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SETI for students

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1. Introduction

The problem of searching for life in the Universe is one of the fundamental problems of modern astrophysics [1]. This problem causes the great interest of the student. For the first time the corresponding course has been worked out for the students of Yaroslavl's State Pedagogical University in 2012 and it facilitates to creatively grow up of the young researches. "The course of astrobiology for teacher's college students" [1] is devoted to – standing up of science of searching for life in the Universe; considering past and future of the Earth's civilization; finding in the space–time of extraterrestrial civilization; considering of results of the contact; interpretation, on the physical laws, of "unknown flight objects". For the first time the system of testing problems demonstrates the modern state of the physical Universe acting upon the mankind and acting of mankind upon the Cosmos. The students try to research the unsolved problems and publish the new obtained results in the form of scientific papers.

2. The long–term plan

The course is worked out with the objects showing of possible unification of a large number of different regions of knowledge into united fundamental science. Tactical scheme of it is to organize research work of the students. We use the following long–term plan of subjects there are 24 hours of lectures and 74 hours of practical work. We use the following long–term plan of subjects. 1. Putting up the problem SETI in XXI century. 2. Acting of the Cosmos upon the Earth's civilization. 3. Acting of the Earth's civilization upon the Cosmos. 4. The problems of the Astrobiology. 5. Models of transitions from inanimate nature to biological activity and the Earth's civilization. 6. Cosmic future of the Earth's civilization. 7. The methods of searching for extraterrestrial planets in the space–time. 8. The methods of estimating of extraterrestrial civilizations number in the Metagalaxy. The Drake's formula – the critical analyses. 9. The directions of searching for extraterrestrial intelligence. 10. The methods of connecting with extraterrestrial intelligence. 11. What will give the contact with extraterrestrial intelligence to the mankind? 12. "UFO" and "the visits" of alien live. The physical base of "anomalous" phenomena. 13. Perspective of development of astrobiology. 14. All–waves searching for extraterrestrial intelligence. 15. The problem of interstellar traveling. 16. The models of the Universe evolution. 17. The space–time scale in the Universe. 18. The peculiarity of physical constants. The dimensionless four fundamental constants. 19. The anthropic principle. 20. The models of cosmic civilizations evolution. 21. Fermi's paradox. 22. Lefebvre's cosmic subjects. 23. Astrosociological paradox. 24. SETI's objects catalogue. 25. Cosmology and SETI. Dark matter and dark energy. 26. Pedagogics and SETI. New picture of the Universe. 27. Methodical possibilities of Cultural and Educational Centre named after V.V. Tereshkova for astronomical education [1].

3. Conclusions

There are known several of the courses of astrobiology, which show the efficiency of theirs using in educational process [1].

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Outreach Testing of Ancient Astronomy

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Abstract

This work is an *outreach* approach to an ubiquitous recent problem in secondary-school education: how to face back the decreasing interest in natural sciences shown by students under 'pressure' of convenient resources in digital devices/applications. The approach rests on two features. First, *empowering* of teen-age students to understand regular natural events around, as very few educated people they meet could do. Secondly, an understanding that rests on personal capability to test and verify experimental results from the oldest science, astronomy, with simple instruments as used from antiquity down to the Renaissance (a capability restricted to just solar and lunar motions).

Because lengths in astronomy and daily life are so disparate, astronomy basically involved observing and registering values of angles (along with times), measurements being of two types, of angles on the ground and of angles in space, from the ground. First, the gnomon, a simple vertical stick introduced in Babylonia and Egypt, and then in Greece, is used to understand solar motion. The gnomon shadow turns around during any given day, varying in length and thus angle between solar ray and vertical as it turns, going through a minimum (noon time, at a *meridian* direction) while sweeping some angular range from sunrise to sunset. Further, the shadow minimum length varies through the year, with times when shortest and sun closest to vertical, at summer *solstice*, and times when longest, at winter solstice six months later. The extreme directions at sunset and sunrise correspond to the solstices, swept angular range greatest at summer, over 180 degrees, and the opposite at winter, with less daytime hours; in between, spring and fall *equinoxes* occur, marked by collinear shadow directions at sunrise and sunset.

The gnomon allows students to determine, in addition to latitude (about 40.4° North at Madrid, say), the inclination of earth equator to plane of its orbit around the sun (*ecliptic*), this fundamental quantity being given by half the difference between solar distances to vertical at winter and summer solstices, with value about 23.5°. Day and year periods greatly differing by about 2 ½ orders of magnitude, 1 day against 365 days, helps students to correctly visualize and interpret the experimental measurements.

Since the gnomon serves to observe at night the moon shadow too, students can also determine the inclination of the lunar orbital plane, as about 5 degrees away from the ecliptic, thus explaining why eclipses are infrequent. Independently, earth taking longer between spring and fall equinoxes than from fall to spring (the solar anomaly), as again verified by the students, was explained in ancient Greek science, which posited orbits universally as circles or their combination, by introducing the *eccentric* circle, with earth placed some distance away from the orbital centre when considering the relative motion of the sun, which would be closer to the earth in winter. In a sense, this can be seen as hint and approximation of the elliptic orbit proposed by *Kepler* many centuries later.

Secondly, by observing lunar phases and eclipses from the ground, students could also determine, following *Aristarchus of Samo*s in the 3rd century BC, 4 length ratios involving moon and sun distances to earth, and radii of all three, moon, sun, and earth. The angular width of the moon could be first determined with simplest optical devices as about half a degree; this yields the ratio between moon diameter $2R_M$ and distance D_M to earth. Next, eclipses of sun prove its angular width, and thus ratio $2R_S/D_S$, similar to the lunar one, though the relatively high lunar orbital eccentricity, 0.055, does result in not quite a full eclipse if at lunar apogee. Further, at a half-moon phase, when the angle sun-moon-earth is a right one, the angle moon-earth-sun observed at earth, though also extremely close to $90°$ and tough to measure, determines the distance ratio D_M/D_S. Finally, at a lunar eclipse, observation of the shadow-cone width at the moon behind the earth, over 2.6 times the moon diameter, yields the ratio R_E/R_M. An actual measurement of R_E on earth, as crudely carried out by *Eratosthenes*, again in the 3rd century BC, could then yield all 4 values of moon and sun sizes and distances to earth.

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"Where On Mars?": A Web Map Visualisation of the ExoMars 2018 Rover Candidate Landing Sites

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Abstract

1. Background

The ExoMars 2018 mission will deliver a European rover and a Russian surface platform to the surface of Mars. Armed with a drill that can bore 2 metres into rock, the ExoMars rover will travel across the Martian surface to search for signs of life, past or present.

But where on Mars to land? - The search for a suitable ExoMars rover landing site began in December 2013, when the planetary science community was asked to propose candidates. Eight proposals were considered during a workshop held by the ExoMars Landing Site Selection Working Group (LSSWG). By the end of the workshop, there were four clear front-runners. Following additional review, the four sites have now been formally recommended for further detailed analysis [1]: Mawrth Vallis, Oxia Planum, Hypanis Vallis and Aram Dorsum. Scientists will continue working on the characterisation of these four sites until they provide their final recommendation in October 2017.

2. The "Where on Mars?" project

The "Where on Mars?" project is a short ESAC-based Trainee project conducted in collaboration with the ExoMars LSSWG and the CartoDB team [2].

It is an outreach project generally aiming at drawing the attention and increasing the interest of the general public for the scientific and robotic exploration of Mars in Europe.

We designed and built an interactive web map visualisation of the four recommended ExoMars landing sites relying on modern open source web mapping technology [3], and based on a selection of ESA and NASA planetary imagery data and additional geospatial information used by the ExoMars LSSWG. It has been be designed so that it is engaging for a non-expert public and facilitating the understanding of a few key concepts for the selection of the landing sites, including scientific and engineering constraints.

We will present the final visualisation that we aim to make available on ESA web site. We hope collecting feedback and engaging discussions around the topic of web mapping using planetary data.

Acknowledgements

We would like to thank the ExoMars LSSWG and the CartoDB team for their great support. In particular, Ernst Hauber (DLR, Berlin), Peter Grindrod (UCL, London), and Elliot Sefton-Nash (Birkbeck, London) for providing us with amazing data and advice on the visualisation narrative. A special thank goes to Javier de la Torre, CEO and Co-Founder of CartoDB, who made this collaboration possible.

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Impact Through Outreach and Education with Europlanet 2020-RI

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Abstract

Since 2005, Europlanet has provided a framework to bring together Europe's fragmented planetary science community. The project has evolved through a number of phases into a self-sustaining membership organization. Now, Europlanet is launching a new Research Infrastructure (RI) funded through the European Commission's Horizon 2020 programme that, for the next four years, will provide support, services, access to facilities, new research tools and a virtual planetary observatory. Europlanet 2020 RI's Impact Through Outreach and Education (IOE) activities aim to ensure that the work of Europlanet and the community it supports is known, understood and used by stakeholders, and that their inputs are taken into account by the project. We will engage citizens, policy makers and potential industrial partners across Europe with planetary science and the opportunities that it provides for innovation, inspiration and job creation. We will reach out to educators and students, both directly and through partner networks, to provide an interactive showcase of Europlanet's activities e.g through live link-ups with scientists participating in planetary analogue field trips, educational video "shorts" and through using real planetary data from the virtual observatory in comparative planetology educational activities. We will support outreach providers within the planetary science community (e.g. schools liaison officers, press officers, social media managers and scientists active in communicating their work) through meetings and best practice workshops, communication training sessions, an annual prize for public engagement and a seed-funding scheme for outreach activities. We will use traditional and social media channels to communicate newsworthy results and activities to diverse audiences not just in Europe but also around the globe.

1. Introduction

Europlanet 2020 RI's IOE activities are focused around three areas: outreach services and community support; dissemination to stakeholders; and development of outreach and educational tools. IOE is led by Science Office Ltd, a Portuguese-based SME, and will be implemented by a network of partners spread across nine countries including University College London, the University of Leiden, University of Latvia, Vilnius University, the University Of Athens, the Observatoire de Paris, CAB-INTA, NUCLIO and the Austrian Space Forum.

1.1 Outreach Services & Community Support

There is a huge amount of effort and investment across Europe by individuals and groups to engage various audiences with planetary science. Europlanet places the highest priority on ensuring that this community is supported and that the impact of efforts is maximised through efficient promotion, dissemination and implementation, and through sharing best practice. We will work strategically with outreach and education networks (e.g. EUSPACE-AWE, the Ecsite Space Group and the Galileo Teacher Training Programme) to ensure that outreach resources are promoted, disseminated and used most effectively across Europe. We will hold a series of workshops to share best practice and develop new ideas for effective engagement, targeting specific communications roles e.g. press officers, schools liaison officers, policy officers and social media managers. We will also hold training workshops to enhance the communication skills of scientists when engaging with different audiences, including the general public, policy makers, the media and educators. Priority will be given to representatives from research institutes in new EU member states. Europlanet 2020 will also carry forward its annual Prize for Public Engagement with Planetary Science, which is awarded to individuals or groups who have developed innovative practices in communication and whose efforts have significantly contributed to a wider public engagement with planetary science.

We will work with the astroEDU open-access platform for peer-reviewed astronomy education activities to identify new collections of resources covering planets, moons, comets and asteroids. Innovative ideas for outreach and education projects will be supported through the Europlanet Funding Scheme and we will provide a professional-quality translation service for selected outreach and dissemination materials. In addition, we will identify an effective, user-friendly suite of evaluation tools, both for assessing the impact of its own outreach, engagement and dissemination programmes, and to offer to outreach providers in the community who wish to assess the impact of their activities.

1.2 Dissemination to Stakeholders

The new emphasis on impact and innovation in Horizon 2020 means that Europlanet must engage with a wide range of stakeholders, including policy makers and industry, as well as the media and the general public. Europlanet's IOE activities provide the planetary science community with a forum to identify key issues and policy areas affecting Europe's competitiveness in planetary science in the Horizon 2020 era. We will maintain and develop communication channels with Members of the European Parliament, representatives of European Commission, as well as high-level representatives of ESA, NASA and other space agencies, through individual briefings, themed dinner debates and exhibitions. We will assist the Europlanet community in engaging with policy makers at a national level and to highlight the importance of national contribution to this growing area of European expertise. We will proactively engage with industry and SMEs through social media platforms (e.g LinkedIn) to highlight commercial opportunities arising from planetary science missions, calls and proposals, as well as build a community of interested parties. Under FP7, Europlanet built up comprehensive media distribution channels to highlight Europe's contribution to planetary science. Europlanet 2020 RI will expand on these activities to publicise newsworthy results from activities, including space missions, ground based observations, laboratory and computer modelling, technological developments and field analogue tests. Social media will be integrated into all aspects of Europlanet's outreach and dissemination programmes.

1.3 Outreach & Educational Tools

Not only will Europlanet 2020 RI's activities help us understand our Solar System, they will also provide context for us to understand our own planet and how life has arisen in some of the most exotic environments on Earth, such as Mars analogues in Morocco, Spain and Ethiopia, and Ganymede/Europa analogues in Iceland. We will make use of this inspiring area of science to develop education and outreach tools to engage students, teachers and the general public with Europlanet's activities. We will produce a series of short, animated videos (each lasting about 5 minutes), aimed at schools (and general) audiences, which will explain key topics related to planetary science and technology, as well as research emerging from Europlanet 2020 RI.

In addition, we will develop educational tools based around comparative planetology. The core of the project will be an Arduino-based kit for students to build climate monitors, which they will use to collect data for comparison with data from planetary analogue sites and from climate measurements by planetary missions e.g. the REMS instrument on the Mars Curiosity rover, Venus Express, and Cassini data for Titan. Activity plans and learning resources will be developed around core curriculum subjects including climate, weather, seasons, the position of planets within the solar system, conditions for life etc. The educational activities will be piloted with the aid of a core group of schools and science centres in the first phase. Following evaluation and adjustments, the kits will be disseminated via MakerSpace, Science Centres, teacher training groups and other partner networks. Scientists participating in Europlanet 2020 RI field trips will be encouraged to carry out at least one live social media event (e.g. Google Hangout, live-streaming experiments, Twitter Q&A etc) during their mission, as well as participating before and/or after their mission in link-ups with schools to discuss field results, data gathered by schools and careers in planetary science.

2. Summary and Conclusions

Europlanet 2020 RI's Impact through Outreach and Education activities aim to broaden the scope of previous Europlanet outreach efforts beyond the media, policy makers and general public, to engage with educators and students, industry and the wider research community.

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An online educational atmospheric global circulation model

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Abstract

As part of online courses on exoplanets of Observatoire de Paris, an online tool designed to vizualise outputs of the Laboratoire de Météorologie Dynamique (LMD) Global Circulation Model (GCM) for various atmospheric circulation regimes has been developed. It includes the possibility for students to visualize 1D and 2D plots along with animations of atmospheric quantities such as temperature, winds, surface pressure, mass flux, etc... from a state-of-the-art model.

1. Project

“Sciences pour les Exoplanètes et les Systèmes Planétaires” (SESP) is a series of online resources and courses on scientific topics concerning our current knowledge about exoplanets for undergraduate students and their teachers. Two of these courses address atmospheric dynamics in the diversity of atmospheric circulations encountered in the Solar System, and specifically what models can teach us about an atmosphere given its main characteristics. As part of this course, an online tool mimicking the behavior of a GCM has been developed, allowing the users to explore results of a state-of-the-art GCM in a simple and intuitive interface.

The goal is, through a series of questions, to understand the various aspects and characteristics of atmospheres by varying the planet's rotation and size by the means of this tool with, for any casual user, the feeling to manipulate actual scientific data.

2. Model

The model used for the simulations is the atmospheric dynamical core of the LMD GCM [1], with a newtonian relaxation for temperature based on mean insolation over one year [2]. Simulations with 3 planet sizes (half, one, and twice the Earth radius) and 6 rotation speed (5h, 10h, 24h, 72 h, 10 days and 100 days) lead to 18 different simulations stored in a single NetCDF file (figure 1).

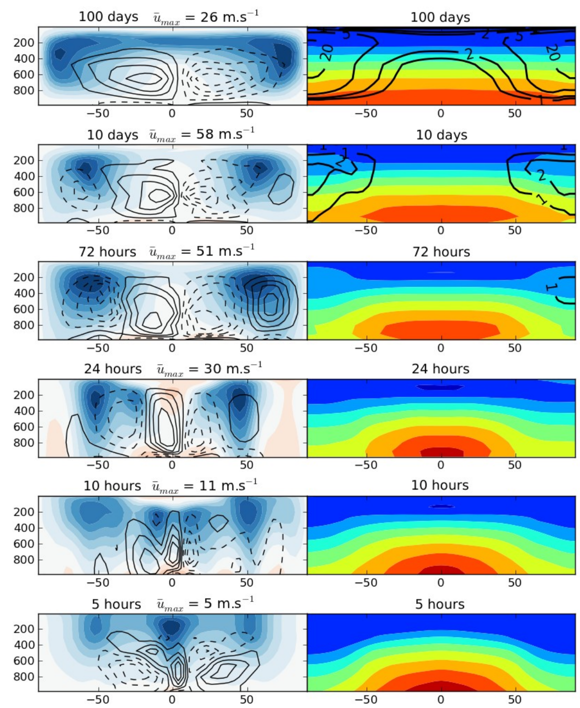

Figure 1: Zonal average of meridional wind and mass flux streamlines (left), along with temperature and super-rotation (right) as a function of latitude and altitude for different rotation rates from the simulations.

4. Implementation

The tool consists of an interface that asks the user what quantities to plot on what axis and then launches a python script on the server to extract the relevant slice(s) data in the already-existing simulation results. The plot is done using mpld3 [3], a Python library using the Python library Matplotlib [4] and the JavaScript library D3.js, allowing an interactive plot or animation in the user's webpage.

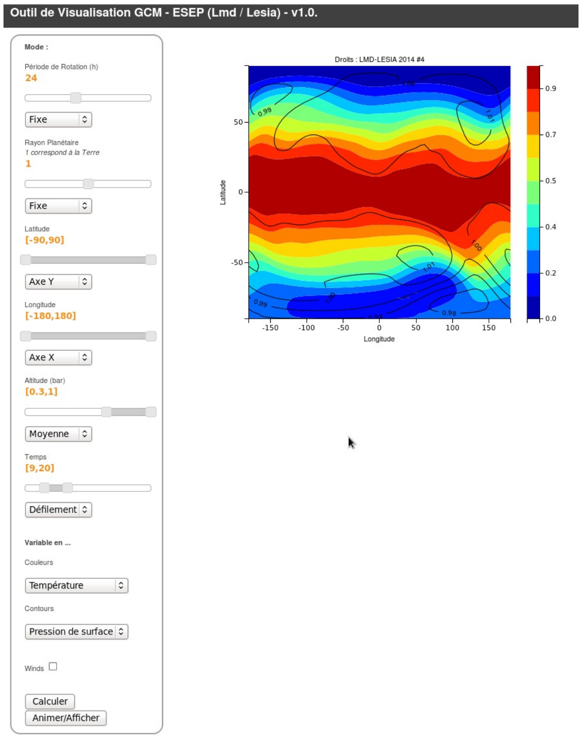

Figure 2: Web-browser interface showing that the user asked in the left panel the plot on the right panel: temperature (colors) and surface pressure (contours) as a function of latitude and longitude, for a planet with 24 hours rotation period and 1 Earth radius.

5. Current Status

A first part of SESP courses, among which the atmospheric dynamics courses using this tool, is expected to be made publicly available in the second half of 2015 in French. A long-term goal is to provide an English version.

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Hello World: Harnessing social media for the Rosetta mission

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Abstract

The European Space Agency's (ESA) comet-chasing Rosetta mission was launched in 2004, before social media became a popular tool for mainstream communication. By harnessing a range of platforms for communicating the key messages of this unprecedented space adventure as the spacecraft reached its destination ten years later, a wide range of new audiences were reached and could follow this once-in-a-lifetime mission.

1. Introduction

Rosetta-specific social media accounts – @ESA_Rosetta on Twitter, the Rosetta Mission Facebook page and the rosettamission Instagram account – were developed during 2013/14 and used alongside the traditional reporting line of the main ESA website and the Rosetta blog to build awareness about the mission. Coordinated with ESA's existing social media channels (Flickr, YouTube, G+, Twitter, Facebook and Livestream) and with the support of ESA's country desks and Rosetta partner agency accounts (including @philae2014), information could be shared in a number of European languages about the key mission milestones in 2014: waking up from deep space hibernation (January), arriving at Comet 67P/Churyumov-Gerasimenko (August) and landing on a comet (November). This ensured a wide reach across Europe – and the world.

2. Rosetta social media channels

2.1 Facebook

The Rosetta Mission Facebook page was set up in late 2013, and launched on 10 December as the central point for the "Wake up, Rosetta!" video competition. The Woobox competition tool was implemented to support entries to the competition; the same approach was also used for the "Rosetta, are we there yet?" photo contest in July/August. The Facebook page is also used to share content from other platforms.

2.2 Instagram

Rosettamission Instagram was set up in late 2013 but not actively used until the launch of the "Rosetta, are we there yet" contest, to allow an additional way to enter the contest. It is also used to share new images of the comet.

2.3 Twitter

The @ESA_Rosetta twitter account is the first occasion where ESA has employed a first person twitter account for spacecraft, following as realistically as possible the actions of the real Rosetta spacecraft. The key moment for the account was the wake-up in January 2014, with the "Hello, world!" tweet sent in the 22 languages of the ESA member and cooperating states at that time.

In addition to sharing general status updates, images and science results, @ESA_Rosetta describes how it is feeling, allowing followers to share the same emotions. The human-like exchanges between @ESA_Rosetta and its lander @philae2014 (managed by DLR) play a key role in sharing their adventure at the comet.

Figure 1: "Hello, world!" – the @ESA_Rosetta twitter account woke up once the real Rosetta spacecraft woke up from 31 months in deep space hibernation.

3. The anthropomorphic characters of Rosetta and Philae

Besides their personification through the twitter accounts, the Rosetta orbiter and the Philae lander were also turned into anthropomorphic characters that were featured in a short series of web cartoons with a fairy-tale flair. The cartoon series, named “Once upon a time”, tells the adventures of Rosetta and Philae, depicted as two brave and friendly explorers on a pioneering journey across the Solar System. Making the mission's goals more accessible via the use of visual storytelling allowed the audience to share both its excitement and risks. Together with their twitter personas, the cartoon characters of Rosetta and Philae contributed to the personal feel of the mission, with members of the public caring for their well-being.

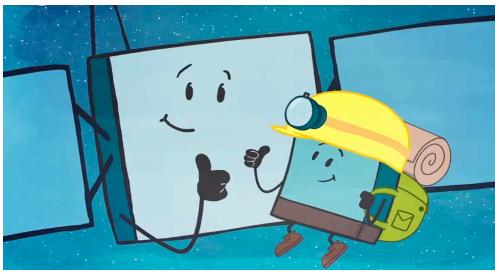

Figure 2: The anthropomorphic characters of Rosetta and Philae were created in collaboration with Design & Data.

4. Summary and Conclusions

By using a variety of social media platforms to target different audiences with specific content, we have been able to increase awareness about the mission, and share the key moments live with our audience. In particular, by focusing on the human angle, we have been able to further engage people in joining the adventure of this historic mission. In many cases Rosetta has allowed people to also discover ESA for the first time.

Results and insights will be shared in a full paper, currently in preparation.

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Involving the Public and Students in Planetary Science

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Abstract

The Institute of Astrophysics and Space Sciences (IA) is a Portuguese research institute with a national dimension. In Lisbon, IA is hosted by the Lisbon Astronomical Observatory (OAL). In particular, IA has been doing research in planetary science since 1997 and its outreach activities have been closely related to its research strategy. The Lisbon Astronomical Observatory, where the activities presented in this talk take place, is a 150 – year old institution known for its communication activities for the non-specialist public. In this communication we will present how a planetary science communication program has been developed since 2010 at IA.

1. Activities for Schools

IA is committed to take Astronomy and Astrophysics to schools, with projects underway and under development. One example is the project "Astronomy is for me," whose main objective is to involve directly high school students and their teachers in the learning of concepts in astronomy and planetary sciences. Such involvement is based on hands-on protocols that require the use of telescopes, by implementing methods of active learning in science education (IBSE - Inquiry Based Science Education). One of these protocols, already in progress, is the measurement of Jupiter’s mass by direct observation of the movement of its Galilean moons – Io, Europa, Ganymede and Callisto. This protocol has produced already amazing results among students of the 10th grade, who have been able to determine Jupiter’s mass with an error of only 1.5%. In order to inspire younger students, IA also develops specific activities. “Our Wonderful Solar System" is an example of a workshop that aims to show the scales in our Solar System making use of the UNAWE’s Universe in a Box. This workshop was recently given, for the first time, to hundreds of students at Malta's Science Expo.

2. Nights at the Observatory

Another of IA’s main public outreach pillars is the “Nights at the Observatory” activity (NOAL), a reconfiguration of the "Public Lectures" that took place at the Lisbon Astronomical Observatory (OAL) since 1994. The NOAL is a free monthly activity with an average participation exceeding 150 attendants in each session. Each NOAL's session consists of a guided tour to the historical building of the Observatory, combined with a lecture and observations of the night sky with telescopes. The lectures are streamed online, which considerably broadens the range of participating public; on some occasions, concerts and theatre plays are held. The NOAL follow well known models of science communication [1, 2], striking a balance between investment in "science literacy", "public understanding of science" and "engagement with science", as witnessed in different periods of its activity.

Figure 1. A session of NOAL - in the central room of OAL during the lecture.

3. Special Planetary Events

Whenever relevant planetary events occur, our activities follow suit. Outstanding examples of activities have been the 2012 Venus Transit, the 2013 Super Moon or the 2013 Annular Solar Eclipse. The Venus Transit has been the last opportunity for observing such an event in 117 years. For this occasion we have deployed a team of observers to Udaipur (India) in the context of the Venus Twilight Experiment [3] for which several science communication items were produced: press releases, social network diaries and a media event. These special events create powerful and timely opportunities for engaging with the public (in particular school students) and the media. It is noteworthy that on site public attendance in such events reached over 2000 people.

Figure 2. The 2013 Super Moon Event (2000 people).

4. Occultation Group

Science and outreach at IA have created a real synergy, with outreach participating actively in some scientific activities. One example is the recent creation of an occultation group. The activities of this group started in 2014, but we already have a very strong involvement of the academic community which in turn is strongly involved with the outreach.

Figure 3. Occultation group during an occultation event.

5. Social and Media Presence

IA invests and manages its presence on social networks, reaching about half a million people with regular posts about astronomy and planetary science. In addition, in early 2013, we launched, with the support of FCCN, a series of Vodcasts, short videos aimed at clarifying major topics of current-day research.

Acknowledgements

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Measuring planetary field parameters by scattered cubes from the Husar-5 rover: educational space probe construction for a field work mission with great number of 5 cm sized sensorcube units launched from the rover.

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1. Introduction

The Hunveyor-Husar project tries to keep step with the main trends in the space research, in our recent case with the so called MSSM (Micro Sized Space-Mothership) and NPSDR (Nano, Pico Space Devices and Robots). [1]Of course, we do not want to scatter the smaller probe-cubes from a mothership, but from the Husar rover, and to do it on the planetary surface after landing.

2. The "Micro"-SensorCubes

The edge size of the cubes are planned to be 5 centimetres. From the 6 faces of the cube 4 should be covered by solar panels. The vortices of the cube should be rounded off (for example a small spherical shell segment should cover them), in order to the better rolling on the surface. The sensors and the electronic equipment should be placed ont he surface and inside the cube. The cubes would be scatterred on the surface therefore it is worthy to measure and to map that kind of parameters which are non-uniform on the surface. We plan to include inside the cubes a Hall-sensor to measure the magnetic field, a pressure sensor to measure the atmospheric pressure, and a vapor content and a temperature sensor, too. The communication with the Husar rover (or the landing unit Hunveyor) should be organized through a Bluetooth. The „brain" of the cubes should be an AVR microcontroller, which synchronizes the measurements and the transportation of the data.

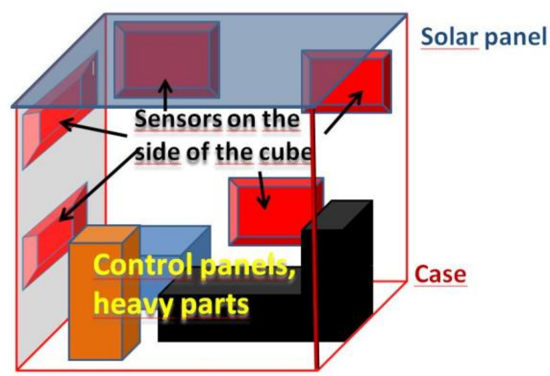

Figure 1: the SensorCube

3. The Ejection Event

The ejection of the cubes is planned to be done by a spring mechanism. We should like to see the connection between the cube data and the locality of that cube, therefore the ejection should be solved in the following way: cubes should be ejected to the left and to the right, alternately. It would be important to eject the cubes almost the same distance from the path of the rover, left and right. Therefore the ejecting arm should be moved by a motor in a plane perpendicular to the path. Using an 2-axial acceleration measuring system we arrange the that way, that in the left and the right position the arm should eject cubes in the arm position 45 degrees to the horizontal plane.

The Husar rover will receive a half circle tube for bracing from an small weight but strong enough material. This half circle should help the rover in standing up, if it turn over during the ejection event.
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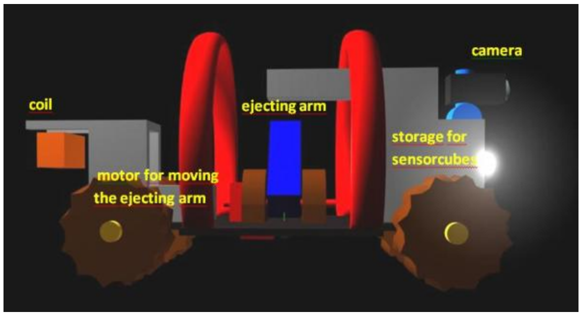

Figure 2: the HUSAR-rover

4. The Mission

The mission would be carried out in the following way. The rover starts from the lander and advances forward with a uniform speed. (By its distance sensor the rover observes the obstacles and tries to bypass them). This way the pathway of the rover can be traced and the positions of the cubes can be estimated. After covering a unit distance the rover stops, it make leveling the ejection subsystem, and lifts up a cube to the 45 degrees height and launch it left. Again lifts a cube and launch it to the right. During the stops the rover measures local gravity. The gravity sensor should not be built to the cubes, because it probably does not change in this distance.

5. Summary and Conclusions

In this abstract we report about a new type of mission planned by students. The sensorcube is not ready yet, but the students have got a lot of experience about the problems connecting of constructing a space-probe.

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Spreading the passion for scientifically useful planetary observations

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Abstract

The "March 2015 - Planetary Observation Project (POP)" was a series of talks and hands-on workshops focused on planetary observation organized in March 2015 by the planetary section of the Hellenic Amateur Astronomy Association. Building on our previous experience (Voutyras et al. 2013), which also includes more than 500 attendants in our 2013-2014 series of lectures in Astronomy, we identified that there is a lack of more focused lectures/workshops on observing techniques. In particular, POP's structure included two talks and two workshops aiming to inspire and educate astronomy enthusiasts. The talks tried to stimulate the participants about the importance of ground-based observations by presenting the most current scientific news and puzzling problems that we are facing in the observation of planets. During the hands-on workshops the beauty of planetary observation was used to inspire participants. However, we trained participants on observing techniques and image processing to enable them to produce scientifically useful results. All POP's events were open to the public and free, meaning both out-of-charge and freely available material provided to the participants (through our website). The project offered attendants unique experiences that may have a significant impact with potential lifelong benefits. In this work we present an overview of the project structure that may work as a prototype for similar outreach programs.

Reference

The Planetary Observation Project POP - March 2015, available in Greek at: http://www.hellas-astro.gr/articles/astromanos-2015-03-04-2132

Figure 1. *The first course of the project on terrestrial planets (Image: E.Vakalopoulos)*

Figure 2. *The first workshop of POP.* *Sharing the passion...and techniques of digital observation of planets (Image: E.Vakalopoulos)*

Figure 3. *An interactive, hands-on workshop of how-to make a scientifically-useful digital planetary observation (Image: E.Kardasis)*

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Engaging the public in planetary science missions: the role of competitions in the Rosetta mission

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Abstract

The year 2014 was an historic and challenging year for the Rosetta mission. On 20 January, the spacecraft awoke from a 957-day hibernation; by August, the spacecraft had arrived at Comet 67P/Churyumov-Gerasimenko; and in November, the lander Philae was deployed to the comet's surface. Each of these mission milestones was marked by a competition. We outline how these competitions provided a means for the public to engage with what was to become one of the most exciting space science missions of this decade.

1. Introduction

Rosetta was launched in March 2004, on a 10-year journey through the Solar System to its destination: Comet 67P/Churyumov-Gerasimenko. Along the way there were some newsworthy moments: the swings past Earth (2005 and 2007) and Mars (2007); fleeting flybys of asteroids Steins (2008) and Lutetia (2010) and the science that came from those; and then, on 8 June 2011, the spacecraft was put into hibernation, to remain in that state until 20 January 2014.

As 2014 approached, one of the biggest challenges facing the mission's science communicators was how to awaken interest in the mission and generate a sustained engagement in the broadest possible audience in a relatively short time.

One approach was to encourage public engagement by means of open competitions. These would provide a way for members of the public to share in the main mission milestones during the year. Three different competitions were run, with different outcomes. The competition entries and associated data have provided us with a means to search for evidence of public engagement in the mission.

2. Rosetta competitions in 2014

2.1 Wake up, Rosetta!

As Rosetta approached the end of the hibernation period the public were invited to help ESA to wake up Rosetta by sending in short video clips showing them "waking up" the spacecraft. The top prize, of a trip to the European Space Operations Centre (ESOC) in Germany to be present on landing day (12 November 2014), was to be decided by public vote. This competition, announced on 10 December 2013, was run using Facebook, Twitter, Vine and Instagram – for submitting competition entries; YouTube – for promoting the competition and individual entries; and Facebook for the public voting, which closed on 24 January 2014. The public voted enthusiastically: more than 75000 votes were cast for the videos. A lower than expected number of entries (just over 200) were received, but the quality of these far exceeded the expectations of the organisers. It was immediately obvious that many participants in this competition were taking part not just because of the unique top prize but also as a way of connecting with the mission. Perhaps surprisingly, a non-negligible percentage (about 7%) of participants could not win the top prize because of residency restrictions associated with it, but they nevertheless took part in the competition.

2.2 Rosetta, are we there yet?

Rosetta would arrive at her destination, Comet 67P/C-G, on 6 August 2014, during Europe's summer time, and this naturally led to the idea of a competition that would play on the theme of journeys ending and destinations being reached. One common expression heard or uttered by anyone who has been on a long journey is: Are we there yet? And so the next competition was born. Announced on 9 July 2014, the competition invited participants to submit photos that capture the "Are we there yet?" feeling. Two props were made available to download, print and include in the photo: a cut-out-and-make Rosetta model, and a banner to fill in a destination. Participants were also encouraged to draw inspiration from Rosetta mission themes, such as photographing comet-like landscapes, or incorporating the themes of water and life. The same channels that had been used for the first competition were used, and the top prize was again a trip to ESOC to be present on landing day. Compared to the 'Wake up, Rosetta!' competition, a similar number of entries were received, and somewhat fewer votes – around 22000 by the time the competition closed on 21 August. Although the number of participants was rather low, the quality of many of the entries was very high, with participants going to extraordinary lengths (and places) to produce imaginative and evocative photographs.

2.3 Name Site J

On 15 October 2014, ESA confirmed the landing site chosen for the Philae lander would be the one referred to up until then as 'Site J'. After careful consideration, the partners involved in Rosetta and Philae agreed to run a competition, inviting the public to propose a name for the landing site. The 'Name Site J' competition was launched on 16 October and ran until 22 October, with a top prize of a trip to ESOC for landing day. The competition attracted proposals from more than 8000 people from 135 countries. A shortlist of 30 names was drawn up by the organisers, and the winning name for the site – Agilkia – was chosen from this shortlist by the Philae Lander Steering Committee. To accompany the proposed name of the landing site, participants were asked to provide a short (maximum 200 words) justification for why they proposed this name. Many used this opportunity to express their delight in having an opportunity to participate in the mission by the competition.

3. Evidence for engagement

What do we mean by engagement in the context of science communication? How do we measure it? Most often, engagement refers to a two-way process, involving interaction and dialogue. Did the Rosetta competitions facilitate this? If we consider the comments that participants made with their entries, in email messages to the organisers, or in posts on social media channels, then the majority of these would seem to indicate that the competitions did fulfil this role. They provided focus points for the public to participate in the main mission milestones of 2014, they provided an opportunity for the public to connect with the mission and vice-versa, and in many cases, participants explicitly stated that the competitions gave them the opportunity to engage with the mission.

4. Summary and Conclusions

Case studies of three competitions run in relation to the Rosetta mission in 2014 have provided an opportunity to search for evidence of public engagement in the mission. The quality of the contributions to each competition and the feedback from participants clearly indicated that, for many people, these competitions provided a way for them to express their excitement, appreciation and admiration for the mission. Moreover, the competitions provided a channel for them to connect with and engage with people directly involved in the mission and with other enthusiastic supporters – in other words, the competitions fulfilled their role as a channel for public engagement in the Rosetta mission.

5. Acknowledgements

The Rosetta competitions were run and organized by ESA, DLR, CNES, and ASI, and were supported and promoted by Rosetta partner agencies and institutes. We gratefully acknowledge the contributions of all those who helped in preparing and running the competition infrastructures, promoted the competitions, assisted with selection of winners, and organized the prizes and their distribution.

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Science in the Pub/“Wissenschaft am Stammtisch“

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Abstract

An outreach campaign has been initiated, which covers a broad range of topics related to astronomy, planetary sciences, astrobiology and space flight. In the course of two years it is scheduled to organize in 20 % of all communities of Lower Austria (117 out of 573) an event consisting of four different outreach and educational elements. In order to perform these events in a decentral way, local pubs or restaurants have been chosen to serve as venues. The elements cover workshops for children, talks for adults and an astronomical observation (optionally in cooperation with local astronomical amateur societies).

1. Introduction

Three central themes form the ideological background of this initiative: 1) Education initiatives have to take place in the local environment of the people, they have to be embedded into their home and life. 2) Education and knowledge is the only resource, which never must deplete, especially because there is a large demand of highly qualified manpower. 3) Scientific research is funded via taxes, consequently the scientific community has a debt to be discharged by the scientists.

Furthermore, space business is a growing industry and it is expected that within the next years the number of available jobs is still increasing. The interest of children in space and related topics offers additionally the chance to encourage their education in STEM subjects.

2. Design of the Initiative

The project is classified into two different project phases. In project phase 1 it is scheduled that small communities form the basis. In Lower Austria 339 communities are smaller or equal to 2000 habitants. It is scheduled that 20 % of this communities can be addressed within one year, in numbers 68 different communities. In the second year/project phase the limit of participating communities is enlarged to 5000 habitants, resulting together with additionally 5 % of communities of phase 1 in 49 different communities to be addressed in the second year.

In each community an event consisting of four different elements is scheduled: 1) Interactive workshops for children on different topics, e.g. asteroids and comets. Therein astronomical input on these themes is given as well as experiments are performed on the impact processes. Comets will be handicrafted with dry ice. 2) Talks for adults, e.g. threats from space, search for the second Earth – are we alone?, etc. 3) A quiz in the style of “Who becomes a millionaire?” is organized, whereby several teams are formed by the public audience and the winning team is honored with a prize. Besides the entertainment character of this element, it is thought to serve as an indicator of the success of the transfer of knowledge and competence. 4) The final element is an astronomical observation with amateur telescopes, whereby a short introduction to the night sky as well as observations of the Moon, selected stars and planets are offered.

3. First results

A pilot test has been performed in a small town with nearly 1500 habitants. With 80 adults and 15 children the outreach initiative was a great success and furthermore, several young high-potentials could be identified. Actually there is a great demand of other communities to participate in this initiative.

Acknowledgements

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