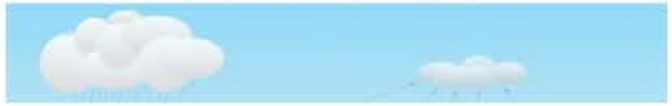
Building a dynamic middleware framework to couple 2D ocean circulation models to the National Water Model

J. Ducker[1], H. Kefelegn[1], H. Mashriqui[2], J. Allen[1], R. Grout[1], R. Gibbs[1], J. Zyserman[1], S. Moghimi[3], Y. Funakoshi[3], A. Abdolali[4], A.J. Van Westhuysen[4], T. Flowers[1], E.P. Clark[1]

[1]NOAA Office of Water Prediction, National Water Center, Tuscaloosa, AL, [2]NOAA Office of Water Prediction, Silver Spring, MD, [3]NOAA Coast Survey Development

Introduction

Representing total water levels in complex coastal areas still proves to be a challenge for the National Water Model (NWM). Having accurate forecasting schemes for coastal water levels are especially critical during coastal flooding/storm surge events.



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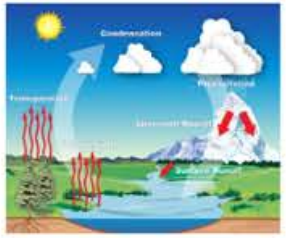
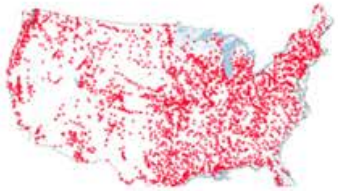
Model Components

National Water Model (NWM) Version 2.1

- Simulates the hydrologic cycle over continental United States (CONUS) grid (1km).
- Ingests meteorological forcings from assimilated observations or forecast models.
- Generates streamflow forecasts at approximately 3,600 locations.



Current River Forecast Points (~3,600)



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A Model Coupling Framework to Improve NWM Forecasting Schemes Along Coastal Regions

NOAA Environmental Modeling System (NEMS) Model Coupling Framework

Using the Earth System Modeling Framework (ESMF) software, we have developed National Unified Operational Capability (NUOPC) Fortran adapaters for D-Flow FM and NWM to dynamically communicate with oceanic models (ADCIRC/WW3) and exchange hydrologic data to improve surge/fresh water induation forecasts along the coastal zones.

Figure 6. The model coupling framework workflow illustrates the fields each model communicates to one another within the NEMS infrastructure. Atmospheric forcings used to force each model reside as external files produced from a variety of meteorological forcing products.

D-Flow FM Model Configurations Required to Succesfully Couple Boundary Conditions With Hydraulic Models

- Link NWM and D-Flow FM hydrologic fields based on NWM

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Achievements to Coastal Model Coupling

D-Flow FM NEMS Coupling Results

Changes to D-Flow FM source code and the NUOPC cap enabled NEMS to properly couple D-Flow FM between inland hydrologic modeling and oceanic models without requiring external forcing files to force the model boundary conditions. When compared to the standalone D-Flow model with external forcing files (Figure 8), NEMS can now reproduce the same results.

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Implications to National Water Model Development

- **This modeling framework highlights the potential for coupling a coastal model (D-Flow FM) with oceanic fields and inland hydraulics in order to improve NWM forecasting schemes over the coastal zones.**
- **With the NextGen Water Model Framework now in development, we can implement D-Flow FM as an extension for the NWM forecasting schemes for coastal zones within the NextGen hydrofabric.**

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