HARMONIZE

clim4health: a new R package to harmonize climate datasets for health impact studies

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Barcelona Supercomputing Center
Centro Nacional de Supercomputación

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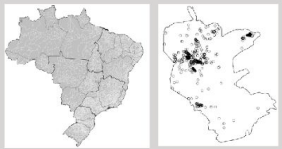
User inputs

What kind of data?
- Health outcome
- Socio-economic and environmental indicators

Spatial scale
- Shape file (administrative level boundaries - country, regions, states, municipalities, etc)
- Coordinates (points)

Temporal scale
- Time step (weekly, monthly, yearly)
- Start/end date



data4health

Incidence rates | Probable infection

socio4health

Census | Household survey

land4health

Satellite images ⇔ Drone images

clim4health

Met station network
Reanalysis
Seasonal forecasts
⇔ Weather and hydrological sensors

Harmonized space-time data for polygons or points

HARMONIZE Users

Observatório de CLIMA e SAÚDE

INFO DENGUE

MINISTERIO DE SALUD Y PROTECCIÓN SOCIAL

PERÚ Ministerio de Salud

GOBIERNO DE LA REPÚBLICA DOMINICANA
SALUD PÚBLICA

HDX

National/regional | Hotspot | ⇕ Downscaling/upscaling algorithms

Example sources of climate data

Seasonal forecasts available from Copernicus:

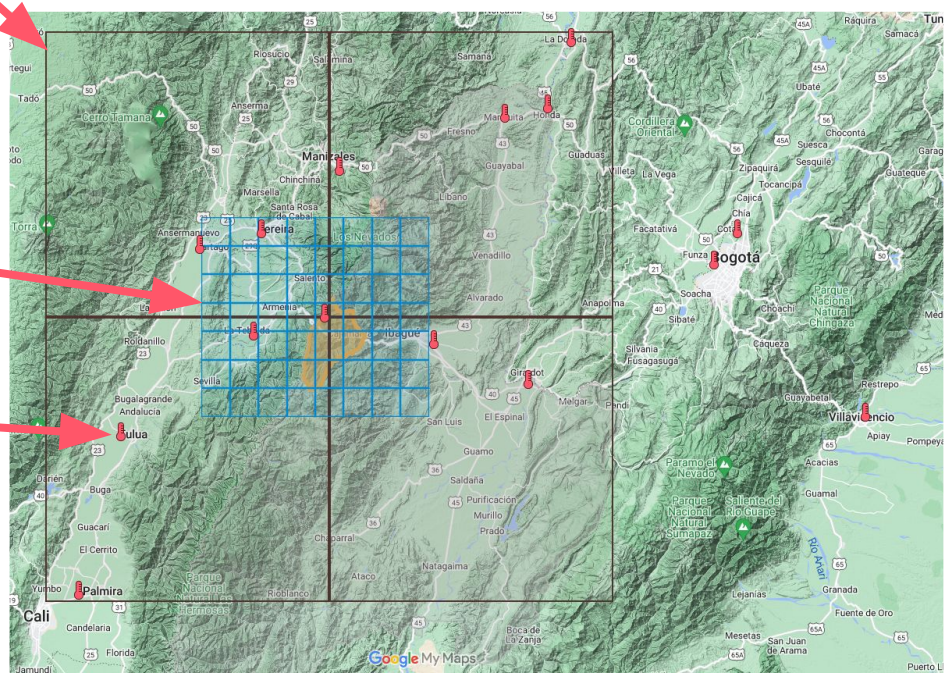
- Spatial resolution: 1° x 1°
- Temporal frequency: 6h, 12h, 24h and monthly statistics
- Hindcast period: 1993-2016
- System: ECMWF-s5

Reanalysis available from Copernicus:

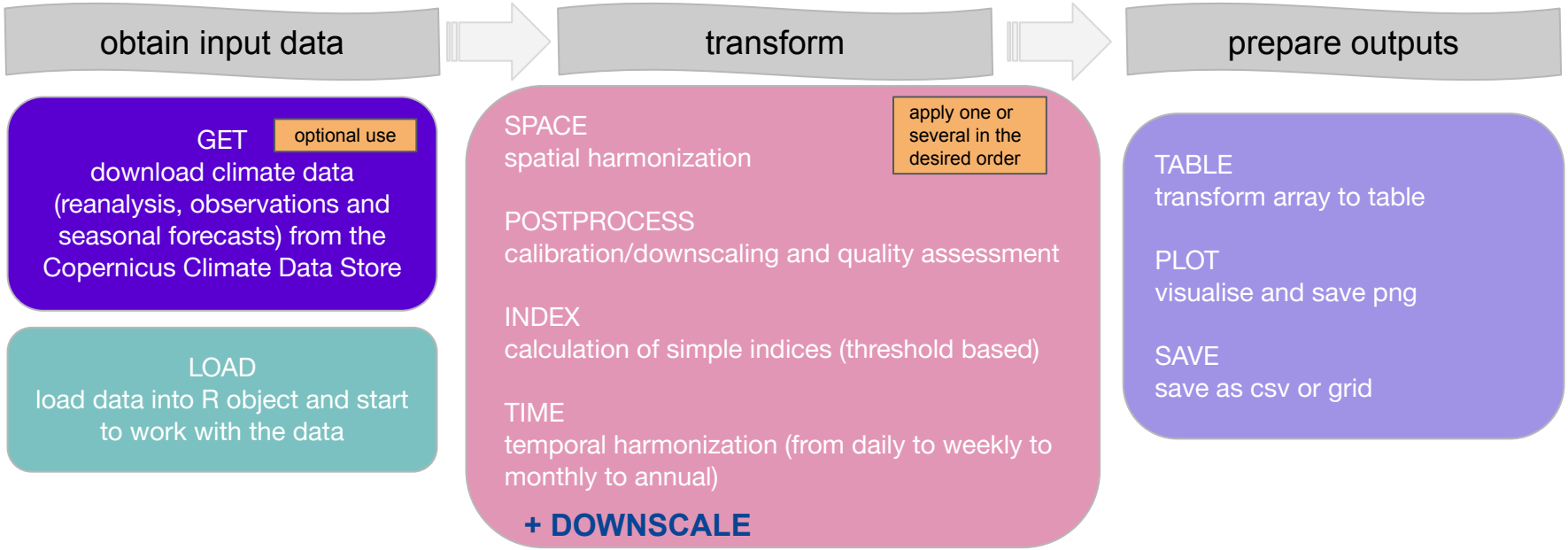
- ERA5 1979-present 0.25° x 0.25°
- ERA5-Land 1950-present 0.1° x 0.1°

Ground-based observations:

- Global Hourly - Integrated Surface Database (ISD): point data, several variables, 1901-present



clim4health structure



For each function, we will also provide detailed vignettes, as well as recommendations for parameter selection

clim4health_get

- Download data from the Copernicus Data Store

- Explore the datasets available
  - datasets
  - variables
  - required inputs
  - how to specify the desired region


```
clim4health_get_help()
# Available climate datasets:
# - reanalysis-era5-land
# - reanalysis-era5-land-monthly-means
# - reanalysis-era5-single-levels
# - reanalysis-era5-single-levels-monthly-means
# - seasonal-monthly-single-levels
```

```
# Download reanalysis data
clim4health_get(pat = pat_api,
                dataset = "reanalysis-era5-land-monthly-means",
                product_type = "monthly_averaged_reanalysis",
                variable = "2m_temperature",
                year = c(2010, 2011, 2012),
                month = c(4, 5),
                area = c(33, -93, -23, -17),
                outname = "era5land")
```

clim4health_load

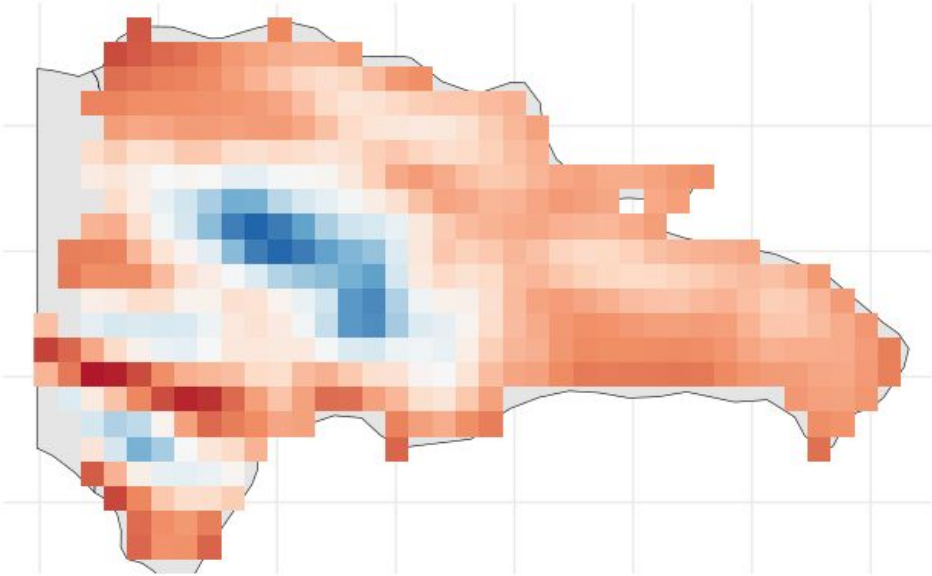
- load NetCDF or csv files
- account for matching dates between reanalysis and hindcasts
- load is the base to establish the dimensions of the array to work with in the rest of the functions

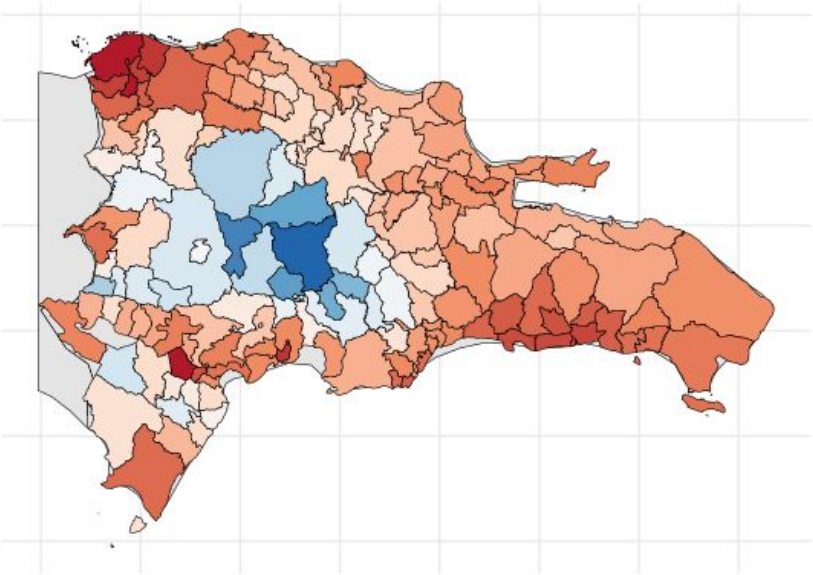
```
class(obs)
#[1] "s2dv_cube"

dim(obs$data)
#  dataset       var      time  ensemble  latitude longitude
#        1         1         6         1       561       761
```

clim4health_space

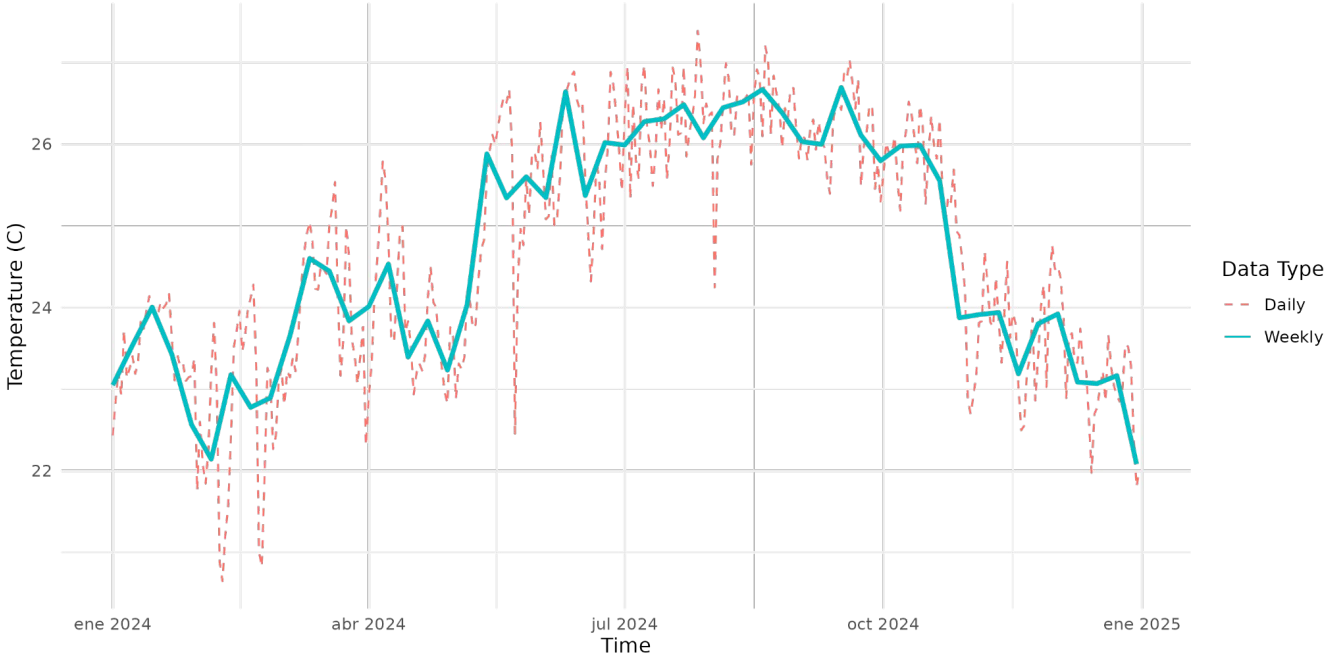
- aggregate gridded climate data to spatial regions





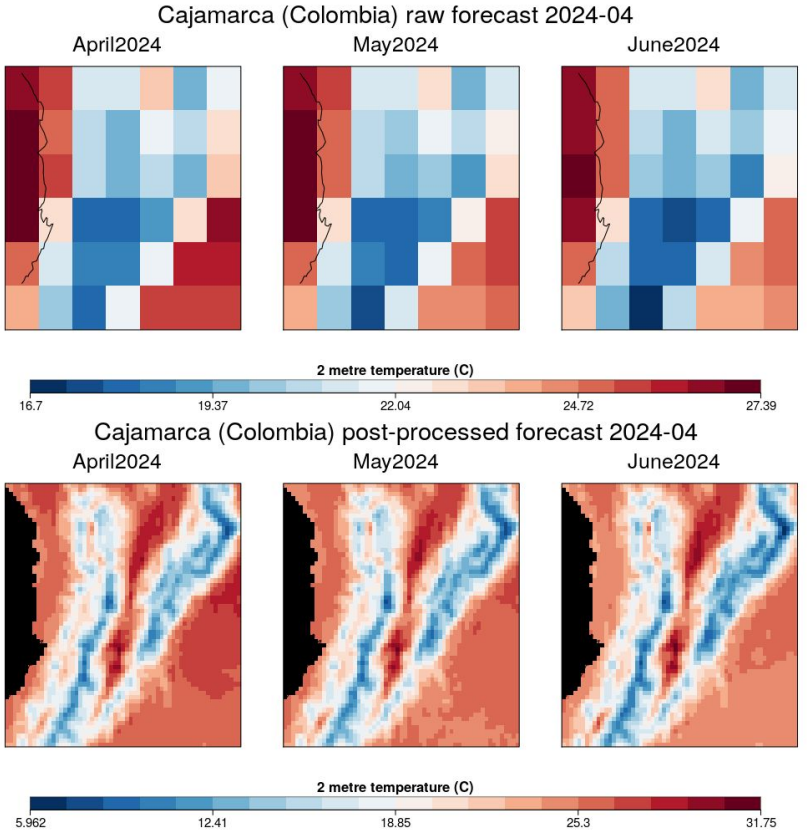
clim4health_time

- aggregate raw climate data to desired temporal frequency
- e.g. daily to weekly data



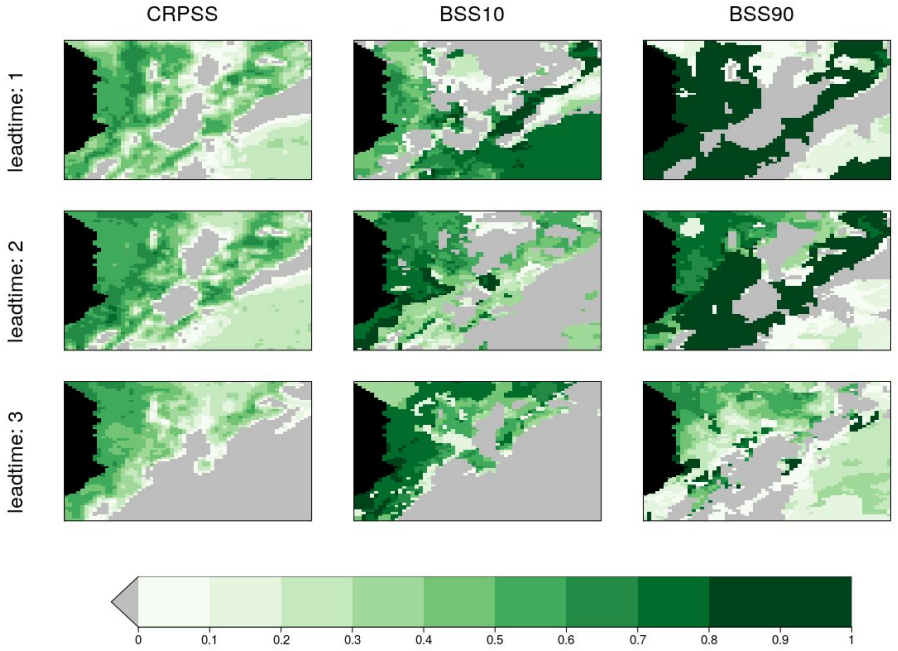
clim4health_downscale

- downscale coarse climate data to a finer grid or to point locations
- plus recommendations of methods for variables and hotspots
- **new function**



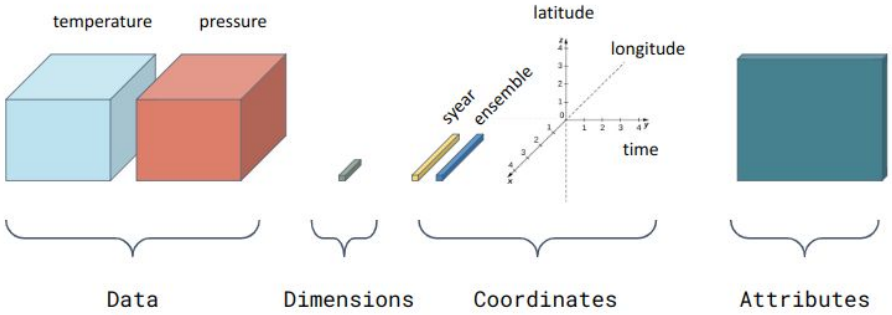
clim4health_postprocess

- calibration and quality assessment of data
- how does the distribution of a hindcast compare to the climatological observations? How skilfully does it predict the:
  - full distribution
  - tails of the distribution
- In progress!



clim4health_table

- output multidimensional climate data with metadata into a tidy dataframe



dataset	var	time	ensemble	latitude	longitude	values
dat1	t2m	2024-04-01	1	33	-93	291.61
dat1	t2m	2024-05-01	1	33	-93	298.08
dat1	t2m	2024-06-01	1	33	-93	301.45
dat1	t2m	2024-04-01	2	33	-93	292.39
dat1	t2m	2024-05-01	2	33	-93	296.74
dat1	t2m	2024-06-01	2	33	-93	299.25

Status: May 2025

clim4health development

finished
started
delayed

	first version	documentation	unit tests	vignette	improvements	final version
clim4health_get	October 2024	November 2024	Feb-July 2025	December 2024	October 2025	October 2025
clim4health_load	October 2024	November 2024	Feb-July 2025	December 2024	October 2025	October 2025
clim4health_spatial	November 2024	November 2024	Feb-July 2025	December 2024	November 2025	November 2025
clim4health_downscale	June 2025	July 2025	August 2025	July 2025	December 2025	March 2026
clim4health_postprocess	May 2025	June 2025	Feb-July 2025	July 2025	December 2025	March 2026
clim4health_index	October 2024	November 2024	Feb-July 2025	December 2024	January 2026	March 2026
clim4health_time	October 2024	November 2024	Feb-July 2025	December 2024	January 2026	March 2026
clim4health_table	November 2024	November 2024	Feb-July 2025	December 2024	January 2026	March 2026
clim4health_plot	August 2025	August 2025	September 2025	September 2025	February 2026	March 2026
clim4health_save	August 2025	August 2025	September 2025	September 2025	February 2026	March 2026

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Thank you - any questions?

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