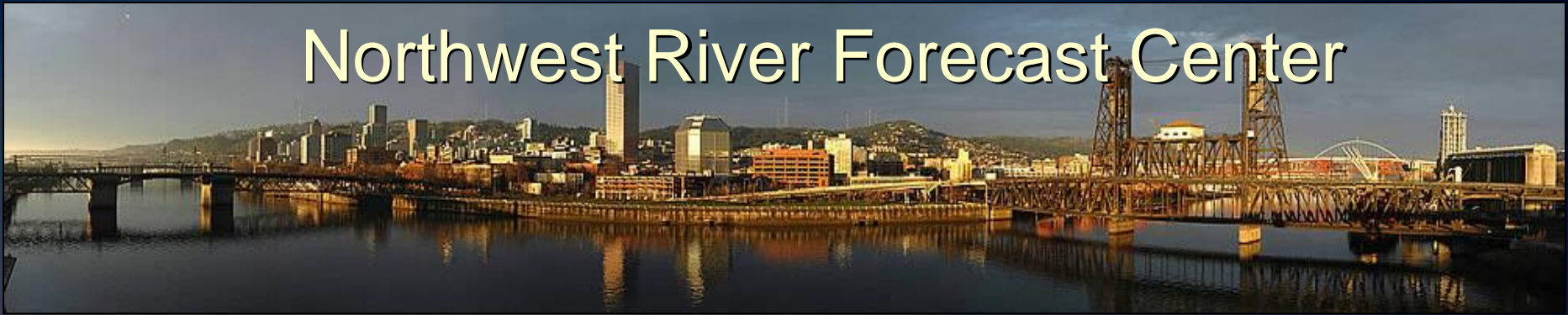


# Northwest River Forecast Center



## Water Supply Forecast Services via Ensemble Streamflow Prediction (ESP)

**December 2011**

# Outline

History Lesson on Regression

Why ESP?

Coordination vs Collaboration

ESP Forecast Services

# A Bit of History – 30+ yr old Regression System

- Legacy system is a multi-linear stepwise indexed regression model
- Seasonal Volumetric and Peak flow forecasts
- WS Volumes used by SSARR as basis for daily (peak) forecasts (pre-1994)
- Seasonal Peak flow – Volumes render seasonal peak forecast (spring only)
  
- Volumes (and WOWs) were basis for shaping long term deterministic trace (120-day) that was used for flood control and power management by COE/BPA
  
- By the late 1970s/early 1980s, coordination between the NWS and NRCS became part of the WS forecast process
  
- In 1993 NWRFC began the transition from SSARR to NWSRFS
  - Completed in 2001
  - NWSRFS brought ESP technology into the operational mainstream
  - Long term goal to employ ESP services across the NWRFC domain

# Legacy Water Supply

## **Pro-Legacy**

- 25 yrs old
- Equations stable after all these years
- Overall does a pretty good job

## **Con-Legacy**

- 25 yrs old
- Software infrastructure required modernizing
  - Based on a “card deck” system which can be resource intensive
- Calibration data and support programs lost in transition from mainframe-era to workstation environment in early 90s
- Reliance on monthly data
  - Assumptions made to fulfilling monthly criteria was often false.
- Technique stable but no improvements likely

**Conclusion - Unable to expand and meet today's service requirements**

# Transition to Water Supply-based ESP

Why?

Consolidation of forecast services into one single modeling system.

- Fully integrated into RFC forecast operations
- More efficient resource and operation in today's lean/mean forecasting machine
- Model is run daily – ESP based on current update states with applied bias and error corrections

Legacy maintenance is problematic with limited RFC resources.

- Not in line with expanded ESP capabilities
- Historical forecaster knowledge waning
- Limited resources better spent on ESP support

# Transition to Water Supply-based ESP

Why?

ESP user community has grown significantly

ESP more flexible and capable

- Updated daily
- Year-round (beyond seasonal)
- Longer lead forecasts
- Ensembles used for different statistics
- Apply medium and long range climate signals 30, 90, CPC
- Real time bias adjustments
- Interval period can change eg, 1948-2003 or 1971-2003
- Others...

Long lead forecasts (request for 1, 2 5 and 10 year forecasts)

- questionable science but “next year” forecasts are available from RFC

# Hydrologic Modeling (ESP & Others)

NWRFC will maintain an independent statistical model

- Corroboration System for comparison
- For internal use only (not for public consumption)

Look forward to a ***Multi Model*** capability

- Research into doing a better job accounting for model uncertainty
- Research into developing tools to help select best multi-model forecast.
- Regression (or other statistical models) continue to be invaluable rather ESP forecasts add value to decision services.
- Establishes ground work for multi-model capabilities eg, CSTAR  
\$300k 3-yr grant with PSU

Expand service capability to incorporate & publish other model results from various users (UofW, PSU, others)

# Transition to Water Supply-based ESP

## Performance

ESP and Regression perform similarly based on verification.

The regression models are slightly better than climatology in the month of January and their skill gradually improves through the forecast season. LEGACY RAW forecasts were often as good or better than COORD values early in the season. COORD forecasts show more skill over the raw model for late season forecasts.

ESP forecasts show less skill in January, but improve at a sharper rate through the season and outperform regression in the late season. *ESP's January low verification scores may reflect model maintenance issues rather than problems with the method itself.*

Both models showed a *slight* tendency to under-predict water supply volumes.

The perception of ESP variability is largely a function of the frequency of issuance and the variable nature of the forcings themselves. Using a subset of ESP forecasts at regular intervals will reduce the rate of variability.



# Transition to Water Supply-based ESP

## Coordination

Similar process as been practiced in past years

## Issues with WS Coordination and ESP

- Making sense of the different statistics
- Ability to apply various forcings and bias adjustments
- Potential real-time run time issues
- Lose strength of individual models

NWS/NRCS has redefined

**“Coordination” to be a “Collaboration”**

- Continue to exchange forecasts digitally
- Each agency will review, and discuss if needed (but not required)
- Differences are likely to occur

# ESP-based Water Supply Forecast Services

Forecast Services remain the same ...

- Volume and peak flow forecasts
- Applied forcings

... and yet services & capabilities expand

- Continual (annual) services – no longer seasonal
- More frequent Volume and Peak issuances (weekly at a minimum)
- RFC reserves right to issue more frequently (eg, daily)
- 10-day precip-temp forced forecasts (official)
- Include 3- and 0-day forced forecasts
- Future services will include climate forcings (eg, CPC), other flavors
- 120-day peak flow forecasts – a “Look-forward” approach

All forecasts issuances are official

Include a “next year” volume forecast during Oct–Dec based on user requests ie, commodities market

# ESP-based Water Supply Forecast Services

## Operations

New emphasis on SNOW

Established RFC 5-person snow team

Integrated snow QC into daily RFC routine

- Daily monitoring
- Briefings
- Snow update
- Model state conditions
- Responsible for ESP issuances

Educate RFC staff to become **fluent** in ESP-speak

# Transition to Water Supply-based ESP

## Forecast distribution

### Two primary distributions of “Final” forecasts

- Westwide
- Web Services

### Has the Westwide outlived its usefulness?

- Agencies agreed to review purpose and need for Westwide
- For WY2012, NWRFC & NRCS agreed to set of sites to be published once per month in Westwide
- Westwide and routing issues

Suggest WFOs start steering customers away from Westwide and toward RFC web

However, no limit to what can be published via web services by each agency

# The Transition to ESP & Water Supply

Discussions with federal partners and other user groups

Very supportive of transition to ESP

- NRCS
- WR HCSD discussions with NRCS
- OHD Director
- CR and SR River Forecast Centers
  
- BPA, COE, TMT, CRFG, Treaty Members
  - TMT, CRFG, Idaho Power
- WFOs and associated monthly calls
  
- Customer calls to NWRFC (commodity traders & stock markets)