VAMOS

Venus Atmosphere exploration through machine learning and open science in preparation to EnVision

DURATION
01/02/2023 – 01/05/2027

BUDGET
999 895 €

PROJECT DESCRIPTION

In the last decades, Belgium has been involved in several planetary space missions, in particular to Venus, being responsible for or associated to space-borne instruments, or through ground-based observations of the planets. For example, the SOIR instrument on board Venus Express was designed by BIRA-IASB. Different series of data on that exciting planet were therefore obtained thanks to the scientific expertise developed in our country. But now we are also preparing the future, with the design of a new instrument that will be part of the next European mission toward Venus, EnVision. We will re-investigate old data series with new and improved methods, applying best practices and strategies to combine and integrate data on the atmosphere of Venus acquired from different sources, and general circulation models, in order to study patterns, trends, and climatologies. We will apply data integration strategies already used by the Earth atmosphere community as well as machine learning applications to harmonize and combine different datasets. Machine learning can be used to model variations in time and space of variables (pressure, temperature, concentration of species…) in order to cope with the irregular coverage of the data. Machine learning can also reduce biases and identify relevant patterns like unknown species correlations and clusters. One of the science objectives of the EnVision mission will be to detect plumes of atmospheric constituents like water vapor or sulfuric gases, emitted from the surface. To constrain the observation capabilities of the on-board instruments, we will search through the existing data if such events already occurred and try to characterize them (duration, size). We will also investigate correlations between atmospheric gases or between the plumes and other parameters like temperature, to propose observation strategies for the future mission. An important aspect of this project is to make sure that the data and their interpretation are rendered accessible to the scientific community, but also valorised and explained to the wider general public, schools and universities. Our objective is to engage a wide variety of audiences and sectors of the society not usually interested in or even excluded from atmosphere science. Final results will be available to the scientific community through different FAIR Open access repositories: VESPA/Europlanet, PSA/ESA and the European Open Science Cloud. Data will also be presented as planetary high-level user-friendly atmospheric maps more accessible to the general public. We will moreover explore new forms of science communication through the interaction between scientists and artists.

The 1st objective of VAMOS is to develop best practices to combine data from planetary atmospheres, with a clear focus on Venus, acquired from different sources (space and ground-based instruments) in order to study long-term trends and climatologies, to understand why the atmosphere of Venus is so variable, and to relate the atmosphere composition to surface changes (planet evolution). We plan to apply data integration strategies already used by the atmospheric Earth community as well as machine learning (ML) to combine different datasets. The non-stationary nature of atmospheric processes will be challenging. ML can also reduce biases and identify relevant patterns such as unknown correlations and clusters or derive detection limits of species in very small abundance.

Besides rendering data and its interpretation in an accessible way for the scientific community (i.e., exploratory visualization), VAMOS also aims to valorize and explain this data to the wider general public as public understanding of contemporary scientific issues is critical for the future of society. There is also a growing need to educate the public on the Nature of Science. Science is comprised of more than knowledge; it is a social endeavour with values (e.g., openness), customs (e.g., peer-reviewing), processes, etc. described by the so-called Nature of Science (NoS). The majority of science communication (SC) efforts focus on the knowledge aspect of science, there is less emphasis on the process of conducting science and on the NoS. Yet, it is important to educate and communicate about NoS as a lack of understanding of NoS is linked to both science scepticism and scientism. Being able to read, interpret and question scientific data is considered key to the fight against misinformation and a way to allow a broad audience to participate in science debate.

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The 2nd objective of VAMOS is to design explorations that offer rich and engaging NoS experiences with VAMOS atmospheric science data. VAMOS is ideal to study NoS experiences because: 1) the object under study (Venus) is far away, i.e., very different from tabletop science experiments many did in school (relatively simple and whatever is studied can be touched), and 2) assembling scattered datasets is an aspect of science that is usually not part of the school science curriculum. Because of this extension of traditional science education, we will focus on designing experiences for adolescents. The careful gathering and analysis of the available empirical data and the use of models, both key elements of NoS, will stretch what science is and can do for many lay persons. The result of this objective will inform future SC efforts, including SC about the atmosphere, the greenhouse effect and climate change on Earth.

CONTACT INFORMATION

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LINKS

https://vamos.aeronomie.be

https://www.kuleuven.be/onderzoek/portaal/#/projecten/3E220816?hl=en&lang=en