Weather Radar and Wind Turbines - Theoretical and Numerical Analysis of the Shadowing and related Precipitation Error

Gerhard Greving
NAVCOM Consult, Germany
Malkomes, Martin (Gamic GmbH, Germany)

E-mail: navcom.consult@t-online.de

The “weather radar” WR is a special type of “primary radar” intended to measure atmospheric volumetric targets. The targets of the WR differ fundamentally from the ones of conventional primary radar targets in ATC (Air Traffic Control) or military AD (Air Defense) applications. The targets of WR are typically large homogeneously distributed volumes of clouds and rain etc. awhile the targets of a “ATC/AD primary radar” are quasi-point-objects as seen from the radar – except for wind turbines WT in close distances. The volumetric targets are much larger than the cells resolution of the WR, in particular also much larger than the half-power beam widths HPBW of the WR.

Objects in the radiation field of the WR can distort the results of the WR measurement in principle. Actually distorting objects are WT which are installed in an increasing number in some distance to the WR.

One of the main tasks of the WR is the measurement of the precipitation Z, R in space. Objects in the radiation field may have impacts on these parameter (or radar meteorological moments) by their presence which is often characterized simply as “shadowing” created by the scattering at the WT.

This paper describes and analyzes theoretically and numerically the scattering mechanism and impact of the WT on the radiation field of WR. The WT can be treated as fully metallic and are by that no absorbers at all. The complex scattering field in relation to the volumetric targets for WR is numerically systematically analyzed and evaluated in this paper.

It is shown that the net precipitation error in the back of WT is very small and negligible if the WT are not located in a too small distance by the averaging or integrating effect within the HPBW.

Systematic numerical results will be shown and will be compared with available measurements which agree well with the theoretical expectations. Some possible mitigation measures are discussed.