A Comparative Study of Soil Moisture using the SMAP Protocol

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Abstract

The purpose of this experiment was to find out if different areas hold different amounts of soil moisture. It is important to remember that scientists study soil so they can know what kind of soil different places have and know why it floods more often in some places rather than others. As a team we learned the SMAP Block Protocol, compared the soil moisture content on our campus at two sites and began to discuss how soil moisture can impact our community, Dove Springs. We concluded that in different areas around the school, soil can hold different amounts of moisture.

Research Question

- Why do different areas around the school hold a different amount of moisture than other places around the school?
- Scientist study soil so they can know what kind of soil different places have to understand why it floods more in some places than others.
- This matters because if a flood happens in Dove Springs, people can do something to prevent their soil from flooding.

Introduction

- Dove Springs has experienced flooding in the past. This has impacted students of Mendez Middle School.
- We learned from "A Little Bit of Water, A Lot of Impact," an article from the NASA Earth Observatory about the importance of soil moisture and its impact on climate and agriculture.
  - "Compared to the amount of water stored elsewhere on the planet, the amount in the soil is minuscule. But that small volume has great significance. It can affect when, where, and what a farmer will plant. It can influence the weather. And at high northern latitudes, soil moisture has serious implications for global climate."
- The impact of soil moisture drove our investigation.

Field Photos

Field Photos Taken Throughout

Research Methods

Protocols:

- Soil Moisture SMAP Block Protocol

GLOBE Soil Protocol Procedure

1. Find the mass of the foil pan with tape label with the triple beam balance.
2. Then, we placed a tin can with a 5 cm depth into the ground. Make sure that each sample is 25 cm apart.
3. We then took a rubber mallet and compressed the tin can into the topsoil.
4. Remove the tin can and put the soil in the foil pan.
5. Then we find the mass of the soil in a pan with the same triple beam balance.
6. Dry the soil under a heat lamp (120 Degrees F) for 72 hours. We figured out when we need to take samples when the SMAP satellite was right above the school.
7. Find the mass of the dry soil on the same triple beam-balance for accuracy.
8. Record data on the GLOBE data sheet.
9. Write down the equation and solve for the mass of the soil moisture.
10. Finally, clean up the area.

Materials:

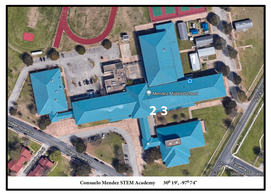
- Tin Can
- Trowel
- Gloves
- Tape
- Sharpie
- Foil Pans
- Triple Beam Balance
- Measuring Tape
- Rubber Mallet
- Bucket Filled w/ Water (Optional)
- Two Poles
- Paper Towels
- Sample Papers
- Pencil
- Journal
- Heat Lamp
- Soil
- Map
- GLOBE Website
- SMAP Block Protocol
- NASA Website for SMAP
- Teacher Badge
- Cardboard/ Pad (Optional)

Sample Site Selection:

- **Sample 1**
  We initially selected a site for the first sample in a grassy area between the main building and the portables. This site was a grassy area. The soil sampled appeared to have a rocky and clay texture. We chose this area to practice the protocol.
- **Sample 2, 3**
  We selected a second site for soil samples 2 and 3. This smooth grassy area was between two buildings. The soil had large clumps and biological factors such as worms, ants and other insects. The texture of the soil was much easier to sample.

Data Collection

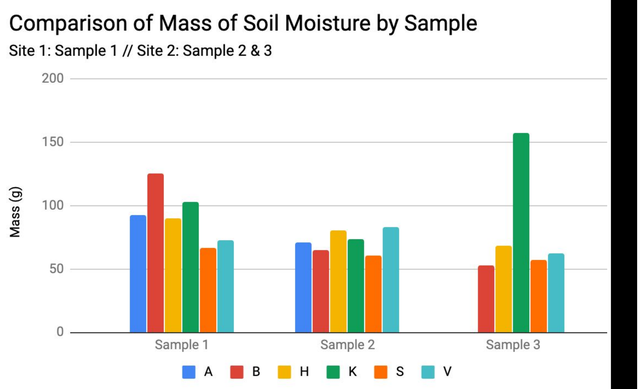
- Samples were collected 3 times by 6 student researchers.
- Data collection was timed with the projected window the satellite was taking data.
- Samples were measured 3 times for accuracy.
- Samples were dried for a period of 72 hours.
- Student researchers used the same triple beam balance and with the same tin cans for consistency.

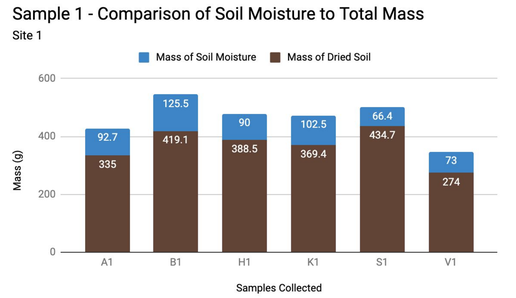


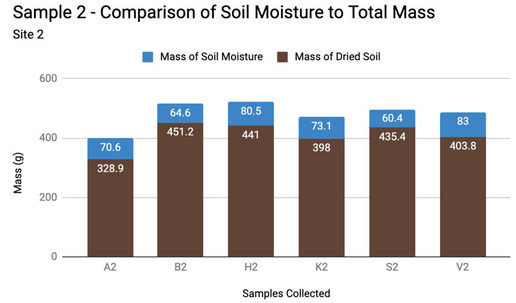
GLOBE Badges

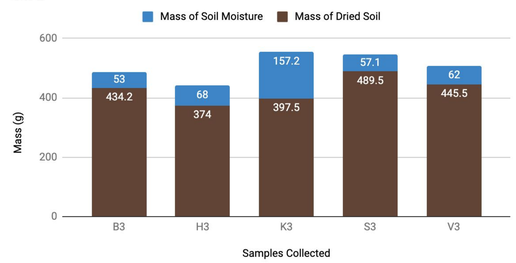
- **Make an Impact** - We selected this protocol in response to the flooding in our area.
- Be a **STEM Professional** - We worked with T-STEM Coalition member, Dr. Joe Ferrara to learn the protocol.
- Be a **Collaborator** - We worked as team to collect the samples and to compile this report.

Results









Discussion

Observations

We observed different amounts of soil moisture in different places around the school. We also observed that when we collected soil, the places we collected the soil felt different. We observed that the soil we collected had different amounts of clay or silt.

We observed that all of the students collected different amounts of soil. We went to different locations to collect the soil for our measurements. All samples of soil were 25 centimeters apart from each other.

According to the data there was more soil moisture after it rained then before it rained. In K2 there was less moisture than K3, because it had rained before she took the sample.Another thing that could of happened is she could of dug in a little slope so more water would go into the soil or maybe she could of dug next to a water drainage pipe.In Sample 1 there could have been more clay and rocks so it would make the soil heavier than the other.

We believe the weather impacted the measurements between soil samples 2 and 3. We also believe that the soil composition between site 1 and site 2 are different. We observed in general that sample one held more moisture than sample two and yet sample two held more moisture than sample three. This told me that sample one held more water than two and two held more water than three.

Interpretations

According to the data, there was more soil moisture within the soil after it rained then before it rained.

In K2 there was less moisture than K3, because it had rained before she took the sample. It is possible she dug next to a water drainage pipe. When comparing samples 2 and 3, sample 1 could have been composed of more clay and rocks so it would allow more moisture to be held.

Conclusions

We conclude that in different areas around the school, soil can hold different amounts of moisture. Now we know that some types of soil from different places around the school can hold more moisture than other areas of soil. The SMAP protocol is a procedure you follow to find out about the soil moisture content. SMAP can be helpful to find out how much moisture soil can hold so we know which places in the world are most likely to flood. In our first month of research, we collected all different types of soil samples and have compared them to each other. We accomplished our goal of learning the SMAP Block Protocol and comparing the soil moisture on our campus and how it can help us to understand the issues that impact our community, Dove Springs.

Evaluation:

We believe that the soil protocol went better than we expected given limited time and learning the protocol for the first time.

Limitations:

- We collected a limited number of samples.
- We should have done multiple soil samples than doing just 2 every 2 days.
- The weather and state testing also prevented us from taking additional samples.

Next Steps:

- The goal we should do as a team is try to work more often and collect more samples.
- We could improve next year by starting the project earlier.

Future Research Question:

- Now we are wondering what if we compared our data collection next year to other biomes. Would the soil moisture content be different or similar?

Bibliography

Hansen, Kathryn. "A Little Bit of Water, A Lot of Impact." *Earth Observatory*, NASA, 4 Nov. 2015, earthobservatory.nasa.gov/features/SoilMoisture.

Trachtenberg, Izolda, et al. "The GLOBE Program - Pedosphere - SMAP Soil Moisture Protocol ." The Globe Program, 1 Dec. 2016.

SMAP Predicted Track

Ephemeris data from: **05/08/2019**
TLE File: **/www/production-website/htdocs/spacetrack/archive/predictor/TLE.190514**

The 5 days Orbital Plots of SMAP:

GIF: 5/8/2019, 5/9/2019, 5/10/2019, 5/11/2019, 5/12/2019, ASCII (W Lon+): 5/8/2019, 5/9/2019, 5/10/2019, 5/11/2019, 5/12/2019,

Site name is: Austin_TX, Spacecraft is: SMAP

Geodetic latitude = 30.27N, Longitude = 97.74W, Geocentric latitude = 30.10N, Local radius = 6372.8km

GMT						Satellite azimuth	Satellite elevation	Viewing zenith	Solar zenith	Relative azimuth	Scat ang (bk=180)	Glint prob(%)	Satellite heading	Satellite direction	Dist to site (km)	MODIS (1165 km)	MOPITT (320 km)	MISR (180 km)	ASTER (30 km)
year	mo	da	hr	mn	sc														
2019	5	8	0	49	47	261.88	31.63	58.37	86.25	25.58	143.19	0.00	347.41	ascend	903.81	+	-	-	-
2019	5	8	12	51	59	282.34	85.75	4.25	76.34	155.61	99.78	0.01	192.75	descend	46.00	+	+	+	-
2019	5	8	23	48	59	74.38	47.43	42.57	73.40	153.76	68.22	1.67	347.25	ascend	547.45	+	-	-	-
2019	5	9	13	28	19	287.58	31.72	58.28	68.42	154.26	58.73	1.65	192.88	descend	901.35	+	-	-	-
2019	5	10	0	25	23	258.84	62.71	27.29	80.93	26.19	123.11	0.00	347.36	ascend	315.54	+	+	-	-
2019	5	10	12	27	37	99.97	47.91	42.09	81.15	25.28	135.48	0.00	192.68	descend	538.97	+	-	-	-
2019	5	10	23	24	46	71.17	25.11	64.89	68.02	152.78	53.99	0.37	347.14	ascend	1117.57	+	-	-	-
2019	5	11	1	1	58	263.31	23.21	66.79	88.36	26.33	146.58	0.00	347.43	ascend	1191.33	-	-	-	-
2019	5	11	13	4	4	284.53	61.78	28.22	73.38	154.08	81.06	0.89	192.79	descend	327.74	+	-	-	-

TLE Data Sent to tracking program