



Short-Term Ensemble Work at the CNRFC

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Foundational Statements

- AHPS promised forecasts with associated uncertainty at all time scales. We currently do not have this operational capability
- Our customers and partners are asking for forecast uncertainty
- We have two major projects that explicitly include short-term forecast uncertainty.
 - Folsom Forecast-Based Operations
 - Yuba-Feather Forecast Coordinated Operations



Foundational Statements

- Forecast forcings likely represent the greatest source of hydrologic forecast uncertainty
 - Improvement in QPF skill, for example, is pretty slow
 - Greatest potential of service improvement may be accurately assessing the uncertainty of our forecasts
- Our forecasters need information related to forecast uncertainty in order to make good decisions that benefit our customers



Foundational Statements

- Uncertainty assessment must be consistent with the single-value forecast system in order to be relevant
 - The CNRFC HAS unit has documented skill in short-term QPF
 - Uncertainty assessment must take advantage of this



Foundational Statements

- Assessment of short-term hydrologic forecast uncertainty is extremely complex and includes dynamic components
 - We need to start with what we know
 - We need to build on our experience
- We need to have realistic expectations
 - Our estimates of uncertainty will include uncertainty
 - Our initial work will not optimally handle all possible conditions



Foundational Statements

- Ultimately, we need a fully integrated system that supports both single-value and ensemble-based operations in the same context
 - Current environment may not be conducive
 - Transportable interim solutions may be feasible

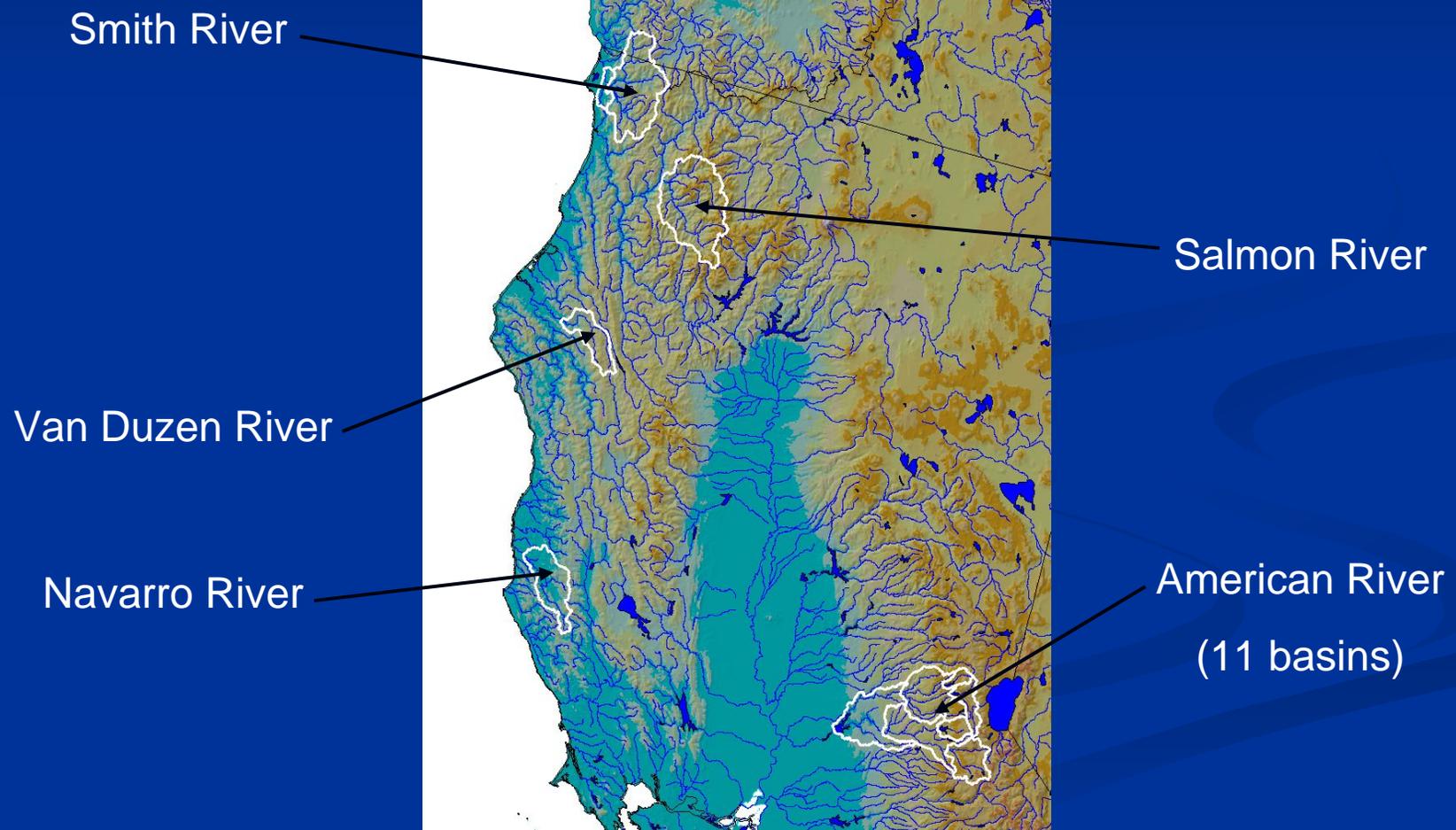


Activities at CNRFC

- Collaborated with HEP Team to implement ensemble preprocessor and gfs subsystem.
 - HAS-based ensembles 1-5 days
 - Frozen GFS-based ensembles 1-14 days
 - Climatology beyond day 14
- Currently “running”
 - American River (11 sub-basins)
 - Smith River
 - Salmon River
 - Van Duzen River
 - Navarro River



Water Year 2007 Test Basins





Raw Materials (data)

- QPF
 - HAS FMAPs (5days) and MAPs (Apr97-date)
 - Frozen GFS forecasts (14days) (1979-2004*)
- Temperature
 - MOS tx/tn forecasts (7days) and obs (Jan01-date)
 - Frozen GFS forecasts (14days) (1979-2004*)
- Calibration MAPs and MATs (30-50years)
- Station/Area characteristics



Software Development

- Installation and debugging of “GFS subsystem” w/ HEP Team and John Schaake
 - Data manipulation programs
 - map06_sbmap06
 - sbtxtn
 - matanalysis
 - runcalbmam
 - Parameter estimation programs
 - gfs_precip_parms
 - gfs_temp_parms
 - Ensemble generation programs
 - gfs_precip_epp
 - gfs_temp_epp
- System also installed at CBRFC and OHD.



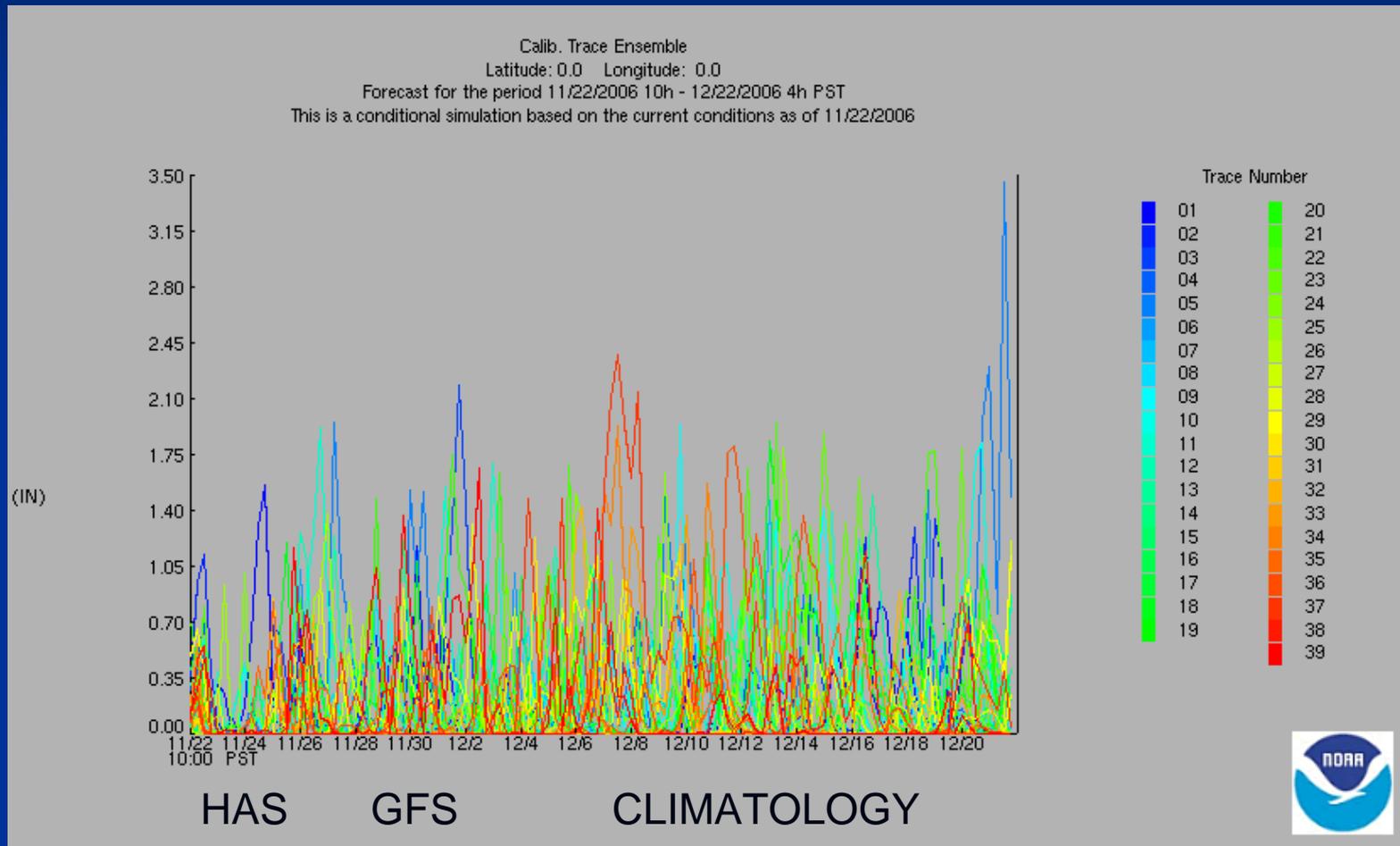
Status

- Collection and processing of Frozen GFS ensembles daily at ~12Z
- Generation of precipitation and temperature ensembles and hydrologic ensembles daily at ~1830.
- Processing and archival of results using batch ESPADP, decoding, and SHEF encoding for databasing.
- Validation software envisioned



Early Results

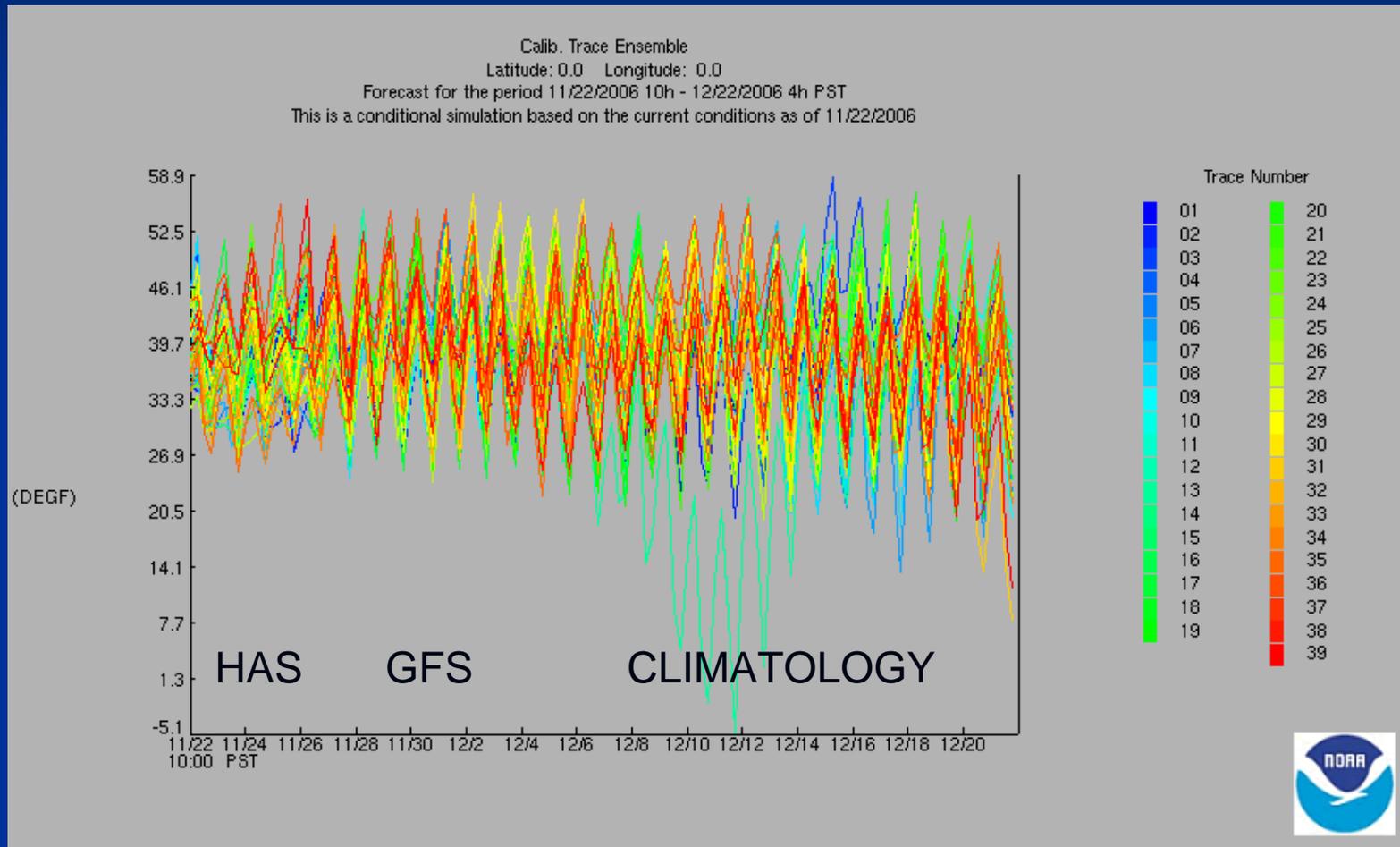
30 Day MAP Ensembles – Smith River





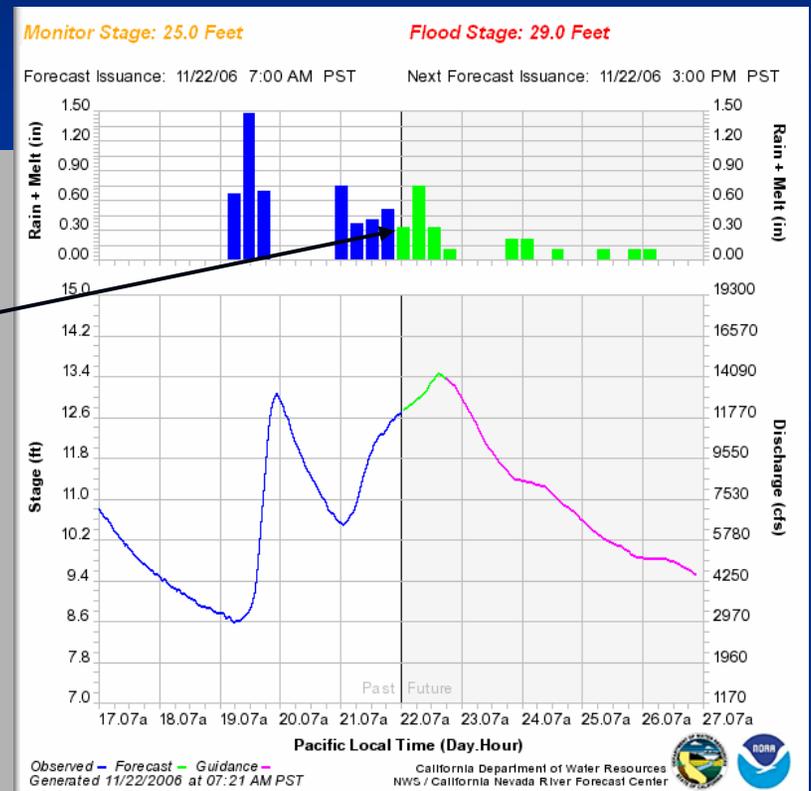
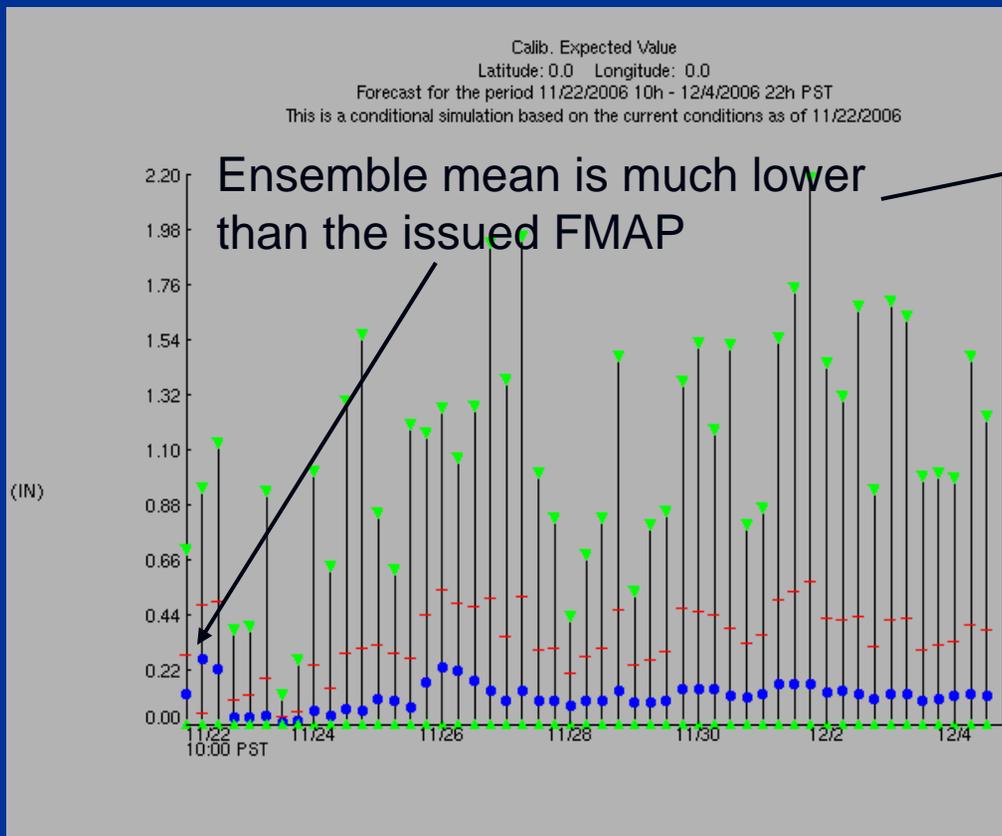
Early Results

30 Day MAT Ensembles – Smith River





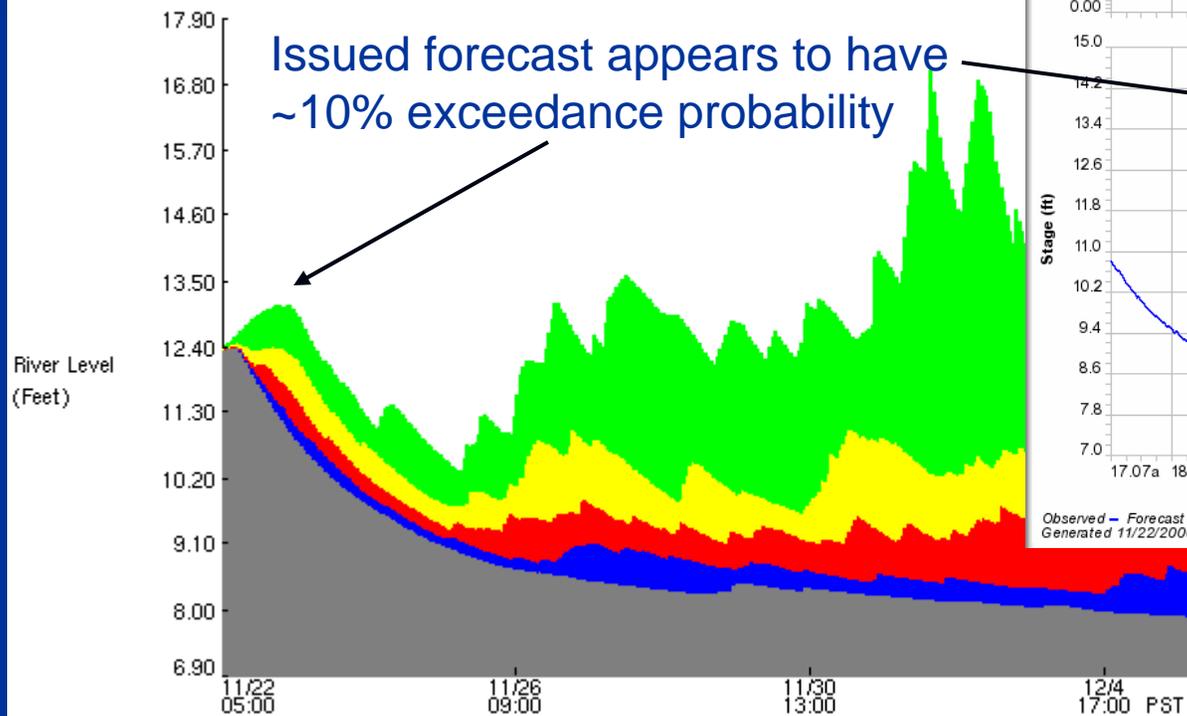
Comparison of Issued Product with Ensemble Expected Value for MAP





Comparison of ESP with Issued Forecast

1 Hour Chances of Not Exceeding River Levels on the SMITH at SMITH-JED
Latitude: 41.8 Longitude: 124.1
Forecast for the period 11/22/2006 5h - 12/5/2006 24h PST
This is a conditional simulation based on the current conditions as of 11/22

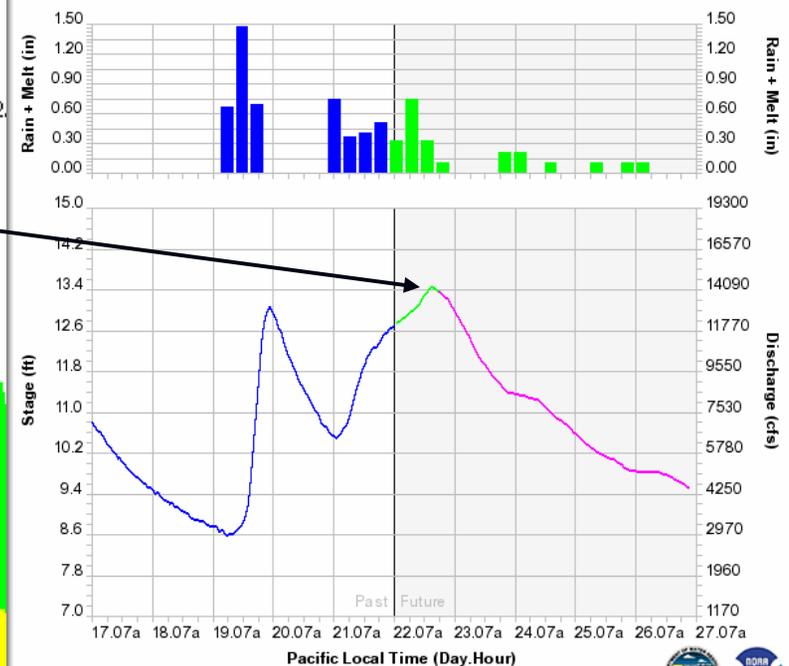


Monitor Stage: 25.0 Feet

Flood Stage: 29.0 Feet

Forecast Issuance: 11/22/06 7:00 AM PST

Next Forecast Issuance: 11/22/06 3:00 PM PST



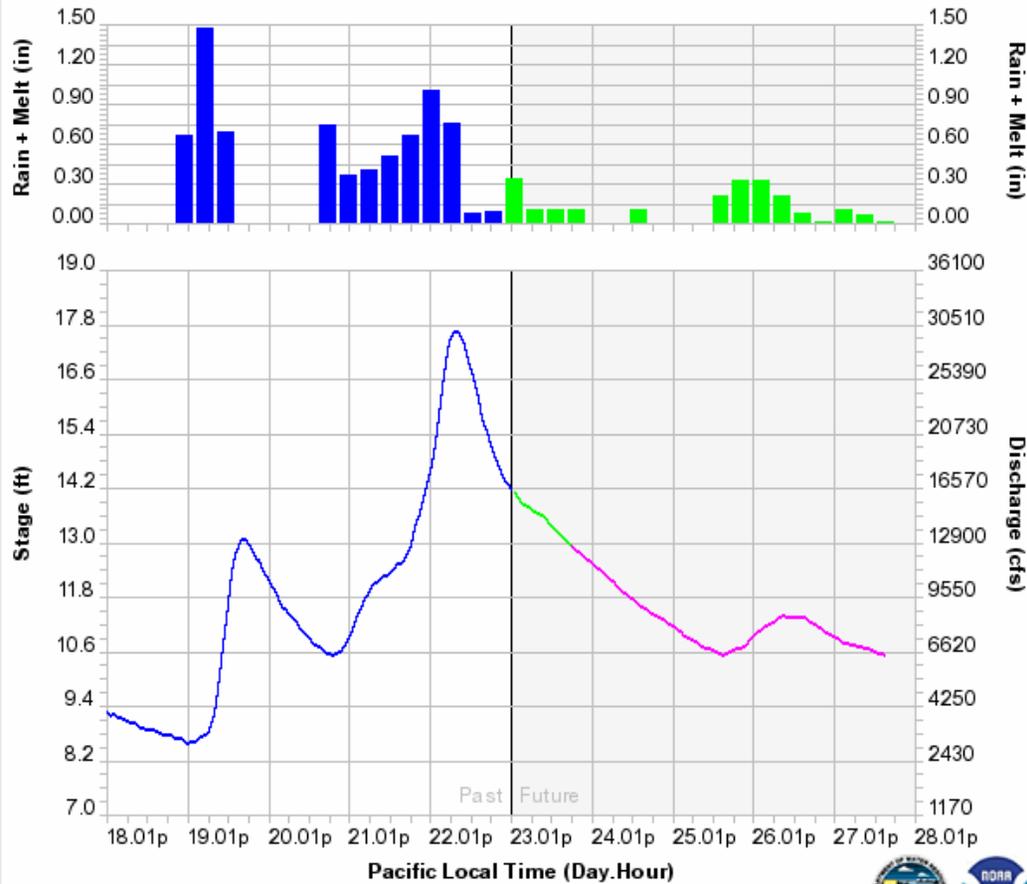


Monitor Stage: 25.0 Feet

Flood Stage: 29.0 Feet

Forecast Issuance: 11/23/06 1:00 PM PST

Next Forecast Issuance: 11/24/06 8:00 AM PST



Observed - Forecast - Guidance -
Generated 11/23/2006 at 01:53 PM PST

California Department of Water Resources
NWS / California Nevada River Forecast Center





Concerns

- We're only dealing with the future forcing.
 - Need to include (approximate) other sources of uncertainty (model, data, etc.)
- Ensemble mean is always less than QPF when $QPF > \text{climatology}$ and $\text{skill} < 1.0$
 - QPF is not biased...
 - Will this create a bias?
 - Too conservative?
 - Lots to learn here!
- Major effort to really systematize this into actual operational context.



Thank You