Plinius Conference Abstracts,
Vol. 11, Plinius11-209, 2009
11th Plinius Conference on Mediterranean Storms

Principles of weather radar network design at attenuating frequencies

F. Junyent, S. Lim, and V. Chandrasekar
Electrical and Computer Engineering, Colorado State University, Fort Collins, CO 80523-1373, USA

The Engineering Research Center for Collaborative Adaptive Sensing of the Atmosphere (CASA) is investigating the use of dense networks of short-range radars for weather sensing. A first test-bed of this new paradigm is currently deployed in southwest Oklahoma. The potential benefits of closely deployed, overlapping, short-range weather radars are easy to see intuitively, amounting to a greater ability to measure at lower beam heights, mitigating the effects of the Earth curvature, an increased spatial and temporal resolution in the measurements, the ability to perform multiple-radar measurements, and the capability of optimally and adaptively tasking the individual radars according to the meteorological scene. All of the previous points can be achieved while using less complex radar units than those in operational use today.

All of the described potential benefits are governed by relationships between the characteristics of the individual radars composing the network and the network spatial distribution. Using the same network layout for two different classes of radars will create different coverage characteristics. Similarly, deploying one class of radars in two different network layouts will not yield the same coverage results. The relationship between the individual radar characteristics and the resulting network characteristics was presented in (Junyent and Chandrasekar, JAOT, 2009), and applied to both characterization and design of weather radar networks.

In this paper, the previously developed radar network characterization analytical and numerical tools are extended to include radar signal attenuation statistics. Signal attenuation is becoming a greater concern as radar systems operating at higher frequencies such as C and X band are becoming commonplace. Attenuation effects when the radar signal is propagating through rain will influence parameters such as minimum detectable reflectivity and number of overlapping radars, which are also dependent both on single radar characteristics and network topology. Taking into account attenuation statistics collected at particular radar operating frequencies in the weather radar network design process, the attenuation margin for both the radar network and the individual radars composing the network can be obtained. Based on the attenuation margins, the number of overlapping of radars capable of sampling a given point in the network in the presence of a given spatial attenuation distribution can also be obtained.