

# Publishing and Federating Global Water Data and Maps via Web Services

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Matt Rodell, Fernando Salas, Jochen Schmidt, Bill Teng

# Web Pages and Web Services

Web pages deliver text and images

<http://water.usgs.gov/>



**USGS**  
science for a changing world

**National Water Information System: Web Interface**

USGS Water Resources

News - updated September 2012

## USGS Water Data for the Nation

Search for Sites With Data

**Current Conditions** Sites with real-time or recent surface-water, groundwater data.

**Site Information** Descriptive site information for all sites with links to all individual sites.

Map of all sites with links to all available water data for in

**Frequent Searches By Data Category**

**Surface Water** Water flow and levels in streams and lakes.

**Groundwater** Water levels in wells.

**Water Quality** Chemical and physical data for streams, lakes, springs, v

Web services deliver data encoded in XML

<http://waterservices.usgs.gov/>



**USGS**  
science for a changing world

## USGS Water Services

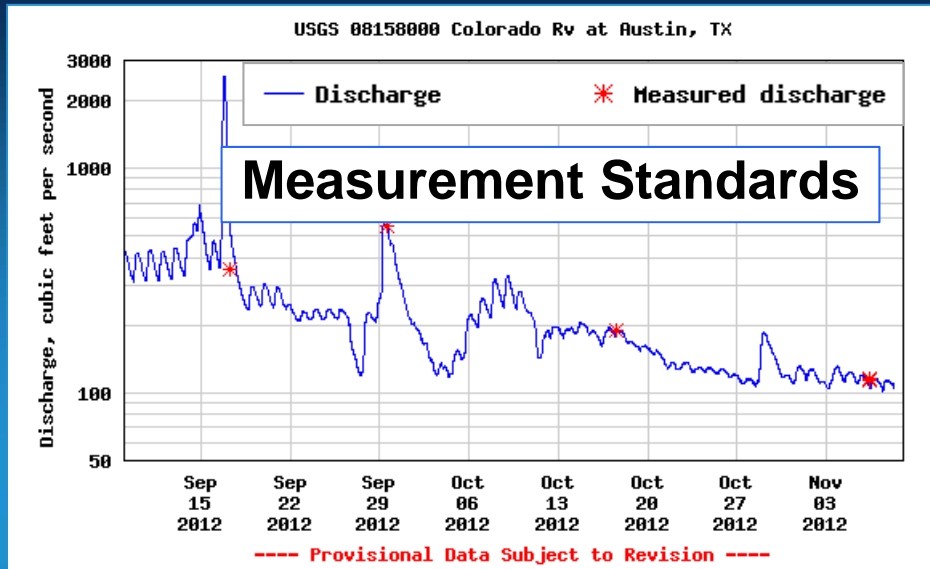
**Home** REST Web Services SOAP Web Services

### Water Service Shortcuts

- > [Instantaneous Values Service](#) for **real-time** data and historical data since October 1, 2007
- > [Site Service](#)
- > [Daily Values Service](#)
- > [Groundwater Levels Service](#)
- > [Water Quality Service](#)
- > [Frequently Asked Questions](#)
- > [Writing Fault-Resistant Code](#)

# WaterML – the US Geological Survey

Water time series data on the internet



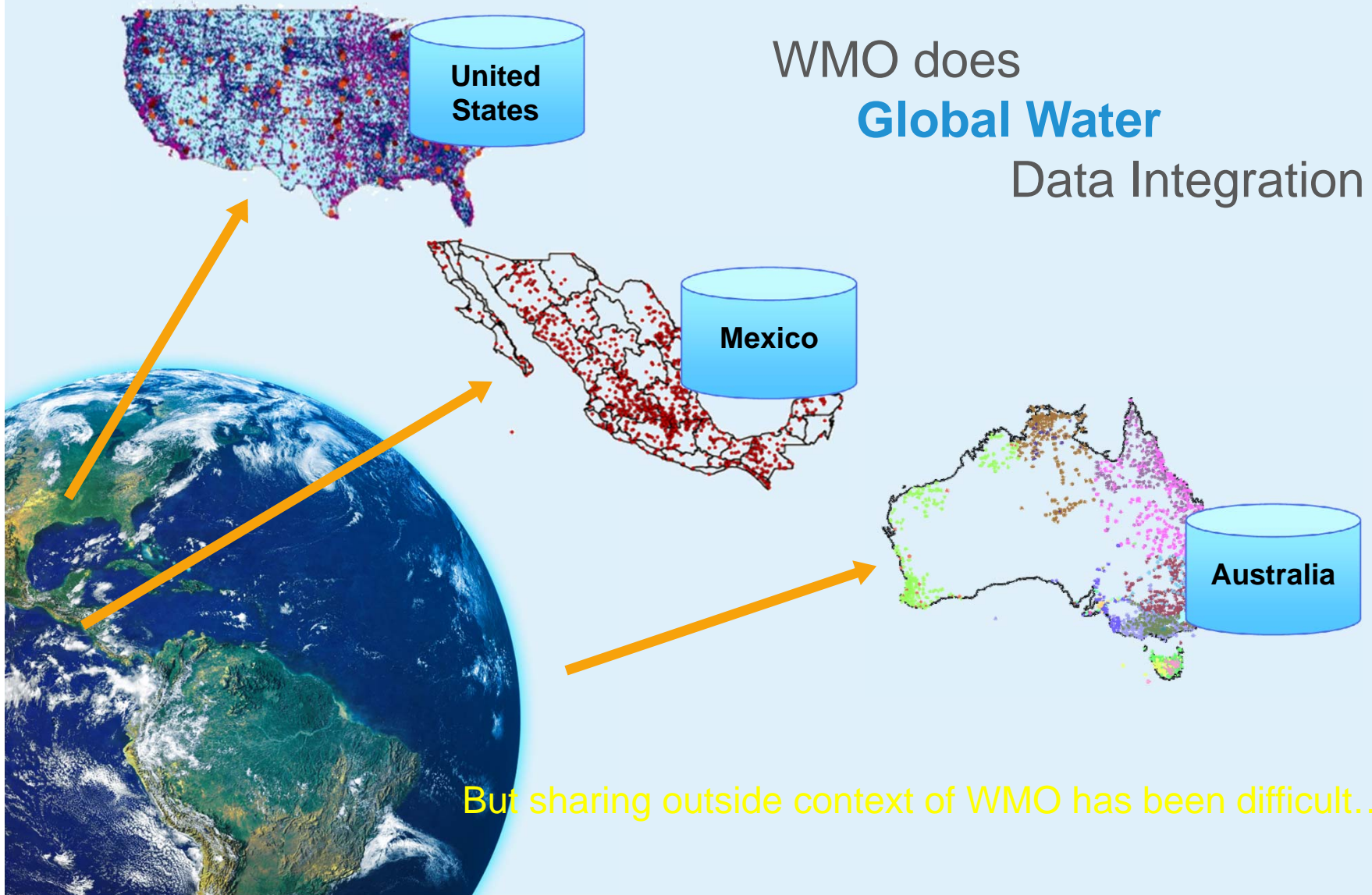
```
<ns1:value dateTime="2013-10-13T08:30:00.000-05:00">24600</ns1:value>  
<ns1:value dateTime="2013-10-13T08:45:00.000-05:00">28900</ns1:value>  
<ns1:value dateTime="2013-10-13T09:00:00.000-05:00">29200</ns1:value>  
<ns1:value dateTime="2013-10-13T09:15:00.000-05:00">29200</ns1:value>  
<ns1:value dateTime="2013-10-13T09:30:00.000-05:00">29200</ns1:value>  
<ns1:value dateTime="2013-10-13T09:45:00.000-05:00">28300</ns1:value>
```

**24/7/365 service**  
For daily and real-time data

... Operational water web services system for the United States

<http://waterservices.usgs.gov/nwis/iv?sites=08158000&period=P1D&parameterCd=00060>

# Every Country Collects These Data



WMO does  
**Global Water**  
Data Integration

But sharing outside context of WMO has been difficult...

# International Trivia

1) How many nations share **weather** data?

*(Just about all, over 190)*

2) How many nations share **water** data?

*(Very few, less than 20)*

3) Why is that??

*Nobody can own the weather...*

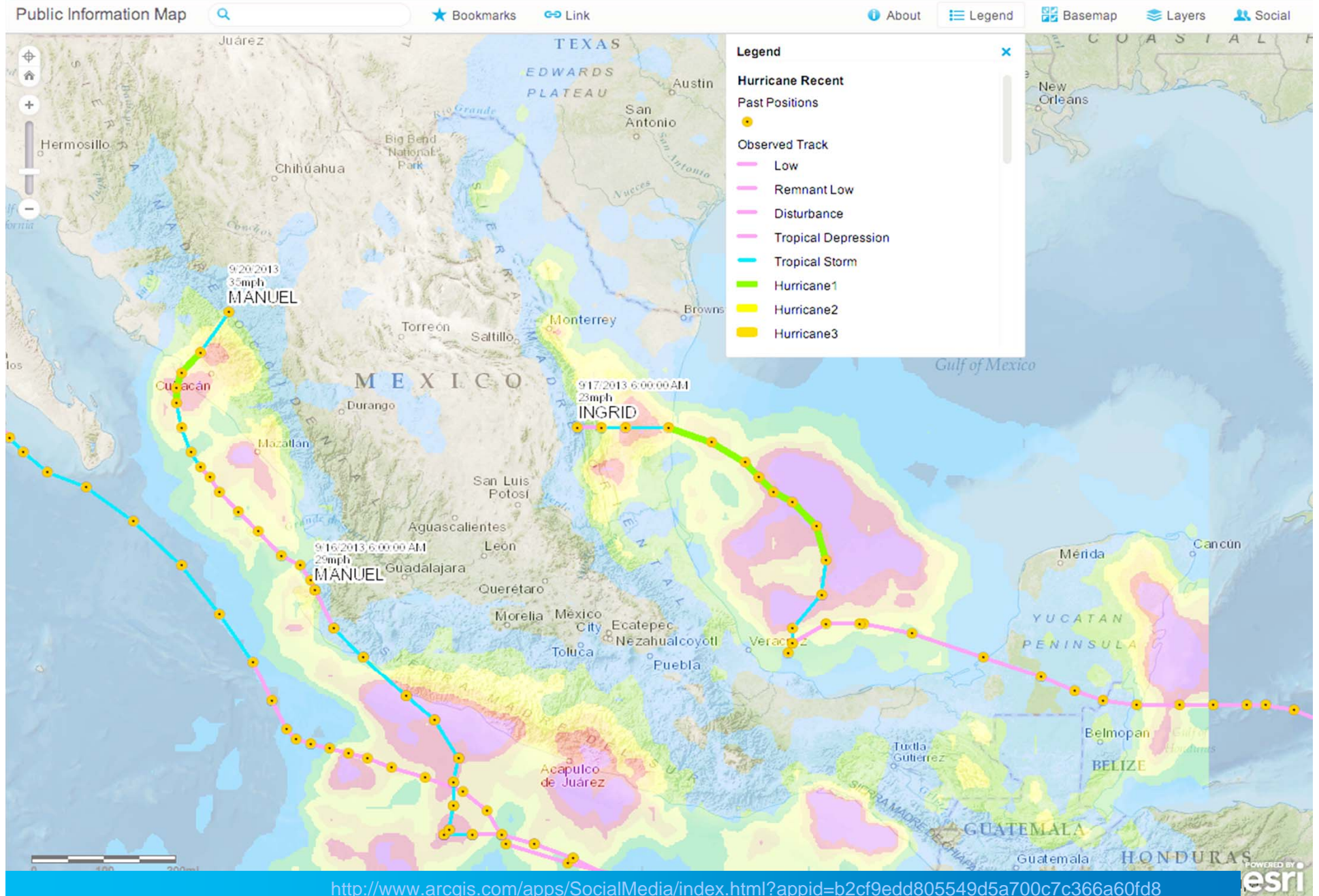
*National to local water security concerns...*

*Technical skills & equipment...*

*Lack of standards...*

*...?*

# But many events cost nations far from the disaster...



# GEOSS – Global Earth Observation System of Systems

Project of the **Group on Earth Observation** (GEO) <http://earthobservations.org>

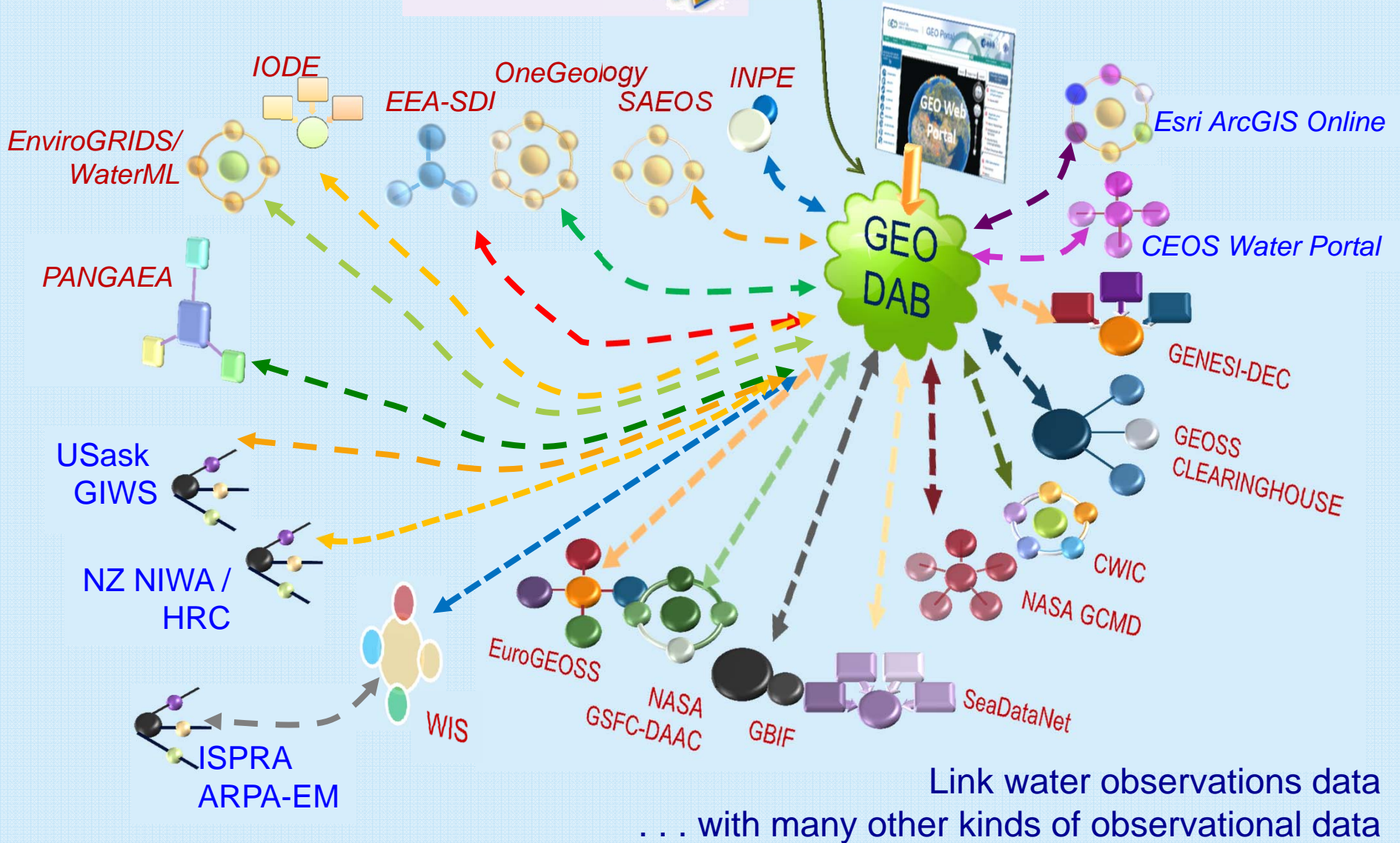
## THE GLOBAL EARTH OBSERVATION SYSTEM OF SYSTEMS



## Community Portals



# GEOSS — A Brokered Connection





# Searching GEOSS Portal

Search for water information

GROUP ON EARTH OBSERVATIONS

[Back](#)

Search GEOSS Resource

Free Text Search:

Advanced Search (Define)

Find streamflow maps for countries

12 Matched Resource (✓ indicates Approved)

[First Page](#)
[Previous Page](#)
[Next Page](#)
[Last Page](#)

1.	WVO_DominicanRepublic_Streamflow_wfs_metadata	S	<a href="#">Details</a>	✓
2.	WVO_Mexico_Streamflow_wms	S	<a href="#">Details</a>	✓
3.	WVO_Global_Streamflow_Observations	C	<a href="#">Details</a>	✓
4.	WVO_UnitedStates_Streamflow_wfs_metadata	S	<a href="#">Details</a>	✓
5.	WVO_Mexico_Streamflow_wfs_metadata	S	<a href="#">Details</a>	✓
6.	WVO_WorldWaterOnline_Portal	C	<a href="#">Details</a>	✓
7.	WVO_NewZealand_Streamflow_wfs_metadata	S	<a href="#">Details</a>	✓
8.	WVO_DominicanRepublic_Streamflow_wms	S	<a href="#">Details</a>	✓
9.	WVO_World_Streamflow_wfs_metadata	S	<a href="#">Details</a>	✓
10.				
11.				
12.				

Streamflow map for the Dominican Republic

**Service Basic Information**

General Resource Id: urn:geoss:csr:component:urn:uuid:d22f7118-8835-ca65-eaf2-33fd887589dc

Service Id: urn:geoss:csr:service:urn:uuid:592bc168-668d-0a44-2b87-0067fbe16098

Name: [WVO\\_DominicanRepublic\\_Streamflow\\_wfs\\_metadata](#)

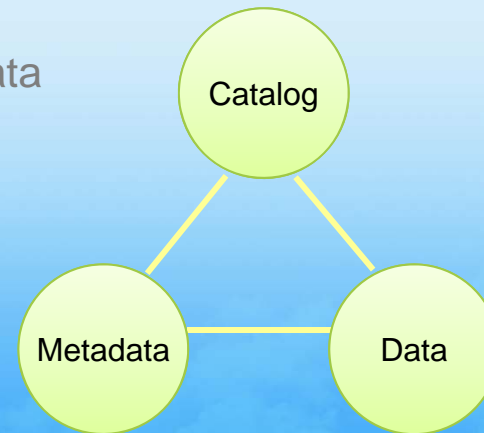
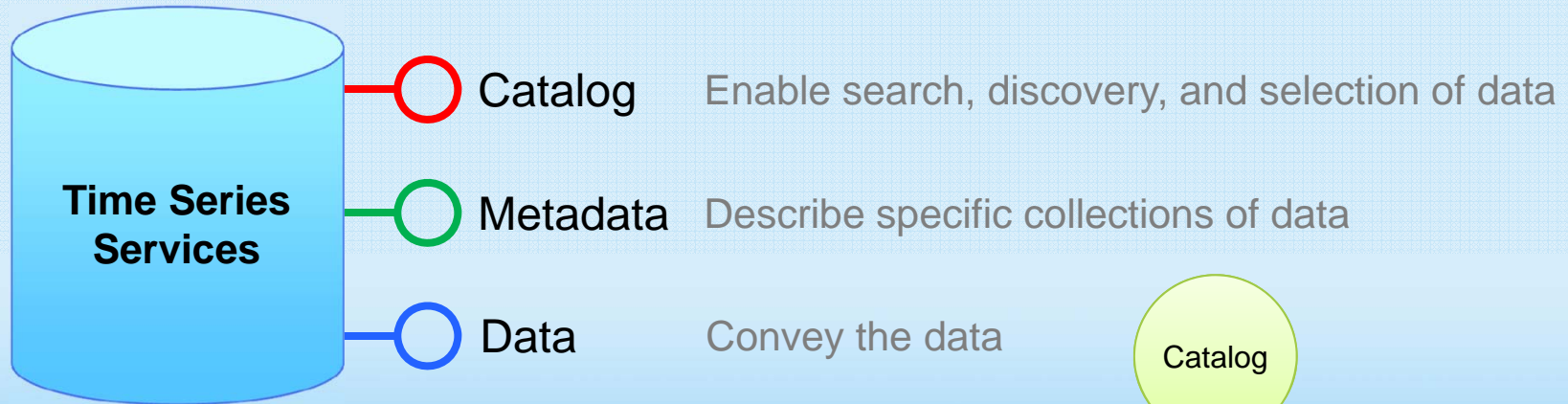
Abbreviation:

Description: Streamflow discharge time series metadata service encoded in WFS. The WaterMLURI field in the metadata can be WSDL, SOS, Kisters Query Service (KiQS), USGS WaterML Service, or other web service endpoint for WaterML 1.x or WaterML 2.0 encoding. CAVEAT: This service registration is a proof of concept only. The Research in Water Resources is not an official map service for the national hydrologic surveys of the country catalog.

Information URL: <http://www.arcgis.com/home/webmap/viewer.html?webmap=87ab07e2aba840828033e80b15fd6727>

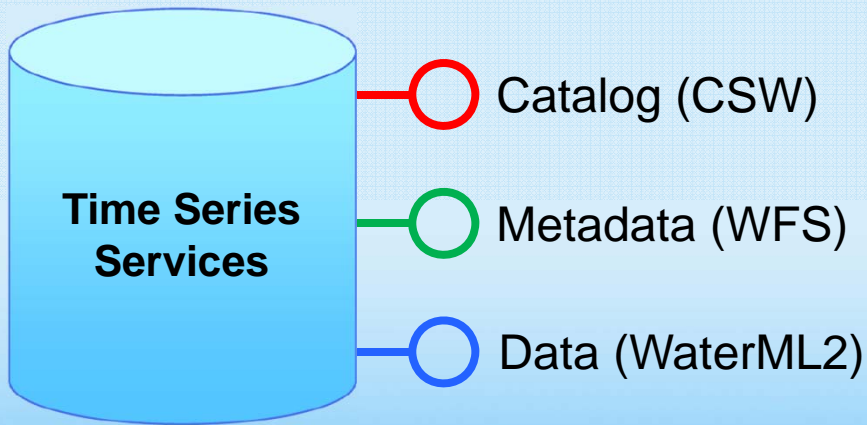
Interface URL: [http://129.116.104.176/ArcGIS/services/WorldWaterOnline/DominicanRepublic\\_Discharge/MapServer/?request=GetCapabilities&service=WFS](http://129.116.104.176/ArcGIS/services/WorldWaterOnline/DominicanRepublic_Discharge/MapServer/?request=GetCapabilities&service=WFS)

# Three Categories of Water Services



A time series data service for one variable at one location . . .  
. . . describe and catalog networks of observation sites

# Web Services Stack for Time Series



CSW = OGC Catalog Service for the Web  
WFS = OGC Web Feature Service for Maps

Catalog Service for the Web with standard metadata: ISO, FGDC, ANZLIC, Dublin Core

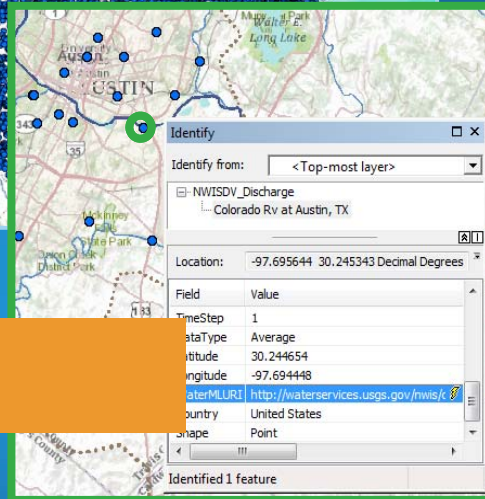
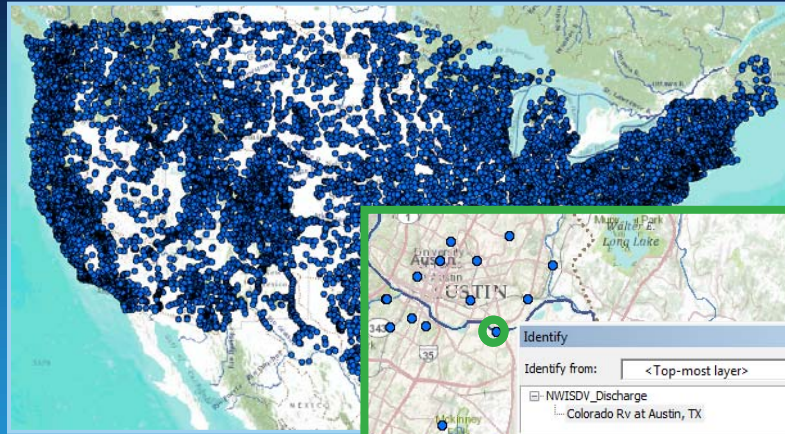
**Who?  
What?**

**Where?  
When?**

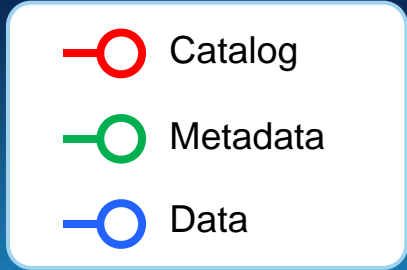
**Access  
Data**

Existing OGC Data Services are Adequate . . .  
. . . Need to Be Customized for Water Information

# United States Services Stack



Colorado River  
at Austin, Texas



Web Feature Service for Observation Metadata



WaterML time series service for data

```
<ns1:value dateTime="2013-10-13T08:30:00.000-05:00">24600</ns1:value>  
<ns1:value dateTime="2013-10-13T08:45:00.000-05:00">28900</ns1:value>  
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```

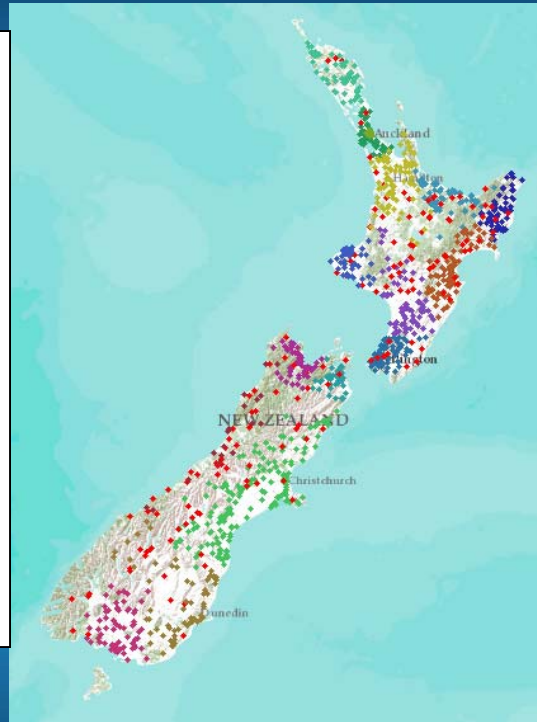
An attribute of each mapped observation point . . .  
. . . is a web link to the WaterML data service

# New Zealand – 16 regions



NIWA operates about 20% of 1300 hydrometric stations  
Regional authorities operate about 80% of stations

- ◆ Auckland Council
- ◆ Bay of Plenty Regional Council
- ◆ Environment Canterbury
- ◆ Environment Southland
- ◆ Gisborne District Council
- ◆ Greater Wellington Regional Council
- ◆ Hawkes Bay Regional Council
- ◆ Horizons Regional Council
- ◆ Marlborough District Council
- ◆ National Institute of Water and Atmospheric Research
- ◆ North Shore City Council
- ◆ Northland Regional Council
- ◆ Otago Regional Council
- ◆ Taranaki Regional Council
- ◆ Tasman District Council
- ◆ Waikato Regional Council
- ◆ West Coast Regional Council



New Zealand  
Water Information System

Develop a federated hydrological information infrastructure . . .  
. . . linking nationally and regionally collected data

# Italy – 22 regions

## National Institute for Environmental Protection and Research (ISPRA)

- ◆ ABRUZZO
- ◆ BASILICATA
- ◆ BOLZANO/BOZEN
- ◆ CALABRIA
- ◆ CAMPANIA
- ◆ EMILIA-ROMAGNA
- ◆ FRIULI VENEZIA GIULIA
- ◆ LAZIO
- ◆ LIGURIA
- ◆ LOMBARDIA
- ◆ MARCHE
- ◆ MOLISE
- ◆ PIEMONTE
- ◆ PUGLIA
- ◆ SARDEGNA
- ◆ SICILIA
- ◆ TOSCANA
- ◆ TRENTO
- ◆ UMBRIA
- ◆ VALLE D'AOSTA/VALLÉE D'AOSTE
- ◆ VENETO



**ISPRA**

Istituto Superiore per la Protezione  
e la Ricerca Ambientale

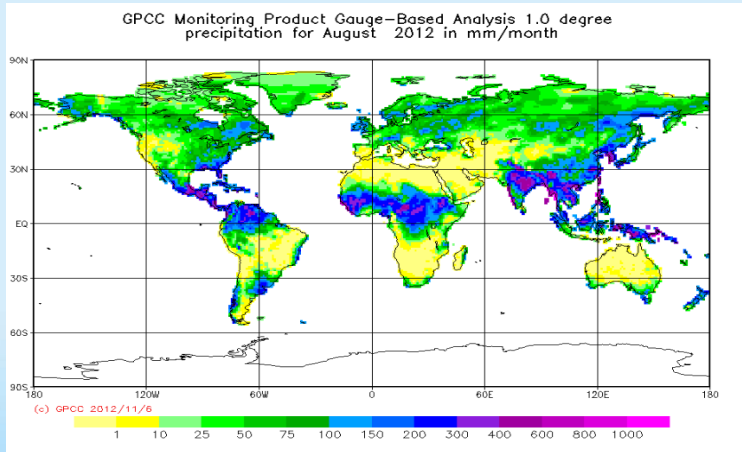
ISPRA is the NIWA of Italy ....  
....Hydrometric measurement was regionalized in 2002

# Dominican Republic – An Example in Latin America



INDRHI (Instituto Nacional de Recursos Hidráulicos) data . . .  
. . . converted to WaterML web services at BYU

# Global Data Centers – Precipitation and Runoff

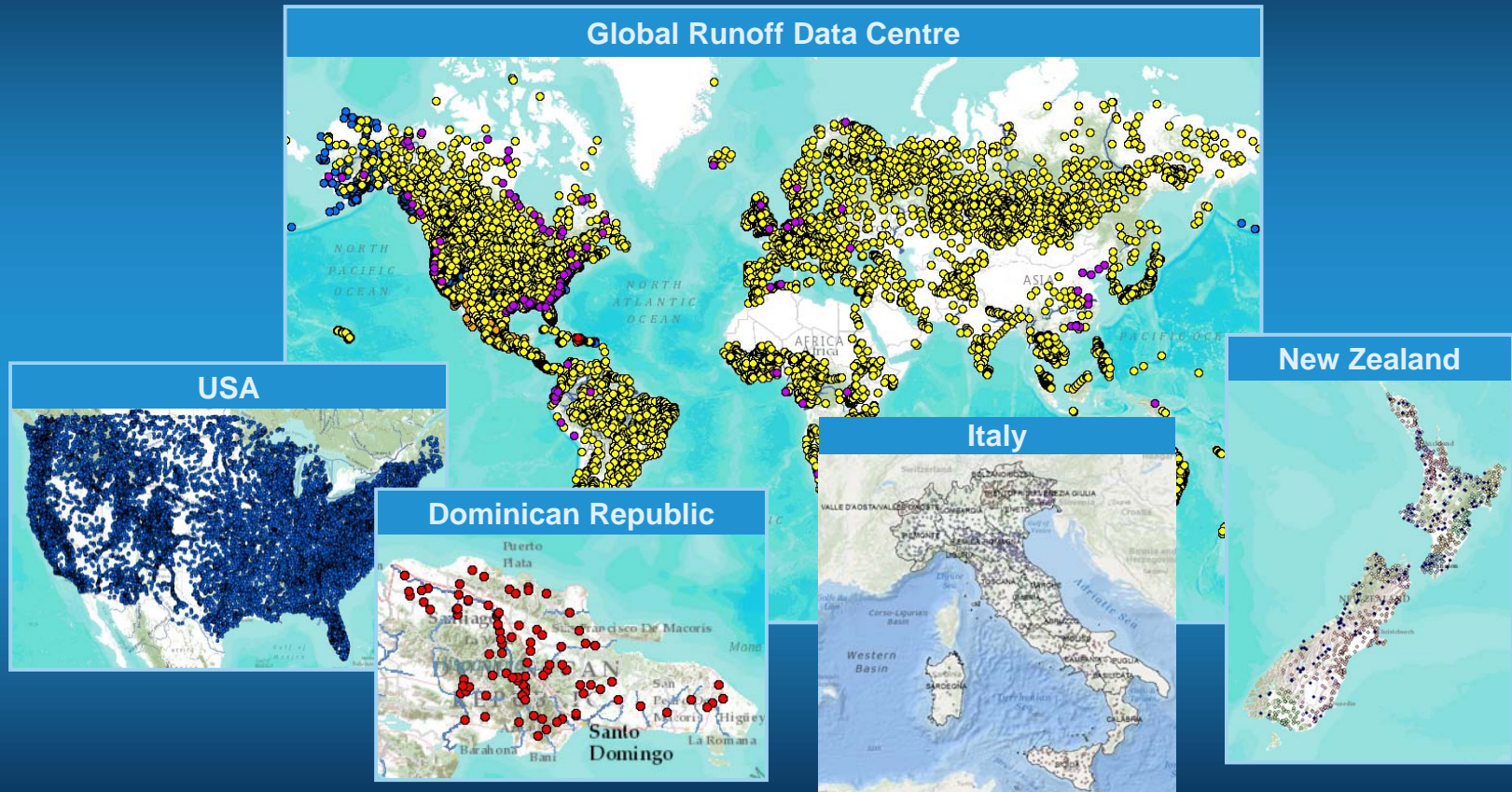


Collect data from National Hydrological Surveys....  
.... using water web services in the future



# Global Streamflow Services

Building a **national** system federating **regions** . . .  
. . . builds a **global** system federating **countries**

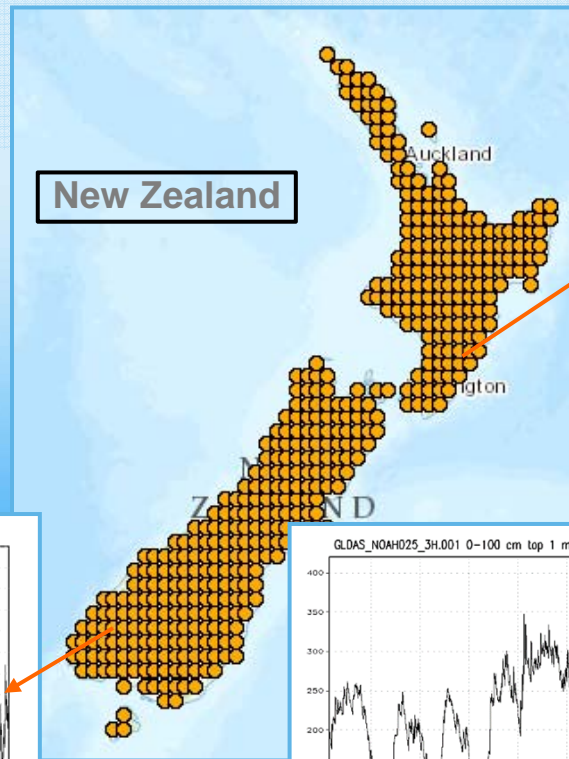
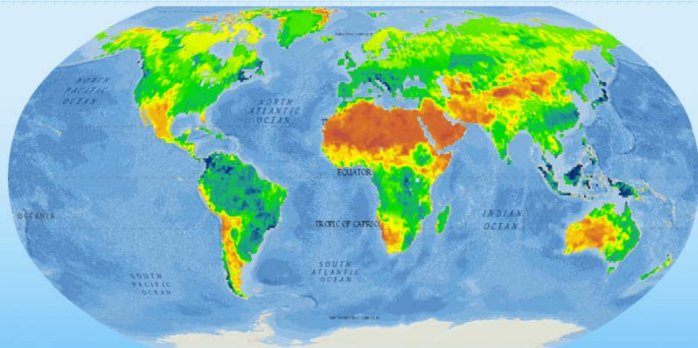


# World Soil Moisture

from the NASA Global Land Data Assimilation System (GLDAS)

<http://www.arcgis.com/home/webmap/viewer.html?webmap=7d6cefd3f324b55b08c136654e91612>

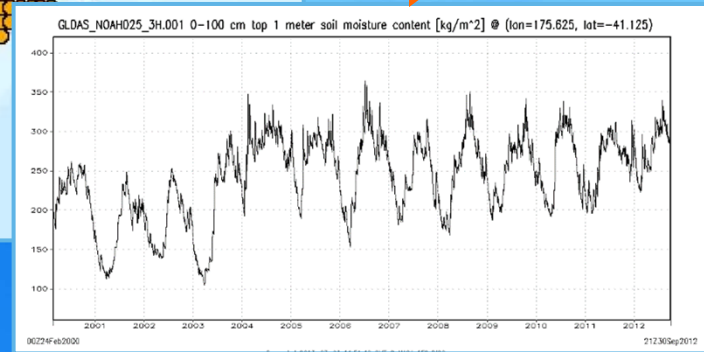
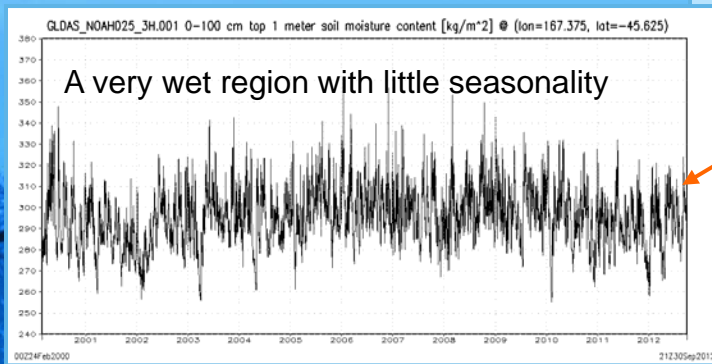
Charts show 3-hourly variation (37,000 values)  
of soil water content of the top 1 m of soil from 2000 to 2012



Popup on point links to  
data and chart

**GLDAS\_SoilMoisture :  
GLDAS\_NOAH**

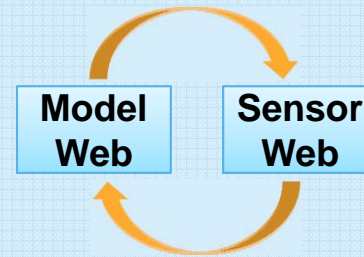
TimeSeries	More info
Graph	More info
DataProvider	NASA
Source	GLDAS
Model	GLDAS_NOAH
VarName	0-100 cm top 1 meter soil moisture content
VarCode	SOILM0-100cm
Concept	Soil Moisture
ValueType	Model Simulation Result



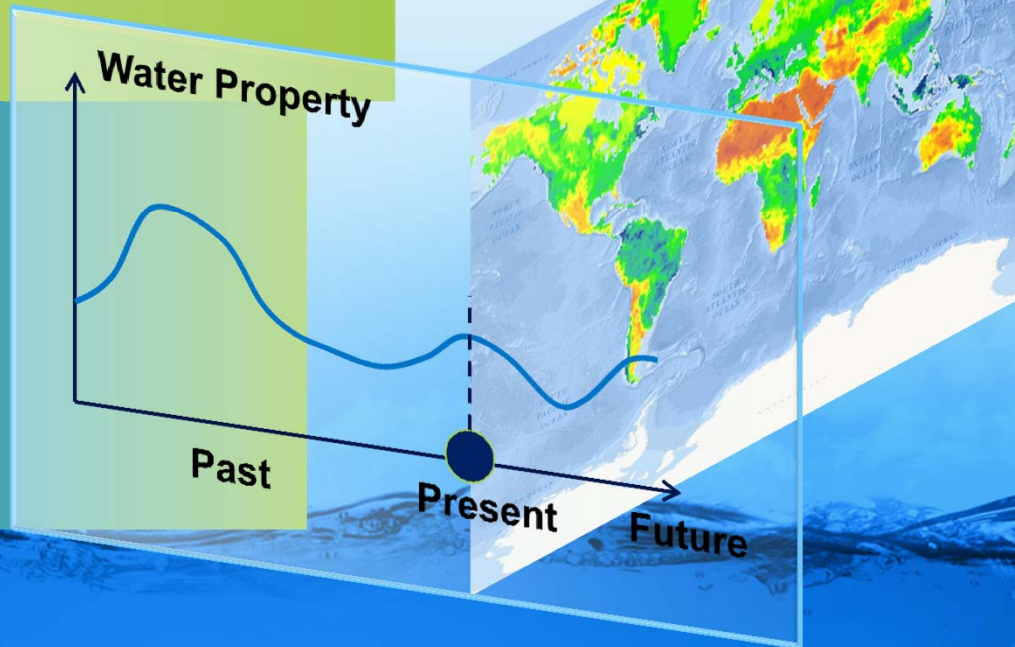
# Global Water Maps

Describe a water property over a domain of space and time

- History
- Current conditions
- Forecasts



Precipitation  
Evaporation  
Soil Moisture  
Streamflow  
Groundwater  
Reservoirs



# World Water Online

Linking people everywhere with water data, maps, and models



# Thank you

[david.arctur@utexas.edu](mailto:david.arctur@utexas.edu)

