Uranus and Neptune are key to understand planets with hydrogen atmospheres

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Uranus and Neptune are the last unexplored planets of the Solar System. I show that they hold crucial keys to understand the atmospheric dynamics and structure of planets with hydrogen atmospheres. Their atmospheres are active and storms are believed to be fueled by methane condensation which is both extremely abundant and occurs at low optical depth. This means that mapping temperature and methane abundance as a function of position and depth will inform us on how convection organizes in an atmosphere with no surface and condensates that are heavier than the surrounding air, a general feature of gas giants. Using this information will be essential to constrain the interior structure of Uranus and Neptune themselves, but also of Jupiter, Saturn and numerous exoplanets with hydrogen atmospheres. Owing to the spatial and temporal variability of these atmospheres, an orbiter is required. A probe would provide a reference profile to lift ambiguities inherent to remote observations. It would also measure abundances of noble gases which can be used to reconstruct the history of planet formation in the Solar System. Finally, mapping the planets' gravity and magnetic fields will be essential to constrain their global composition, structure and evolution. [see Guillot 2019, arXiv:1908.02092]

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