The Transportable Phased Array Radar: Meeting community imperatives in weather science

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Weather radars provide essential observations to enable scientists to understand the structure, composition, and motion of clouds, precipitation, and clear-air phenomena. Scientists have conveyed a clear need for improved temporal resolution and moving toward 4D observations, that can be achieved with rapid-scanning and globally transportable phased-array systems. The community-accessible high-resolution Transportable Phased Array Radar (TPAR) embodies that vision for the future. It will allow improved observations of clouds, convection, precipitation, atmospheric winds, and the boundary layer that have been repeatedly identified as priorities by the Earth Science community over recent decades. TPAR will enable rapid and adaptive volume scans of S-Band, dual-polarization and 3D winds (via multi-static passive receivers) with excellent sensitivity and with fine spatial sampling specifically in the vertical. This evolutionary technological will provide 1-degree beamwidth and excellent polarimetric quality using a scalable all-digital phased array architecture. Through its convergent design with other sensing technologies (e.g., lidars, cameras, satellites) and leveraging AI/ML concepts, TPAR will transcend the current paradigm of asynchronous measurements of individual variables. It will fill a long-standing spatial and temporal gap by enabling a 4D depiction of microphysical and dynamic weather processes, fostering new developments in atmospheric science theory and modeling. It will address critical science observing priorities in physical and dynamic processes, formation and evolution of severe weather, atmospheric boundary layer, numerical weather prediction, and data assimilation. By bridging across atmospheric science disciplines and broader environmental applications (e.g., aeroecology), TPAR will build a more comprehensive and integrated understanding of the atmosphere through deployments worldwide.

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