

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

Paul Taconet ¹ and Nicolas Moiroux ¹

¹ MIVEGEC, Université de Montpellier, CNRS, IRD, Montpellier, France ¶ Corresponding author

DOI: [10.21105/joss.07343](https://doi.org/10.21105/joss.07343)

Software

- [Review](#) 
- [Repository](#) 
- [Archive](#) 

Editor: [Michael Mahoney](#)  

Reviewers:

- [@rmendels](#)
- [@V-Agudetse](#)

Submitted: 18 July 2024

Published: 13 November 2024

License

Authors of papers retain copyright and release the work under a Creative Commons Attribution 4.0 International License ([CC BY 4.0](#)).

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.

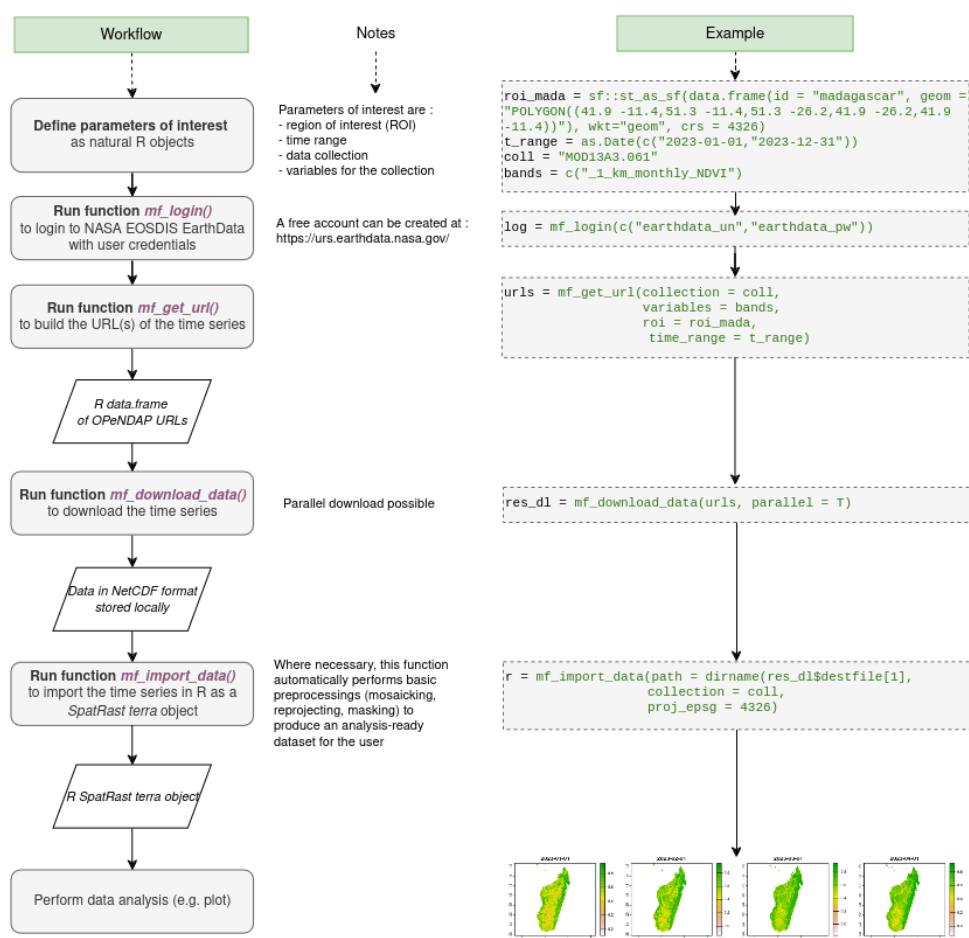


Figure 1: Workflow for MODIS, VIIRS or GPM data download and import with modisfast.

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	appears	MODIS	MODIS _{tsp}	MODIS _{tools}	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

	modisfast	appeears	MODIS	MODISrsp	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

We thank NASA and its partners for making all their Earth science data freely available, and financing and implementing open data access protocols such as OPeNDAP. We also thank the non-profit [OPeNDAP, Inc.](#) for developing and maintaining the eponym tool, and the developers of the R packages modisfast depends on.

This work has been developed over the course of several research projects (REACT 1, REACT 2, ANORHYTHM and DIV-YOO) funded by Expertise France and the French National Research Agency (ANR).

References

- Agnoli, L., Urquhart, E., Georgantzis, N., Schaeffer, B., Simmons, R., Hoque, B., Neely, M. B., Neil, C., Oliver, J., & Tyler, A. (2023). Perspectives on user engagement of satellite earth observation for water quality management. *Technological Forecasting and Social Change*, 189, 122357. <https://doi.org/10.1016/j.techfore.2023.122357>
- Aybar, C., Wu, Q., Bautista, L., Yali, R., & Barja, A. (2020). *rgee: An R package for interacting with Google Earth Engine* (v.1.0.0-alpha). Zenodo. <https://doi.org/10.5281/zenodo.3945409>
- Busetto, L., & Ranghetti, L. (2016). MODISrsp: An R package for preprocessing of MODIS land products time series. *Computers & Geosciences*, 97, 40–48. <https://doi.org/10.1016/j.cageo.2016.08.020>
- Gallagher, J., Potter, N., kyang2014, Travis, T. R., Neumiller, K., Korolev, S., Hemphill, C., Lee, H. J., Rimer, R., Lloyd, S., blackone-sudo, Kari, U., Holloway, D., rmmorris2342, Poplawski, O., Kirk, C. J. T., Hartnett, E., Davis, E., McGibbney, L. J., ... ptype. (2024). *OPeNDAP/bes: BES-3.21.0-46 for Hyrax-1.17.0* (Version 3.21.0-46). Zenodo. <https://doi.org/10.5281/zenodo.10564745>
- Gallagher, J., Potter, N., rmmorris2342, kyang2014, Kirk, C. J. T., Neumiller, K., Travis, T. R., tsgouros, blackone-sudo, Korolev, S., Horák, D., Davis, E., Lee, H. J., yuanho, Anderson, B., Holloway, D., Poplawski, O., Schmidt, R. C., & Lloyd, S. (2024). *OPeNDAP/libdap4: Hyrax-1.17.0* (Version 3.21.0-27). Zenodo. <https://doi.org/10.5281/zenodo.10564122>
- Hufkens, K. (2022). *The MODISTools package: An interface to the MODIS land products subsets web services*. <https://doi.org/10.5281/zenodo.7551165>
- Hufkens, K., & Campitelli, E. (2023). *The appeears package: An interface to NASA AppEEARS API endpoints*. <https://doi.org/10.5281/zenodo.7938190>
- Justice, C. O., Townshend, J. R. G., Vermote, E. F., Masuoka, E., Wolfe, R. E., Saleous, N., Roy, D. P., & Morisette, J. T. (2002). An overview of MODIS land data processing and product status. *Remote Sensing of Environment*, 83(1), 3–15. [https://doi.org/10.1016/S0034-4257\(02\)00084-6](https://doi.org/10.1016/S0034-4257(02)00084-6)
- Potter, N., Travis, T. R., Gallagher, J., Kari, U., Korolev, S., Neumiller, K., ideaesb, Rimer, R.,

- Holloway, D., & Lloyd, S. (2024). *OPENDAP/olfs: OLFS version 1.18.14 for Hyrax-1.17.0* (Version 1.18.14). Zenodo. <https://doi.org/10.5281/zenodo.10565216>
- R Core Team. (2024). *R: A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing. <https://www.R-project.org/>
- Román, M. O., Justice, C., Paynter, I., Boucher, P. B., Devadiga, S., Endsley, A., Erb, A., Friedl, M., Gao, H., Giglio, L., Gray, J. M., Hall, D., Hulley, G., Kimball, J., Knyazikhin, Y., Lyapustin, A., Myneni, R. B., Noojipady, P., Pu, J., ... Wolfe, R. (2024). Continuity between NASA MODIS collection 6.1 and VIIRS collection 2 land products. *Remote Sensing of Environment*, 302, 113963. <https://doi.org/10.1016/j.rse.2023.113963>
- Shao, Y., Taff, G., & Lunetta, R. (2011). *A review of selected MODIS algorithms, data products, and applications* (pp. 31–55).
- Skofronick-Jackson, G., Petersen, W. A., Berg, W., Kidd, C., Stocker, E. F., Kirschbaum, D. B., Kakar, R., Braun, S. A., Huffman, G. J., Iguchi, T., Kirstetter, P. E., Kummerow, C., Meneghini, R., Oki, R., Olson, W. S., Takayabu, Y. N., Furukawa, K., & Wilhelm, T. (2017). The Global Precipitation Measurement (GPM) Mission for Science and Society. *Bulletin of the American Meteorological Society*, 98(8), 1679–1695. <https://doi.org/10.1175/bams-d-15-00306.1>
- Taconet, P., & Moiroux, N. (2024). *modisfast: An R package for fast and efficient access to MODIS, VIIRS and GPM Earth Observation data* (Version 0.9.2). Zenodo. <https://doi.org/10.5281/zenodo.12772739>