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Long-term monitoring of Jupiter's stratospheric H_2O abundance with the Odin Space Telescope

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Abstract

Water vapor and CO_2 have been detected in the stratospheres of the giant planets and Titan (Feuchtgruber et al. 1997, Coustenis et al. 1998, Burgdorf et al. 2006). The presence of the atmospheric cold trap implies an external origin for H_2O, and the possible sources are: interplanetary dust particles (IDP), icy rings and/or satellites, and large comet impacts.

In July 1994, the Shoemaker-Levy 9 comet (SL9) spectacularly impacted Jupiter near 44°S. On the long term, Jupiter was left with a variety of new species in its stratosphere, including CO, HCN, CS, etc (Lellouch et al. 1995). Herschel observations have enabled to demonstrate that the bulk of Jupiter's stratospheric H_2O was delivered by SL9 (Cavalié et al. 2013).

All these species can be used as tracers for Jupiter's stratospheric chemistry and dynamics. In this paper, we present the long-term monitoring observations from 2002 to 2019 of Jupiter's stratospheric H_2O with the Odin submillimeter space telescope (Nordh et al. 2003). We use a 1D time-dependent photochemical model combined to a radiative transfer model to constrain the temporal evolution of the H_2O emission. This work is done in the framework of the preparation of the operations of the Submillimetre Wave Instrument (SWI) aboard the ESA-led Jupiter Icy Moons Explorer (JUICE) mission. SWI will use the H_2O submillimeter line at 557GHz to map the Jovian stratospheric winds to constrain its general circulation. Our model enables predicting the H_2O abundance in 2030 when JUICE/SWI will operate.

References

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