MUSICA version 0

MUSICA version 0 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 regionally 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 MUSICA version 0 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.

MUSICA version 0 Configuration

To build the MUSICA version 0 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 / MUSICA version 0 (scroll right to see more columns)

<table>
<thead>
<tr>
<th>Compsets</th>
<th>Chemistry</th>
<th>Supported Resolution</th>
<th>Default Start Date</th>
<th>Meteorology (Calendar)</th>
<th>Other Components</th>
<th>Emissions</th>
<th>physics time step (sec)</th>
<th>Run Time (yrs/day)</th>
<th>Cost (Core hours / yr)</th>
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</thead>
<tbody>
<tr>
<td>FC2010</td>
<td>TS1</td>
<td>f09_f09_mg17</td>
<td>Jan 2010</td>
<td>CAM6 (NO_LEAP)</td>
<td>prescribed SST</td>
<td>CMIP6</td>
<td>1800</td>
<td>5.1</td>
<td>5400</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ne30_ne30_mg17</td>
<td></td>
<td>repeats year 2010</td>
<td>prescribed LAI1</td>
<td></td>
<td>5.8</td>
<td>6.8</td>
<td>7500</td>
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<td>6.8</td>
<td>6.8</td>
<td>6900</td>
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<td>TS1 (229)</td>
<td>f09_f09_mg17</td>
<td>Jan 2010</td>
<td>CAM6</td>
<td>prescribed SST</td>
<td>CMIP6</td>
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<td>5.1</td>
<td>5400</td>
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<tr>
<td></td>
<td></td>
<td>ne30_ne30_mg17</td>
<td></td>
<td>(NO_LEAP)</td>
<td>prescribed LAI1</td>
<td></td>
<td>5.8</td>
<td>6.8</td>
<td>7500</td>
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<td></td>
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<td>ne30pg3_ne30pg3_mg17</td>
<td></td>
<td>transient</td>
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<td>6.8</td>
<td>6.8</td>
<td>6900</td>
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<tr>
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<td>TS2 (317)</td>
<td>ne30_ne30_mg17</td>
<td>Jan 2010</td>
<td>~50hrs nudging to</td>
<td>prescribed SST</td>
<td>CMIP6</td>
<td>1800</td>
<td>5.1</td>
<td>5400</td>
</tr>
<tr>
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<td></td>
<td></td>
<td>MERRA2 (Gregorian)</td>
<td>prescribed LAI1</td>
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<td>5.8</td>
<td>6.8</td>
<td>7500</td>
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<td>6.8</td>
<td>6900</td>
</tr>
<tr>
<td>FCnudged</td>
<td>TS1</td>
<td>ne0CONUSne30x8_ne0CONUSne30x8_mt12</td>
<td>Jan 2013</td>
<td>~50hrs nudging to MERRA2</td>
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<td>FCSD</td>
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<td>MERRA2</td>
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<tr>
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</tbody>
</table>

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

Example: MUSICA version 0 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 spin up 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/cesmda/cseg/inputdata/atm/cam/met/nudging/MERRA2_ne0CONUS30x8_L32"
  Nudge_File_Template="%y/MERRA2_ne0CONUS30x8_L32.cam2.1.%y-%m-%d-%s.nc"
  Nudge_Force_Opt = 0
  Nudge_TimeScale_Opt= 0
  Nudge_Times_Per_Day= 384
  Model_Times_Per_Day= 384
  ! Nudge_Uprof =2 window nudging
  ! Nudge_Uprof =1 global nudging
  ! Nudge_Vprof =2 6hour nudging
  ! Nudge_Vprof =1 50hour nudging
  ! Nudge_Tprof =1
  ! Nudge_Tprof =2
  Nudge_Beg_Year =2013 adjust when you want to start (nudging will not happen outside the defined begin and end times)
  Nudge_Beg_Month=1
  Nudge_End_Year =2020
  Nudge_End_Month=12
  Nudge_Beg_Day =1
  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_p0 =264.
  Nudge_Hwin_pWidth=94.
  Nudge_Hwin_pDelta=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.