Discovery and Access to Global Water Data, Maps and Services

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Why is it so important to share water data?

- Improving **agriculture**
  - Water quality
  - Managing the economics and conflicts of shared access
- Understanding, predicting and mitigating **drought and flooding**
  - Learning patterns of natural variability
    - Within and across watersheds
    - Along coastlines
- Anticipating and mitigating other **natural and manmade disasters**
  - Debris flows, toxic spills
- Helping improve skills in **developing countries**
- Understanding **global water** cycle

*Using standards lowers costs and learning curves for equipment, software development, tools, training, and maintenance*
GEOSS Introduction

- **GEOSS:** Global Earth Observation System of Systems
  - Hosted by GEO (Group on Earth Observations) to publish Earth observation datasets from 92 member countries
  - Enables distributed search among dozens of catalogs, accessing millions of data services, following international data exchange standards (ISO, WMO, OGC, ...) 
  - Data is organized around **9 Societal Benefit Areas (SBAs): Water, Weather, Climate, Biodiversity, Ecosystems, Energy, Agriculture, Health, Disasters**

- **GEOSS AIP (Architecture Implementation Pilot)**
  - Series of 1-year project cycles to implement GEOSS, started in 2007; AIP-6 now complete; AIP-7 just started
AIP-6 Water Services (2013): Key Concepts

Current international standards work mainly at the Internet level, still need refining for consistency of terms and usage within and across international hydrology communities…

This project has made water data sharing easier, through:
1. Improved discovery and access to water time series data, across domain-community resources
2. Integration of gridded & time series data sources
3. Enabling federation of regional & national water data around a common information model and service architecture
Useful organizing principle and registry for cross-community resources: [http://www.geoportal.org/](http://www.geoportal.org/)
GEOSS Portal: connecting to community portals and other resources
Water Community Portals added in AIP-6

- CUAHSI HIS Central (moved and being updated to OGC standards)
- ISPRA Monitoring Network (Italy)
- Canadian Monitoring Network
- New Zealand Government Network
- CEOS Water Portal (JAXA, Univ of Tokyo DIAS)
- Esri ArcGIS Online
Next step is from community portals to water data maps

- **GEOSS and community portals** provide coverage and download access to data services and data sets.
- For water observation data that are time series, a more convenient way of visualizing the data services is with **maps of the monitoring points**.
- These can be browsed at the monitoring station level, grouped by various means, and selected for data downloads.
GWS GEOSS Water Services Global Streamflow

Streamflow discharge time series metadata service encoded in WFS. The WaterML URI field in the metadata contains a URI that could be WSDL, SOS, KiQS Query Service (KiQS), USGS WaterML Service, or other web service endpoint for stream discharge content in WaterML 1.0 or WaterML 2.0 encoding. CAVEAT: This

Click to read more...

EOSD-GWS: EOSD Forest Landcover of Canada - Grid-enabled WMS

GWMS provides landcover classification maps of Canada, created from Landsat-7 ETM+ data (circa 2000). The Landcover products were produced from the Global Forest Change Project (GFCP), and can be visualized in a grid-enabled WMS.
Water Data Maps: Global Stream Gauges
Not just seeing data providers’ bounding boxes, but actual locations of specific data… (Esri ArcGIS Online web map viewer)

1. WMO GRDC (gauge descriptions only, no water data)
2. Kisters GRDC (WaterML 2 data for OGC Surface Water IE)
3. USGS NWIS (most have real-time data)
4. Mexico (some with historical data, hosted by Univ of Texas)
5. Dominican Republic (historical data hosted by BYU)
6. Italy & New Zealand (real-time data, developed for AIP-6)

Gauge description and data links...

For quick overview

For easy analysis

WaterML for full details
WaterML 2.0

Document metadata

- Phenomena time
- Result time
- Procedure
- Observed property
- Feature of interest
- Result

Time series metadata

Time series data, cont’d
2. Integrated gridded & time series data sources

- Many data sources and model-output are created as continuous grids of a variable over the earth at a point in time.
- NASA is integrating soil moisture grids to generate time series at discrete locations (data rods).
- This grid is from the **Land Data Assimilation System (LDAS)**.
- Other gridded variables are planned for future projects.
Viewing & comparing time series values

Gridded map at timestamp

Time series & stats at grid point
3. Federating regional & national water data

- All the mechanisms described so far make access easier, but don’t address a fundamental issue: **conventions for information content**
- Without **consistent use of standards for data content and description**, every water management agency would have a different way of telling their story
- In this project, we have started convergence toward a common way of describing water data time series among these countries:
  - United States (USGS NWIS)
  - Italy (ISPRA/ARPA-ER)
  - New Zealand (NIWA/HRC)
  - Canada (USask GIWS for Environment Canada)
  - Dominican Republic (through BYU)
  - Honduras (through BYU)
  - Nicaragua (through BYU)
  - Guatemala (through BYU)
Summary of Recommendations

1. **Use OGC WaterML 2** for water-variable time series data (streamflow, precipitation, runoff, etc).

2. **Use OGC WFS** or similar feature layer of water data sites; one WFS service per data layer / producer.

3. **Use consistent & minimal subset** of time series description fields in the WFS data service (*this is a current discussion topic*).

4. **Use OGC SOS 2** as the web data service for WaterML 2, **but be prepared for the many sites running CUAHSI WaterOneFlow** (WOF) web service for WaterML 1.x data, and even WFS for WaterML time series data. **Use ISO 8601 for time expressions** in the data service.

5. Each data provider could install and manage a catalog registry of relevant time series descriptions (WFS feature layers), or use an established community catalog for that purpose (eg, CUAHSI HIS Central). This catalog should itself be registered in GEOSS.

**WMO is advancing that the core WaterML be renamed TimeSeriesML, and the hydrology-specific portion (still to be called WaterML) become a profile of TimeSeriesML.**
Behind the map...

1. Request data about [observed property]
2. Return list of Data Providers’ map layers
3. Request map from each Data Provider about [observed property]
4. Return gauge locations as a map layer (GML SF)
5. Request data service for time series of selected gauge
6. Return time series data or graph (WaterML, CSV)

Community Web Portal
Discovery, Access and Visualization

(CSW)
Catalog of Data Providers’ gauge layers

(SOS)
Data service for time series at one gauge

(WFS)
Map of gauges (one layer per observed property) for one Data Provider
GEOSS promotes interdisciplinary discovery

By registering the community portal and its catalog in GEOSS, interdisciplinary users can more easily discover these resources.

www.geoportal.org

GEOSS

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Started April 2014: AIP-7 Water Services Project

- Develop more application-oriented scenarios around water quality observations, flood monitoring, prediction, and damage assessment.
- Capacity building in Latin America, through cooperation with the Latin American Development Bank / GeoSUR
Past

The Dartmouth Flood Observatory preserves the record of each major flood event, for posterity, and for use in global flood hazard modeling.
Current
DFO provides ongoing flood delineation from remote sensing (NASA MODIS)
Future - GloFAS

Inputs: global spatial data

- Digital elevation
- Land use

Hydro-Meteo model with grid-based routing (LisFlood)

Output: global daily discharge

ECMWF ERA-INTERIM Re-ANALYSIS for discharge climatology (1979-2010)
ECMWF VAREPS for forecasts since June 2011

Spatial resolution 0.1 degree
GloFAS provides probabilistic forecasts of flooding events for large basins, based on 4-yr historical data.
AIP-7 Water Services Team  (* new members)

Academic
• University of Texas at Austin, USA
• Brigham Young University, USA
• University of Saskatchewan, Canada
• Feng Chia University, Taiwan *
• George Mason University, USA *

Community Labs, Portals
• CUAHSI Water Data Center
• Dartmouth Flood Observatory *
• CEOS Water Portal (JAXA)
• NASA Goddard Hydrological Science Lab
• NASA Goddard Earth Sciences DISC
• German Federal Institute of Hydrology *
• EC Joint Research Centre (JRC)
• UK Centre for Ecology and Hydrology *
• European Centre for Midrange Weather Forecasting (ECMWF)
• Latin American Development Bank & Pan American Institute of Geography & History *
AIP-7 Water Services Team

National and regional agencies
• Italian National Institute for Environmental Protection and Research (ISPRA)
• Regional Agency for Environmental Protection in Emilia-Romagna (ARPA-ER), Italy
• New Zealand National Institute of Water and Atmospheric Research (NIWA)
• Horizons Regional Council (HRC), New Zealand

Commercial Engineering & Software
• Esri
• Kisters AG
Thank you!

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