



Jet Propulsion Laboratory
California Institute of Technology



Airborne Snow Observatory

ASO In The Tuolumne: 3 Years Of Basin SWE, and PRMS Assimilation Results

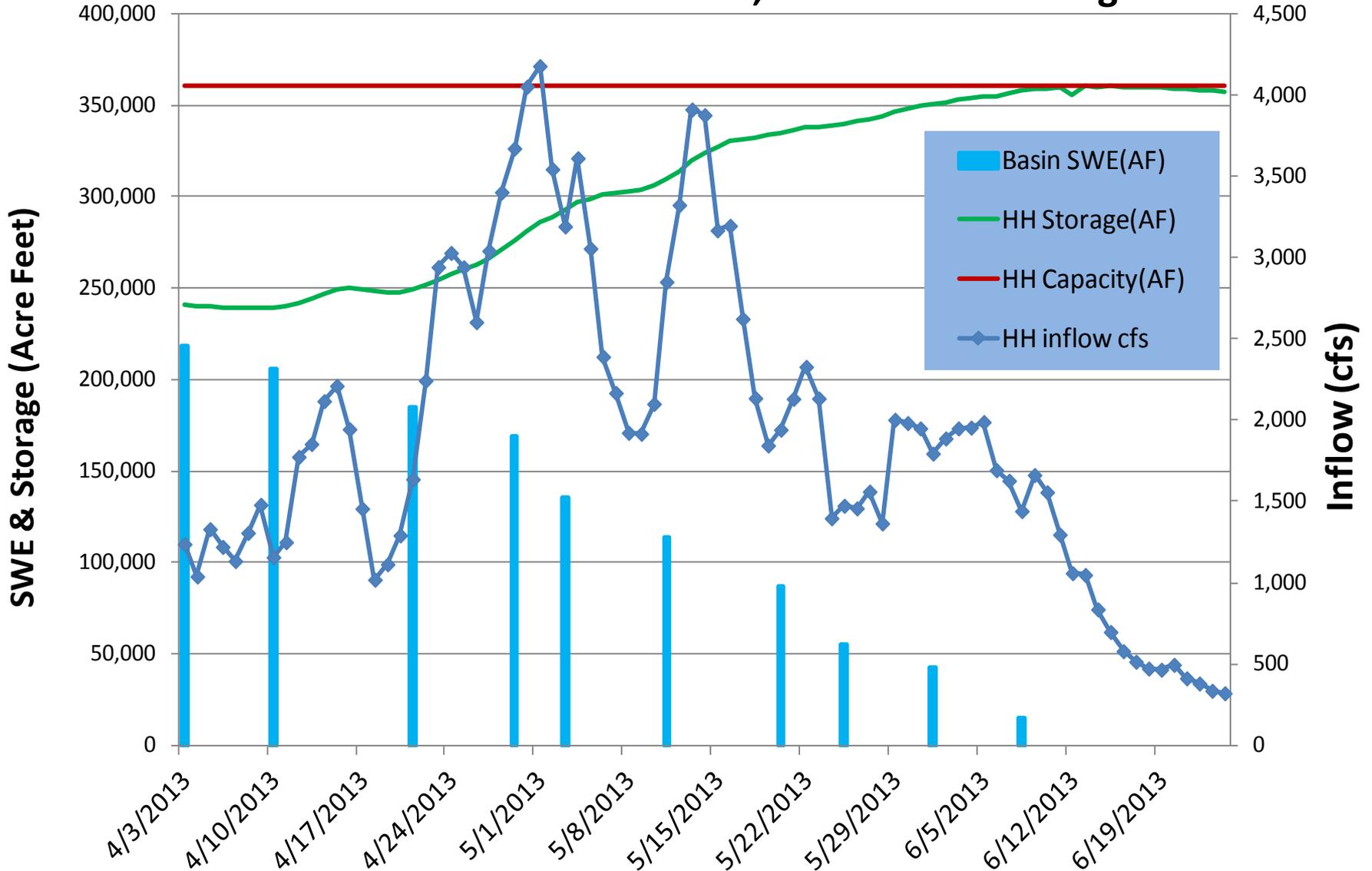


Bruce J. McGurk and Thomas H. Painter & ASO Team
Coop Snow Workshop, 4 Nov. 2015



Basin SWE, Inflow, & Storage-2013

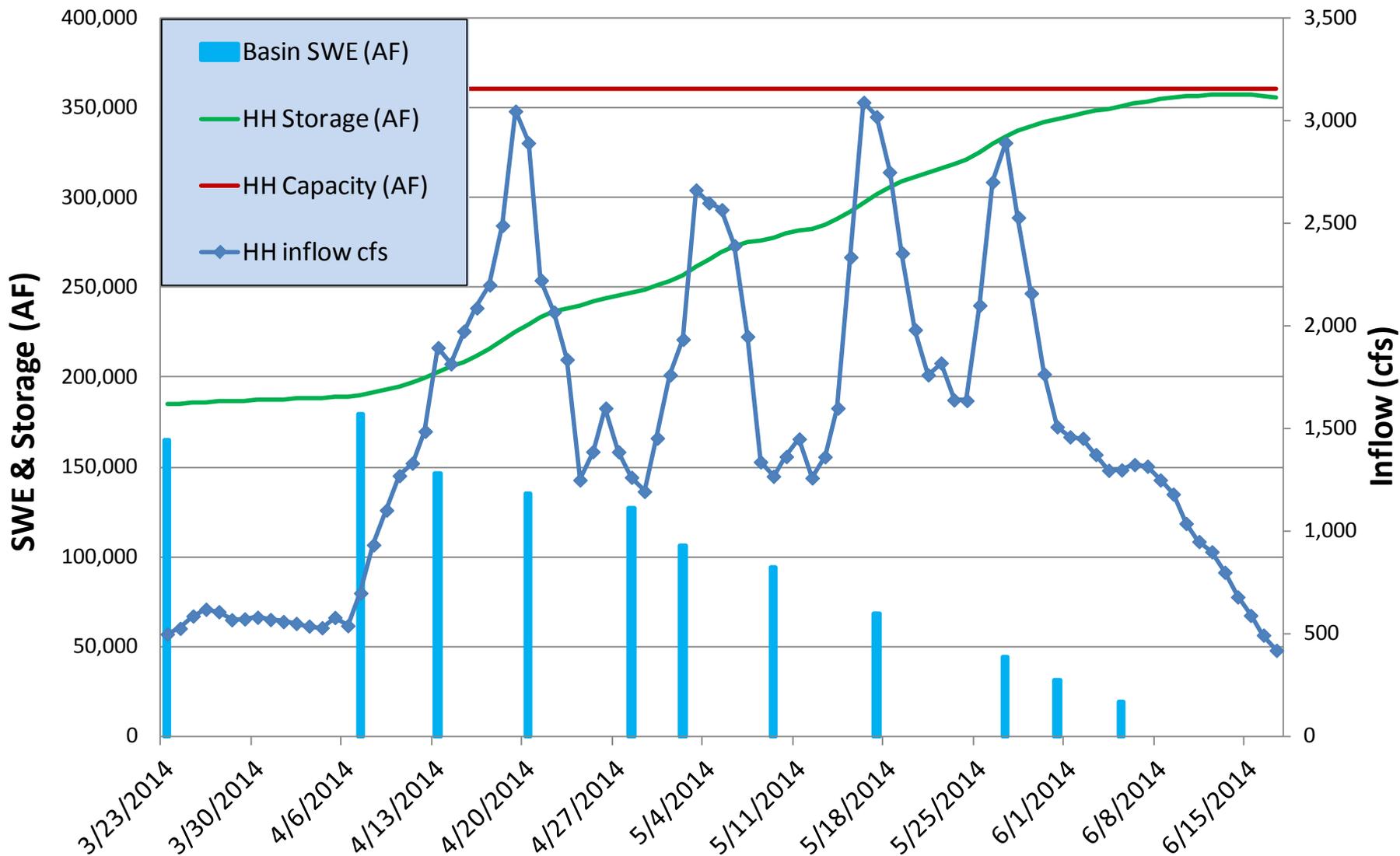
2013 Tuolumne ASO Basin SWE, HH Inflow & Storage





Basin SWE, Inflow, & Storage-2014

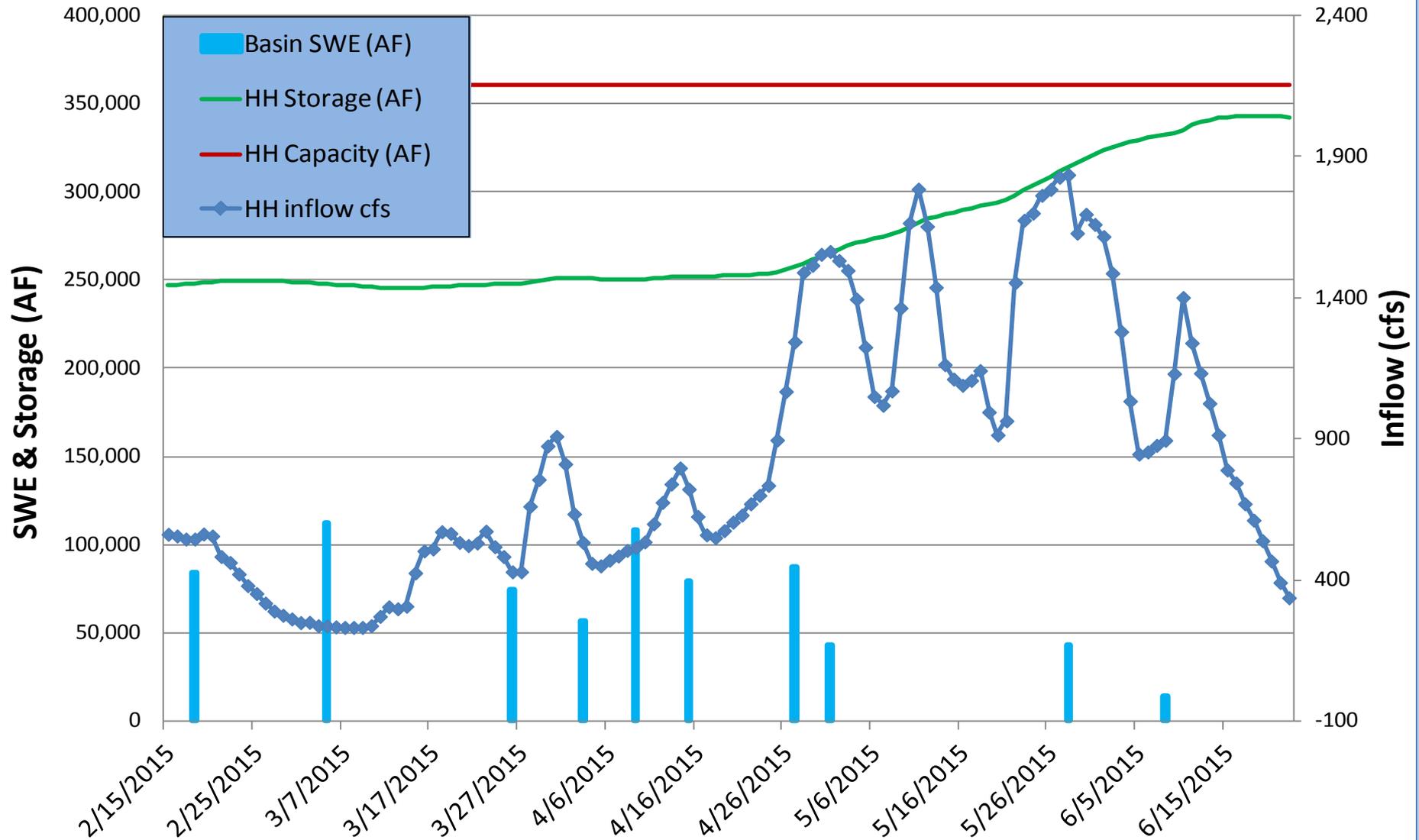
2014 Tuolumne ASO Basin SWE, HH Inflow & Storage





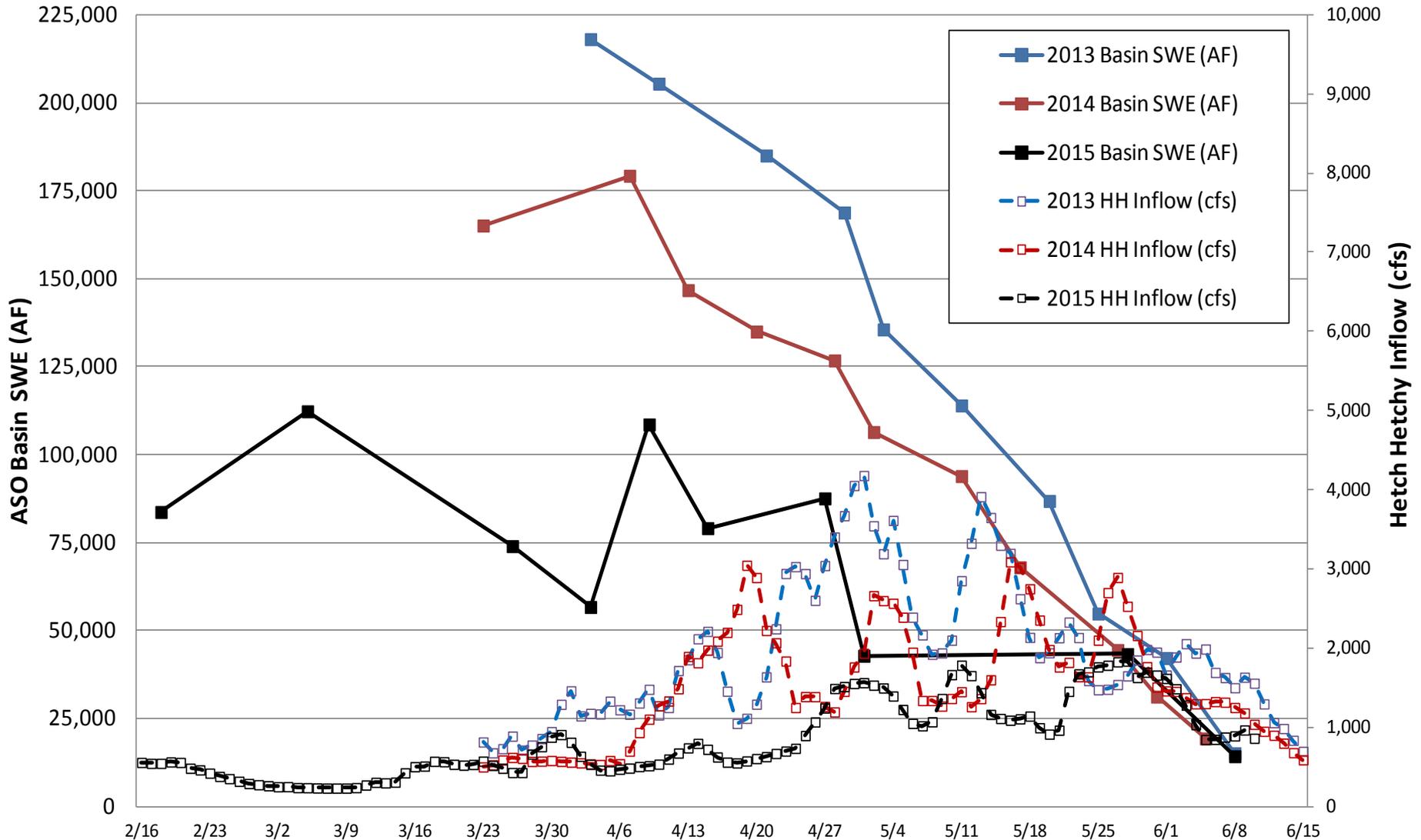
Basin SWE, Inflow, & Storage-2015

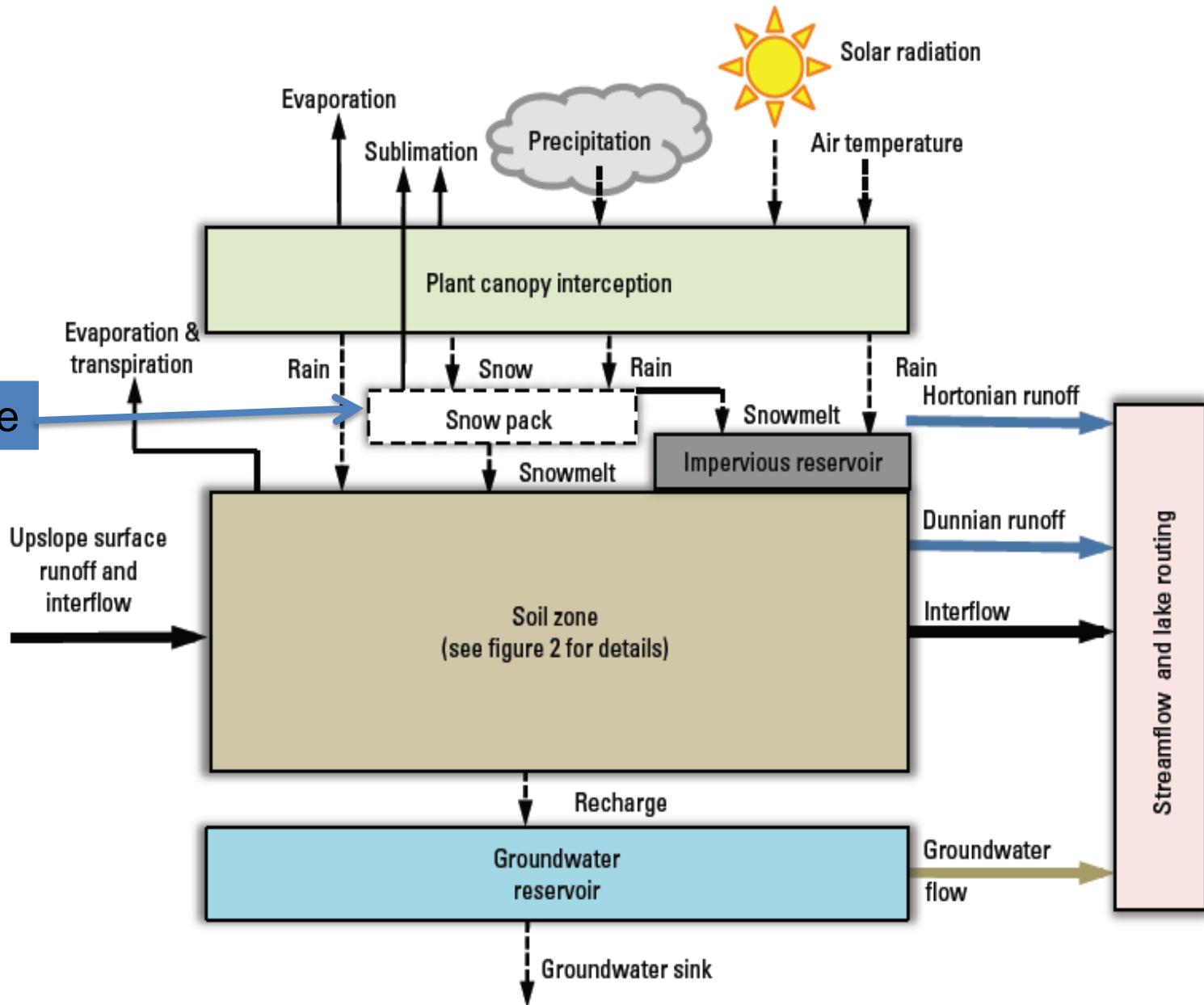
2015 Tuolumne ASO Basin SWE, HH Inflow & Storage



3 Years of ASO SWE and HH Inflow Rates

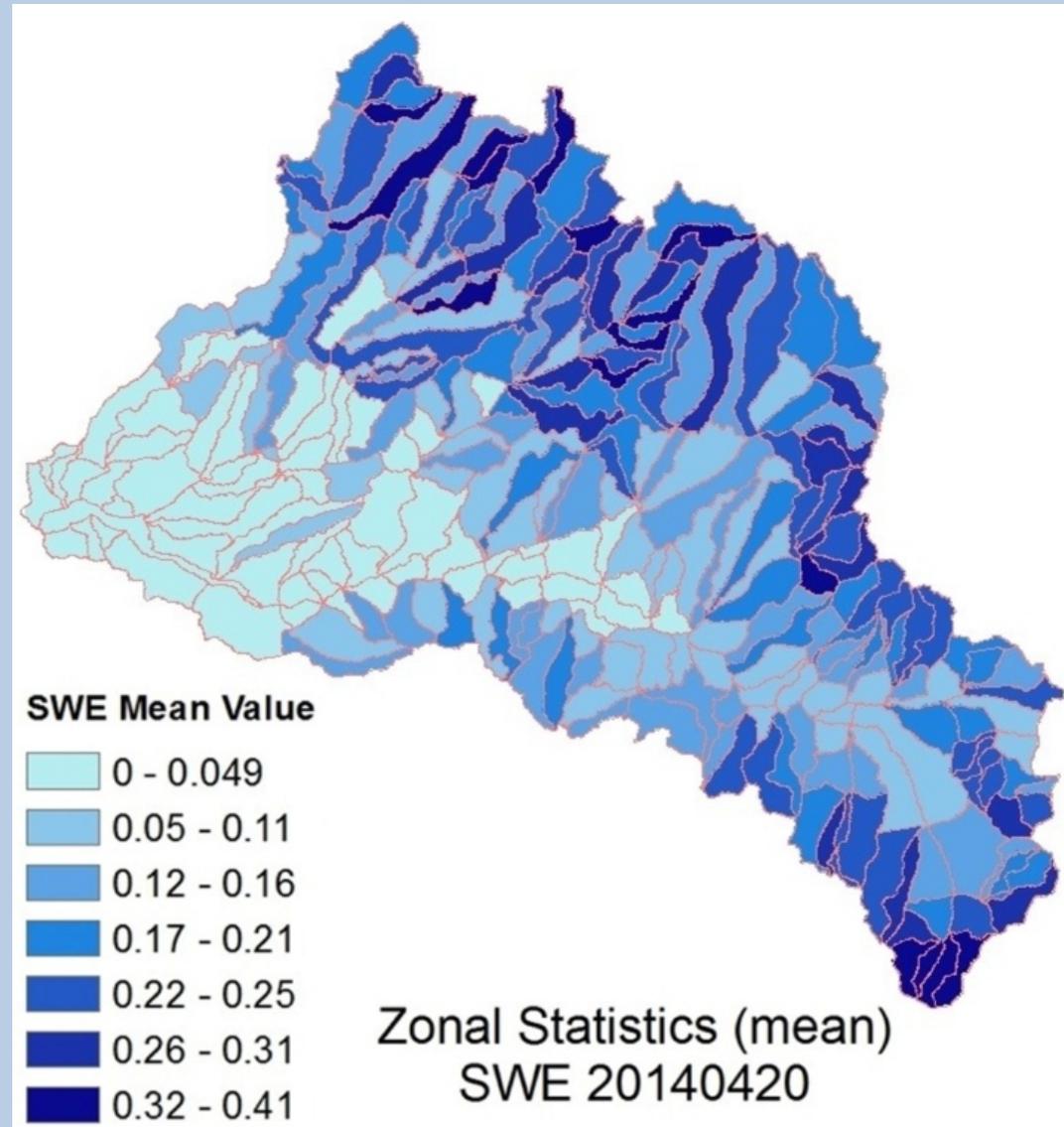
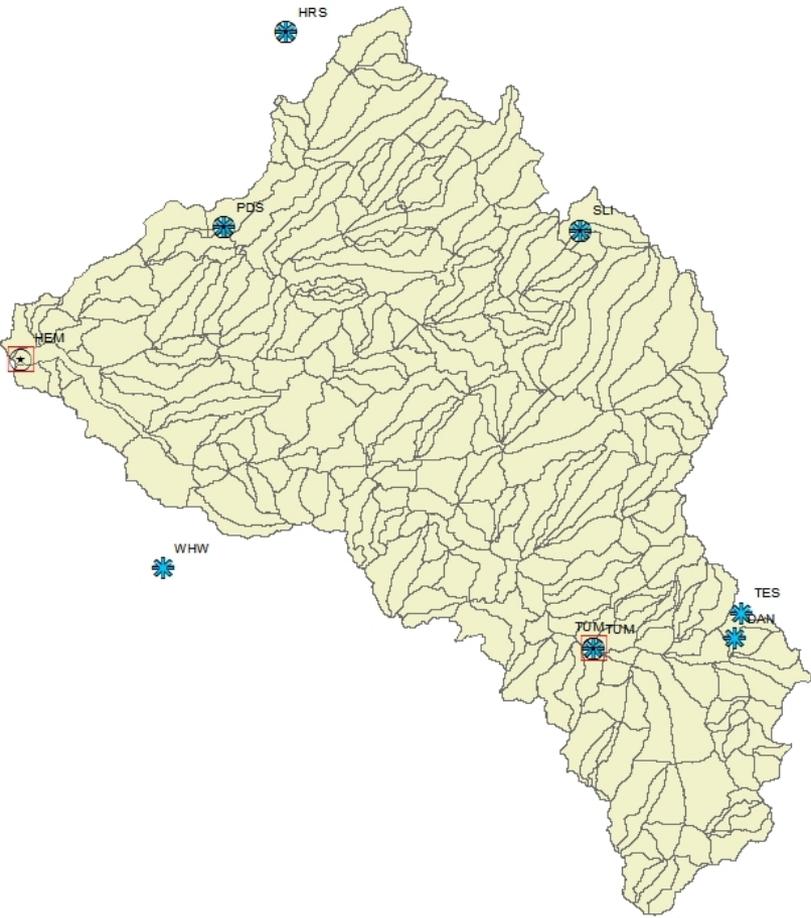
ASO HH Basin SWE & Inflow - Tuolumne - 2013 vs 2014 vs 2015





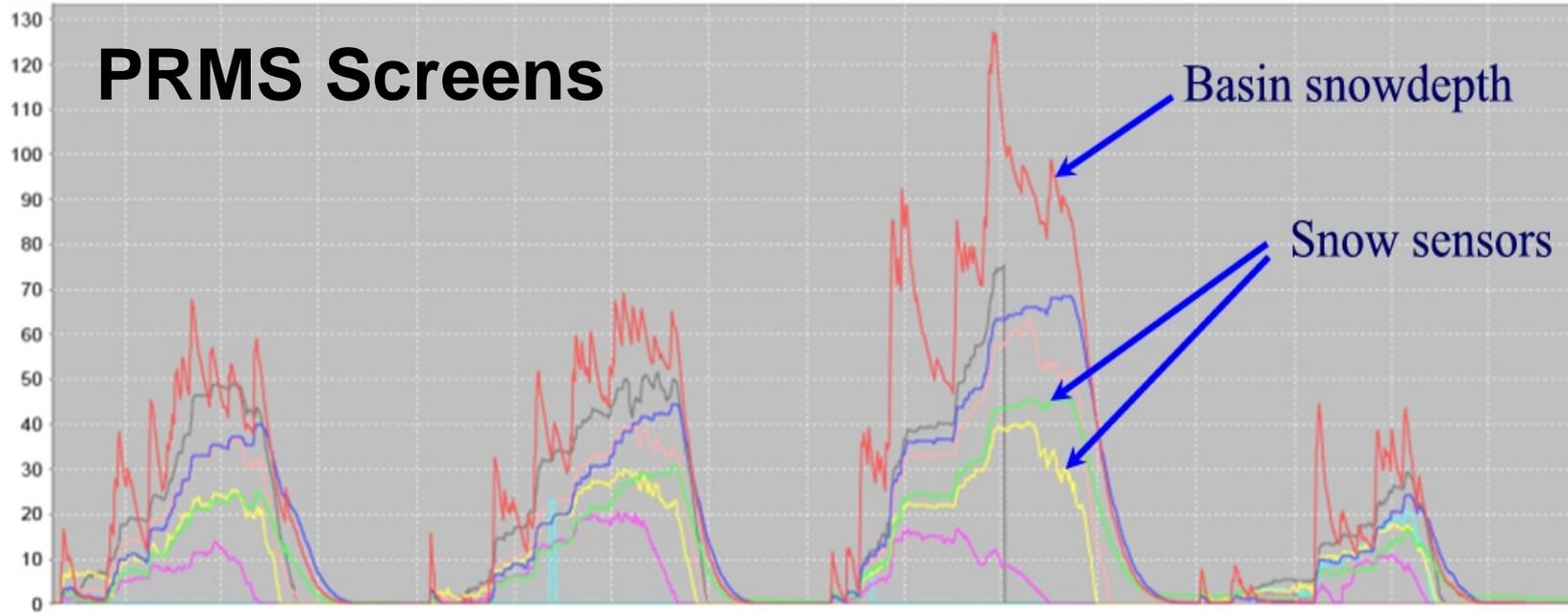
ASO SWE Here

**USGS
PRMS
Hydrologic
Budget**



Hetch Hetchy Basin – Stations & PRMS HRUs

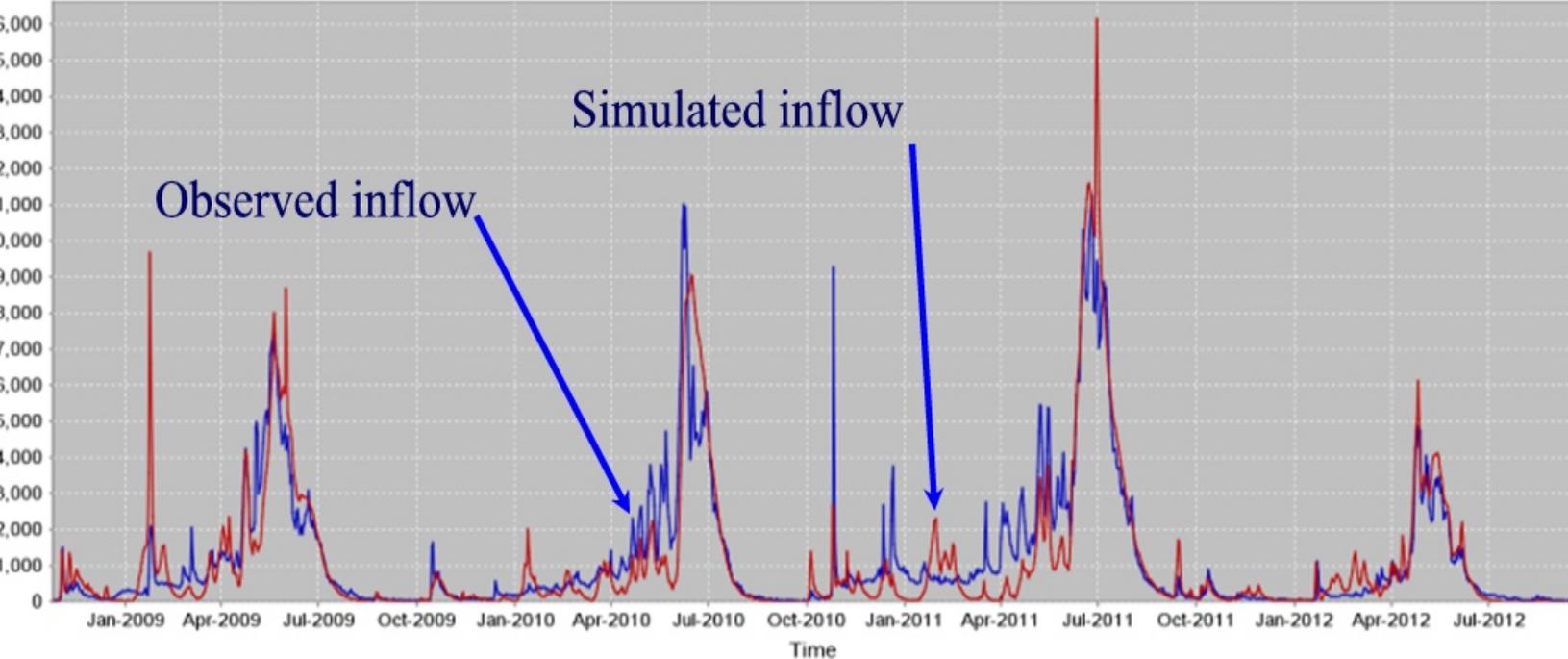
PRMS Screens



- basin_snowdepth[1]
- subinc_pkweqv[10]
- subinc_pkweqv[2]
- snow[1]
- snow[2]
- snow[3]
- snow[4]
- snow[5]
- basin_cfs[1]
- runoff[1]

Simulated inflow

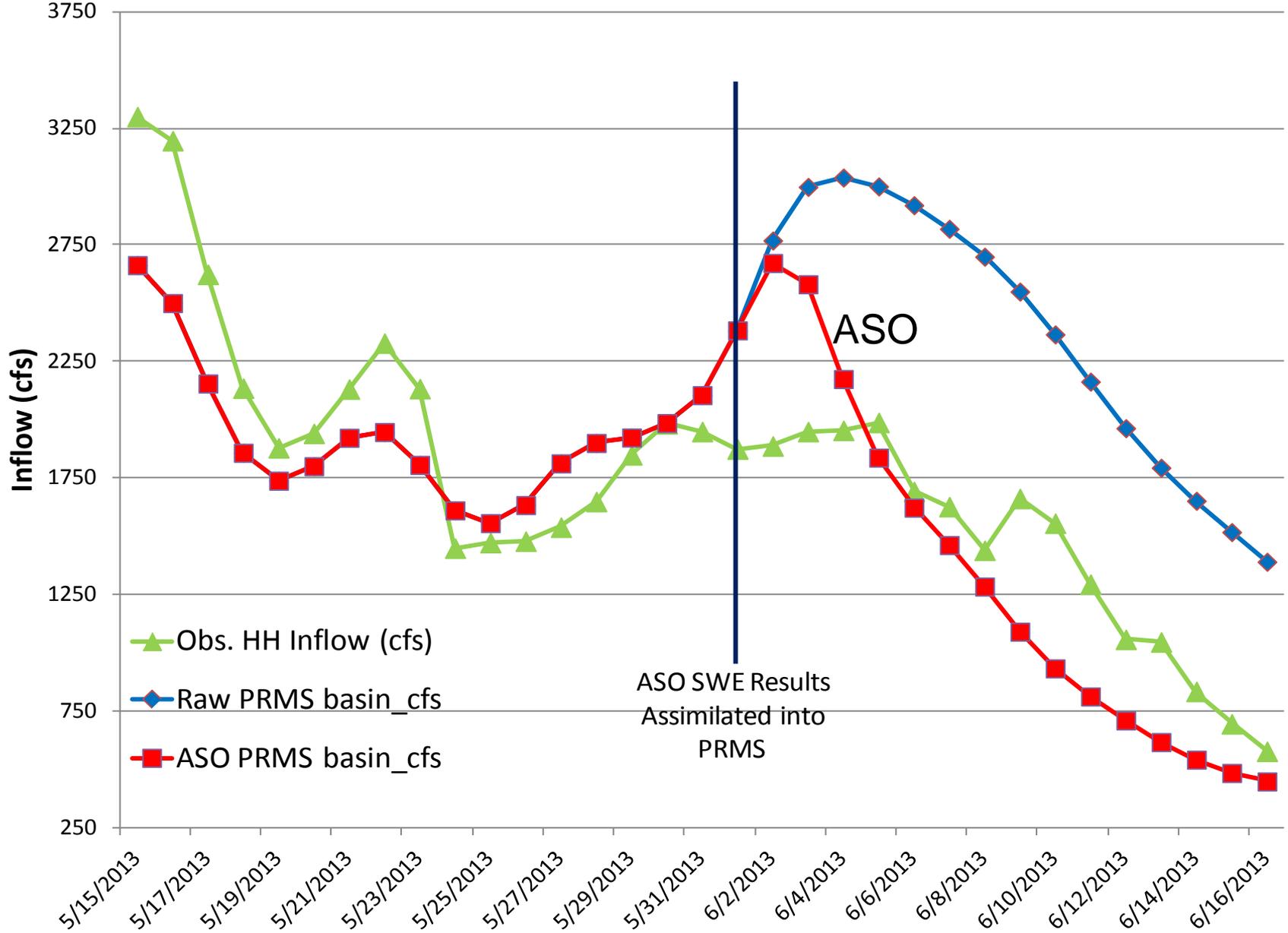
Observed inflow



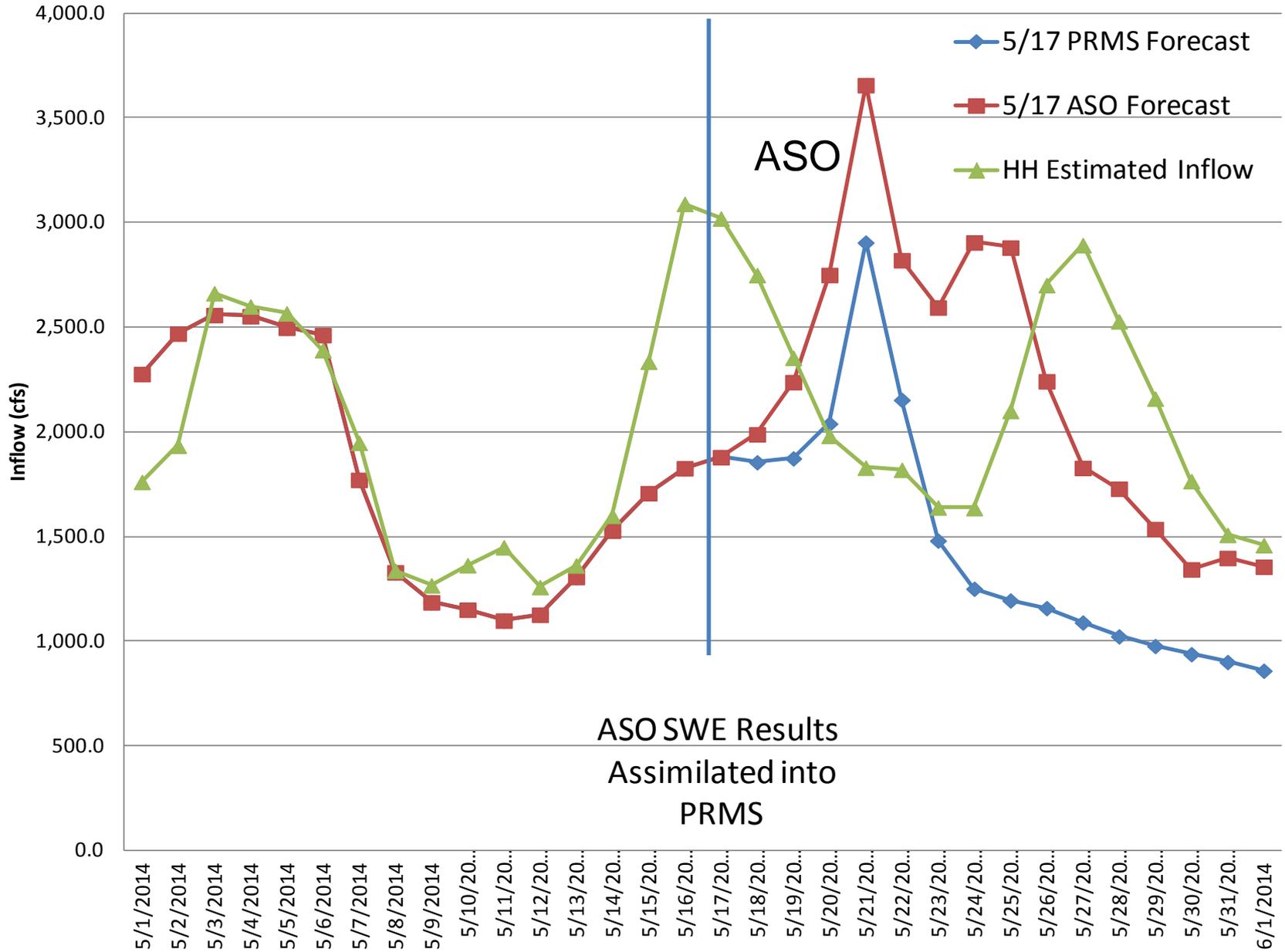
Time

Assimilation of ASO SWE

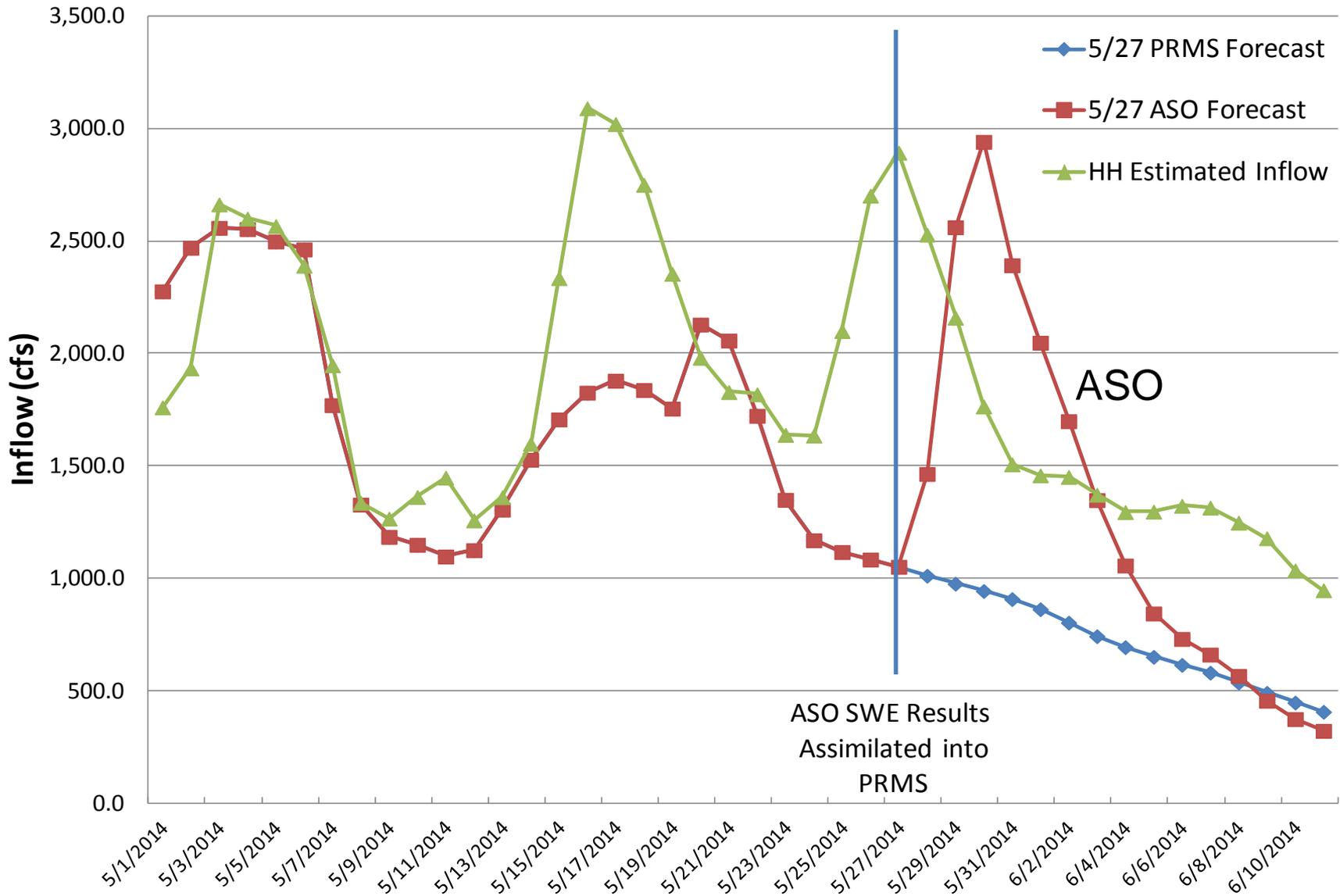
2013 Hetch Hetchy Observed & Forecasted Inflow



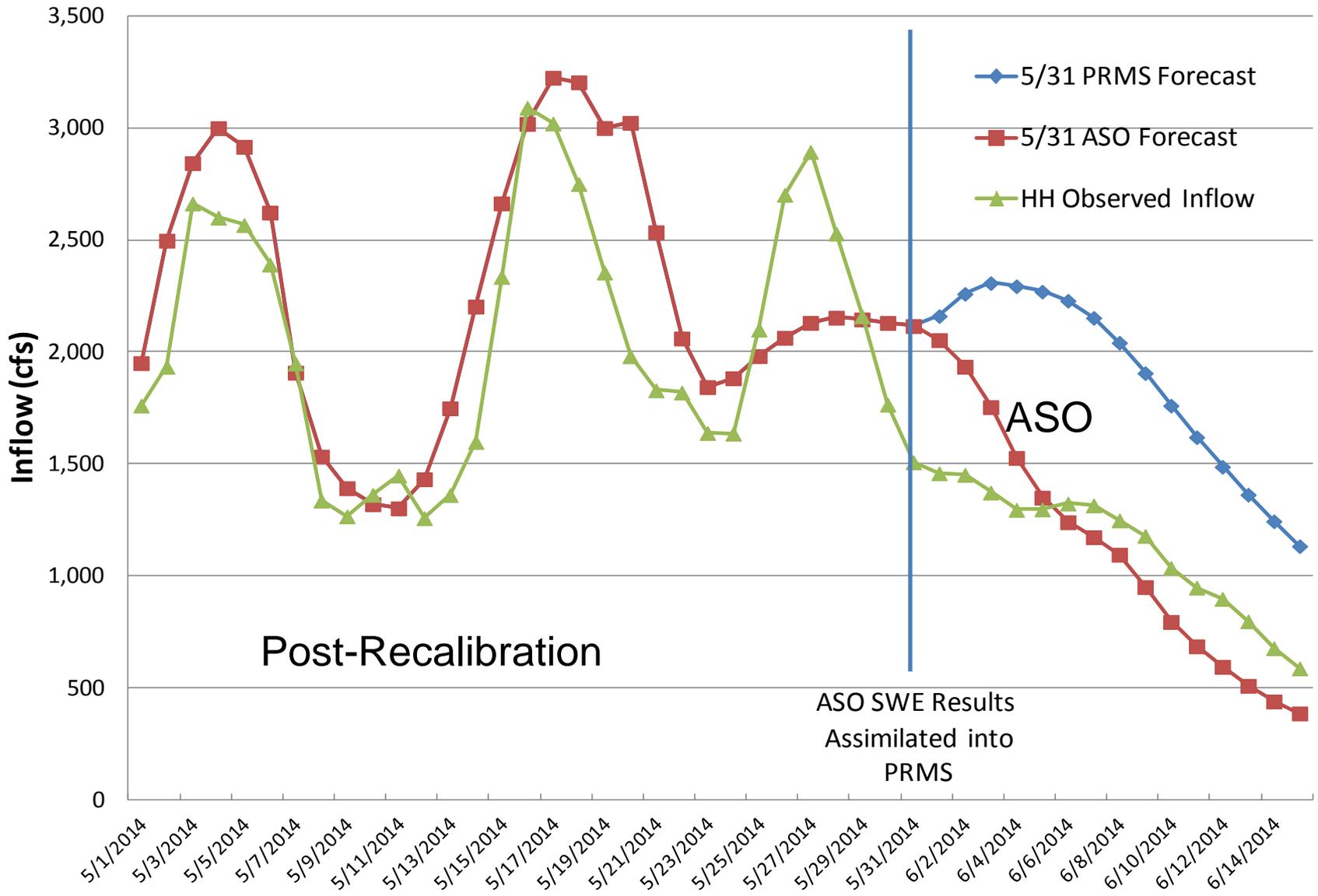
2014 Hetch Hetchy Observed & Forecasted Inflow



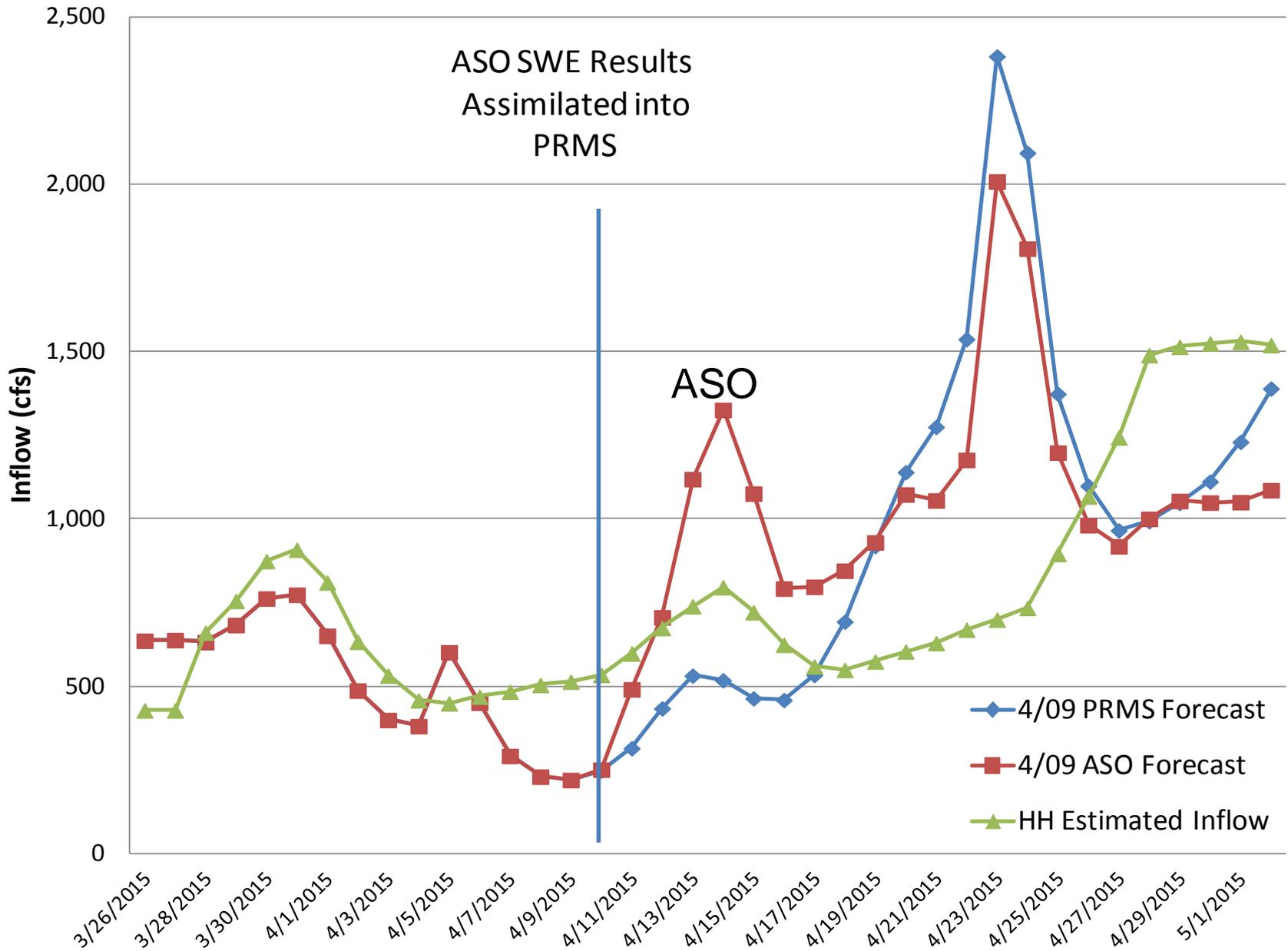
2014 Hetch Hetchy Observed & Forecasted Inflow



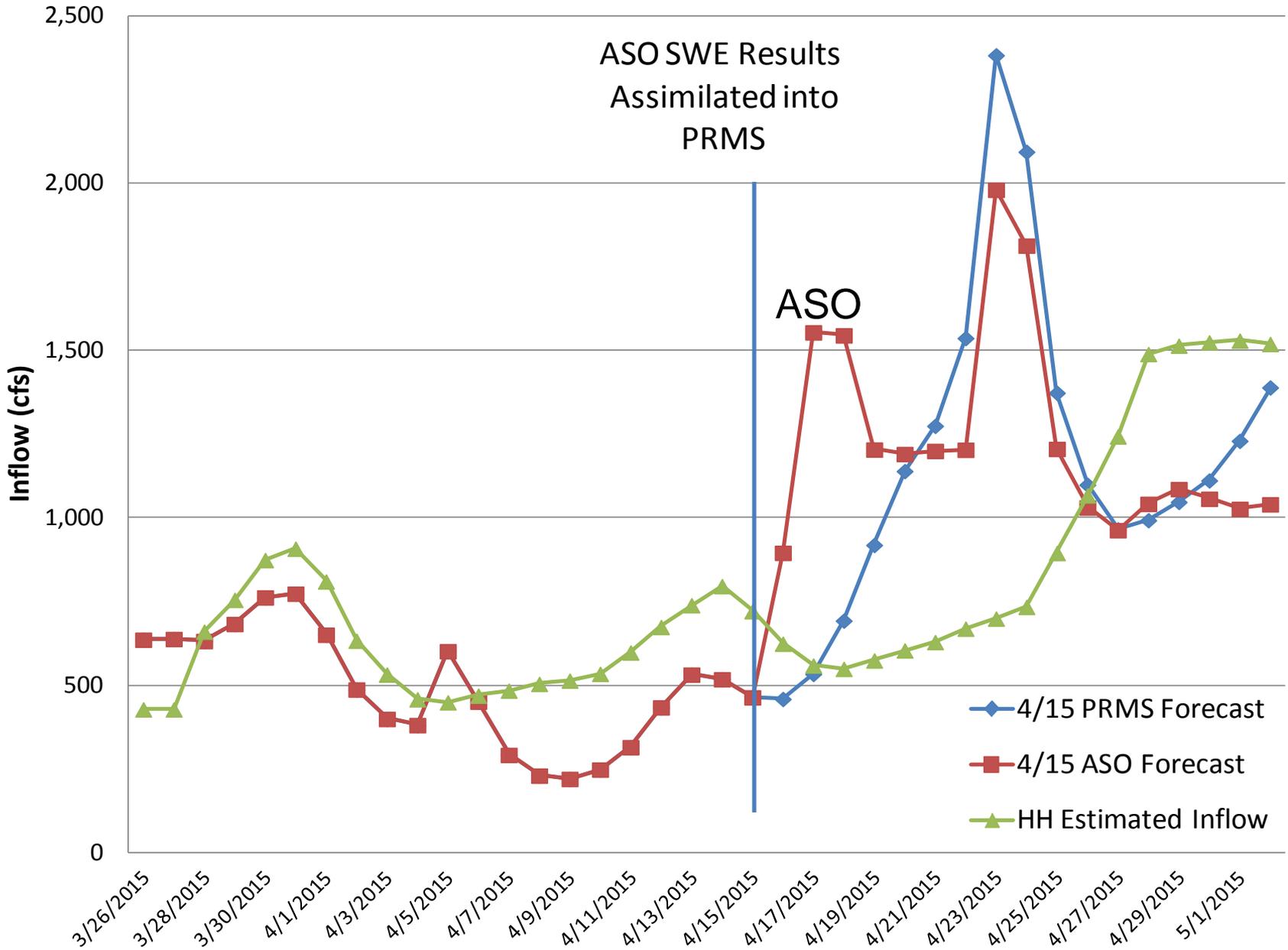
2014 Hetch Hetchy Observed & Forecasted Inflow



2015 Hetch Hetchy Observed & Forecasted Inflow



2015 Hetch Hetchy Observed & Forecasted Inflow





Modeling Needs

- **ASO results** are gridded (3 - 50 m²), and PRMS polygons (HRU's) are 1,000 to 10,000 acres. Further HRU discretization is desired.
- **Advanced snowmelt routines** now exist that use long- and short-wave radiation. Current version of PRMS uses a temperature-index algorithm, calibrated with shortwave radiation records.
- **Integrate iSNOBAL** and compute an average value in the HRU from iSnobal for SWE, density, height, and provide the amount of melt input to the soil.
- **Albedo** (percentage of reflected shortwave insolation) is measured by ASO, but is not able to be input into PRMS.
- **Assimilation of ASO Data** is possible, but best procedure that guarantees stable predictions has not been identified.
- **Good model predictions** depend on good upper elevation forcing data, and most basins have minimal climate stations at high elevations, most particularly precipitation information.



iSNOBAL Features

- Spatially-distributed snowmelt simulation
- Variation in energy transfer based on topographic and veg. canopy effects
- Melt based on snow properties and topography
- Simulate timing and rate of water delivery to soil
- Data & computing requirements may be challenging

