# GEO (Group on Earth Observations) Water and GEO Global Water Sustainability

# (GEOGloWS)

Rick Lawford
with inputs from Angelica Gutierrez, Bradley Doorn and many more

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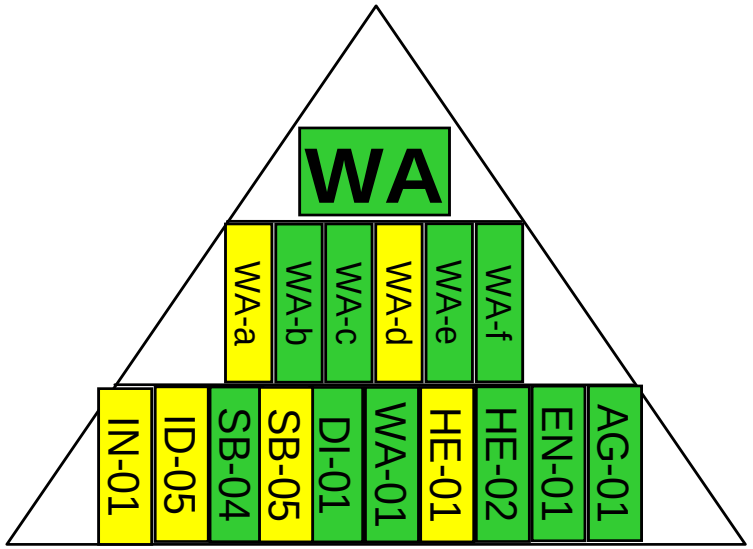
# Status of GEO Water at the end of 2015

**The international Water Task Target:**

By 2015, produce comprehensive sets of data and information products to support decision-making for efficient management of the world's water resources, based on coordinated, sustained observations of the water cycle on multiple scales.



Components of the Water Task:

C1: Integrated Water-cycle Products and Services

C2: Information Systems for Hydro-meteorological Extremes (incl. Floods and Droughts)

C3: Information Service for Cold Regions

C4: Global Water-Quality Products and Services

C5: Information System Development and Capacity Building

# 2016 Community Activities

CA-07 - Integrated Water-cycle products and service (Merge with GEOGLOWS) - Rick Lawford
CA-08 - Water Vapour and Clouds – Ralph Ferraro
CA - 09 - Precipitation - George Huffman
CA-10 - Evapotranspiration - Forrest Melton
CA-11 - Soil Moisture - Peter van Oevelen and Chris Rudiger
CA -12 - Streamflow - Dominique Berod (new lead)
CA - 13 - Groundwater - Neno Kukuric
CA-14 - Water Quality - Steve Greb
CA-15 - Capacity Building - Angelica Gutierrez (and Nancy Searby/Toshio Koike)
CA-16 - Drought - Will Pozzi - being proposed as a new initiative
CA -17 - GEO Great Lakes - Norman Grannemann and Gail Faveri
CA -18- WCI - Toshio Koike
CA-19 - Global WEF E2E - Charles Vorsomarty
CA-20 - EartH2Observe - Jaap Schellekens (EU project coming up on 3 years)
CA 22 - The Water Task and other SBAs and post-2015 development – Rick Lawford – Wetlands component to become a GEO initiative
CA - 29 - Integrated Water Prediction – Angelica Gutierrez - Will become part of GEOGLOWS

## Highlights (Focus on policy areas):

1) The report adopts themes for the water strategy:

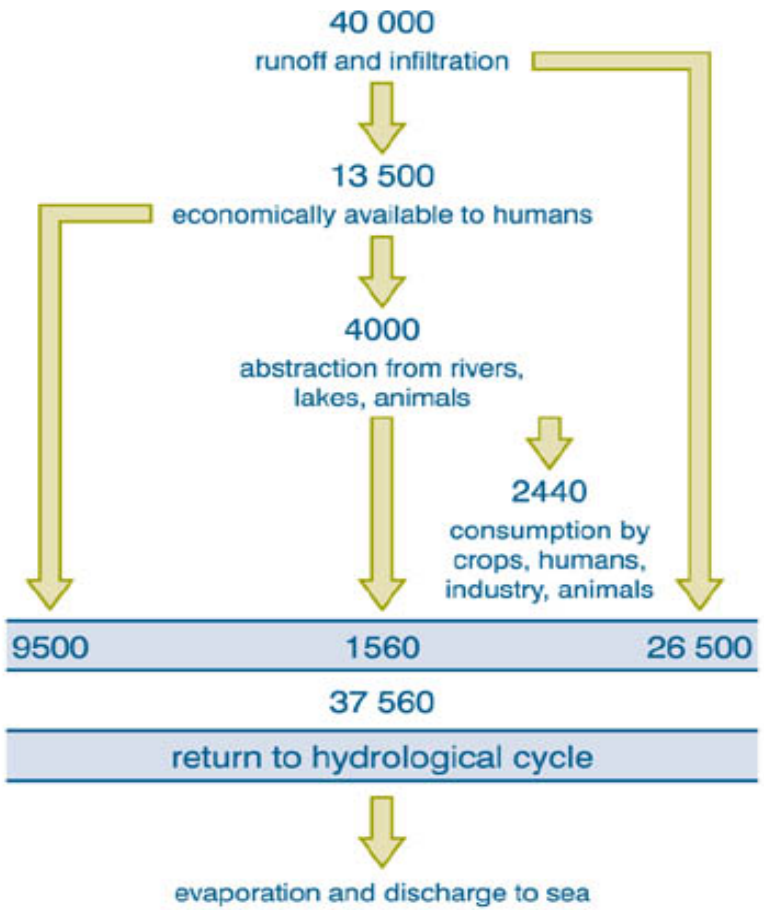
1. Addressing water security and sustainable development
2. Supporting the climate change adaptation agenda.
3. Warning systems for hydrometeorological hazards.
4. Enhancing human and environmental resilience
5. Addressing Water-Energy-Food nexus issues.
6. Improving the welfare of the poor in developing countries through more effective water management.

2) GEO members have been invited to identify recommendations that they would like to address.

# The report also identified provisional Essential Water Variables (EWVs)

| Primary EWVs | Supplemental EWVs (Apply to Water and other SBAs) |
|---|---|
| **Precipitation** | Surface meteorology |
| **Evaporation and evapotranspiration** | Surface and atmospheric radiation budgets |
| **Snow cover (including snow water equivalent, depth, freeze thaw margins)** | Clouds and aerosols |
| **Soil moisture/temperature** | Permafrost |
| **Groundwater** | Land cover, vegetation and land use |
| **Runoff/streamflow/river discharge** | Elevation/topography and geological stratification |
| **Lakes/reservoir levels and aquifer volumetric change** | |
| **Glaciers/ice sheets** | |
| **Water quality** | |
| **Water use/demand (agriculture, hydrology, energy, urbanization)** | |

# Options for Defining User Needs and User Engagement



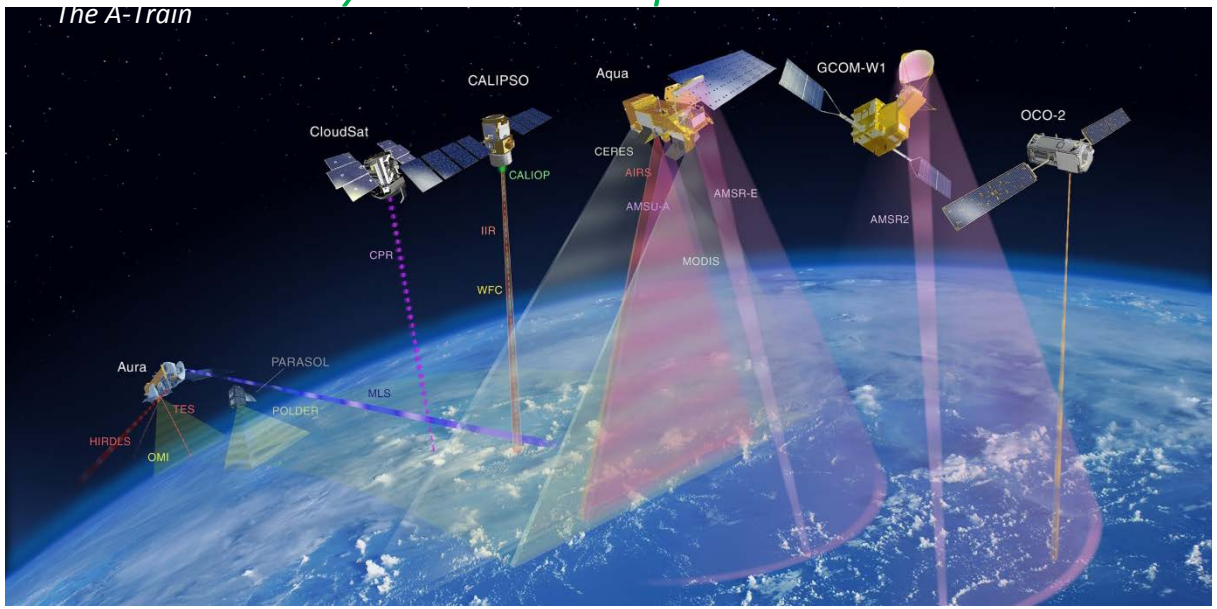

(courtesy of Massimo Menenti)

- Review of studies of user needs to derive criteria for data needs.
- Engage with users of data products to assess how suitable and meaningful products are before making them operational.
- Co-design products with users.

# CEOS has been one of the major contributors to the implementation of the recommendations in the GEOSS Water Strategy

GEO Water Strategy Recommendation C1:

*The feasibility of developing a Water-Train satellite constellation should be assessed. This suite of satellites would be modelled after the A-Train, providing a space segment of an observation system that would capture all fluxes and stores of the water cycle using a diverse suite of platforms and instruments. This system would operate as a Virtual Water Cycle Constellation.*




CEOS has formed a Water Strategy Implementation Study Team (WSIST) which is addressing this recommendation

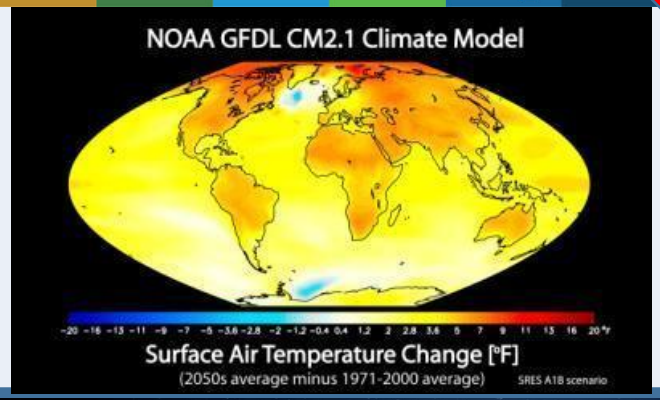
# GEO Global Water Sustainability (GEOGLoWS)

## OBJECTIVES

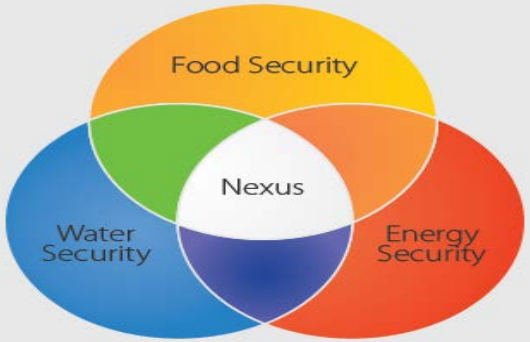
1) Strengthen capacity to understand water data needs and develop user-driven applications products from EO data and applications
2) Engage end users and boundary organizations to understand needs by region and decision making process and prioritize activities based on vulnerability analyses
3) Coordinate and leverage GEOGLOWS partners to more effectively provide information and expertise to US and international stakeholder and end user communities
4) Strengthen U.S. and international capacity to use water EO and science effectively across spatial and temporal scales
5) Contribute to the assessments of impacts of climate change with population and economic growth on water resources and their availability, and to inform planning and adaptation activities

# GEO Global Water Sustainability (GEOGLOWS)

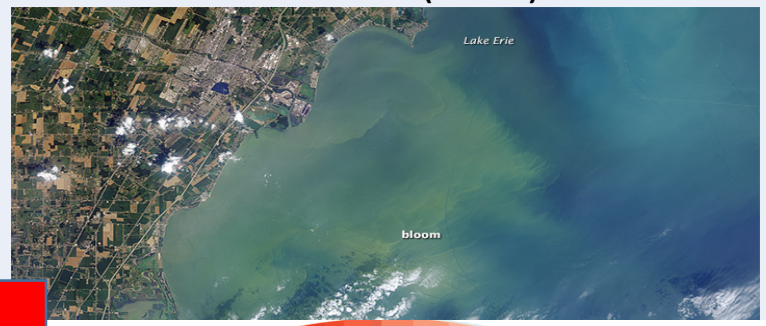
## 1. Enhancing Global Water Sustainable Development

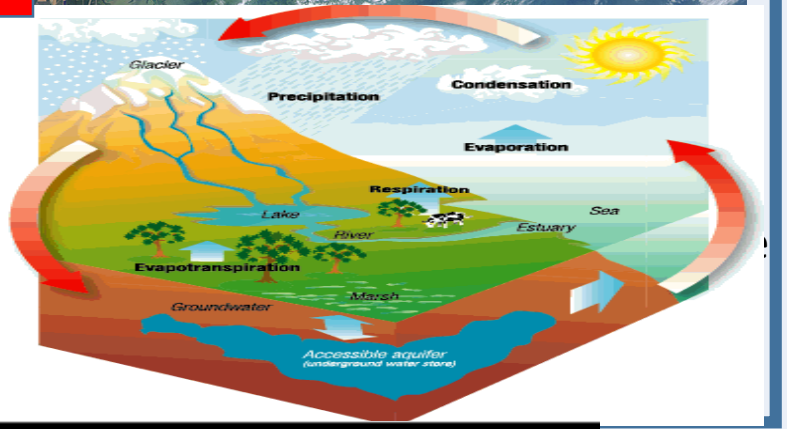


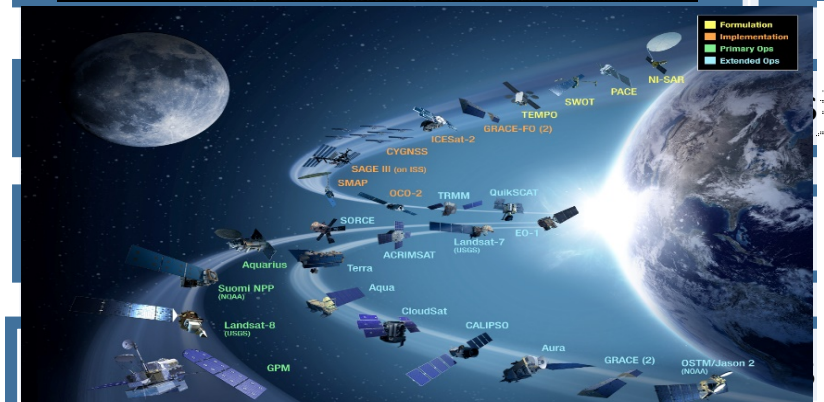

## 2. Minimizing Basin and Regional Risk

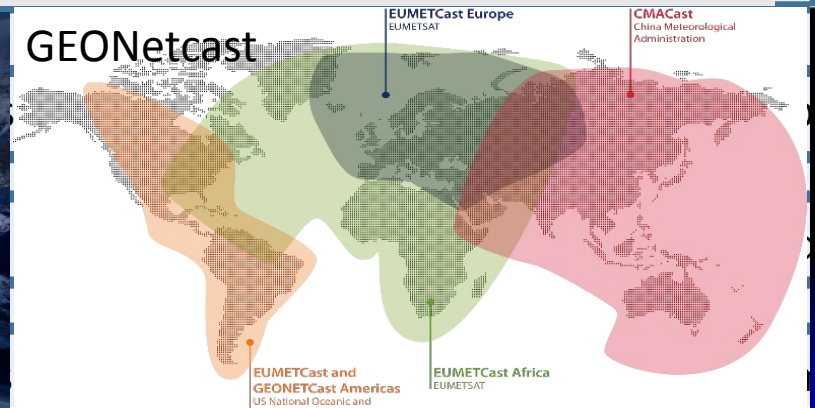


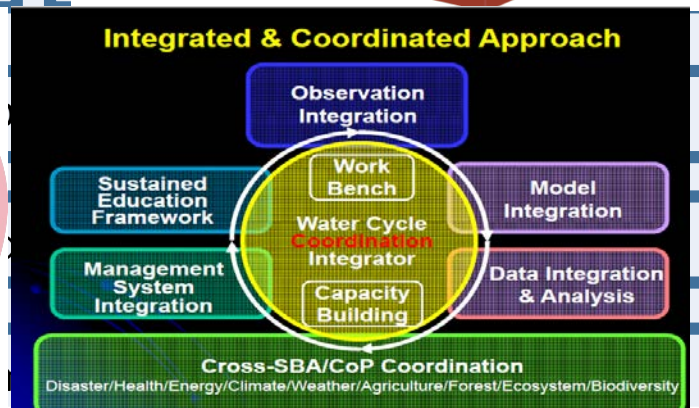

## 3. Understanding Essential Water Variables (EWV)



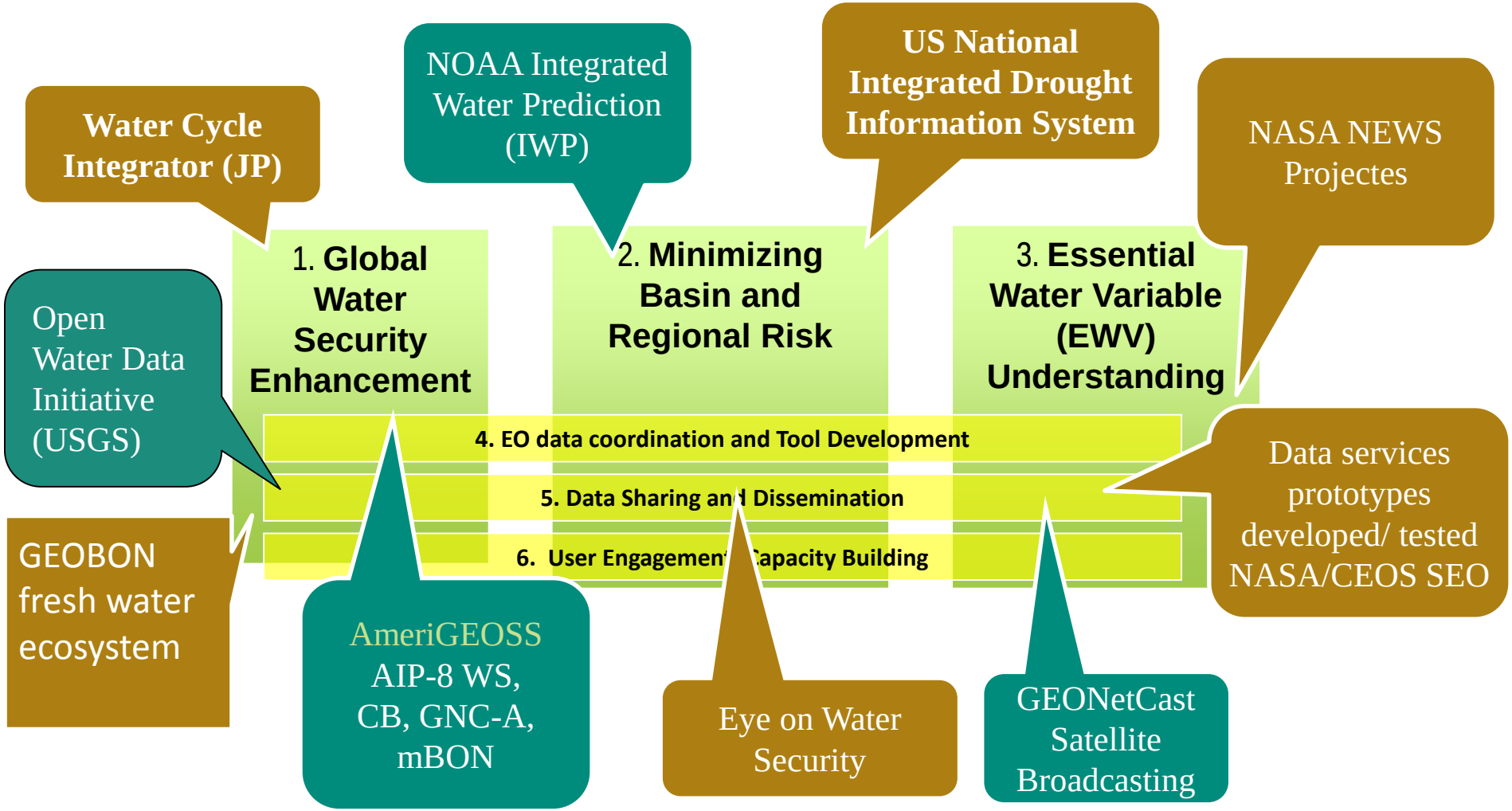



# The Evolution of GEOGloWS

1. 2014:GEOGloWS as a NASA contribution to US GEO: Applications projects were mapped to the GEOGloWS themes.

2. 2015: GEOGloWS as a USGEO initiative:
   NOAA and the USGS engaged and IWP, Water Quality and Water Use became essential elements

3. 2015-2016: GEOGloWS as an international GEO initiative: AmeriGEOSS (Colombia), SDGs and the work of the JRC and Japan became more visible.




Potential (examples)

Proposed

# DRAFT GEOGLOWS STRUCTURE with User-Driven and Supported Projects

**The GEOSS Water Strategy identified areas that need to be strengthened in its implementation. GEOGloWS supports the following issues:**

1. *Commitments for GEO Members and GEO POs are needed to address specific recommendations*

*GEOGLOWS provides a framework within which GEO members can coordinate their responses to the GEOSS Water Strategy. It also coordinates the USGEO contributions to the GEOSS Water Strategy.*

2. *Strengthen User Engagement through relationships with users and product co-design.*

*As an example for other GEO Members, US GEO and NASA will develop mechanisms for user interaction.*

***3. There are Essential Water Variables (EWVs) that are not being addressed by GCOS (and CEOS) - a strategy is needed to obtain a commitment to produce better quality versions of these variables on the required space and time scales. (Water use should be addressed as a critical missing variable at the global scale.)***

- ***NASA plans to work with USGS to evaluate the feasibility of developing a global water use assessment tool that relies on satellite data as well as surveys and multiple types of information.***

- ***NASA hosted a successful ET workshop at the World Bank in September 2015. Recommendations from that workshop are expected to lead to better quality ET products. (It should be noted that there are indications that GCOS will adopt ET as an Essential Climate Variable)***

A.8: GEO should develop a strategy to ensure that future water cycle solution integration activities utilize techniques to quantify uncertainty in various products delivered to end-users and engage with these end-users to enhance the use and understanding of these supplemental error and uncertainty products through a risk-based approach to water management.

- NASA has been producing error estimates for various water cycle fields. The data have been helpful in identifying where improvements in measurements are needed. Efforts will be made to use this information on uncertainties to see how the information can best be used in applications and in mission planning.

# NATIONAL WATER CENTER

# OPERATIONS CENTER

**“Street Level” Water Prediction and Impact-Based Decision Support**

## WATER PREDICTION +
## GEO-INTELLIGENCE

USGS
science for a changing world

# Multi-Year Strategic Vision
# Science and Services Plan
## *Integrated Water Prediction (IWP)*
*and the National Water Center*

### FY 15-20
**Core Capability**

**Centralized Water Forecasting**

- **National Water Model (NWM) operational 2016**
  - *Water forecasts for 2.7 million stream reaches in U.S.*
  - ***100 million people get a terrestrial water forecast for first time***
  - *National Water Center (NWC) begins providing daily situational awareness and guidance to NWS field offices*

### FY 16-21
**Key Enhancement**

**Flash Flood and Urban Hydrology**

- **Enhance NWM with nested hyper-resolution zoom capability and urban hydrologic processes**
  - *Heightened focus on regions of interests (e.g. follow storms)*
  - *Street level **flood inundation forecasts** for selected urban demonstration areas*
  - *NWC increases guidance to NWS field offices to improve consistency and services for flash floods*

### FY 17-22
**Major Integration**

**Coastal Total Water Level**

- **Couple NWM with marine models to predict combined storm surge, tide, and riverine effects**
  - *More complete picture of coastal storm impacts*
  - *Water prediction information linked to geospatial risk and vulnerability*
  - ***New service delivery model implemented** – increased stakeholder engagement and integrated information*
  - ***NWC operations center opens** and provides national decision support services and situational awareness*

### FY 18-23
**Key Enhancement**

**Dry Side: Drought and Post-Fire**

- **Couple NWM with groundwater and transport models to predict low flows, drought and fire impacts**
  - *Add NWM processes that affect subsurface water movement and storage during dry conditions*
  - *Add NWM ability to track constituents (e.g. sediment, contaminants, nutrients) through stream network*
  - *New decision support services for water shortage situations and waterborne transport*
  - ***NWC operations center expands to include drought and post-fire decision support services***

### FY 19-24
**Major Integration**

**Water Quality**

- **Integrate enhanced NWM with key water quality data sets, models and tools to begin water quality prediction**
  - *Incorporate water quality data from federal and State partners into NWM*
  - *Link NWM output to NOAA ecological forecasting operations*
  - *New decision support services for predicting water quality issues such as Harmful Algal Blooms*
  - *New decision support services for emergencies such as chemical spils*
  - ***NWC operations center expands to include water quality decision support services***

# GEOGLOWS Partners and Benefits

**Benefits of GEOGLOWS:**

- National Water Agencies: GEOGLOWS will provide managers with better and more access to information for decision making
- Space Agencies: GEOGLOWS would facilitate access to datasets needed for EO-based water cycle models and to inform new societally relevant missions
- International Organizations (GEO, UN Water, USWP, World Bank, USAID, among others) and development groups (academia/private sector): GEOGLOWS will provide more efficient access to technical expertise, datasets and synergistic, important in data-scarce regions
- Research and data providers: GEOGLOWS will provide an improved understanding of global water information priorities for societal needs
- User communities: GEOGLOWS will provide improved, tailored information products and services AND a global community of practice to address water challenges

# What we need to do after this meeting

1. We need to update NASA project descriptions in the current GEOGloWS document.

2. We need to broaden the involvement of US agencies in the GEOGloWS program (USDA, EPA, etc)

3. We need to encourage more international participation in the program and provide an umbrella for many international GEO Water activities.

4. We need to implement an active and visible coordination structure to ensure GEOGloWS becomes a viable community driven mechanism for coordinating water activities and using observational science to address policy issues.

5. IGWCO COP will need to expand its membership and review its operations in order to ensure it effectively serves the needs of GEOGloWS.