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Amateur Astronomers' Support for ESA's JUICE Mission II. Getting ready for 2031-2035

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JUICE (JUpiter ICy moons Explorer) is the first large mission in ESA's Cosmic Vision 2015-2025 programme. The spacecraft was launched on April 2023 and will arrive at the Jupiter system in July 2031. The primary science goals of the mission are to characterize the Jovian icy satellites, studying their surfaces and interiors to unveil their history and internal structures, and to assess the emergence of habitable environments in their internal oceans **[1]**. To reach those goals JUICE will perform a complex series of orbits around Jupiter in which it will also run an extensive series of observations of the planet's atmosphere **[2]**, its magnetosphere and the ring system. All previous Jupiter missions since Galileo have benefited from extensive ground-based campaigns with a variety of telescopes and observational capabilities. A brilliant example of those collaborations comes from NASA's Juno mission, which has requested collaboration with amateurs for a full decade, enhancing the spatial context and investigations in the time domain of various instruments with a particular strong participation with the Juno camera [**3**]. In this regard, amateur observations of Jupiter have demonstrated the capability to provide an excellent coverage of atmospheric phenomena that serve as spatial and temporal context to the close observations from spacecraft instruments or space telescopes. Databases of amateur observations such as ALPO Japan (https://alpo-j.sakura.ne.jp/indexE.htm) and PVOL (http://pvol2.ehu.eus/) **[4]** serve the science community providing access to the amateur data. Open source software tools popular in the amateur community (WinJupos, available at https://jupos.org/) **[5]** or more python-oriented tools such as PlanetMapper **[6]** support the analysis of amateur data. In addition, ESA's Planetary Science Archive (https://archives.esac.esa.int/psa/#/pages/home) releases public data obtained by the two monitoring cameras (JMC; Juice Monitoring Camera 1 and 2) and will soon release also data from the navigation camera (NAVCAM). Data from the science instruments will be released through ESA's Planetary Science Archive after proprietary time.

In this contribution, we discuss the interest of the mission and its Jupiter Atmosphere Working Group to receive observational support from amateur astronomers. This support is needed during the years before Juno and JUICE to continue understanding temporal changes in the atmosphere of the planet. During the JUICE mission, particular needs will arise over different periods. For example, over the first year of the mission JUICE orbits will be eccentric with larger apojoves implying longer periods of time between close perijoves. Later, orbits will have high-inclinations with reduced views

of the equatorial latitudes and in the year before Ganymede orbit insertion orbits will be more regular but constrained by Data Volume. We expect that JUICE collaboration with amateur astronomers will broaden public involvement in the mission and will enhance outreach activities of the mission.

With Jupiter having a negative declination over 2031-2035 when observed from Earth, observations from the southern hemisphere and equatorial latitudes will be favored. Thus, specific outreach activities targeting amateur astronomy in the Global South may improve the amateur collaboration in the mission. Jupiter's south declination implies that amateur observers in Japan, European countries and the US, where most experienced observers actively participating in collaborations with Jupiter researchers reside, will observe Jupiter under low elevations. Thus, we will actively promote knowledge of the mission in South America and Africa, where amateur astronomy is popular but Jupiter observations are less frequent. We expect to identify JUICE science activities that can be promoted within partners such the Astronomical Society of Southern Africa, the *Asociación Argentina Amigos de la Astronomía* and *Sociedad Astronómica de Valparaiso y Viña del Mar*. Such activities can be fostered with the help and participation of international societies promoting astronomy worldwide. Key partners toward that effort are The Europlanet Society and the International Astronomical Union Outreach Group. We will also seek a global collaboration with traditional actors in the amateur planetary astronomy world including the British Astronomical Association Jupiter Section, the Association of Lunar and Planetary Observers and planetary imaging communities on well-known international forums such as Cloudy Nights.

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