

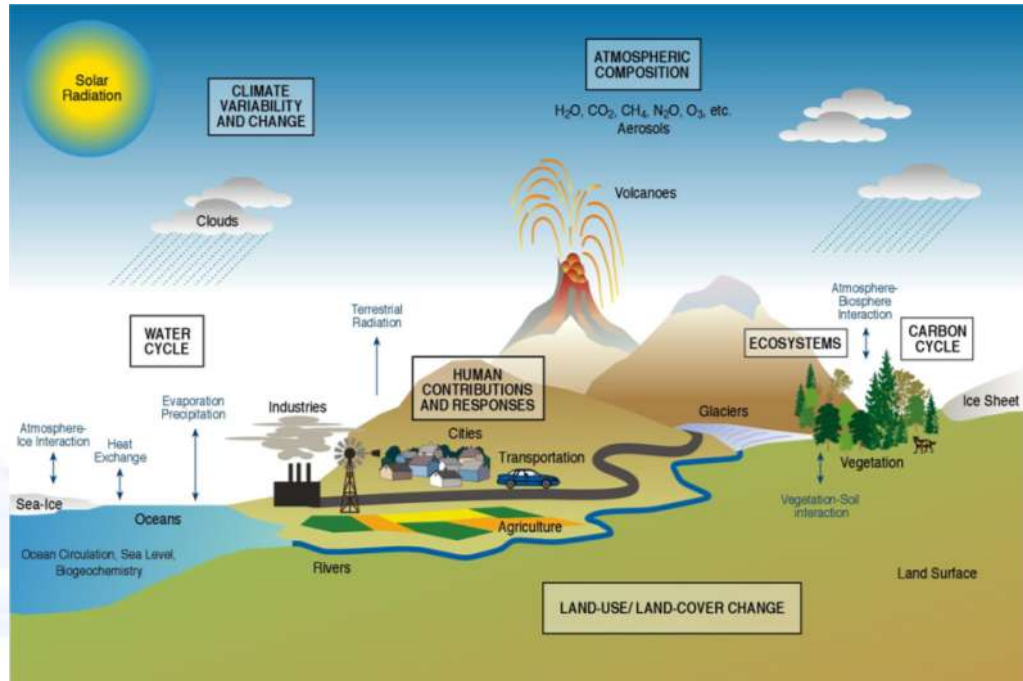


Global Approach to Earth Observation



Lawrence Friedl
NASA Earth Science

**Making Space
for Earth**



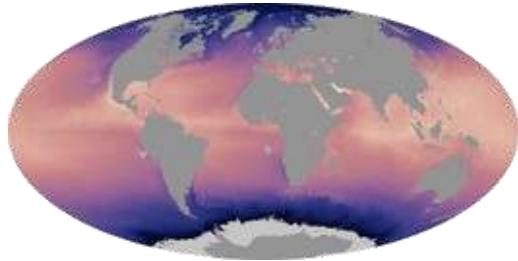
NASA Earth Science supports basic and applied research on the Earth system and its processes.

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

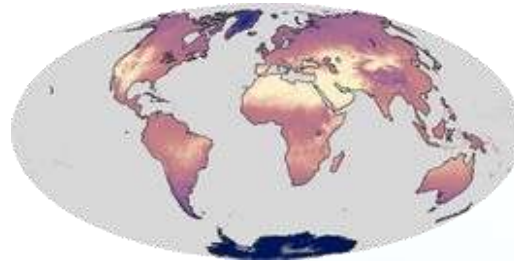
Technology
Flight Missions
Research
Data Systems
Education
Applications



Range of environmental observations ...



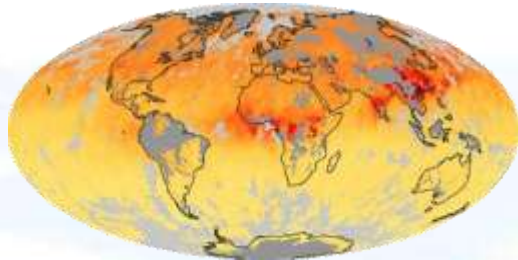
Sea Surface Temperature



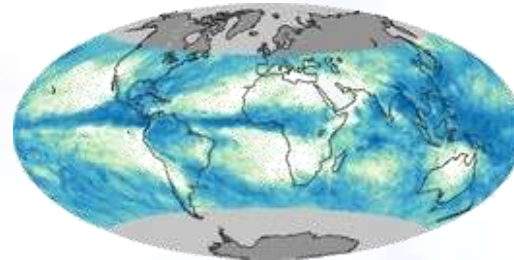
Land Temperature



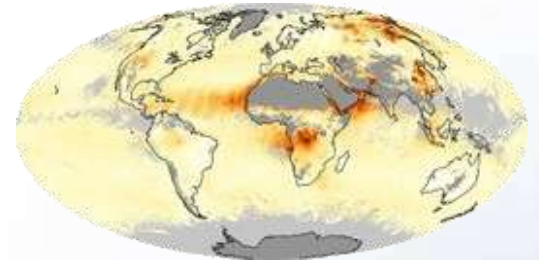
Vegetation



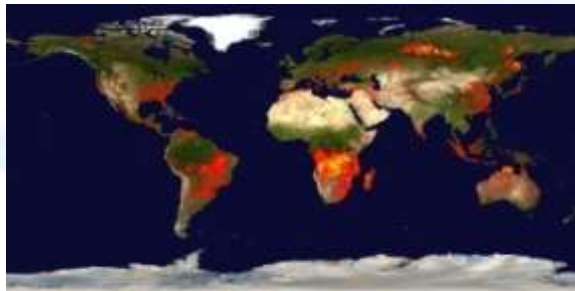
Carbon Monoxide



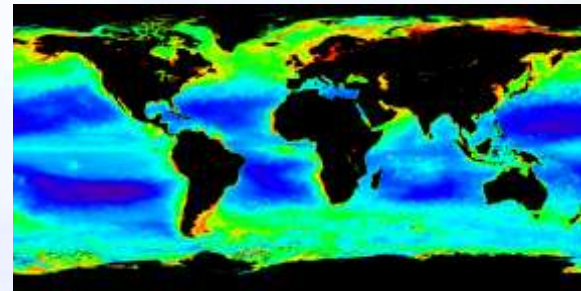
Total Rainfall



Aerosols



Fires



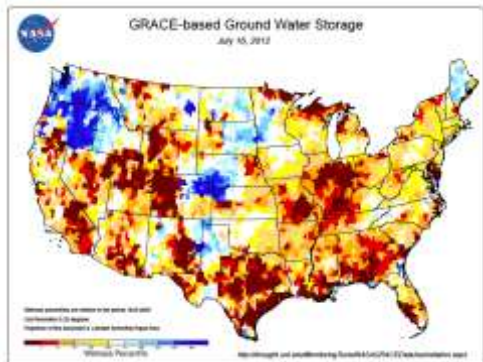
Chlorophyll

NASA GRACE Products Actively Supporting Official U.S. Drought Assessments

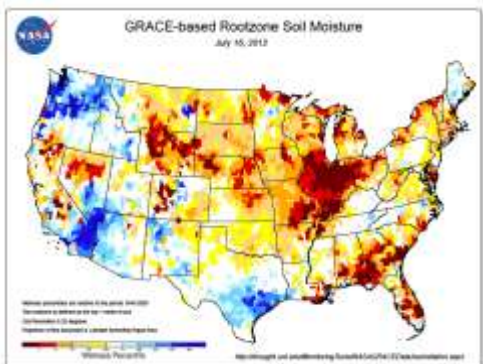


Derived from GRACE Satellites:

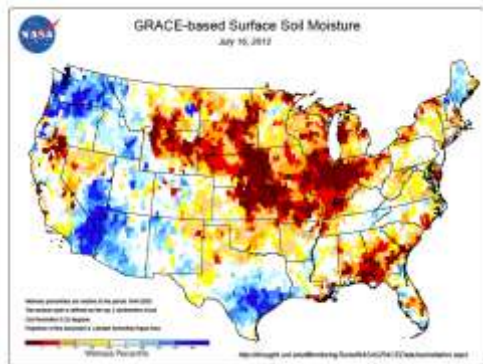
Ground Water Storage



Rootzone Soil Moisture

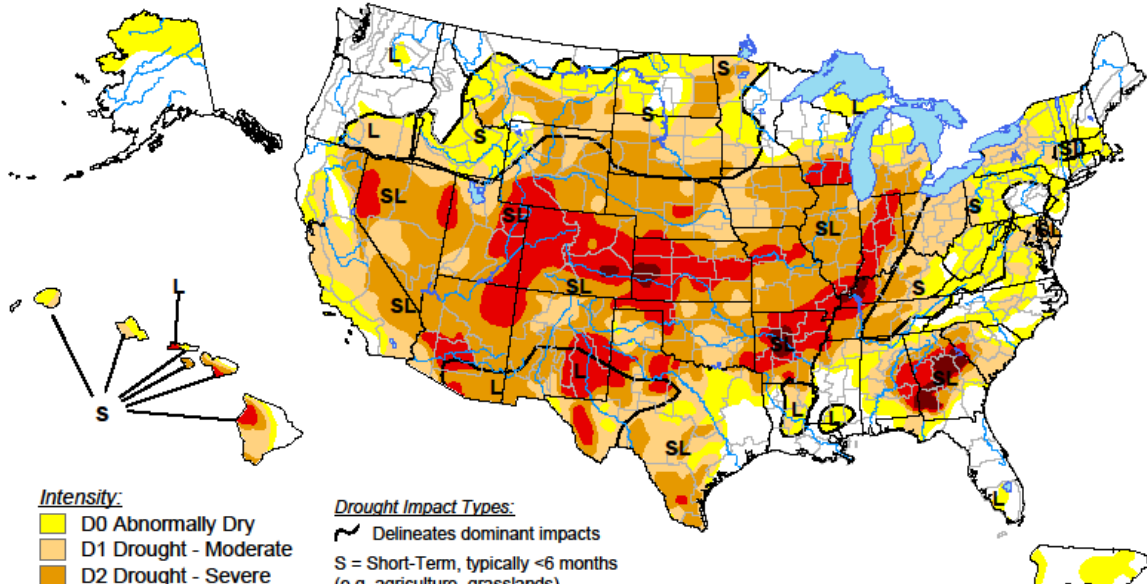


Surface Soil Moisture



U.S. Drought Monitor

July 17, 2012
Valid 7 a.m. EDT



- Intensity:
- D0 Abnormally Dry
 - D1 Drought - Moderate
 - D2 Drought - Severe
 - D3 Drought - Extreme
 - D4 Drought - Exceptional

- Drought Impact Types:
- Delineates dominant impacts
 - S = Short-Term, typically <6 months (e.g. agriculture, grasslands)
 - L = Long-Term, typically >6 months (e.g. hydrology, ecology)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

<http://droughtmonitor.unl.edu/>



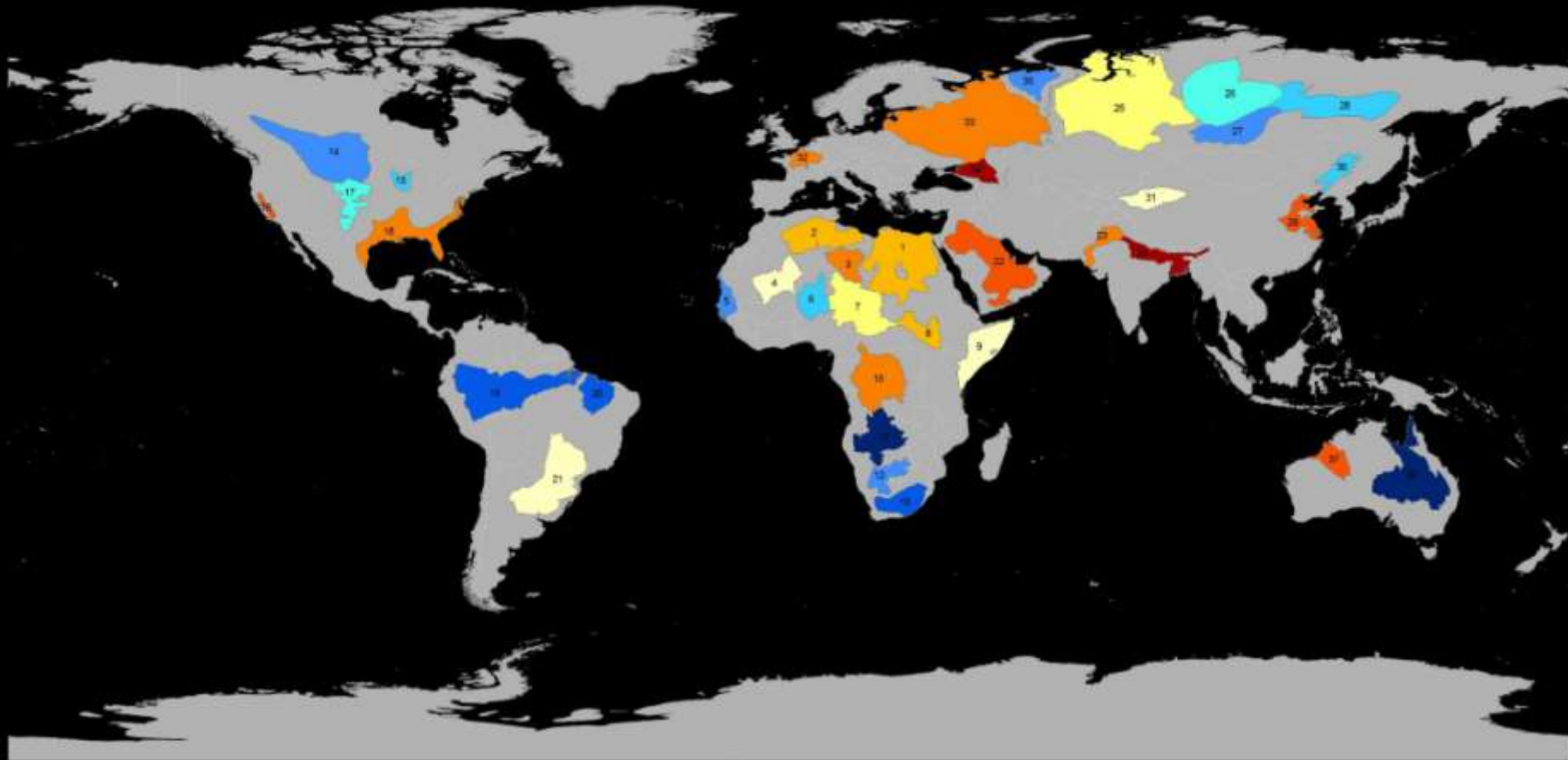
Released Thursday, July 19, 2012

Author: Richard Heim/Liz Love-Brotak, NOAA/NESDIS/NCDC

“These [GRACE] maps provide regional to national-level water resource information that was previously unavailable to policy and decision makers. The novel use of satellite-based gravity data in combination with advanced modeling techniques has given us a unique perspective on groundwater that was not resolvable through just ground-based observations.”

Brian Wardlow, National Drought Mitigation Center

Trends in Groundwater Storage from NASA GRACE Mission (2003-2013)



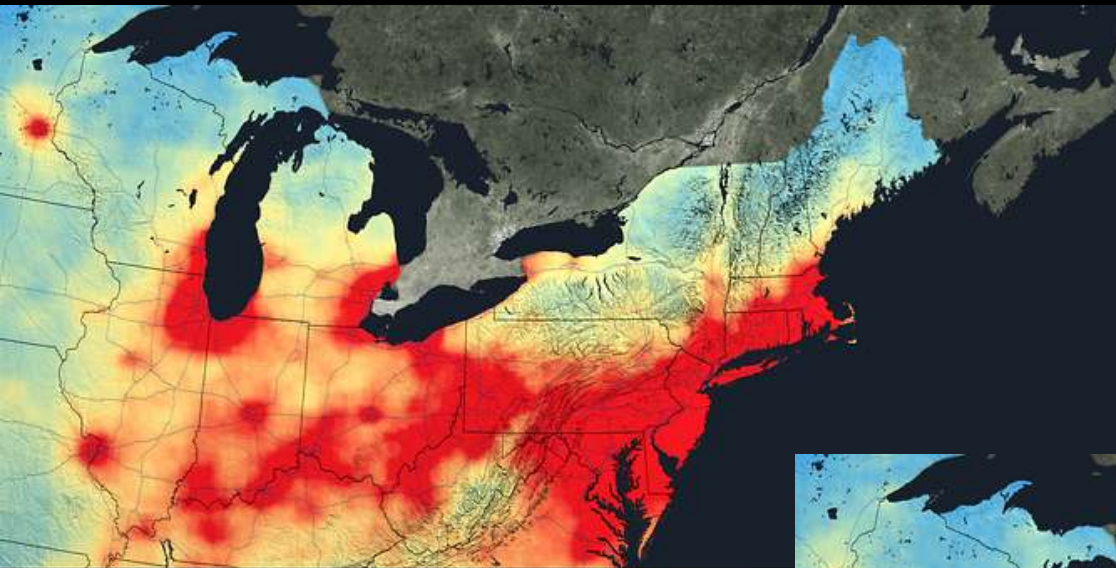
[mm H₂O yr⁻¹]



Richey, A.S., B.F. Thomas, M. Lo, J.T. Reager, J.S. Famiglietti, K. Voss, S. Swenson, M. Rodell (2015). Quantifying Renewable Groundwater Stress with GRACE. *Water Resour. Res.*, doi: 10.1002/2015WR017349

- | | | | |
|--|---|-----------------------------|-------------------------------|
| 1 Nubian Aquifer System (NAS) | 11 Upper Kalahari-Cuvetai-Upper Zambezi Basin | 20 Maranhao Basin | 29 North China Aquifer System |
| 2 Northwestern Sahara Aquifer System (NWSAS) | 12 Lower Kalahari-Stamriet Basin | 21 Guarani Aquifer System | 30 Song-Liao Basin |
| 3 Murzuk-Djado Basin | 13 Karoo Basin | 22 Arabian Aquifer System | 31 Tarim Basin |
| 4 Taoudeni-Tanezrouft Basin | 14 Northern Great Plains Aquifer | 23 Indus Basin | 32 Paris Basin |
| 5 Senegalo-Mauritanian Basin | 15 Cambro-Ordovician Aquifer System | 24 Ganges-Brahmaputra Basin | 33 Russian Platform Basins |
| 6 Iullemeden-Irhazer Aquifer System | 16 Californian Central Valley Aquifer System | 25 West Siberian Basin | 34 North Caucasus Basin |
| 7 Lake Chad Basin | 17 Ogallala Aquifer (High Plains) | 26 Tunguss Basin | 35 Pechora Basin |
| 8 Sudd Basin (Umm Ruwaba Aquifer) | 18 Atlantic and Gulf Coastal Plains Aquifer | 27 Angara-Lena Basin | 36 Great Artesian Basin |
| 9 Ogaden-Juba Basin | 19 Amazon Basin | 28 Yakut Basin | 37 Canning Basin |
| 10 Congo Basin | | | |

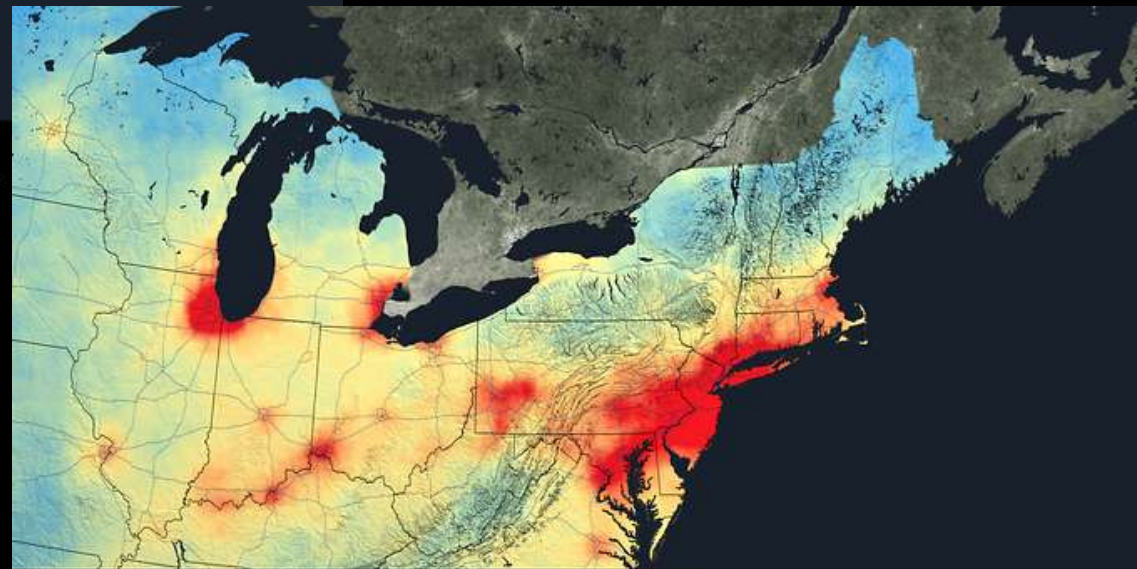
Earth observations to track progress on environmental policies



2005



Nitrogen Dioxide NO₂



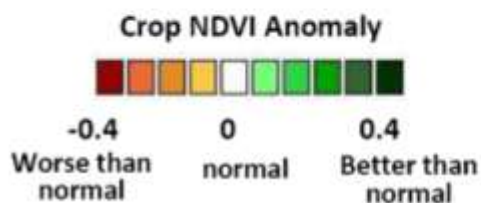
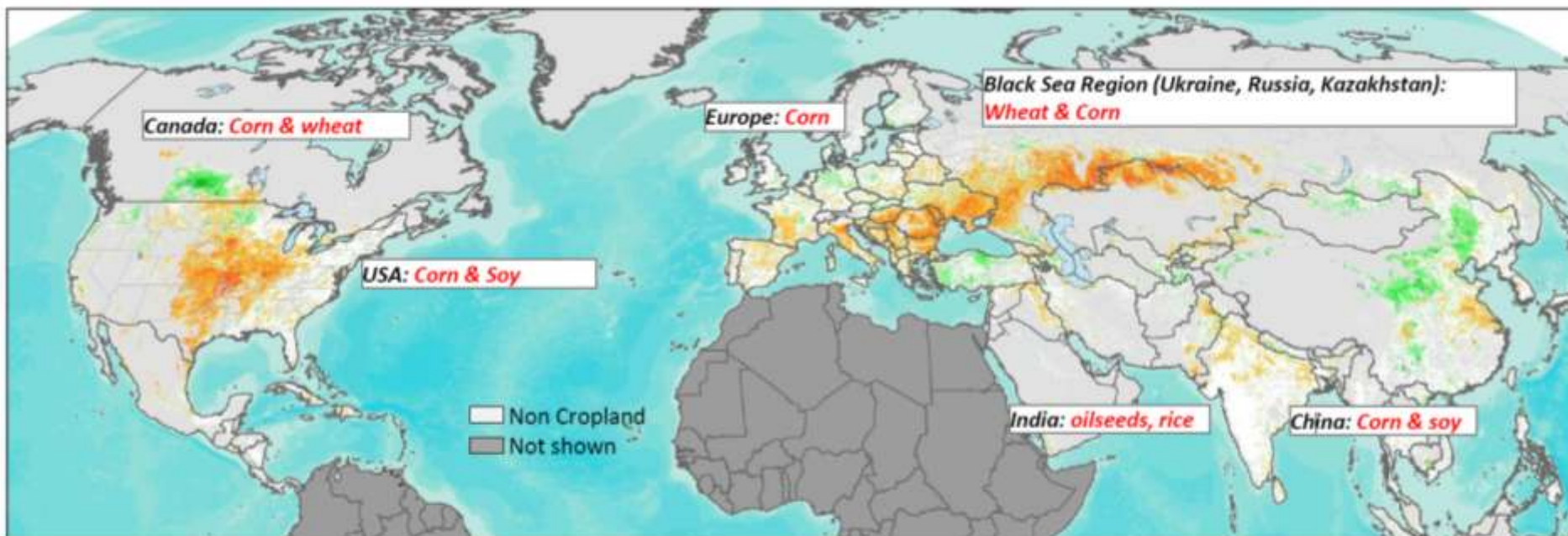
2011

Crop Condition: Global Outlooks



Northern Hemisphere: August 2012 Crop Conditions

Crop NDVI Anomalies from 2000-2013 average



Observed highlights:

- Drought conditions persist in US, south eastern Ukraine, Russia, and Kazakhstan, with slight improvement in some areas in northern Kazakhstan
- Rains in India mitigate dry conditions



G20 Final Declaration

Cannes, France
November 2011

44. We commit to improve market information and transparency in order to make international markets for agricultural commodities more effective. To that end, we launched:

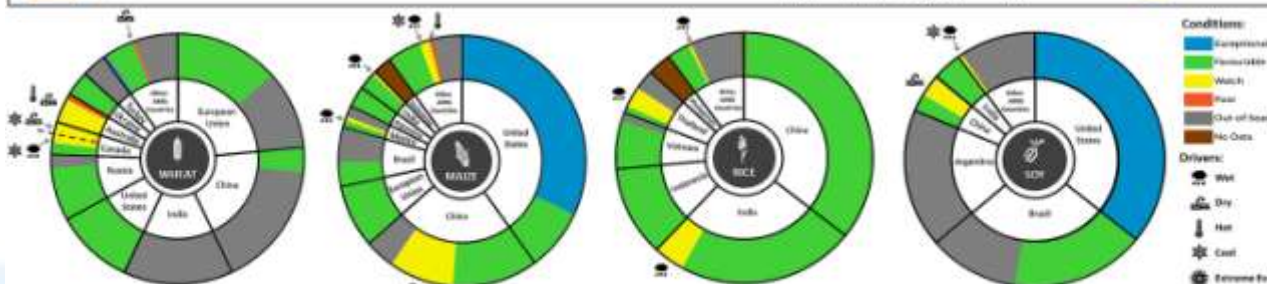
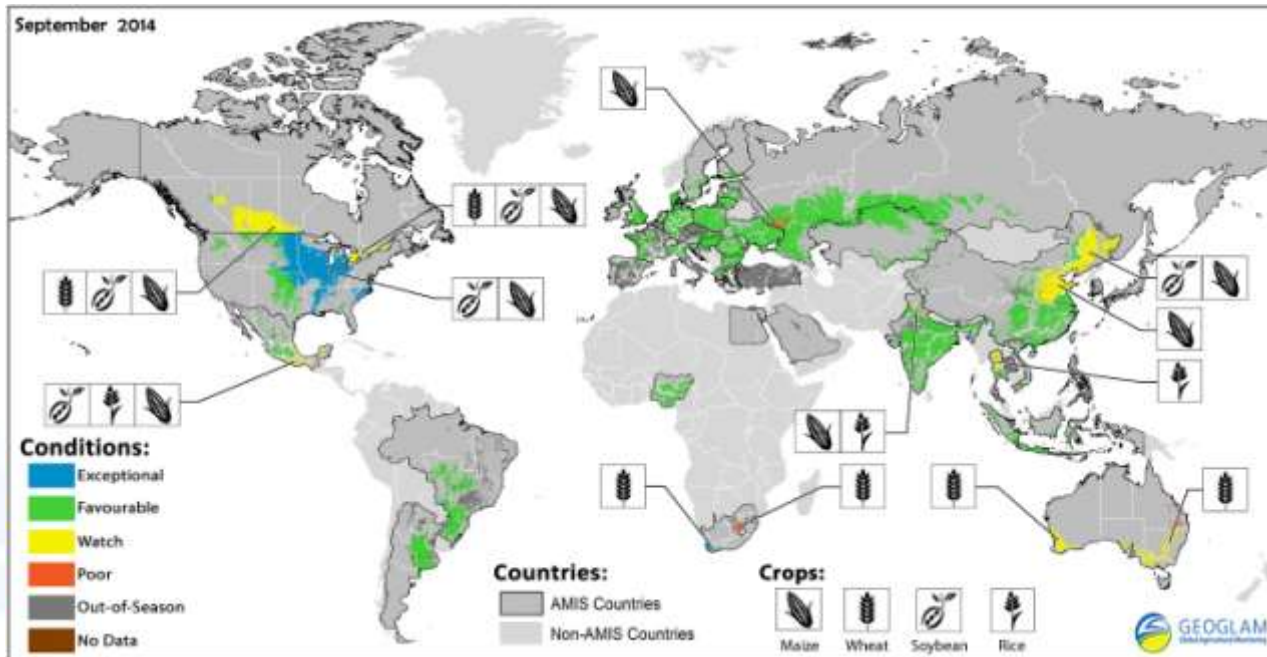
- The "Agricultural Market Information System" (AMIS) in Rome on September 15, 2011, to improve information on markets ...;
- The "**Global Agricultural Geo-monitoring Initiative**" (GEO-GLAM) in Geneva on September 22-23, 2011. This initiative will coordinate satellite monitoring observation systems in different regions of the world in order to enhance crop production projections and weather forecasting data.



Worse than normal normal Better than normal

improvement in some areas in northern Kazakhstan
- Rains in India mitigate dry conditions

Data >> Information >> Decisions >> Actions



Crop conditions over the main growing areas for wheat, maize, rice, and soybean are based on a combination of national and regional crop analyst inputs along with earth observation data. Conditions are based on information as of September 28th, 2014. Crops that are in other than favourable conditions are displayed on the map with their crop symbol and then with the specific climatic driver in the charts.



- » Published monthly.
- » Crop conditions over the main growing areas are based on a combination of national and regional crop analyst inputs along with Earth satellite observations data.
- » Monthly publication read by traders, agriculture economists, policy analysts, etc.

<http://www.amis-outlook.org/amis-monitoring>

National Civil Earth Observations Plan



Defines a new framework for constructing a balanced portfolio of Earth observations and observing systems

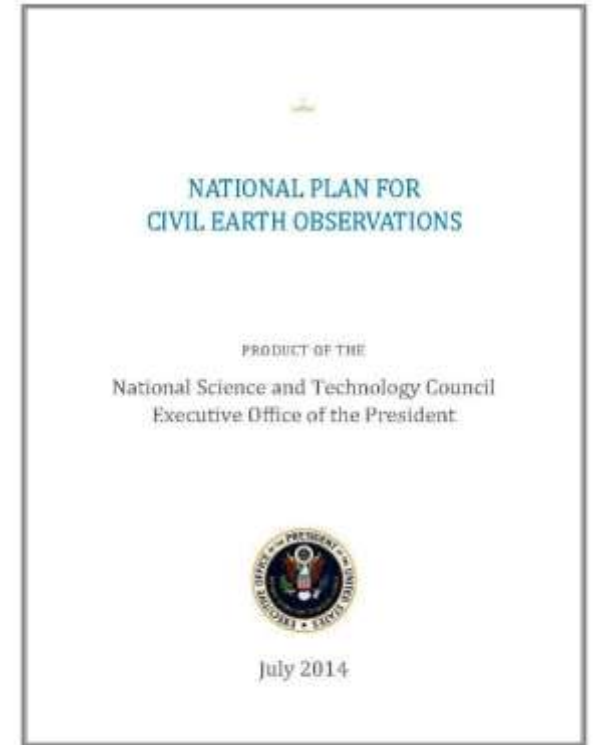
Classifies Earth-observation activities according to two broad categories:

Sustained Observations: Measurements generally taken for seven years or more

- Public services
- Research in public interest

Experimental Observations: Measurements taken for a limited observing period generally for research or development purposes

Employs a measurement-driven approach by setting aside the immediate questions of hardware, sensors, and systems in order to prioritize measurement needs.



*Research
Operations*

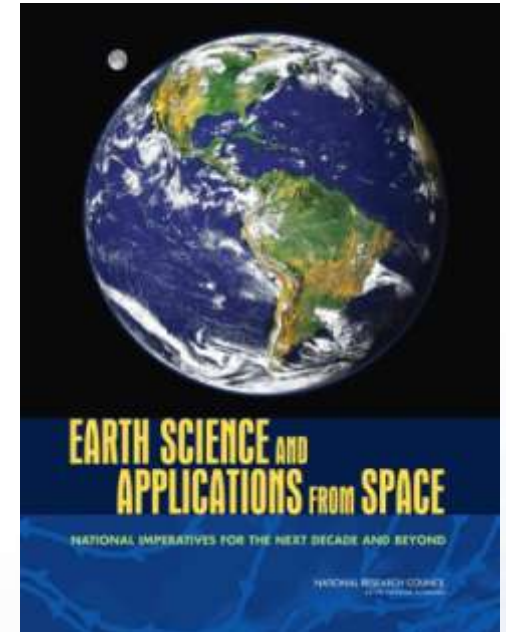
Moving away from these terms to describe missions

Earth Science & Applications from Space



2007 Earth Science Decadal Survey

“The national strategy outlined here has as its overarching objective a program of scientific discovery and development of applications that will enhance economic competitiveness, protect life and property, and assist in the stewardship of the planet for this and future generations.”



2017 Earth Science Decadal Survey

Sponsors:

- NASA-Earth Science Division;
- NOAA-NESDIS;
- USGS, Climate & Land Use Change

Due circa
Summer 2017

Conducted by National Academy of Sciences' National Research Council's Space Studies Board with other Boards supporting

Primary Elements of the Statement of Task



1. Assess progress in addressing the major scientific and application challenges outlined in the 2007 Earth Science Decadal Survey.
2. Develop a prioritized list of top-level science and application objectives to guide space-based Earth observations over a 10-year period commencing approximately at the start of fiscal year 2018.
3. Identify gaps and opportunities in the programs of record at NASA, NOAA, and USGS in pursuit of the top-level science and application challenges—including space-based opportunities that provide both sustained and experimental observations.
4. Recommend approaches to facilitate the development of a robust, resilient, and appropriately balanced U.S. program of Earth obs. from space.

Agency Specific Tasks

For NASA , the committee will pay particular attention to prioritizing and recommending balances among the full suite of Earth system science research, technology development, flight mission development and operation, and applications/capacity building development conducted in NASA Earth Science.

Consider: Science priorities, implementation costs, new technologies and platforms, interagency partnerships, international partners, and the *in situ* and other complementary programs carried out at NSF, DoE, DoA, DoD.



**Questions
and Discussion**



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