Tools to regrid emissions for MUSICA-V0
Emissions for CAM-chem-SE-RR(conus)

CESM will interpolate input emissions files to the model grid, but this does not conserve mass.

Emissions files (anthropogenic, fires, ocean, etc.) must be conservatively regridded ahead of time.

{hopefully in the not-too-distant future CESM will include conservative regridding and this step will be obsolete}

NO emissions: FV 0.9° x 1.25°

NO emissions: SE-RR ~14km
Original emissions files

Some possible emissions inventories are listed at:

https://wiki.ucar.edu/display/MUSICA/Available+Input+Datasets
https://wiki.ucar.edu/display/camchem/Emission+Inventories

- Start with a grid finer than the model grid, if possible
- CAMS anthropogenic emissions are provided at 0.1° x 0.1°
- CMIP6 original files are at 0.5°
- FINN fire emissions are at 1km x 1km resolution
- QFED original files are available at 0.1° and 0.25°, but our current script regrids 0.9°x 1.25° files that are already in MOZART species created with FINN emission factors
- NEI (US EPA) emissions are at 4 km or point sources
- In addition to regridding, additional transformations are needed to create CESM/MOZART species (CAMS, CMIP6)
Separate programs are available for each inventory

- Programs are available on github:
  https://github.com/NCAR/IPT/ -> Emissions

- More explanation is provided on the MUSICA wiki page:
  https://wiki.ucar.edu/display/MUSICA/Regridding+emissions
NCL routines to regrid regular lat-lon grids

• Earth System Modeling Framework (ESMF) regridding functions are used in NCL: https://www.ncl.ucar.edu/Applications/ESMF.shtml

• Separate routines for CAMS, CMIP6, QFED because input files are different (e.g., multiple sectors as separate variables or another dimension in emissions array)

• All use generally same procedure: calculate weights to map original grid to new grid, then conservatively regrid emissions
CAMS anthropogenic emissions

https://wiki.ucar.edu/display/MUSICA/Regridding+emissions

Original 0.1° resolution files for 2000-2019 are on cheyenne in: /glade/p/acom/acom-climate/tilmes/emis/download/

Scripts: https://github.com/NCAR/IPT/tree/master/Emissions/CAMS_Anthropogenic

**Step 1**: Regrid original files to new grid with ncl. This processes all files in srcPath and keeps original CAMS species.

Regrid_fv2se_cams_anthro.ncl

Edit ncl program for paths, resolution, etc.

**Step 2**: Transform species to CESM compounds, convert emissions to molecules/cm2/s, create aerosol number files, SOA precursors, etc.

rename_cams_anthro_se.ncl

Edit file for paths, resolution, etc.

Run on casper

>execdav --mem 50G
>ncl Regrid_fv2se_cams_anthro.ncl
>ncl rename_cams_anthro_se.ncl
Fortran programs for special cases

FINN emissions
• Provided as text files with emissions for each fire
• Instructions on MUSICA wiki: https://wiki.ucar.edu/display/MUSICA/Grid+FINN
• FINN regridding program and readme: https://github.com/NCAR/IPT/tree/master/Emissions/Fire/FINN

EPA/NEI (U.S. Anthro) emissions
• Combination of grids and point sources
• Fortran program (written by Stacy Walters) combines all types, applies vertical distribution for power plant sources, ...
Verify results

Before running model with new emissions, it is highly recommended to:

• Calculate totals
• Plot maps