

Science from PVOL2 (The Planetary Virtual Observatory and Laboratory): A database of amateur observations of Solar system planets integrated in VESPA

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Abstract

The Planetary Virtual Observatory and Laboratory (PVOL2) stores and serves publicly through its web site a large database of amateur observations of solar system planets [1, 2]. The PVOL service started in 2003 and was completely rebuilt in 2016 into a new service PVOL2 in the framework of the Virtual European Solar and Planetary Access (VESPA) services developed through the Europlanet 2020 Research Infrastructure. After 15 years of use of the PVOL service we review its use in professional studies of solar system [3], we strengthen the new capabilities in the modern PVOL2 service, and we show current research projects based on the analysis of the amateur data. PVOL2 contains amateur observations from Mercury to Neptune including the Moon and the Galilean satellites and is integrated in the VESPA portal (Virtual European Space and Planetary Access) as one general service in VESPA. PVOL2 can be consulted in <http://pvol2.ehu.eus> or through the VESPA portal in: <http://vespa.obspm.fr/>

1. Introduction

The original PVOL website and the current PVOL2 are a database of amateur images of Solar System planets contributed by hundredths of observers. The PVOL2 website offers different searching tools that allow retrieving observations from specific objects, a particular range of dates, a given observer, particular locations in a planet, movies, map projections and many others searching options. Data can be uploaded by amateur astronomers with a personal username and password or can be submitted by e-mail to pvol@ehu.eus. Most users of PVOL2 are amateur astronomers and the webpage includes relevant news and alerts, short reports and even links to other major

image sources such as ALPO-Japan or the Junocam images of Jupiter. For professional astronomers PVOL2 can be also consulted using other platforms like TOPCAT. The main important characteristic of PVOL2 is that it is now fully integrated in the VESPA query portal which offers different services to the professional community. VESPA is building a Virtual Observatory for Planetary Science, connecting all sorts of data and providing modern query and inter-comparison tools. For instance, queries on VESPA of spectra of a particular planet in a given time range would also show images of that planet in PVOL2 obtained in the time range of the spectra.

2. Updated data in PVOL2

PVOL2 contains amateur observations of Jupiter since the year 2000 and has been expanding ever since then. It now contains more than 35,000 image registries contributed by about 400 observers. Most of the images are Jupiter observations (71%) followed by Saturn observations (23%) with an increasing number of Mars and Venus images since 2016. Uranus and Neptune observations (about 450 images for each planet) are also present in PVOL and, although they constitute a minor volume of the data, they are considered of high value for scientific research of these planets [4]. Observations of Mercury, the Galilean satellites and the Moon are also available on the site and can be used for teaching projects. Images uploaded since 2017 can be “tagged” so that it becomes easy to find images containing a particular detail like a particular crater on the Moon. Images acquired by amateur astronomers sometimes operating telescopes of the 1-m class are also available in PVOL2.

3. Science

Planetary observations currently obtained by an increasing number of amateur astronomers reach a spatial resolution that is rarely obtained from professional telescopes. The combination of observations from many different observers allows time-resolved studies of the atmosphere dynamics of different planets that can be compared with snapshots at high-resolution obtained by large telescopes with Adaptive Optics, HST observations of the Giant planets, or spacecraft observations of Mars dust storms and cloud systems. While historically most research works using PVOL data have concentrated in the study of Jupiter atmosphere dynamics, the increased quality of the observations improves research opportunities in Saturn [5], Uranus [6] and Neptune [4], Venus [7] and Mars [8] science. The outcome of professional and amateur collaborations is very large and the PVOL website lists about 30 scientific publications with amateur data available in PVOL2 including publications in major scientific journals (Nature or Science). We aim for a wider use of the data by the professional community. PVOL2 also hosts an specific page about impacts in Jupiter and their detection with software tools like DeTeCt3.1 [9-10] where an active collaboration with many amateurs is essential.

Current “hot topics” followed by amateur astronomers contributing relevant data in PVOL are the wide range of atmospheric activity in Jupiter in comparison with data from the Juno mission, the bright polar and equatorial features in Saturn [5], and the follow-up of atmospheric activity in Neptune. At the time of this writing amateur astronomers are also making a survey of Martian clouds and small dust storms with the expectancy based on Martian seasonal phenomena to observe a Large Dust Storm at high-resolution.

The current version of PVOL is indented to boost new professional and amateur collaborations in these and other related fields.

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