

NorESM2 CLM memo

CLM spinup, recoupling and diagnostics
CLM-related resources

Yuanchao Fan, 2019-10-15

Directories for CLM spinup and recoupling

- Codebase: featureCESM2.1.0-OsloDevelopment (frequently synchronized to the branch):
 - /cluster/projects/nn2345k/yfan/noresm-dev (for most spinup and recoupling cases)
 - /cluster/projects/nn2345k/yfan/NorESM2/noresm-dev-3c8a5d6 (only for f09 recoupling)
- All simulations on Fram (cases):
 - /cluster/projects/nn2345k/yfan/NorESM2/cases
 - (most cases originally created under /cluster/projects/nn2345k/yfan/noresm-dev/cases/)
- All case archives on Nird:
 - /projects/NS2345K/noresm/cases/

Spinup cases for **f19**

- Accelerated spinup (years 0-300):
I1850CIm50BgcCropCPLHIST_ADspinup_f19_tn14_160619
- Post-accelerated spinup (years 301-2101):
I1850CIm50BgcCropSpinup_cplhist_f19_tn14_160619
- Final spinup restart file copied to:
/cluster/shared/noresm/inputdata/Ind/clm2/initdata/I1850CIm50BgcCropSpinup_cplhist_f19_tn14_160619.clm2.r.2101-01-01-00000.nc
- When entering “Accelerated Spinup” mode, soil carbon pools will be scaled down by a factor ~ 40 , vegetation pools scaled down by ~ 5
- When exiting Accelerated Spinup and entering normal spinup, the carbon pools will be scaled up back to normal levels

Basic settings for “Accelerated spinup”

- In env_run.xml set below:

```
./xmlchange RUN_TYPE="startup",STOP_N=400,STOP_OPTION="nyears",REST_N=50
```

```
./xmlchange CLM_ACCELERATED_SPINUP="on"
```

```
./xmlchange CLM_FORCE_COLDSTART="on"
```

```
./xmlchange DATM_MODE=CPLHIST,DATM_PRESAERO=cplhist,DATM_TOPO=cplhist
```

```
./xmlchange
```

```
DATM_CPLHIST_DIR=/cluster/shared/noresm/inputdata/cplhist/N1850_f09_tn14_20190726_751-850
```

```
./xmlchange DATM_CPLHIST_CASE=N1850_f09_tn14_20190726
```

```
./xmlchange
```

```
DATM_CPLHIST_YR_ALIGN=751,DATM_CPLHIST_YR_START=751,DATM_CPLHIST_YR_END=850
```

- In user_nl_clm set output frequency to every 50 or 100 years <= REST_N

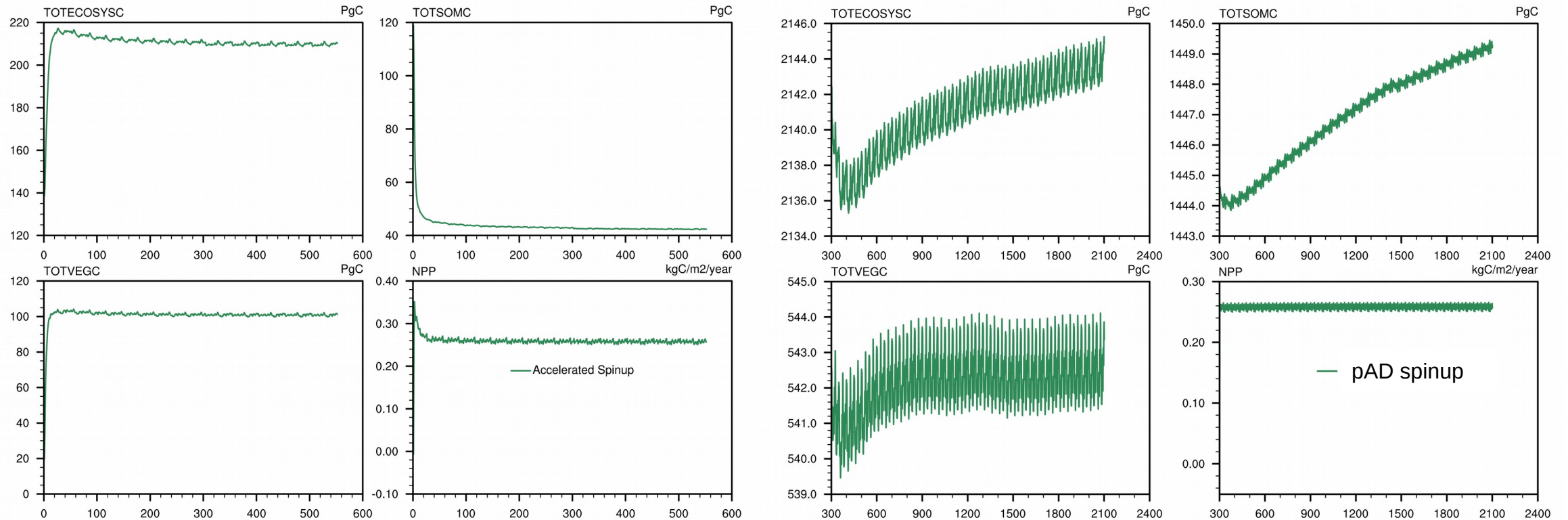
```
hist_mfilt = 50
```

```
hist_nhtfrq = -8760
```

Recoupling cases for **f19**

- Recoupling case 1 (years 1750 to 1850):
N1850_f19_tn14_20190621_finidat2101
(hybrid from Øyvinds case RUN_REFCASE=N1850_f19_tn14_20190621,
RUN_REFDATE=1751-01-01, incorporating CLM final spinup restart in user_nl_clm:
finidat = I1850Clm50BgcCropSpinup_cplhist_f19_tn14_160619.clm2.r.2101-01-01-00000.nc)
Final restart file (nird):
/projects/NS2345K/noresm/cases/N1850_f19_tn14_20190621_finidat2101/rest/1851-01-01-00000
- Recoupling case 2 (years 1600 to 1750): N1850_f19_tn14_1600
(hybrid from Øyvinds case RUN_REFCASE=N1850_f19_tn14_11062019,
RUN_REFDATE=1600-01-01, incorporating CLM final spinup restart in user_nl_clm:
finidat = I1850Clm50BgcCropSpinup_cplhist_f19_tn14_160619.clm2.r.2101-01-01-00000.nc)
Final restart file (nird): /projects/NS2345K/noresm/cases/N1850_f19_tn14_1600/rest/1750-01-01-00000

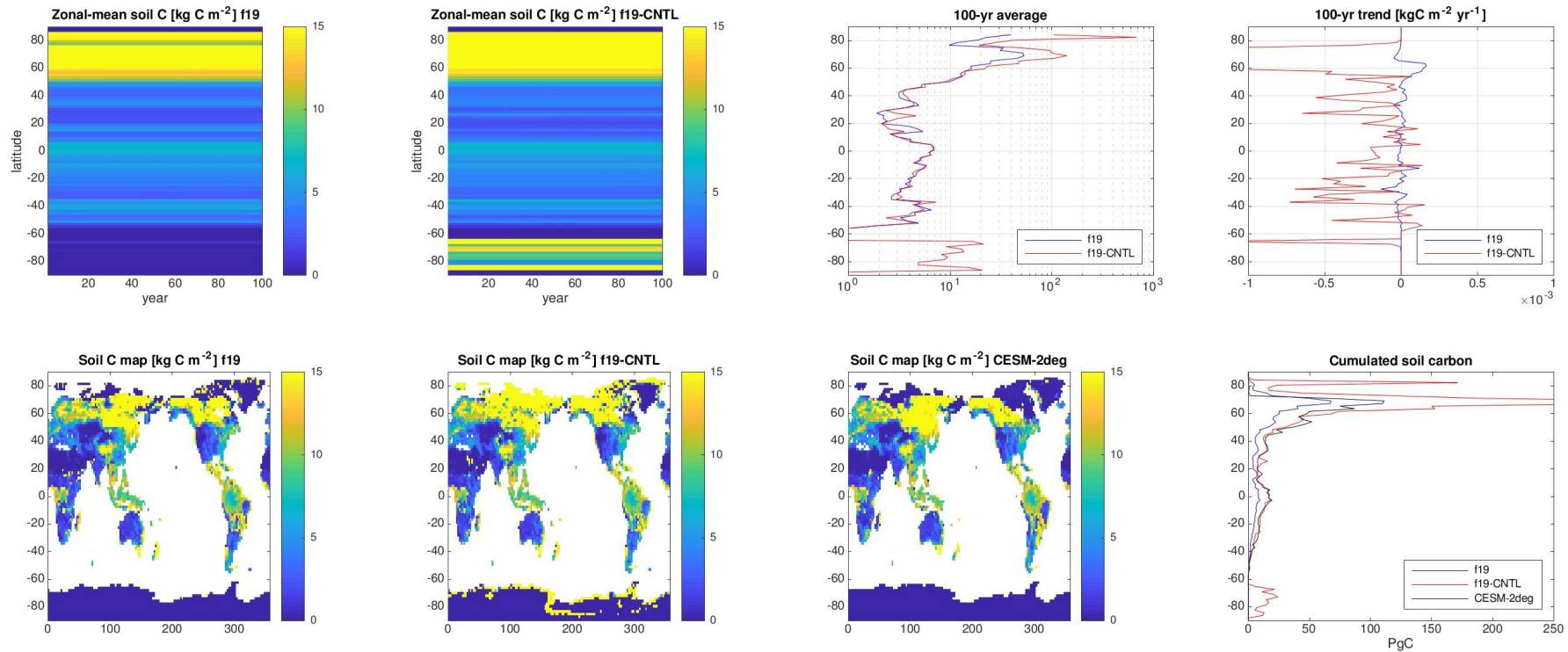
Diagnostics: f19 spinup carbon pools and fluxes



Left: accelerated spinup "I1850CIm50BgCpCropCPLHIST_ADspinup_f19_tn14_160619" of years 0-550 (note: the longer accelerated spinup gives lower soil C pools, thus year 301 was used as restart for post-accelerated spinup)

Right: post-accelerated spinup "I1850CIm50BgCpCropSpinup_cplhist_f19_tn14_160619" of

Diagnostics: f19 spinup



Soil carbon stock and stability comparing 1) CLM offline spinup I1850Clm50BgcCropSpinup_cplhist_f19_tn14_160619 of years 2001-2100 (f19-CPLHIST), 2) coupled N1850OCBDRDDMS_f19_tn14_13052019 of years 1400-1499 (f19-CNTL), 3) the CESM2 f19 piControl "clm50_release-clm5.0.24_2deg_CPLHST_yr480_1850pAD.clm2.h0.1200-12.nc" (CESM-2deg)

Diagnostics: f19 recoupling

- Comparing N1850_f19_tn14_20190621_finidat2101 (Recoupling) and N1850_f19_tn14_20190621 (REF):
http://ns2345k.web.sigma2.no/noresm_diagnostics/N1850_f19_tn14_20190621_finidat2101/
- Time series:
CAM_DIAG/yrs1751to1850-N1850_f19_tn14_20190621-yrs1701to1800/tset1/tset1.htm
- Zonal means:
CAM_DIAG/yrs1751to1850-N1850_f19_tn14_20190621-yrs1701to1800/set3/set3.htm
- Maps (contour plots):
CAM_DIAG/yrs1751to1850-N1850_f19_tn14_20190621-yrs1701to1800/set5_6/set5_6.htm

Spinup cases for **f09**

- Accelerated spinup (years 0-400):

I1850CIm50BgcCropSpinup_cplhist_f09_tn14

- Post-accelerated (pAD) spinup (years 401-1051 or -1751):

I1850CIm50BgcCropSpinup_pAD_cplhist_f09_tn14

- Final spinup restart file:

/cluster/shared/noresm/inputdata/Ind/clm2/initdata/I1850CIm50BgcCropSpinup_pAD_cplhist_f09_tn14.clm2.r.1051-01-01-00000.nc (used by N1850_f09_tn14_20190913)

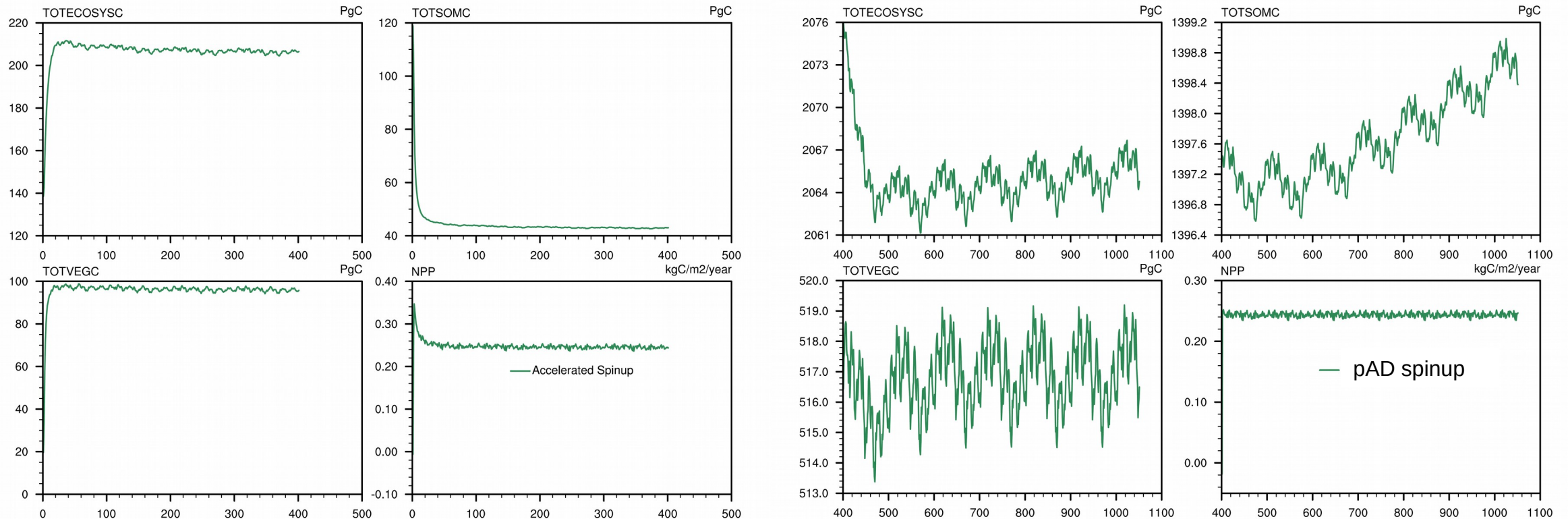
Or a longer spinup until 1751:

/projects/NS2345K/noresm/cases/I1850CIm50BgcCropSpinup_pAD_cplhist_f09_tn14/rest/ 1751-01-01-00000

Recoupling cases for f09

- Recoupling case 1 (years 1051-1100): **N1850_f09_tn14_20190913** (identical to N1850_f09_tn14_20190812_finidat1051);
RUN_REFCASE=N1850_f09_tn14_20190812, RUN_REFDATE=1051-01-01,
incorporating CLM spinup in user_nl_clm: finidat =
I1850CIm50BgcCropSpinup_pAD_cplhist_f09_tn14.clm2.r.1051-01-01-00000.nc
Final restart file (nird): /projects/NS2345K/noresm/cases/N1850_f09_tn14_20190913/rest/
1201-01-01-00000, or
/projects/NS2345K/noresm/cases/N1850_f09_tn14_20190812_finidat1051/rest/1131-01-
01-00000
- Recoupling case 2 (years 1081-1120): N1850_f09_tn14_20190918
RUN_REFCASE=N1850_f09_tn14_20190913, RUN_REFDATE=1081-01-01; using
longer CLM spinup in user_nl_clm: finidat =
I1850CIm50BgcCropSpinup_pAD_cplhist_f09_tn14.clm2.r.1401-01-01-00000.nc
Final restart file (nird): /projects/NS2345K/noresm/cases/N1850_f09_tn14_20190918/rest/
1121-01-01-00000

Diagnostics: f09 spinup carbon pools and fluxes

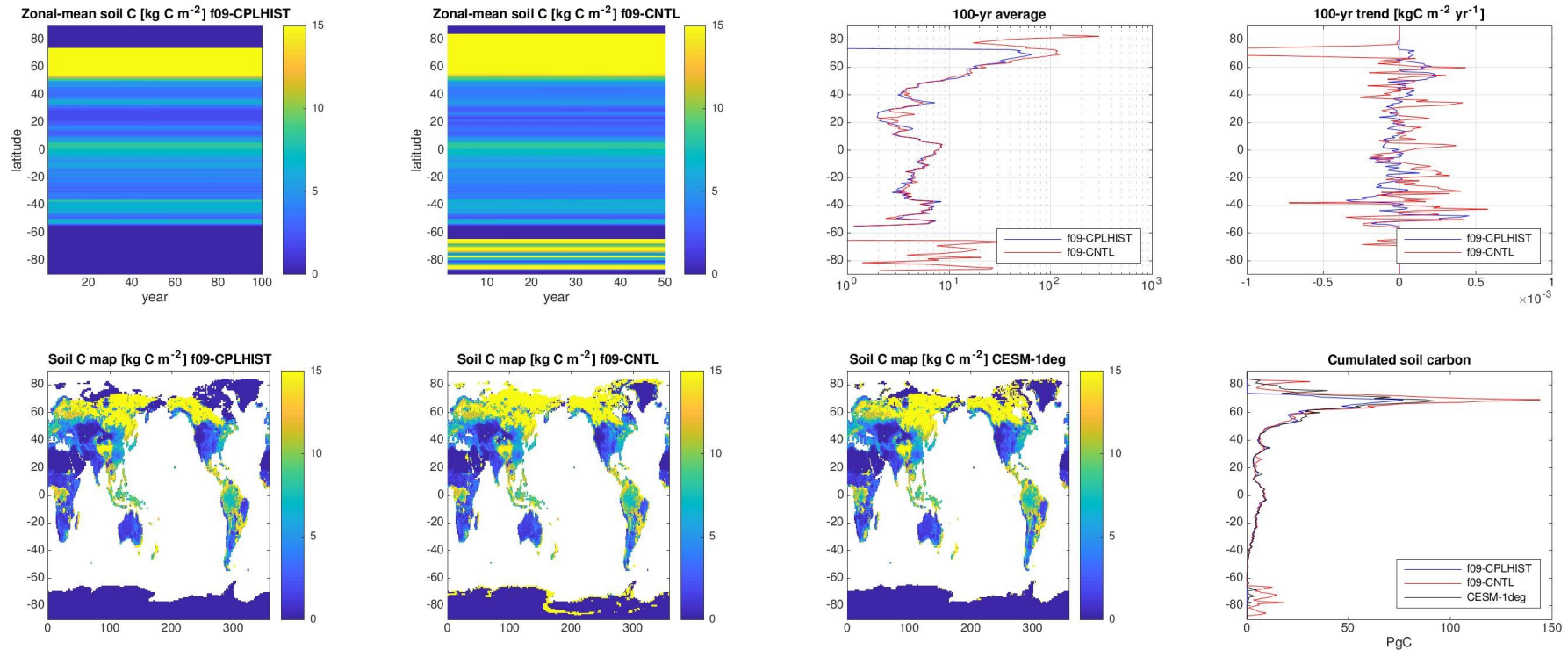


Left: accelerated spinup "I1850CIm50BgcCropSpinup_cplhist_f09_tn14" of years 0-400

Right: post-accelerated spinup

"I1850CIm50BgcCropSpinup_cplhist_f09_tn14" of years 401-1050

Diagnostics: f09 spinup soil carbon



Soil carbon stock and stability comparing 1) CLM offline spinup of years 1301-1400 (f09-CPLHIST), 2) coupled CLM output of N1850_f09_tn14_20190812 of years 1001-1050 (f09-CNTL), 3) CESM2 f09 piControl “b.e21.B1850.f09_g17.CMIP6-piControl.001.clm2.h0.1200-12.nc” (CESM-1deg)

Diagnostics: f09 recoupling

- Comparing N1850_f09_tn14_20190913 (Recoupling) and N1850_f09_tn14_20190812 (REF):
http://ns2345k.web.sigma2.no/noresm_diagnostics/N1850_f09_tn14_20190913/
- Time series:
CAM_DIAG/yrs1051to1080-N1850_f09_tn14_20190812-yrs1051to1080/tset1/tset1.htm
- Zonal means:
CAM_DIAG/yrs1051to1080-N1850_f09_tn14_20190812-yrs1051to1080/set3/set3.htm
- Maps (contour plots):
CAM_DIAG/yrs1051to1080-N1850_f09_tn14_20190812-yrs1051to1080/set5_6/set5_6.htm

Resources of CLM boundary conditions

- Land use time series data for SSP5-8.5, SSP2-4.5 and SSP3-7.0 under
/cluster/shared/noresm/inputdata/Ind/clm2/surfdata_map/

landuse.timeseries_**1.9x2.5_SSP5-8.5**_78pfts_CMIP6_simyr1850-2100_c181204.nc

landuse.timeseries_**0.9x1.25_SSP5-8.5**_78pfts_CMIP6_simyr1850-2100_c181209.nc

landuse.timeseries_**1.9x2.5_SSP2-4.5**_78pfts_CMIP6_simyr1850-2100_c190116.nc

landuse.timeseries_**0.9x1.25_SSP2-4.5**_78pfts_CMIP6_simyr1850-2100_c190102.nc

landuse.timeseries_**0.9x1.25_SSP3-7.0**_78pfts_CMIP6_simyr1850-2100_c181220.nc

NOTE: 0.9x1.25 data are downloaded from NCAR, 1.9x2.5 data are newly created (**1.9x2.5_SSP3-7.0 will be created too**)

- Raw data for creating the above files are downloaded to:
/cluster/shared/noresm/inputdata/Ind/clm2/rawdata
- Most raw data named mksrf_* are shared by all scenarios, except that
pftcftdynharv files are specified for different future scenarios (see next page)
- Mapping files for f19 (1.9x2.5) are created:
/cluster/shared/noresm/inputdata/Ind/clm2/mappingdata/maps/1.9x2.5/

Resources of CLM boundary conditions

- For example, I have created SSP2-4.5 land use time series data for f19 using the mapping files and raw data under ../rawdata/pftcftdynharv.0.25x0.25.SSP2-4.5.simyr2016-2100.c181217 in the namelist input to the tool: mksurfddata_map < namelist-1.9x2.5_SSP2-4.5_78pfts_CMIP6
- I am downloading raw data files pftcftdynharv.0.25x0.25.SSP3-7.0.simyr2016-2100.c181217 from NCAR to /cluster/shared/noresm/inputdata/Ind/clm2/rawdata
- I will create SSP3-7.0 surface boundary condition for f19 (1.9x2.5) using the above raw data and surface data creation tools under \$noresm-dev/components/clm/tools/mkmapgrids ... mkmapdata ... mksurfddata_map
- See detailed steps:
https://escomp.github.io/ctsm-docs/doc/build/html/users_guide/using-clm-tools/creating-surface-datasets.html
- I also prepared a CLM Surface Data Creation Memo (step by step guide). If anyone needs it, please let me know.

Future contact:

Yuanchao Fan, former postdoctoral researcher at NORCE
Klima

Center for the Environment

Department of Earth and Planetary Sciences

Harvard University

Emails: yfansunny@gmail.com | yufa@norceresearch.no
(till 2019.12)

Skype: ycfan1985