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Distributed Collaborative Adaptive Sensing (DCAS) for Improved Detection, Understanding, and Prediction of Atmospheric Hazards

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This paper describes a new approach to radar atmospheric sensing being designed to overcome several important and fundamental limitations to current approaches. Today's observing network relies on long-range (hundreds of km) radars that comprehensively map winds and precipitation in the mid- to upper-troposphere, but Earth curvature prevents this system from viewing the lower troposphere (nearly 80% of the volume below 3 km altitude is blocked). Distributed Collaborative Adaptive Sensing (DCAS) refers to the use of large numbers of small radars that are appropriately spaced to overcome Earth curvature blockage, improve resolution degradation caused by beam spreading at long ranges in today's system and achieve rapid beam-scanning through the use of very low cost electronically scanned antennas. By concentrating their resources (radar beams and other resources in the network, such as communication bandwidth) onto specific regions of the atmosphere where threats exist, and by reconfiguring in response to changing weather, DCAS networks have the potential to vastly improve our ability to detect, understand, and predict severe storms, floods, and other atmospheric and airborne hazards. In this paper, we describe the key fundamental and technological trade-offs that establish the design-space for DCAS radar networks including signal-to-noise and sensitivity; antenna size and spatial resolution; scan/update time; attenuation; ambiguity removal; and finally, issues of cost and the number of radars needed to implement a practical DCAS system in the future.

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