

The Interactive Weather Radar Visibility Analysis Tool

Kurtuluş ÖZTÜRK¹, Alper ÇUBUK¹

¹*Turkish State Meteorological Service*

Remote Sensing Division

kozturk@mgm.gov.tr, acubuk@mgm.gov.tr

ABSTRACT Managing the land in terms of deciding where to install weather radar in mountainous terrains such like Turkey is a challenging issue. Together with the challenging mountainous terrain increasing amount of other obstacles due to urbanization such as wind turbines and skyscrapers also cause beam blockage and therefore result in restricted radar coverage and deviated radar echoes. It is important for forecasters/hydrologists/researchers to have information of how much of the beam is visible, meaning how much of it passes through the obstacles. In order to supply this crucial information Turkish State Meteorological Service (TSMS) developed a new interactive tool to make visibility analysis for Turkish radar network.
Key words: *Partial Beam Blockage, Radar Coverage, Visibility Analysis, Weather Radar, GIS.*

1. INTRODUCTION

Choosing the right place for weather radar installation is very important considering data quality. All possible quality and accuracy restrictions needed to be mapped beforehand such as beam blockage, interference sources, etc. After all possible locations assessed in terms of cost and data quality, the theoretically best location is picked. Although all the best conditions determined and so called “the best” place is chosen, because of many reasons such like urbanization, the installation area might not be controlled and turned into a constructed land. As a result those constructions may lead interference; clutter problem and partial beam blockage (PBB) and affect the possible best radar data quality. Aim of this study is to introduce the interactive tool that is developed by Turkish State Meteorological Service (TSMS) to visualize map and cross section of beam blockage percentage, visible beam radius, visible beam percentage, minimum height of visibility (above mean sea level (MSL)), station altitude and minimum visible angle for Turkish radar network.

2. MATERIAL AND METHODS

PBB diagrams and beam blockage fractions are derived by using 30m resolution digital elevation model and open source wradlib libraries. Theoretical PBB is calculated using coordinates of radar site and concerned site, number of rays, number of bins, the elevation, the beam width (Figure 1) and the range resolution information.

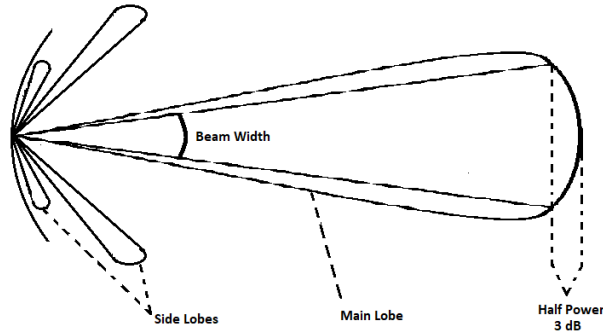


Figure 1. The 3-dB beam width of a radar antenna

Maximum beam height values were then calculated using the formula (Equation 1) provided by Rinehart (2000):

$$H = \sqrt{r^2 + R'^2 + 2rR' \sin \phi} - R' + H_0 \quad \text{Eq1}$$

where r is the distance between the radar and the point of interest, ϕ is the elevation angle of the radar beam, H_0 is the height of the radar antenna above mean sea level, $R' = 4R/3$ and R is the earth's radius.

Lowest levels of the beam height and terrain elevation values were matched to determine how much of the beam is blocked. An iterative process goes on with successive elevation angles in operational task till it is at least partially blocked. With these steps finally, for a given point, following outputs are obtained; map of topography, map and cross section of beam blockage percentage, visible beam radius, visible beam percentage, minimum height of visibility (above mean sea level (MSL)), station altitude and minimum visible angle (Figure 2).

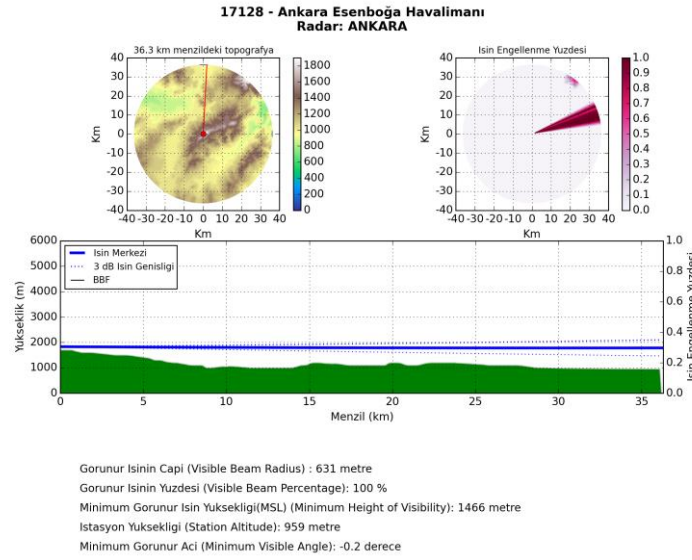


Figure 2. Output of the interactive tool for a given point.

3. RESULTS AND DISCUSSIONS

The tool (Figure 3) provides two options for users, first option is consisting pre-calculated (Figure 4) outputs for all the installed stations in the radar coverage, and the second option is interactive part which lets users to pick whichever point on the map service they like to have the information of (Figure 4). Together with the ease it provides for users, it will be used in all radar related studies such as hydrological modelling and radar quality index (RQI) studies.



Figure 3. Main page of the web site

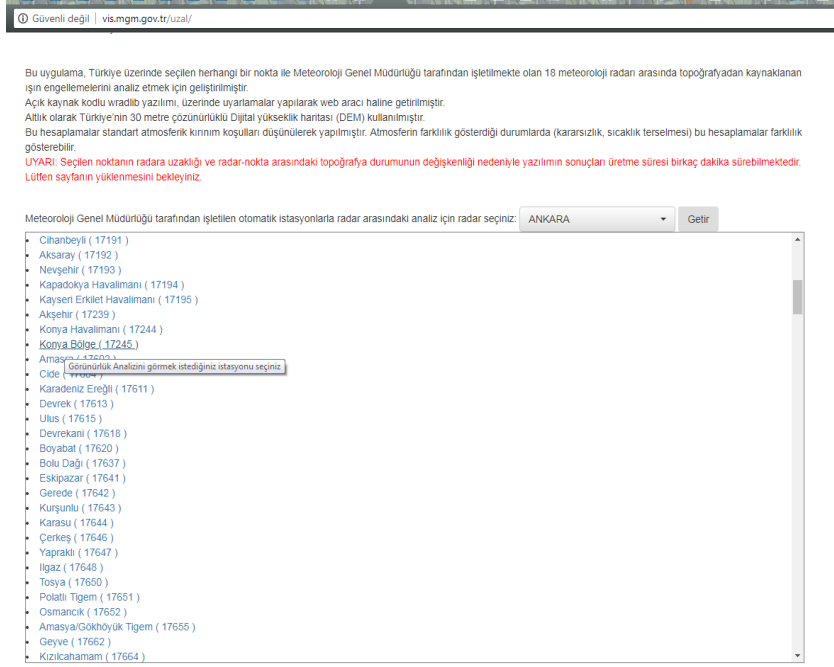


Figure 4. Pre-calculated option of interactive tool.

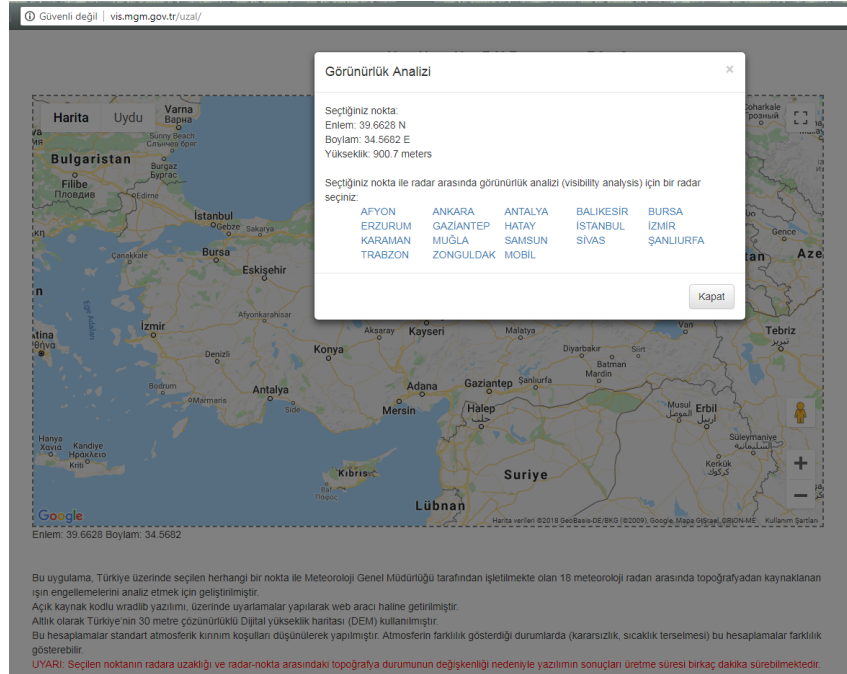


Figure 5. Interactive tool that lets users chose the radar for a desired point.

REFERENCES

1. Rinehart, R. 2000. Radar for meteorologists, Rinehart Publications, Columbia, 62-63.

Internet References:

<https://wradlib.org/> visited on:10 April 2018.