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A GIS-Based Decision Support System for the Optimal Siting of Weather Radars Network

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Climate changes have become major causes of concerns as they are becoming more violent and extreme. Draughts, inundations, tornadoes are few severe weather phenomenons that are causing devastating damages and sometimes heavy losses of lives. Acquiring real time precise data is an essential factor in better understanding and forecasting weather conditions. It is also a major piece in climatology and hydrology modelling. An important instrument for obtaining this valuable data are weather radar network.

Contrary to satellite observation of the top of weather system, radars can provide a much more regional and multilayer view of the same system. The heavier core of a moving weather system lies below an altitude of 1km requiring a tool which can provide real time accurate data in order to announce early warning for communities. Radars are also used for the studies of sandstorms phenomenons and even assist in the monitoring of birds and insects migration. Several radar network exists nowadays such the OPERA network in Europe and the NEXRAD in the united states.

Selecting a site for the installation of radar is a major challenge in which multi criteria decision problem need to be solved. Such criterion that need to be addressed in the selection process are population density, surface complexity effects on radar beam propagation, coverage of sensitive facilities such as airports, ports, military bases, power stations, signal interference, environmental impacts, and most important cost. The cost is associated with price of the land, the availability of electric and communication lines and the distance to existing roads.

Site selection is frequently left to a committee of experts and their decisions are based on infield visits and studies. This mean that a selection is drawn from a short list of potential sites which most of the times doesn't satisfy sufficiently all criterion. A GIS based tool could offer a much larger and diverse list from which decision makers can choose from. The proposed tool can perform a macro level analysis of a whole region and classify regions according to their constraints satisfaction. It is clear that finding a site that would completely satisfy all criterion is near impossible. Taking this limitation in consideration, it is primordial to classify the criterion based on their importance.

Using Analytic Hierarchy Process, the criterion are pairwise compared based on literature information and a classification of sites is produced based on the weight affected to each criterion. Combined with a GIS tool such as QGIS, a geographical view of the suitable regions is produced. A more refined search could then be performed on the filtered regions.

The process is then followed by a micro selection of potential sites inside the macro selected regions. This is achieved through a solution of multiobjective problem representation of the optimal placement problem. A Pareto solution set is then generated from which decision makers can choose suitable sites and perform further infield analysis.