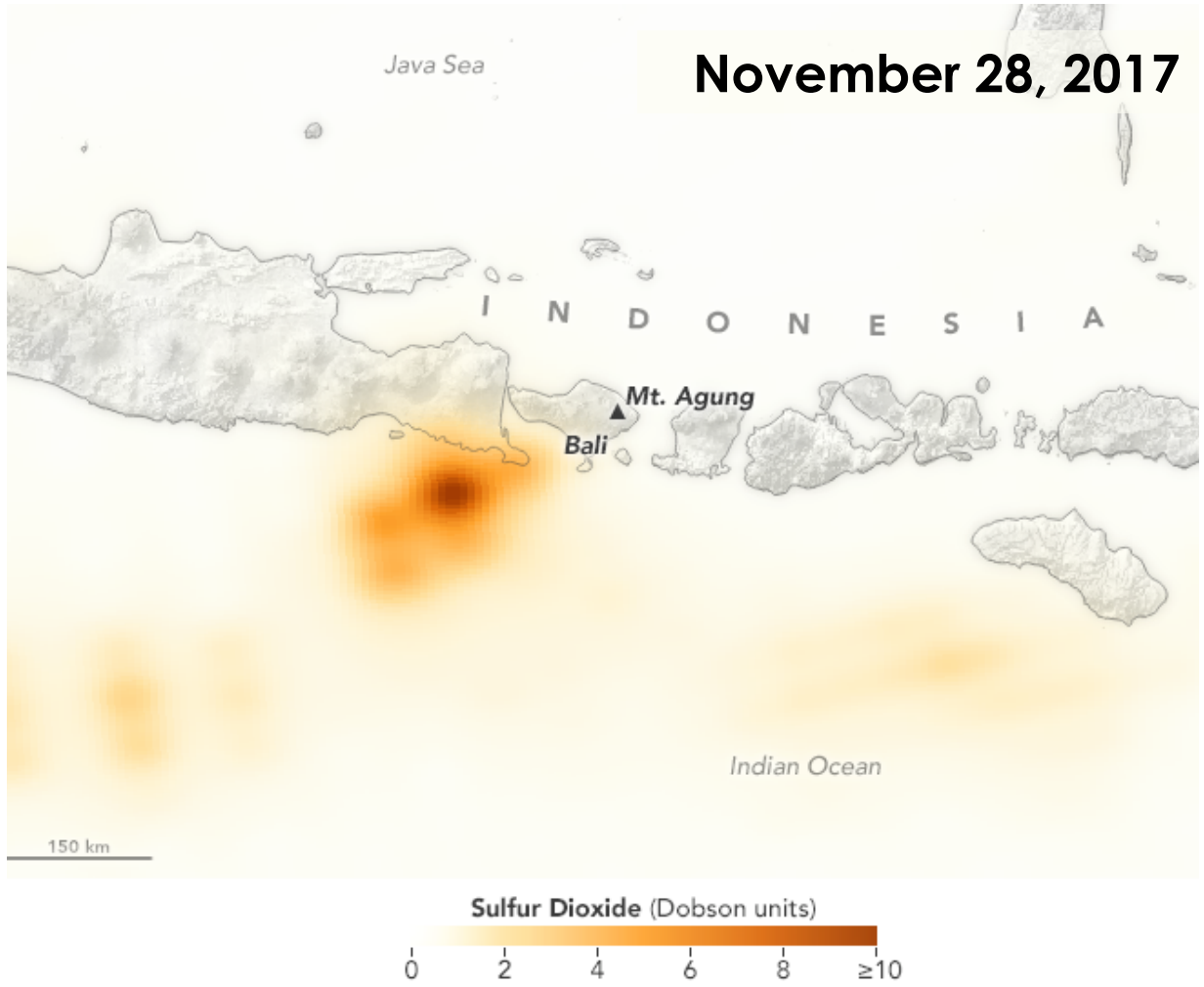
OMI NO2



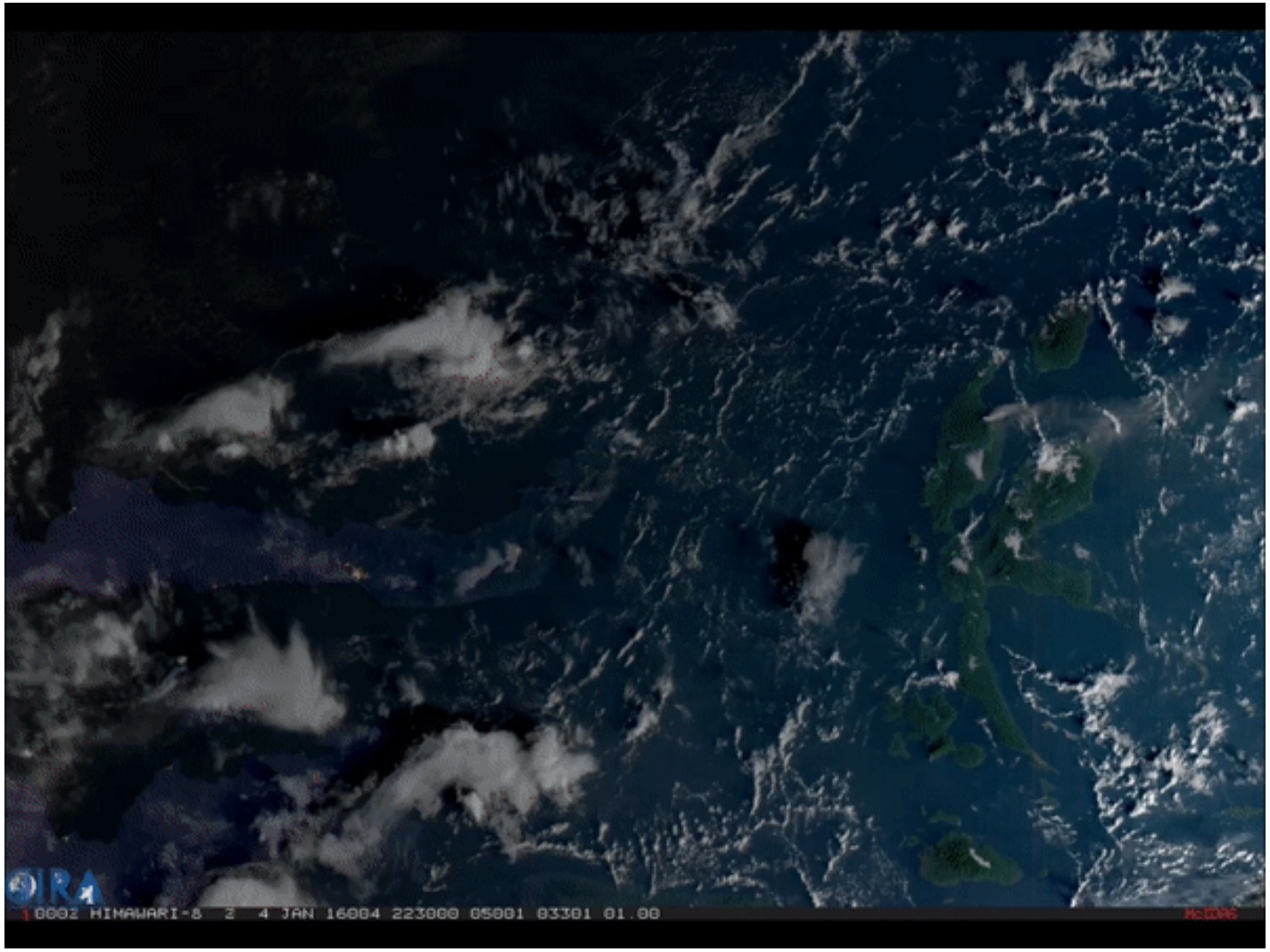


Sulfur Dioxide (SO_2) – OMPS/NPP





Credit: https://earthobservatory.nasa.gov/IOTD/view.php?id=91329



Questions