The CMEPS Mediator in the UFS-S2S Model

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What is CMEPS?

CMEPS is the *Community Mediator for Earth Prediction Systems*

- ***Community***

  A collaboration between NCAR, NOAA/EMC, and NOAA/GFDL; developed openly on GitHub to allow community code contributions and encourage collaboration and innovation

- ***Mediator***

  A NUOPC-compliant coupler designed to flexibly couple configurations of atmosphere, land, ocean, wave, sea ice, and land ice components using a hub-and-spoke architecture

- ***Earth Prediction Systems***

  Currently being used in NCAR's Community Earth System Model (CESM), NOAA's UFS Subseasonal-to-Seasonal application, and NOAA's Hurricane Analysis and Forecast System (HAFS)

CMEPS Repos in UFS-S2S-model

- Authoritative Repository hosted at ESCOMP
  - https://github.com/ESCOMP/CMEPS
  - Documentation (work in progress): https://escomp.github.io/CMEPS/
- UFS-S2S-model contains a fork of ESCOMP/CMEPS
  - Only a develop branch is maintained
  - Users doing development work need to fork both ufs-s2s-model and any component repository where work is planned. More information here: https://docs.google.com/presentation/d/1UVq7O0djhOO99VCIbftwi-WFRdF9fjnMijZNw4kRxnM

Working with CMEPS

- **CMEPS** can be loosely organized into three types of code:
  - Totally generic code to carry out mediator functionality
    - Mapping and merging
    - History and restart writing
  - Application specific code: **CESM**, **NEMS** and **HAFS** versions:
    - Determines what fields are exchanged between components
    - Determines how they are mapped and merged
    - **NEMS** versions: esmFldsExchange_nems_mod.F90 and fd_nems.yaml
    - Configure options for **NEMS**: coupling_mode = [nems_orig, nems_frac, nems_orig_data]
  - Component ”Prep” phase code
    - Component specific merging to create the export state for a given destination component

Understanding Field Exchanges in CMEPS

- Any exchange of fields between components defined by three actions:
  - **addfld:** specifies the fields needed by or available from a component
  - **addmap:** specifies the mapping method used to map a specific field from one component to another component
  - **addmrg**: specifies how to merge one or more mapped fields to create the target destination field in the mediator's export state
    - 'Auto' merges using **addmrg** and generic med_merge_mod
    - 'Custom' merges for individual fields using med_merge_field

Example Field Exchange

- **Addfld**: send surface temperature *from* Ocean *to* Atm

```
call addfld(fldListFr(compocn)%flds, 'So_t')
call addfld(fldListTo(compatm)%flds, 'So_t')
```

  - 'So_t' may have an alias in the field dictionary yaml file

- **Addmap**: map surface temperature *from* Ocean *to* Atm with conservative fraction mapping, where fraction is the ocean fraction

```
call addmap(fldListFr(compocn)%flds, 'So_t', compatm, mapconsf, 'ofrac', 'unset')
```

- **Addmrg** : merge mapped field 'So_t' *from* Ocean *to* Atm by copy

```
call addmrg(fldListTo(compatm)%flds, 'So_t', mrg_from1=compocn, mrg_fld1='So_t', mrg_type1='copy')
```

Auto and Custom Merges in “Prep” mods

- **Auto merges**: merge mapped fields to the Field Bundle exported to component (med_phase_prep_atm_mod.F90)

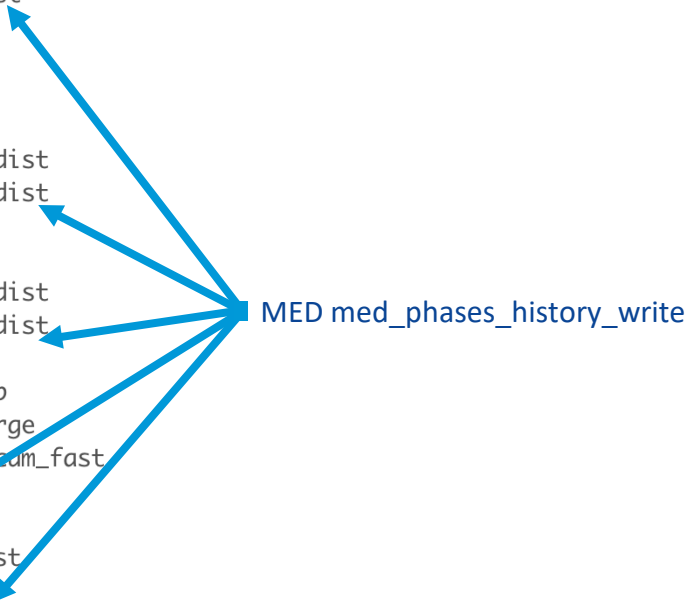
```
call med_merge_auto(trim(compname(compatm)), &
          is_local%wrap%FBExp(compatm), is_local%wrap%FBFrac(compatm), &
          is_local%wrap%FBImp(:,compatm), fldListTo(compatm), rc=rc)
```

- **Custom merges**: merge one or more mapped fields to the Field Bundle exported to the component (med_phase_prep_ocn_mod.F90)

```
customwgt(:) = ofrac(:) * (1.0 - 0.06)
call med_merge_field(is_local%wrap%FBExp(compocn),  'Foxx_swnet_idf', &
     FBinA=is_local%wrap%FBImp(compatm,compocn), fnameA='Faxa_swndf',     wgtA=customwgt, &
     FBinB=is_local%wrap%FBImp(compice,compocn),  fnameB='Fioi_swpen_idf', wgtB=ifrac, rc=rc)
```

Using the CMEPS Run Sequence to Understand Field Exchanges

```
runSeq::
@1800
   MED med_phases_prep_ocn_accum_avg
   MED -> OCN :remapMethod=redist
   OCN
   @450
     MED med_phases_prep_atm
     MED med_phases_prep_ice
     MED -> ATM :remapMethod=redist
     MED -> ICE :remapMethod=redist
     ATM
     ICE
     ATM -> MED :remapMethod=redist
     ICE -> MED :remapMethod=redist
     MED med_fraction_set
     MED med_phases_prep_ocn_map
     MED med_phases_prep_ocn_merge
     MED med_phases_prep_ocn_accum_fast
     MED med_phases_profile
   @
   OCN -> MED :remapMethod=redist
   MED med_phases_restart_write
@
::
```



A history write phase can be inserted at any point in the run sequence

- Use history_n =1 and history_option = nsteps to record every step through the run sequence
- Allows examination of fields to and from all components at given timestep

Thanks!
Any Questions?