

Recent contributions of amateur astronomers to the study of planetary atmospheres from Venus to Neptune

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Abstract

During the last two decades amateur contributions to professional publications in the field of planetary astronomy have increased exponentially [1-2]. Technical advancements in instrumentation and the collaboration of amateurs with professional astronomers have flourished making some amateur observers essential actors in planetary astronomy with regular scientific contributions and a capacity to perform unique discoveries [3-5]. The role of amateurs and citizen scientists is also acknowledged in missions such as the Juno mission [6] or in large projects like Europlanet 2020 RI, which has organized several activities aimed to increase the participation of amateur astronomers in planetary science. Here we review some of the current trends and recent collaborations in professional and amateur studies of planetary atmospheres.

1. Amateur astronomy and planetary atmospheres

The dynamic nature of the atmospheres of Jupiter, Saturn, Mars and Venus make frequent observations of them an essential need to understand their atmospheres. Over the last decade many amateur astronomers have mastered high-resolution observations of bright planets. Thanks to fast-acquisition cameras and image processing techniques, a large number of amateur observers now obtain images that can beat seeing effects and reach the diffraction limit of their telescopes. The amateur community provides regular observations that can discover the onset of storms in Jupiter [7] or Saturn [8-9], discover unusual events in Jupiter [3-4] or Mars [8], or that can be used to study the global dynamics of these planets [10-12] including also Venus [13-14]. Recent advancements allow amateurs to contribute to the study of exceptionally bright features in Uranus [15] and regularly to the study of Neptune [16-17].

2. Sharing data

A key element for collaboration is sharing the data online. The two most important databases where amateurs post their data are ALPO Japan (<http://alpo-j.asahikawa-med.ac.jp/>) and PVOL (<http://pvol2.ehu.eu>). The latter has a database structure, can be searched for specific data easily [18] and is integrated in the Virtual European Solar and Planetary Access (VESPA) query portal. Figure 1 shows a summary of the data available in PVOL. These observations are supplied by a few hundred observers distributed all around the globe.

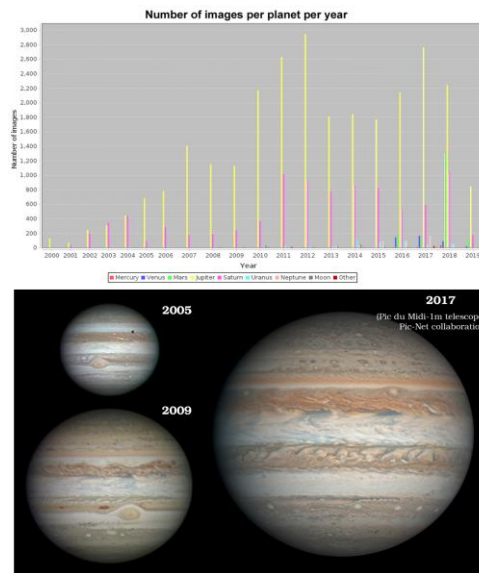


Figure 1: Number of observations per planet per year in the PVOL database and examples of the quality of some of the best data for the last 15 years. ALPO Japan contains an even larger number of observations.

3. Individual missions

A unique example of a broad collaboration between amateur and professional observations is currently

the planning and interpretation of JunoCam observations with context images provided by amateur astronomers and processing of JunoCam images by citizen scientists [6]. See: <https://www.missionjuno.swri.edu/> and the Jupiter section of the British Astronomical Association: https://www.britastro.org/section_front/15.

Coordination of spacecraft and ground-based amateur observations has also been planned for the Akatsuki Venus orbiter, but the collaboration of the Juno mission with amateur astronomers is unprecedented and articulates most of the current pro-am collaborations in Jupiter research. After the end of the Cassini mission much research can be done through a combination of past Cassini and current Saturn observations [9, 12].

4. Conclusions

Amateur observations of solar system planets are a very valuable resource to study open questions that range from the characterization of Venus atmospheric superrotation to Neptune's changing features including violent and rapidly evolving events in Jupiter, Saturn or Mars and unexpected phenomena like impacts in Jupiter. Amateurs respond rapidly to observational alerts, provide excellent data, are distributed around the globe and develop excellent software tools like the widely popular AutoStakkert and WinJupos. Amateur astronomers also obtain valuable spectroscopic data and their contribution to planetary science will undoubtedly continue to grow. With the end of the Europlanet-2020 RI, the Europlanet Consortium has solicited a new research infrastructure Europlanet-2024 RI that, if funded, will continue to foster amateur collaborations in planetary sciences.

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