Space Age Tools for Effective Water Management: NASA’s Contribution Today and Tomorrow

National Water Issues Panel
American Water Resources Association, Florida Section Meeting
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Earth Science Mission

...to understand and protect our home planet by using our view from space to study the Earth system and improve prediction of Earth system change.
Recommended with high priority that NASA launch a soil moisture mission in the 2010-2013 timeframe.
Earth Science Research Foci

- Atmospheric Chemistry and Composition
- Carbon Cycle and Ecosystems
- Climate Variability and Change
- Earth Surface and Interior
- Water and Energy Cycle
- Weather

Earth Science Applications

- Agriculture
- Air Quality
- Climate
- Natural Disasters
- Ecological Forecasting
- Public Health
- Water Resources
- Weather
Earth Science Satellite Assets

20 Operational Missions
6 In Development
5 Under Study
## Hydrometeorological Missions

<table>
<thead>
<tr>
<th>Mission</th>
<th>Start</th>
<th>Description</th>
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<tr>
<td><strong>GRACE</strong></td>
<td>2002-2015</td>
<td>Provide detailed measurements of Earth's gravity field. Retrieve changes in ground water storage.</td>
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<td><strong>SMAP</strong></td>
<td>2014-</td>
<td>Global measurement of surface soil moisture and freeze/thaw state.</td>
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<tr>
<td><strong>SWOT</strong></td>
<td>2020-</td>
<td>First global survey of Earth's surface water. Will measure water storage changes in all wetlands, lakes, and reservoirs. Repeated measurements of water height during floods.</td>
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<tr>
<td><strong>GPM</strong></td>
<td>2013-</td>
<td>Global measurement of precipitation, its distribution, and physical processes; to improve the accuracy of weather forecasts; better understanding of climate and hydrometeorological processes.</td>
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Marshall’s Airborne Science Instruments

MAPIR
Soil Moisture Remote Sensing
PI: C. Laymon, NASA/MSFC

Objective:
Measure soil moisture to improve streamflow and weather forecasts, and estimation of evaporation.

HIRAD
Remote Sensing of Sea Surface Wind Speed and Rain Rate in Hurricanes
PI: T. Miller, NASA/MSFC

Objective:
- To improve prediction of storm intensity, structure, and path.
- To better determine storm location, intensity, and flooding prediction will save lives and property.

Partnership between Government, Universities and Industry
Research to Operations Transition

...To enable timely and affordable delivery of Earth Science data and information to users
Applied Science Projects in Hydrology

**Improved Streamflow Forecasts**

*Infusing NASA Science & Technology to Improve Streamflow Forecasts*

**Objective:** Use remotely sensed cloud cover, and surface temperature data to estimate evapotranspiration, which was ingested into NOAA hydrologic models to improve streamflow prediction. –recover lost functionality

**Partner:** NOAA Office of Hydrologic Development

**Study Area:** San Joaquin Valley, CA

**Partners:** Federal, State, Local NGOs

**Annual Average Potential Evapotranspiration**

- 2001
- 2002
- 2003
- 2004
- 2005
- 2006
- 2007
- 2008

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**Improved Water Management**

*Infusing NASA Science & Technology to Improve Water Management*

**Objective:** Use precipitation estimates from NEXRAD radars, and estimates of soil moisture and ET from a distributed hydrologic model to improve efficiency of agricultural irrigation and municipal water use.

**Study Area:** San Joaquin Valley, CA

**Partners:** Federal, State, Local NGOs

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**Water Supply**

- NREPS PRECIP (MSFC)
- River Discharge / (JPL/DFO)
- MODIS-SNOTEL SWE (JPL)

**Agricultural Water Demand**

- TOPS - CDX IT Integration
- ET / soil moisture / irrigation demand
- CA DWR / Water Districts

**Flow Chart**

- NREPS PECIP (MSFC)
- SHEDS ET and SOILW (MSFC)
- TOPS (ARC)
- CIMIS DSS / CA DWR / Ag. Producers

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AWRA—Florida Section Mtg; Key West, FL; 15 July 2010
Improved Streamflow with Better Precipitation

Infusing NASA Science & Technology to Improve Operational Hydrologic Forecasts

**NEXRAD Rainfall Estimation Processing System (NREPS)**

- **NEXRAD Data**
- **Quality Control (Noise removal)**
- **Grid and Merge Radar Estimates**
- **Radar-based Rainfall Estimates**
- **N-hour Sub-Basin Accumulations**
- **Data Files Web Images**

**CURRENT TVA**
Lumped inflow-model relies on coarse gauge net

**NSSTC Transition of Radar and QPE Research to operations**

**FUTURE TVA**
Quality radar-based QPE that reduces gauge costs; basis for distributed model

**Customer:** Tennessee Valley Authority
Improved Operational Weather Forecasts

**Mission:**
Apply *NASA measurement systems and unique Earth science research* to improve the accuracy of short-term (0-24 hr) weather prediction at the regional and local scale

- conduct focused research
- evaluate in “testbed” mode
- transition priority products to WFOs

**End users:**
National Weather Service Forecast Offices across the country, other government organizations, and numerous private sector weather partners

**Partners:** *Other NASA Centers, NOAA, private sector weather entities*

**Short-term Prediction Research and Transition (SPoRT)**

- Apply real-time data from NASA climate satellites such as Terra, Aqua, and CloudSat to weather forecast problems
- NASA satellites are prototypes for future NOAA satellites
Summary

Mission:
To improve scientific understanding of the Earth's global water cycle and other major weather and climate processes, to assess the interaction between Earth's weather and climate systems and human activity as it relates to regional and global weather and climate variability, and to apply this scientific knowledge to specific issues of concern to decision-makers and the general scientific community.

Who We Serve:
Governmental and non-governmental partners with global to local scale needs

What We Provide:
• Innovative solutions that maximize utility of existing assets
• Solutions that are smarter, not harder
• Focus in areas in which we excel
• Engage in partnerships where relationships matter

Core Competencies
Research
Surface hydrology
Meteorological processes
Atmospheric electricity
Climate dynamics & variability
Applications
Water management
Public health
Research to operations
Application specific solutions