Status of Current and Future Earth Observation Satellites to Support Water and Food Management

NASA Missions and Water Resource Program

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Christine Lee, Associate PM, NASA JPL

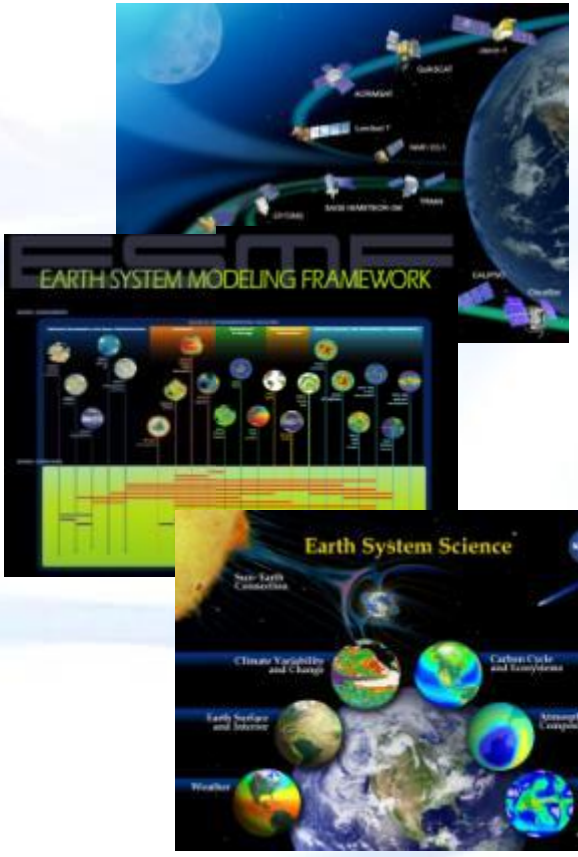
International ET Workshop
15-17 Sep 2015

NASA Applied Sciences Program

A Pathway Between Earth Science & Society

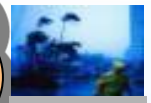
Results of NASA Earth Science Research

Uses by Partners and Stakeholder Communities



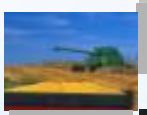
NASA Applied Sciences Program

GEOSS Societal Benefit Areas


Natural Disasters

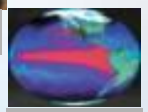

Water Resources


Ecosystems


Agriculture


Air Quality


Weather

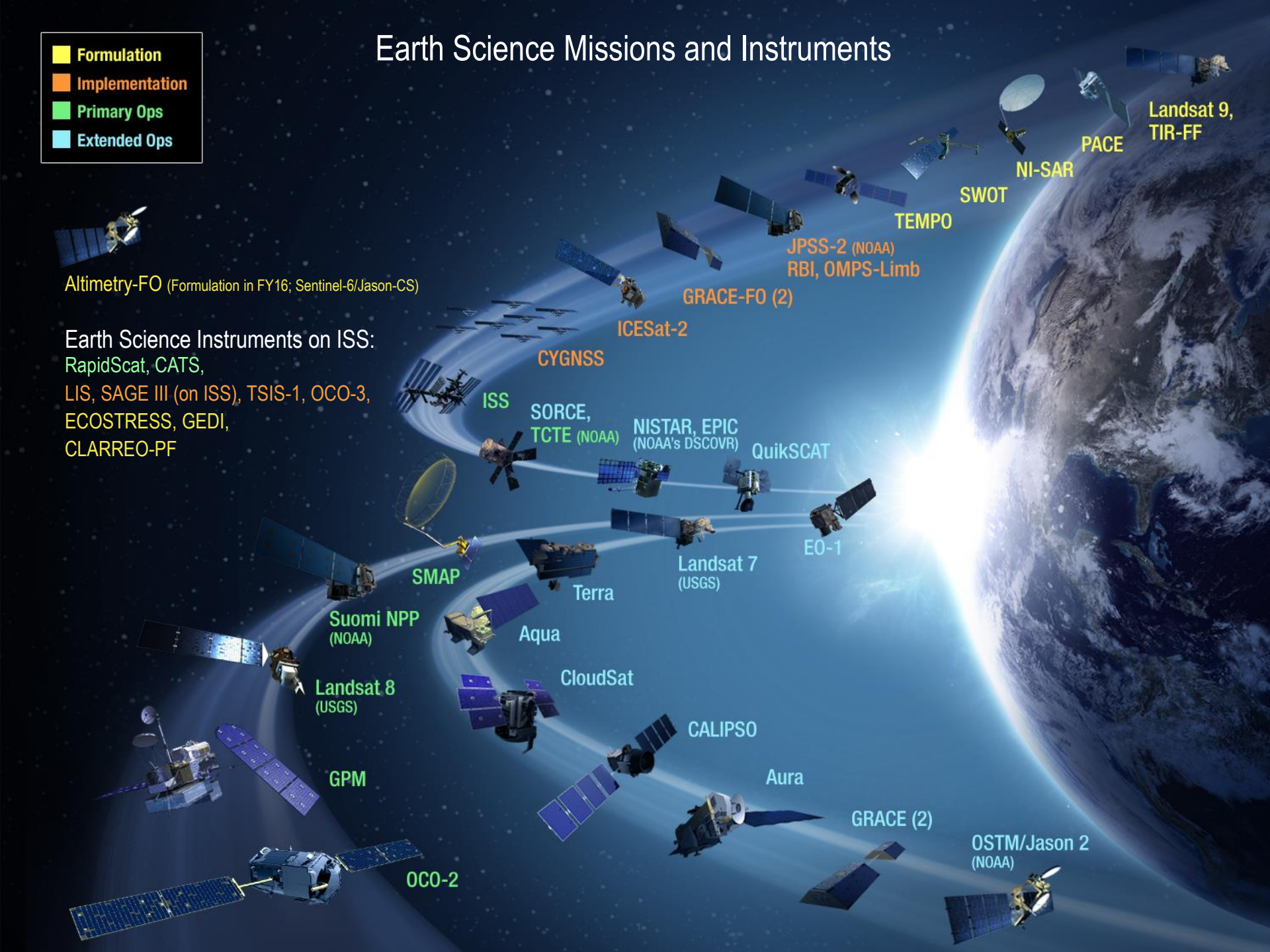

Climate


Public Health

WATER RESOURCE RESEARCH AND APPLICATIONS FROM

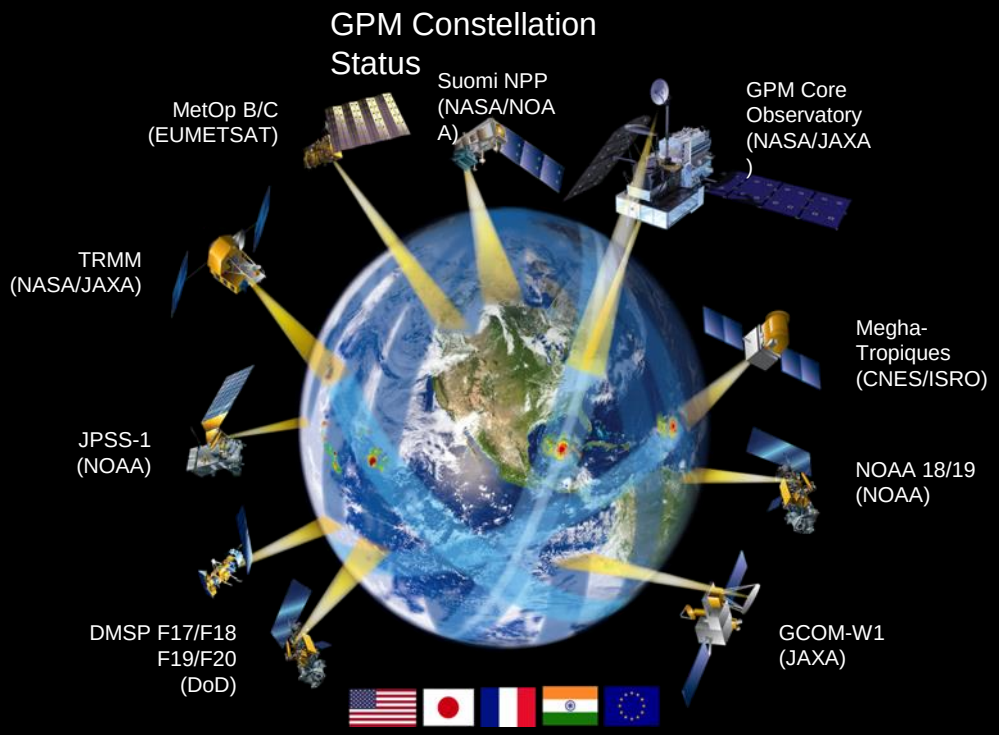
SPACE OBSERVATIONS

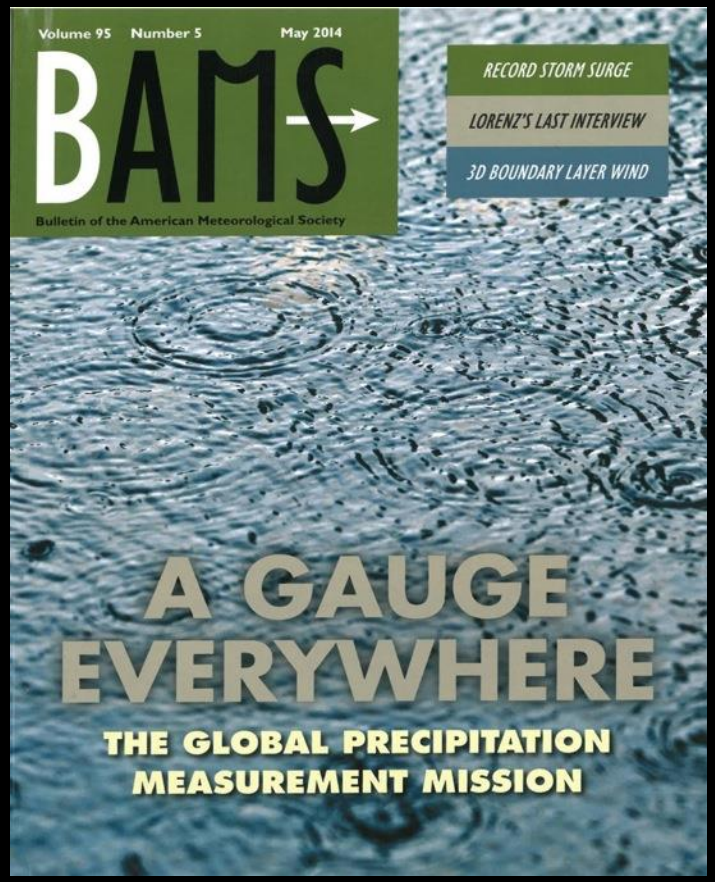
Earth Science Missions and Instruments




Formulation
Implementation
Primary Ops
Extended Ops
Earth Science Missions and Instruments
Altimetry-FO (Formulation in FY16; Sentinel-6/Jason-CS)
Earth Science Instruments on ISS:
RapidScat, CATS,
LIS, SAGE III (on ISS), TSIS-1, OCO-3,
ECOSTRESS, GEDI,
CLARREO-PF
Landsat 9, TIR-FF
PACE
NI-SAR
SWOT
TEMPO
JPSS-2 (NOAA)
RBI, OMPS-Limb
GRACE-FO (2)
ICESat-2
CYGNSS
ISS
SORCE,
TCTE (NOAA)
NISTAR, EPIC
(NOAA's DSCOVR)
QuikSCAT
EO-1
Landsat 7
(USGS)
SMAP
Terra
Suomi NPP
(NOAA)
Aqua
Landsat 8
(USGS)
CloudSat
CALIPSO
Aura
GPM
GRACE (2)
OSTM/Jason 2
(NOAA)
OCO-2
Contributing to
Water Cycle and
Food Security
Studies

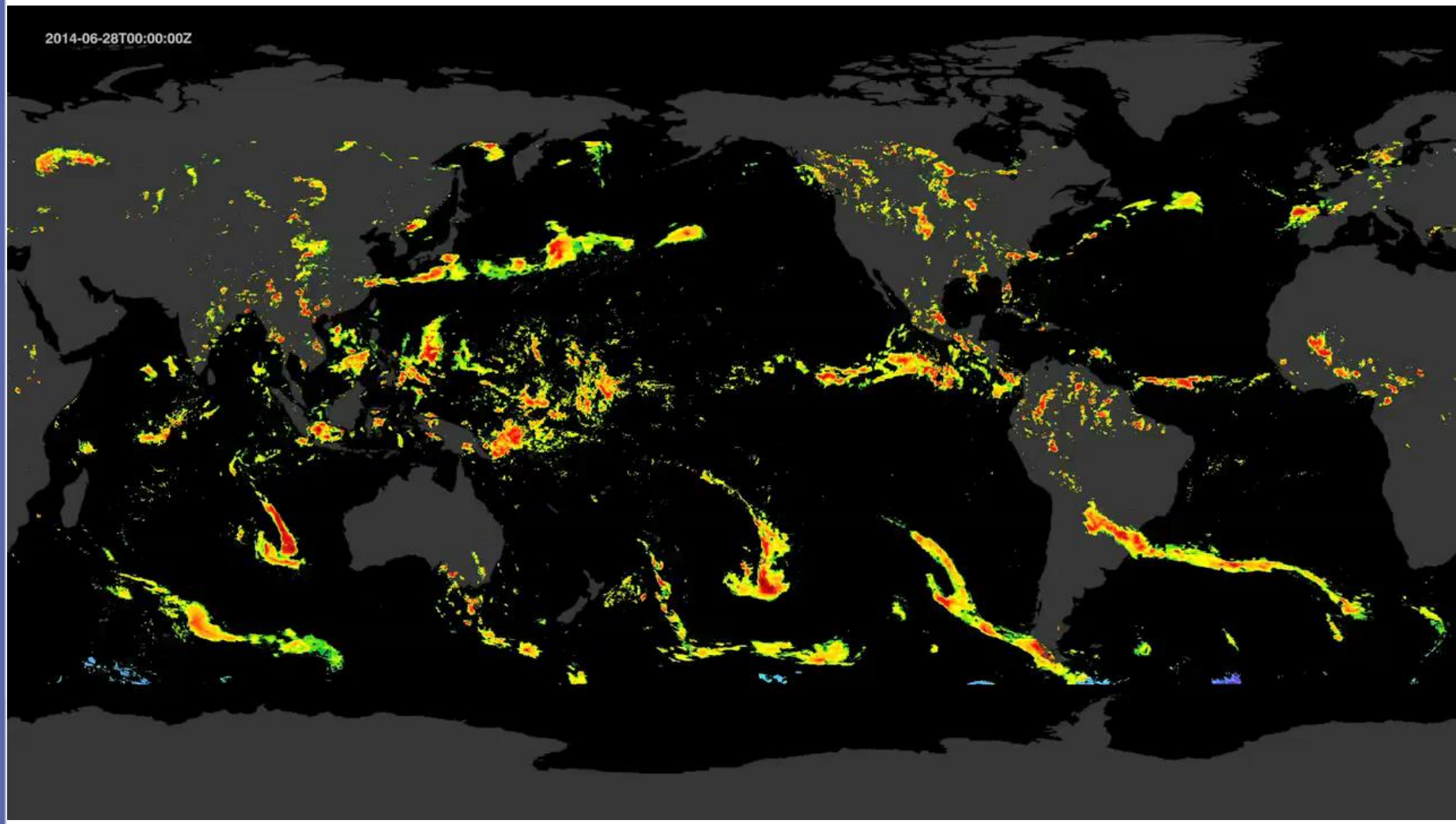
Global Precipitation Measurement Mission





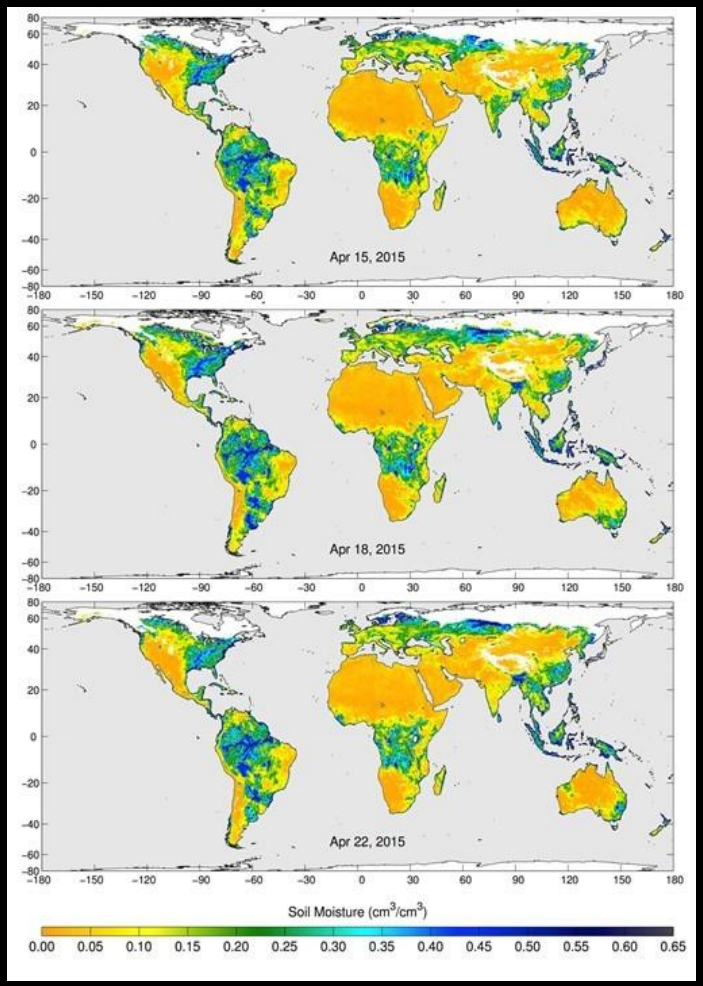
Active Joint Projects (19 PI's from 13 countries)

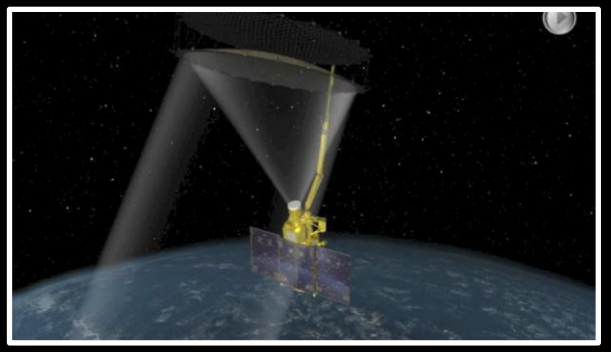
IMERG: Integrated Multi-satellitE Retrievals for GPM

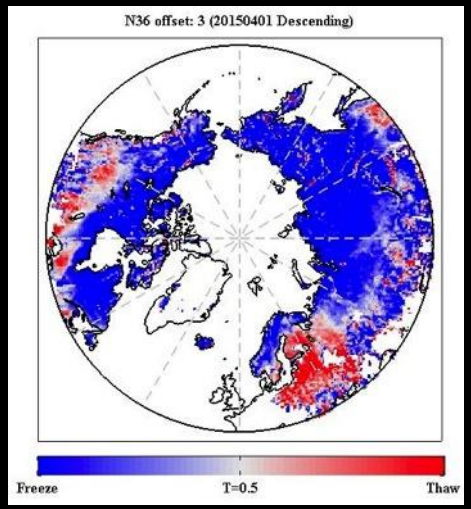


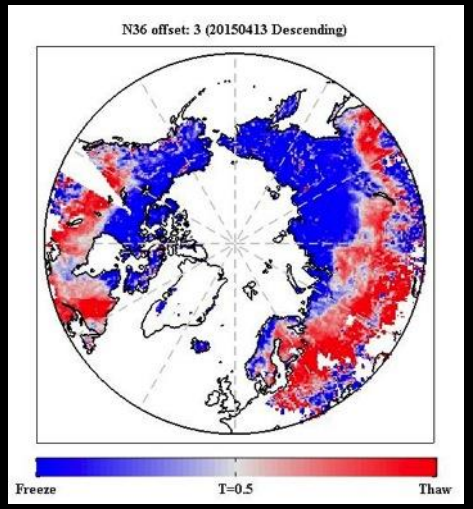
SMAP Measurements

- SMAP is providing moisture content in the top 5 cm of soil, at 10 km resolution, globally every 3 days









SMAP measurements of soil moisture address a wide range of water cycle research and science applications, including weather prediction, drought/flood monitoring, and food production

SMAP Mission Update

- Release of first calibrated data on July 31
  - paves way for ground validation
- Radar Instrument Anomaly
  - Radar halted on Jul 7 after nearly 3 months of operations
  - Radar formally ends operations Sep 2
  - All other systems (incl. radiometer, antenna) working nominally
    - Soil Moisture products are being produced albeit at a lower resolution (~40km)

GRACE Mission Status

GRACE data producing excellent science

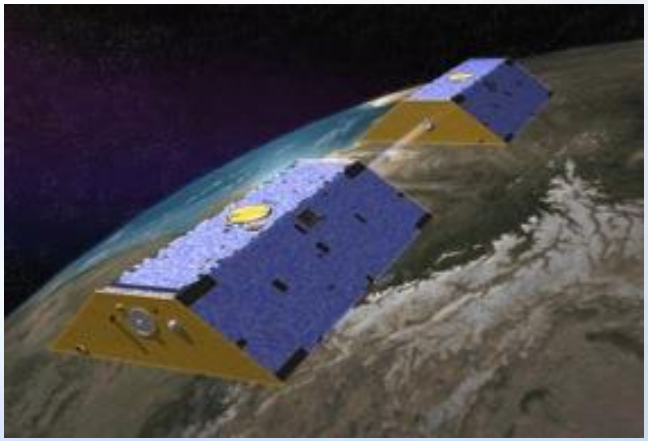
- Launched March 2002, over 12.5 years in orbit
- Time variable gravity observations enable studies in hydrology, oceanography, cryosphere and solid earth sciences.

Mission Life

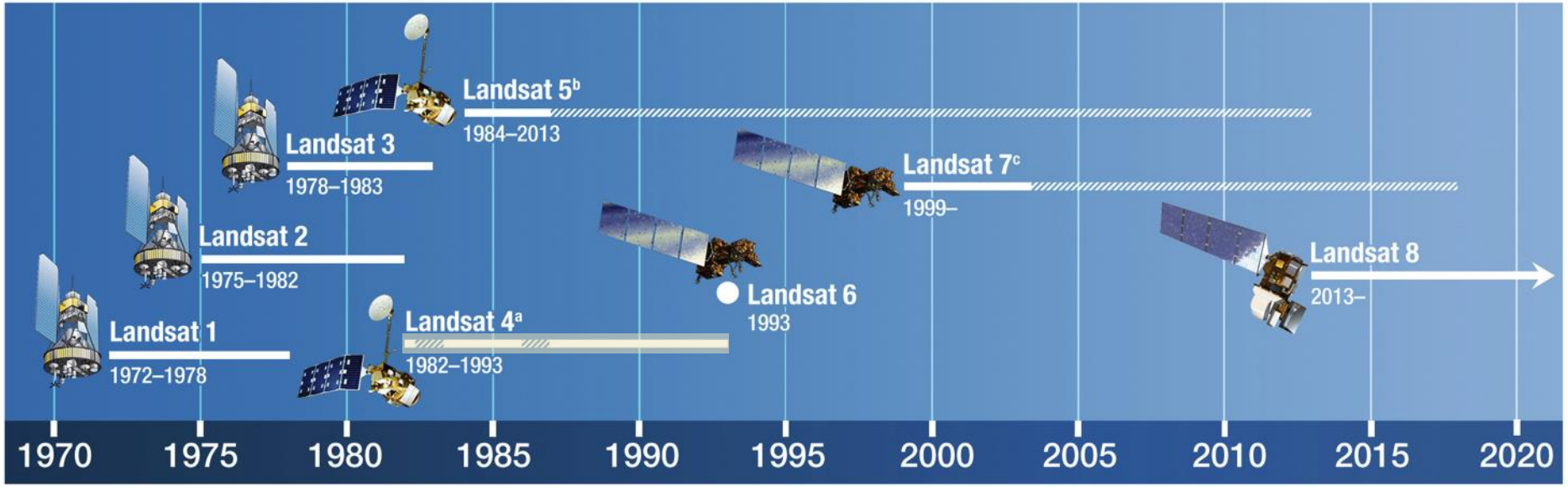
- Adequate satellite resources for continued mission
- Aging components a concern
  - » Recent improvements to battery management strategy have reduced yearly data loss from ~50 days to less than 40 days

Measurement Continuity Prospects

- NASA GRACE FO - 2017
- GRACE 2 - future



Landsat History



[a]Limited data due to transmitter failure soon after launch. Only 45,172 Landsat 4 Thematic Mapper scenes from 1982–1993 available for science users—~10 scenes/day (vs 725 scenes/day from L8)

[b]Data coverage limited to Continental US (CONUS) and International Ground Station sites after a transmitter failure in 1987; Multispectral Scanner turned off in August 1995

[c]Degraded Performance due to Scan Line Corrector failure in May 2003

- The Landsat program began as the Earth Resources Technology Satellites Program in 1966, with Landsat 1 (ERTS) launched in July 1972
- NASA built and launched Landsats 1-5 and Landsats 7-8
- Thermal band added for Landsats 3 and beyond
- After launch, Landsat operations are transferred from NASA to USGS, and USGS collects, archives, processes, and distributes the image data via the internet at no cost to users
- Landsat 8 began as a data purchase and became known as the Landsat Data Continuity Mission (LDCM)
    - Although the thermal bands were originally not incorporated in the mission, they were added back into the Observatory's capabilities following strong support from a variety of stakeholders

SLI in FY16 President's Budget Submission

- A multi-component program, with the essential investments in technology and observational innovation to ensure a world class, sustainable, and responsible land imaging program through 2035:

SLI in FY16 President's Budget Submission

- A multi-component program, with the essential investments in technology and observational innovation to ensure a world class, sustainable, and responsible land imaging program through 2035:

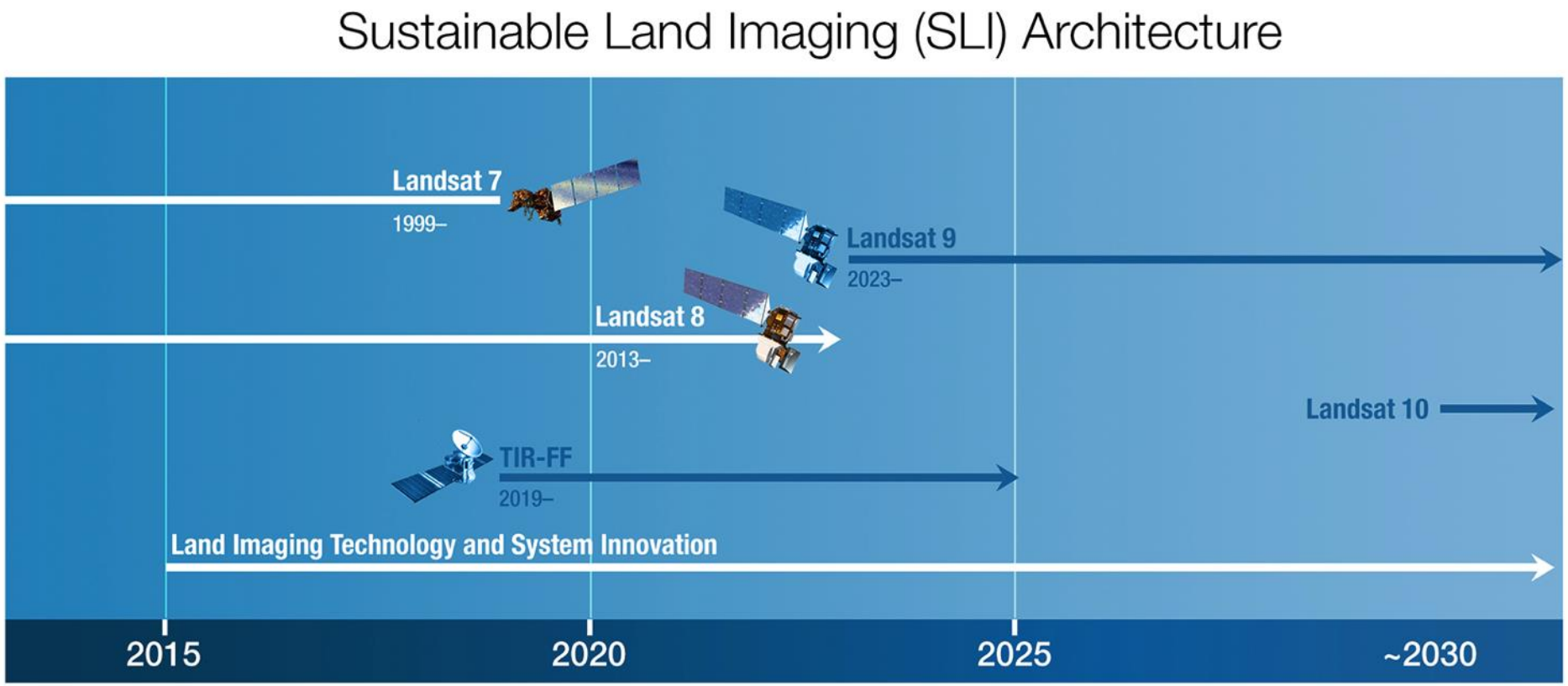
1. TIR-FF (Class D Thermal Infrared Free Flyer) to launch ASAP (no later than 2019) and to fly in constellation with a reflective band imager like OLI on L-8
   - Low-cost mitigation against an early loss of the Landsat 8 Class C TIRS, while demonstrating feasibility of constellation flying for land imaging

2. Landsat 9 (Class B upgraded rebuild of Landsat 8) to launch in 2023
   - Low programmatic risk implementation of a proven system with upgrades to bring the whole system to Class B

3. Land Imaging Technology and Systems Innovation
   - Hardware, operations and data management/processing investments to reduce risk in next generation missions

4. Landsat 10
   - Mission definition to be informed by the Technology investments, leading to key mission configuration/architecture decisions by the end of the decade

Landsat Future



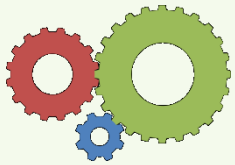
WATER RESOURCE RESEARCH AND APPLICATIONS FROM

APPLIED SCIENCES PROGRAM

Applied Sciences: Lines of Business

Applications in Mission Planning

Identify applications early and throughout mission lifecycle, integrate end-user needs in design and development, enable user feedback, and broaden advocacy.



Societal & Economic Applications

Generate, test, develop, enable adoption, and extol applications ideas for sustained uses of Earth obs. in decisions and actions.

Capacity Building

Build skills, workforce, and capabilities in US and developing countries to apply Earth obs. to benefit society and build economies.

NASA Water Resource Applied Sciences

Applied Sciences Program

Home (Start here) | About (Our Mission) | News (What's happening) | Projects (Learn more) | Community (Collaborate) | Resources (More info) | Events | Login / Register

NASA Applied Sciences Program
Water Resources

Earth Science Serving Society

The goal of the ASP Water Resources application area is to apply NASA satellite data to improve the decision support systems of organizations and user groups that manage water resources. The ASP Water Resources application area partners with Federal agencies, academia, private firms, and international organizations.

LEARN MORE

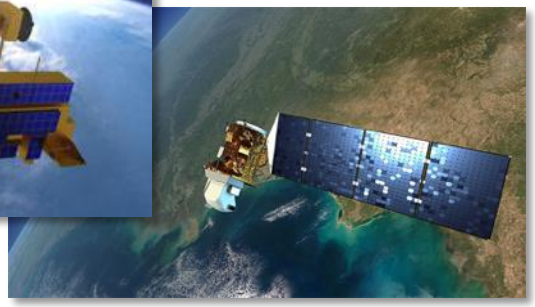
https://c3.nasa.gov/water/

Welcome to the NASA Applied Sciences Program Water Resources Application Area

NASA Satellite Irrigation Management Support: Mapping Crop Water Requirements to Assist Growers in Optimizing Water Use

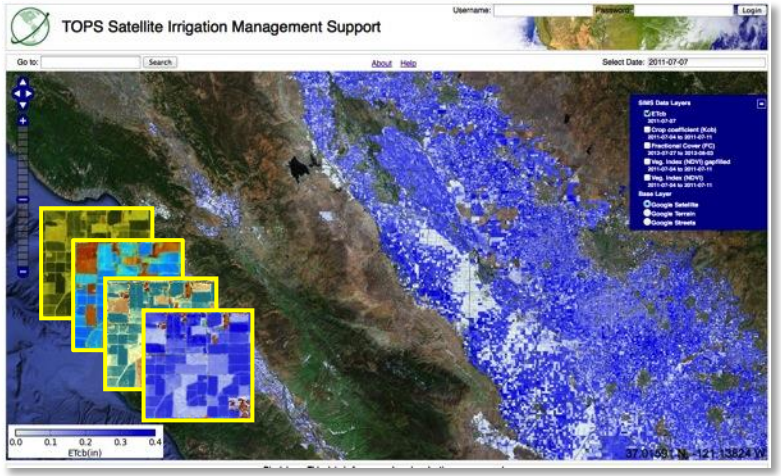
PROJECT TEAM: NASA Ames Research Center, California Dept. of Water Resources, Western Growers Association, California State University, Univ. of California Cooperative Extension, Desert Research Institute, USDA Ag. Research Service, USGS, Booth Ranches, Chiquita, Constellation Wines, Del Monte Produce, Dole, E & J. Gallo, Farming D, Fresh Express, Pereira Farms, Ryan Palm Farms

Terra Satellite



Landsat 8

California agricultural sector produced $46.4b In 2013



NASA SIMS web and mobile data services puts irrigation demand across 8 million acres of farm land directly into the hands of farmers and water managers

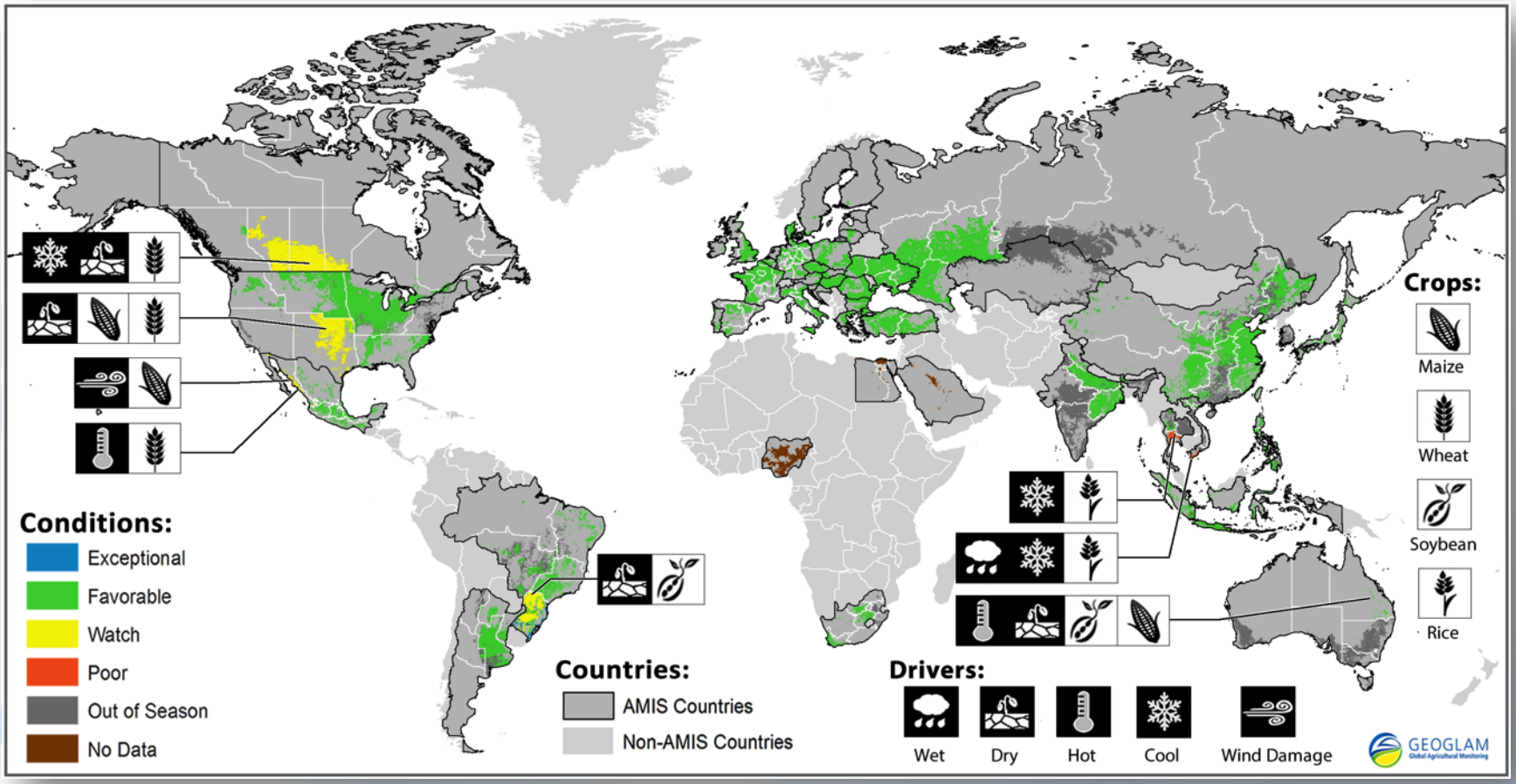
Students work hand in hand with growers to validate the system and quantify benefits

For more information, contact forrest.s.melton@nasa.gov, or visit https://c3.nasa.gov/water/projects/1/

GEO – Global Agriculture Monitoring (GEOGLAM)
PI: Justice/Becker-Reshef (UMD)

Crop Conditions as of April 28th, 2014

Crop Type & Drivers



Crop condition map synthesizing information for all four AMIS crops

Crops that are in other than favorable conditions are displayed on the map with their crop symbol and associated climatic drivers affecting conditions