A comparative research study on relative humidity in the soil in four different regions of Israel

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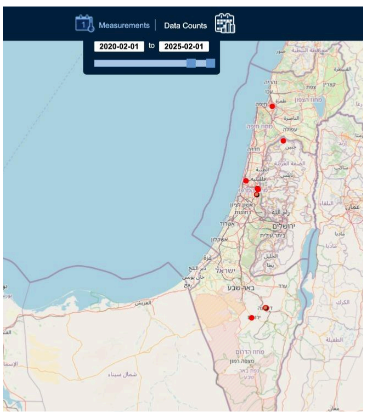
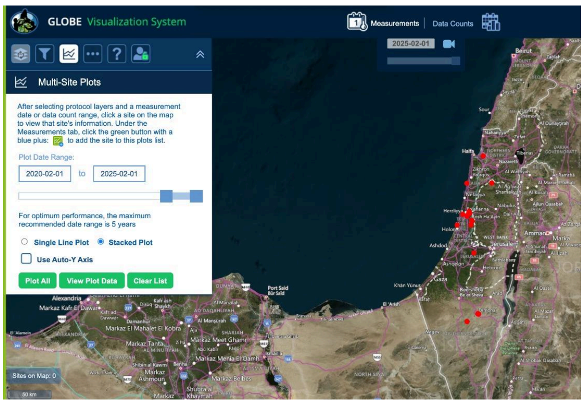
School: Begin, Dimona

Collaboration: Afek, Rush Haayin, Dir Hanna, Alterman Herzliya

Observation analysis time: 16/02-27/2





The Problem

This comparative study examined the impact of soil type on relative humidity across four schools in Israel, conducting a year-long collaborative research project. Soil plays a crucial role in water retention, infiltration, and evaporation, directly influencing agriculture, ecological stability, and water resource management. Different soil types have varying capacities to retain moisture, affecting local humidity levels and environmental conditions. To explore these variations, students followed the SMAP protocol, conducting research under identical conditions on the same days each week. They participated in cultural learning sessions, studying Arabic and Hebrew, and later reconvened to exchange data and draw conclusions. Understanding these soil-related differences is essential for sustainable water management and efficient land use planning, particularly in diverse climatic regions like Israel.

Research Question:

How different Soil Type influences Relative Humidity in Four Regions of Israel?

Objectives Set

- To analyze the effect of different **soil types** (sandy, clayey, loamy) on **relative humidity** in four distinct **geographic regions** of Israel.
- To assess how **climatic factors** (precipitation, evaporation, and cloud cover) interact with soil moisture retention.
- To provide **data-driven insights** that support **agricultural planning** and **environmental sustainability**.
- To contribute to **global soil-climate research** through **the GLOBE program and SMAP protocol**.

Conclusions

- **Clay soils (Rosh HaAyin)** retain higher moisture levels due to **fine particle size and high water absorption capacity**.
- **Sandy soils (Dimona)** have **low moisture retention**, influenced by **high evaporation rates in arid climates**.
- **Red Loam (red sandy clay soil) soils (Dir Hanna)** show **moderate moisture retention**, balancing **water absorption and drainage** effectively.
- **Mixed sandy-clay soil (Herzliya, near the mediterranean sea)** demonstrates **humidity variations linked to proximity to the sea**, with fluctuating moisture levels.
- These findings highlight the importance of **soil type in sustainable water resource management and agricultural adaptation**.
- Future research should **expand seasonal observations**, integrate **predictive modeling**, and examine **additional factors like vegetation and erosion** to refine soil-climate interaction analysis.

Introduction

Description of the Problem

In an era of rapid **climate change and environmental challenges**, understanding the interaction between **soil type and relative humidity** is critical for **sustainable water management and agricultural development**. Soil properties affect **water infiltration, retention, and evaporation**, which in turn influence **local humidity, plant growth, and ecosystem stability**. Israel, with its **diverse climatic regions**, provides an ideal setting for studying these interactions.

Significant variations exist in **soil moisture retention** across different regions, impacting **agriculture, water conservation, and land-use planning**. By examining how **soil type influences humidity levels**, this study contributes to a broader understanding of **earth systems and environmental sustainability**.

Soil moisture plays a crucial role in **Earth's water cycle**, affecting **climate regulation, drought resilience, and ecosystem health**. Understanding **how different soil types retain water** can help improve **irrigation efficiency, prevent soil degradation, and optimize land management practices**.

This research is particularly relevant for **semi-arid and arid regions**, where **water scarcity is a growing concern**. By identifying **patterns in soil moisture retention**, policymakers, farmers, and environmental scientists can **develop better strategies for water conservation and sustainable agriculture**.

Moreover, this study aligns with **global scientific efforts** to monitor **soil-climate interactions**, using standardized data collection methods such as the **GLOBE SMAP protocol**. This ensures that the findings contribute to **both local and international environmental research initiatives**.

Community Relevance

The findings of this study have **direct implications for local communities**, particularly in **agriculture, urban planning, and environmental sustainability**. In Israel, where **water resources are limited**, understanding **soil moisture retention** can help improve **crop selection, irrigation techniques, and land management policies**.

Additionally, this research fosters **scientific collaboration between different communities**, including **Jewish and Arab schools**, through a shared commitment to **environmental monitoring and data collection**. By engaging students and educators in **citizen science initiatives**, this project promotes **environmental awareness, scientific literacy, and community-driven sustainability efforts**.

The study's findings will help local communities:

- **Improve agricultural planning** based on soil moisture patterns.
- **Optimize water usage** in irrigation and conservation efforts.
- **Develop long-term land-use strategies** that align with climate resilience.
- **Enhance environmental education** and awareness through collaborative research.

By addressing both **scientific and practical concerns**, this research bridges the gap between **academic study and real-world environmental challenges**, making a meaningful impact at both the **local and global levels**.

Research Methods

Link Between Datasets and Research Questions

The data collected in this study directly addresses the research question: **"How does soil type influence relative humidity in different regions of Israel?"**. By analyzing soil moisture retention across **four geographic locations**, the study examines the correlation between **soil type, atmospheric humidity, and climatic conditions**. The research employs the **GLOBE SMAP protocol**, ensuring accurate and standardized data collection, allowing for **comparative analysis** and contributing to **global environmental research**.

This study was conducted in **four distinct regions in Israel**, representing **different climatic zones and soil types**:

1. **Dimona (Negev Desert – Arid Climate)**
   - **Climate:** Extreme aridity, **low precipitation (<200mm annually)**, high evaporation.
   - **Soil Type: Sandy soil**, characterized by **low water retention** and **rapid drainage**.
2. **Dir Hanna (Mediterranean Climate – Northern Israel)**
   - **Climate: Moderate rainfall (600–800mm annually)**, hilly terrain with **seasonal variations**.
   - **Soil Type: Loam soil (red clay)** , with **balanced moisture retention and drainage**.
3. **Rosh HaAyin (Transition Zone – Central Israel)**
   - **Climate:** Semi-arid, **moderate precipitation (400–500mm annually)**.
   - **Soil Type: Clay soil**, with **high moisture retention and slower infiltration**.
4. **Herzliya (Coastal Region – Mediterranean Climate)**
   - **Climate:** Humid due to **proximity to the sea**, seasonal rainfall (**700–1000mm annually**).
   - **Soil Type: Mixed sandy-clay soil**, influenced by **sea moisture and urbanization**.

The **geographic and climatic diversity** of these study sites enables a **comprehensive analysis** of soil-moisture interactions under varying environmental conditions.

Data Collection: GLOBE Protocols and Field Methods

The study followed the **GLOBE SMAP protocol**, using standardized methods for **soil and humidity data collection**.

Sampling Methodology:

- Soil samples were collected from **each study site** using **randomized sampling** techniques.
- A total of **multiple soil samples** were taken at a **5cm depth** to assess **surface moisture retention**.
- The samples were **classified** based on **soil texture (sand, clay, loam)** and analyzed for **moisture content**.

Field Measurements:

- **Soil Moisture Measurement:**
  - Samples were weighed **before and after drying** to determine **moisture content**.
  - **A heat lamp** was used to **standardize drying conditions**.
- **Atmospheric Humidity and Climate Data:**
  - **Relative humidity, temperature, and precipitation** were recorded at each site.
  - Data was collected using **LABDISC ENVIRO**
- **Cloud Cover and Additional Observations:**
  - **Cloud type and coverage percentage** were documented to analyze atmospheric influence on soil moisture using the GLOBE clouds protocol.

The dataset collected in this study is **comprehensive and scientifically robust**, enabling a direct evaluation of the **relationship between soil type and relative humidity**. By integrating **soil texture analysis, atmospheric measurements, and climatic variables**, this research provides **significant insights into soil-climate interactions**.

The results can be applied to:

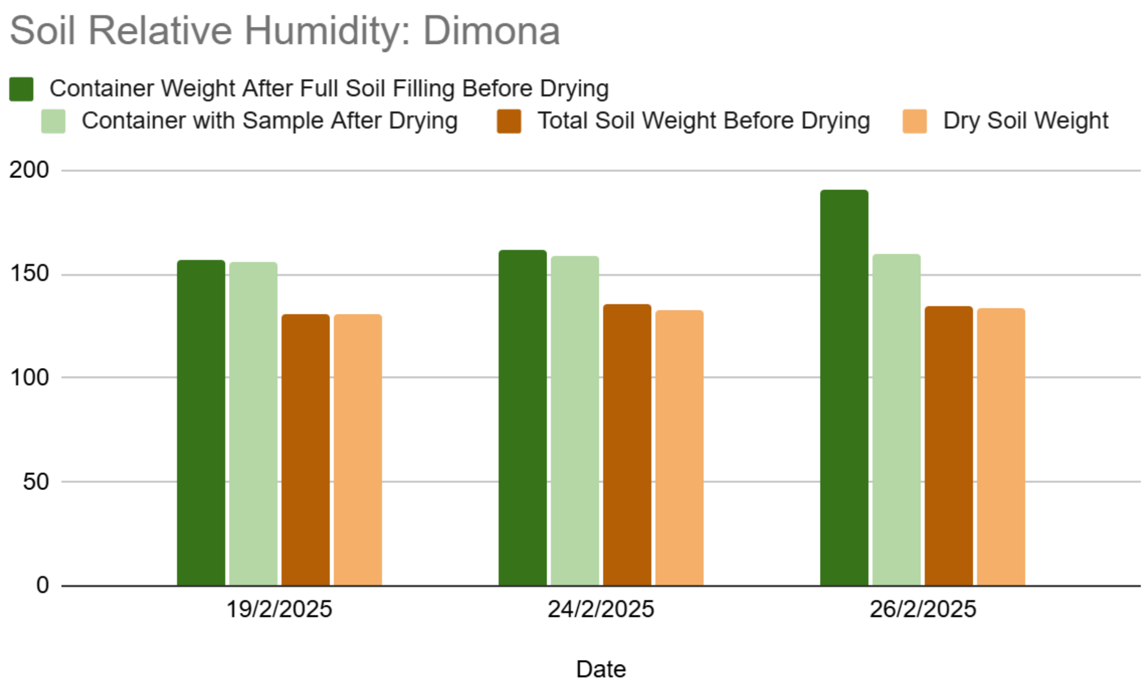
- **Agricultural optimization** – understanding soil moisture patterns for better crop selection and irrigation management.
- **Environmental sustainability** – developing **efficient water conservation** strategies.
- **Scientific modeling** – contributing to **global climate research** through the **GLOBE program**.

This study highlights the **critical role of soil properties** in **local and regional humidity regulation**, offering **valuable data for future research and policy development**.

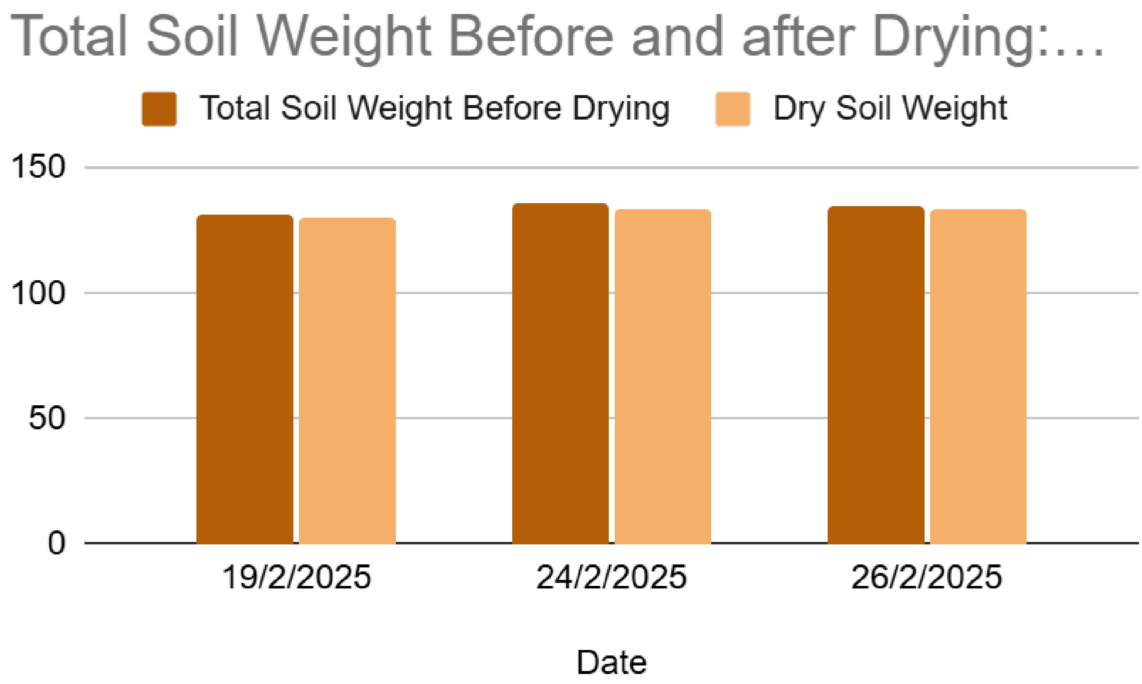
Results

Begin, Dimona

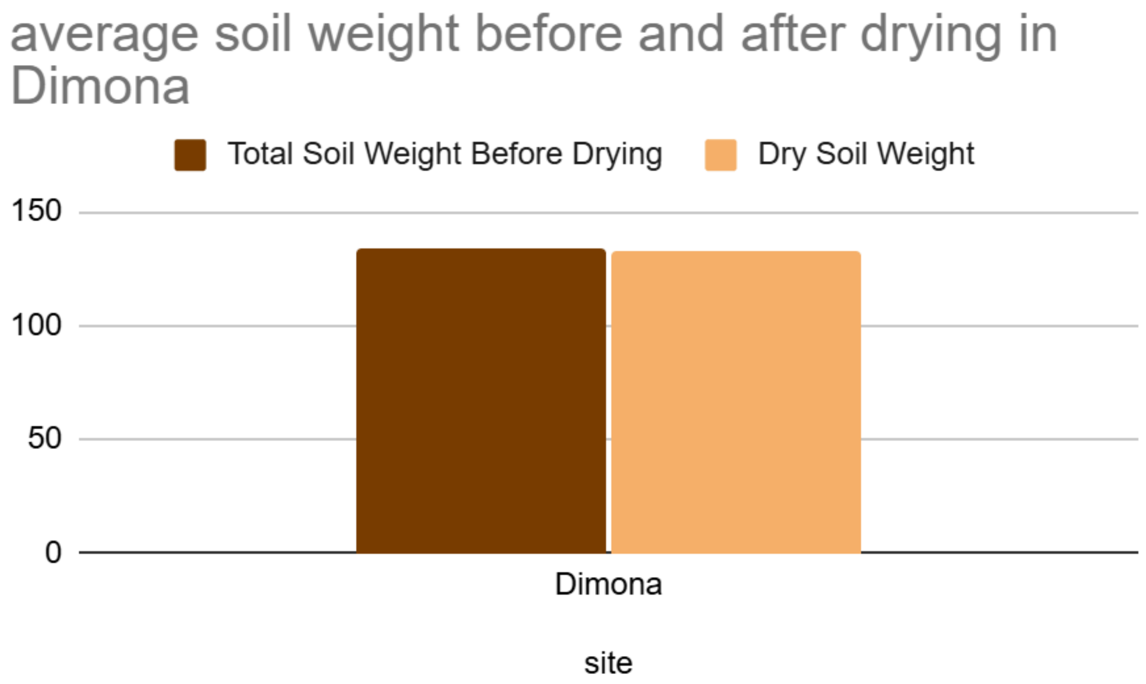
Dry Soil Weight	Total Soil Weight Before Drying	Container with Sample After Drying	Container Weight After Full Soil Filling Before Drying	Date
130.29	131	156.29	157	19/2/2025
133.14	135.36	159.14	161.86	24/2/2025
133.82	134.92	159.82	190.92	26/2/2025



Dry Soil Weight	Total Soil Weight Before Drying	Date
130.29	131	19/2/2025
133.14	135.36	24/2/2025
133.82	134.92	26/2/2025



Dry Soil Weight	Total Soil Weight Before Drying	Date
130.29	131	19/2/2025
133.14	135.36	24/2/2025
133.82	134.92	26/2/2025
132.4166667	133.76	average



ביה"ס ע"ש מנחם בגין
למדעים וטיפוח מצוינות

המשרד להגנת הסביבה
الوزارة لحماية البيئة
Israel Ministry of Environmental Protection

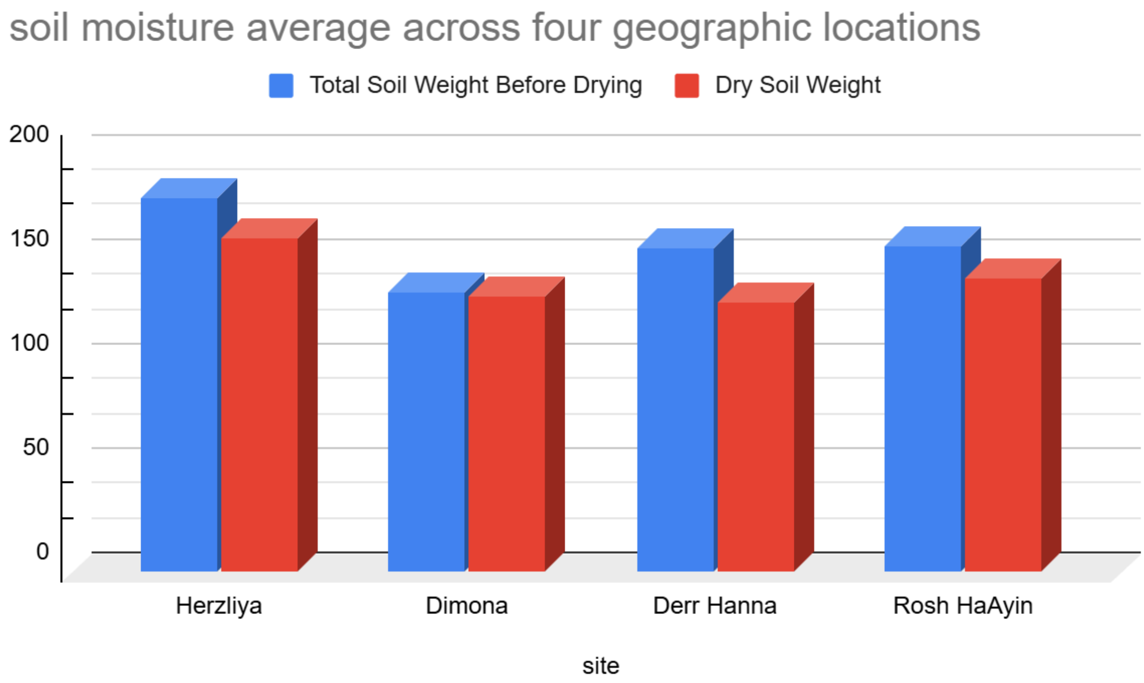
משרד החינוך

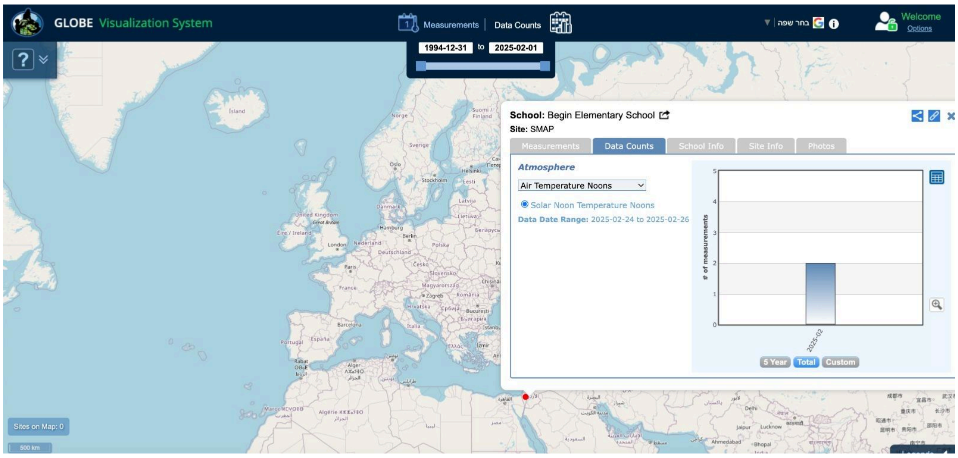
אגף מדעים

THE GLOBE PROGRAM
Global Learning and Observations to Benefit the Environment

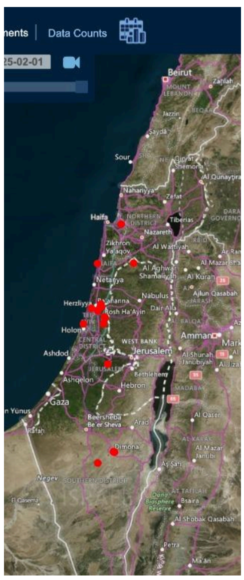
soil moisture retention across four geographic locations: soil type, atmospheric .humidity, and climatic conditions

Center - Herzliya Sandy	Center - Herzliya Sandy	Center - Herzliya Sandy	South Sandy Soil	South Sandy Soil	South Sandy Soil	North Loam Soil	North Loam Soil	North Loam Soil	Rosh HaAyin Clay Soil	Rosh HaAyin Clay Soil	Rosh HaAyin Clay Soil	Research Site
26/2	24/2	19/2	26/2	24/2	19/2	26/2	24/2	19/2	26/2	24/2	19/2	Date
18	17	17	13	13	20.7	8	7	20	15	7	8	Air Temperature
47	49	64	40	43.4	39.5	89	89	50	45	48	17.2	Air Humidity
Cirrocumulus	Cirrostratus	Altocumulus	Altocumulus	Altostratus	Cumulus	Altocumulus	Cumulus	Cirrus	Cirrus (Light Feathe(r	Cumulonimbus	Altocumulus	Cloud Type
20-50	50-90	50-90	9-50% 0%	0.9	0.7	50-90	100	20-50	0-10	50-90	50-90	Sky Cloud % Coverage
0	0	0	0	7	0	0	18	10	0	2	0	Precipitation Amount
Moist	Wet	Wet	Dry	Dry	Dry	Wet	Wet	Wet	Wet	Wet	Moist	Soil Condition
26	26	26	26	26	26	26	26	26	26	26	26	a) Container) Weight Before Filling with Soil grams
215	205	197	160.92	161.86	157	183	190	171	227.85	225.85	188.25	b) Container) Weight After Full Soil Filling Before Drying grams
189	179	171	134.92	135.36	131	157	164	145	201.85	199.85	162.25	b) - (a) = Total) Soil Weight Before Drying grams
189	192	183	159.82	159.14	156.29	147	163	153.4	205.21	204.67	179.71	Container with Sample After Drying (c) grams
161	164	155	133.82	133.14	130.29	121	138	127.4	179.21	178.67	153.71	Dry Soil Weight grams
26	13	14	1.1	2.72	0.71	26	26	17.6	22.64	21.18	8.54	Water Weight in Grams


soil moisture average across four geographic locations
Total Soil Weight Before Drying
Dry Soil Weight
200
150
100
50
0
Herzliya
Dimona
Derr Hanna
Rosh HaAyin
site


GLOBE Visualization System
Measurements
Data Counts
1994-12-31
to
2025-02-01
School: Begin Elementary School
Site: SMAP
Measurements
Data Counts
School Info
Site Info
Photos
Atmosphere
Air Temperature Noons
Solar Noon Temperature Noons
Data Date Range: 2025-02-24 to 2025-02-26
5 Year
Total
Custom


Data Counts
to
2025-02-01


Data Counts
Beirut
Haifa
Tiberias
Nazareth
Netanya
Herzliya
Rosh Ha'Ayin
Nablus
Jerusalem
Amman
Ashdod
Gaza
Hebron

Conclusion

This research study examined the impact of soil type on relative humidity across four different regions in Israel using the GLOBE SMAP protocol. By analyzing soil moisture retention in Dimona, Dir Hanna, Rosh HaAyin, and Herzliya, the study demonstrated the significant role of soil composition in regulating water availability and atmospheric humidity.

Key Findings:

- Clay soils (Rosh HaAyin) retained the highest moisture levels due to fine particle size and high water absorption capacity, making them more resistant to evaporation.
- Sandy soils (Dimona) exhibited low moisture retention, influenced by high evaporation rates in arid climates, which supports the need for effective water conservation in desert regions.
- Red Loam (Dir Hanna) demonstrated moderate moisture retention, balancing water absorption and drainage, making it suitable for agriculture.
- Mixed sandy-clay soils (Herzliya, near the Mediterranean Sea) showed humidity variations influenced by proximity to the sea, with fluctuating moisture levels affected by atmospheric humidity.

These results confirm that soil type plays a critical role in moisture retention and climate interactions, impacting agriculture, water conservation, and land management strategies.

Social and Educational Impact

Beyond its scientific value, this research was conducted as a collaborative learning project between Jewish and Arab students, fostering coexistence, teamwork, and shared scientific inquiry. The study not only advanced environmental understanding but also promoted social cohesion, encouraging dialogue and cooperation among diverse communities.

Conducting research in a shared learning environment is particularly significant in Israel, where educational initiatives that bring different communities together contribute to greater social understanding and mutual respect.

This study exemplifies how scientific collaboration can serve as a bridge for cultural and educational exchange, reinforcing the importance of joint problem-solving for environmental and societal challenges.

Future Research Recommendations:

- Expand seasonal observations to assess variations in soil moisture throughout the year.
- Integrate predictive modeling to improve understanding of long-term soil-climate interactions.
- Examine additional environmental factors such as vegetation cover, erosion, and urbanization to refine insights into soil and water conservation strategies.

This study underscores the importance of soil type in sustainable resource management while simultaneously promoting social and educational collaboration. The findings not only contribute to scientific knowledge on land-atmosphere interactions but also highlight the value of cooperative learning in advancing both environmental awareness and social harmony in Israel.

Bibliography

Materials Listed

To ensure accurate and standardized data collection, the following materials and tools were used in this research study:

Field and Laboratory Equipment:

- **Soil sampling tools** (small shovels, scoops, and containers) for collecting soil samples.
- **Digital scales** for measuring soil weight before and after drying.
- **Heat lamps** for drying soil samples and determining moisture content.
- **Hygrometers** for measuring air humidity at different research sites.
- **Thermometers** for recording air temperature.
- **Precipitation gauges** for measuring rainfall amounts at each location.
- **Cloud observation charts** for identifying cloud types and coverage percentages.
- **Data recording sheets and notebooks** for documenting field observations.

GLOBE Materials Used

This study followed the **GLOBE SMAP protocol**, using the following GLOBE-approved materials and methods:

- **GLOBE Soil Moisture Protocol** – for systematic measurement of soil moisture levels.
- **GLOBE Atmosphere Protocol** – for recording air temperature, humidity, and cloud cover.
- **GLOBE Cloud Identification Guide** – for classifying cloud types and sky coverage.
- **GLOBE Data Entry System** – for uploading collected data into the global research database.
- **GLOBE-approved sensors** for air humidity and temperature measurement.
- **GLOBE precipitation measurement tools** for collecting rainfall data.

By using **GLOBE-certified materials and methods**, the study ensured **data accuracy, international comparability, and alignment with global environmental monitoring efforts**.