Europlanet 2024 INAF

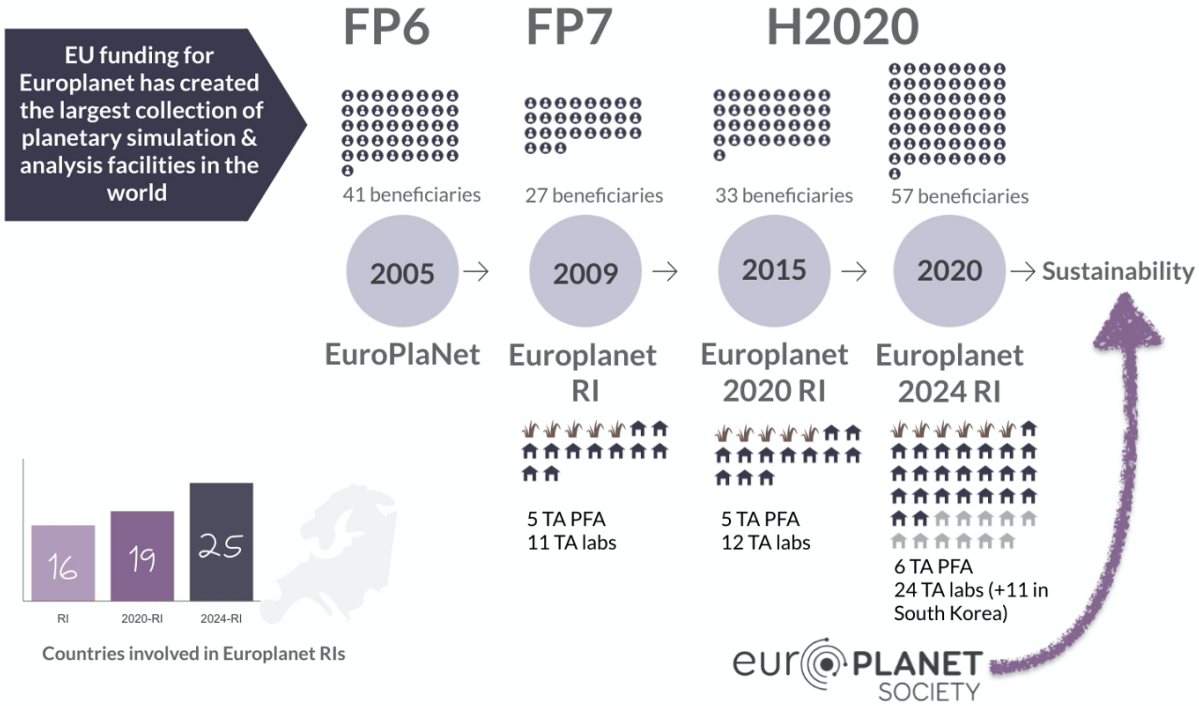
Stavro Ivanovski on behalf of the Europlanet INAF team

Europlanet 2024 Research Infrastructure (RI)

- The project is funded through the European Commission's Horizon 2020 programme and runs for four years from 1 February 2020 until 31 January 2024.
- The Consortium is led by the University of Kent, UK, with 56 beneficiary institutions from 25 countries in Europe and around the world, plus a further 44 affiliated partners.
- The project draws on the Europlanet Society and its network of Regional Hubs to disseminate activities and develop a diverse community of users.

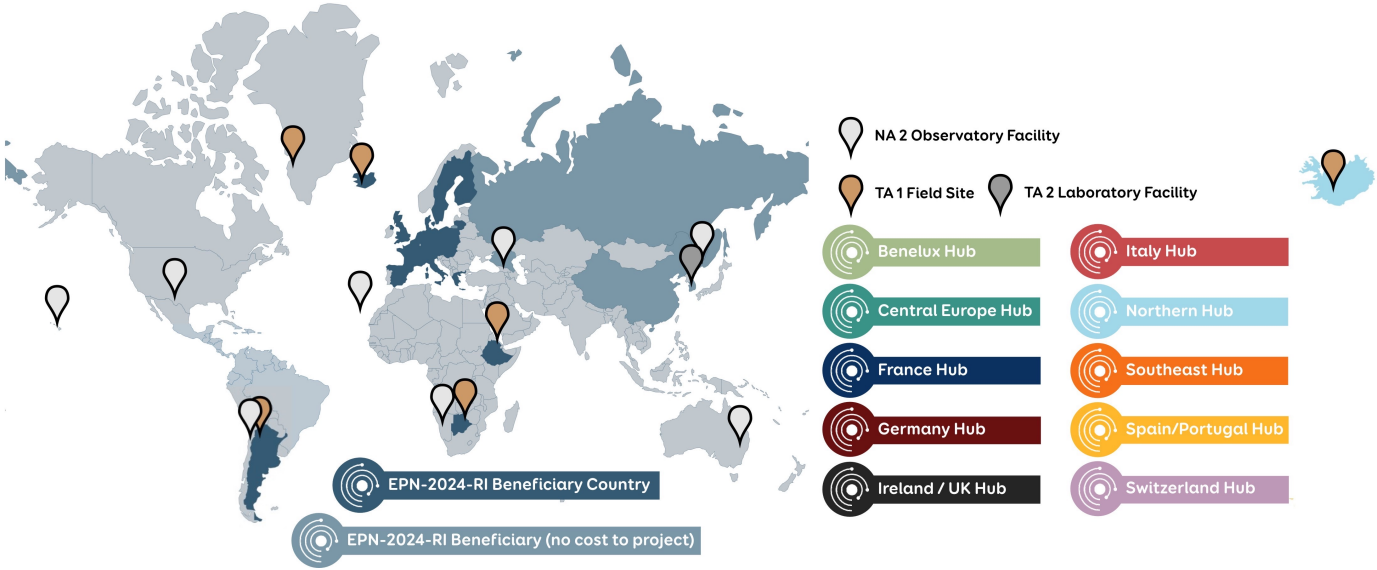
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 871149.

Europlanet Evolution: 2005-2021



www.europlanet-society.org/europlanet-2024-ri-facts-and-figures/

Who is involved in Europlanet 2024 RI?



https://www.europlanet-society.org/participants-in-europlanet-2024-ri/

Italian Regional Hub

Italy participates as a beneficiary of the Europlanet 2024 Research Infrastructure (RI) project with different institutions:

INAF (Istituto Nazionale di Astrofisica)
Universita Degli Studi Gabriele D'annunzio di Chieti-Pescara
Università di Bologna
University of Padova

Members of the Committee of the Italy Hub:

- Chair: Maria Cristina De Sanctis (INAF)
- Vice Chair: Stavro Ivanovski (INAF)
- Advisor: Maria Teresa Capria (INAF)
- Industry Officer: Laura Gatti (ALTEC / Thales Alenia Space Italia)
- Outreach Officers: Livia Giacomini (INAF) and Federica Duras (INAF)
- Diversity Officer: Valentina Galluzzi (INAF)
- Early Career Officer: Alice Lucchetti (INAF)

- The Europlanet Society Regional Hubs **support the development of planetary science** at a **national** and **regional level**, particularly in countries and areas that are currently under-represented within the community.
- The Regional Hub Committees organize **networking events** and **workshops** to support the research community, and **build links** with amateur astronomers, industrial partners, policymakers, educators, the media and the wider public.
- Europlanet Society members are **welcome to participate** in the activities of one or more Hubs.

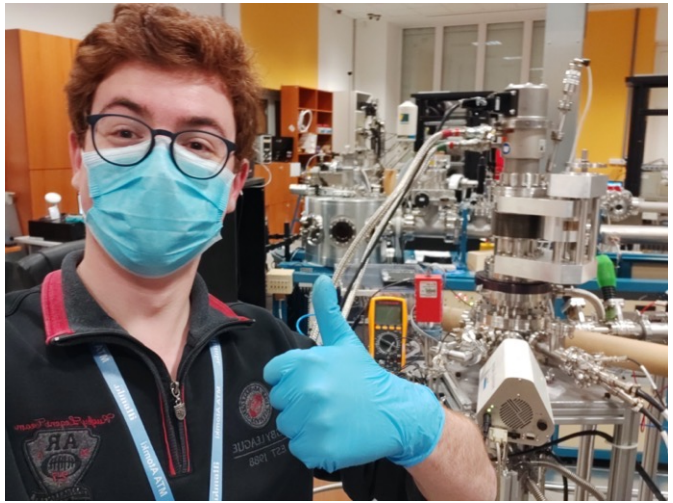
https://www.europlanet-society.org/europlanet-society/regional-hubs/italy/

12 Work Packages (WPs)

WP1: Management	WP2: TA1 - Planetary Field Analogues (PFA)	WP3: TA2 - The Distributed Planetary Laboratory Facility (DPLF)	WP4: JRA1 - The Distributed Planetary Laboratory Facility (DPLF)
WP5: VA1 - SPIDER (Sun Planet Interactions Digital Environment on Request)	WP6: VA2 - VESPA (Virtual Planetary and Solar European Access)	WP7: JRA2 - VESPA (Virtual Planetary and Solar European Access)	WP8: VA3 - GMAP (Geologic MApping of Planetary bodies)
WP9: JRA3 - GMAP (Geologic MApping of Planetary bodies)	JRA4: ML - Machine Learning Solutions for Data Analysis and Exploitation in Planetary Science	WP11: NA1 - Community Support, Dissemination and Engagement with Stakeholders	WP12: NA2 - Coordination of Ground-based Observations

Transnational Access (TA) programme

- Europlanet 2024 RI provides FREE access to the world's largest collection of planetary simulation and analysis facilities.



TA Facilities

Annual Calls issued for access to:

- **Planetary Field Analogues (PFA)** – 7 field sites available in next Call.
- **Distributed Planetary Laboratory Facility (DPLF)** – 24 lab facilities in Europe, plus 11 facilities in South Korea. Further facilities in Korea and China will be added in next Call.

Joint Research Activities – upgrades are ongoing for 6 facilities that are offered through the TA programme.

https://bit.ly/europlanet2024ri-ta

Virtual Access (VA) Services

- **SPIDER** (Sun Planet Interactions Digital Environment on Request) - contextual information on predictions & alerts for planetary space weather analysis & spacecraft operations.
- **VESPA** (Virtual European Solar & Planetary Access) - Virtual Observatory for planetary data that provides access to 50+ data services & tools.
- **GMAP** (Geologic Mapping) - tools & services for geological mapping of any Solar System body.
- **Machine Learning** - tools to address science challenges, applicable to many planetary datasets.

https://bit.ly/europlanet2024ri-va

Networking Activities (NA)

Webinars, workshops, funding and resources to support:

- Industry-academia collaboration
- Widening participation
- Global collaboration & international development
- Expert exchanges
- Early career support & education
- Policy engagement
- Europlanet Media Centre
- Outreach & education
- Mentoring

http://bit.ly/epn2024ri-networking

Europlanet Telescope Network

- Provides remote and physical access to a network of 16 small telescopes (0.5-1.2m diameter) around the world
- Open call for applications, decisions provided within 2 months

https://bit.ly/EuroplanetTelescopeNetwork

Europlanet INAF in numbers

PI: Maria Cristina De Sanctis, Deputy: S. Ivanovski

Funds INAF: 186 k€ (2021-2023); 174 k€ (till 2020)

Personnel: 23 TI+TD and 1 AdR

WP5/SPIDER Task 2 INAF/IAPS - a service for runs on request of their analytical version of EGEON model of Jupiter's moon exospheres that will be implemented in the web. INAF will also interface its Mercury exospheric model with the SPIDER runs on request architecture. These services will have direct applications and relevance to the preparation and the data exploitation of the future BepiColombo and JUICE missions.

WP6/VA2, Task 2 & 5 INAF/OATS will participate in designing, installing, and maintaining new data services related to atmospheres and exoplanets. OATS will be set up as one of the three European hubs. The regional data hub will be responsible to backup existing data service tables, and possibly upgrade them if the original provider can't for any reason ensuring service sustainability in the long term.

WP8/VA3, Task 2, 3, 4 & 5 and WP9/JRA3, Task : INAF/IAPS +GMAP teams will define the correct workflows on the basis of the final products to be generated, will make available to the mappers appropriate base maps, standards and workflow guidance for the realization of their specific products with the aims to develop geological maps of planetary surfaces. IAPS will help integration all the high level products to pre-existing and to consolidate the Planetary geological Mapping network beyond EPN. In particular IAPS will help on VNIR spectroscopic data sets and Mercury mapping.

WP10/JRA4, Task 1, 2, 3 & 5 INAF/APS will provide the scientific case of mineral identification via reflectance spectra (planetary surfaces / compositions / interiors) that targeting to define requirements and validate the developed ML tools, assuring their practical relevance and generality. The scientific case is based on the large experience on systematic laboratory dataset between mineral endmembers and their mixtures, a variable grain- sizes and will be utilized for training the machine to recognize specific spectral properties and their variability.

WP11, Task 8 & 9 INAF-IAPS has considerable experience in scientific outreach and education activities related to planetary science, hosting the Europlanet RI Italian Regional Hub and collaborating to EPSC media and press office activities during the years. For task 9, it developed the educational project "Planets in a room" in collaboration with the no-profit association Speak Science and is spreading it in Europe. For task 8, INAF-IAPS also has relevant experience in Policy activities and hosted among its staff the Policy Officer for the project Europlanet RI.

SPIDER @ INAF

SPIDER - Panoramica

L'attività virtuale (VA) SPIDER (Sun-Planet Interactions Digital Environment on Request) estenderà i servizi dei domini PSWS (A. Prediction, C. Modeling, E. Databases) e darà ai planetologi europei, alle agenzie spaziali e alle industrie l'accesso a servizi sofisticati e disponibili al pubblico al fine di modellare ambienti planetari e interazioni del vento solare attraverso la distribuzione di un'infrastruttura dedicata "run on request" e dei database associati.

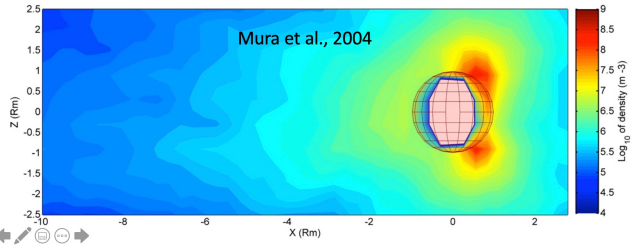
INAF ha la responsabilità di: "***C5. A service for runs on request of models of Jupiter's moon exospheres as well as the exosphere of Mercury***"

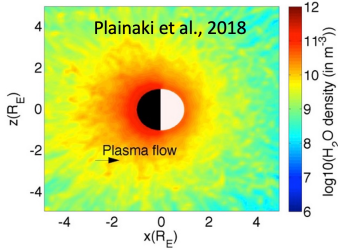
CLIENT

1) Connect to http://bepi.iaps.inaf.it
2) Simulation inputs
3) Launch simulation
4) Get results and data preview

SERVER

1) Check for a previous sim.
2) Elaborate.
3) Send an E-mail with results



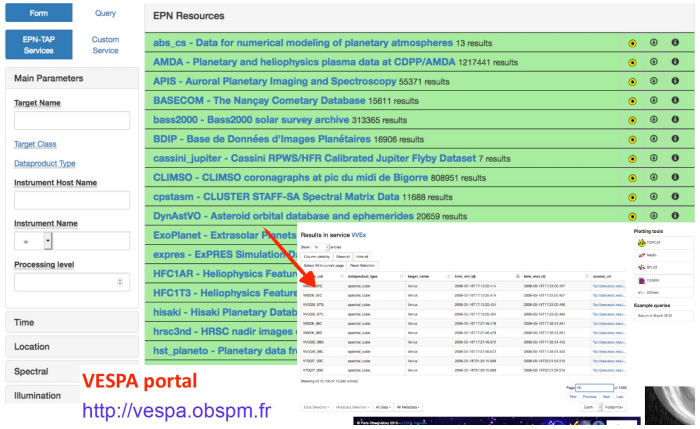


Risultati, Stato del Programma, Criticità

- **Stato del progetto.** Lo sviluppo della maggior parte dei moduli è già stato avviato (**modello Montecarlo di Mercurio in Fortran, interfaccia web in Perl, server di calcolo e gestione del database**). Attualmente un prototipo del servizio gira per uso interno e di primo debug
- **Personale:** A. Mura (Modello Mercurio), A. Milillo (Modello Lune Gioviane), + 1 AdR (Sviluppo e mantenimento modello web)
- **Finanziamenti: 100K**
- **Criticità:** Il concorso per personale non-staff è stato bandito ma dovrà essere ri-bandito in quanto il vincitore ha successivamente ottenuto un posto di dottorato.

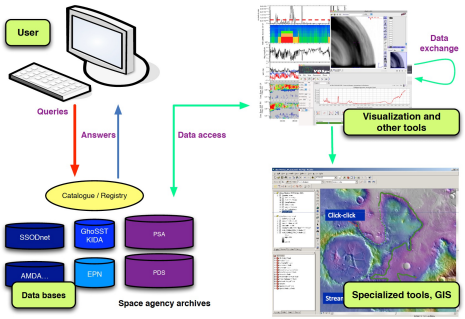
VESPA @ INAF

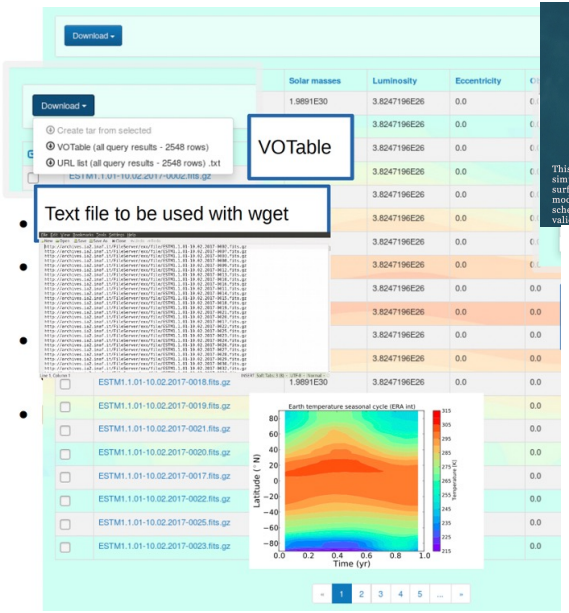
I. New INAF/OATs service on exoplanet atmospheres and climate (from ARTECS archive of terrestrial exoplanet simulations) - based on climate and habitability studies by OATs Astrobiology group (ref. Scheda "Climate Modelling of Habitable Exoplanets" by Silva et al.)

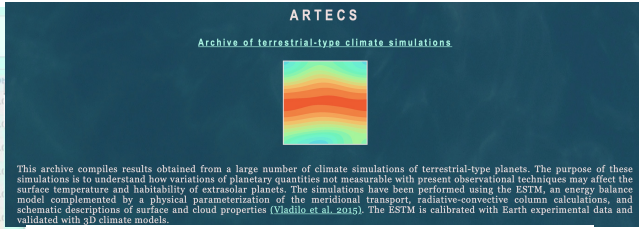


VESPA portal
http://vespa.obspm.fr

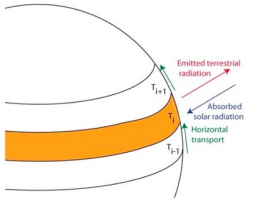
User's experience







Earth Like Surface Temperature Model (ESTM)



- ESTM (Vladilo et al. 2013, 2015):
  - 1d model (lat) + time dependence (orbital motion)
  - EBM calibrated on 3D Global Circulation Models (GCM)
  - Radiative equilibrium
  - Long v.z. short wave radiation transport
  - Meridional transport
  - Albedo accounts for: surface A., radiative transport in a column => top of atmosphere albedo
  - Accounts for distribution of "continents" (rock outside ocean) and ices (distribution parameter)

Leadership: II. INAF/Oats is Lead of the Three VESPA Data Sevices Hubs

Personale all OATs: S. Ivanovski, M. Molinaro, C. Knapic (IA2), G. Murante, and G. Vladilo

GMAP @ INAF

Geological Maps

The geological map is a planar representation of a territory from which its is inferable its surface composition and material properties, subsurface structure and composition and geological evolution (stratigraphy).

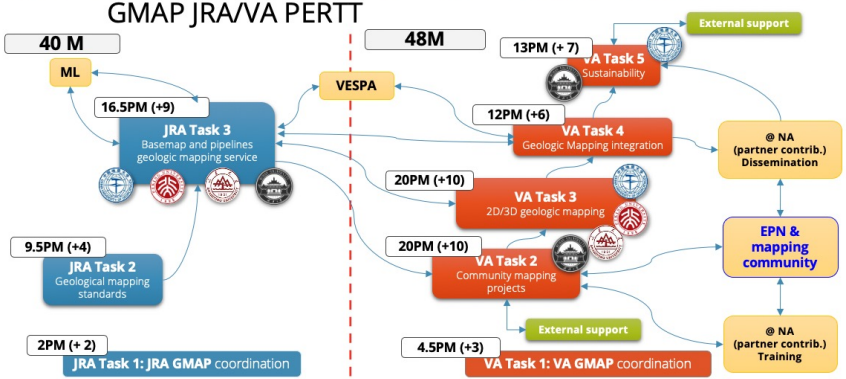
Since the early 19th century is essential for any kind of activity implying:

- Science investigation
- Resources and Mininig exploration
- Resources evaluation, exploitation and management
- Hazard and Risk assessment
- Land use and Infrastructure planning
- Environment safeguard

GMAP@EPN 02.01.19

GMAP Geological Mapping

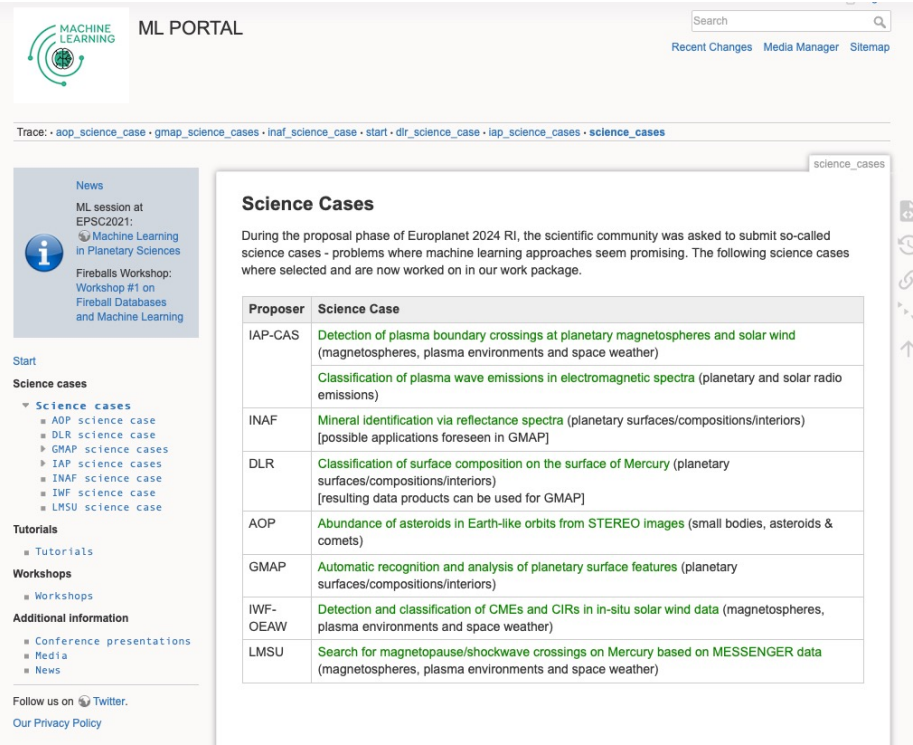
GMAP JRA/VA PERTT



INAF involvement

#	Name	PM all	Envisaged Main Partners (tentative, not in order)	Start	Stop
JRA T2	Geological Mapping Standardisation	9.5 (5)	Lead: DLR (Andrea Naß); **Deputy: INAF (Alessandro Frigeri)**; CBK PAN, UNIPD, JacobsUni	1	32
JRA T3	Basemap and Pipelines geological mapping services	16.5 (9)	Lead: JacobsUni (Angelo Pio Rossi, Carlos Brandt); **Deputy: INAF (Francesca Altieri, Cristian Carli)**; DLR, UNIPD, WWU, CBK PAN **INAF support: *Valentina Galluzzi, Lorenza Giacomini, Francesca Zambon***	1	40
VA T2	Community Mapping projects	20 (11)	Lead: WWU (Carolyn Van Der Bogert, Claudia Poehler), Deputy: CBK PAN (Daniel Mège, Joanna Gurgurewicz), **Deputy: INAF (Alessandro Frigeri, Cristian Carli)**; UNIPD , JacobsUni , UDA/ISPRA **INAF support: *Valentina Galluzzi, Lorenza Giacomini, Francesca Zambon***	1	48
VA T3	2D/3D Geological mapping	20 (10)	Lead: UDA/ISPRA (Lucia Marinangeli, Monica Pondrelli), Deputy: UNIPD (Luca Penasa, Riccardo Pozzobon), **Deputy: INAF (*Valentina Galluzzi*)**; JacobsUni, CBK PAN, WWU, **INAF support: *Lorenza Giacomini, Roberto Orosei, Luca Guallini***	1	29
VA T4	Geological Mapping Integration	12 (6)	Lead: JacobsUni (Angelo Pio Rossi, Carlos Brandt), **Deputy:** UDA/**INAF** (Deputy: Monica Pondrelli, **Francesca Altieri**), DLR (Andrea Naß), UNIPD (Luca Penasa); CBK PAN, WWU **INAF support: Alessandro Frigeri, *Valentina Galluzzi, Lorenza Giacomini,* Cristian Carli, *Francesca Zambon***	6	48

ML @ INAF



https://ml-portal.oeaw.ac.at/doku.php

Machine learning applied to spectral analysis for planetary minerals interpretation

- Machine learning applied to spectral analysis for planetary minerals interpretation
  - Short description
  - Aim of the science case

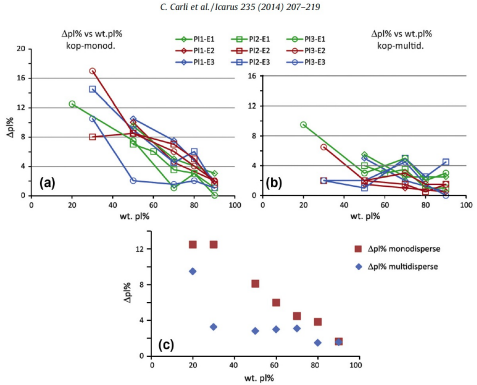
MACHINE LEARNING

Short description

The identification of minerals by using reflectance spectra is an important issue since this technique is the most used by remote sensing campaigns. The spectral information can be wide depending on spectral range and resolution of the data acquired. This implies that the analysis can be complex and time consuming, often reducing hyperspectral data to a multispectral approach to investigate only some spectral features. A machine that helps to search a large variability in the features can be used into a first screening of a dataset; the goal of this task is to train a ML algorithm with the laboratory data in part of the visible to near infrared range that could be applied to spectra data coming from the planetary missions. This is a multi-features ML problem applied to a limited reflectance spectra acquired in laboratory activities during the last years.

Aim of the science case

Machine Learning techniques will be applied to mineral identification via reflectance spectra using some laboratory dataset between mineral endmembers and their mixtures, having as a variable the grain (or particle) size. We will train the machine to recognize specific spectral properties and their variability taking into account the limits of retrieving this information. Some set of spectra acquired between bi-modal mixtures, produced at more than one size range will be utilized to determine the optimal algorithm. The 2 end-members for each grain size will be used to teach the machine to recognize them and test the capability to define their presence in the mixtures, separating the sets of spectra from the same size range. Moreover we will include spectra from other cases to test the machine capability to distinguish these spectra and exclude them.



Absolute differences between modelled and weighed amount (%) of plagioclase in the mixtures vs. the amount of plagioclase.

Personale:
S. Fonte(IAPS),
S. Ivanovski(OATs),
C. Carli (IAPS),
R.Politi (IAPS),
M. T. Capria(IAPS)

Europlanet Edu activity and Outreach @ INAF

Attività di comunicazione, ufficio Stampa e Policy

A sostegno di Europlanet, INAF-IAPS ha collaborato alle attività di Ufficio stampa internazionale e comunicazione di Europlanet e dell'EPSC, nonché alle attività di rappresentanza e policy presso l'Europarlamento.

Queste attività hanno avuto importanti ricadute per la sostenibilità del progetto e sulla copertura mediatica delle scienze planetarie in Italia.

Nelle immagini: una mostra e un evento organizzati all'Europarlamento, una intervista all'EPSC 2019

Attività di didattica e divulgazione

INAF-IAPS ha progettato e realizzato il monitor sferico lowcost **Pianeti in una Stanza** con il supporto di Europlanet e in collaborazione con l'associazione Speak Science e il Dipartimento di Matematica e Fisica dell'Università Roma Tre.

Pianeti in una stanza è stato successivamente distribuito e usato in tutta Europa, nell'ambito del progetto Europlanet, per essere utilizzato con le scuole e il pubblico.

Nelle immagini: Pianeti in una stanza, una lezione con le scuole e i paesi europei che attualmente ospitano Pianeti in una stanza

Skills to be acquired and critical issues

- EPN-2024-RI builds on previous RI projects by retaining tried and tested facilities shown to meet user needs whilst expanding the range and quantity of infrastructure services to meet demand of an extended multidisciplinary community.
- EPN-2024-RI's seven field sites will offer some of the most extreme conditions on Earth and direct analogues for icy moons and current/past surface environments on Mars. Laboratory facilities for the study of cold-icy and high radiation environments have been added in support of missions to icy moons (e.g. JUICE), outer planets and small bodies. Additional rare gas analytical capabilities, 14C dating and clumped isotope capability (CO2) have been included in response to a demand for better age information from TA field-based researchers.
- JRAs will develop 5 new analytical capabilities for low-temperature and low-pressure environments, non-destructive or micro-analyses of rare samples and the effect of ion-impact on ices. Searchable access to ~100 databases will be provided through EPN-2024-RI's VESPA VA2, currently the only data distribution system offering an integrated environment in all fields of planetary science and interoperability between tools.
- The SPIDER VA's expanded service of planetary space weather predictions and alerts will engage a larger user community and provide new tools for the scientific community, space agencies and industries involved in mission planning and operations.
- The GMAP programme will expand and consolidate the production of planetary geological maps and the related products to provide key support for planetary science and exploration, including robotic and human planetary missions and in situ resource evaluation.
- ML tools will be developed for analysis and exploitation of planetary science data with a focus on time-based signal analysis and general classification systems.
- EPN-2024-RI will establish a network of ground based telescopes to carry out observation campaigns in support of planetary missions.
- EPN-2024-RI's networking activities provide engagement and training for targeted audiences (industry, URS, non-EU collaborators, ERC, policy-makers, media, amateurs, citizen scientists, public and teachers) and will utilise the Europlanet Society Regional Hubs to devolve dissemination and the sharing of best practice, thus enabling a more efficient, culturally sensitive and sustainable approach to developing collaborations across Europe and beyond. NA1 includes a task to support and educate early career professionals through events (summer schools and training workshops) and ongoing mentoring and careers advice. EPN-2024-RI will use the platform of the Europlanet Society's Europlanet Early Careers (EPEC) Network to develop a sustainable training and education programme for the distributed Europlanet RI facilities and services.

Critical Issues

- the lack of capacity in some TA facilities due to reduced availability or too many successful applicants.
- Any interruption to the provision of VESPA data services will be limited by setting up VESPA hubs to maintain access in the case of the failure or withdrawal of any one beneficiary for any reason.
- For GMAP to maximise its potential, it needs the active involvement of the mapping community (national and European institutions and SMEs), which has had no or limited engagement with Europlanet to date.
- A potential barrier to impact for the ML JRA is the availability and quality of data and hence features to train on. A further potential issue is that the problems are too specific for a general ML solution to be developed. This is resolved through a modular approach to make sure that individual components can be reused and adapted for other purposes. Further comprehensive documentation of approaches and implementations will support users in adapting the toolset (available via a GIT repository) or even creating new tools on the basis of the existing solutions.

For INAF : Explain and help using the capabilities and opportunities this project offers for all Italian planetology community

Video introductions to Europlanet 2024 RI activities

TA programme (5m 30s): https://youtu.be/_BFISi91gyg

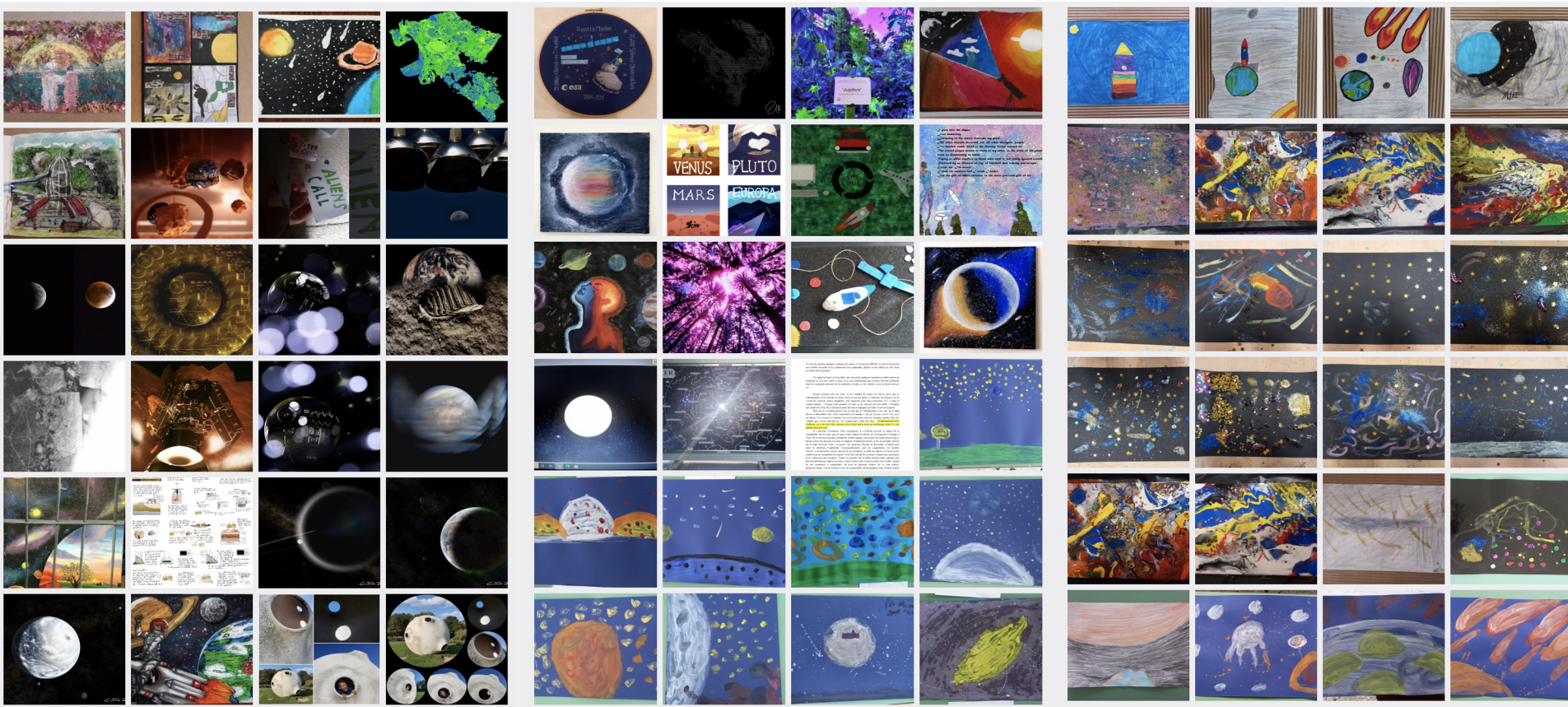
VA programme (4m 17s): https://youtu.be/m2MvHdoiwHU

NA programme (4m 17s): https://youtu.be/JrJ8n3dM1bc

Europlanet Telescope Network (2m 15s): https://youtu.be/6GNGAoKFvQ

europlanet2024ri@kent.ac.uk

http://europlanet-2024-ri.eu



Credits:#InspiredByOtherWorlds 2020

Thank you!