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Small Next-generation Atmospheric Probe (SNAP) for In-Situ Atmospheric Exploration of Ice Giant Planets

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We present a concept for a small, atmospheric probe that could be flexibly added to future missions to a giant planet as a secondary payload, which we call the Small Next-generation Atmospheric Probe (SNAP). SNAP's main scientific objectives are to determine the vertical distribution of clouds and cloud-forming chemical species, thermal stratification, and wind speed as a function of depth. As a case study, we present the advantages, cost and risk of adding SNAP to the future Uranus Orbiter and Probe flagship mission; in combination with the mission's main probe, SNAP would perform atmospheric in-situ measurements at a second location, and thus enable and enhance the scientific objectives recommended by the 2013 Planetary Science Decadal Survey and the 2014 NASA Science Plan to determine atmospheric spatial variabilities.

Out study demonstrates that the science objectives can be achieved with a 30-kg entry probe $\sim$0.5m in diameter (less than half the size of the Galileo probe) that reaches 5-bar pressure-altitude and returns data to Earth via the carrier spacecraft. As the baseline instruments, the probe will carry an Atmospheric Structure Instrument (ASI) that measures the temperature, pressure and acceleration, a carbon nanotube-based NanoChem atmospheric composition sensor, and an Ultra-Stable Oscillator (USO) to conduct a Doppler Wind Experiment (DWE). We also catalog promising technologies currently under development that will strengthen small atmospheric entry probe missions in the future. Our study demonstrates that such a mission will cost While SNAP is applicable to multiple planets, we examine the feasibility, benefits and impacts of adding SNAP to the Uranus Orbiter and Probe flagship mission.