

Water Data and Modeling Services

Presented by: Fernando Salas¹ and Cindy Hooper²

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University of Texas at Austin

²Texas Commission on Environmental Quality

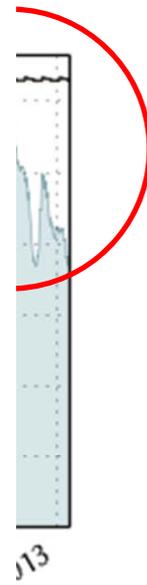
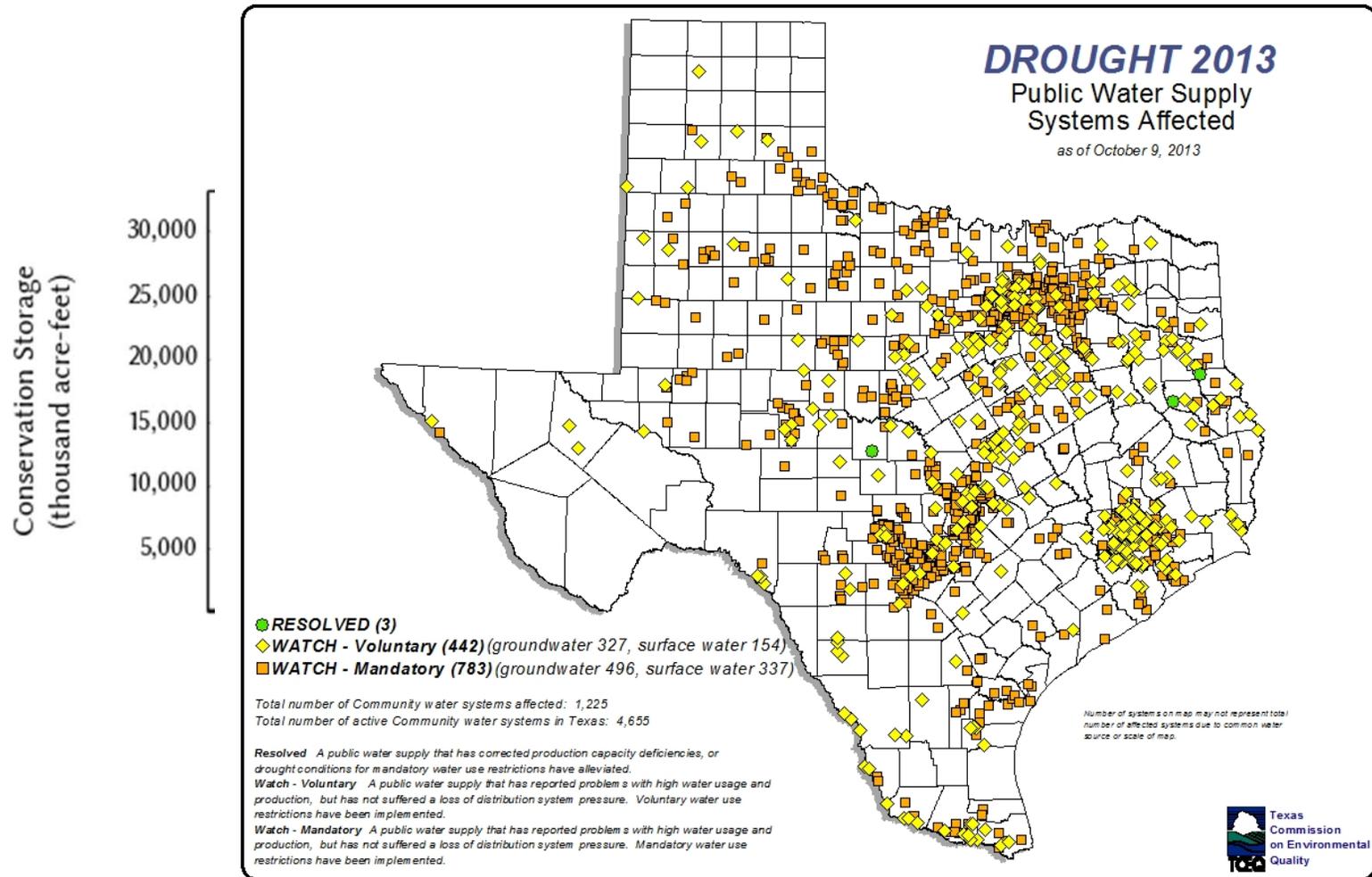
October 14th, 2013

Drought Forum III: Droughts and Other Extreme Weather Events

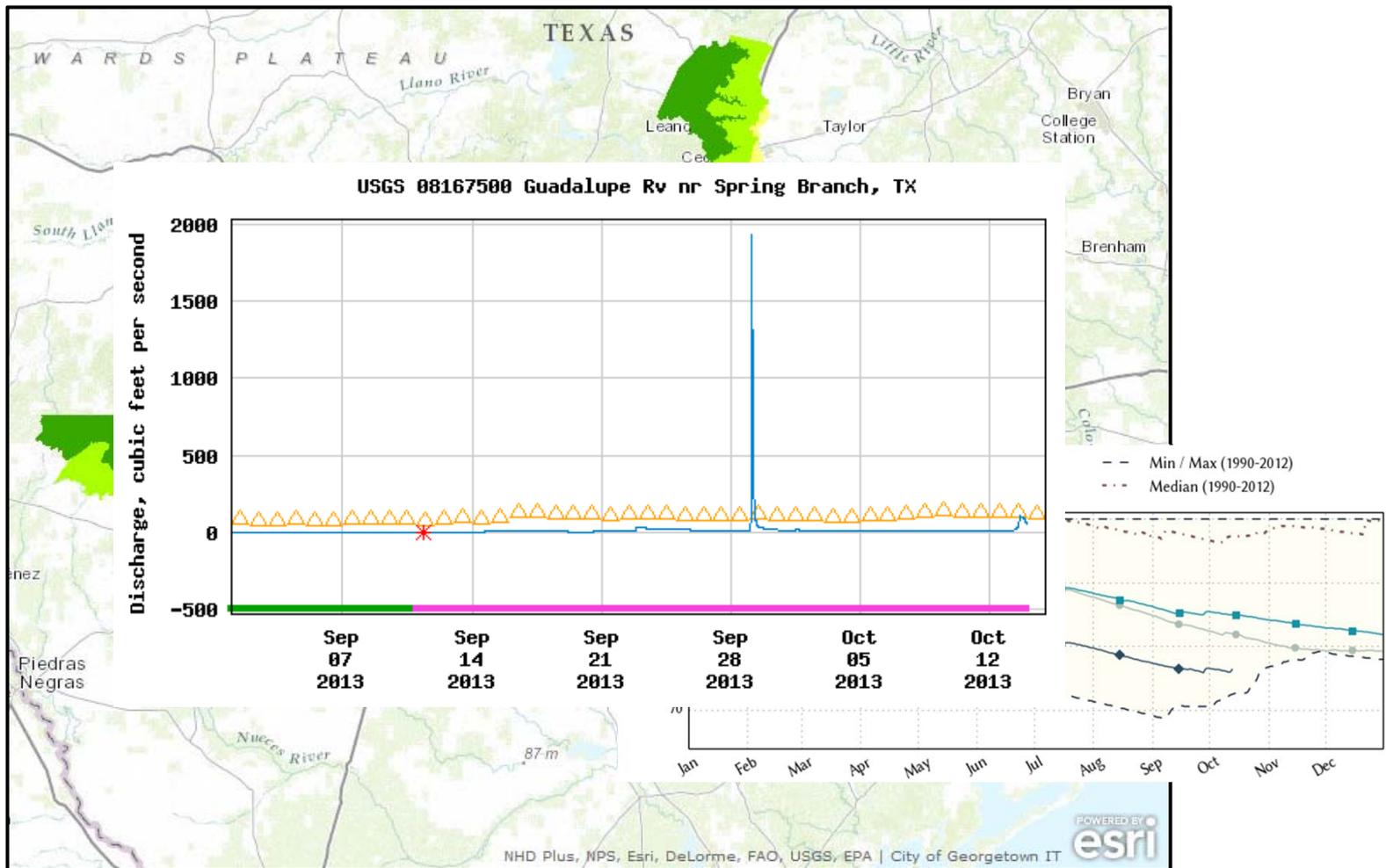
Center for Integrated Earth System Science
University of Texas at Austin

Acknowledgements: David Maidment, Kathy Alexander, Tim Whiteaker

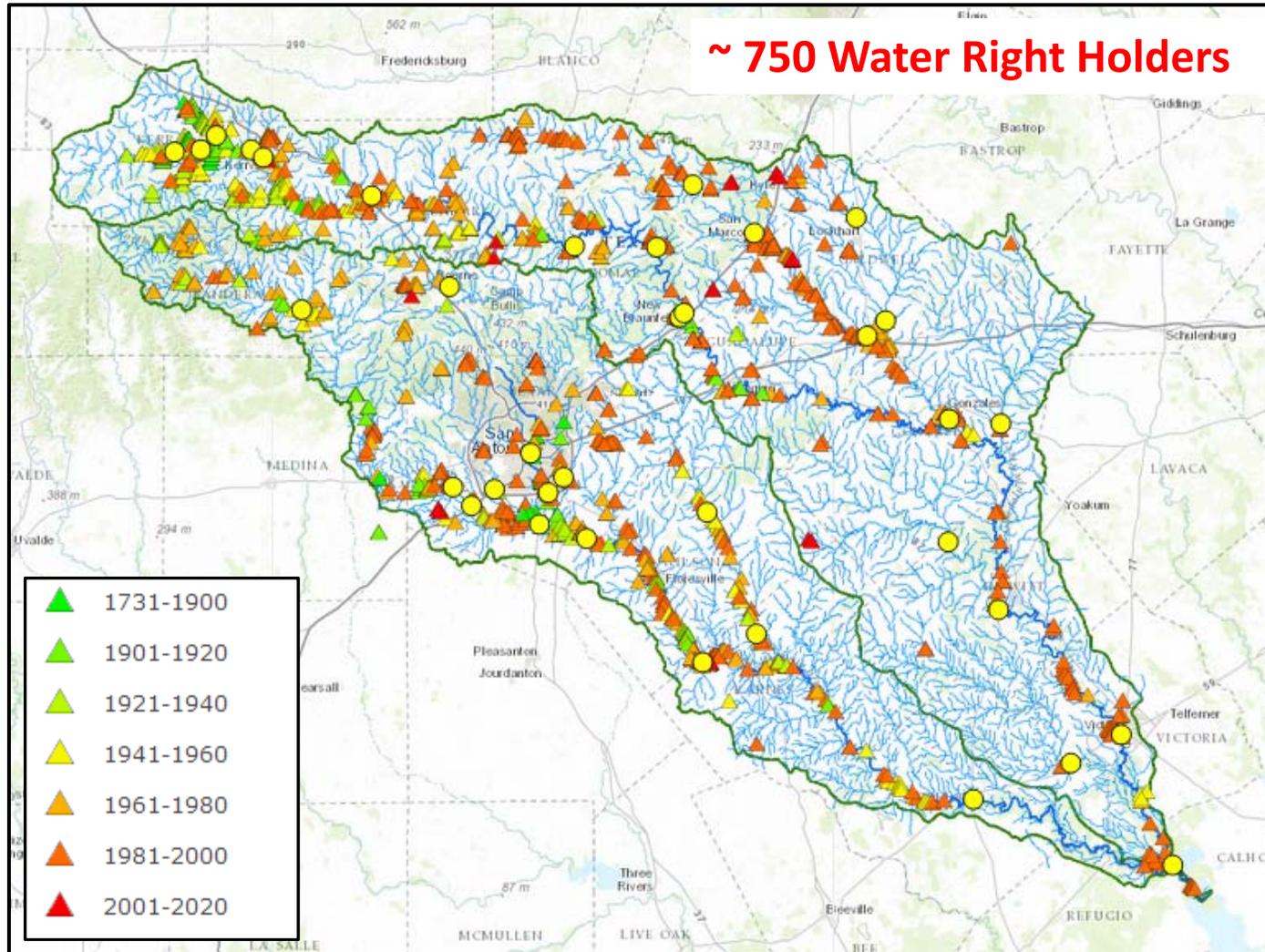
Drought Severity in Texas



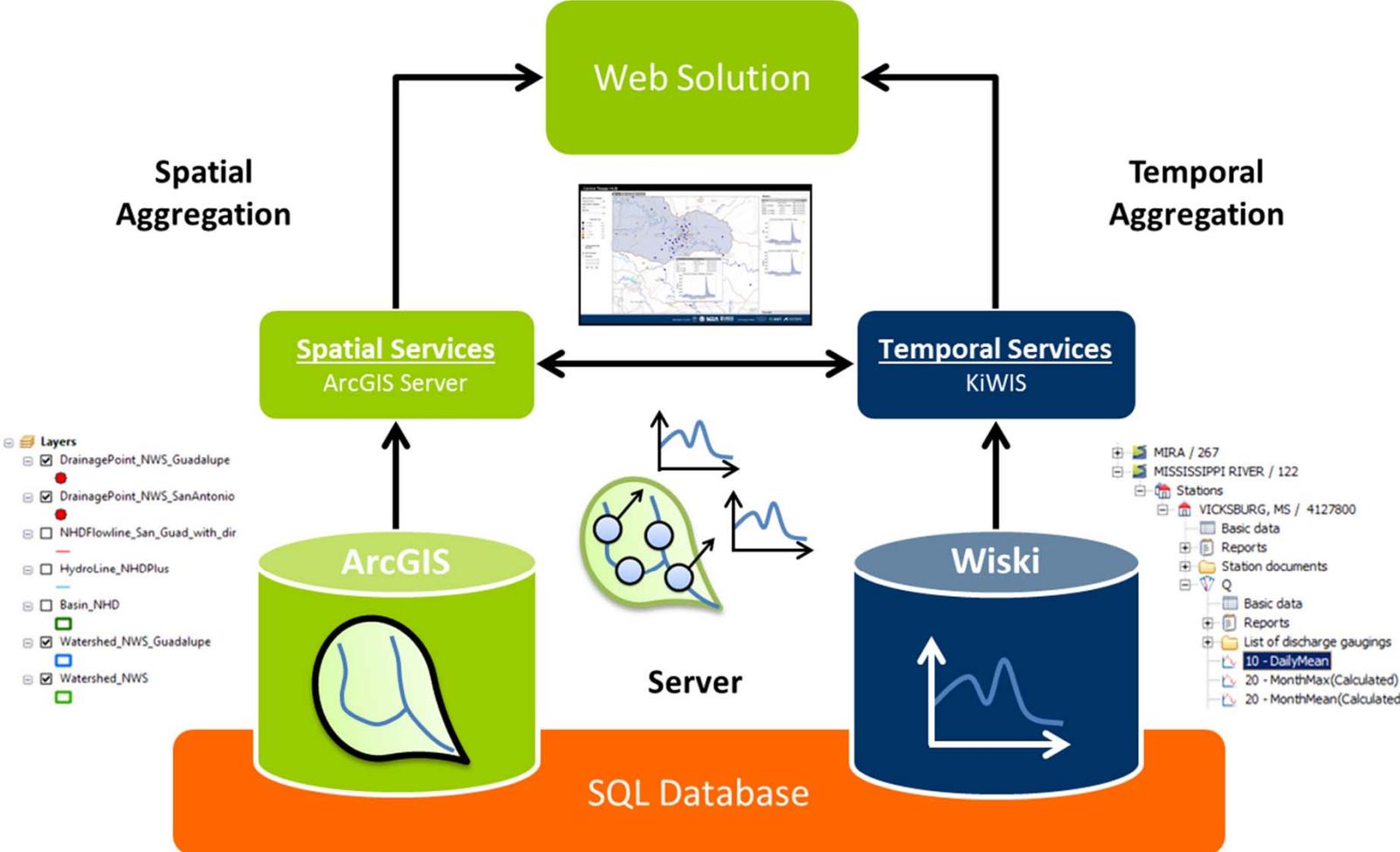
Drought in San Antonio and Guadalupe River Basins



TCEQ Watermaster Operations



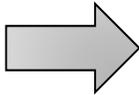
Integration of GIS and Time Series



Inputs



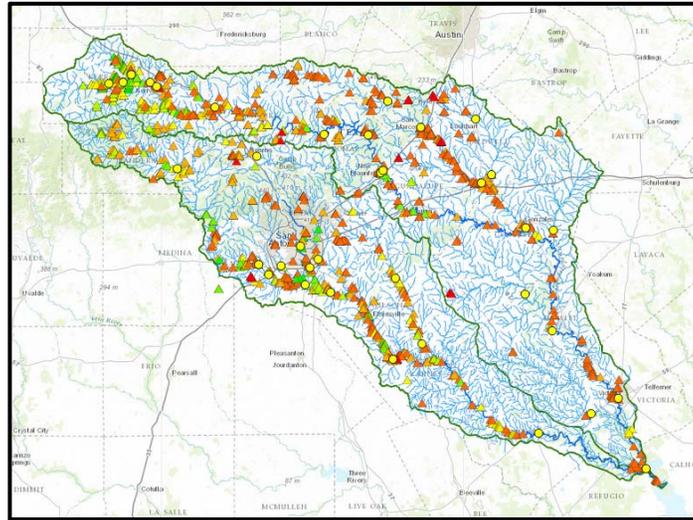
Observation
Data
Services



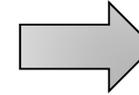
Geospatial
Data
Services

- USGS
- TCEQ
- GBRA
- NWS
- SARA

Water Web Services HUB



Data
Services

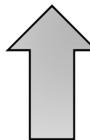
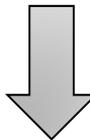


Map
Services

Outputs



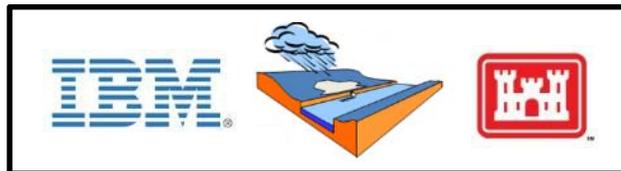
Data
Services



Modeling
Services



Mapping
Services



Models



Maps



CUAHSI
universities allied for water research

Consortium of Universities for the
Advancement of Hydrologic Science, Inc.
www.cuahsi.org

CUAHSI

A consortium representing 125 US universities
Dr. Richard Hooper, President and CEO

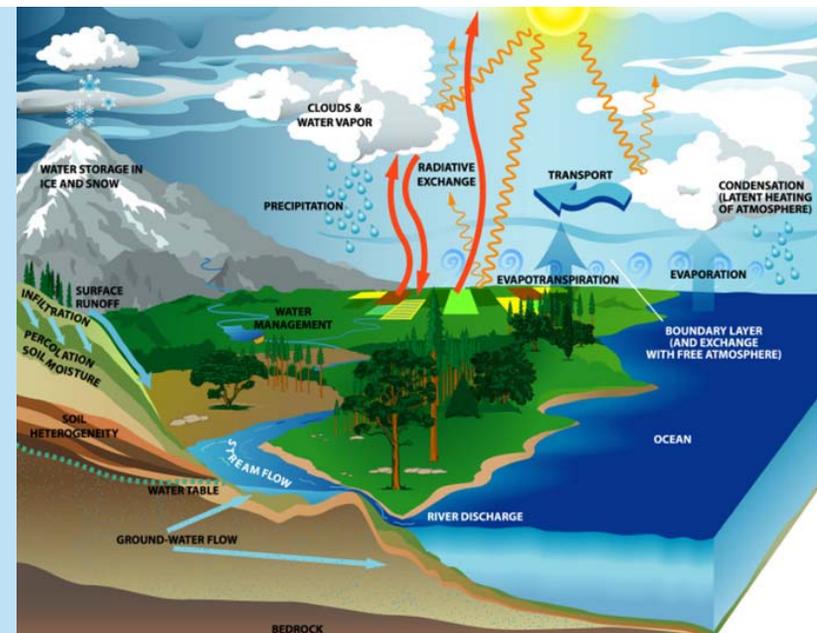


Supported by the **National Science Foundation** Earth Science Division

Advances **hydrologic science** in
nation's universities

Includes a **Hydrologic Information System** project

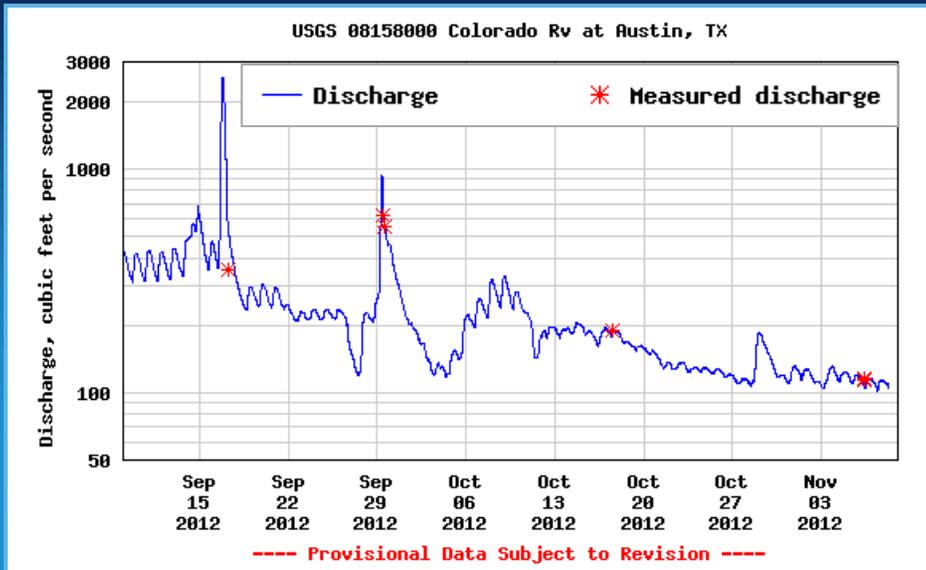
Invented **WaterML** language for
water resources time series



Building an academic prototype system

WaterML – the US Geological Survey

Water time series data on the internet

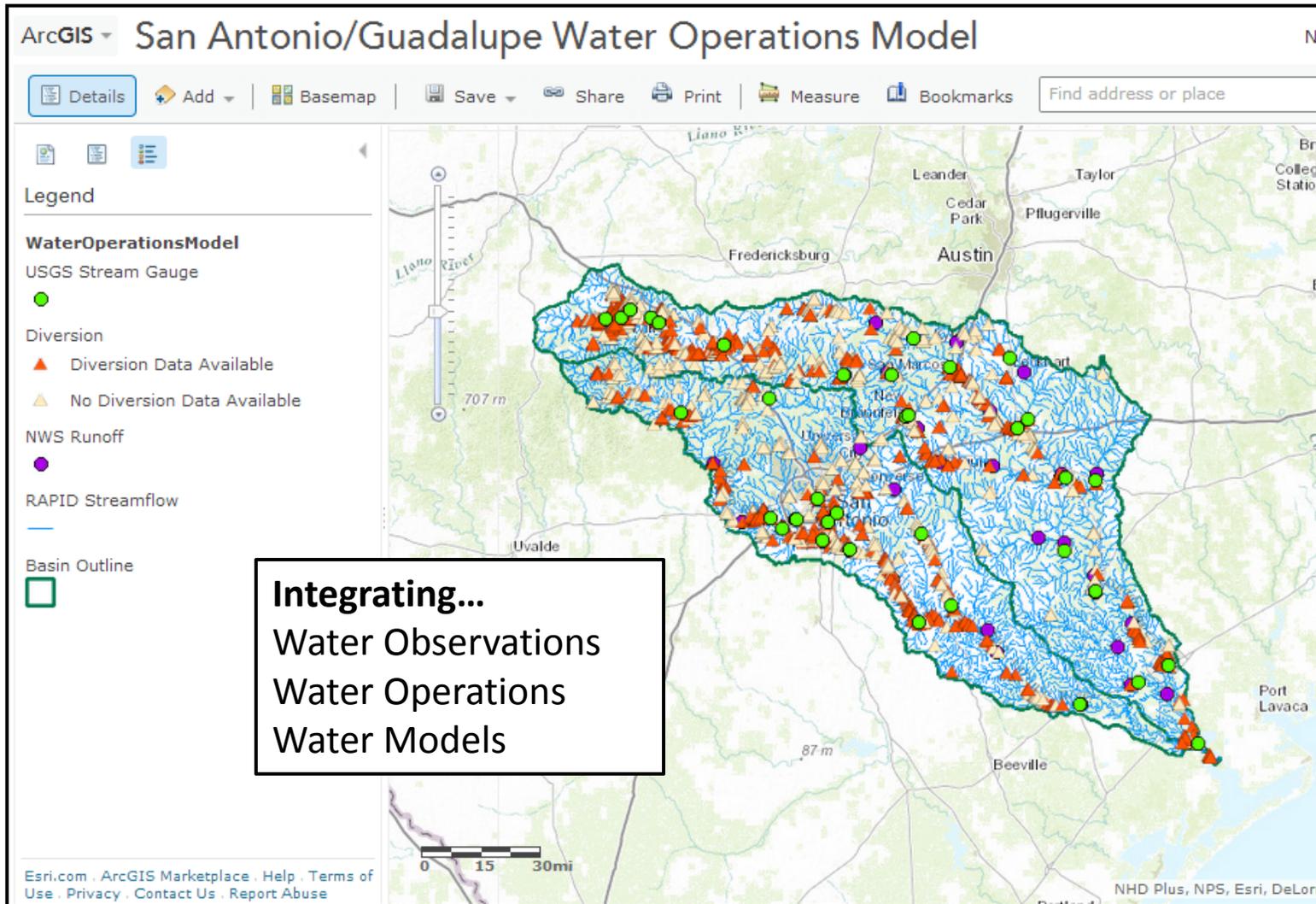


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24/7/365 service
For daily and real-time data

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

Water Operations Model



Water Operations Model - Layers

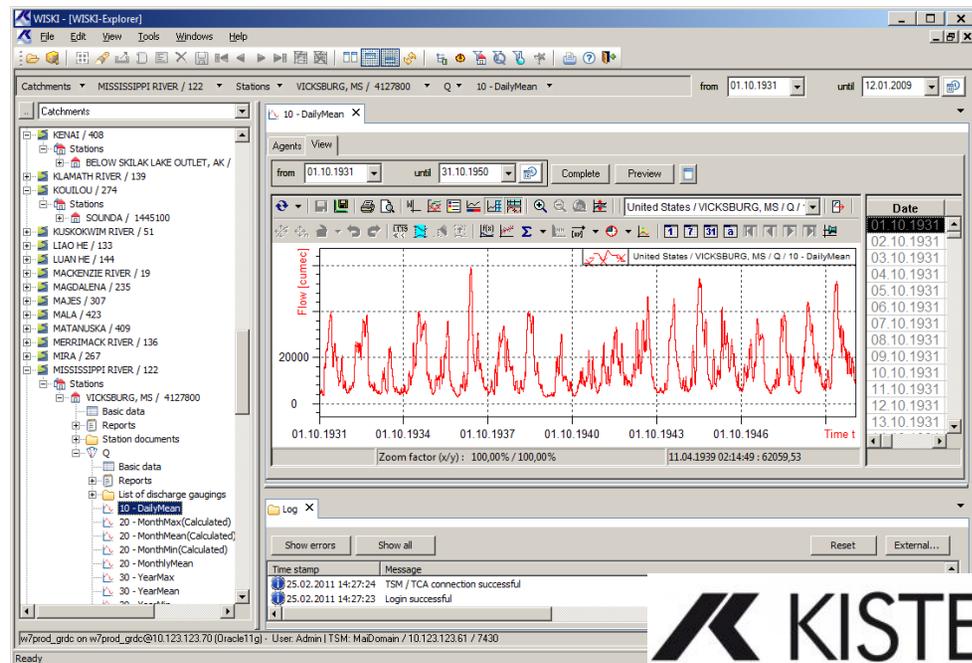
- Observations
 - USGS near real-time streamflow (15 min)
- Operations
 - TCEQ real-time water diversions (irregular)
- Models
 - NWS real-time surface runoff (1 hour)
 - CRWR streamflow (3 hour)

Water Information System Kisters (WISKi)

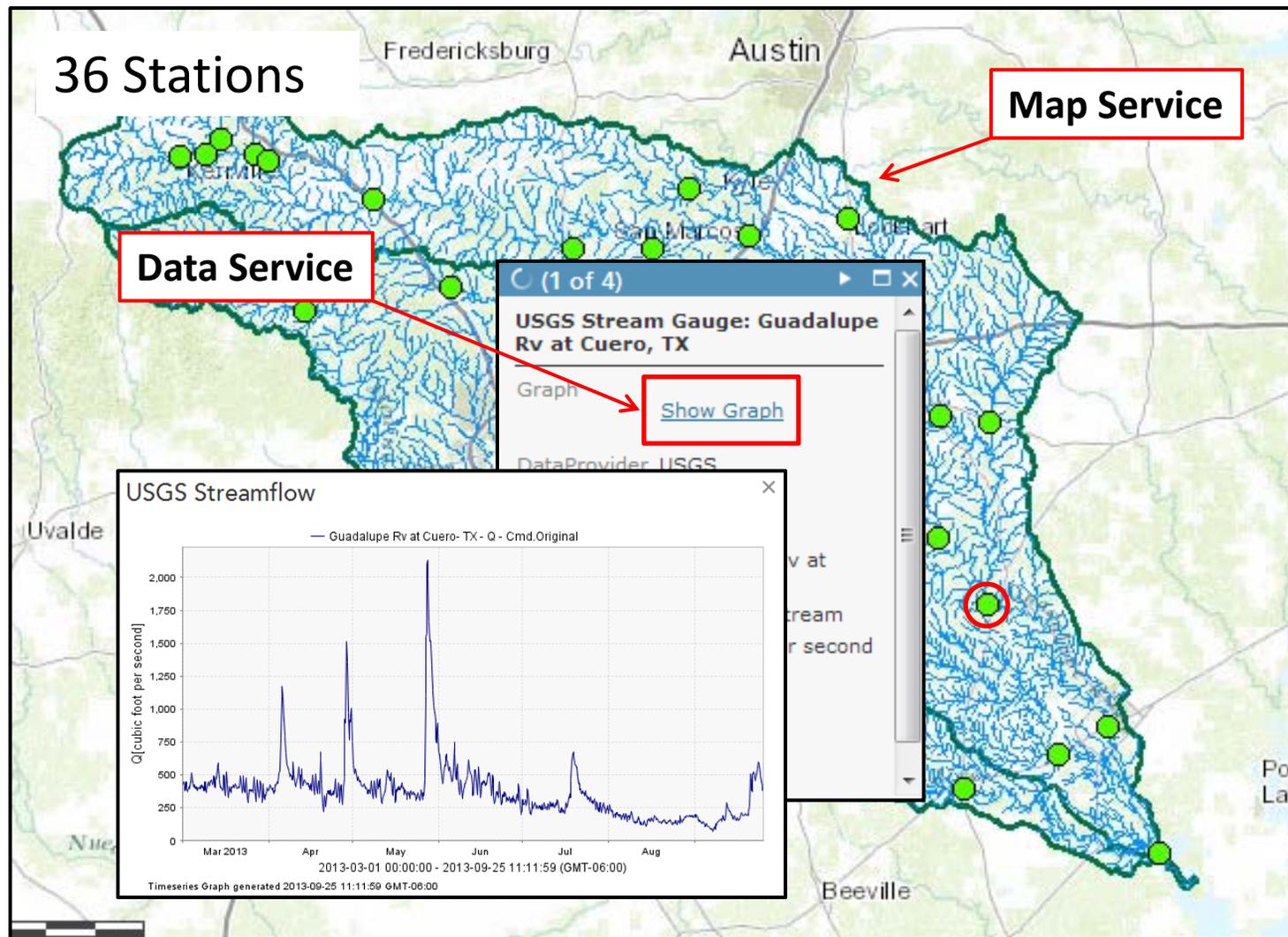
- A database solution for managing time series data
- Interface like a GIS but for time series
- Create WaterML data services using Kisters Web Interoperability Solution (KiWIS)

Each Time Series Becomes a Data Service

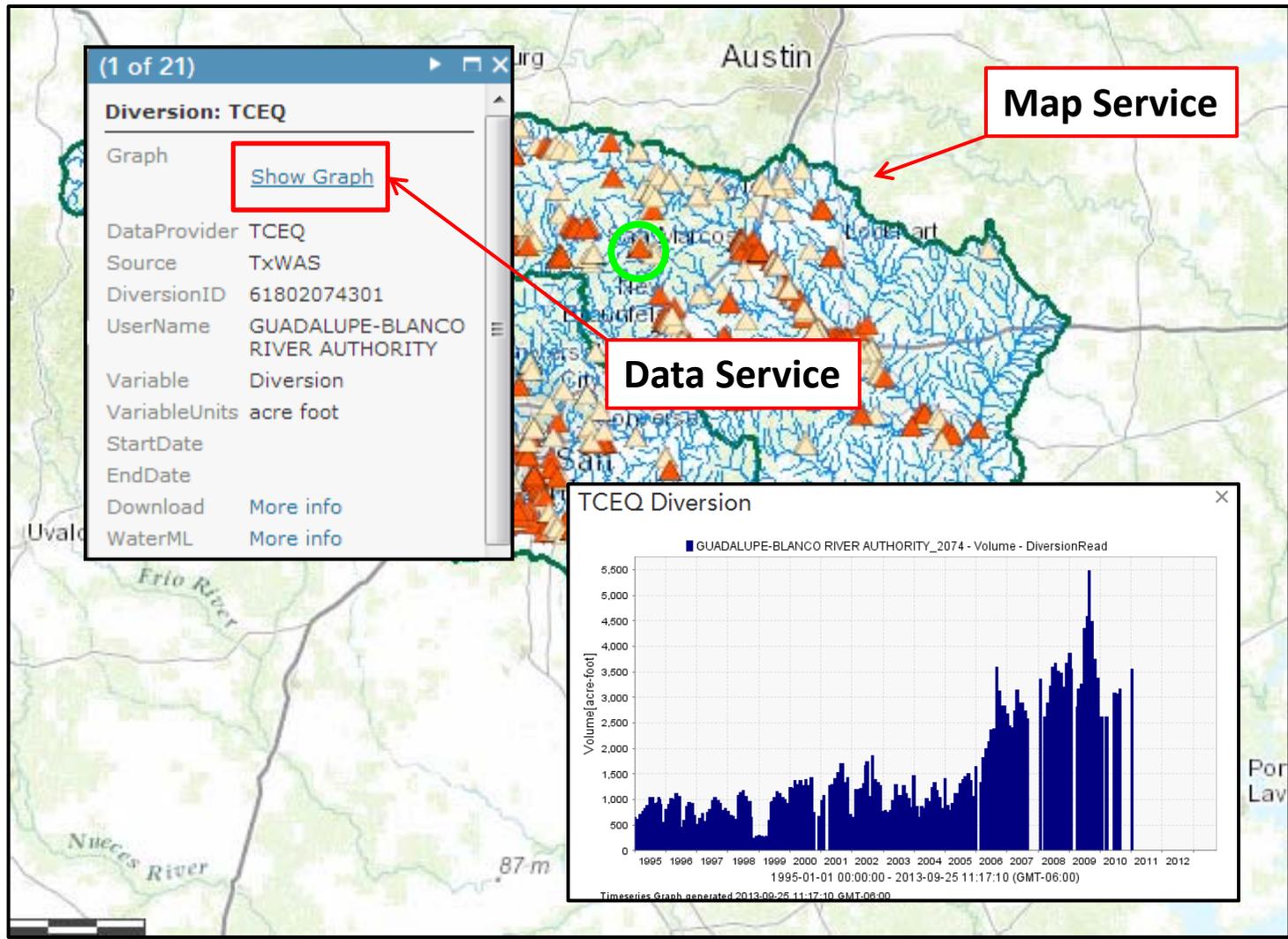
- 10 - DailyMean
- 20 - MonthMax(Calculated)
- 20 - MonthMean(Calculated)
- 20 - MonthMin(Calculated)
- 20 - MonthlyMean
- 30 - YearMax
- 30 - YearMean



Observations: USGS Streamflow



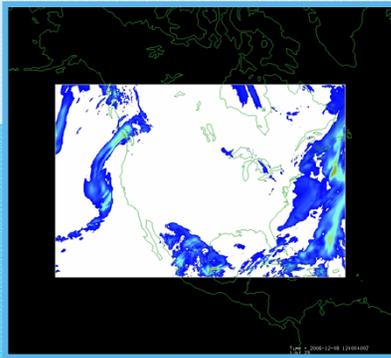
Operations: TCEQ Water Diversions



Water Operations Model Layers

- Observations
 - USGS near real-time streamflow (15 min)
- Operations
 - TCEQ real-time water diversions (irregular)
- Models
 - NWS real-time surface runoff (1 hour)
 - CRWR streamflow (3 hour)

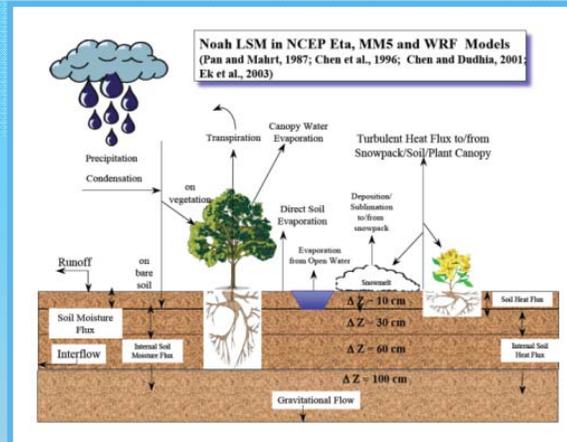
Land-Surface Modeling



Observations
Datasets, Numerical
Weather Model

Soil
Vegetation
Terrain

Forcing:
Radiation
Precipitation
Surface climate



Land Surface Model



Evaporation
Soil Moisture
Runoff
Recharge

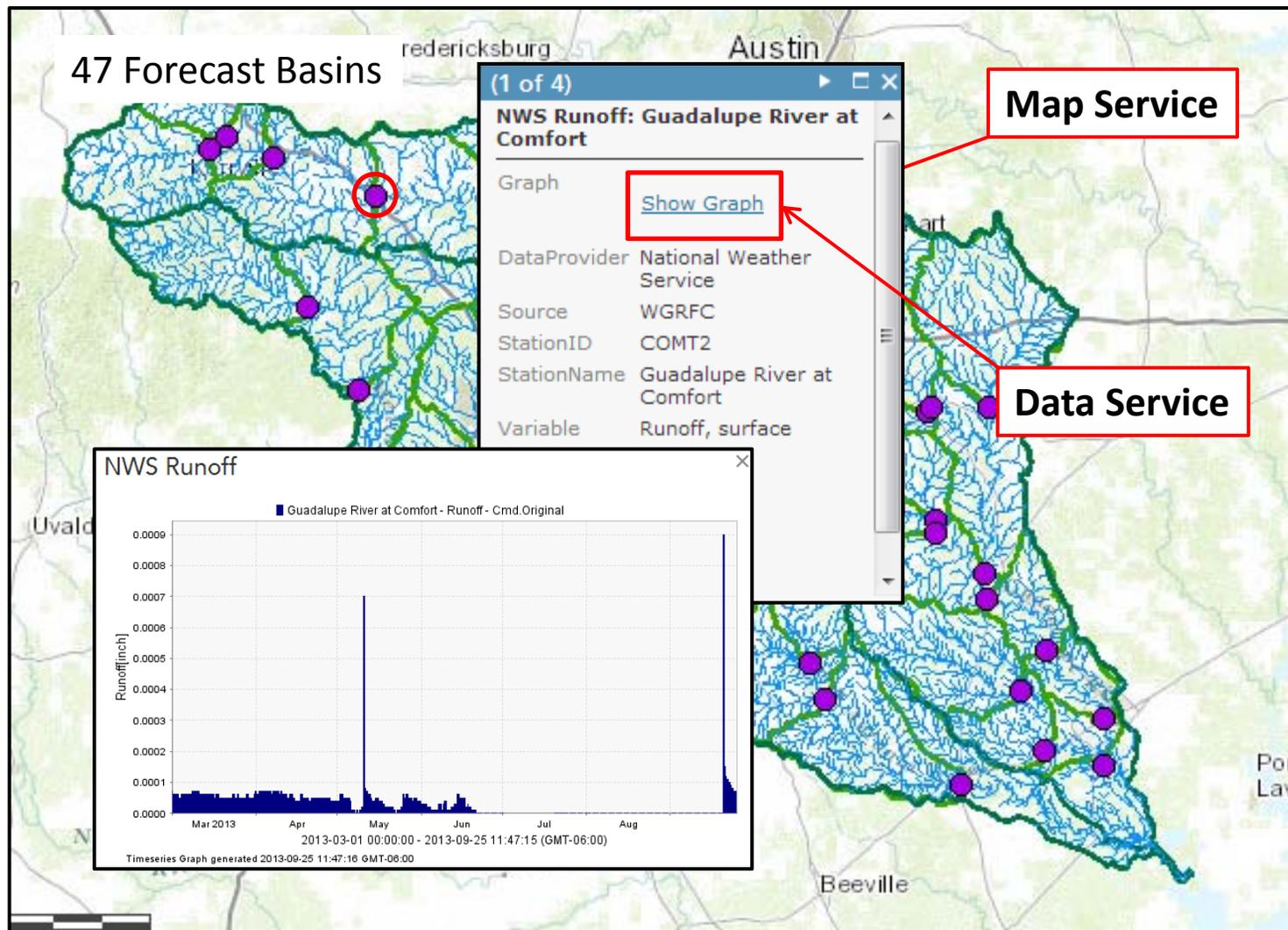
10 day moving window

Domain	Space	Time
San Antonio/ Guadalupe	Forecast basin	1 hour/ 6 hour

Deduction:

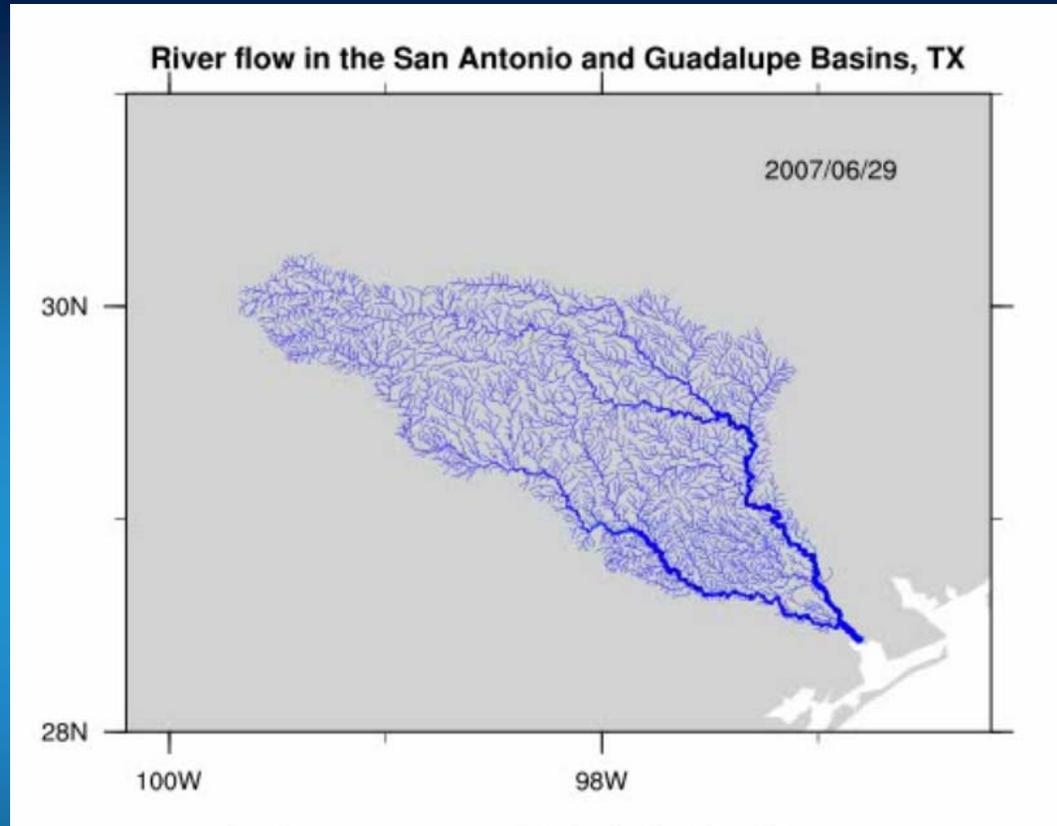
Given these forcing and land surface conditions
Then, using a land surface simulation model
Derive surface moisture and energy balance

Models: NWS Surface Runoff



Flow in the San Antonio/Guadalupe Basin

RAPID model, 3 hour time steps



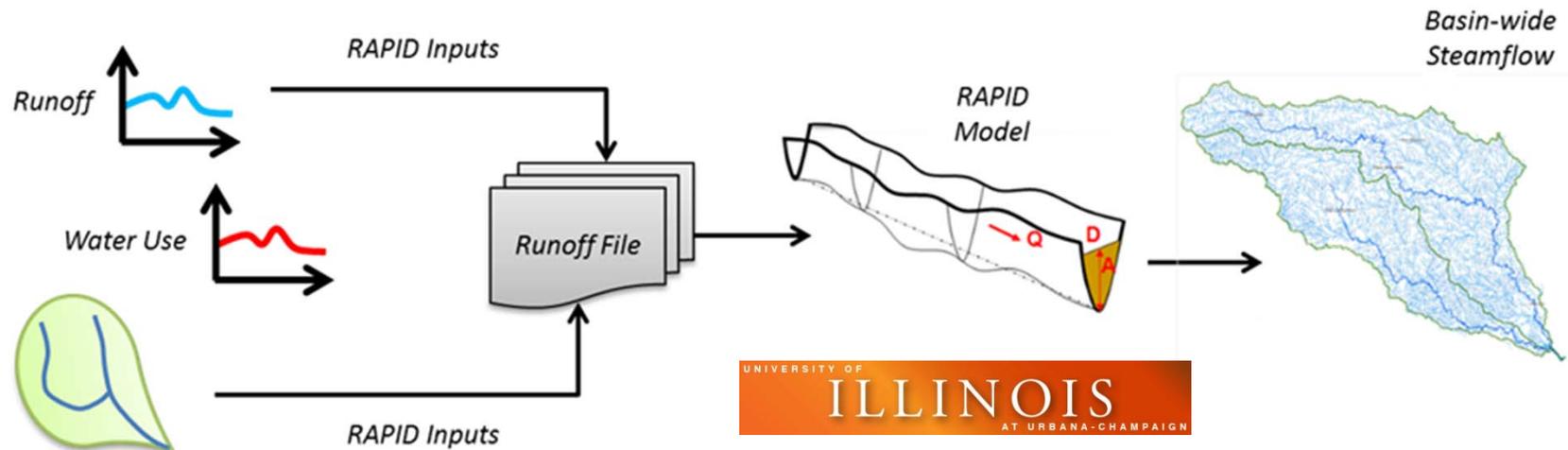
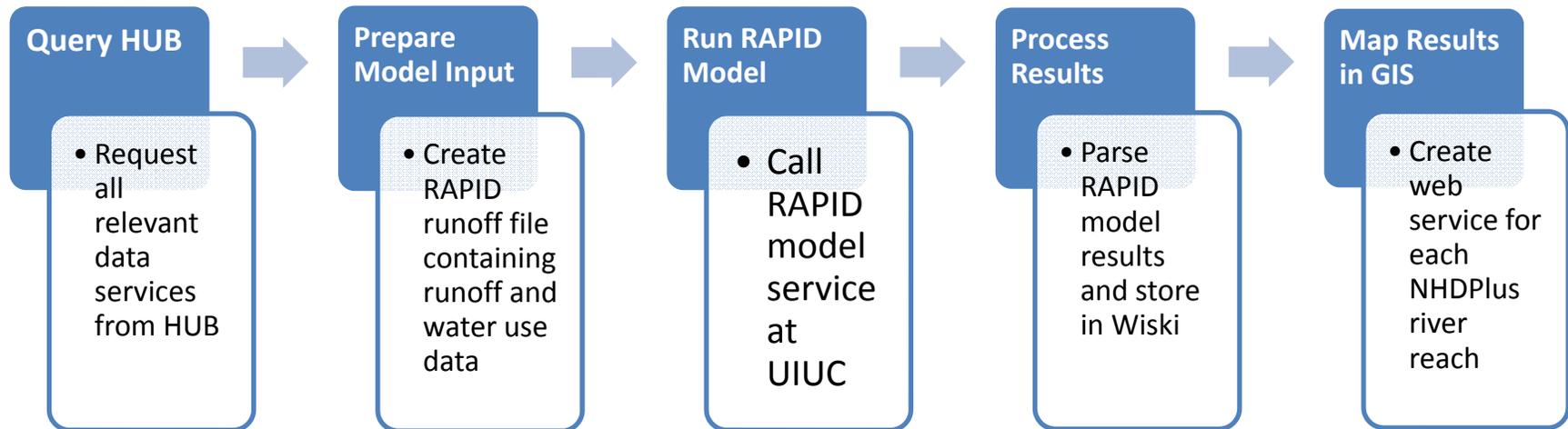
<http://www.ucchm.org/david/rapid.htm>

David et al. (2011) DOI:
10.1175/2011JHM1345.1

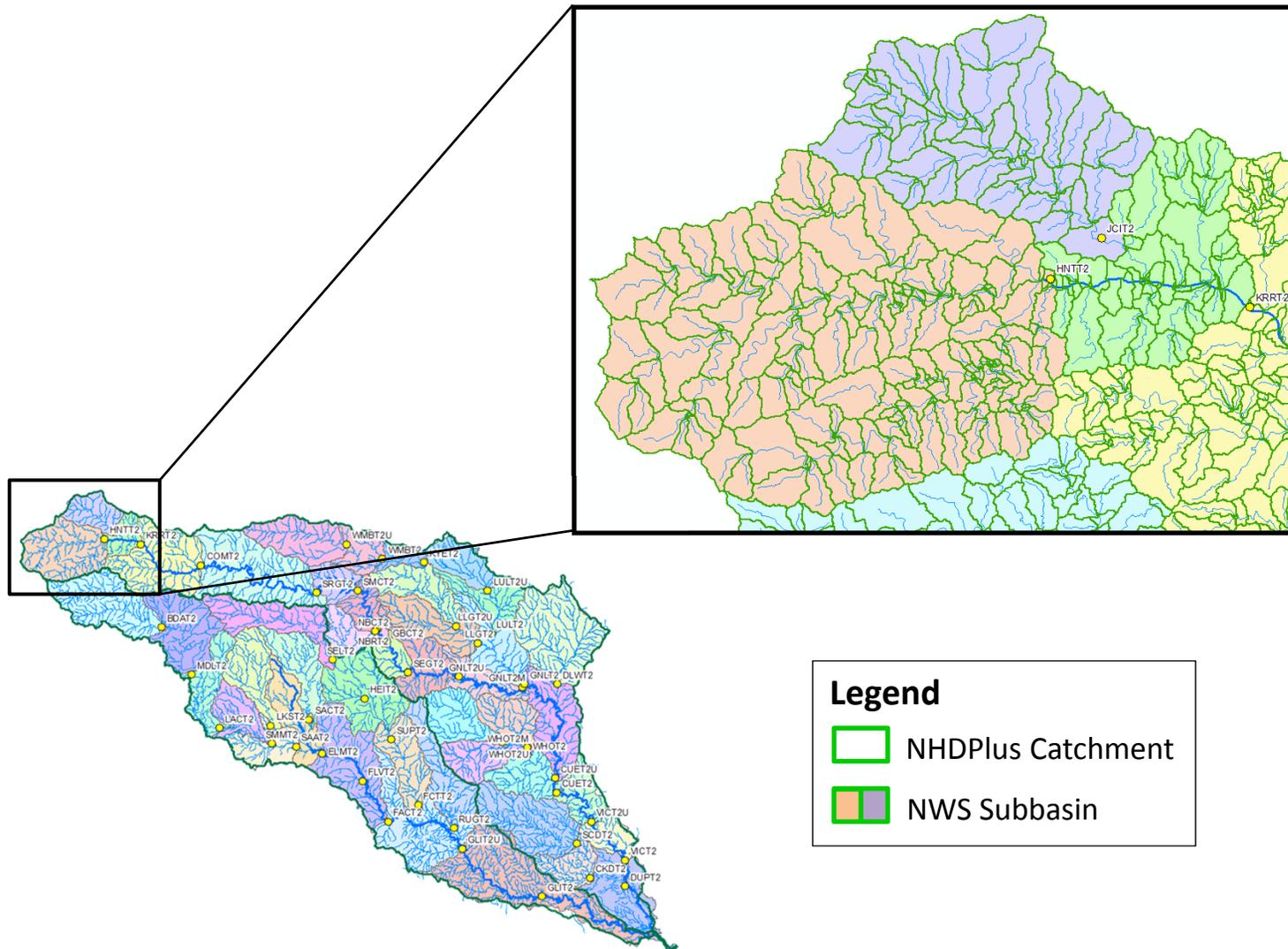
GIS data describes 5,175 river reaches . . .
. . . simulate flow in each reach in each time step

Can the HUB inform Models?..YES!

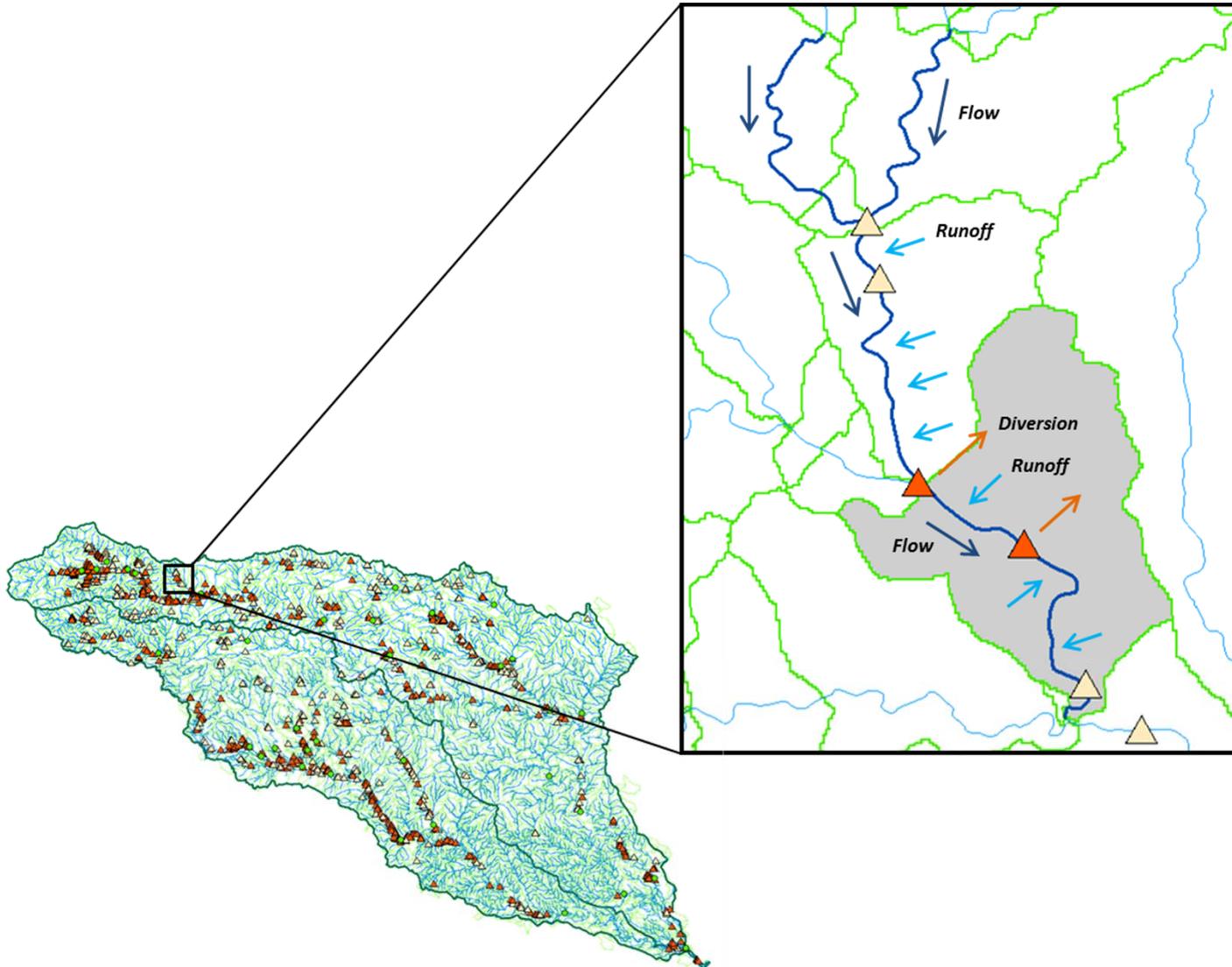
Data Services to Model Services



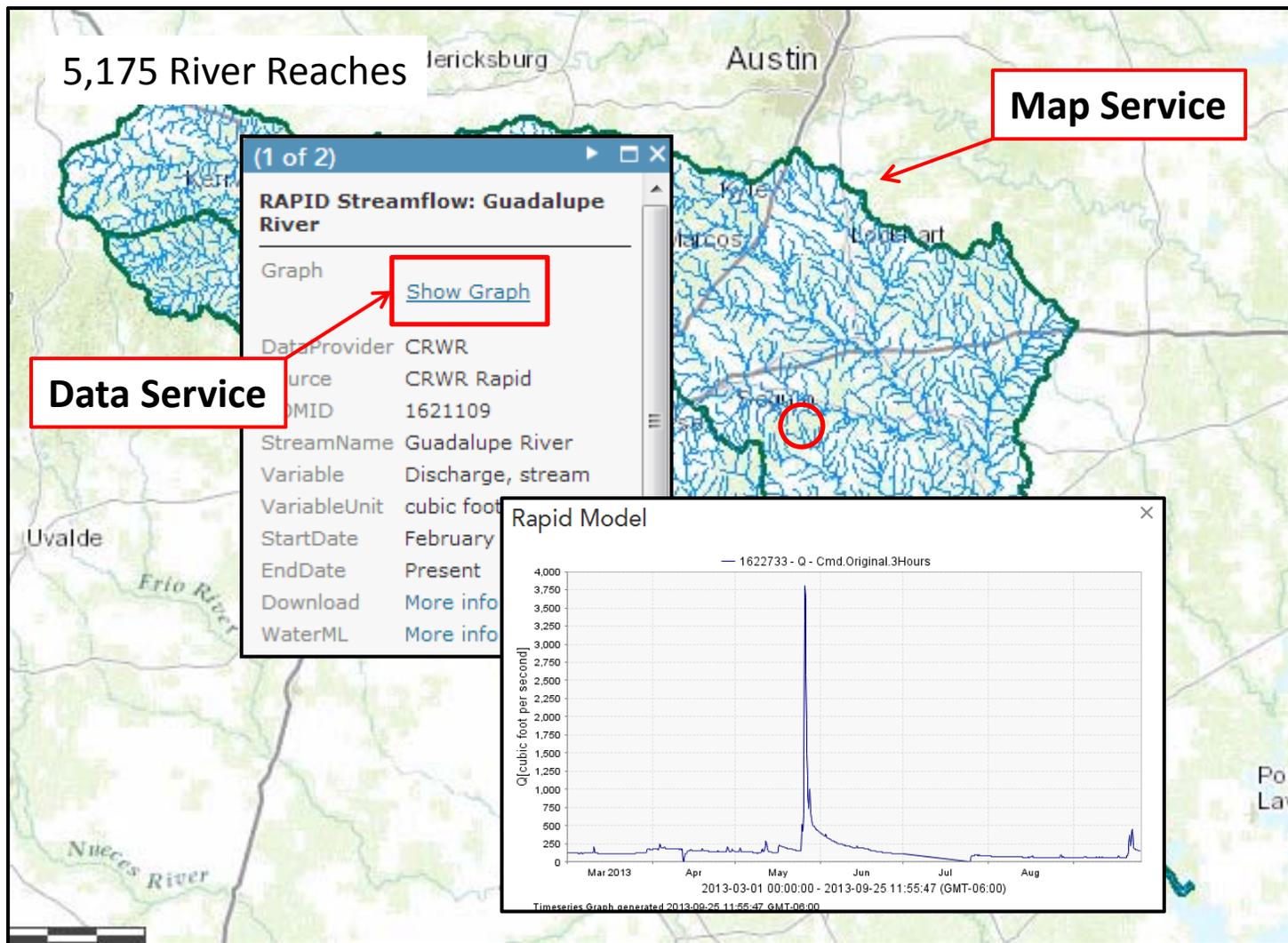
Transform NWS data from 47 forecast points to 5,175 NHDPlus Catchments and River Reaches



Computing Inputs for RAPID Model

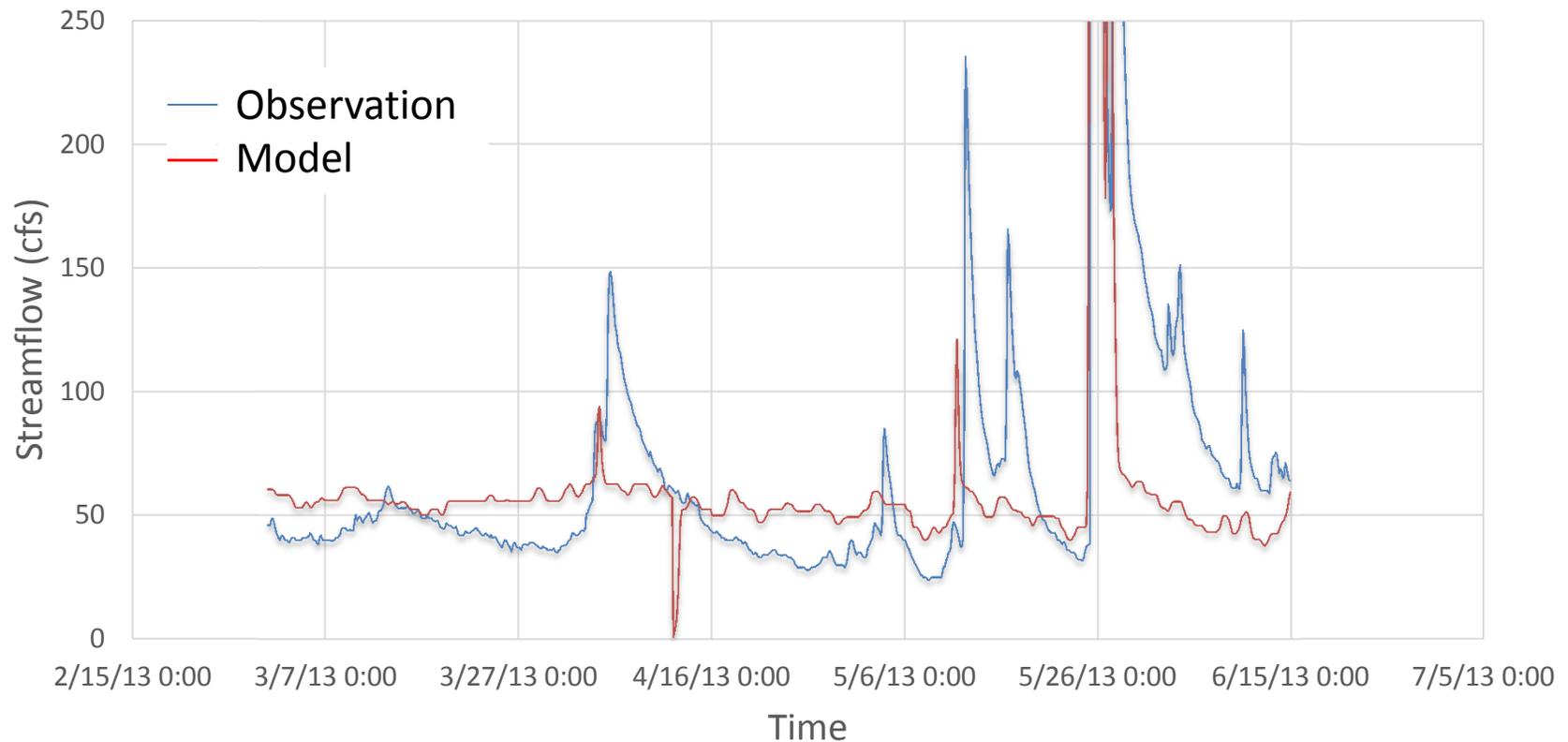


Models: CRWR Streamflow



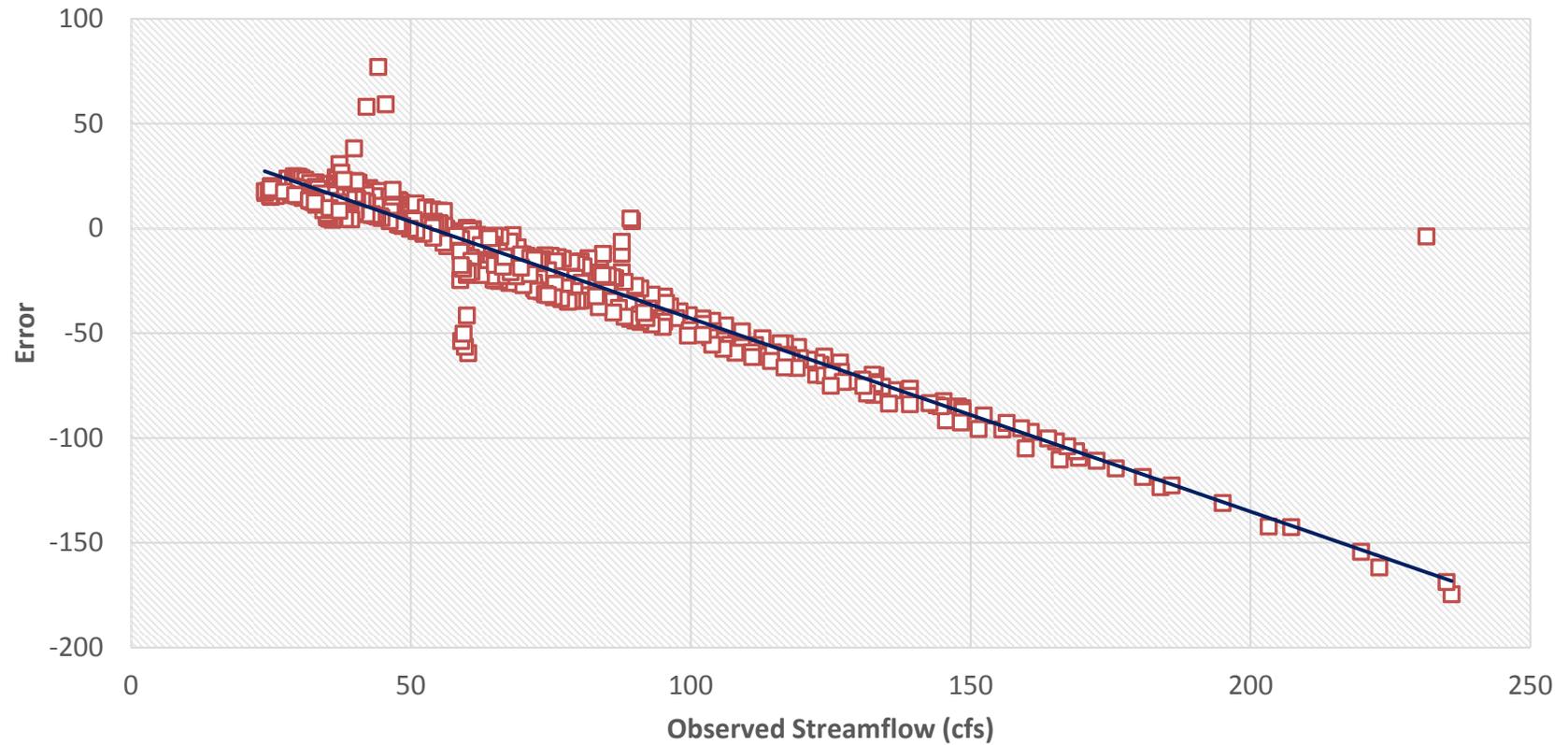
Correcting for Bias and Model Error

Guadalupe River at Spring Branch



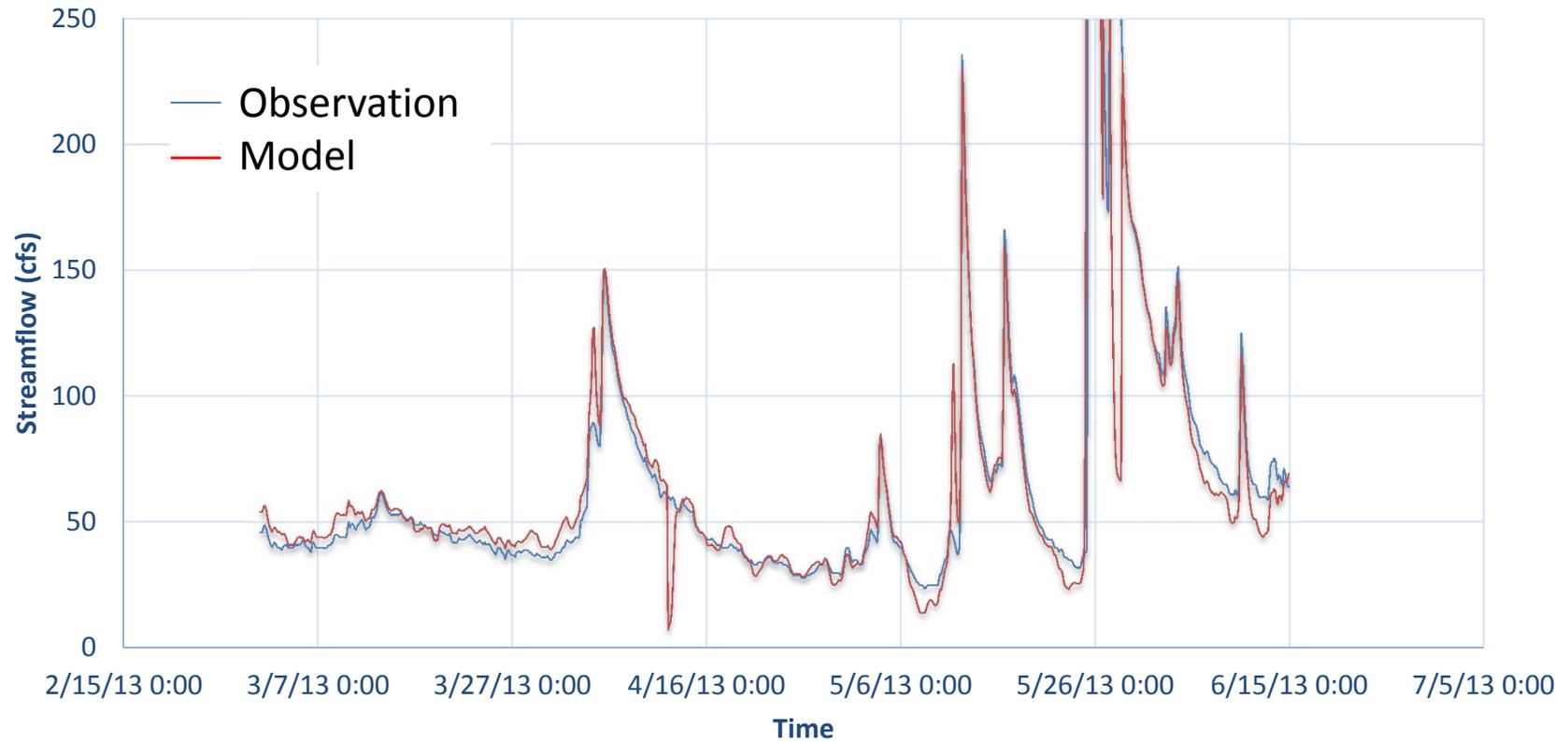
Correcting for Bias and Model Error

Model Error vs. USGS Observation



Correcting for Bias and Model Error

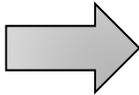
Guadalupe River at Spring Branch



Inputs



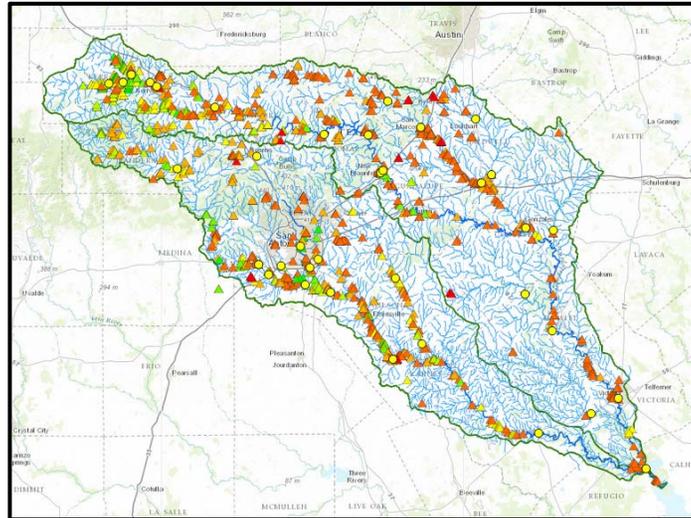
Observation
Data
Services



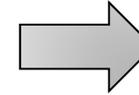
Geospatial
Data
Services

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Water Web Services HUB

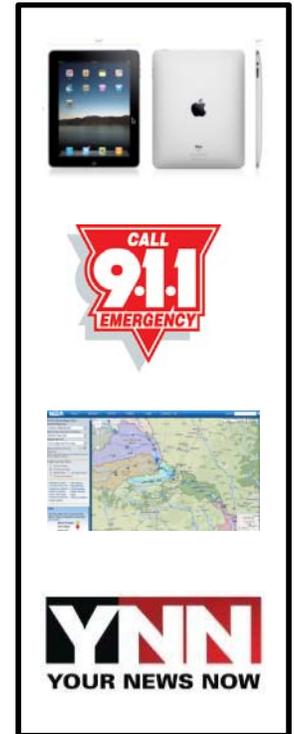


Data
Services

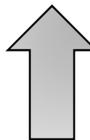
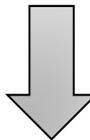


Map
Services

Outputs



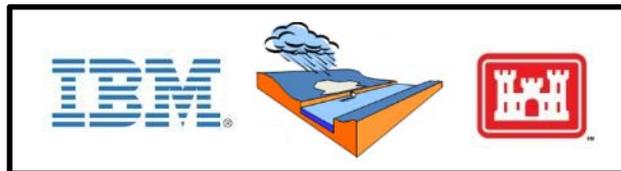
Data
Services



Modeling
Services



Mapping
Services



Models



Maps

Land Surface Calculations for Texas

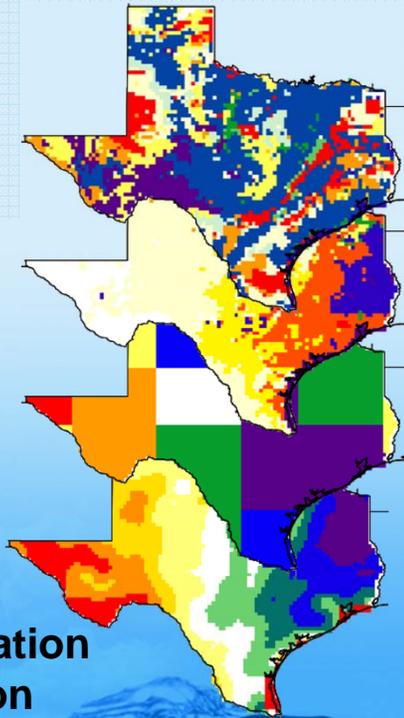
Land surface features

Soil type

Land cover

Soil color

Green vegetation fraction



NLDAS atmospheric forcing

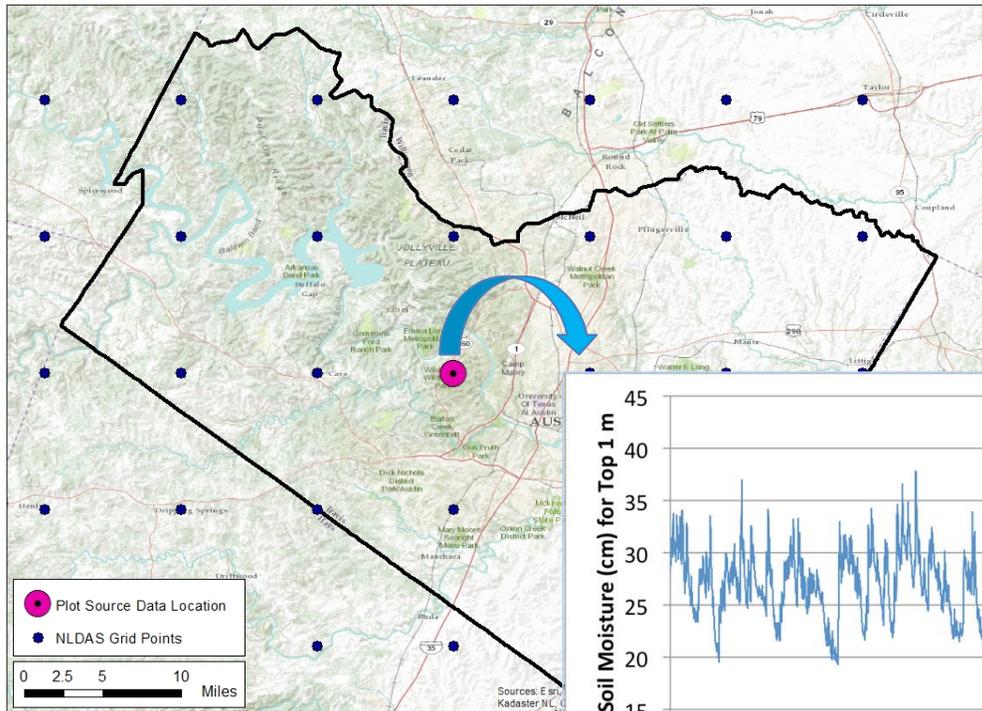
Temperature
Precipitation
Wind speed
Specific humidity
Surface pressure
Downward SW radiation
Downward LW radiation

Noah-MP
land surface
model

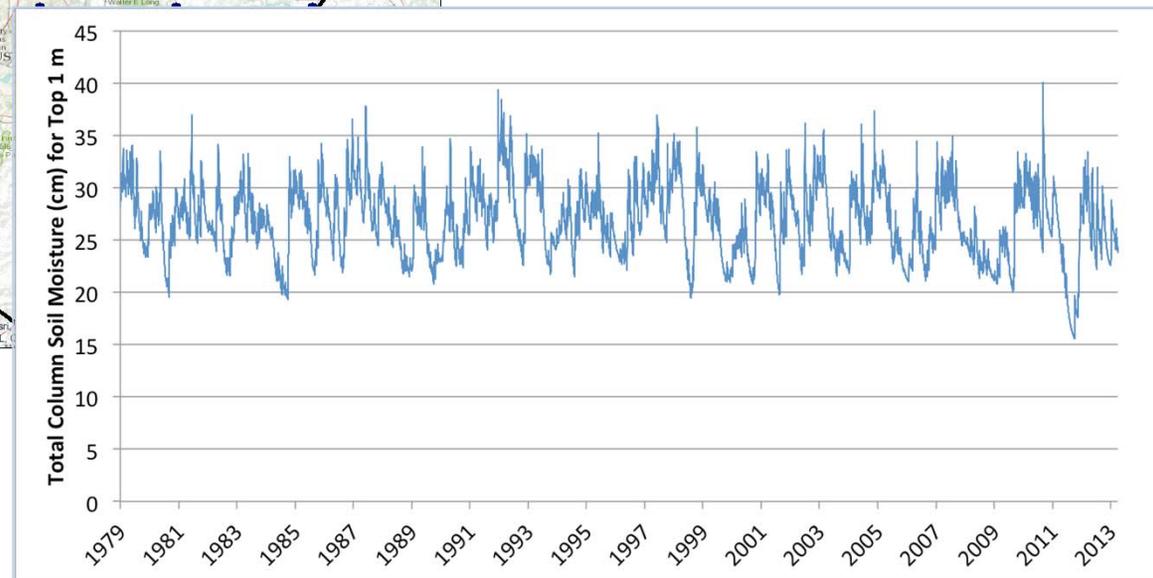
Surface runoff
Sub-surface runoff
Soil moisture
Evapotranspiration
Water table ...

Model
output

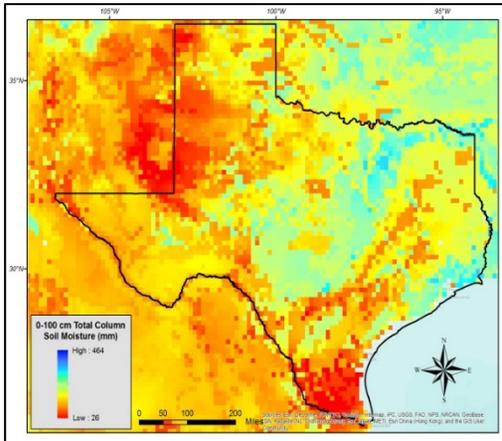
Data Rods for Land Surface Models



**Time series at every
point**



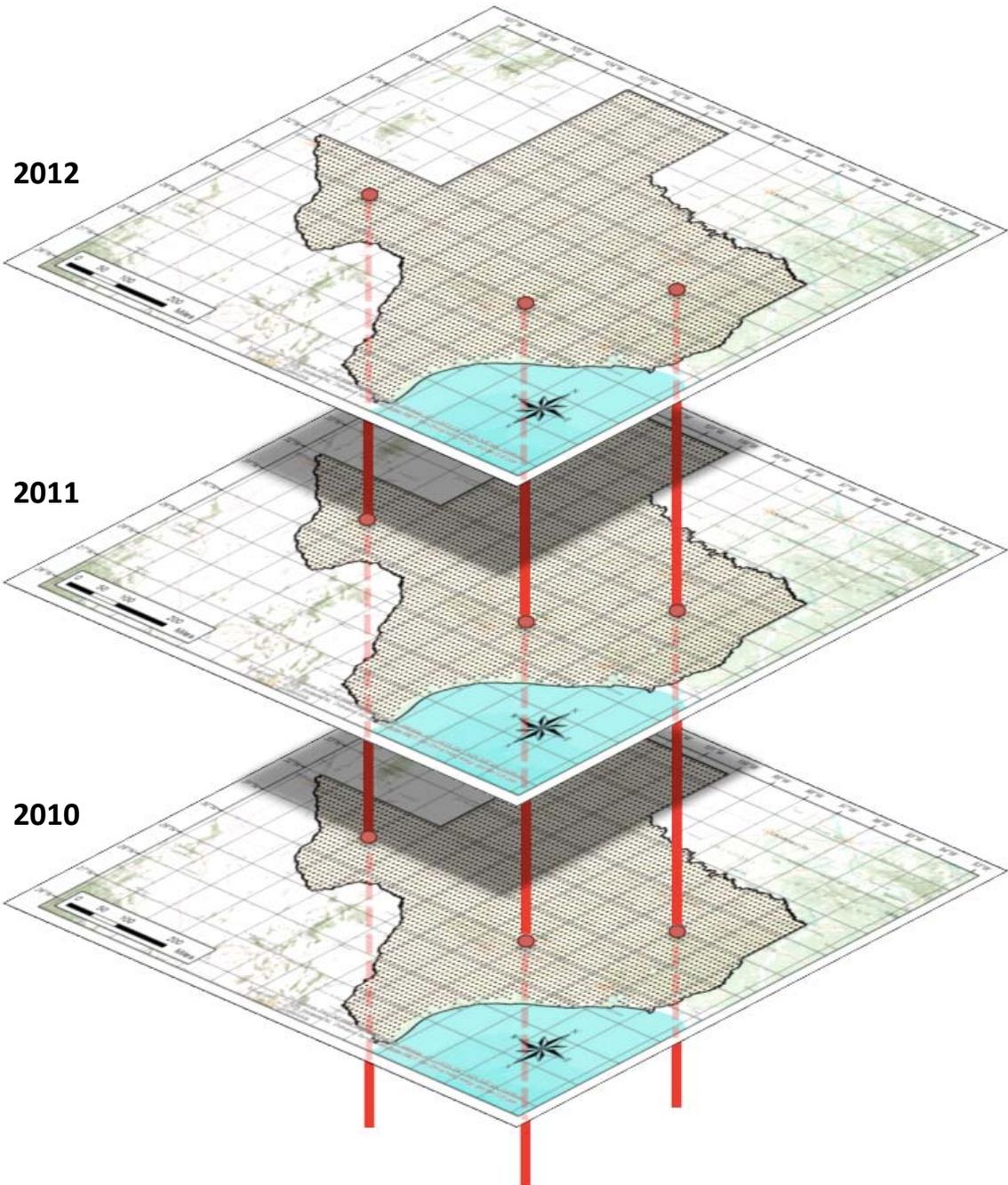
“Data Rods” for Texas



April 25, 2013

**Surface Runoff
Evaporation
Soil Moisture**

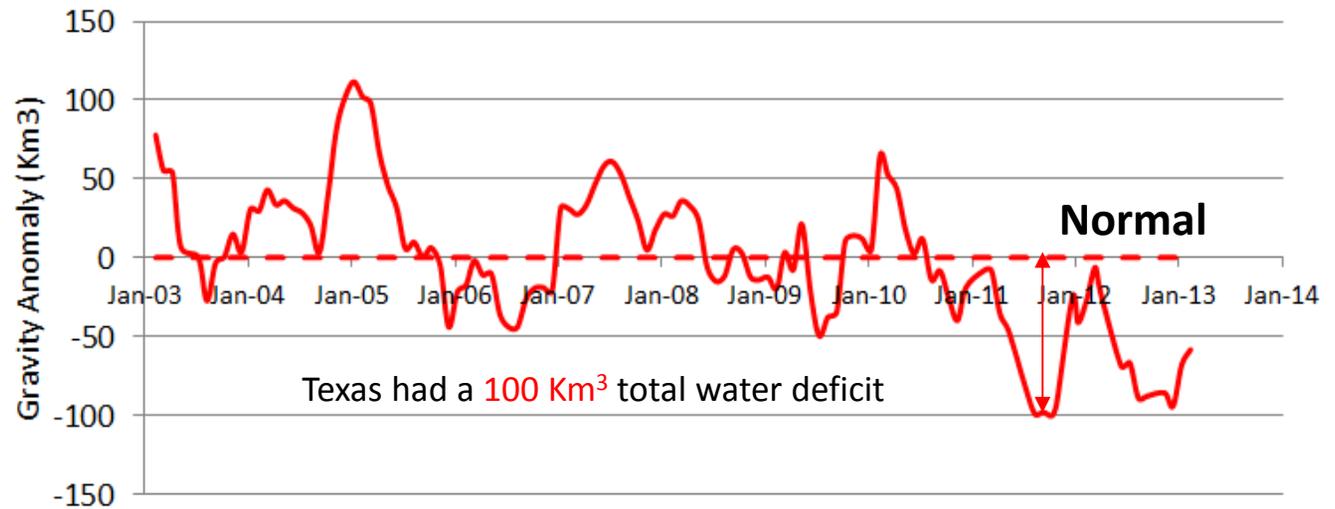
In Texas



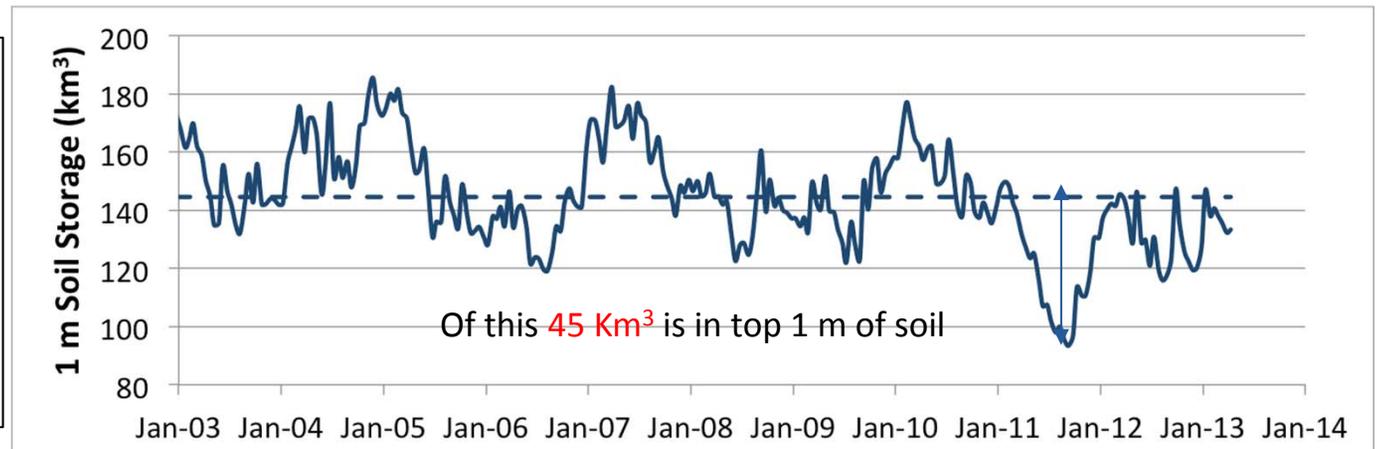
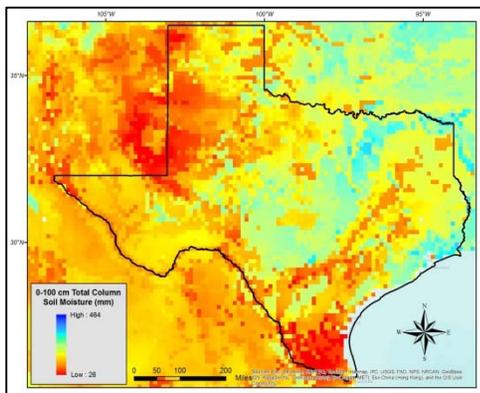
GRACE and Texas Soil Water Storage

Soil water reservoir storage is closely correlated with the GRACE data

Grace Satellites

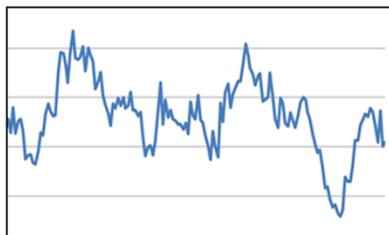


Soil Water in top 1m

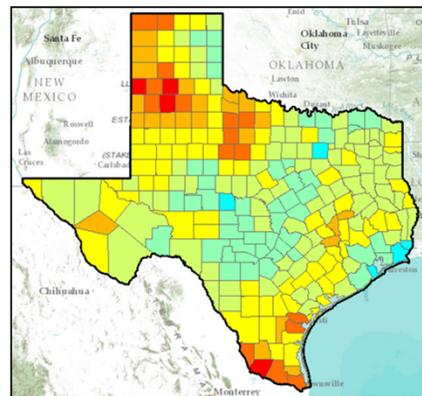


Conclusions

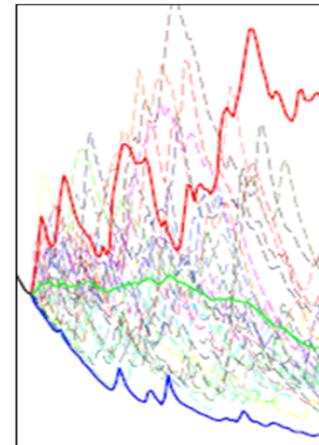
- **Texas Water Resource Information System**
 - Continuously updated, synoptic-scale picture of the water conditions of our state
 - Need statistics from the past, current conditions and predictions to understand water and climate
 - *Web-linked water data and modeling services* from many sources



Statistics from past

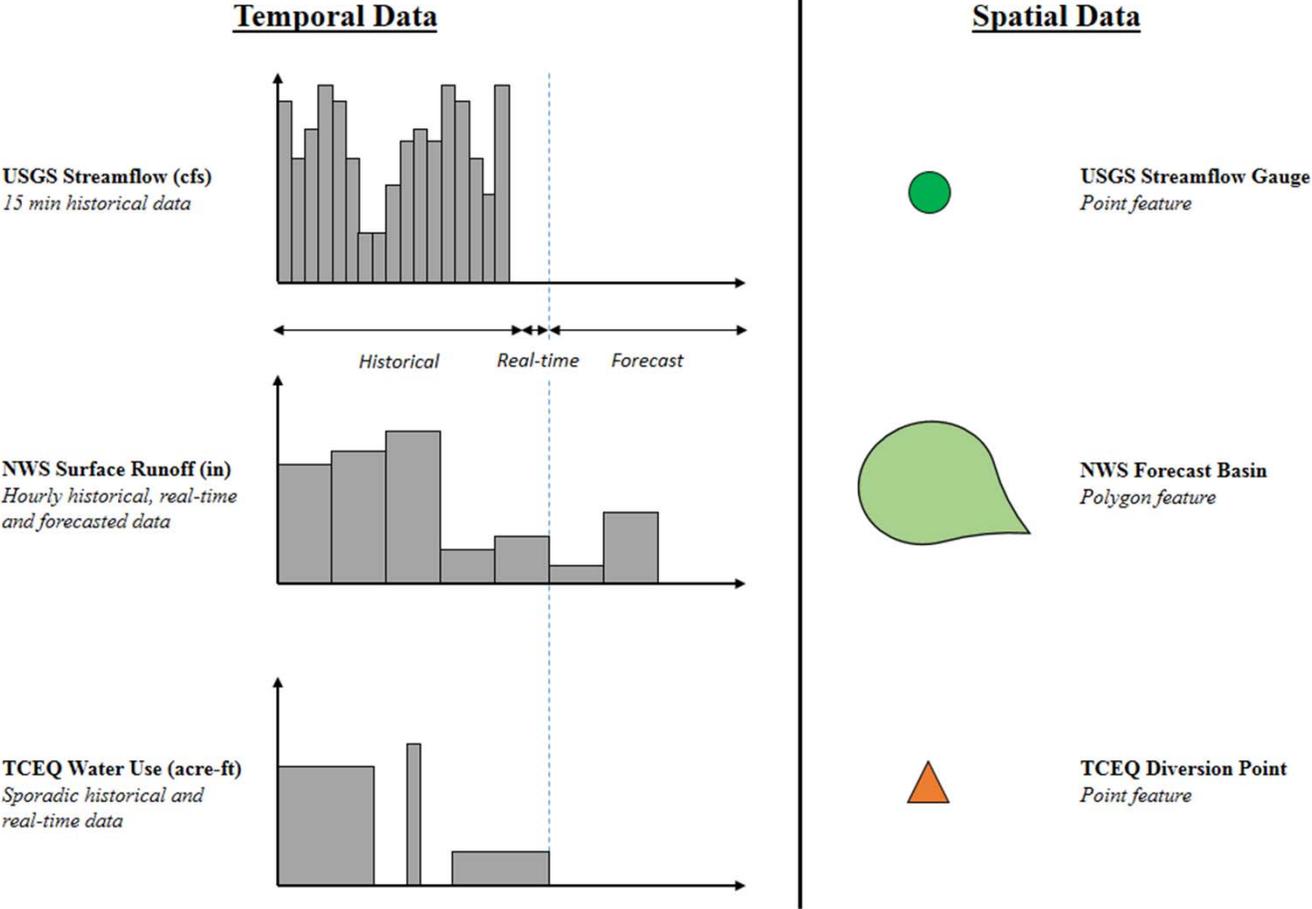


Current situation

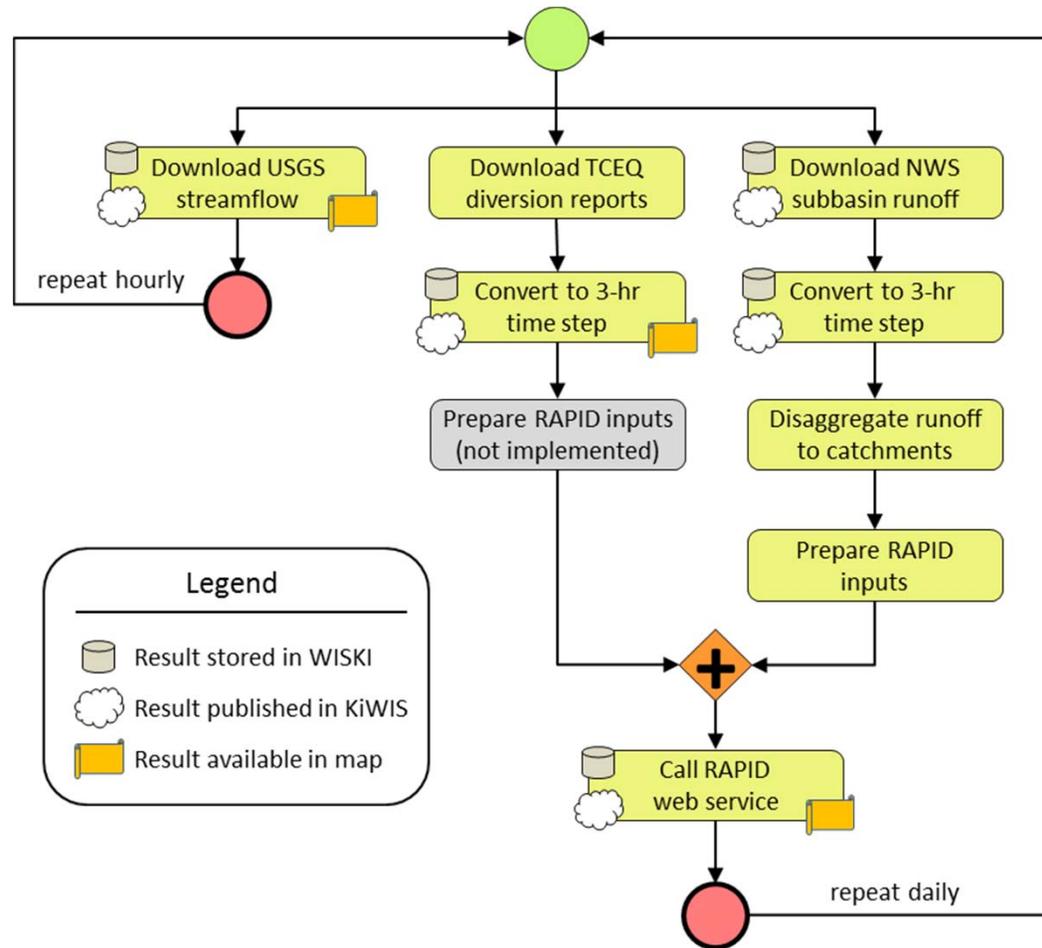


Predictions

Geotemporal Framework for Water Data



Water Operations Model Workflow



Water Operations Model Architecture

