

Introduction to Forecasts and Verification

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Presented by:

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Colorado River Commission
Technical Workshop
December 5, 2008

Forecasts and decision-making

What is a forecast?

What kinds of forecasts exist?

What makes a forecast good?



Predictions are everywhere!

Issued By: [Portland, Oregon](#) [\[Printable\]](#)

Point Forecast: Portland, OR

45.53N -122.67W (Elev. 200 ft)

[Text Forecast \(°C\)](#) [En Español](#)

Last Update: 9:37 am PST Feb 5, 2008

Forecast Valid: 1pm PST Feb 5, 2008-6pm PST Feb 11, 2008

Forecast at a Glance

This Afternoon	Tonight	Wednesday	Wednesday Night	Thursday	Thursday Night	Friday	Friday Night	Saturday
 100% Rain	 90% Showers	 70% Rain Likely	 100% Rain	 80% Rain	 50% Chance Showers	 60% Rain Likely	 Chance Rain	 Likely Showers
Hi 45°F	Lo 37°F	Hi 44°F	Lo 37°F	Hi 44°F	Lo 40°F	Hi 45°F	Lo 39°F	Hi 47°F

Weather forecasts

Predictions are everywhere!

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Point Forecast: Portland, OR

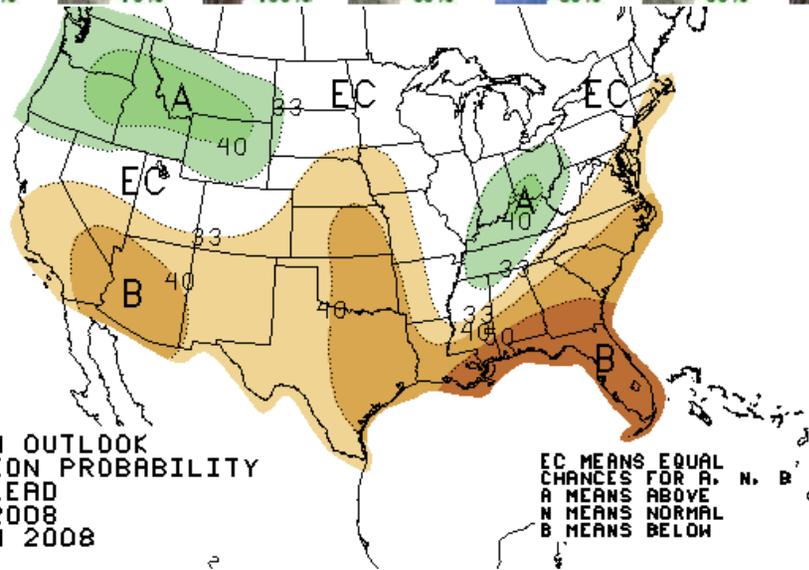
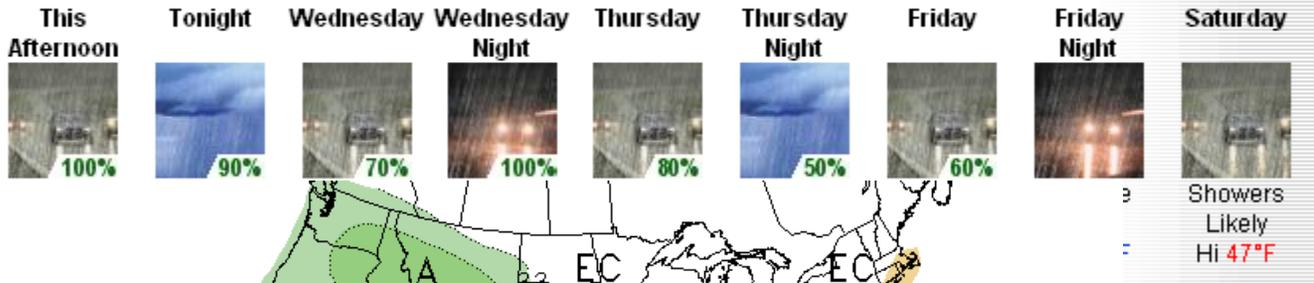
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Forecast at a Glance



THREE-MONTH OUTLOOK
 PRECIPITATION PROBABILITY
 0.5 MONTH LEAD
 VALID FMA 2008
 MADE 17 JAN 2008

EC MEANS EQUAL
 CHANCES FOR A, N, B
 A MEANS ABOVE
 N MEANS NORMAL
 B MEANS BELOW

Weather forecasts

Climate forecasts

Predictions are everywhere!

Issued By: [Portland, Oregon](#) [Printable]

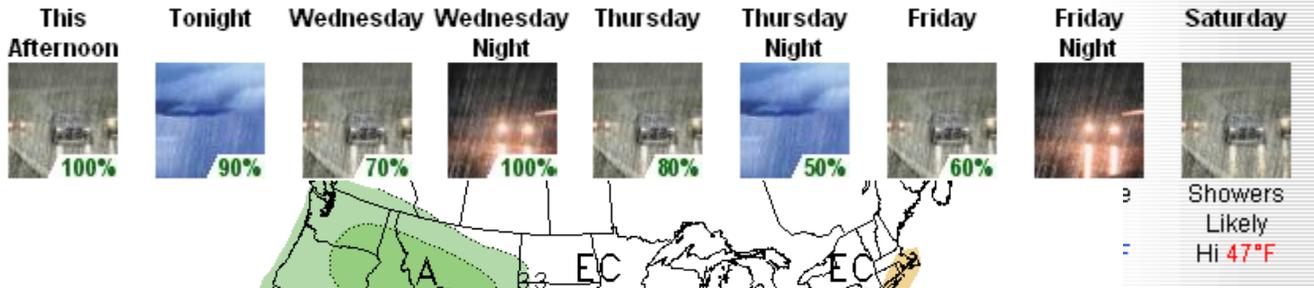
Point Forecast: Portland, OR
45.53N -122.67W (Elev. 200 ft)

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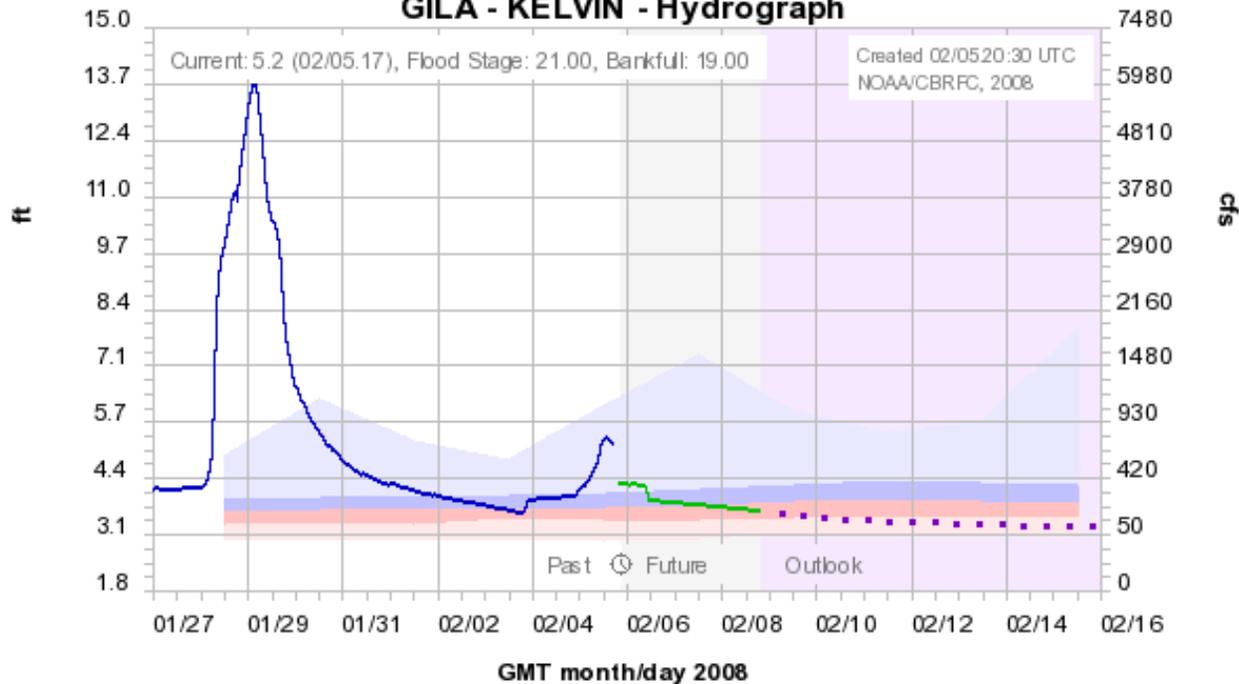
Forecast Valid: 1pm PST Feb 5, 2008-6pm PST Feb 11, 2008

Forecast at a Glance



Weather forecasts

GILA - KELVIN - Hydrograph



Climate forecasts

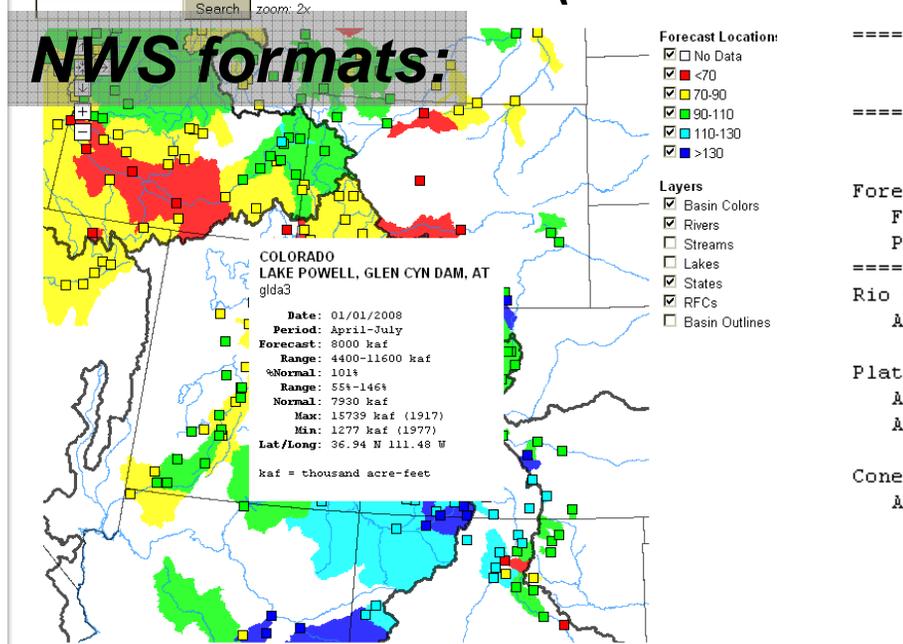
Observed  Forecast (02/05.18:00)  Outlook (increasing uncertainty) 

Historical Exceedance Probability (USGS): 90-75%  75-50%  50-25%  25-10% 

River Forecasts

The focus of today: Seasonal water supply volume forecasts (available in a variety of formats)

Seasonal Runoff Volume Forecasts

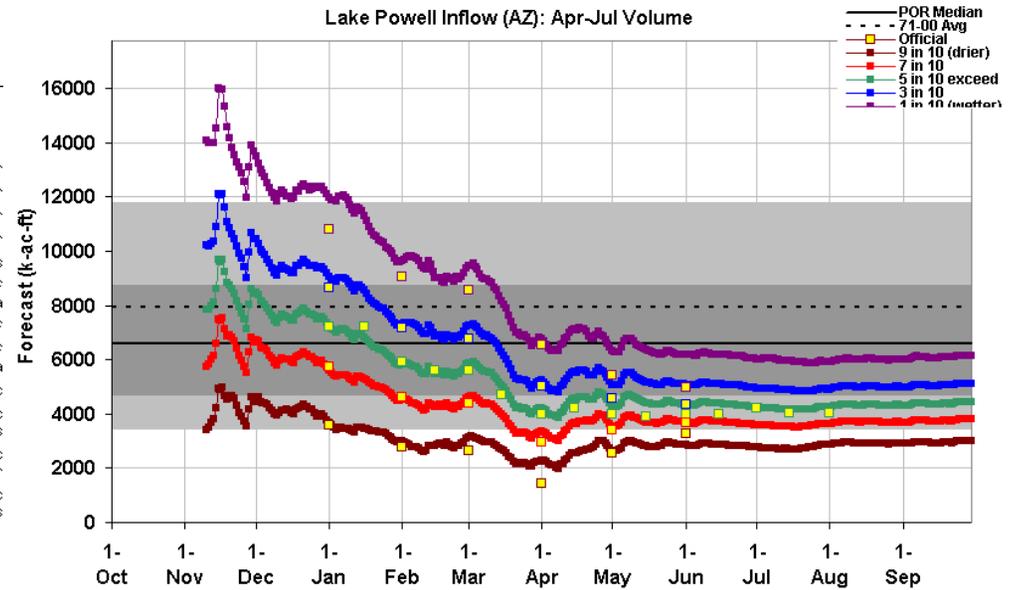
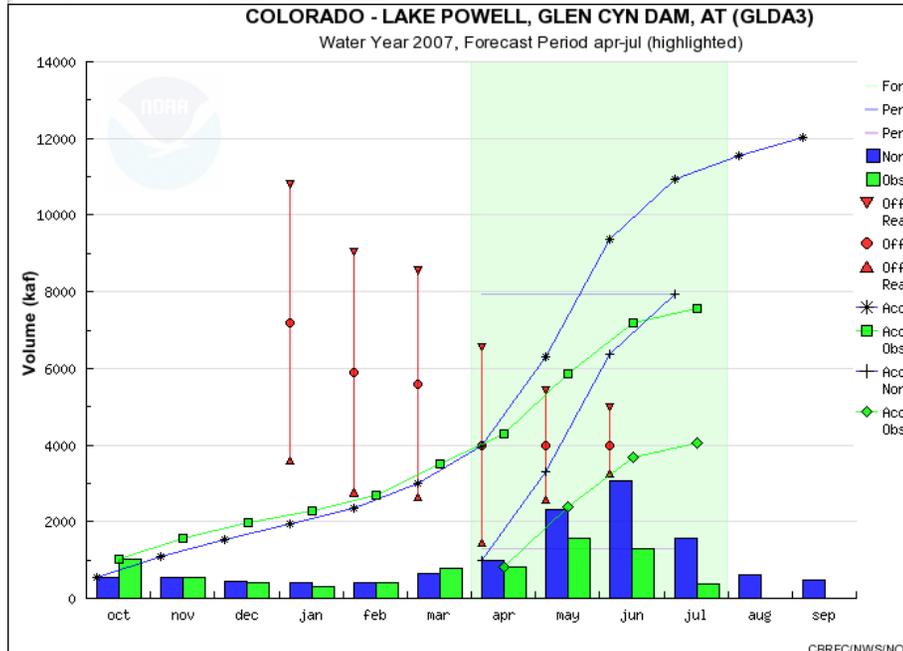


NRCS formats:

Streamflow Forecasts - April 1, 2002

<=== Drier === Future Conditions === Wetter ===>

Forecast Pt	Chance of Exceeding *					
Forecast Period	90% (1000AF)	70% (1000AF)	50% (Most Prob) (1000AF) (% AVG.)	30% (1000AF)	10% (1000AF)	30 Yr Avg (1000AF)
Rio Grande nr Del Norte						
APR-SEP	129	157	177	33	242	339
Platoro Reservoir Inflow						
APR-JUL	12.0	19.7	25	39	30	38
APR-SEP	23	27	29	41	35	43
Conejos River nr Mogote						
APR-SEP	57	68	75	38	95	125



This is an automated product based solely on SNOTEL data, provisional data are subject to change. This product is a statistically based guidance forecast combining indices of snowpack and precipitation. **Yellow squares** are the official outlooks. **Gray background** is the historical period of record variability. This product does not consider climate information such as El Nino or short range weather forecasts, or a variety of other factors considered in the official forecasts. This product is not meant to replace or supersede the official forecasts produced in coordination with the National Weather Service. Science Contact: Tom.Pagano@por.usda.gov 503 414 3010 www.wcc.nrcs.usda.gov/wvst/daily_forecasts.html



Elements of a forecast: Location, Time, Magnitude, Probability

```

=====
                                RIO GRANDE BASIN
                                Streamflow Forecasts - April 1, 2002
=====
                                <=== Drier === Future Conditions === Wetter ===>
Forecast Pt | ===== Chance of Exceeding * ===== |
Forecast | 90%      70%   | 50% (Most Prob) | 30%      10%   | 30 Yr Avg
Period | (1000AF) (1000AF) | (1000AF) (% AVG.) | (1000AF) (1000AF) | (1000AF)
=====
Rio Grande nr Del Norte
  APR-SEP      129      157      177      33      242      339      531

Jemez River nr Jemez
  MAR-JUL      2.3      3.4      4.2      9      12.7      25      47

Jemez Canyon Reservoir inflow
  MAR-JUL      1.1      2.1      2.7      7      11.9      25      38

Rio Grande at San Marcial
  MAR-JUL      3.0      7.0      10.0     2      147      349      573

```

Location

Rio Grande at San Marcial

Elements of a forecast: Location, Time, Magnitude, Probability

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Jemez Canyon Reservoir inflow
  MAR-JUL      1.1      2.1      2.7      7      11.9      2 Historical Average

Rio Grande at San Marcial
  MAR-JUL      3.0      7.0      10.0     2      147      349      573
  
```

Location

Time Period

Elements of a forecast: Location, Time, Magnitude, Probability

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Historical Average

Location

Time Period

Error Bounds

**“Most Probable”
Water Volume**

**Term retired in 2005 – now just
50% exceedance value*

Ways of expressing a forecast:

Categorical – “It will rain”

Deterministic – “It will be 45 degrees”

Probabilistic – “There is a 90% chance of rain”

Issued By: **Portland, Oregon**
Point Forecast: Portland, OR
45.53N -122.67W (Elev. 200 ft)

Forecast at a Glance

This Afternoon	Tonight	We
Rain	Showers	
Hi 45°F	Lo 37°F	
		
100%	90%	

Ways of verifying forecasts:

Categorical – Did you predict the right category?

Deterministic – Was the observed amount very far from the forecast?

Probabilistic – Was the outcome unlikely?

Water supply forecasts are probabilistic at their core, but most products are deterministic

average, down slightly from the amounts reported last year at this time. Near normal streamflows are forecast for most forecast points in the basin. Expected runoff will range from 88 percent of average for Muddy Creek below Wolford Mountain Reservoir to 106 percent of average for the Inflow to Ruedi Reservoir and the Roaring Fork at Glenwood Springs.

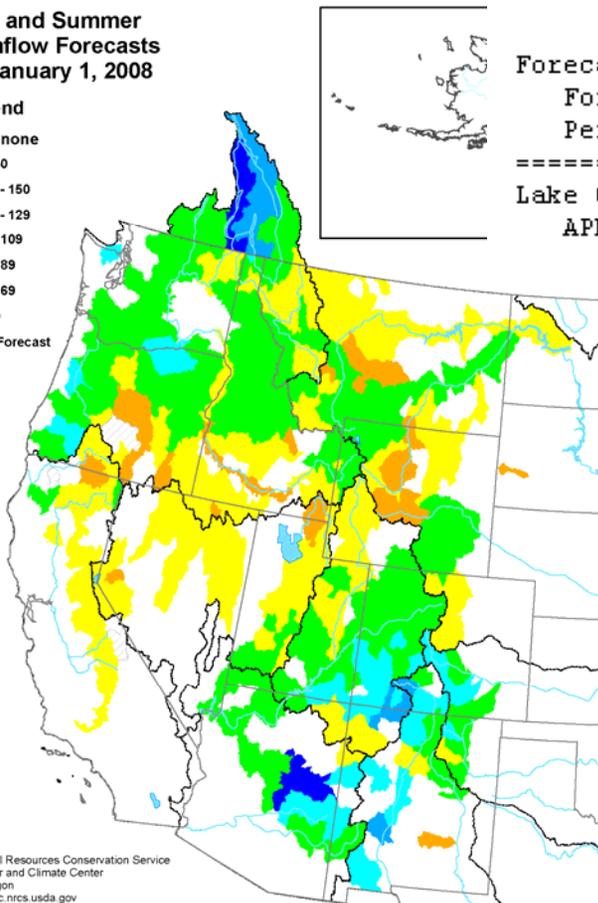
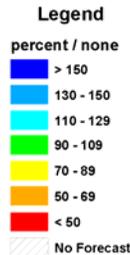
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UPPER COLORADO RIVER BASIN
Streamflow Forecasts - January 1, 2008

=====

Forecast Pt	<=== Drier === Future Conditions === Wetter ===>					
	90%	70%	50%	30%	10%	30 Yr Avg
Forecast Period	(1000AF)	(1000AF)	(1000AF) (% AVG.)	(1000AF)	(1000AF)	(1000AF)
Lake Granby Inflow (2)						
APR-JUL	155	187	210 93	235	273	225

Spring and Summer Streamflow Forecasts as of January 1, 2008



Prepared by
USDA, Natural Resources Conservation Service
National Water and Climate Center
Portland, Oregon
<http://www.wcc.nrcs.usda.gov>



Timely, Reliable Information
for Western Agriculture

DELTA | SOUTHWEST | SOUTHEAST | WEST

- HOME
- GRAPES
- RICE
- ALFALFA
- NUTS
- VEGETABLES
- COTTON
- CITRUS/ORCHARDS
- EN

First Arizona NRCS 2008 snow pack report: Close to 30-year average, normal spring runoff expected

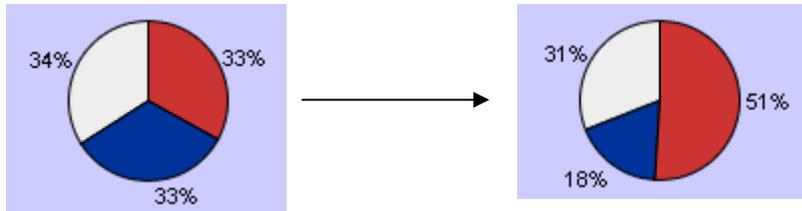
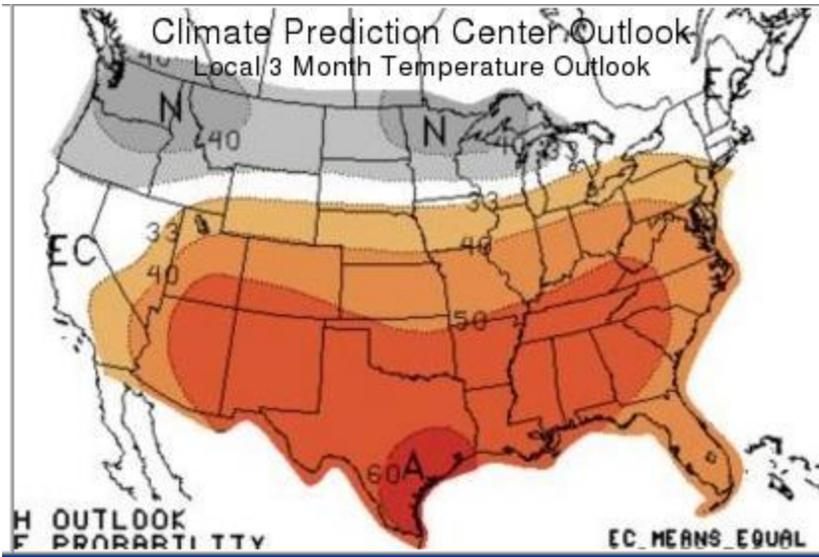
Jan 8, 2008 10:21 AM

SAVE THIS EMAIL THIS PRINT THIS MOST POPULAR

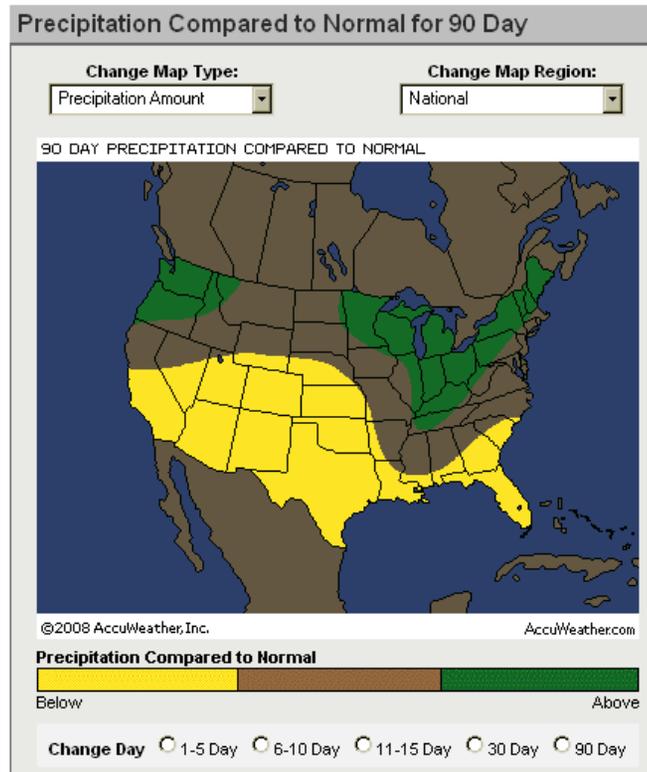
Water resources specialists from the Arizona Natural Resources Conservation Service (NRCS) and cooperating partners are forecasting normal spring runoff in Arizona's major rivers and streams based on recent snowpack measurements in Arizona's mountain watersheds.

Statewide, the January 1 snowpack measured 93-percent of the 30-year average, compared with 38-percent a year ago. The Salt River and San Francisco-Upper Gila River Basins have slightly above normal snow levels for this time of year, but the Verde River and Little Colorado River Basins are below normal for January 1.

Climate forecasts are probabilistic too, but mostly they're discussed categorically



Tilts in the odds



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Satellite/Radar

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PLAY EMBED EMAIL

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Sports Weather

Travel Weather

North-East Region

Ads by Google

Special Offers

The video player shows a weather presenter in front of a map of the United States. The player includes standard video controls and navigation options.

What is the “Climatology” forecast?

The safest forecast in the absence of skill or a signal...

But what is “normal”?

**Standard definition is the 30-year normal, 1971-2000.
Long enough to be stable, recent enough to be relevant.**

**“Baselines” are useful for determining skill, or
how much better a forecasting system is, comparatively.
Can use climatology, persistence, or even another forecast method.**

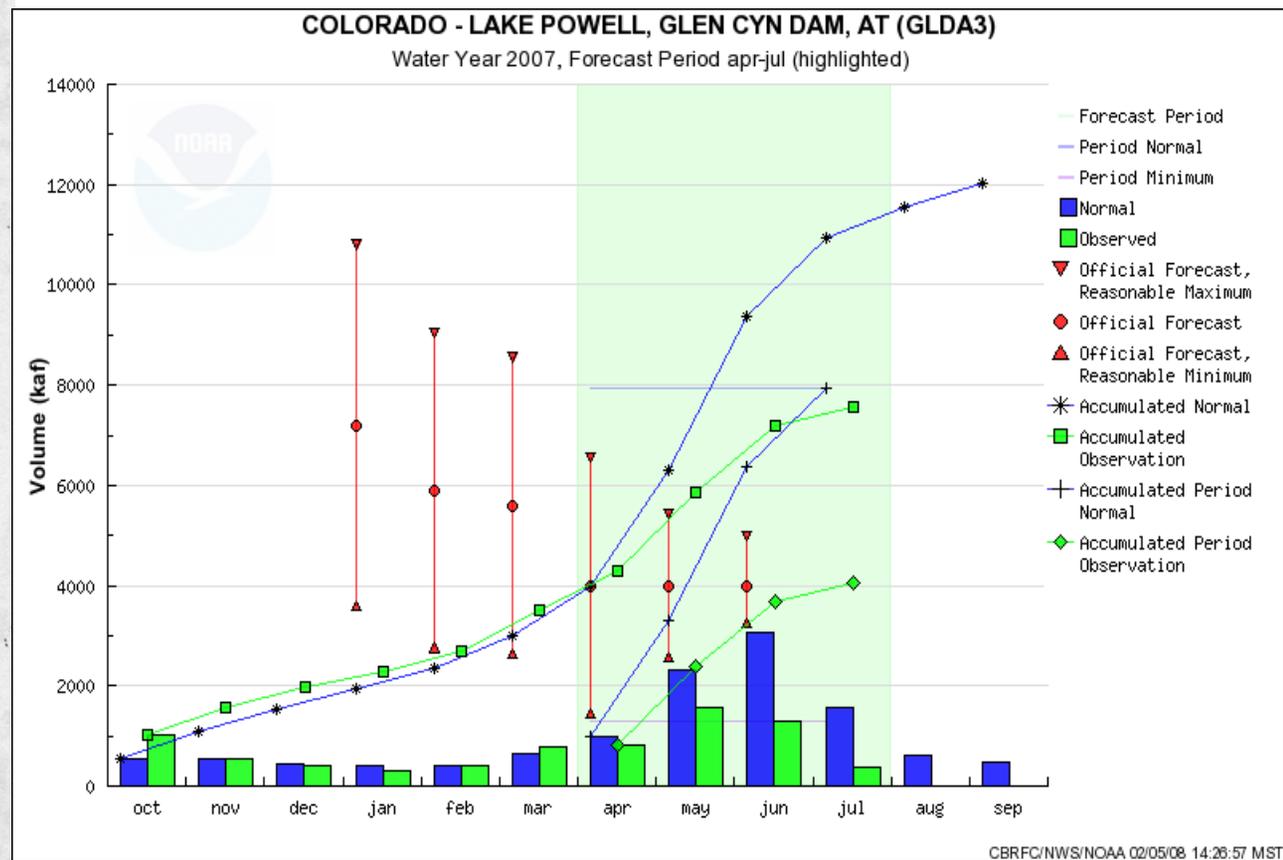
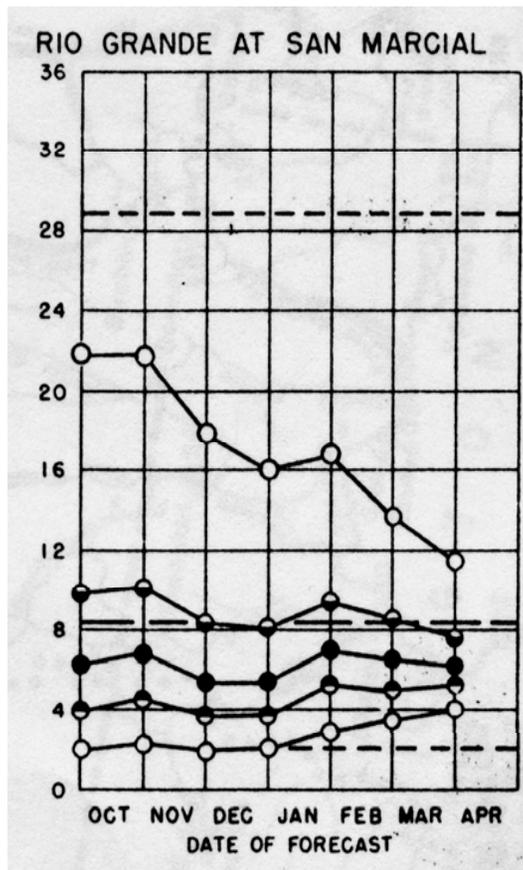
Resolution versus Reliability

Resolution/Sharpness: How confident are your forecasts? How much do they differ from climatology? How much do you go out on a limb?

One of the best indicators of confidence is built into the forecasts – the “cone of uncertainty”

Graph from 1949!

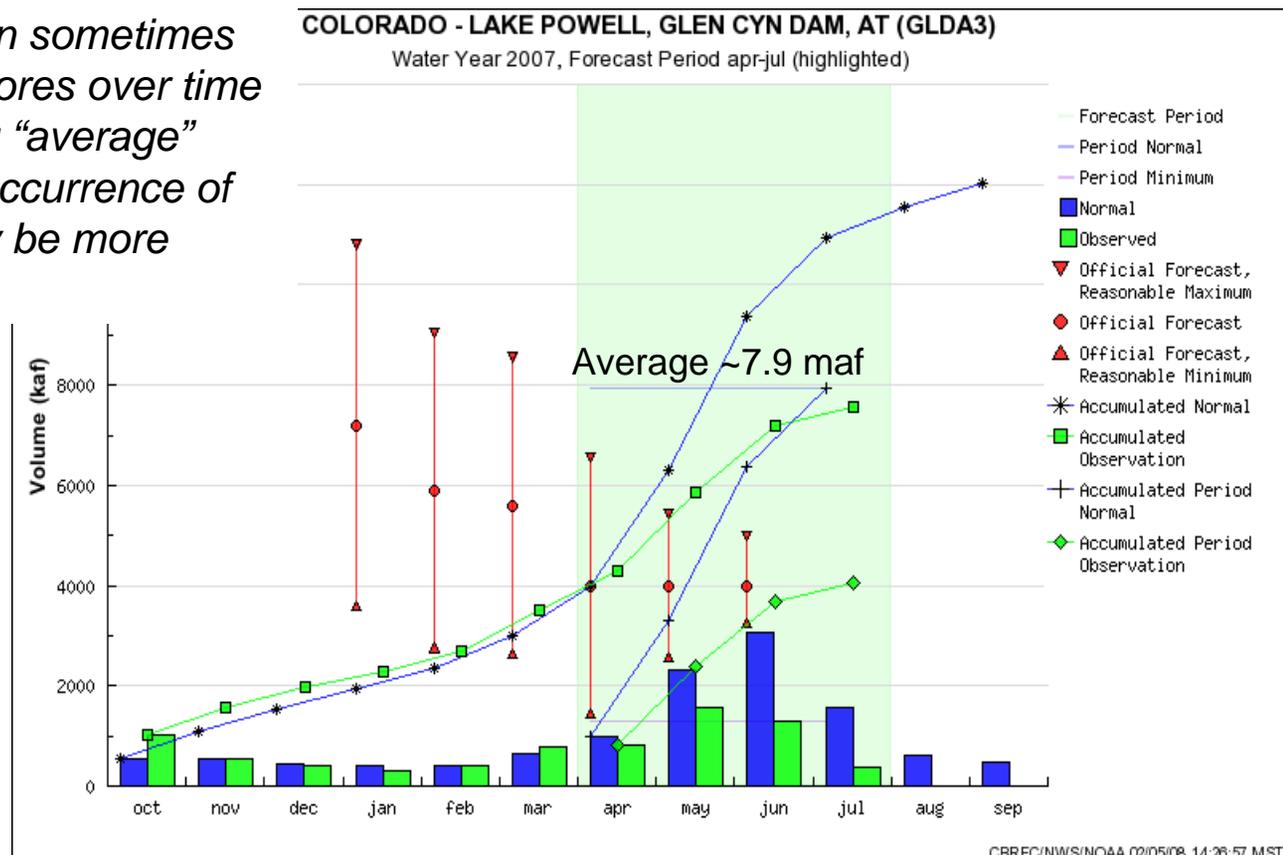
58 years later...



Resolution versus Reliability

Resolution/Sharpness: How confident are your forecasts? How much do they differ from climatology? How much do you go out on a limb?

Sharpness is important because forecast systems can sometimes achieve high skill scores over time by always predicting “average” conditions, but the occurrence of extreme events may be more important to users.



April 1 forecast 4.0 maf / 50%

Resolution versus Reliability

Reliability: Are you going out on the right limb? When you make a statement, is it generally correct? e.g. When you say there's a 30% chance of rain, does it rain 30% of the time?

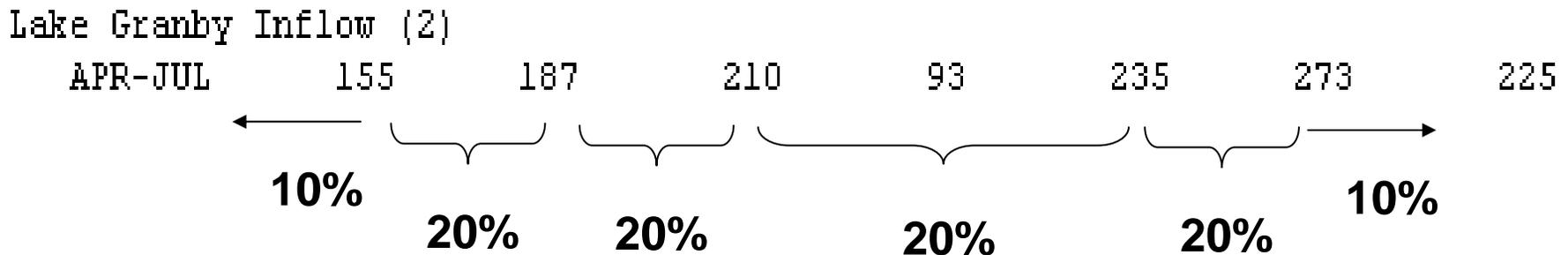
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UPPER COLORADO RIVER BASIN
Streamflow Forecasts - January 1, 2008

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	<=== Drier ===	Future Conditions	=== Wetter ===>			
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Period	(1000AF)	(1000AF)	(1000AF) (% AVG.)	(1000AF)	(1000AF)	(1000AF)

=====



Percent of time the observed should fall in different categories

Forecast “Appropriateness”

Is this the most appropriate forecast given the information at hand?

	07M31S	Animas at Durango		
<u>Year</u>	<u>Apr 1 snow</u>	<u>Apr-Jul fcst</u>	<u>Apr-Jul obs</u>	<u>Fcst - Obs</u>
2006	57%	68%	68%	0%
2007	54%	68%	89%	-18%

Was 2007 a “bad” forecast?

In 2007, Apr-Jun precipitation was >400% what it was in 2006.

2006 Apr-Jul precip 3rd lowest on record.

Maybe 2006 was the “bad” forecast with a lucky outcome?

Skill and Value are different

Consider also:

Timeliness

Cost to produce

Understandability

Relevance

Specificity

Transparency

Credibility

Ability to use

**Skill is probably one of
the hardest things on the list to improve**

Summary

**3 Classes of Forecasts:
Categorical, Deterministic, Probabilistic**

**At their core, all forecasts probabilistic,
but derived products are not.**

Resolution:

How confident are the forecasts? Can you predict extremes?

Reliability:

When you make a statement, are you generally correct?

Appropriateness:

Are you using the best information on hand?

**Skill is only one part of value and
is one of the hardest things to improve**