

Integrating Climate Data Into Forecasting Hydrologic Inflow

Forecast Informed Reservoir Operations

Workshop

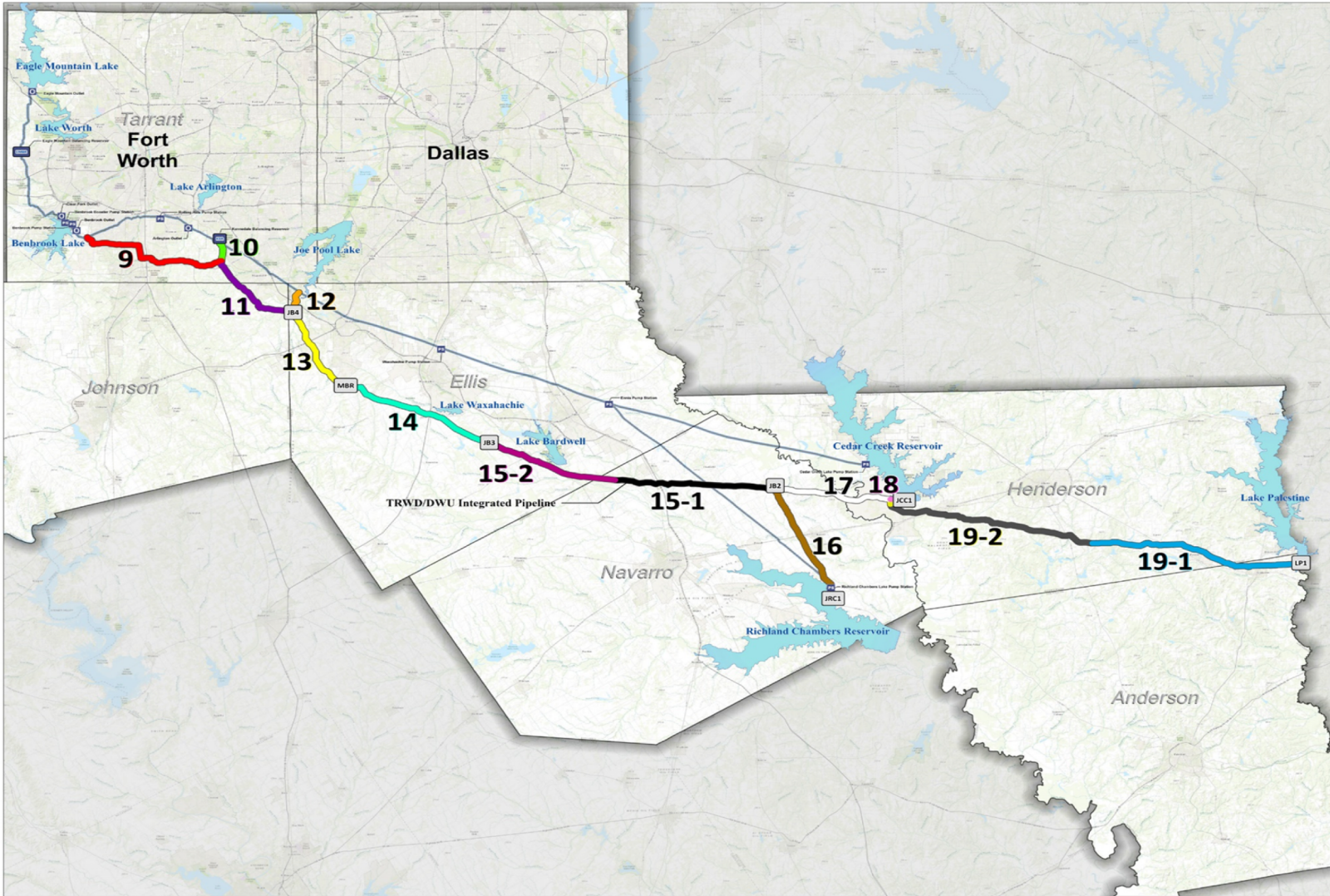
UTA

September 12-13, 2019

Tarrant Regional Water District

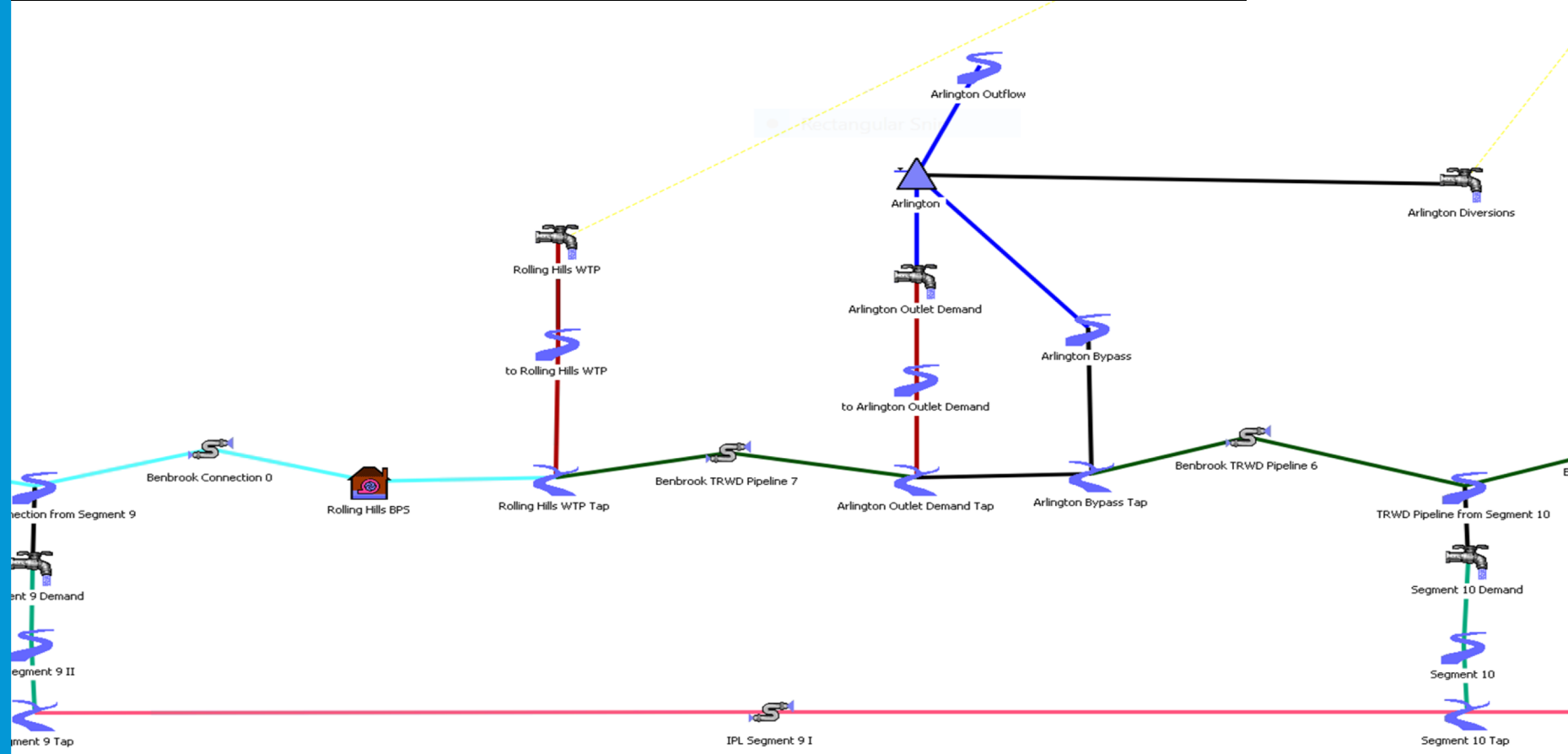
in collaboration with

Hydros Consulting



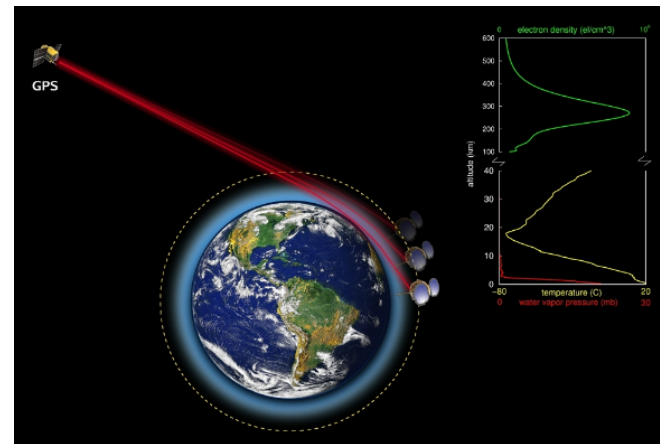
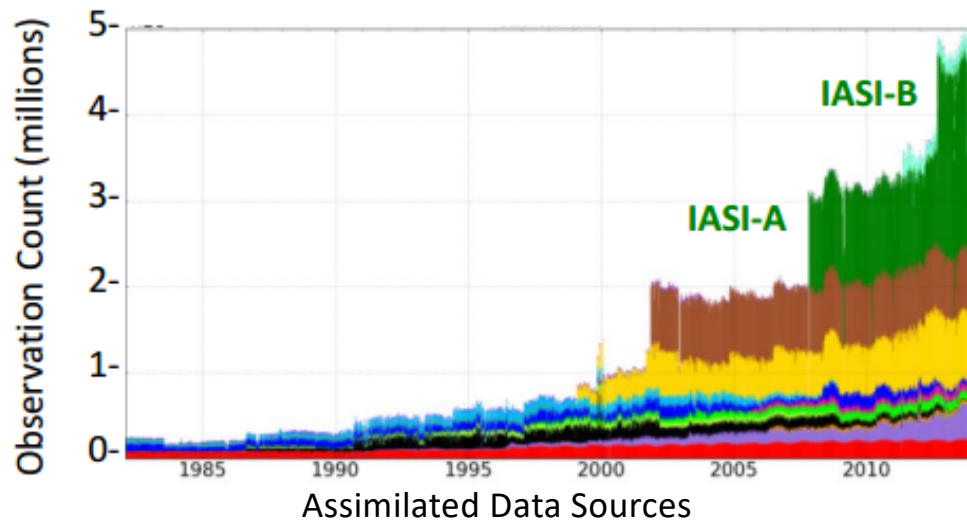
**INTEGRATED
PIPELINE
PROJECT**

RIVERWARE



Climate Reanalysis Data

- MERRA-2 Data from NASA
 - Monthly Data (~70,000,000 Data Points)
 - “Assimilated” Observations from Ground, Air, & Space
 - <https://gmao.gsfc.nasa.gov/reanalysis/MERRA-2/>

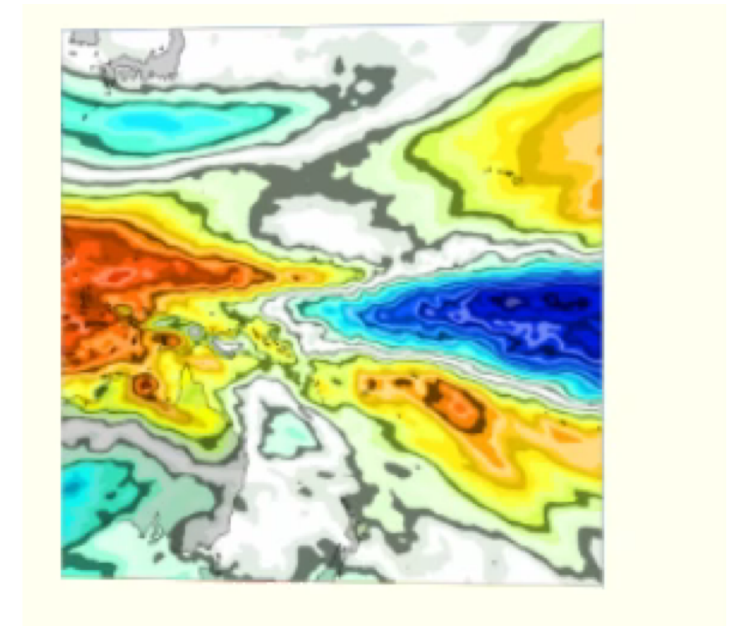


Example: GPS Occultation

Image Sources: NASA Global Modeling and Assimilation Office & UCAR COSMIC

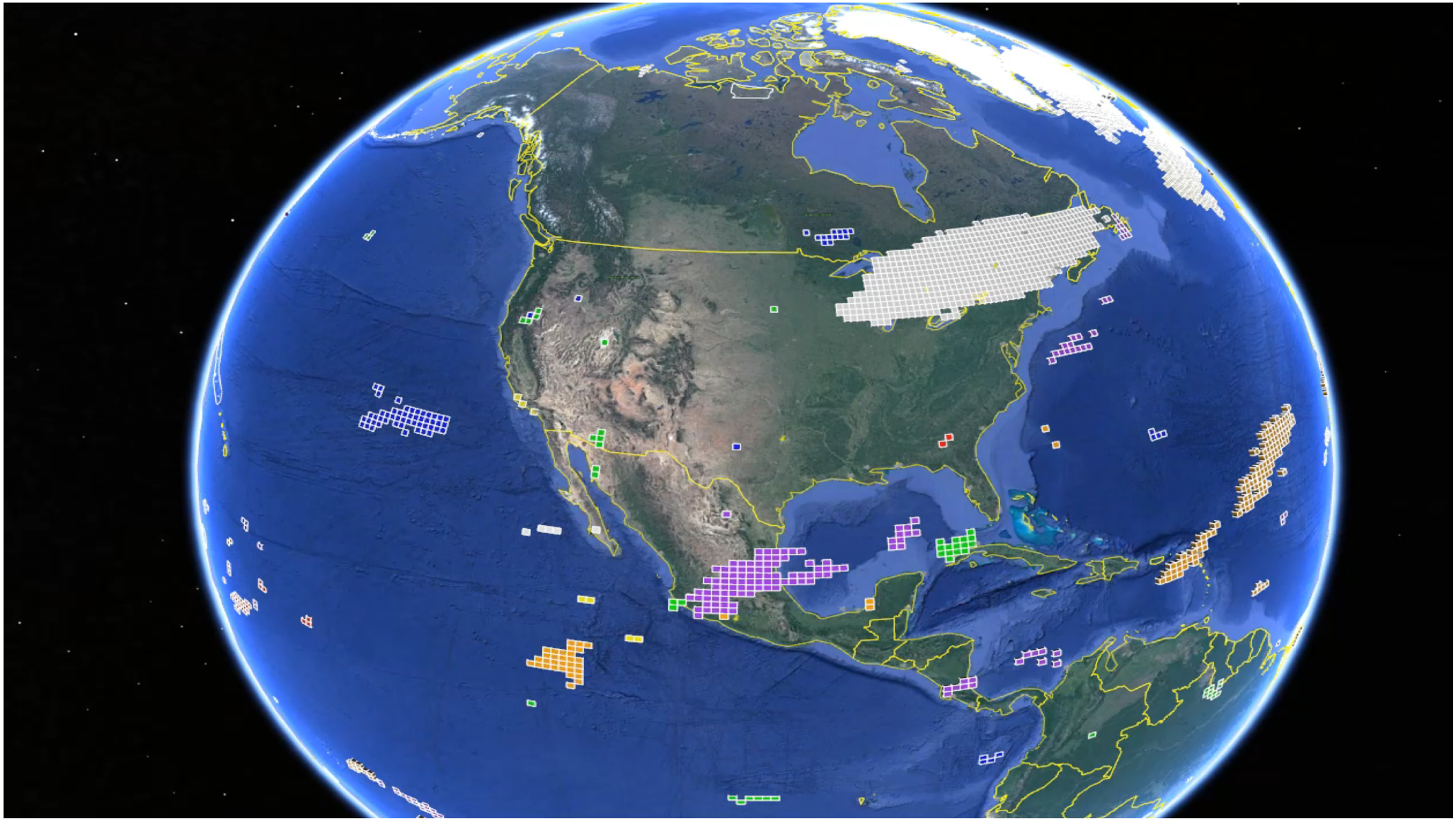
Atmospheric Variables Used at TRWD

| Parameter Description |
|---|
| Relative Humidity |
| Zonal (E-W) Wind |
| Meridional (N-S) Wind |
| Product of Wind Speed Anomalies |
| Covariance of Relative Humidity and Zonal Wind |
| Covariance of Relative Humidity and Meridional Wind |
| Geopotential Height |
| Temperature |



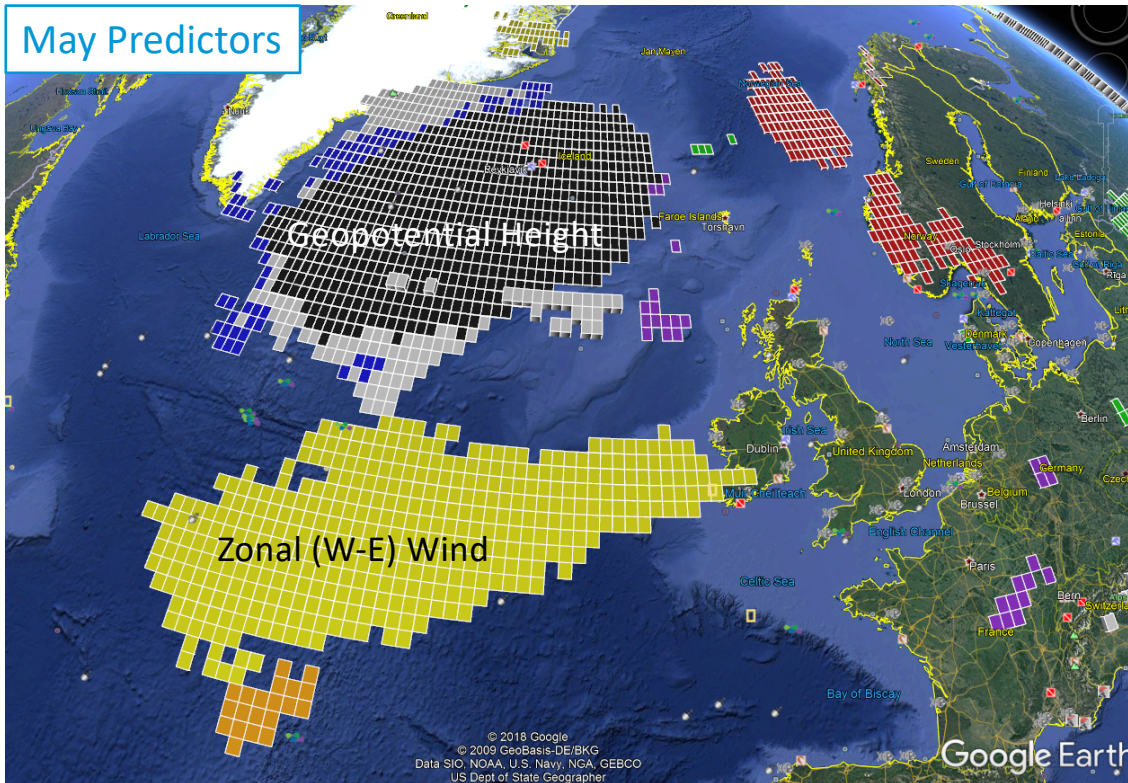
- Wide range of predictors available for each month that correlate to the inflow at TRWD's Reservoirs
- The number of predictors vary from 15 in September to 246 in May

Image Source: NASA Global Modeling and Assimilation Office

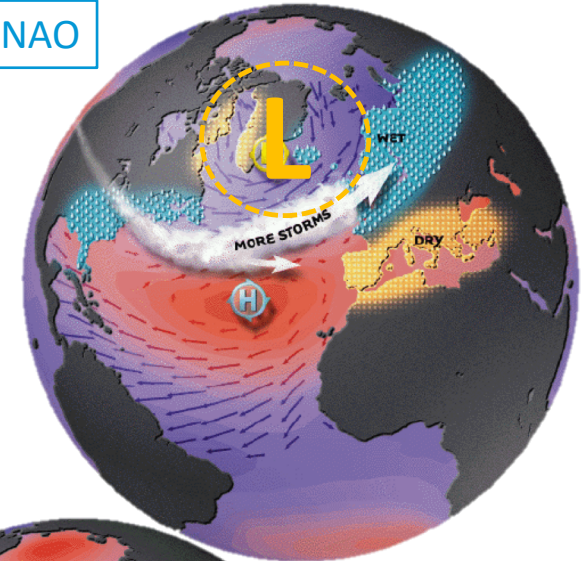


Correlations to the North Atlantic Oscillation (NAO) Found in the Predictors

May Predictors



+NAO



-NAO

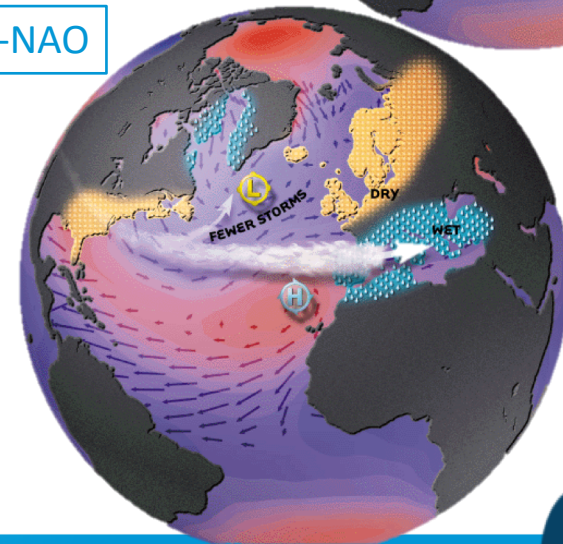
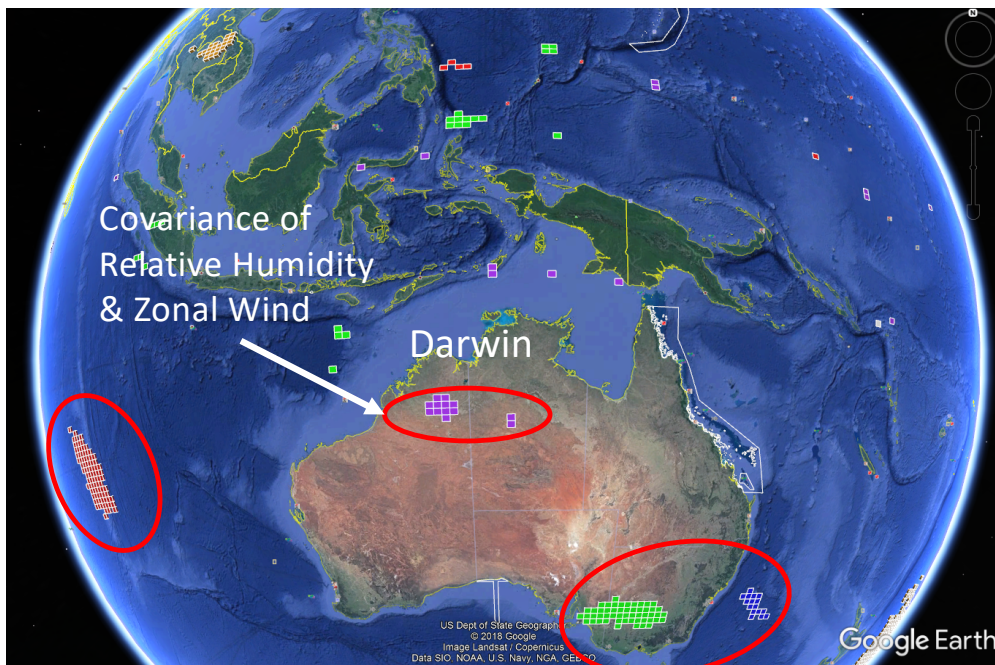


Image Sources: Google Earth & Ideo.Columbia.edu

Correlations to ENSO Found in the Predictors



Covariance of Relative Humidity & Zonal Wind

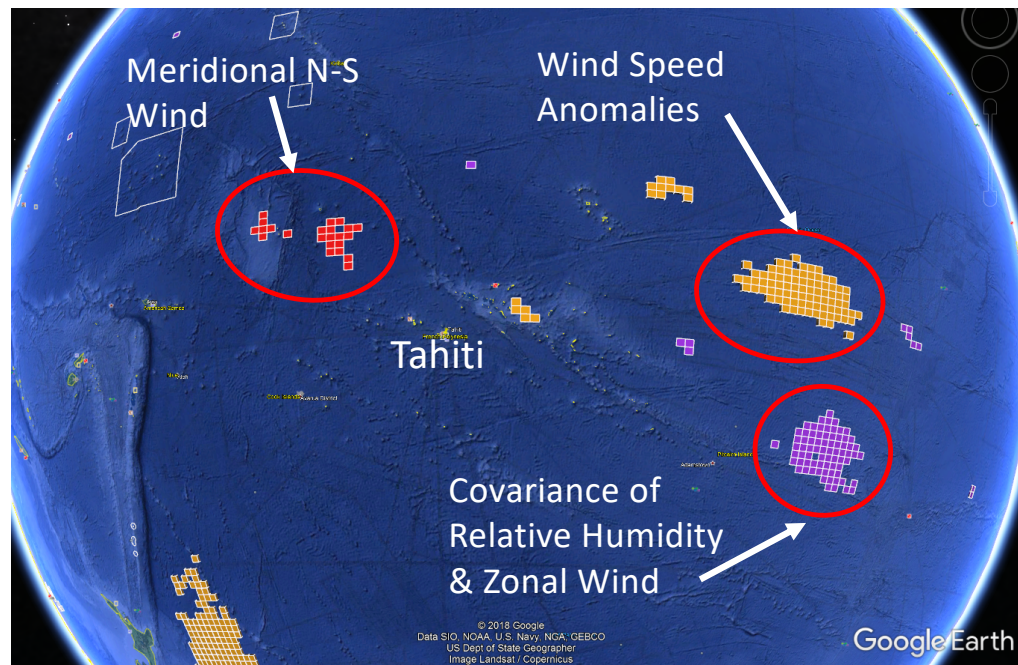
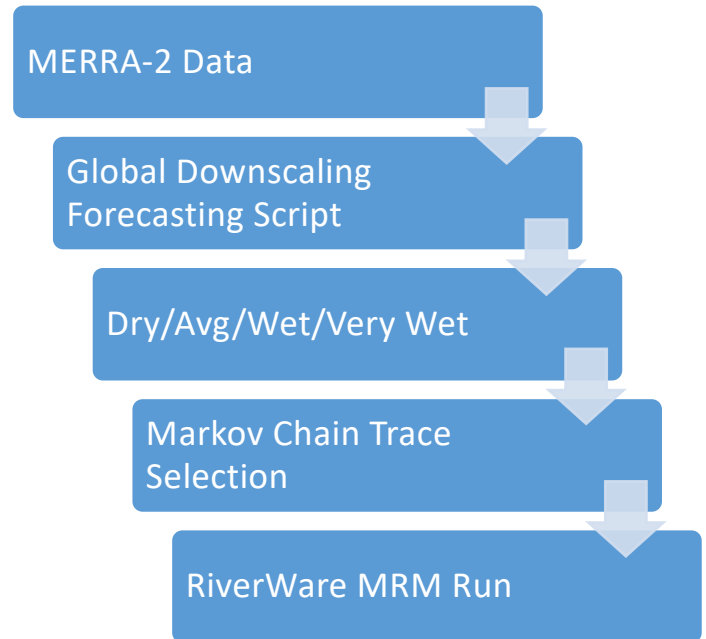


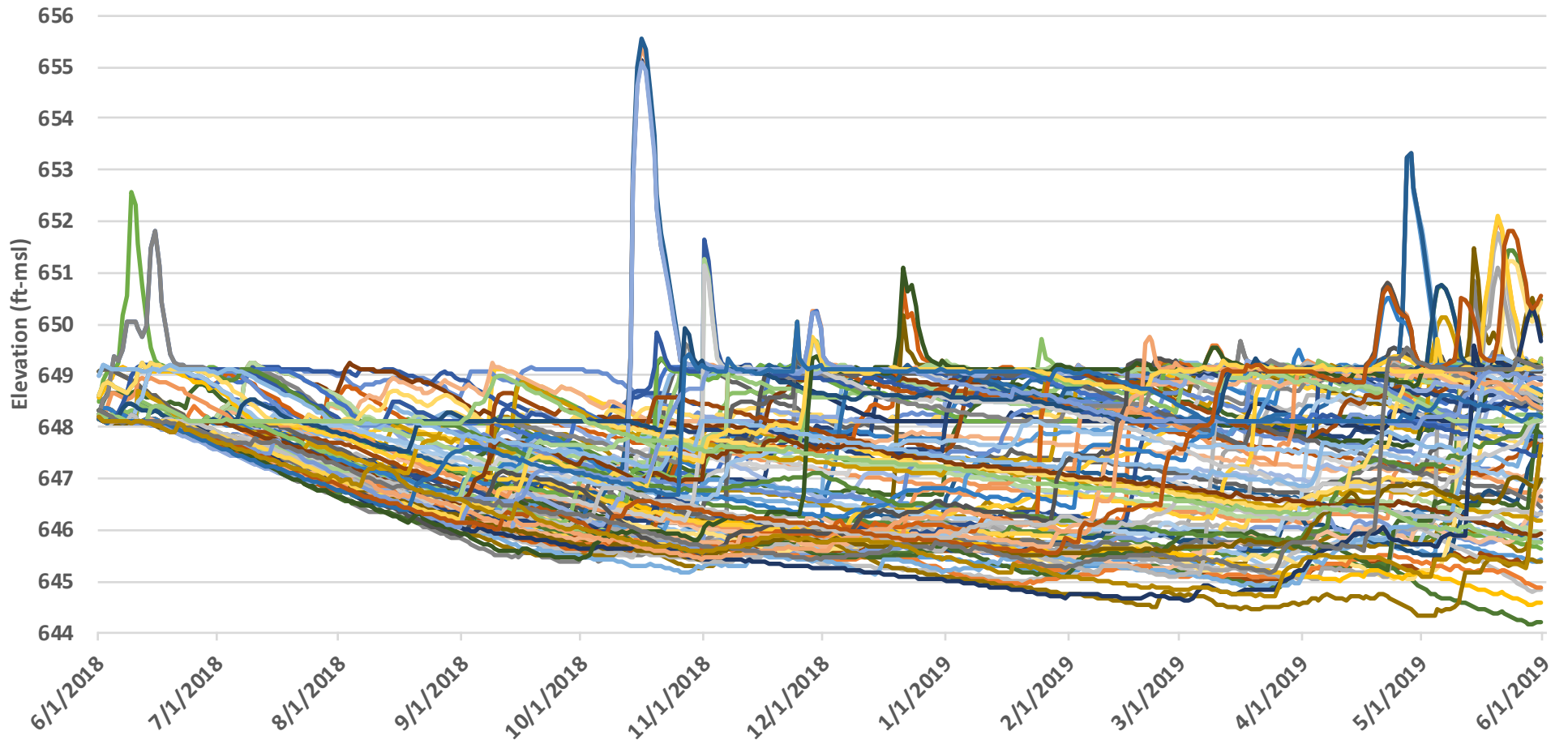
Image Source: Google Earth

RiverWare Implementation

- Generate Forecast
 - Climate State Probability Distribution
 - Dry, Avg, Wet, Very Wet binning
- Generate 100 Markov Chain Traces
 - Number of Traces for Each Bin Match Probability Distribution
 - Observed Hydrologic Data Resampled
 - Historical Transition Probabilities Used to Simulate Likely Climate Progression
 - 100 Runs Simulated in RiverWare Planning Model
- Review Results



Eagle Mountain Elevations for 100 Traces



Thank You for The Opportunity

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