Hydrologic Ensemble Forecasting Service (HEFS)

Seminar I

HEFS Project Status and Plans

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HEFS Training Workshop 5, Silver Spring, MD
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Objective and Outline

☐ **Objective: Discuss proposed plans to rollout HEFS to the remaining RFCs**

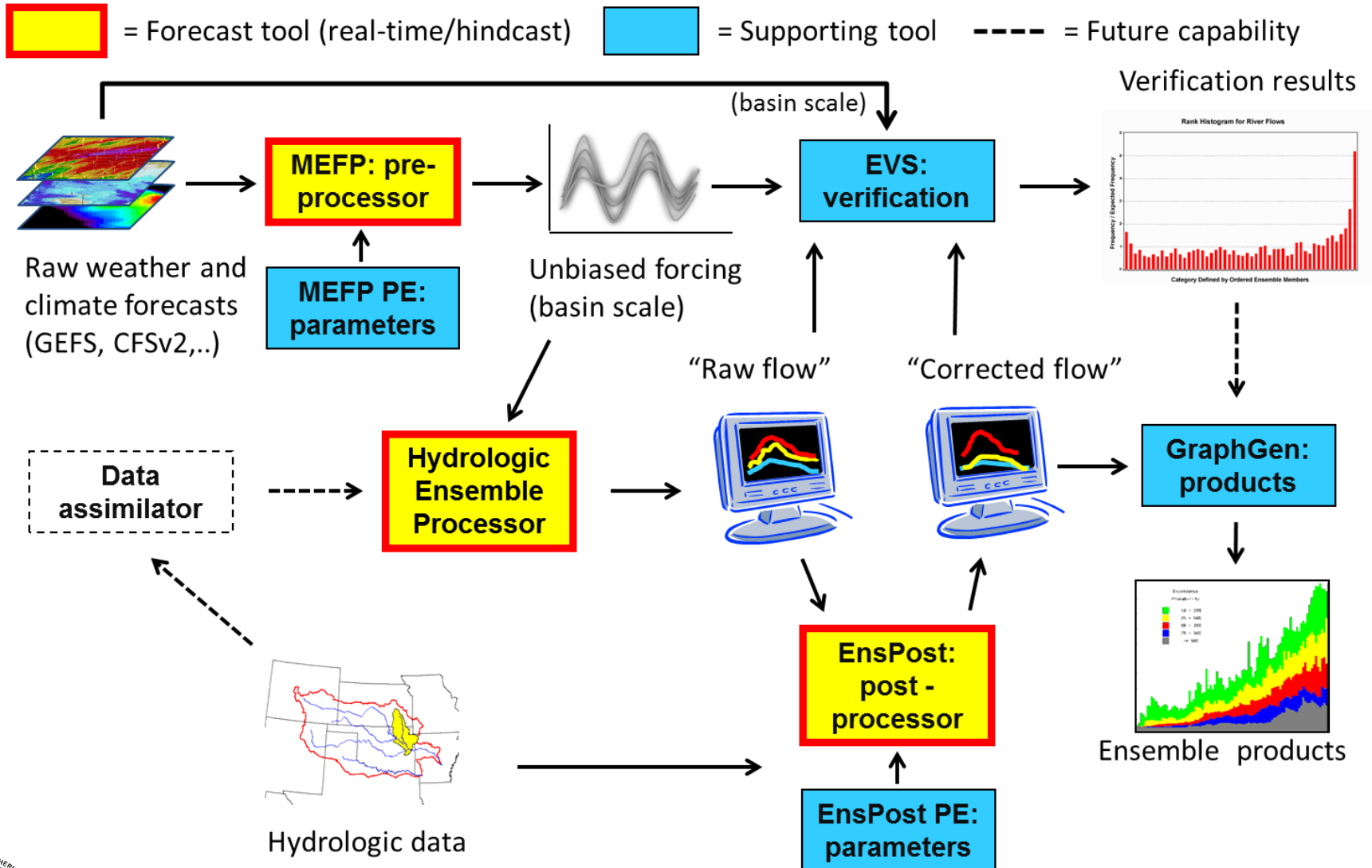☐ **Outline**

   o Current status

   o Rollout

   o Long term plans

Current Status – HEFS Overview

❑ HEFS operational (real-time) forecasting and (offline) tools for ensemble forecasting[1]

- o **Meteorological Ensemble Processor (MEFP):** ingests precipitation and temperature forecasts from various sources in order to produce bias-corrected forcing ensembles for hydrologic basins

- o **Hydrologic ensemble processor:** integrates each trace of temperature and precipitation through the operational hydrologic, hydraulic, and reservoir models in order to produce an ensemble of streamflow forecasts

- o **Ensemble Post-processor (EnsPost):** aims to account for the total hydrologic uncertainty and correct for systematic biases in the ensemble streamflow forecasts

- o **MEFP Parameter Estimator (MEFPPE) and EnsPost Parameter Estimator (EnsPostPE):** GUI based tools for calibrating MEFP and EnsPost, respectively

- o **Ensemble Verification Service (EVS):** verifies the forcing and streamflow forecasts in order to identify the strengths and weaknesses in the forecasts

1 – these are in the original HEFS A-Team requirements, in name or function

HEFS Components

= Forecast tool (real-time/hindcast)   = Supporting tool   ---- = Future capability

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

MEFP: pre-processor

MEFP PE: parameters

Unbiased forcing (basin scale)

(basin scale)

EVS: verification

Verification results

"Raw flow"   "Corrected flow"

Data assimilator

Hydrologic Ensemble Processor

EnsPost: post-processor

EnsPost PE: parameters

GraphGen: products

Hydrologic data

Ensemble products

Current Status – Coverage

After two years:

- **ABRFC:** MEFP at 440 basins for precip. & 103 basins for temp.; streamflow at 239 pts; and EnsPost and GraphGen at ~140 of those pts

- **CBRFC:** MEFP at 317 basins & streamflow for ~240 pts and adding EnsPost

- **CNRFC:** MEFP at 319 basins; streamflow at 199 pts.; and EnsPost at 30 pts. Plans to expand EnsPost & add GraphGen

- **MARFC:** MEFP at ~100 basins and streamflow and GraphGen at 53 pts (the Del. R.) for internal use and a second run of MEFP and streamflow for (14) NYCDEP points

- **NERFC:** MEFP at 12 basins; streamflow and EnsPost at 6 pts for internal use and a second run of MEFP and streamflow for (8) NYCDEP points

Current Status – Initial Implementation

❑ **All test RFCs are using the latest CHPS (4.0.1) and HEFS (1.0.2) builds for their HEFS forecasts**

❑ **HEFS has full set of documentation (users manuals and configuration guides) and support methods like CHPS, including Fogbugz, HSD, email list, OHD, & webpages**

❑ **HEFS runs are automated workflows[1]. Training and documentation is oriented to this approach**

❑ **HEFS is fully integrated into CHPS. Experience with CHPS configurations was very helpful implementing HEFS, and there's a lot of flexibility provided**

1 – Automated workflows are scheduled or manually initiated batch runs for many locations at a time such as a forecast group.

Current Status – Keys to success

❑ Commitment of OHD, HSD, &, especially at HEFS test RFC

❑ Frequent communication to provide feedback on HEFS

❑ Operational support started early

❑ Training included precursor material, Goto Meeting seminars, and multiple off-site workshops. Workshops keys:

- o Each training topic included lecture, demo, and hands-on exercise component
- o Good learning environment (isolated, facilities)
- o Adequate number of trainers on-hand
- o Training included an organized binder with all sessions

❑ HEFS initially implemented on CHPS Dev/Test with live data feed

❑ HEFS outside of CHPS and AWIPS baselines

❑ RFCs made slow steady progress. RFCs were not asked to implement HEFS across the RFC all at once

Rollout

❑ **HEFS initial implementation**

    o Works in an operational setting

    o Broadly working as anticipated in limited phased validation (i.e. reasonably skillful and unbiased forecasts)[1]

❑ **Recommend phased implementation at remaining RFCs, similar to HEFS test RFCs**

1- Technical reports on the validation results are available at:

http://www.nws.noaa.gov/oh/hrl/hsmb/hydrologic_ensembles/publications_presentations/index.html

Rollout – Strategy

❑ **Strategy for rollout, similar to the initial implementation**

- o RFCs implement HEFS and expand coverage at a slow/steady pace

- o Communication: new RFCs designate a focal point, attend routine meetings; current RFCs become buddies (like CHPS)

- o Training (more later) – good and repeatable

- o RFCs learn HEFS hindcasting and verification & eventually partner with OHD to validate HEFS and improve implementation at their RFCs

- o Initially run on the CHPS Dev/Test system, temporarily (~6 mos.), until next CHPS build in early CY2015, then merge configurations

Rollout – AWIPS/CHPS

❑ **Key AWIPS/CHPS milestones**
  - o Late 2013 – CHPS and HEFS provided to AWIPS for testing/integration
  - o Late Spring/Early Summer – AWIPS Program replaces RPs which will become the host servers for CHPS
  - o Early CY2015 – next CHPS Build & will be delivered via AWIPS processes

❑ **Reasons for temporarily remaining outside the AWIPS/CHPS baseline and temporarily running HEFS on the CHPS Dev/Test System**
  - o Keeps operational CHPS isolated during initial implementation & familiarization
  - o Provides an opportunity to change HEFS before early 2015, if needed
  - o Avoids period of RP replacement, and potential schedule slips

Rollout – Roles

❑ Project Manager: Mark Fresch

❑ Software Development Project Area Leader: Lee Cajina

❑ Software Development Project Lead: Hank Herr

❑ Test Manager and Training Coordinator: Shaif Hussain

❑ Service Requirements and Products: Ernie Wells

Proposed HEFS Buddy Pairings

❑ NERFC (Erick Boehmler) - OHRFC

❑ MARFC (Ned Pryor) - SERFC

❑ ABRFC (Eric Jones) - LMRFC and WGRFC

❑ CBRFC (John Lhotak) - MBRFC and NCRFC

❑ CNRFC (Brett Whitin) - NWRFC and APRFC

Rollout – Roles, continued

❑ **HEFS Test RFC Focal Points**
- o Help finalize the ConOps
- o Attend HEFS meetings, at least through Summer 2014
- o Expand their HEFS implementation (coverage and components)
- o Begin hindcasting and verification projects partnered with OHD
- o Improve the consistency of their implementation w/r to the ConOps

❑ **New HEFS RFCs**
- o Get CHPS Dev/Test working, if needed
- o Help finalize the ConOps
- o Designate a Focal Point (and potentially secondary at each RFC)
  - • Attend HEFS meetings
  - • Attend training
  - • Implement and expand HEFS coverage
  - • Join HEFS email list

Rollout – Proposed Schedule

❑ **Now through May: Complete ConOps**

 o Now through mid-April: Iterate draft ConOps with HEFS test RFCs

 o April 15: Provide draft ConOps to all RFCs for comment

 o May 10: Comments due back from RFCs

 o May 31: Finalize ConOps

❑ **Before May 2014:**

 o Remaining RFCs designate an HEFS focal point

 o Make sure your CHPS Dev/Test system is in working order

❑ **May 2014: remaining RFCs start attend HEFS meetings, initially every two weeks**

Rollout – Proposed Schedule, cont'd

❑ **Late June/Early July 2014**

- o Group of seminars on basic ensemble theory and HEFS functionality

- o Remaining RFCs get HEFS software

- o Quickly followed by off-site training workshop covering implementation and use of HEFS components (more on training in a minute)

❑ **Mid-July through late August 2014**

- o RFCs implement HEFS for two locations

❑ **Early September 2014 -** Off-site training workshop on hindcasting and verification

Rollout – Proposed Schedule, cont'd

❑ **September – December 2014 -** Expand coverage to a forecast group

❑ **Early CY2015:**

    o Next CHPS build, will include HEFS with potential small changes

    o RFCs transition HEFS configurations to their CHPS operations

❑ **Winter/Spring 2015:** Expand coverage across all unregulated locations

Rollout – Training

Training has been done mainly via off-site workshops with about 10 attendees.

❑ **Considerations – (see next few slides for options)**

- o Training room at HQ is limited to ~10 attendees

- o Training staff can best handle that many attendees for exercises

- o Best training occurs away from other duties, i.e. off-site

- o Training includes seminars and demos which are relatively easy to broadcast, but exercises would suffer from not having trainers on-hand

- o **Rollout will be slow and steady: not expected to implement HEFS RFC-wide right away**

Rollout – Training Options

1) Hold initial HEFS training workshops at NWS HQ

❑ **Pros**

- o Best training occurs away from other duties, i.e. off-site

- o Facility is good, including CHPS workstations

- o Trainers will be able to handle about that many attendees

- o Trainers able to dry run on final equipment

- o Travel costs are less than Option 2

- o Trainers on-hand

❑ **Cons**

- o Only allows for ~1 student/RFC per workshop to off-site training

Rollout – Training Options

1b) Hold initial HEFS training workshops at NWS HQ and repeat later for more students, if necessary, possibly at a different location -

<u>recommended</u>

❑ **Pros**
  - o Best training occurs away from other duties, i.e. off-site
  - o Facility is good, including CHPS workstations
  - o Trainers will be able to handle about that many attendees
  - o Trainers able to dry run on final equipment
  - o Travel costs are less than Option 2
  - o Trainers on-hand

❑ **Cons**
  - o Travel costs are greater
  - o Training staff is less available for other HEFS activities, such as solving issues

Rollout – Training Options

2) Hold initial HEFS training workshop at NWTC

❑ **Pros**

- o Allows for 2 students per RFC to attend the workshop

- o Best training occurs away from other duties, i.e. off-site

- o Facility is good, including CHPS workstations

- o Trainers on-hand

- o Helps with transition of training to NWTC – isn't this a goal?

❑ **Cons**

- o Trainers won't be able to handle about that many attendees, as effectively

- o Trainers not able to dry run on final equipment

- o Travel costs are more than Option 1: (more) students & trainers (multiple trips)

Rollout – Training Options

3) Hold initial HEFS training workshops at NWS HQ & make entire workshop available via Goto Meeting

❑ **Pros**
- o Others could attend at their RFCs
- o Costs are same as Option 1
- o Facility is good, including CHPS workstations
- o Trainers able to dry run on final equipment
- o Trainers on-hand for some students

❑ **Cons**
- o Training would be less effective to remote attendees
- o Trainers not available to remote attendees
- o Best training occurs away from other duties, i.e. off-site
- o Difficult to coordinate

Rollout – Training Options

4) Hold initial HEFS training workshops at NWC

❑ **Pros**

- o Allows for 2 students per RFC to attend the workshop
- o Best training occurs away from other duties, i.e. off-site
- o Facility is good, including CHPS workstations
- o Dedicated facility, which would also be available in the future

❑ **Cons**

- o Trainers won't be able to handle about that many attendees, as effectively
- o Trainers not able to dry run on final equipment
- o Travel costs are more than Option 1: (more) students & trainers (multiple trips)
- o Difficult to coordinate without dedicated on-site focal point
- o Facilities under-construction (but could be planned)

Rollout – Training Options

4b) Hold initial HEFS training workshops at NWC & make entire workshop available via Goto Meeting

❑ **Pros**
- o Allows for 2 students per RFC to attend the workshop, and others to attend remotely
- o Facility is good, including CHPS workstations
- o Dedicated facility, which would also be available in the future

❑ **Cons**
- o Trainers won't be able to handle about that many attendees, as effectively
- o Trainers not able to dry run on final equipment
- o Travel costs are more than Option 1: (more) students & trainers (multiple trips)
- o Difficult to coordinate without dedicated on-site focal point
- o Facilities under-construction (but could be planned)
- o Training would be less effective to remote attendees
- o Trainers not available to remote attendees
- o Best training occurs away from other duties, i.e. off-site

Rollout – Training Options

5) Other options?

❑ **Pros**

❑ **Cons**

Recommend: Option 1b - Hold initial HEFS training workshops at NWS HQ and repeat later for more students, if necessary

Consensus?

Rollout

❑ **Other issues**

    o NCEP grid data – GEFS and CFS data is transferred to RFCs through an ftp, which is not extremely reliable. Process was started to get this grid data sent over SBN, but won't happen until late FY14, at the earliest

    o Reforecasts (for calibration) – need to be moved off HSD ftp

    o Need to develop schedule for announcing / posting new HEFS forecasts for public products

    o Need to develop methodology / criteria for validation at RFCs for providing HEFS as the source of public products, such as AHPS

Long term - goals & issues

These are beyond 2014, unless otherwise stated

❑ **Investigate and fix most critical science issues**

    o MEFP

        • Probability of precipitation bias – investigate in late 2014

        • Extreme events – under investigation in 2014

    o EnsPost –

        • Provide capability to run at 6 hr time steps

        • Evaluate and improve for/on regulated flows

❑ **Connect HEFS to WFIPP (Water Forecast Improvement Preparatory Project, i.e. Water Center) activities**

❑ **Add forcings: WPC QPF, others**

❑ **Add data assimilator to account for hydrologic initial conditions uncertainty (in the original A-Team requirements)**

Questions and comments?