Build fv3gfs CAP in NEMS

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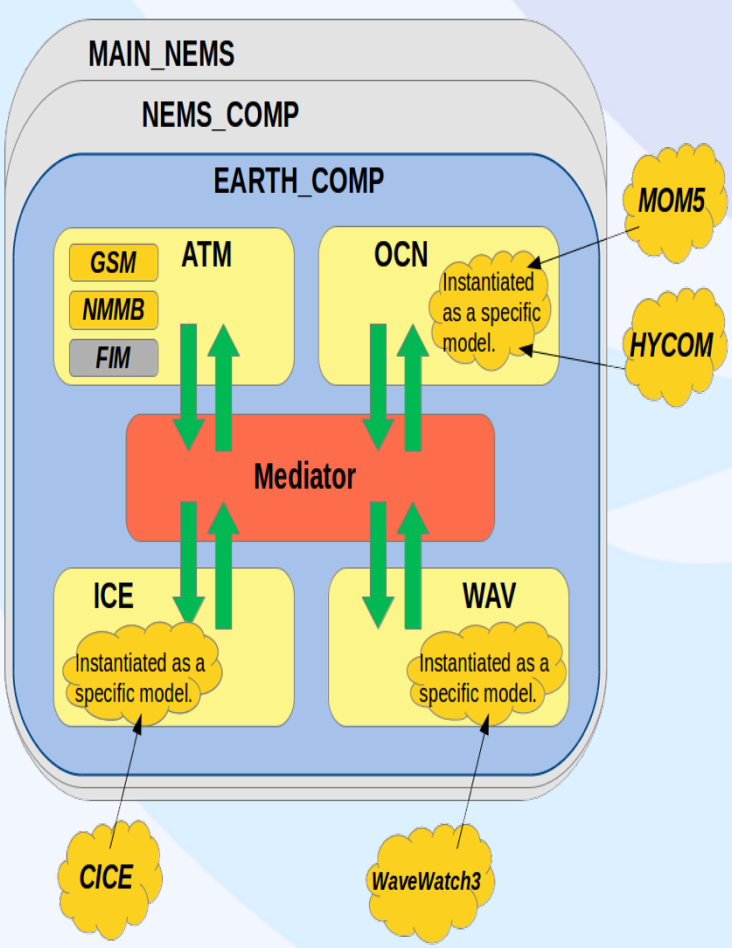
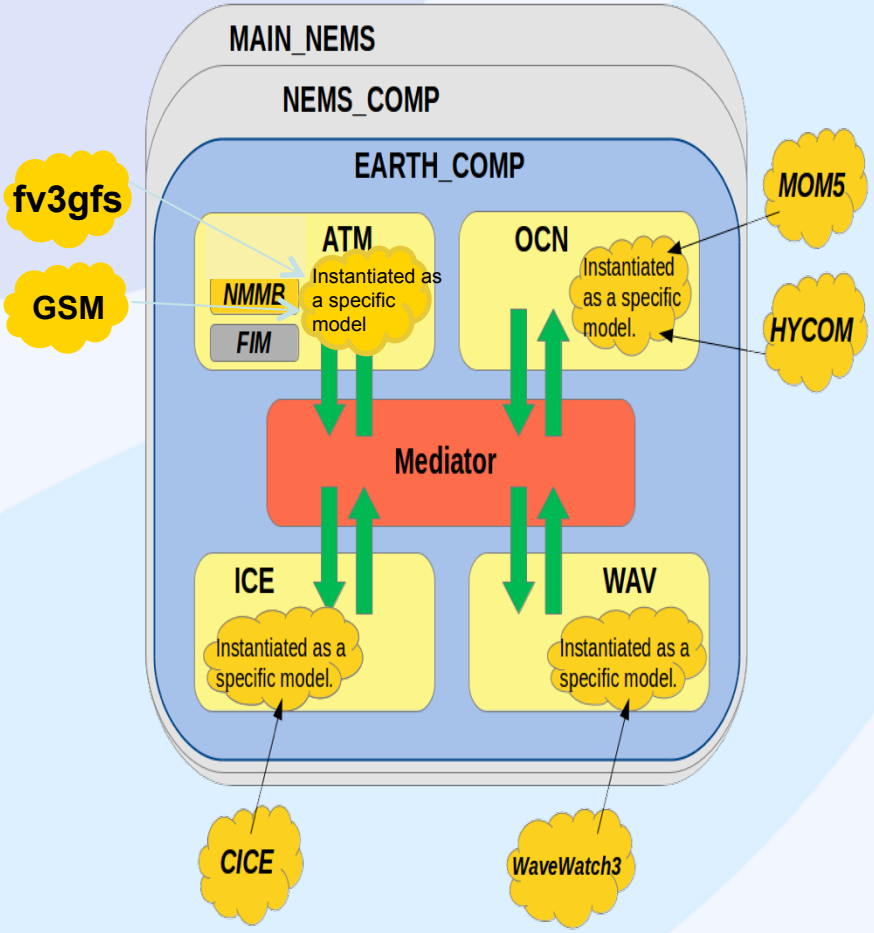
Steps to build FV3 in nems

- Build standalone fv3 as independent atmosphere grid component in NEMS
- Update physics driver and gsm physics
- Set quilt for I/O and inline POST
- Build coupled system with fv3 atmosphere grid component
- Split dynamics and physics into separate grid components

Build standalone FV3 in NEMS

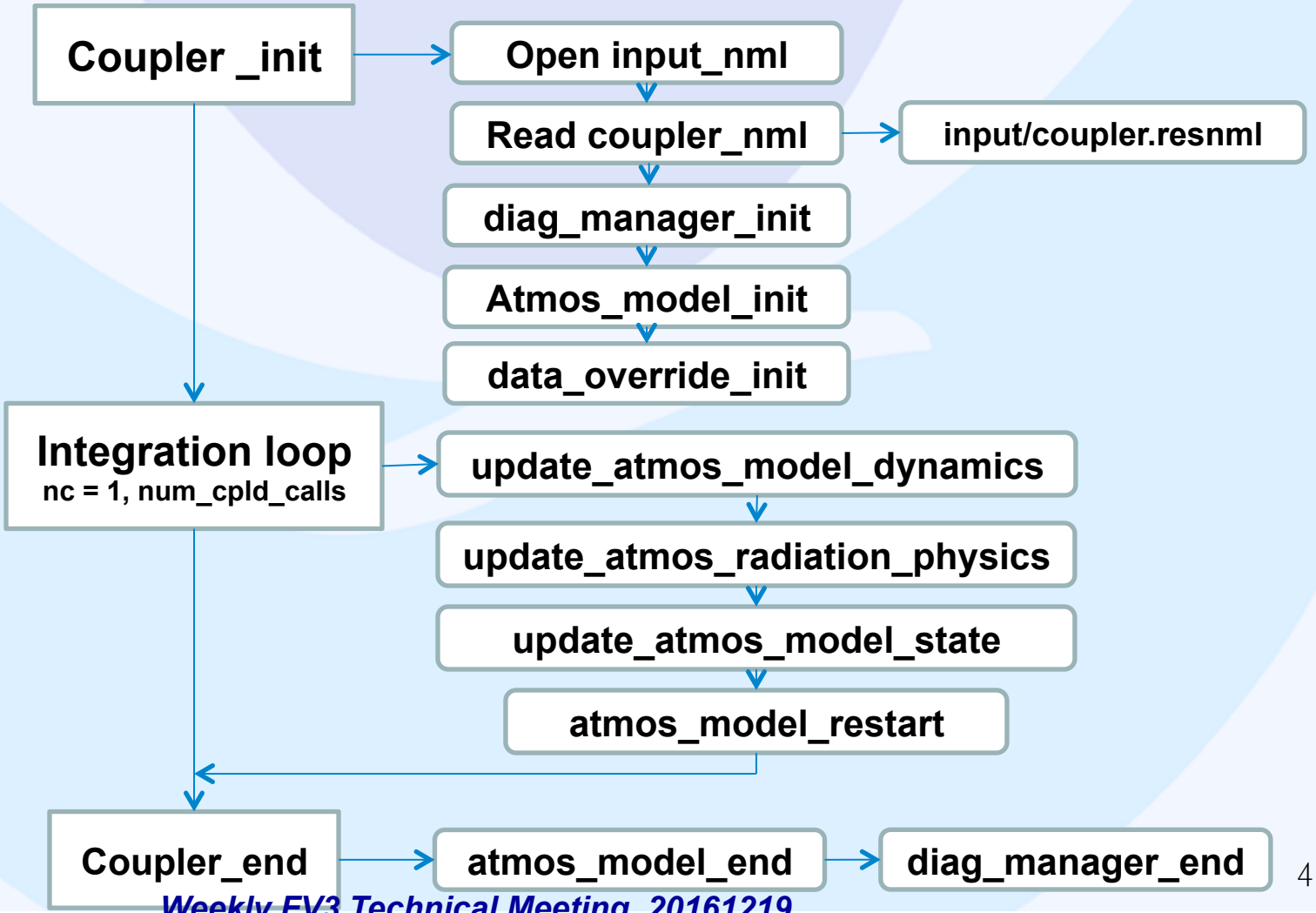
- fv3gfs is implemented as an instantiation of atmosphere model
- An atmosphere CAP fv3gfs_cap.F90 will be created and added to fv3gfs repository





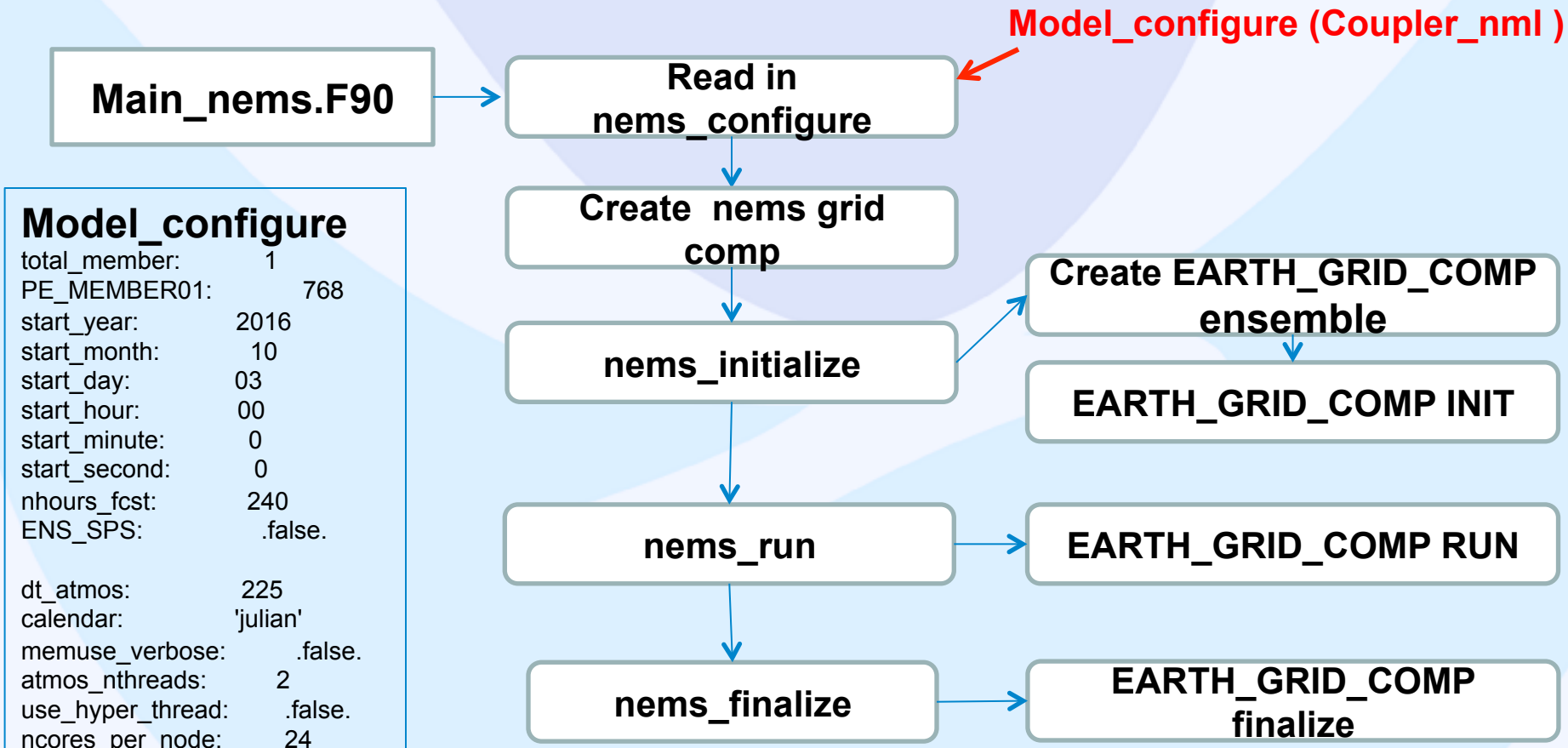
GFDL fv3gfs main driver

- Main program: fv3gfs/sorc/fv3gfs.fd/fv3_gfsphysics/simple_coupler/coupler_main.F90



NEMS fv3gfs

- Main program: NEMS/src/MAIN_NEMS.F90

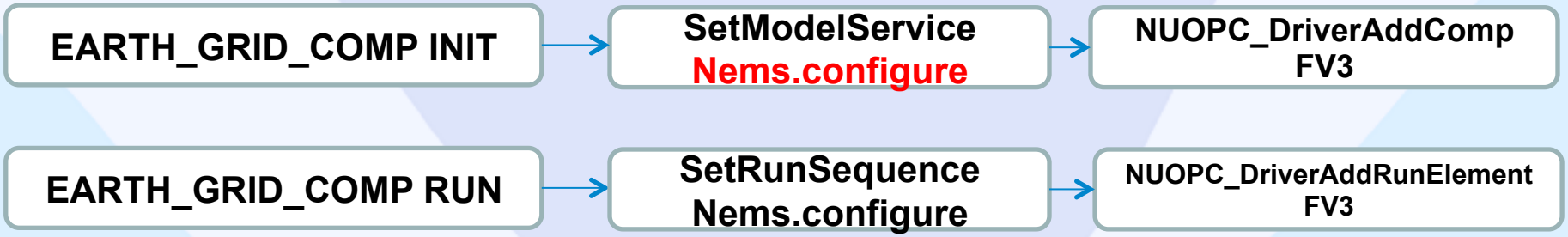


Model_configure

```
total_member:          1
PE_MEMBER01:           768
start_year:            2016
start_month:           10
start_day:             03
start_hour:            00
start_minute:          0
start_second:          0
nhours_fcst:           240
ENS_SPS:               .false.

dt_atmos:              225
calendar:              'julian'
memuse_verbose:        .false.
atmos_nthreads:        2
use_hyper_thread:      .false.
ncores_per_node:       24
restart_interval:      0
```

NEMS fv3gfs (cont.)

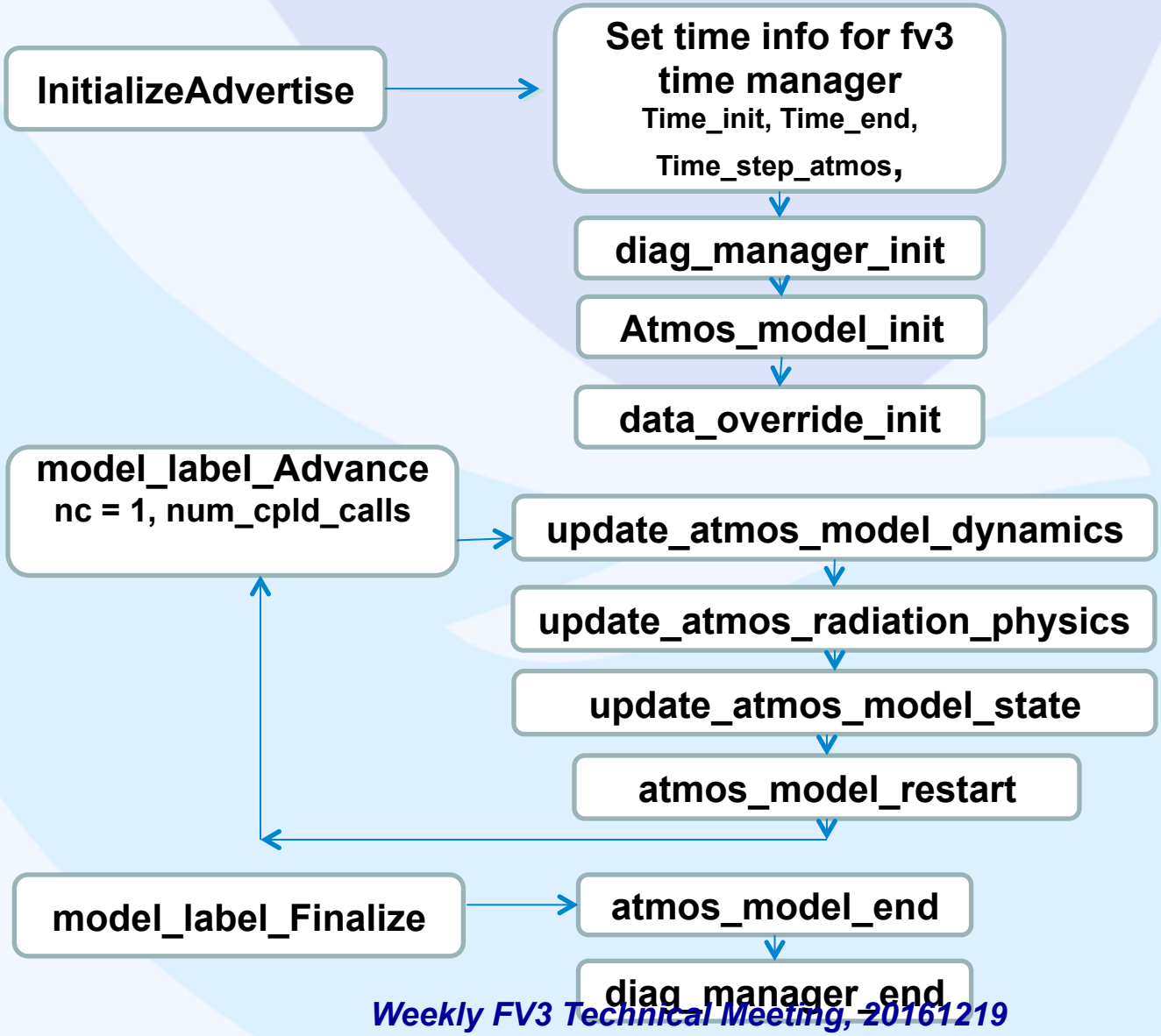


nems.configure

```
EARTH_component_list: ATM
ATM_model:            fv3
runSeq::
  ATM
::
```

NEMS fv3gfs_CAP

nems4fv3/FV3/sorc/fv3gfs.fd/fv3_gfsphysics/atmos_drivers/coupled/fv3_cap.F90



Code repository

- NEMS apps:

https://svnemc.ncep.noaa.gov/projects/nems/apps/NEMSLegacy/branches/jun/nems4fv3

- Externals:

NEMS https://svnemc.ncep.noaa.gov/projects/nems/branches/jun/atm_refactor_fv3
FV3 https://svnemc.ncep.noaa.gov/projects/fv3gfs/branches/jun/fv3_nems

Compile and run NEMS fv3gfs

- **Check out nems4fv3 branch at:**

svn co https://svnemc.ncep.noaa.gov/projects/nems/ apps/NEMSLegacy/branches/jun/nems4fv3

- **Compile**
  - The mkmf is used to create the makefiles, which are the same as current fv3gfs.
  - Fv3 makefile will create two libraries: libfv3.a and libgfs.a in FV3/sorc/fv3gfs.fd/BUILD/exec , the two libraries are linked in NEMS makefile to create the executable NEMS/src/NEMS.x
  - To compile, in nems4fv3, do: ./NEMS/NEMSAppBuilder

- **Run a job**
  - Same as current fv3gfs, tested C96, C192, C384, and C786
  - In nems4fv3/FV3/jobs in submit_fv3.sh, update the days(total forecast time)
    - Cold start: warm_start=.F.
    - To run restrart: warm_start=.T.

./ submit_fv3.sh

Issues

- NEMS fv3gfs generates identical results with different mpi tasks.
- But NEMS fv3gfs does not generate identical results as current fv3gfs on Luna/Surge.
- All the settings in namelist and configure file are checked to be identical in NEMS fv3gfs and fv3gfs
- Current debugging found that differences first show up in remap_scalar_nggps in computing global_area, the mpp_global_sum might be the cause. Need to consult with GFDL and further debug.
  - global_area = mpp_global_sum(domain, area, flags=BITWISE_EFP_SUM)
  - In NEMS fv3gfs: Global Area= 510096496551870.
  - In fv3gfs: Global Area= 510096496551871.

Future work

- Consult with GFDL on the bit identical identical issue between NEMS fv3gfs and current non-nems version fv3gfs.
- Merge fv3 branch to the latest fv3 super structure
- Work with NEMS group to commit nems branch atm_refactor_fv3 changes into NEMS trunk
- Compile configuration: Makefile(mkmk), 32bits/64bits