1 - Research Title

study the causes of desertification in Dhofar Governorate

Preparing students

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Sultanate of Oman – Dhofar – Salalah

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May 2025

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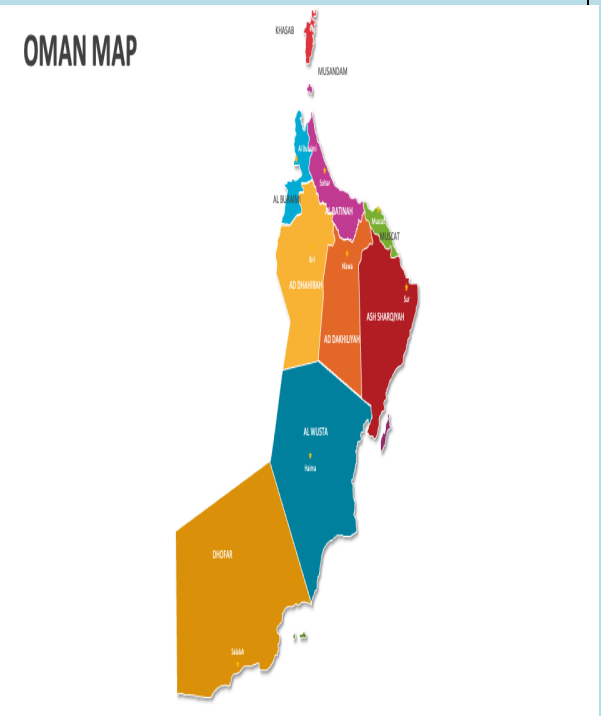


3 -Summary

This research aims to study the causes of desertification in Dhofar. The research team's first hypothesis, which strongly suggests the cause, is climate change (Including rising temperatures, decreasing rainfall, increased evaporation and transpiration, and increased wind speeds resulting in dust storms and sand dunes). The second hypothesis is human intervention (including negative or incorrect land use and management practices that lead to the degradation of vegetation cover, increased salinity, and water and wind erosion, as well as overgrazing and premature grazing).

These hypotheses led to the following research questions:

1. **What climate changes are the region experiencing?**
2. **How have climate changes affected the environment?**
3. **What human activities are taking place in the region?**
4. **What is the impact of human activities on the environment?**

We developed a work timeline, beginning with identifying the study site. The team then conducted a field visit to the site to study the problem, understand its causes, and develop hypotheses and potential solutions.

The research team contacted the Environment Authority and the Directorate General of Agriculture in Dhofar to assess the monitoring and response. processes for this problem and requested their cooperation in the study. Fieldwork commenced, and the relevant program protocols were implemented.

- **The results were as follows:**
  - **Climate change has had a significant impact on the environment in terms of increased temperatures, decreased rainfall, wind, soil salinization, and a decrease in the quantity and quality of groundwater and surface water (Supporting the first hypothesis).**
  - **The protocols and tests applied by the research team indicated that climate change has a clear impact on soil properties, specifically increasing soil alkalinity and salinity (supporting the first hypothesis).**
  - **Negative human interventions have an impact on the environment in terms of overgrazing, waste and its disposal methods, industrial facilities and their by products, repetitive farming and traditional farming methods, and the use of pesticides and chemical fertilizers (supporting the second hypothesis).**
- **Conclusion: Climate change and negative human interventions negatively affect soil and its quality.**
- **Recommendations: Monitor groundwater quality, improve water management and irrigation, work to protect and increase vegetation cover in the region, limit urban expansion In agricultural areas, stabilize sand dunes, develop mechanisms to regulate grazing in areas prone to desertification and support local research** Abdullah,H.(2010).

Basic terms

- Desertification: is a phenomenon in arid, semi-arid, and dry sub-humid regions, resulting from various factors including climate change and human activities.
-Vegetation cover: This refers to the collection of plants that grow in a specific area and cover the Earth's surface.
- Land cover: This is a general term used to describe what covers the Earth and the changes that occur in vegetation cover over time.
- Overgrazing: This is the increase in the number of animals relative to the area of pasture, leading to desertification of the region.

STEM : Abbreviation: Science, Technology, Engineering and Mathematics (STEM)

4 .Research questions

❶ What climate changes are the region experiencing?
❷ How have climate changes affected the environment?
❸ What human activities are taking place in the region?
❹ What is the impact of human activities on the environment?

5- Introduction

The climate changes the region is experiencing have a negative impact on the environment in general and on the soil in particular. Agriculture is a profession practiced by a large segment of Omani citizens and supports several industries that affect major sectors of society. It plays a pivotal role in increasing national income, providing a portion of the food supply, and achieving food security for Omani citizens (Ghafarm,S.,2025). With the worsening problem of desertification and the degradation of agricultural lands, a large portion of these lands is negatively impacted, affecting the agricultural sector and its benefits to Omani citizens through food scarcity and a lack of diversity. This, in turn, harms other sectors of society and its stability. The limited area of arable land and the increasing human needs for it motivated us to study the problem and its impact on the environment, identifying the underlying causes. The study was successful and based on sound scientific principles, from defining the problem and formulating and verifying hypotheses to implementing the necessary protocols for studying the characteristics of water, air, and soil. The results revealed potential causes of the problem, and recommendations were offered to address it, aiming for a positive impact on our local community and citizens, and to maintain ecological balance, ultimately benefiting the environment and our beloved country, Oman. Finally, we hope that the relevant authorities will take the initiative to find radical solutions to mitigate the impact of climate change on the soil and study the recommendations presented by the research team to address this problem. This is crucial for preserving vegetation cover and natural resources from various threats before the situation becomes unmanageable (Alroya,2025) .

6- Methods and materials

First, the research plan

1 – Establishment of the proposed timetable for the research plan.

Table (1) Work plan

workplan	month
Formulating the research problem - Identifying study locations - Identifying and preparing the tools used	May 2025
Data collection and analysis	June: October 2025
Reaching conclusions and writing the research	November: December 2025
Reviewing the research - Designing the poster - Presenting the research	January 2026

2-Distributing work roles among the research team and starting implementation

Table (2) Distribution of roles among the research team

Work	The student
Formulating the research problem and identifying study locations	Farag M.
Developing a research plan, identifying the necessary tools, and preparing them	Ahmed M.
Collect and analyze data by applying planned protocols and conducting interviews.	Farag M. Ahmed M.
Data entry	Al Oufi S.
Reaching conclusions for the study and providing recommendations	All
Formulating the abstract and writing the research paper	Ahmed M.
Research review	Al Oufi S.

3-Identifying and inspecting study site, determining what needs to be implemented at the site and selecting the appropriate protocol to apply.

Table (3) shows the study location and identification of the appropriate protocol

Location	Work	Protocol used
Raysut	Study of atmospheric, water, and soil characteristics	Atmosphere, Hydrosphere, soil, land cover and vegetation protocol

4 – Organizing meetings with STEM specialists and environmental experts to support the study.

Table (4) shows the details of the specialists who contributed to the research.

Name	position
Dr. Ahmed bin Bakheet Al-Shanfar	Director of the Department of Agricultural and Animal Research in Dhofar
Engineer / Mohammed Abed Al-Masheli	Soil and Water Researcher at the Agricultural and Animal Research Department
Mr. Ali Salem Beit Saeed	Director General of the Environment Authority in Dhofar
Dr. Salem Ahmed Salem	Environmental expert – Environment Authority Dhofar
Mr. Salem Abdullah Salem Mufleh	Environmental Authority Laboratory Technician

5- Identifying the devices and tools used in the study

Table (5) shows the tools used and the function of each.

Identifying geographic trends	compass	Determining the location coordinates	GPS
Measuring dissolved oxygen in water	dissolved oxygen group	Measuring water transparency	Transparency tube
Conductivity and salinity meter	conductivity meter	Temperature measurement	alcohol thermometer
Identifying soil colors	soil color book	Specify the cloud shape	Guide to Cloud Types
Soil temperature measurement	soil thermometer	pH measurement	pH meter
Tree density scale	densitometer	measuring distances	Metric tape
Bucket – (2) 100ml glasses – Distilled water – Soft towels		Measuring relative humidity	Humidity meter

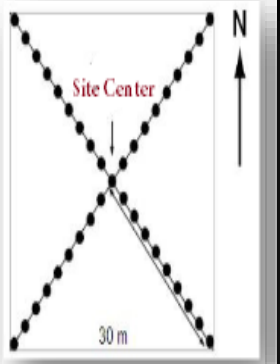
6 – Calibration of devices: The alcohol thermometer, soil thermometer, pH meter, and water conductivity meter are calibrated.

7 –Applying the study to samples by implementing appropriate protocol activities. Amos, H.(2022)

📖 **Protocol implementation location: At study site – school laboratory**

Table (6) Mechanism for implementing protocols for data collection.

Research question	Protocol	Application mechanism
Question 1 What climate changes is the region undergoing?	atmosphere	This is answered using information gathered through the implementation of the program protocols: - Measuring air temperature using an alcohol thermometer. - Measuring relative humidity using a hygrometer. - Determining cloud type and quantity using a cloud index. - Determining rainfall amount using a rain gauge and consulting the meteorological authority. - Determining the quantity and size of particulate matter in the air from air quality reports from the Environment Authority. - Consulting the meteorological authority and the Environment Authority to identify climate changes affecting the region.
Question 2: How have climate changes affected the environment?	Hydrosphere	We take three water samples, then: - Measure the temperature of the sample water using an alcohol thermometer. - Measure the transparency of the water using a transparency tube. - Measure the dissolved oxygen using a dissolved oxygen kit: Take 25 ml of the water sample into the designated beaker, then place the tube in it and break its tip. Get it gently shaken and invert it up and down and leave it undisturbed for two minutes. Then compare the color to the indicator and record the reading - Measure the pH using a pH meter. The meter must first be washed with distilled water, then with the sample water. Place it in the sample and take the reading after it has stabilized. Repeat the steps used when measuring salinity and conductivity. - Measure salinity (S) and total dissolved solids (TDS) using a conductivity meter. - Measure conductivity (CE) using a conductivity meter. - Calculate the average for each of the three samples. - Record the results on the forms prepared by the team

Research question	Protocol	Application mechanism
	Pedosphere	Measure soil temperature using a soil thermometer at depths of 3 cm and 5 cm. Repeat the measurement three times at each depth and calculate the average for each depth. - Take a vertical soil section by drilling to a depth of 40 cm due to the difficulty of drilling at the site. - Identify and measure the soil layers, then study the soil properties of each layer in terms of: (Structure - Color - Consistency - Texture - Rocks - Roots - Carbonates) - Soil pH protocol: In a laboratory container, mix 40 g of dry soil with 40 mL of distilled water. Stir for 30 seconds and wait 3 minutes, repeating this five times consecutively. Then, allow the mixture to settle for 5 minutes until a separate layer is obtained (clear liquid on top of the settled soil). Measure the pH of the separated liquid. Repeat the protocol for two new samples from the same soil layer. - Measure salinity: Following the steps used to measure pH, measure the salinity of the sample using a conductivity meter. - Measure the conductivity and solubility of the sample by repeating the same steps.
	Biosphere	- Select and determine the location of the ground cover sample (30 m x 30 m) - We perform biometric measurements following the biometric protocol (canopy cover- ground cover – identification of dominant and subdominant species) to determine the appropriate MUC code. We take a double step from the center of the square for 21.2 m along the square's radius (NE – SE – NW – SW). After each double step, we record the shrub cover and ground cover measurements on the designated data form.
Question 3: What human activities are taking place in the area? Question 4: What is the impact of human activities on the environment(water, air, soil)?	field visits	Through field visits to the site, the following was observed: - Industrial facilities are densely concentrated - Urban sprawl - Overgrazing This resulted in a change in soil properties and quality.

8-Collect and organize data into tables.

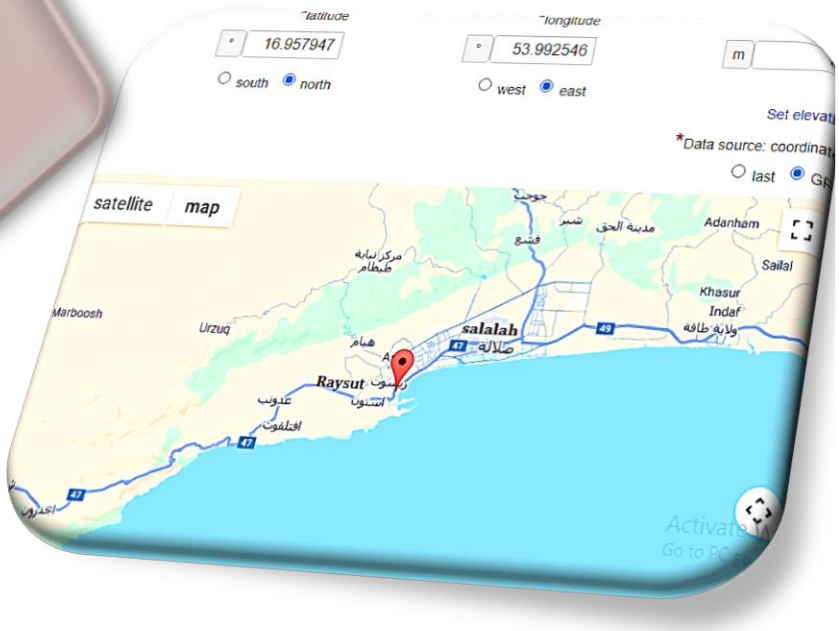
9- Enter data into the program's website, www.GLOBE.gov.

10- Analyze and graphically represent the data.

11- Draw conclusions and make recommendations.

Second: Study Location

(Sultanate of Oman – Dhofar Governorate) Raysut, December, moderate weather, atmosphere- Hydrosphere - Biosphere- Pedosphere protocols were used



Third: Data Collection and Analysis

The data related to questions three and four were collected through interviews with:

Table (7) shows the research team's meetings.

Name	position	Contribution
Dr. Ahmed bin Bakheet Al-Shanfar	Director of the Department of Agricultural and Animal Research in Dhofar	Supporting the team - providing the team with available technologies - and research guidelines for conducting the study on scientific grounds
Mr. Ali Salem Beit Saeed	Director General of the Environment Authority in Dhofar	Team support - Informing the team about the nature of the Authority's work, its systems and regulations, and the extent to which everyone is committed to them.
Dr. Salem Ahmed Salem	Environmental expert – Environment Authority Dhofar	Providing full support to the research team and its research guidelines to conduct the study on scientific grounds
Engineer / Mohammed Abed Al-Masheli	Soil and Water Researcher at the Agricultural and Animal Research Department	Providing full support to the research team in terms of training, sample collection, and analysis
Mr. Salem Abdullah Salem Mufleh	Environmental Authority Laboratory Technician	Sample analysis and technical support

The data related to the first and second questions was collected on-site through:

1. **Implementing the atmospheric protocol, which included measuring air temperature, cloud cover, and humidity, and utilizing meteorological centers to determine rainfall amounts.**

❷ Implementing the Hydrosphere protocol, which included measuring transparency, water temperature, dissolved oxygen, salinity, conductivity, dissolved substances, and water pH.

❸ Implementing the soil protocol: measuring soil temperature; studying the soil properties of each layer in terms of:

(structure, color, consistency, texture, rocks, roots, carbonates) - soil pH protocol - salinity: by repeating the steps used to measure pH, the sample salinity and dissolved substances were measured using a conductivity meter.

❹Implementing the land cover protocol and site classification (MUC).

- The study data was entered into the program website.
- The data was organized into tables.
- Comparison tables were created for different time periods.

❁ Graphs were used to represent and compare the data.

The team had several suggestions through our study of the problem under study - reviewing several studies that we will address through our study.

Photos of students during the implementation of protocols on site

7 -Results

First: The results collected by the team for the site under study:

Summer (dry) season measurements

atmosphere

Table (8) The Atmosphere

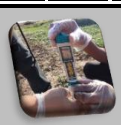
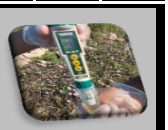
date 2025	local time 24 h	air temperature C°	relative % humidity	clouds	The amount of rain(mm)
14 / 05	12:00	42	47	%25 -50	0
22/ 05	12:00	41	46	%25 -50	0
28/05	13:00	42	51	%10 -25	0
12/06	12:00	42	56	%25 -50	0
26 / 06	12:00	41	56	%25 -50	0
Average		41.5	51		0

Hydrosphere

Average water temperature: 35°C

Table (9) Properties of Water

Local time 12:00 AM

PH				salinity ppt				TDS g/L				dissolved oxygen mg/L				transparency Cm	conductivity ms/cm				Date2025
AV	3	2	1	Av	3	2	1	Av	3	2	1	Av	3	2	1		Av	3	2	1	
8.5	8.5	8.5	8.5	15	15	15	15	14.7	14.8	14.8	14.5	4	4	4	4	120	24.7	24.7	24.7	24.7	14/5
8.6	8.6	8.6	8.5	16	16	16	16	15.7	15.8	15.8	15.6	4	4	4	4	120	26	26	26	26	26/6
8.55				15.5				15.2				4				120	25.4				Average

soil

Table (10) Soil Temperature

Local time 12:00 AM

Surface temperature C°				T C⁰	Depth 5 Cm				Depth 3 Cm				Date 2025
Av	3	2	1	Av	Av	3	2	1	Av	3	2	1	
52.5	52	53	52	52	47.5	47	47	47	47	48	47	47	47	14/05
	53	53	53	53		48	48	48	48	48	48	47	48	48	26/06

Table (11) Soil readings

pH				salinity ppt				DTS g / L				conductivity ms/cm				Local time	Date 2025
Av	3	2	1	Av	3	2	1	Av	3	2	1	Av	3	2	1		
9.36	9.38	9.4	9.3	17	17	17	17	18	18	17.8	18	26.5	26.5	26.5	26.5	11:00 AM	14/05
9.4	9.3	9.4	9.4	18	18	18	18	18.6	18.6	18.7	18.5	28	28	28	28	11:00 AM	26/06
9.38				17.5				18.25				27.3				Average	

Table (12) Soil characteristics

Layer	depth Cm		structure	texture	consistency	Soil Color		Rocks	Roots	Carbonates
	from	to				Primary	Secondary			
1	0	25	Single Grained	Sandy loam	firm	7.5YR5/6	-	None	little	Strong
2	25	40	blocky	Sandy loam	Extremely firm	7.5YR4/6	-	many	None	Strong

❁ Autumn (rainy) measurements ❁

atmosphere

Table (13) The Atmosphere

date 2025	local time 24 h	air temperature C°	relative % humidity	clouds	The amount of rain mm
17 / 07	13:00	37	67	%90-50	1
24 / 07	13:00	35	69	%90-50	1
31/07	12:00	33	68	%90-100	2
06/08	12:00	31	70	%90-100	3
14 / 08	12:00	30	72	%90-100	2
20 / 08	12:00	29	71	%90-100	2
28 / 08	12:00	27	71	%90-100	2
07/09	12:00	29	66	%50-90	1
Average		31	69		2

Hydrosphere

Average water temperature: 25°C

Table (14) Properties of Water

Local time 11:00 AM

PH				salinity ppt				TDS g/L				dissolved oxygen mg/L				transparency Cm	conductivity ms/cm				Date2025
Av	3	2	1	Av	3	2	1	Av	3	2	1	Av	3	2	1		Av	3	2	1	
5	5	5	5	7	7	7	7	7.2	7.2	7.2	7.2	6	6	6	6	120	11	11	11	11	6/8
5	5	5	5	6.5	6.5	6.5	6.5	6.8	6.8	6.8	6.8	6	6	6	6	120	10.2	10.2	10.2	10.2	28/8
5				6.75				7				6				120	10.6				Average

soil

Table (15) Soil Temperature

Surface temperature C°				T C⁰	Depth 5 Cm				Depth 3 Cm				Date 2025
Av	3	2	1	Av	Av	3	2	1	Av	3	2	1	
31.5	31	31	31	32	33.5	33	33	33	34	33	33	33	33	6/08
	32	32	32	32		34	34	34	34	34	34	34	34	28/08

Table (16) Soil readings

pH				salinity ppt				DTS g / L				conductivity ms/cm				Local time	Date 2025
Av	3	2	1	Av	3	2	1	Av	3	2	1	Av	3	2	1		
6	6	6	6	9	8.9	9.2	8.9	9.5	9.55	9.48	9.50	14	14	14	14	11:00 AM	06/08
5.5	5.5	5.5	5.5	9	9	9.2	9	9.58	9.61	9.55	9.58	14	14	14	14	11:00 AM	28/08
5.75				9				9.54				14				Average	

Table (17) Soil characteristics

Layer	depth Cm		structure	texture	consistency	Soil Color		Rocks	Roots	Carbonates
	from	to				Primary	Secondary			
1	0	25	granular	Sandy loam	friable	7.5YR5/6	-	None	little	Strong
2	25	40	blocky	Sandy loam	firm	7.5YR4/6	-	many	None	Strong

From the measurements shown, we find a noticeable difference in the time periods specified in the measurements of many readings, and this is what we will express in the following tables and graphs:

Table (18) Air Temperature Comparison

period	Summer			Autumn		
	1	2	3	1	2	3
T(C°)	42	41	42	31	30	29

Air Temperature chart (1)

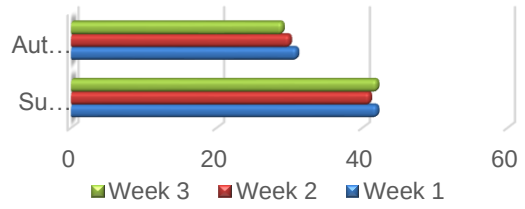


Table (19) Rainfall

period	Summer			Autumn		
	1	2	3	1	2	3
mm	0	0	0	2	3	2

Rainfall chart (2)

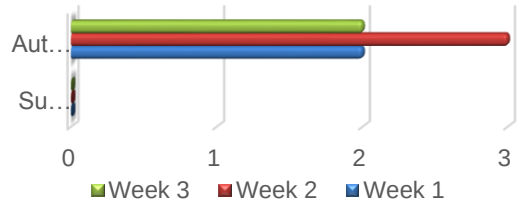


Table (20) Dissolved oxygen in water

period	Summer			Autumn		
	1	2	3	1	2	3
mg/L	4	4	4	6	6	6

Dissolved oxygen in water chart (3)

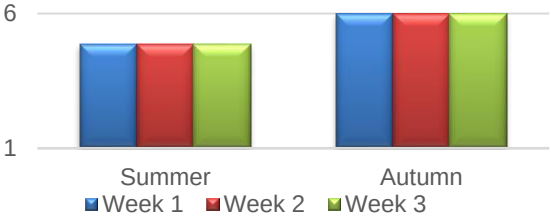


Table (21) DTS in water Comparison

period	Summer			Autumn		
	1	2	3	1	2	3
g/L	14.7	15.7	15.2	7.2	6.8	7

DTS in water chart (4)

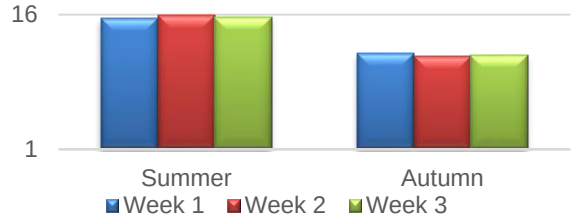


Table (22) Comparison of water conductivity

period	Summer			Autumn		
	1	2	3	1	2	3
ms/cm	24.7	26	25.4	11	10.2	10.6

conductivity of water chart (5)

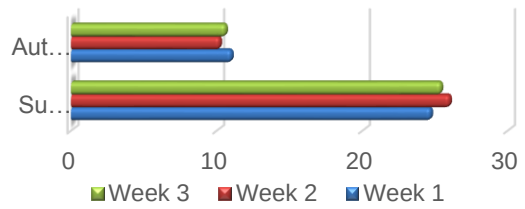


Table (23) Comparison of Water Salinity

period	Summer			Autumn		
	1	2	3	1	2	3
ppt	15	16	15.5	6.75	6.5	6.75

Water Salinity chart (6)

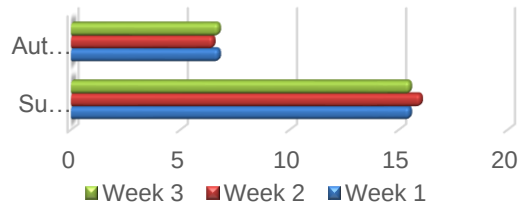
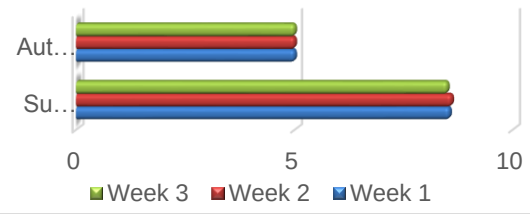


Table (24) pH of water

period	Summer			Autumn		
	1	2	3	1	2	3
pH	8.55	8.6	8.5	5	5	5

pH of water chart (7)



SOiL

Table (25) soil Temperature Comparison

period	Summer			Autumn		
	3cm	5cm	S	3cm	5cm	S
T(C°)	47.5	47.5	52.5	33.5	33.5	31.5

Temperature chart (8)

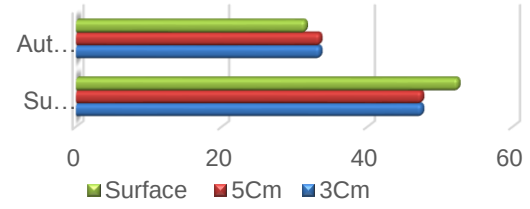


Table (26) Comparison of soil conductivity

period	Summer			Autumn		
	1	2	3	1	2	3
ms/cm	26.5	28	27.3	14	14	14

conductivity of soil chart (9)

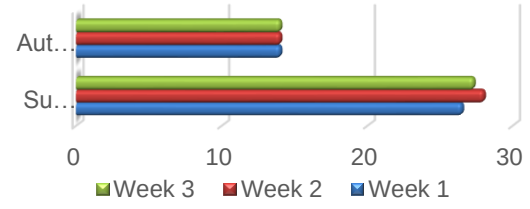


Table (27) Comparison of soil Salinity

period	Summer			Autumn		
	1	2	3	1	2	3
ppt	17.5	18	17	9	9	9

soil Salinity chart (10)

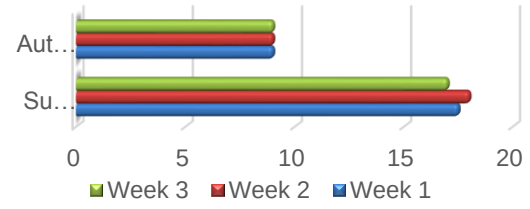


Table (28) DTS in soil Comparison

period	Summer			Autumn		
	1	2	3	1	2	3
g/L	18.2	18.5	18	9	9	9

DTS in soil chart (11)

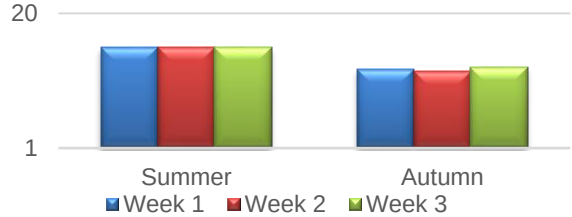
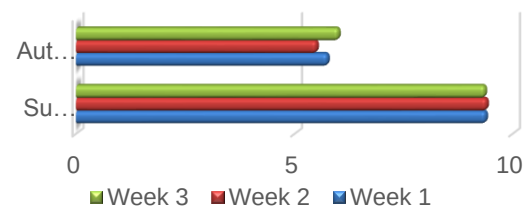


Table (29) pH of soil

period	Summer			Autumn		
	1	2	3	1	2	3
pH	9.38	9.4	9.36	5.75	5.5	6

pH of soil chart (12)



Second: Interview results:

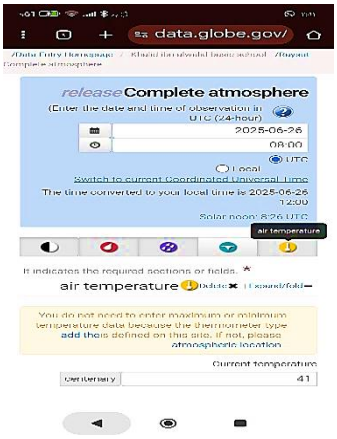
1 - Dr Ahmed bin Bakhit al-Shanfari, Director of the Agricultural and Animal Research Department in Dhofar, reported that the province of Dhofar is suffering from desertification as a result of climate change in the Gulf region, which has led to a decline and deterioration of arable land.

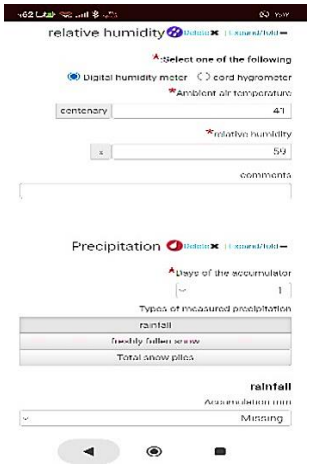
2 - Engineer Mohammed Abood Al-Masheli, soil and water researcher at the Agricultural and Animal Research Department, stated that soil degradation and decline in soil quality are problems we suffer from as a result of high temperatures and drought.

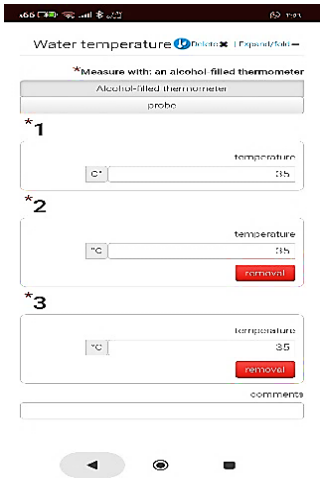
3 – Mr Ali Salem Beit Saeed, Director General of the Environment Authority in Dhofar, stated that the Environment Authority is doing its job and monitoring the development of this problem, as well as monitoring soil, air and water quality and grazing in agricultural areas.

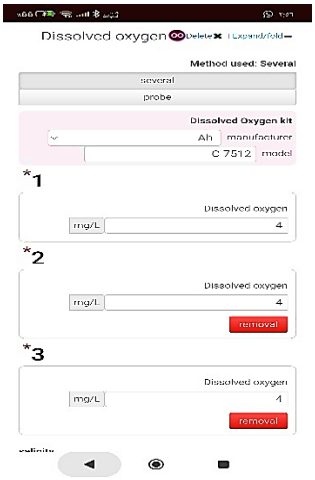
4 – Dr. Salim Ahmed Salim, environmental expert at the Environment Authority, stated that the climate changes affecting the region have a significant impact on the growth of this problem and that everyone must cooperate to minimise its impact.

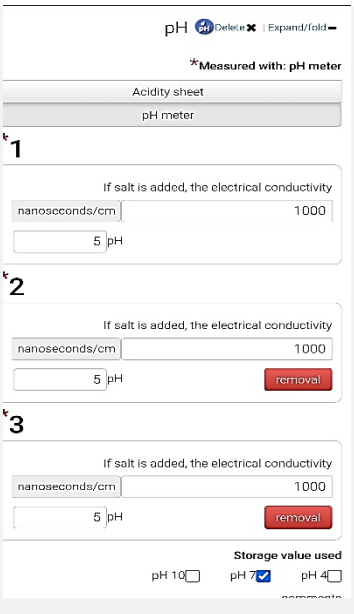
Part of the data entered on the program's website (WWW.GLOBE.gov)

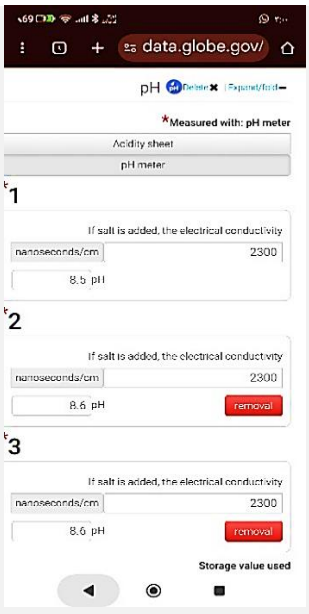


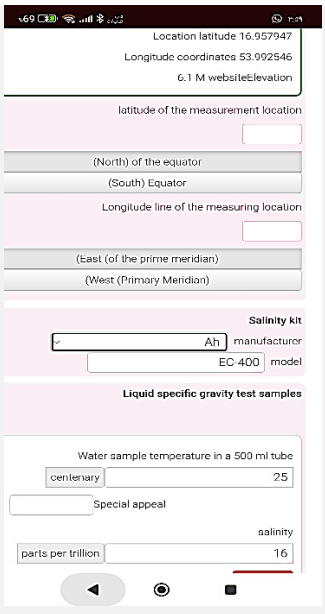


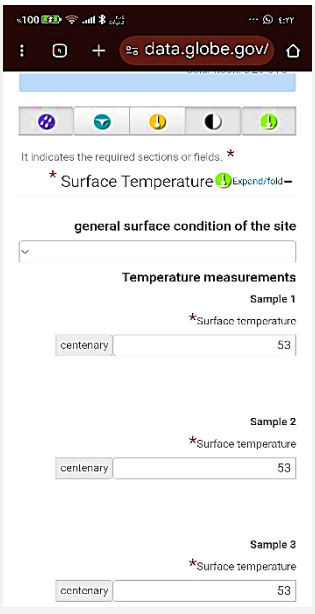




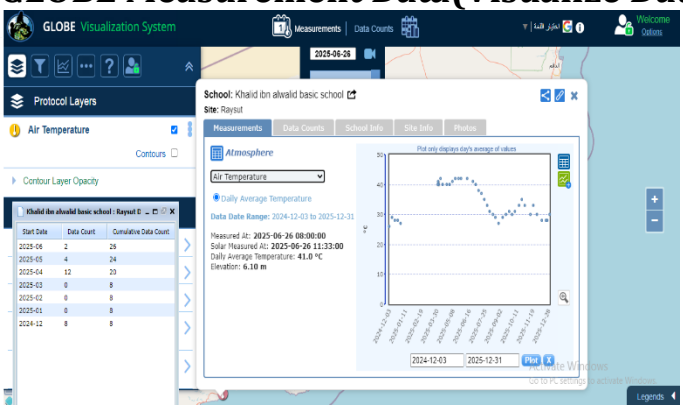


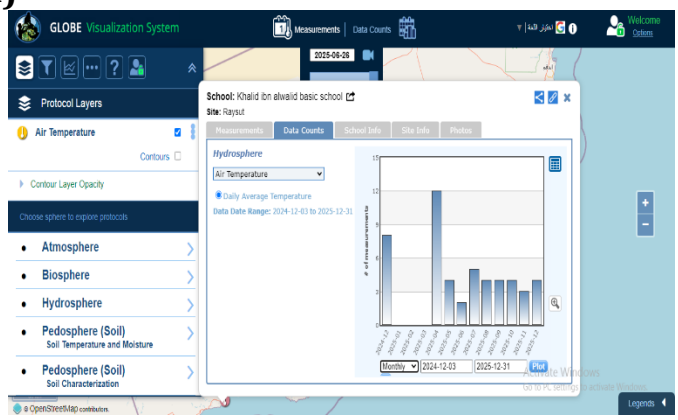


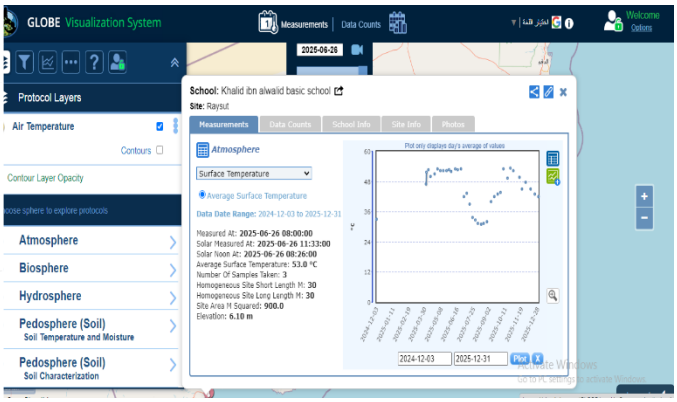


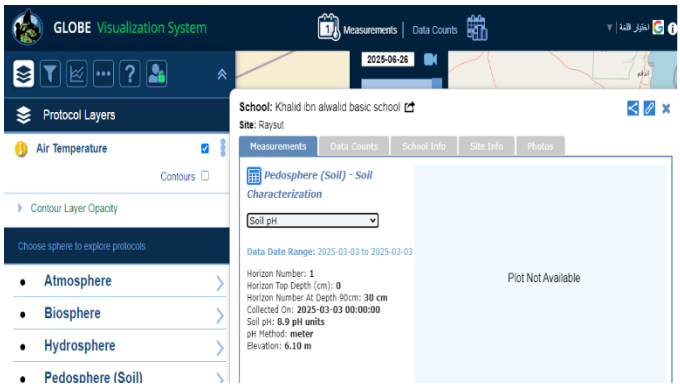


GLOBE Measurement Data(Visualize Data)



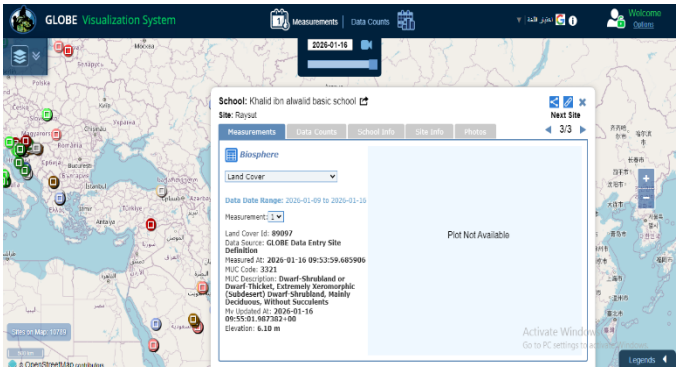




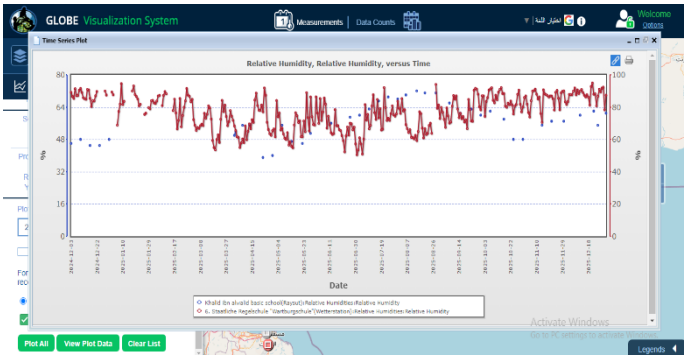


a,b,c Measurements of Khalid ibn al-Walid School,Warburg School,and Sawda Umm al-Mu'minin School

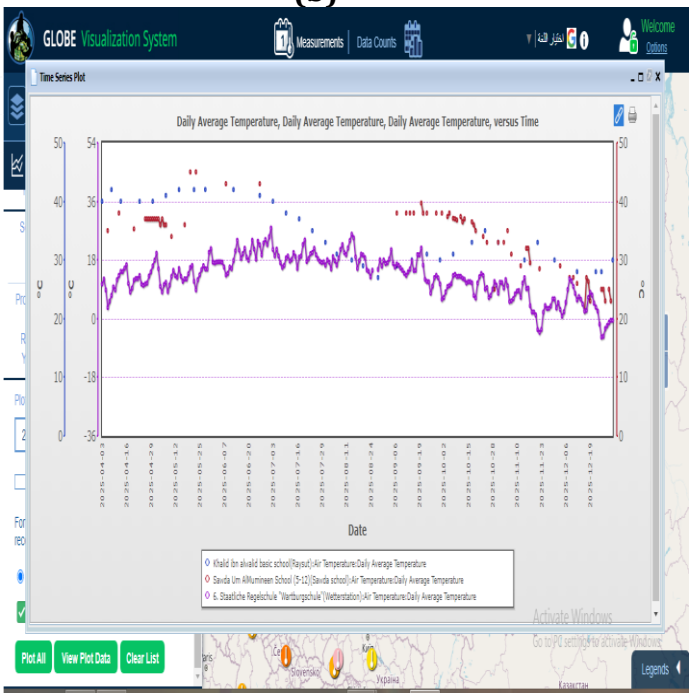
(a)

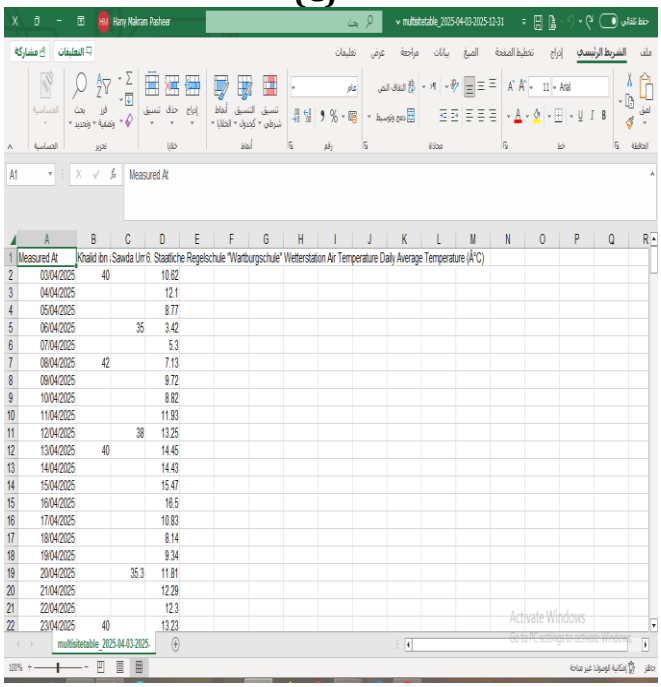


(b)

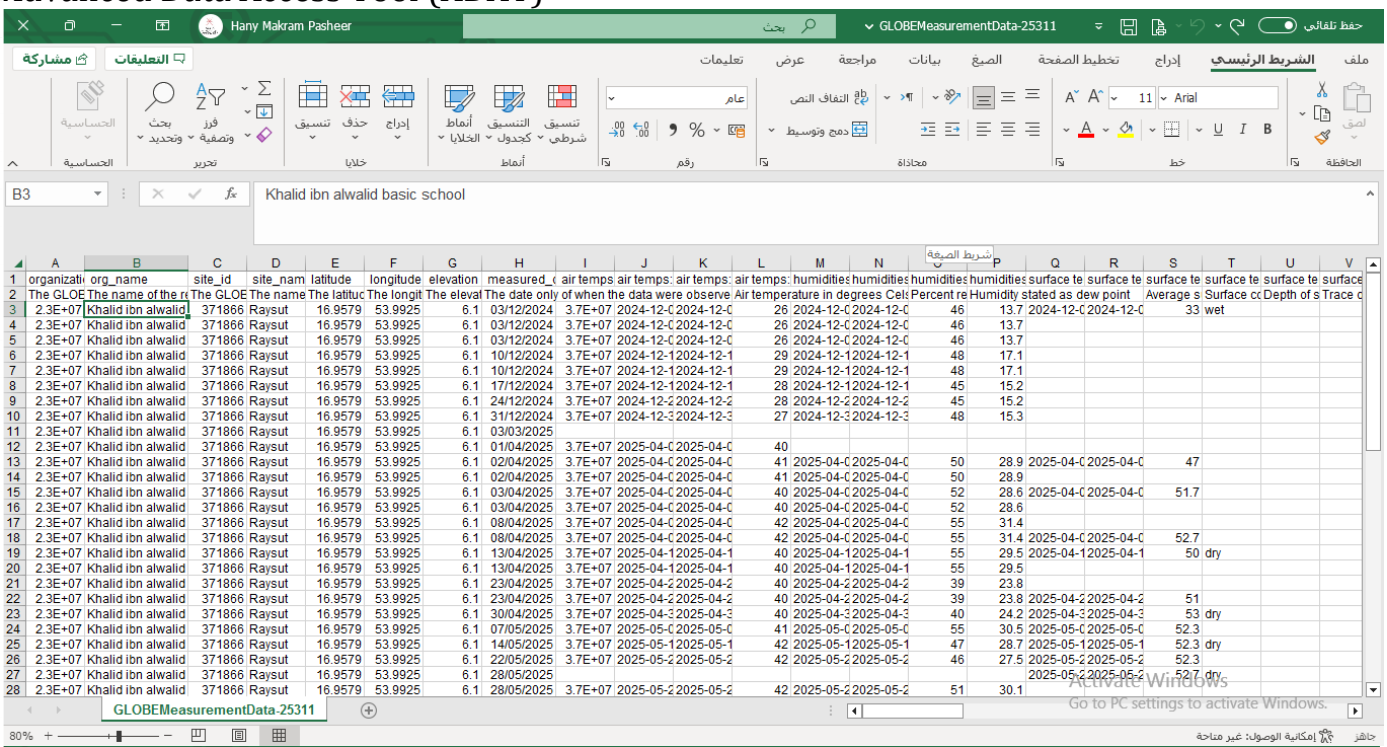


(C)

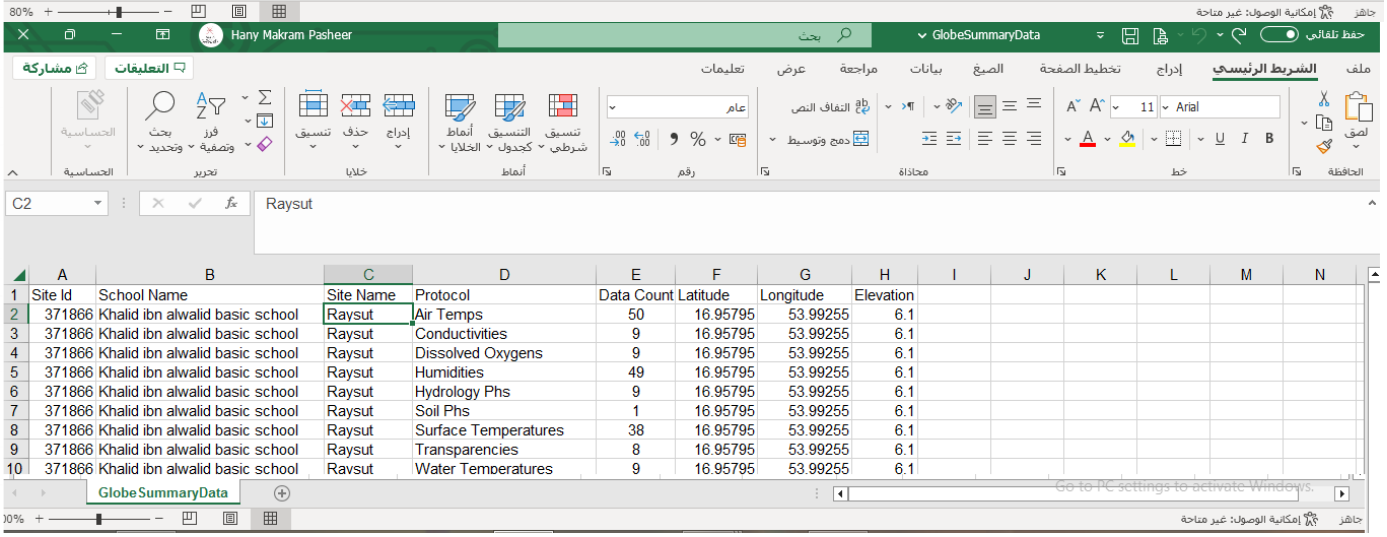




Advanced Data Access Tool (ADAT)

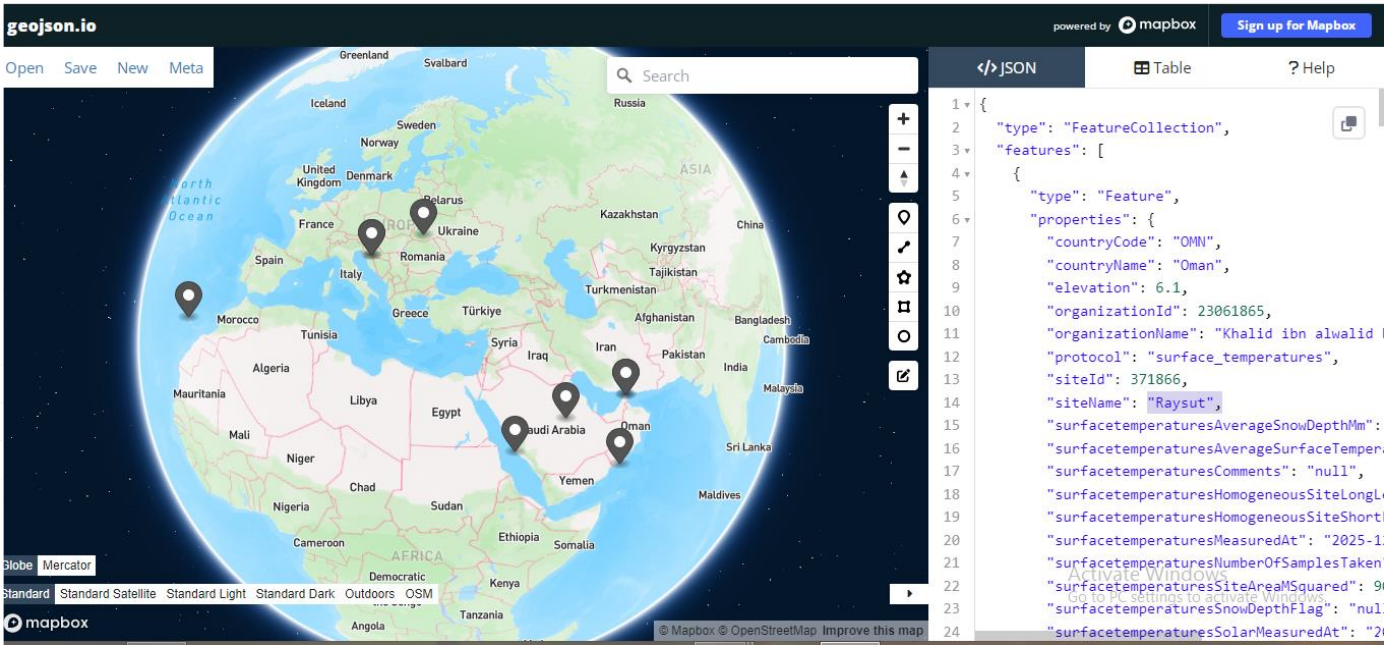


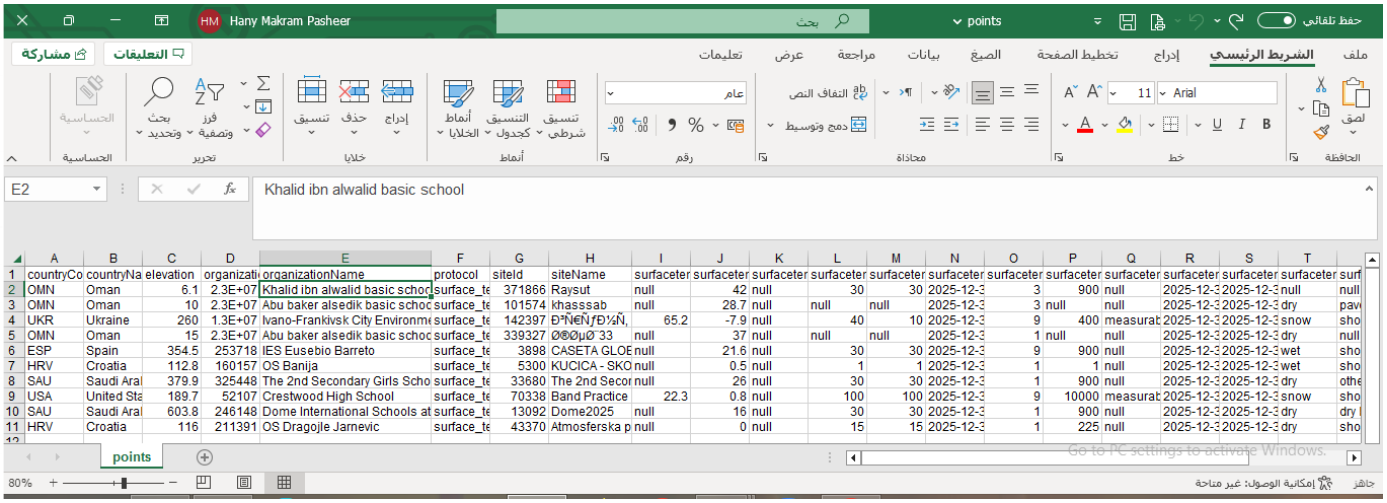
organizati	org_name	site_id	site_nam	latitude	longitude	elevation	measured_	air temps	air temps:	air temps:	air temps:	humidities	humidities	humidities	humidities	surface te	surface te	surface te	surface te	surface te	surface
The GLOE	The name of the re	The GLOE	The name	The latituc	The longit	The elevat	The date only	of when the data were		observe	Air temperature in degrees Cels			Percent re	Humidity	stated as dew point		Average s	Surface cc	Depth of s	Trace c
2.3E+07	Khalid ibn alwalid	371866	Raysut	16.9579	53.9925	6.1	03/12/2024	3.7E+07	2024-12-0	2024-12-0	26	2024-12-0	2024-12-0	46	13.7	2024-12-0	2024-12-0	33	wet		
2.3E+07	Khalid ibn alwalid	371866	Raysut	16.9579	53.9925	6.1	03/12/2024	3.7E+07	2024-12-0	2024-12-0	26	2024-12-0	2024-12-0	46	13.7						
2.3E+07	Khalid ibn alwalid	371866	Raysut	16.9579	53.9925	6.1	03/12/2024	3.7E+07	2024-12-0	2024-12-0	26	2024-12-0	2024-12-0	46	13.7						
2.3E+07	Khalid ibn alwalid	371866	Raysut	16.9579	53.9925	6.1	10/12/2024	3.7E+07	2024-12-1	2024-12-1	29	2024-12-1	2024-12-1	48	17.1						
2.3E+07	Khalid ibn alwalid	371866	Raysut	16.9579	53.9925	6.1	10/12/2024	3.7E+07	2024-12-1	2024-12-1	29	2024-12-1	2024-12-1	48	17.1						
2.3E+07	Khalid ibn alwalid	371866	Raysut	16.9579	53.9925	6.1	17/12/2024	3.7E+07	2024-12-1	2024-12-1	28	2024-12-1	2024-12-1	45	15.2						
2.3E+07	Khalid ibn alwalid	371866	Raysut	16.9579	53.9925	6.1	24/12/2024	3.7E+07	2024-12-2	2024-12-2	28	2024-12-2	2024-12-2	45	15.2						
2.3E+07	Khalid ibn alwalid	371866	Raysut	16.9579	53.9925	6.1	31/12/2024	3.7E+07	2024-12-3	2024-12-3	27	2024-12-3	2024-12-3	48	15.3						
2.3E+07	Khalid ibn alwalid	371866	Raysut	16.9579	53.9925	6.1	03/03/2025														
2.3E+07	Khalid ibn alwalid	371866	Raysut	16.9579	53.9925	6.1	01/04/2025	3.7E+07	2025-04-0	2025-04-0	40										
2.3E+07	Khalid ibn alwalid	371866	Raysut	16.9579	53.9925	6.1	02/04/2025	3.7E+07	2025-04-0	2025-04-0	41	2025-04-0	2025-04-0	50	28.9	2025-04-0	2025-04-0	47			
2.3E+07	Khalid ibn alwalid	371866	Raysut	16.9579	53.9925	6.1	02/04/2025	3.7E+07	2025-04-0	2025-04-0	41	2025-04-0	2025-04-0	50	28.9						
2.3E+07	Khalid ibn alwalid	371866	Raysut	16.9579	53.9925	6.1	03/04/2025	3.7E+07	2025-04-0	2025-04-0	40	2025-04-0	2025-04-0	52	28.6	2025-04-0	2025-04-0	51.7			
2.3E+07	Khalid ibn alwalid	371866	Raysut	16.9579	53.9925	6.1	03/04/2025	3.7E+07	2025-04-0	2025-04-0	40	2025-04-0	2025-04-0	52	28.6						
2.3E+07	Khalid ibn alwalid	371866	Raysut	16.9579	53.9925	6.1	08/04/2025	3.7E+07	2025-04-0	2025-04-0	42	2025-04-0	2025-04-0	55	31.4						
2.3E+07	Khalid ibn alwalid	371866	Raysut	16.9579	53.9925	6.1	08/04/2025	3.7E+07	2025-04-0	2025-04-0	42	2025-04-0	2025-04-0	55	31.4	2025-04-0	2025-04-0	52.7			
2.3E+07	Khalid ibn alwalid	371866	Raysut	16.9579	53.9925	6.1	13/04/2025	3.7E+07	2025-04-1	2025-04-1	40	2025-04-1	2025-04-1	55	29.5	2025-04-1	2025-04-1	50	dry		
2.3E+07	Khalid ibn alwalid	371866	Raysut	16.9579	53.9925	6.1	13/04/2025	3.7E+07	2025-04-1	2025-04-1	40	2025-04-1	2025-04-1	55	29.5						
2.3E+07	Khalid ibn alwalid	371866	Raysut	16.9579	53.9925	6.1	23/04/2025	3.7E+07	2025-04-2	2025-04-2	40	2025-04-2	2025-04-2	39	23.8						
2.3E+07	Khalid ibn alwalid	371866	Raysut	16.9579	53.9925	6.1	23/04/2025	3.7E+07	2025-04-2	2025-04-2	40	2025-04-2	2025-04-2	39	23.8	2025-04-2	2025-04-2	51			
2.3E+07	Khalid ibn alwalid	371866	Raysut	16.9579	53.9925	6.1	30/04/2025	3.7E+07	2025-04-3	2025-04-3	40	2025-04-3	2025-04-3	40	24.2	2025-04-3	2025-04-3	53	dry		
2.3E+07	Khalid ibn alwalid	371866	Raysut	16.9579	53.9925	6.1	07/05/2025	3.7E+07	2025-05-0	2025-05-0	41	2025-05-0	2025-05-0	55	30.5	2025-05-0	2025-05-0	52.3			
2.3E+07	Khalid ibn alwalid	371866	Raysut	16.9579	53.9925	6.1	14/05/2025	3.7E+07	2025-05-1	2025-05-1	42	2025-05-1	2025-05-1	47	28.7	2025-05-1	2025-05-1	52.3	dry		
2.3E+07	Khalid ibn alwalid	371866	Raysut	16.9579	53.9925	6.1	22/05/2025	3.7E+07	2025-05-2	2025-05-2	42	2025-05-2	2025-05-2	46	27.5	2025-05-2	2025-05-2	52.3			
2.3E+07	Khalid ibn alwalid	371866	Raysut	16.9579	53.9925	6.1	28/05/2025									2025-05-2	2025-05-2	52.7	dry		
2.3E+07	Khalid ibn alwalid	371866	Raysut	16.9579	53.9925	6.1	28/05/2025	3.7E+07	2025-05-2	2025-05-2	42	2025-05-2	2025-05-2	51	30.1						



Site Id	School Name	Site Name	Protocol	Data Count	Latitude	Longitude	Elevation
371866	Khalid ibn alwalid basic school	Raysut	Air Temps	50	16.95795	53.99255	6.1
371866	Khalid ibn alwalid basic school	Raysut	Conductivities	9	16.95795	53.99255	6.1
371866	Khalid ibn alwalid basic school	Raysut	Dissolved Oxygens	9	16.95795	53.99255	6.1
371866	Khalid ibn alwalid basic school	Raysut	Humidities	49	16.95795	53.99255	6.1
371866	Khalid ibn alwalid basic school	Raysut	Hydrology Phs	9	16.95795	53.99255	6.1
371866	Khalid ibn alwalid basic school	Raysut	Soil Phs	1	16.95795	53.99255	6.1
371866	Khalid ibn alwalid basic school	Raysut	Surface Temperatures	38	16.95795	53.99255	6.1
371866	Khalid ibn alwalid basic school	Raysut	Transparencies	8	16.95795	53.99255	6.1
371866	Khalid ibn alwalid basic school	Raysut	Water Temperatures	9	16.95795	53.99255	6.1

GLOBE API





Hany Makram Pasheer — points

E2: Khalid ibn alwalid basic school

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	countryCo	countryNa	elevation	organizati	organizationName	protocol	siteId	siteName	surfaceter	surfaceter	surfaceter	surfaceter	surfaceter	surfaceter	surfaceter	surfaceter	surfaceter	surfaceter	surfaceter	surf
2	OMN	Oman	6.1	2.3E+07	Khalid ibn alwalid basic schoc	surface_te	371866	Raysut	null	42	null	30	30	2025-12-3	3	900	null	2025-12-3	2025-12-3	null
3	OMN	Oman	10	2.3E+07	Abu baker alsedik basic schoc	surface_te	101574	khasssab	null	28.7	null	null	null	2025-12-3	3	null	null	2025-12-3	2025-12-3	dry
4	UKR	Ukraine	260	1.3E+07	Ivano-Frankivsk City Environme	surface_te	142397	Ð°ÑëÑƒÐ½Ñ,	65.2	-7.9	null	40	10	2025-12-3	9	400	measurat	2025-12-3	2025-12-3	snow
5	OMN	Oman	15	2.3E+07	Abu baker alsedik basic schoc	surface_te	339327	Ø®Ø¡Ø 33	null	37	null	null	null	2025-12-3	1	null	null	2025-12-3	2025-12-3	dry
6	ESP	Spain	354.5	253718	IES Eusebio Barreto	surface_te	3898	CASETA GLOE	null	21.6	null	30	30	2025-12-3	9	900	null	2025-12-3	2025-12-3	wet
7	HRV	Croatia	112.8	160157	OS Banija	surface_te	5300	KUCICA - SKO	null	0.5	null	1	1	2025-12-3	1	1	null	2025-12-3	2025-12-3	wet
8	SAU	Saudi Aral	379.9	325448	The 2nd Secondary Girls Scho	surface_te	33680	The 2nd Secor	null	26	null	30	30	2025-12-3	1	900	null	2025-12-3	2025-12-3	dry
9	USA	United Sta	189.7	52107	Crestwood High School	surface_te	70338	Band Practice	22.3	0.8	null	100	100	2025-12-3	9	10000	measurat	2025-12-3	2025-12-3	snow
10	SAU	Saudi Aral	603.8	246148	Dome International Schools at	surface_te	13092	Dome2025	null	16	null	30	30	2025-12-3	1	900	null	2025-12-3	2025-12-3	dry
11	HRV	Croatia	116	211391	OS Dragojle Jarnevic	surface_te	43370	Atmosferska p	null	0	null	15	15	2025-12-3	1	225	null	2025-12-3	2025-12-3	dry

SATELLITE DATA

GLOBE Cloud Observations Paired with NASA Satellite Data

Total Satellite Comparisons: 186

Useful Resources: How to Read My NASA GLOBE Clouds Satellite Comparison Table, How to Compare My Cloud Observations with Satellite Data, Cloud Cover, Cloud Type, Cloud Opacity, Satellites

Observation	GLOBE	METEOSAT-9 Satellite	NOAA-20 Satellite
Universal Date/Time	2025-10-04 10:00:00	2025-10-04 10:10	2025-10-04 10:10
Latitude	17.01	16.69 to 17.33	16.64 to 17.44
Longitude	54.05	53.73 to 54.37	53.68 to 54.48
Total Cloud Cover	Isolated (10-25%)	Few 6.80%	Isolated 16.34%
High Clouds	Cirrus Cover: Isolated (10-25%) Opacity: Transparent	No Clouds	Cover: Few (9.42%) Altitude: 16.22 (km) Phase: Ice 199.4 (K) Opacity: Transparent
Mid Clouds		No Clouds	Cover: Few (1.21%) Altitude: 2.95 (km) Phase: Ice/Water Mix 286.88 (K) Opacity: Transparent
Low Clouds		Cover: Few (6.80%) Altitude: 0.16 (km) Phase: Water 307.73 (K) Opacity: Translucent	Cover: Few (5.72%) Altitude: 0.93 (km) Phase: Ice/Water Mix 300.73 (K) Opacity: Transparent
GLOBE Cloud Photos and		*METEOSAT-9* Visible	*VIIRS NOAA-20* Worldview

GLOBE Cloud Observations Paired with NASA Satellite Data

Total Satellite Comparisons: 186

Useful Resources: How to Read My NASA GLOBE Clouds Satellite Comparison Table, How to Compare My Cloud Observations with Satellite Data, Cloud Cover, Cloud Type, Cloud Opacity, Satellites

Observation	GLOBE	METEOSAT-9 Satellite	NOAA-20 Satellite
Universal Date/Time	2025-10-26 10:10:00	2025-10-26 10:10	2025-10-26 09:58
Latitude	17.01	16.69 to 17.33	16.6 to 17.4
Longitude	54.05	53.73 to 54.37	53.63 to 54.43
Total Cloud Cover	Scattered (25-50%)	Scattered 25.74%	Scattered 40.50%
High Clouds		Cover: Few (7.92%) Altitude: 11.6 (km) Phase: Ice/Water Mix 247.45 (K) Opacity: Transparent	Cover: Isolated 22.88% Altitude: 11.9 (km) Phase: Ice/Water Mix 225.07 (K) Opacity: Transparent
Mid Clouds	Altostratus Cover: Scattered (25-50%) Opacity: Transparent	Cover: Few (4.95%) Altitude: 2.78 (km) Phase: Water 290.84 (K) Opacity: Transparent	Cover: Few (8.84%) Altitude: 3.52 (km) Phase: Ice/Water Mix 282.28 (K) Opacity: Transparent
Low Clouds		Cover: Isolated 12.87% Altitude: 1.07 (km) Phase: Water 298.4 (K) Opacity: Transparent	Cover: Few (8.78%) Altitude: 1.67 (km) Phase: Water 295.49 (K) Opacity: Transparent
GLOBE Cloud Photos and		*METEOSAT-9* Visible	*VIIRS NOAA-20* Worldview

GLOBE Cloud Observations Paired with NASA Satellite Data

Total Satellite Comparisons: 186

Useful Resources: How to Read My NASA GLOBE Clouds Satellite Comparison Table, How to Compare My Cloud Observations with Satellite Data, Cloud Cover, Cloud Type, Cloud Opacity, Satellites

Observation	GLOBE	METEOSAT-9 Satellite
Universal Date/Time	2025-08-20 08:00:00	2025-08-20 08:10
Latitude	16.96	16.64 to 17.28
Longitude	53.99	53.67 to 54.31
Total Cloud Cover	Overcast (>90%)	Overcast 100.00%
High Clouds	Cirrocumulus Cover: Scattered (25-50%)	Cover: Broken 89.43% Altitude: 11.43 (km) Phase: Ice/Water Mix 244.05 (K) Opacity: Opaque
Mid Clouds	Altocumulus Cover: Scattered (25-50%) Opacity: Opaque	Cover: Isolated 10.57% Altitude: 5.21 (km) Phase: Water 273.53 (K) Opacity: Translucent
Low Clouds		
GLOBE Cloud Photos and Corresponding NASA Satellite		*METEOSAT-9* Visible Infrared

8-Discussion of results

After collecting and presenting the data, which was previously summarized in tables and graphs that express the measurements and readings taken during the application of the protocols, all of which answer the research questions:

To answer the third and fourth questions in the research through interviews with all parties concerned with the subject of the study: All experts agree that climate changes, in terms of rising temperatures and drought, are factors that the region is going through, as well as negative human activities in terms of industrial and commercial activities and urban expansion, have had a clear impact on the deterioration of agricultural lands and the increase of desertification in the region

To answer the first and second questions, protocols for the atmosphere, Hydrosphere, soil, land cover, and vegetation were implemented at the study site during different time periods. Comparing the results, it was found that:

1- As shown in Tables (8 and 13) of the Atmospheric Protocol, the average air temperature in summer was 41.5°C, consistently higher than in autumn (31°C). Summer rainfall was negligible, while in autumn it averaged 2 mm. Relative humidity also decreased in summer,averaging 51% compared to 69% in autumn. The high temperature in summer, coinciding with the dry season, exposes the soil to heat stress and reduces vegetation cover.

2 - As shown in Tables (9 and 14) of the Water Protocol:

- In summer the average water temperature is (35°C) while in autumn (25°C). Also, all measurements in summer of conductivity, salinity, dissolved substances and alkalinity are clearly higher than in autumn, as well as a decrease in dissolved oxygen in the water, which has an effect on the soil and groundwater in the region.

3- As shown in Tables (10-11) and (15-16), the soil protocol here demonstrates the impact of thermal changes on the soil. There is a significant difference in surface soil temperature. The average temperature in summer is 52.5°C, while the average soil temperature in autumn is 31.5°C. Furthermore, all measurements in summer (conductivity, salinity, dissolved substances, and alkalinity) are significantly higher than in autumn. This is due to the high air temperature and lack of rainfall during the summer, leading to rapid evaporation and increased soil salinity and alkalinity. This also affects soil properties, particularly soil structure, as shown in Tables (12-17).

- The ground cover and vegetation protocol also indicate Non-existence of trees and a scarcity of shrubs in the area, along with a lack of cultivated plants and the presence of short, dry grasses. The ground cover is classified as 3321 according to the MUC classification.

- The study was supported by measurements from two schools, one of which has

a climate like ours in terms of temperature, humidity, and ground cover and vegetation, namely Sawda Umm Al-Mu'minin School (Oman), and another school whose climate is different from ours, namely Wartburg School (Germany).
The difference in measurements was clear, which led to a difference in ground cover and vegetation between them.

9-Conclusions

The research aimed to study the causes of desertification in the Dhofar Governorate. This was achieved by the research team identifying the study site (Raysut region), as shown on the attached map, and implementing a protocol for the atmosphere, soil, Hydrosphere, land cover, and vegetation during two different time periods (summer and autumn). The team then assessed the extent to which the region was affected to test the first hypothesis we formulated. Field interviews were conducted to test the second hypothesis.The results confirmed that desertification in Raysut is due to the impact of climate changes that the region has experienced, as follows: First, the atmospheric protocol revealed that the average air temperature in Raysut is high and humidity is low for most of the year, leading to rapid evaporation from the soil and increased salinity. This has negatively impacted soil quality, causing degradation and the gradual disappearance of vegetation cover Project Management(2018).
Second, the Hydrosphere protocol demonstrated that the water has been affected by an increase in groundwater levels, an increase in temperature and salinity, and a decrease in dissolved oxygen. Furthermore, the high pH indicates alkalinity, which is related to the percentage of solids in the water. This has negatively impacted soil quality and the types of plants that grow in it.
Third, the soil protocol results supported those of the water protocol, showing a significant difference in average soil temperature 47.5°C and surface temperature 52.5°C compared to autumn 33.5°C and surface temperature 31.5°C. This difference leads to thermal stress in the soil, resulting in changes to its properties in Raysut (Al-amry,2023) .
Fourth, the land cover and vegetation protocol results clearly demonstrate the impact of climate change on the soil in the region, including rising temperatures and a semi-arid state over the decades.

- The change in weather between summer and autumn, and the changes that occur in the soil during this period, are clear evidence of the impact of climate change in general on soil quality and the reduction of arable land (ipcc2019).
- Negative human interventions affect the environment through overgrazing, industrial facilities and their byproducts,repetitive farming practices,traditional farming methods, and the use of pesticides and chemical fertilizers(ipcc2023).

Our study was supported by a master's thesis entitled "The Problem of Desertification in Diyala Governorate and its Environmental Dimensions" presented by Saleh Hassan Ali Khalaf Al-Jawhar, University of Diyala, College of Education for Human Sciences, Department of Geography - Iraq. We benefited greatly from it, and the similarity was clear in terms of research methodology and sequence, with the only differences being the age group and available research resources.

- We conclude that harsh climate change is a primary cause of desertification in Dhofar Governorate, in addition to negative human interventions.
- Strengths of the study: The collaborative spirit among the research team members and the clear division of roles, with each member playing an active part in enriching the study, and the presence of cooperation and support from all those involved in and concerned with the problem. The study's methodology and strengths, in terms of its comprehensive coverage from problem definition and goal setting to hypothesis formulation, precise site selection, and implementation of program protocols. The study also supported what we learn in our social studies course, positively impacting our research. Furthermore, we consulted with experts and experienced individuals and reviewed previous studies to arrive at our findings. The conclusion is the study's objective.
- Study weaknesses: The research team was unable to conduct the study in several locations in more remote areas within the Dhofar Governorate due to insufficient time.
- The study could be replicated in different locations across the Sultanate in various states, and this will be the objective of our next study.

10 - Thanks and appreciation

The members of the GLOBE Khalid bin Al-Walid team are pleased to extend their sincere thanks and appreciation to everyone who contributed to this study, especially:

- Members of the GLOBE team in Dhofar Governorate for their support and encouragement.
- Mr. Youssef Al-Dafai, Director of Khalid Bin Al-Walid School, for the support he provided us and for overcoming the obstacles we faced.
- We also thank all the specialists from the Environment Authority and the Ministry of Agriculture who contributed to the study.

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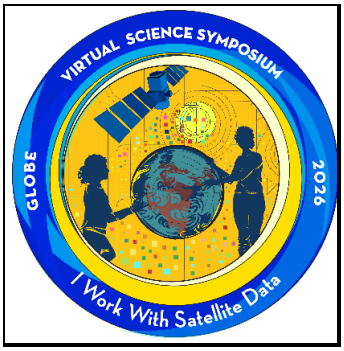
Badge descriptions

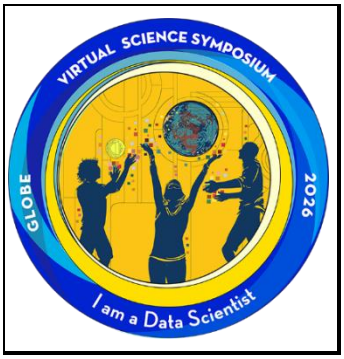


I WORK WITH SATELLITE DATA

NASA satellite mission data were used to answer research questions and to implement the Atmospher Protocol, and they played an effective role in training us and confirming our observations.(METOSAT-9 Satellite , NOAA-20 Satellite)

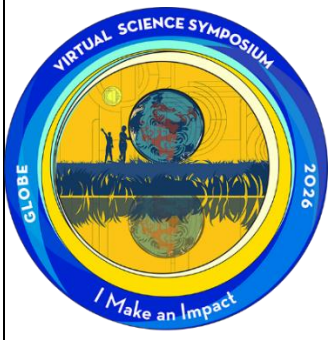
I AM A COLLABORATOR

Each student had a specific role in the study according to the schedule shown in the research, and each student's role complements the work of the other, as the team works as an integrated unit. Cooperation with all students of the program in the governorate was during the transfer of experiences by the governorate team and the use of their experiences in setting the outlines of the study and implementing the protocols. Some similar studies in other countries were also used, as mentioned in the research.



I AM A DATA SCIENTIST

By implementing the program protocols, obtaining the results, organizing them in tables, analyzing them, and expressing them graphically to facilitate their study, and from there reaching a conclusion and providing recommendations and solutions for the purpose of the study, and using the GLOBE database and some studies similar to the subject of our study, as shown in the attached references.



I MAKE AN IMPACT

Our aim in this study was to address a problem that, while global, is local to our community: desertification and its negative impact. It was essential to study the problem, understand its causes, and develop solutions and recommendations that would positively impact the community and preserve the ecological balance and our natural resources. We also published information on the school websites, such as the "Let's Go" campaign, to raise awareness about the dangers of desertification, encourage action, and disseminate recommendations. This had a clear and effective impact on all stakeholders.

https://x.com/EduGovDhf8109/status/2010055506065531209?s=20

https://x.com/EduGovDhf8109/status/2015012628884799744?s=20