rsnodas vignette

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Contents

0.1 Introduction

This rsnodas package allows users to access, clean, visualize, and analyze data from the following sources:

- Snow Data Assimulation System (SNODAS)

- University of Arizona (UA)

- Parameter-elevation Regressions on Independent Slopes Model (PRISM)

- Historical Climatology Network daily (GHCND) which provides access to Snow Telemetry (SNOTEL) stations

SNODAS, UA, and PRISM provide data in the form of gridded rasters for the contiguous United States. Each source can have different spatial resolutions like 800m, 1km, or 4km and multiple temporal scales of daily, monthly, annual, and 30 year normals. GHCND provides in-situ measurements, spatial point data, with different temporal scales. This package focuses on downloading the daily measurements. Please refer to their webpages for more information about each data product.

0.1.1 Installation

rsnodas is available on GitHub and can be installed with devtools:

```
# install.packages("devtools")
library(devtools)
install_github("lschneider93/rsnodas")
```

The outline for understanding rsnodas capabilities is as follows:

1. Download SNODAS

2. Download SNOTEL and PRISM

3. GAM to Raster

    (a) Station Density

4. Ensemble

0.2 Downloading SNODAS

SNODAS provides maps of the following data:

- Snow water equivalent (SWE)

- Snow Depth (SnD)

- Snow melt runoff (SM)

- Sublimation from the Snow Pack (SSP)

- Sublimation of Blowing Snow (SBS)

- Solid and liquid precipitation (PPT)

- Snow pack average temperature (SPTave)

The function `format_date` will create a character vector with each element being a different day in the format YYYY-MM-DD that most functions require. This function can be used inside other functions to allow for mass downloading specific dates of a year. The function `download_snodas_data` is one example in which this function will be applicable

```r
# Download Snodas SWE data for April 1st in 2014 and 2015
snodas_april1 <- download_snodas(dates = format_dates(day = 1,
                                                       month = 4,
                                                       year = 2014:2015),
                                  masked = TRUE,
                                  remove_zip = TRUE,
                                  data_saved = c("swe"),
                                  out_dir = "C:/Users/Logan/Desktop/GitHub/snodas_data",
                                  GTiff = FALSE)

# get the pipe function from magrittr
"%>%" <- magrittr::"%>%"

# Get an shape of utah from the maps package
ut_map <- maps::map("state", plot = FALSE, fill = TRUE) %>%
  sf::st_as_sf() %>%
  dplyr::filter(ID == "utah") %>%
  sf::st_transform(crs = sf::st_crs(snodas_april1$'swe_2014-04-01'))

# Crop the maps to just the state of Utah
snodas_ut_2014 <- sf::st_crop(snodas_april1$'swe_2014-04-01', ut_map)

# Change the name so text file isn't seen when plotting
names(snodas_ut_2014) <- "Value"

# Plot SNODAS April 1st 2015 SWE map of Utah with blue outline
g <- ggplot() +
  stars::geom_stars(data = snodas_ut_2014) +
  geom_sf(data = ut_map, fill = "NA", size = 1, color = "blue") +
  ggtitle("2014 SNODAS SWE predictions") +
  scale_fill_viridis_c(option = "A") +
  theme(plot.title = element_text(hjust = 0.5, size = 24),
        text = element_text(size = 22))
g
```

0.3 Download SNOTEL and PRISM

0.3.1 Downloading SNOTEL site data

The `data-raw` folder contains an script titled `DATASET` that shows how to download the all SNOTEL data by using `download_all_ghcnd_stations`. Note that there is more than 30 gigabytes of data and this will take time to download. The functions `download_all_ghcnd_stations` and `download_all_ghcnd_stations` are for the purpose of sifting through all the data to get the stations in a specific state. These functions were used to create the dataset `april_1_snotel_data`.

```r
# Code to download all stations in your working directory. A file path could
#  have been used instead of ".".
download_all_ghcnd_stations(directory = ".")

# april 1st data for SNOTEL stations in Utah
snotel_ut <- rsnodas::april_1_snotel_data

# subset to just April 1st, 2015.
snotel_ut_2014 <- snotel_ut[snotel_ut$DATE == "2014-04-01", ]
```

0.3.2 Downloading PRISM climate data

The PRISM climate group has been provided maps since 1895 for the following climate elements:

- Precipitation (PPT)

- Minimum and maximum temperature (Tmin and Tmax)

- Minimum and maximum vapor pressure deficit (vpdmin and vpdmax)

- mean dew point (tdmean)

- Elevation (Elev)

- Total global shortwave solar radiation

Most of this data can be downloaded by utilizing the R package, `prism`, and more examples and information is available at \href{https://cran.r-project.org/web/packages/prism/vignettes/prism.html}{this link. The function `download_prism` can be used to download and store PRISM climate data that can be utilized later for model prediction. These are examples of downloading daily, monthly, and yearly data from separate years and multiple types.

0.4 GAM to Raster

After downloading the point data provided by SNOTEL sites and climate variables from PRISM. The process of creating gridded raster estimates will be demonstrated. This uses the function, `gam_to_raster`.

0.4.1 Creating gridded estimates from point data

One functionality is the creation of a grid of predictions using precipitation and elevation. This also allows the user to input a model, that only uses 30-year PRISM normal variables.