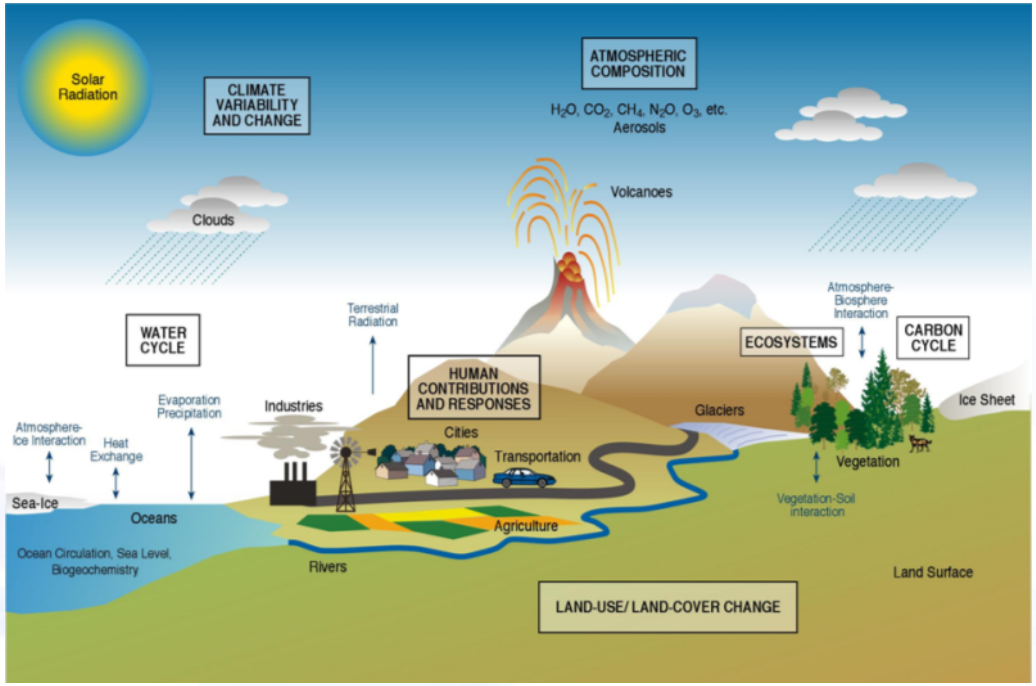
WSWC Water Management Workshop
Special Remote Sensing Science Session

NASA Earth Science to Water Resources

Bradley Doorn – Water Resources Program

Jet Propulsion Laboratory, Pasadena CA
August 25 – 27, 2014

NASA Earth Science



NASA Earth Science supports basic and applied research on the Earth system and its processes.

Characterize, understand, and improve predictions of the Earth system to advance knowledge and benefit society.

Technology

Flight Missions

Research

Data Systems

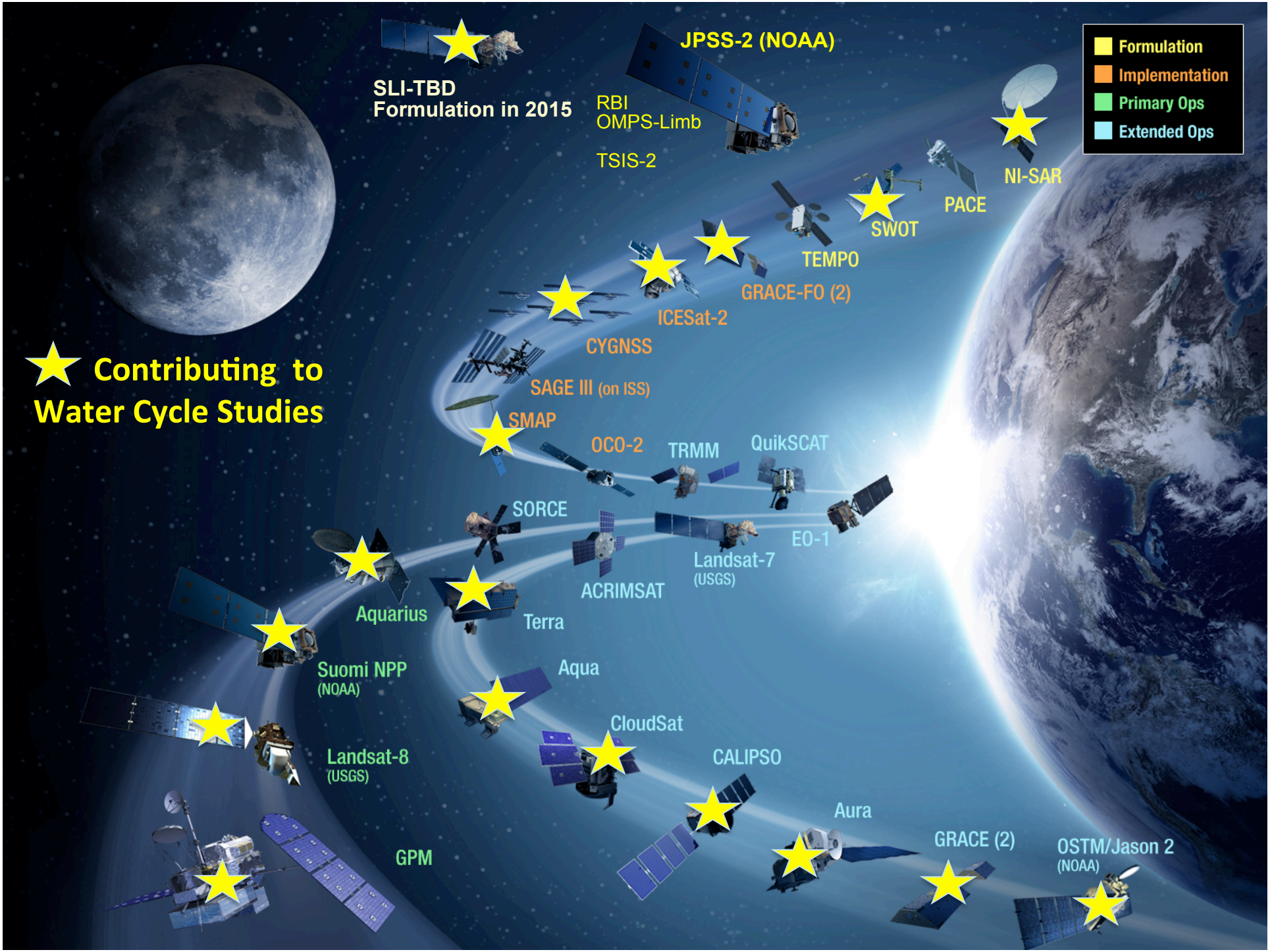
Education

Applications

WATER RESOURCE RESEARCH AND APPLICATIONS FROM

SPACE OBSERVATIONS


Formulation
Implementation
Primary Ops
Extended Ops
JPSS-2 (NOAA)
SLI-TBD
Formulation in 2015
RBI
OMPS-Limb
TSIS-2
NI-SAR
PACE
SWOT
TEMPO
GRACE-FO (2)
ICESat-2
CYGNSS
SAGE III (on ISS)
SMAP
OCO-2
TRMM
QuikSCAT
SORCE
EO-1
Landsat-7
(USGS)
ACRIMSAT
Aquarius
Terra
Suomi NPP
(NOAA)
Aqua
CloudSat
Landsat-8
(USGS)
CALIPSO
Aura
GPM
GRACE (2)
OSTM/Jason 2
(NOAA)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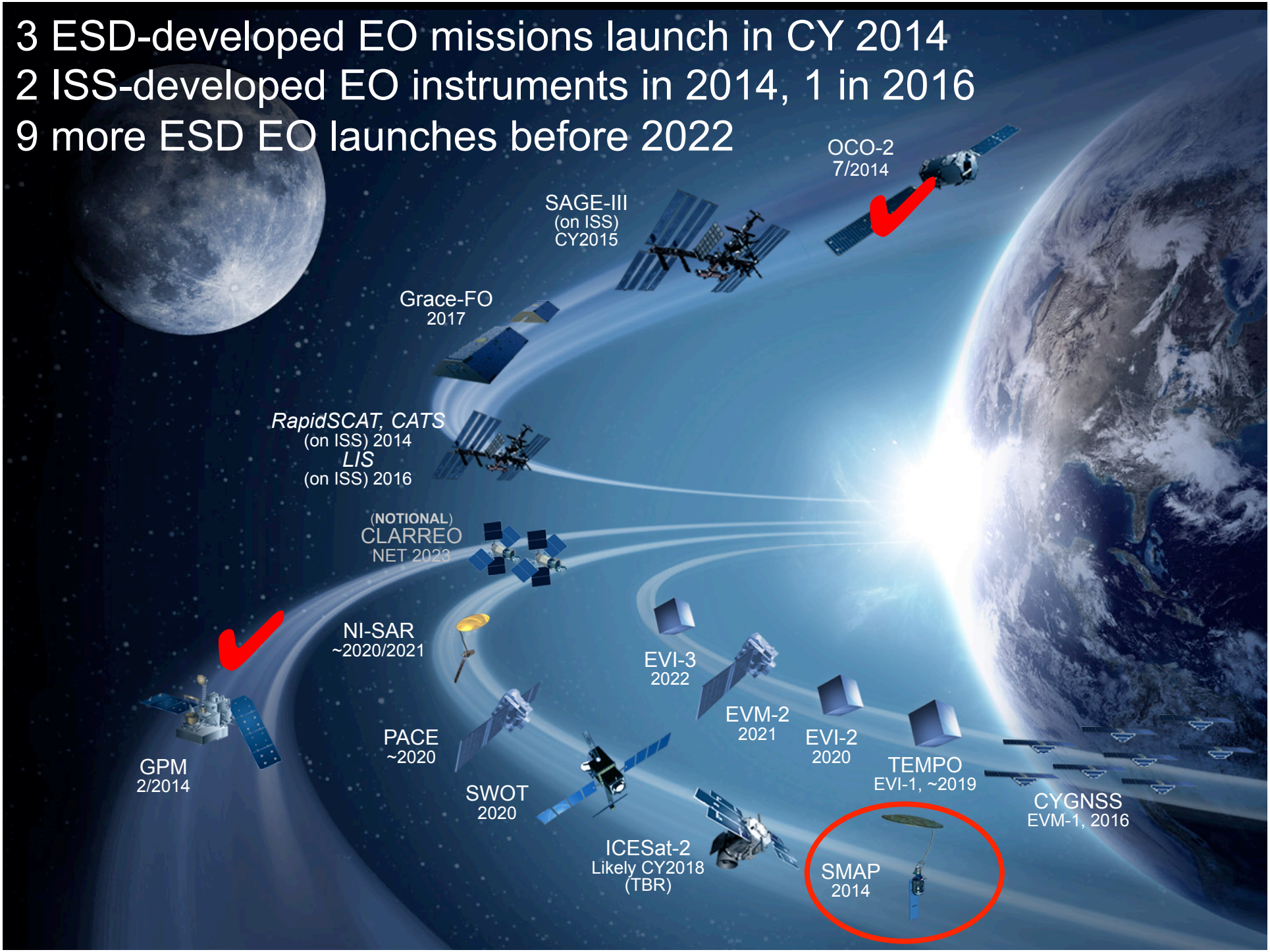
(NOAA)
Contributing to
Water Cycle Studies


3 ESD-developed EO missions launch in CY 2014
2 ISS-developed EO instruments in 2014, 1 in 2016
9 more ESD EO launches before 2022
OCO-2
7/2014
SAGE-III
(on ISS)
CY2015
Grace-FO
2017
RapidSCAT, CATS
(on ISS) 2014
LIS
(on ISS) 2016
(NOTIONAL)
CLARREO
NET 2023
NI-SAR
~2020/2021
GPM
2/2014
PACE
~2020
SWOT
2020
EVI-3
2022
EVM-2
2021
EVI-2
2020
TEMPO
EVI-1, ~2019
CYGNSS
EVM-1, 2016
ICESat-2
Likely CY2018
(TBR)
SMAP
2014

Landsat 8 Launch – Feb. 11, 2013

- **Landsat Data Continuity Mission (LDCM) developed through an interagency partnership between NASA and the U.S. Geological Survey (USGS)/Dept. of the Interior**

- **LDCM launched Feb. 11, 2013 from Vandenberg Air Force Base (VAFB), California – ATLAS V 401 launch vehicle**

- **On-orbit commissioning completed May 30, 2013**
  - USGS assumed lead responsibility for mission operations
  - Satellite renamed Landsat 8

Earth Science Missions – Early Adopters

Early Adopters: *New with SMAP*

Purpose is to conduct pre-launch applications research to accelerate use of data after launch.

Organizations with clearly-defined needs for *SMAP*-like data products evaluate & demonstrate the utility of *SMAP* data for their application and decision making.

Early Adopters:

- » Use data products prior to launch (simulated data and cal/val data from field campaigns)
- » Provide feedback on products and formats to increase applications value of mission
- » Streamline and accelerate use of data soon after launch and check-out
- » Supply own resources to do these activities

***** ICESat-2 started Early Adopters in 2013 *****

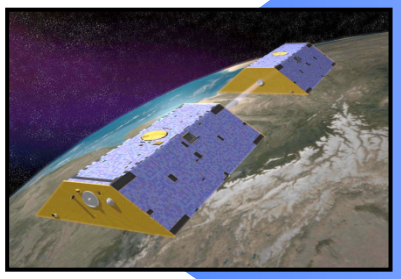
25+ organizations are currently EAs from public & private-sector, domestic & foreign

New and Upcoming Freshwater Observing Satellite Missions

Landsat 8
2013
Water Impacts and Water Demand

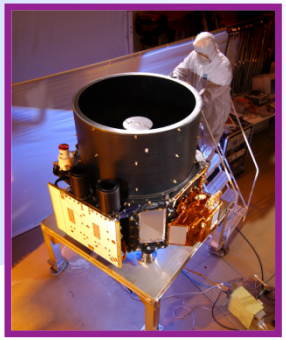
Global Precipitation Measurement (GPM)
2014
Precipitation

Soil Moisture Active-Passive (SMAP)
2014
Soil Moist., Freeze/Thaw



Gravity Recovery and Climate Experiment (GRACE) Follow-On
2017
Global Mass & Water Variation

Cyclone Global Navigation Satellite System (CYGNSS)
2016
Cyclone Generation



Ice, Cloud,and land Elevation Satellite (ICESat-2)
2016
Ice Dynamics

Land Imaging (2018-2035)

FY14 President's NASA budget featured a new activity for development of a sustainable, national Land Imaging satellite system (with USGS).

Basic study tenets for the program

- *Sustainability:* Provide data products for the long haul within the budget guidance provided ($120M/year NASA cost).
- *Continuity:* Continue the long-term Landsat data record; focus is on usable products that define the utility of the data record.
- *Reliability:* Exhibit a form of functional redundancy. Data sets should be able to draw on equivalent or "near equivalent" deliverables from different sources to provide the data for the highest priority land imaging data products; loss of a single satellite or instrument on orbit should not cripple the program.

OMB-OSTP Direction to NASA

- $30 million in FY14 for NASA to study options for a future sustained land imaging system, in collaboration with USGS.
- The study shall define a system for sustained global land-imaging multispectral and thermal infrared information for an approximately 20-year period starting in 2018.
- The study should provide options which consider various weightings of near-term capability, continuity/gap risk mitigation, and technology infusion over the system's lifetime.
- While the basic system requirement is the continuation of global data and information having the quality of Landsat-8 products, the study should consider refined capabilities requested by the user communities.

OMB-OSTP Direction to NASA - continued

- The study should also consider a range of implementation strategies that could spur innovation and increase efficiencies, including international and private sector collaborations.

- The study should recognize that lowering the cost of the system is an important goal.

Established Study Schedule

FY13 Accomplishments

- Kick-off briefing to Administration August 6, 2013
- Establish Architecture Study Team (AST) Sep 2013
- Industry & Partner Day, RFI Release Sep 18, 2013
- Landsat User's Forum December 4, 2013

SLI Design Cycle #1

FY14 Activities

- 1st Quarterly briefing to Stakeholders November 21, 2013
- 2nd Quarterly briefing to Stakeholders Jan 27, 2014

SLI Design Cycle #2

- AST Design Cycle 2 Jan 27 – Mar 15, 2014
- SLI Community/Industry Forum 1 April 2014
- 3rd Quarterly briefing to Stakeholders early April 2014
- NASA ESD SLI interim report to Congress May 18, 2014

SLI Design Cycle #3

- AST completion of full SLI program options May 15 – Jul 15, 2014
- Completion of SLI study report Aug 2014

http://espd.gsfc.nasa.gov/landimagingstudy/

Preparations for Next Decadal Survey

Earth Science Decadal Survey

10-year anniversary is 2017, preceded by years of preparation and data gathering

Terms of reference developed in 2014 timeframe

Several activities Earth Science has started will provide input:

- Land imaging program analysis
- NRC Continuity study
- Constellation and convoy studies
- Alternative acquisition and implementation approaches
- Missions & apps value study

Notional Schedule

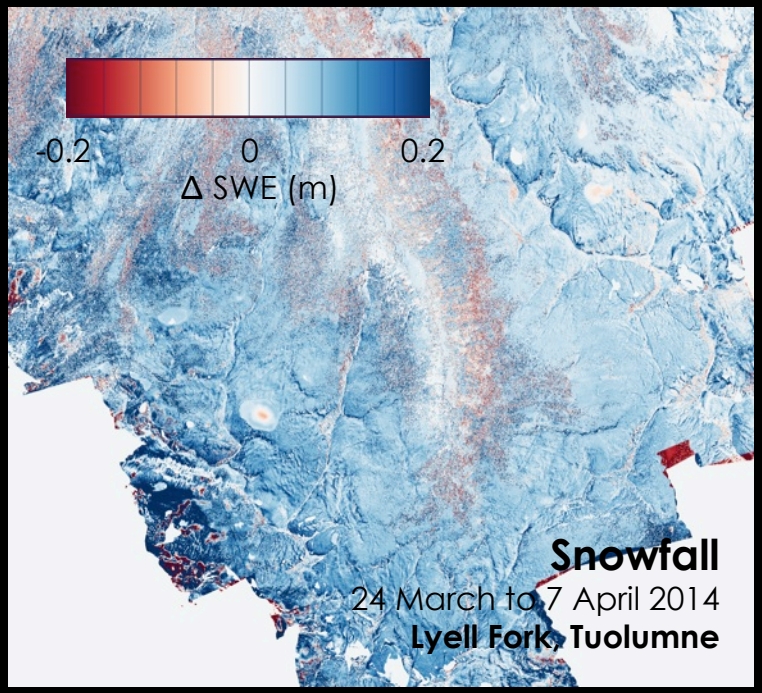
Event	End Date	Duration (months)
ESD preparation	Oct-13	15
Call for inputs	Jan-15	3
Community meetings	Apr-15	9
Report writing period	Jan-16	8
Final report editing	Sep-16	4
Release of NRC's 2nd Earth Science Decadal Survey	Jan-17	

In 2013, the water community had a meeting to examine water priorities and mission concepts.

WATER RESOURCE RESEARCH AND APPLICATIONS FROM

AIRBORNE OBSERVATIONS

Airborne Snow Observatory 2014

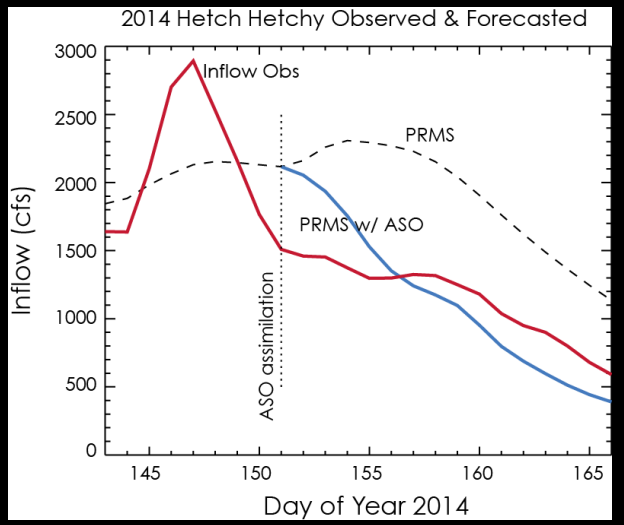


Most accurate maps of snowfall

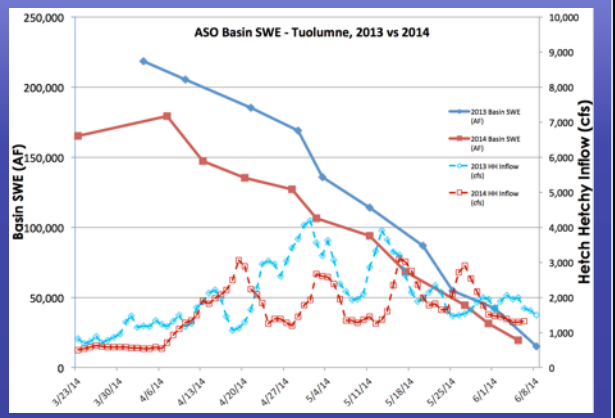
AIRBORNE SNOW OBSERVATORY

Snow Water Equivalent
2014

More accurate runoff forecasting



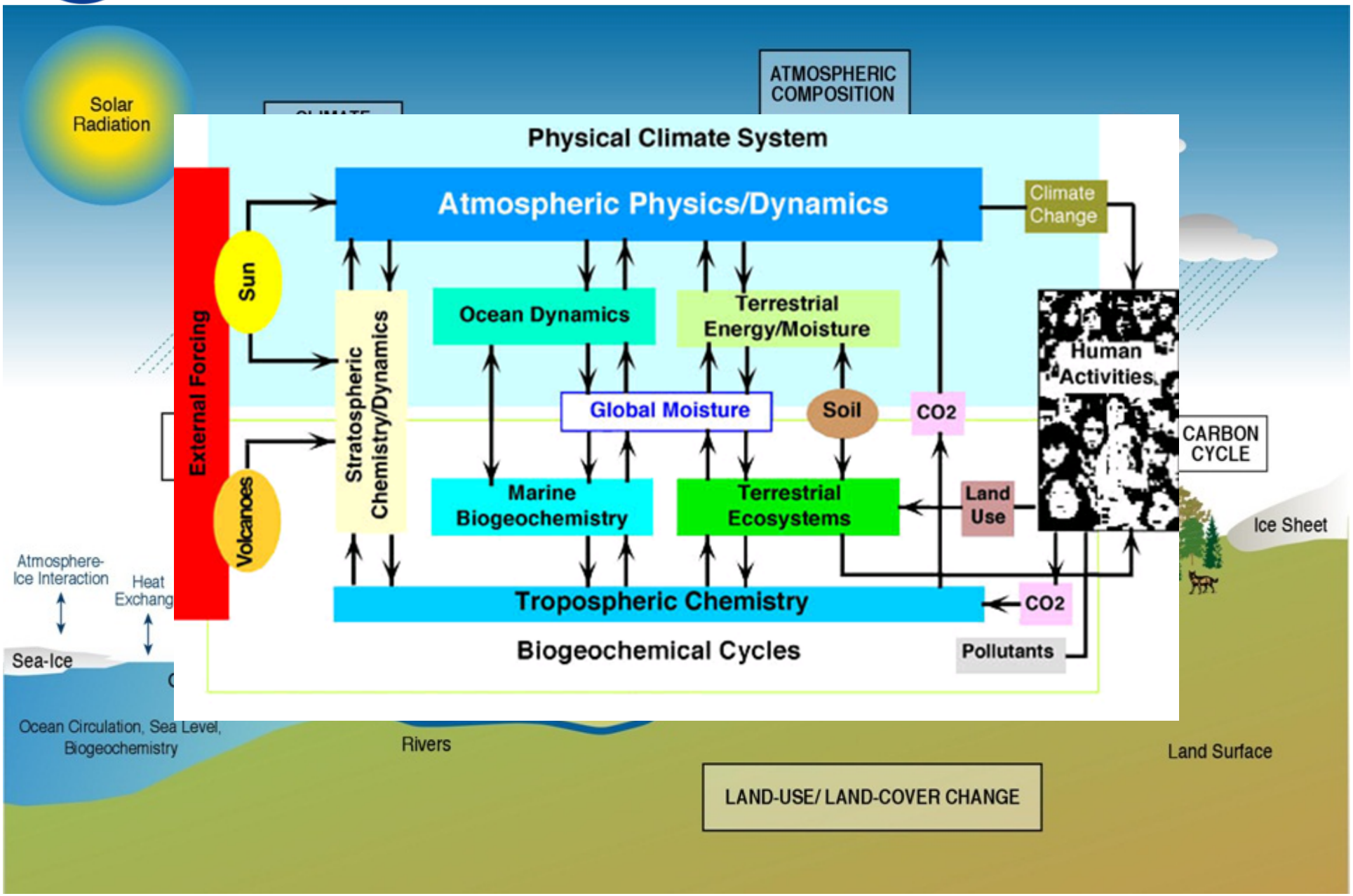
According to snow pillows, winter/spring 2014 was close to worst snowfall season on record in California, on top of ongoing drought. ASO data were key in understanding that Hetch Hetchy reservoir would in fact come very close to filling rather than falling well short of filling.



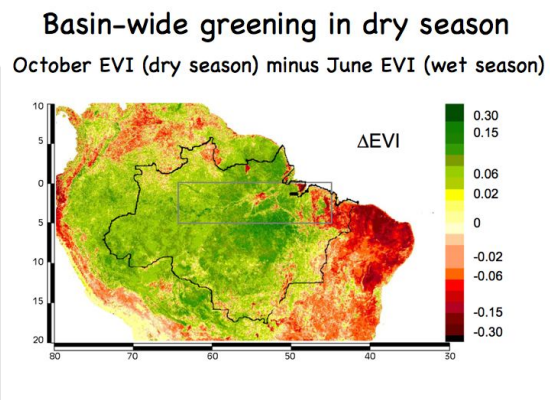
WATER RESOURCE RESEARCH AND APPLICATIONS FROM

RESEARCH AND ANALYSIS PROGRAM

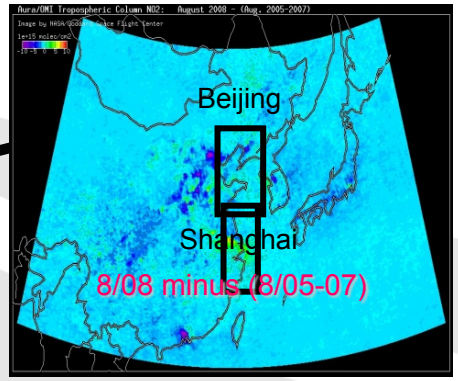
Earth as a Complex Inter-related System



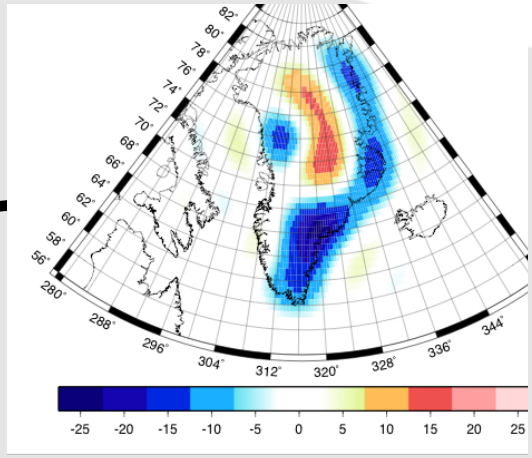
Earth **SCIENCE** Division Focus Areas



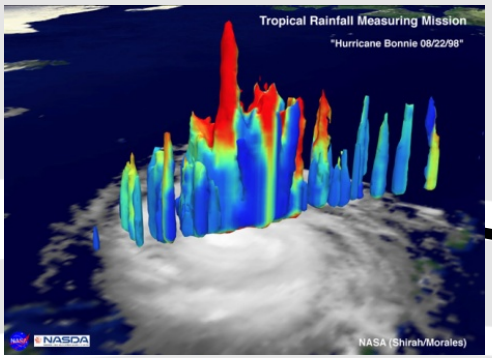
Atmospheric Composition



Carbon Cycle and Ecosystems

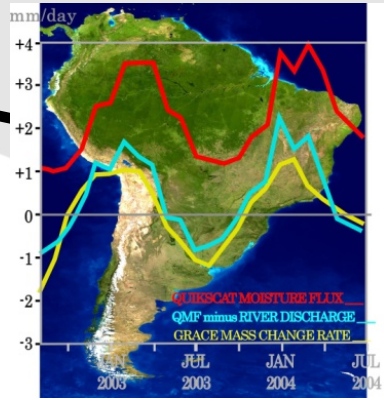


Climate Variability and Change



Weather

Water and Energy Cycle



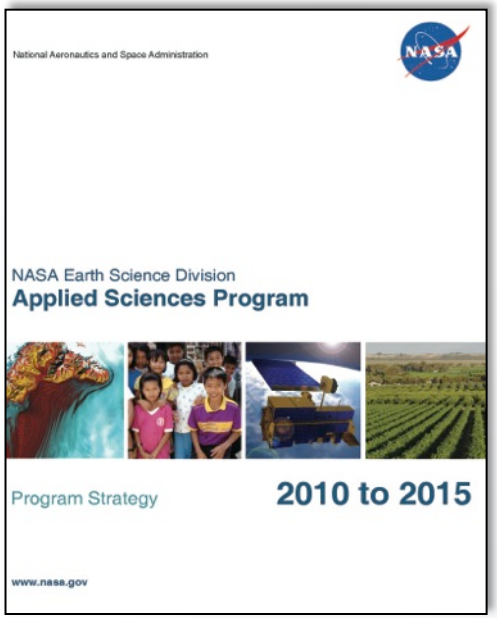
Earth Surface and Interior

WATER RESOURCE RESEARCH AND APPLICATIONS FROM

APPLIED SCIENCES PROGRAM

Lines of Business

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

Emphasis in 4 Applications Areas

Health & Air Quality

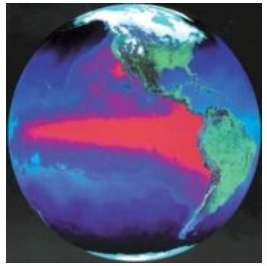
Water Resources

Disasters

Ecological Forecasting

Support opportunities in 5 additional areas

Agriculture



Climate

Weather

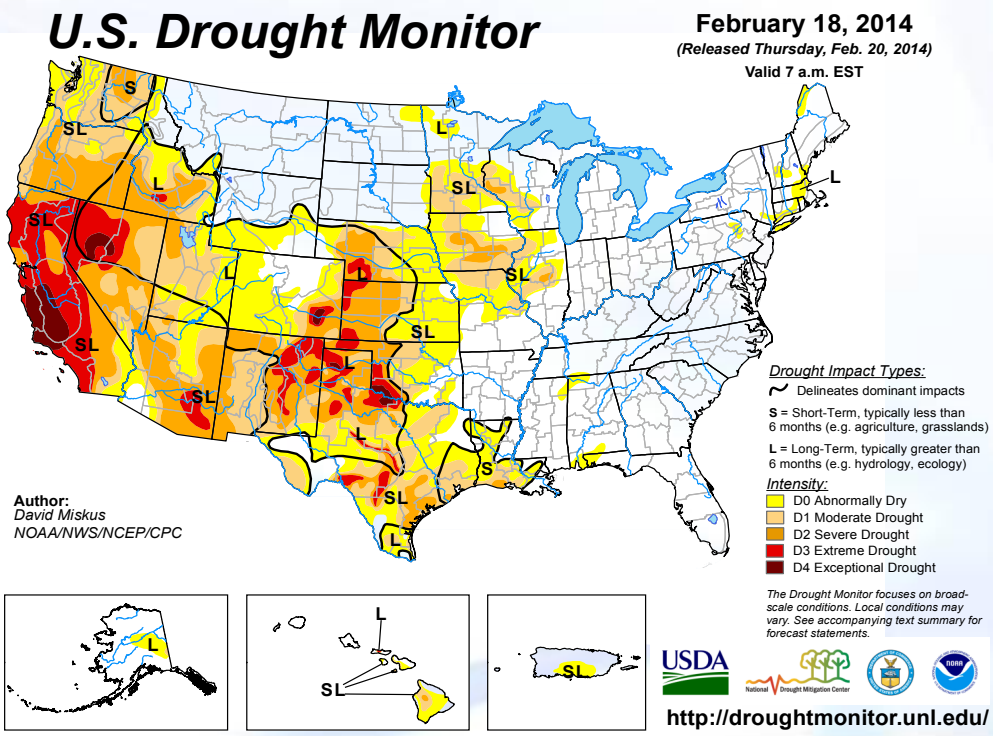
Energy

Oceans

NASA Water Resource Applied Sciences

The NASA Water Resources Program Element:

The Water Resources Program Element addresses concerns and decision processes that are related to water availability, water forecast, and water quality. The goal of the Water Resources Program Element is to apply NASA satellite data to improve the Decision Support Tools (DSTs) of user groups that manage water resources. Implementation requires close and enduring partnerships with Federal agencies, academia, private firms, and international organizations.



Water Resources Projects:

Projects are tactical implementations led by Principle Investigators, driven by water management challenges, and ultimately sustained by water resource information stakeholders.

Programmatic Activities:

National and international activities to improve skills, share data and applications, and broaden the range of users who apply satellite data and Earth science in water resource decisions.

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/

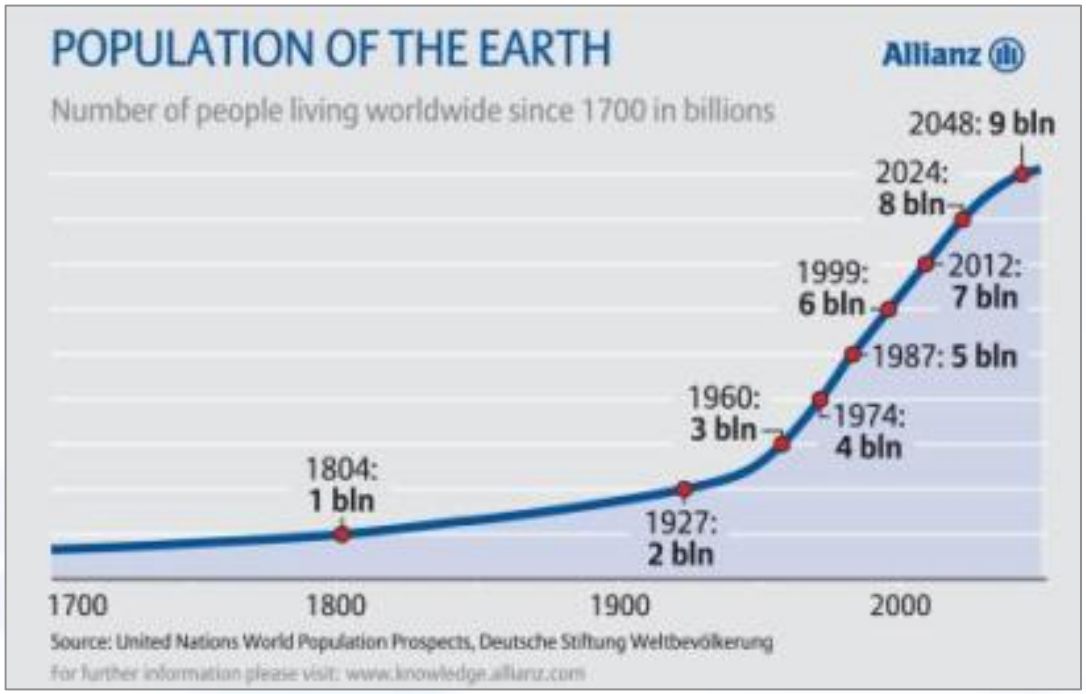
Welcome to the NASA Applied Sciences Program Water Resources Application Area

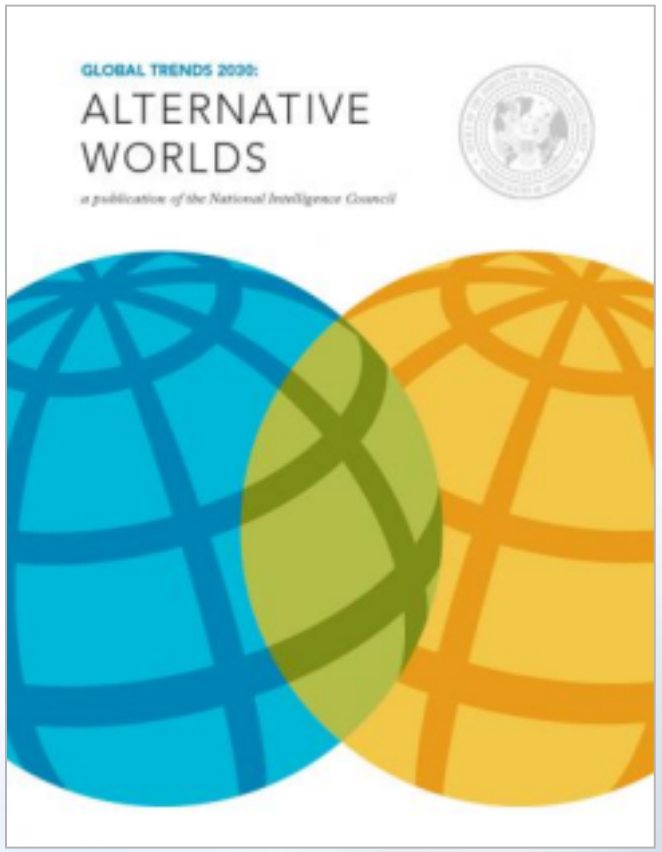
ROSES 2013 A.45 Earth Science Applications: WATER RESOURCES

The specific goal of this solicitation is to advance the long-term (30-180 day) outlooks of water supply anomalies and their effective use by water managers, their organizations, and/or decision-makers.

- Projected start dates for proposals - October

Earth in 2030+





"… half of the world's population will probably be living in areas that suffer from severe shortages of fresh water, meaning that management of natural resources will be a crucial component of global national security efforts."

Global Trends 2030
National Intelligence Council