

A Tactile Voyage Through the Solar System: Venus.

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Abstract

“A Touch of Venus” is a project funded by the International Astronomical Union’s Office of Astronomy for Development (OAD) with the goal of developing educational tactile resources focused on the planet Venus. The project has developed a three-dimensional (3D) tactile model of Venus and a series of related educational activities for the general public, including people with low vision and blind. The model was created from the topographic map obtained by NASA’s Magellan spacecraft by using a novel software specifically developed for this project (Mapelia). The educational activities to use the tactile globe will be freely downloadable from the project’s website and from IAU’s online peer review educational repository AstroEDU. The funding allowed the project to print 20 globes and activity books that will be sent to educators/science communicators around the world that work with groups of blind persons mainly in developing countries or underserved communities. Social media will be used to reach to a wider community and will allow for the exchange of ideas and experiences among all those who wish to be involved in this project of tactile astronomy.

1 Introduction

The project “A Touch of the Universe” ([4]) was funded in 2013 by the IAU’s Office of Astronomy for Development (OAD) with the goal of developing a kit of educational tactile astronomy materials that educators/science communicators could use with the general public, including blind or visually impaired persons. A total of 30 kits were distributed among educators and teachers in underdeveloped countries in the Americas, Asia and Africa. Among the materials included in the kit there was a tactile globe of the Moon ([7]) and a half-sphere with some relevant constellations of the northern sky engraved on it that was part of the planetarium show for the blind “The sky in your hands” ([2], [8]). The project was very successful and we have received many requests for the kit materials. We could only provide them in digital formats to be downloaded, though, as we lacked any further funds to print more kits.

The resources in the kit of “A Touch of the Universe” were developed according to the Universal Design for Learning (UDL, see [9] for example), a learning framework which allows to reach to the general public as well as to audiences which might be regarded as “special” because they have some disability. It has been shown that everybody has a preferred style of learning (some remember better what they see, others what they hear or what they touch) and therefore, everybody is more or less able under the different styles of learning. We believe that these principles of the UDL should be applied in the teaching and communication of astronomy ([10]), and therefore we implemented them in the project “A Touch of the Universe” ([5]).

In 2017 we applied again for funding to the OAD for the project “A Touch of Venus” which intends to be an addition to the materials that were part of the initial kit of “A Touch of the Universe”. In this case we intended to build a 3D tactile model of the planet Venus supporting the users with a related activity book and some video tutorials. A first 3D test model was produced with the financial support of ESA ([3]) and tested at the SpaceIn event in ESA/ESAC in June 2017 ([11]).

2 From the 2D map to the 3D globe

We started with the topographical map that was created from radar data obtained by NASA’s Magellan space probe during its exploration from orbit of the planet Venus between 1990 and 1994 (Fig. 1). Magellan employed a radar technique to create topographical maps of the surface below the thick atmosphere that makes it impossible to probe the surface in optical wavelengths from orbit.

The next step was to enhance the contrast of the most relevant features and to smooth out the smallest structures to simplify the model and get rid of details that could lead to confusion when touching the globe without seeing it.

When the image was ready for our purposes we processed it with Mapelia[6], a software which produces digital 3D tactile globes from 2D maps in an easy and fast way. It works with many different map projections and the output is a ready-to-print 3D file in several

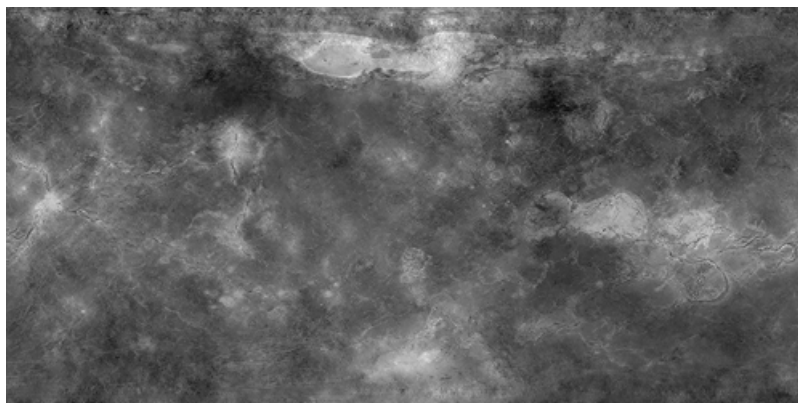


Figure 1: Radar map of Venus surface in grayscale. Source: NASA.

digital formats. Examples of the 3D files created by Mapelia are shown in Fig. 2, and can be downloaded from the “A Touch of the Universe” website.

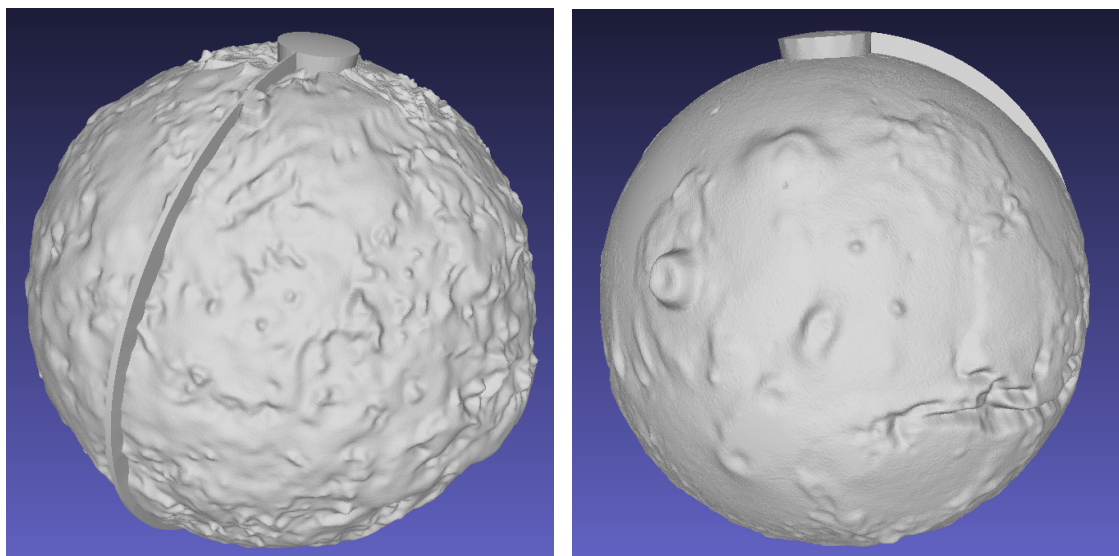


Figure 2: 3D rendered tactile models of Venus (left) and Mars (right) obtained with Mapelia. Credit: A. Ortiz-Gil & J. Burguet-Castell.

3 Activity book

A series of educational activities to be carried out with the Venus globe have been developed teaching the user how to identify craters, volcanos, mountains, plains and highlands by touching the model. Other activities reflect on Venus retrograde motion, phases and global warming. Finally one activity has been devoted to the nomenclature of Venus features, which

are mostly named after female characters, both real and fictional or legendary. In the activity we highlight the particular achievements of some of them.

The activity book has been printed in Braille and large fonts to make it readable for blind, low-vision and non-blind users.

These activities will be expanded to fit the format of the IAU's educational repository AstroEDU ([1]). Once submitted they will be peer-reviewed and the final approved versions will be published at the AstroEDU as well as at the "A Touch of the Universe" website.

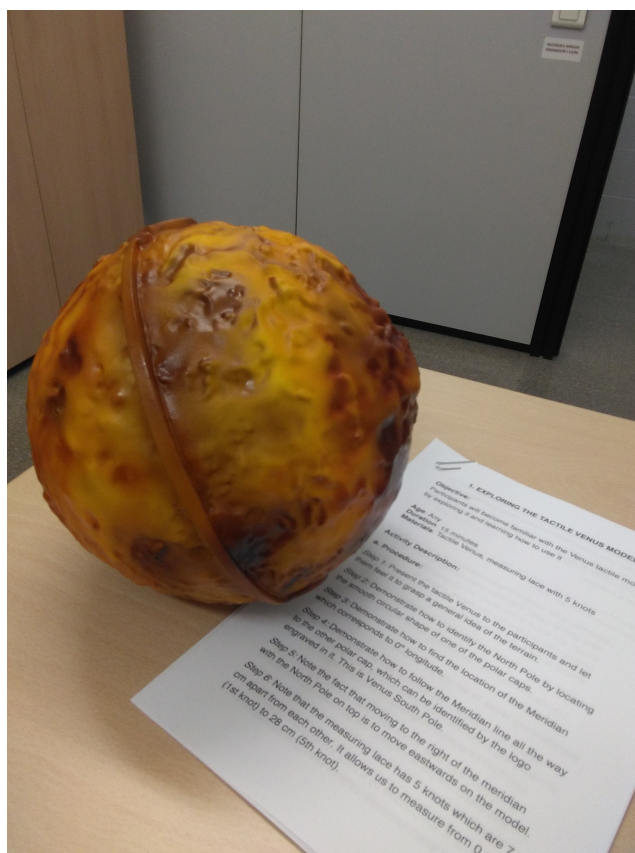


Figure 3: Venus 3D printed globe with the plain text version of the activity book. Credit: A. Ortiz-Gil.

4 Reaching out to the community

As we did with the "A Touch of the Universe" kits, we now intend to print 20 Venus globes and activity books that will be sent to educators/science communicators around the world who work with visually impaired or blind persons mainly in developing countries or underserved communities.

In order to reach a larger community than only those 20 teachers, we will publish the 3D model of Venus (already available) and the final peer-reviewed activity book on the project's website ([4]). Social media (e.g. Facebook group) will allow the exchange of ideas and experiences among all those who would like to be part of the project. A video tutorial will explain how to use the resources, give some hints and ideas about the activities and serve as the basis for online training sessions that will be offered to the recipients of the materials.

Acknowledgments

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References

- [1] AstroEDU, Peer-reviewed Astronomy Education Activities <http://astroedu.iau.org/>
- [2] Canas, L., Borges, I., & Ortiz-Gil, A. 2013. Proceedings of the European Planetary Science Congress 2013, 2013EPSC....8..716C
- [3] Gálvez, A., Ballesteros, F., García-Frank, A., Gil, S., Ortiz-Gil, A., Gómez-Heras, M., Martínez-Frías, J., Parro, L. M., Parro, V., Pérez-Montero, E., Raposo, V. & Vaquerizo, J. A. 2017. EPSC 2017 - 905-2, Vol. 11.
- [4] Project "A Touch of the Universe" website, Ortiz-Gil, A. 2013, <https://astrokit.uv.es>
- [5] Ortiz-Gil, A., Ballesteros, F., Espinós, H., Fernández-Soto, A., Lanzara, M., Moya, M. J., & Navarro, J. 2015, Highlights of Spanish Astrophysics VIII, ISBN 978-84-606-8760-3. A. J. Cenarro, F. Figueras, C. Hernández-Monteagudo, J. Trujillo Bueno, and L. Valdivielso (eds.), p. 880-888
- [6] Ortiz-Gil, A., & Burguet-Castell, J. 2018, *Journal of Open Source Software*, 3(25),660
- [7] Ortiz-Gil, A. 2018. Proceedings of the European Planetary Science Congress 2018, in press
- [8] Pérez-Montero, E.; García Gómez-Caro, E.; Sánchez Molina, Y.; Ortiz-Gil, A.; López de Lacalle, S.; Tamayo, A. 2017, Highlights on Spanish Astrophysics IX, ISBN 978-84-617-8931-3. S. Arribas, A. Alonso-Herrero, F. Figueras, C. Hernández-Monteagudo, A. Sánchez-Lavega, S. Pérez-Hoyos (eds.), p. 742-747
- [9] Rose, DH, & Meyer, A. 2002. "Teaching Every Student in the Digital Age: Universal Design for Learning", Alexandria, VA: ASCD
- [10] "Space Science Is for Everyone: Lessons from the Filed", 2008. Runyon, C., Hall, C., Heitger, C., Gonzales, L. (eds.), https://www.nasa.gov/pdf/259240main_Space_Science_Is_for_Everyone.pdf
- [11] SpaceIn meeting, 2017. http://www.esa.int/esl/ESA_in_your_country/Spain/SpaceIN_en_ESAC