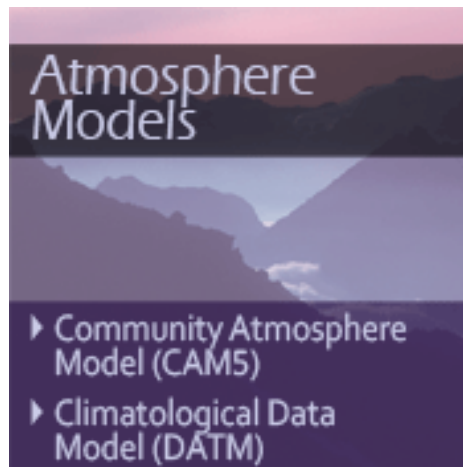
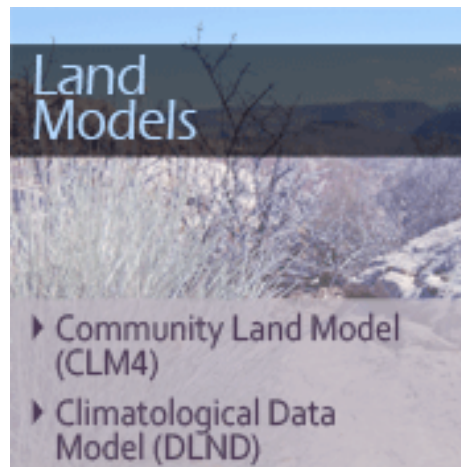


# CESM Community Earth System Model



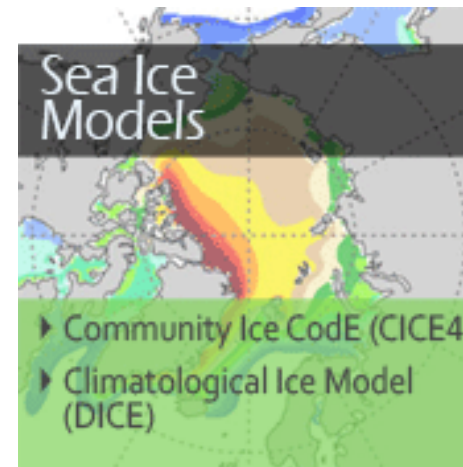
## Atmosphere Models

- ▶ Community Atmosphere Model (CAM5)
- ▶ Climatological Data Model (DATM)



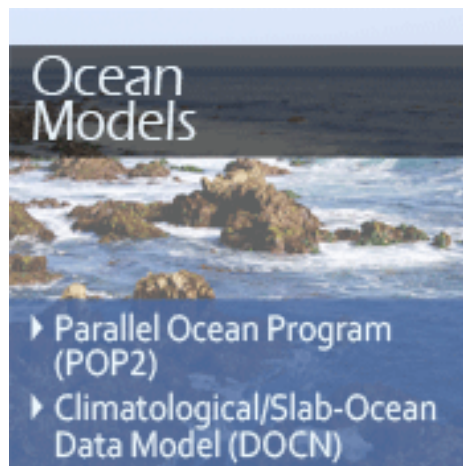
## Land Models

- ▶ Community Land Model (CLM4)
- ▶ Climatological Data Model (DLND)



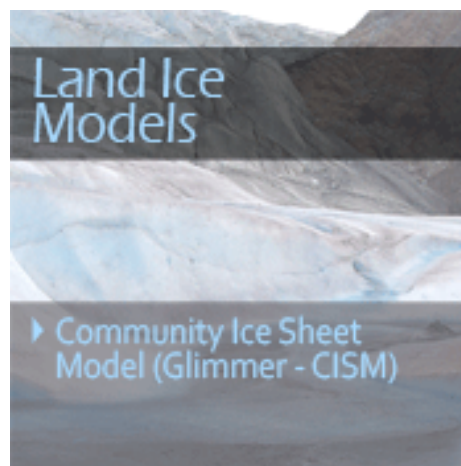
## Sea Ice Models

- ▶ Community Ice Code (CICE4)
- ▶ Climatological Ice Model (DICE)



## Ocean Models

- ▶ Parallel Ocean Program (POP2)
- ▶ Climatological/Slab-Ocean Data Model (DOCN)



## Land Ice Models

- ▶ Community Ice Sheet Model (Glimmer - CISM)



## CESM Coupler

- ▶ CESM Coupler (CPL7)

<b>MODEL</b>	<b>Meteorological Fields</b>	<b>Tracer Advection</b>	<b>Aerosol Scheme</b>	<b>Chemistry</b>
<p><b>CAM4</b> fully coupled to ocean, land, ice model</p> <p><b>CAM SD</b> (specified dynamics)</p>	<p><b>Fully-interactive</b>, i.e., dynamics consistent with model derived : O<sub>3</sub>, CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, H<sub>2</sub>O, CFC-11, CFC-12, O<sub>2</sub>, NO</p> <p><b>Nudged by Meteorological Fields</b></p>	<p><b>Flux Form Finite Volume</b> (Lin, 2004)</p> <p><b>Resolution</b> <b>Horizontal:</b> 1.9° x 2.5 0.9° x 1.25°</p> <p><b>Spectral Element Core</b></p>	<p><b>Aerosol bulk model</b> Simulates aerosol heating</p> <p><b>Modal Aerosol Model</b></p>	<p><b>Tropospheric Chemistry</b> 103 species</p> <p><b>Stratospheric Chemistry</b> additional 20 species</p> <p><b>Or prescribed chemistry</b></p>

# Running CAMchem

- Available Component Sets
- Setup of the Simulation
- Changes to the Simulation

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

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
B_1850_CAM5 (B1850C5) B_1850-2000_CAM5 (B20TRC5) E_1850_CAM5 (E1850C5) F_AMIP_CAM5 (FAMIPC5) F_1850_CAM5 (F1850C5) F_2000_CAM5 (FC5)	CAM5, active	MAM	

# Chemistry/ Datasets

## **MOZART4 Chemistry: trop\_mozart (103 species)**

Including HCN, CH<sub>3</sub>CH + C<sub>2</sub>H<sub>2</sub>, HCOOH

## **Strat\_mozart Chemistry: trop\_mozart + about 20 more species and reactions in the stratosphere**

Including heterogeneous reactions

## **Emissions in trop\_mozart for the past (Louisa Emmons)**

- 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; 2009-2010: FINN.
- Biogenic, soil, ocean, volcano: POET, GEIA, etc. as described in Emmons et al., 2010.

## **Emissions in trop\_mozart for RCP 4.5 scenario (Maria Val Martin)**

## **MEGAN VOC emissions**



# Chemistry/ Datasets

**Improved Climatology for the Stratosphere ( $O_3$ ,  $NO_y$ ,  $CH_4$ ,  $CO$ )**  
**Time dependent 3D chemistry sources aircraft emissions**

## **Meteorological Dataset (ESG)**

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

## **Depositions schemes**

gas\_wetdep\_method =

- 'NEU' (J Neu's scheme)
- 'MOZ' (MOZART scheme)



# Setup of a Simulation

Run the model out of the box (using an existing Compset)

- **Create a new case called <case\_name>:**

- **CESM\_ROOT** = (/glade/proj3/cseg/collections/cesm1\_0\_3)

Go to your model directory **CESM\_ROOT**, then **cd scripts** and invoke:

```
create_newcase -case $HOME/<case_name>
```

```
-res f19_f19 (1.9x2.5)
```

```
-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>**)



# Setup of a Simulation

## Modification to the Simulation: in your \$HOME

- env\_conf.xml, env\_build.xml, env\_run.xml, env\_case.xml, env\_mach\_pers.xml
- **\*.run** to change run specific parameters (length per segment, account number)
- Changes to the model scripts: SourceMods

# Setup of a Simulation

## Run the model out of the box (using an existing Compset)

- **Create a new case called <case\_name>:**
  - **CESM\_ROOT** = (/glade/proj3/cseg/collections/)  
Go to your model directory **CESM\_ROOT**, then **cd scripts** and invoke:  
**create\_newcase -case \$HOME/<case\_name>**
    - res f19\_f19 (1.9x2.5)**
    - compset \$COMPSET**
    - mach bluefire** (change 'bluefire' to your computer name)
    - skip\_rundb**

**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>)
- **Configure the case, in <case\_dir>: configure -case**
- **Build the model: ./\*.build file**
- **Run the model: bsub < ./\*.run (or ./\*.submit) for bluefire**
  - model output is in <run\_dir>: /ptmp/<username>/<case\_name>/run
  - namelist that was used for run in <run\_dir>/atm\_in
- **Archiving:**
  - short-term archiving in /ptmp/<username>/archive
  - long-term archiving on the mass store



# Setup of a Simulation

Information of my simulation (don't change those):

- `<case_dir>/CaseStatus` model setup and history of simulations
- `<case_dir>/CaseDocs/atm_in` namelist for atmospheric components

# Setup of a Simulation

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

- **\*.run** to change run specific parameters (length per segment, account number)
- **env\_run.xml**: change run specifications, run time, output, restart etc.,
  - CONTINUE\_RUN: needs to be set to TRUE to continue a run
  - RESUBMIT: set value to the number of segments you want to run  
(value counts down during the simulation)
  - REST\_OPTION: will write out restart files in the frequency chosen
  - 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
- **after these changes you can just resubmit the run**

# Changes to the Simulation

Modification to the namelist (f.ex. model output, emission, met field)  
(<http://www.cesm.ucar.edu/cgi-bin/eaton/namelist/nldef2html-pub>)

- open empty **user\_nl\_cam** in your <case\_dir> ,
- edit **user\_nl\_cam** in your <case\_dir> from atm\_in file
  - fincl ...
  - ncddata: initial condition file
  - met\_data\_file, met\_data\_path (meteorology)
  - bnd\_topo (boundary conditions for offline model runs)
  - srf\_emis\_specifier (emissions)
  - srf\_emis\_type = 'CYCLICAL' ; srf\_emis\_cycle\_yr = 2000
  - for SERIAL 'srf\_emis\_cycle\_yr' this is not allowed
  - srf\_emis\_type = 'FIXED'; srf\_emis\_fixed\_yrmd = 20000101
  - nudging
- &satellite\_options\_nl: sathist\_fincl, sathist\_hfilename\_spec, sathist\_track\_infile
- **configure -cleannamelist** to unlock env\_conf.xml
- **configure -case** in your <case\_dir> (**you do not need to rebuild the model**)
- **run the model**



# Changes to the Simulation

## Modification of your output in the namelist

The default history file from CAM is a monthly average.

**nhtrfq**: change the output frequency

If **nhtrfq=0**, the file will be a monthly average

If **nhtrfq>0**, frequency is input as number of timesteps.

If **nhtrfq<0**, frequency is input as number of hours.

**mfilt**: change timestep in the history file

**mfilt = 1** one time sample on each history file (monthly averages)

**avgflag\_pertape = 'A','I'** average or instantaneous output

**fincl1-6**: customize your CAM history files:

*The file “h0” contains the default variables (in the code: “call add\_default”).*

*This includes the variables necessary for the AMWG package.*

*For the files “h1” to “h5”, the user has to specify the variables to output.*



# Changes to the Simulation

## Modification to your configuration: env\_conf.xml

- edit **env\_conf.xml** in your <case\_dir>
  - RUN\_STARTDATE: change start date of the simulation (including possible changes to the namelist)
  - CAM\_CONFIG\_OPTS:
    - change vertical levels (-offline\_dyn -lev nn)
    - modify chemical mechanism (-usr\_mech\_infile)
- **configure --cleanall** to unlock env\_conf.xml
- **configure --case** in your <case\_dir>
- **rebuild the model**
- **run the model**

# Changes to the Simulation

## Modification of your calendar option: GREGORIAN/ NO\_LEAP

- edit **env\_run.xml**
  - change CALENDAR value = “NO\_LEAP” to “GREGORIAN”  
default for SD model runs is “GREGORIAN”, else it is “NO\_LEAP”
- edit **env\_build.xml** in your <case\_dir>
  - calendar option: set USE\_ESMF\_LIB to TRUE
  - invoke \*.clean\_build
  - build your model again: invoke \*.build

# Latest Developments

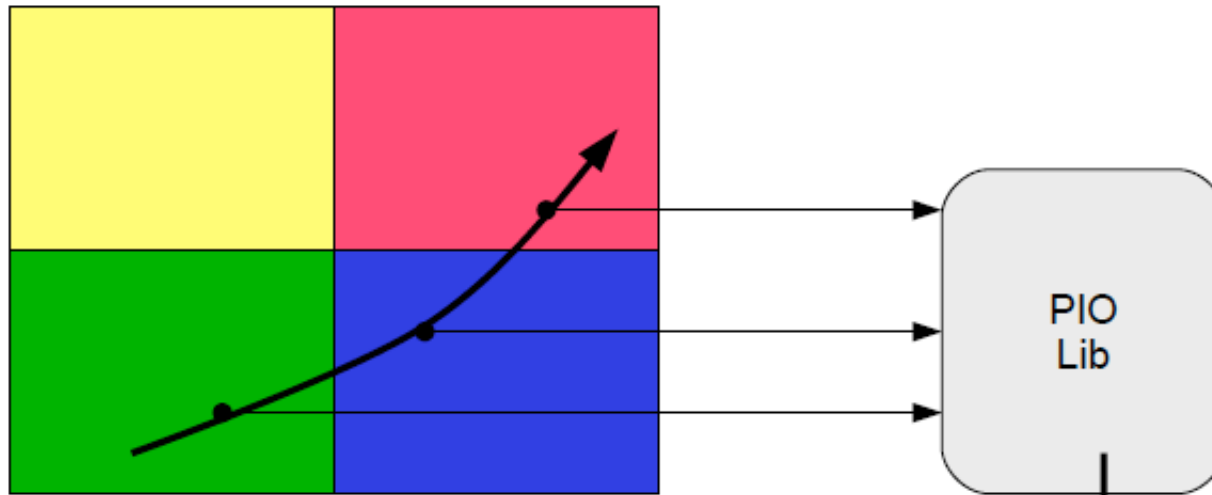
- **History sampling along observation tracks**
  - Satellite track (more than one dataset can be included)
  - Aircraft flight path
- **Local time averaging history output (C. Bardeen)**

# History sampling along observation tracks

Tracking file determines sequence of coordinates and time

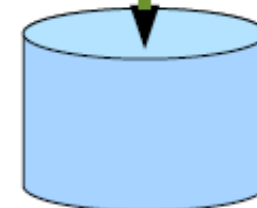
- Uses nearest model time: maximum deviation from observation time is +/- half the time step of the current model time
- Uses nearest lon/lat model coordinate to the observed values

Horizontal grid distributed across MPI tasks



Output individual columns along the flight path

Stream columns to Netcdf file



The corresponding model columns along the flight path are extracted and output in the same sequence as the input tracking file

# Local Time Averaging

Namelist settings:

avgflag\_pertape = 'A','L'

fincl2 = 'Q','T','PS'

lcltod\_start = 0,0

lcltod\_stop = 0,7200

