EAGLE radar: An extremely low-cost, multi-beam, rapid-scan X-band radar for weather radar networks

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Through a partnership among the University of Oklahoma, Nanowave Technologies, and Weathernews Inc., a low-cost, multi-beam X-band radar has been developed called the EAGLE radar. The EAGLE radar transmits two beams simultaneously that can be configured at the same or different elevation angles, allowing the radar to cover a greater vertical depth or scan faster than a single-beam radar system. At a nominal rotation speed of 20 degrees per second, the radar can provide scans at two different elevation angles every 12 s. The EAGLE radar is designed to be compact, low-power, and portable such that it can be easily deployed. Over the next few years, Weathernews Inc. will be deploying EAGLE radars across Japan to provide faster temporal resolution data and improve low-level coverage, including critical areas often missed by operational radars (e.g., complex terrain).

The goal of this study is to document the system performance of the EAGLE radar and conduct meteorological analyses of EAGLE radar cases. Since 2018, field experiments have been conducted with the EAGLE radar in Norman, Oklahoma to evaluate system performance and conduct meteorological analyses. Data comparisons between the EAGLE radar, the OU PX-1000, and NEXRAD will be presented to investigate system performance. In addition to system intercomparisons, several meteorological cases have been collected including tornado, hail, convection initiation, and winter weather cases. On 9 October 2018, the EAGLE radar documented the formation of low-level rotation associated with a brief tornado in a quasi-linear convective system. Such line-embedded tornadoes are transient and difficult to detect with operational WSR-88Ds due to limited temporal resolution. The EAGLE radar detected the increase in rotational velocity leading up to tornadogenesis. Thus, this case illustrates the potential benefits of a rapid-scan, multi-beam radar to augment operational radar networks. Several other applications and analyses of these low-cost radar systems will be discussed, including melting layer detection using quasi-vertical profiles (QVPs), detection of thunderstorm initiation, and observations of turbulence in stratiform precipitation. Plans for future experiments as well as permanent radar deployments in Japan will be discussed.

Keywords: Radar Technology, Convective Storms, Radar Networks, Tornadoes