جامعة نجران
NAJRAN UNIVERSITY
كلية الهندسة

GIS day

فعالية يوم نظم المعلومات الجغرافية

الأربعاء 15-11-2023م

قسم الهندسة المدنية | نوفمبر 2023

نبذة

برعاية سعادة رئيس جامعة نجران

دشن سعادة د.بندر الشهري وكيل الجامعة للشؤون التعليمية فعالية اليوم العالمي لنظم المعلومات الجغرافية (GIS day) بكلية الهندسة ,حيث نظم الفعالية قسم الهندسة المدنية , وتضمنت الفعالية ندوة علمية لعدد من الخبراء وكذلك مسابقة طلابية بمشاركة طلاب وطالبات من كلية الهندسة وكلية علوم الحاسب ونظم المعلومات ,ومشاركة عدد من الجهات من القطاعين العام والخاص في المعرض المصاحب.

كلمة عميد كلية الهندسة

د.صالح بن سالم المصعبي

الحمد لله رب العالمين والصلاة والسلام على أشرف الأنبياء والمرسلين

حيث تحرص كلية الهندسة بجامعة نجران على المساهمة بشكل نوعي في اثراء المعرفة وخدمة المجتمع ولما تحصل عليه الكلية من دعم لا محدود من قبل سعادة رئيس الجامعة ا.د. عبدالرحمن بن إبراهيم الخضيري قامت كلية الهندسة ممثلة في قسم الهندسة المدنية بالاحتفاء باليوم العالمي لنظم المعلومات الجغرافية الـ GIS Day حيث تم تنظيم ندوة تضم مجموعة من الخبراء والباحثين في هذا المجال ونوقش فيها التحديات والتطورات في مجال GIS والاستفادة منها في المشاريع الهندسية, وكذلك تم عمل معرض مصحاب بمشاركة ٢٠ جهة حكومية وخاصة مما أسهم في اثراء هذه الفعالية وإيجاد فرص للتكامل والتعاون بين مختلف هذه الجهات.

وختاما أتقدم بجزيل الشكر والعرفان لسعادة رئيس الجامعة على دعمه الدائم للكلية وبرامجها, وللجهات المشاركة, وكذلك لقسم الهندسة المدنية على إنجاح الفعالية

كلمة رئيس قسم الهندسة المدنية

د.علي بن حسين الهمامي

الحمد لله الذي بنعمته تتم الصالحات، والصلاة والسلام على أشرف الأنبياء والمرسلين، نبينا محمد وعلى آله وصحبه أجمعين، أما بعد:

ضمن الاهتمام الذي توليه كلية الهندسة بالمساهمة في الفعاليات العالمية والأحداث العلمية التي تسهم في رفع مستوى البحث العلمي والابتكار في مجالات الهندسة المختلفة. وسعي جامعة نجران الى أن تكون رائدة في استخدام التقنيات المتقدمة لخدمة المجتمع وتحقيق رؤية المملكة 2030.

فبرعاية كريمة من سعادة رئيس الجامعة سعادة الأستاذ الدكتور عبد الرحمن بن إبراهيم الخضيري نظمت كلية الهندسة ممثلة في قسم الهندسة المدنية فعالية اليوم العالمي لنظم المعلومات الجغرافيةGIS DAY الذي وافق يوم الأربعاء 15 نوفمبر 2023, والذي سلط الضوء على أهمية وفوائد وتطبيقات نظم المعلومات الجغرافية في مجالات الحياة المختلفة.

ودشن الفعالية سعادة وكيل الجامعة للشؤون التعليمية والتي تضمنت ندوة شارك فيها نخبة من الخبراء, تم النقاش فيها حول التحديات والتطورات في مجال GIS والاستفادة منها في المشاريع الهندسية. كذلك تم عمل مسابقة طلابية شارك فيها عدد كبير من طلاب وطالبات كلية الهندسة وكلية علوم الحاسب ونظم المعلومات. وكذلك صاحب الفعالية معرض تضمن عروض توضيحية للمشاريع الهندسية التي تستخدم تطبيقات GIS بمشاركة عدد من الجهات من القطاعين العام والخاص وكذلك كان هناك ركن للملصقات العلمية عن نظم المعلومات الجغرافية والمقدمة من عدد من أعضاء من هيئة التدريس بكلية الهندسة وكلية علوم الحاسب ونظم المعلومات, وكذلك تم عرض الخرائط المقدمة من الطلاب والطالبات في المعرض. ولقيت الفعالية إقبال كبير من الطلاب والطالبات وأعضاء هيئة التدريس والمهندسين في القطاعات المختلفة.

أخيرا أود أن أتقدم بالشكر الجزيل لسعادة رئيس الجامعة لدعمه اللامحدود ولعميد كلية الهندسة وكذلك لفريق العمل المتميز لتنظيم هذه الفعالية من قسم الهندسة المدنية.

قسم الهندسة المدنية | نوفمبر 2023

الجهات المشاركة

هيئة الهلال الأحمر السعودي
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الهيئة العامة لعقارات الدولة
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الجدول الزمني للفعالية

ندوة| المسرح الرئيسي

التدشين	09.40 - 09.30
كلمة رئيس قسم الهندسة المدنية	10.00 - 09.40
تكريم الفائزين في المسابقة والجهات المشاركة	10.25 - 10.00
عروض تقديمية من قبل مختصين	11.30 - 10.25

المسابقة| البهو

عرض أعمال المتسابقين الفائزين	12.00 - 11.30

المعرض| البهو

المعرض	2.00 - 12.00

جانب من حضور الندوة وتكريم المشاركين

جانب من المعرض المصاحب

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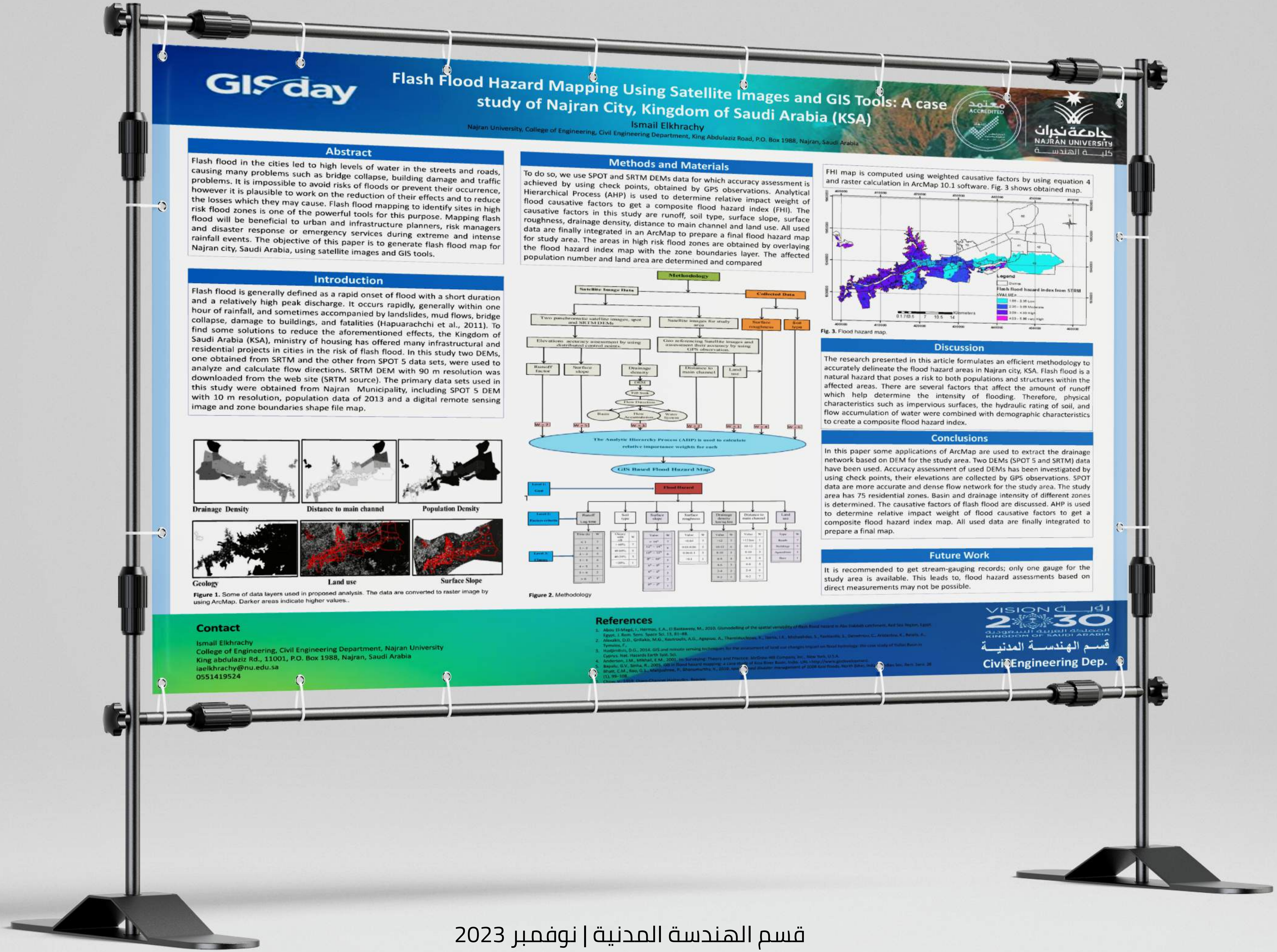
جانب من ركن الملصقات العلمية


GIS day
Flash Flood Hazard Mapping Using Satellite Images and GIS Tools: A case study of Najran City, Kingdom of Saudi Arabia (KSA)
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معتمد ACCREDITED
جامعة نجران NAJRAN UNIVERSITY كلية الهندسة
Abstract
Flash flood in the cities led to high levels of water in the streets and roads, causing many problems such as bridge collapse, building damage and traffic problems. It is impossible to avoid risks of floods or prevent their occurrence, however it is plausible to work on the reduction of their effects and to reduce the losses which they may cause. Flash flood mapping to identify sites in high risk flood zones is one of the powerful tools for this purpose. Mapping flash flood will be beneficial to urban and infrastructure planners, risk managers and disaster response or emergency services during extreme and intense rainfall events. The objective of this paper is to generate flash flood map for Najran city, Saudi Arabia, using satellite images and GIS tools.
Introduction
Flash flood is generally defined as a rapid onset of flood with a short duration and a relatively high peak discharge. It occurs rapidly, generally within one hour of rainfall, and sometimes accompanied by landslides, mud flows, bridge collapse, damage to buildings, and fatalities (Hapuarachchi et al., 2011). To find some solutions to reduce the aforementioned effects, the Kingdom of Saudi Arabia (KSA), ministry of housing has offered many infrastructural and residential projects in cities in the risk of flash flood. In this study two DEMs, one obtained from SRTM and the other from SPOT 5 data sets, were used to analyze and calculate flow directions. SRTM DEM with 90 m resolution was downloaded from the web site (SRTM source). The primary data sets used in this study were obtained from Najran Municipality, including SPOT 5 DEM with 10 m resolution, population data of 2013 and a digital remote sensing image and zone boundaries shape file map.
Drainage Density
Distance to main channel
Population Density
Geology
Land use
Surface Slope
Figure 1. Some of data layers used in proposed analysis. The data are converted to raster image by using ArcMap. Darker areas indicate higher values.
Methods and Materials
To do so, we use SPOT and SRTM DEMs data for which accuracy assessment is achieved by using check points, obtained by GPS observations. Analytical Hierarchical Process (AHP) is used to determine relative impact weight of flood causative factors to get a composite flood hazard index (FHI). The causative factors in this study are runoff, soil type, surface slope, surface roughness, drainage density, distance to main channel and land use. All used data are finally integrated in an ArcMap to prepare a final flood hazard map for study area. The areas in high risk flood zones are obtained by overlaying the flood hazard index map with the zone boundaries layer. The affected population number and land area are determined and compared
Methodology
Satellite Image Data
Collected Data
GIS Based Flood Hazard Map
Flood Hazard
Figure 2. Methodology
FHI map is computed using weighted causative factors by using equation 4 and raster calculation in ArcMap 10.1 software. Fig. 3 shows obtained map.
Fig. 3. Flood hazard map.
Discussion
The research presented in this article formulates an efficient methodology to accurately delineate the flood hazard areas in Najran city, KSA. Flash flood is a natural hazard that poses a risk to both populations and structures within the affected areas. There are several factors that affect the amount of runoff which help determine the intensity of flooding. Therefore, physical characteristics such as impervious surfaces, the hydraulic rating of soil, and flow accumulation of water were combined with demographic characteristics to create a composite flood hazard index.
Conclusions
In this paper some applications of ArcMap are used to extract the drainage network based on DEM for the study area. Two DEMs (SPOT 5 and SRTM) data have been used. Accuracy assessment of used DEMs has been investigated by using check points, their elevations are collected by GPS observations. SPOT data are more accurate and dense flow network for the study area. The study area has 75 residential zones. Basin and drainage intensity of different zones is determined. The causative factors of flash flood are discussed. AHP is used to determine relative impact weight of flood causative factors to get a composite flood hazard index map. All used data are finally integrated to prepare a final map.
Future Work
It is recommended to get stream-gauging records; only one gauge for the study area is available. This leads to, flood hazard assessments based on direct measurements may not be possible.
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GIS day

Environmental Analysis of Land Use and Land Change of Najran City: GIS and Remote Sensing

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Abstract

This study critically analyzes changes in land use and land cover by means of multi-temporal remote sensing of Najran City in Saudi Arabia between 1975 and 2019. A number of remotely sensed data were employed to create multi-maps using: (a)the normalized difference vegetation index; (b) head-up digitizing; and (c) supervised classification of Landsat images using field observation and accuracy assessment, including field verification and Google Earth Professional. Therefore, land around Najran can be characterized as follows: (1) Najran valley; (2) agricultural land; (3) built-up areas; (4) reclaimed land; (5) basement rock; and (6) desert.

Introduction

Agriculture land and built-up areas cover the majority of Najran valley. The agricultural lands are located along the mainstream of Najran valley, in the center of the study area, which is primarily dedicated to the growing of wheat and maize, in addition to palm and acidic fruit crops. Until the end of the previous decade, this agricultural area saw continuous expansion, but this declined from 2010 to the present day. Najran is divided into two main areas. West Najran extends from west to east and has many residential neighborhoods and agricultural land, being surrounded by mountains in the north and south, while East Najran is mostly made up of empty desert.

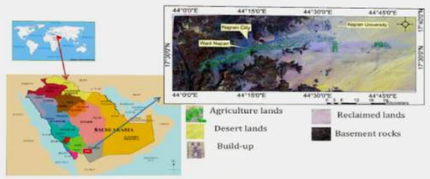

Fig. 1 Location of the study area, (year 2018)

Methods and Materials

Several methods were applied in this study to exactly detect the land use, land cover changes; including the followings:

(a) Supervised classification,
(b) Head-up digitizing, the normalized difference vegetation index (NDVI),
(c) Normalized difference built-up index (NDBI),
(d) Normalized difference bareness index (NDBaI) and
(e) Urban index (UI).

Results

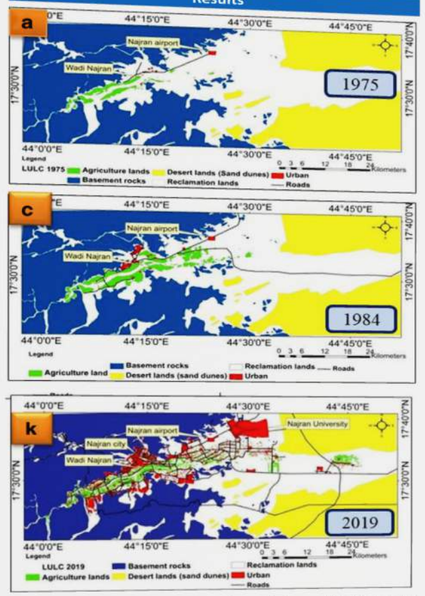

Fig. 3. Heads-up digitization of land use land cover maps from satellite images and Google Earth pro. From 1975 to 2019

Results

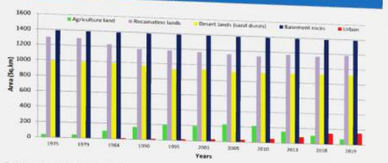

Fig. 5 Statistics of heads-up-digitization land cover areas for Najran area based on Landsat images from 1975 to 2019

Discussion

The agricultural land grew from an average of 39.81 km2 (1.07%) in 1975 to 218.51 km2 (5.9%) in 2005, although this was followed by a marked decline between 2005 and 2019. Urban land increased from 1.12 km2 (0.031%) in 1975 to 154.35 km2 (4.13%) in 2019. Furthermore, there was approximately 1289.47 km2 of reclaimed land in 1975 (i.e., 34.64% of the total area study area) but approximately 1151.1 km2 (30.86%) in 2019. There was a small amount of desert (i.e., sand dunes) in the study area, and no change was recorded in the basement rock. This study analyzed these land changes, likening them to BREEAM criteria of ecology and land use. A number of unsustainable practices were potentially resulting in serious land contamination and pollution of both surface and ground water, as well as an increased risk of flooding.

Conclusions

This study has therefore concluded that if these practices are permitted to continue in Najran without the implementation of protective action or sustainable measurement, it is likely that pollution will continue to degrade the environment, thus causing many serious health problems for the local population.

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Using Remote Sensing and GIS Techniques in Monitoring and Mitigation of Geohazards in Najran Region, Saudi Arabia

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Abstract

Many sources of data (Remote sensing and meteorological data, soils and groundwater samples) were used to estimate the magnitude of geological hazards, which are confirmed with field and laboratory investigation in Najran area, Kingdom Saudi Arabia. Najran area is one of these locations. It is subjected to a range of geo-hazards due to its intrinsic physiographic and geologic nature. Najran area is a growing urban and agricultural development region; however, some infrastructures have been constructed in vulnerable locations to geo-environmental hazards. The potential geo-hazards that may occur under desert conditions include sand accumulations, dune movement, mass westing and rock fall hazards, flash floods, sand stroom and problematic soils. The current study throws more light on all these geo-hazards in Najran area. Also, remediation hazard degree. Our findings indicate that Najran area needs more attention and care. The Saudi Government has to join together with other people to reduce the resulting geological hazards.

Introduction

Najran region is one of the most important areas in the Kingdom of Saudi Arabia (KSA) in terms of renewable water resources due to rainfall-runoff recharge events. Because of the rapid growth in population, and usage of existing facilities, nowadays the government of KSA is resorting to the construction of infrastructure such as roads, urban and agricultural lands into places close to the hazard regions. The impact of the disaster directs proportionally with the susceptibility of the land and increases since it was based on the vulnerability of the society (Verstappen 1995).
The satellite imageries and DEMs data have been processed and managed to detect the impact of geological hazard in arid and semi-arid areas (Robinnove et al. 1981; Jensen and Toll 1982; Fung 1990; Pathirana 1999; Wyatt 2000)..
Any area has high steep slope and subject to high-intensity rainy storms probably it will be liable to flash flood risk. The time and the places of occurrence nature hazards are unknown. So, the protection of people and infrastructure is absolute unachievable and unsustainable. National and international agencies should take into account all measures required to reduce, avoid and prevent these geological hazards that obstruct the development train in the countries

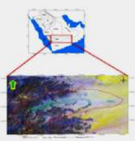

Fig. (1): Distribution of geological hazards in Najran area.

Fig. (2): Rock falls in central part of Najran, b, in highway between Najran-Abah road; and c and d slope failure in Najran Habona road.

Methods and Materials

The integration of available remote sensing, ASTER DEMs, meteorological data, soil and groundwater samples and geological maps were used to achievement the principal target in this study (Fig. 4). These data include the followings:
3.1 Computer programs:
The available remote sensing data and ASTER DEM were processed and analyzed using a number of specialized computer software, named; Erdas Imagine (2014), Envi 5.2, Arc-GIS 10.2.2 and Google Earth Pro.
3.2 Geologic maps:

Fig. 3. The general process of SIM is illustrated.

Results

Because of its physiographic and geologic nature, it is vulnerable to a variety of geo-hazards. Although the Najran area is a rapidly developing urban and agricultural sector, some infrastructure has been built in geo-environmental hazards-prone areas.

1-Flood hazard
As a result, drainage basins can be divided as Extremely hazardous: hazard degree (5), Highly hazardous: hazard degree (4), Moderately hazardous: hazard degree (3), Slightly hazardous: hazard degree (2), and Weakly hazardous: hazard degree (1), according to the estimated degree of risks (1).
Table 1 shows the values of actual danger degrees for each morphometric parameter of the analyzed basin (5). These scales are used to construct the hazard map. It was utilized to divide the sub-basins under study into three categories: very hazardous, moderately hazardous, and mildly hazardous.
2. Rock falls hazards
The shaky blocks pose a threat to the traveling public, transportation infrastructure, local businesses, and the environment. From time to time, road and highway cuttings fail. Large rock blocks or even larger assemblages of rock can crash down on the road surface below, such as the Najran-Abha road, due to high groundwater pressures (after heavy rains). The failed material is frequently contained in the ditch. The material occasionally spills out onto the road, causing damage to the road surface or automobiles passing over it, as well as injury and death to vehicle occupants.

3. Sand and Dust Storms hazards
Dust storms have a negative influence on human existence since they are a major source of airborne infections and cause nuisance, as well as causing delays in road and air traffic and causing damage to communication equipment (El-Osta et al. 2013). The size of dust particles varies significantly; the smaller the particle, the greater the distance it is taken away and the longer it remains suspended in the troposphere (up to a week). Other minerals found in the dust include feldspar, calcite, dolomite, micas, clay minerals, gypsum, halite, opal, amorphous inorganic and organic material, and amorphous inorganic and organic material (Pye 1987). The dust is everywhere

Discussion

Najran area is considered one of the most important promising areas for various types of sustainable development (urban and industrial expansions, as well as Agriculture growth) at the present and in the future in KSA, but the natural hazards are attack and impede these sustainable development, especially sand dune movement, rock falls, problem soils, earth fissures, dust storms and flash floods.
Many factors contribute to the appearance of these problems including climatic, geologic and geomorphic conditions, and human activities. The geologic setting is usually the controlling factor influencing the type of hazards that will be found. The potential geohazards that may occur in the Wadi Najran and surrounding areas under desert conditions may include sand draft and dune movement, earth fissures, rockfall and slope stability hazards, water quality, dust storms, problematic soils and flash floods.
Wadi Najran roads represent a vital important lifeline to all people in the city, main road run from east to west in the middle area. Also the Najran basin represents the main drainage basin, in which the Wadi Najran discharges its water to the low laying area at the east, where it quickly filled with flood water, trapping unsuspecting motorists, and caused severe damage to the economy, urban areas, infrastructural facilities, and roads. This road and some cities and villages have been subjected to flash floods once or twice annually, especially in the spring and autumn.

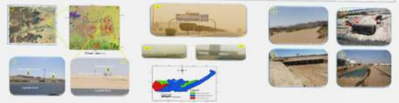

Fig. (4): a and b- Sand accumulations to the east of Wadi Najran, c- the destructive effect of sand dunes along asphalt roads in the studied area towards main building of Najran University, d- Najran water station.

Conclusions

Today, flood protection is essential. It complements other preventive tools like the effective planning of the growth of cities by creating a computerized GIS database for the flood-prone areas. Construction of successive incomplete rocky dams using the available locale materials at least along the elongated main course of large wadis as drainage sub-basins No. B1, No. B3 and No. B6 to decrease the velocity of flood waters and increase their percolation into the wadi bed.

Future Work

Our findings indicate that Najran area needs much concern and care. Governments have to join together with other people to reduce the resulting geological hazards.

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Spatial distribution of public elementary schools: a case study of Najran, Saudi Arabia

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Abstract

- Spatial equity in the provision of educational services is a major component to provide a healthy and cheerful living environment in cities.
- Experts set many standards for selecting school locations.
- This study has used many of those standards to investigate the spatial distribution of boys' public elementary schools in Najran city.
- Statistical techniques such as Locational Quotient, Lorenz Curve, and Geographic Information System (GIS) tools were employed to show the spatial distribution and analysis of elementary schools.
- The results indicate that some districts are experiencing a glut and concentration of schools, especially in old, fully developed, and highly populated districts, while most of the new eastern districts suffer a lack and have no adequate access to schools.
- Furthermore, many schools are located close to sources of danger or nuisance sources.
- The study concluded by showing suitable locations for future schools.

Method

- This study utilizes the quantitative methods related to the statistical and spatial analytical approach.
- The Location Quotient (LQ) is used to show the inequity of elementary schools in the districts, and it can be computed by using an equation.
- The Lorenz Curve is used to measure the equality distribution through a diagonal line where the greater the deviations of the Lorenz Curve means the greater the inequality.
- Ratios and percentages are used to explain the relationships between some variables.
- GIS technology is used to show the schools' numbers, locations, and density per district and population in the maps provided by Najran Municipality. Then, some important spatial tools available in GIS are used to measure the spatial geographic distributions (e.g., concentration, dispersion, and directions).
- This is followed by using GIS proximity tools (e.g., buffer zone, point distance, and Thiessen polygons) and the spatial interpolation (raster form).
- Finally, some GIS techniques are used to examine the suitability of current school locations and suggest proper future elementary school locations.

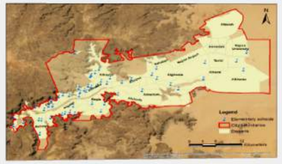

Figure 1: Elementary schools in Najran city

Experiments and Results

Figure 2: Buffer zone of elementary schools

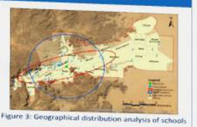

Figure 3: Geographical distribution analysis of schools

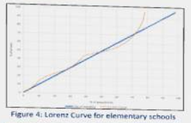

Figure 4: Lorenz Curve for elementary schools

Figure 5: schools in proximity to gas cylinder distributors

Figure 6: Schools next to main roads and highways

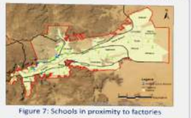

Figure 7: Schools in proximity to factories

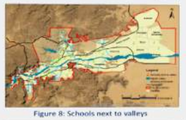

Figure 8: Schools next to valleys

Figure 9: Hotspot analysis

Suitability grade	Location suitability	Schools numbers	%
0	Very suitable	0	0
1-6	Suitable	0	0
7-12	Good	14	26.3
13-18	Fair	28	53
19-25	Not suitable	11	20.7
Total		53	100

Table 1: Location suitability of current schools

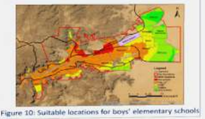

Figure 10: Suitable locations for boys' elementary schools

Discussion and Conclusion

- In Najran city, there is a positive correlation between school numbers and population density.
- Elementary schools follow a clustered distribution pattern in that they are concentrated in old and fully developed districts that are mainly located in proximity to the city center.
- Students in half of the city districts took a long time to reach their schools since their districts are not covered by elementary schools.
- Regarding the distances between boys' elementary schools and impactful land uses, many schools are located in proximity to undesirable land uses.
- Investigating the suitability of elementary schools' current locations shows that no school is found in a very suitable location, while around 53% of schools are located in fair locations that follow a few of the standards, and 21% of the schools did not follow almost all of the school site selection standards.
- Thus, local educations agencies and planners must evaluate current school locations to find whether they constitute an actual or potential endangerment of school users' health and safety, or corrective measures should be taken that will result in danger and noise mitigation to levels that will not constitute endangerment.
- It is recommended that they build barriers (e.g., berms or walls) between schools and highways to reduce air pollution and noise levels and to protect students.
- It is suggested that educational agencies need to clearly define and update the current standards, combine all of them under one major guideline, and take advantage of international professional standards for selecting elementary schools' locations.
- Then, they should establish new schools to fill the deficit in fully developed and far-located districts, especially as the population is increasing sharply during this period.
- Future research can use the updated standards to investigate the current spatial distribution of schools and the demand for new schools in the future. Also, future research can add additional factors when investigating current schools' locations or suggesting locations for future schools.
- Finally, future research can compare the spatial distribution of boys' and girls' schools, when the data becomes available.

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Predicted Spread of Vehicle Crashes Using Story Map in ArcGIS

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Abstract

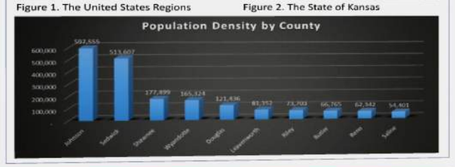
Motor vehicles are the primary source of transportation in the United States. While this is true for any age group, the population tend to rely more heavily on automobiles because of easy access and availability, compared to public transportation even when it is available. One location where driver experience higher crash risk is intersection, due to the complexity of the situation involving multiple tasks and movements. The objectives of this study were to determine risky locations associated with intersection-related crashes in the State of Kansas, USA and to provide countermeasure ideas to improve safety. Vehicle crash data from Kansas department of transportation database were utilized, and story map in ArcGIS was carried out to identify risky locations of vehicle crashes. Therefore, the results and suggested countermeasures can provide guidance to improve safety of road users.

Background

Investigation the number of crashes occurred in the state of Kansas in 2018. The area of study is identifying crashes and what is the reason behind multiple crashes in one specific location. Starting by manipulate with the data that was obtained from the Kansas Department of Transportation. The data was focused only for one year which is 2018 crash data. The total number of data was reached around 52,000 records for the whole the state of Kansas. Fivteen tables (layers) were created for the size of data purposes to upload into ArcGIS online. The data were shown according to number of traffic unit involved in crashes. Explanation of the colors in the map define the number of traffic unit involved over one location as red to yellow consider as a high-risk location. The following figure 1 (map) illustrate the map of regions in the USA. Figure 2 is the state of Kansas which is the focused of the study.

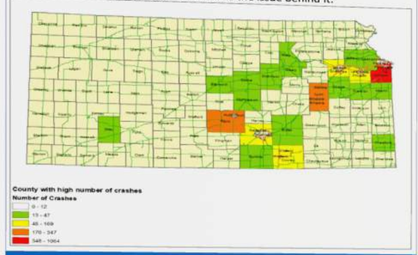
Figure 1. The United States Regions

Figure 2. The State of Kansas



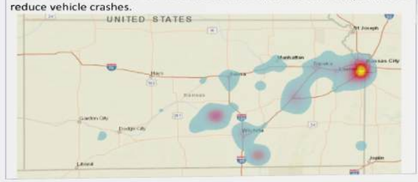
Methods and Materials

The story map in ArcGIS was utilized to explore and analyze vehicle crashes by location in the state of Kansas. Starting to manipulate with the data that was obtained from the Kansas Department of Transportation. The data were focused only for one year which is 2018 crash data. The total number of data reached around 52,000 records for the whole the state of Kansas. There were over 2900 crashes in one year period. It considers a high-rate number of crashes that needs more attention to solve the issue behind it.



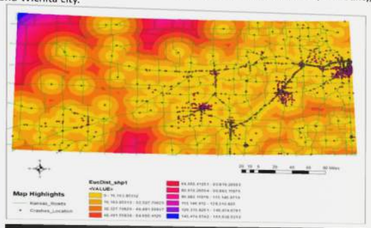
Results

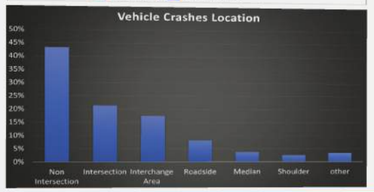
Explanation of the color on the map. It shown the data according to the number of traffic units involved in crashes occurred over the area or location. The red to yellow consider a high-risk location which means there were many accidents occurred on a period of twelve months. The red dots area is the concertation area that has to discover and find out some implication to reduce vehicle crashes.



Results

The map shows the euclidian distance of crashes and it could tell where the crashes concentrate. The concentration of collision is around a populated city. The high dense of crashes in the Kansas City area with more than 1000 crashes in one year period. The next high dense area in Reno, Lyon County, and Wichita city.





Conclusions

Examining the frequency of accidents that took place within the state of Kansas during the year of 2018. The study aims to pinpoint accident clusters and determine the underlying causes of multiple accidents in specific areas. In order to manage this large dataset efficiently, the data were divided into 15 layers, which were subsequently uploaded to ArcGIS Online. Locations with a high number of traffic units involved were depicted with colors ranging from red to yellow to indicate a higher risk location.

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Mapping Groundwater Potential Zones in the Habawnah Basin of Southern Saudi Arabia: An AHP- and GIS-based Approach

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Abstract

GIS studies have gained significant attention for groundwater exploration because of their ability to provide rapid and comprehensive information about resources for further development. This study aims to assess and map the groundwater potential of a sizable basin located in the southern region of Saudi Arabia. Techniques such as GIS and AHP were employed in this study. To perform the delineation for the groundwater potential zones (GWPZ), seven thematic layers were prepared and analyzed. These layers include geology, slope, land use, and lineament densities, soil characteristics, drainage density and rainfall. The resulting GWPZ map was classified into the following five categories: very low, low, moderate, high, and very high. The study revealed that approximately 42.56% of the basin is classified as having a high GWPZ. The low and moderate potential zones cover 36.12% and 19.55% of the area, respectively. Very low and very high potential zones were found only in a limited number of areas within the basin.

Introduction

Groundwater (GW) is a crucial and precious resource retained within subsurface geological formations in Earth's crustal zone [1]. In arid countries such as Saudi Arabia, surface water may not always be readily available for various uses, leading to a heavy reliance on GW for daily needs [2]. Due to water scarcity, GW resources in Saudi Arabia are being heavily utilized; it is reported that 37% of extracted GW is used for domestic and more than 82% for irrigation purposes [3]. The main deep groundwater aquifer in Saudi Arabia is being depleted at an alarming rate, with studies indicating that approximately 92 to 97% of irrigated land in the eight regions of the country rely on this non-renewable source of water [4].The integrated approach using remote sensing, GIS, and the analytical hierarchy process (AHP), offering a more efficient and accurate assessment of groundwater potential zones [5,6]. Geospatial tools offer a swift and cost-efficient approach for generating and modeling crucial data for different geoscience applications [6]. Remote sensing and GIS have been recognized as powerful tools for the rapid estimation of natural resources, especially compared to other traditional approaches [7,8]. The scientific literature reveals that remote sensing and GIS tools have been generally utilized for mapping GW potential zones in different regions of the world. The current study aims to explore the occurrence of GW in the Habawnah basin basement complex situated in the southern region of Saudi Arabia **(Figure 1)** using remote sensing, GIS, and analytical hierarchy process (AHP) techniques.

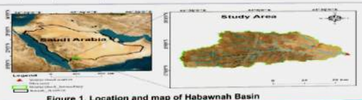

Figure 1. Location and map of Habawnah Basin

Methods and Materials

Figure 2 shows the approach utilized in this study. Thematic layers were constructed using spatial analysis tools in ArcGIS software, specifically the interpolation method and weighted overlay analysis. The inverse distance weighted (IDW) procedure was used for interpolation. These layers were used to assess the aquifer potential. AHP is a generally recognized and commonly utilized GIS-based method for delineating GWPZ by considering multiple criteria. This method facilitated the integration of various thematic layers, with seven distinct layers considered in this study. These layers are essential to understanding the storage and flow of water in an area. The relationships between these influencing factors were assigned to weights based on their impact on the occurrence of groundwater and expert opinions.

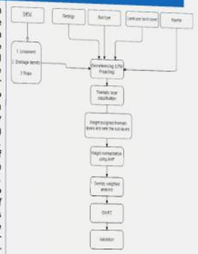

Figure 2. Flowchart of the used methodoloav.

Parameters with higher weights indicated a greater influence, whereas those with lower weights had a lesser impact on the groundwater potential. The assignment of weights was accomplished by utilizing a pairwise comparison matrix within the analytic hierarchy process (AHP) framework, as shown in **Table1**

Results

As shown in **Figure 3**, the groundwater potential zones map in the Habawnah Basin, categorized as having very low (3.64 km²), low (2750.1 km²), moderate (1488.44 km²), high (3240.17 km²), and very high (130.72 km²) potential. These zones are dispersed throughout the basin, where the highland regions have a higher concentration of extremely low and low groundwater potential zones. Moderate potential zones are generally found in the midlands and lowlands with a high drainage density. High-potential zones are located in the midland and lowland areas and are characterized by high infiltration potential. Very high potential groundwater zones primarily characterize lowland areas.

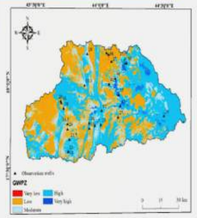

Fig.3. Study Area zones with potential for groundwater resources

Discussion

The presence of low- and very low-potential zones can be attributed to factors such as the presence of igneous rocks, steep slopes, and high drainage density. that groundwater buildup is concentrated in fault-bounded depressions and Wadis in different locations within the study area, primarily in the eastern area. The findings of this study align with previous investigations on groundwater flow in the Habawnah Basin, indicating flow routes typically in the eastern direction towards the desert. The study also validated potential groundwater zones by comparing them with data from observational wells. Of the 28 wells analyzed, one fell within a low potential zone, seven within moderate potential zones, and two within very high potential zones, while the majority of the wells (18) were located in high potential zones. The distribution of groundwater potential zones in the Habawnah Basin, with very low to very high zones covering different percentages of the area, aligns with the spatial variability observed in other studies.

Table 1 Construction of a Normalized Pairwise Comparison Matrix with seven layers for zoning of groundwater potential using AHP.

Thematic layer	Geology	Lineament density	Slope	L.U.L.C	Soil type	Drainage density	Rainfall	weight
Geology	1	4	3	4	3	2	5	0.307
Lineament density	1/4	4/7	2/3	4/7	3/7	2/7	5/7	0.177
Slope	1/3	4/7	6/9	4/9	3/9	2/9	5/9	0.177
L.U.L.C	1/4	4/7	6/9	4/9	3/9	2/9	5/9	0.177
Soil type	1/3	4/7	6/9	4/9	3/9	2/9	5/9	0.177
Drainage density	1/2	4/7	6/9	4/9	3/9	2/9	5/9	0.177
Rainfall	1/5	4/7	6/9	4/9	3/9	2/9	5/9	0.177

Conclusions

This study successfully employed GIS and AHP techniques to assess and map the groundwater potential of a large basin in southern Saudi Arabia. The resulting map divides the Habawnah Basin into five distinct groundwater potential zones: very high, high, moderate, low, and very low. Zones with very low and low groundwater potential were more common in highland areas. In contrast, regions with a high drainage density in the midlands and lowlands frequently have moderate potential zones.

Future Work

Future studies should consider the inclusion of additional thematic layers, such as aquifer thickness, pre-and post-monsoon groundwater depth, recharge rate, distance to Wadi, and the amount of water utilized for agricultural and household purposes. Also conduct long-term monitoring, validate the results through field investigations, and integrate socio-economic factors.

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References

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Liquefaction hazards mapping along Red Sea coast, Jeddah city, Kingdom of Saudi Arabia

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Abstract

This study mainly aims to evaluate as well as to develop maps of the liquefaction potential for Jeddah City in the Kingdom of Saudi Arabia. Data is obtained and used from 214 boreholes associated with standard penetration tests (SPT). Through taking into account comparable seismic hazardous situations to amax = 0.1 g, the liquefaction potential index (LPI) is measured. In order to compile the liquefaction hazard map, LPI values are correlated, showing the quantitative aspects of the liquefiable layers and the area of likelihood of induced disturbance. This data was analyzed within the framework of the Geographical Information Systems (GIS) application. The results show that, with the exception of the sites in the Abhur and Al-Hamra districts where the liquefaction potential is moderate to high, the main part of the city of Jeddah belongs to a very low liquefaction potential area. The developed liquefaction hazard maps will serve as helpful guides for land planning and management in Jeddah city.

Introduction

Many recent studies have addressed the liquefaction phenomena occurrence using many methods and methodology and presenting with the aiding of (GIS), set of maps demonstrating the liquefaction threat distribution through the investigated areas [1]; [2]; [3,4–9]. However, nothing was found in the literature for Jeddah region. Liquefaction hazard maps are indeed helpful in identifying places wherever detailed hazardous liquefaction assessments are required or may be necessary prior to the construction of any project. However, like these maps are not vital for site project design of constructions. Therefore, only for land development and building. The goal of this work is to use GIS technique to prepare liquefaction threat maps of urban areas along the Red Sea coast of Jeddah City. The liquefaction evaluation was carried out using data collected from soil boring and standard penetration tests (SPT) with regard to the (FS) and (LPI). The steps taken for this purpose are: (i) collection of data on geological, hydrogeological, geotechnical and seismic hazards; (ii) evaluation and (LPI) mapping. The result of this research is reported to construct hazard maps of

Fig. (1): Location map of Jeddah city with the drilling boreholes over all the districts of Jeddah City.

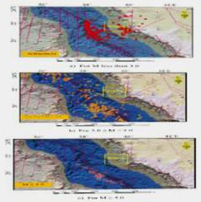

Fig. (2): Seismicity of Jeddah region in terms of earthquake magnitude

Methodology

The methodology used to assess and map the susceptibility of liquefaction in Jeddah City involves four phases: I) The compilation and analysis of hydrogeological, geological and geotechnical data from the research field (ii) Drawing up representative geotechnical and geological profiles on the basis of geotechnical and geological data; (iii) Assessment of the soil layer potential liquefaction index (LPI) utilizing geotechnical properties given by boreholes and SPT considering an earthquake scenario equivalent to the reported seismicity amax = 0.1 (Saudi Building Code 2018, SBC 301-CR) and lastly, (iv) Develop maps of LPI for the Jeddah City by connection among the findings the (LPI) and (FS) within a (GIS) framework.

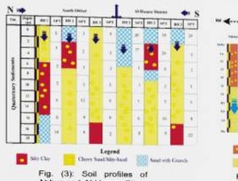

Fig. (3): Soil profiles of Abhur and Al-Hamra Sites-Jeddah city.

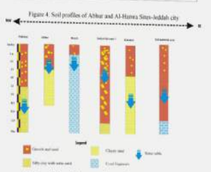

Fig. (4): Soil profiles in studied districts along NW-SE of Jeddah city.

Results

-In terms of fine content, Fig. 5 clearly shows hat the fraction of the fines particles (FC) ranges from one percent to 36% for most sites in the studied area except two areas that have finec ontents range from 36 to 57 and from 57 to 93%. Low fine contents of sandy soil layers increase their vulnerability to liquefaction even at lower value of PGA.

-Fig. 5 below demonstrates soils distribution dependent upon their liquid limits and plastic limits distribution. A strong differentiation has been noticed among liquefiable soils and no liquefiable ones depending on the ranges of plasticity and liquidity. The study indicates that the non-liquefiable soil marked by high plasticity coincides with the clays found in the sands and silts unit. Most non-susceptible soils display up to 60% (LL) values and up to 40% (PL) values. Based on the results of LL and PL there is not any liquefaction indication. However, the silty sand layers in Al-Hamra site are non-plastic materials, which could be an indication of liquefaction susceptibility.

-The map displays that liquefaction in most sites of the city is poor due to the presence of clay, solid stratum (rock), and thick gravel and sandy layer with a deeper groundwater level (usually over 10 m). In western part of the region, the liquefaction potential is very low to high equivalent to zones created by silty sand deposit, reasonably dense and quite loose sand deposits, identified by a superficial water level (fluctuating from zero to 3 m). Liquefaction is very evident in two locations in the western part of the city (Fig. 6), in Abhur and Al-Hamra-Cornish sites, a superficial level of groundwater besides thick loose silty sand deposits

3and organic material, and amorphous inorganic and organic material (Pye 1987). The dust is everywhere

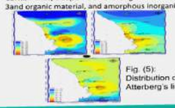

Fig. (5): Distribution of Atterberg s limits

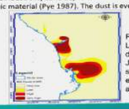

Fig. (6): Liquefaction risk distribution of Jeddah City for a seismicity equivalent to amax = 0.1 g.

Discussion

The map displays that liquefaction in most sites of the city is poor due to the presence of clay, solid stratum (rock), and thick gravel and sandy layer with a deeper groundwater level (usually over 10 m). In western part of the region, the liquefaction potential is very low to high equivalent to zones created by silty sand deposit, reasonably dense and quite loose sand deposits, identified by a superficial water level (fluctuating from zero to 3 m). Liquefaction is very evident in two locations in the western part of the city (Fig. 8), in Abhur and Al-Hamra-Cornish sites, a superficial level of groundwater besides thick loose silty sand deposits.

The soil becomes less susceptible to liquefaction with distance increases far away from the sea where the ground water level ranges between 5 and 10 m. There is mild sensitivity where depth of the groundwater is below 10 m. Non-affected region refers to deposits of the sand with gravels, coral fragments and silty clay with some sand where the level of the water table exceeds 10 m.

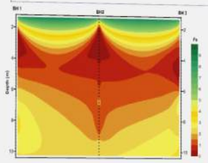

Fig. (7): Safety factor (Fs) distribution with depth in Al-Hamra-Cornish site

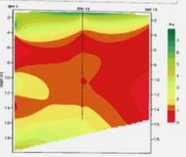

Fig. (8): Safety factor (Fs) distribution with depth in Abhur site.

Conclusions

The generated maps display the measureable features of the liquefiable strata and the zone where the possibility of surface indication of liquefaction is present. Our findings indicate that most areas of the city of Jeddah have no or very low liquefaction potential with the exception of two sites (Abhur and Al-Hamra-Cornish) in the western parts of the Jeddah City, where the possible liquefaction is medium to high. The obtained maps of the liquefaction hazard can serve as valuable guides for land planning and management in the city of Jeddah and as an instance of the assessment of the liquefaction risk that might be used in further inhabited towns in earthquake-prone regions of southern and eastern Saudi Arabia.

Future Work

The recommendation including conducting detailed geotechnical site investigations prior to any construction. Furthermore, deep soil modification are needed in terms of deep soil mixing (DSM) technique or stone columns

Contact

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0507538134

References

Civil Engineering Dep.

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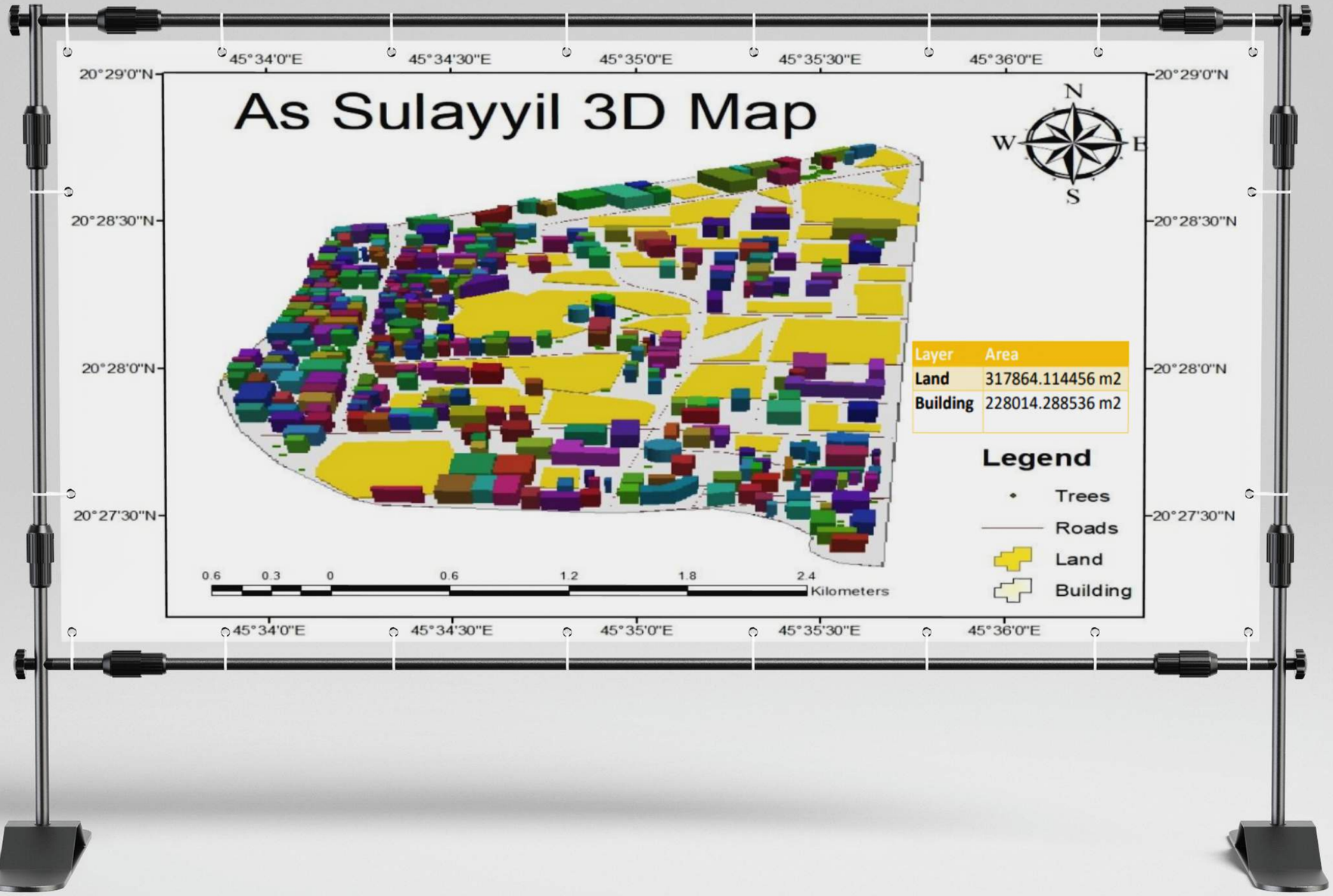
جانب من أعمال الطلاب في المسابقة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20°29'0"N
20°28'30"N
20°28'0"N
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N
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Layer
Area
Land
317864.114456 m2
Building
228014.288536 m2
Legend
Trees
Roads
Land
Building
0.6
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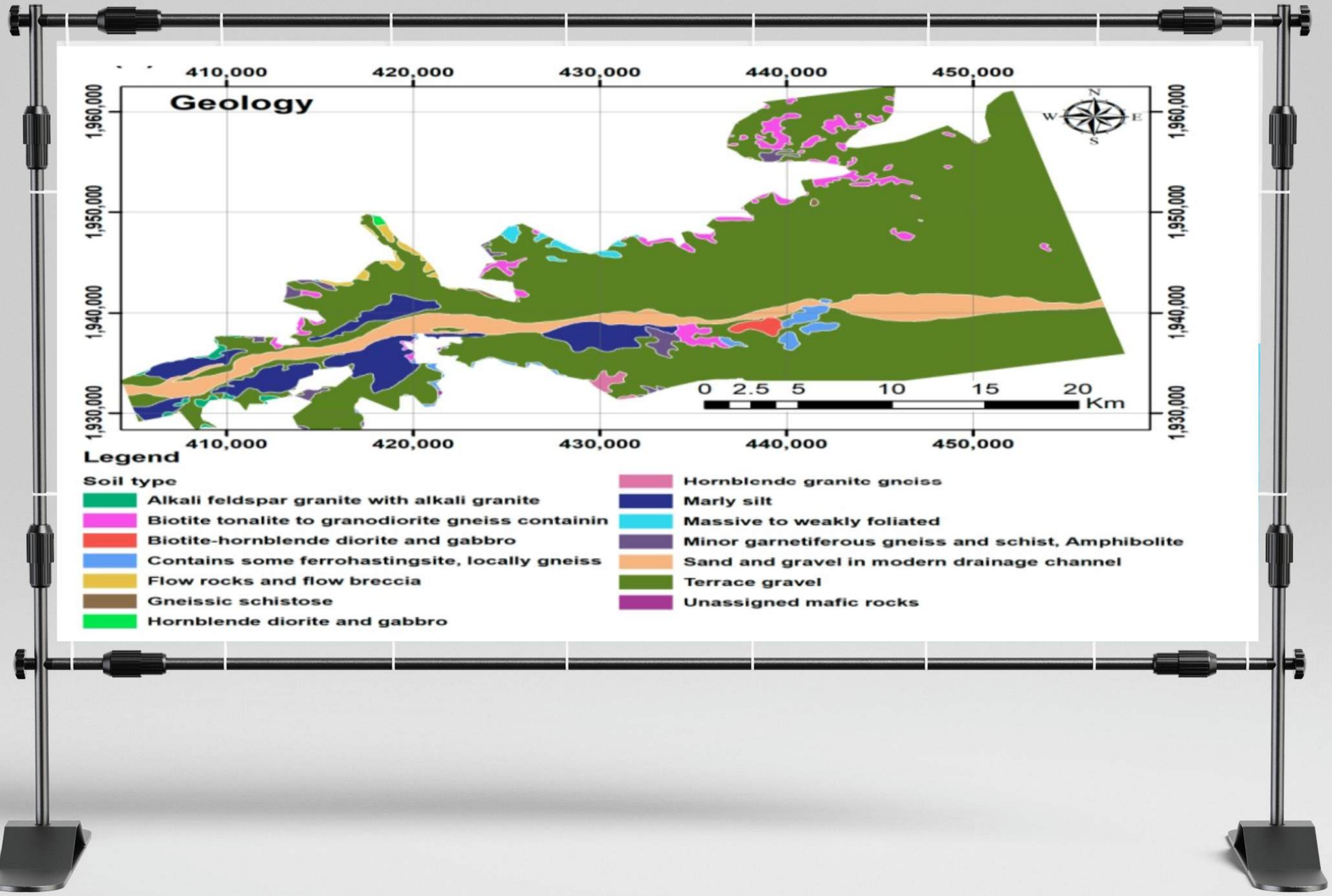
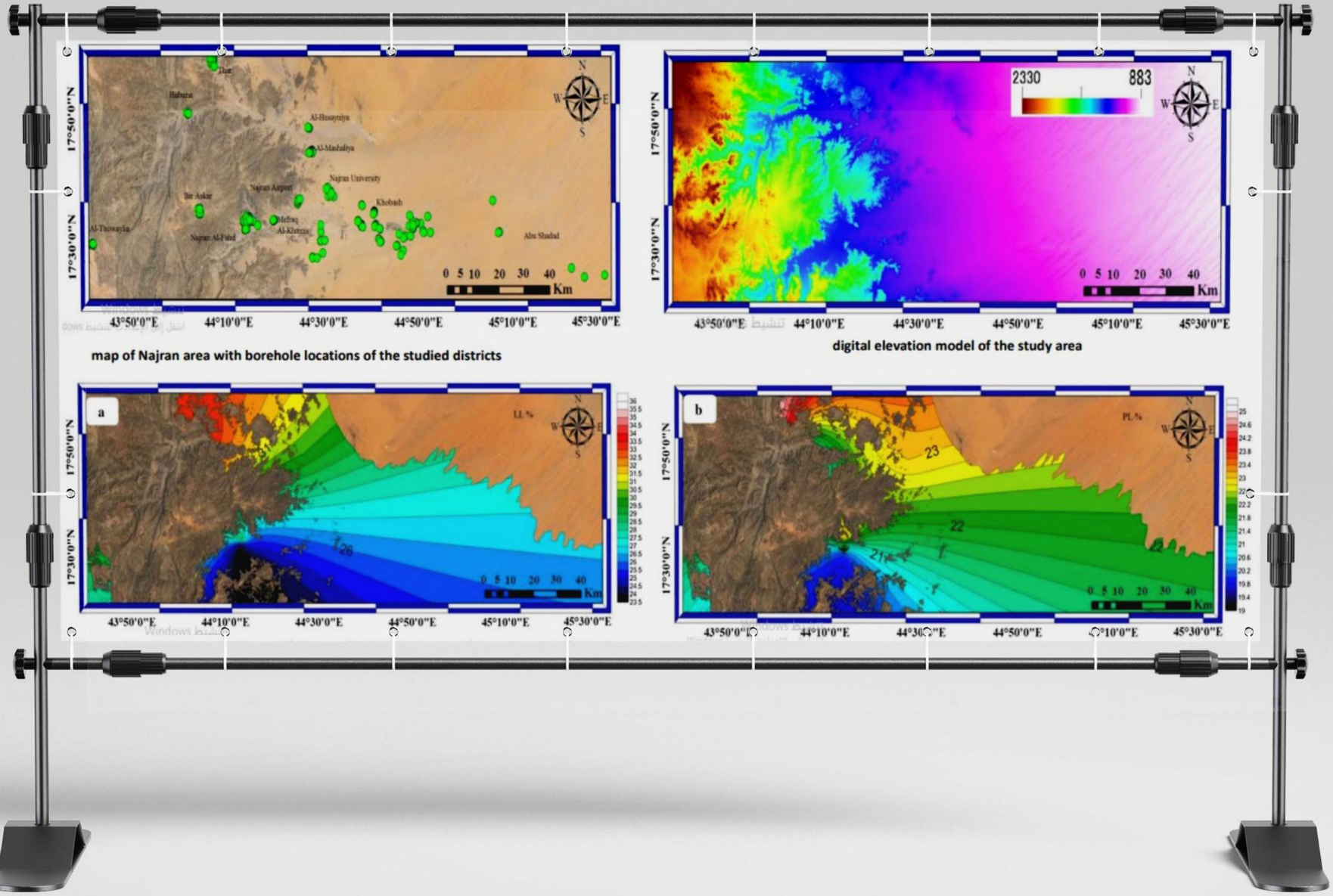
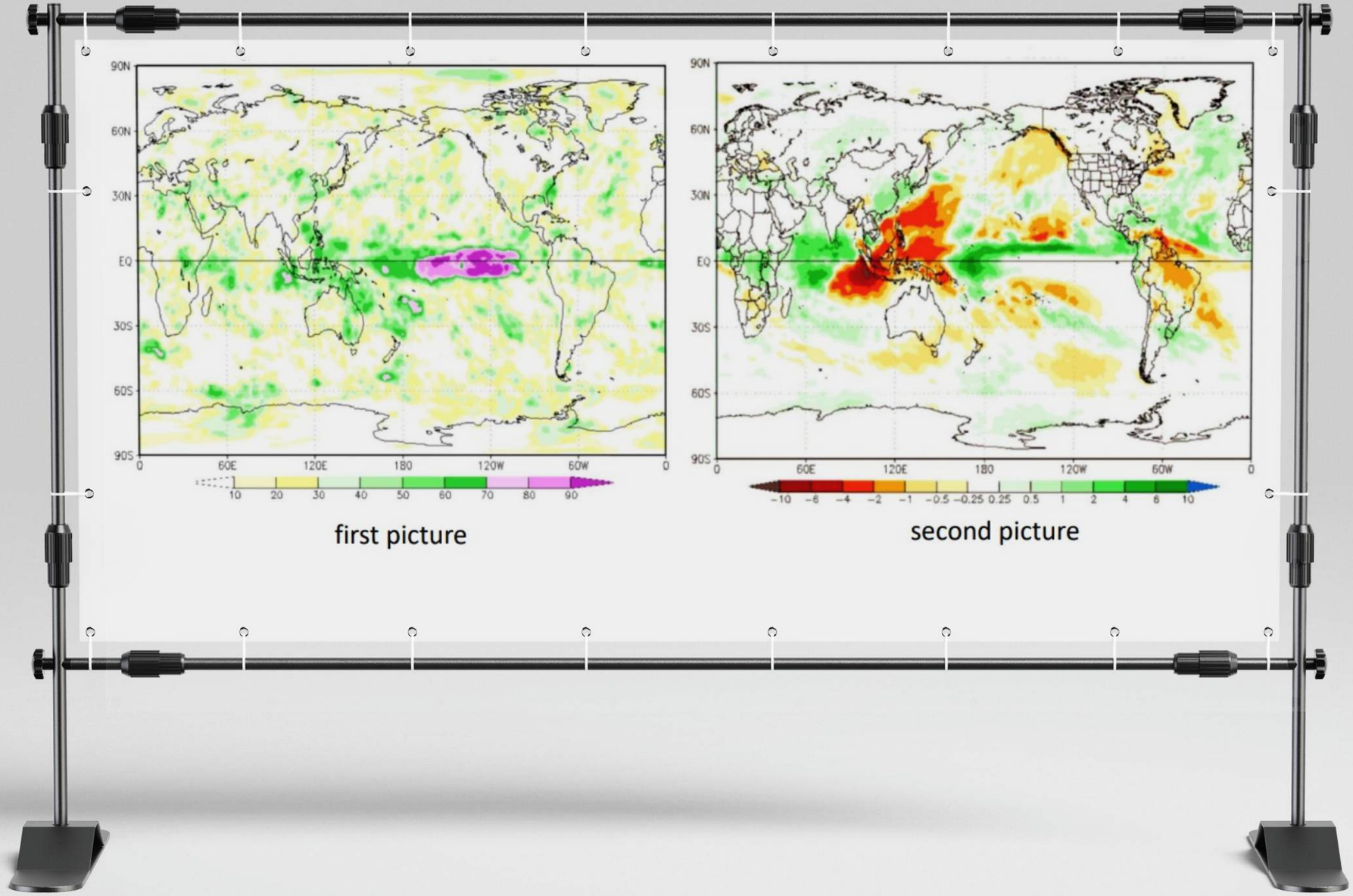
1.8
2.4
Kilometers


Geology
410,000
420,000
430,000
440,000
450,000
1,960,000
1,950,000
1,940,000
1,930,000
N
S
W
E
0 2.5 5 10 15 20
Km
Legend
Soil type
Alkali feldspar granite with alkali granite
Biotite tonalite to granodiorite gneiss containin
Biotite-hornblende diorite and gabbro
Contains some ferrohastingsite, locally gneiss
Flow rocks and flow breccia
Gneissic schistose
Hornblende diorite and gabbro
Hornblende granite gneiss
Marly silt
Massive to weakly foliated
Minor garnetiferous gneiss and schist, Amphibolite
Sand and gravel in modern drainage channel
Terrace gravel
Unassigned mafic rocks

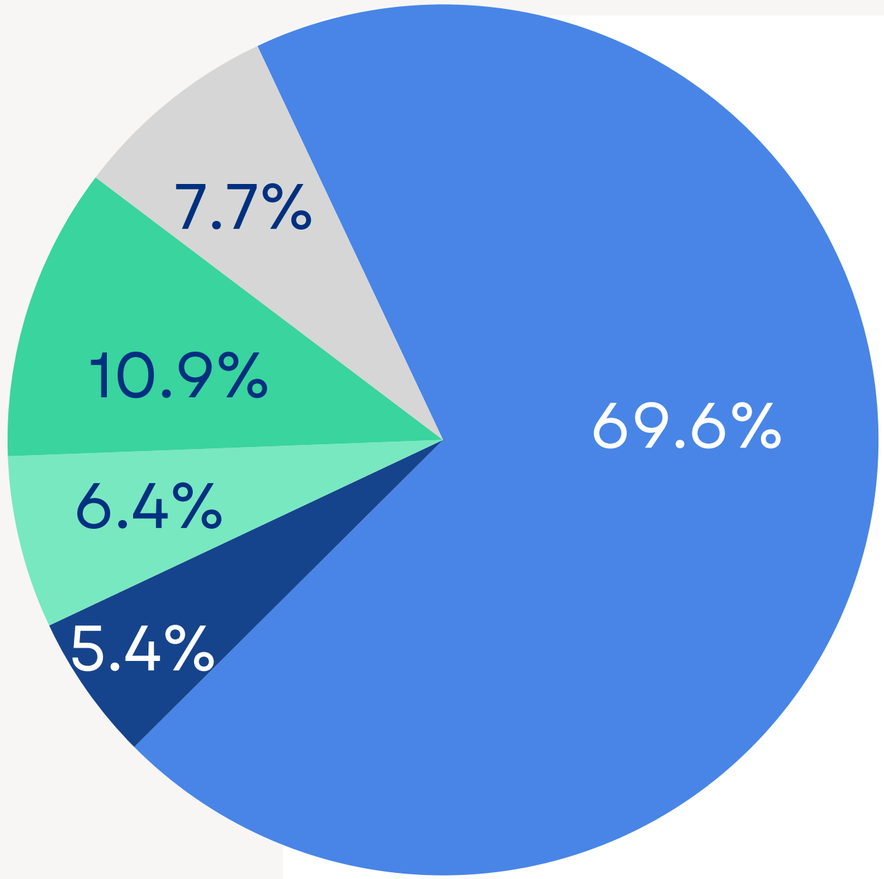

Najran
Hubuna
Al-Husayniya
Al-Madaliya
Najran University
Najran Airport
Bir Askar
Khobash
Mefraq
Al-Khirriza
Najran Al-Fahd
Al-Thowayfa
Abu Shadad
0 5 10 20 30 40
Km
17°50'0"N
17°30'0"N
43°50'0"E
44°10'0"E
44°30'0"E
44°50'0"E
45°10'0"E
45°30'0"E
N
S
W
E
map of Najran area with borehole locations of the studied districts
2330
883
digital elevation model of the study area
a
LL %
b
PL %
23
22
21


90N
60N
30N
EQ
30S
60S
90S
0
60E
120E
180
120W
60W
10 20 30 40 50 60 70 80 90
first picture
−10 −6 −4 −2 −1 −0.5 −0.25 0.25 0.5 1 2 4 6 10
second picture

فهم كوكب الأرض

UNDERSTAND EARTH

احصائيات الحضور



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الختام!

نعتبر هذا النجاح في تنظيم "يوم نظم المعلومات الجغرافية" خطوة مهمة نحو تحقيق رؤية قسم الهندسة المدنية في تطوير وتعزيز ميدان نظم المعلومات الجغرافية, والأحداث العالمية. نشكر كل من ساهم في إحداث هذا التأثير الإيجابي ونتطلع إلى المزيد من التفوق والابتكار في المستقبل