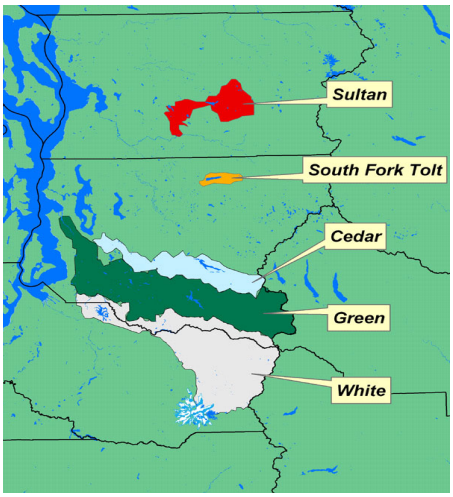
Puget Sound Regional Water Supply Forecast, March 2006:

The Puget Sound Regional Water Supply Forecast (PSWSF) is a product of the University of Washington's Climate Impacts Group, the Water Resources Planning and Drought Management Group, and the Puget Sound Regional Synthesis Model (PRISM) Project. The PSWSF provides information about the current and near future state of the major river basins (illustrated at right) that provide municipal water to the majority of the residents in the Puget Sound region. The Forecast is intended for water managers and others interested in Puget Sound water resources. This is an experimental product and contains features that may be removed or revised in future editions.



Current Conditions

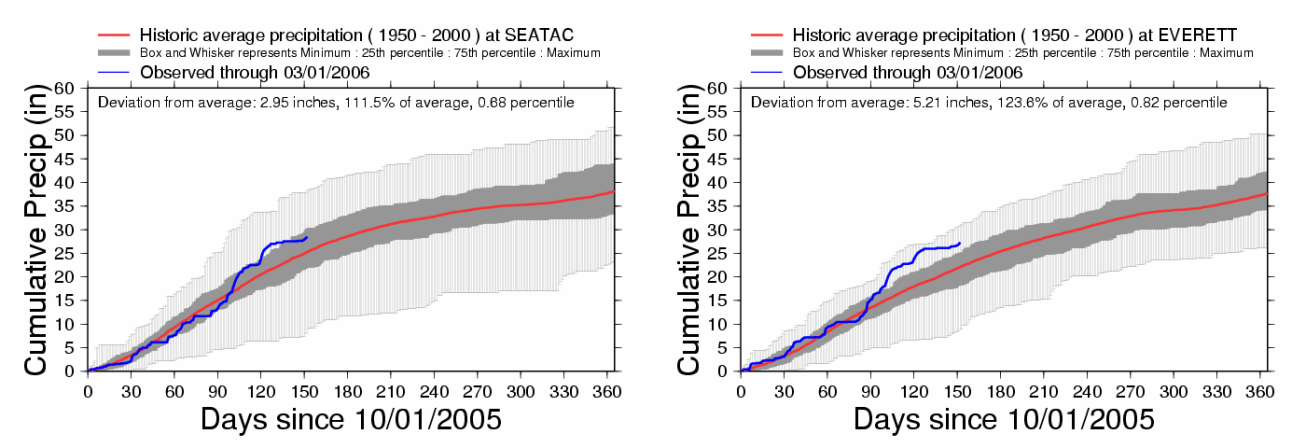
February of 2006 brought below average amounts of precipitation to the Pacific Northwest, along with slightly below average temperatures. The precipitation largely coincided with the colder periods in the month resulting in increased snow levels across most of the PNW. By combining observed and interpolated weather station data from 31 locations around the Puget Sound and the Olympic Peninsula, we describe the conditions for the region in the month of February as follows:

> The average temperature in February 2006 was 36.9° F. This is 0.6 F warmer than the 1930-2006 average, the 30th coldest February in 77 years. The temperature trend for the period from (1930 to present) is 0.03 degrees Fahrenheit per decade. February had 4.6 inches of precipitation. This is 2.6 inches less than the 1930- 2006 average, the 13th driest such month on record. The precipitation trend for the period of record (1930 to present) is a decline of 0.16 inches per decade.
>
> (Climate data source: UW West Wide Forecast System http://www.hydro.washington.edu/forecast/westwide/)

Local conditions were similar to the regional averages. At SeaTac Airport there was an average temperature of 43.0° F, which is 0.1° F above average, making this the 25 warmest February since 1950. There were 2.14 inches of precipitation, which is 1.72 inches below average, for the 11th driest February between 1950 and 2005. At Paine Field in Everett, the February temperature averaged 41.2° F, which is 0.8° F below average, making it the 20th coldest February from 1950-2005. There were 1.66 inches of rain, which is 1.65 inches below average, resulting again in the 8th driest February from 1950-2005.

Total precipitation for the water year remains above average in the Central Puget Sound region. Water year 2006 precipitation as of March 1st at SeaTac has totaled 111% of the 50 year average, 124% at Paine Field. The 2006 water year ranks at the 68th percentile in terms of total precipitation at SeaTac. The 2006 water year at Paine Field ranks as the 82nd percentile in terms of total precipitation (1st percentile being the driest, 100th the wettest).

(Data Source: National Climatic Data Center: http://www.ncdc.noaa.gov/oa/ncdc.html)



• Cumulative precipitation for WY2006 as of March 1st for SeaTac airport and Everett's Paine Field.

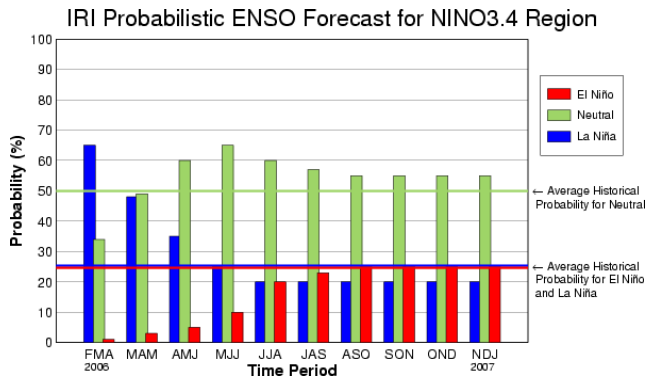
Streamflows in February were near to slightly above the historic average levels, reflecting the near average temperature and precipitation. Observed February flows in the water supply basins were approximately 114%, 102%, 99% and 90% of their historic averages for the Cedar, Green, Sultan, and Tolt basins respectively.

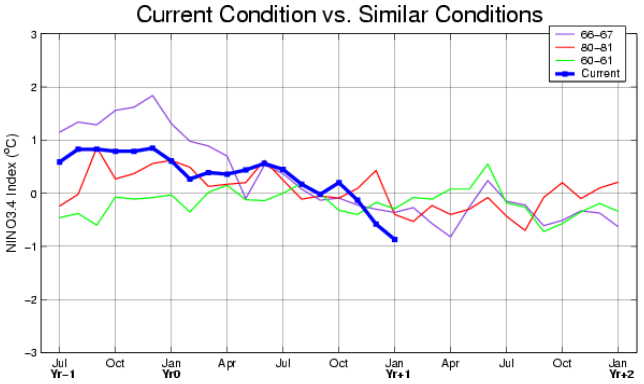
Climate Outlook

The International Research Institute's (IRI) projections of sea surface temperatures in the eastern and central equatorial Pacific have continued to become "cooler than average" and have cooled to such a degree that the year has been officially been categorized as a *La Niña event*. Based on the latest observations and forecasts, there is a roughly 50% chance that neutral conditions will return within in the next three months, and a roughly 50% chance of remaining in a La Niña state. The probability of an El Niño event occurring in the next few months is approximately 2%, rising to around 25% by the June-July-August Season. Based on this information, the Extended Streamflow Prediction (ESP) component of the water supply forecast has been changed to favor years in the historic record that demonstrated similar La Niña conditions.

The Climate Prediction Center (CPC) has observed the developing La Niña conditions and note, "…as SSTs in the central equatorial pacific have become increasingly negative. However since this is a weak, late developing episode … it is not clear if typical La Niña impacts will be observed over North America."
(Source: http://www.cpc.ncep.noaa.gov/products/predictions/long_range/fxus05.html)

The seasonal climate outlook from the CPC indicates that the Pacific Northwest has equal probabilities of experiencing below average, average, or above average temperatures in the March-April-May and April-May-June seasons. The chance of receiving above average temperature rises to 40% from May-June-July through the remainder of the summer. The probabilities return to equal chances of all conditions in the upcoming fall and winter. The region has equal changes of receiving below, average or above average precipitation for the entire 13 month forecast.

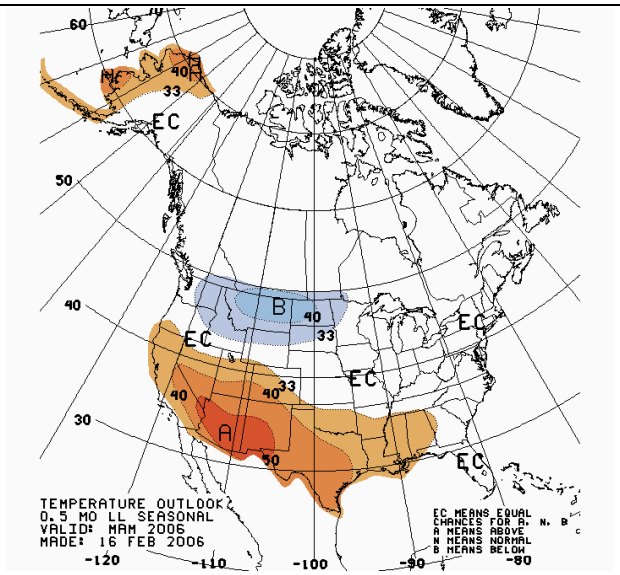


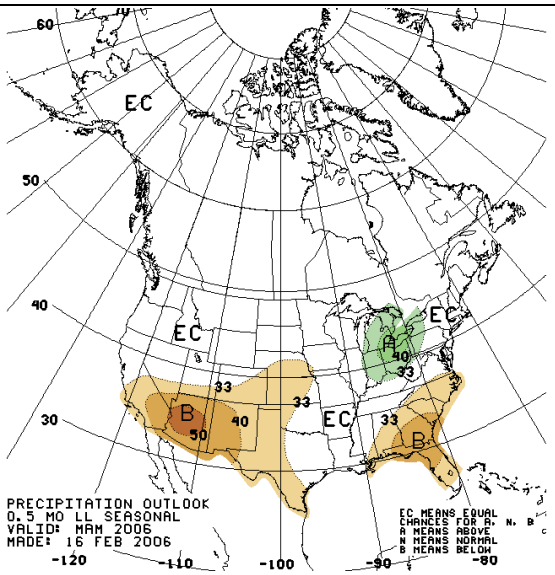


ENSO Quicklook: February 18, 2006

(Source: http://iri.columbia.edu/climate/ENSO/currentinfo/QuickLook.html)

• IRI probabilistic ENSO outlook used to select condition ESP forecast component





Additional seasonal graphics at: http://www.cpc.ncep.noaa.gov/products/predictions/multi_season

• CPC Temperature and Precipitation Outlook for February-March-April 2006. The full 13 season CPC long lead outlook is used to formulate the "CPC" based component of the water supply forecast.

Water Supply Forecast

The mild weather in February 2005 continues the trend for a positive outlook for the current water year's water supply conditions. The majority of the region continues to have average to above average snow accumulation. The most notable characteristic of the WY2006 snow season is the influence of above average temperatures. In spite of the below average precipitation in February accumulated snowpacks around the Puget Sound region have risen from approximately 90%-130% of the 30 year average at the end of January to around 100-150% by the end of February. In spite of overall above average temperatures and below average precipitation for the month, the precipitation timing in February tended to coincide with the colder times of the month resulting in good snow accumulation.

• Puget Sound Area Watersheds, Average Current Snow Conditions

Basin	Percent of 30 year average as of 03/03/2006
CEDAR RIVER	148%
GREEN RIVER	114%
OLYMPIC PENINSULA	91%
PUYALLUP RIVER	125%
SKAGIT RIVER	99%
SKYKOMISH RIVER	121%
TOLT RIVER	140%
Source: Natural Resource Conservation Service ftp://ftp.wcc.nrcs.usda.gov/data/snow/basin_reports/washington/wy2006/basnwa3.txt	

Flow volumes in all four basins were near average for the month of February due to the coincidence of the above mentioned pattern of precipitation during the colder times of the month. Flows tended to be a little higher, and snow pack accumulation a little less in the southern basins, the Cedar and the Green. Of the four water supply basins, the Green River Basin has the least amount of snow at present. Based on the current conditions in the watersheds, the recently developed La Niña ENSO state, and the CPC forecasts, the generalized forecast for the remainder of the winter is for an elevated probability of near average flows in the months of March and April. Flows in the month of May show an increased chance of being below average (April is also forecast to be below average on the Sultan River), followed by elevated chances of above average flows for the months of June, July, and August. It is presumed that the below average period being modeled in April and May is caused by the assumption of cooler temperatures associated with La Nina events causing snow accumulation to extend further into the spring than average.

The change in ENSO condition has resulted in the forecast traces representing increased probabilities of cooler weather and high snow accumulation in the coming spring. This pattern, in combination with the already above average snow pack, has the potential to create above average flows this late spring?. The lower temperatures associated with a La Niña event are reflected in the delay of the onset of the snow melt peak until later May or June. The timing of the spring snowmelt pulse will be dependant on the whether the above average temperatures seen so far this winter continue, or if instead the cooler temperature typically associated with a La Niña event prevail. Continued monitoring of the developing La Niña event, and estimates of its strength will play an important role in upcoming spring forecasts.

Pages six through nine of the PSWSF presents the specific streamflow forecast ensembles and distributions for inflow to the major water supply reservoirs in each of the four basins. The accompanying pages and tables contain:

1) Graphical representation of historic flow terciles and the forecasted shifts in those terciles as projected using a combined ESP-CPC forecast and an ENSO conditioned ESP-Only forecast.
2) Total monthly volume of inflows as a percentage of historic average,
3) The probabilities of monthly flows falling in the lower, middle, and upper historic terciles using the combined ESP-CPC forecast
4) The probabilities of monthly flows falling in the lower, middle, and upper historic terciles using a ENSO conditioned ESP-Only forecast

The forecasts are for four locations: the Sultan River's input to Spada Reservoir, water supply for the Everett Area, the Green River's input to Howard Hanson Reservoir, water supply for the Tacoma Area, the Cedar River's input to Chester Morse Reservoir, water supply for the Seattle Area, and the South Fork Tolt River's input to South Fork Tolt Reservoir, also part of the water supply for the Seattle Area.

Contact Information

Questions regarding the PSWSF or requests to be added to the distribution list can be directed to

Matthew Wiley
Research Engineer
Department of Civil and Environmental Engineering,
University of Washington, Seattle, WA
email: mwwiley@u.washington.edu
phone: 206.616.1775
fax: 206.685.9185

Additional information about this forecast and forecasts from past months can be found at http://www.tag.washington.edu/projects/midrange.html

Disclaimer

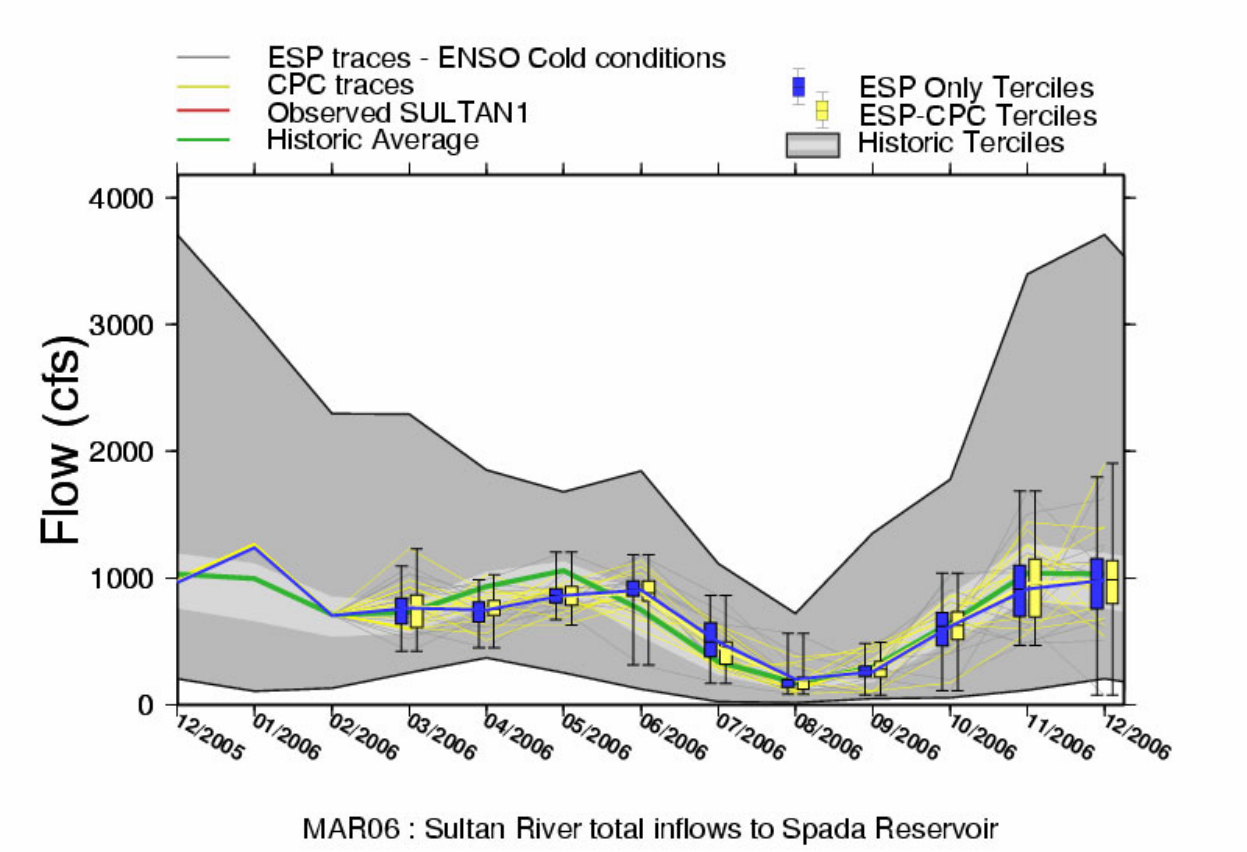
The forecasts provided here are experimental and are provided to familiarize researchers and potential users with the methods and performance of the techniques used. The forecasts are offered with no guarantee of appropriateness for any particular purpose. Use of these forecasts for any purpose other than academic research is therefore entirely at the discretion of the user. The authors, CIG, PRISM, and the University of Washington accept no responsibility for the consequences of such use.

Acknowledgement

The downscaling methods for the CPC forecast used in this forecast, and portions of the initial condition data, are provided by Dr. Andrew Wood of the University of Washington. The DHSVM hydrology model used in this research was developed in part by the University Of Washington Land Surface Hydrology Group. (http://www.hydro.washington.edu)

Partial funding for the development and production of this forecast product is provided by the Central Puget Sound Water Supplier's Forum.

Sultan River: Inflows to Spada Reservoir



MAR06 : Sultan River total inflows to Spada Reservoir

ESP-Only ensemble forecast average as percent of historic average

03/2006	775	107%
04/2006	756	81%
05/2006	854	81%
06/2006	882	118%
07/2006	451	134%
08/2006	194	112%
09/2006	281	95%
10/2006	624	97%
11/2006	955	92%
12/2006	986	96%

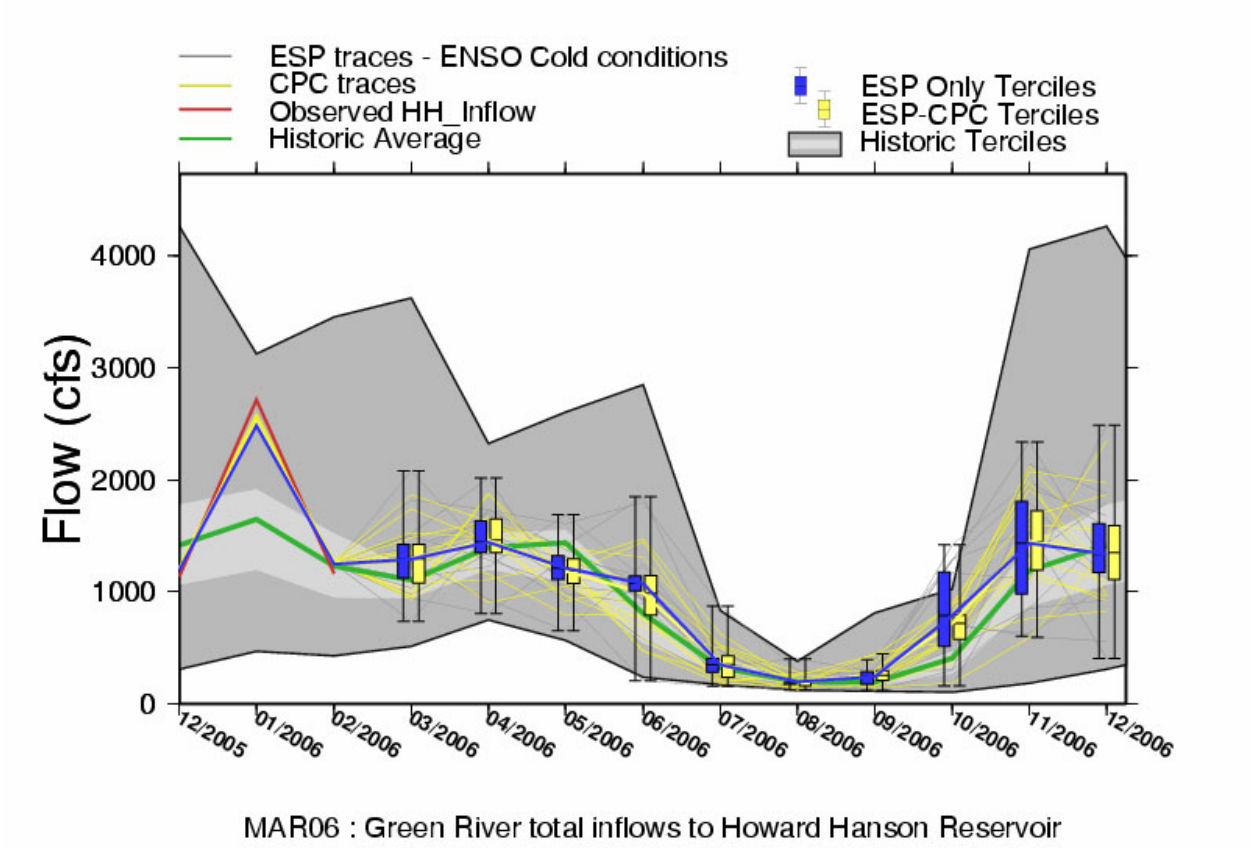
ESP-CPC chance of flows by tercile

MONTH	LOW	MID	HIGH
03/2006	11%	44%	44%
04/2006	51%	47%	0%
05/2006	67%	27%	4%
06/2006	5%	41%	53%
07/2006	5%	43%	51%
08/2006	29%	42%	28%
09/2006	24%	45%	30%
10/2006	31%	54%	13%
11/2006	42%	39%	17%
12/2006	28%	44%	26%

ESP-Only chance of flows by tercile

MONTH	LOW	MID	HIGH
03/2006	22%	32%	45%
04/2006	57%	42%	0%
05/2006	73%	18%	7%
06/2006	8%	23%	68%
07/2006	8%	36%	54%
08/2006	31%	42%	26%
09/2006	26%	49%	23%
10/2006	36%	40%	22%
11/2006	49%	32%	17%
12/2006	32%	36%	30%

Green River: Inflows to Howard Hanson Reservoir



MAR06 : Green River total inflows to Howard Hanson Reservoir

ESP-Only ensemble forecast average as percent of historic average

03/2006	1294	117%
04/2006	1460	105%
05/2006	1182	82%
06/2006	986	123%
07/2006	353	110%
08/2006	196	101%
09/2006	255	132%
10/2006	715	177%
11/2006	1453	122%
12/2006	1348	95%

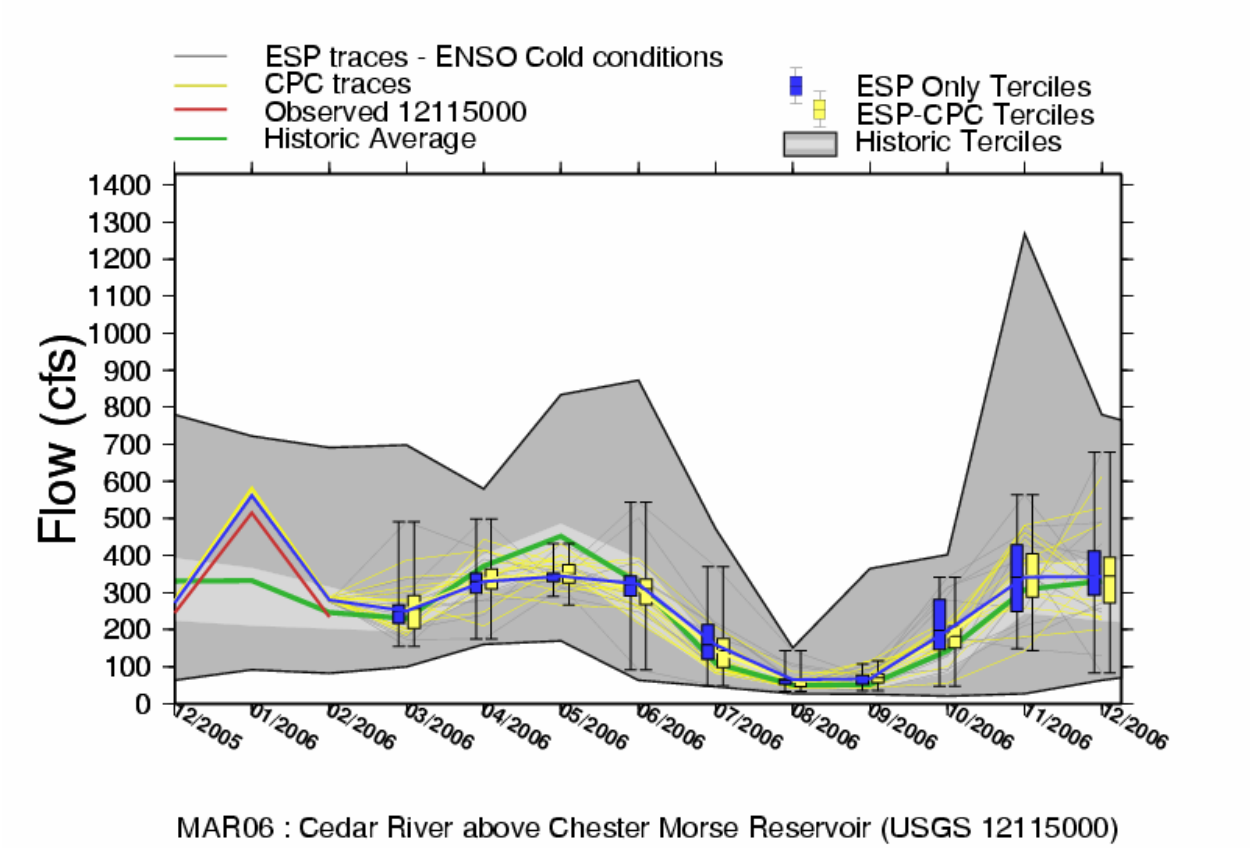
ESP-CPC chance of flows by tercile

MONTH	LOW	MID	HIGH
03/2006	9%	33%	57%
04/2006	19%	34%	45%
05/2006	37%	54%	7%
06/2006	12%	27%	59%
07/2006	45%	25%	28%
08/2006	51%	14%	34%
09/2006	24%	14%	61%
10/2006	8%	15%	75%
11/2006	21%	24%	53%
12/2006	29%	48%	22%

ESP-Only chance of flows by tercile

MONTH	LOW	MID	HIGH
03/2006	12%	34%	53%
04/2006	19%	36%	44%
05/2006	37%	48%	14%
06/2006	11%	8%	80%
07/2006	47%	27%	25%
08/2006	64%	9%	25%
09/2006	28%	12%	58%
10/2006	10%	23%	66%
11/2006	27%	18%	53%
12/2006	28%	50%	21%

Cedar River: Flows at USGS 12115000, above Chester Morse Reservoir



MAR06 : Cedar River above Chester Morse Reservoir (USGS 12115000)

ESP-Only ensemble forecast average as percent of historic average

03/2006	256	111%
04/2006	336	90%
05/2006	351	78%
06/2006	309	95%
07/2006	143	132%
08/2006	60	119%
09/2006	70	135%
10/2006	182	127%
11/2006	344	112%
12/2006	344	104%

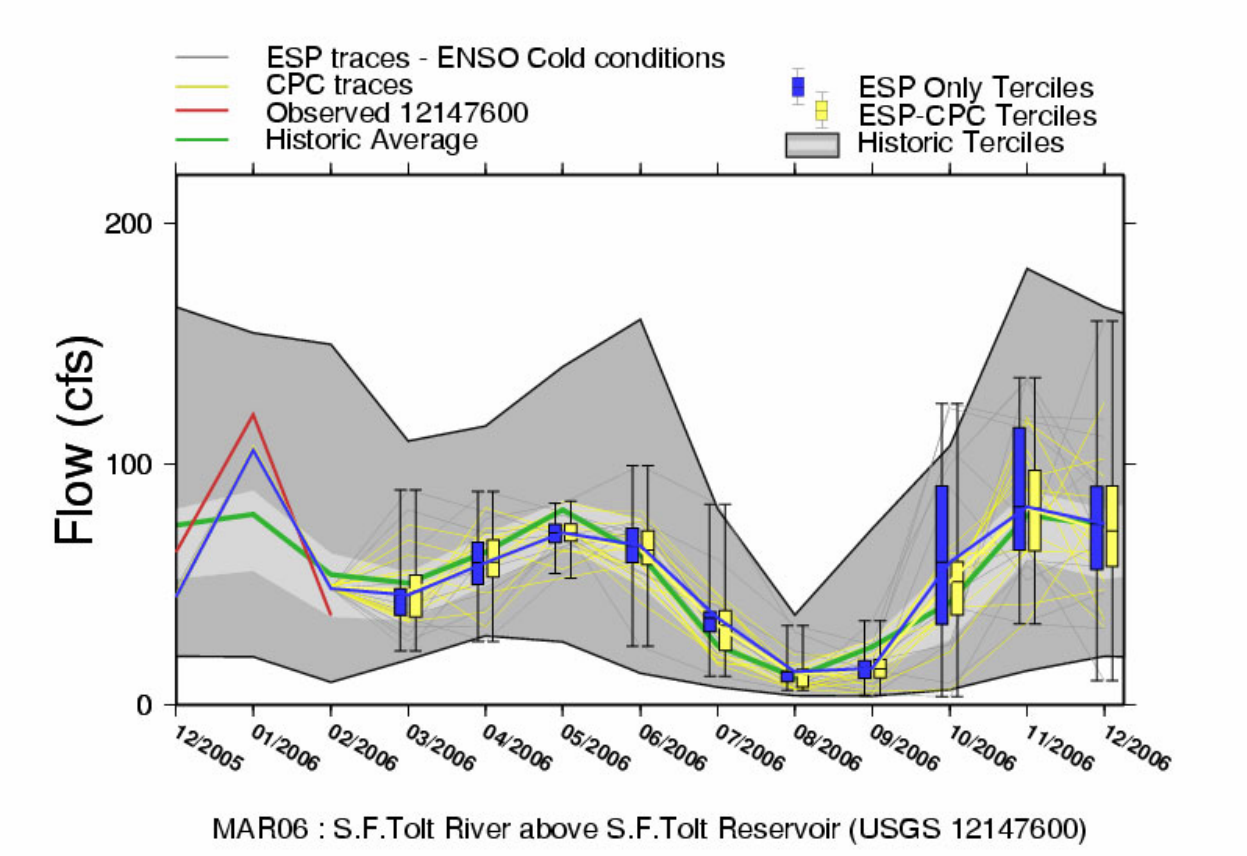
ESP-CPC chance of flows by tercile

MONTH	LOW	MID	HIGH
03/2006	22%	33%	43%
04/2006	25%	55%	19%
05/2006	60%	39%	0%
06/2006	7%	81%	10%
07/2006	6%	53%	40%
08/2006	14%	43%	42%
09/2006	8%	30%	61%
10/2006	9%	40%	49%
11/2006	23%	27%	48%
12/2006	13%	55%	30%

ESP-Only chance of flows by tercile

MONTH	LOW	MID	HIGH
03/2006	30%	36%	33%
04/2006	34%	49%	15%
05/2006	75%	24%	0%
06/2006	10%	69%	19%
07/2006	11%	42%	46%
08/2006	15%	41%	42%
09/2006	16%	22%	60%
10/2006	11%	35%	53%
11/2006	32%	21%	45%
12/2006	18%	44%	37%

South Fork Tolt River: Flows at USGS 12147600, above South Fork Tolt Reservoir



ESP-Only ensemble forecast average as percent of historic average

03/2006	47	93%
04/2006	59	93%
05/2006	71	88%
06/2006	64	103%
07/2006	33	135%
08/2006	13	109%
09/2006	15	62%
10/2006	51	120%
11/2006	82	104%
12/2006	72	97%

ESP-CPC chance of flows by tercile

MONTH	LOW	MID	HIGH
03/2006	22%	49%	27%
04/2006	28%	45%	26%
05/2006	29%	68%	1%
06/2006	11%	77%	11%
07/2006	20%	24%	54%
08/2006	25%	51%	22%
09/2006	54%	39%	5%
10/2006	25%	44%	29%
11/2006	25%	29%	44%
12/2006	29%	29%	40%

ESP-Only chance of flows by tercile

MONTH	LOW	MID	HIGH
03/2006	32%	42%	24%
04/2006	33%	38%	28%
05/2006	29%	67%	3%
06/2006	11%	76%	11%
07/2006	11%	28%	59%
08/2006	20%	53%	25%
09/2006	50%	38%	10%
10/2006	35%	22%	41%
11/2006	35%	24%	39%
12/2006	31%	24%	44%