XEFS Overview

Presented by D.-J. Seo

Hydrologic Ensemble Prediction Group (HEP)
Hydrologic Science and Modeling Branch
Hydrology Laboratory
Office of Hydrologic Development
NOAA/National Weather Service

Acknowledgments (for all overview presentations)

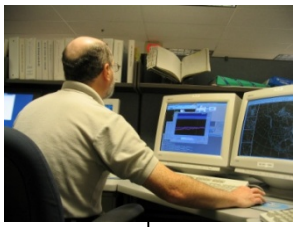
- Advanced Hydrologic Prediction Service (AHPS)
- Water Resources Initiative
- Climate Prediction Program for the Americas (CPPA)
- Many at AB-, CB-, CN-, MA-, NE-, OH-, WGRFC, ER, WR
- Many at OHD, OCWWS/HSD
- Many at NCEP/EMC, CPC, HPC
- Many at U. of Iowa, Iowa State, Princeton U., SUNY-Stonybrook, U. of Washington
- Hydrologic Ensemble Prediction EXperiment (HEPEX)

Objective

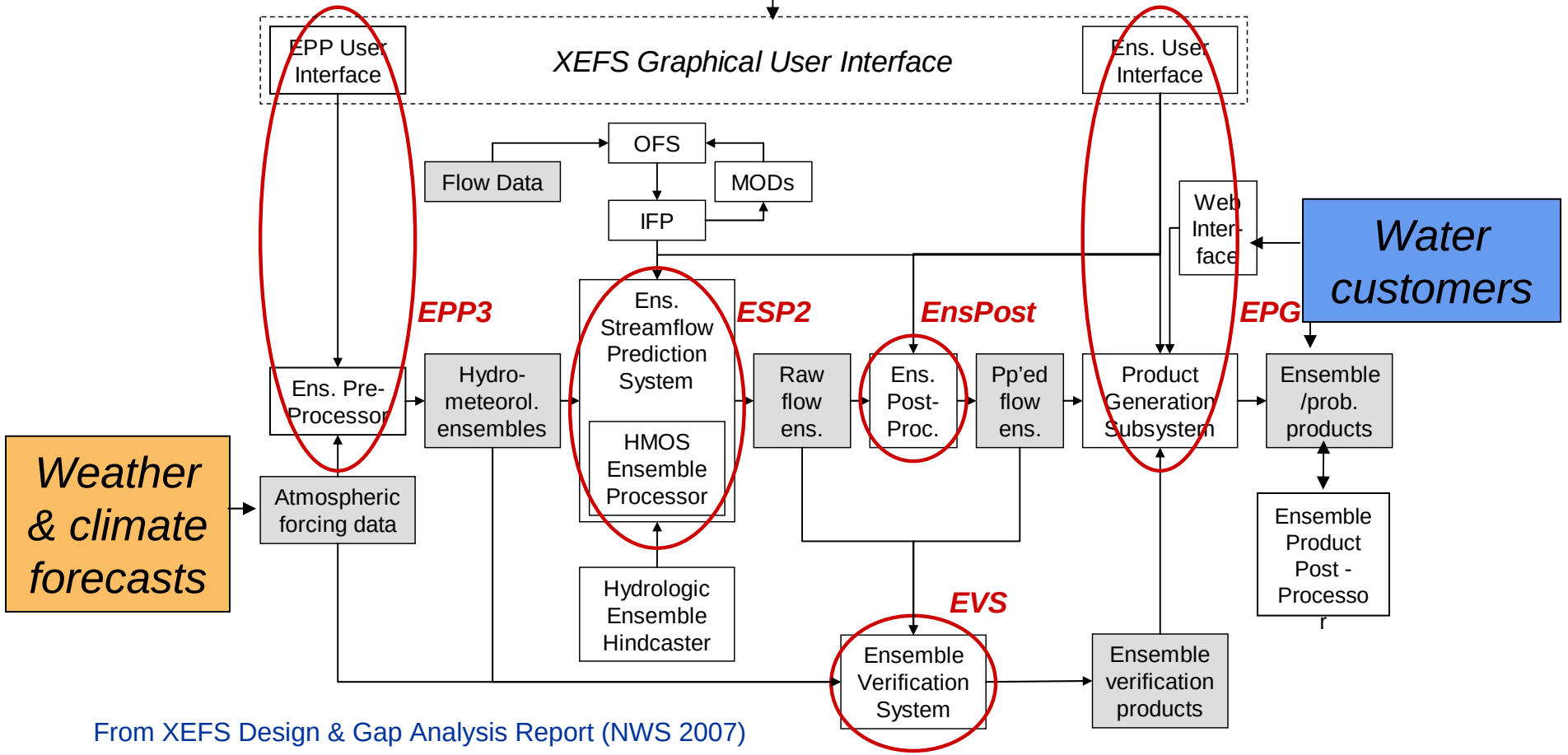
- Describe and discuss:
  - Progress, findings, issues, and next steps
  - Underlying science
  - Linkages, interdependencies and opportunities with other projects and activities
  - Research-to-operations transition and science infusion strategy

Notetakers – Satish Regonda (AM), Yuqiong Liu (PM)

EXperimental Ensemble Forecast System (XEFS)



Forecasters add value



From XEFS Design & Gap Analysis Report (NWS 2007)

XEFS will enable seamless hydrologic ensemble prediction from weather to climate scales and translate weather and climate prediction into uncertainty-quantified water information

XEFS Products & Services

Reliable and skillful ENSEMBLES
(streamflow and forcings)
and associated
meta data
for 1 hour to 2 years

Archive of hindcasts, forecasts, simulations, observations, and meta data

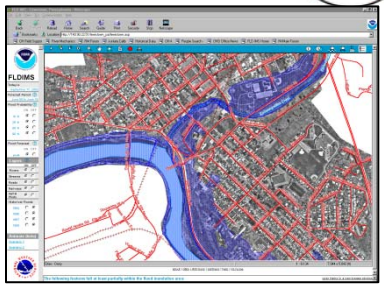
Specific data, forecasts, ensembles, and analysis for use in *value added* processes (e.g. flood inundation mapping)

User selectable attributes:
period
duration
time aggregation
probability levels
thresholds
probability type
analogs based on meta data

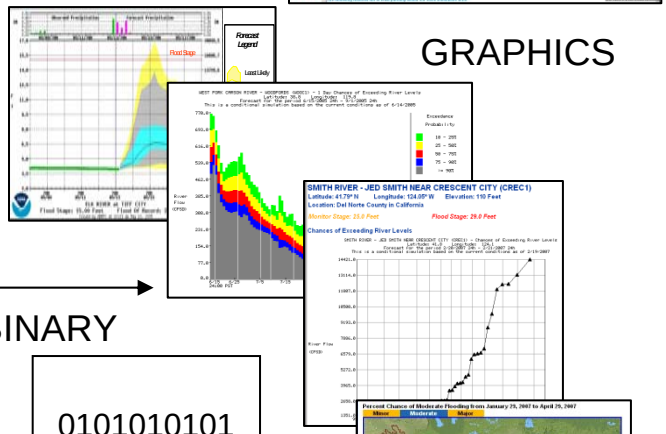
User selectable context
mean, median, max, min
analogs based on meta data
specific years
specific forecast w/outcome

Verification information in user friendly form

Instructional (annotated examples)



GRAPHICS



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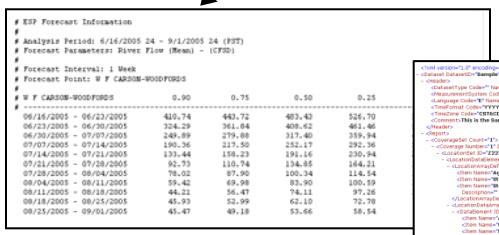
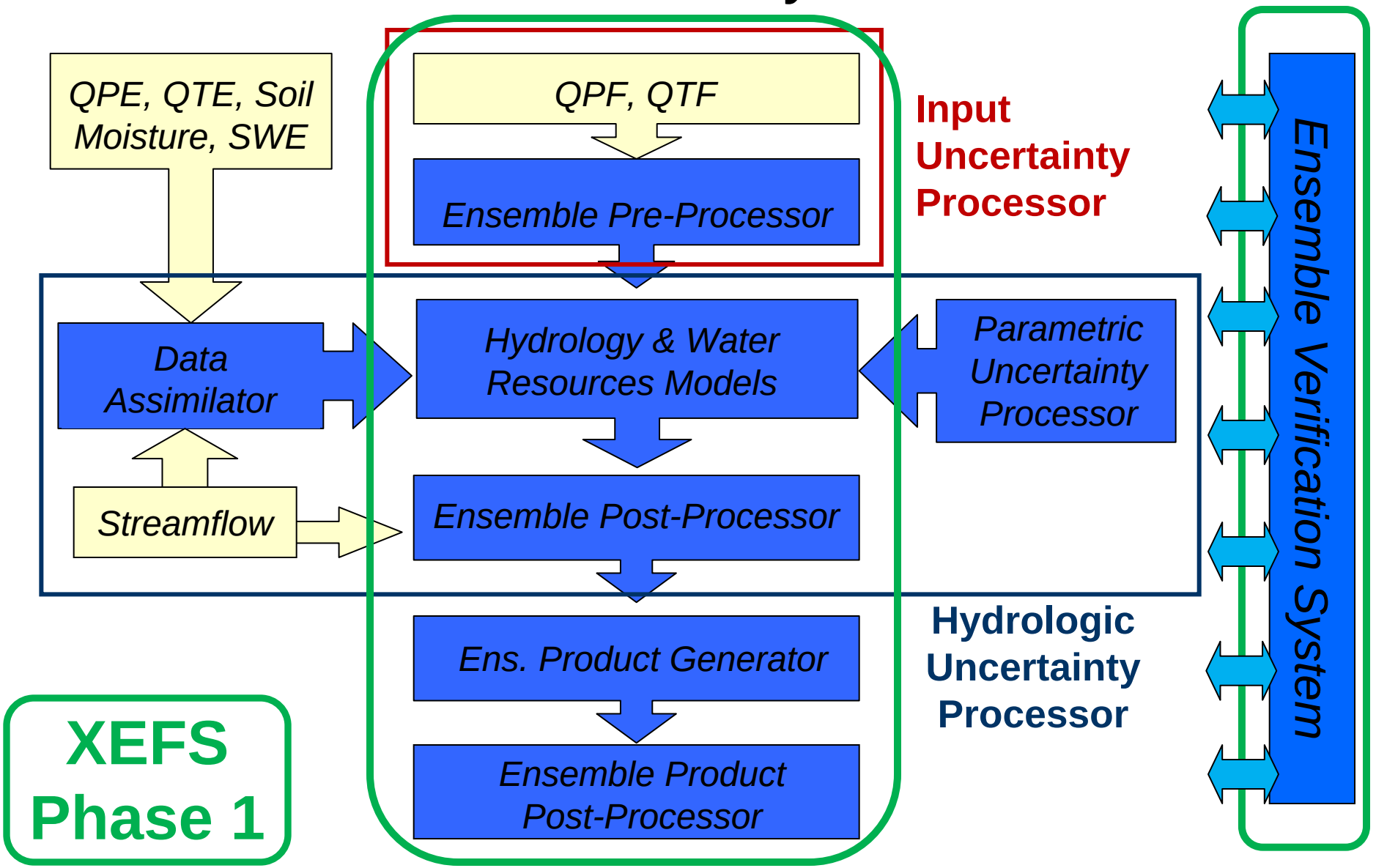


XML

From XEFS Design & Gap Analysis Report (NWS 2007)

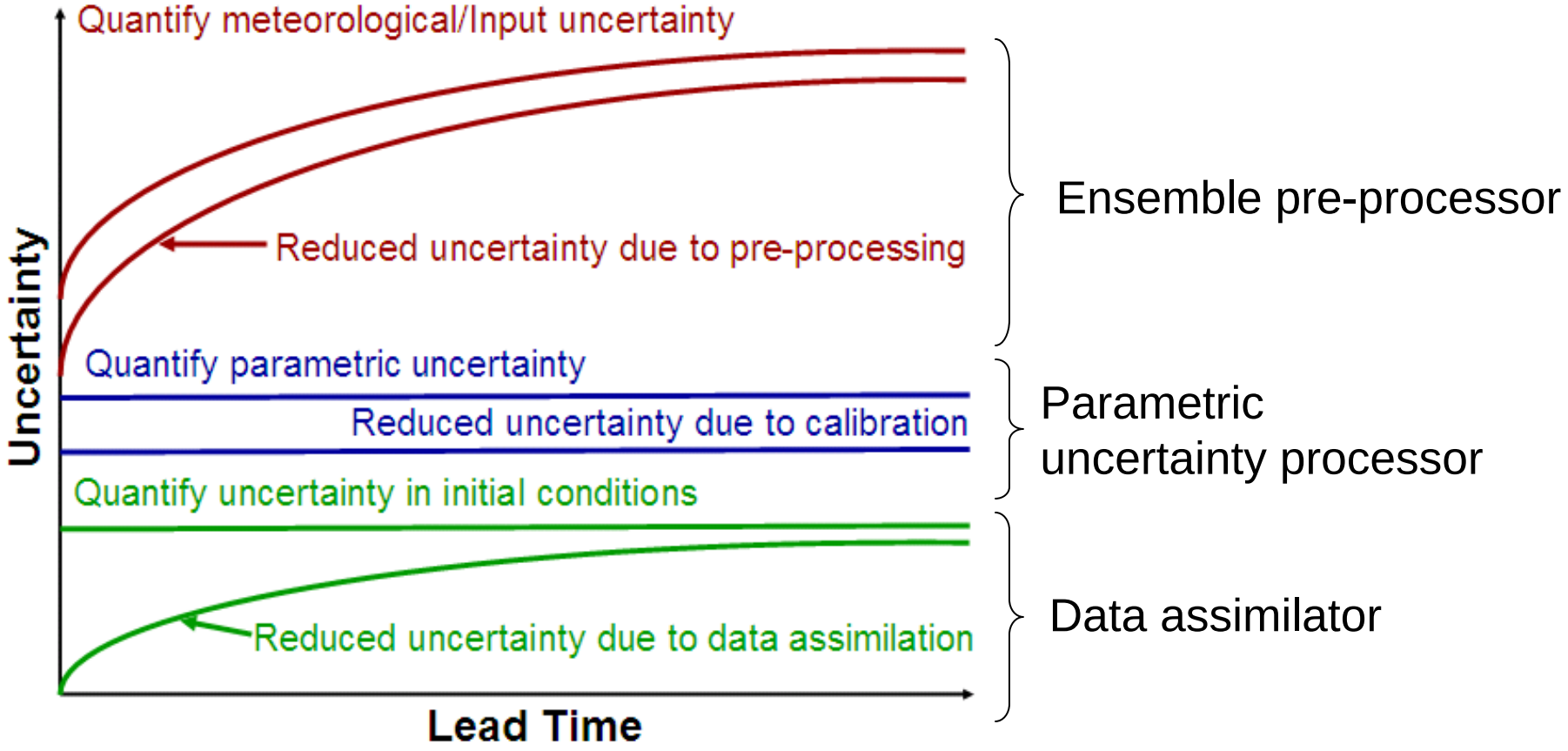
Elements of a Hydrologic Ensemble Prediction System



Why ensemble forecasting?

- Provide an estimate of the forecast (i.e. *predictive*) uncertainty
  - Confidence information
  - User-specific decision-making
- Extend forecast lead time
  - Weather and climate forecasts are highly uncertain and noisy; practically, they can only be conveyed in the form of ensembles
- Improve forecast accuracy
  - An average of two good (or bad) forecasts is better than either of the two
- Improve forecast cost-effectively

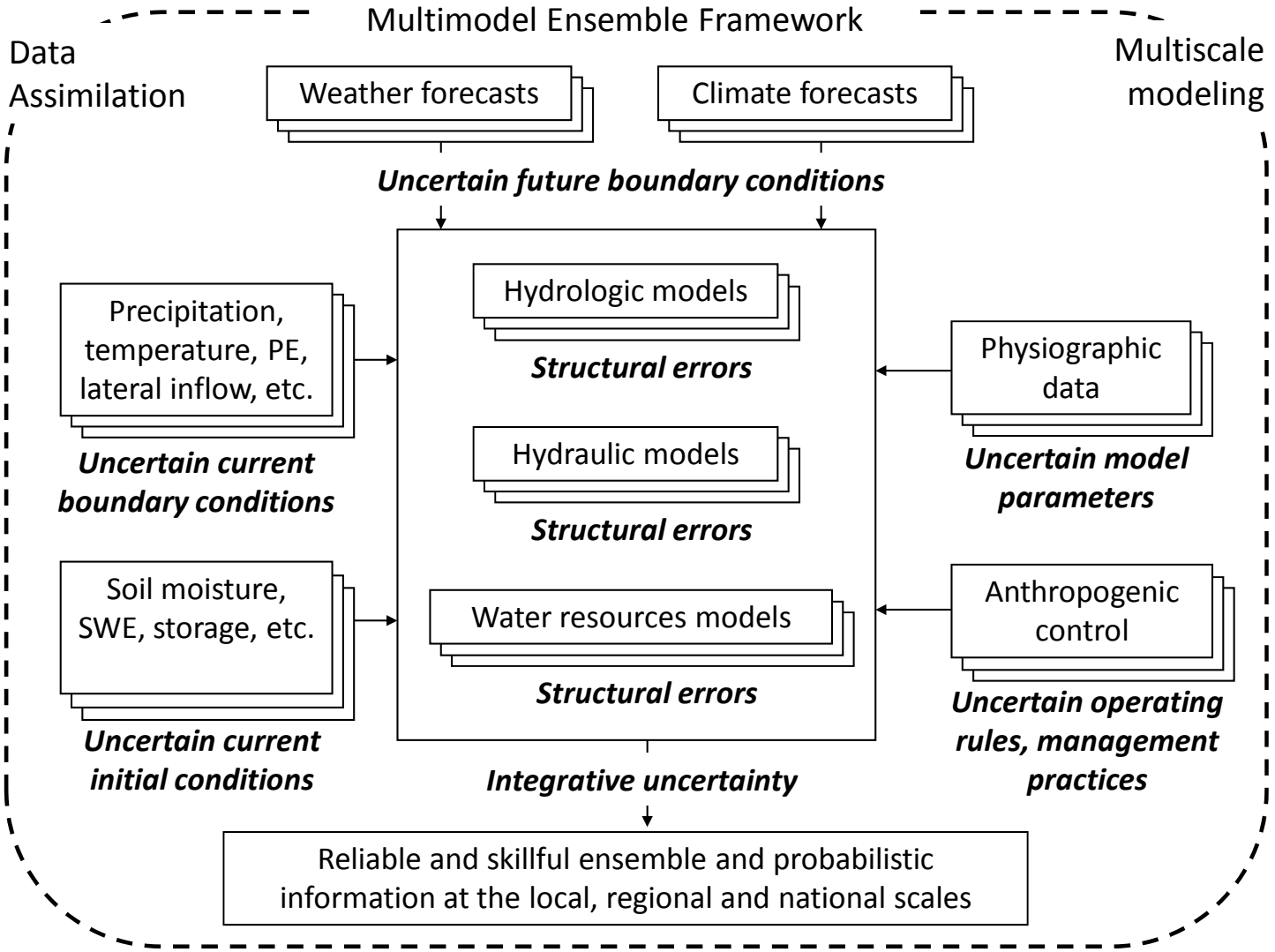
Uncertainties in Hydrologic Forecast



Structural uncertainty
residual uncertainty
} Ensemble post –processor, multimodel ensemble

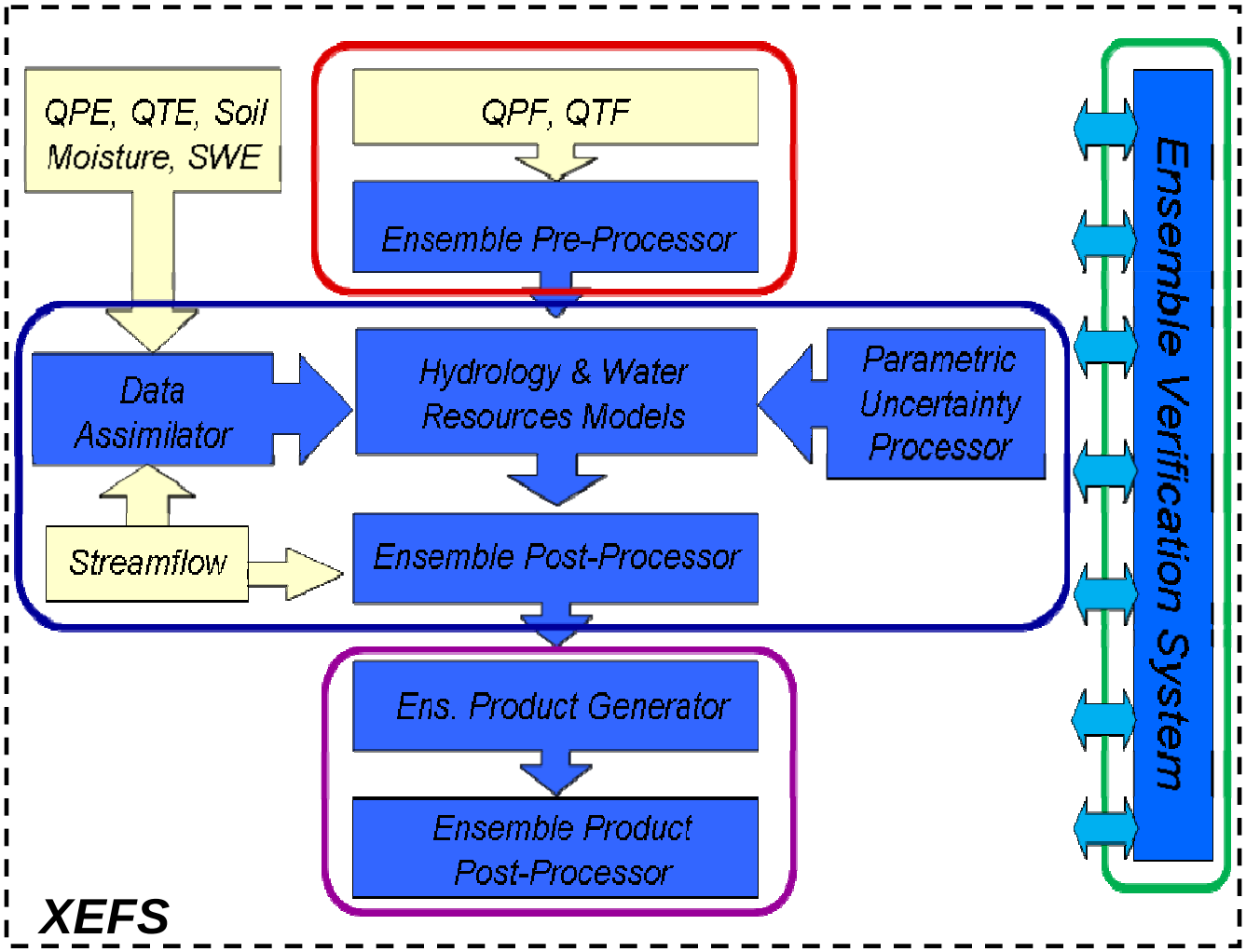
Flow regulations: A large challenge

Envisioned ensemble forecasting capability



From NWS/OHD Strategic Science Plan (2008)

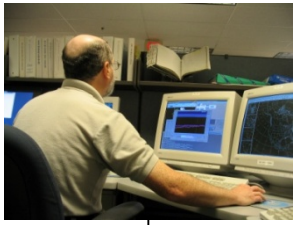
Today's Agenda



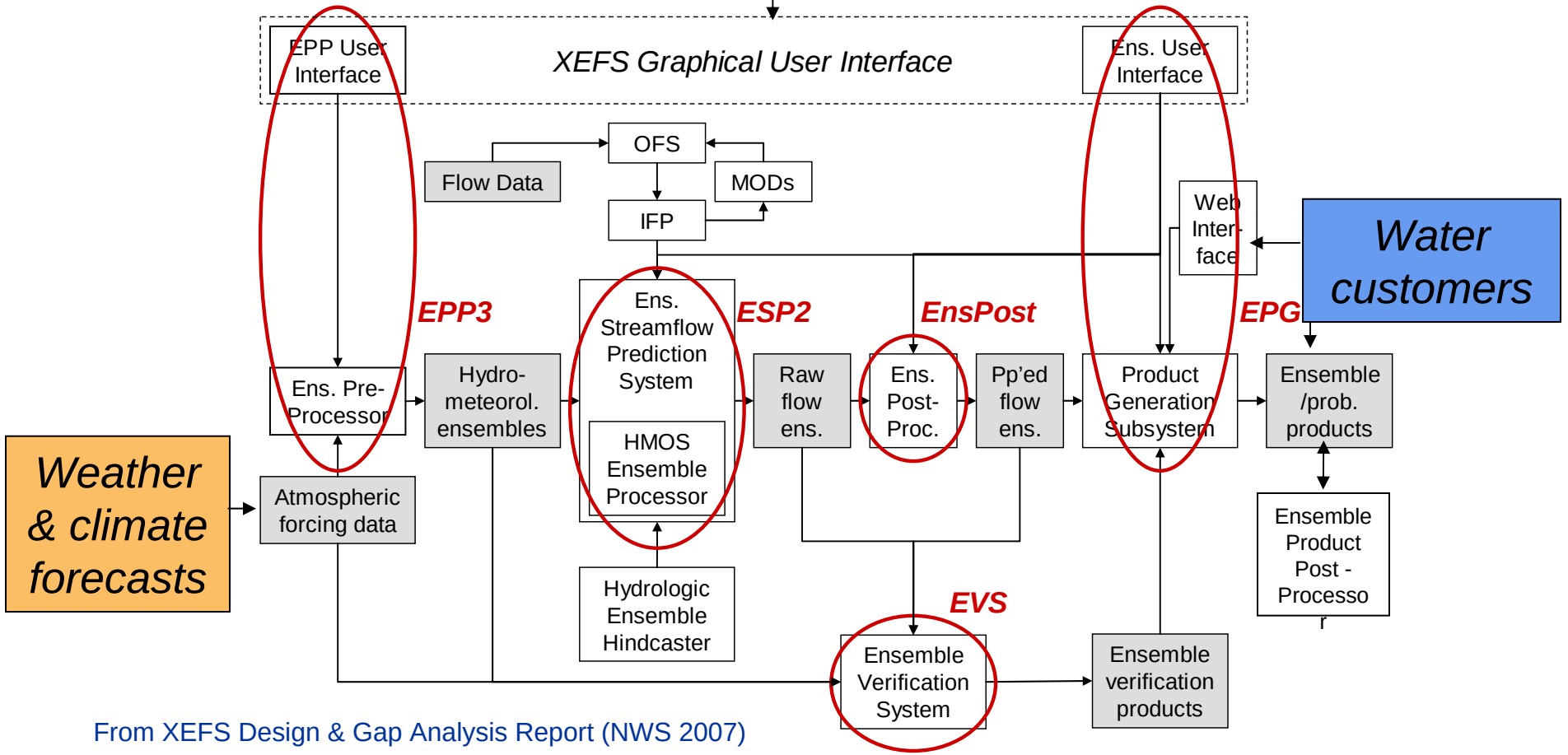
1. Forcing Ensembles
2. Hydrologic Ensembles
3. Verification
4. Products & Services
5. XEFS Phase 2

EXperimental Ensemble Forecast System (XEFS)

Forecasting, hindcasting and calibration of forcing and hydrologic variables



Forecasters add value



From XEFS Design & Gap Analysis Report (NWS 2007)

XEFS will enable seamless hydrologic ensemble prediction from weather to climate scales and translate weather and climate prediction into uncertainty-quantified water information

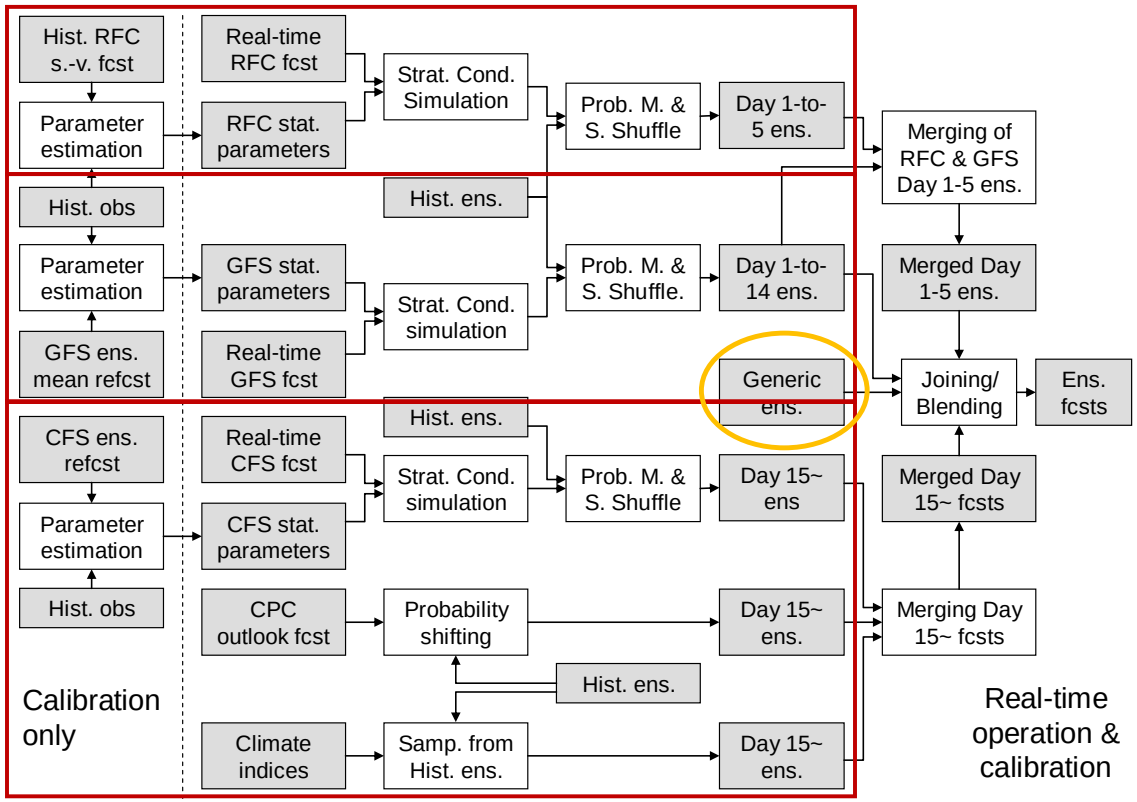
Some context for the NCEP presentations

XEFS/Ensemble Pre-Processor III (EPP3)

Short-range ensembles – Jun Du — Short-Range

Global ensembles – Yuejian Zhu — Medium-Range

Climate prediction – Ed O'Lenic — Long-Range



From XEFS Design & Gap Analysis Report (NWS 2007)

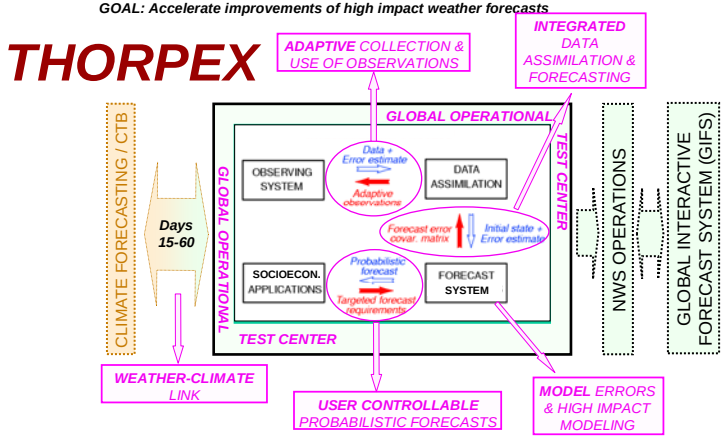
THORPEX-HYDRO

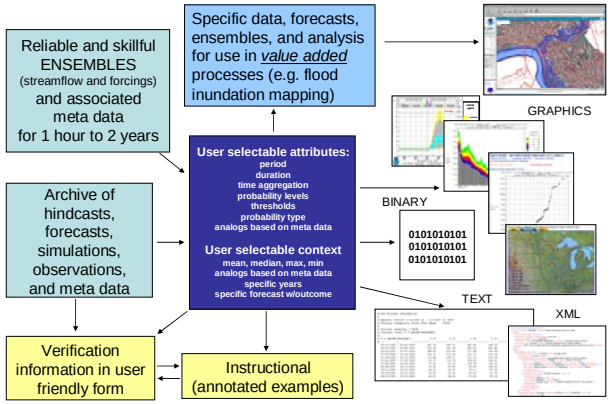
- An OHD-supported, THORPEX-NCEP-OHD joint project in collaboration with HMT, ESRL/GSD, UVA, CPO/CPPA
- To produce reliable and skillful ensemble forecasts of hydrometeorological variables at the weather scale, in particular for high-impact events
- The targeted users are:
  - RFCs for operational hydrologic ensemble forecasting using XEFS
  - Water resources managers and end users for various hydrology and water resources applications

Critical User Feedback

Ensemble Products & Services for Hydrology & Water Resources

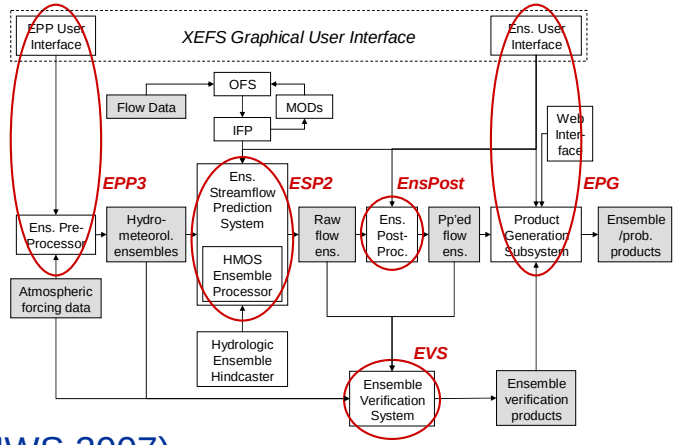
ENSEMBLES AND THE RESEARCH COMMUNITY
LINKED THROUGH THORPEX – MAJOR INTERNATIONAL RESEARCH PROGRAM
GOAL: Accelerate improvements of high impact weather forecasts





XEFS

Reliable and skillful ensemble forcing



Reliable and skillful streamflow and soil water ensembles

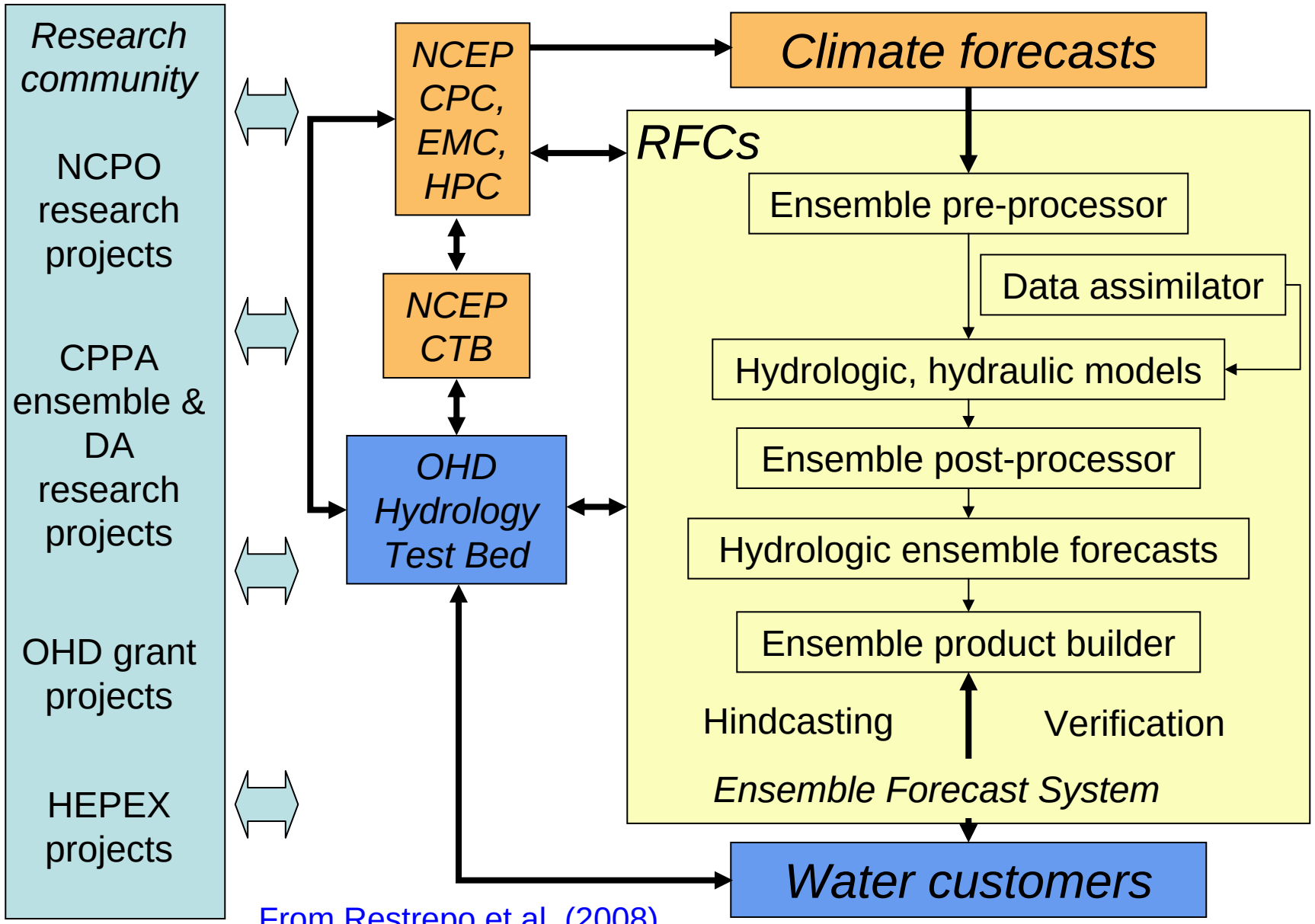
From THORPEX-HYDRO Plan (NWS 2007)

THORPEX-HYDRO: Objectives

- Develop and operationally implement **real-time bias correction, downscaling and hindcasting** techniques that are **applicable to global, regional, and climate ensembles**
- Develop capabilities for routine **ingestion, testing, and use in XEFS of NCEP ensembles by OHD and RFCs**
- Improve land surface modeling capabilities for **large-scale hydrologic evaluation of hydrometeorological ensembles** at the weather scale and for collaborative research and development of hydrologic ensemble techniques and products that may best utilize them
- Enhance capabilities for **seamless verification of hydrometeorological and hydrologic ensembles across NCEP, OHD and RFCs**

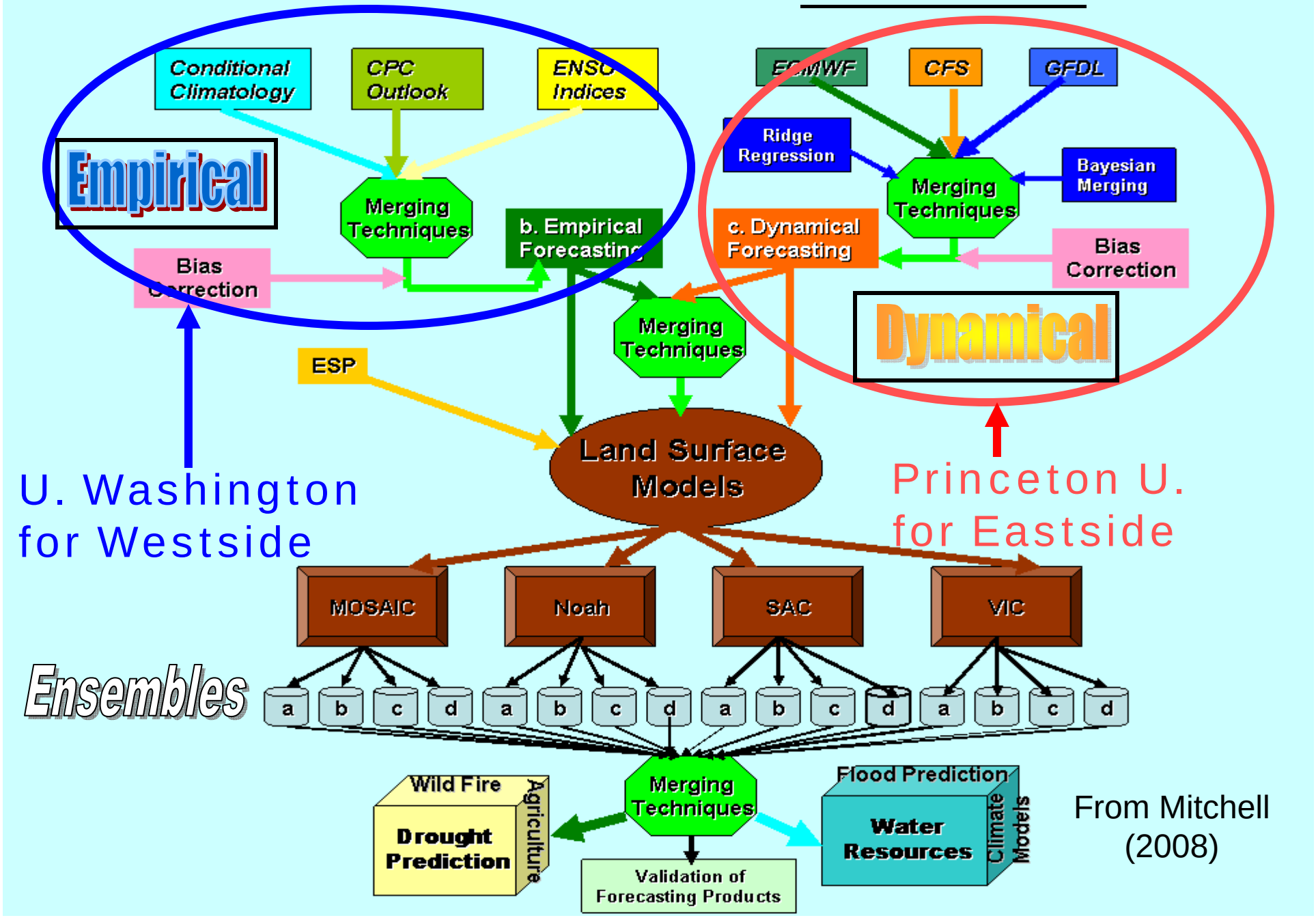
From THORPEX-HYDRO Plan (NWS 2007)

Climate-to-Water RTO Pathways



From Restrepo et al. (2008)

NLDAS Phase II: Ensemble Prediction Mode



From Mitchell (2008)

End of slides