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Geospatial intelligence (GeoINT) risk maps producing with geographic information systems (GIS) and creation of the 2D simulation model

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ABSTRACT

In today's world, many complex and hybrid warfare models are applied. Operational action plans play an active role in the implementation of these models. These plans use intelligence and spatial data as a base. At this point, we come across the concept of spatial intelligence, which brings together space and intelligence. Spatial intelligence; it is the analysis of data related to location, space and geography by bringing together data. In this study, the concept of intelligence and geospatial intelligence will be explained in detail. Afterwards, risk studies from the literature will be included. Finally, the modeling of risk in GIS environment and the production of risk maps will be discussed from a geospatial intelligence perspective. By transferring the steps of a model application with the aim of contributing to the literature of the study. The geospatial intelligence of the risk will be revealed with a 2 dimension three simulation model.

1. Introduction

Intelligence has been used effectively with different meanings by many civilizations from past to present. As an agent, in 5000 B.C. (BC), Egyptian King Tutmosis the 3rd determined his strategies in order to take the city of Jaffa; according to the intelligence reports of the agents he had previously sent to the country; he made his war plans. Thus, he captured the city of Jaffa with less cost (Acar, 2011; Odemis, 2014).

Today, fully institutionalized intelligence agencies have reached the national level institutional structure.

For domestic intelligence in the USA; Federal Bureau of Investigation (FBI), Central Intelligence Agency (CIA) for foreign intelligence, National Intelligence Organization (MIT) in our country, Federal Intelligence Service (BND) in Germany, Foreign Intelligence and Special Operations (MOSSAD) in Israel, Iran The Intelligence of the Islamic Republic of Iran (VAJA) is institutionalized with 7 different intelligence agencies in the British Kingdom (IA,2020).

The task of these intelligence agencies, which have been established in many countries and have survived to the present day, is to provide data flow to decision makers about current or potential risks, threats and opportunities. (Kucukbas, 2015).

The answer to the question of what is intelligence, in many languages; we see that it means different things. In English, 'intelligence', intelligence, mind, knowledge, 'reseignement' in French, (information), 'razvedka' in Russian, 'nachricten' in German, in Turkish intelligence is derived from the word news in Arabic (Ozkan, 2003; Oztoprak, 2011).

Intelligence, by definition, is a product information produced as a result of processing (extracting, interpreting) news (raw data) (Ilter, 2002, Oztoprak, 2011).

According to another definition, it is the whole of the data obtained from any open, semi-open or confidential source that can be accessed. These data are collected for the purpose of preventing damage to national or private policies. It is the information obtained as a result of classification, comparison, analysis and evaluation process according to importance and accuracy. (Ozdag, 2009).

Although the types of intelligence gathering are expressed in different ways, they are classified according to its purpose, level and method (Gundogar, 2007; Oztoprak, 2011).

In spatial/spatial intelligence with the recently developing spatial technologies; took its place in technical intelligence. With this intelligence method, it is

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important that satellite images and data from the field can be evaluated together.

Spatial intelligence is called Geospatial Intelligence (GeoINT) in English.

Geospatial intelligence is a discipline that contains three basic elements as shown in Figure 1. These are imagery, imagery intelligence and geospatial information.

The image includes any natural or man-made object; it is the recording of the existing range in the electromagnetic spectrum from satellite, aircraft or unmanned aerial platforms with remote sensing technologies.

Imagery intelligence is an auxiliary material that allows interpretations and analyses of geographic area with the help of images.

Geospatial information, on the other hand, is information that describes the spatial information and characteristics of a natural geographical area. This information is remote sensing, geodetic data and mapping products (GeoINT Basic Doctirine, 2006).

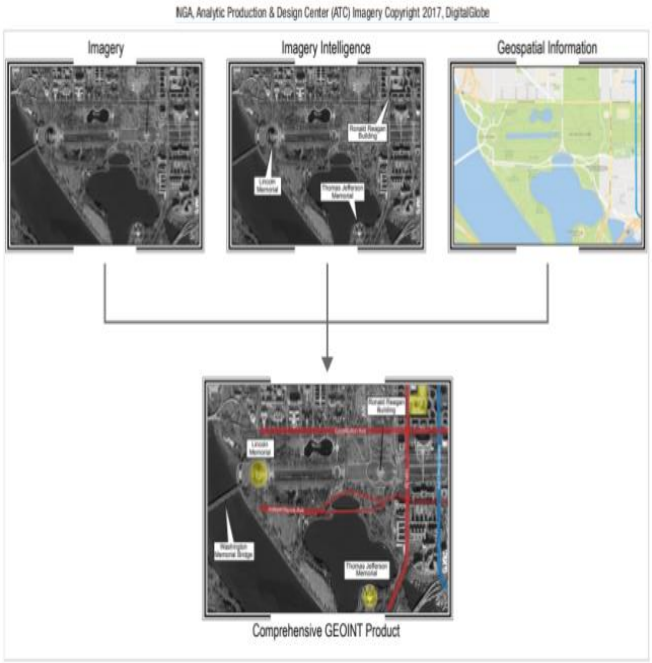

Figure 1. Geospatial Intelligence and the Three Elements (GeoINT Basic Doctirine, 2018)

When we look at the features of geospatial intelligence, geographic data set collection is performed using many different advanced sensors, shown in Figure 2. It brings together map data from many different sources. By providing three-dimensional (3D) and 4-dimensional (4D) thinking ability, it provides an intelligence opportunity that is used to determine the time and course of action in a dynamic and interactive way. (GeoINT Basic Doctirine, 2006).

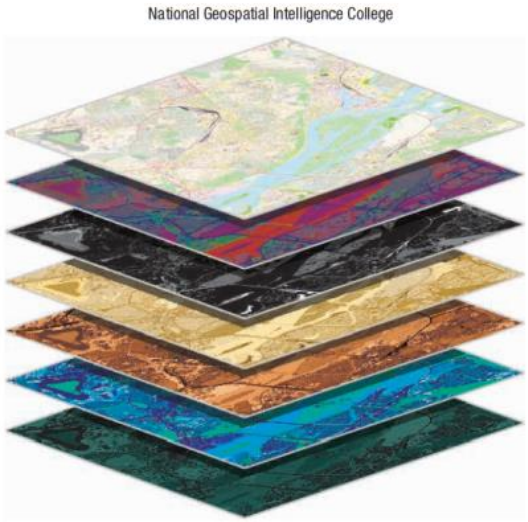

Figure 2. Geographic Datasets (GeoINT, 2018)

Geographical information systems (GIS) is one of the most effective tools that spatial intelligence uses in data analysis and interpretation, with its ability to combine many data sets, three-dimensional analysis and map production. GIS is an information system that provides results and outputs with the collection, storage, query and analysis possibilities of the data obtained through the observation of geographical information (Yomralioglu & Doner, 2000).

In the GIS environment, it is possible to bring together spatial data of different types and formats, to query and analyse separately or in an integrated way. With these capabilities, GIS acts as a decision-support system (Sarı ve Turk, 2020). The spatial analysis opportunity of GIS provides the opportunity to come up with stronger and sustainable solutions to problems by analysing spatial data under certain values and conditions (Onyıl & Yılmaz, 2020).

Among the wide usage areas of GIS, there are many areas such as earthquake, urban planning, urban transformation, production of epidemiological maps. (Erdogan, 2010; Yalcin & Sabah, 2017; Ledoux et al., 2021; Biljecki et al., 2021). In this context, GIS has become a must for hazard and risk analysis studies with its strong analysis capabilities. And it has been used in many risk and hazard analysis studies. (Udono & Sah, 2002; Fell et al., 2008; Yalcin & Sabah, 2018; Hepdeniz & Soyaslan, 2018; Sarı & Turk, 2020).

There are many GIS-based hazard and risk analysis studies in the literature. In the study carried out by Karakas et al. (2004), crime maps were produced with GIS. Within the scope of the study, it was stated that dangers and risks would be prevented by producing maps of time and places that pose risks, which were analyzed depending on different variables.

Yalcin &Sabah (2017)'s within the scope of the studies of industrial organizations in Edirne province and its districts that analyse the earthquake risk, earthquake risk analysis was carried out with the Analytical Hierarchy Process (AHP) method in the open source GIS software (QGIS) environment. As data sets; Active fault lines, geological formation status, earthquake epicentre points between 1908-2016 and locations of industrial establishments were used. As a

result of the analysis, dangerous districts and industrial establishments were determined. Thematic maps were produced. As a result, it was stated that the earthquake hazard value of 59 industrial establishments in Enez and Keşan districts is high.

Aydar (2020)' s It is a study that includes the three-dimensional modeling of risky areas in hunting areas, in wildlife ecology, in a GIS environment. In the study, a survey was conducted by spatially correlating the wildlife data in Çanakkale province, Kalkım town pilot region. Obtained survey data were modelled via GIS with three-dimensional terrain model and satellite images; The maps were produced and the follow-up was given to the hunters and the personnel of the Provincial Directorate of National Parks to obtain information about the risky areas.

2. Method

In this study, within the scope of literature and developing technologies, against the risks and threats that may come in the operation area, for military base areas; It is aimed to provide a foresight for the future.

The study includes the operation area; modeling in the GIS environment and predicting the risks that may come, so that; to contribute to the preparation of complex action plans and the development of measures against the risks that may exist. In this study, an exemplary model was established for this purpose.

Afterwards, able to predict the data, the mode of operation of the enemy element and the risks, risks were revealed by producing risk maps in the GIS environment. Thus, whether there is a significant relationship between the behaviours of people and war elements and risk black points were tested on the sample model.

At this stage, the model consists of the steps of establishing the military base area and production of risk maps in the GIS environment. The flow diagram shown in Figure 3 has been designed for the process steps to be performed during the implementation phase.

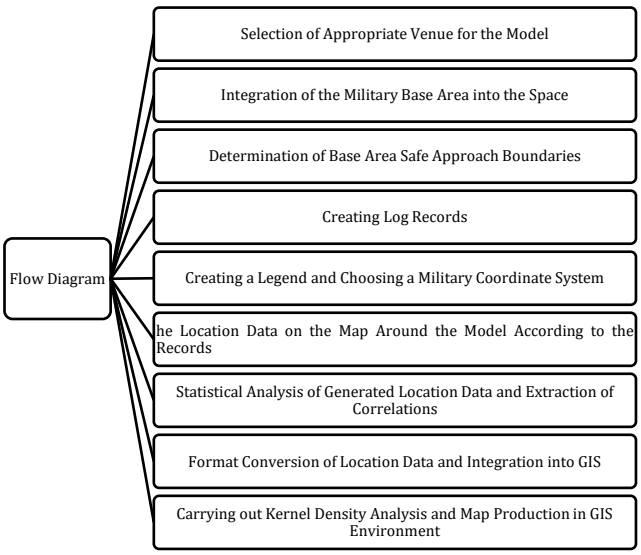

Figure 3. Flow Diagram

According to the flow chart, firstly, a suitable location was selected for the model military base area in Figure 4, then a 3D base area model was designed and the base area was placed in its position on the map for data generation, then; Ceride records of safe approach boundaries and daily living space mobility were produced by the author.

Figure 4. Selected for a military model and 3D base area

Then, a legend group was created according to the data records, and the data were processed around the model with the military coordinate system, according to the data records in Figure 5.

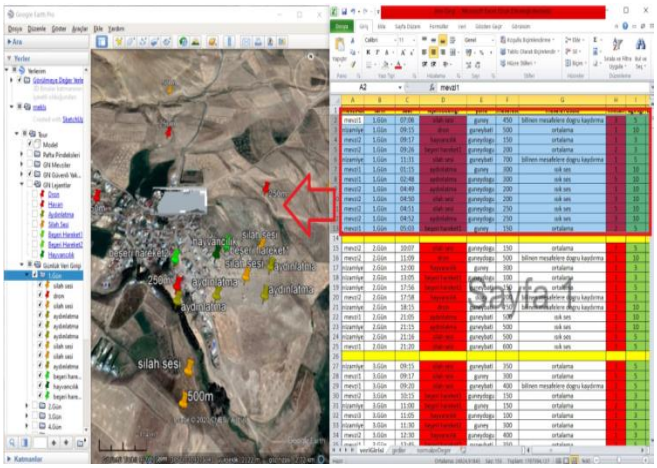

Figure 5. Data processed with Military Coordinate System

Finally, the transfer of the data to the GIS environment (ArcGIS Desktop) and the production of 72 risk analysis as shown in Figure 6.

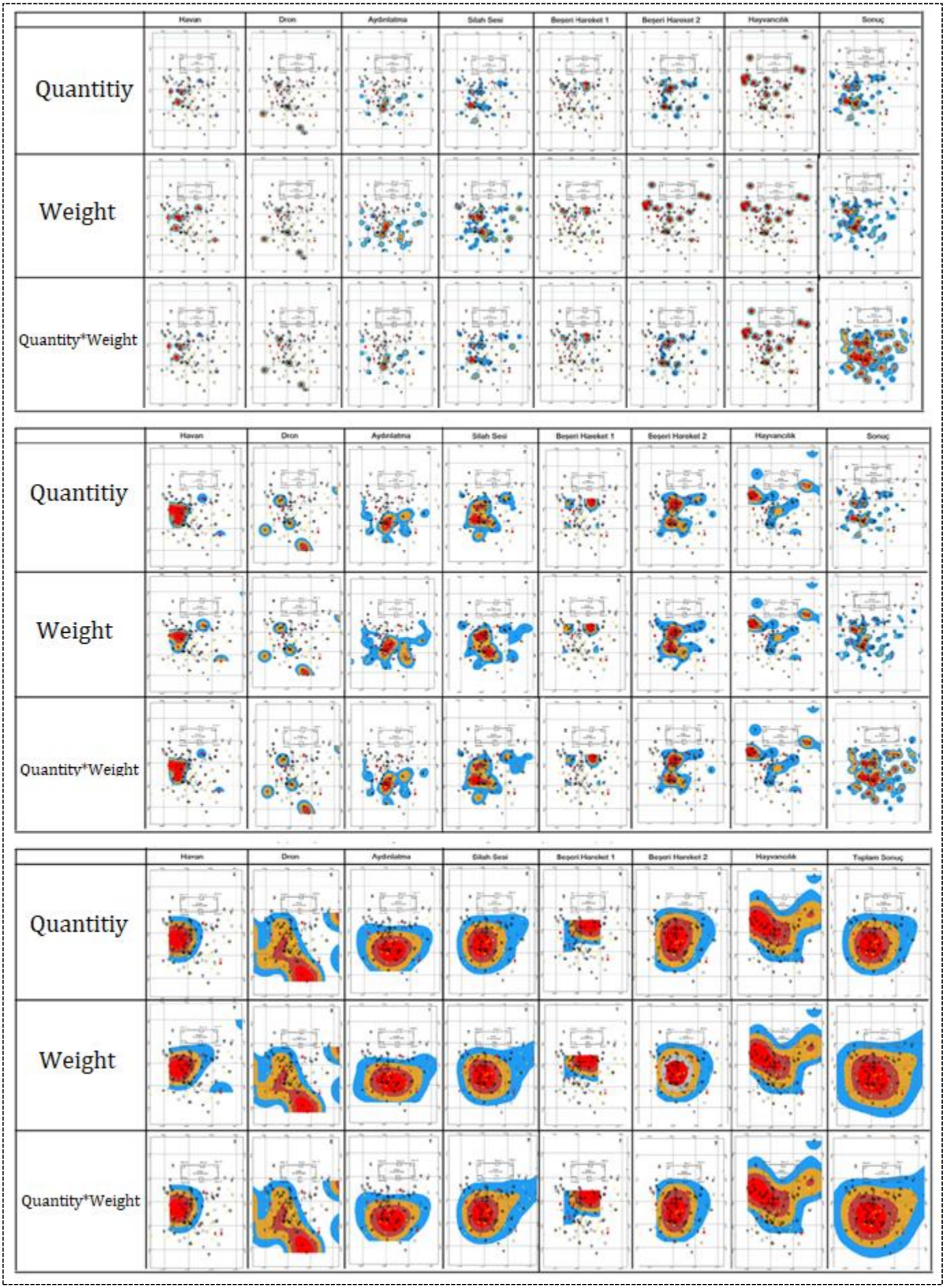

Figure 6. Risk analysis

3. Results

With the operation steps carried out within the scope of the study, a risk analysis was carried out with GIS in terms of spatial intelligence of the model military base region. The following findings were obtained with the process steps.

- It has been observed that the implementation phase, which starts with data acquisition, is practical in terms of modeling the reality.
- It has been found that the statistical analysis of the data is important for the analytical evaluation process of intelligence and will form the basis for the spatial analyses to be carried out in the process in Figure 7.

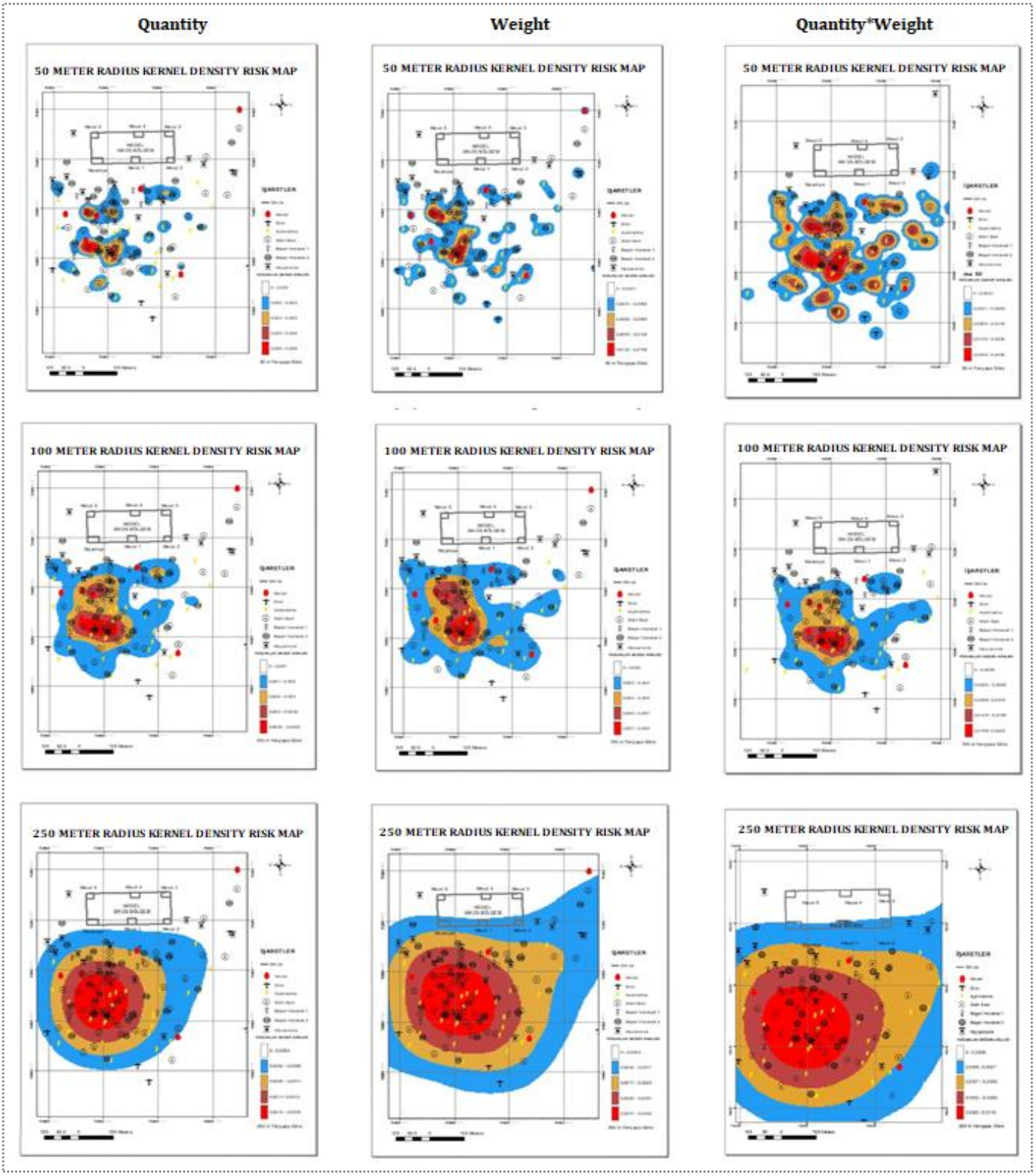

Figure 7. Risk analysis to risk maps

- The predictive modeling capability of the GIS for the future has been shown to be at a good level by testing the model on the military base area.
- It has been seen that the production of visual models of data through maps by using GIS can be used as an effective intelligence report source and will provide decision support for complex operation plans.
- In risk maps produced 2D simulation model with GIF simulation method. 2D simulation model to in Figure 8.

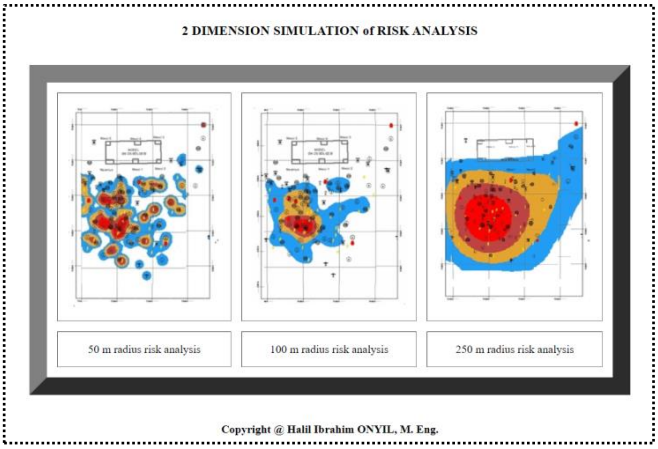

Figure 8. Creation of the 2D simulation model

Internet web site address of 2D simulation model: http://onyilharitamuhendislik.com/index6.html

4. Discussion

The success of this study is possible if the personnel in the military base area have been given intelligence and counter-intelligence (IKK) training, complete map information training, and speed, accuracy and analysis are carried out on time and delivered to the relevant units and institutions. In addition, a good temporal resolution can be gained with the 2.5 m resolution Gokturk-2 Satellite Images as a base satellite image for the studies.

In the coming years, time can be saved by transferring the data directly from the personnel in the position to the military operations center and from there to the joint operations centers with encrypted and user-friendly, easy, useful mobile software applications.

Finally, the analysis of the data and the production of the maps can be accelerated by developing a desktop and mobile application that will query and analyse the incoming data with user interfaces.

5. Conclusion

Within the scope of the study, a model military base area was established, enemy element data was produced considering the operation area and statistical analyses were carried out. Spatial data representation and estimation success of the operation area have been demonstrated.

Finally, a situation map was produced to show the current state of spatial data via GIS. Then, 72 different Kernel Density analyses were carried out according to the 7 legend values of the data, the determined weight values, the recorded amount values and the multiplication of the amount and weight values.

Thus, the risky areas around the military base areas located in the dangerous area within the operation area were presented as a visual product with maps.

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Author Contributions

The study was carried out by a single author.

Statement of Conflicts of Interest

The author declares no conflicts of interest.

Statement of Research and Publication Ethics

Research and publication ethics were complied with in the study.

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