Climate data for LTER sites

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Here, I download climate data for each of the LTER sites from Prism and put it in a long format data frame.

First, load required packages

```
library(tidyverse)
library(stringr)
library(prism)
library(raster)
library(magrittr)
library(popler)
```

Fetch Climate Data

Prism has daily, monthly, or annual climate data. Climate measures are tmin, tmax, tmean, and ppt. Here, I've extracted monthly tmean and ppt for from 2000-2005.

```
# First, set a file path where prism data will be stored
# I recommend deleting contents this folder before downloading each new batch of data
options(prism.path = 'C:\\Users\\Shannon\\Documents\\F18 Topics in Ecology\\prism.path')

# Now, select the type and date range
get_prism_monthlys(type = 'tmean', years = 1990:2016, mo = 1:12, keepZip = F)
get_prism_monthlys(type = 'ppt', years = 1990:2016, mo = 1:12, keepZip = F)
```

Process Climate Data

The data is downloaded as a zip folder of raster files. Luckily, R's 'prism' package has some simple functions to compile the files into a format we can work with. Here, I first stack the raster data and then extract coordinates.

```
# Grab the prism data and compile the files
climate_data <- ls_prism_data() %>%
  prism_stack(.)

# Extract project coordinates from raster stack
climate_crs <- climate_data@crs@projargs
```

Fetch & Process LTER Data

Now, make a dataframe of coordinates for each LTER site, put them in the same coordinate reference system (CRS) as the Prism data, and match them

```
# First, pull the metadata for all LTER sites using pplr_browse
lter_sites <- popler::pplr_browse()
```

```r
# Select just the lat/long and site ID (3-letter code for site) columns and make a df
lter_sites <- lter_sites %>%
  dplyr::select(lng_lter,lat_lter, lterid)
lter_sites <- as.data.frame(lter_sites)

# Convert these locations to format that can be matched to Prism climate data
coordinates(lter_sites) <- c('lng_lter', 'lat_lter')
proj4string(lter_sites) <- CRS(climate_crs)
```

Join Climate & LTER data

The Prism climate data comes in pretty nasty shape, so here I wrangle that into a manageable format that I can join with the LTER data.

```r
# Extract the  extracted from the raster stack for those sites
climate_lter <- data.frame(coordinates(lter_sites),
                   lter_sites$lterid,
                   extract(climate_data, lter_sites))

# Reshape data. Col 1:3 are lat, long, and site ID. Col 4:ncol are climate data
# Column headers include date and climate type info
climate_lter <- climate_lter %>%
  gather(date, value, 4:ncol(climate_lter))

# The column header includes the date and data type, but also some other metadata that we don't need
# Here, I remove the extra info from the column header
climate_lter$date <- gsub('PRISM_', '', climate_lter$date) %>%
  gsub('stable_4kmM3_', '', .) %>%
  gsub('stable_4kmM2_', '', .) %>%
  gsub('_bil', '', .)

# Split header into type (precipitation or temperature), year, and month
climate_lter <- separate(climate_lter, 'date',
                 into = c('type', 'YearMonth'),
                 sep = '_')
climate_lter <- separate(climate_lter, 'YearMonth',
                 into = c('year', 'month'),
                 sep = 4)

# Reshape data-- make a separate column for temperature and precipitation
climate_lter <- unique(climate_lter)
climate_lter <- climate_lter %>%
  spread(type, value) %>%
  rename(lng = lng_lter, lat = lat_lter, lterid = lter_sites.lterid)

# Make year and month numeric variables
climate_lter$year  <- as.numeric(climate_lter$year)

# Order data by LTER site
climate_lter <- climate_lter[order(climate_lter$lterid),]
write.csv(climate_lter, "monthlyclimate_lter.csv")
```

View Data

The final product is a long format dataset with lat/long, LTER site ID code, year and month, precipitation (in mm) and mean temperature (in °C)

```
head(climate_lter)
```

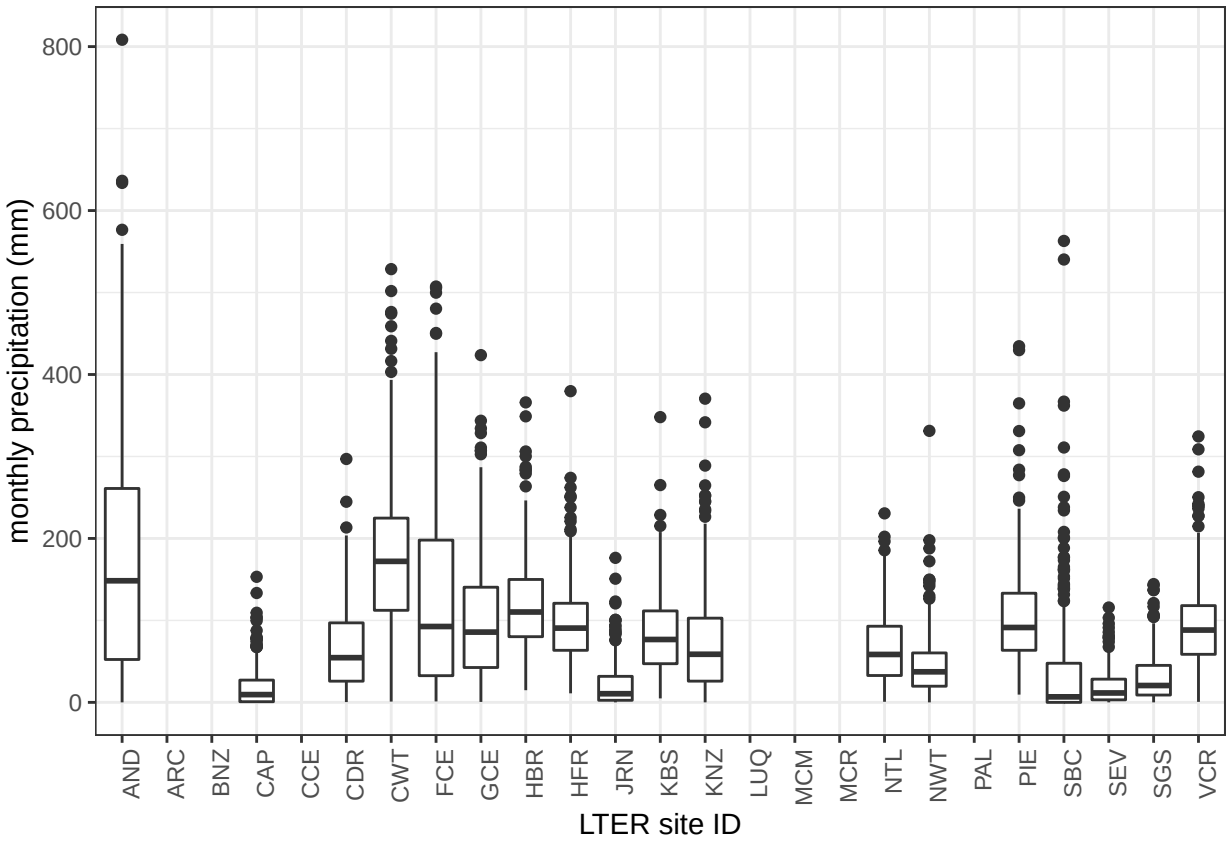
```
##         lng   lat lterid year month    ppt  tmean
## 973 -122.26 44.21    AND 1990    01 476.16  3.370
## 974 -122.26 44.21    AND 1990    02 298.48  1.255
## 975 -122.26 44.21    AND 1990    03 111.90  6.930
## 976 -122.26 44.21    AND 1990    04 232.78 11.530
## 977 -122.26 44.21    AND 1990    05 120.62 11.800
## 978 -122.26 44.21    AND 1990    06  97.38 15.705
```

```
str(climate_lter)
```

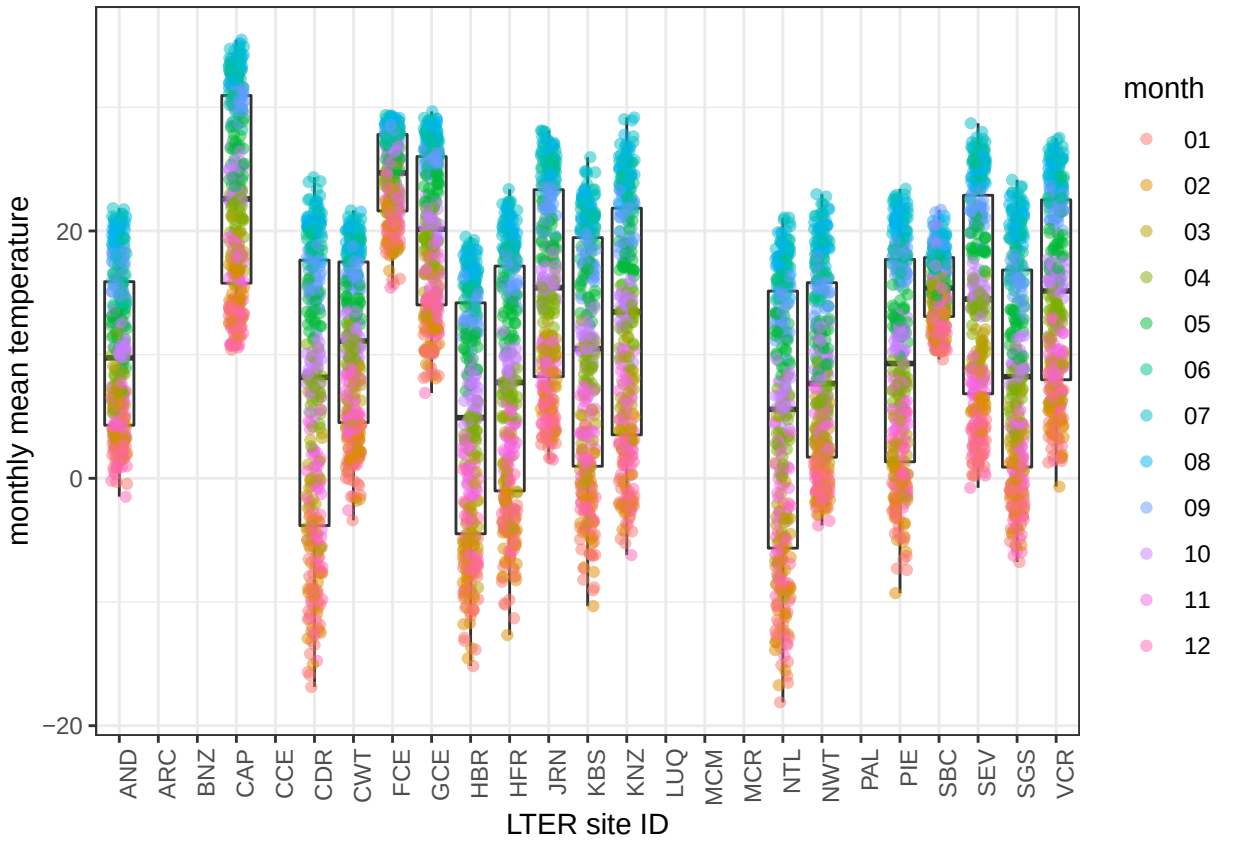
```
## 'data.frame':    8100 obs. of  7 variables:
##  $ lng   : num  -122 -122 -122 -122 -122 ...
##  $ lat   : num  44.2 44.2 44.2 44.2 44.2 ...
##  $ lterid: Factor w/ 25 levels "AND","ARC","BNZ",..: 1 1 1 1 1 1 1 1 1 1 ...
##  $ year  : num  1990 1990 1990 1990 1990 1990 1990 1990 1990 1990 ...
##  $ month : chr  "01" "02" "03" "04" ...
##  $ ppt   : num  476 298 112 233 121 ...
##  $ tmean : num  3.37 1.25 6.93 11.53 11.8 ...
```

Some Plots

First, precipitation: CAP, JRN, and SEV are 3 sites in Arizona/New Mexico, and as expected, they look quite dry. The site with the most rainfall, AND, is in Portland. So looks like the precipitation data worked well. The sites that don't have data are either in Antarctica or oceanic islands. So my next step is to figure out why Prism can't produce that data and find a workaround or alternative data source.



Now, temperature: Here, I colored points by month so we can spot check by seasonal trends as well as sites. It's clear that the blue points that represent summer months are warmer than red/orange points that represent winter months. Good. The hottest sites, CAP and FCE, are in Phoenix and the Florida Everglades.


monthly mean temperature
20
0
−20
AND
ARC
BNZ
CAP
CCE
CDR
CWT
FCE
GCE
HBR
HFR
JRN
KBS
KNZ
LUQ
MCM
MCR
NTL
NWT
PAL
PIE
SBC
SEV
SGS
VCR
LTER site ID
month
01
02
03
04
05
06
07
08
09
10
11
12