



ESMF NCAR

Presentation on HAFS: NESII/ESMF Coupling Progress

Daniel Rosen, Ufuk Turuncoglu

HAFS Coordination Meeting
March 31st, 2021



Overview

Previous Accomplishments

- Directly coupled UFSATM-HYCOM regional application

New Accomplishments

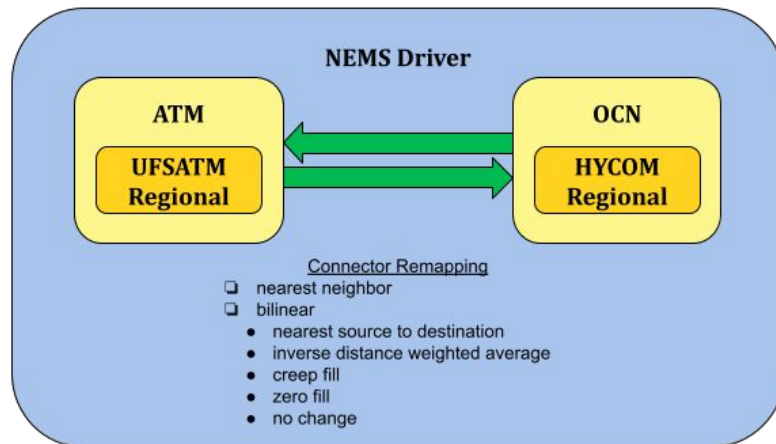
- Coupling UFSATM-HYCOM using the CMEPS mediator
- Transition to CMake build system
- Added CDEPS data components
- Added regression tests

In Progress

- Coupling WW3 wave model

Review: ATM - OCN Coupling

Direct coupling through the bilinear regridding method with data merging of external forcings for non-overlapped areas `forecast.cpl_ocean=2`



From ATM to OCN:

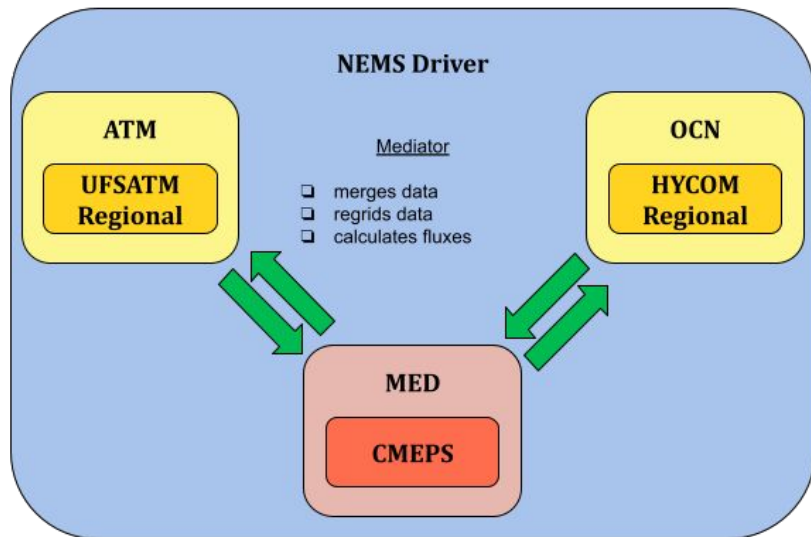
10-m wind, air-sea momentum flux, 2-m temperature, 2-m humidity, net shortwave and longwave radiation fluxes, precipitation, surface pressure

From OCN to ATM:

sea surface temperature

Accomplishment 1: Mediator

Mediator coupling, also using bilinear regridding, with data merging of external forcings for non-overlapped areas `forecast.cpl_ocean=3`



Field Exchanges:

Identical to direct coupling. Fields pass through mediator and mediator uses bilinear regridding

Bit for Bit:

Results are bit for bit* compared to direct coupling.

*Requires grid to mesh term ordering fix.

CMEPS

Community Mediator for Earth Prediction Systems (CMEPS)

- Community development and testing in close collaboration with NCAR
- Consistent use across UFS applications
- Regrids advanced geometric structures
- Time-averages varying coupling periods
- Merges data from multiple components
- Multiple options for handling flux computations
- Remap and merge defined in a single file for field exchanges
- Use of YAML external file for NUOPC field dictionary

<https://escomp.github.io/CMEPS/versions/master/html/introduction.html>

Accomplishment 2: CMake

UFS applications have migrated to a CMake build system

- Easier to build applications that include multiple subcomponents and libraries
- Cleaner build logging and output files
- Faster builds using parallelization

All UFS weather model subcomponents provide CMake library targets to UFS application.

Accomplishment 3: Data Components

Community Data Models for Earth Prediction Systems (CDEPS)

- Help build and diagnose coupled systems
- Compare impact of different forcing data sets on coupled applications
- Bring in forcings data sets for DA purposes

The following data streams are available:

- **DATM**
 - ECMWF's ERA5 Reanalysis data set (~30 km spatial resolution, hourly)
- **DOCN**
 - AVHRR OISST data set (0.25 deg., daily)
 - Regional MOM6 (experimental)

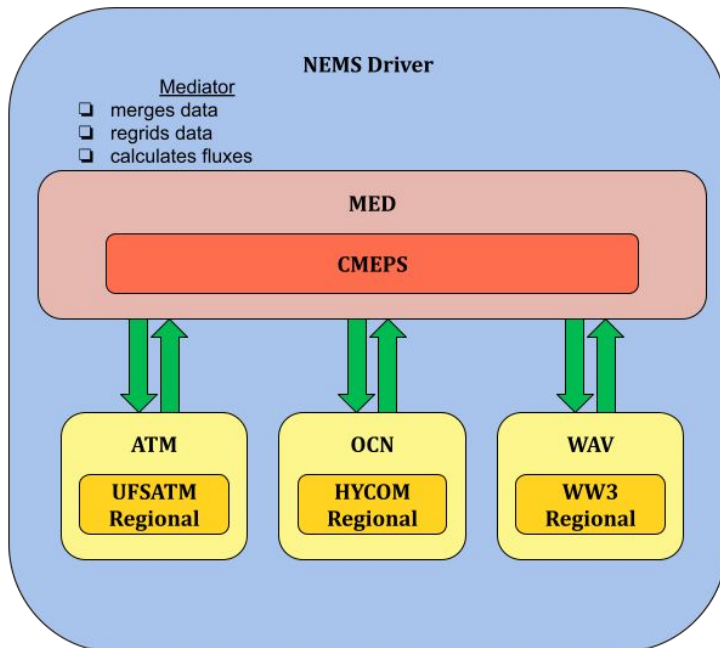
Accomplishment 4: Regression Tests

HAFS regression tests have been added to UFS:

- Regional UFSATM standalone (fv3_ccpp_regional_natl_c192)
- Regional UFSATM coupled with regional HYCOM (cpld_regional_natl_c192)
- Regional UFSATM coupled with global DOCN-OISST (cpld_regional_natl_c192_docn_oisst)
- Regional UFSATM coupled with regional DOCN-MOM6 (cpld_regional_natl_c192_docn_mom6)
- Global DATM-ERA5 with regional HYCOM (datm_era5_hycom)

Future Work: WAV Coupling

Analyze effects of waves on atmospheric stress at ocean surface.



Iteration 1: ATM <-> WAV

From ATM to WAV:

10m wind

From WAV to ATM:

Z0 - surface roughness

Iteration 2: OCN <-> WAV

From OCN to WAV:

surface currents

From WAV to OCN:

Stokes drift

WW3

WAVEWATCH III

- 1/10 degree regular lat/lon regional grid
- Used in global UFS S2S and regional coastal applications

Status:

- WW3 builds within HAFS on Hera and builds on Orion are in progress
- Currently gathering WW3 regional input files

<https://github.com/NOAA-EMC/WW3/wiki/About-WW3>

Summary

- UFS collaboration across applications
 - UFS applications have switched to using CMEPS mediator
 - UFS applications have switched to CMake build
 - New UFS regression tests have been added for HAFS
 - Forecast components synchronized and shared across applications
- Data components available
 - Help build and diagnose coupled systems
 - Compare impact of different forcing data sets on coupled applications
 - Bring in forcings data sets for DA purposes
- Wave coupling
 - UFSATM-WW3 coupling milestone set for June 2021

Thank You