Water Supply and Data Assimilation at the ABRFC

Developments in Water Supply Forecasting: Combining New Methods and Existing Models

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"There are an infinite number of ways to get the right answer for the wrong reason"

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Talking Today

1. ABRFC Water Supply Program
2. ABRFC Water Supply Methods
    1. Deterministic Forecasts
    2. Ensemble / Probabilistic Forecasts
        1. ESP
        2. HEFS
3. Future Development
    1. Ensemble Forecasting Techniques
        1. ESP
        2. HEFS
    2. Forecast Frequency
    3. Customer Needs and Expectations

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Arkansas River Basin Forecast Points (Colorado)

Forecast Point	Drainage Area	Forecast Type
ARGC2	427	Native Flow
PTRC2	795	Native Flow
SALC2	1,218	Native Flow
CNCC2	3,060	Native Flow
PDAC2	4,670	Native Flow
CLVC2	56	Native Flow*
HMZC2	73	Native Flow*
CHKC2	88.7	Native Flow*
GCWC2	320	Native Flow*
	New Points	
LARC2	14,245	Observed Flow
LAPC2	3,441	Observed Flow

Canadian River Basin Forecast Points (New Mexico)

Forecast Point	Drainage Area	Forecast Type
EGLN5	167	Native Flow
CMMN5	294	Native Flow
CNCN5	7,409	Native Flow*
CRCN5	65	Native Flow*
CMRN5	294	Native Flow*
DAWN5	301	Native Flow*

* Indicates no adjustments are made to the data to account for upstream reservoirs or diversions.

RED Indicates unique verification conditions

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Summary Data

Group	Number	Drainage Area Average and Range
Colorado Points Native Flow	9	1,190 mi2 (56 – 4,670)
Colorado Points Observed Flow	2	8,843 mi2 (3,441 – 14,245)
New Mexico Points	6	1,422 mi2 (65 – 7,409)

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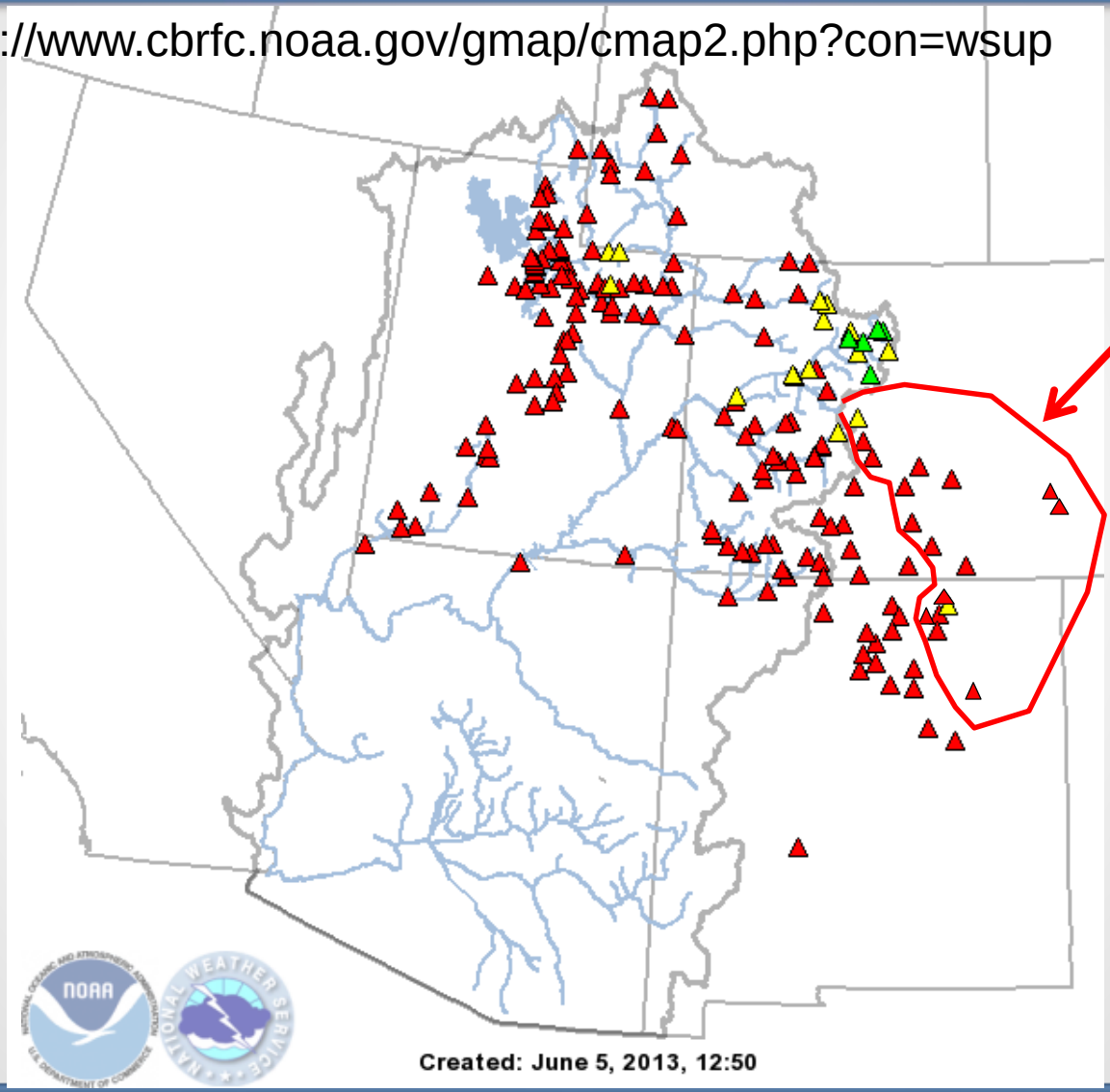
The Arkansas-Red Basin River Forecast Center in the NWS Water Supply Regime

	NWRFC	CNRFC	CBRFC	MBRFC	WGRFC	ABRFC	NWS
Forecast Points	126	150	157	58*	21	**17**	529
Staff	12	5	5	5	1+	**1**	29

CBRFC WSP Front Page

http://www.cbrfc.noaa.gov/gmap/cmap2.php?con=wsup



ABRFC
Forecast Points

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Current Methods

- Statistical Water Supply
  - Multivariate Regression Based Forecast methods
  - Static. Suited to once monthly deterministic forecasts
  - Can be and is used to generate probable maximum and minimums

- Ensemble Streamflow Prediction
  - Runs a hydrologic model with historical weather data
  - Creates an ensemble of “potential” hydrologic outcomes
  - 1 hydrologic outcome for each year of historical data
  - 50th percentile of the ensemble is used as a deterministic forecast

- Coordination with experts at the NRCS
  - NRCS forecasters produce similar forecasts
  - Historically a single value was coordinated between agencies
  - Now forecasts are collaborative but may differ

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Current Methods

- SWS and ESP forecasts were combined
  (usually but not always averaged)
- NWS average was relayed to NRCS and compared to their forecast.
- ABRFC and NRCS would come to agreement on a final deterministic forecast.
- The SWS software would be used to calculate a new probable max/min values based on distributions associated with the primary forecast equation.

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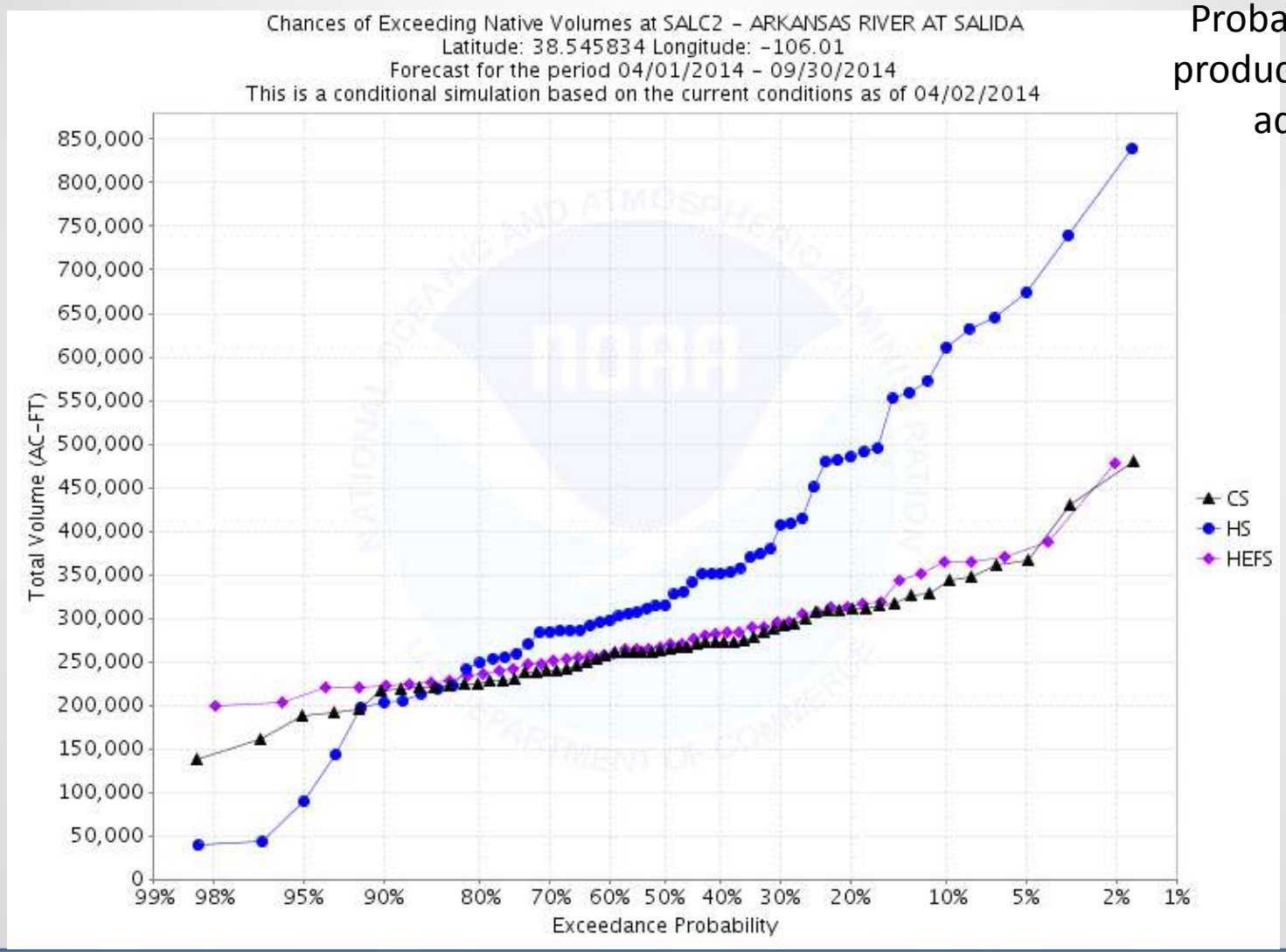

Probabilistic ESP product with HEFS addition.

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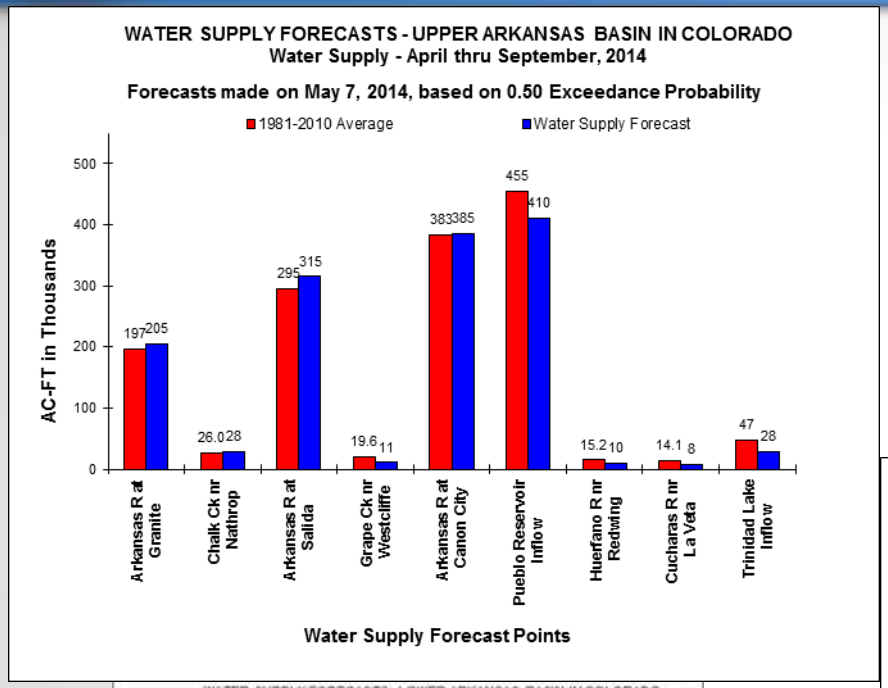
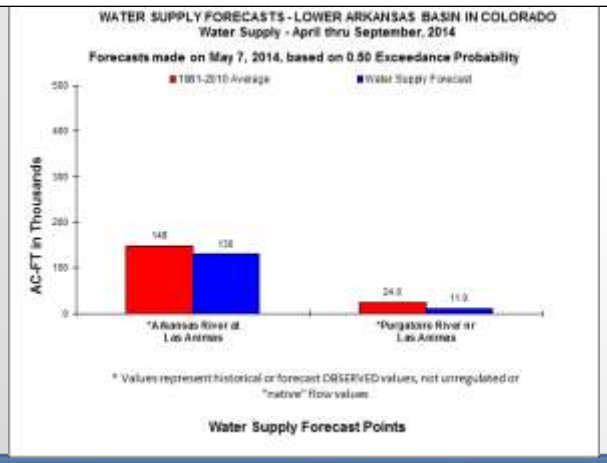
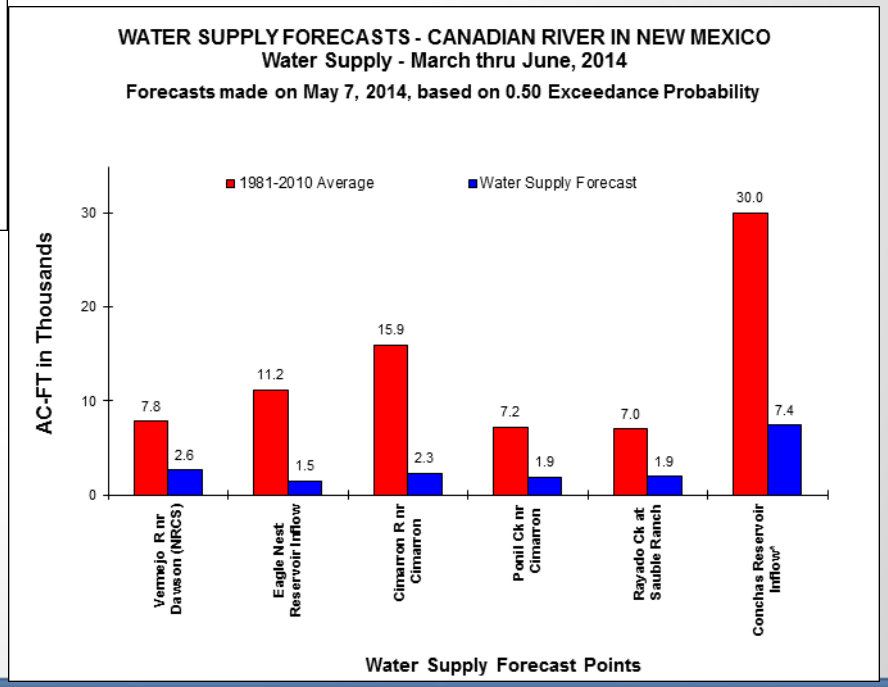




Traditional Web Products from the ABRFC



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U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Arkansas Red River Forecast Center
10159 East 11th Street, Suite 300
Tulsa, Oklahoma 74128-3050

2014 Water Supply Forecast — Issued as of May 7, 2014

Forecast Point	Forecast Period (*)	Forecast Runoff: Most Probable 1000 AF	Most Probable % 30YR AVG.	Reasonable Maximum 1000 AF	Reasonable Maximum % 30YR AVG.	Reasonable Minimum 1000 AF	Reasonable Minimum % 30YR AVG.	Average Runoff 30YR 1981-2010 1000 AF
	*(1)Apr-Sep							
	*(2)Mar-Jun							
UPPER ARKANSAS RIVER BASIN, COLORADO								
ARKANSAS RIVER								
Granite, Co	001	205	104	260	132	150	76	197
Salida, Co	001	315	107	395	134	235	80	295
Canon City, Co	001	385	101	495	129	275	72	383
Pueblo Abv, Co	001	410	90	555	122	265	58	455
GRAPE CREEK								
Westcliffe Nr, Co	001	10.6	54	21.0	107	1.3	7	19.6
CUCHARAS RIVER								
Boyd Ranch, La Veta	001	8.0	57	13.1	93	3.0	21	14.1
PURGATOIRE RIVER								
Trinidad, Co	001	28.2	60	47.0	100	11.3	24	47
HUERFANO RIVER								
Redwing Nr, Co	001	10.4	68	14.2	93	6.6	43	15.2
CHALK CREEK								
Nathrop Nr, Co	001	28.0	108	36.0	138	19.5	75	26.0
LOWER ARKANSAS RIVER BASIN, COLORADO								
**ARKANSAS RIVER								
Las Animas, Co	001	130	88	230	155	31	21	148
**PURGATOIRE RIVER								
Las Animas, Co	001	11.0	46	31.0	129	5.6	23	24.0

Traditional text product from the ABRFC

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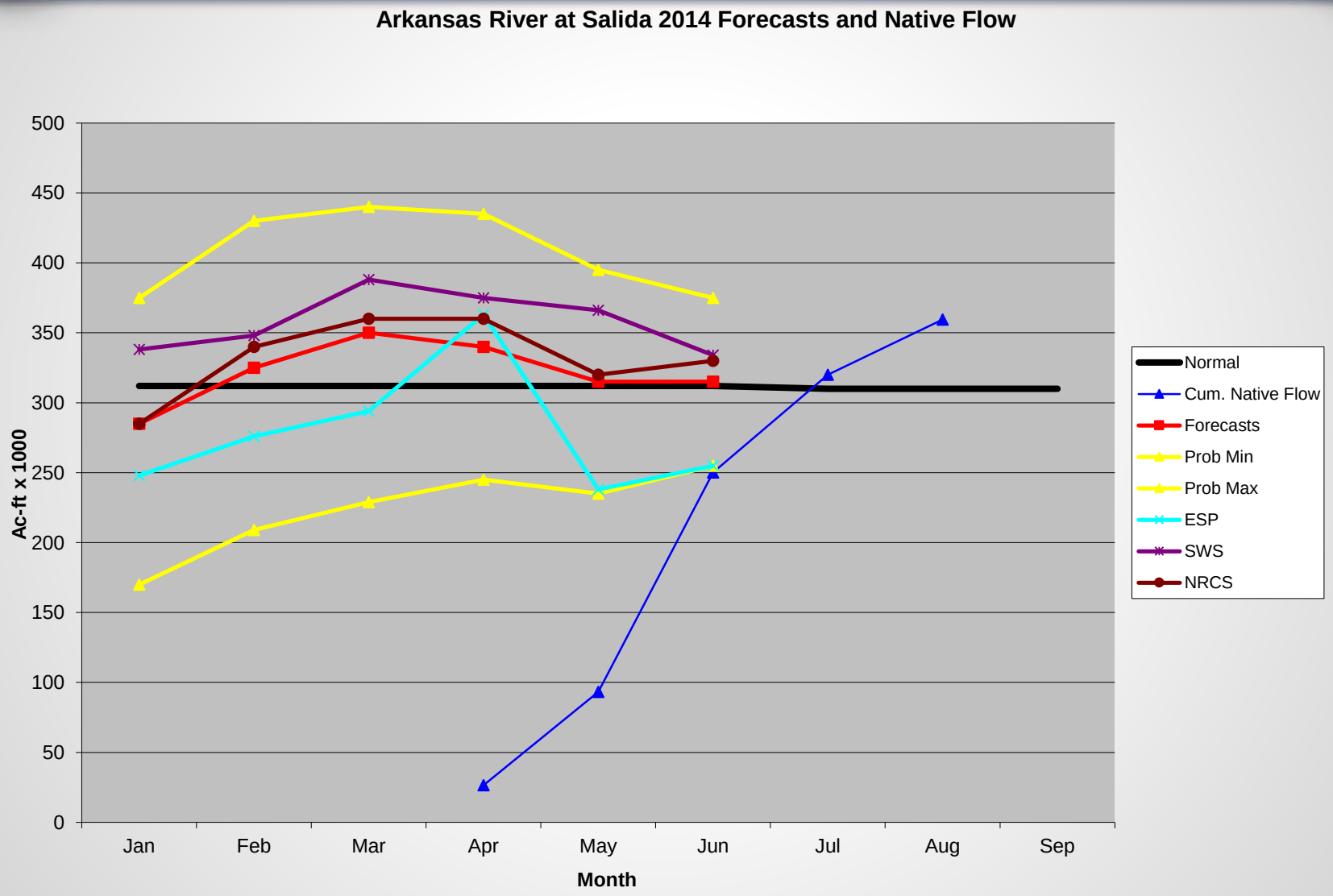

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Problems in Methodology

- Relationship between deterministic forecasts and the probable max/min are suspect
- Western customers are requesting more frequent forecasts with more uncertainty information
- SWS software is ancient and is losing support
- Increased Emphasis on ESP and HEFS as our primary forecasting tools
- Current method does not allow for increased forecast frequency

Solutions (and new problems)

Solutions

- HEFS and ESP
  - Provide consistent probabilistic forecasts
  - Can provide an array of forecast graphics and products
  - Allow for increased forecast frequency
  - Better able to identify trends through forecast season

New Problems

- No requests by customers for probabilistic forecasts
- No requests by customers for increased forecast frequency
- SWS may be our best forecasting tool for deterministic forecasts
- NRCS definitely adds value to our deterministic forecasts
- HEFS is currently under development and testing.

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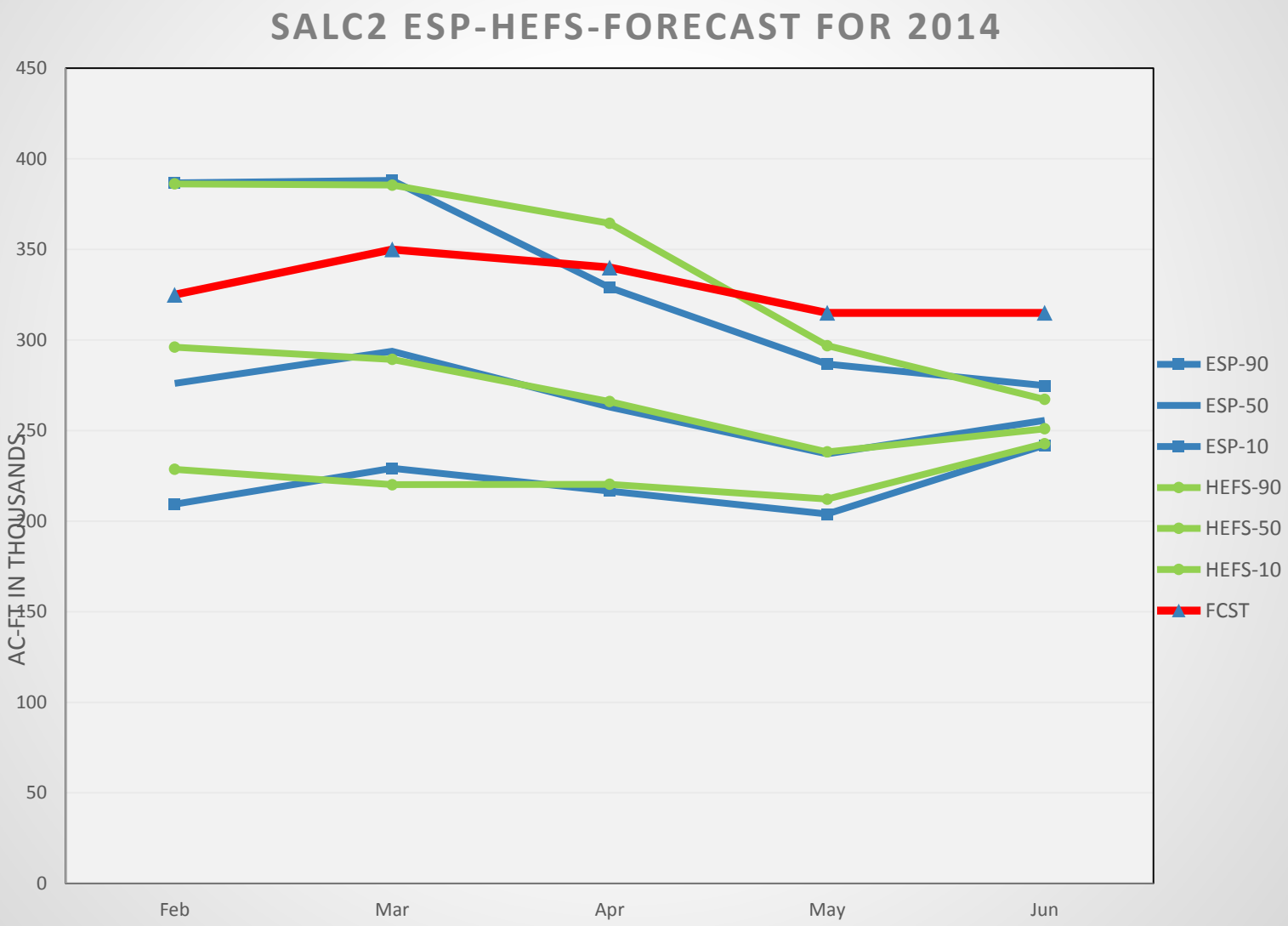

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Questions moving forward

- Can we continue to provide the same deterministic forecasts and the same skill, in the new probabilistic paradigm?
- How can we assimilate the skill of the NRCS into our forecasts?
- How can we assimilate the deterministic predictive skill of station data (SWS)?
  - NRCS SNOTEL and Snow course Data
  - NOHRSC Snow Water Equivalent estimates
  - Precipitation data

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Solutions

- Benefit from the experience of others.
  - Learn from those who went before us
    - (and steal their ideas)
  - Improve our model
  - Improve our precipitation estimation
- Education
  - Outreach
  - Training
- Innovation
  - Force the system to provide what our customers want

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Solutions

- More Intense Model Balancing
  - Increased Frequency
  - Increased Intensity
  - Improve data ingest of location and time specific sources
- Model Calibration
  - Greater emphasis on SNOW-17 calibration
- Innovation
  - Force the system to provide what our customers want

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Questions????

Comments???

Suggestions???

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