



Amateur astronomy support to current and future space missions: From the 2010s to the 2030s

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Amateur astronomy of the Solar System is living a golden age with major contributions to modern planetary science. These contributions cover a wide spectrum of topics that range from the discovery of impacts in Jupiter [1-2], to the observation of stellar occultations by minor bodies [3-4], the characterization of unexpected high-atmospheric events in Mars [5], or the characterization of giant storms on Jupiter [6] and Saturn [7-8]. Besides these examples of high-profile publications, there is an increasing number of amateur contributions to dozens of studies of planetary atmospheres and countless contributions to the study of minor bodies. While we focus here in the role of amateur astronomy observations of planetary atmospheres, we also recognize the varied and healthy professional and amateur collaborations in other areas of solar system astronomy.

The reasons behind this golden age lie in the two sides of the collaboration: On the side of amateur astronomers, many of them use very efficient detectors and advanced software tools, and they are highly connected at an international level. Thus, they provide high-quality observations on a regular basis to professional astronomers, or have strong analysis teams like the JUPOS team as an example (<http://jupos.privat.t-online.de/index.htm>). These frequent amateur observations provide essential monitoring of the temporal evolution of planetary atmospheres. On the other side, professional astronomers are aware of the potential of these observations and actively seek the collaboration of amateur astronomers and citizen scientists. A key case in this regard is NASA's Juno mission to the giant planet Jupiter, and its large-scale collaboration around the JunoCam instrument on the mission Juno website: <https://www.missionjuno.swri.edu/>. The mission has been recently extended until 2025 and details of the contribution of amateur observers to this new mission scenario are presented by Orton et al. in session ODAA5 in this meeting. Other examples of professionals seeking a global collaboration with amateurs are the various professional and amateur astronomy services and workshops organized by research projects like the Europlanet 2020 Research Infrastructure (2016-2019) and Europlanet 2024 Research Infrastructure (2020-2024).

We anticipate that the trend of amateur astronomy playing an important role in providing additional data sets to space missions will continue to grow and we advocate for the early establishment of such collaborations. We review some of the elements that have made the collaboration of amateur astronomers with the Juno mission so fruitful for both parties and how this collaboration has grown beyond Jupiter into enhanced collaborations in other fields through networking amateur astronomers and providing a successful example to other fields.

We also discuss future ground-based high-resolution amateur observations of Solar System planets in support of future missions. These include the James Webb Space Telescope observations of planets (launch in October 2021), ESA's Jupiter Icy moons Explorer (JUICE, launching in 2022) and NASA's Europa Clipper missions to the Jupiter system in the early 2030s, the in situ exploration of Saturn's moon Titan by the Dragonfly mission (NASA) in 2034, the Envision mission to Venus (if selected by ESA), and possible future missions to the Icy Giants Uranus and Neptune. Each of these ambitious missions will benefit from the strong partnership between amateur and professional planetary scientists. The first in this line is the JWST observations of Giant planets to be conducted in 2022 (see Fletcher et al. in session OPS3 in this conference).

Finally, we also show some professional and amateur networking elements developed under the umbrella of the Europlanet projects, including the recently launched Europlanet Telescope Network (<https://bit.ly/2Br5LDt>), and we present possible scenarios for future pro-am collaborations beyond the end of the Europlanet 2024 project.

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