eur PLANET 2024
Research Infrastructure

H2020-INFRAIA-2019-1

Europlanet 2024 RI has received funding from the
European Union's Horizon 2020 Research and Innovation Programme under

Grant agreement no: 871149

Deliverable D1.15

Deliverable Title:	VAs 4th Year External Board Review
Due date of deliverable:	31 July 2024
Nature[1]:	R
Dissemination level[2]:	PU
Work package:	WP1
Lead beneficiary:	Constructor University
Contributing beneficiaries:	External review
Document status:	Final

Start date of project:	01 February 2020
Project Duration:	54 months
Co-ordinator:	Prof Nigel Mason, University of Kent

Table of Contents

1. Reference period

This summary covers previous reporting periods and the near-final state of the projects - the period from March 2020 to February 2024.

2. Composition of the review boards

This final report was prepared by the Chair by compiling comments from previous reports and comparing the current (as of 29 February 2024) state of the VA websites and deliverables to the original goals and objectives for each project as stated in the work package descriptions. The contributing reviewers with their years of service were:

Anne C. Raugh, PDS Small Bodies Node, University of Maryland, USA (Chair, 2022-24)
Christophe Arviset, ESA, Madrid, Spain (2021, 2022)
Caitriona M. Jackman, Dublin Institute for Advanced Studies, Ireland (2021)

Hannah Kerner, University of Maryland, USA (2021)

Giovanni Lapenta, Katholieke Universiteit Leuven, Flanders, Belgium (2021)

Benjamin Lynch, University of California - Berkeley (2023)

Chiara Marmo, Inria, Paris Saclay, scikit-learn Consortium (2021, 2022)

Beatriz Sanchez-Cano, University of Leicester, UK (2022)

James A. Skinner, Jr. United States Geological Survey (2023)

Maria Teresa Melis, University of Cagliari, Italy (2021)

Kiri Wagstaff, AAAS Congressional Fellow in Artificial Intelligence (2023)

David A. Williams, Arizona State University, Tempe, Arizona, USA (2021)

The chair wishes to thank all those reviewers who have contributed over the years.

3. Summary Comments

This period marks the end, or nearly the end where extensions have been granted to mitigate the impact of the 2020-2021 pandemic, of the Europlanet 2024 RI Virtual Access activities. Consequently, this report will summarise the highlights and achievements of the VA projects and provide some guidance for details to be wrapped up in the final few months of funding where available.

3.2 Objectives

Has the set of VA activities met the objectives in the relevant period as described in the Description of Action? If not, please provide suggestions. If not applicable to the current reporting period, please state it.

Briefly: Yes. Each project has succeeded in meeting all or nearly all of the objectives laid out in the original work packages, usually completely, and in some notable cases to a greater degree than anticipated. As this is the last report to be generated, it seems appropriate to detail the accomplishment of the objectives laid out in the work package in the "Highlights" section for each project.

3.3 Impact

Has the set of VA activities met the expected impact in the relevant period as described in the Description of Action? If not, please provide suggestions. If not applicable to the current reporting period, please state it.

It is difficult, if not impossible, to identify meaningful metrics that can truly reflect even the short-term, let alone the long-term impact of the VA projects. It is, in some sense, like trying to assess the impact of a teacher on a class of students at the time of graduation. Yes, there are test scores that might give some indication of baseline learning, but the impact that a teacher has on a student extends beyond demonstrating the acquisition of some factual knowledge. The experience of learning with a good teacher can motivate, mitigate, and subtly direct the actions and achievements of the former student for decades after the direct interaction has ended.

All the VA projects have seen increased numbers of users at websites, papers at conferences, interactions in workshops. All have spent significant effort developing materials, methods, and/or datasets that will continue to contribute to the growth of

their respective communities for some years. All the projects have made significant contributions of long-term benefit to their communities in these respects. Among these significant achievements, some are of particular note. These will be described in the "Impact Highlights" section for each VA project.

3.4 Dissemination

Has the set of VA activities disseminated and exploited results in the relevant period as described in the Description of Action? If not, please provide suggestions. If not applicable to the current reporting period, please state it. If not applicable to the current reporting period, please state it.

In dissemination the VA projects have been uniformly successful. To the limited extent that web metrics can be trusted, all web sites are seeing increased use by likely "real users" - users who are seeking data, information, training, and support. In an era where citation of datasets and service portals is still the exception rather than the rule, there are slowly growing counts of citations and acknowledgements of project outputs. The 2020-21 pandemic had the surprising positive outcome of demonstrating both the usefulness of and the demand for virtual opportunities for training, and in particular for meeting the needs of potential users with limited ability to travel who might otherwise never have joined the community. Collaborations outside the VA projects - either with missions, or institutions and agencies, or individuals - have established professional relationships that are likely to last substantially longer than the Europlanet 2024 RI-funded interactions.

Specific per-VA Comments

In this section, the usual "Highlights" topic has been replaced by an "Objectives Review" topic, and an "Impact Highlights" topic has been added. "Specific actions suggested" has been supplanted by "Suggested actions to prioritise", which is primarily aimed at providing an indication of what might be given higher priority for attention in the final months of funding, where available.

4.1 VESPA

4.1.1 Objectives Review

1.1.a.1 *Increase data service basis*
Done. VESPA began the period hosting about 50 services. At the date of this writing, 68 services were listed - an increase of over one third. This is following the Year 3 "Cleanup" activities, in which many existing services were updated for protocol changes or improved data, and a few older services no longer of use to the community were retired.

1.1.a.2 *Adoption of data distribution service by data providers*
Done. Data located by the VESPA interface can be downloaded, accessed by URL, and/or piped directly to compatible analysis environments, as appropriate.

1.1.a.3 *Provide access to more users*
Done. The number of users showing in the web logs (using a consistent analysis technique to mask spider and robot activity) were up each year. The addition of new disciplines (heliophysics and exoplanets, in particular) has

also drawn in new users who are being served by new data services apropos to their interests. The improvements to the VESPA portal, including additional search parameters, further encourage new use and new users.

1.1.a.4 *Connect new display and analysis tools*

Done. The expansion of IVOA protocols and recommendations into the planetary domain is leading to increasing numbers of existing tools supporting planetary analysis, as well as new tool development.

1.1.a.5 *Increase thematic diversity (add solar and exoplanet)*

Done. Multiple data services have been added for both solar/heliophysics and exoplanet research.

1.1.a.6 *Simulations on demand*

Not as yet, but there are deliverables for this objective pending in the extended period. There are results of on-demand runs from, for example, the TRANSPLANET simulator of the SPIDER project, available as static data sets.

1.1.a.7 *Establish three data hubs*

Done. Three hubs were established as part of the Year 2 activities, and cooperation through GitLabs in this endeavour has resulted in unexpected benefits to implementation workshops, as well as the addition of continuous integration to support automatic deployment and updates in physical servers and in the European Open Science Cloud.

4.1.2 Impact Highlights

Part of the VESPA development has included expanding the International Virtual Observatory Alliance (IVOA) protocols and recommendations to include support for solar system data, related searches, and tools. This included extending the core Table Access Protocol (TAP), used pervasively in the IVOA for communication, to include planetary parameters. It also included extending existing vocabularies and developing new ones to support planetary concepts and data types not previously represented in the IVOA. The impact that these enabling developments will have on access to planetary data will continue long after the 2024RI program has ended. Even now they are driving additional adaptations in related standards for further solar system application.

4.1.2 Specific issues

No major issues are noted.

One minor issue: The "VESPA Wiki", linked from the VESPA Support pages, is in need of an update for the end of the Europlanet 2024 RI project in order to adjust verb tenses, and also to supply some sort of disposition for pages that were anticipated, but never created - for example, about half the links in the lists on the VA-Task 2. Enlarging content from beneficiaries (https://voparis-wiki.obspm.fr/display/VES/VA-Task+2.+Enlarging+content+from+beneficiaries) page. This is a minor issue because the primary VESPA Support pages are up to date and in good shape.

4.1.3 Suggested actions to prioritise

Highest priority, of course, should go to completing the run-on-demand integration work.

A general review and update for the VESPA2024 section of the VESPA Wiki would be nice to have if resources permit.

4.2 SPIDER

4.2.1 Objectives Review

1.1.a.8 *Transform PSWS into SPIDER*
Nominally done. In fact, the existing PSWS website has been carried along as a sort of "Easter egg" under the new SPIDER site. There has been no real "transformation". The designs of both sites are the same, but the content has been kept distinctly separated - accessible only from the respective SPIDER or PSWS page. Content on the older site tends to languish more than that of the SPIDER site.

1.1.a.9 *Provide contextual information like predictions and alerts for analysis and mission support*
Done. Predictions have been incorporated into the Automated Multi-Dataset Analysis (AMDA) tool. No "Alerts", however, were included in SPIDER development activities, nor were they scheduled to be. It seems to be an anomaly that they are mentioned in the objective.

1.1.a.10 *Support BepiColombo and JUICE missions*
Very much done. In addition to the two missions targeted at the beginning of the RI, SPIDER is also supplying predictions and support for Juno and Solar Orbiter - a substantial extension.

1.1.a.11 *Deploy run-on-request infrastructure and related databases*
Pending. This is one of the final planned activities for SPIDER. It will be deployed through VESPA and, as noted above, this activity is expected to be completed by VESPA during the extension period.

1.1.a.12 *Archive runs and make available through VESPA*
Nominally done. The only identifiable such service on VESPA currently is from the TRANSPLANET service, which was an existing PSWS service, not a new SPIDER service. It is not clear when these runs were made available through VESPA. (It is possible that there are other datasets that would fall into this category, but they are not recognized as such from the descriptions available in the VESPA portal.)

4.2.2 Impact Highlights

The influence of the collaboration between the SPIDER team and the Juice, BepiColombo, JUNO, and Solar Orbiter missions helps not only the mission planners, but also the greater community of users by establishing *de facto* standards for these services and related data. The SPIDER-developed prediction services, in particular, have the potential to positively impact the success rate of missions, planetary and otherwise, for many years.

4.2.2 Specific issues

Virtual access, at least through the SPIDER portal, does not appear to be a priority for the SPIDER project.

On the SPIDER site:
● On the "About" page, Europlanet 2024 RI is referred to as "starting" and future tense is used throughout.
● Function C5 is still described as a "prototype"
● Function C7 is described as "runs-on-request" but is presented as an executable with no information given about environment or licensing requirements.
● Function E2 is described as "In development, operational end of 2022".
● On the "Presentations & News" page, the most recent item is from EPSC 2021, and none of the presentations can be viewed because of privacy settings on the videos.

On the PSWS site:
● There is still pervasive use of future tense throughout the site with very few exceptions.
● On the Predictions page, the "Meteor Showers" VESPA link returns an "Internal Server" error.
● On the Alerts page, there is a future-tense reference to an alert system with no indication if this ever came into existence, and a link to "planetary space weather predictions" that apparently leads to a service that is not available.

Issues with the site mentioned in previous reports persist and seem to get a bit worse as links become inoperative over time. This has been mentioned as an issue in all previous reports, but never thoroughly addressed. The VESPA link reported as inoperable in 2022 is still inoperable, for example.

4.2.3 Suggested actions to prioritise

The website(s) needs a careful and sweeping round of editing and updating if it is going to remain in its present form. The verb tenses should be corrected, the links should be checked, the final dispositions for all functions should be updated, and users should encounter a website that gives an accurate and up-to-date description of the code and services that are truly available. It is difficult to justify the claim that Virtual Access has been provided without a well-curated website to act as the hub for that access.

4.3 GMAP

4.3.1 Objectives Review

1.1.a.13 *Establish a solid infrastructure to foster, support and sustain the production of planetary geological maps and related products following standard procedures.*

Done. GMAP has been noted for its training documents, its data access portal, and its establishment of multiple international collaborations. It has been an active, positive force in growing the mapping community through its participation in workshops and conferences, and its user support on various platforms, including social media.

4.3.2 Impact Highlights

The GMAP project devoted a significant amount of effort to developing training materials for basic mapping processes very early in the funding period. This put them in an ideal position to begin to grow the community through most of its development. Capitalising on the already established social media presence of the prior PLANMAP project, GMAP provided and continues to provide active support for its user community through social media, workshops, recorded presentations, and directly through its Europlanet portal via "Contact Us" forms users and potential users can immediately fill in and submit.

4.3.2 Specific issues

No major issues are noted. In fact, no minor issues are noted either, notwithstanding the prolonged downtime the site and its various components recently experienced. This was a situation where having multiple methods of communication with users paid dividends.

4.3.3 Suggested actions to prioritise

None noted. If there are resources that can be put to preventing another incident of prolonged outage, they are most likely best invested there.

4.4 ML

4.4.1 Objectives Review

1.1.a.14 *Link tools developed via VESPA, GMAP, SPIDER as appropriate*

Done. In the case of VESPA, the datasets resulting from the science cases have been configured as VESPA data services. In the case of SPIDER, the relevant ML pipelines have been incorporated into the tools. In the case of GMAP, ML pipelines have been deposited in GitHub to address the mapping use cases presented, which focused on feature identification.

1.1.a.15 *Provide sustainable, open access to tools developed, with documentation*

Partially done. For pipeline code intended for adaptation and reuse, GitHub is a well-suited venue. *The Europlanet Machine Learning Book*, in its online presentation, is shaping up to be an excellent, interactive resource. The ML portal, with its links to both real-world use cases and tutorials at various levels, is also a valuable though still incomplete resource for both experienced users and newcomers to machine learning. There are, however, issues of completeness, described following.

4.4.2 Impact Highlights

The ML project has been working through a period of explosive growth in Artificial Intelligence (AI) and its applications. The introductory level tutorials, practical Jupyter notebooks, and documented, working science use cases they have created and collected provide an introduction to the field that invites and supports the growth of a very young solar system community of practice employing machine learning.

4.4.2 Specific issues

There are multiple significant missing pieces on the ML portal:
- "Science Case Tutorial" promises a tutorial for each case. There are currently only 2.
- About a third of the science cases do not include links to repos with results. A few containing nothing more than a brief description of the use case.
- The last "News" item was posted in mid-2022. In fact, it appears that most of the website has not been updated since 2022.
- While what is currently included in *The Europlanet Machine Learning Book* appears to be informative, useful, and a good basis for developing new users, it is far from complete and accessible only to users who already know where to find it.

Surprisingly, *The Europlanet Machine Learning Book* does not appear to be linked into the website at all, which seems a significant oversight. Even partially complete, the content it contains for some of the science cases might be valuable to prospective users.

4.4.3 Suggested actions to prioritise

In some respects, the website, the tutorials, and the book present similar information in different forms. In the face of limited resources, the best strategy may be to focus on providing one complete set in whichever form can be produced within those limits. Then, if additional resources are available, the other formats can be filled out from the completed set.

If the website cannot be maintained, then the non-static sections would be better removed. Sections like "News" that are clearly not being maintained lead users to assume the entire website has been abandoned.

 Additional comments and suggestions

Overall, the Virtual Access projects and tasks have been successful in creating content and services that have served their communities and will continue to have impact long after the end of the funded period. Despite the 2020-21 pandemic, and in particular cases because of it, most of the VA projects extended opportunities for

training and collaboration past the usual hands-on threshold to include more and varied virtual participants than could have been reached otherwise. The user communities have grown, and are becoming intertwined in ways that will benefit planetary research now and in the future.
It has been a pleasure watching them succeed.