Hydrologic Applications of NCEP Products

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Outline

- Hydrologic Products and Services
- Hydrologic Ensemble Prediction System
- Ensemble Preprocessor
- Leveraging and Collaboration
- Requirements

Hydrologic Products & Services

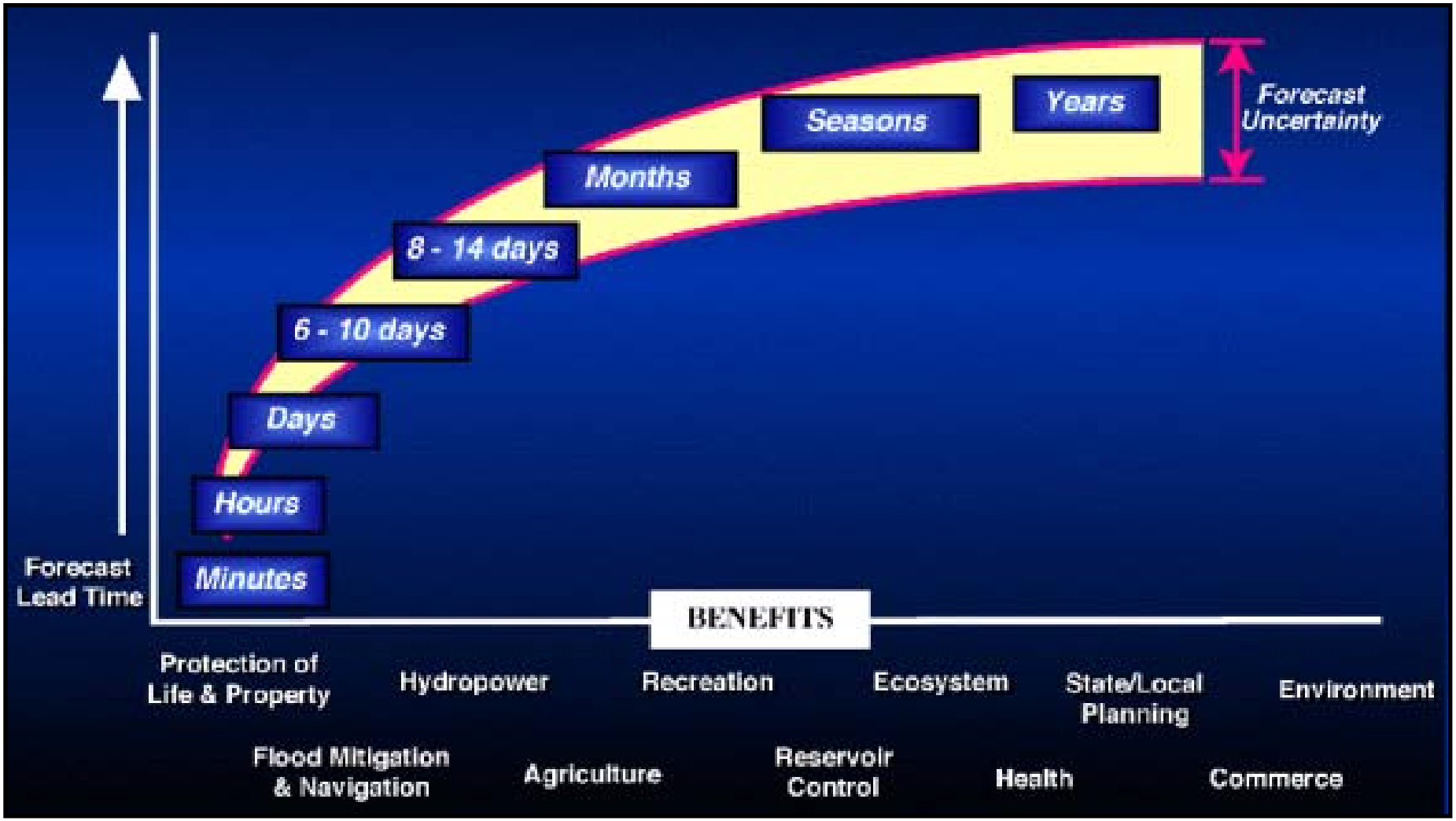
- Objectives:
  - Provide seamless and consistent probabilistic forecasts for all lead times
  - Reduce and quantify input and hydrologic uncertainties

- The methodology is currently tied to the lead times of available meteorological forecasts:
  - 1 to 5 days: short term
  - 6 to 14 days: medium range
  - two weeks and beyond: long range

- The spatial scale ranges from a few km^2 to the continental

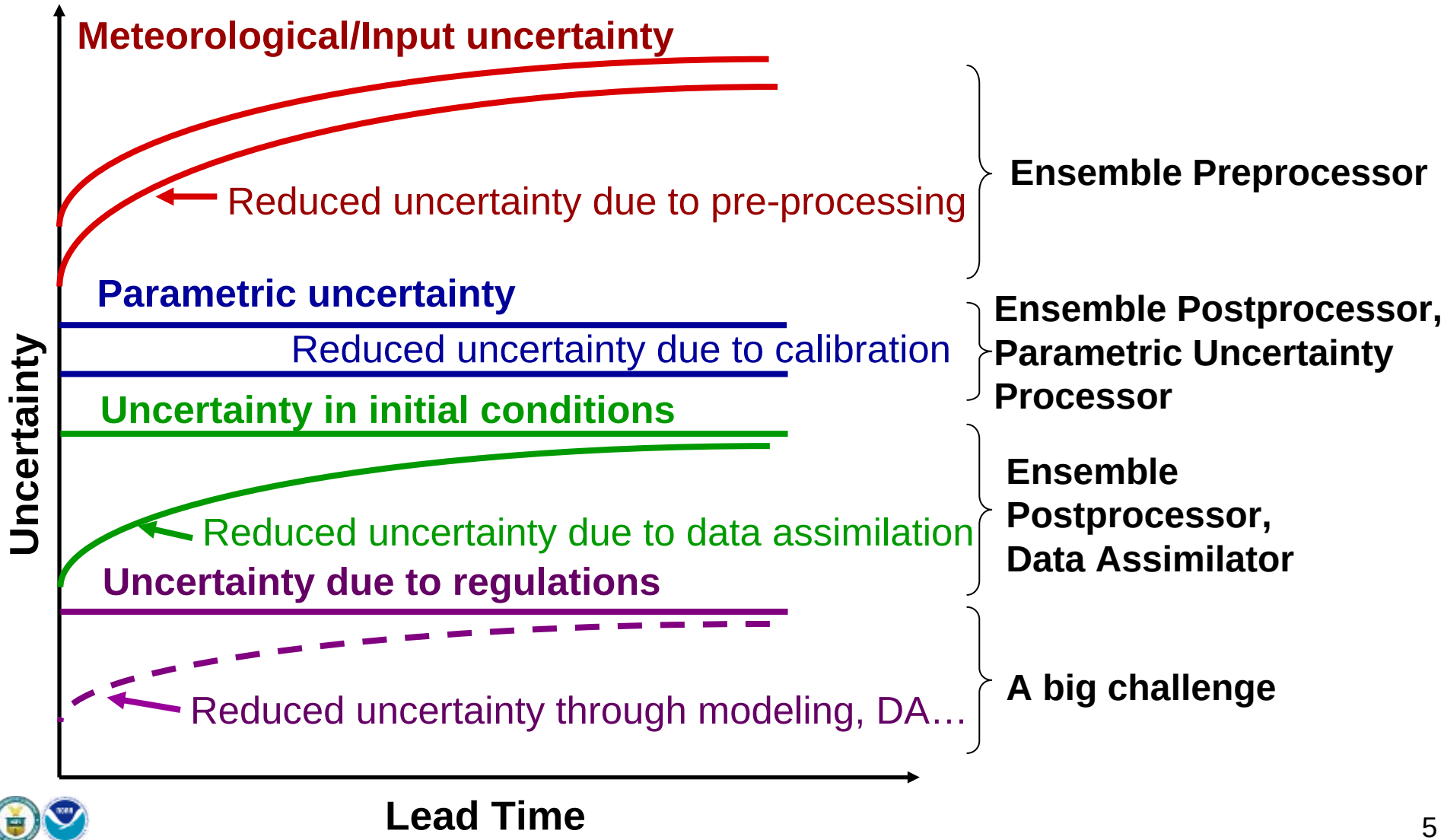
Hydrologic Products & Services

- Seamless probabilistic forecasts for all lead times



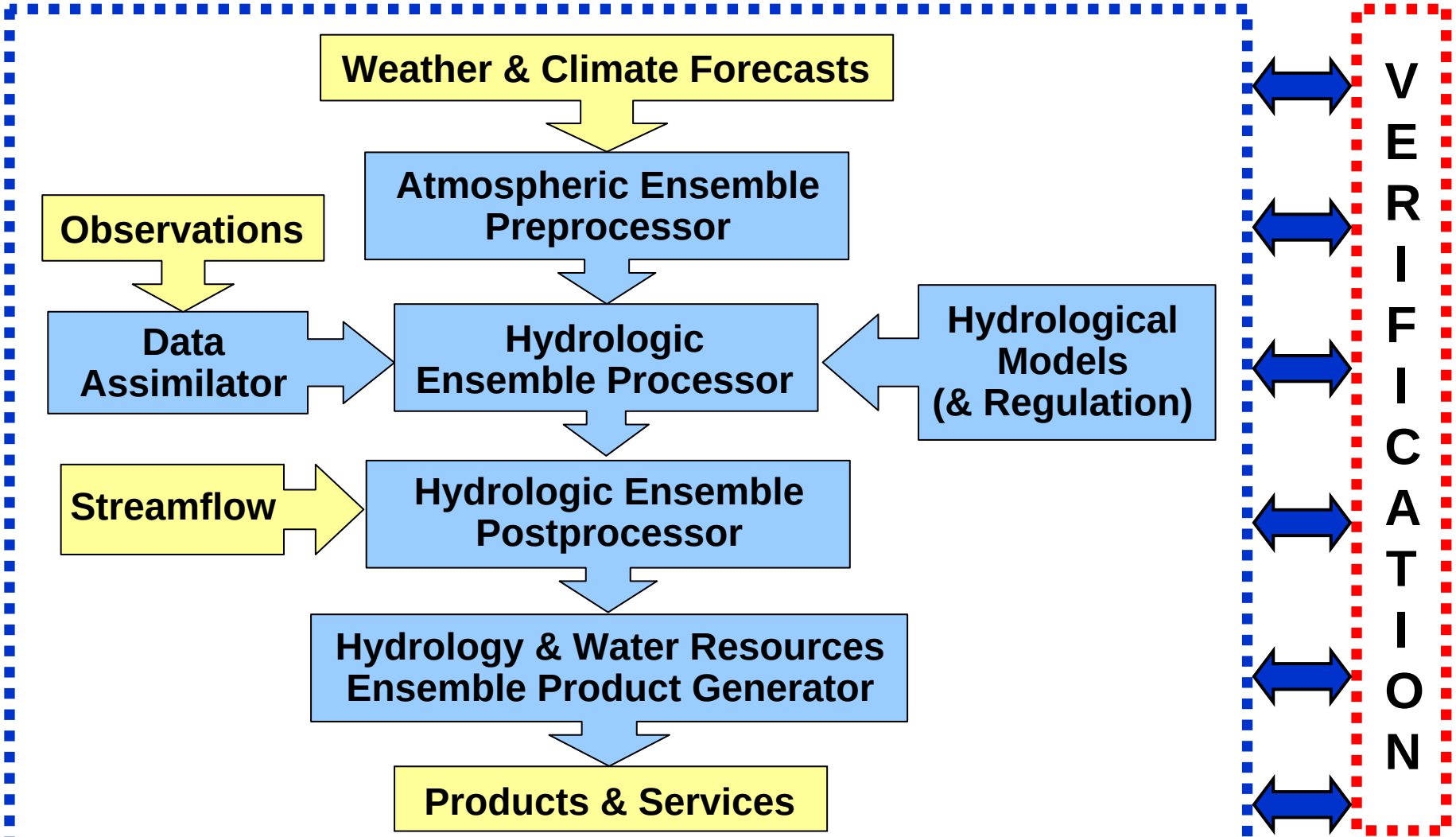
Hydrologic Products & Services

- Uncertainties in Hydrologic Forecast



Hydrologic Products & Services

- Hydrologic Ensemble Prediction System under development



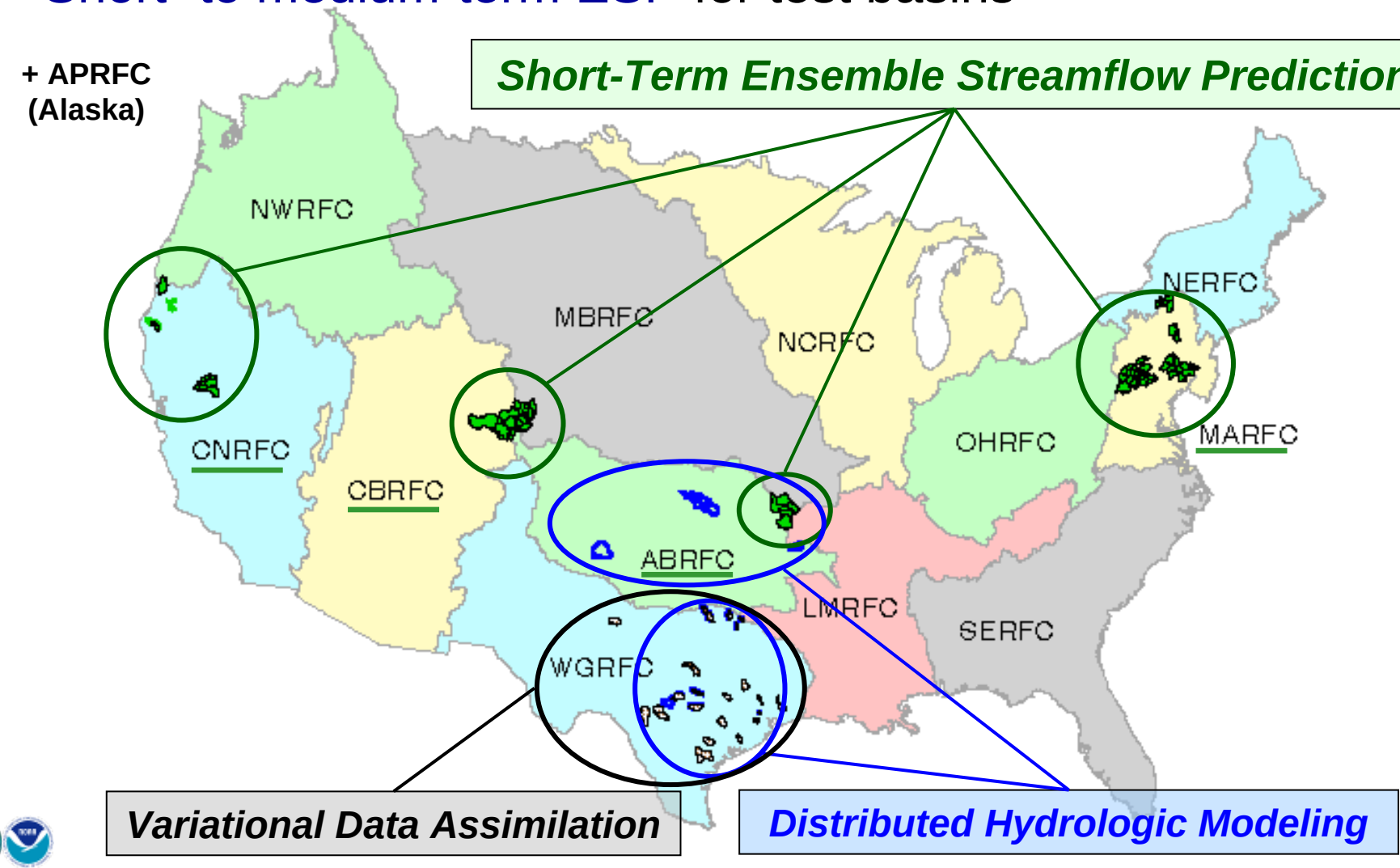
Hydrologic Products & Services

- Ensembles and associated meta data for each River Forecast Center (RFC) basin and for all lead times (1 hr to 2 yrs)
  - Ensemble inputs: precipitation, temperature, potential evaporation, freezing level
  - Ensemble outputs: streamflow, river stage, soil moisture, channel storage…
  - Meta data: how product information was generated; full disclosure of assumptions, inputs, impact of regulations, disclaimers

- Verification information for all ensemble forecasts
  - How reliable and skillful are the forecasts?
  - Requires retrospective forecasts - hindcasts

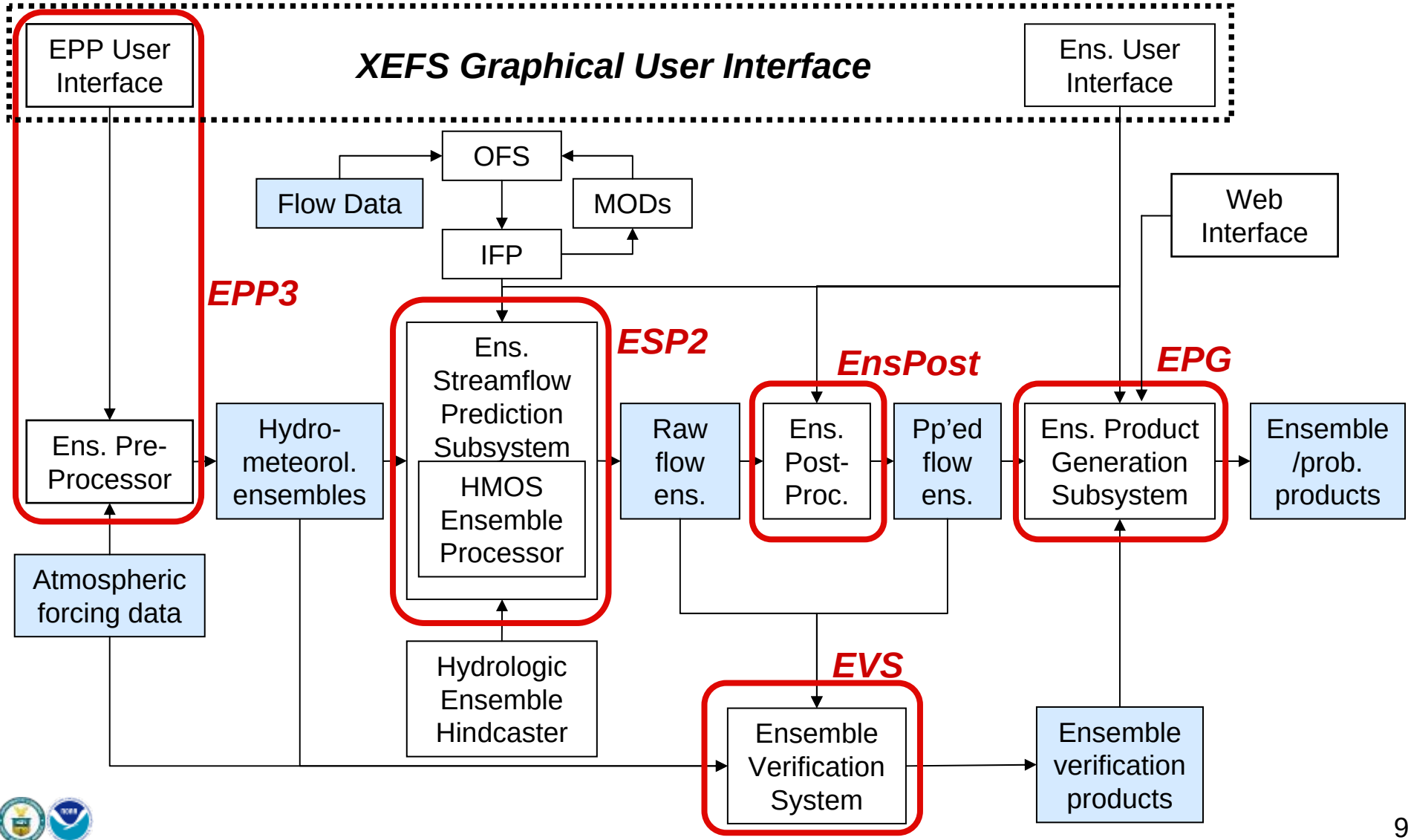
Ensemble Streamflow Prediction (ESP)

- Long-term ESP for all RFC basins
- Short- to medium-term ESP for test basins



ESP Under Improvement

- Design of Experimental Ensemble Forecast System (XEFS)



ESP Under Improvement

- Products from Experimental Ensemble Forecast System (XEFS)

Reliable and skillful ensembles
(streamflow and inputs) and associated meta data
for 1 hour to 2 years

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

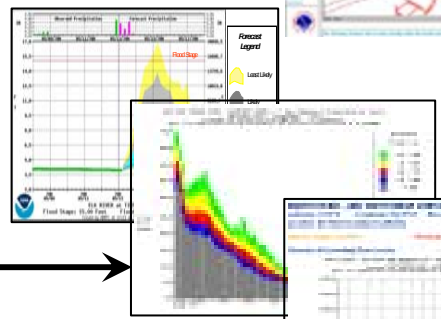
Archive of hindcasts, forecasts, simulations, observations, and meta data

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

BINARY

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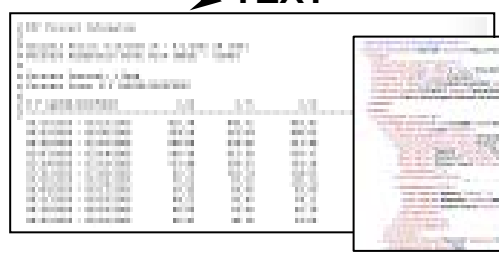


TEXT

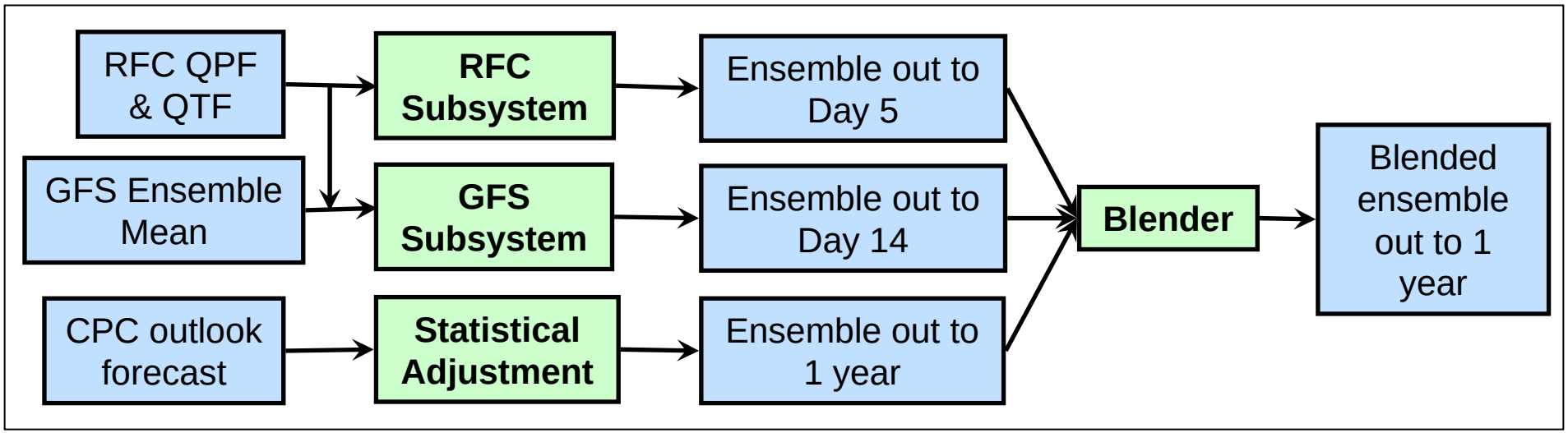
XML

Ensemble Preprocessor: Goals

- Current ensemble forecasts from NWP have significant biases in the mean and in the spread
- Single-value forecasts (HPC/RFC deterministic, atmospheric model ensemble mean) have additional skill
- Goals of Ensemble Preprocessor:
  - Retain/Improve on skill contained in single-value forecasts
  - Correct systematic biases (in the mean) in single-value forecasts
  - Generate ensembles that are unbiased in the mean and in the spread
  - Preserve space-time properties of hydrometeorological variables (Schaake Shuffle method)
  - Account for temporal scale-dependency of meteorological variables
  - Simple, efficient and robust; can be extended to longer range

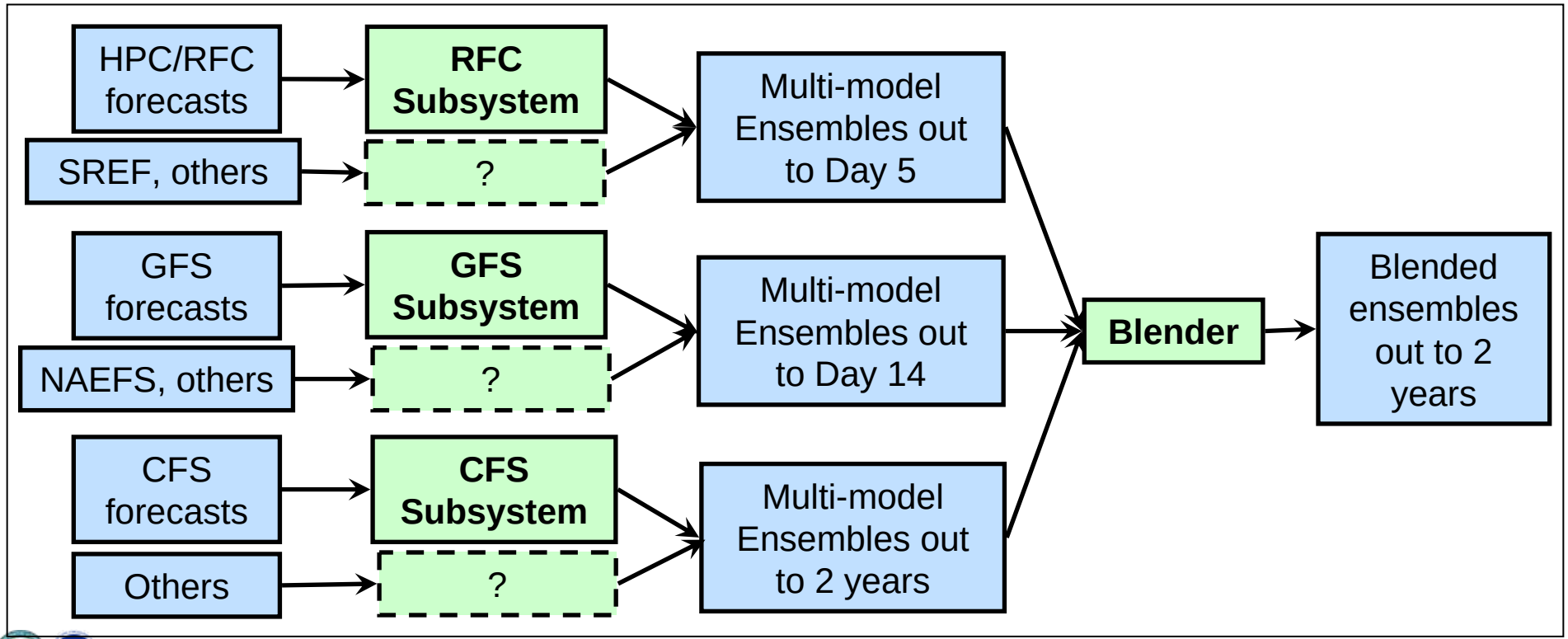
Current Ensemble Preprocessor

- Current Ensemble Preprocessor produces:
  - Short-range ensembles conditioned on HPC/RFC deterministic forecasts
  - Medium-range ensembles conditioned on ensemble means from frozen version of NCEP Global Forecast System (GFS)
  - Long-range ensembles using:
    - climate adjustment of historical ensembles based on CPC outlooks
    - climatology distribution re-sampling to better estimate true climatological distribution

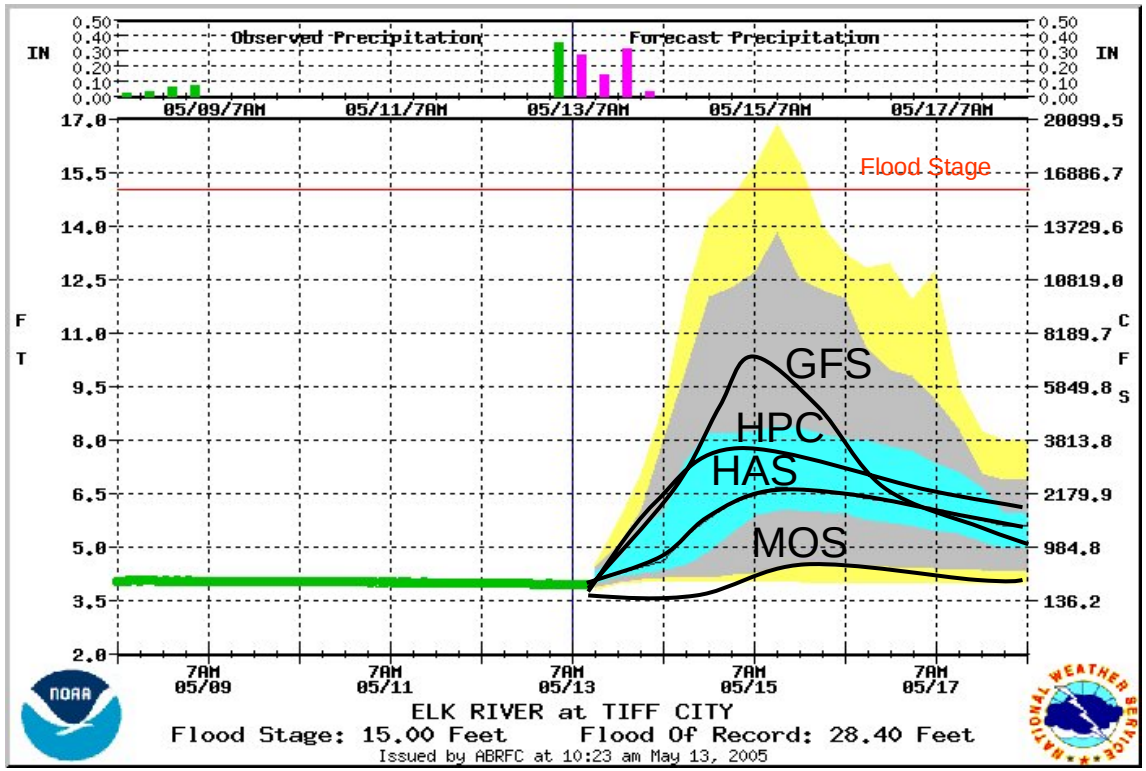


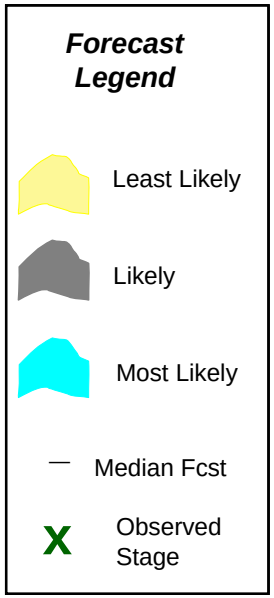
Envisioned Ensemble Preprocessor

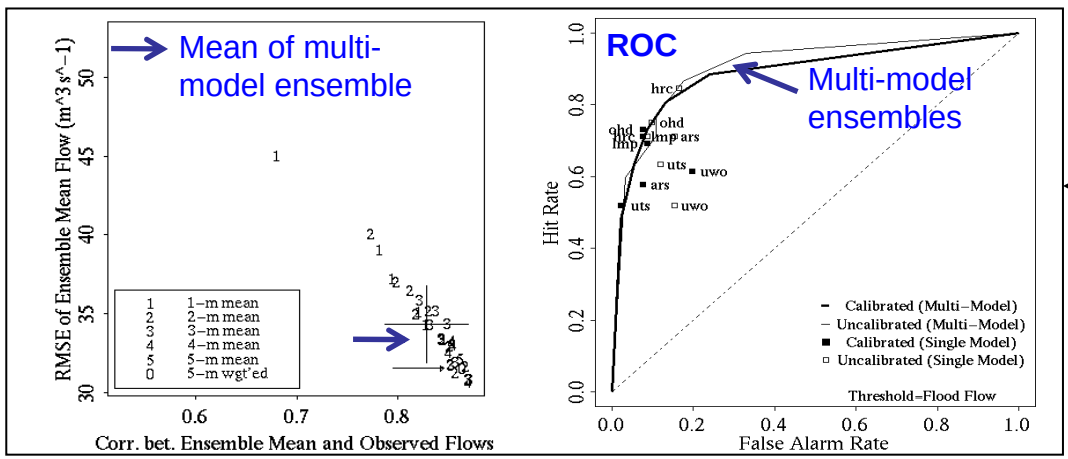
- Envisioned Ensemble Pre-Processor will integrate:
  - other short-term ensemble forecasts: SREF, etc.
  - other medium-term ensemble forecasts from NCEP GFS and NAEFS
  - additional climate forecasts: CFS forecasts



Envisioned Multi-Model Ensemble Forecasts

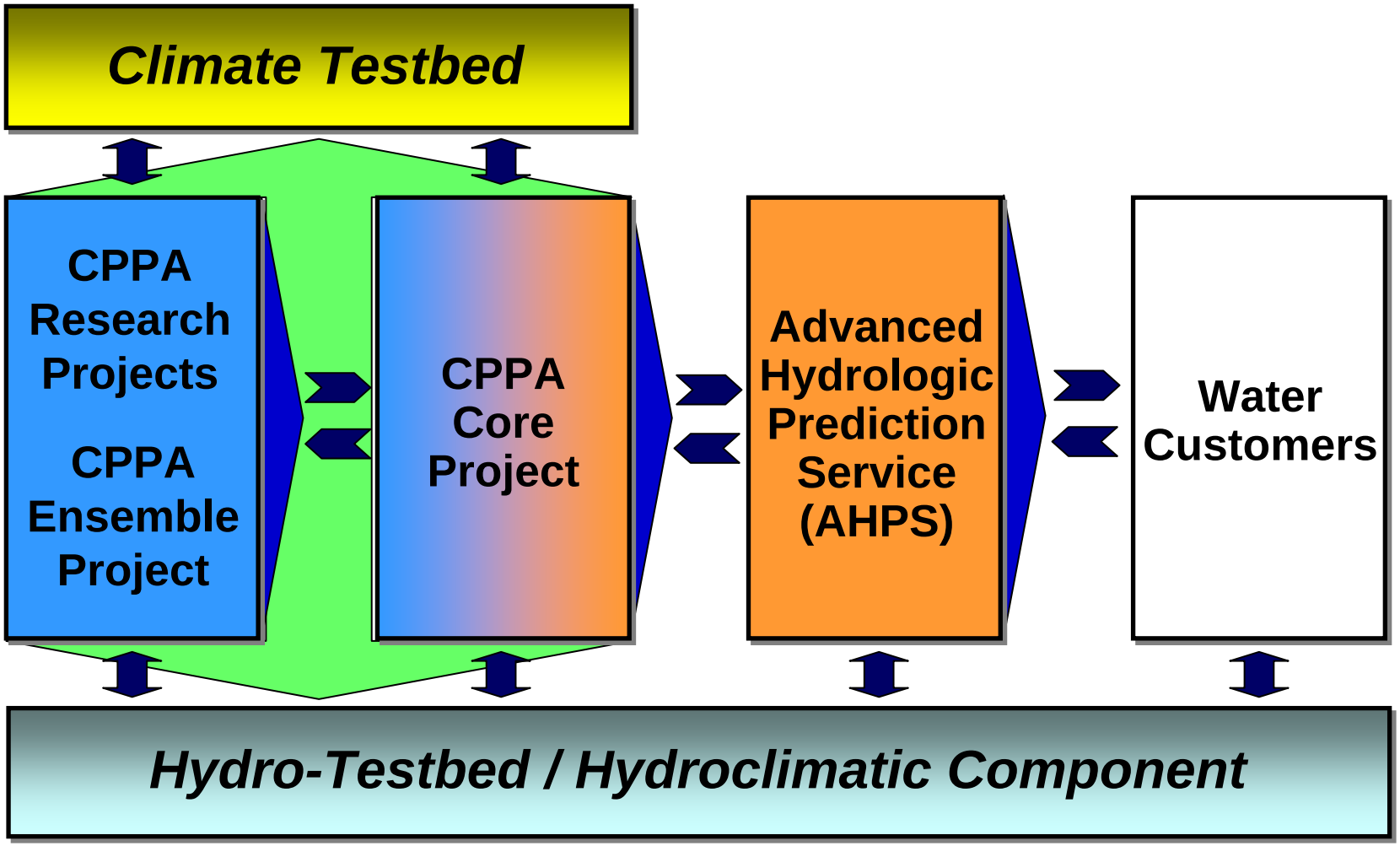






Performance measures for individual and multi-model ensemble forecasts

Leveraging NCPO/Climate Prediction Program for the Americas (CPPA)



Collaboration with NCPO PIs

- NCEP (Mitchell, Toth et al.)
- Clark (verification, ensemble prediction, data assimilation, pre-processor)
- East-Wide and West-Wide forecast system and multi-model applications (Wood and Lettenmeier)
- K & A Georgakakos (INFORM, California)
- Alternative algorithms: Clark/Hay, Werner, Princeton, NCEP, others
- Conditional uncertainty confidence: NCEP, Princeton, Washington
- Verification statistics: Bradley, UCI, Arizona, Weber
- Future unified NWS Ensemble Pre-Processor:
  Community Ensemble Pre-Processor (CEPP)

Requirements

- Reliable and skillful hydrometeorological ensemble forecasts for Hydrologic Ensemble Prediction System
  - For all RFC basins
  - For all lead times from 1 hr to 2 yrs

- Weather and Climate ensemble re-forecasts/hindcasts with “recent” models for EPP calibration and hydrologic forecast verification

- Integrated verification of hydrometeorological and hydrologic ensembles across NCEP, OHD, and RFCs

- Community effort is needed toward multi-model ensemble prediction

Thank you!

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