Documentation for CESM CAM4 with Chemistry (and Prescribed Dynamics); Running an existing component set (on bluefire)

More information on how to run CESM:
http://www.cesm.ucar.edu/models/cesm1.0/cesm/cesm_doc/book1.html

To start, check out the latest version of the model: http://www.cesm.ucar.edu/models/cesm1.0/
Skip this step if you are working on bluefire.

Creating, building and running

Pick One Component Set (see table)
Example: F_SD_CAMCHEM (CAM-Chem, using CAM4, trop-mozart chemistry and GOES5 wind starting January 2008, 1.9x2.5 horizontal resolution, default emissions are POET emissions for 1992-2010)

Compsets	Model (phys)/ radiation	Chemistry	Components / Meteorology
B_2000_TROP_MOZART (BMOZ) F_2000_TROP_MOZART (FMOZ)	CAM4, active CAM4, passive	trop_mozart trop_mozart	All active Prescr. ocn/ice, CLM dry dep
F_SD_CAMCHEM (FSDCHM) F_SD_BAM (FSDBAM)	CAM4, passive	trop_mozart trop_bam	Prescr. ocn/ice, clm dry dep, offline: GEOS5 (56lev)
F_TROP_STRAT_CHEM	CAM4, passive	trop/ strat_mozart	Prescr. ocn/ice, clm dry dep
B_2000_CN_CHEM (B2000CNCHM) B_1850_CN_CHEM (B1850CNCHM) F_1850_CN_CHEM (F1850CNCHM) B_1850-2000_CN_CHEM (B20TRCNCHM)	CAM4, active	super_fast_llnl	MEGAN VOC emis CLM dry dep, land nitrogen cycle

Roadmap for a CAM-Chem model run:

1. Create a new case called <case_name>:
   CESM_ROOT = <release tag> (intern)
   Go to your model directory **CESM_ROOT**, then **cd scripts** and invoke:
   create_newcase -skip_rundb -case $HOME/<case_name> -res f19_f19 -compset <COMPSET> -mach bluefire (change **'bluefire'** to your computer name)
   f19_f19: data ocean (finite volume of the atmosphere)
   f19_g16: active ocean
   A new directory **<case_name>** is created in your **<home_dir>** (below, **<case_dir>** is **<home_dir>/<case_name>**)
2. Make changes to defaults (see description below)
   - edit/create file **user_nl_cam** in **<case_dir>** to modify paths to emissions, output variables, etc. (see below)

- edit **env_conf.xml** to change run type (startup, branch), start date, etc. (RUN_STARTDATE), change your user_nl_cam accordingly

3. Configure the case, in **<case_dir>**: **configure –case**
4. Build the model: **./*.build** file
5. Run (the default is a test run -- 5 days, no restart): **bsub < ./*.run** (or ./*.submit)

- model output is in **<run_dir>: /ptmp/<username>/<case_name>/run**
- namelist that was used for run in **<run_dir>/atm_in**

Modification of the run (no changes to the model configuration):

1. edit **env_run.xml** to change run specifications, run time, output, restart etc., for example
2. open ***.run** to change run specific parameters (length per segment, etc)
3. after these changes you can just resubmit the run

Some additional useful information:
CONTINUE_RUN: needs to be set to TRUE to continue a run for several time segments
RESUBMIT: set value to the number of segments you want to run (value counts down during the simulatio
REST_OPTION: will write out restart files in the frequency chosen (e.g., nmonths every months)
REST_N: frequency of restart file output, 0: no restart file
DOUT_L_MS: archiving to mss is not a default and needs to be set

Archiving:
–short-term archiving in /ptmp/<username>/archive
–long-term archiving on the mass store

Modification of the namelist:
(nl definitions**:** http://www.cesm.ucar.edu/cgi-bin/eaton/namelist/nldef2html-pub)

1. cp **user_nl_cam** to your <case_dir>,
2. edit **user_nl_cam** in your <case_dir> to change your namelist, for example, emissions, met fields, model output etc.

add aircraft of satellite obs. track option:

```
&satellite_options_nl
  sathist_fincl   =  species
  sathist_hfilename_spec   = '%c.cam2.aircraft.%y-%m-%d-%s.nc'
  sathist_track_infile          = '<aircraft track file location>'
```

Note if you want to change to different vertical/horizontal levels you have to configure a new case and start at point 1 of the roadmap.

3. invoke **configure –cleannamelist** to unlock env_conf.xml and to create a new namelist
4. invoke **configure –case** in your <case_dir> **(you do not need to rebuild the model)**
5. run the model

Modification of your configuration: env_conf.xml

1. edit **env_conf.xml** for example to change the **start date** of your model run or add **new chemical mechanism (see below)**
2. invoke **configure –cleanall** and **configure –case** to produce a new configuration

More information:
http://www.cesm.ucar.edu/models/cesm1.0/cesm/cesm_doc/a3863.html

Modification of before building the model: env_build xml

1. modify env_build.xml (for example to be able to use GREGORIAN calendar option: set USE_ESMF_LIB to TRUE
2. invoke *.clean_build
3. build your model again: invoke *.build

Modification of the chemistry mechanism

1. copy an input file in $CCSMROOT/models/atm/cam/chem_proc/input to your directory and name it **my_mozart_mech.in**
2. edit **my_mozart_mech.in**
3. edit **env_conf.xml** and change:
   <entry id="CAM_CONFIG_OPTS" value="-phys cam4 -chem trop_mozart –nlev 56 –offline_dyn" />
   to
   <entry id="CAM_CONFIG_OPTS" value="-phys cam4 -chem trop_mozart –nlev 56 –offline_dyn -usr_mech_infile my_mozart_mech.in" />
4. if needed, modify source code (for example for wet-dep or dry-dep) and place in appropriate subdirectory of **<case_dir>/SourceMods/**:
   - files originally in /models/atm/cam/src/chemistry/mozart/ go in **<case_dir>/SourceMods/src.cam/**
   - files originally in models/drv/shr/ (e.g., seq_drydep_mod.F90) go in **<case_dir>/SourceMods/src.share/**
5. change namelist to add new dry dep species
   - add variables to **drydep_list**, under **&drydep_inparm** group
   - wet dep species are listed in the mechanism file
6. invoke **configure –cleanall** and **configure –case** to produce a new configuration
7. if you have trouble configuring (e.g., errors in your mechanism file), edit the **configure** script, commenting out the line: rm -rf $CASEBUILD (line 213). This allows you to track down how far the pre-processor got, etc.

Available Deposition Schemes:

Dry Deposition:
namelist options in drv_flds_in (drydep_inparm):
drydep_list = list of species
drydep_method =
'table' (prescribed method in CAM)
'xactive_atm' (interactive method in CAM)
'xactive_lnd' (interactive method in CLM)

Wet Depostion (wash out):
namelist options in atm_in (wetdep_inparm)
gas_wetdep_list = list of species
gas_wetdep_method =
'NEU' (J Neu's scheme)
'MOZ' (MOZART scheme)

Available Chemistry Mechanisms:
MOZART4 Chemistry: trop_mozart (103 species) including HCN,CH_3CH + C_2H_2, HCOOH
MOZART4 trop-start mozart (122 species) including stratospheric heterogeneous reactions

Available Emissions for the past:
Surface Emissions:
Default for offline model runs:
–Anthropogenic: POET, with REAS over Asia (time-varying for 1997-2010; 1997 used for 1992-1996).
–Biomass burning: GFED-v2 - 1992-1996: avg of 1999-2007; 1997-2008: for each year/month; 2009-201(
FINN.
–Biogenic, soil, ocean, volcano: POET, GEIA, etc. as described in Emmons et al., 2010.

Available Emissions for the future:
Surface Emissions for RCP4.5 scenario

Improved Climatology for the Stratosphere based on IPCC model runs based on WACCM
(O_3, NOy, CH_4, CO)

Time dependent 3D chemistry sources aircraft emissions

Available Meteorological Datasets: (ESG)

GEOS5: 1.9x2.5, 0.5x0.6 2004-present
MERRA: 1.9x2.5 0.5x06, 1979-present