

Measuring Mars Atmospheric Winds from Orbit

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Description: This white paper advocates for global atmospheric wind observations from Mars orbit. It demonstrates the science case for measuring Mars atmospheric winds (particularly vector-resolved, horizontal winds from the surface to >60 km at a horizontal resolution of ≤ 300 km) from orbit, discusses the relevance of these measurements to future human and robotic exploration of Mars, and describes the existing and in-development instruments that could make such measurements.

Wind measurements remain a critical gap in our understanding of Mars' climate and atmospheric processes and have been highlighted by the new MEPAG goals document as a high priority for Mars science (e.g., Goal II A1.1, Goal IV A1.3, A3.3). Wind is one of the predominant forces that has shaped Mars' surface over the last 3 billion years, depositing, burying, and eroding an extensive sedimentary and climatic record comprising sand, dust, and ice. In addition, wind is the agent of transport for water vapor, dust, trace gases, and to a significant extent, heat, around the planet. Understanding wind and the atmospheric circulation is necessary to understand the present and past water, dust, and CO₂ cycles.

Furthermore, understanding wind patterns helps close strategic knowledge gaps identified for human exploration of Mars, reduces risk in entry, descent, and landing of spacecraft and their launch from the surface, and helps understand and constrain the environmental impacts human exploration may have on the pristine martian environment.

Existing instrumentation is ready for flight to measure winds globally, with additional concepts in development. The MARs Lidar for global climate measurements from orbit (MARLI) is being developed at NASA GSFC under MatISSE program funding and is expected to reach TRL 6 in June 2020. A sub-millimeter sounder developed at JPL is currently rated TRL 5 and was already proposed for flight on a recent Discovery mission. NASA Ames is developing the Doppler Wind and Temperature Sounder, a compact (3U-sized) instrument, currently rated at TRL 4-5 with a flight demonstration in low Earth orbit planned in 2021. Additional instrument

and measurement concepts (e.g., cloud tracking from imagery) have also been proposed for development.

Status/Schedule: Writing is beginning in the next 1-2 weeks with the goal of a complete draft no later than June 7th, 2020.

Contributions from the Community: People who are interested in authoring text, reviewing/editing drafts and providing comments, or adding their name as co-author/co-signer are all welcome and should contact the point of contact listed above.