Community Dynamics Simulation

Kristina Riemer

3/25/2019

Run model

The Ecosystem Demography (ED2) model was run using the PEcAn VM in Virtualbox. Follow steps 1-5 in section 4.2.1 to get the PEcAn virtual machine installed and running, and open the web interface for PEcAn by going to `localhost:6480/pecan/` in the browser.

Click "Next" button, then specify the following settings on the next page ("Select host, model, site"):

- Host = pecan.vm
- Model = ED2.2 (git)
- Site Group = All Sites
- Site = EBI Energy farm

Select "Next" button and select the following:

- PFTs (use control+click to select multiple)
  1. ebifarm.c3grass
  2. ebifarm.c4crop
  3. ebifarm.forb
- Start Date = 2004/01/01
- End Date = 2009/12/31
- ED2.cohort = ebifarm.lat40.0long-88.0.css
- ED2.patch = ebifarm.lat40lon-88.0.pss
- ED2.site = ebifarm. lat40.0lon88.0.site
- Ed.met_driver_header = ED_MET_DRIVER_HEADER 2004-2009
- Land use = Earth Land Surface
- Soil = FAO_
- Thermal sums = Earth Land Surface
- Vegetation = OGE2

Check "Edit model config" box to be able to edit the configuration file for the model on the next page. The file was changed to match what is below:

```
!-----------------------------------------------------------------------------------------!
! ED2 File output.  For all the variables 0 means no output and 3 means HDF5 output.     !
!                                                                                         !
! IFOUTPUT -- Fast analysis.  These are mostly polygon-level averages, and the time      !
!             interval between files is determined by FRQANL                              !
! IDOUTPUT -- Daily means (one file per day)                                              !
! IMOUTPUT -- Monthly means (one file per month)                                          !
! IQOUTPUT -- Monthly means of the diurnal cycle (one file per month).  The number       !
!             of points for the diurnal cycle is 86400 / FRQANL                           !
! IYOUTPUT -- Annual output.                                                              !
! ITOUTPUT -- Instantaneous fluxes, mostly polygon-level variables, one file per year.   !
! IOOUTPUT -- Observation time output. Equivalent to IFOUTPUT, except only at the         !
!             times specified in OBSTIME_DB.                                              !
! ISOUTPUT -- restart file, for HISTORY runs.  The time interval between files is         !
!             determined by FRQHIS                                                        !
!-----------------------------------------------------------------------------------------!
NL%IFOUTPUT = 0
```

```
NL%IDOUTPUT = 0
NL%IMOUTPUT = 3
NL%IQOUTPUT = 0
NL%IYOUTPUT = 0
NL%ITOUTPUT = 0
NL%IOOUTPUT = 0
NL%ISOUTPUT = 0
!-------------------------------------------------------------------------------------!
```

```
!-------------------------------------------------------------------------------------!
! ATTACH_METADATA -- Flag for attaching metadata to HDF datasets.  Attaching metadata  !
!                    will aid new users in quickly identifying dataset descriptions but !
!                    will compromise I/O performance significantly.                   !
!                    0 = no metadata, 1 = attach metadata                             !
!-------------------------------------------------------------------------------------!
NL%ATTACH_METADATA = 1
!-------------------------------------------------------------------------------------!
```

```
!-------------------------------------------------------------------------------------!
! UNITFAST  --  The following variables control the units for FRQFAST/OUTFAST, and    !
! UNITSTATE     FRQSTATE/OUTSTATE, respectively.  Possible values are:                !
!               0.  Seconds;                                                          !
!               1.  Days;                                                             !
!               2.  Calendar months (variable)                                        !
!               3.  Calendar years  (variable)                                        !
!                                                                                     !
! N.B.: 1. In case OUTFAST/OUTSTATE are set to special flags (-1 or -2)               !
!          UNITFAST/UNITSTATE will be ignored for them.                               !
!       2. In case IQOUTPUT is set to 3, then UNITFAST has to be 0.                   !
!                                                                                     !
!-------------------------------------------------------------------------------------!
NL%UNITFAST = 1
NL%UNITSTATE = 1
!-------------------------------------------------------------------------------------!

!-------------------------------------------------------------------------------------!
! OUTFAST/OUTSTATE -- these control the number of times per file.                     !
!                      0. Each time gets its own file                                 !
!                     -1. One file per day                                            !
!                     -2. One file per month                                          !
!                    > 0. Multiple timepoints can be recorded to a single file reducing !
!                         the number of files and i/o time in post-processing.        !
!                         Multiple timepoints should not be used in the history files !
!                         if you intend to use these for HISTORY runs.                !
!-------------------------------------------------------------------------------------!
NL%OUTFAST = 0
NL%OUTSTATE = 0
!-------------------------------------------------------------------------------------!
```

Visualize results

All the Output files of the format `analysis-E-*-*-00-000000-g01.h5` were downloaded by selecting them from the dropdown menu and selecting the "Show Output File" button.

There is one file per month. The data format for a single month for the variable `MMEAN_LAI_PY` is shown below. Each row is a PFT and each column is a cohort.

```
library(ncdf4)
single_nc <- nc_open("ed2_results/analysis-E-2004-01-00-000000-g01.h5")
single_nc_lai <- ncvar_get(single_nc, "MMEAN_LAI_PY")
single_nc_lai
```

```
##             [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8] [,9] [,10]       [,11]
##  [1,] 0.06157984    0    0    0    0    0    0    0    0     0 0.002042686
##  [2,] 0.03313895    0    0    0    0    0    0    0    0     0 0.000000000
##  [3,] 0.05085608    0    0    0    0    0    0    0    0     0 0.001686965
##  [4,] 0.00000000    0    0    0    0    0    0    0    0     0 0.000000000
##  [5,] 0.00000000    0    0    0    0    0    0    0    0     0 0.000000000
##  [6,] 0.00000000    0    0    0    0    0    0    0    0     0 0.000000000
##  [7,] 0.00000000    0    0    0    0    0    0    0    0     0 0.000000000
##  [8,] 0.00000000    0    0    0    0    0    0    0    0     0 0.000000000
##  [9,] 0.00000000    0    0    0    0    0    0    0    0     0 0.000000000
## [10,] 0.00000000    0    0    0    0    0    0    0    0     0 0.000000000
## [11,] 0.00000000    0    0    0    0    0    0    0    0     0 0.000000000
## [12,] 0.00000000    0    0    0    0    0    0    0    0     0 0.000000000
## [13,] 0.00000000    0    0    0    0    0    0    0    0     0 0.000000000
## [14,] 0.00000000    0    0    0    0    0    0    0    0     0 0.000000000
## [15,] 0.00000000    0    0    0    0    0    0    0    0     0 0.000000000
## [16,] 0.00000000    0    0    0    0    0    0    0    0     0 0.000000000
## [17,] 0.00000000    0    0    0    0    0    0    0    0     0 0.000000000
```

Each monthly LAI dataset is summed across cohort and only the rows for the three PFTs of interest are retained. All the monthly datasets are combined into one.

```
library(dplyr)
library(tibble)

extract_lai <- function(file_path){
  nc <- nc_open(file_path)
  lai <- ncvar_get(nc, "MMEAN_LAI_PY")
  lai_df <- data.frame(lai)
  clean_lai_df <- lai_df %>%
    transmute(LAI = rowMeans(.)) %>%
    slice(1:3) %>%
    add_column(PFT = c("c3grass", "c4crop", "forb"),
               date = substr(file_path, 24, 30)) %>%
    mutate(date = as.Date(paste0(date, "-01")))
}

nc_files <- list.files("ed2_results/", pattern = "*.h5")
nc_file_paths <- paste0("ed2_results/", nc_files)

all_lai <- lapply(nc_file_paths, extract_lai)
all_lai <- do.call(rbind, all_lai)
head(all_lai)
```

```
##           LAI     PFT       date
## 1 0.005783866 c3grass 2004-01-01
## 2 0.003012631  c4crop 2004-01-01
## 3 0.004776640    forb 2004-01-01
```

```
## 4 0.008135376 c3grass 2004-02-01
## 5 0.003429235  c4crop 2004-02-01
## 6 0.007496156    forb 2004-02-01
```

The LAI time series per PFT is plotted.

```
library(ggplot2)

ggplot(all_lai, aes(x = date, y = LAI, color = PFT)) +
  geom_line()
```