How to use the `meteoland` shiny app

Contents

Under contruction!!

Here will be the super-useful user guide to the meteoland app, stay tuned!

General info

This app is intended as an useful example of the `meteoland` package capabilities, and is limited to the Catalonian area, as the servers space is limited and we can not have all the station data from around the world.
If you want to interpolate metereological variables from another area yo can use the `meteoland` package, given that metereological data and/or climate model projections are available for you. See the package user guide to know how!

Points

Historical Points mode

In this mode you will be able to select up to ten points by coordinates (latitude and longitude) and a range of dates between 1976 and the last year (2016 at the moment of writing this guide) and retrieve the interpolated data from those points for that period, based on the available metereological stations data around the selected points.

Data input

1. Go to the `USER INPUT` tab

2. Select `Historical` and `Points` in the left sidebar

3. Introduce the starting and ending dates of the period of interest (if you want to retrieve only one day, starting and ending date must be the same)

4. Select the points, as coordinates. You can do this in two ways:
   - Clicking in the map at the desired coordinates. You will see that clicked points are added to the `selected points` list

   - Filling the `Latitude` and `Longitude` boxes with the desired coordinates and clicking in `Append coordinates` button. Again, you will see that the `selected points` list will be updated

5. If you want to clear the coordinates introduced, click the `Reset coordinates` button. This will clear all coordinates and you will have to start again

6. After you have introduced all the points, click in the `Go` button and the app will start to process the coordinates and will show the results in the `DATA OUTPUT` tab

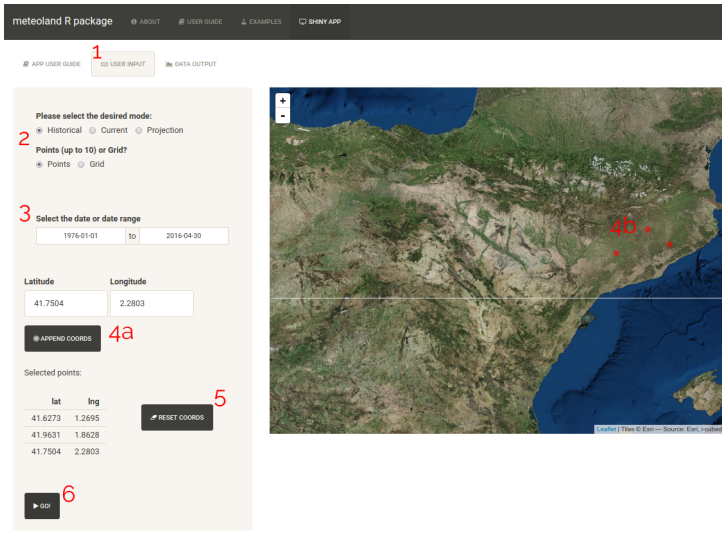

Figure 1: Introducing parameters in the historical points mode

Data output

After clicking the `Go` button, app view will change to the `DATA OUTPUT` tab, showing the progress of the interpolation process. Be warned that it can take a while to process the data, depending on the date range and the number of points.
When the process is finished, a visual report will appear in the `DATA OUTPUT` tab, showing the time series of the temperature, humidity, precipitation and PET values. You will be able to change between the selected points and also you can zoom in/out in the time series visualization. The topographic information of the point is also showed.
You can retrieve the processed data by clicking in the `Download` button. This will download a `zip` file containing the `txt` files with the data for each selected point.

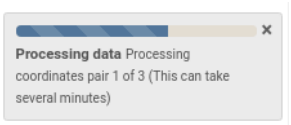

Figure 2: Progress dialogue

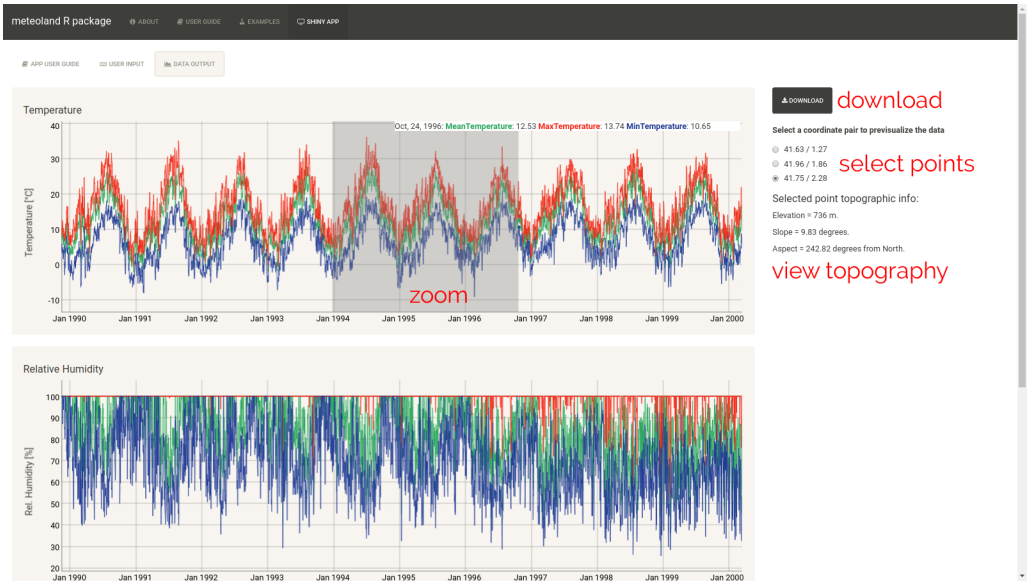

Figure 3: Data output overview

Limitations

1. Point selection limited to 10 points

2. Dates range limited from 1976-01-01 to 2016-12-01

Also, if you want all the historical period in ten different points, it will take some minutes to process the data, so you can slack off a little ;)

What's happening behind the curtains?

In this mode we load a calibrated dataset from all AEMET metereological stations (built with the `meteoland::interpolation.calibration` function) and interpolate the data for the coordinates selected

Figure 4: Ecologists working hard (modified from https://xkcd.com/303/)

using the `meteoland::interpolationpoints` function. For that we need both the stations and the points topographies, loaded as `SpatialTopographyPoints` objects.

Current Points mode

Here you will be able to interpolate data from the current year up to the actual date, based on the available metereological stations data around the selected points.

Data input

1. Go to the `USER INPUT` tab

2. Select `Current` and `Points` in the left sidebar

3. Introduce the starting and ending dates of the period of interest (if you want to retrieve only one day, starting and ending date must be the same)

4. Select the points, as coordinates. You can do this in two ways:
   - Clicking in the map at the desired coordinates. You will see that clicked points are added to the `selected points` list

   - Filling the `Latitude` and `Longitude` boxes with the desired coordinates and clicking in `Append coordinates` button. Again, you will see that the `selected points` list will be updated

5. If you want to clear the coordinates introduced, click the `Reset coordinates` button. This will clear all coordinates and you will have to start again

6. After you have introduced all the points, click in the `Go` button and the app will start to process the coordinates and will show the results in the `DATA OUTPUT` tab

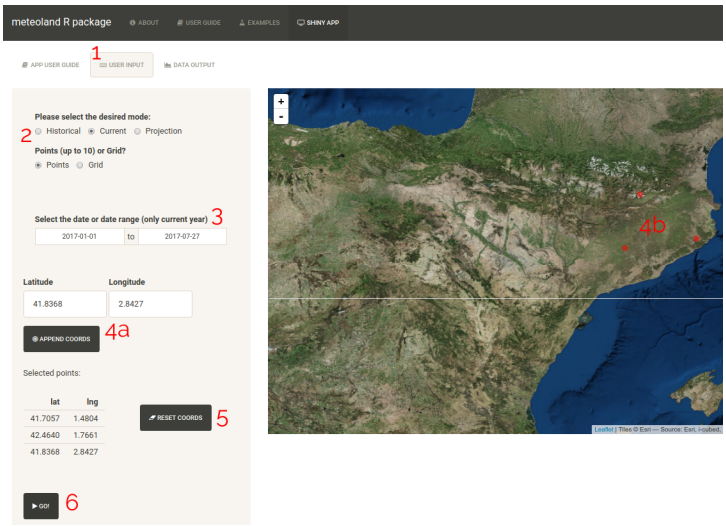

Figure 5: Introducing parameters in the current points mode

Data output

In this mode app view also will change to the `DATA OUTPUT` tab automatically after pressing the `Go` button. Usually this mode is faster in processing the data as the time span is one year as maximum (No slack off time in this mode).
When the process is finished a visual report similar to the one we saw for the previuos mode is presented,

showing the time series of the temperature, humidity, precipitation and PET values. You will be able to change between the selected points and also you can zoom in/out in the time series visualization. The topographic information of the point is also showed.
You can retrieve the processed data by clicking in the `Download` button. This will download a `zip` file containing the `txt` files with the data for each selected point.

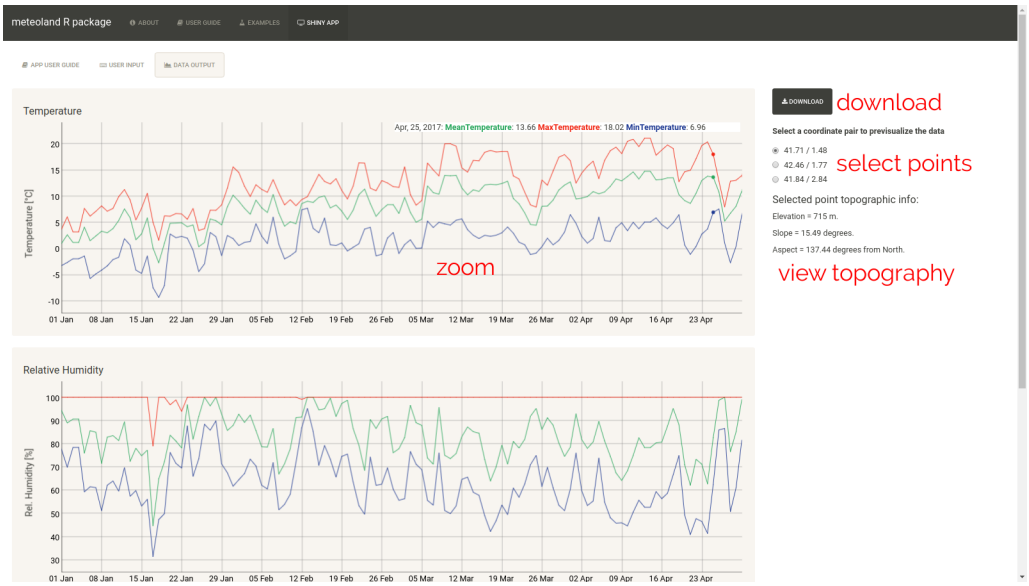

Figure 6: Current points mode data output overview

Limitations

1. Point selection limited to 10 points

2. Dates ranges limited to the available current year dates

What's happening behind the curtains?

Similar to the *Historical Points mode*, an interpolation object is created for the dates range provided, and the interpolation parameters are loaded (as they are pre-calculated). After that, the datta is interpolated using the `meteoland::interpolationpoints` function and the data is returned as a `SpatialMetereologyPoints` object to visualize.

Projection Points mode

In this case data are interpolated and downscaled from coarse climate models projections (using both, historical and future data and including a statistical correction) to the selected points scale.

Data input

1. Go to the `USER INPUT` tab

2. Select `Projection` and `Points` in the left sidebar

3. Select the desired combination of `Regional Climate Model` and `Representative Concentration Pathway`. In this case there is no date selection as all the future projection until 2100-12-01 is retrieved

4. Select the points, as coordinates. You can do this in two ways:
   - Clicking in the map at the desired coordinates. You will see that clicked points are added to the `selected points` list

   - Filling the `Latitude` and `Longitude` boxes with the desired coordinates and clicking in `Append coordinates` button. Again, you will see that the `selected points` list will be updated

5. If you want to clear the coordinates introduced, click the `Reset coordinates` button. This will clear all coordinates and you will have to start again

6. After you have introduced all the points, click in the `Go` button and the app will start to process the coordinates and will show the results in the `DATA OUTPUT` tab

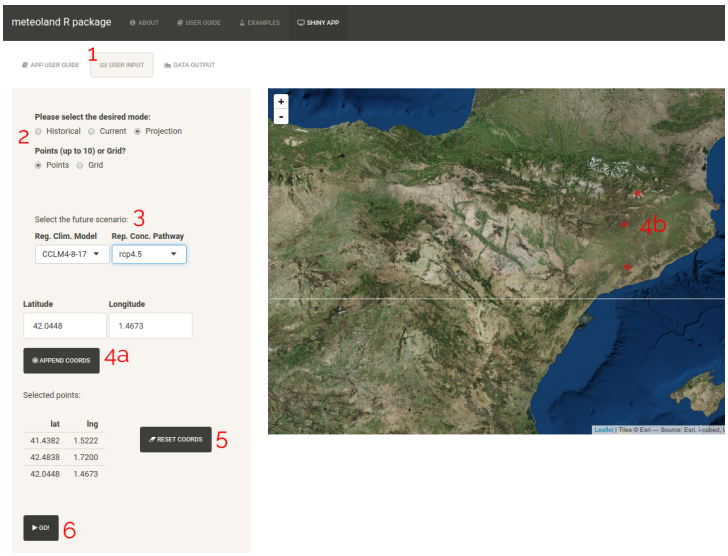

Figure 7: Introducing parameters in the projection points mode

Data output

After pressing the `Go` button the view will change to the `DATA OUTPUT` tab automatically, whereas the progress of the interpolation and the correction is showed.

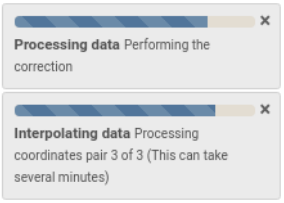

Figure 8: Progress dialogue in the Projection Points mode

When it is finished we can see the time series for the different variables predictions in the selected points. Again, you can zoom/unzoom to be able to inspect the data more closely. Topography info of the selected points is also shown. If all is ok the data can be downloaded clicking in the `Download` button resulting in a `zip` file containing `txt` files for each point.

Figure 9: Output data overview in the Projection Points mode

Limitations

1. Point selection limited to 10 points

2. No dates range available, all period up to 2100-12-01 is provided

As in the historical mode, processing the data can take several minutes, as all the future projection is processed. Time for slacking off again!

What's happening behind the curtains?

Here the app is working really hard for you. First we build the interpolator object for the historical period as we did in the *Historical Points mode* to have a reference for the correction step. After that we build the future uncorrected data in a `MetereologicalUncorrectedData` object from the regional climate model and the representative pathway concentration combination selected and we retrieve the topography info for the selected points. By means of the `meteoland::correctionpoints` function the future projection is statistically corrected and the results are returned as a `SpatialMetereologyData` object to visualize it.

Grids

Historical Grid mode

In this mode you will be able to interpolate a grid (rectangular area) in a range of dates between 1976 and the last year, based on the available metereological stations data.

Data Input

1. Go to the `USER INPUT` tab

2. Select `Historical` and `Grid` in the left sidebar

3. Introduce the starting and ending dates of the period of interest (if you want to retrieve only one day, starting and ending date must be the same)

4. Select the area, as a two coordinates pair, the upper left pair and the bottom right pair describing the rectangle desired. You can do this in two ways:
   - Clicking in the map, first for the upper left limit and last for the bottom right limit. Coordinates values will appear in the boxes
   - Filling the both pairs of coordinates directly in the boxes

5. After you have introduced all the points, click in the `Go` button and the app will start to process the grid and will show the results in the `DATA OUTPUT` tab

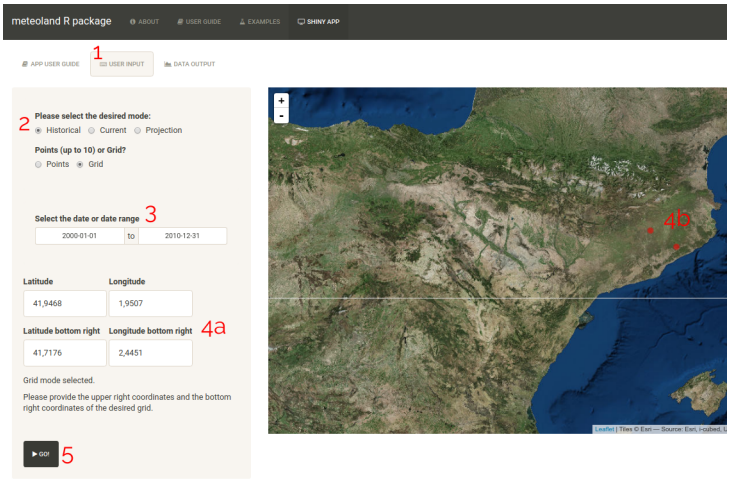

Figure 10: Introducing parameters in the historical grid mode

Data output

After pressing the `Go` button the data process starts, showing a progress dialogue. When the process is finished the app changes automatically to the `DATA OUTPUT` tab allowing to inspect the results.

In this tab a grid plot is presented for the selected variable and date. Data can be downloaded using the `Download` button, which will return a `netCDF` file.

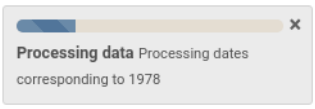

Figure 11: Introducing parameters in the historical grid mode

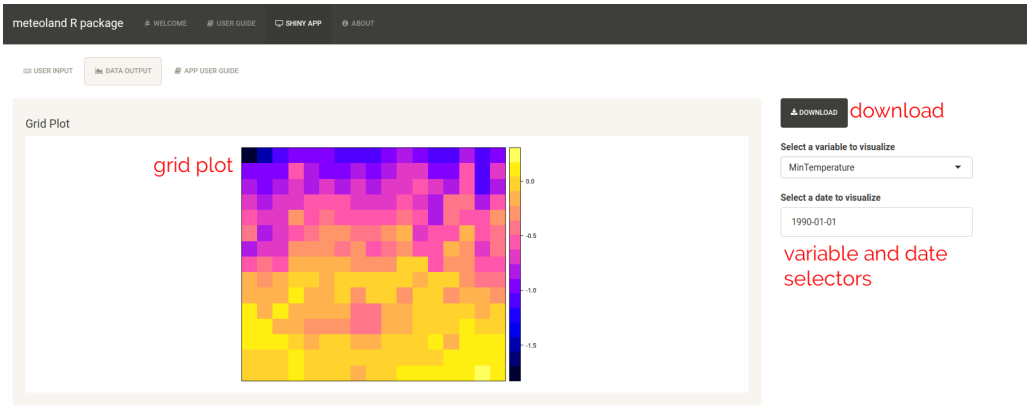

Figure 12: Introducing parameters in the historical grid mode

Limitations

1. Data range requests limited to 5 years.
2. Grid size limited to ???

What's happening behind the curtains?

Grid interpolations are expensive (in terms of processing and memory), so in this case we have a precalculated grid for all Catalonia with the interpolated values, so in this case we subset the precalculated grid and create an `SpatialMetereologyGrid` object to visualize the results.

Current Grid Mode

Here you can interpolate data from the current year up to the actual date for a rectangular grid, based on the available metereological stations data inside and around (in a 30km buffer area) the selected area.

Data input

1. Go to the `USER INPUT` tab

2. Select `Current` and `Grid` in the left sidebar

3. Introduce the starting and ending dates of the period of interest (if you want to retrieve only one day, starting and ending date must be the same)

4. Select the area, as a two coordinates pair, the upper left pair and the bottom right pair describing the rectangle desired. You can do this in two ways:
   - Clicking in the map, first for the upper left limit and last for the bottom right limit. Coordinates values will appear in the boxes
   - Filling the both pairs of coordinates directly in the boxes

5. After you have introduced all the points, click in the `Go` button and the app will start to process the grid and will show the results in the `DATA OUTPUT` tab

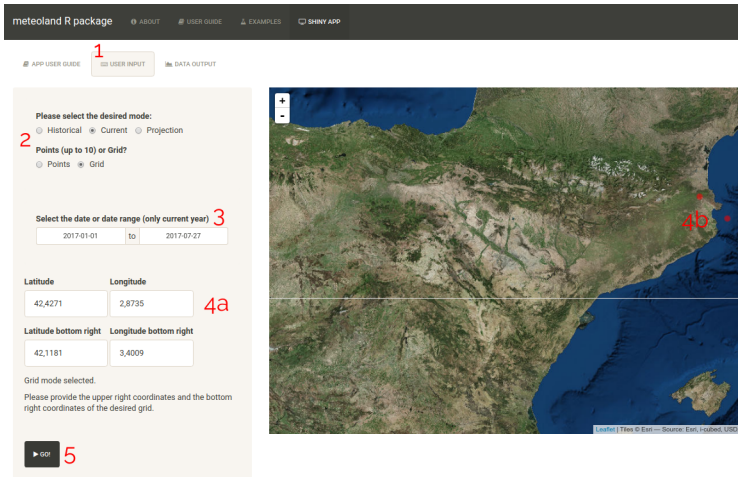

Figure 13: Introducing parameters in the current grid mode

Data output

After the `Go` button is pressed and the data is processed, app will change to the `DATA OUTPUT` tab automatically. Depending on the grid size, it can take a while to process all the data.

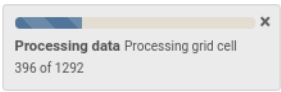

Figure 14: Progress dialogue in the Current Grid mode

In the `DATA OUTPUT` tab you will find a grid plot showing the results for the selected variable and date, which you can change in the right sidebar of the tab. In order to download the data, if the `Download` button is pressed a `zip` file will be generated, containing a `netCDF` file for each day of the dates range selected (see the ncdf4 package to read and acces the data from R).

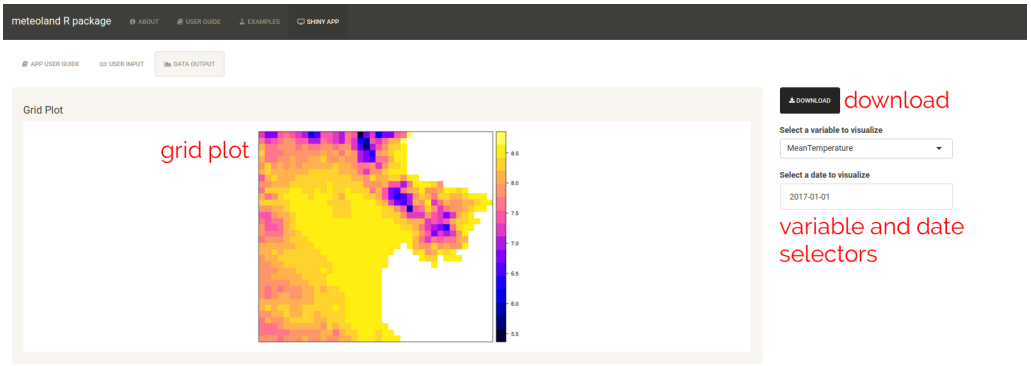

Figure 15: Output overview of the Current Grid mode

Limitations

1. Dates ranges limited to the available current year dates

What's happening behind the curtains?

Here we *cheat* a little. Instead of processing grids, we have precalculated the grid topography as spatial points, and from that the interpolation is made for the points inside the grid provided in the `USER INPUT` tab. In this way the interpolation is made with the `interpolationpoints` function (faster than the grid equivalent function). After that a `SpatialMetereologyGrid` is created and returned to visualize the results. Results are served as `netCDF` files, an standard file type for multidimensional data.

Projection Grid Mode

In this case data are interpolated and downscaled from coarse climate models projections (using both, historical and future data and including a statistical correction) to the selected grid scale ($1km^2$).

Data input

1. Go to the `USER INPUT` tab

2. Select `Projection` and `Points` in the left sidebar

3. Select the desired combination of `Regional Climate Model` and `Representative Concentration Pathway`. In this case there is no date selection as all the future projection until 2100-12-01 is retrieved

4. Select the area, as a two coordinates pair, the upper left pair and the bottom right pair describing the rectangle desired. You can do this in two ways:
   - Clicking in the map, first for the upper left limit and last for the bottom right limit. Coordinates values will appear in the boxes
   - Filling the both pairs of coordinates directly in the boxes

5. If you want to clear the coordinates introduced, click the `Reset coordinates` button. This will clear all coordinates and you will have to start again

6. After you have introduced all the points, click in the `Go` button and the app will start to process the coordinates and will show the results in the `DATA OUTPUT` tab

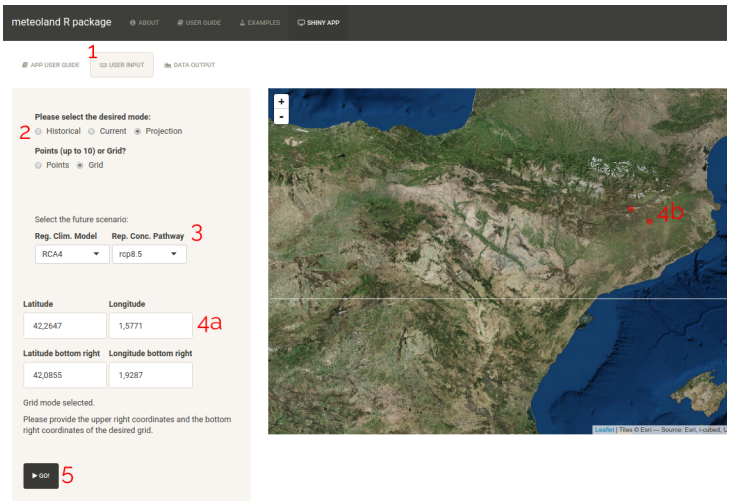

Figure 16: Introducing parameters in the projection grid mode

Data output

For this mode only mean month values are returned, as doing it at day scale is computationally expensive. So in this case the process will also take a while to complete, as all months from 2006 to 2100 are processed.

`DATA OUTPUT` tab is similar to the *Current Grid mode* one, as a grid plot is presented for the selected variable and date (first day of the month in this case). After clicking in the `Download` button an single `netCDF` file containing all dates and metereological values for all variables is created and downloaded.

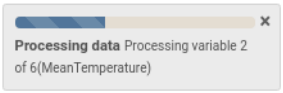

Figure 17: Progress dialogue in the Projection Grid mode

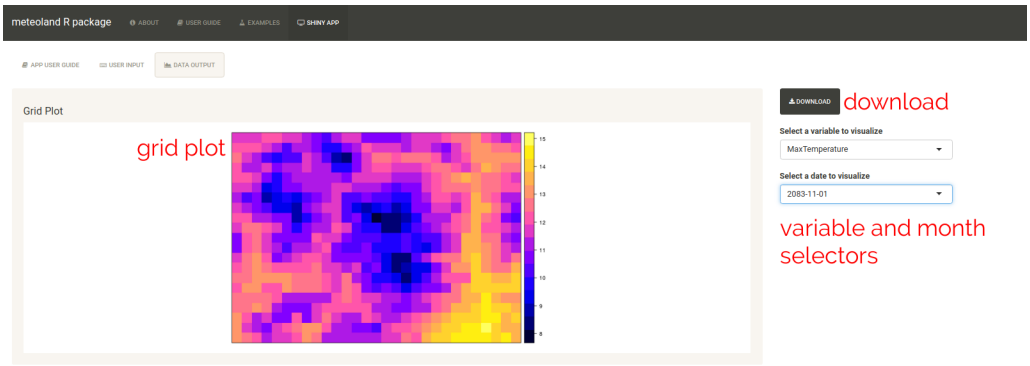

Figure 18: Output overview of the Projection Grid mode

Limitations

1. Grid size is limited to a maximium size of 2500 km^2

2. No date selection, all future projection is returned

What's happening behind the curtains?

Grid projections are expensive (in terms of processing and memory), so in this case we have a precalculated grid for all Catalonia with the interpolated and corrected values, so in this case we subset the precalculated grid and create an `SpatialMetereologyGrid` object to visualize the results.