The Journal of Open Source Software

OMEGA-Py: Python Tools for OMEGA Data

Aurélien Stcherbinine [1], **Yves Langevin** [2], **John Carter** [2,3], **Mathieu Vincendon** [2], **Yann Leseigneur** [2], **and Océane Barraud** [4]

1 Department of Astronomy and Planetary Science, Northern Arizona University, Flagstaff, AZ USA **2** IAS, Université Paris-Saclay, CNRS, Orsay, France **3** LAM, Université Aix-Marseille, CNRS, CNES, Marseille, France **4** German Aerospace Center (DLR), Institute of Planetary Research, Berlin, Germany

DOI: 10.xxxxxx/draft

Software

- Review
- Repository
- Archive

Editor:

Submitted: 01 December 2023
Published: unpublished

Summary

`OMEGA-Py` is a Python 3 module dedicated to the scientific use of data provided by the Observatoire pour la Minéralogie, l'Eau, les Glaces et l'Activité (OMEGA) instrument onboard the ESA Mars Express (MEx) orbiter (Bibring et al., 2004). It has been developed as an alternative to the IDL routines of the OMEGA legacy software provided by the instrument team for the past 20 years.

The module notably includes a re-implementation of the most recent release of the IDL OMEGA software (v10, `SOFT 10`) but also contains several additional data reduction functions such as built-in atmospheric and thermal corrections (using previously published methods) and graphics tools including interactive visualization of the data or generation of composite OMEGA maps using the `matplotlib` module, including geographic projection (Hunter, 2007).

The objective of the module is to facilitate the scientific exploitation of OMEGA observations, especially for the younger generation of planetary scientists who are more used to the Python language than IDL. Plus, the presence of built-in correction and visualization functions aims at making the huge and very complete OMEGA dataset (rich of 20 years of observations now) more easily accessible.

Since its first release in 2020, `OMEGA-Py` has been used in published studies (Leseigneur & Vincendon, 2023; Stcherbinine et al., 2021) as well as in currently ongoing projects (e.g., Barraud et al., 2022).

`OMEGA-Py` can be installed from PyPI with `pip install omegapy`, and is distributed as an official software by the OMEGA team since the release of version 3.0 deployed in October 2023.

Statement of need

The accessibility of data returned by space missions is a crucial point to ensure the development of open science. While the OMEGA dataset is public with yearly releases as of 2023, the legacy pipeline uses a proprietary software and several crucial data reduction algorithms are not public, thus severely hindering its use. Since the beginning of the science phase of the OMEGA instrument in 2004, the instrument team has provided 10 releases of the IDL software (`SOFT01` to `SOFT10`) to read the level 1B binary files that can be downloaded from the ESA PSA and generate level 2A data with reflectance spectra. However, the presence of an IDL solution only may raise some concerns:

- The cost of an IDL license, as it is a proprietary language, makes it not accessible to everyone.

- As the community (and especially the youngest generation) is moving to use mostly Python instead of IDL, the requirement to use the IDL language to access OMEGA data can limit its accessibility.

In addition, over the past years, the OMEGA dataset had a reputation in the community for being challenging and requiring a lot of investment to use. With `OMEGA-Py` we aim to tackle this reputation by providing a free all-in-one toolbox to load, correct, analyze, and visualize the OMEGA data, and thus make the unique OMEGA dataset rich of 20 years of observations easily accessible to the community and especially to the younger generation of scientists and students.

Acknowledgements

We thank all the people who helped with testing and improving the module.

References

Barraud, O., Carter, J., Vincendon, M., & Stcherbinine, A. (2022). *Spectral variability of the south polar region of Mars and implications for hydration and sulfate mineralogy*. EPSC2022–847. https://doi.org/10.5194/epsc2022-847

Bibring, J.-P., Soufflot, A., Berthé, M., Langevin, Y., Gondet, B., Drossart, P., Bouyé, M., Combes, M., Semery, A., Bellucci, G., Formisano, V., Moroz, V., Kottsov, V., Bonello, G., Erard, S., Forni, O., Gendrin, A., Manaud, N., Poulet, F., … Forget, F. (2004). OMEGA: Observatoire pour la Minéralogie, l'Eau, les Glaces et l'Activité. *ESA Publication Division*, *1240*, 37–49.

Hunter, J. D. (2007). Matplotlib: A 2D Graphics Environment. *Computing in Science & Engineering*, *9*(3), 90–95. https://doi.org/10.1109/MCSE.2007.55

Leseigneur, Y., & Vincendon, M. (2023). OMEGA/Mars Express: A new martian atmospheric dust hunter. *Icarus*, *392*, 115366. https://doi.org/10.1016/j.icarus.2022.115366

Stcherbinine, A., Vincendon, M., Montmessin, F., & Beck, P. (2021). Identification of a new spectral signature at 3 μm over Martian northern high latitudes: Implications for surface composition. *Icarus*, *369*, 114627. https://doi.org/10.1016/j.icarus.2021.114627