MUSICA version 0

MUSICAv0 is a configuration of the Community Earth System Model (CESM) Community Atmosphere Model with Chemistry (CAM-chem) using the Spectral Element (SE) dynamical core, with any regionally refined (RR) grid. The scientifically validated regional refined grid is over the conterminous United States (CONUS). This configuration has been released in CESM2.2. Other regions of refinement will need to be created and evaluated by the user. Other global uniform resolution configurations are also available with this version.

Running MUSICAv0 is essentially the same as running CAM-chem, as described on the CAM-chem wiki page.

If you are unfamiliar with CESM, the CESM tutorial provides a good overview. More information about the Spectral Element dynamical core is in the CAM5 Scientific Guide. Also, see Peter Lauritzen's lecture on dynamics from the CESM tutorial. If you are not running on NCAR's supercomputer (cheyenne) you will need to identify the machine you are using, and perhaps modify configuration files; see the CESM information on supported machines.

Please note the very high computing cost for the regionally refined configuration and plan accordingly. Also, the output files can be very large.

MUSICAv0 Configuration

To build the MUSICAv0 configuration use the "FCnudged" compset with the "ne0CONUSne30x8_ne0CONUSne30x8_mt12" resolution:

```
./create_newcase --compset FCnudged --res ne0CONUSne30x8_ne0CONUSne30x8_mt12 --case your_directory
```

Additional Configurations

All CESM2.2 configurations are listed in the code base under components/cam/cime_config/config_compsets.xml. See also Table 1 below.

Table 1: CESM2.2 / MUSICAv0 (scroll right to see more columns)

Compsets	Chemistry	Supported Resolution	Default Start Date	Meteorology (Calendar)	Other Components	Emissions	physics time step (sec)	Run Time (yrs/ day)	Cost (Core hours / yr)
FC2010	TS1	f09_f09_mg17 ne30_ne30_mg17 ne30pg3_ne30pg3_mg17	Jan 2010	CAM6 (NO_LEAP) repeats year 2010	prescribed SST prescribed LAI[1]	CMIP6	1800	5.1 5.8 6.8	5400 7500 6900
FCHIST FCnudged FCts2nudged	TS1 (229) TS2 (317)	f09_f09_mg17 ne30_ne30_mg17 ne30pg3_ne30pg3_mg17 ne30_ne30_mg17	Jan 2010	CAM6 ~50hrs nudging to MERRA2 (NO_LEAP) transient	prescribed SST prescribed LAI[1]	CMIP6	1800	5.1 5.8 6.8 3.7	5400 7500 6900 12000
FCnudged FCts2nudged	TS1 TS2	ne0CONUSne30x8_ne0CONUSne30x8_mt12	Jan 2013	~50hrs nudging to MERRA2 (Gregorian)	prescribed SST prescribed LAI[1]	FINN1.5 (2010-2017) CAMS (2000-2019)	225	0.20	220000
FCSD	TS1 TS2			Specified Dynamics MERRA2			1800		

1: uses satellite phenology (bgc sp) from observed present day LAI

Example: MUSICAv0 or CESM2.2 CAM-chem with Regional Refinement of CONUS

./create_newcase --compset FCnudged --project <project> --res ne0CONUSne30x8_ne0CONUSne30x8_mt12 --case <case_name>

See: CESM conventions for naming cases

For example, f.e22.ne0CONUSne30x8_ne0CONUSne30x8_mt12.001 (f: F-case; e22: CESM2.2 version; ne0CONUSne30x8_ne0CONUSne30x8_mt12: resolution; run number)

Adjusting your simulations to your needs:

Change start date (different month or year) requires changing IC files for atmosphere and land

Atmosphere:

- Make sure to use the same year and month for IC conditions. Changes in greenhouse gases and long-lived tracers need a long time (several years) to spinup.
- You can use a ne30 configuration to spin up the run; Interpolate your spun-up IC file to your grid (CONUS) (see interpolation routines). Atmospheric initial conditions for ne30_ne30 are available from 2015-2020: /glade/p/acom/MUSICA/init/ne30_ne30/
- Run one month with CONUS to spinup the run

Land:

- needs more careful spinup, from the highest resolution file (CAM run)
- Can use a land IC file from a different year (close to the simulation)

Initial Conditions and restart files for CONUS are available for the year 2013:

- /glade/p/acom/MUSICA/init/ne0CONUSne30x8/atm
- /glade/p/acom/MUSICA/init/ne0CONUSne30x8/rest

Change emissions:

Detailed information about available emissions and regridding of emissions can be found on the MUSICA emissions page.

Change met data or nudging:

Detailed information about nudging to met data can be found in the CAM User's Guide.

Some resolutions and years are available on cheyenne: /glade/p/acom/MUSICA/met_data

If you are running f09 resolution, with 30 minute model timestep, use **Model_Times_Per_Day = 48 (note this is currently not set correctly in the compset)**

If you are running with MERRA2 meteorological analysis (3 hour met fields), use **Nudge_Times_Per_Day= 8 (note this is currently not set correctly in the compset)**

Default nudging variables for the current compsets are:
```
&nudging_nl
 Nudge_Model       =.true.
 Nudge_Path         ='/glade/p/cesmdata/cseg/inputdata/atm/cam/met/nudging/MERRA2_ne0CONUS30x8_L32/'
 Nudge_File_Template='%y/MERRA2_ne0CONUS30x8_L32.cam2.i.%y-%m-%d-%s.nc'
 Nudge_Force_Opt   = 0
 Nudge_TimeScale_Opt= 0
 Nudge_Times_Per_Day= 8      3 hour met fields
 Model_Times_Per_Day= 384   needs to be adjusted to physics time step of the simulation
! Nudge_Uprof  =2                    window nudging
 Nudge_Uprof  =1                    global nudging
! Nudge_Ucoef  =0.5               6hour nudging
 Nudge_Ucoef  =0.06                50hour nudging
! Nudge_Vprof  =2
 Nudge_Vprof  =1
 Nudge_Vcoef  =0.06
! Nudge_Vcoef  =0.5
 Nudge_Tprof  =1
! Nudge_Tprof  =2
 Nudge_Tcoef  =0.06
! Nudge_Tcoef  =0.5
 Nudge_Qprof  =0
 Nudge_Qcoef  =0.00
 Nudge_PSprof =0
 Nudge_PScoef =0.00
 Nudge_Beg_Year =2013        adjust to when you want to start   (nudging will not  happen outside the defined begin and end times)
 Nudge_Beg_Month=1
 Nudge_Beg_Day  =1
 Nudge_End_Year =2020
 Nudge_End_Month=12
 Nudge_End_Day  =31
 Nudge_Hwin_lat0   =37.        definition of window nudging (not used with current settings)
 Nudge_Hwin_latWidth=56.
 Nudge_Hwin_latDelta=5.
 Nudge_Hwin_lon0   =264.
 Nudge_Hwin_lonWidth=94.
 Nudge_Hwin_lonDelta=5.
 Nudge_Hwin_Invert  =.true.
 Nudge_Vwin_Hindex  =33.
 Nudge_Vwin_Hdelta  =0.001
 Nudge_Vwin_Lindex  =0.
 Nudge_Vwin_Ldelta  =0.1
 Nudge_Vwin_Invert  =.false.
/
```