Biogenic Emission Options (MEGAN)

Biogenic emissions in CAM-Chem are calculated online based on v2.1 of the Model of Emissions of Gases and Aerosols from Nature (MEGAN) framework (Guenther et al. 2012) as described in Emmons et al. 2010. You can edit the MEGAN emissions factors and mapping of compounds to surrogate species with simple adjustments in the user_nl_cam namelist.

Directions:

- Build your case.
- Copy megan_factors_file, megan_mapped_emisfctrs, megan_specifier from $CASEROOT/CaseDocs/drv_flds_in to user_nl_cam.
  - Update or specify a new emissions file by revising megan_factors_file.
  - megan_mapped_emisfctrs = .false. (Default) uses the MEGAN emission factors specified in the megan_factors_file. megan_mapped_emisfctrs = .true. uses the mapped emission factors from the fsurdat file.
  - Update how MEGAN emissions are mapped to current model surrogate species by revising megan_specifier.

The MEGAN framework requires leaf area index (LAI) and plant functional types as input. In CAM-Chem, monthly LAI can be estimated based on the Community Land Model (CLM) or specified based on a monthly climatology developed from MODIS satellite data (Lawrence and Chase 2007). The crop and plant functional types used in CAM-Chem are from the CLM model and based on satellite data (MODIS and AVHRR) as described in Lawrence and Chase 2007. CAM-Chem can read a single year of plant functional types or simulate land use changes by adding a timeseries file. Some options to help you decide which settings are best to answer your science question are provided below:

Emissions Option 1: Use the monthly climatology of MODIS satellite data for LAI and run with plant functional types that change over time based on landuse changes. This is the current default for FCSD compsets in CESM2.1.0, so no changes are necessary if you are running with this version. The monthly MODIS climatology for LAI uses 16 plant functional types. Crop and and plant landuse changes occur. Wood harvesting and crop planting/harvesting are not simulated. Crops are simulated as more productive natural grasslands with no human management.

Settings:

- In env_run.xml, change CLM_BLDNML_OPTS value to "-bgc sp"
- Build your case.
- Confirm fsurdat in $CASEROOT/CaseDocs/lnd_in is correct (the following should change by default), if not make adjustments in user_nl_clm
  - Crop and plant functional types main file:
    - fsurdat = '/glade/p/cesmdata/cseg/inputdata/lnd/clm2/surfdata_map/surfdata_0.9x1.25_16pfts_Irrig_CMIP6_simyr1850_c170824.nc'
  - Timeseries settings:
    - do_transient_crops = .true.
    - do_transient_pfts = .true.
    - flanduse_timeseries = '/glade/p/cesmdata/cseg/inputdata/lnd/clm2/surfdata_map/landuse.timeseries_0.9x1.25_hist_16pfts_Irrig_CMIP6_simyr1850-2015_c170824.nc'
    - Note: the first time in the timeseries file needs to be identical to the time in the fsurdat file.

Emissions Option 2: Use a specified phenology monthly LAI (climatology of MODIS satellite data), like option 1, but hold your crop and plant functional types constant for a specified year.

Settings:

- In env_run.xml, change CLM_BLDNML_OPTS value to "-bgc sp"
- Build your case.
- Confirm fsurdat in $CASEROOT/CaseDocs/lnd_in is correct, if not make adjustments in user_nl_clm
  - Crop and plant functional types main file:
    - Choose the fsurdat file for your simulation year.
    - For example, for modern simulations use the file for year 2000. fsurdat = '/glade/p/cesmdata/cseg/inputdata/lnd/clm2/surfdata_map/surfdata_0.9x1.25_16pfts_Irrig_CMIP6_simyr2000_c170824.nc'
  - Timeseries settings:
    - Set the flanduse_timeseries file to null. flanduse_timeseries = ''
    - This command tells the model to use the plant functional types specified in the fsurdat file for all years with no changes. If you want to vary landuse change over time in your simulation, you should use option 1 or option 3.

Emissions Option 3: Use the CLM model to simulate monthly LAI and vary landuse over time. Note: the LAI using this method has known biases. This option is good for simulations far into the future with unknown landuse changes. The CLM model simulated LAI uses 78 plant functional types. Human management such as wood harvesting and crop planting/harvesting is simulated.

Settings:

- In env_run.xml, change CLM_BLDNML_OPTS value to "-bgc bgc -crop"
- Build your case.
- Confirm fsurdat in $CASEROOT/CaseDocs/lnd_in is correct (the following should change by default), if not make adjustments in user_nl_clm
  - Crop and plant functional types main file:
    - fsurdat = '/glade/p/cesmdata/cseg/inputdata/lnd/clm2/surfdata_map/surfdata_0.9x1.25_78pfts_CMIP6_simyr1850_c170824.nc'

- Timeseries settings:
  - do_harvest = .true.
  - do_transient_crops = .true.
  - do_transient_pfts = .true.
  - flanduse_timeseries = '/glade/p/cesmdata/cseg/inputdata/lnd/clm2/surfdata_map/landuse.timeseries_0.9x1.25_hist_78pfts_CMIP6_simyr1850-2015_c170824.nc'