A Terrestrial Hydrology Climate Information Dashboard for Water Management Decision Support in the Rio Grande Basin

Jessica Erlingis (UMD/GSFC)
Kim Locke (SAIC/GSFC)
Sujay Kumar (GSFC)
Lucas Barrett (Reclamation)
Kristen Whitney (NPP/GSFC)
John Bolten (GSFC)

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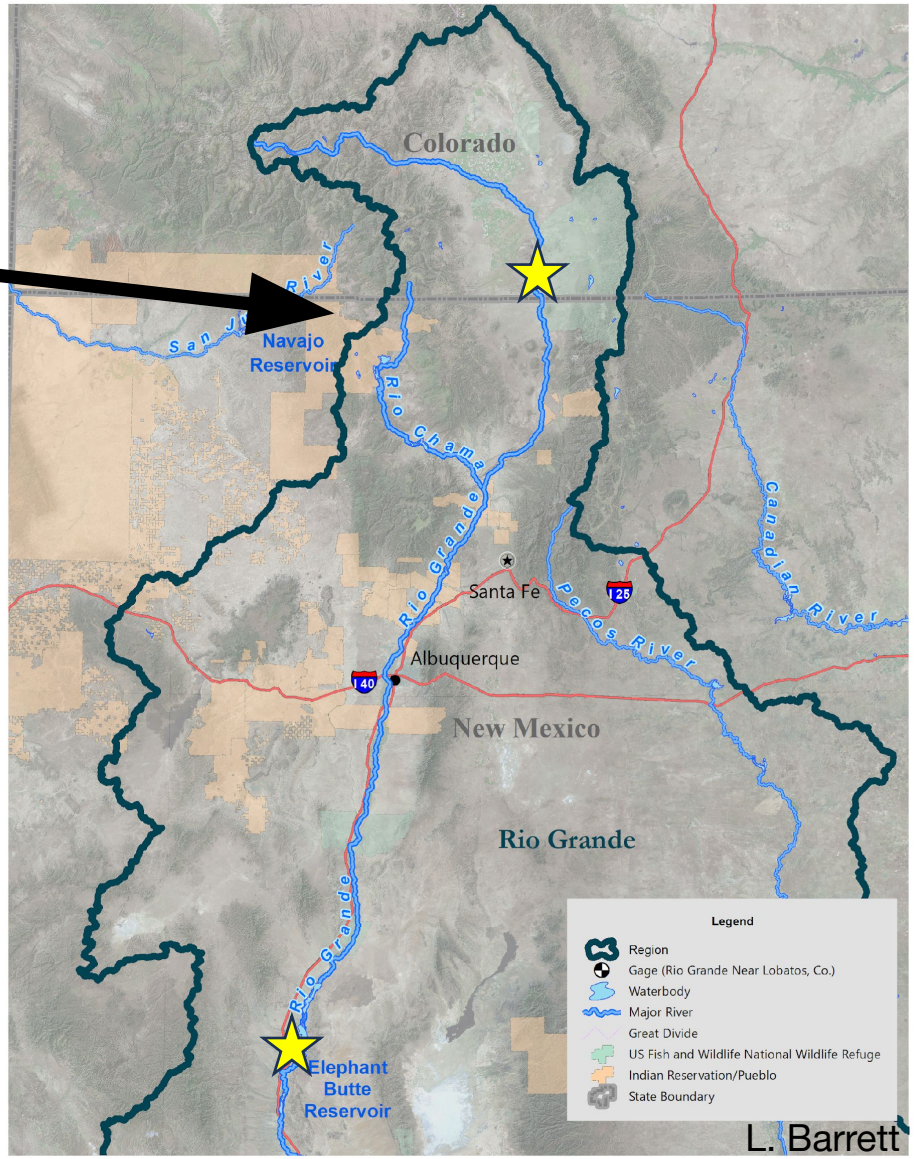
Reclamation Basin Study

- **Rio Grande Basin** Colorado-New Mexico state line (Lobatos stream gage)to Elephant Butte Reservoir **and trans-basin diversion** San Juan – Chama Project

- **Partners:** Reclamation Albuquerque Area Office (AAO), Middle Rio Grande Conservancy District, local water management agencies, irrigation districts and acequias, tribes, municipalities, educational institutions, NGOs, community organizations, etc.

- **Basin Study Area Goals**:
  - Increase preparedness for future changes in water supply and demand
  - Provide technical bases for water planning infrastructure and policy decisions



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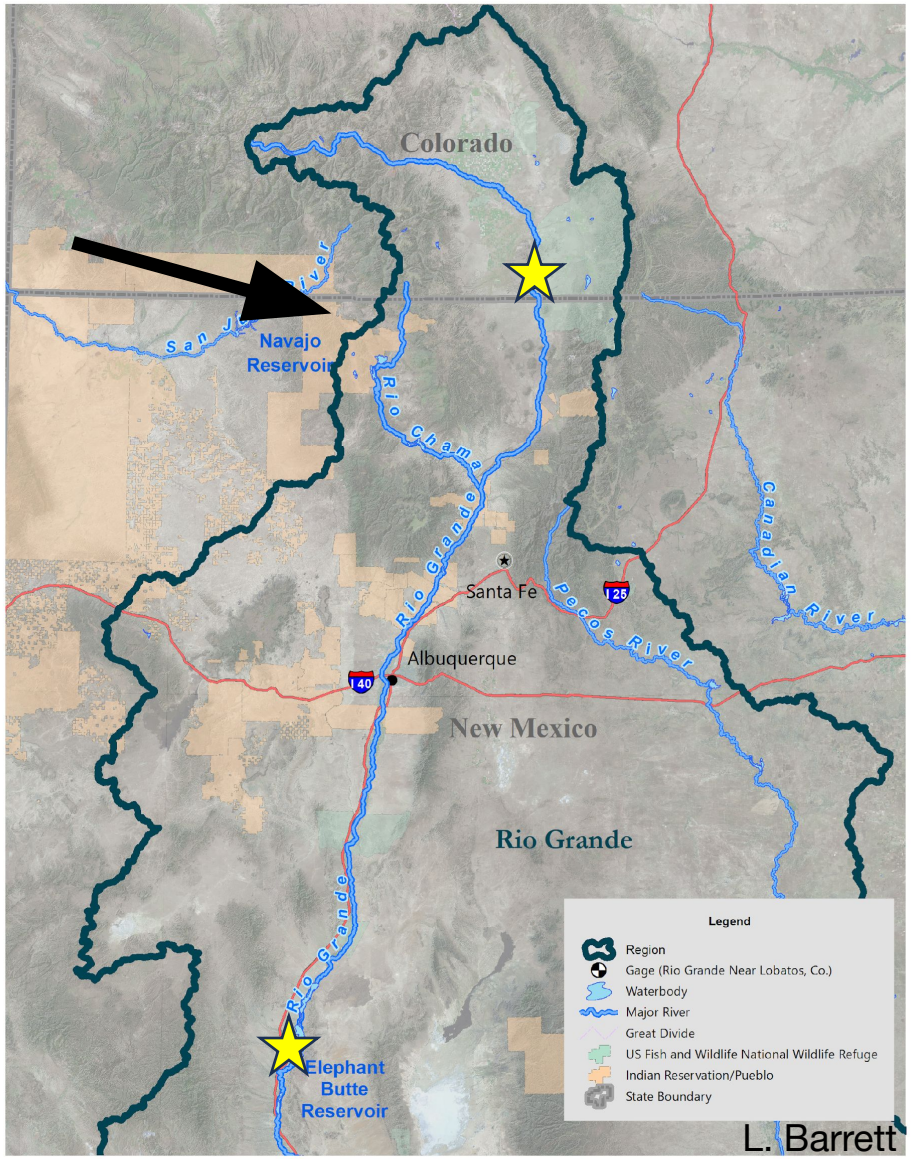
Reclamation Basin Study

- **Basin Study Characteristics**:
  - Home to over 1.1 million people (~55% of New Mexico's population)
  - Includes 20 Pueblos and Tribes
  - Supports ~100,000 acres of irrigated agriculture
  - Includes 3 of New Mexico's 4 largest cities
  - Includes 2 hydroelectric powerplants (24 MW capacity)
  - 3 National Wildlife Refuges



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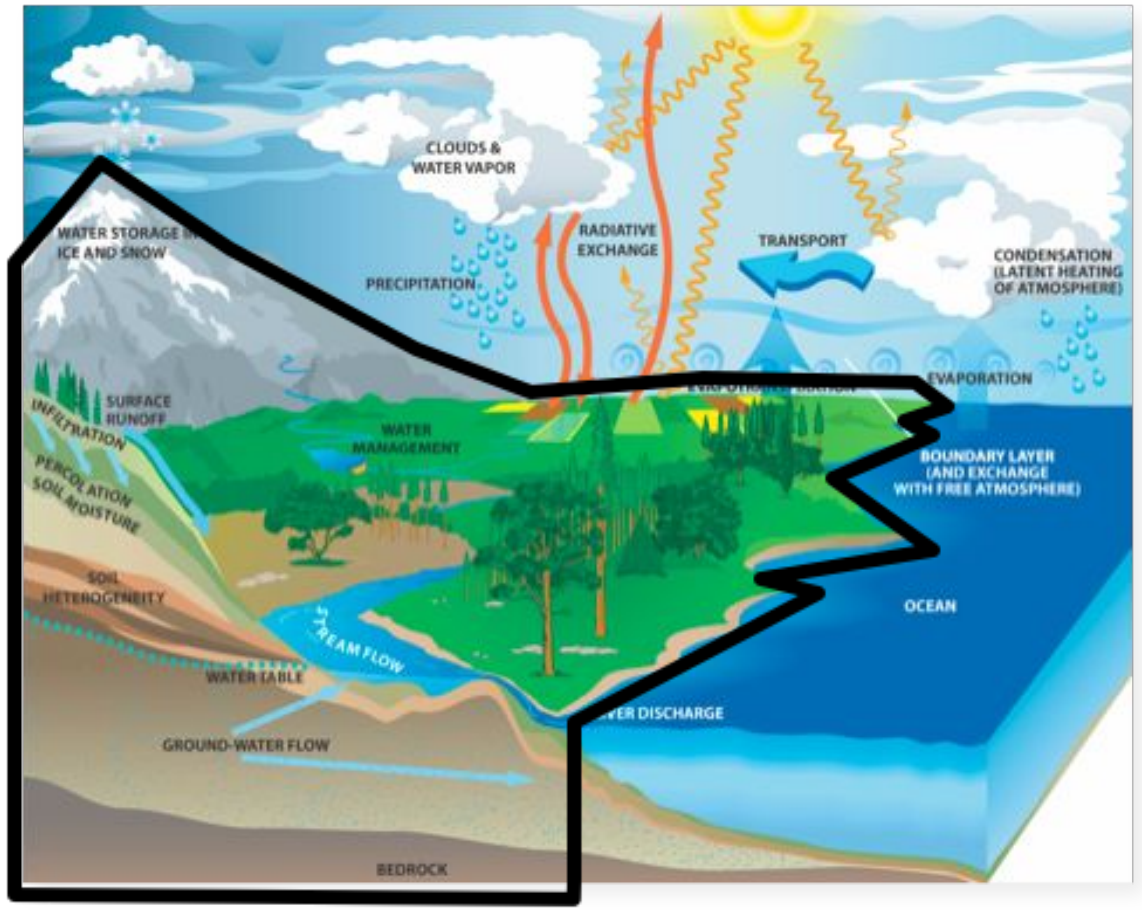
Approach

- Support the basin study's modeling group's efforts to assess changes in water supply and demand by co-developing an online analysis tool to access NASA hydroclimate information from an ensemble of 10 km land surface climate simulations (CASI LIS) from 1950-2100
- Co-create Jupyter notebooks for analysis and "Data Stories" (similar to StoryMaps) that highlight key science questions on NASA's Visualization, Exploration, and Data Analysis (VEDA) open-source science dashboard

Science Goals

- Identify
  - The strongest influences on subbasin streamflow trends
  - The impact of soil moisture deficits on runoff generation processes
  - How future variability in monsoon timing and rainfall will affect water supply in the basin study region
  - Changing risk of drought under climate change

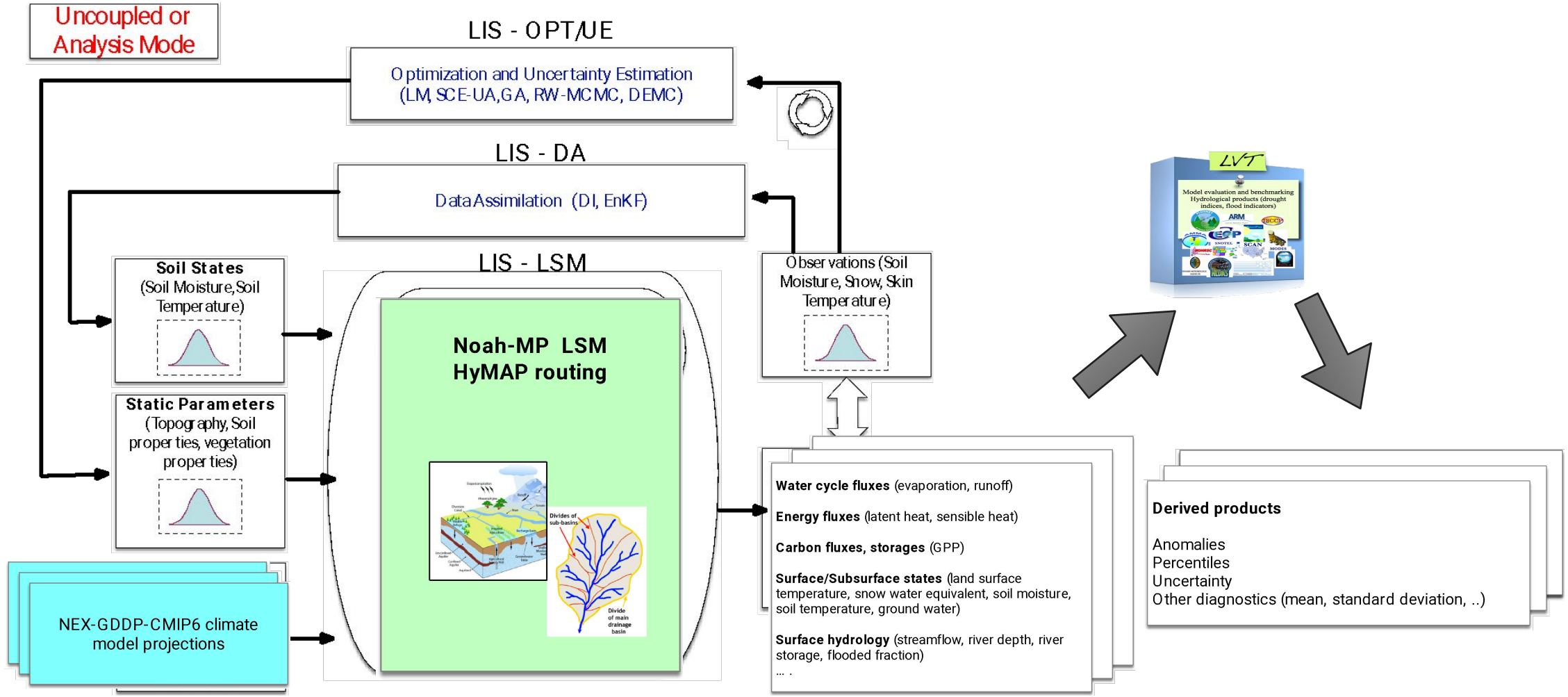
- LIS is a land surface modeling and data assimilation system (LDAS)
- Capable of modeling at different spatial scales, globally and regionally
- Used to study land surface processes and land-atmosphere interactions
- “Use best available observations” to force and constrain the models
- Applications: Weather and climate model initialization, water resources management, natural hazards management



What is NASA’s Land Information System (LIS)?

Scales

A LIS-based configuration has been setup to develop hydrological projections for the NASA Climate Adaptation Science Investigation (CASI)



Downscaled CMIP6 data (NEX-GDDP-CMIP6)

Employs the NASA Earth Exchange (NEX) Global Daily Downscaled Projections (GDDP) dataset (NEX-GDDP-CMIP6)

- Climate scenarios derived from CMIP6
- Across four Tier-1 greenhouse gas emissions scenarios known as Shared Socio-economic Pathways (SSPs)
- Developed for the Sixth assessment report of IPCC (IPCC AR6)
- 0.25 deg spatial resolution, globally
- Historical data from 1950 to 2014
- Future projections for 2015 to 2100
- Daily data is generated by applying the Bias-Correction Spatial Disaggregation (BCSD) method to the Princeton forcing data (Sheffield et al. 2006)
- Includes 36 GCMs, employed as ensembles within LIS. A reduced set of 25 ensemble models are used after removing ”hot” models
- Four SSPs – 1.2.6, **2.4.5**, 3.7.0, **5.8.5**

Table 1. CMIP6 models included in downscaled archive

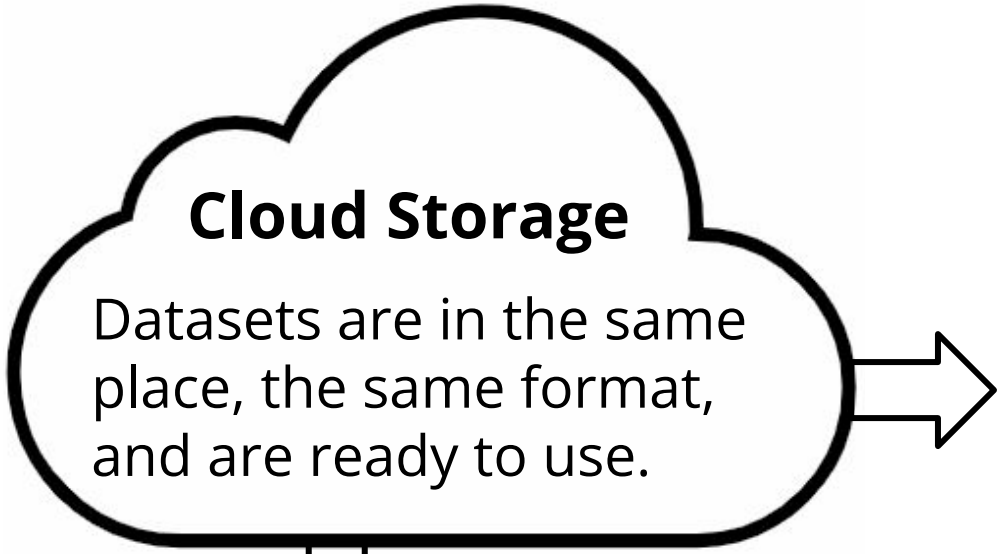
Model	hurs	huss	pr	rlds	rsds	sfcWind	tas	tasmax	tasmin
ACCESS-CM2									
ACCESS-ESM1-5									
BCC-CSM2-MR									
CanESM5									
CESM2									
CESM2-WACCM									
CMCC-CM2-SR5									
CMCC-ESM2									
CNRM-CM6-1									
CNRM-ESM2-1									
EC-Earth3									
EC-Earth3-Veg-LR									
FGOALS-g3									
GFDL-CM4 (gr1)									
GFDL-CM4 (gr2)									
GFDL-ESM4									
GISS-E2-1-G									
HadGEM3-GC31-LL									
HadGEM3-GC31-MM									
IITM-ESM									
INM-CM4-8									
INM-CM5-0									
IPSL-CM6A-LR									
KACE-1-0-G									
KIOST-ESM	*								
MIROC-ES2L									
MIROC6									
MPI-ESM1-2-HR									
MPI-ESM1-2-LR									
MRI-ESM2-0									
NESM3									
NorESM2-LM									
NorESM2-MM									
TaiESM1									
UKESM1-0-LL									

https://www.nccs.nasa.gov/services/data-collections/land-based-products/nex-gddp-cmip6

VEDA: a framework for Earth data visualization and analysis

NASA Uploads Data to the Cloud

✓ **Selects** the most useful datasets
✓ **Transforms** the data into cloud-ready formats
✓ **Uploads** the data to the cloud



Data Visualization and Analysis Tools

- Tools for analyzing data in GIS
- Visualize and explore data in a web browser
- Develop custom tools for using data

Multi-Mission Algorithm and Analysis Platform (MAAP)

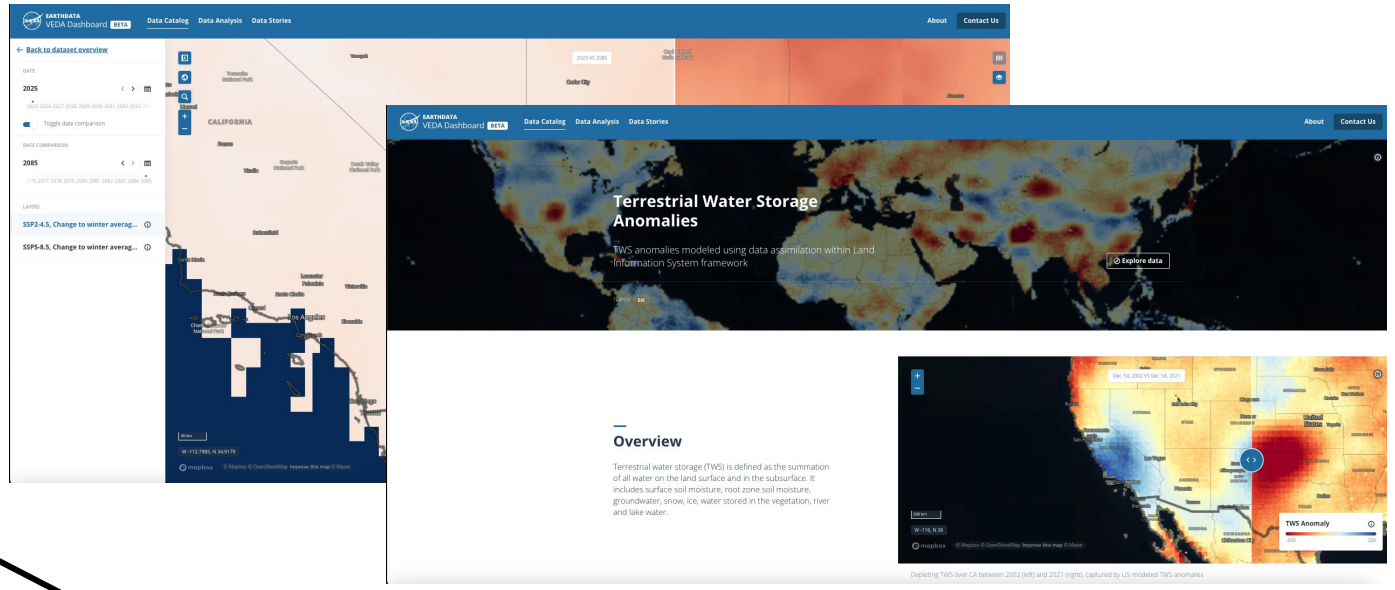
Collaborative cloud environment for data processing, data analysis, and scientific software development

https://www.earthdata.nasa.gov/dashboard/

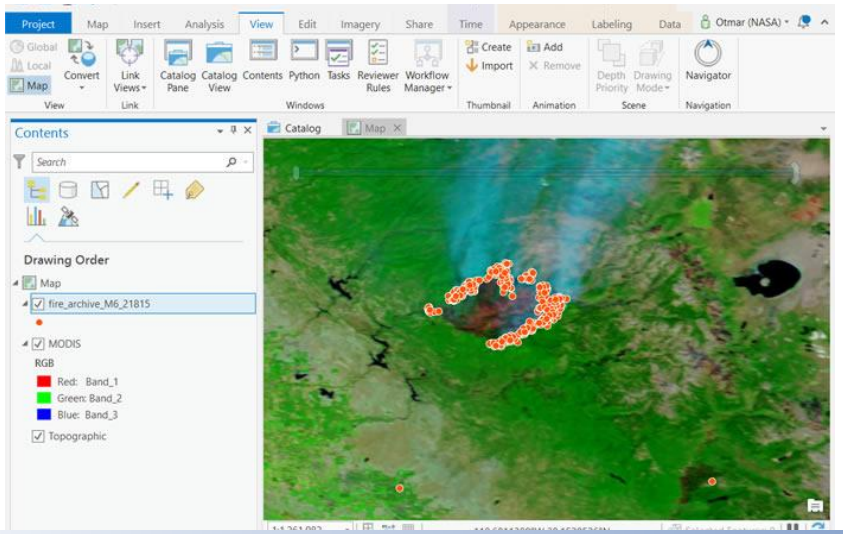
Interactive dashboard capabilities for data-driven storytelling

Cloud Storage

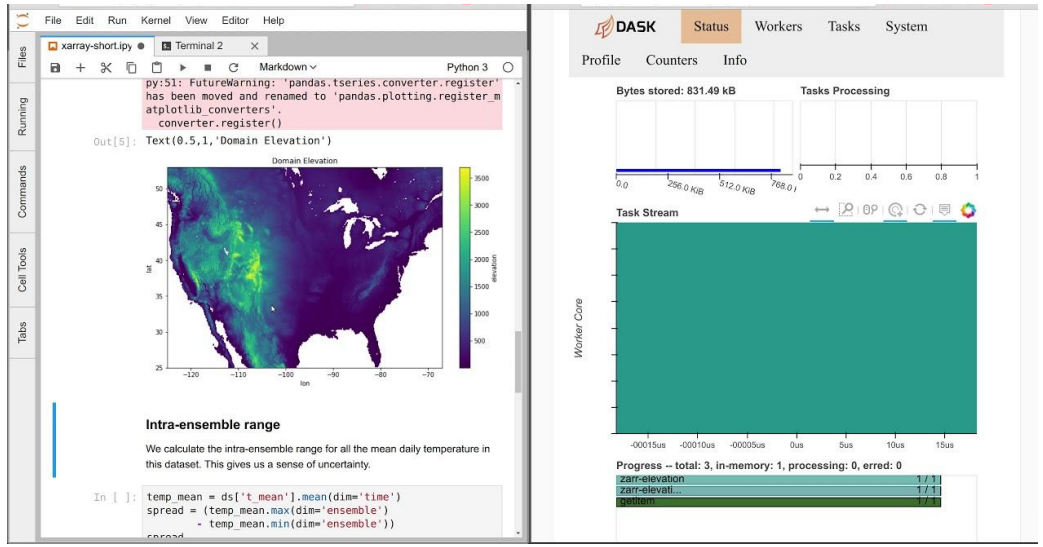
Datasets are in the same place, the same format, and are ready to use.



GIS Applications



Cloud-based analysis in place



Project Timeline

- June 2024 – December 2025
- Monthly discussions with project partners at AAO
- Demonstrate dashboard and incorporate feedback from basin modeling sectoral committee
- Presentation to basin study partners
- Track impact using metrics from VEDA website about use of final tool (number of users, sessions per user, engagement time per page, etc.)

Additional Slides

Temporal disaggregation from daily to sub-daily timescales

To run the land surface and hydrology models, the daily NEX-GDDP-CMIP6 data need to be temporally disaggregated to sub-daily timesteps

This is conducted using the MERRA2 reanalysis climatology, for each variable.