

GEOSS Water Services: Federating Data, Maps & Processing Water SBA for AIP-5, 6, 7 & 8

David K Arctur

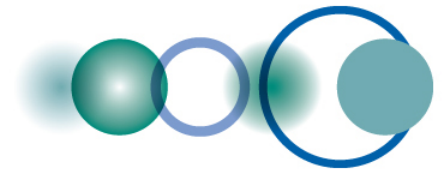
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University of Texas at Austin
Open Geospatial Consortium (OGC)

Presented at GEOSS Workshop 3
Norfolk, Virginia -- March 24, 2015

Acknowledgements: David Maidment, Fernando Salas,
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Peter Salamon, Dan Ames, Jim Nelson,
Alan Snow, Nathan Swain, Cedric David,
Kris Cauwenberghs





**This is a story about millions of small datasets:
each with a time series of a variable at a point location...**

Water Quantity



Rainfall

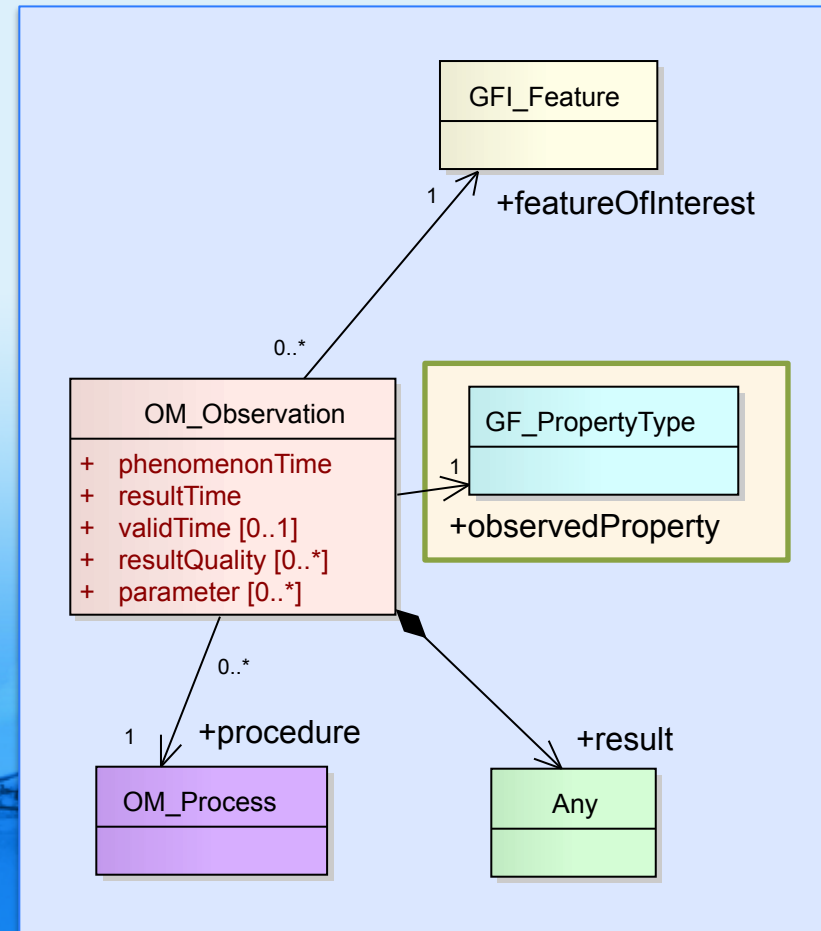


Soil Moisture



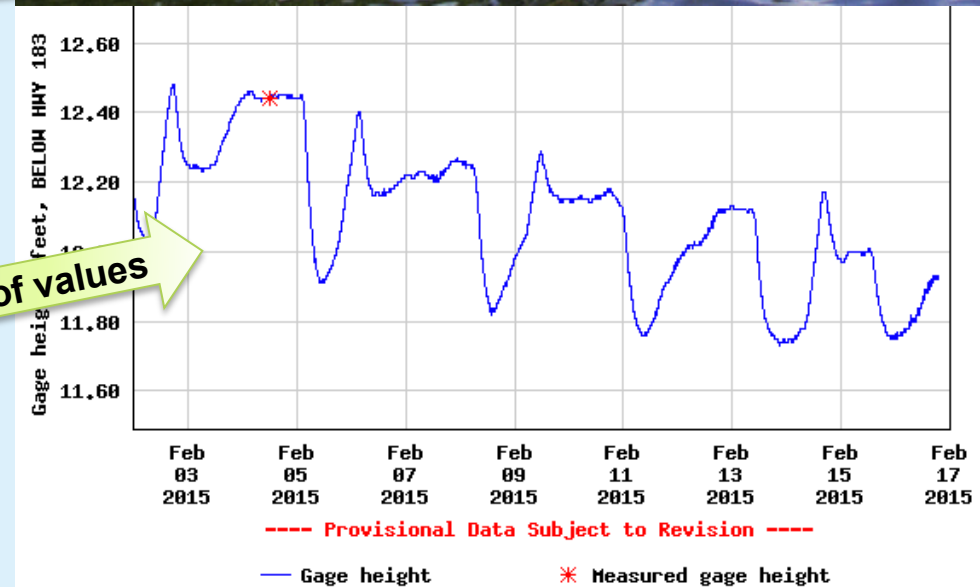
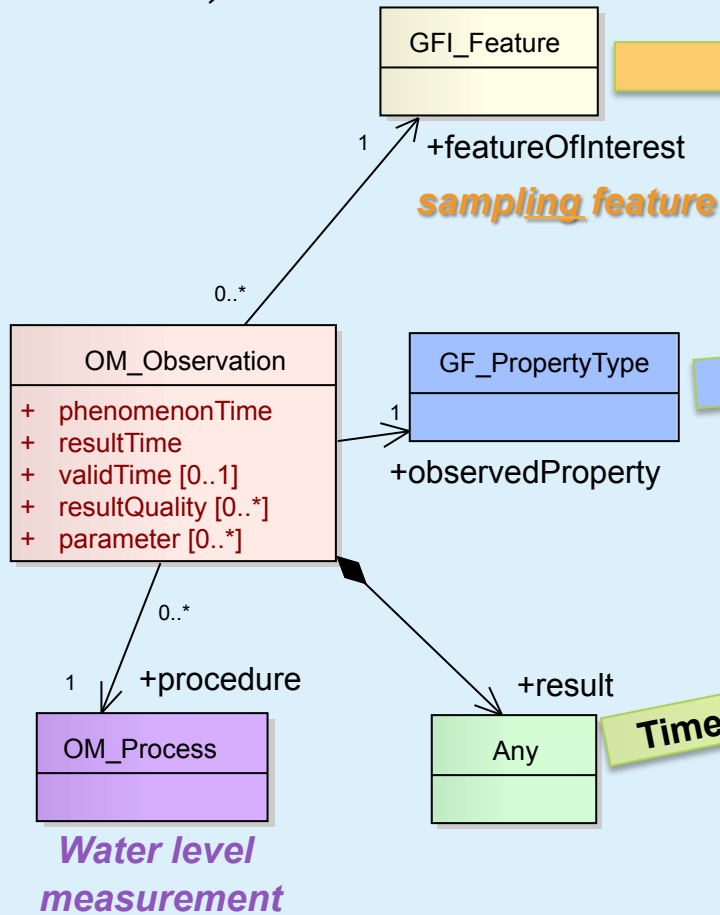
OGC Observations & Measurements: a way of relating features & phenomena

An **Observation** is an action whose **result** is an estimate of the value of some **property** of the **feature-of-interest**, obtained using a specified **procedure**



Using OGC O&M model for water level ...

(WaterML2 Part 1)

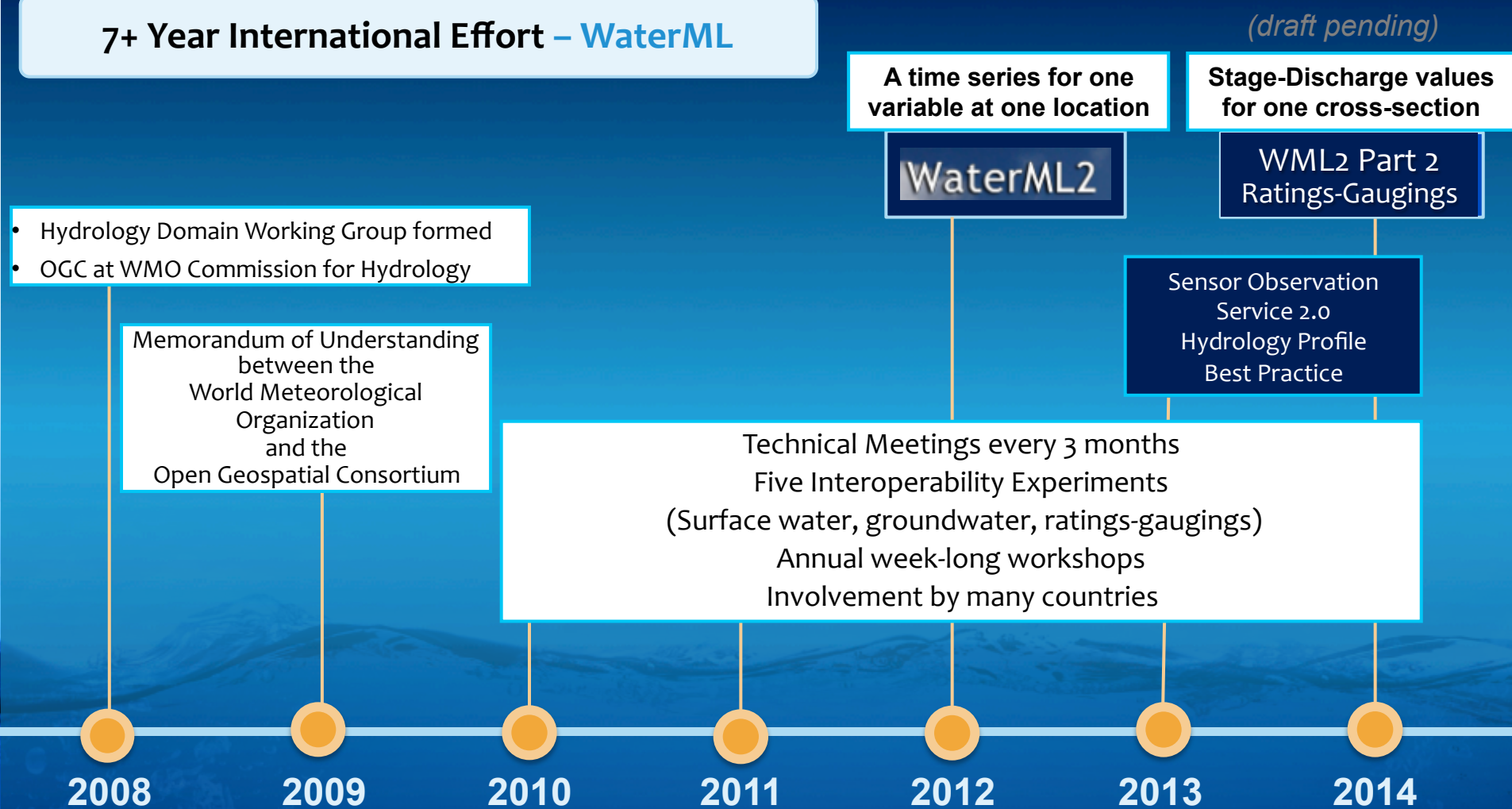


Source: USGS

An **Observation** is an action whose **result** is an estimate of the value of some **property** of the **feature-of-interest**, obtained using a specified **procedure**

OGC/WMO Hydrology Domain Working Group

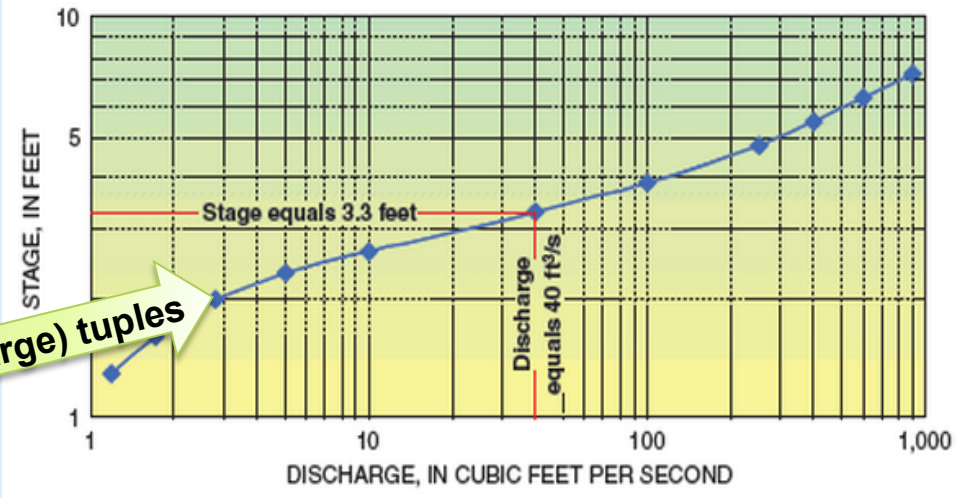
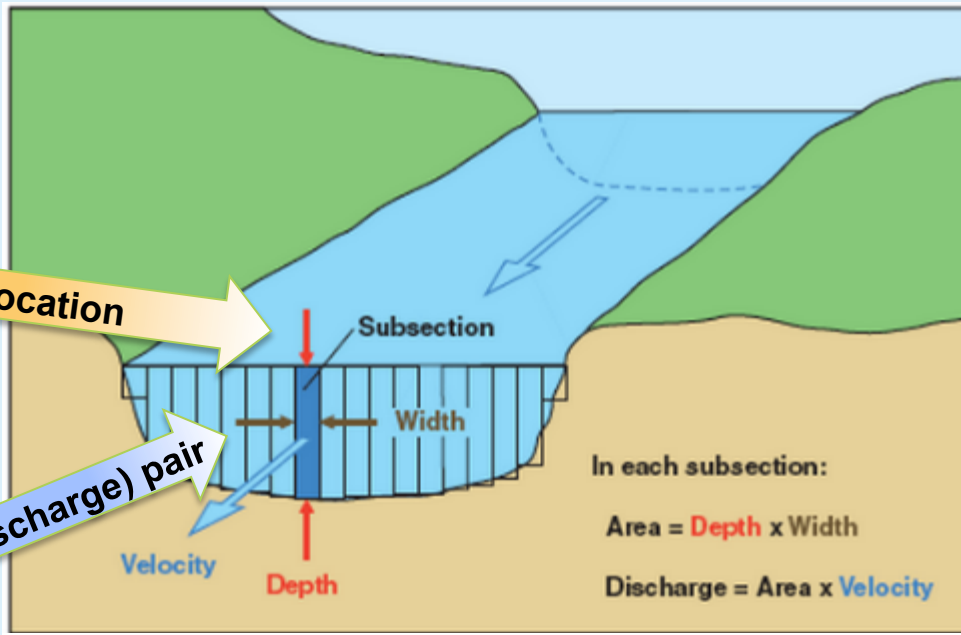
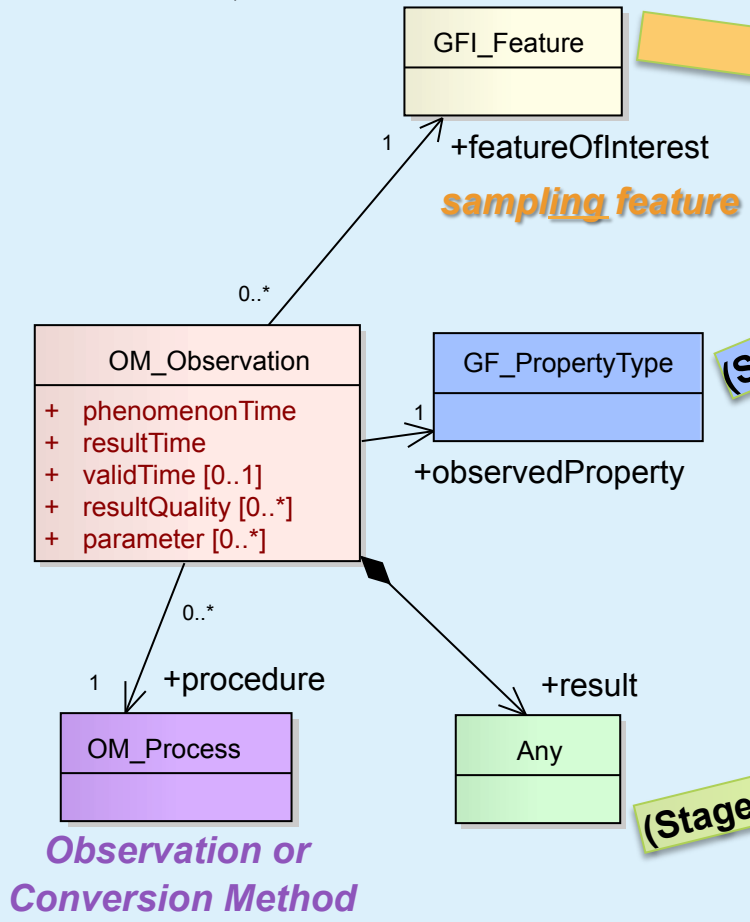
7+ Year International Effort – WaterML



Acknowledgements: OGC, WMO, GRDC, NWS, CUAHSI, BoM/CSIRO, USGS, GSC, Kisters,

Treating rating curves as a measurement ...

(WaterML2 Part 2)

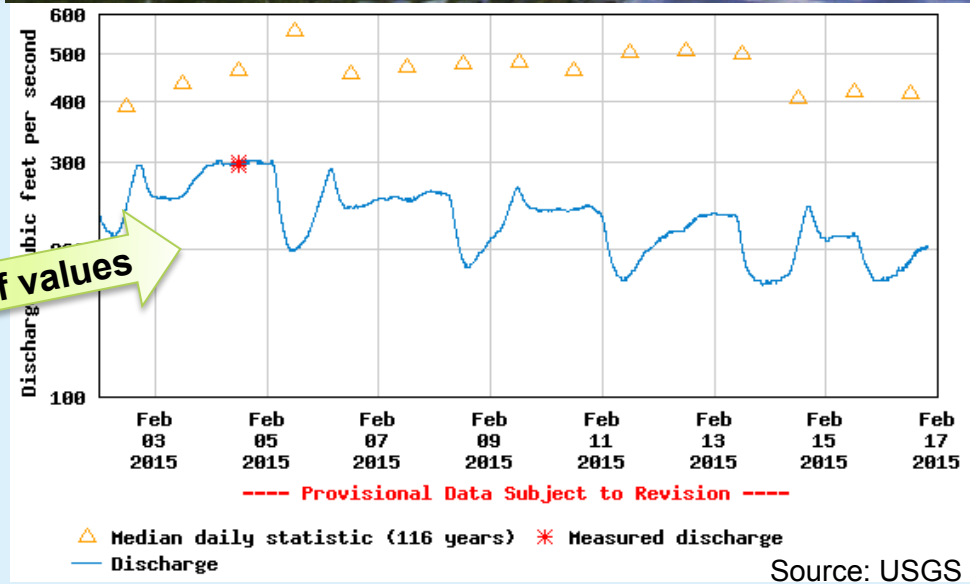
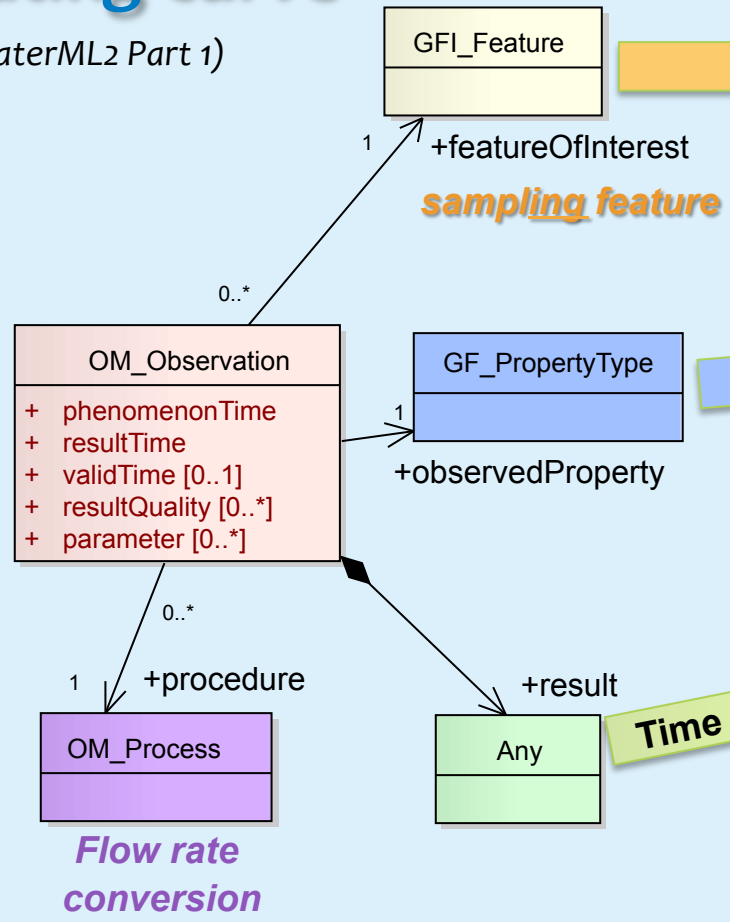


Source: USGS

An **Observation** is an action whose **result** is an estimate of the value of some **property** of the **feature-of-interest**, obtained using a specified **procedure**

The stream flow can then be determined from the rating curve

(WaterML2 Part 1)

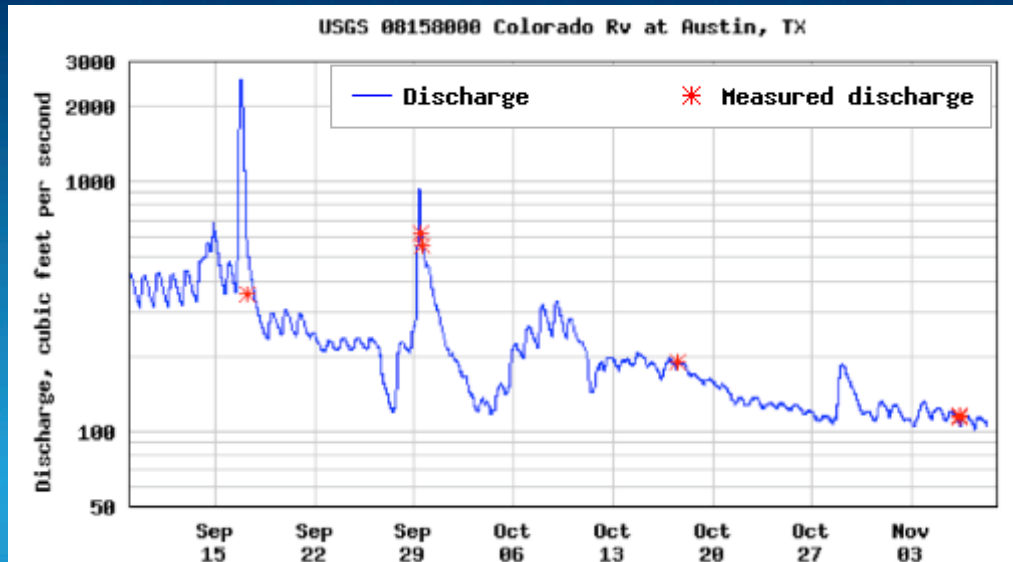


An **Observation** is an action whose **result** is an estimate of the value of some **property** of the **feature-of-interest**, obtained using a specified **procedure**

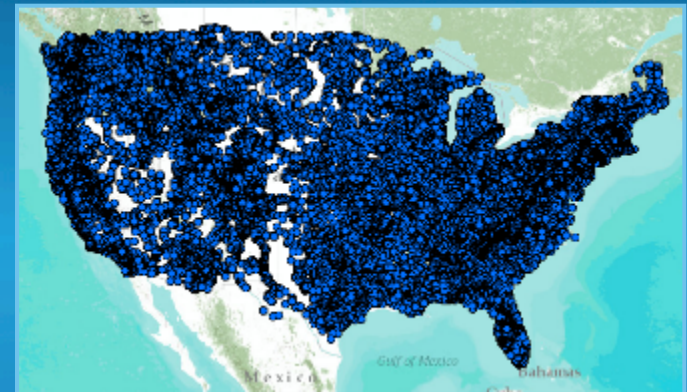
WaterML Web Services

CUAHSI, USGS, OGC, WMO...

Water time series data on the internet



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```



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/?format=waterml_2.0&sites=08158000&period=P1D¶meterCd=00060

Advances through GEOSS AIP-5, 6, 7

WaterML2

AIP-6: CUAHSI HIS Central is ported to open source.

Italy, New Zealand, Canada host their own web maps and data services. **CEOS Water Portal** and **Esri** integrate their catalogs with GEOSS Broker.

NASA generates WaterML time series for GLDAS, NLDAS products. **Esri, Kisters** develop web maps with time series.

WML2 Part 2
Ratings-Gaugings

Sensor Observation
Service 2.0
Hydrology Profile
Best Practice

AIP-5: Web map of **GRDC, Mexico, Dominican Republic** stream gage sites created, each site linked to data services where allowed, with web maps hosted at Univ of Texas at Austin.

AIP-7: **France, Belgium, Taiwan** host WaterML data services. **New Zealand, Belgium** host public water data portals. **ECMWF/JRC** publish **GloFAS** flood predictions in WaterML. **USGS** converts **NWIS** to WaterML2.

2012

2013

2014

2015

AIP-5 (2012): First resource in GEOSS

HOME

VIDEO TUTORIAL

SEND FEEDBACK

Focus on: Precipitation (DAB) +

SEARCH

GWS x

Related Topics x

+ Themes

+ Country/Geography

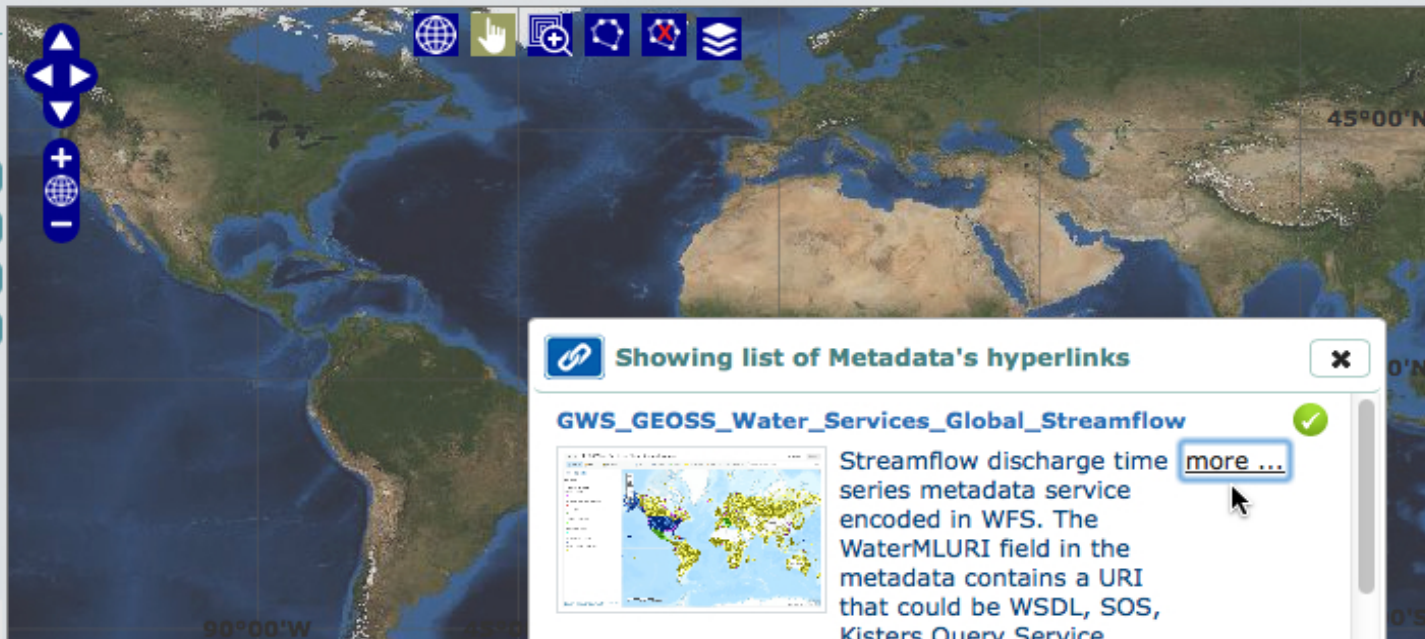
+ Data Access Conditions

+ Earth Observation Catalogs

Start Date  End Date 

CLEAR

SEARCH



Showing list of Metadata's hyperlinks



GWS_GEOSS_Water_Services_Global_Streamflow



Streamflow discharge time series metadata service encoded in WFS. The WaterMLURI field in the metadata contains a URI that could be WSDL, SOS, Kisters Query Service (KiQS), USGS WaterML Service, or other web service endpoint for stream discharge content in WaterML 1.x or WaterML 2.0 encoding. CAVEAT: This

[more ...](#)

Total Results: 5

All

Analysis and visualization

Websites and documents

Datasets

Legend



GWS_GEOSS_Water_Services_Global_Streamflow

Streamflow discharge time series metadata service encoded in WFS. The WaterMLURI field in the metadata contains a URI that could be WSDL, SOS,



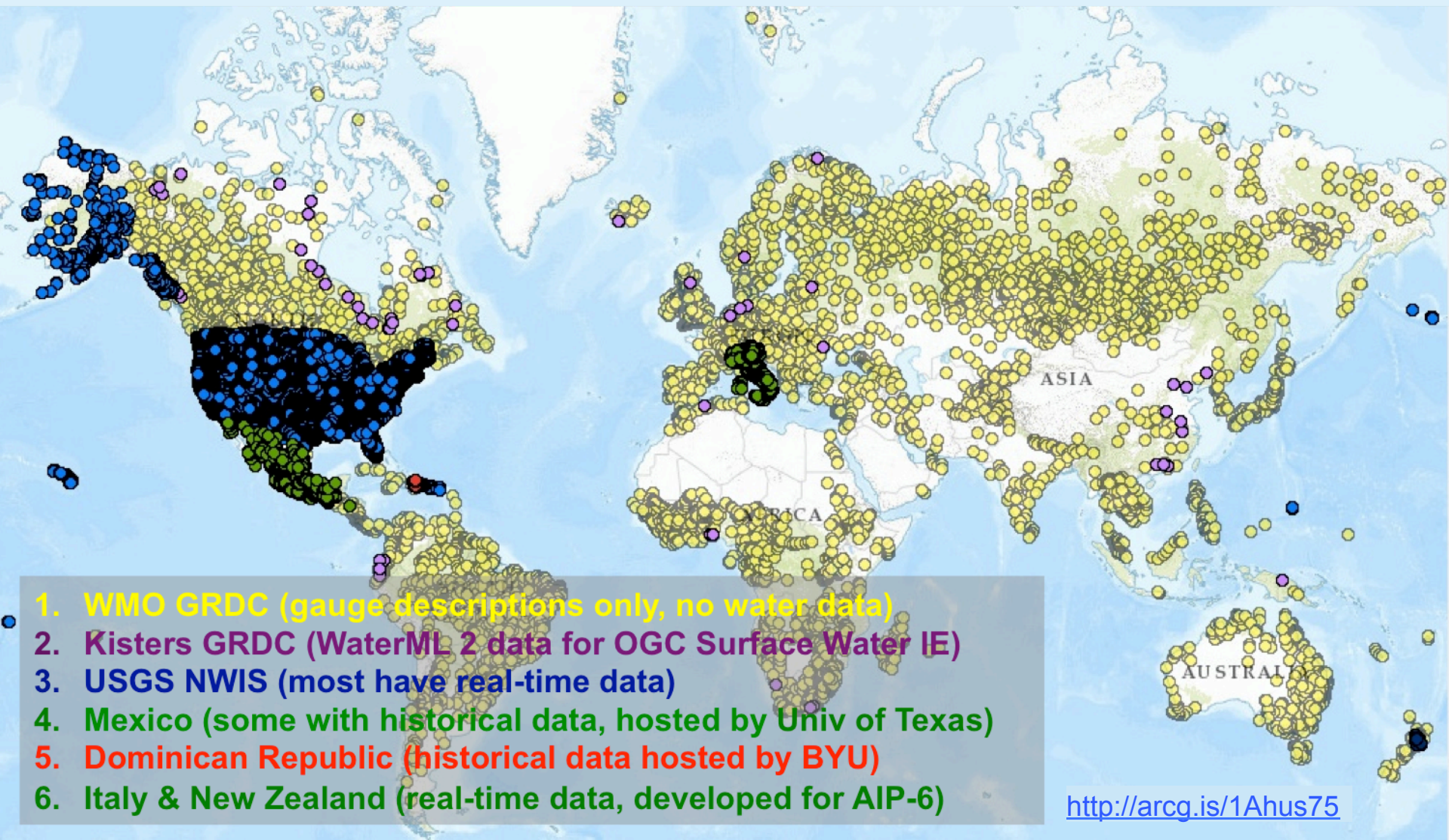
[Click to read more...](#)



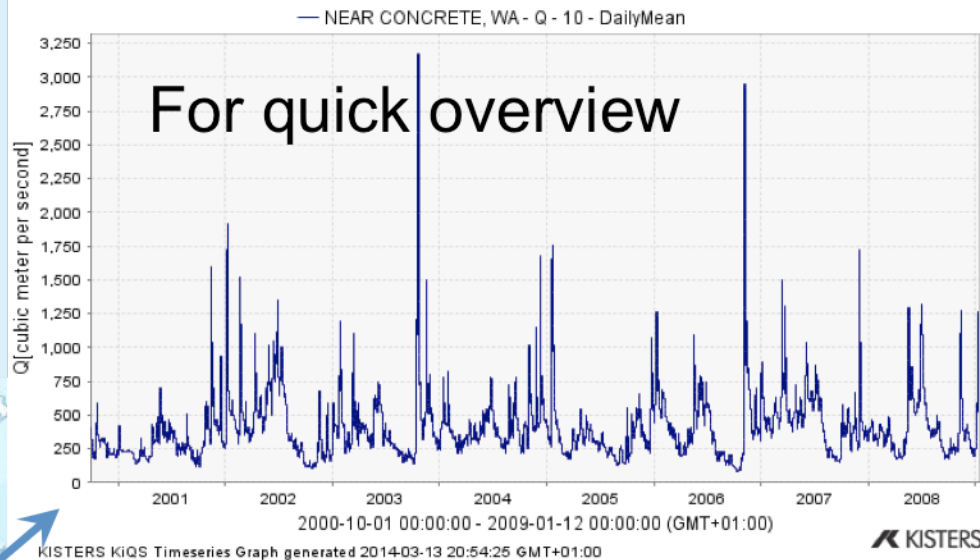
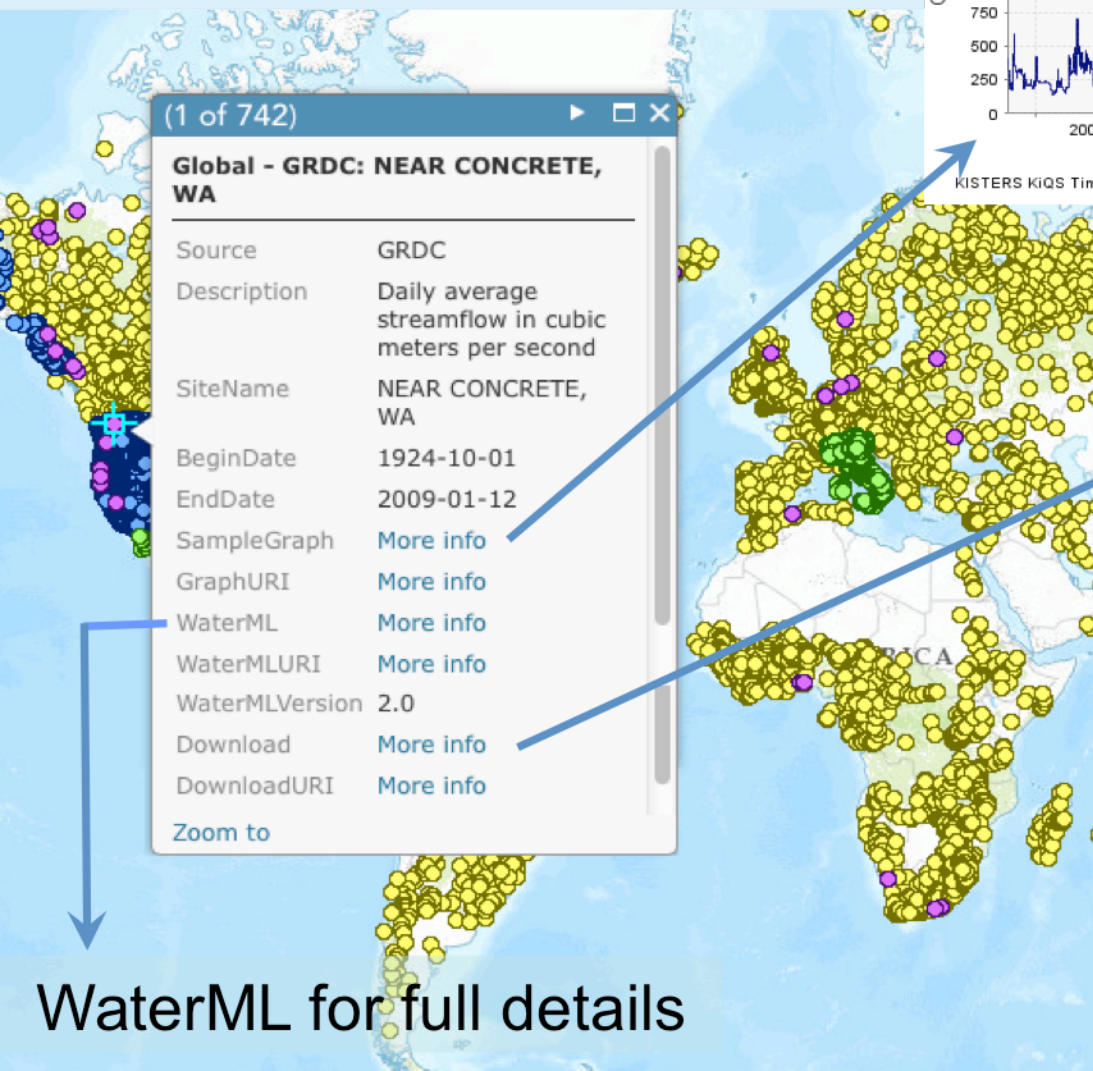
EOSD-GWS: EOSD Forest Landcover of Canada - Grid-enabled WMS

GWMS provides landcover classification maps of Canada, created from Landsat-7 ETM+ data (circa 2000). The Landcover products were produced

Web map of global stream gages



Stream Gage Data Services



For easy analysis

	A
1	#ts_id;2634042
2	#rows;365
3	#Timestamp;Value
4	2008-01-13T09:00:00.000+01:00;442.804625
5	2008-01-13T09:00:00.000+01:00;442.804625
6	2008-01-14T09:00:00.000+01:00;457.316875
7	2008-01-14T09:00:00.000+01:00;457.316875
8	2008-01-15T09:00:00.000+01:00;450.946
9	2008-01-15T09:00:00.000+01:00;450.946
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16	2008-01-19T09:00:00.000+01:00;306.88375
17	2008-01-19T09:00:00.000+01:00;306.88375
18	2008-01-20T09:00:00.000+01:00;342.279625
19	2008-01-20T09:00:00.000+01:00;342.279625
20	2008-01-21T09:00:00.000+01:00;350.067
21	2008-01-21T09:00:00.000+01:00;350.067
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23	2008-01-22T09:00:00.000+01:00;331.306875
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25	2008-01-23T09:00:00.000+01:00;310.42325

AIP-6 (2013) GEOSS Water Services Team

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arpa
agenzia
regionale
prevenzione e
ambiente dell'emilia-romagna



ISPRA



Italy – 21 regional authorities, 1530 hydrometric sites

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

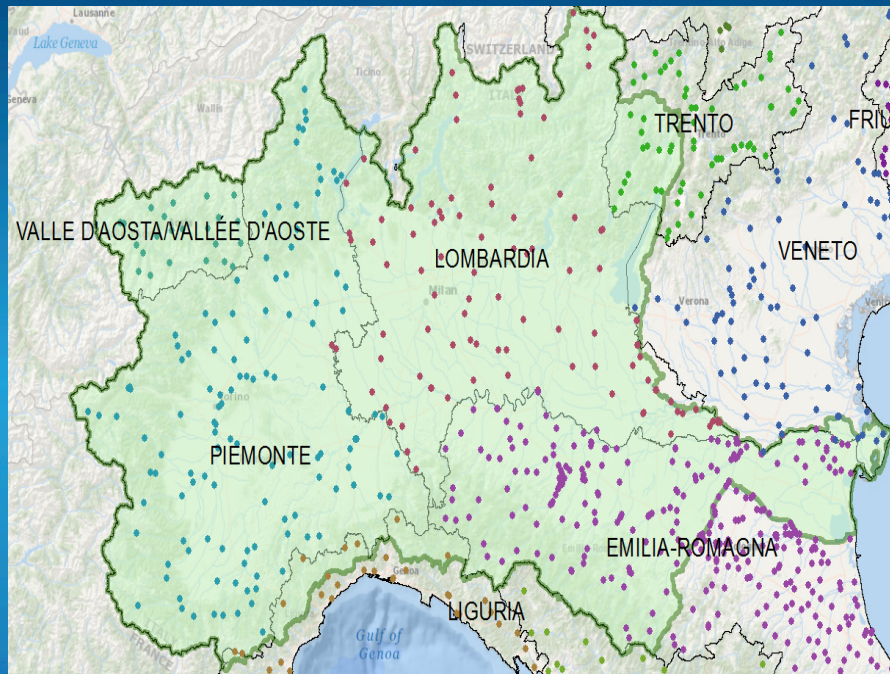


Istituto Superiore per
la Protezione e la
Ricerca Ambientale
(ISPRA)



Italy – River Basins

Data for the Po River basin is managed by seven different regional authorities



Develop a federated hydrological information infrastructure . . .
. . . linking regionally collected data for a river basin



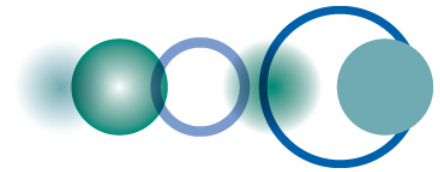
Water Data Maps: Italian Stream Gauges



Water Data Maps: Italian Stream Gauges

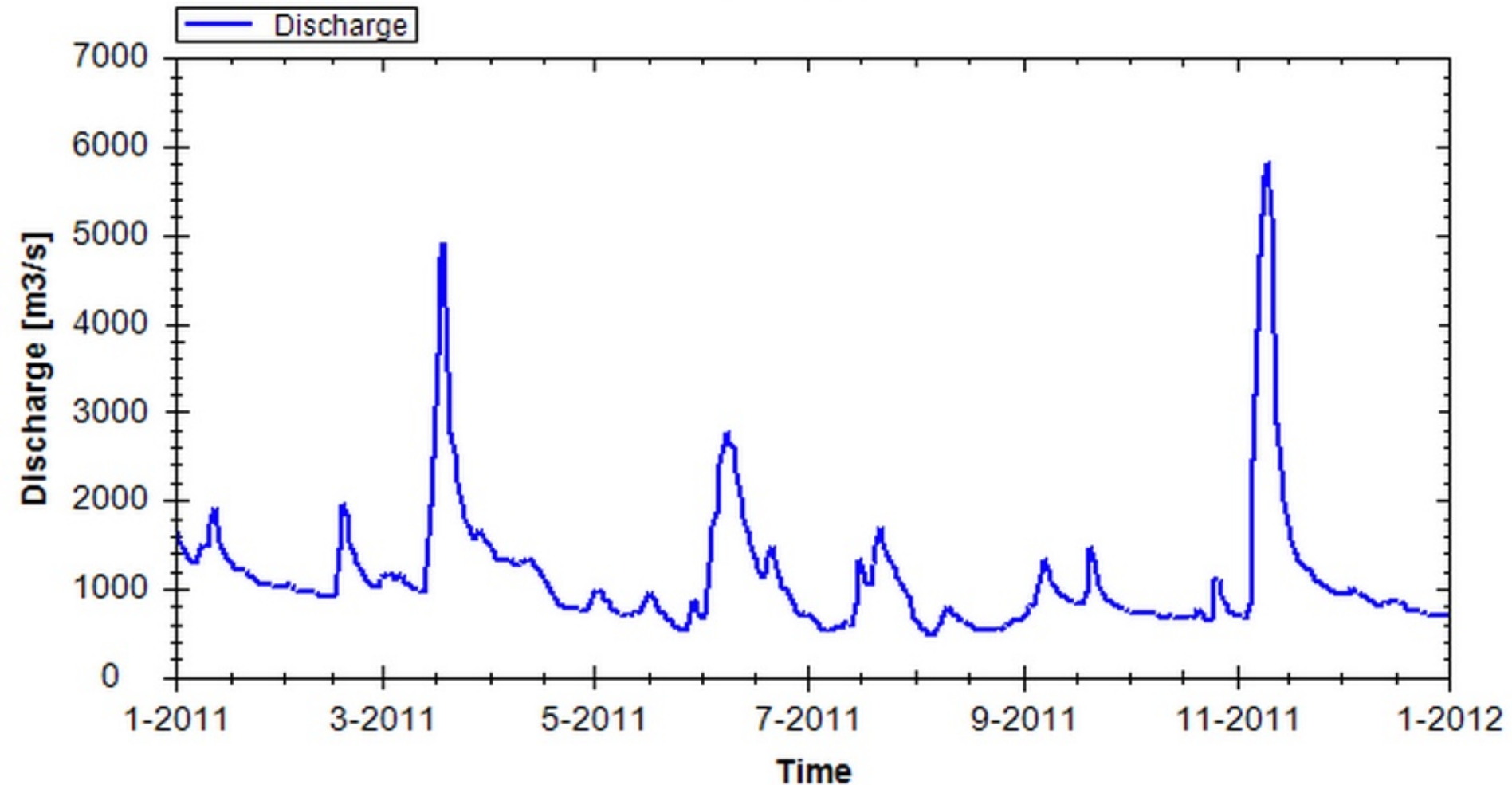
Italy - ISPRA: Po a Boretto

Source	ISPRA
Description	Daily average streamflow in cubic meters per second
SiteName	Po a Boretto
BeginDate	2011-01-01
EndDate	2012-01-01
SampleGraph	More info
GraphURI	More info
WaterML	More info
WaterMLURI	More info
WaterMLVersion	1.10
Download	
Zoom to	



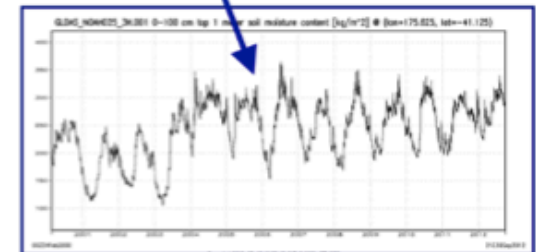
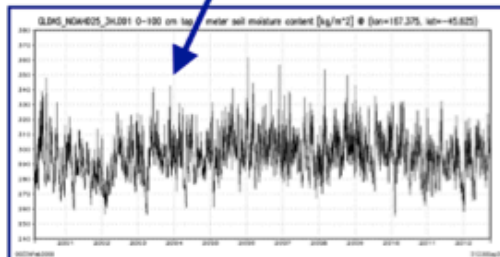
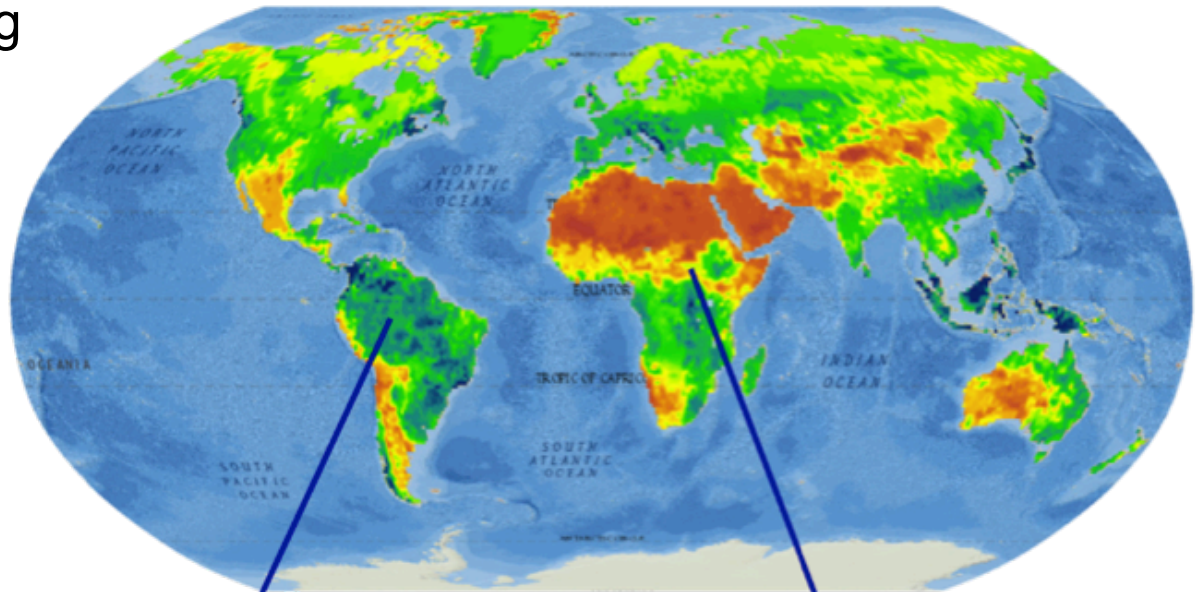
Water Data Maps: Time Series Data Access

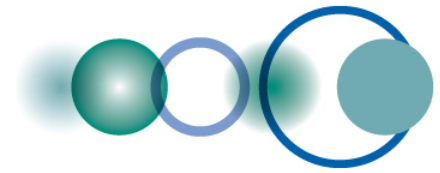
Po a Boretto



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





NASA Land Data Assimilation System: *Grid and time series globally*

World Soil Moisture Application

Soil moisture data from 2010 - 2012 that was derived from NASA's GLDAS data product. Mean Monthly for 0-100 cm from NOAH model.



<http://bit.ly/J2I43m>

▼ Animation

► ◀◀ Fri Jul 02 2010 ▶▶

► Graphing

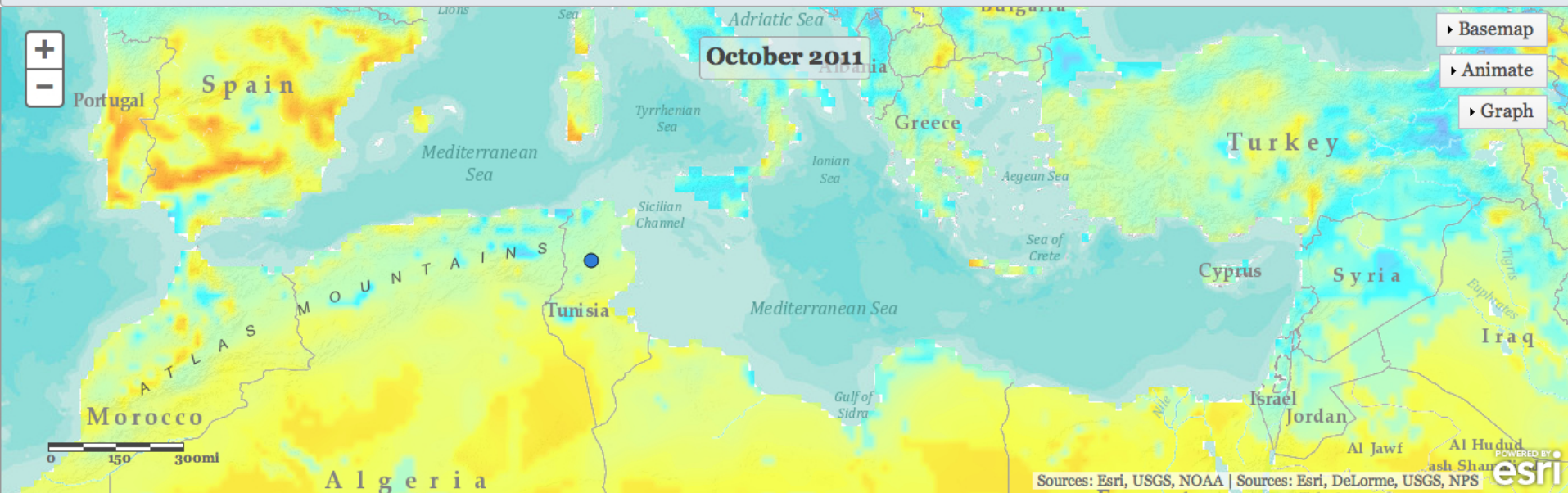
Map Date: Fri Jul 02 2010



Viewing time series values

World Soil Moisture Explorer

Monthly mean soil moisture 2003 – 2013, upper 100cm, from NASA GLDAS NOAH model



1m 3m 6m 1y 3y From: 31/12/2009 To: 31/01/2013

main 35.447,9.371 x



Generated at 2014-02-06 23:32:42 GMT

KISTERS NASA

October 2011

2010

2011

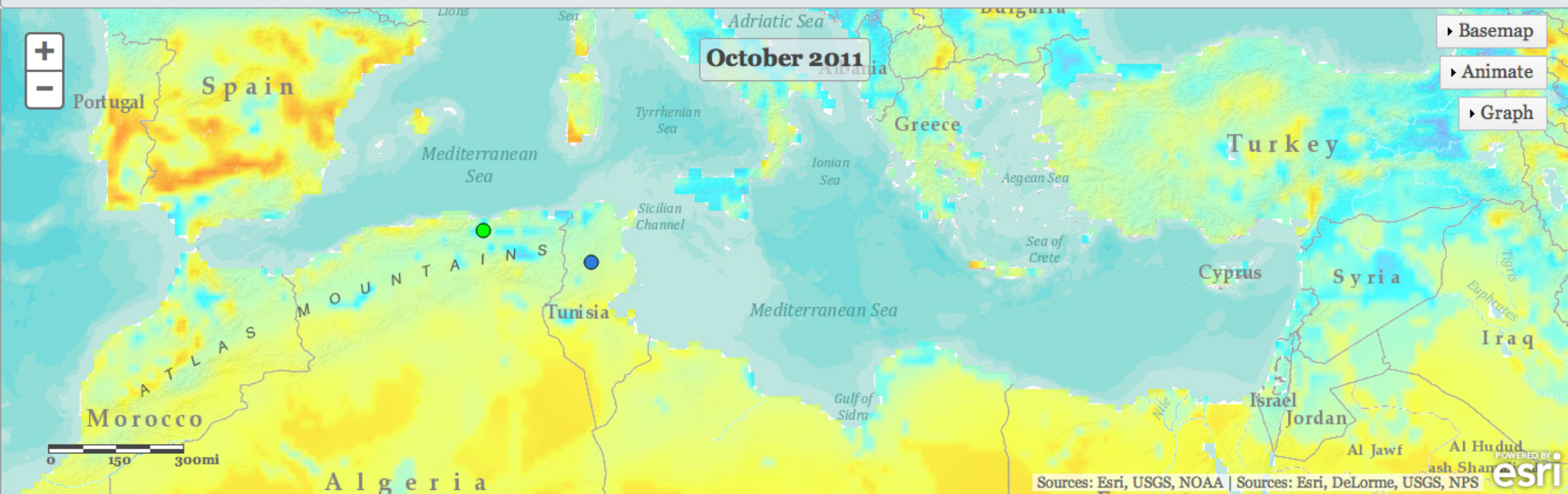
2012

2013

Comparing time series at 2 locations

World Soil Moisture Explorer

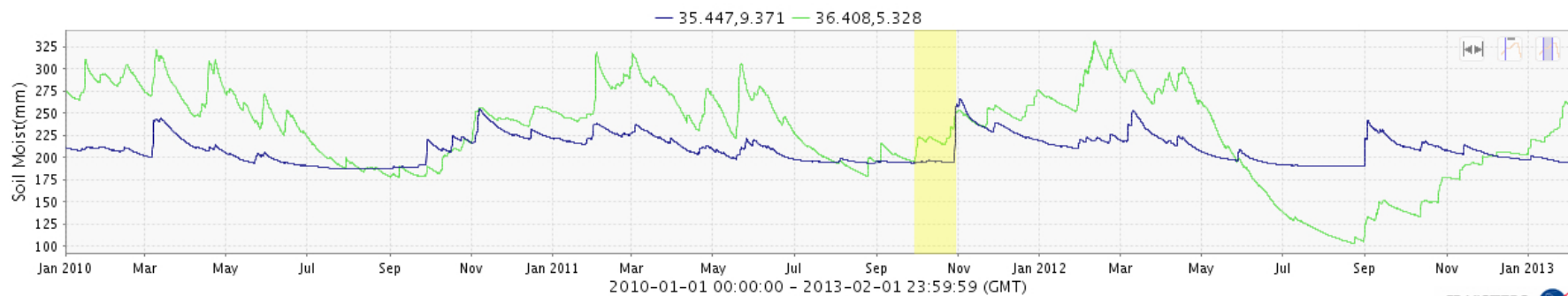
Monthly mean soil moisture 2003 – 2013, upper 100cm, from NASA GLDAS NOAH model



1m 3m 6m 1y 3y From: 31/12/2009 To: 31/01/2013

main

35.447,9.371 x 36.408,5.328 x



October 2011

2010

2011

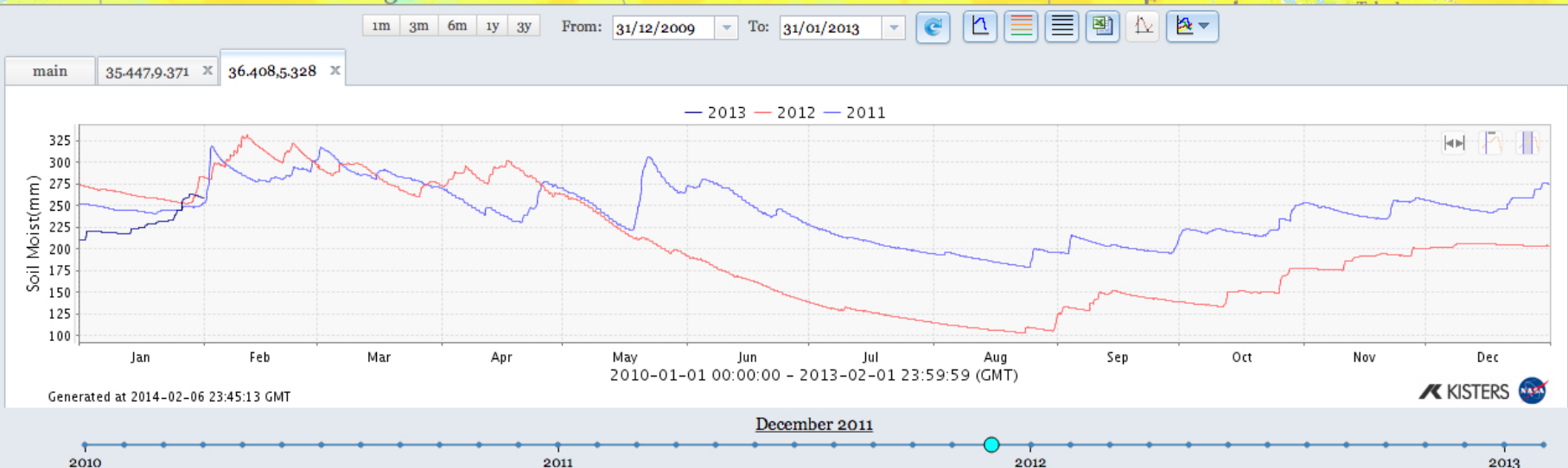
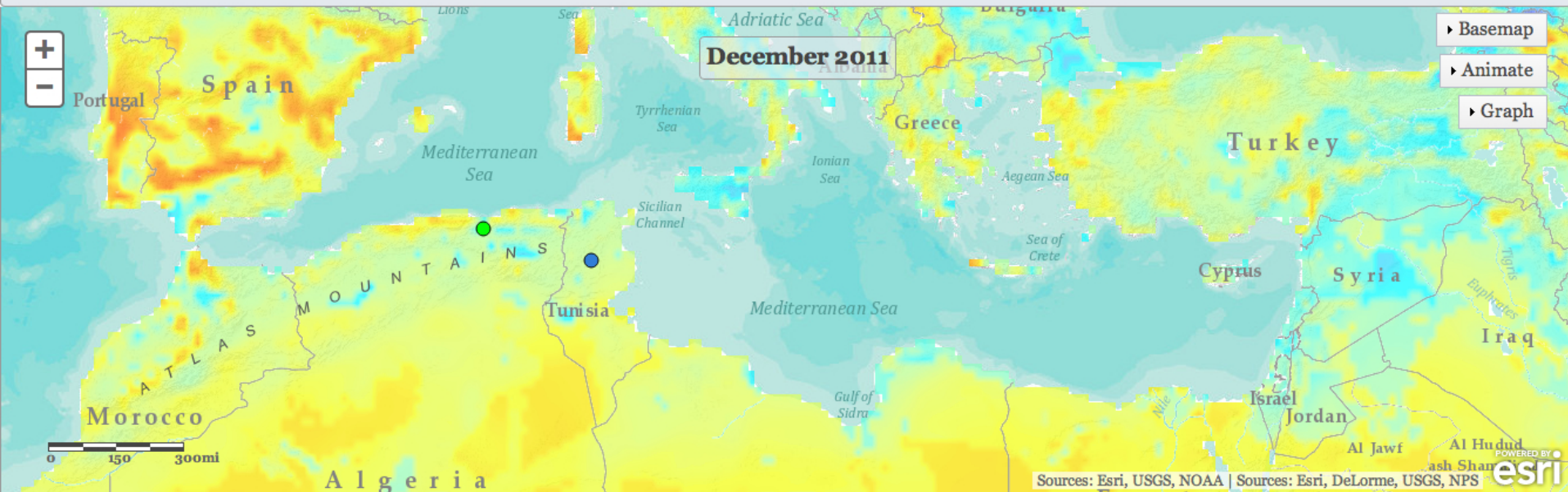
2012

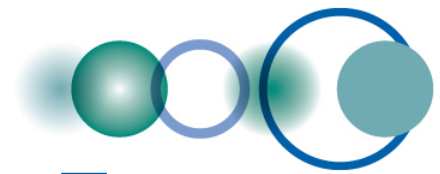
2013

Comparing time series for multiple years

World Soil Moisture Explorer

Monthly mean soil moisture 2003 – 2013, upper 100cm, from NASA GLDAS NOAH model

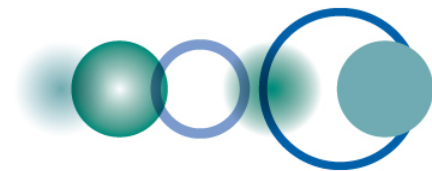




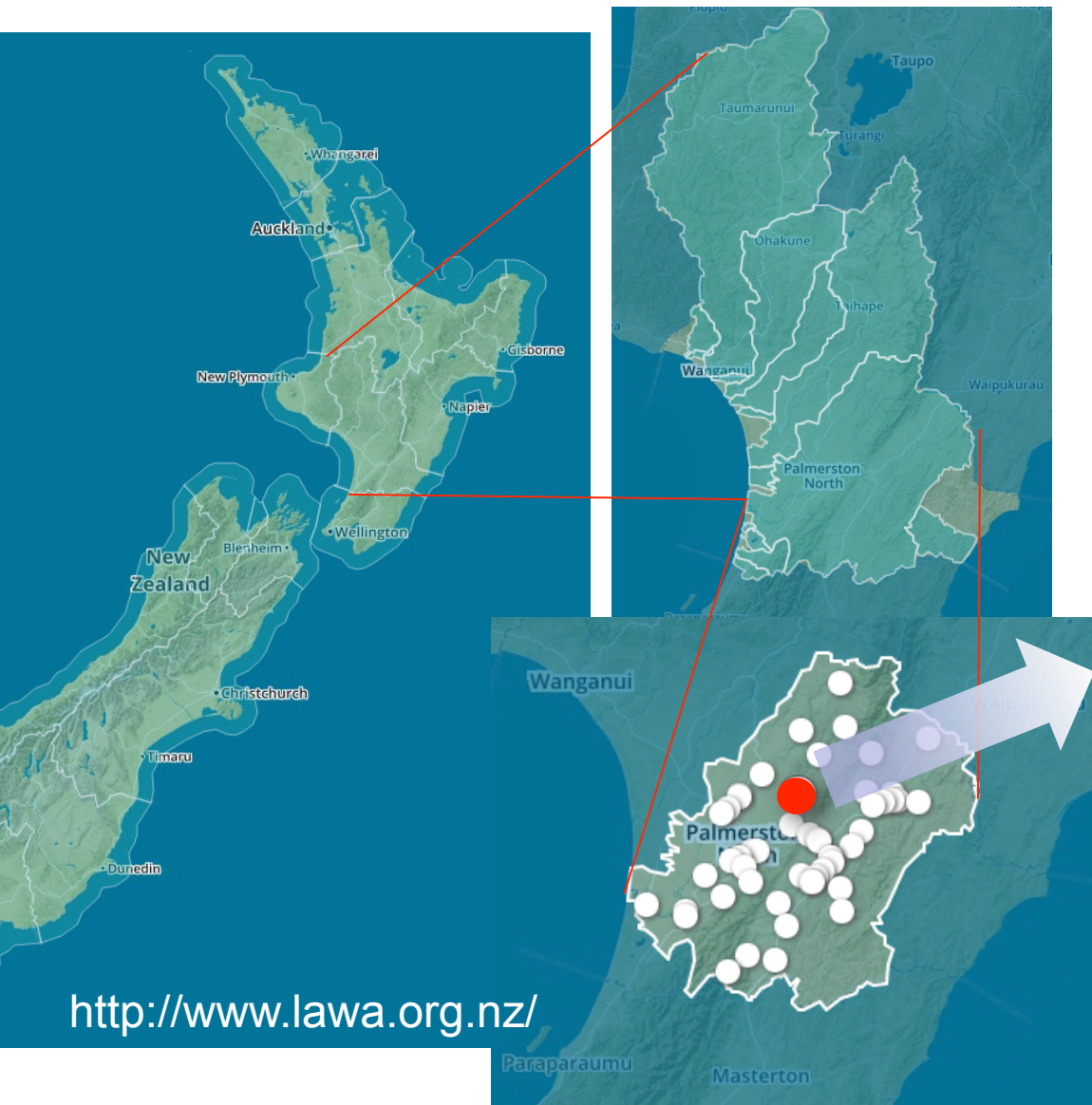
AIP-7 (2014) GEOSS Water Services Team

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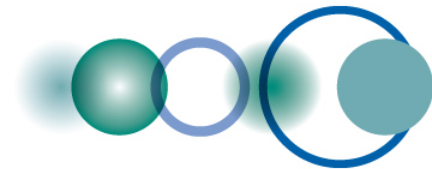


Land Air Water Aoteara: LAWA New Zealand



<http://www.lawa.org.nz/>

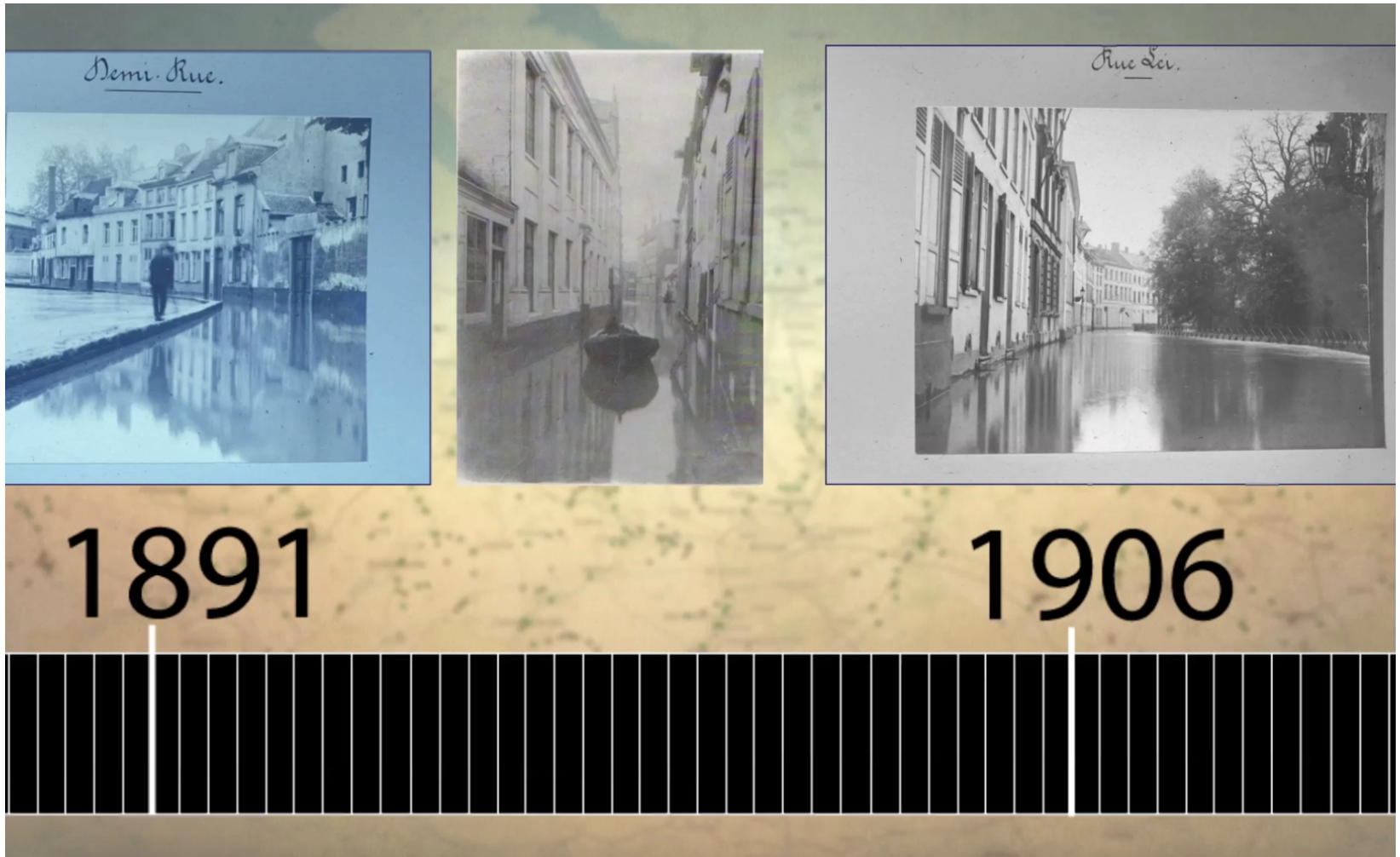




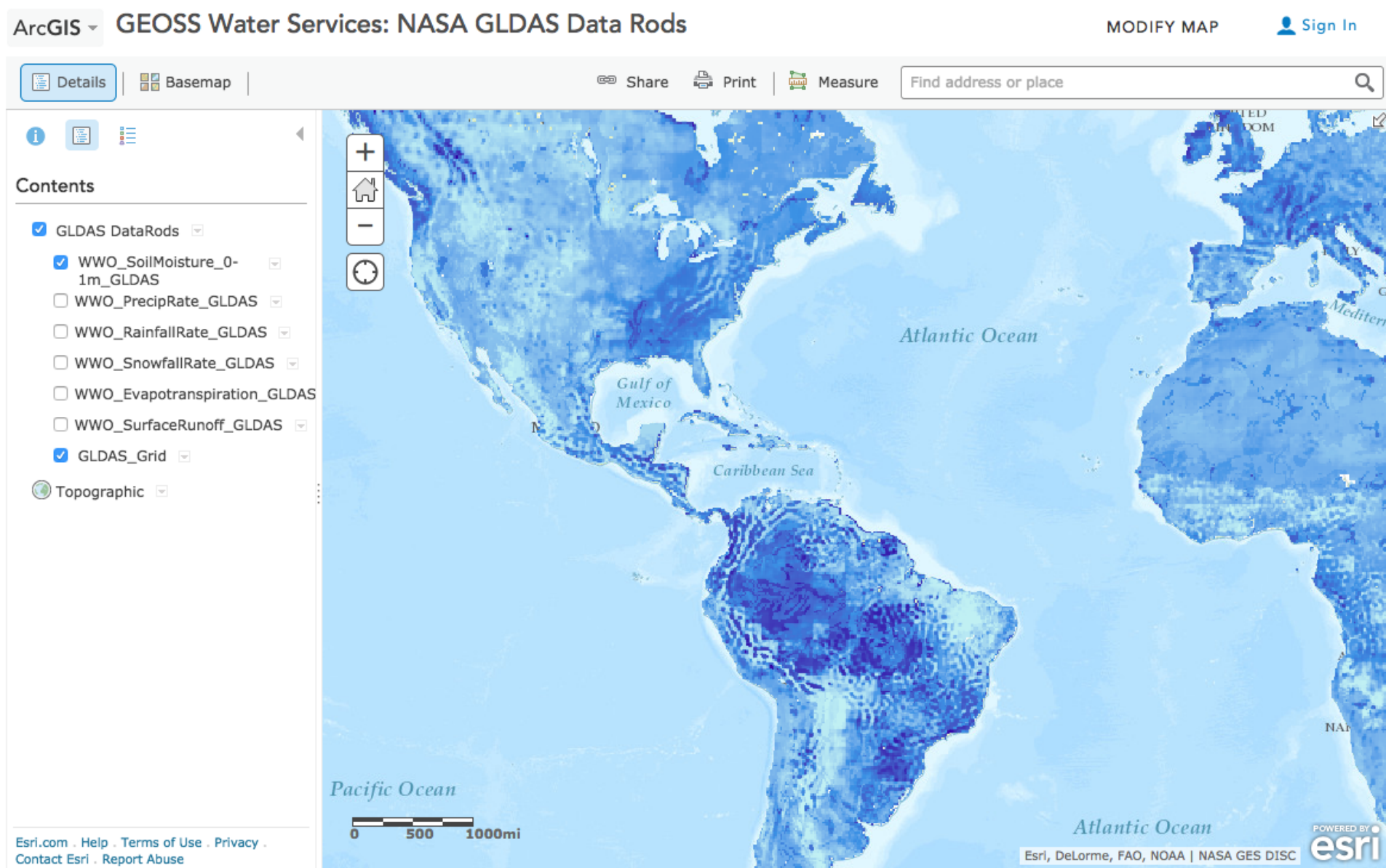
Land Air Water Aoteara: LAWA New Zealand



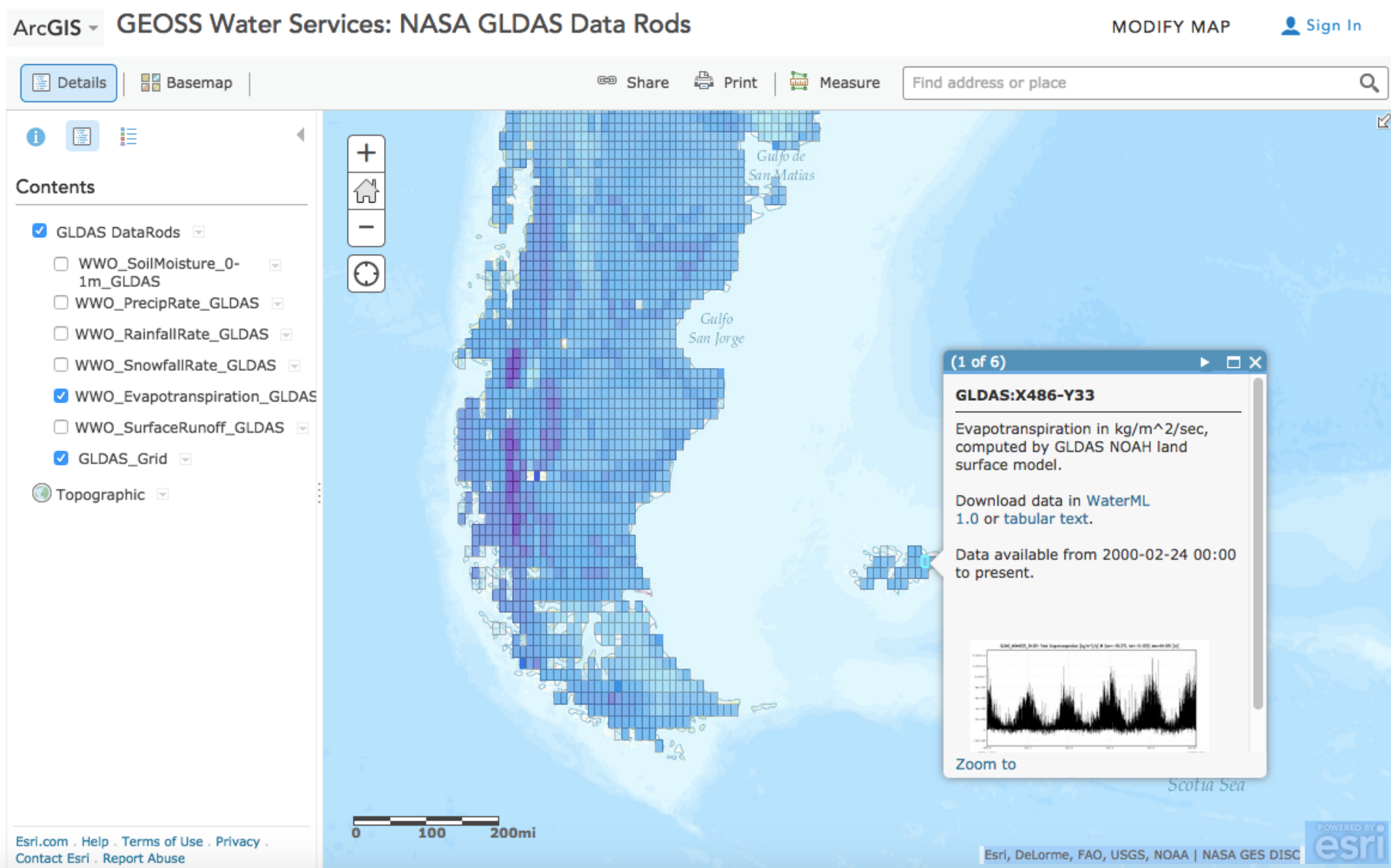
WaterInfo.be: Flemish Water Portal



Time Series of Land Surface Modeling Outputs



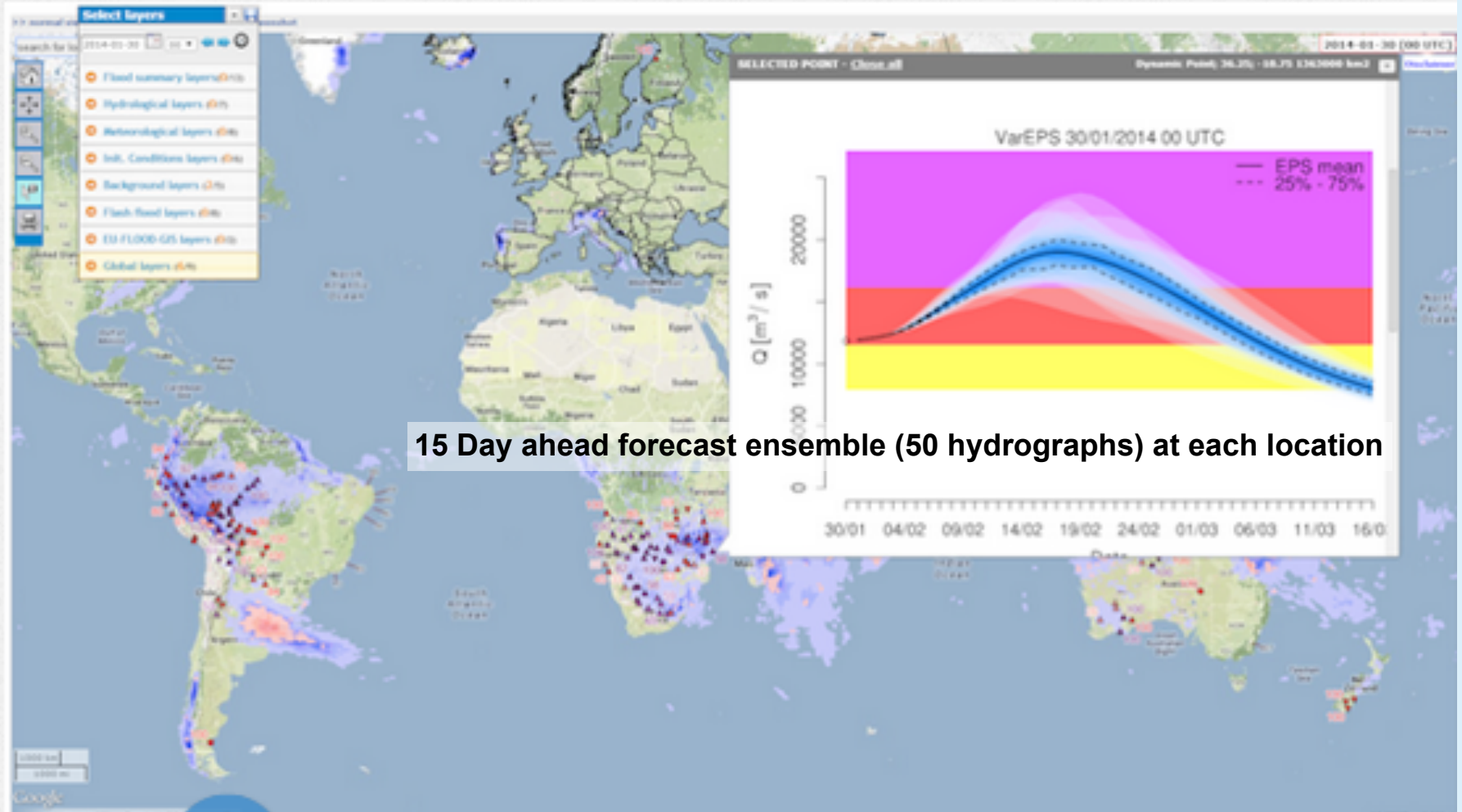
Time Series of Land Surface Modeling Outputs

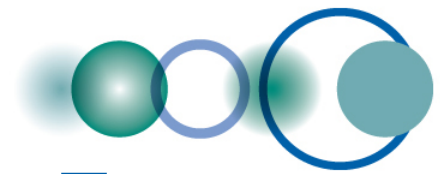


GloFAS

Global Flood Awareness System

European Center for Medium Range Weather Forecasting and European Joint Research Commission





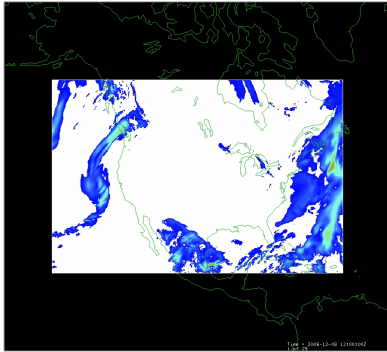
AIP-8 (2015) GEOSS Water Services Team

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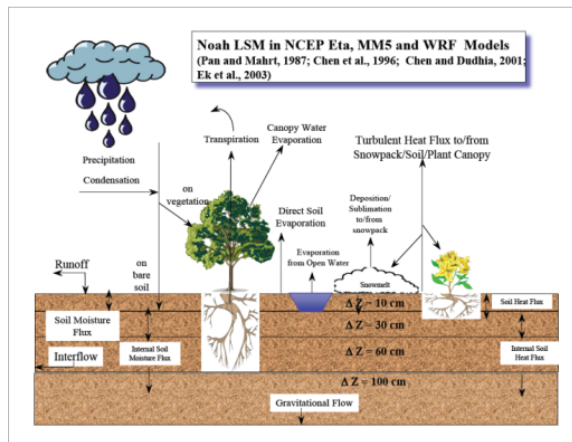


Models for Flood Forecasting

Weather model and forecasts

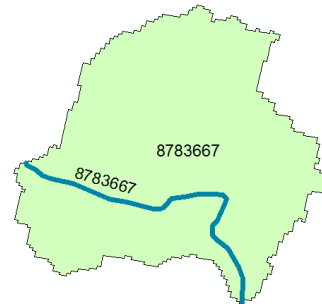


Weather  Precipitation



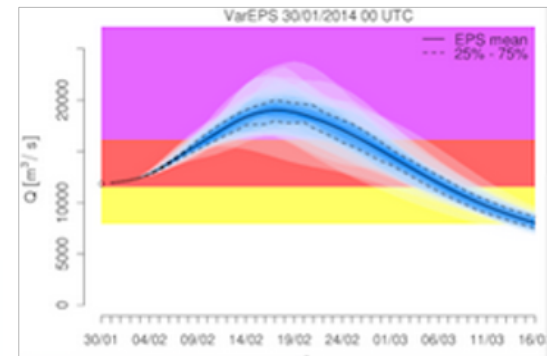
Land-Atmosphere Model

Catchment-level forecasts

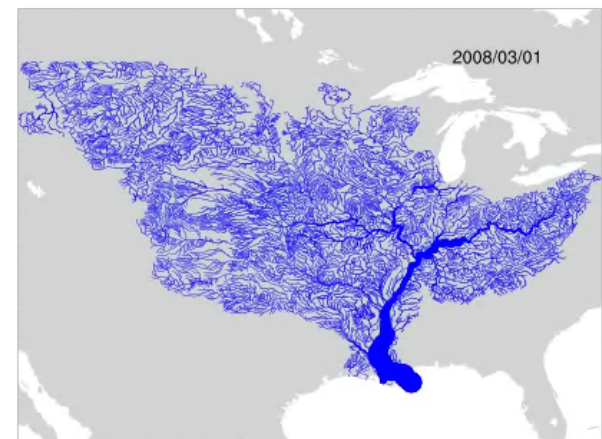


 Surface & Subsurface Runoff

Probabilistic flood forecasts

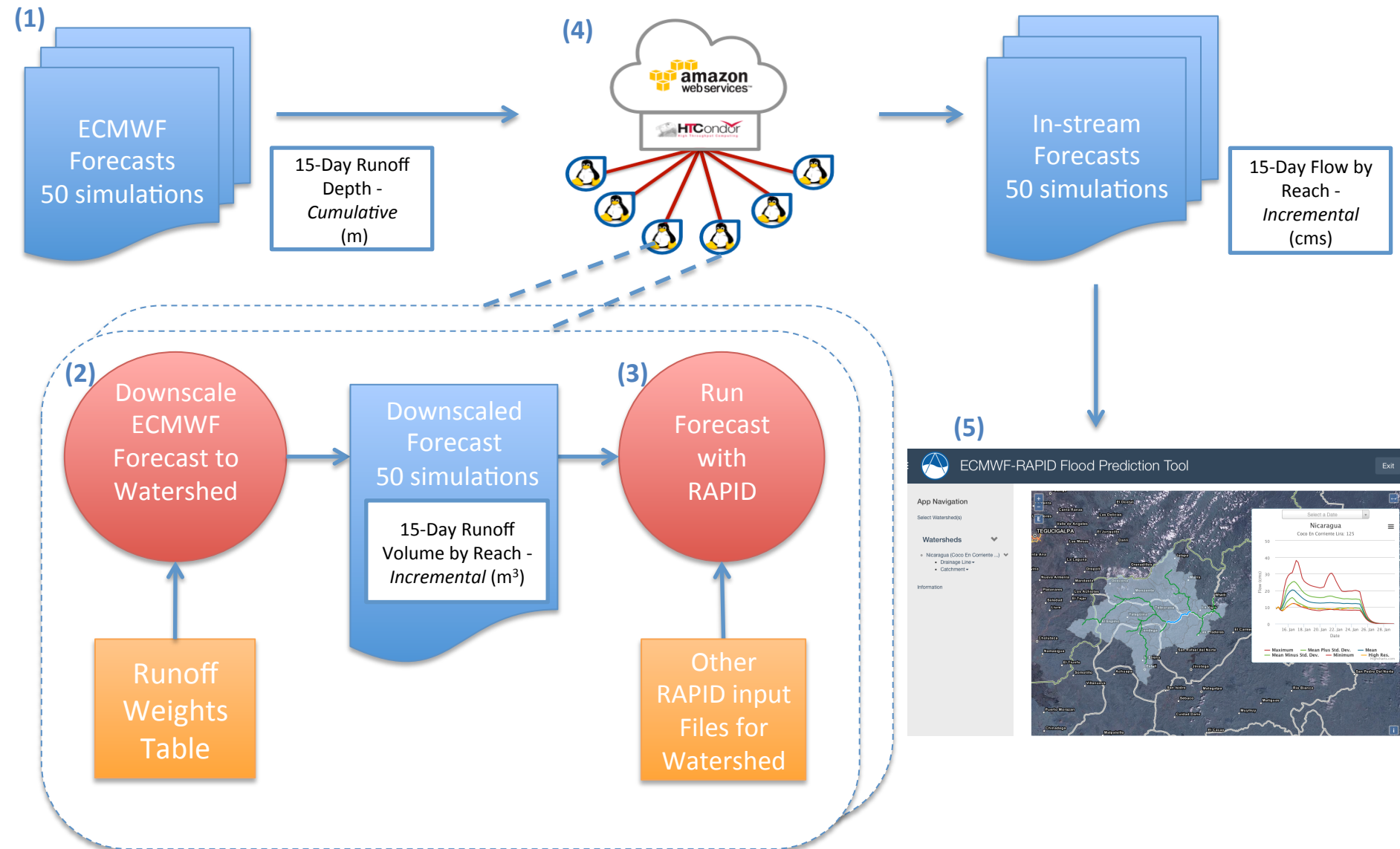


 Streamflow



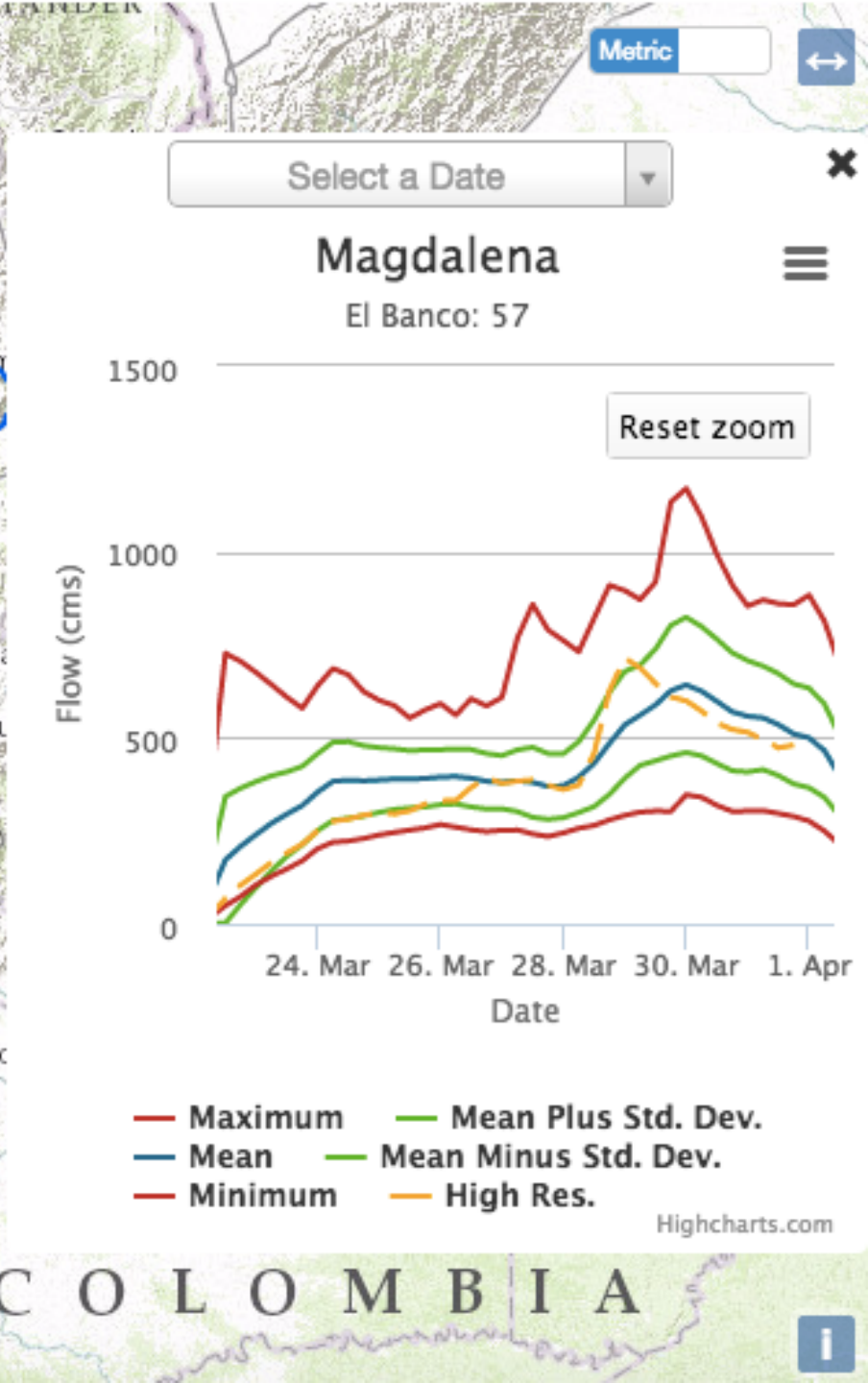
Channel flow routing (for continental US)

BYU Flood Forecasting Workflow



BYU Latin American Case Studies



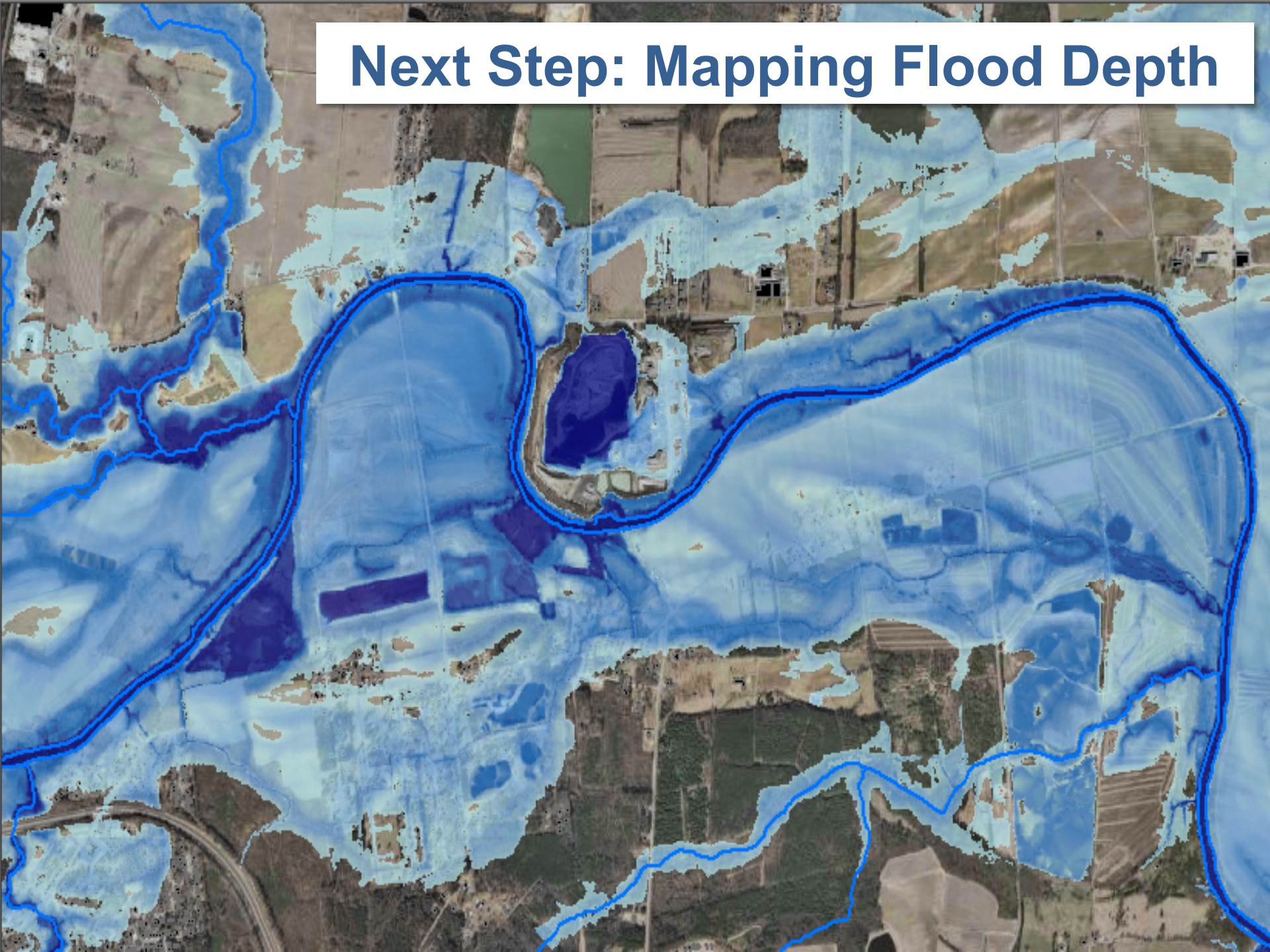


The recipe for doing this (*prototype*):

- Delineate watersheds with automated tools working from elevation models (*quick and easy now*)
- Create stream networks and catchments (*GIS tools*)
- Download ECMWF forecast ensembles (*ftp*)
- Downscale ensemble to local catchments (*Esri toolkit*)
- Run RAPID streamflow routing model (*cloud computing*)
- Store results in HydroShare (*community portal*)
- Run Tethys app to access the results and display (*browser*)

We are working on ways to leverage current implementations for global use

Next Step: Mapping Flood Depth



BYU Python Toolkit for Hydro Apps



Tethys Platform

[Documentation](#) [Demo](#)



Water resources web applications
for the 21st century.

[Learn More](#)

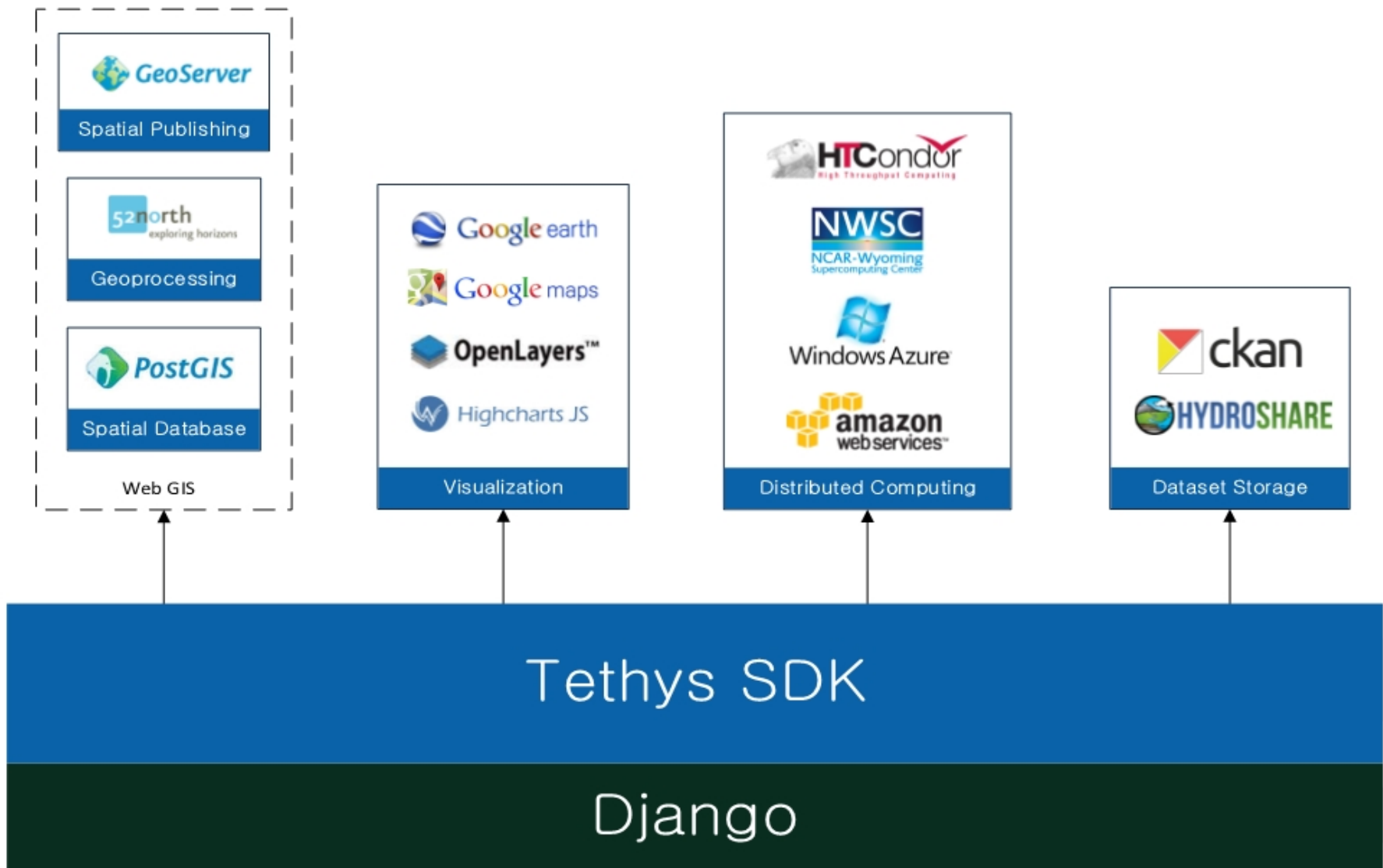
Tethys Platform has been designed to lower the barrier to water resources web app development. Convey your models and data as interactive web apps.

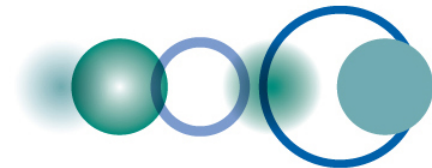
<http://tethys.ci-water.org/>



Web Apps

Tethys Platform





Thank you!

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david.arctur@utexas.edu

University of Texas at Austin

Open Geospatial Consortium (OGC)

