EPSC2018

OEP2 abstracts

EPSC Abstracts
Vol. 12, EPSC2018-3, 2018
European Planetary Science Congress 2018

The education initiative CESAR

M. Pérez-Ayúcar (1), M. Breitfelner (1), M. Castillo Fraile (1)
(1) European Space Astronomy Center (ESAC), Madrid, Spain (mperez@rssd.esa.int)

Abstract

CESAR (Cooperation through Education in Science and Astronomy Research) is an educational ESA (European Space Agency) initiative whose main objective is to engage school students with the wonders of astronomy and, more generally, science and technology. Through CESAR, students (supported by their teachers) have access to telescopes, tools, and the expertise of ESA scientists to make real astronomical observations, collect scientific data and analyze the results, applying the same methodology used in real life by professional scientists.

The CESAR programme also offers teachers the tools and resources necessary to prepare and support their students during the CESAR experience, as well as dedicated teacher conferences to inspire them to use space as a context when teaching STEM subjects (Science, Technology, Engineering and Mathematics) at school.

• Space Science Experience. Primary and secondary school teachers from ESA's Member States can register their class for a unique 2-hour session of real hands-on astronomy at ESAC (European Space Astronomy Centre). The students will be guided by ESA scientists through a group activity during which they will be assigned a 'mission' within a space science theme that the teachers can choose at the time of registration (based on the students' age and curriculum). To accomplish their mission, the students will have to answer questions, use imagery taken by the CESAR telescopes and other ESA space missions, analyse the data, and communicate their results. The teachers will be provided in advance with explanations and resources to prepare their students to the experience itself, including a videoconference with a scientist (if technically feasible at the school).

• Science cases. This is a series of classroom resources (teacher's guide, student worksheets, background information, etc) on astronomical topics ranging from the Sun to the deep universe, based on astronomical data and images collected by the CESAR telescopes. These resources are available for download, and can be used by the teachers as a basis for their STEM lessons in the classroom.

• CESAR teacher training. During the year, ESA scientists and the CESAR team organize conferences and lectures to introduce astronomy and space science to teachers, provide hints and inspiration for the use of space in their lessons, and make them interact with real space experts.

• Watch the Sun Live. Since April 2016, the Helios CESAR Solar Observatory operates daily, weather permitting, and provides Sun images online.

The CESAR programme provides students with access to several ground-based observatories:

- Two solar twin telescopes (visible light and H-alpha) with a diameter of 9cm

- Two night telescopes (visible light) with diameters of 50cm and 28cm

- One radio telescope (S-Band) made up of a Cassegrain Antenna with a diameter of 15m

- Cubesat station

These telescopes are all based at, or in the vicinity of, ESA's European Space Astronomy Centre near Madrid, Spain. They are all controlled by experts working at the CESAR Control Room located at ESAC.

CESAR is the result of a partnership between the European Space Agency (ESA), the Spanish National Institute for Aerospace Technology (INTA) and Ingeniería de Sistemas para la Defensa de España (ISDEFE).

EPSC Abstracts
Vol. 12, EPSC2018-89, 2018
European Planetary Science Congress 2018

OpenPlanetary: An Open Science Community and Framework for Planetary Scientists and Developers

Nicolas Manaud (1), Angelo Pio Rossi (2), Chase Million (3) and the OpenPlanetary Team. (1) nicolas@spacefrog.design, SpaceFrog Design, Toulouse, France, (2) Jacobs University Bremen, Bremen, Germany, (3) Million Concepts LLC, State College, PA, United States

1. Introduction

OpenPlanetary, OP for short, is a community-driven initiative and effort to address the need of the planetary science community for sharing ideas and collaborating on common planetary research and data analysis problems, new challenges, and opportunities [1].

2. Community

With 300+ members across many countries, the OpenPlanetary community is made-up of and intended for research and education professionals: scientists, engineers, designers, teachers and students, as well as space enthusiasts and citizen scientists.

Our common goal is to promote and facilitate the open practice of planetary science and data analysis for professionals and amateurs. We do so by organizing events and conducting collaborative projects aimed at creating scientific, technical and educational resources, tools and data accessible to all.

3. Framework

We develop and use an online framework to stay connected, share, discuss, collaborate on common community-driven projects, and to reach out to the planetary science community and the general public. Our approach is to connect and administer existing free or low-cost cloud-based solutions, services and open-source tools (such as Slack, GitHub, and AWS S3)

4. Projects and Events

One of our flagship project is OpenPlanetaryMap (OPM), an open planetary mapping and social platform to foster planetary mapping and cartography on the web for all. With OPM, our goal is to make it easy and collaborative to create and share location-based knowledge and maps of others planets of our Solar System [2].

We held our first "OpenPlanetary Data Café" at the at the European Planetary Science Conference 2017 in Riga, Latvia [3]; the idea for this Data Café was to invite both junior and senior scientists to share their expertise, tools, science use cases and issues through participative hands-on sessions.

5. Toward a non-profit organisation

OpenPlanetary started back in 2015 from an initial participants effort to stay connected and share information related to and beyond the ESA's first Planetary GIS Workshop [4]. It then continued during the 2nd USGS Planetary Data Workshop [5], and aggregated more people.

We are now establishing OpenPlanetary as a non-profit organisation in order to provide us with a legal framework to sustainably fund our projects and activities, and better serve the planetary science community as a whole. We also intend to enter the Europlanet Memorandum of Understanding (MoU) signatory group [6] so as to gain more visibility and credibility within the community. We will present the challenges, results and our experience of building such a community.

References

[1] OpenPlanetary website: http://openplanetary.org,

[2] "OpenPlanetaryMap: Building the first Open Planetary Mapping and Social platform for researchers, educators, storytellers, and the general

public", N. Manaud et al., Vol. 11, EPSC2017-27-1, 2017,

[3] "OpenPlanetary Data Café at EPSC 2017", http://bit.ly/op-data-cafe_epsc17,

[4] "Summary and Recommendations from the 2015 ESAC Planetary GIS Workshop", N. Manaud et al., Lunar Planet. Sci. XLVII, #1387,

[5] "Planetary Data: Workshops for Users and Software Developers", http://bit.ly/PlanetaryDataWorkshops

[6] EuroPlanet, http://www.europlanet-2020-ri.eu/consortium

EPSC Abstracts
Vol. 12, EPSC2018-119, 2018
European Planetary Science Congress 2018

The Age of Planetary Defense

Doris Daou (1) and the NASA Planetary Defense Coordination Office
(1) NASA Headquarter, Washington, (Doris.Daou@nasa.gov)

Abstract

NASA and its partners maintain a watch for near-Earth objects (NEOs), asteroids and comets that pass within Earth's vicinity, as part of an ongoing effort to discover, catalog, and characterize these bodies and to determine if any pose an impact threat. NASA's Planetary Defense Coordination Office (PDCO) is responsible for:

- Ensuring the early detection of potentially hazardous objects (PHOs) – asteroids and comets whose orbits are predicted to bring them within 0.05 astronomical units of Earth's orbit; and of a size large enough to reach Earth's surface – that is, greater than perhaps 30 to 50 meters;
- Tracking and characterizing PHOs and issuing warnings about potential impacts;
- Providing timely and accurate communications about PHOs; and
- Performing as a lead coordination node in U.S. Government planning for response to an actual impact threat.

The PDCO collaborates with other U.S. Government agencies, other national and international agencies, and astronomers around the world. The PDCO also is responsible for facilitating communications between the science community and the public should any potentially hazardous NEO be discovered. In addition, the PDCO works closely with the United Nations Office of Outer Space Affairs, its Committee on the Peaceful Uses of Outer Space, and its Action Team on Near Earth Objects. The PDCO is a leading member of the International Asteroid Warning Network (IAWN) and the Space Missions Planning Advisory Group (SMPAG), multinational endeavors endorsed by the United Nations for an international response to the NEO impact hazard and established and operated by the space capable nations. In this paper, we will provide an overview of the office's various planetary defense efforts.

1. Introduction

Near-Earth objects are asteroids and comets whose orbits periodically bring them within 1.3 Astronomical Units (AU) of the Sun. This implies that they can come within ~0.3 AU – about 30 million miles, or 50 million kilometers – of Earth's orbit. A subset of NEOs includes potentially hazardous object (PHOs), which pass within 0.05 AU of Earth's orbit.

Dust, meteoroids, and small asteroids impact Earth regularly, but larger objects have both the potential for considerable damage yet also the potential for discovery with enough lead time to formulate a response. Responding to a potential asteroid impact to Earth will require expertise and resources from across federal governments across the world. A strategy to both integrate existing assets and add important capabilities in an effort to improve our collective preparedness is of critical value and the reason behind the creation of the NASA's Planetary Defense Coordination Office (PDCO) [1]. Planetary defense is the term used to encompass all the capabilities needed to detect and warn of potential asteroid or comet impacts with Earth, and then either prevent them or mitigate their possible effects. The first step of planetary defense involves finding and tracking near-Earth objects regarding observational assets and statistics. Finally, we will go over the interagency and international planetary defense coordination strategy with information on how to join.

2. Near-Earth Object Observations Program

The NEO Observations Program sponsors applied research conducted by NASA, other federal agencies, universities, space science institutes, and other organizations around the United States. The NEO Observations Program supports astronomical surveys for NEOs that contribute to a sustained and productive campaign to find and track NEOs, collecting data of sufficient precision to allow accurate predictions of the future trajectories of discovered objects. The Program also supports efforts to characterize a representative sample of NEOs by measuring their sizes, shapes, and compositions. In addition, the Program devotes a limited amount of funding to research into NEO characteristics that relate to development of impact mitigation and deflection strategies and techniques.

NASA-funded survey projects have found about 98 percent of the known catalogue of close to 17,000 NEOs as of October 2017. NASA-funded surveys are currently finding NEOs at a rate of about 1,800 per year. The current congressionally directed objective of the NEO Observations Program is to find, track, and catalogue at least 90 percent of the estimated population of NEOs that are equal to or greater than 140 meters in size by 2020 and to characterize a subset of those objects that is representative of the entire population. Roughly half of the known catalogue of NEOs are objects larger than 140 meters in size. The predicted population of NEOs of this size is about 25,000. Current surveys are finding NEOs of this size at a rate of about 500 per year, and roughly two thirds of the population remain to be discovered after almost 20 years of NEO search efforts.

NEO surveys currently supported by the NEOO Program include the University of Hawaii's Panoramic Survey Telescope & Rapid Response System (Pan-STARRS), the University of Arizona's Catalina Sky Survey, the Lincoln Near-Earth Asteroid Research (LINEAR) project on the Space Surveillance Telescope, and the NEO Wide Infrared Survey Explorer (NEOWISE) mission. The NEO-optimized infrared survey mission concept NEOCam is currently in extended Phase A study as a planetary defense focused mission. NEO follow-up and physical characterization efforts are supported at a number of NASA Centers, observatories, universities, and institutes.

All NEO search and tracking projects supported by the Program are required to make their astrometric data permanently available in a timely manner to the scientific community. The internationally recognized public archive for these data is the Minor Planet Center [4], which is sanctioned by the International Astronomical Union and supported by the NEO Observations Program as a sub-node of NASA's Planetary Data System's Small Bodies Node [5]. The Minor Planet Center is also tasked with notifying observers worldwide about new discoveries so they can conduct timely follow-up observations critical for confirmation and future orbit determination.

The NEO Observations Program also supports the Center for NEO Studies (CNEOS) [2] at the Jet Propulsion Laboratory which maintains up-to-date data and statistics on NEO discoveries. CNEOS also uses the collected observations to compute high-precision orbits of NEOs, model new orbits for NEO discoveries to determine impact hazard, perform long-term analyses of future orbits of potentially hazardous asteroids, and calculate the impact time, location and other parameters in the event of a predicted impact.

3. International Cooridnation

The PDCO has also worked closely with the United Nations Office of Outer Space Affairs and the Committee on the Peaceful Uses of Outer Space, through its Action Team on Near Earth Objects (also known as Action Team 14). The International Asteroid Warning Network (IAWN) [3] and the Space Missions Planning Advisory Group (SMPAG) [6] are multinational endeavors endorsed by the United Nations for an international response to the NEO impact hazard. NASA currently chairs IAWN, whose intent is to establish a worldwide effort to detect, track, and physically characterize near-Earth objects (NEOs) to determine those that are potential impact threats to Earth and to which there are eight international signatories that include observatories, national institutes, and space agencies. NASA participates with other space-capable nations in SMPAG, whose objectives are to develop cooperative activities among its members and to build consensus on space mission recommendations for planetary defense measures. In the event of a credible impact warning by IAWN, the SMPAG would propose mitigation options and implementation plans for consideration by the international community

4. Summary and Conclusions

The PDCO's activities described here involving the NEO Observations Program and international coordination are consistent with its mission to lead national and international efforts to detect any potential for significant impact of planet Earth by natural objects, appraise the range of potential effects by any possible impact, and develop strategies to mitigate impact effects on human welfare.

References

[1] Planetary Defense Coordination Office Web site: https://www.nasa.gov/planetarydefense/overview

[2] Center for Near Earth Object Studies Web site: https://cneos.jpl.nasa.gov

[3] International Asteroid Warning Network Web site: http://iawn.net

[4] International Astronomical Union Minor Planets Center Web site: http://www.minorplanetcenter.net

[5] Planetary Data System Small Bodies Node Web site: https://pds-smallbodies.astro.umd.edu/

[6] Space Mission Planning Advisory Group Web site: https://www.cosmos.esa.int/web/smpag/home

EPSC Abstracts
Vol. 12, EPSC2018-148, 2018
European Planetary Science Congress 2018

The Radio Meteor Zoo: involving citizen scientists in radio meteor research

Stijn Calders (1), Hervé Lamy (1) , Johan De Keyser (1), Cis Verbeeck (2), Antonio Martinez Picar (2), and Cédric Tetard (1)
(1) Royal Belgian Institute for Space Aeronomy, Belgium, (2) Royal Observatory of Belgium
(stijn.calders@aeronomie.be)

Abstract

BRAMS (Belgian RAdio Meteor Stations, http://brams.aeronomie.be) is a project of the Royal Belgian Institute for Space Aeronomy (BIRA-IASB, http://www.aeronomie.be) and partially funded by the Solar-Terrestrial Centre of Excellence (STCE, http://www.stce.be). Its main goal is to study meteoroids by using radio techniques. The BRAMS network consists of one beacon in the south of Belgium and about 25 receiving stations distributed all over the country. Many of these receiving stations are hosted by radio amateurs and astronomy enthusiasts.

Processing the observations is not an easy task. Each station generates a spectrogram every five minutes, so the whole network generates 7200 spectrograms per day. Most meteor reflections are visible as short vertical lines, for which we have developed automatic detection algorithms. However, especially during meteor showers more complex reflections occur (called overdense reflections) for which the human eye remains the best detector.

Therefore, the BRAMS researchers, in collaboration with the Zooniverse team (http://www.zooniverse.org/), have launched a citizen science project called the Radio Meteor Zoo (RMZ, http://www.radiometeorzoo.eu/) in August 2016. With the RMZ, thousands of citizen scientist eyes are manually identifying meteor echoes during meteor showers. Today the RMZ has more than 6000 volunteers who have classified meteors in almost 36000 spectrograms. Thanks to our volunteers we were able to generate activity curves for several meteor showers.

Communication with citizen scientists in the RMZ serves several goals: first we recruit new volunteers by giving lectures about meteors research at public observatories and during astronomical events (e.g. the "Night of the Stars" in August). We also get them involved into scientific research by showing them the results of their effort, i.e. the activity curves of the meteor showers. Thirdly we want to keep them motivated, e.g. by asking them to process spectrograms that are challenging yet not too complex. The penultimate goal is to teach them about meteor research. This is done through the background information pages and through a forum where they can interact with each other and the BRAMS researchers. Finally we disseminate the aggregated results to external platforms in order to share the results with other (citizen) scientists.

Based on lessons we have learned from the RMZ, we are preparing some improvements in our communication strategy and the user interface, e.g. by providing automatically feedback to the volunteer during the classification process. We also plan to train a machine learning algorithm with our large database of already processed spectrograms to automatically detect complex meteor reflections.

EPSC Abstracts
Vol. 12, EPSC2018-180, 2018
European Planetary Science Congress 2018

SVO-ast: A citizen-science project to identify NEAs and Mars crossers using the Virtual Observatory

Enrique Solano (1,2), Carlos Rodrigo (1,2), Benoit Carry (3) and **Miriam Cortés-Contreras** (1,2)
(1) Departmento de Astrofísica, Centro de Astrobiología (CSIC-INTA), ESAC Campus, Camino Bajo del Castillo (esm, crb, mcortes@cab.inta-csic.es) (2) Spanish Virtual Observatory, Spain, (3) Université Côte d'Azur, Observatoire de la Côte d'Azur, CNRS, Lagrange, 06304, Nice, France (bcarry@oca.eu).

Abstract

We describe here a citizen-science project conducted by the Spanish Virtual Observatory to improve the orbits of near-Earth asteroids (NEAs) and Mars crossers (MCs) using data from astronomical archives. At the time of writing, almost 4000 registered users from 76 different countries have made more than 420 000 measurements which have improved the orbital elements of 613 NEAs and 508 MCs (3% and 4% of the total number of these types of asteroids, respectively). Even more remarkable is the fact that these results have been obtained at zero cost of telescope time as asteroids were serendipitously observed while the surveys were being carried out. This demonstrates the enormous scientific potential hidden in astronomical archives and the power of Virtual Observatory tools to mine them. The excellent reception of the project as well as the results obtained makes it a valuable initiative to improve the knowledge of near-Earth asteroids and Mars crossers.

1. Introduction

The discovery in the late 1980s of NEAs passing by the Earth at distances comparable to that of the Moon or the impact of the comet Shoemaker-Levy 9 to Jupiter in July 1994 led to an increased awareness of the potential threat of these objects.Therefore, many projects both from ground and space are presently devoted to discover new asteroids passing close to the Earth.

Nevertheless, discovery alone is not enough to quantify the threat level of a NEA. Above all, it is necessary to compute reliable orbits through accurate astrometric positions covering a period of time as long as possible. This can be achieved using two complementary approaches: performing follow-up observations after discovery or mining astronomical archives.

Together with discovery and orbit determination, the study of the asteroid composition is key in the design of a protection strategy: different compositions yield different densities and internal structure/cohesion [1], and an asteroid on an impact trajectory with Earth of a given size will require a different energy to be deflected or destroyed according to its nature.

Every single image taken by the most important ground and space-based astronomical observatories eventually end up in open archives, freely available on the Web. This represents an immensely data-rich field where the general public can significantly contribute, in particular in projects related to classification, pattern recognition and outlier identification where the visual inspection has proved exceptionally good. The Virtual Observatory[1] is an international initiative designed to provide the standards and tools necessary to enable the exploration of the digital, multiwavelength universe resident in the astronomical data archives in an efficient and seamless way for the users.

In this paper we describe SVO-ast[2], a citizen-science project designed by the Spanish Virtual Observatory[3] (SVO) to precover NEAs and MCs using images of the SDSS, UKIDSS, VISTA and VST surveys.

2. Methodology

People willing to participate in the project must register first. The new user is informed by e-mail when the authorization request is accepted, which allows him/her to start with the measurement process. The system, then provides the user with blocks of images that can be visualized using the Aladin VO tool [2] (Figure 1). NEAs and MCs are identified by visually comparing images of the same region of the sky taken at different moments. While the vast majority of the

[1] http://www.ivoa.net
[2] http://www.laeff.cab.inta-csic.es/projects/near/main/?&newlang=esp
[3] http://svo.cab.inta-csic.es

objects recorded in the images are stars and galaxies that will appear in the same position in all the images, NEAs and MCs are nearby objects with proper motions of several arcseconds per minute and they will appear in slightly different positions. To help users in the identification, the predicted position of the asteroid as given by NEODyS[4] is indicated (Figure 2) .

Once identified, the user must measure the position of the asteroid in the different images and include it in the RA/DEC column (Figure 1). After different quality control tests, the information is submitted to the Minor Planet Center[5] (MPC).

It is also important to stress that the system implements a rapid response capability for newly discovered asteroids of special interest needing a rapid identification in archives for a reliable characterization. Instead of waiting until the normal measurement process ends (typically of the order of weeks), these asteroids are prioritized to be looked for as soon as they are available in the MPC.

3. Results

- The top-five nations visiting the project are Spain (49%), France (10%), Argentina(4%), USA (3%) and Mexico (3%). The fact that the site is offered in Spanish, English and French helps to have this diversity of countries.

- A limiting magnitude of V:21-21.5 is reached, in good agreement with the nominal limiting magnitude of the surveys. This translates into a peak in H at $\sim$ 19-20 mag.

- Participants found asteroids prior to the first observation reported in the MPC (sometimes more than four thousand days), after the last observation given by MPC, and at new intermediate oppositions. New observations for single-opposition asteroids were also added. In all cases our astrometry significantly improved the orbital elements.

- Potential spacecraft targets: NEAs represent ideal targets for space exploration owing to their close distance from Earth. We have improved the orbits of more than 70 potential mission targets. Particularly remarkable are the cases of 2009 EK1 and 2006 KM103, whose arc lengths were dramatically increased thanks to our observations.

- The measurements made by the "citizens" have been the basis for "professional" papers: Carry et al. (2016) [3] determined the taxonomy of a large sample of NEAs and MCs, increasing 40% and 663% respectively the number of asteroids with known taxonomy in these populations.

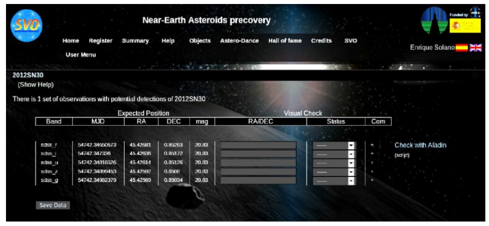

Figure 1: System's input window. The observing epoch of each image as well as the expected position and V magnitude as provided by NEODyS is given in columns 2-5. Participants measurements and the associated status can be included in columns 6-7. Images are displayed by clicking on "Check with Aladin (see Figure 2). The measurements are stored clicking on the "Save Data" button.

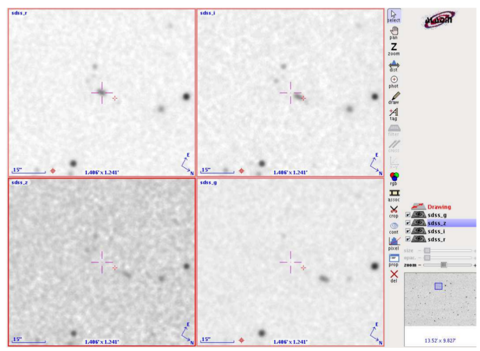

Figure 2: Asteroid identification. The asteroid 2007JZ20 is clearly seen moving in the sequence of SDSS images from South to North. The small red cross indicates the expected position as computed by NEODyS. The user must put the large magenta cross on the asteroid and paste the coordinates in the table shown in Figure 1.

[4]https://newton.dm.unipi.it/neodys/
[5]https://www.minorplanetcenter.net/

Acknowledgements

This research has made use of the Spanish Virtual Observatory (http://svo.cab.inta-csic.es) supported from the Spanish MINECO/FEDER through grants AyA2011-24052 and AyA2014-55216.

References

[1] DeMeo, F. E.; Carry, B. 2013. Icarus 226, 723.

[2] Bonnarel, F., et al. 2000, A&AS 143, 33

[3] Carry, B.; Solano, E.; Eggl, S.; DeMeo, F. E. 2016. Icarus 268, 340.

EPSC Abstracts
Vol. 12, EPSC2018-262, 2018
European Planetary Science Congress 2018

The ASL (Alternanza Scuola Lavoro) program: an italian example to bring research to school and school to research

L.Giacomini (2,3,4), **A. Postiglione** (1,2), I. De Angelis (1,2), M. Ziggiotti (2)
(1) Roma Tre University, Dipartimento di Matematica e Fisica, Rome, Italy, (2) Speak Science, Rome, Italy (postiglione@fis.uniroma3.it), (3) IAPS-INAF, (4) Europlanet 2020 RI

Abstract

Teaching science in high school in innovative and fascinating ways is not always easy. In most cases, this subject is seen as difficult and boring and often students, at the end of their scholastic career have no idea of what scientific research is like and why it is important in everyday life. At the same time, it is hard for the research community to attract young people to STEM careers starting from high schools, presenting science and research as a feasible job for the future of many students.

In this context, the Italian program ASL [1] (that stands for "Alternanza Scuola Lavoro" and that can be translated in School Work Alternation), introduced by the Government starting from the year 2015, can provide an excellent opportunity both for schools and for the research community, including Institutions, Universities and Research Centers. ASL is an over-all revolution in the Italian educational system: in 2017/2018 it became mandatory for more than 1,5 million students in the all country, completely changing high school everyday activity and affecting the organization and results of final examination. The program consists in 200 hours (or 400 hours for technical Institutes) that all students of the last three years of high school have to spend in working experiences. During this time, all Italian high school students are obliged to perform activities as similar as possible to real job, organized in collaboration between the School and a private or public entity (such as a Research Center, a University, but also a firm, an industry, a shop or other).

In this framework, INAF (the National Institute for Astrophysics) on a national scale [2] and the Roma Tre University in the Rome Area, represent two different and complementary examples of how this experience can be used by researchers and university members to share their knowledge and work with young people, bringing them closer to science. During the first three years of the program, many activities have been developed, involving laboratory experiences, seminars, guided tours and outreach activities. In this presentation, we will resume some of the experience, knowledge and results acquired until now, giving a global picture of how ASL can be a great opportunity to bring research to school and, at the same time, school to research.

Acknowledgements

We acknowledge for this work: INAF National and local Offices for Education and Outreach and all the staff involved in ASL; the Master in Scienza e Tecnologia Spaziale (Master in Space Science and Technology) of University of Roma Tor Vergata for supporting a thesis on ASL in INAF; the ASL Group of Roma Tre University managed by Professor Antonio Cocozza; the Education and Outreach Group of the Department of Mathematics and Physics of Roma Tre University.

References

[1] "Attività Di Alternanza Scuola Lavoro: Guida Operativa Per La Scuola 2017", M.I.U.R - Direzione generale per gli ordinamenti scolastici e la valutazione del sistema nazionale di istruzione

[2] Ziggiotti, M.: "Alternanza Scuola Lavoro in INAF: come trasformare l'eccellenza della ricerca astrofisica e spaziale italiana in un precursore di didattica della scienza", Thesys of Master di II Livello Scienza e Tecnologia Spaziale, Università di Roma Tor Vergata, 22nd of January 2018.

EPSC Abstracts
Vol. 12, EPSC2018-336, 2018
European Planetary Science Congress 2018

Planetary Science Communication through Public Events

Stefanie Musiol, Heike Balthasar and Heike Rosenberg, supported by the Planetary Sciences and Remote Sensing Team
Freie Universität Berlin, Planetary Sciences and Remote Sensing, Berlin, Germany (stefanie.musiol@fu-berlin.de)

Abstract

The team of Planetary Sciences and Remote Sensing at Freie Universität Berlin (www.fu-berlin.de/planets) is involved in international space missions such as *Mars Express*, *Cassini* at Saturn, and *Dawn* at Vesta and Ceres. Science communication through educational and public outreach activities is a basic component of our research. In particular, we take part in several outreach events over the year and we provide image data and models to exhibitors.

1. Workshop concepts for pupils

The *Girls'Day* is a national future career day in Germany that takes place anually at the end of April. It is especially aimed to promote training and studies of IT, handcraft, natural sciences and technology, disciplines in which women are typically underrepresented. Since 2011 we are engaged with planetary science workshops in the *Girls'Day*. Up to now, five hands-on workshops have been designed which target mainly pupils aged 10-12. The topics cover the structure of the solar system (Fig. 1), geologic processes on planets, and digital as well as three-dimensional images. All workshops begin with a general introduction that provides overview and background information to the subject.

Figure 1: Pupils taking part in a workshop about distances and rotations in the solar system.

The introduction is followed by practical work such as drawing, creating models, and performing measurements or experiments (Fig. 2). This part is realized in small groups of 2-4 girls. To support understanding and for documentation reasons special worksheets have been designed that have to be filled in by the pupils during the course of the workshop. In the last part, the results are presented by each group to all participants, to foster interactive collaboration and exchange among the kids.

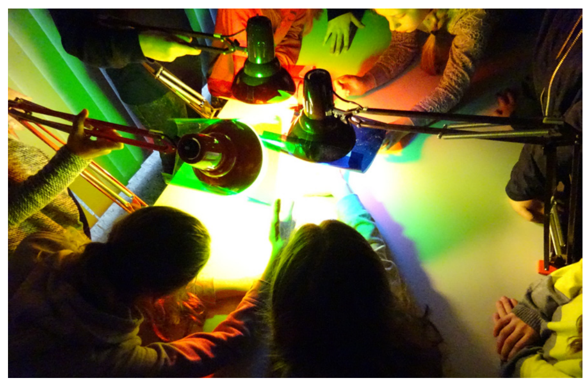

Figure 2: Pupils performing light experiments with Red/Green/Blue colors.

To follow up each workshop with their teachers in class, the participants receive some additional take-home material what we have prepared beforehand (handouts, flyers, booklets, red-blue anaglyph glasses and images). Finally, we evaluated the workshops with questionnaires: Most of the participants gave our workshops a credit of "very good", in particular the girls enjoyed working in small groups and filling in the worksheets.

2. Long Night of the Sciences

Yearly at the beginning of June the science event *Long Night of the Sciences* (Lange Nacht der Wissenschaften) takes place in Berlin at the Freie Universität and many other universities and research centers. From 5 pm to midnight, laboratories and lecture rooms are open to the public. Young and old are likewise invited to see were and how research is being done. The departments of the Freie Universität Berlin present themselves with their projects and involvements, give presentations, and answer questions. The Planetary Sciences and Remote Sensing Team has been taking part in this event since 2006. Last year a modern 3D beamer with shutter-glasses for cinema-mode projection of our Mars movies was purchased. More than 500 visitors saw the 3D animated flights over the surface of Mars. In addition, we provided a large Mars landscape panorama as background for smartphone-pictures. For kids we also made astronaut costumes and helmets available (Fig. 3).

Figure 3: Kids become "astronauts on Mars".

3. Participation in exhibitions

With various planetary anaglyph images, which generate a 3D impression of the landscape when viewed using red-green or red-blue glasses, we have compiled a mobile exhibition for display at, e.g., observatories, planetariums, or institutions (Fig. 4).

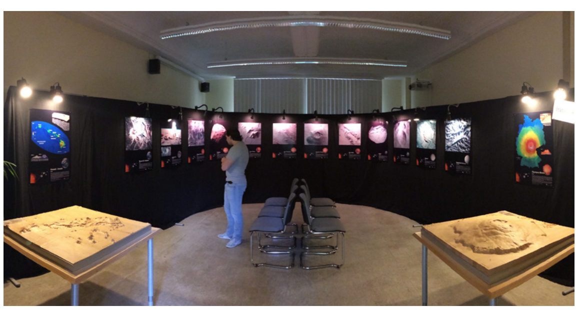

Figure 4: Anaglyph exhibition.

In 2014 we prepared high resolution space imagery for the exhibition *Mars Attacks* of the Kunstverein Salzgitter, in which artist Sven Reile presented oil paintings of the Earth moon, the Martian moon Phobos, and asteroids. In addition, a 1:1 model of the High Resolution Stereo Camera (HRSC) onboard the ESA mission Mars Express was provided (Fig. 5).

Figure 5: Model of the HRSC on loan for the arts exhibition *Mars Attacks* in Salzgitter.

In 2018 the *Mars Express* mission teams are celebrating 15 years successful launch of the orbiter. On this special occasion we are planning an exhibition of Mars images together with the Planetarium Hamburg.

4. Motivation for public outreach

With public events in planetary sciences we fulfill multiple tasks: to enable open access to planetary mission data, to communicate science results, to present possible fields of study to pupils and students, and to create a public confidence in science to justify public funding in the end. We want to become aware of the public perspective of planetary sciences by establishing a dialogue with citizens, to help improve accessibility to and understanding of the outcome of planetary missions.

Acknowledgements

Image credit: Planetary Sciences (Figs. 1, 2, and 4), Bernd Wannenmacher (Fig. 3), Dr. Klaus Berner (Fig. 5). This work was supported by the DLR Space Administration on behalf of the Federal Ministry for Economic Affairs and Energy, grants 50OH1503 (*Cassini*), 50OW1505 (*Dawn*), and 50QM1702 (*HRSC on MarsExpress*). We want to thank our former team members that were involved in the accomplishment of the science events.

EPSC Abstracts
Vol. 12, EPSC2018-403, 2018
European Planetary Science Congress 2018

Europlanet – Impact of outreach activities to date and looking ahead to a sustainable future

A. Heward (1, 2), M. Barrosa (1,2), Livia Giacomini (1,3) on behalf of the Europlanet 2020-RI NA2 Outreach Team (1)
(1) Europlanet 2020 Research Infrastructure, (2) Science Office, Portugal (3) IAPS-INAF, Italy
(anita.heward@europlanet-eu.org)

Abstract

Outreach has been a core part of Europlanet since its foundation in 2004. In each of Europlanet's EU FP6, FP7 and Horizon 2020 funded programmes, around 10% of the total budget has been dedicated to outreach and engagement with external communities.

The Europlanet 2020 Research Infrastructure (RI), funded through the European Commission's Horizon 2020 programme, supports Europe's planetary science community through the provision of services, access to facilities, new research tools and a virtual planetary observatory. Europlanet 2020 RI was launched in September 2015 and runs through to August 2019. The project's Impact Through Outreach and Education (IOE) activities aim to engage the widest possible community with the work of Europlanet 2020 RI, and to involve the public, the media, policy makers, educators and students with the ongoing adventure of planetary science and the people that work in the field.

In 2018, Europlanet is launching a new Society, which welcomes individual membership. The Society will provide a sustainable structure to support Europe's planetary science community for decades to come and will provide a permanent home for the Europlanet Media Centre and many of Europlanet's outreach initiatives. The new Society will be structured around regional hubs, enabling a more local and culturally sensitive approach to outreach activities.

In this presentation, we will review the impact of Europlanet's outreach activities to date and look ahead to plans for how Europlanet will support the European planetary outreach community through the Society and other future projects.

EPSC Abstracts
Vol. 12, EPSC2018-485-2, 2018
European Planetary Science Congress 2018

PRIME: a REXUS project to demonstrate a miniature free falling unit for plasma measurements

Florine Enengl, Anton Franzén, Alberto Alonso Pinar, Ramez Al-Hamarneh, Moinak Banerjee, Byron Bradford Hopps, Nandan Dutta Chaudhury, Carl-Johann Von Gegerfelt, Timo Gierlich, Isabelle Gürsac, Muhammad Usman Imtiaz, Akshay Kallianpur, Anton Kåbjörn, Erik Lindblad Nyman, Martin Petek, Frederik Rorro, Elene Sajaja, Chaitanya Prasad Sishtla, Christos Tolis, Nickolay Ivchenko, Gunnar TibertKTH Royal Institute of Technology, Stockholm, Sweden
(prime-experiment@kth.se)

Abstract

PRIME (Plasma Measurement with Micro Experiment) is a student experiment, to be launched on REXUS26 sounding rocket in 2019 as part of the REXUS/BEXUS programme. The project aims to develop a miniature recoverable Free Falling Unit for plasma parameter measurements in the lower ionosphere. Two identical Free Falling Units are ejectable from the Rocket Mounted Unit. The geometry of the Free Falling Units is designed to be compatible with future 'DART' rockets, from the company T-Minus Engineering. A Free Falling Unit consists of an Experiment and a Recovery Unit, which share a common battery and an umbilical. The Recovery Unit consists of a parachute with its deployment mechanism and a localization system. The Experiment Unit includes the deployable, cylindrical Langmuir probes with a data acquisition system. The measurements will be validated against model and independent observations of the ionospheric parameters.

1. Introduction

Communication and navigation systems are dependent on signal propagation in the ionosphere, which is affected by space weather. Observations of plasma parameters under various conditions are important for improving models of this region. This gives a motivation to study the ionosphere [1]. Information about the properties of plasma in the ionosphere is limited by the amount and frequency of the measurements that can be performed. The measurements can be either in-situ or remote ones, with in-situ measurements usually giving better accuracy and resolution. In-situ measurements require the use of sounding rockets, and hence cannot be performed regularly.

Currently, the 'Improved Orion' is one of the standard sounding rocket launch vehicles used for atmospheric and ionospheric measurements, bringing tens of kg payload up to about 100 km altitude. It is the launch vehicle used in the REXUS/BEXUS programme, The REXUS/BEXUS programme is realised under a bilateral Agency Agreement between the German Aerospace Center (DLR) and the Swedish National Space Board (SNSB). The Swedish share of the payload has been made available to students from other European countries through the collaboration with the European Space Agency (ESA). Experts from DLR, SSC, ZARM and ESA provide technical support to the student teams throughout the project. EuroLaunch, the cooperation between the Esrange Space Center of SSC and the Mobile Rocket Base (MORABA) of DLR, is responsible for the campaign management and operations of the launch vehicles. T-Minus Engineering [2] a company based in the Netherlands is developing a smaller 'DART' launch vehicle, providing an affordable alternative for bringing small payload (about 1 kg) to altitudes of over 100 km, which would enable more frequent measurements of the upper atmosphere. The volume available for payload of the DART is constrained by its inner diameter of 30 mm.

The purpose of the Plasma Measurement with Micro Experiment (PRIME) is to validate a miniature free falling payload complying with the dimensions of the DART rocket, in a flight on board REXUS26 sounding rocket. Two Free Falling Units (FFUs) with Langmuir probe based measurement system, see figure 1, will be ejected from the rocket module. The FFUs will continue in the ballistic flight, reaching an apogee of about 85 km, and record the currents collected by the probes. These measurements will enable us to obtain altitude profiles of electron temperature and density and compare the results with incoherent scatter radar data (EISCAT), ionosondes, and compared to models.

This abstract presents the status of the PRIME experiment development in the experiment part after the Preliminary Design Review.

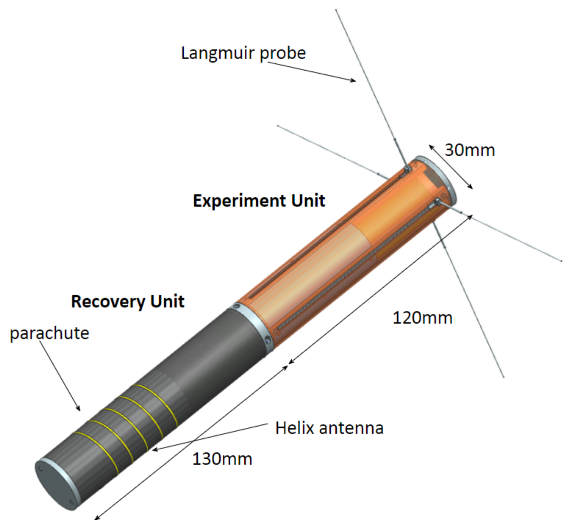

Figure 1: Free Falling Unit

2. Experiment

2.1 Langmuir Probes

The PRIME experiment uses four cylindrical Langmuir probes. Measuring current collected by the probes for known bias voltages is used to reconstruct the electron density and the electron temperature by analyzing the current-voltage curve. The analysis is dependent on assumptions about the plasma, such as the magnetic field strength, frequency of collisions and photoelectric currents. The probes deploy from the FFU in a symmetric configuration in the plane perpendicular to the FFU axis. An angular rate sensor, magnetometer and sun sensors provide data for reconstruction of the orientation of the probes with respect to the magnetic field of the Earth and the sun direction [3]. As the launch of the REXUS rocket is usually during the day, photoelectron emission will contribute to the current balance of the probes. The value of the photelectric current depends on material of the probe and the illumination conditions. The values of the maximum photoelectric current density in full illumination by the solar UV radiation for stainless steel (2.4 nA/cm2) and gold (2.9 nA/cm2) are lower than for aluminium (4.8 nA/cm2), making them suitable for the probe surface [4]. The expected value of the electron density in the altitude range of 60 km to 90 km is between 104 m-3 to 1011 m-3 [5]. The expected temperature will be in the range of 170K to 300K [6]. The Debye length resulting out of these parameters is maximum 2 mm [7]. Given the experiment dimensions, the Langmuir Probe will operate in the "thick sheath collisionless regime" [3]. Thus, the radius of the probe shall be much smaller than the Debye length and the length of the probe to much larger than the radius of the probe.

2.2 Similar Experiments

Our arrangement is similar to the design of the Multi-Needle Langmuir Probe [8]. The Multi-Needle Langmuir probe was flown up to an altitude of 300 km above ground level. It had a length of 41 mm and radius of 1 mm. The analysis started from the "thick sheath collisionless regime". Although the geometry and dimensions of the probe relating to the plasma is similar for the PRIME and Multi-Needle Langmuir probe experiment, we may not necessarily use the same analysis due to the differing conditions in which the probe will be flown, in particular with respect to higher collisionality and solar UV irradiation. The KTH SPIDER experiment used four spherical Langmuir Probes with a radius of 12.5 mm to measure plasma parameters in the E region of the ionosphere [9]. The interpretation of the data was intended based on "thin sheath collisionless regime", although it may not be fully applicable to it. For the PRIME experiment, we intend to investigate the refinements of the basic Langmuir probe theory that can improve the results of the analysis.

References

[1] Mark A. Clilverd et al. Remote sensing space weather events: Antarctic- Arctic Radiation-belt (Dynamic) Deposition-VLF Atmospheric Research Konsortium network. In: Space Weather 7(4). 2009

[2] T-Minus Engineering. http://www.t-minus.nl/, accesed on 10.3.2018

[3] Cherrington, B.E. Plasma Chem Plasma Process 2: 113. 1982

[4] Feuerbacher, B., Fitton, B. Experimental investigation of photoemission from satellite surface materials. In: J. Appl. Phys. 43 (9), 1563– 157. 1972

[5] Barabash, V., Osepian, A., Dalin, P., and Kirkwood, S. Electron density profiles in the quiet lower ionosphere based on the resultsof modeling and experimental data. In: Ann. Geophys., 30, pp. 1345-1360. 2012

[6] W.Kohnlein. A model of the electron and ion temperatures in the ionosphere. In: Planetary and Space Science. 34(7), 609-630. 1986

[7] G. D. Severn. A note on the plasma sheath and the Bohm criterion. In: American J. Phys. 75 (92). 2007

[8] K S Jacobsen, A Pedersen, J I Moen and T A Bekkeng. A new Langmuir probe concept for rapid sampling of space plasma electron density. In: Measurement Science and Technology 21, 8. 2010

[9] Asplund, Joakim. Design and Implementation of a Sounding-Rocket Electric-Field Instrument: Signal Conditioning and Power Supplies. reference for picture of circuitry. EES Examensarbete / Master Thesis ; TRITA EE 2016:049. p. 82. 2016 [10] Katharina Schüttauf et al. RXUserManualv7-1507Nov17. pp 3. 2017

EPSC Abstracts
Vol. 12, EPSC2018-503-2, 2018
European Planetary Science Congress 2018

Outreach activities of UniverSCiel association.

Lucile Fayon (1), Ines Belgacem (2) and the UniverSCiel association (3)
(1) Institut de Physique du Globe de Paris-Sorbonne Paris Cité, Université Paris Diderot, Paris, France (2) GEOPS, Université Paris Sud, CNRS, University Paris-Saclay, Orsay, France (3) Institut de Recherche d'Astrophysique et de Planétologie, Université Paul Sabatier, Toulouse, France (fayon@ipgp.fr)

1. UniverSCiel association

Created in 2012 at the Institut de Recherche d'Astrophysique et de Planétologie (IRAP) based in Toulouse, UniverSCiel is a French non-profit association made of young astronomers (most are PhD. students) volunteering on their free time to organize and to animate outreach events promoting astronomy and astrophysics for youth. The main focus of the association over the past 12 years has been the co-organization of the Astro-Jeunes festival. More recently, the association started to cover a wider spectrum of activities and to organize countless other events, such as day-long intervention in school and medical institutes or sky-wacthing sessions. In 2015, for its past accomplishments and dedication the association received the "Lucien Babonneau" prize of the science academy of Toulouse.

Figure 1: Logo of the UniverSCiel association.

2. Astro-Jeunes festival

The Astro-Jeunes festival was created 13 years ago to transmit passion and lessons of astronomy to children. It takes place in parallel of the astronomy festival of Fleurance, in southern France, one of the biggest festivals in the country. Every year, Astro-Jeunes welcomes every morning about 200 children a day (from 4 to 17 years old) during one week. It has been recognized by ESA (European Space Agency) as the largest European outreach event aimed at children around the theme of astronomy and space (2013). This event is entirely organized by the association members and welcomes about a thousand of children every year.

The level of knowledge is adapted depending on children's age, as they are separated in groups based on it. In addition, a dedicated group (with children from 12 years old) focuses on the design, development and launch of a high-altiude stratoshperic balloon, carrying on its board various probes selected and integrated by children (Fig. 2).

Figure 2: Picture taken by one of the installed cameras on the balloon realized by the children in 2016.

Over the duration of the festival (6 half days), we offer an insight into general astronomical culture, but also spotlights various main topics such as recent discoveries, experiments and manual crafts (Fig. 3). Those activities are enriched by a number of other events such as live discussions with astronomers from the largest observatories, astronauts in the ISS, but also the meeting with scientists and actors of the space world. More than a passive audience, we want youths to become actors of this week. To do so, we keep a certain freedom in the proposed activities, leaving them the choice to take the lead in their learning process. Our activities are punctuated by a 30 min break, during which we propose some original activities like for example sun observations or water rockets realizations. This week is concluded by a friendly fair where kids are encouraged to bring their parents and show them what they have learnt. It's also punctuated by educational games where they can win prizes from our generous sponsors.

Figure 3: Telluric soils (Earth on the left, Mars at the middle and Moon on the right) and martian robots realized by the 8-10 years old group, in 2017.

For the 2018 edition, being even more ambitious a brand new group was launched and dedicated of learning about the more technical aspects of astronomy for kids between the ages of 10 and 14. This group will be dedicated to astronomical observations learning. Moreover, this year is special with the launch of Insight to Mars to study its interior. We wanted to take this opportunity to teach the participants all there is to know about this mission. That's why we put together an exhibition that is displayed all week long and open to all.

3. Experiments

Several experiments are realized by the association during the year in order to display them during the different outreach interventions and explain some key concepts of our work. One example is the "Cloud chamber" which is a particle detector (a transparent enclosure) that shows the charged particles tracks in a simulated fog (saturated alcohol vapour). Another experiment is the "Planeterella" which is a transparent vacuum chamber with two magnetized spheres and an electron gun. This experiment allows to visualize and understand the formation mechanism of the polar auroras. A hand-made experiment on "gravitational assistance" was also developed using a tight elastic cloth on which two metal balls of different weights are arranged. This allows to simulate one probe passing by one planet. Finally, the association is currently working on a mobile planetarium.

UniverSCiel also recently teamed up with another association "DDE" (Délires d'Encre) a year and a half ago to create an itinerant escape game. This game is made available for schools and scientific outreach events. Participants will step in astronaut shoes by facing a disaster scenario in the ISS (International Space Station) to solve space related puzzles to save the day!

4. Other outreach events

In the last two years, UniverSCiel also participated to the "Scientilivre" festival, whose objective is the discovery and awareness of science and reading. This event takes place once a year over a weekend, in October. For this event, the association presents its different experiments and a new exhibition depending on the festival yearly theme.

Interventions in primary and secondary schools are also planned throughout the year. This is the opportunity to build sky maps with children, to show them the Apollo 11 mission thanks to virtual reality, or to learn some basic notions about the stars by using a thermal probe and hand-made spectrometers.

5. And now ?

UniverSCiel has been quickly growing in the last couple of years and we have greatly diversified our activities. Because the association relies mainly on volunteer PhD students, the high demand of outreach activities can be hard to fulfil. One of our objectives in the close future is to expand and recruit new volunteers to be able to keep proposing fun and educational activities for all. We are continuously developing new experiments for show and tell. Our next endeavours include finishing the mobile planetarium and an experiment to illustrate extra-terrestrial planets transits before their star for instance.

Acknowledgements

We acknowledge the continuous financial support of IRAP, the doctoral school SDU2E and the Observatoire Midi-Pyrénées (OMP), Toulouse, France. Our work was also made possible thanks to grants from the Région Occitanie and the Université de Toulouse (FSI project). We would also like to acknowledge our sponsors for their support and contribution in kind offered to the young participants of the festival Astro-Jeunes. An exhaustive list can be found at universciel.info.

EPSC Abstracts
Vol. 12, EPSC2018-514, 2018
European Planetary Science Congress 2018

Aspects of teaching Visual Basic for Application for students of natural scientific specialties

Natalia Petrova (1,2), Sergey Sitnikov (1,2)

(1) Kazan Power Engineering University, (2) Kazan (Volga region) Federal University, Kazan, Russia, (nk_petrova@mail.ru)

Abstract

The Department of Computer Sciences of the Kazan State Power Engineering University has a long-term experience in the successful teaching of computer science and programming fundamentals for first-year students of natural scientific, technical and humanitarian specialties on the basis of the Visual Basic for Application (VBA) language, which is part of the Microsoft Excel spreadsheet. VBA is a language that allows students concentrating their attention on the understanding of the principles of algorithmization, to form the basic programming skills of both simple and complex problems. Methodological justification of the effectiveness of teaching of VBA is presented in the report.

1. Introduction

In a course of laboratory works on the subjects "Computer sciences" and "Information Technologies" the teachers of the department, realize the tasks of developing skills for competent work with Windows Office applications. After mastering the work with standard tools of these applications, in the course of learning the transition to building macros is carried out, first of all, in the environment of the VBA editor [1] built into MS Excel. There are no other options for creating scripts (macros) for office programs. On the senior courses there is a transition to the study of C #, C ++, and high-level languages of technical calculations - Matlab, etc [2].

The development environment consisting of the Microsoft Excel spreadsheet processor and the built in VBA language proved to be successful for building your own applications and projects, mostly of a calculated nature. During the first year of teaching, students learn to program, first, in a frame of procedural approach, then of structural, and finally use elements of object-oriented programming, in particular, when building user forms for their own applications.

2. Possibilities of the VBA language, important in the learning process

A problem of many Russian universities is that students come to the first year of the university with different levels of computer science: the school curriculum at the computer science course is not standardized, therefore, someone paid more attention to the standard means of working with a computer, someone to programming, but herewith the languages are also different. Most students come with initial knowledge of Pascal. Our experience shows that VBA is the golden mean, which allows to teach strong students even greater, weaker - to pull up to the required level of knowledge. The VBA tools proved to be attractive for teachers of natural scientific departments - astronomy, physics, chemistry, geophysics, etc.: the students who know the tools of this language effectively perform laboratory works, where a software for processing data and graphical presentation of results are required. For sociologists and economists, an irreplaceable application is Excel, based on which it is possible to create simple databases, use built-in statistical and financial functions.

1.1 Why VBA, not Pascal?

Pascal has a complex syntax. Many students, confusing in the complicated punctuation of the language, do not have time to go to debug their programs and bring the skills of algorithmization to the required level. Some problem is the rigid requirements for the types of variables that are a definite obstacle to the first steps in programming:

students study the internal representation of numbers in a computer, as a rule, later than the basics of programming.

The next problems arise when passing to the structured programming, when it is necessary to break the algorithm into modules. The passing data from one program to another through a list of formal parameters cause difficulties for many students. In this situation, it is better do not distract student's attention to the compulsory correspondence of data types. It is more important to teach how to break the algorithm into modules and to establish correct communication channels between them. VBA with its Variant-type data by default makes it possible to focus the student's attention to the essence of the algorithm, and the interpretation mode allows correcting some logical errors during the program operating without interrupting it and without wasting valuable time to re-input the initial data. The syntax of VBA is extremely simple and the logic of writing operators is close to human logic.

1.2 Diagrams and Macro Recorder

Often a specialist needs to visualize the results to assess their quality. To do this, you need graphics applications where you can export the results to build charts and diagrams. Using MS Excel and VBA eliminate this defect. When the data of experiment and of corresponding theoretical calculations are output onto a WorkSheet, a user can immediately build a different kind of corresponding diagrams using standard tools for formatting axes, markers, etc. If these operations are the same type and are repeated many times, then they can be automated using the Macro Recorder.

Macro Recorder is a tool for automatically recording, for example, some manual operations in the form of a program on VBA. The principle of its operation is similar to the principle of a tape recorder. The result is a program written by VBA-operators that displays all your actions, for example, when formatting the chart. From this program, a student can make a flexible tool for optimizing his work.

3. Application VBA for scientific work

Using VBA, we, together with students, often carry out quite serious scientific work. So on EGU-2009, our students presented the report on the creation of a database about the Moon and its geophysical properties [3]. As a result of our joint work, the software package was created to simulate the planned observations from the lunar surface. The package is based on the integration of several Excel WorkBooks, and the implementation of mathematical calculations by VBA codes.

4. Summary and Conclusions

VBA, on the other hand, has a set of convenient defaults and simplest syntax that allows focusing a student's attention on the features of the algorithm, and, on the other hand, the capabilities of VBA include all the necessary arsenal of tools for programming tasks of any level of complexity, including serious ones scientific projects. VBA is most effective in the Excel application; the presence of Macro Recorder allows making the automatic many time-consuming operations. VBA is the closest relative of VB.NET, which ranks 6th in popularity in 2018 by the TIOBE index.

Acknowledgements

This work was funded by the subsidy allocated to Kazan Federal University for the state assignment in the sphere of scientific activities and it was supported by grants RFBR 16 02 00496 a.

References

[1] J. Walkenbach: Excel 2013 Power Programming with VBA. – M.: «Dialektika», – 960 p, 2014 (In Russian).

[2] Sitnikov S.: Industrial software packages in the educational process. Vestnik KGEU, Kazan, Russia, No 22, p. 339-345, 2014 (In Russian).

[3] Petrova N., Nefedyev, T. Abdulmjanov, A. Zagidullin, A. Andreev: The software complex for computer simulating the observation of stars from the lunar surface and calculating their selenographical coordinates. SGEM. – V. 17, No. 21. – P. 687-694, 2017.

EPSC Abstracts
Vol. 12, EPSC2018-524-1, 2018
European Planetary Science Congress 2018

Stories of Tomorrow in Portugal: the first year

José Saraiva (1), Rosa Doran (1,2) and Steph Tyszka (1)

(1) NUCLIO, Portugal, (2) Universidade de Coimbra, Portugal; (jose.saraiva@nuclio.net)

Abstract

Portugal is one of the countries involved in the implementation of the Stories of Tomorrow project [1]. After the completion of the first school year, in which the many facets of the project have been tested, it is time to look back, evaluate what went well and what should be improved, and take the opportunity to learn the lessons this year has taught us. We look forward to the next year of implementation with renewed enthusiasm and certainty that the project will achieve its goals and demonstrate the power of new methodologies and technologies to help learning in our schools.

1. Introduction

The Stories of Tomorrow project started in 2017, and will run up to the end of the 2018-19 school year in Europe. It involves the creation by young students (10 to 12 year olds) of digital books narrating stories about the conquest of Mars. Schools in several European countries were chosen to run the project in the first year, a pilot phase where it was clear from the start that many hurdles would be met. Finding ways to overcome those obstacles in Portuguese schools has given the NUCLIO team involved in the project a much better understanding of the way things happen in schools, and what can be done to make the implementation of the project a smooth and fun activity for all involved, from school principals to the students, the major reason for its existence.

2. Context

In Portugal, any kind of project that is intended to run through the whole school year faces a major problem right at the start: many teachers change schools from year to year, and spend their first weeks of work trying to get acquainted with a new school and a new environment, finding it hard to concentrate in activities that are seen as being out of the normal schooling work. When implementing a technology (computer) based project such as this one, the quality and access conditions of the computer park in each school can also give rise to issues that require much ingenuity to overcome.

There were four Portuguese schools picked for the first year implementation. All had classes in the 5th grade, which in Portugal is the first year in which the students are introduced to multiple disciplines and teachers. One of them was in Lisbon, two were to the west, in Cascais and Carcavelos, and one to the north, in Póvoa de Santa Iria, though all were within a 30 km radius. The number of classes varied – two of the schools had all 5th grade classes involved in the project, the other two did not take that approach. The number of students per group also varied, from just two elements to six, depending on the size of class and the opinion of the teachers. In all, though, there were close to 100 groups involved in the project, each trying to produce a digital book with their story.

3. Activities

Information about Mars was provided to the teachers, so they could help the students along the creation of their stories. This came in the shape of four booklets produced by the project, covering the diverse settings that should be present in the stories. Some teachers (the school coordinators) were present at the first Summer School, in Greece, to learn about the platform and participate in some activities that could be done with the students at the school.

There were a number of talks about Mars that took place at the schools, as well as hands-on activities about the Solar System and planets that happened at a NUCLIO location. The time devoted by the different classes to the project was not uniform, and so some classes benefited more from this type of activities. The teachers most deeply involved in the project and its activities were those of Science, Portuguese, Mathematics and Visual and Technological Education. Other than producing a story with some degree of continuity and internal coherence, the students were encouraged to produce drawings, search for images, do their own research and include in the digital books assets of diverse nature - images, videos, sounds, animations (Figure 1).

Figure 1: Working in the digital book.

4. Discussion

There were a number of difficulties in the running the project during this first school year of implementation; they should be viewed as normal when dealing with such an elaborate project, which involves technology and science. Also, they can best be viewed as opportunities to learn a few lessons that will lead to a better experience for all.

Many details of the relations with the schools need to be improved. Some of these are the allocation of time and its management through the school year, and the interplay of teachers from different disciplines to achieve a full interdisciplinary nature in this endeavour. But it is also felt that teachers involved in the project need much more information – not only on the peculiarities of the platform used for the creation of the digital books, but also on the subject matters of the stories that their students will create, namely space and Mars. With this in view, we created an accredited course that they can take (and gain points for professional advancement) and thus become much more at ease with the questions that their students will raise.

For the students, we intend to offer regular opportunities to participate in hands-on activities with scientific content, and provide channels for them to get in touch with experts on diverse aspects of space exploration. They will also have access to some sort of printed information on the topics that they will have to deal with in the creation of stories.

5. Conclusions

The project Stories of Tomorrow is in the middle of its implementation period. In Portugal, the first year brought to light a number of issues that required a lot of thought and effort to overcome. Though in the end we had to be satisfied with what was achieved, we feel that the lessons learned provide the basis for a much improved implementation in the second year.

With some changes in organization issues, and a closer monitoring of the development of activities in schools to provide help when needed, the experience for those involved – teachers and students – will gain a much better quality, and provide quality data to help demonstrate the validity of the principles on which the project was built – the use of storytelling and a technologically advanced platform to achieve Deeper Learning in young students.

Acknowledgements

We would like to acknowledge the financing of the project by the EU’s Horizon 2020 Research and Innovation Program under grant agreement no. 731872.

Furthermore, we thank all the teachers and students that have so enthusiastically participated in the first year of implementation at the following schools: Cidadela, Carcavelos. Piscinas/Olivais, and Póvoa de Sta. Iria, Portugal.

References

[1] Saraiva, J., and the Stories of Tomorrow team: Stories of Tomorrow: schoolkids and the conquest of Mars, EPSC Abstracts Vol. 11, EPSC 2017-459-1, 2017.

EPSC Abstracts
Vol. 12, EPSC2018-535-1, 2018
European Planetary Science Congress 2018

Design Thinking for Space Exploration

Rosa Doran (1,2), José Saraiva (1), Steph Tyszka (1)
(1) NUCLIO – Núcleo Interativo de Astronomia, Cascais, Portugal, (2) CITEUC - Centro de Investigação da Terra e do Espaço da Universidade de Coimbra, Portugal (rosa.doran@nuclio.pt)

Abstract

The next generation of humans in space is now entering schools. Space exploration and data management have now to be integrated in the training of the future Space and Earth explorers.

This challenge will require different types of careers, talents and skills. The profile of the 21st century student needs to encompass the learning pillars required for any worker in the future labor world, the 4 Cs: Communication, Critical Thinking, Collaboration and Creativity.

These are the key requirements of any modern standards for school education. To achieve this, a large global effort needs to be put in place. A new education strategy is necessary, where students and communities work together for the construction of a modern and relevant school system, a system that goes beyond the school walls into the community and vice-versa.

1. Introduction

At that same time the topic of space exploration is invading headlines, with thrilling information about new planets being discovered, new missions being designed, new careers being foreseen and the possibility of humans living elsewhere, outside the safety of our planet and far beyond the orbit of the Moon, students are entering their schools, following their daily routine.

Most of the school systems in the world are trying to find optimum solutions to make their students thrive in the world of work. However, schools are built in such a way that very commonly we find teachers and students struggling to perform well in a single event, entering University.

Space Exploration will require and has always been about reaching the limit of our technology and bringing us beyond. This can't be taught in schools or University. Individuals taking up these challenges must have creativity, critical thinking, perseverance among other important skills. In this paper we refer to a few projects that are trying to support the change of the education paradigm in schools. Moving from a content delivery and structured format to a individually tailored solution. We present here a few initiatives that are being presented to educators and how we foresee their impact for the work force of the future.

2. Interdisciplinarity with the Big Ideas of Science

Space exploration is a perfect topic to bring innovation to classrooms. It has a strong interdisciplinary character, requires several important skills and sparkles the imagination of the young minds. Successful educational systems, like for instance in Finland, with their phenomenology based learning project, are trying new models where teachers from all subject domains have to collaborate to deliver the same topics, seen from the perspective of their own field. In the framework of the project Stories of Tomorrow, funded by the European Commission in the framework of the H2020 research and innovation program, this strategy is being adopted.

Students, from 10 to 12 years old, have to create a digital book about a mission to Mars. The mission encompasses several different phases ranging from the full preparation of the mission, the trip and finally a sustainable settlement on the surface of the red planet.

In order to prepare their teachers, we have introduced them to the concept of the Big Ideas of Science, a collection of ideas that tries to aggregate the milestones of the scientific knowledge in all science domains. This main pillars can be further developed within each discipline and from different angles. For instance: human anatomy in space can be explored under the big idea "Cell" and its implications for those travelling in space can be explored in the framework of natural sciences, physical education, arts, etc. Teachers can collaborate for the preparation of each specific topic and the aggregate of ideas be used to improve the preparation of the student's digital stories. Another important part of this mission was the autonomy of the students and the importance of their own research for the specific challenge they had in hands. For this another component was introduced to their educators: Inquiry Based Learning (IBL)

3. Inquiry Based Learning

IBL is a learning methodology where students are invited to follow the steps of a scientific discovery. For the construction of their stories students had to solve a series of issues related to a variety of situations. For instance, how can we travel to Mars, how long would it take and how much material would be necessary? How can we build a community on Mars? What type of expertise would be necessary?

The solutions to these problems could be delivered to the students as a list of things to do and thing not to do. But this was not the approach of the project, the main idea was to invite students to find the problems and their respective solutions by gently guiding them towards the desired end. Using this model is not always comfortable for the educators who are accustomed to a more traditional way of delivering knowledge to their students. In the framework of the project PLATON, a project co-funded by the European Commission in the framework of the Erasmus plus program, a series of tips and trick on how to properly implement inquiry were created. A package was produced where IBL was divided in nine main components. The Inquiry under the Microscope toolkit. Equipped with this tools teachers are more likely to engage their students in projects such as Stories of Tomorrow.

4. Design thinking for Space Exploration

Another important aspect needs to be taken into account. There is no recipe for a success story when we are dealing with schools, teachers and students. Each case requires a different solution. In some of the schools involved in the project the ICT infrastructure was good enough to enable a smoot creation of the different stories. Some of the schools had good computers but their internet connection was challenging. In some cases, students had only one teacher and in other cases more than nine educators were in charge of the tutoring of the participants.

In some of the schools, teachers were not convinced that exploring Mars was something with any relevance for the future of their students. In other we had to convince the parents that these experience was introducing their children to content and competencies that were relevant to their future. To accommodate all these diverse realities, we had to use a bit of Design Thinking, a methodology that requires an individualized coordination. First it is necessary to "Feel" the environment where all the experience is taking place, next we had to "imagine" a possible solution to each challenge, next "Do" phase took over where we had to implement the designed proposal and finally we are in the process of "sharing" the outcome.

The four phases of Design Thinking are crucial in order to ensure an optimal uptake of the project. This process is being developed in the framework of the project Open Schools for Open Societies, in the framework of the H2020 research and innovation program.

5. Conclusion

The use of these different models and strategies are key in order to inspire and encourage students to reflect on the challenges of space exploration. They are also important to engage educators and parents in fruitful discussions about the importance of Space Exploration in our daily lives. Storytelling can act as a catalyst and trigger for interdisciplinarity and the promotion of STEAM (Science, Technology, Engineering, Arts and Mathematics) disciplines.

References

[1] Stories of Tomorrow – http://storiesoftomorrow.eu

[2] PLATON – http://platon-projecct.eu

[3] OSOS – http://portal.opendiscoveryspace.eu/osos

EPSC Abstracts
Vol. 12, EPSC2018-675, 2018
European Planetary Science Congress 2018

EPSC European Planetary Science Congress

Stories of Tomorrow: first year of implementation

Steph Tyszka (1), Rosa Doran (1, 2) and José Saraiva (1)

(1) NUCLIO, Portugal, (2) Universidade de Coimbra, Portugal. (Steph@nuclio.pt)

Abstract

We report on the pilot phase of implementation of the project Stories of Tomorrow [1], funded by the EU in the framework of its Horizon 2020 Research and Innovation Program. The project has been implemented in schools of three European countries (Greece, France and Portugal). It has seen the development of some hundreds of stories about the conquest of Mars, created by school kids on a digital platform developed specifically for the project. For the second year of implementation, some changes are in store, including the addition of VR (Virtual Reality) and AR (Augmented Reality).

1. Introduction

The main objective of the project Stories of Tomorrow is to evaluate the application of a series of methodologies (Inquiry-based learning, Storytelling, Interdisciplinarity) to foster Deeper Learning among students of a young age (10-12 years old), at the moment when they apparently seem to lose a measure of curiosity and capacity for wonder, and as a consequence tend to drift away and lose interest in Science-related matters. The use of a computer-based platform for the creation of digital books, allowing them to mix text and assets of diverse nature (images, videos, sounds, external links) is another measure thought to help them relate to Science and Technology.

2. Consortium

The consortium involves a number of partners from several countries, involved in the management, technical development, evaluation and school implementation of the project. A website [2] was created to present the project to a general audience. Other than news about the project, this comprises a list of resources about Mars in diverse media, and it will also showcase the stories created by students in a special section that will soon become available.

Two Summer Schools devoted to the project have taken place, bringing together the parties responsible for management, technical development, and evaluation, along with country-wide and school-level responsibles, that deal more closely with the implementation in classes.

There is also a facebook group where teachers from all the countries involved can interact, show the work of their students, trade ideas and find new references on space exploration. They have also participated in a number of country-level workshops, first to be introduced to the project, and more recently to reflect on the way the first year of the project went, namely to identify and analyse the issues that need reappraisal or changes, or those that were perfectly suited to the age of the students involved.

3. Platform and evaluation

The students were asked to create a digital book using a dedicated platform (Figure 1), that allowed for collaborative work. Students within classes were grouped into teams that had to come up with a narrative, structured into episodes, that told the story of a human expedition to Mars. Ideally, the story should contain at least four episodes (one on the Earth, preparing for the journey; another in space, giving an account of the long voyage to the red planet; and two on Mars, from the exploration of the surface of the planet to the installation of a manned base or colony). Through talks, activities and research, the students were encouraged to stick to firm scientific knowledge when creating their stories. The plan called for them to interact with experts and have access to a large amount of information that they should then strive to include in their stories (without turning them into dry scientific reports).

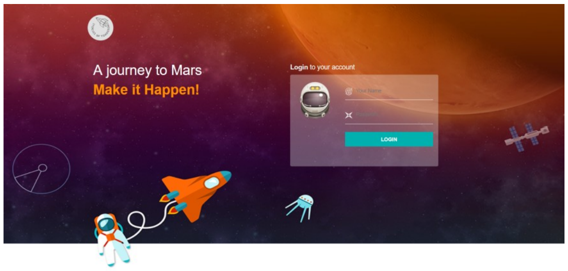

Figure 1: The login page for the platform.

Evaluation of the goals of the project is done through the collection of the answers of the students to a number of questionnaires designed to assess their skills at collaborative work, fascination with science, and knowledge. Also, the platform collects data on several parameters judged to be relevant, such as the number of assets included in the stories, the wordage and vocabulary, and the successive changes made to the stories; furthermore, the stories produced by students will be evaluated by the teachers, according to a prepared grid that focuses on different aspects of their content.

4. National settings

Since the school organization and environment in the three countries shows profound differences, and though there were general guidelines, there were also many differences in the way the project was implemented through this first school year of activity.

The platform is built with a hierarchical structure, such that teachers can check the work of the student groups, and intervene to a certain degree, mainly to sort out any problems. There are national language versions available, since the students are of an age that does not permit the use of a common language.

The number of schools, teachers, students, groups (and respective stories) varied. Though all classes involved were of the 5th grade, this does not mean that they all followed the same approach: in France, for instance, the classes had only one teacher, responsible for all subjects taught, while in Portugal the students faced for the first time many different disciplines and teachers.

The class dynamics were thus very different from country to country, and this is reflected not only in the number of stories but also in the time allocated for work in the project in each case. Furthermore, the classes had different activities and opportunities for learning and asking questions, according to the programming done by their national coordinators.

All this resulted in a wide diversity of stories, some of which do not fully respond to the requirements made at the beginning of the implementation. Still, the efforts made by all involved can not be dismissed. Final numbers are now being collected, and will be presented. All the stories will be available for appreciation on the project site.

5. Conclusions

The project is now gearing up for a second year of implementation. The second Summer School, scheduled for July, is the right moment to assess all that went well and should be reinforced, and also the many details that need corrections.

We strongly believe in the rationale and purpose of the project, and look forward to a new batch of students and helping them turn their imagination and creativity into stories about Mars, using the tools for the creation of digital books. For the next year, some exciting additions are scheduled, such as the introduction of AR (Augmented Reality) and VR (Virtual Reality) that can enrich the books.

Acknowledgements

We would like to acknowledge the financing of the project by the EU’s Horizon 2020 Research and Innovation Program under grant agreement no. 731872.

We also want to manifest our appreciation to all the members of the Consortium for their continued efforts to turn the implementation of the project an enjoyable experience. And last but not least, we thank all the schools, teachers and students that have participated and produced such wonderful examples of imagination and creativity.

References

[1] Saraiva, J., and the Stories of Tomorrow team: Stories of Tomorrow: schoolkids and the conquest of Mars, EPSC Abstracts Vol. 11, EPSC 2017-459-1, 2017.

[2] http://www.storiesoftomorrow.eu/

EPSC Abstracts
Vol. 12, EPSC2018-727, 2018
European Planetary Science Congress 2018

Mars Sample Return Outreach — Planning a Meaningful and Participatory Public Engagement Programme

Anita Heward (1), Sheri Klug Boonstra (2), 2nd International Mars Sample Return Conference Organising Committee
(1) Europlanet 2020 RI (anita.heward@europlanet-eu.org), (2) Arizona State University (sklug@asu.edu)

Introduction

Mars Sample Return (MSR) offers planetary science the prospect of an historical leap forward in the understanding of the geology and habitability of the red planet. In addition to this important science return, MSR also offers an unprecedented opportunity to engage the citizenry of this planet in one of the enduring questions of humanity, "Are we alone?"

The 2018 report of the International Mars Sample Return Objectives and Samples Team (iMOST) study says, "Exploration of Mars to date, from orbit and from the surface, has given us incredibly valuable insights into many aspects of Mars. These insights have allowed us to pose new, far more detailed, questions that could not have been asked before. A certain set of scientific objectives can only be achieved with samples in a laboratory. For Mars, we are at the point where the scientific logic implies this should be done next. Results are expected to be profound ("civilization-scale" science)."[1]

2nd International Mars Sample Return Conference

The 2nd International Mars Sample Return Conference[2] took place from 25-27 April 2018 in Berlin, Germany. The conference aimed to establish a better understanding of the options for a possible International Mars Sample Return campaign in the next decade, given the 2018 context, to highlight recent accomplishments in Mars exploration that feed forward to Mars Sample Return, and to share international agency and private industry preparatory plans for future Mars missions relating to Mars Sample Return.

Around 200 participants attended the conference, including representatives of space agencies, the international science community, industry and outreach providers, to discuss scientific objectives of an MSR mission, engineering design stages, planetary protection issues, curation and analytical facilities, and outreach strategy.

At the ILA Berlin air show, which took place in parallel to the meeting, Dr Thomas Zurbuchen, NASA's Associate Administrator for Science, and Dave Parker, Director of Human and Robotic Exploration at ESA, signed a Statement of Intent to explore concepts for missions to bring samples from Mars to Earth.[3]

At the end of the meeting, opportunities and motivations for carrying out MSR on an international basis were identified in the following four categories:

Science:
- *Civilization-scale science*
- *Samples: the gift that keeps on giving*
- *Definitive scientific results*
- *Only way to advance critical sectors of planetary science & astrobiology*

Engineering:
- *Unique technical challenges drive unprecedented innovation*
- *Advances will benefit future robotic and human missions.*
- *Crucible for engineering as a discipline.*

Preparation:
- *Prepare for humans to Mars*
- *Inform planetary protection policy evolution to enable future missions*

Inspiration:
- *Inspire and train the next generation*
- *Magnet for international cooperation*

Conference Position Statement:
The scientific exploration of Mars and the search for extra-terrestrial life have advanced to the point that

---

[1] Report of the iMOST Study, 9 May 2018

[2] https://atpi.eventsair.com/QuickEventWebsitePortal/2nd-international-conference-on-mars-sample-return/home

[3] https://mepag.jpl.nasa.gov/announcements/2018-04-26 NASA-ESA SOI (Signed).pdf

the return of samples from Mars is more important than ever to enable the next big discoveries in Mars exploration. Capitalising on major engineering progress in recent years by the world's space agencies and industries, we are technically ready to start the development of the flight missions associated with retrieving the samples. In parallel, planning for the potential receipt and evaluation of the samples has started, and should accelerate, as well as for the processes associated with making the samples available to the world's science community. Given the nature and scope of the Mars Sample Return campaign, we expect that engaging the public early and keeping them involved throughout will be a particularly important component of this effort. We have the opportunity and the motivation to make the Mars Sample Return campaign an international endeavour and a reality for all humankind.

Recommendations for developing an outreach strategy for MSR

During the outreach session at the 2nd International MSR Conference, the following recommendations for MSR public engagement strategies were presented and discussed[4],[5]:

- Begin formulation of key MSR elements that will be of public interest and assess any related existing opinions, misconceptions (risk communication), and needs that could be relevant to our planning and communication;
- Beginning ***now***, in getting ready for the upcoming Mars 2020 rover mission, prepare a long-term plan for MSR education and public outreach strategies that will be inclusive of multiple audiences and will leverage available technologies;
- Prepare a timeline and depository that will include major mission milestones, related scientific activities (e.g., curation preparation, analogue field trips, discoveries, spinoffs), and MSR outreach events;
- Identify participatory programmes where citizens and students can contribute actively towards mission science goals;
- Identify synergistic groups that we can engage to expand our reach;
- Identify evaluative program mechanisms to assess impact;
- Involve the international MSR team as our "faces of exploration" and expert advisors as we take on this amazing challenge.

MSR will involve a set of complex steps that will occur over a long timeframe and will necessitate the development of outreach strategies that will enable the public to fully engage, dialogue, and meaningfully participate with the science community during this endeavour. The discussions in Berlin were an important first step, but it will be important to consult and involve the international planetary outreach community if this is to become an effective global programme.

Continuing and expanding discussions

This presentation at EPSC aims to continue and broaden the discussion on MSR outreach strategy to include the wider planetary science and outreach communities in Europe and beyond.* The authors would welcome any thoughts, comments or suggestion.

*If the session conveners are able to allocate any additional time for discussion, it would be much appreciated.

---

[4] Klug Boonstra presentation, 2nd MSR Conference: https://drive.google.com/file/d/1DF6kLm3NhOQfNctuSnyzSq47dY6LRRZ0/view

[5] Heward presentation, 2nd MSR Conference: https://drive.google.com/open?id=1qCCDuxiGnAIn1ydbLdrPf8IGmd6HAnFF

EPSC Abstracts
Vol. 12, EPSC2018-772, 2018
European Planetary Science Congress 2018

Participation of women scientists in ESA solar system missions: an historical trend

Arianna Piccialli (1), Julie A. Rathbun (2), Ann Carine Vandaele (1), Francesca Altieri (3) Anni Määttänen (4) Anna Milillo (3) Alessandra Rotundi (3,5), Miriam Rengel (6), Pierre Drossart (7)

(1) Royal Belgian Institute for Space Aeronomy, Belgium, (2) Planetary Science Institute, Tucson, USA, (3) INAF, Istituto di Astrofisica e Planetologia Spaziali, Italy, (4) LATMOS/IPSL, UVSQ Université Paris-Saclay, Sorbonne université, CNRS, Guyancourt, France, (5) Dip. di Scienze e Tecnologie Università degli Studi di Napoli "Parthenope", (6) Max Planck Institute for Solar System Research, Göttingen, (7) LESIA, Observatoire de Paris, CNRS, Sorbonne université, Univ. Denis Diderot, F-92195 Meudon, France. (email: arianna.piccialli@aeronomie.be, Twitter: @apic79)

Abstract

We will present the participation of women scientists in ESA (European Space Agency) solar system missions and discuss how this trend changed over time.

1. Introduction

A recent study by [1] analyzed the participation of women in US planetary science missions. Their analysis show women scientists to be consistently under-represented in NASA's robotic planetary spacecraft missions. We plan to count science team members of 10 ESA solar system missions over a period of 38 years and to determine the percentage of women on each team.

2. Method

We will follow the same methodology described in [2,3], for consistency with their study. We therefore will consider only the original team scientists from European institutions: engineers, members of project management, students and postdocs will not be included. For each team, we search team web pages, published articles and when possible, we directly contact the Principal Investigators. In order to determine gender we rely on personal knowledge, first name or photographs.

One difficulty we are encountering is to find the original team members, as often new members are added over time. An additional difficulty is to determine the percentage of women in the field during the missions' selection year, as this information is not easy to obtain for different European countries.

3. Preliminary results

As preliminary analysis we counted the number of Principal Investigators of 10 ESA solar system missions and determined the percentage of PI women (See Table 1). We excluded the Cassini mission, since it is particularly difficult to determine the original team members, but we plan to add it in future.

Table 1: Percentage of PI women involved in ESA solar system missions

Launch year	Mission name	#PI women	Total #PI	% women
1985	Giotto	1	9	11.1
2003	SMART-1	0	8	0
2000	Cluster	0	9	0
2003	Double Star	2	9	22.2
2003	Mars Express	0	10	0
2004	Rosetta orbiter	1	13	7.69
2005	Venus Express	0	8	0
2016	ExoMars/TGO - Schiaparelli	3	10	30
2018	BepiColombo	1	23	4.35
2022	JUICE	1	10	10

We will extend this study to the entire team members, including therefore also Co-Investigators of each mission.

References

[1] Rathbun, Julie A.: Participation of women in spacecraft science teams, Nature Astronomy, Volume 1, id. 0148 (2017).

[2] Rathbun, Julie A.; Dones, Luke; Gay, Pamela; Cohen, Barbara; Horst, Sarah; Lakdawalla, Emily; Spickard, James; Milazzo, Moses; Sayanagi, Kunio M.; Schug, Joanna: Historical trends of participation of women in robotic spacecraft missions, American Astronomical Society, DPS meeting #47, 2015.

[3] Rathbun, Julie A.; Castillo-Rogez, Julie; Diniega, Serina; Hurley, Dana; New, Michael; Pappalardo, Robert T.; Prockter, Louise; Sayanagi, Kunio M.; Schug, Joanna; Turtle, Elizabeth P.; Vasavada, Ashwin R.: Historical Trends of Participation of Women Scientists in Robotic Spacecraft Mission Science Teams: Effect of Participating Scientist Programs, American Astronomical Society, DPS meeting #48,, 2016.

EPSC Abstracts
Vol. 12, EPSC2018-784, 2018
European Planetary Science Congress 2018

Europlanet Policy Activities toward FP9

L.Giacomini (1,2), A. Heward (1,3), N. Mason (1,4)
(1) Europlanet 2020 RI, (2) IAPS-INAF, Rome, Italy, (3) Science Office, Porto, Portugal, (4) The Open University, London, UK

Abstract

In the past years, part of Europlanet 2020 Research Infrastructure (RI)'s efforts were dedicated to building connections and organising activities for and within the European Parliament to increase engagement between our policy makers and the planetary science community.

From September 2015 to August 2018, Europlanet 2020 RI has contacted all Members of the European Parliament (MEPs) on the Committee on Industry, Research and Energy (ITRE), participating to meetings and conferences and organizing several individual briefings with MEPS and/or their representatives.

In April 2018, just before the launch of the next Multiannual Financial Framework and the new framework programme FP9 that will succeed Horizon 2020, Europlanet organized in the European Parliament in Bruxelles a successful Dinner Debate on the topic 'Planetary exploration inspiring European innovation'.

These were only the last of a series of events organized to enable members of the Europlanet community, politicians and interested parties to come together and discuss views on topics of interest or concern to the space and planetary sectors.

All these Policy activities have led to important opportunities for our community to feed into reporting and consultative processes: we will discuss these opportunities and the results achieved for FP9.

Acknowledgements

We acknowledge Steve Miller (Impact Officer) and Veronika Raszler (Policy Officer) for their previous contributions to this activity for Europlanet.

EPSC Abstracts
Vol. 12, EPSC2018-874, 2018
European Planetary Science Congress 2018

Europlanet Outreach Videos, using popular science videos to reach a wider audience

M. Barrosa (1,2), A. Heward (1, 2), on behalf of the Europlanet 2020-RI NA2 Outreach Team (1)
(1) Europlanet 2020 Research Infrastructure, (2) Science Office, Portugal
(mariana.barrosa@scienceoffice.org)

Abstract

Four popular-science animation videos have been produced in the framework of Europlanet's ‘Impact through Outreach and Engagement’ work package with the aim of widening engagement with planetary science amongst Europe’s citizens. The titles are “The Transit of Mercury”, “Jupiter and its Icy Moons”, “Astrobiology – Life in the Universe” and “Space Detectives - The Case of the Rocks from Space”.

The themes chosen for the videos included high profile events related to planetary science (the Transit of Mercury), priorities for the planetary science community (exploration of Jupiter’s icy moons) and the key areas of research supported by Europlanet’s TA programme (planetary analogues, astrobiology, sample analysis). The topics were chosen through a consultation with the Europlanet community. The scripts were written in collaboration with at least one researcher that specialised in the relevant scientific area, who provided consultancy, input and feedback to ensure the videos’ scientific accuracy.

The videos, which were disseminated online through social media and other platforms and are part of Europlanet’s legacy and are (and will continue to be) available for use free of charge by the community.

EPSC Abstracts
Vol. 12, EPSC2018-959, 2018
European Planetary Science Congress 2018

Digital museum collection to maintain heritage in planetary research

M.M. Kolenkina, N.A. Kozlova, A.S. Garov, I.P. Karachevtseva
Moscow State University of Geodesy and Cartography (MIIGAiK), MIIGAiK Extraterrestrial Laboratory (MExLab), Moscow, Russia (maria_kolenkina@list.ru)

1. Introduction

The most part of fundamental knowledge about planetary bodies is obtained by means of remote sensing. The most part of historical remote sensing data and results of their processing was in analogue form. To make it accessible and useful in modern world we need to bring them to proper formats. That is why we aim to create a digital collection of the available historic materials in the field of planetary studies and mapping. It is planned to use GIS techniques for cartographic products and organize web access to all data.

2. Digital museum collection

An example of similar project, is the NASA Regional Planetary Image Facility (RPIF), where photographic and digital data, including photographs and maps, as well as mission documentation, are presented (https://www.lpi.usra.edu/library/RPIF). These libraries, located in the US and some other countries, not only store the results of space research, but also carry out educational activities and popularize space science.

Our approach is aimed to the formation of an digital collection of planetary data as an information and technological support for the educational and scientific activities of the MIIGAiK Educational and Historical Center (http://www.miigaik.ru/sveden/unique/muzeum/), whose main tasks in terms of education problems are:

- to increase the level of professional knowledge;
- to enlarge training resources, including remote sources;
- expansion of the educational base with new archival and documentary materials;
- to increase interest in specialized studies.

For these purposes, we plan development of various instruments, including the possibility of 3D-modeling and processing of spatial information, of thematic online mapping, intellectual search and retrieving data, and tools for online communication and web-conferencing [1].

As information and technological support of the proposed interactive collection, it is planned to use the MIIGAiK Planetary Data Geoportal, which supports modern GIS and Internet technologies, providing cartographic visualization and access to planetary data online in an interactive mode (http://cartsrv.mexlab.ru/geoportal).

Modern technologies have already given new life to some archive data. Scanning of original Lunokhod films made it possible to perform computer processing of panoramic images of the lunar surface (Fig. 1) and bring them to a view convenient both for amateurs in astronomy and formats supported by the software products adopted in the scientific community.

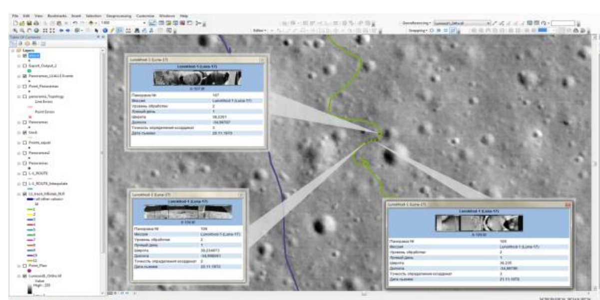

Figure 1: Example of student's GIS project for processing and visualization of archive Lunokhod panoramic images.

The combination of archival information with the data of the modern remote sensing of the Moon made it possible not only to clarify the routes of the Lunokhods [2], but also to partially reconstruct the information about the places of shooting of the lunar panoramas, which was considered lost [3]. Thus, the results of modern processing of archival lunar panoramas are already available on the MIIGAiK Planetary Data Geoportal. It is important to note that modern technologies make it possible to provide the coordinated consistency of archival cartographic materials with data obtained by planetary rovers, which makes it possible to integrate the latest and historical materials in a single environment.

In addition, geoinformation software helps to prepare visual materials and teaching aids in the form of maps and GIS projects that reflect both general information about the lunar surface and allow to highlight and pay attention to particular features of the territories, details of the relief or historical facts. Such maps can be used for classes in schools, seminars, workshops, at planetariums, interactive museums, and GIS projects - in training specialists (Fig. 2).

Figure 2: The driver of Lunokhods – V.G. Dovgan – at a seminar with students and young scientists, who prepared the new maps of Lunokhods routes.

3. Summary and Conclusions

The digital museum collection, developed as a pilot project on the history of space exploration by geodetic and cartographic methods, will be further expanded with exhibits from other museum expositions, thereby forming an interactive museum with web access that will be a useful tool not only for researchers but also used in as an educational material for a wide range of interested in space exploration people.

Acknowledgements

We would like to acknowledge Russian State Archive of Scientific and Technical Documentation which provided lunar panoramas for the research. Processing of Lunokhod panoramic images received funding from the European Community’s Seventh Framework Programme (FP7/2007-2013) under grant agreement № 312377 PRoViDE.

References

[1] Garov A.S., Karachevtseva I.P., Matveev E.V., Zubarev A.E., Patratiy V.D., 2016. Development of heterogenic distributed environment for spatial data processing using cloud technologies. 2016. InInt. Arch. Photogramm. Remote Sens. Spatial Inf. Sci., XLI-B4, 385-390, doi:10.5194/isprs-archives-XLI-B4-385-2016/ ISPRS 2016

[2] Karachevtseva I., Kozlova N., Kokhanov A., Zubarev A., Patratiy V., Konopikhin A., Basilevsky A., Oberst J., Haase I., Joliff B., Plescia J., Robinson M., 2016. Cartography of the Luna-21 landing site and Lunokhod-2 traverse area based on Lunar Reconnaissance Orbiter Camera images and surface archive TV-panoramas. Icarus 2017, Vol. 283, pp. 104–121. (Doi: 10.1016/j.icarus.2016.05.021).

[3] Kozlova N.A., Zubarev A.E., Patratiy V.D., Konopikhin A.A., Oberst J. Method of a planetary rover localization based on synthetic Lunokhod images // Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci., 2016, XLI-B4, 435-439, doi:10.5194/isprs-archives-XLI-B4-435-2016, 2016.

EPSC Abstracts
Vol. 12, EPSC2018-970, 2018
European Planetary Science Congress 2018

Involving School Students in Exoplanet Research Through the Twinkle Space Mission - ORBYTS

William Dunn (1,2), Katy Chubb (1), Marcell Tessenyi (1), Jonathan Tennyson (1), Tomas James (1), Daniel Darby (1), Maria Niculescu-Duvaz (1), Romain Meyer (1), Jonathan Holdship (1), Jack Baker (1), Jana Smutna (1), Mala Virdee (1), Sian Brannan (1), Giovanna Tinetti (1), Anita Heward (1), Clara Sousa-Silva (4), Laura McKemmish (5), Maire Gorman (6), Tom Rivlin (1)

(1) University College London, London, UK,

(2) Mullard Space Science Laboratory, University College London, Dorking, UK

(3) Imperial College, London, UK

(4) Earth, Atmospheric and Planetary Sciences, MIT, Cambridge MA, USA

(5) University of South Wales, Sydney, Australia

(6) Aberystwyth University, Aberystwyth, UK

Abstract

ORBYTS[1,2,3] (Original Research By Young Twinkle Scientists) is the flagship outreach programme for the Twinkle space mission (launch: 2021), which will be the first spacecraft dedicated to studying the atmospheres and conditions of newly discovered planets. We believe that all school students should have the opportunity to become involved in active scientific research and to be culturally connected to space missions. To achieve this, ORBYTS partners dynamic, passionate science researchers with secondary schools, where, through fortnightly school visits over an academic year, the researcher facilitates pupil involvement in active science research. The goal of every partnership is that school students will have the opportunity to contribute towards publishable research.

By partnering schools with relatable researchers we hope that the programme will not only improve student aspirations and scientific literacy, but will also help to address diversity challenges by dispelling harmful stereotypes and will provide teachers with relevant exciting CPD at a time when the UK is chronically short of specialist physics teachers.

In the three years since ORBYTS launched, we have had tens of school pupils contribute to scientific papers and listed as co-authors on these works. In 2017-2018 academic year, we have 14 researcher-school partnerships and ~100 pupils involved in the programme. Currently, school students are actively working on research topics including: conducting and analysing their own exoplanet observations, spectra from star and planet forming regions and developing theoretical lists of molecular spectra applicable to both industry and exoplanet atmospheres (through UCL's ExoMol project). We hope this will continue our excellent school student publication record.

The ORBYTS programme is one that embraces a symbiotic relationship between research and outreach. Researchers involved report that they learn not only leadership and management skills, but also are provided with practical communication training applicable to their own research. They also receive remuneration for their time.

For Sept 2018, we hope to continue to grow the programme in order to further the positive impact the programme seems to be having on all involved. If you are a teacher or an active researcher, please do visit our poster or drop us an email if you are interested in becoming involved.

Figures: images of some the ORBYTS schools and tutors in action and during the end of year school conference and start of year launch event respectively.

References

[1] Sousa-Silva, Clara, et al. "Original Research By Young Twinkle Students (ORBYTS): when can students start performing original research?." *Physics Education* 53.1 (2017): 015020.

[2] McKemmish, Laura K., et al. "Bringing pupils into the ORBYTS of research." *Astronomy & Geophysics* 58.5 (2017): 5-11.

[3] http://www.twinkle-spacemission.co.uk/orbyts/

EPSC Abstracts
Vol. 12, EPSC2018-1080, 2018
European Planetary Science Congress 2018

Communicating Planetary Science Through Social Media at Europlanet

T. Heenatigala (1,2)
(1) Europlanet, Portugal (2) Science Office, Portugal (thilinah@astroepo.org / +31 649 099 747)

Abstract

Social Media plays a dominant role in Public Engagement of science. From 'Save the Hubble' campaign to Europe's Rosetta Mission, many space missions and discoveries have used social media successfully. Under the Horizon 2020, the Europlanet Media Centre[1] identifies the importance of using social media for outreach. Europlanet uses primary and secondary social media platforms strategically to engage with the followers and a new audience.

1. Introduction

What are the best practices in using social media for science communication and how much should we invest on it? With ever increasing advancements in science, the ways people communicate have drastically changed. With how scientists interacting with peers and public, the ways that scientific information is disseminated, and methods of scientific outreach/education have changed, in many ways becoming more efficient. The use of social media has not only allowed scientists to engage in more efficient public outreach and education but has provided a unique platform for communication and networking within the scientific community.

2. Social Media at Europlanet

While Europlanet has a representation across all the major social media, it focuses on two levels. Primarily Facebook, Twitter, and Youtube, where content is posted regularly for most dynamic engagement. The campaigns are run on these platforms. Europlanet also produces regular videos for organisational events, planetary highlights, topical discussions, and live webinars. Secondarily Europlanet uses Instagram, LinkedIn, Google+ where updates are posted regularly to keep a presence. Each of the platforms serves a different purpose and an audience. Having a presence in different platforms helps to reach a wider audience. Europlanet also maintains a Flickr profile to archive photos from the organisation related events.

3. Best Practices: Europlanet Social Media Campaigns

While there are regular posts across all the social media platforms. Europlanet organises various campaigns to keep the public engaged. From the past campaign results, it clearly shows the public engagement can be spiked and reach a wider audience.

Europlanet social media strategy uses important planetary milestones and events to create campaigns, such as ‘Transit of Mercury’ featured video animation reached 17K views, Juno mission video reached 9K views. Europlanet also runs a monthly webinar series featuring planetary scientists with various expertise. The first series of webinars focused on general public while the second series is addressed teachers and students as the primary focus.

As another effort towards building a better relationship between scientists and public, Europlanet will focus on getting planetary scientists involved via Twitter in the future. This effort was highlighted during the EPSC2017 where EPSC was a trending topic in Latvia and Riga.

References

[1] Heward, A., Miller, S., Barrosa, M., Fouchet, T., and Raszler, V.: Europlanet outreach in Horizon 2020, European Planetary Science Congress 2014.

EPSC Abstracts
Vol. 12, EPSC2018-1112, 2018
European Planetary Science Congress 2018

Summer Schools at Vulcano (2015-2018): A natural laboratory for marine, terrestrial and planetary science and technology

Vikram Unnithan (1), Frank Sohl (2), Laurenz Thomsen (1), Martina Wilde (3), and the Vulcano Summer School Team
(1) Jacobs University Bremen, Germany (v.unnithan@jacobs-university.de), (2) (2) DLR Berlin, Germany, (3) AWI Bremerhaven, Germany

Abstract

ROBEX was the Helmholtz Alliance for Robotic Exploration of Extreme Environments that brought together scientists and engineers from different communities of space sciences, polar and deep-sea research to jointly develop strategies and technologies for the exploration of diverse terrestrial, marine and planetary terrains. Funding for this alliance came to an end in 2017. Summer schools formed an important outreach element of this alliance. For the past 3 years, a two-week summer school under the aspics of ROBEX was held at Vulcano, Italy. This year, it was supported by DLR and Jacobs University on a shoe-string budget. The summer school focusses on bringing together scientists, researchers, students, technicians and policy makers, to provide field exposure and training on a variety of topics ranging from geology, volcanology, geophysics, oceanography to robotic, and the study of planetary analogues.

This presentation provides a brief overview of the various field activities and the educational concept developed for and during the summer schools at Vulcano, Italy. Vulcano is the third largest and southern most island of the Aeolian archipelago. The larger part of the island consists two main edifices built by strombolian to phreatomagmatic eruptions. Apart from the dry and arid climate, the surface morphology is similar to lunar and martian regions (see Fig. 1)

Drone photogrammetry, and optical infrared (IR) measurements show the the present day activity is stable. Seismic refraction and magnetic gradiometery mapping was used to map to extent of the regolith and surface / subsurface lave flows. Oceanographic work such as CTD, Ph and biological sampling indicate that in the vicinity of the underwater vents low Ph and acidification is prevalent. Finally marine crawler and terrestrial robotic traverses highlighted the need for further testing concepts and finding innovative solutions for locomotion on diverse planetary terrains. The summer schools also highlighted the need to mix students with experienced researchers, scientists with engineers and politicians and administrators with academics, in order to get the optimum learning experience and networking opportunities.

Acknowledgements

The authors gratefully acknowledge funding support by the German Helmholtz Alliance Robotic Exploration of Extreme Environments - ROBEX for the past field camps. Many thanks to all the summer school participants for their help and support over the past 3 years.

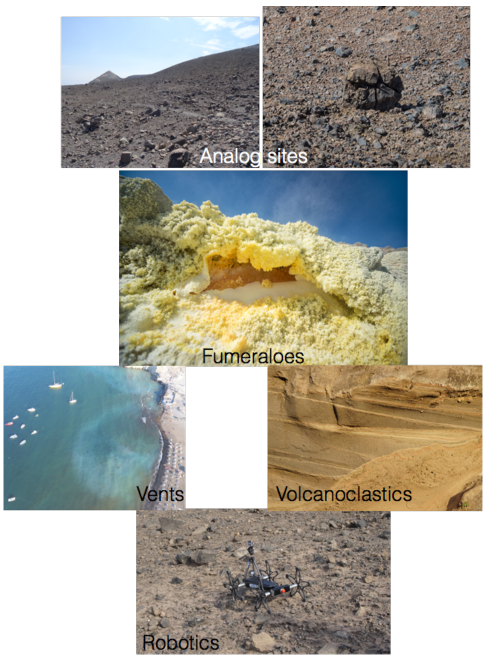

Figure 1: Various images from the past summer schools at Vulcano, Italy. The island offers excellent opportunity to study a variety of volcanic processes and provides unique planetary analog sites.

EPSC Abstracts
Vol. 12, EPSC2018-1140, 2018
European Planetary Science Congress 2018

Developing an Arabic Equivalent of the Planetary Nomenclature: a draft for a standardized system

Mohamed Amine ETTAHRI
PhD school of Earth science, Eötvös Loránd University, Hungary (amine.ettahri@gmail.com)

Abstract

This paper describes the making process aiming to develop the first basis for an Arabic equivalent of the planetary nomenclature that have been produced in many other languages, we have developed priorities for the Arabic translation and conversion of the original Latin forms of planetary specific and descriptor terms. It also shows the main difficulties and some recommendations. This work will hopefully serve as a draft and preparatory base for a standardized system of the Planetary nomenclature in Arabic script.

Keywords—Cartography, Gazetteer, Nomenclature, Planetary.

1. Introduction

Planetary science has been for the last decades a ground of research restricted only for space faring nations that are capable to develop and operate planetary spacecrafts, and thus are able to discover new surface features and send missions to the outer space in the case of few countries citing the United states, Russia, China, Japan... But as the interest with astronomy and planetary science grows up and the access to information and technology became easier for scientists from other countries. Then groups and research teams from different countries emerged in order to collaborate with Space agencies and are closely involved in studying the enormous amounts of data from previous works or planning the science programs of future spacecraft missions.

In this context we can encounter scientific communications and many research results published in different languages, following those researchers official mother tongue or due to governmental obligations to publish in their own language to address the local public. Although English is the predominant language in today's scientific communications, we can find Russian, Chinese, French, German or Japanese research results in local websites used for local development or educational purposes.

This conduct us to talk about The Arabic language which is spoken today by over 420 million people in the Middle East and North Africa. but actually it is also used as a religious language by the world's Muslims, who total around one billion people, making it the fifth most spoken language in the world. 'By analyzing the number of Planetary Science Papers by the First Author's City of Affiliation (Published in JGR, PSS and Icarus in 2009-2012) we can assume that the United state, Russia and European countries are the most active nations alongside with other nations from Asia (China India and Japan), on the other hand we can observe the absence of any publication from other continents in the case of South America, Australia and Africa, Although we are focusing on Middle eastern and North African countries that are Arabic speakers."[1] The fact that centuries ago, during the Golden age of Islam, the contributions islamic science in the making of the european renaissance.

"Islamic astronomy played a significant role in the revival of Byzantine and European astronomy following the loss of knowledge during the early medieval period, notably with the production of Latin translations of Arabic works during the 12th century. Islamic astronomy also had an influence on Chinese and Malian astronomy. A significant number of stars in the sky, such as Aldebaran, Altair and Deneb, and astronomical terms such as Alidade, Azimuth, and nadir, are still referred to by their Arabic names. 10,000 Arabic manuscripts scattered throughout the world is the number of Astronomy related literature. [4]

"Given the awareness of the potential of space applications, countries are aware of the benefits of including space capabilities in their national development programs, and this has been an important development in recent years, with countries moving forward seeking to take advantage of space and promote their national development towards joining the scene of space technology, Such as Japan, India, Brazil, Canada, and South Africa, proved the success of their programs, and took the recent emerging countries such as Venezuela, Thailand, Turkey, Algeria, Malaysia, Taiwan, Indonesia, the United Arab Emirates, Egypt and others Through small and low-cost satellite technology transfer programs through cooperation with countries that are already in the process It has a long history in space technology." [2]

In this context the United Arab Emirate has entered the space race with a project to send an unmanned probe to Mars by 2021 under the oversight of its own Outer space federal agency becoming the Arab world's first foreign space mission. "The UAE space agency will become the ninth country in the world with space programs to explore the Red Planet, according to the statement. Mohammad Bin Rashid Space Centre".[3]

Given the opportunity to contribute to the space community with this mission, it will be a chance for Arabic speaking nations to aim for the new Amateur public interested in Astronomy and space industry with their Mother tongue language and especially the younger ones by communicating the passion in the most simple and understandable way.

1.1 Gazetteer of Planetary Nomenclature

Every last one of three crewed space faring nations (the USA, china and Russia) use different writing systems, in spite of the fact that the International Astronomical Union’s Gazetteer of Planetary Nomenclature (GPN) has proper and specific names originating from more than 300 ethnic groups and nations. "So Instead of being international, the GPN should be considered ”supra-national”, giving all nations an equal right to use the names determined by IAU WGPSN in their respective languages and writing systems, while maintaining the standardized, single IAU forms in international communication." [2]

"The Latin-based planetary nomenclature may be more or less transparent for the well educated Euro-American reader, but it is obscure for most young students in Europe and is as alien for the Arabic or Chinese readers, as alien Arabic or Chinese is for the Euro-American readers." [2]

For young amateurs in this field, dominated by English language, the focus of the apprentices should be on acquiring the information and not just in learning exotic words. The linguistic barrier can be tackled after years of learning but the first interest of the person can change to another science or activity, so why not paving the road for the young educated children and students and target a more general audience in event and public conferences or just news broadcasting where a more popularized and vulgarized language can be used and make it understandable for them as it is for the professionals.

"The authors of previous papers participated in efforts to transform the international standard forms in the GPN into their respective languages (Chinese, Russian and Hungarian). This processes also called localization: the creation of a local variant, in this case, the local equivalent of the GPN." [2]

In contrast with the fact that the Russian version has been under development since the 1960s, the Chinese variant has been created only in recent years, answering the needs connected to the successful Chinese Moon program. And with the upcoming event of the first Emirati and Arabic Hope probe project the scientific community has no more excuses not to work on a localized Arabic GPN, where this work can be a pilot effort aiming to engage future efforts and contributions by professionals in other fields.

2. Materials

A) The Arabization process

The process of the "Arabization" has been commonly used in many educational programs but the need to generalize the use of Arabic as the language of academic teaching, research and publication can be a challenge and a good prospective with the upcoming events for the UAE space agency in order to communicate the results and last updates to the general public audience and especially young students and Amateurs fascinated by space and Astronomy in general and planetary science as one of its most attractive fields.

B) Benefiting from Romanization works

Romanization is often termed "transliteration", but this is not technically correct. "Transliteration is the direct representation of foreign letters using Latin symbols, while most systems for romanizing Arabic are actually transcription systems, which represent the sound of the language."[6]

	1	2	3	4	5		1	2	3	4	5		1	2	3	4
1	ء				’, - [A]	11	ر			ـر	r	21	ف	ـفـ	فـ	ـف
2	ا			ـا	- [B]	12	ز			ـز	z	22	ق	ـقـ	قـ	ـق
3	ب	ـبـ	بـ	ـب	b	13	س	ـسـ	سـ	ـس	s	23	ك	ـكـ	كـ	ـك
4	ت	ـتـ	تـ	ـت	t[C]	14	ش	ـشـ	شـ	ـش	sh	24	ل	ـلـ	لـ	ـل
5	ث	ـثـ	ثـ	ـث	th	15	ص	ـصـ	صـ	ـص	ṣ	25	م	ـمـ	مـ	ـم
6	ج	ـجـ	جـ	ـج	j	16	ض	ـضـ	ضـ	ـض	ḍ	26	ن	ـنـ	نـ	ـن
7	ح	ـحـ	حـ	ـح	ḥ	17	ط	ـطـ	طـ	ـط	ṭ	27	ه	ـهـ	هـ	ـه
8	خ	ـخـ	خـ	ـخ	kh	18	ظ	ـظـ	ظـ	ـظ	ẓ	28	و			ـو
9	د			ـد	d	19	ع	ـعـ	عـ	ـع	‘	29	ي	ـيـ	يـ	ـي
10	ذ			ـذ	dh	20	غ	ـغـ	غـ	ـغ	gh					

[A] Not romanized word-initially.
[B] Not romanized, but see romanizations accompanying *alif* (ا) in the table for vowels.
[C] In certain endings, an original *tā’* (ت) is written ة , i.e., like *hā’* (ه) with two dots, and is k *tā’ marbūṭah*. It is romanized *h*, except in the construct form of feminine nouns, wh romanized *t*, instead.

C) Modern Standard Arabic (MSA)

Most printed material by the Arab League—including most books, newspapers, magazines, official documents, and reading primers for small children—is written in MSA standing for Modern Standard Arabic. It is considered the literary standard across the Middle East and North Africa, and it is one of the six official languages of the United Nations. It is considered relatively new and was developed in the early part of the 19th century. [7]

D) Translation from Latin and English

The movement of Arabic translation have played a significant role in the revival of Byzantine and European astronomy following the loss of knowledge during the early medieval period. The fact that Latin-Arabic glossaries and dictionaries existed for centuries and were used in scientific progress provided this work with a good reliability and is considered the main and most accurate process in this product. [9]

3. Methods

A) Structure of the nomenclature: "A planetary name is generally binominal: it consists of two elements, a specific part (e.g., Imbrium) and a generic part called “descriptor term” (e.g., Mare). Descriptor terms are in Latin language. The specific parts are in the original language (for personal names, terrestrial geographical names and in some exceptional cases), or in Latin or in English. Some names (e.g., crater names) are composed of one element only, having no descriptor term (e.g., Tycho)."[1]

B) Transformation methods:

"Two principle methods are used to transform a toponym:

1) Translation: finding the equivalent denotative and connotative meaning in the other language’s vocabulary

2) Conversion: which includes

2.1) Transcription, which is a phonetic conversion between different languages, in which the sounds of a source language are recorded in terms of a specific target language and its particular script.

2.2) Transliteration, which is a conversion between different alphabetic scripts and syllabic scripts, in which each character or di-, tri- and tetragraph of the source script is represented in the target script in principle by one character or di-, tri-, or tetragraph, or a combination of these. It aims at complete reversibility, and must be accompanied by a transliteration key (Kadmon, 2000)." [1]

"Several of the planetary names are eponyms: named after a person. Two or more toponyms employed in reference to a single topographic feature are called allonyms. IAU recognizes only one single name and form for each feature: there are no official allonyms allowed. However, there are several informal or historic names that are allonyms of the same planetary feature."[1]

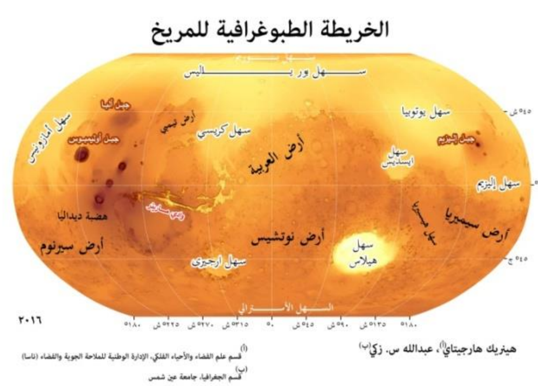

Figure 1 Arabic Topographic Map of Mars (MOLA data). [7]

Latin name (sing.plur.)	**Arabic name**	**Type of conversion**	**Arabic pronounciat ion**	**Original Geographic examples**	**Arabic translation**
Arcus, arces	قوس	translation from latin	qaws		
Astrum, astra	نجم	translation from latin	nad ʒm		
Catena, catenae	سلسلة	translation from latin	silsila		
Cavus, cavi	تجويف	translation from latin	tad ʒwif		
Chaos, chaoses	كايوس	Conversion (transcription)	kaios		
Chasma, chasmata	شازما	Conversion (transcription)	kazma	Coprateschasma (on Mars)	كوبراتس شازما
Corona	تاج	translation from latin	taj		
Collis, Colles	تل	translation from latin	tel	Arena Dorsum	قمم دورسم
Dorsum, dorsa	قمة قمم	english translation reffers to ridge	qimma	Solarfaculae (the sun)	صياخد شمسية
Facula, faculae	صياخد	translation from latin	sˤayakhid	Carmentafarra (on venus)	كارمنتا فارا
Farrum, farra	فاروم. فيرا	Conversion (transcription)	farrumfarra	Delphi Flexus(on Europa)	انحناء يوروبا
Flexus, flexūs	انحناء	translation from the original meaning	inħina	Karesosflumen(on Titan)	نهر كاريسوس
Flumen, flumina	نهر أنهار	translation from latin	nahr, anhar	Olympicafossae (on Mars)	خندق أولمبيكا
Fluctus, fluctūs	موجة, أمواج	translation from latin	mawd ʒa, amwad ʒ	Hardin Fretum (on Mars)	قناة هاردن
Fossa, fossae	خندق	translation from latin	khandaq	Bimini insula (on Titan)	جزيرة بيميني
Fretum, freta	قناة	translation of meaning from channel	qanat	Candorlabes (on Mars)	انزلاق كاندور
Insula, insulae	جزيرة	translation from latin	jazira	Adamas labyrinthus	أداماس لابيرانت متاهة اداماس
Labes, labēs	انزلاق	translation from english equivalent 'landslide'	inzilaq	Solislacus (on Mars)	سهل سوليس
Labyrinthus (labyrinthi)	لابيرانت/ متاهة	translation	labyrinth/ mataha	Balaton lacus (On Titan)	بحيرة بالاتون
Lacus (lacūs)	سهل	translation according to the IAU description small plain	sahl	Adonis linea (on Europa)	أدونيس لينيا
Lacus (lacūs)	بحيرة	translation according to the IAU description 'lake'	bouħaira	UltimaLingula (on Mars)	أولتيما لينغولا
Linea, lineae	لينيا	Conversion (transliteration)	linea	No examples on theGazetteer (only on Europa)	////////////
Lingula, lingulae	لينغولا	Conversion (transliteration)	lingoula		
Mare, maria	بحر	translation from latin	bahr	Olympusmons	جبل أولمبيس

Table 1: Table presenting the attempt to find the most accurate Arabic equivalent to some Latin names and the Type of conversion used.

4. Summary and Conclusions

This work being a first attempt to implement a basis for Developing an Arabic Equivalent of the Planetary Nomenclature, we came to a conclusion that creating such a standardized system will require the collaboration of a team of experts, this is why we can recommend the creation of a working group composed of Planetary scientists, Cartographers, planetary geologists and use the previous experience of the United Nations Group of Experts[5] on Geographical names and include a recognized Institute of translation.
Direct Translation from the Latin name can sometimes cause an ambiguity or confusion with the real meaning which have been the case of Labyrinthus translated to labyrynth or Maze structure where in Arabic it's more accurate to use the translation of a maze. those problems provided a good reason to think about a system of hierarchy by priority:

1) Latin name.
2)original meaning in Latin.
3)English translation.
4)conversion by transliteration.

Transcription is used when the proposed translation from latin or english is either confusing, can't contribute in the field of geology & planetary science or just isn't widely used in the Arabic language to refer to that meaning so we adopt this conversion method.Conversion by transliteration should take in consideration the same order of Translating Latin before English term (eg: Chasma should be transliterated to kazma).
The next step would be the creation of detailed topographic and geologic planetary maps in Arabic similar in quality to those produced by renowned agencies to the benefit of both the public and research community in the Arab world.

Acknowledgements

The original idea for this article came from my mentor Pr. Henrik Hargitai to whom I am very grateful and proud to work alongside and for his expert guidance.
We thank the Stepindum hungaricum scholarship Foundation for the funding of this PhD degree in collaboration with the Algerian Ministry of Higher education and scientific research.

References

[1] H. Hargitai, C. Li, Z. Zhang, W. Zuo, L. Mu, H. Li, K.B. Shingareva and V.V Shevchenko, "Chinese and Russian Language Equivalents of the IAU Gazetteer of Planetary Nomenclature: an Overview of Planetary Toponym Localization Methods", The Cartographic Journal, http://dx.doi.org/10.1179/1743277413Y.0000000051

[2] phys.org, "UAE to create space agency, send unmanned probe to Mars", July 16, 2014, URL https://phys.org/news/2014-07-uae-space-agency-unmanned-probe.html, accessed:17/11/2017

[3] solomon,"صناعة الفضاء في العالم العربي " (Space industry in the Arab world,in Arabic), SME advisor, 28 March2016, URL: goo.gl/ZzAC7y, accessed:17/11/2017

[4] Shannon Stirone, "How Islamic Scholarship birthed modern Astronomy", Astronomy.com, February 14, 2017, URL: http://www.astronomy.com/news/2017/02/muslim-contributions-to-astronomy

[5] Department of Economic and Social Affairs Statistics Division, "Technical reference manual for the standardization of geographical names", New York, 2007, pp iii.

[6] gov.uk, "ROMANIZATION SYSTEM FOR ARABIC', BGN/PCGN 1956, pp 1-3

[7] H. Hargitai, A.S Zaki, Map of Mars, Arabic nomenclature, MOLA DTM,20 july 2016 URL: goo.gl/LyUiar

[8] AL Arabic 03 August 2017 Modern standard arabic website URL http://www.msarabic.com/index.php/en/

[9] Astronomy in the medieval Islamic world URL: https://www.revolvy.com/main/index.php?s=Islamic%20astronomy

EPSC Abstracts
Vol. 12, EPSC2018-1212, 2018
European Planetary Science Congress 2018

Europlanet Evaluation Toolkit

K. Bultitude (1, 2), **J. DeWitt** (1,2), Anita Heward (2) on behalf of the Europlanet 2020-RI NA2 Outreach Team (2)
(1) UCL, London, UK (2) Europlanet 2020 Research Infrastructure

Abstract

Europlanet 2020 RI has developed a dedicated evaluation toolkit to empower outreach providers and educators in measuring and appraising the impact of their activities. The toolkit is intended to provide advice and resources that can be simply and easily integrated into normal outreach and education activities. This poster will provide an overview of the toolkit, to increase awareness of it and encourage use.

The toolkit itself is a set of interlinked Googledocs. It begins with a brief introduction to evaluation generally, as well as the Toolkit specifically. It particularly emphasizes potential uses for evaluation, responding to the question of 'Why evaluate?' There is also a short description of the intended users for this Toolkit, as well as how it was developed.

The toolkit will be accessible from this link: http://www.europlanet-eu.org/europlanet-evaluation-toolkit/

Major sections of the toolkit

We realise that for most users, evaluation (or even public engagement) is not a major part of their role. Thus, the toolkit was developed with this in mind, and includes the following sections:

Steps to choosing the right tools

This crucial advice takes the form of a series of questions which will help you design your approach, and especially make your evaluation as efficient and effective as possible within limited time and resources. It considers key questions such as:

- What do I want to find out?
- How will I use that information?
- What resource (time/budget) do I have available?
- How will I analyse the data that I collect?
- What methods will I use?

Data collection tools

The majority of the toolkit focuses on data collection tools. This section includes an overview table to help with the actual selection of which tool is most appropriate for particular situations (e.g. festival, lecture, school outreach etc). The tools are grouped according to when they might best be used (during, beginning/end, or after an event).

For some of these tools, members of the Europlanet community have generously provided details of how they applied such tools in their own evaluation of outreach activities. These case study examples include information about the event context, how data was actually collected and analysed and what conclusions were reached, based on the data gathered.

The tools featured in the toolkit are generally relatively easy to implement and appropriate for a variety of activities. Some of these tools include:

Graffiti wall
Mentimeter (and other interactive tools)
3 words
Snapshot interviews
Pre-post quizzes
Post-event surveys
Photograph diary

Analysis techniques

The toolkit includes descriptions and worked examples of how to use two analysis techniques – word-clouds and thematic coding – to analyse the data. These two techniques are common ways to analyse open-response (qualitative) data. Details are provided to help users select which might be best suited for their data and worked examples of how to carry out the techniques are also included. Additionally, the toolkit contains tips on analyzing and presenting numerical (quantitative) evaluation data.

Other sections

Finally, the toolkit also contains top tips and recommended resources. The *top tips* have been divided into categories according to the various stages of conducting an evaluation (planning, collecting data, coming up with conclusions, report writing and sharing your findings). Following these tips will help users design and conduct a more successful evaluation – one that answers questions they want to know and that helps them communicate and use the findings, so efforts don’t go to waste.

In addition to the content provided within the Toolkit, there are references and links to some of the other excellent evaluation resources available for anyone who wants to take evaluation further.

EPSC Abstracts
Vol. 12, EPSC2018-1261, 2018
European Planetary Science Congress 2018

A hard sell? Engaging UK and European politicians with space science

Robert Massey

Royal Astronomical Society, Burlington House, London, UK (rmassey@ras.ac.uk)

Abstract

The UK, and the whole of Europe, face uncertain times. Science, particularly blue skies research, is equally affected by social change, and the relationship between collaborating nations. Securing political and public support for space science and astronomy, including exploration of the Solar system, is by no means easy, and science as a whole is some way down the list of priorities in international relations.

In this paper I will describe the efforts made by the Royal Astronomical Society (RAS)[1], the lead UK body representing professional astronomers, space and planetary scientists, with examples that may be of use to similar organisations at a European and national level.

Some challenges in the UK are likely similar to those across Europe: difficulty in recruiting women and members of minority groups to STEM occupations, variable political support, complicated migration rules and constrained financial resources. The 2016 vote to leave the European Union, set to be enacted in March next year, is an additional overarching pressure on scientists and society in general.

The Society's public policy works aims to engage in all these areas. It rests on analysis, for example regular surveys of the demographics and research interests of the scientific community, efforts to map the funding landscape, and dialogue with the astronomers and space scientists we represent. We assemble both qualitative and quantitative evidence to make our case to policymakers, organise meetings at an individual and community level, and set out position statements on key issues.

This paper will look at the success of our work, attempting to reflect on the achievements and sometimes disappointments from our approach, and plans for the future.

References

[1] Royal Astronomical Society: http://www.ras.ac.uk/

EPSC Abstracts
Vol. 12, EPSC2018-1268-1, 2018
European Planetary Science Congress 2018

ExoWorlds Spies: a project for public involvement in exoplanet research

Anastasia Kokori (1,2) and Angelos Tsiaras (2)
(1) Aristotle University of Thessaloniki, Thessaloniki, Greece, (2) UCL, London, UK (anastasia.kokori@gmail.com)

Abstract

We present here the project entitled ExoWorlds Spies, aiming to monitor exoplanets through regular observations. ExoWorlds Spies is a long-term project to monitor transiting exoplanets with small and medium scale telescopes. The project aims to improve the parameters and ephemerides of known transiting exoplanets, in support of future space missions such as the JWST and ARIEL. The main idea of the project is to observe stars hosting exoplanets with the aim of improving their parameters and their ephemerides. Understanding worlds beyond the Earth is a key issue for humanity and concerns everyone, not only the scientific communities. We strongly believe that research and science is an effort that everyone can take part. For this reason, in the context of our project, we are open to collaborations with members of the public including also students of schools and universities and help towards answering fundamental questions of science and society: Are there other planets like the Earth? Could they host life? Is there any other type of life?

Today, the general public can get involved in the effort of answering the above questions through citizen science projects. In our project, members of the public and students can contribute by obtaining or analysing data from small ground-based telescopes. In this presentation we will discuss the progress and the strategies followed to design an open project where everyone could take part and learn. We have also developed a dedicated website for the project in order to disseminate the material and the tools to as many people as possible. The website includes audiovisual material, information on the project, data analysis tools, instructions, observational data and graphics. All sources are online, free, and available for everyone both in English (and Greek). In order to approach various audiences from the public and more effectively communicate with them, we created also a social media platform (a Facebook page).

Website: **www.astro.auth.gr/n/?p=exoworlds_spies_(english)**
Facebook: **ExoWorlds Spies**

EPSC Abstracts
Vol. 12, EPSC2018-1272-2, 2018
European Planetary Science Congress 2018

Europlanet 2020 RI Outreach Innovation and Communication Training Workshops

Eleni Chatzichristou (1,2), Ioannis Daglis (2), Anita Heward (3), Grazina Tautvaisiene (4), Pedro Russo (5), Rosa Doran (6,7)
(1) Université Paris-Diderot, France, (2) IASA NKUA, Greece, (3) Europlanet 2020 Research Infrastructure, (4) Vilnius University, Lithuania, (5) Leiden University, The Netherlands, (6) NUCLIO, Cascais Portugal (7) CITEUC Universidade de Coimbra, Portugal, (eleni@apc.in2p3.fr)

Abstract

Europlanet 2020 RI promotes public engagement through science communication, yearly training and best practice workshops, the aim being to develop new ways of communicating planetary science, encourage planetary scientists to communicate their research, engage hard-to-reach, diverse audiences, help develop partnerships between communicators, scientists and educators.

To this end, Europlanet RI 2020 offers a series of ***Outreach Innovation Expert Workshops*** during the four years of the project (2015-2019). These are "best practice" meetings addressed to a broad range of outreach providers and science communicators, working both professionally and voluntarily, to engage the public with planetary science. The workshops aim to build networks, share resources and best practice, brainstorm in order to develop new ideas for effective communication, and keep in touch with the latest scientific achievements through contact with the broader scientific community.

In parallel, Europlanet 2020 RI holds a series of ***Science Communication Training Workshops***, acknowledging that space and planetary sciences fascinate the audience, especially children, offering an inspiring context for science, technology, engineering and mathematics (STEM) education in formal and informal environments. They are addressed to educators and young scientists, with a focus on engaging with schools.

The first ***Outreach Innovation Expert Workshop*** titled ***"Touching the Planets"*** was held together with the first Science Communication Training workshop, planned to coincide with the European Week of Astronomy and Space Science (EWASS), in Athens in July 2016. A major outcome of the brainstorming session was the need to provide training for both scientists and journalists on their respective priorities and requirements in order to foster better communication. As a result of the Workshop, Europlanet issued a special call for journalists, science communicators and lecturers in journalism to participate in an expert exchange to visit Europlanet facilities and find out more about the scientific process. This expert exchange program has now been an established Europlanet 2020 RI activity.

To celebrate Juno's orbit insertion to Jupiter, a public event was organized on the same day, attracting a very large and diverse audience of space enthusiasts. During the event an international panel of space experts (e.g. the Juno principal investigator and co-investigator) engaged in a live discussion with the public.

The first ***Science Communication Training workshop*** was offered to young researchers, aiming to develop their skills and experience in engaging with education and encourage them to build communication skills and confidence to engage with schools and teachers, based on their field of interest.

Outreach Innovation Expert Workshop 2016

An ***Outreach Best Practice session*** was held during the ***Europlanet Summer School 2017*** at the Molėtai Astronomical Observatory in Lithuania. Instead of organizing a stand-alone science communication training workshop in 2017, Europlanet's outreach activity joined forces with its science networking activity. The summer school lectures and hands-on activities aimed to equip young researchers and amateur astronomers with skills in observational astronomy and in science communication with six modules: basics of science communication, writing for the media, engaging with schools, engaging with the public, social media communications. The activities were well attended by students originating from 13 countries.

Europlanet Summer School 2017

The **third *Outreach Innovation Expert Workshop***, titled **"*Touching the Planets, Evaluating Excellence*"**, will be held in Athens in July 2018. This year, the workshop will target primarily (but not exclusively) an audience of amateur astronomers, who often perform cutting-edge science partnering with professional astronomers, while also transmit their enthusiasm to wide audiences through sky observing activities. The workshop will also focus on the evaluation of outreach activities, through the real-time application of the Europlanet evaluation toolkit, developed to provide resources to integrate in outreach and educational activities, so as to appraise their impact.

References

[1] https://www.europlanet-eu.org/outreach/best-practice/

[2] https://www.europlanet-eu.org/europlanet-summer-schools-2017-reports/

[3] http://www.europlanet-eu.org/outreach/science-communication-training/1st-training-workshop/

[4] http://www.europlanet-eu.org/outreach/best-practice/europlanet-outreach-innovation-day-athens/