Art of Climate Modeling
Community Land Model (CLM) Tutorial

"Assessing the Climatic Effects of Global Deforestation"

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1. Introduction to the CLM

   a. What the CLM does in less than 100 words (CLMtutorial.pdf slides 4-7):
      Given radiation fluxes and temperature, humidity, wind, pressure, CO_2 and precipitation (from data or atm model), plus surface, vegetation, and soil information (from data or veg model), the CLM calculates sensible, latent, and ground heat fluxes, reflected and emitted radiation fluxes, soil, snow, and plant temperature and moisture, runoff and river flow, volatile organic compound emissions, and CO_2 fluxes. The coupler passes much of this information to the atm model and passes river flow to the ocean model. In this way, the CLM is a source of climate system feedbacks.

   b. CLM documentation: http://www.ccsm.ucar.edu/models/ccsm3.0/clm3

   c. The CLM in the CCSM:
      $CCSMROOT/models/lnd/clm2/src
      Exercise: In bluesky window, cd to the CLM code

   d. Find specific code in the CLM:
      grep -i 'character string' */*
      Exercise: - Find how the atmospheric concentration of CO_2 is defined in CLM
      - Why does CLM need the CO_2 concentration?

   e. Make code changes to the CLM here:
      /home/bluesky/<logname>/ccsm3/scripts/$CASE/SourceMods/src.clm
      Typically you will change code in a new case that you will run & compare to a control
      Exercise: Discuss code modifications for changing the CO_2 concentration.
      NB: In CCSM4, the coupler will pass CO_2 between components!

   f. CLM's input files:
      Exercise:
      - cd /home/bluesky/<logname>/ccsm3/scripts/$CASE/Buildnml_Prestage
      - vi clm.buildnml_prestage.csh to see a list of files that CLM may need in order to run
      - in tempest window cd /fis/cgd/cseg/csm/inputdata/lnd/clm2/srfdata/csm
      - ncview surface-data.096x048_atm.gx3v5_ocn.040209.nc to look at one of these files

   g. CLM output may be found here: /ptmp/<logname>/$CASE/lnd
      (/bsptmp if on tempest →) /ptmp/<logname>/archive/$CASE/lnd
      mss:/<LOGNAME>/csm/$CASE/lnd

      - in this class we will view netcdf files with ncview
      - lnd_latlon.ncl is available in /home/tempest/shields/ACM_2006/nclscripts

2. Global Deforestation

   a. Change code or change input data?
      Exercise:
      - in bluesky window vi clm.buildnml_prestage.csh. Which file would you change?
      - in tempest window cd /fis/cgd/cseg/csm/inputdata/lnd/clm2/rawdata
      - ncview mksrf_pft.nc to look at the file that I recommend changing
      - cd /bsptmp/slevis/b30.mksrfdef/lnd
      - vi deforest.m to see Sam's matlab script that modified mksrf_pft.nc
      - ncview mksrf_pftdef.nc to look at Sam's modified file

   b. Making a new surface data file:
      Exercise:
      - in bluesky window vi clm.buildnml_prestage.csh
      - change fsurdat='surface-data…nc' to fsurdat=''. Why?
      - change mksrf_pft.nc to mksrf_pftdef.nc twice in this file. Why?
      - change hist_nhtfrq to -24 and hist_mfilt to 1. Why?
      - build the code and submit a run with llsubmit b30.mksrfdef.bluesky.run
      NB: In CCSM4, you will use an offline tool to make new surface data files

   c. Look at the new surface data file:
      Exercise:
      - once running, the model should take 5-10 min to create the new surface data file
      - in tempest window cd /bsptmp/<logname>/$CASE/lnd
      - ncview surface-data.096x048.nc to look at the new surface data file

   d. Look at the output:
      Exercise:
      - cd /bsptmp/<logname>/archive/$CASE/lnd
      - ncview b30.mksrfdef.clm2.h0.0001-01-05.nc
      - in separate tempest window cd to output location of the control run
            /bsptmp/slevis/archive/b30.btst/lnd
      - ncview b30.btst.clm2.h0.0001-01-05.nc
      - compare a few variables
      - ncdiff b30.mksrfdef.clm2.h0.0001-01-05.nc b30.btst.clm2.h0.0001-01-05.nc dif5.nc
      - ncview dif5.nc for an easier way to look at differences between the two runs