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Analysis of external influences on weather radars

ABSTRACT - Masterthesis

Weather radars are important and unique instruments for the German meteorological service to measure and forecast weather phenomena. As an Example, the different reflection intensities from raindrops, hailstones or snow are used to determine the type and density of the rainfall. Another important tool is the Doppler shift which is used to measure the radial speed of the rainfall. There are also external influences like terrain and buildings; however those moveable (but stationary) objects like wind turbines are especially able to influence meteorological measurements and the resulting weather forecasts in a negative way. The German meteorological service has the duty, by law, to protect the life and manor which is at risk due to the influences on the measurements caused by stationary, but also moving objects like wind turbines. Therefore, qualitative statements are necessary.

The following work deals with the study of the explained influences by using different analyses. First of all, the influence of the electromagnetic shadow zones created by stationary objects on weather radar systems (Meteor 360 and EECDSR5001C) from the German meteorological service had been analyzed. The goals were to determine critical and less critical distances around the weather radar system. According to the given results, recommendations for building around weather radar systems were found.

Moreover, the analysis of the resulting echoes caused by wind turbines was carried both, on the basis of weather radar measurement data and by means of theory. On the first approach, by using the data, the influence of wind turbines on different measurement methods has been shown. When using the theory approach, a detailed analysis of radar cross sections and Doppler shifts of wind turbines was done. On this way, a complete explanation of the problem and the precise definition of the disturbed area around a wind turbine were obtained.

Another part of this thesis deals with the influences on stationary ground targets on polarimetric radar systems. These systems compare the echoes of horizontal and vertical polarized electromagnetic waves to determine the type and the shape of the weather phenomena. The goals were to describe the influences and to determine the resulting problems on measurement methods, especially on the different measurands of a polarimetric radar.