The CM SAF R TOOLBOX
- Manual -

QUICK START

- Install R (Version >= 3.5): ***https://cran.r-project.org***
- Install RStudio (recommended): ***https://www.rstudio.com/download***
- Run RStudio and execute the following command in the R command line
  - ***install.packages("cmsaf")***
- Start the Toolbox by executing the commands
  - ***library(cmsaf)***
  - ***run_toolbox()***
- Optionally you can include arguments that will be passed to the function shiny::runApp(). For instance, to run the Toolbox in your default browser execute
  - ***run_toolbox(launch.browser = TRUE)***
- Have fun

STRUCTURE

Starting the Toolbox for the first time will prompt you to set up.

Select a user directory: You will be asked to choose a user directory on your computer. An ***output*** directory will be created in this folder in which all created NetCDF files will be stored. If you want to change this directory at a later point you can do so by clicking ***View or change the user*** **directory** on your Toolbox home screen. Recommended is the Toolbox configuration directory, which will be placed in your home directory under ***CMSAF-Toolbox***.

Specify a grid resolution: In order to visualize data that is not provided on a rectangular longitude/latitude grid, the Toolbox will remap this data onto such a grid. The given value will determine its spatial resolution. Note that either a comma or period will be accepted as decimal separator dependent on what browser you are running the Toolbox in.

FUNCTIONALITY

The CMSAF R TOOLBOX consists of three main aspects: Prepare, Analyze and Visualize.

The section ***Prepare*** provides methods to create a NetCDF file from a .tar packed file, which is how you will receive your climate data when ordering them from CM SAF Web User Interface (***https://wui.cmsaf.eu***).

You can use the ***Analyze*** section to apply various operators from the *cmsaf* package to your data. See the *cmsaf* package documentation for details. On the right information about the current data is displayed. You also have the option to apply multiple operators accumulatively to the same file. For each applied operator an output file is generated. Its name will consist of variable, operator and a timestamp.

To ***Visualize*** data, once again, choose a NetCDF file and the Toolbox creates your plots. There are several options to adapt the plot to your requirements.

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FUNCTIONALITY

For two-dimensional plots:

- ***Select timestep***: Select the time step you want to display
- ***Show Zoom***: Displays a panel to select an area to zoom in
- ***Plot region***: You can select a country contained in your data or provide your own shapefile and select a region
- ***Longitude*** / ***Latitude:*** Adjust the spatial boundaries for the plot
- ***No. of Colors*** / ***Colorbar:*** Change colors and refinement of the color scale
- ***Number of Ticks***: Change refinement of legend
- ***Scale Range Min*** / ***Max:*** Adjust legend boundaries
- ***Plot country borders:*** Toggle display of country borders
- ***Plot R-Instat:*** Gives the opportunity to add station data, which were exported from the statistical software R-Instat in .RData (more details on *r-instat.org*)
- ***Plot Own Location:*** Add a location to the plot by spatial coordinates
- ***Projection:*** Switch between projection on a plane (rectangular) or on the globe (orthographic). If choosing orthographic projection, you may rotate the globe to center a desired area but some other options are not available.
- ***Title*** / ***Subtitle*** / ***Scale Caption:*** Adjust labelling of your plot

For time series analysis:

- ***X-Range*** / ***Y-Range:*** Adjust the x and y axes
- ***Color*** / ***Line type:*** Set Line Color and Plot type
- ***Add linear trend line:*** Display a linear regression line
- ***Analyze time series:*** Show various analytical plots about the data
- ***Number of major ticks***: Select refinement of x-axis
- ***Date format:*** Select format for dates shown in the graph
- ***Title*** / ***Subtitle:*** Adjust labelling of your plot

Also provided are a ***File Summary*** of the current file and some basic ***Statistics***.

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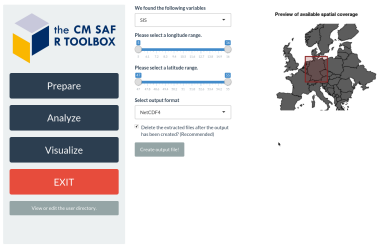
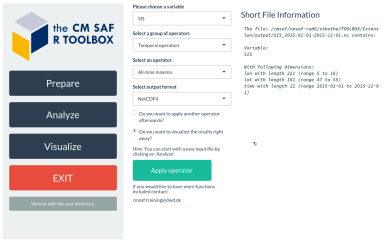
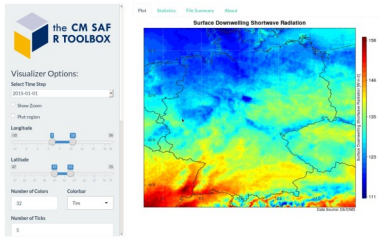
EXAMPLE







- Order CM SAF data via ***https://wui.cmsaf.eu*** and download them (For testing, example data can be downloaded via ***www.cmsaf.eu/R_toolbox***, which will be used in this example)
- Open RStudio and run
  - ***library(cmsaf)***
  - ***run_toolbox()***
- Click ***Prepare*** and select the downloaded ORD12345.tar-file to start the preparation process.
  - Select a time range.
  - Press ***untar and unzip files***.
  - Specify a variable, e.g. 'SIS', spatial range and other options.
  - Click ***Create output file*** to create the NetCDF file containing the combined data.
  - Once this is done you will be referred to the ***Analyze*** panel.
- Click ***Analyze this file***
  - Select ***Temporal operators*** in ***Group of operators***
  - Select the operator ***All-time means***.
- Switch to ***Visualize*** and select your created NetCDF file ***SIS_timmean….nc*** (or select ***Visualize the results right away*** in the Analyze panel)
  - You will get a 2D map displaying the average Surface Downwelling Shortwave Radiation for 2015 in the selected area.
  - Adjust the parameters on the left to suit your requirements. (see Functionality)
  - The example data also comes with an R-instat data file you can used with the monthly mean SIS data
  - If you want to save the plot click ***Save plot*** on the bottom of the sidebar panel.

cmsaf R-package

The Toolbox comes as part of the *cmsaf* R-package. All operators in the analyze section are functions provided in the package. You can also apply them separately. The functions are documented in the package manual (***https://cran.r-project.org/web/packages/cmsaf/cmsaf.pdf***). The *cmsaf* R-package includes more than 60 functions, which are fairly easy to use, including some that are not part of the CM SAF R TOOLBOX.

User Help Desk

In case that a question or problem can not be solved by help of the Manual or the *cmsaf* R-package documentation contact the CM SAF User Help Desk (***contact.cmsaf@dwd.de***).

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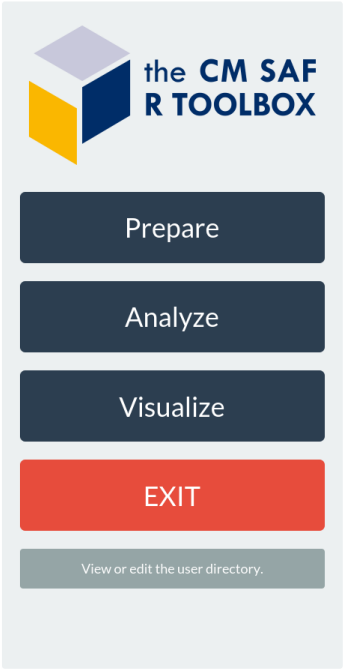
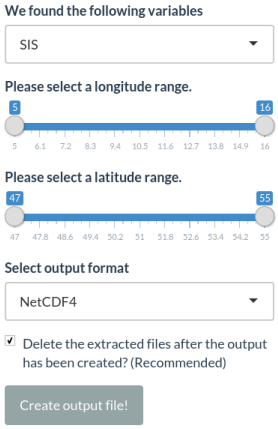
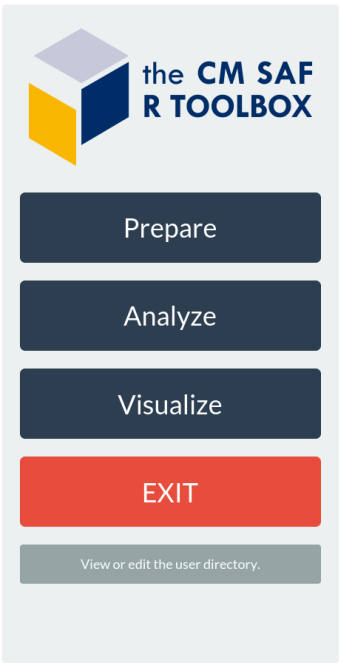
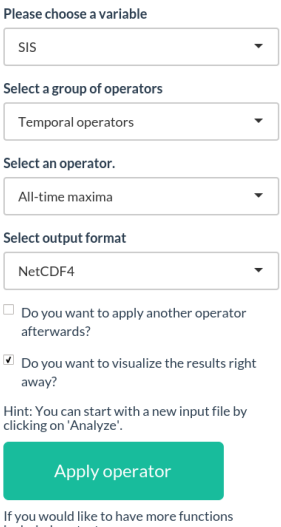
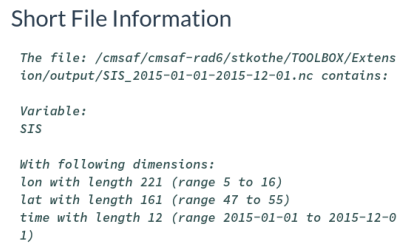
IMPRESSIONS











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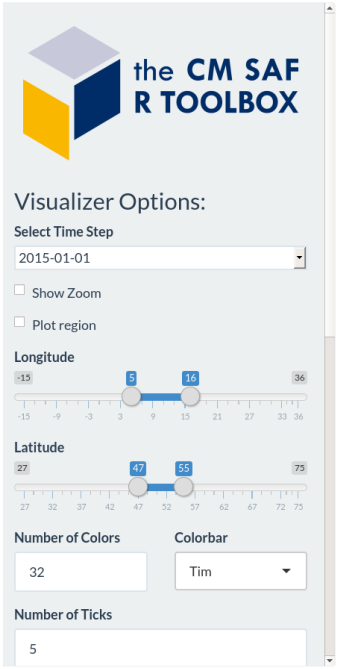

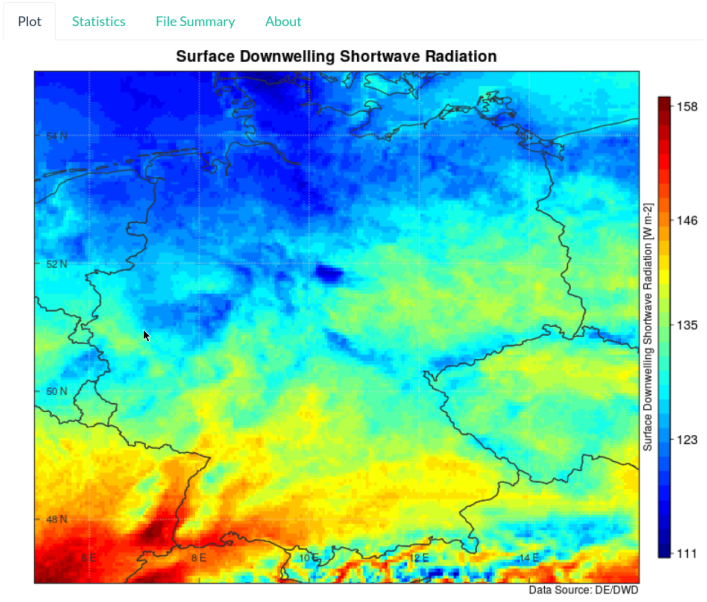

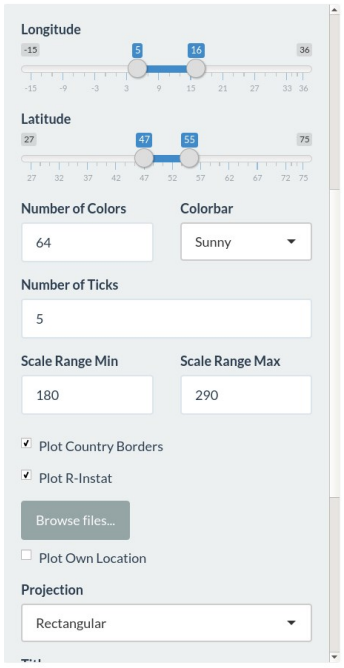

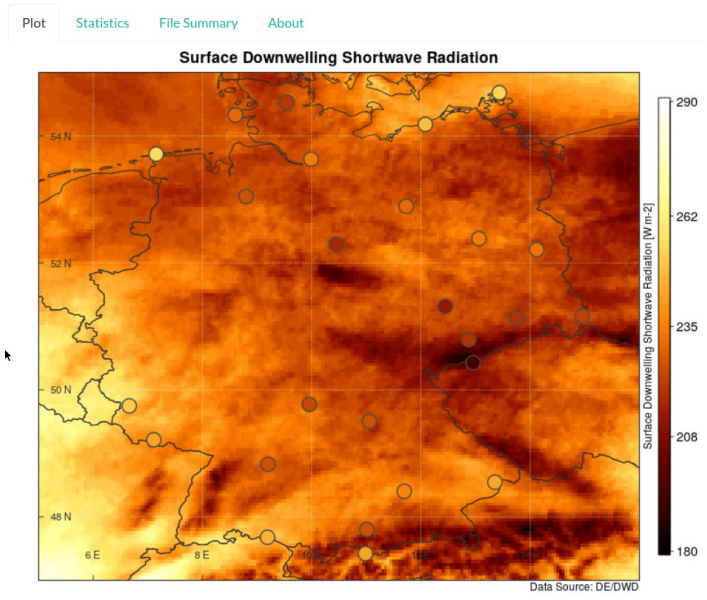

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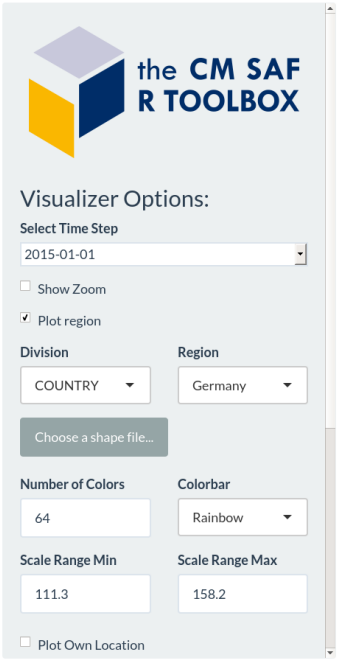

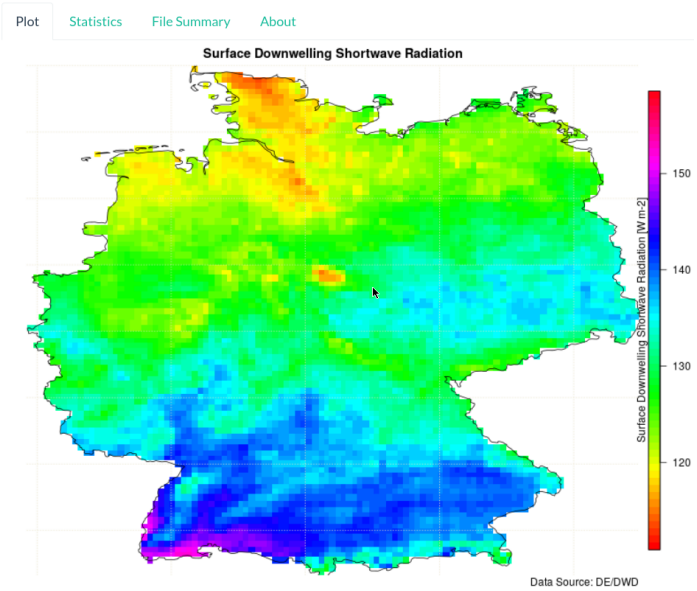

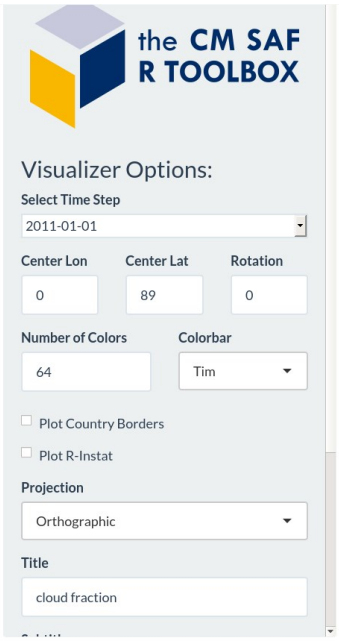

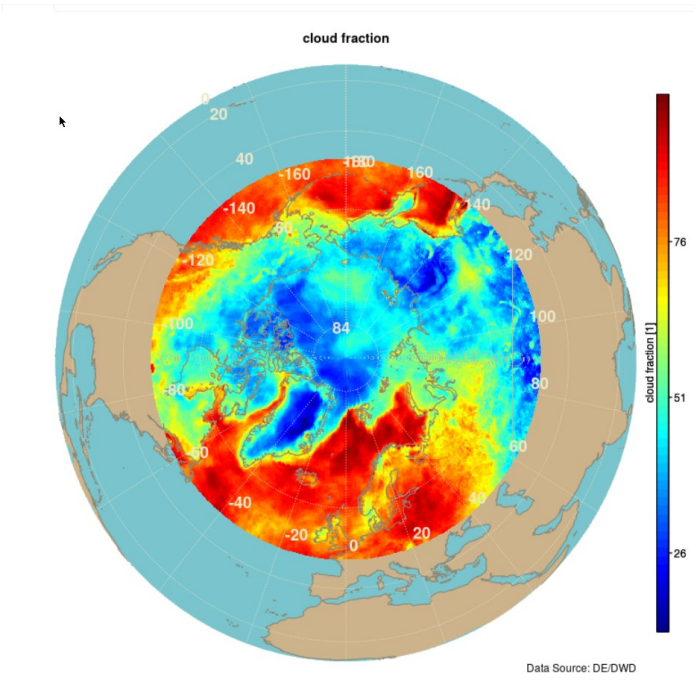

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