CPPA OHD Core Project

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- Many others
In this presentation

- Objectives
- Project areas
- Progress and plans
- New initiatives
- Closing thoughts
GAPP OHD Core Project

Objectives

• Establish collaborative activities among the GAPP researchers, the NWS Office and Hydrologic Development and the NWS River Forecast Centers to improve seasonal hydrologic forecasting techniques.

• Evaluate improved models and techniques for making probabilistic hydrologic forecasts that integrate with GAPP research in land memory process, orographic process, remote sensing, and climate predictions for possible application in NWS hydrologic forecast systems within the context of the HOSIP process.

• Demonstrate improvements to end-to-end hydroclimatic forecasting technologies at intraseasonal and seasonal climate time scales.
CPPA Core Project Hydroclimatic Prediction Goals

• Develop a capability to predict water cycle variables on intra-seasonal to seasonal time scales based on improved understanding and representation of land-atmosphere interactions *(NCEP w/ OHD contributions)*

• Interpret these predictions for water management *(OHD w/ NCEP contributions)*
Major Project Areas

• Forecast Systems Development
  – These activities are needed to develop prototype software components that enable new procedures to be developed and tested in an RFC environment. They are needed to facilitate the HOSIP process so that proven science can be used in RFC operations.

• Testbed and RFC Pilot Projects
  – These activities involve evaluation of new procedures for possible future use by the RFCs. These activities are organized around proposed HEPEX testbed projects. One reason for this approach to organizing the testbeds is to ensure they are open to all scientists that have something to contribute.

• NLDAS Support
  – This activity supports continued OHD involvement in the NLDAS project

• Development of Supporting Data Sets
  – The testbed activities require retrospective data sets including forecasts, observations and analyses of precipitation, temperature and streamflow. This activity provides a focused effort to produce these data sets and to make them available to the scientific community via an anonymous ftp site maintained by OHD.

• HEPEX Support
  – This activity provides for continued OHD leadership of the HEPEX project and continued OHD leadership contributions to GAPP and GEWEX.
CPPA-OHD Core Project leverages

- Advanced Hydrologic Prediction Service (AHPS)
- Water Resources Initiative
- NASA Grants
- Hurricane Supplemental
- Base funding
- NRC Fellowship
Climate-to-Water RTO Pathways

Research community
- NCPO research projects
- CPPA ensemble & DA research projects
- OHD grant projects
- HEPEX projects

NCEP CPC, EMC, HPC

NCEP CTB

OHD Hydrology Test Bed

Climate forecasts

RFCs
- Ensemble pre-processor
- Data assimilator
- Hydrologic, hydraulic models
- Ensemble post-processor
- Hydrologic ensemble forecasts
- Ensemble product builder

Hindcasting Verification

Ensemble Forecast System

Water customers
Overarching considerations

• To translate skill in climate prediction into uncertainty-quantified water information
  – Ensemble streamflow prediction must be seamless across short-, medium- and long-ranges
    • Capitalize on the skill in subseasonal (Week 2 and less than one month) prediction
  – Hydrologic uncertainties must be reduced to the maximum extent possible
    • Greatly impact the quality of hydrologic prediction and water information at all scales
    • Understanding, characterization, assessment and quantification of hydrologic initial condition uncertainty as a function of space-time scale is fundamental to hydrologic prediction
Elements of a Hydrologic Ensemble Prediction System

- **QPE, QTE, Soil Moisture, SWE**
- **QPF, QTF**
- **Ensemble Pre-Processor**

**Data Assimilator**

- **Hydrology & Water Resources Models**
- **Ensemble Post-Processor**

**Ens. Product Generator**

**Ensemble Product Post-Processor**

**Input Uncertainty Processor**

**Parametric Uncertainty Processor**

**Hydrologic Uncertainty Processor**

**Ensemble Verification System**
EXperimental Ensemble Forecast System (XEFS)

Forensicators add value

XEFS will enable seamless hydrologic ensemble prediction from weather to climate scales and translate weather and climate prediction into uncertainty-quantified water information.
CPPA-OHD Core Project Accomplishments

- Continued and newly developed RFC Test Bed and Pilot Projects for collaborative research and development, and research-to-operations transition of the R&D outcome
  - Experimental operation of XEFS components at RFCs
- Provided support to NLDAS
- Provided leadership to collaborative ensemble research and community test bed projects
  - Hydrologic Ensemble Prediction Experiment (http://hydis8.eng.uci.edu/hepex/)
Development/Enhancement of hydrologic ensemble forecast system components (CPPA-supported)

- Ensemble Pre-Processor (EPP) (Schaake, this afternoon)
- Ensemble Streamflow Processor II (ESP2)
  - Hydrologic Model Output Statistics Ensemble Processor (HMOS)
- Hydrologic Ensemble Hindcaster (HEH)
- Ensemble Post-Processor (Ens Post) (Regonda and Seo, poster)
- Ensemble Verification System (EVS) (Demargne et al., poster)
- Ensemble Product Generator (EPG)
  - Ensemble Product Post-Processor
- Data Assimilator (DA)
  - 2DVAR and ensemble filter for lumped SAC-UH models
  - 4DVAR for distributed SAC and kinematic-wave routing models (Lee et al., poster)
  - 1DVAR for hydrologic routing

See OHD-HL Strategic Science Plan (2007) for science issues in hydrologic ensemble forecasting and data assimilation
RFC Test Beds and Pilot Projects

Ensemble Pre-Processor (EPP)

Hydrologic Ensemble hindcaster (HEH)

Hydrologic Model Output Statistics (HMOS) Ensemble Processor

2DVAR with SAC-UH

Distributed Hydrologic Modeling (DHM)

Hydrologic Model Output Statistics (HMOS) Ensemble Processor

Ensemble Verification System (EVS)
California-Nevada RFC Prototype Hydrologic Ensemble Forecasting Operation

30-day Temperature Ensembles

Smith River – February 7, 2007

30-day Precipitation Ensembles

http://www.cnrrc.noaa.gov/ahps.php
HEPEX/HAP Accomplishments

- Special issue of Atmospheric Sciences Letters (ASL) on HEPEX (February, 2008)
- BAMS article on HEPEX (November, 2007)
- Hydrologic uncertainty workshop hosted by Deltares in Delft (June, 2008)
- Operating ~20 test-bed projects globally
- Supporting Data Sets
- Planning for future activities
HEPEX/HAP Future Plans

• Workshops:
  – Atmospheric Downscaling (June 15-19, 2009)
  – Ensemble QPE (EGU-2008/Workshop-2009?)
  – User Applications (2010)
  – 4th HEPEX Workshop (2010 – NCEP new facility)

• Intercomparison Studies
  – Atmospheric Downscaling (TBD)
  – Hydrologic Post-Processing (Delft follow-up)

• Supporting Data Sets

• Ensemble Verification/Diagnostic Tools
New Initiatives

- RFC pilot project in the Upper Colorado in support of NIDIS
  - OHD and CBRFC, in collaboration with NCEP, will develop and execute a new RFC pilot project toward development and implementation of a drought early warning capability for NIDIS for the Colorado River above Kremmling

- NCEP-OHD joint development of high-resolution modeling and data assimilation capability for CONUS *(Seo et al., poster)*
  - Will allow cost-effective improvement of model physics and data assimilators, and hydrologic evaluation of forcing, including climate, ensembles.
  - Will produce a 30-yr model climatology and a suite of guidance products for NIDIS, which will directly support the above RFC pilot projects in the Upper Colorado and elsewhere.

- THORPEX-HYDRO
  - Develop and operationally implement real-time bias correction, downscaling and hindcasting techniques applicable to global, regional, and climate ensembles
  - Develop capabilities for routine ingestion, testing, and use in XEFS of NCEP ensembles by OHD and RFCs
  - Enhance capabilities for seamless verification of atmospheric and hydrologic ensembles across NCEP, OHD and RFCs
In Closing

- XEFS is on a fast-track to operational implementation at all RFCs as a baseline hydrologic ensemble forecast system
- RFCs are poised to play a much bigger role as the primary provider of climate prediction-based water information to a wide range of customers
- A number of scientific challenges must be addressed to produce reliable and skillful hydrologic ensemble forecasts that fully utilize climate prediction
- To leverage CPPA research outcome more cost-effectively, a community-wide locus for science infusion is necessary
- The Hydrology Test Bed (HTB) is meant to serve that role in some capacity, but a scaled-up approach is necessary to accelerate, in step with the XEFS development and implementation, the scope and pace of science infusion to realize integrated service and products for climate-to-water information
Facilitating SI and RTO in Hydrologic Ensemble Forecasting via R&D XEFS

- Provide flexible R&D environment that is functionally equivalent to operational XEFS to develop, test and evaluate new science capabilities
- Enable in XEFS plug-and-play of new capabilities

CHPS (Community Hydrologic Prediction System)
Thank you

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