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GMAP VA 1st year report

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Executive Summary / Abstract:

A summary of the initial VA activities and preparations for the upcoming VA call and call for GMAP users is provided. The impact of COVID-19 on the VA is also described. An outlook of upcoming VA activities and overall timeline for Yyear 2 is provided. Within Task 8.1 the information and data access components of the VA have been set up, for both internal and external community use (documentation, code, data sharing platforms). Task 8.2 concentrated on reaching the community in EU and beyond through a call embedded in a dedicated Winter School, making use of developments from both JRA (See D9.2) and existing or past H2020 Space projects. The integration of those existing results were included in Task 8.3, and additional external inputs to WP10 were provided. Task 8.4 started and Task 8.5 activities resulted in the successful matching MOST project by the GMAP VA Chinese partners.

1. **Nature:** R = Report, P = Prototype, D = Demonstrator, O = Other

2. **Dissemination level:**

PU	PP	RE	CO
Public	Restricted to other programme participants (including the Commission Service)	Restricted to a group specified by the consortium (including the Commission Services)	Confidential, only for members of the consortium (excluding the Commission Services)

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1. List of Acronyms and abbreviations

Table 1: List of acronyms and abbreviations

Acronym	Description
ASP	Ames Stereo Pipeline
CBK PAN	Centrum Badań Kosmicznych - Polskiej Akademii Nauk
DLR	Deutsches Zentrum für Luft- und Raumfahrt
DoA	Description Of Action
EPEC	Europlanet Early Career
EPN	Europlanet
ESA	European Space Agency
FAIR	Findable Accessible Interoperable Reusable
INAF	Istituto Nazionale di Astrofisica
ISIS	Integrated Software for Imagers and Spectrometers
ISRU	In Situ Resource Utilization
JACOBSUNI	Jacobs University Bremen
JRA	Joint Research Activity
ML	Machine Learning
MOST	Ministry Of Science and Technology
PLANMAP	PLANetary MAPping (H2020 project)
RI	Research Infrastructure
UDA	Università D'Annunzio
UNIPD	Università degli Studi di Padova
UPWARDS	Understanding Planet Mars (H2020 project)
USGS	United States Geological Survey
VA	Virtual Access
VESPA	Virtual European Solar and Planetary Access
WWU	Westfälische Wilhelms Universität Munster

2. Introduction

The GMAP VA activities set out in the DoA include the following tasks:

- Task 8.1 - Coordination
- Task 8.2 - Community mapping projects
- Task 8.3 - 2D/3D Geological mapping
- Task 8.4 - Geological Mapping Integration
- Task 8.5 - Sustainability

The various tasks, individually and collectively, based on inputs and developments of the JRA (e.g. Nass et al., 2020; D9.1) have started, although no major output or deliverable is scheduled yet for the current reporting period (Year 1). The COVID-19 situation has prompted some delay for the upcoming deliverables and milestones, as detailed in the section a.

The mechanics of the GMAP VA Call have also been detailed internally, so that the call will coincide, not exclusively, with a periodic (yearly) winter school or workshop.

a. Impact of the COVID-19 situation on VA

GMAP VA Activities are from the design phase virtual in nature, in terms of interaction and tools (mostly online data services). In-person events are limited and largely linked to possible visits to VA-contributing institutes on specific tasks and techniques by the mappers, or through workshops and courses / summer and winter schools.

The impact of COVID-19 has been both on the infrastructure-participating partners and the community as a whole. Therefore, the planning for 2021-2022 has been rescheduled, with some delays on relevant deliverables and milestones identified in the Grant Amendment, summarised below in Table 2:

Table 2: list of the deliverables, leading partners and delivery dates in project months

No.	Deliverable name	Lead partner	OLD Due project month	NEW Due project month
D8.1	GMAP VA 1st year report	UNIPD	12	12
D8.2	Data integration portal	JACOBSUNI	12	16
D8.3	Mapping training material: Basic geological maps	UDA	17	19
D8.4	GMAP VA 2nd year report	UNIPD	24	24
D8.5	Community mapping report 1	UDA	25	26
D8.6	Training materials: 3d and geomodelling	UNIPD	25	26
D8.7	Training materials: lithostratigraphy and landing sites	WWU	26	27
D8.8	Geologic mapping integration report and published data (first iteration)	JACOBSUNI	26	27
D8.9	Training materials for resources	CBK PAN	29	30
D8.10	GMAP VA 3rd year report	UNIPD	36	36
D8.11	Community mapping report 2	CBK PAN	41	41

D8.12	Geologic mapping integration report and published data (second iteration)	INAF	46	46
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3. Activities performed (per task) in the reporting period

The activities carried out during Year 1 are described for each task. An overview of upcoming activities of the various tasks is provided in the final section.

a. Task 8.1 - Coordination

Activities in the coordination task 8.1 during the first year targeted the planning and the initial setup of basic services that will be needed for supporting VA3 and JRA3 activities in terms of digital infrastructure.

The domain europlanet-gmap.eu was acquired by GMAP and dedicated to the main website (Figure 1) that will serve as the entry point for presenting the GMAP initiative, collecting most notable resources in a single place for users access and providing basic guidance for publishing new maps, request support and contributing to the overall project.

The website is built on the same open source Content Management System (wordpress) already employed for the main Europlanet website europlanet-society.org. The same theme, with minor changes has also been adapted. The website has been already populated with the basic content needed to support the calls and will be updated as soon as new deliverables are published.

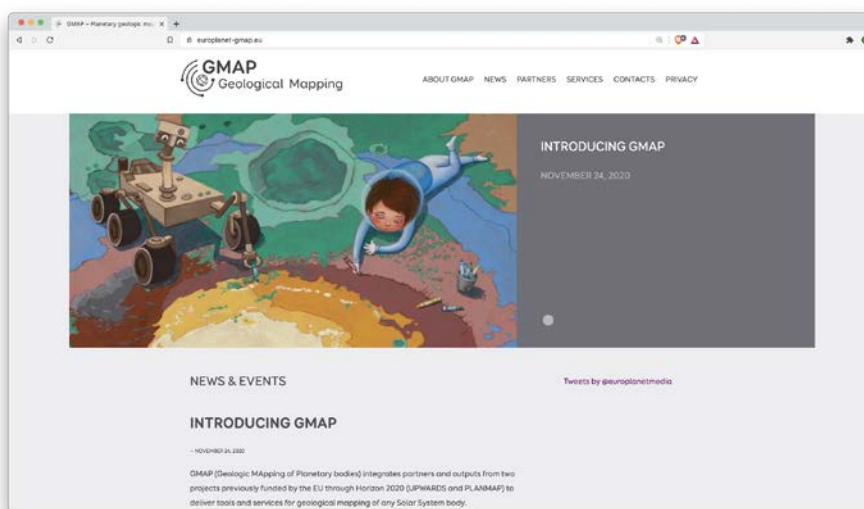


Figure 1: The GMAP website based on the same theme used for europlanet-society.eu. The graphics for the website are in large part inherited from the PLANMAP project. The website now hosts basic presentation content for the GMAP activities and will serve to introduce the overall project to the end users, providing an easy-to-access and clear entry point.

To support the code development and long term tracing of the activities, an internal gitlab instance has been set up at git.europlanet-gmap.eu, providing a repository system that will be used internally for development purposes and versioning control. Its use is mostly internal and it also provides tools adequate for issue tracking that can be employed for managing tasks within coordination (T8.1).

To foster the mutual exchange of information within the action and towards end users, an additional wiki portal has been launched at wiki.europlanet-gmap.eu. The portal is supported by open source XWiki platform, and provides collaborative editing of documentation for both end users and internal use. The wiki provides granular access depending on users' permissions and it is meant to become a public resource for planetary mapping activities, hosting the more dynamic content that will not be featured on the main website (europlanet-gmap.eu).

b. Publication venues

Preliminary agreements with the Journal of Field Trips and Geological Maps editorial board have been reached for publishing GMAP-produced maps in a peer-reviewed journal. Although not yet indexed in the web of knowledge the journal is the only one exclusively dedicated to geological maps in Europe and, to our knowledge, worldwide; it is golden open access, free of charge and supported by a European national geological survey (Italian geological survey). All these aspects should guarantee the necessary visibility to the mapping products. The agreement comprises a slight modification of the journal aims, web page and editor members in order to enhance the planetary mapping topic. The possibility exists of a dedicated space for planetary mapping and future special issues to collect GMAP inputs. Since in Europe there are no national geological surveys producing geological maps on a regular basis and many GMAP products will be not standard quadrangles, this solution appears the most suitable one for the sustainability of the publication of future planetary geological maps in Europe.

c. Task 8.2 - Community mapping projects

Initial support to the community of mappers have been provided by GMAP members in the form of data processing and map-creation support. Contacts with mappers has been mostly inherited by previous projects, such as PLANMAP and UPWARDS although some new collaborations have been already established (i.e. University of Tokyo) and further ones are expected after the Planetary Mapping Winter School.

The user-base will consistently be increased in the coming months through activities that will directly target individuals and entities through dedicated actions. In addition, newsletters, social media channels and mailing lists of the Europlanet Society/RI, EPEC and the VA partners will reach out to different countries and communities . To this aim, specific duties have been already defined to distribute the load of establishing new contacts and managing existing ones (Table 2).

Table 2: current state of the worldwide contact coverage

Countries and areas	Contacts being performed within GMAP	Notes
Italy, Spain, Balcanic countries	UDA, UNIPD	
Germany, Scandinavian countries, Russia	WWU, UDA	
France, Eastern Europe	CBK PAN	
Africa	UDA, UNIPD	
South America	JACOBSUNI	
China and other Asian countries	UNIPD, JACOBSUNI	

India, Japan	UNIPD	Individuals contacted, more to be reached
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i. GMAP VA Call

GMAP activities will focus on an open call for end-users that need support in map creation. The call has been established to remain open for the whole duration of the RI. This choice is due to the peculiarity of the mapping process which might require many months to be completed and is better supported by a long term activity, in which each new action to support users is staggered in time, to produce a constant load of the infrastructure.

As a first-year activity this call will be formally open during the planetary mapping winter school, which is organised by the former planetary mapping project PLANMAP and the EPN-2024-RI GMAP VA.

The planetary mapping winter school will focus on planetary geologic mapping and 3D geological modelling, and will be held virtually between the 1st and the 5th February 2021. The school will provide an overview of the technical and scientific skills needed by the next generation of planetary mappers by targeting young scientists at master, PhD and early Post-doc level. Interest in the school was so high that the registration had to be closed two weeks early after 200 participants was reached.

This event will also put in place an overall architecture for future GMAP schools that will serve as a core event to publicise VA/JRA activities during the years to come. The infrastructure comprises a dedicated web domain (<https://www.planetarymapping.eu/>) which will be used to host the main website for this and future schools and the required event subscription system.

The school will also provide filmed material for future promotion of GMAP activities. The school is planned to be repeated online and coupled, in the future, with focused in person workshops. The event will correspond to the opening of the public Call, which from that moment onward will be opened to potential mappers. The Call will be kept open during the year with a rolling system with a potential for formal mid-year submissions. The GMAP VA will support proposals similar to the VESPA VA, i.e. using a school/workshop yearly event (similar to the VESPA implementation workshop) to kick-start the mapping projects to be carried out in the upcoming year(s). The follow-up, as per the DoA, will be performed using mostly online interactions (e.g. direct or via the Open Planetary forum) and - when relevant, possible and desirable – dedicated on-site visits.

The experience so far, driven by the COVID-19 situation and the forced choice of online interaction methods, despite difficulties, has demonstrated the potential added value of such online school/workshop interaction, particularly related to its scalability, e.g. recording and sharing school/workshop materials, as well as not being limited by synchronous interactions. This is particularly valid for a winter school with people joining from very different time zones and potentially different travel resources.

d. Task 8.3 - 2D/3D Geological mapping

Activities of Task 8.3 targeted the adaptation and creation of teaching material and the contribution to mapping tools that will be needed for practical mapping activities and 3D models creation.

Python notebooks, resulting from previous activities, are used as the code for reproducing the 3D geological modelling performed using the Chang'e 3 radargram and are now maintained by GMAP on the dedicated GitHub space (github.com/europlanet-gmap) and will serve as introductory material for learning 3D geological modelling.

Task 8.3 also contributed to several other community-driven projects that are instrumental to JRA activities:

- Contributions to the mappy tool (<https://github.com/europlanet-gmap/mappy>). This tool is meant to help the creation of complete and consistent mappings throughout the project, and it is built in the form of an easy to use QGIS plugin.
- Initial python3 port of circle craters QGIS plugin (<https://github.com/europlanet-gmap/circle-craters>). The tool aims at the easy mapping of craters for crater counting and 'diam' file export.
- Contributions to planetary mapping symbols (<https://github.com/afrigeri/geologic-symbols-qgis>), which constitutes the first collection of open source symbologies for planetary geologic mapping. Contribution to WP 10 (ML): GMAP provided a landform recognition use case within Task 8.3 by providing datasets and documentation for supporting the creation of a machine-learning pipeline for the automatic recognition of mounds on Mars (Figure 2 – see D10.1 ML 1st Year Report for more details).

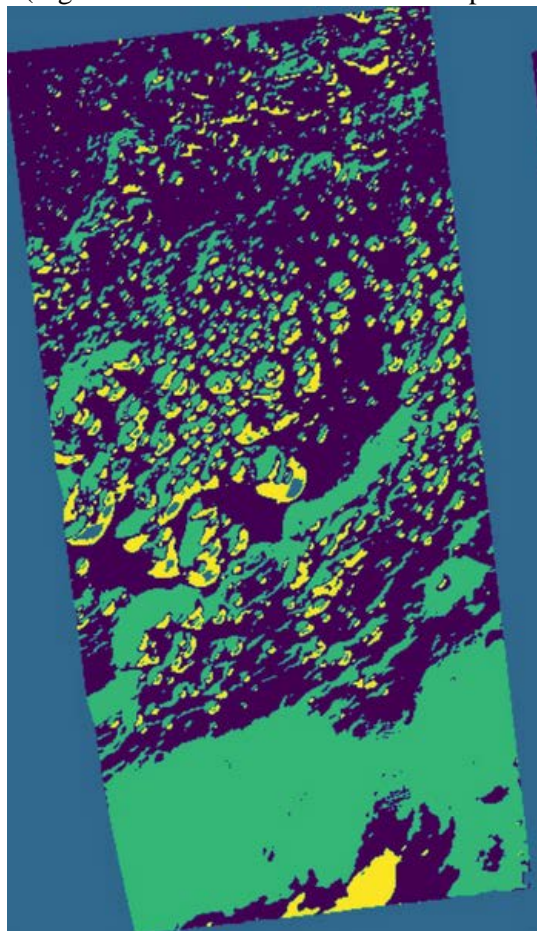


Figure 2. Surfaces corresponding to mounds detected by WP10 team with the data made available by GMAP.

The datasets are currently available over the private gitlab infrastructure and will be made publicly available after the end of the development of the mound recognition processing pipeline.

Additional mapping projects currently under development and supported by the GMAP infrastructure are :

- Structural map of Noctis Labyrinthus region on Mars, which will provide a quantitative framework for a better characterisation of the extensional history of the region. The mapping is performed by PhD candidate Mayssa El Yazidi.
- Characterisation of La Corona lava field planetary analogue at Lanzarote island (Spain), comprising mapping and 3D laser scanning of an extended lava tube, which represent a good analogue for lava tubes on the Moon or Mars. The project is developed by Ilaria De Tomasi, PhD candidate, UniPD.
- Landing site and traverses geologic map - Northwestern quadrant of Copernicus crater, Moon - Mapping aims to evaluate this region as landing site for exploration and sampling. The mapping is performed by Filippo Tusberti, at the moment with no affiliation, but formerly UniPD
- Landing site and traverses geologic map - Tsiolkovskiy crater, Moon
The mapping is performed by Gloria Tognon, PhD candidate, UniPD
- Cerberus Fossae, Mars - Structural mapping of the huge fractures system
The mapping is performed by Trishit Ruj, University of Tokyo

Cited mapping products will be totally or in part published by GMAP.

An image classification python notebook, based on pytorch, is available for demonstration purposes and includes a small dataset and a pretrained model. The code relative to proper classification will be published after the consolidation of pipelines (Nodjoumi, 2021). A landforms object detection python notebook, based on pytorch, has been developed and has been used for mapping possible cave candidates on Mars's Tharsis Region, still under validation. Obtained results will be published and the notebook, including reference dataset, will be released.

Deep learning methods are investigated parallel to machine learning methods and pipelines are under development and testing.

e. Task 8.4 - Geological Mapping Integration

i. Data Portal

The development of the GMAP data portal was initiated, based on existing developments from PLANMAP¹.

ii. FAIR data

The availability of GMAP products and underlying datasets is going to be FAIR, as also recommended by the VA Review Board (see also Raugh et al., 2020), and building on the practice of PLANMAP (e.g. Brandt et al., 2020, also in Luzzi et al., 2020).

f. Task 8.5 - Sustainability

Although the sustainability action was planned to begin at a later stage of the project, some relevant activities have been already carried out. The Task 8.5 activities are in line with the following main objectives:

- 1) Preparing concepts for future new projects that can support planetary geological mapping activity during EPN-2024-RI and beyond
- 2) Setting up a common coordination with Chinese projects on similar subjects
- 3) Improving the interactions with USGS for future cooperation

¹ <https://data.planmap.eu/>

- 4) Consolidating the cooperation with the European and national space agencies
- 5) Setting up relationships with European national geological surveys and societies
- 6) Setting up relationship with private companies interested on in situ resource utilisation

Funding of more than 3M RMB (400kEuros) from the MOST project of the Chinese partners of GMAP has been confirmed. This successful bid is particularly significant for delivering points 1 and 2 of the list.

The cooperation with USGS will be strengthened thanks to planned common actions such as workshops, conferences as well as dedicated meetings. In particular, an initial discussion on the following topics of common interest and mutual benefit has been initiated:

- Promotion of an international discussion on techniques and methods, e.g. on map units description, units correlation and mapping of cratered terrains.
- Co-authorship of resulting manuscripts on methods and techniques.
- Formation international geological mapping working group with different panels for each planetary body.
- Potential for USGS publication of non-U.S. maps.
- Future shared planetary mapping meetings in Europe to foster European community efforts.

An initial step towards the integration of geological maps within the Matisse database (<https://tools.ssdsc.asi.it/matisse.jsp>) of the Italian Space Agency has also begun as a sustainability action for future stable dissemination of GMAP products.

An agreement has been made with the Geological Field Trip and Map journal (<https://www.geologicalfieldtripsandmaps.com>). This represents the start of a strong relationship with the Italian Geological Survey and the Italian Geological Society, which also is in turn associated with the Spanish Geological Society for planetary geological science topics.

Preliminary contacts have been carried out with the mining exploration company SRK consulting (<https://www.srk.com>) for in situ resource detection and evaluation. However a long-term collaboration project is not yet agreed.

The mapping projects and related products of the MOST project will be published via GMAP VA channels.

g. Outreach and dissemination

- GMAP has been presented as an invited keynote at the DLR Software System internal workshop in November 2020.
- GMAP is co-organising the first virtual Planetary Mapping Winter School that will be held in February, 2021.
- GMAP established its initial presence on several online platforms to foster outreach
- New communication channels (i.e. forum and direct communication) will be established and maintained as heritage to the first Planetary Mapping Winter School.

4. Timeline and outlook

The GMAP Winter School embeds several activities of the VA, including the collection of community mapping projects, the training of the community at various levels, and the initial preparation of documentation on 2D and 3D mapping that will evolve through the projects.

The ongoing high interest of the community in the winter school is prompting the planning of follow-up activities in the form of online or hybrid summer schools and organisation of workshops at different levels that will allow for engagement with the community and follow-up with participants starting mapping projects.

A plan for each task is included in Table 3.

Table 3: Envisaged activities of GMAP VA for Year 2

Task no.	Name	Plan for Y2 of RI
8.1	Coordination	Coordination among GMAP partners both within VA and JRA. Coordinate activities with Chinese equivalent MOST project.
8.2	a. Community mapping projects	Organise future Winter Schools and sustain mapping projects that will be activated at the first Open Call, in addition to follow-up schools and workshops.
8.3	b. 2D/3D Geological mapping	Preparing the first mapping training materials
8.4	c. Geological Mapping Integration	
8.5	d. Sustainability	Iteration with MOST and embedding of initial Chinese mapping project. Improving the relationship with USGS, European Geological services and societies, ESA and National Space Agencies. Defining common projects with SRK and other companies potentially interested in ISRU.

5. References

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