Hydrologic Ensemble Forecasting Service (HEFS)

Seminar B: HEFS Overview

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Outline

- **Components**
  - o What are they?
  - o How do they fit together?
- **Performance**

Introduction

❑Why ensembles?

- National Research Council (2006)
  - Inherent uncertainty in weather, climate and hydrologic forecast needs to be quantified and communicated to users
  - Aids decision-making
    - Forecasters get objective guidance for level of confidence in forecasts
    - End users can decide whether to take action based on their own risk tolerance
- Adoption by forecasters and users will take years

Introduction - continued

❑Workshop training

Latest user's guides/manuals are posted to…

HSD RFC Support

http://www.nws.noaa.gov/om/water/RFC_support/

CHPS and HEFS Documentation

http://www.nws.noaa.gov/oh/hrl/general/indexdoc.htm

Plus, HEFS workshop presentations, science validation reports, and ConOps are also available at the 2nd link.

HEFS Components
What are they ?

Meteorological Ensemble Forecast Processor (MEFP)

Quantifies the forcing uncertainties and corrects for biases: generates reliable and skillful ensemble forecasts of precipitation and temperature using raw forecasts from multiple sources

Hydrologic Ensemble Processor (actually part of CHPS)

Generates ensembles of hydrologic outputs by running the hydrologic models with the MEFP forcings

Ensemble Post-Processor (EnsPost)

Produces ensemble streamflow forecasts that reflect the hydrologic uncertainty and reduce biases from the hydrologic modeling

HEFS Components - continued
What are they ?

MEFP Parameter Estimator (MEFP PE) & EnsPost Parameter Estimator (EnsPost PE)

Tools with Graphical User Interfaces (GUIs) to estimate the parameters of the MEFP and the EnsPost

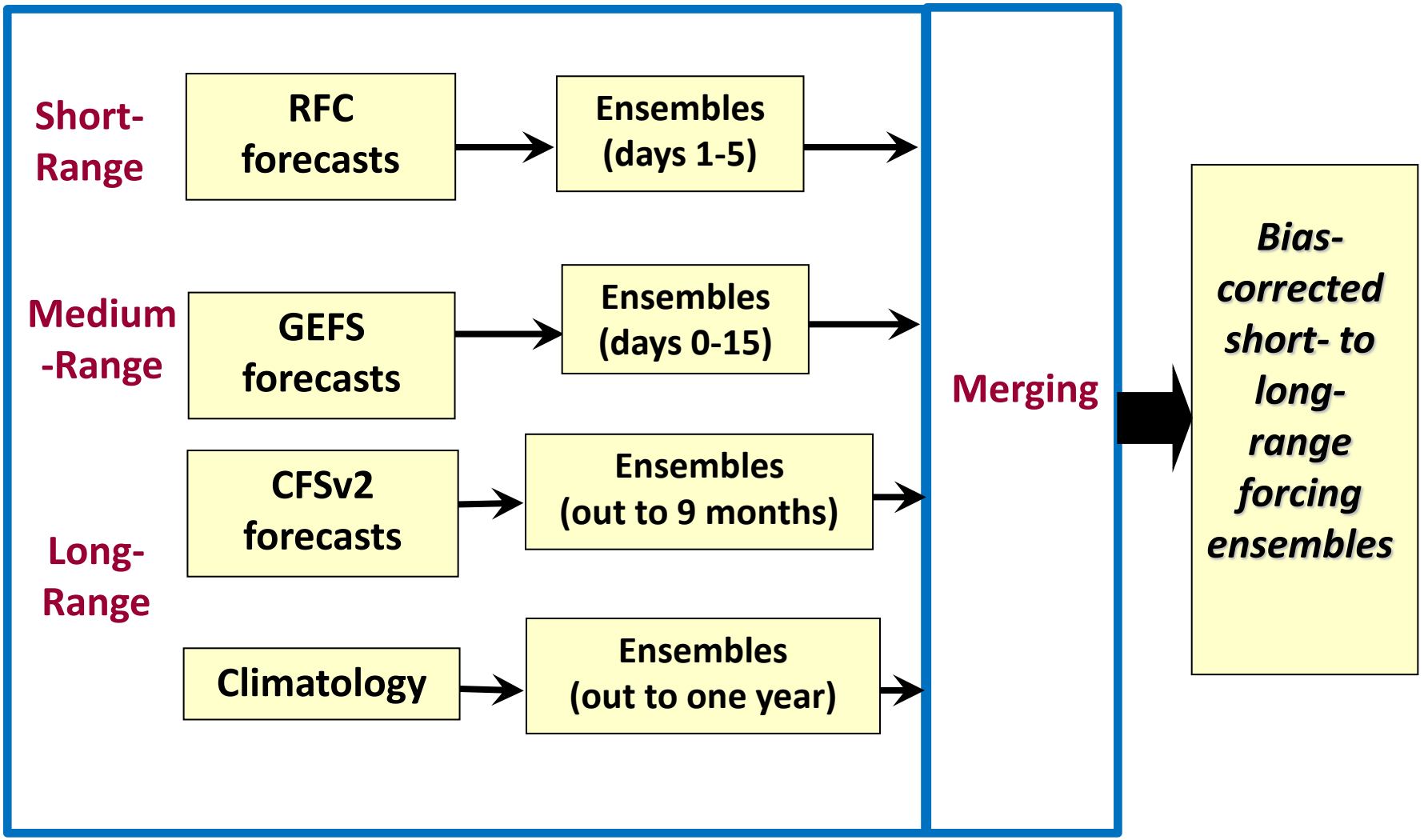
Ensemble Verification Service – (EVS)

Tool with GUI to verify a large sample of archived ensemble forecasts or hindcasts (e.g. flow., temp., precip.)

Graphics Generator (GraphGen)

Tool with GUI to create graphical products from ensembles and other data sources – already transitioned from HEFS project to CHPS baseline

MEFP


Short-Range
RFC forecasts
Ensembles (days 1-5)
Medium-Range
GEFS forecasts
Ensembles (days 0-15)
Long-Range
CFSv2 forecasts
Ensembles (out to 9 months)
Climatology
Ensembles (out to one year)
Merging
Bias-corrected short- to long-range forcing ensembles

HEFS Components
How do they fit together?

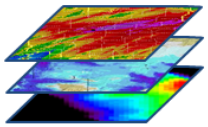
= Forecast tool (real-time/hindcast)

= Supporting tool

= Future capability

Verification results

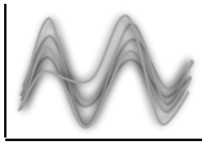
(basin scale)



Raw weather and climate forecasts (GEFS, CFSv2,..)

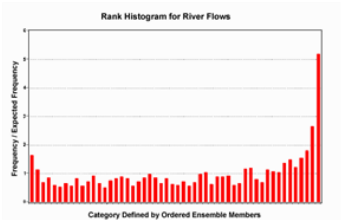
MEFP: pre-processor

MEFP PE: parameters



Unbiased forcing (basin scale)

EVS: verification

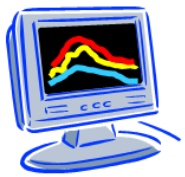


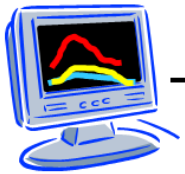
"Raw flow"

"Corrected flow"

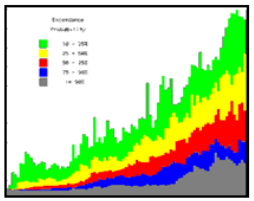
Data assimilator

Hydrologic Ensemble Processor





GraphGen: products



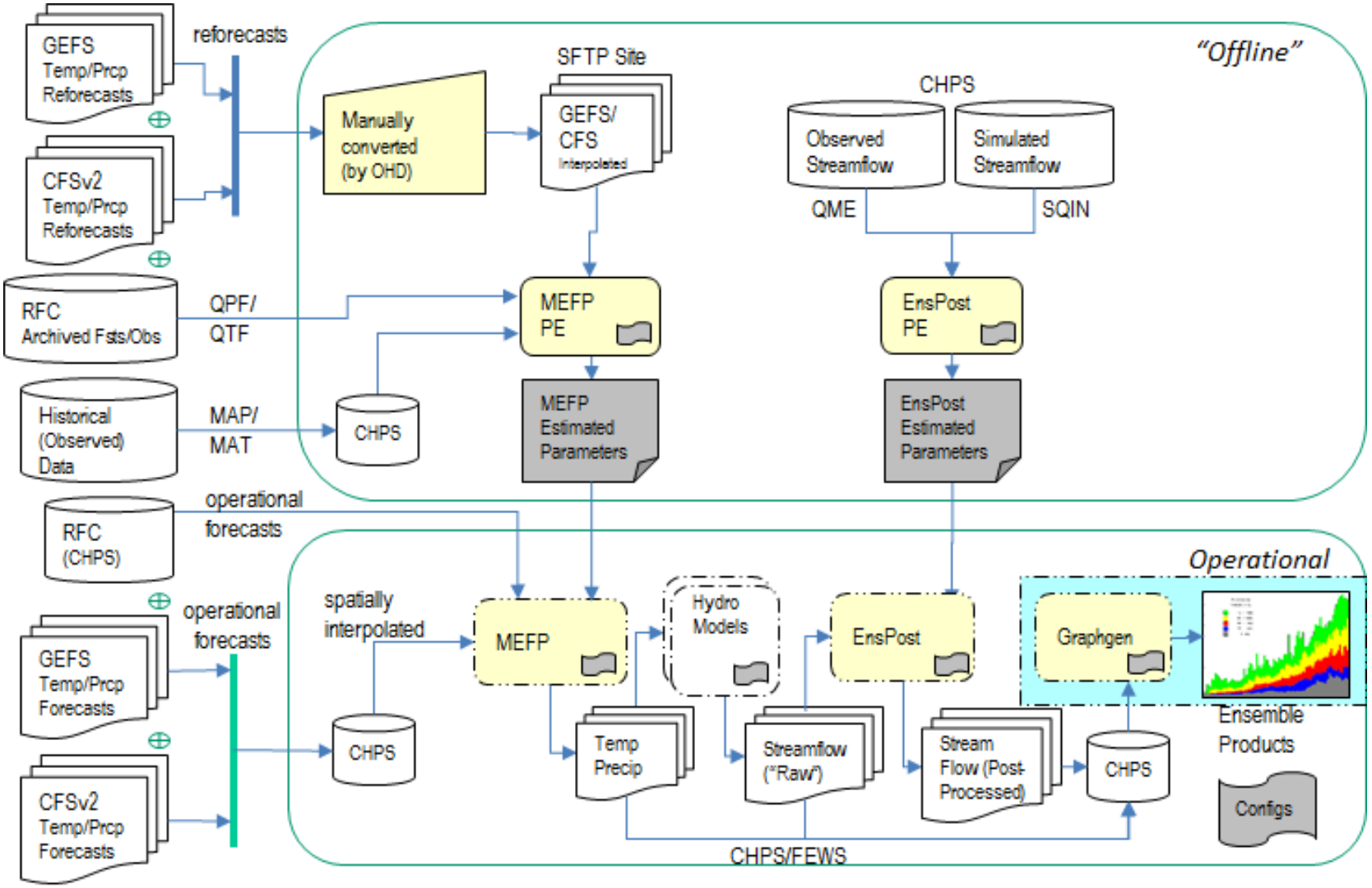
Ensemble products

Hydrologic data

EnsPost: post - processor

EnsPost PE: parameters

HEFS Components Data Flow



Basic Steps to Initial HEFS Implementation

1. **Download HEFS build**
2. **Acquire historical data**
   a) MAP/MAT & optional RFC QPF (& QTF?) for MEFP, HS for EnsPost
3. **Set up acquisition of NCEP grids**
4. **Estimate the MEFP Parameters**
5. **Configure the MEFP**
6. **Configure the Hydrological Ensemble Processor**
7. **Estimate the EnsPost Parameters**
8. **Configure the EnsPost**
9. **Configure (HEFS products using) the Graphics Generator**

More detailed steps are in the documentation and will be explained as part of this workshop

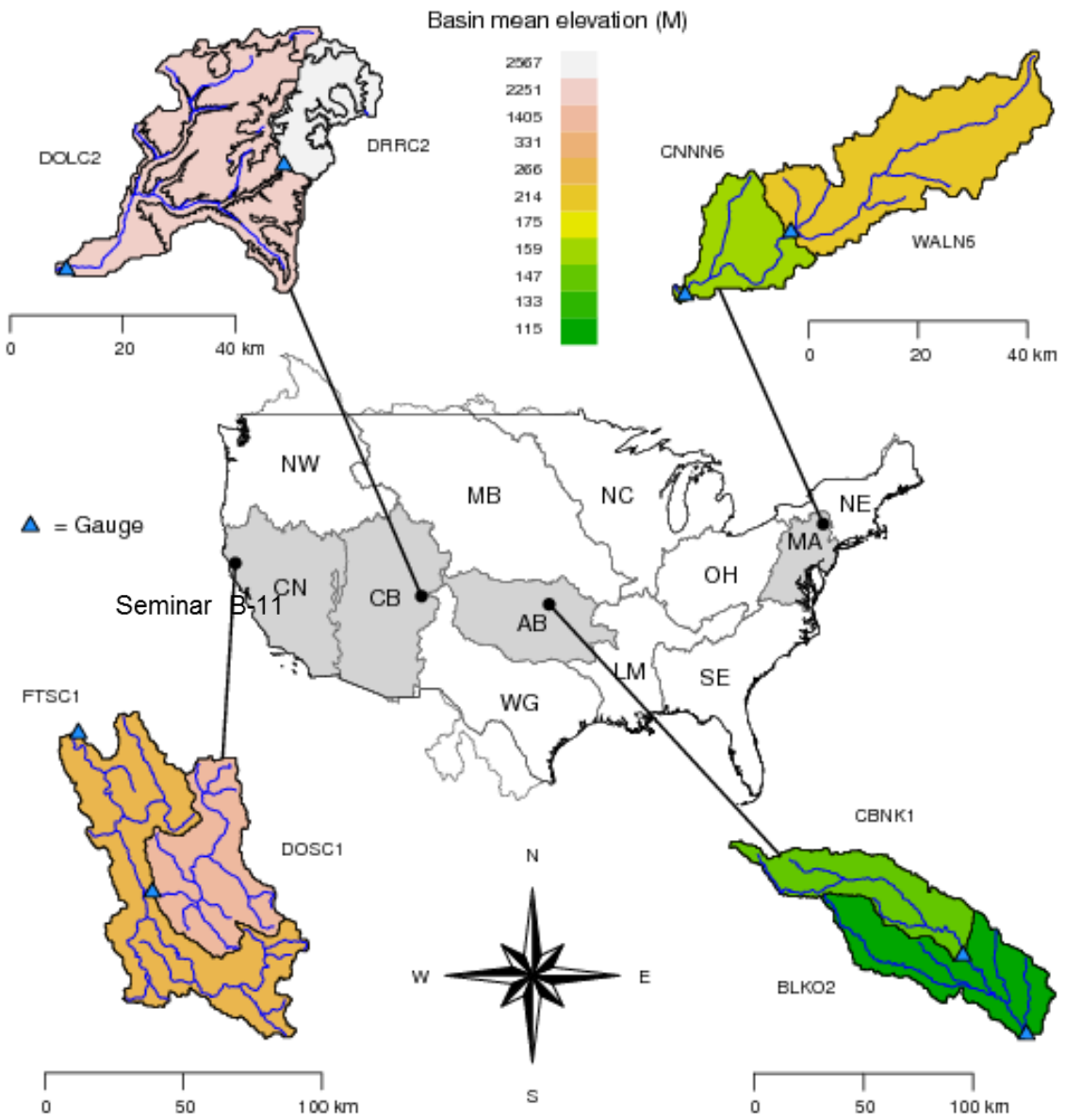
HEFS Releases

- **HEFS Releases**
  - Release Notes
  - Software
  - Install Notes
  - User's manuals with configuration instructions (and examples)
- **How will you get the release?**
  - Now (HEFS 1.1.1) and in Oct (HEFS 1.2.1), from HSD ftp site (http://165.92.28.30/release/HEFS) announced via email
  - Starting in early 2015, HEFS will be part of CHPS baseline releases

Performance – with GEFS (days 0-15)

Basins

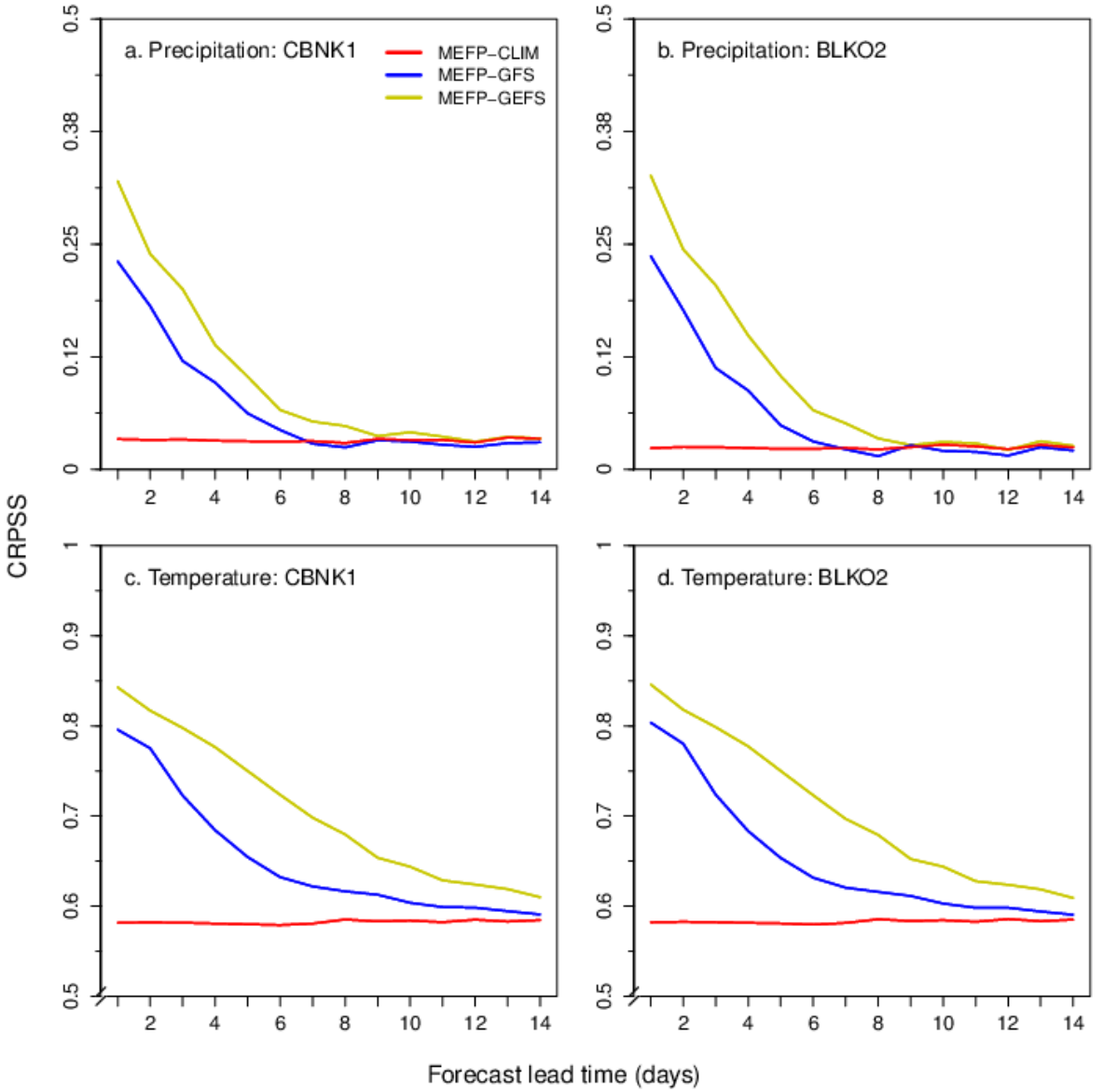
- Four RFCs
- Hindcasts: 1985-1999
- Upper/lower pairing
- USGS gauge at the outlet of each basin
- Relatively small basins (largest 2000 sq. miles)
- Low elevations in AB and MA
- Higher elevations in CB and CN
- CB and CN have MAT/MAP sub-basins



MEFP-GEFS: forcing

MEFP-GEFS adds value

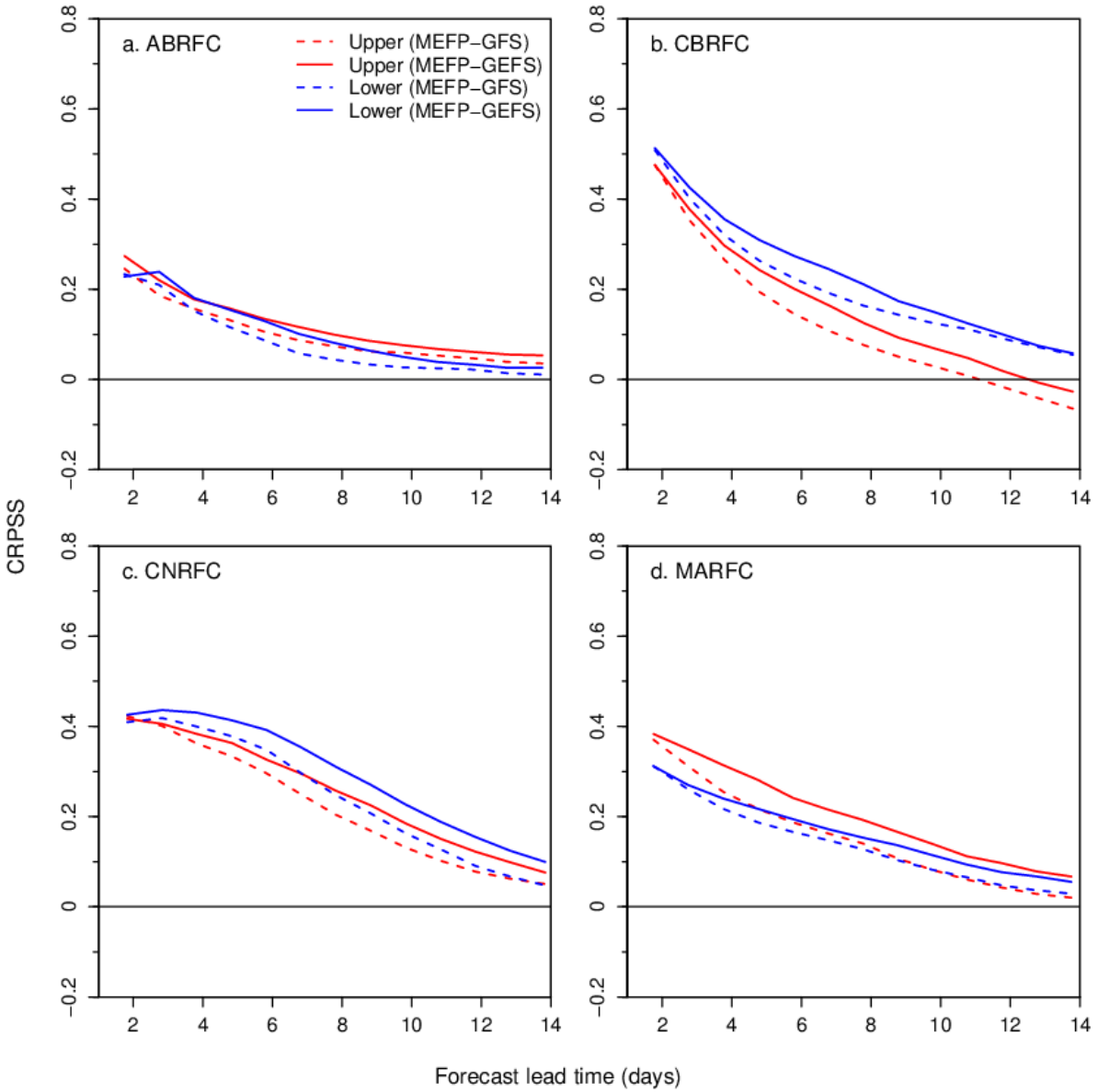
- Preliminary verification results from MEFP-GEFS
- Skill (CRPSS) from two basins in ABRFC, precipitation (top) and temperature (bottom)
- Sample climatology as baseline (unconditional)
- Raw GEFS improves substantially on GFS and this is reflected in MEFP-GEFS results shown here
- Improvements particularly noticeable in first week, longer for temperature



HEFS streamflow, GEFS forcings only

Value also added to flow

- Streamflow with MEFP-CLIM baseline
- Skill shown for lower and upper basin
- Results include EnsPost
- GEFS consistently beats GFS (statistically)
- Skill from initial conditions and EnsPost dominates earliest times
- On time horizon of 4-10 days, GEFS adds ~1-2 days in lead time



Findings

Forcing

- MEFP preserving correlations, reducing bias
- GEFS around 5-20% more skill than GFS in P (~1-7 days)
- As much as 50-75% more skill in T (~1-14 days)
- GEFS adds ~1-2 days lead time for P, and ~1-4 days for T

Streamflow

- Streamflow largely reflects P skill (T for snowmelt)
- Smaller added-value at early lead times (hydro. dominant)
- Once P washes through, GEFS adds ~1-2 days of skill

Questions?