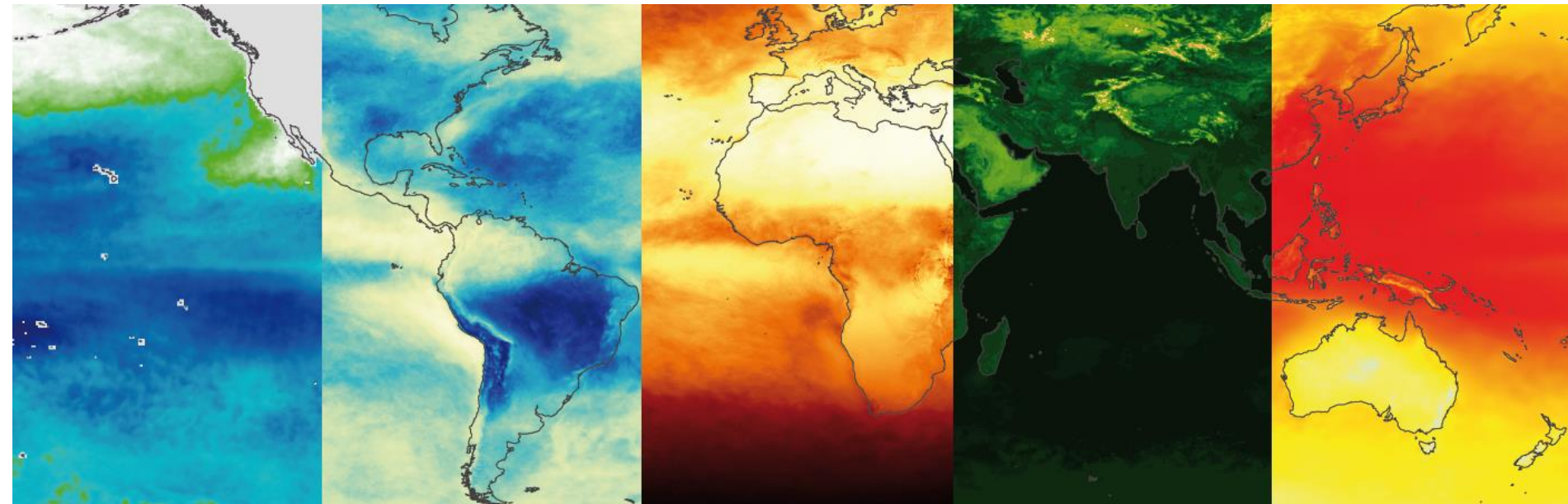


# Introducing the CM SAF R TOOLBOX

Dr. Steffen Kothe  
Deutscher Wetterdienst



## Motivation

- Developed for CM SAF Workshops
  - R-based software because:
    - One of the best data science languages
    - Large worldwide community
    - R is a free software
    - R is easy to learn
  - Easy handling of CM SAF NetCDF data
  - One software for:
    - Data preparation
    - Data analysis
    - Data visualization





# The CM SAF R TOOLBOX

— R-based tools for an easy usage of CM SAF NetCDF data —

## PREPARE

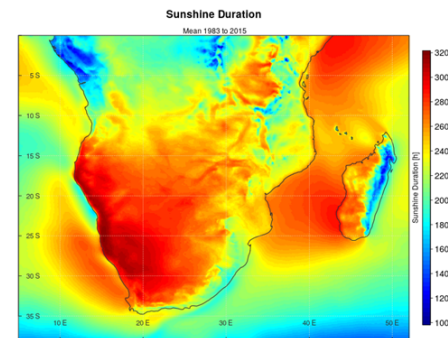
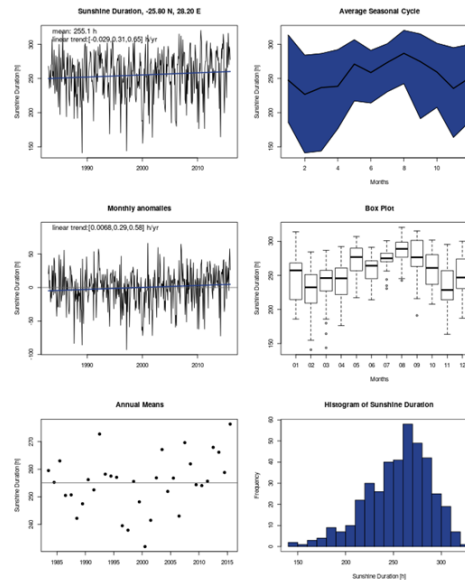
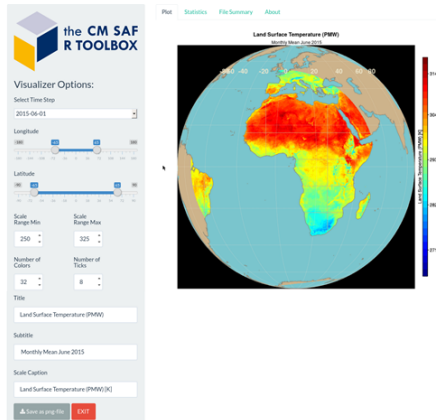
Extract, unzip, select time range and region, merge.

## ANALYSE

The cmsaf R-package contains more than 60 useful operators.

## VISUALIZE


Visualize spatial data, statistical analysis and 1D-timeseries.



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## CM SAF R TOOLBOX Scripts

- The CM SAF R TOOLBOX consists of prepared R-scripts
- The scripts require **no** R or scripting experience
- After starting a script the user is guided through all options
- One script to control all steps



The screenshot shows the CM SAF R TOOLBOX interface. On the left, there is a vertical stack of buttons: 'Prepare' (dark blue), 'Analyze' (dark blue), 'Visualize' (dark blue), 'GO' (teal), 'EXIT' (red), and 'Browse files...' (grey). The main area on the right contains text instructions. At the top, it says 'the CM SAF R TOOLBOX' with a logo. Below that, it reads: 'the CM SAF R TOOLBOX 'Mostly Harmless''. The intention of the toolbox is to help users using CM SAF NetCDF formatted data. It includes three steps: 1. Preparation of ordered CM SAF data files, 2. Analysis of prepared CM SAF data, and 3. Visualization of the results. Users are instructed to select one of the three steps and launch it by clicking the GO button, and to stop the application by clicking the EXIT button. A note suggests sending improvements or praise to contact.cmsaf@dwd.de, dated 2018-07-26. The 'Visualize' section is highlighted, with instructions to select a NetCDF file (.nc) and click on GO to start the R-script CMSAF\_Visualizer.R. It also states that the application can be used to display NetCDF data and provides information on the data and the NetCDF file. To stop the visualizer, users should click on EXIT. At the bottom, a text box shows the selected file path: /cmsaf/cmsaf-rad6/stkothe/TOOLBOX/CHSAF-R-TOOLBOX\_work/output/SDU\_198301-201512.nc.



## Data Preparation

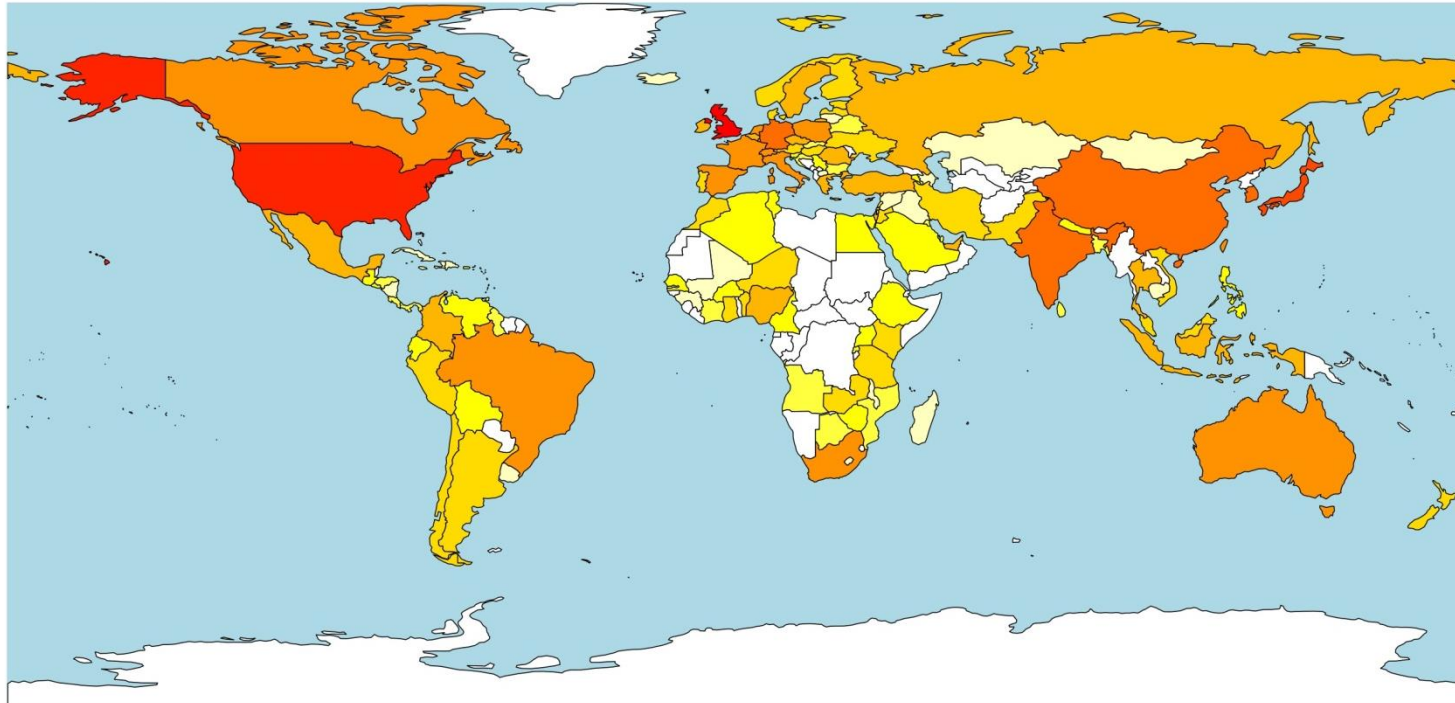
- CM SAF data records can be ordered free of charge via *wui.cmsaf.eu*
- Data are provided via sftp as tarball
- This step helps to get from downloaded .tar-file to ready-to-use NetCDF
- Use the **Prep.Data.R** script to:
  - Extract
  - Unzip
  - Select time range
  - Select region
  - Merge single files into one

## Data Analysis

- The **Apply.Function.R** script serves as simple-to-apply interface to functions of the *cmsaf* R-package
- ***cmsaf* R-package**
  - The *cmsaf* R-package is a collection of functions for basic analysis and manipulation of CM SAF NetCDF data
  - It contains more than 60 operators, such as:
    - `fldmean` → mean of a 2d field
    - `mon.anomaly` → monthly anomalies
    - `monmean` → monthly means
    - `ncinfo` → content of a NetCDF file
    - `remapbil` → bilinear interpolation
    - `selpoint` → extract a point or time series
    - `trend` → linear trend

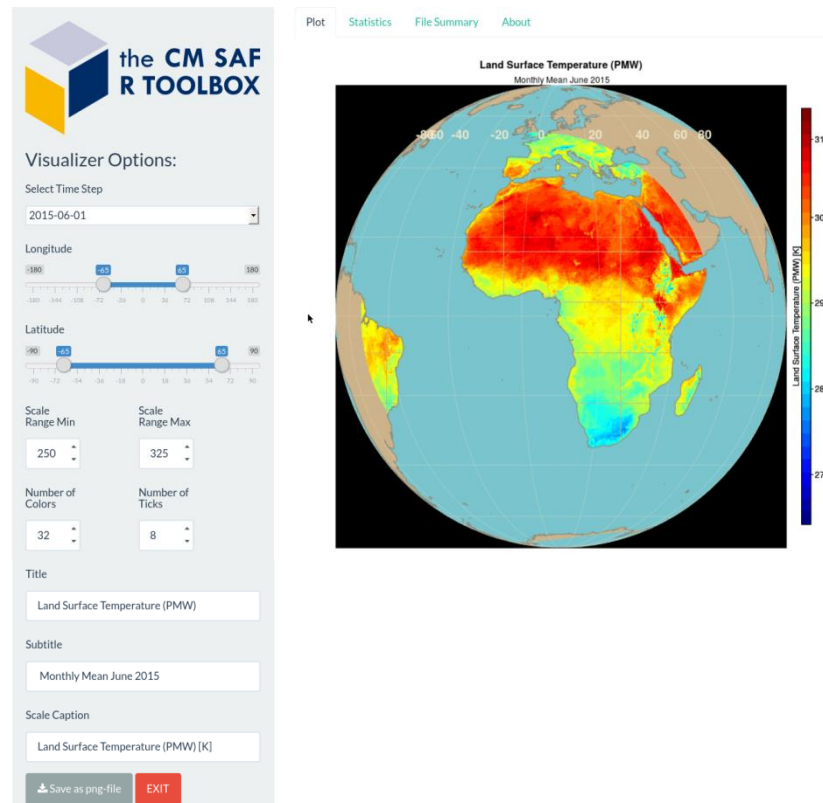
## 'cmsaf' R-package downloads since 26-06-2015

Total downloads: 23426 (01 February 2019)



# Data Visualization

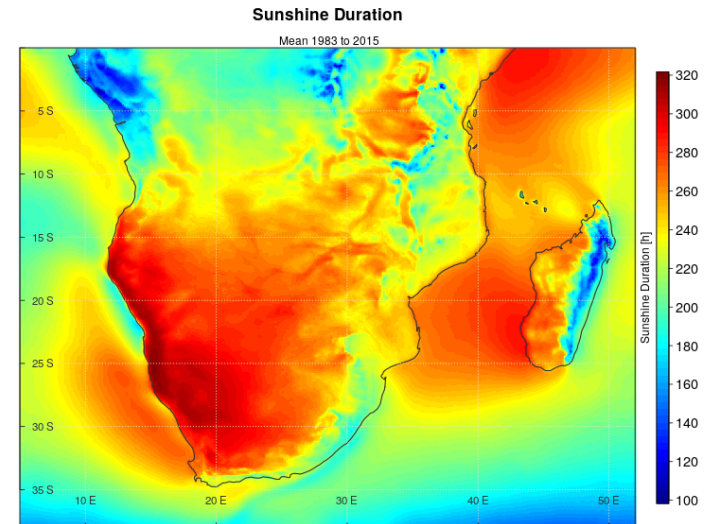
➔ The **CMSAF\_Visualizer.R** script is a GUI-based tool for interactive plotting





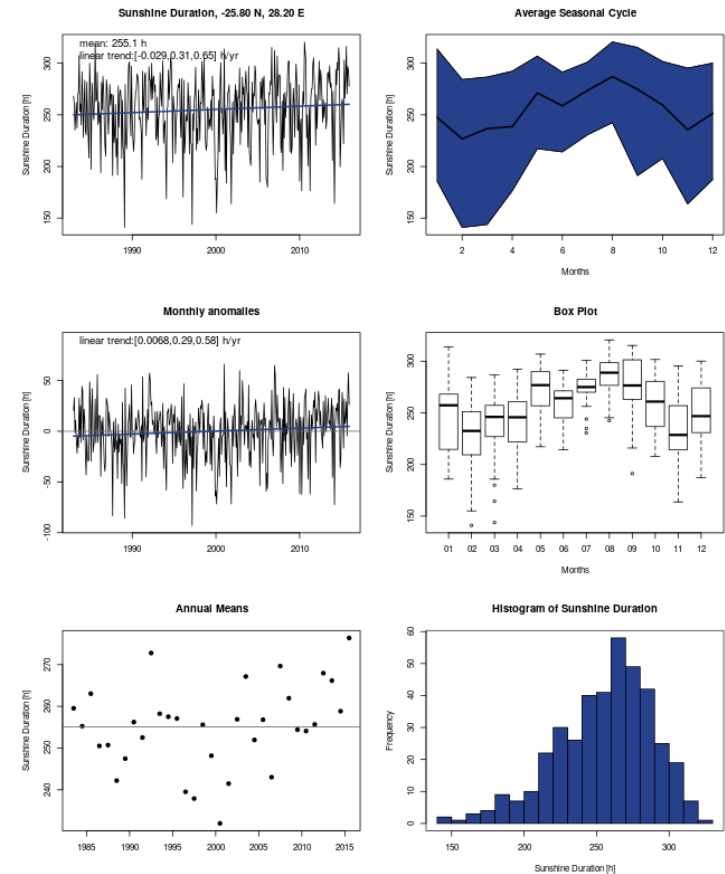
## Data Visualization

- The CM SAF Visualizer allows plotting of:
  - 2d maps
  - 1d line plots
  - statistical figures of 1d time series
- Provides useful information on the data
- There are several possibilities of adaptations



# Data Visualization

- ➔ The CM SAF Visualizer allows plotting of:
  - ➔ 2d maps
  - ➔ 1d line plots
  - ➔ statistical figures of 1d time series
- ➔ Provides useful information on the data
- ➔ There are several possibilities of adaptations



## Summary

- CM SAF freely provides the CM SAF R Toolbox
- R-scripts for preparation, analysis and visualization of CM SAF data
- ‘cmsaf’ R-package offers collection of functions for analysis and manipulation of CM SAF NetCDF data  
(<https://cran.r-project.org/web/packages/cmsaf/index.html>)
- R-scripts, which help unexperienced R-users to handle the data and to apply easily functions of ‘cmsaf’ R-package



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[www.cmsaf.eu/tools](http://www.cmsaf.eu/tools)

Article

## The CM SAF R Toolbox – A Tool for an easy usage of satellite-based climate data in NetCDF format

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**Abstract:** The EUMETSAT Satellite Application Facility on Climate Monitoring (CM SAF) provides satellite-based climate data records of essential climate variables of the energy budget and water cycle. The data records are generally distributed in NetCDF format. To simplify the preparation, analysis and visualization of the data, CM SAF provides the so-called CM SAF R Toolbox. This is a collection of R-based tools, which are optimized for spatial data with longitude, latitude and time dimension. For analysis and manipulation of spatial NetCDF formatted data the functionality of the cmsaf R-package is implemented. This R-package provides more than 60 operators. The visualization of the data, its properties and corresponding statistics can be done with an interactive plotting tool with a graphical user interface, which is part of the CM SAF R Toolbox. The handling, functionality and visual appearance are demonstrated here based on the analysis of sunshine duration in Europe for the year 2018. Sunshine duration in Scandinavia and Central Europe was extraordinary in 2018 compared to the long-term average.

**Keywords:** NetCDF; satellite-based; climate monitoring; sunshine duration, R-project