Demo: Access Distributed NASA Earth Science Data from OPeNDAP Services from your R Workspace

Access time series of maximum temperature at an AmeriFlux site location

Step 1. Load R package required in this demo

In [20]:
```
library("ncdf4")
library("repr")
library("IRdisplay")
```

Step 2. Define location of interest: Ameriflux site (Sky Oaks Old / US-SO2)

In [21]:
```
mylat = 33.3739
mylon = -116.6229
```

Step 3. Connect to the remote data and retrieve their metadata

Step 3.1. Daymet data

In [22]:
```
daymet_url = "http://thredds.daac.ornl.gov/thredds/dodsC/ornldaac/1219/1990/tmax_199(
daymet_data = nc_open(daymet_url)
daymet_data
```

Out[22]:
```
File http://thredds.daac.ornl.gov/thredds/dodsC/ornldaac/1219/1990/tmax_1990.nc4 (
http://thredds.daac.ornl.gov/thredds/dodsC/ornldaac/1219/1990/tmax_1990.nc4) (NC_F
ORMAT_64BIT):

     6 variables (excluding dimension variables):
        short lambert_conformal_conic[]
            grid_mapping_name: lambert_conformal_conic
            longitude_of_central_meridian: -100
            latitude_of_projection_origin: 42.5
            false_easting: 0
            false_northing: 0
            standard_parallel: 25
             standard_parallel: 60
            longitude_of_prime_meridian: 0
        float time_bnds[nv,time]
            _ChunkSize: 1
             _ChunkSize: 2
        short yearday[time]
            long_name: yearday
            valid_range: 1
             valid_range: 365
            _ChunkSize: 1
        float lat[x,y]
            units: degrees_north
            long_name: latitude coordinate
            standard_name: latitude
            _ChunkSize: 496
             _ChunkSize: 542
        float lon[x,y]
            units: degrees_east
            long_name: longitude coordinate
            standard_name: longitude
            _ChunkSize: 496
             _ChunkSize: 542
        float tmax[x,y,time]
            long_name: daily maximum temperature
            units: degrees C
            missing_value: -9999
            valid_range: -50
             valid_range: 50
            coordinates: lat lon
            grid_mapping: lambert_conformal_conic
            cell_methods: area: mean time: maximum
            _FillValue: -9999
            _ChunkSize: 1
             _ChunkSize: 496
             _ChunkSize: 542

     4 dimensions:
        time  Size:365   *** is unlimited ***
            long_name: time
            calendar: standard
            units: days since 1980-01-01 00:00:00 UTC
            bounds: time_bnds
            _ChunkSize: 1
        nv  Size:2
        x  Size:5268
            units: m
            long_name: x coordinate of projection
            standard_name: projection_x_coordinate
             _ChunkSize: 5268
```

Step 3.2. Climatology data

In [23]:
```
climatology_url = "http://thredds.daac.ornl.gov/thredds/dodsC/ornldaac/542/climate619
climatology_data = nc_open(climatology_url)
climatology_data
```

Out[23]:
```
File http://thredds.daac.ornl.gov/thredds/dodsC/ornldaac/542/climate6190_TMX.nc4 (
http://thredds.daac.ornl.gov/thredds/dodsC/ornldaac/542/climate6190_TMX.nc4) (NC_F
ORMAT_64BIT):

     4 variables (excluding dimension variables):
        short climatology_bounds[nv,time]
        double lat_bnds[nv,lat]
            units: degrees_north
        double lon_bnds[nv,lon]
            units: degrees_east
        short TMX[lon,lat,time]
            _FillValue: -9999
            cell_methods: time: maximum within months time: mean over years
            long_name: Maximum Temperature
            units: degreeC
            valid_range: 0
             valid_range: 1000
            _ChunkSize: 6
             _ChunkSize: 180
             _ChunkSize: 360

     4 dimensions:
        lat  Size:360
            bounds: lat_bnds
            standard_name: latitude
            long_name: latitude
            units: degrees_north
        lon  Size:720
            bounds: lon_bnds
            long_name: longitude
            standard_name: longitude
            units: degrees_east
            valid_range: -180
             valid_range: 180
            _ChunkSize: 720
        nv  Size:2
        time  Size:12
            climatology: climatology_bounds
            long_name: month
            units: months since 1960-01
            valid_range: 1
             valid_range: 12
            standard_name: time
            _ChunkSize: 12

    5 global attributes:
        Conventions: CF-1.0
        history: version 1.0, created on 11/05/2007-10:50
        institution: Oak Ridge National Laboratory Distributed Active Archive Cent
er (ORNL DAAC)
        comment: A dataset of mean monthly surface climate over global land areas,
excluding Antarctica. Interpolated from station data to 0.5 degree lat/lon for a r
ange of variables
        title: CRU05 0.5 Degree 1961-1990 Mean Monthly Climatology (New et al.): M
aximum Temperature
```

Step 4. Find out which grid cell contains the location of your interest

Step 4.1. Daymet data

In [24]:
```
daymet_lats = ncvar_get(daymet_data, "lat")
daymet_lons = ncvar_get(daymet_data, "lon")
daymet_dist = sqrt((daymet_lats - mylat)^2 + (daymet_lons - mylon)^2)
daymet_inds = which(daymet_dist == min(daymet_dist), arr.ind = TRUE)
daymet_x = daymet_inds[,1]
daymet_y = daymet_inds[,2]
sprintf("Daymet: x=%d, y=%d", daymet_x, daymet_y)
```

Out[24]: 'Daymet: x=529, y=2609'

Step 4.2. Climatology data

In [25]:
```
climatology_lats = ncvar_get(climatology_data, "lat")
climatology_lons = ncvar_get(climatology_data, "lon")
climatology_x = which.min(abs(climatology_lons - mylon))
climatology_y = which.min(abs(climatology_lats - mylat))
sprintf("Climatology: x=%d, y=%d", climatology_x, climatology_y)
```

Out[25]: 'Climatology: x=127, y=247'

Step 5. Retrieve data at the location of your interest for the whole year

Step 5.1. Daily Daymet data

In [26]:
```
start = c(daymet_x, daymet_y, 1)
count = c(1, 1, 365)
daymet_tmax = ncvar_get(daymet_data, "tmax", start=start, count=count)
daymet_tmax
```

Out[26]:
```
14  10.5  4.5  6.5  10  11.5  12.5  16.5  21  23.5  21  20  12.5  9.5  6.5  5.5  3  1  5
6  8  11.5  16.5  16  14  15  14.5  14.5  14.5  14  9  6  6.5  8  10  7.5  10  11  9  9.5
14  17.5  18.5  12.5  5  0.5  4  5.5  5  4  9  14.5  16  17.5  20.5  20  19  19  20  21
19.5  18  14.5  10.5  11  15  16.5  16.5  13.5  11  5.5  5.5  8.5  13.5  17  18  21.5  23
24.5  23.5  24.5  25  25  23.5  22  20  11.5  9  14  13  15  15.5  17.5  17.5  14.5  15.5
17  15  16.5  22.5  24.5  25.5  26.5  27  25  20  11.5  12.5  15  19  18  17  15  12  18
22.5  25.5  26  21.5  13  12.5  16.5  20.5  25  27  27.5  28  24.5  22  20.5  12  16.5
21.5  22  18.5  21  24.5  22.5  20.5  17  21  24.5  25  23  22.5  22  20  17.5  13  15.5
17.5  19.5  25  30  33  32.5  30  28  30  30  22  22.5  24  23.5  20.5  19.5  20  25.5
27  30  32.5  33  32  32  34  34.5  36  36  35.5  34.5  33.5  33  32  30  30  30.5  31
31.5  30.5  31  31.5  31.5  32.5  33.5  31  30  28.5  29.5  31.5  32.5  34.5  34  33  32.5
31  30  29  31  31  33  35  33.5  33  31  31  33  35  35  32.5  33  33  33.5  33  32
31  29.5  27.5  26.5  28  29  26.5  25  26.5  28  28.5  26.5  25.5  26  28.5  31  32  32
31.5  32  32.5  32.5  31.5  29  28  30  31.5  32.5  34.5  35  35.5  34  33  31  29  27
25  22  23  23.5  22  23  23.5  25.5  25.5  24  21.5  23  25  25  22.5  26  27  28.5
25.5  23  21.5  23  24  26.5  26.5  26.5  27  26.5  25.5  25  24.5  22  18  19  21.5
25.5  26.5  27.5  28.5  28.5  28  26.5  24  21.5  18.5  12  12.5  15  18.5  17  13  15.5
20  21.5  22.5  23  23.5  24  21.5  21.5  18.5  18  16.5  12  10.5  14  16.5  20  19.5
14.5  7  10.5  12.5  14  16.5  17.5  16.5  14.5  16  18  15.5  16.5  17  18  18  15  10.5
10.5  11  9  5.5  8  8.5  5  -1  -2  -1.5  0  5  7.5  7.5  7  6.5  4  9
```

Step 5.2. Monthly Climatology data

In [27]:
```
start = c(climatology_x, climatology_y, 1)
count = c(1, 1, 12)
climatology_tmax = ncvar_get(climatology_data, "TMX", start=start, count=count)
climatology_tmax
```

Out[27]:
```
14  15  16  18  22  26  30  30  27  23  18  14
```

Step 6. Make a simple plot of the data

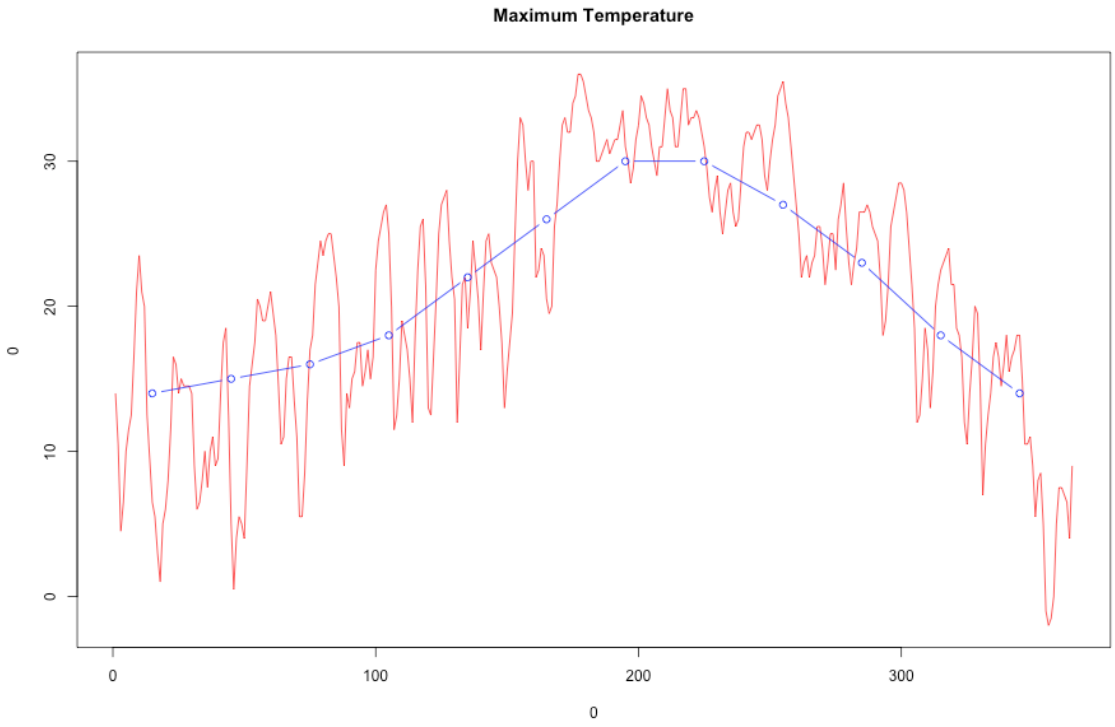
In [28]:
```
daymet_time = seq(1, 365, 1)
climatology_time = seq(15, 350, 30)

tf <- tempfile()
png(tf, width=900, height=600)
plot(0, 0, xlim = c(1,365), ylim = c(min(daymet_tmax), max(daymet_tmax)), type = "n")
lines(daymet_time, daymet_tmax, type="l", col="red")
lines(climatology_time, climatology_tmax, type="b", col="blue")
title("Maximum Temperature")

dev.off()

display_png(file = tf)
```

Out[28]: **pdf:** 2



In [ ]: