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

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.

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

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

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