modisfast: An R package for fast and efficient access to MODIS, VIIRS and GPM Earth Observation data

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Summary

`modisfast` is an R package designed for easy and fast downloads of various Earth Observation (EO) data, including the Moderate Resolution Imaging Spectroradiometer (MODIS) Land products, the Visible Infrared Imaging Radiometer Suite (VIIRS) Land products, and the Global Precipitation Measurement mission (GPM) products. It enables users to subset the data directly at the download phase using spatial, temporal, and dimensional filters and supports parallelized downloads. It also streamlines the process of importing the downloaded data into R. Overall, `modisfast` offers R users a cost-effective, time-efficient, and energy-saving approach to accessing a set of key EO datasets with R.

Statement of need

EO satellite data are invaluable for monitoring and understanding our planet, with NASA's datasets like MODIS (Justice et al., 2002), VIIRS (Román et al., 2024), and GPM (Skofronick-Jackson et al., 2017) among the most important. These collections have provided crucial data for over 20 years, supporting research in areas such as climate change, disaster response, biodiversity, public health, and more (Shao et al., 2011).

However, despite the increasing availability of EO data, accessing and utilizing them remains challenging (Agnoli et al., 2023). The large file sizes and complex multidimensional layers make it difficult to access and handle long time series, especially in regions with limited internet infrastructure. This complexity often leads to underutilization of data, fragmented workflows, and reliance on proprietary, energy-intensive tools like Google Earth Engine, which can hinder transparent and reproducible Open Science.

To address these challenges, we developed `modisfast`, an R (R Core Team, 2024) package designed to simplify and speed-up the download and import of MODIS, VIIRS, and GPM time series for R users. Built on the OPeNDAP protocol (Gallagher, Potter, rmorris2342, et al., 2024; Gallagher, Potter, kyang2014, et al., 2024; Potter et al., 2024), `modisfast` enhances the existing R ecosystem of tools for accessing MODIS data by introducing new features and supporting additional data sources. It allows users to apply spatial, temporal, and band/layer filters during the download phase, optimizing data retrieval and processing while promoting open-source international standards for data access.

Target audience

`modisfast` is suitable to any R user looking to use MODIS, VIIRS or GPM Earth Observation data, either for research, education, or operational purposes.

`modisfast` is particularly suited for :

- Retrieving MODIS, VIIRS or GPM data over **long time series** and **large areas**,
- **Embedding data extraction within complex R workflows**,
- Users in regions with **limited internet access**,
- Promoting **international data access standards** and Open Science in general,
- Users who are concerned about **digital sobriety**.

Main features

Data collections available with `modisfast`

Currently `modisfast` supports download of 77 data collections, extracted from MODIS land products, VIIRS land products, and Global Precipitation Measurement.

This list may change over time. The function `mf_list_collections()` enables to get the latest list of available data collections.

Typical workflow with `modisfast`

The typical workflow to access and import MODIS, VIIRS or GPM data in R with `modisfast` is presented in Figure 1, along with a toy example.
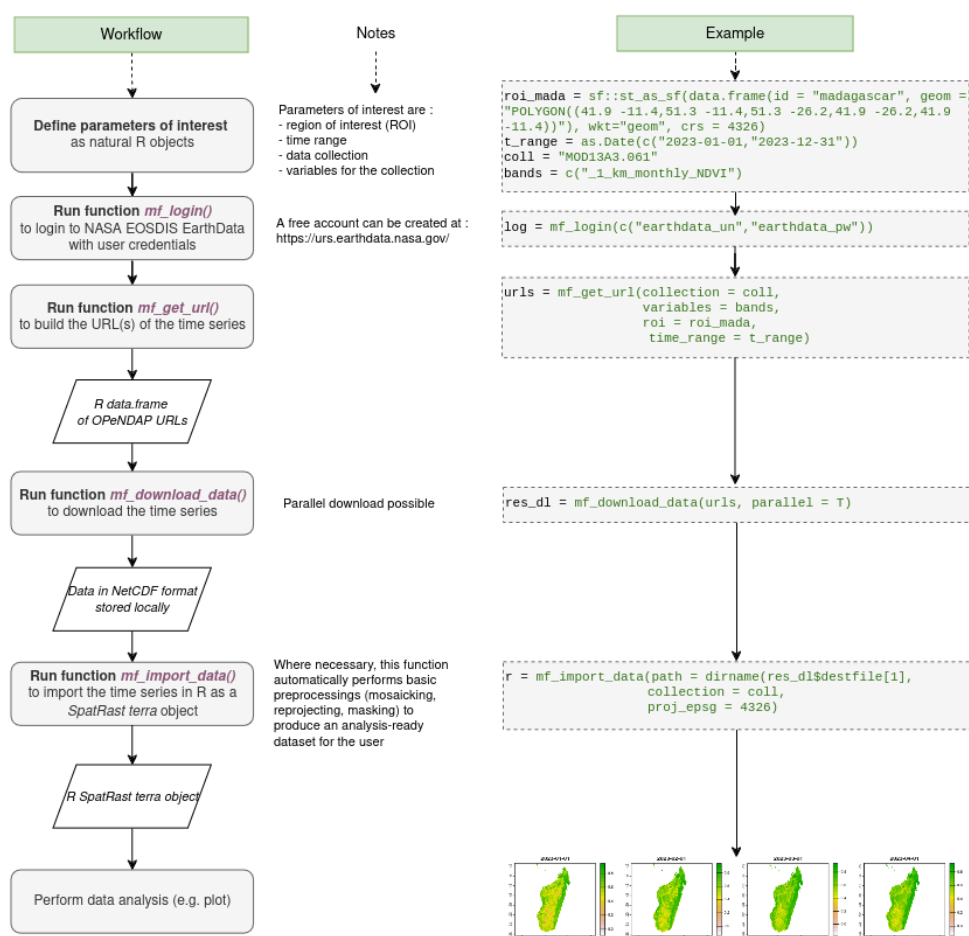

Figure 1: Workflow for MODIS, VIIRS or GPM data download and import with `modisfast`.

Vignettes and examples

modisfast provides three vignettes and examples to learn more about the package :

- a Get started vignette describing the core features of the package;
- a Get data on several regions or periods of interest simultaneously vignette detailing advanced functionalities of modisfast (for multi-time frame or multi-regions data access);
- a Full use case vignette showcasing an example of use of the package in a scientific context (geo-epidemiology).

Alternatives

Besides modisfast, there are several open-source R packages available for accessing MODIS or VIIRS Land products. Table 1 summarizes the main features of these packages. A thorough comparison of modisfast with these R packages (including data access time) can be found in the package documentation.

	modisfast	appeears	MODIS	MODIStsp	MODIStools	rgee
EO Data collections accessible	MODIS, VIIRS, GPM	MODIS, VIIRS, and many others	MODIS	MODIS	MODIS, VIIRS	MODIS, VIIRS, GPM, and many others
Last updated	August 2024	March 2024	January 2023	July 2024	December 2022	August 2024
License	GPL-3.0	AGPL-3	NA	GPL-3.0	AGPL-3	Apache License v.2.0
Available on CRAN ?	yes	yes	no	no	yes	yes
Utilizes open standards for data access protocols	yes	yes	no	NA	no	no
Enables spatial subsetting at the download phase	yes	yes	no	no	yes	yes
Enables dimensional subsetting at the download phase	yes	yes	no	yes	yes	yes
Maximum area size allowed for download	unlimited	unlimited	NA	unlimited	200 km x 200 km	unlimited
Website	GitHub	GitHub	GitHub	GitHub	GitHub	GitHub

Taconet, & Moiroux. (2024). modisfast: An R package for fast and efficient access to MODIS, VIIRS and GPM Earth Observation data. *Journal of Open Source Software*, 9(103), 7343. https://doi.org/10.21105/joss.07343.

	modisfast	appeears	MODIS	MODIStsp	MODIStools	rgee
Reference	Taconet & Moiroux (2024)	Hufkens & Campitelli (2023)	NA	Busetto & Ranghetti (2016)	Hufkens (2022)	Aybar et al. (2020)

Table 1: Comparison of modisfast with other alternatives.

Acknowledgements

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