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Earth & Planetary Image Facility

UFRPE

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TEXAS TECH UNIVERSITY

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# She Space

*In Memory of Devorah Blumberg*

# INTERNATIONAL

## Final report 2019

*And only her light remains shining...*

***The project is dedicated in beloved memory of***
***Devorah Blumberg, 1963-2013***


This report was composed by all participants of this project

# She Space International

**The She Space program was built to inspire young girls to study science, technology, engineering, arts and mathematics (STEAM) subjects. The basic premise of the program is that exposure to advanced scientific disciplines, especially in an active research context, encourages young women to continue studying science throughout their educational careers. She Space uses exposure to remote sensing to push high school-age girls outside of their comfort zones and help them learn about STEAM subjects without preconceptions and existing stereotypes.**

**This year, She Space has gone international and it has been a resounding success!**

**The addition of the international component of the program added several key elements: 1) students had to interact in English, which added an element of language exposure and challenge; 2) students learned about scientific communication; and 3) each group acted as ambassadors for their respective countries and for the space agencies of those countries.**

**The students who participated this year came from four countries: Israel, Germany, the United States, and Brazil. Students contributed to individual research projects using satellites launched by their countries: Venμs Satellite (Israel), Sentinel-2 (Germany), LandSat-8 (U.S.), and a new China-Brazil (CBERS) joint research satellite venture (Brazil). Each group studied a research question related environmental issues in their native countries. The students in each group then had to work together to produce final, group presentations combining the results of their individual projects. Participants used advanced scientific research instruments, computer programs, and techniques that are all actively in use at the labs and organizations that helped to run the program.**

**Project participants actively experienced what it is to be a researcher and doing scientific work using real, advanced research techniques. In each country, active research groups were responsible for directing the research projects of each of the student participants.**

**This report is the culmination of this year's project for each group of participants. Sections are divided by country. Each section provides information on the researcher that led each group, the mentors from within the research lab that helped to guide the student participants, the satellite used, the research questions investigated, and, finally, the results of the participants' research projects.**

**We hope that you enjoy reading this report as much we all enjoyed putting it together!**

# Director General

**Shimrit Maman**

**Dearest students and staff,**

**From the dawn of time, humanity has looked to the stars for inspiration and seen the future. Modern space exploration enables the development of fantastic new technology and improvements to our collective scientific knowledge. Personally, though it is a vast, icy void, I think space holds unique opportunities for those who dream and aren't afraid to face personal challenges. It is in this special encounter between curiosity and longing for the unknown that creativity is born. It is in the desire to better understand the universe we live in, that we understand that this knowledge holds a great opportunity that also allows us to change our society. Humans have observed the sky, explored, and studied the movement of stars and planets throughout history. Improved measurements and technology have enabled researchers to reveal more and more of the structure and makeup of the universe. It was the telescopes of Galileo that first proved that the universe around us is dynamic and changing. In recent decades, technology has enabled satellites to be launched out of Earth's atmosphere. Such satellites, equipped with different sensors, assist in research both looking down on Earth and out toward the celestial reaches of outer space. In this international project, you were all exposed to both state-of-the-art remote sensing technologies and societal-gender issues. You received rare opportunities to enter excellent research labs and work with leading scientists who were, not by chance, majority female. The outstanding performance throughout the project of the whole (international) team only emphasized how it's a small world after all. The added scientific values of excellence, seriousness, persistence, patience, attention to detail, and the ability to meet various challenges are all clear and present in this research report.**

# Director General

**To have completed a project such as this with so much success, at such a young age, just goes to show how impressive and inspiring each and every one of you are. Allow me to use the words of Golda Meir: "Make the most of yourself by fanning the tiny, inner sparks of possibility into flames of achievement." I would like to thank each one of you, both students and staff, and I ask each of you to carry on in your personal paths with all the tools you received in this project and "to boldly go, where no woman has gone before…"**

**Yours truly , Shimrit**

Dr. Maman is currently a research associate in the Homeland Security Institute and director of the Earth and Planetary Image Facility (EPIF) at Ben-Gurion University of the Negev. She is a remote sensing and aeolian geomorphology specialist. Her main research interests are in the fields of remote sensing and GIS technologies, climate change, and the environmental applications of remote sensing. In addition, Dr. Maman is an integral part of the research team leading BGUSAT, Israeli academia's first nanosatellite, which was successfully launched into space on February 15, 2017. The satellite is only 10x10x30 centimeters and weighs barely five kilograms. Its SWIR camera can detect climate phenomena and it possesses a guidance system that allows operators to select target imaging regions through a dedicated ground station at EPIF. Dr. Maman leads a variety of education and public outreach programs for youth promoting Science Technology Engineering Arts and Mathematics (STEAM) subjects using hands-on research activities. In addition, Dr. Maman serves as a UN-Spider expert and is currently the board director of D-mars.

# Greeting by Simoneta Di Pippo

http://www.unoosa.org/

**Hello ,**

**My name is Simonetta Di Pippo, and I am the director of the UN office for outer-space affairs .**

**I want to wish you, young ladies, good luck with this new experience at "She Space."**
**As the director of UNOOSA, and international gender champion, and a woman, it is very exciting for me to see the next generation of women scientists already engaged in state-of-the-art technology in an international project .**
**I can understand the excitement that you might be feeling right now. It is the same feeling I had when I was working on the Cassini–Huygens mission, or when I contributed to the search of water on Mars.**

**Here at the office, we are working very hard on our space for women projects, to make sure that great girls and women, like you, get all the opportunities they deserve, regardless of where they come from. We need more girls in stem and many more girls in space.**

**If I could give you any advice about how to succeed in the space sector, I would be "dream big, keep working hard, and don't let anyone tell you what to do."**
**I'll be looking forward to the day when I will see you as leaders of space programs, heads of your national space agencies, or who knows, directors of UNOOSA .**

**Keep working hard and dreaming big.**

**Good luck!**

**(The greeting was a video message for all participants:)**

# Germany Team
# DLR School Lab,
# Oberpfaffenhofen

# Team Leaders

**Dear girls,**

**Unfortunately, all good things come to an end – just like our project. We hope you had a lot of fun – we definitely did. You worked independently on this project, learned a lot about remote sensing and made new contacts. We are proud of what came out in the end. Research is a tough business because there is always something new to discover and you have to learn all the time and persevere. But, above all, fun and curiosity should always be at the top.**
**We talked a lot about remote sensing and working with LEOWorks. You have gained insight into the research of the German Aerospace Center, DLR, and have also established new international contacts. We supported you in your presentation and scientific work. You are confident and strong girls who were not afraid even though the presentation language was English.**

**We are happy to see how much joy and commitment you have shown in this project. On behalf of the She-Space Team of the German Aerospace Center, we would like to thank you. You have filled this project with life and joy.**

**We wish you all the best for your future. Stay just as confident and committed in the rest of your lives!**

**Best regards,**

**Lisa & Tobi**

# Team mentors

## Tobias Schüttler

Tobias Schüttler studied Physics and Mathematics at LMU Munich and worked as a high school teacher until 2015. Since 2003, he has worked at the German Aerospace Center (DLR) in promoting young talent. He is currently doing his doctorate with the chair of physics education at LMU Munich. His research interests are extracurricular physics teaching and learning in the context of space technologies and gifted education.

## Andrea Lisa Nagel

Hi, my name is Lisa. I work in the School Lab at the German Aerospace Center (DLR) in Oberpfaffenhofen and at the University of Munich. At the School Lab I supervise the experiment on satellite navigation. At the University of Munich, I work in the SatTec project, which deals with the basics of satellite technology for school education.

## Christin Ganserer

Hi, my name is Christin. I am a working student in the School Lab at the German Aerospace Center (DLR) in Oberpfaffenhofen. In the School Lab I supervise the experiment on Earth Observation. In addition, I also study Geography at the University of Munich.

# DLR girls

**Christina**

Age: 14

From: Germany (Munich)

Birthday: 10.05.2005

Hobby: fencing

Likes: swimming, shopping

Dislikes: nothing

**Lara**

Hello, my name is Lara
and I am 16 years old.
My hobbies are riflery
(air rifles) and playing
Rugby.

**Lya**

Age: 15

Hobbies: Dancing, drawing,
reading

**Hannah**

Age: 14

Hobbys: playing music,
science, reading

Favourite subject: french,
physics

I joined this project to learn about applied science on the spot at DLR, together with international participants.

# DLR girls

## Kitti –The cat whisperer

Nationality: Hungarian

Age: 14 (8th Grade)

Favorite movies/books: The Hunger Games, Interstellar, Percy Jackson, The Avengers

Hobbies and Interests: Questions about time and time travel fascinate me. Amongst my other scientific interests, I'm planning on studying medicine. On the other hand, photography and technical/artistic work are also exactly my thing. Hungarian is my mother tongue, but I've been learning English and German on a high level in international schools for seven years now. Cats are my absolute favorite animals. Therefore, I have two myself, Rocky and Maya. Since I like playing the clarinet, I also joined our school orchestra, where we perform regularly. Every summer my friend and I enjoy stargazing at the night sky in Croatia on the beach. This has become a tradition in the last few years.

## Leah

Age: 13

School: Maria-Ward-Realschule Nymphenburg, Munich

Hobbies:Karate, Singing and CrossFit

Most liked lessons: Math, Geography, Art

What I wish about this Project: I want to meet new Friends and to learn more about our satellites and how they work.

Why I am here: I am here because of the Girls' Day and because I think it is cool to communicate with girls from other countries who have the similar interests to me.

I joined this project to learn about applied science on the spot at DLR, together with international participants.

# The girls

## Mathilda

Age: 14

Likes: sports, horseback riding, reading books

Dislikes: Math, mosquitos

Favorite movies: comedies, fantasy

## Vivien

Age: 14

Hobbies: Volleyball & Dancing

Favorite subject: Math

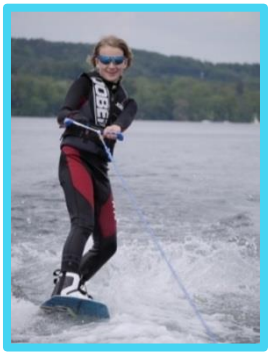
## Ming-Ming

Hobbies: Ballet, Piano, meeting with friends

Favorite subjects: Math, Chemistry, English

Languages: English at home, German at school and French as a class

## Tamara



Age: 14

Birthday: 14.08.2004

Hobbies: Wakeboarding, Swimming, Skiing

School: Otto von Taube Gymnasium, Gauting

# Sentinel-2 satellite

Sentinel-2 is an earth observation mission from the EU Copernicus Program and belongs to the European Space Agency (ESA). It is a constellation with two twin satellites, they are called Sentinel-2A and Sentinel-2B. The applications are land and sea monitoring, natural disaster mapping, sea ice observations, and ship detection. Sentinel-2 is one of three ESA satellites and in orbit since 2015. The field of view is 290 km and Sentinel-2 is 3.4X1.8X2.35 m big. The flight duration is about 8 Years. The satellite has three spatial resolutions of 10 m, 20 m and 60 m. The Sentinel-2 satellites will each carry a single MSI (multi-spectral instrument) with 13 spectral channels in the VNIR (visible/near infrared) and SWIR (short wave infrared) spectral ranges. The two twin Satellites are identical and they revisit the same locations on Earth every 5 days, under the same viewing angles.

Background story of the satellites (our research area)

1945-50: After WW2 Europe realized that scientific research and related projects were better if done internationally.

1958: Two important people recommended creating an institution for these purposes, following the CERN as their model.

1964: There were conventions that were specifically created and in 1964 they became active.

The first European satellite was launched on the 15 of December, 1964 (Italy). The first German satellite was launched on the 8 of November, 1969. (By the DLR!)

# Research results

## Snowpack development in the Bavarian Alps

( by Hannah, Ming-Ming, Lya, Tamara, Vivien)

### The Satellite

During our research, we used the Sentinel-2 satellite. It is an earth-observing mission from the EU Copernicus program.

It has a very high spatial resolution (10 m up to 60 m) over land, but of coastal waters often resolutions aren't so good.

There are two "twin" satellites they are sentinel-2A and sentinel-2B (we used Sentinell-2A)

It supports agricultural monitoring, emergency management, land cover classification, and water quality.

It was developed by ESA. The DLR works closely with the Sentinal-2-Project, so we can also easily use Sentinel-2 data for our project.

### Research about the area

We researched snowpack development in the Bavarian Alps. We especially looked at the area around the town of Garmisch-Partenkirchen. We already knew that the area would become less snowy over the period of our research, but we were surprised by how much change we could see.

### Methods

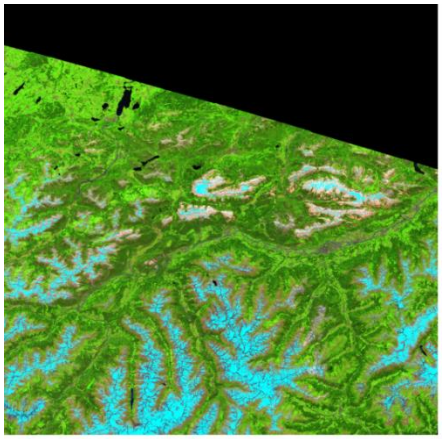
We worked with the open-access Copernicus program homepage. We could look at the Sentinel 2 pictures and download them into the LEOWorks program. In the program, we worked with the channels 2, 3, 4, 8, 11 and 12. We combined them for the best picture with the RGB function. To see the snow best we often combined two of the infrared channels (often 8 and 11) and the red channel (4).

# Research results

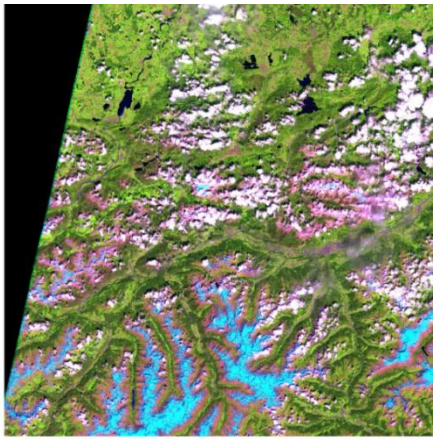
**Results and conclusions**

Results: Over the past 4 years, snowpack has receded rapidly.

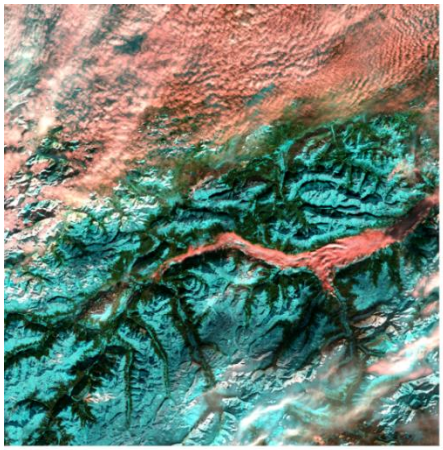
You can especially see that in the Bavarian Alps.



Summer 2015
RGB- B11(red); B08(green); B04(green)



Summer 2019
RGB- B11(red); B08(green); B04(green)



Winter 2015
RGB- B11(red); B08(green); B04(green)

Winter 2019
RGB- B11(red); B08(green); B04(green)

Snowpack will continue to recede in the coming years, as you can tell from the images. At some point there might not be any snow anymore or at least not very much, which is bad for the ski loving Bavarians.

Precipitation is now mostly rain and barely any snow.

# Research results

## Detecting wildfire by satellite

(Mathilda, Leah, Lara, Kitti, Christina)

### Things we used

LEOWorks: This free program is similar to Photoshop. You can edit and change the satellite data according to your needs and then save them accordingly. It represents the main tool for demonstrating Earth Observation techniques within the European Earth Observation Web Site.
Furthermore, it opens WinZip files.

Copernicus SciHub: This is an internet website where you can access all of the Sentinel project satellites' data across the world. After downloading these, they still have to be edited. This website was made by ESA (the European Space Agency) and is often used by schools or for other educational purposes.

It saves the data as WinZip files so you can use LEOWorks. When we started LEOWorks we edited the satellite pictures to creating a fitting final image. LEOWorks merges three layers into one, one with green, blue and red. Since we wanted to use the files in our presentation, they also had to be reduced to a smaller size.

# Research results

**Results and Conclusions**

Throughout our project, we learned a lot about our theme through the satellite pictures.

For example:

There were houses nearby, but no animals or schools because our research location was a government-owned forest

The area wasn't used for agriculture

Around 7 hectares of land were burned

This information could be obtained through the Copernicus SciHub.

The data was then edited by us on LEOWorks and pasted into our presentation.

Process of observation:
The selected territory was evaluate on the satellite images taken immediately after the onset
I joined this project to learn about applied science on the spot at DLR, together with international participants.

# Research results

**Process of observation:**

The selected territory was evaluated on the satellite images taken immediately after the onset and five days before the wildfire.

Comparison was made to find potential reasons for the fire's emergence.

Process of observation:

The selected territory was evaluate on the satellite images taken immediately after the onset

I joined this project to learn about applied science on the spot at DLR, together with international participants.

# Research results

**Findings:**

We found that the entire selected territory including the wildfire area was fully green and flourishing in the first image (left). In contrast, the second image (right) was dried out and had a yellow tint.

**Conclusion:**

Therefore, we hypothesized that a drier period followed by a sudden thunderstorm possibly made the dry wood catch fire easily. (Note: this was confirmed by the local fire department.)

On the other hand, we also learned about Sentinel 2, its gear, and other interesting facts such as:

Weight: 1200 kg

Size: 3.4 m x 1.8 m x 2.34 m

Launch: 23rd June 2015

1 orbit around the Earth takes approx. 100 minutes

In summary, we learned through this project in general, that satellite pictures can tell us a lot about:

Climate change

Snow/Rainfall

Wildfires

Sea eroding the shore

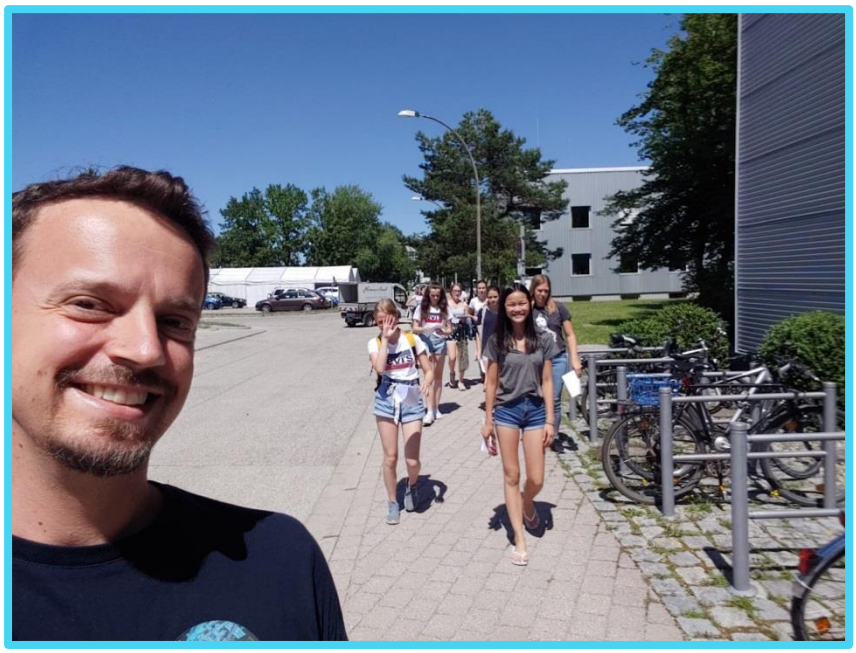
The disappearing of the rainforest

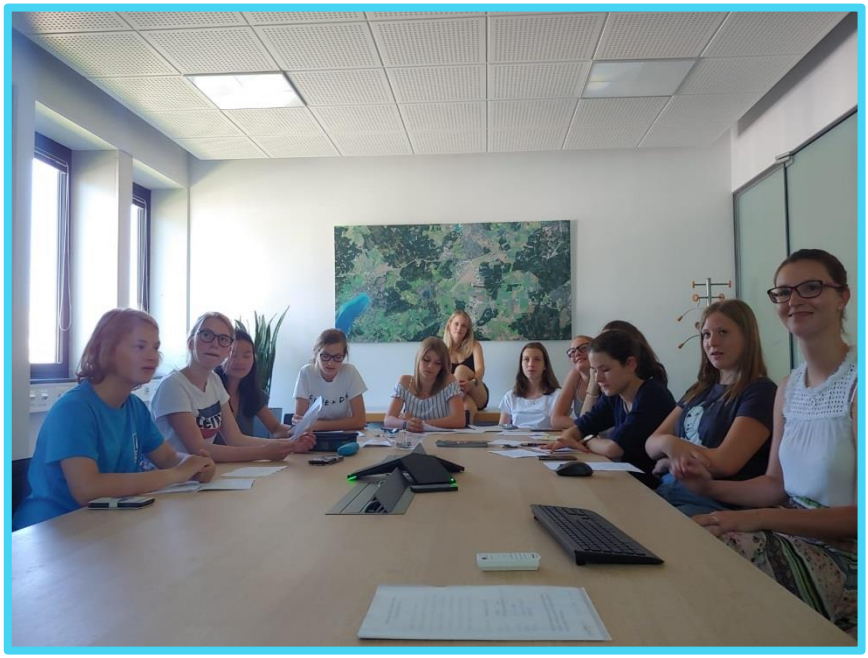
The impacts, causes, and courses can be examined through satellite records thoroughly

Satellites also help with scientific research and weather forecasts; natural disasters, such as tornados, hurricanes, or tsunamis; and measuring the movement of the continents. GPS made it possible to locate differences in position by reflecting satellite signals back to Earth.

# First conference call…

# Second conference call…





# Brazil Team

# Federal Rural University of Pernambuco


UFRPE

# Team mentor

**Rodrigo Eiji Hakamada**

I finished my undergraduate degree in forest engineering in 2004 and started working in the private sector as a forest researcher. One of my main interests is to apply remote sensing technologies to solve problems related with forest management. Since June 2018 I have been working at the Federal Rural University of Pernambuco, in the Northeast region in Brazil.

# The team

**Bianka Luise de Oliveira**

25 years old, Forest Engineering student with experience in geoprocessing after studying abroad in the USA. Did an internship at the Michigan Department of Environmental Quality, where she worked on GIS and environmental education projects. Currently concluding a project on the urban/forest maps of a Southern city of Brazil.

**Carolina Rovira Pereira Fernandes**

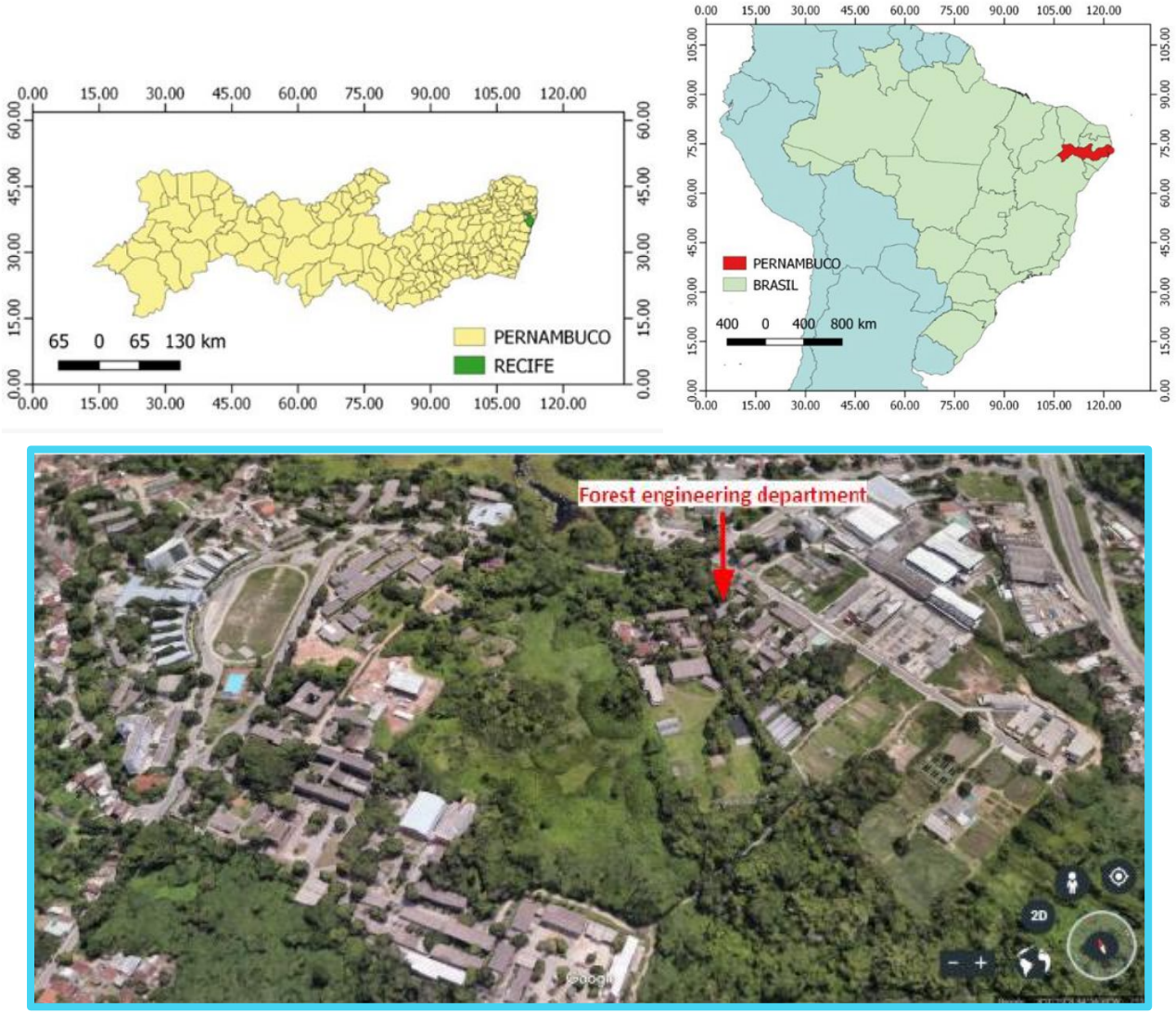
23 years old, technical-professional degree in environmental control, currently a forest engineering student. Has some research experience with LANDSAT-8 from a previous project on the dry vegetation of Brazil's northeast, the Caatinga. Currently doing an internship about drone image processing.

# Our University and Surroundings

The Federal Rural University of Pernambuco (UFRPE) is located in Recife, the capital of Pernambuco state in the northeast region of Brazil (Fig. 1).

It has 105 years of history and around 15,000 students. The northeast region of Brazil has two main climates, dry and tropical. The vegetation that developed here is divided into the tropical forest Mata Atlântica and the dry forest Caatinga. In the tropical areas of the state, the main land use is related to sugarcane for ethanol and sugar production. The dry vegetation is explored for firewood and goat production.

**Figure 1 - Image of the Federal Rural University of Pernambuco, located in Recife city.**



# Research Area

Brazil possesses vast vegetal and animal biodiversity, and we, as Forest Engineering students, are always concerned about preserving and restoring forests. The use of satellites is crucial to monitor Earth's territory and track changes that have happened in nature over the passing years. For this reason, we aimed to study these changes and evaluate the forest land cover change in different types of the native forests of Brazil.

In forest science, common research is often related to land cover use, biomass accumulation, fire monitoring, ecological succession, etc. But, it was noticed that most of the studies are made with the satellite LandSat or others with the easiest data access, like the Sentinel satellite series.

The objective of this project was to discover how to do this analysis with CBERS-4, due to its imagery quality.

# China-Brazil Earth Resources Satellite (CBERS)

Facing reliance on other country's satellite imagery, which can be expensive and sometimes not suitable for all territories, Brazil and China became partners in the China-Brazil Earth Resources Satellite (CBERS) program. The alliance started in 1988 when both countries signed an agreement joining their technology and investments to build remote sensing satellites and launch them into space. The main goal of this program was to achieve autonomy by providing good quality satellite imagery of both countries' areas, from a completely remote observation system. The Instituto Nacional de Pesquisas Espaciais (National Institute of Spatial Research), known as INPE, was created in 1971. The use of satellite imagery is one of INPE's areas of interest as a tool to find answers to environmental problems and to monitor them. At first, only two satellites were planned to be built and launched, CBERS-1 and 2. These satellites were technically identical and they were launched in 1999 and 2003, respectively. Because of the success of these satellites, the program was expanded, and CBERS-2B, 3 and 4 were launched. The very last satellite (CBERS-04A) has already been built in Brazil and was recently sent to China to be launched. For this reason, this research will be developed using images from CBERS-4, which is currently in orbit. The CBERS-4 Assembly, Integration and Test (AIT) activities were executed at CAST (China Academy of Space Technology), located in Beijing, China. Its successful launch happened in December of 2014 from Taiyuan Satellite Launch Center (TSLC). The satellite carries four cameras (Panchromatic Camera - PAN, Multispectral Camera - MUX, Infrared Scanner - IRS, and Wide Field Imager - WFI) with improved geometric and radiometric performance. The images from CBERS-4 have a good spatial resolution (20 m), and besides that, a 120 km field of view, which promotes better detail observation and small scale studies (cities or regions). A series of applications can be performed by using the satellite camera set. These include, identifying forest areas, quantifying agricultural areas, mapping soil use, monitoring water tanks, and cartographic studies. In addition, CBERS-4 satellite imagery can also be used as a source of educational data for projects focused on environmental topics and geography.

**Methodology and Results**

The acquisition of images were made using INPE's website. For processing, methodologies to adjust the atmospheric distortion were required. Some papers were analyzed to identify the correct methodology, but none of them defined the correction in-detail. The next step was to email some specialists. Their replies showed that this correction is difficult even for them. The last step included internet research for information about the future use of CBERS. In 2018, João Vianei Soares, the CBERS program coordinator reported that "INPE is now implementing new methods of atmospheric correction to offer surface reflectance to users, not only the original bands, that include atmospheric effect."

Also, he mentioned that the methodology would be published soon in a paper under the title: "Continental-scale surface reflectance product from CBERS-4 MUX data: Assessment of atmospheric correction method using coincident Landsat observations."

**Conclusions**

Even though the CBERS satellite is under Brazilian control, its images are not so suitable for public use yet. CBERS imagery still requires some complex treatment that mainly INPE's team operates and some parameters have not been released to the public yet. For the next steps, as the products of the CBERS program are as good as other satellite information, we plan to contact INPE to know more about CBERS image treatment. By doing this we may be able to work on the desired analysis.

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- UFRPE. Apresentação. Available from: http://www.ufrpe.br/br/content/apresenta%C3%A7%C3%A3o. Access on 23 Ago. 2019.

# US Team
# Texas Tech University

# Team leader

**Karin Ardon-Dryer**

**Dear girls,**

**It's hard to believe that our time together has come to an end; I hope that you, like me, enjoyed being part of this program. During our time together we covered many aspects of what it means to conduct research, we had lectures on different subjects, and we learned many terms in remote sensing. You worked on your own scientific project, asked questions and performed the research needed to answer them; I am proud of what you accomplished in our time together. Research is a never-ending journey of discovery, there is always more to learn, more to uncover, it may be hard at times, but it should always be fun.**

**Science is only one part of what we worked on; we also talked about self-empowerment, how to prepare, and how to present. You are powerful young women, don't let anyone tell you that you can't do something or that you don't belong, never doubt who you are or what you can accomplish; you are bound only by the limits of your imaginations.**

**On behalf of the TTU She Space International team, I wish you all the best. We are excited to see where you will go from here, the roles you will take upon yourself and the discoveries you will make, we are confident that you will succeed in whichever path you choose.**

**Best Regards,**

**Karin**

Dr. Karin Ardon-Dryer is an Assistant Professor in the Department of Geosciences at the Atmospheric Science Group at Texas Tech University. Her group studies the effect that aerosol particles have on climate, the environment, and our health. In particular, she takes an interdisciplinary approach and combines field and laboratory work to investigate the interaction between human and climate, in particular the effects of particulate air pollution on health at a single cell level.

# Team mentors

### Cece Kelley

Hello, my name is Cece. I am a master's student and research assistant in the Department of Geosciences, Atmospheric Science Group at Texas Tech University. I am currently working om $PM_{2.5}$ measurements from Lubbock, Texas from 2001 until today. I am also in charge of AEROS our aerosol measurement station.

### Jessica Souza,

Hi, my name is Jessica. I am currently a graduate student studying Atmospheric Sciences at Texas Tech University where I also serve as a graduate research assistant. My research focuses primarily on thunderstorm electrification and lightning. In my free time, I enjoy spending time outdoors and cooking.

### Darbie Cooper

My name is Darbie Cooper, and I am a cell and molecular biology undergraduate student at Texas Tech University. I am a research assistant in Dr. Karin Ardon-Dryer's aerosol lab. I am working on the effects that dust particles have on human health by looking at human epithelial lung cells.

### Jake Nathaniel Williams

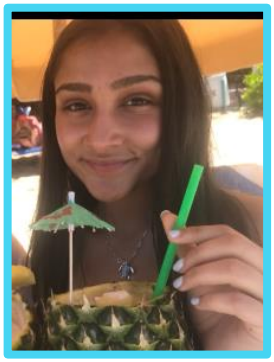

Hi, my name is Jake. I am a master's student and teaching assistant in the Department of Geosciences, Atmospheric Science Group at Texas Tech University in Lubbock, Texas. For my research as a master's student, I study the effect of ice nuclei particles on precipitation processes and cloud electrification in convective systems. As a teaching assistant, I teach an introductory lab section in atmospheric science. A fun fact about me is that I can juggle various objects.

# Texas tech girls

### Bella Johnson

I am a junior at Talkington and I am 16 years old. At my school I am involved in Cheer, Choir, UIL state competition and show choir. I have 1 sister who is 19 years old. I enjoy listening to music, playing games, and spending time with family and friends.

### Anika Iyer



I am a student at Lubbock High and I really enjoy how diverse my school is. I play volleyball at school and outside of school and it is a really great team building activity. My ultimate goal is to one day become a doctor like my parents and make the most of myself, as a woman.

### Addie Bleu Short

Addie Bleu Short, 14, is a freshman at the Talkington School for Young Women Leaders in Lubbock, Texas. She competes in her school's Destination Imagination team, Academic UIL competitions, NJHS, and was the MS Student Council President. She sings with the Cactus Theatre and with Caldwell Entertainment, and loves all things related to music. She plays guitar, piano, and ukulele, and enjoys reading, writing, and all things science. She wants to be an Entertainment Lawyer.

### Eliot Stevens

My name is Elle and I am a 14 year old homeschooler from Lubbock, Texas. I enjoy computer programming and learning new things.

I also enjoy running and drawing digitally.

# Texas tech girls

### Sandra Gurrola

I am a student at Lubbock High School and am 15. I play viola and cello as well as participate in my school's NHS program. Most of my time is spent playing with my dog or watching tv, likely both. I eventually want to become a biological engineer.

### Elise Snow

Hi, my name is Elise. I am 15 years old and I live in Lubbock, Texas. When I'm not focusing on academics or extracurricular activities, I play basketball and spend time with friends and family.

### Shirley Emendack

My name is Shirley and I'm 14 years. I live in Lubbock, Texas and attend Lubbock High School. My hobbies include running and painting. I joined the SheSpace Program to better understand satellite imagery and the analysis of data.

### Jasmine Galdamez

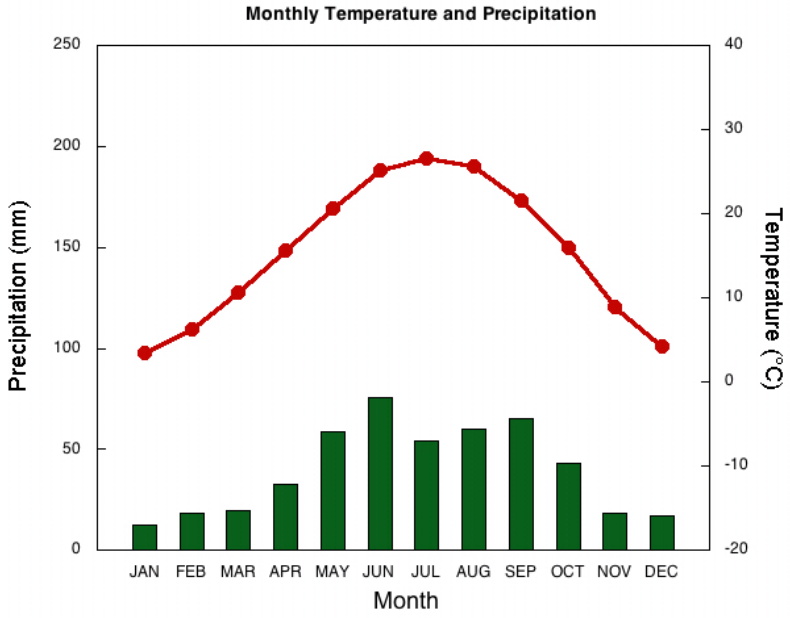
I am a student at Talkington SYWL, and am going into the 10th grade. I am currently 15 and enjoy reading, watching movies, and cooking. My favorite school subjects are history and biology. I also love to run and am involved in my school's track team.

### Kalin Klameth

My name is Kalin Klameth and I just turned 17. I go to Lubbock High School and I am in band. I play the flute, piccolo, and oboe, as well as the ukulele, piano, and electric guitar. I love classic books and music and my favorite foods are chips and queso, and French fries.

# West Texas

We are based in Lubbock, Texas. A southern city located in the United States with a population of about 250,000 people. The climate in this area is arid to semiarid with constantly fluctuating weather. There are hot summers and mild winters. Lubbock averages about 50 cm of rain per year. Agriculture is very common in this region. Due to the specific climate, crops such as cotton, grain sorghum, and peanuts flourish here.

# West Texas agriculture

**Cotton**

- Grows well in the ample sunshine and fairly dry conditions
- Thrives at temperatures between 18℃ - 30℃
- Requires long vegetation periods without frost

https://www.travlinphoto.com/wp-content/uploads/2017/11/cotton-field-rows.jpg

**Grain Sorghum**

- Useful for feeding animals (large cattle population)
- -Does not require a lot of rain
- West Texas has a climate able to sustain it well
- Grows well in semiarid regions

https://www.sorghumcheckoff.com/assets/media/images/SorghumHarvest4x6.jpg

**Peanuts**

- Short crop so constant wind does not affect it
- Indeterminate crop, can recover from erratic weather patterns
- Grows well in soft sandy soil, loose soil allows it to achieve maximum yield
- Helps with soil erosion

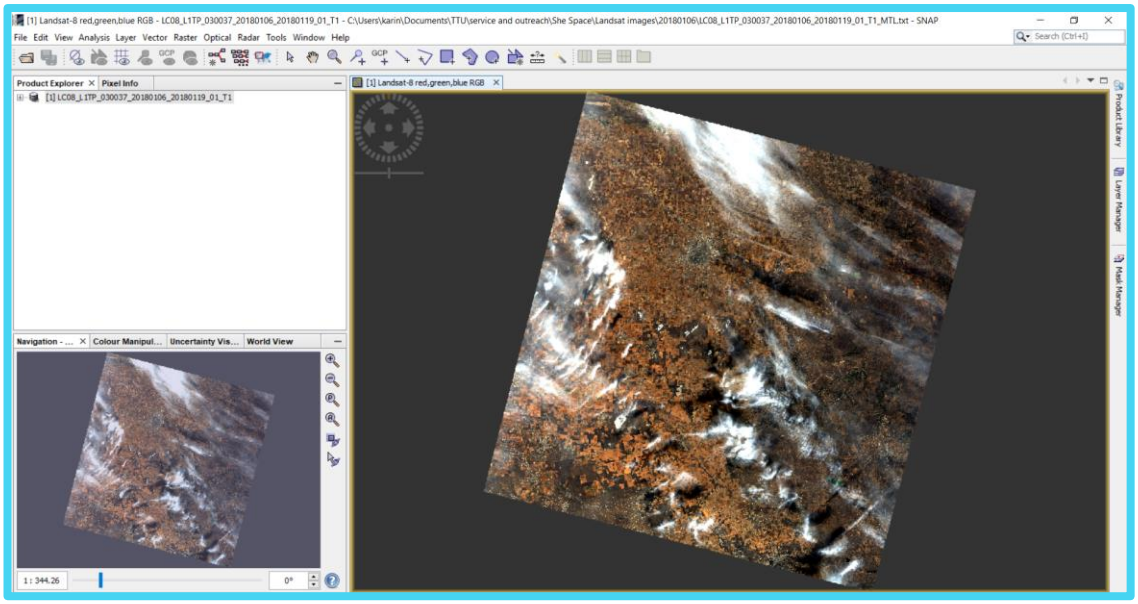
http://texaspeanutboard.com/wp-content/uploads/IMG_9834.jpg

# Methodology

For our region, we used two different methods of analysis. We used NDVI, which is Normalized Difference Vegetation Index, as well as an image analysis software called SNAP, or Sentinel Application Platform. NDVI is a simple graphic indicator that can be used to analyze remote sensing measurements, typically, but not necessarily, from a space platform, and assess whether the target being observed contains live green vegetation. For our project, we used NDVI to measure the vegetation health or, more specific to our project, to measure the health of the agricultural crops in our area. We are also used the SNAP software to directly analyze images from the LANDSAT satellite.

For our research purposes, we use NDVI to measure the health of the plants and crops surrounding our area of interest. With NDVI, the higher values that show up as the greener areas in the image are the healthier plants. In contrast, the plants with low or negative NDVI values are the plants or crops showing signs of poor health. This information is useful to farmers and people with an agricultural lifestyle because it is an easy way to determine the health of the crop.

Another analysis tool we used was the SNAP software. We used this software to help convert our NDVI images into the RGB bands. With the images in RGB format we could then see the NDVI values and determine the health of the plants and crops in our area.



# NASA Landsat satellite

For the She Space program, we used a satellite called Landsat. It is a satellite that gives people a view of the land we live on, and it can give us a detailed analysis of vegetation and industrial development. Landsat is a particular program that offers a visual image of the planet and it can be used to assess changes on the Earth's landscape.

It does not show individuals or houses, but it shows large man-made structures and landscape changes that can be used to determine vegetation and urban growth.

Landsat provides specific information about the Earth and its ecosystems, such as the coral reefs, tropics, glaciers, and farmland. The satellite is unique in its ability to both be precise and have global coverage at the same time. Time also plays a factor in the natural growth of vegetation, so Landsat images can be used to compare the same area at different times to see how they differ.

Landsat is also used to form maps and environmental conditions without having to travel to the particular location. Scientists can determine the health of vegetation in a certain area, without ever having to visit the location. Landsat provides a view of the Earth's surface, and many maps have been made from those images. Maps have been made from Landsat imaging software beginning in 1972 with Dr. Paul Lowman Poorly, who charted areas such as the arctic and mountains that were difficult to reach. The satellite can also detect faults and fracture lines on the Earth's surface that can be used to create maps and locations of large-scale tectonic activity.

The Landsat satellite has become widely accepted by scientists across the world as a research tool, and it has evolved to become fundamental to the agriculture, forestry, land, water, and natural resource fields. In 1972, when it was first used, Landsat was primarily a tool for remote sensing, which is the detection of certain physical characteristics of the Earth's surface, but it has become fundamentally important in research. Remote sensing can now be used to monitor the growth of industrialized areas and to watch the pattern of destruction in wildlife areas. It can also detect storms and clouds as well as temperature, which is incredibly important for the health of the plants in an environment.

# Slaton, TX

(By Anika Iyer, Bella Johnson, and Elise Snow)

Slaton is a city in Lubbock County, Texas, United States.

The semiarid climate makes this area's agriculture very similar to that of Lubbock. Annually, this region experiences 6.3 inches of snowfall and 19.91 inches of rain.

Slaton was the location for our group due to its agricultural importance.

This region produces oil and cotton, similar to Lubbock. It is mostly a rural area, but it was a good location to choose for our project because of its radiance in the satellite images in our software.

During our time researching our team used a variety of methods to help answer our focus questions. The main method we used was comparing the NDVI image to that of the image used for google maps. We used this method to help pinpoint certain objects that were in areas of interest in and surrounding our research location. Once we figured out what the objects in the areas were, we could then relate the object to the NDVI value it corresponded to.

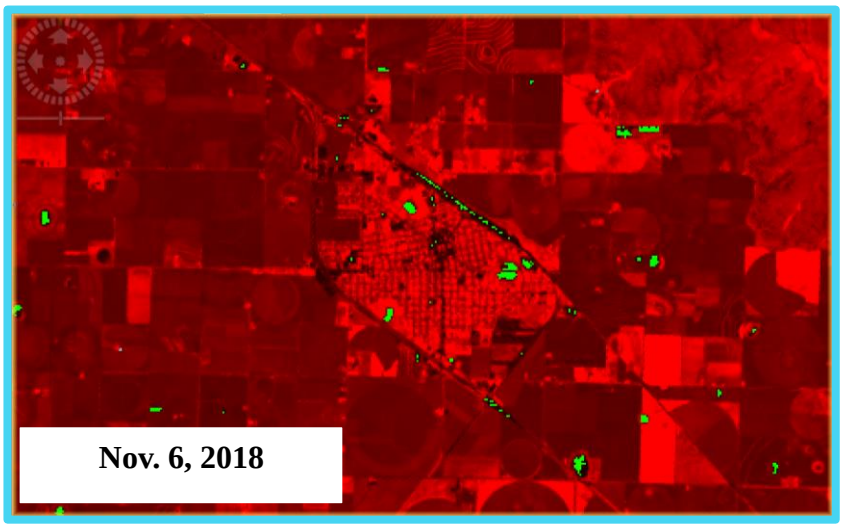
## Research Questions

- Why does the NDVI differ in different seasons and how does that relate to the type of vegetation grown in the area?
- May 14, 2018- Why is there more green during May than the other months?
- January 26, 2018- Why does this picture have such a low NDVI?
- November 6, 2018- Why is the NDVI value higher in some places but lower in others?

# Research results

## Results

- May 14, 2018- Green represents healthy vegetation and because May is at the end of spring, there is more vegetation than during the fall and winter months.
- January 26, 2018- During the winter months there is less moisture in the air which causes plants to be less healthy than they would be in fall months like November.
- November 6, 2018- During November most of the agricultural crops have recently been harvested so the fields are bare therefore giving off a lower NDVI. In the picture showing the NDVI there is mostly Red with spots of Green. The Green spots are either made of artificial grass or turf for sports fields.




# Littlefield, TX

(By Shirley Emendack, Addie Short, and Jasmine Galdamez)


Littlefield is a small town northwest of Lubbock (our location). The population is close to about 6000 as of 2017. Its economy primarily depends on agriculture, more specifically: cotton. Littlefield also has a biodiesel fuel plant, but it comes second to the economic income that cotton brings to the small town. Like Lubbock, Littlefield has a semi to mildly arid climate, with warm temperatures year round with summers going into the high 90s and the winters into the 60s. The area gets only 18 inches of rain, on average, which leaves the town susceptible to drought and thus a low NDVI.

During our research, we used SNAP software in order to further analyze the NDVI of Littlefield, finding that there were only a few small spots of land that had a high NDVI value. This, of course, was not surprising, due to the area having only a few water sources and high temperatures. However, looking further into our NDVI images, we found that there was a particular area that had a negative NDVI value. On the date October 5th, a small rectangular area outside of the city appeared, but on the dates of January and July 1st, the area appeared dark and almost non-existent. This perplexed us, as we were confused as to how an area could go from having seemingly nothing to having some entity by the end of the year. After some deliberation, we turned to google maps in order to get a better look at the space and determine what exactly the area was. We found that it was a body of water, explaining why it was not green in the NDVI images of January and July 1st. Though, it did not explain as to why in October the area had a completely negative NDVI value. Upon further inspection, we found that on the satellite image provided by Google, the water appears black, seemingly covered with some sort of tarp or other material. We then questioned as to why the body of water would be covered up, and assumed that the cover could be used to decrease water evaporation.

# Research results

Later on, we discovered that this small body of water and those around it could be used for both sewage and watering cotton crops from January to August, answering our questions as to why the body of water would be covered by a tarp and produce a negative NDVI value. We found that the small area with changing NDVI values had actually come about from the accumulation of the city's precipitation so as to supply the city with water throughout its dryer months.

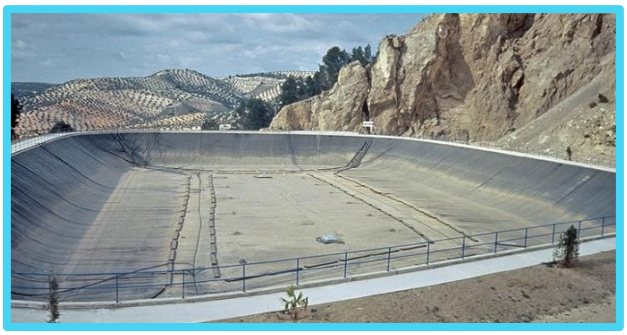
The negative NDVI values represented a series of covered water reservoirs in the town.

- The source for water in the reservoirs came from a nearby aquifer that extends throughout most of the central US.
- Littlefield contains seasonal tarps used to cover the water reservoirs.
- These reservoirs are used for local vegetation, such as cotton, as well as sewage systems.
- During the months of January - August these particular reservoirs are used to water the cotton crops therefore they are consistently covered.

These areas have lower NDVIs consistently through the year but during the fall, another reservoir appears spontaneously. The reasoning for this is that during the harvest period of cotton (Late July - November), this particular reservoir appears as precipitation in Littlefield slows down. The reservoir’s purpose is to maintain the town’s water system throughout the dryer months.

# Research results

The reasoning for a new NDVI value presented on the satellite image of October 5 ,2018 is because a new water reservoir appears. This reservoir produces a negative NDVI value and is in direct conjunction with the seasonal and agricultural changes present within the city during that period.

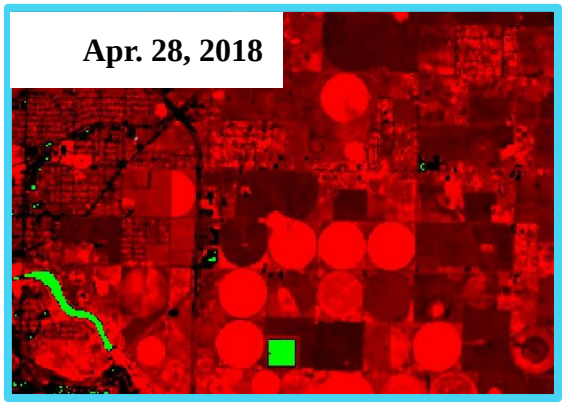
# NE Lubbock, TX

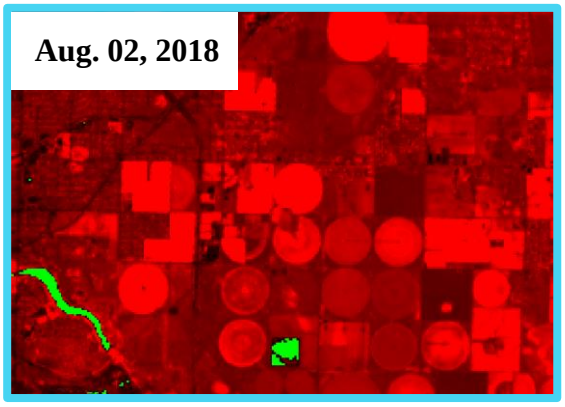
(*By Kalin Klameth, Sandra Gurrola, Elle Stevens*)

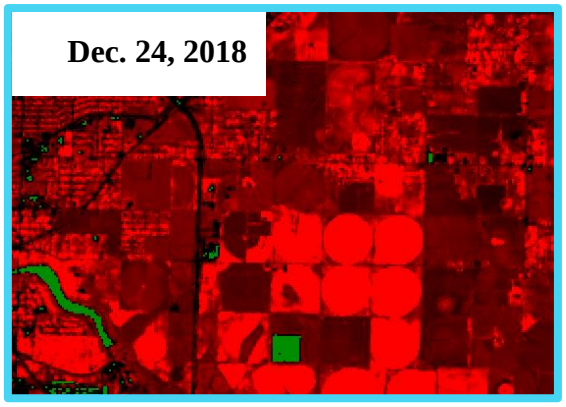
Our selected images focus on North East Lubbock, which has a lot of farmland surrounding it and has a semiarid climate. This region largely grows wheat year round with harvest times in April and October.

## Research Questions

- What does analyzing NDVI show about vegetation?
- Why does our winter image have a high NDVI in comparison with the other images?



# Research results

Method - Using the SNAP program we were able to analyze the provided images captured by Landsat. The program allowed us to check the NDVI of each image showing red as a positive NDVI and green as a negative NDVI. The more vibrant red means higher NDVI. Using this information, we were able to gauge vegetation health, taking into consideration regional norms and the NDVI images.

In the April image there is a decent amount of visible vegetation, which we have inferred to be wheat partially harvested because April is in the middle of the harvest season. The August image has vegetation in different fields, but this is likely still wheat being grown by different growers or in rotation. The December image has the most visible vegetation despite the cold weather. Winter wheat is what grows in the area at this time and would be in its growing stage. The higher NDVI is explained by winter wheat having large leaves which contribute to these NDVI results.

# All the hard work…


# Israel Team

## Beit Yatziv & Earth and Planetary Image Facility (EPIF)
## Ben-Gurion University of the Negev (BGU)

# Team leader

**Lonia Friedlander**

Dear Meshi, Shira, Roni, Ofek, and Nikol,

Since the beginning of this project, I have tried to view you as fellow researchers rather than students. I wanted you to feel as if we were all working together toward the common goal of understanding remote sensing for environmental applications, and not that I was your instructor. I hope that you do feel this way, I know that I definitely view you now as astute, careful investigators and creative thinkers.

I cannot believe the program is over already! It has gone by so fast and we have learned so much. I have been very impressed by your ability as a group to put each of your individual projects together into a fantastic and cohesive project. Telling a story with scientific results is one of the most challenging aspects of science; and you have excelled at it.

I am so proud of all of you.

You volunteered for this program and took on an advanced research project, learning right along with us (university researchers) about the Venμs Satellite and the best ways to process and use its image data. I can't imagine that you knew what you were getting into when you found out about this project and decided to do it, but I am so happy that each of you did. It is hard to imagine that less than four months ago you hadn't met and today you are a strong research team.

We intentionally focus on research rather than specifically female empowerment, but I'm sure that it didn't escape any of you that you worked in an all-girl team, with an all-female staff. We wanted to show you all the different ways that women can be themselves in the world and all the ways that women can contribute to science and to research.

# Team leader

We also wanted you to bond as a team and learn from each other about research and about being young women. I have seen you all grow so much as friends and as a team. I hope that you know that you can rely on each other and, more importantly, I hope that you will all stay in-touch as you move on in your education and in your lives. It has been a privilege working with you. You are all remarkable.

I can't tell you how much fun I've had working on this project; watching you all do active research, learn about remote sensing and image analysis, and succeed in putting your results together into a great presentation. I truly hope you've all learned how capable you are. I have been (and continue to be) amazed by you. I can't wait to see how far beyond the stars you go.

Wishing you all the very best in life and in research!

Lonia

Dr. Lonia Friedlander is an Ilan Ramon post-doctoral fellow at the Earth and Planetary Image Facility at Ben Gurion University of the Negev. Her work focuses on the use of remote sensing for the detection of trace metal contamination in soil. More generally, she is interested in the application of remote sensing and geochemical methodologies for environmental preservation and remediation. Previously, she used spectroscopy and remote sensing to investigate the effects of interstellar impacts on the martian water cycle and on martian clay minerals, in particular. In 2015, she was awarded a Fulbright post-doctoral fellowship to come to Israel and study the geochemistry of trace metals released into the environment by informal electronic waste processing; bringing her to Israel and turning her research interests toward terrestrial and environmental remote sensing applications. In the future, she plans to continue investigating environmental geochemistry and geochemical questions as a Research Associate and manager of the X-ray Diffractometry Laboratory in the Ilse Katz Institute for Nanoscale Science & Technology at Ben Gurion University of the Negev.

# Team mentors

**Chen Meged**

Hi, my name is Chen, I'm a master's student at Ben-Gurion University of the Negev. I am part of the Earth and Planetary Image Facility (EPIF) laboratory team. I study the morphology of the dunes of the Central Asian sand seas – the Karakum and Kyzylkum – using remote sensing technologies.

**Inbal Ronay**

Hi, my name is Inbal, I'm a master's student at Ben-Gurion University of the Negev. I am part of the Earth and Planetary Image Facility (EPIF) laboratory team. I'm doing my master's project in the field of precision agriculture. I am working on characterizing the effects of weed infestation on the spectral properties of crop species.

**Shiran Havivi**

Hi, my name is Shiran, I'm a Ph.D. student at Ben-Gurion University of the Negev. I am part of the Earth and Planetary Image Facility (EPIF) laboratory team. My work deals with damage assessment in rural areas, following earthquakes, by integrating different remote sensing sensors.

# EPIF girls

**Shira Maimon**

Hi, my name is Shira, I'm 16 years old. I'm a high school Student at Mekif Zain Amal Beer Sheva. I have a lot of hobbies, but the two things that I like to do the most are going shopping with my girlfriends and dancing. I love music, especially Justin and my favorite singer is Beyonce. What characterizes me is my passion for sports.

**Meshi sarusi**

Hi, my name is Meshi, I am 16 years old. I'm a high school Student at Mekif Zain Amal Beer Sheva. I'm interested in politics and israel's history. Outside of school I perform as a dancer. The thing I like to do the most is hang out with my friends.

**Nikol Machnikiv**

My name is Nikol Machnikiv. I am at an Israeli youth performing arts school where I have been studying singing and acting for 4 years. In the future I want to be an actress.

# EPIF girls

**Rony Rubin**

My name is Rony rubin, I am 16 years old, I live in Eilat and I go to Rabin High School. I love book trilogies and to hang out with my friends. My favorite foods are pasta and pizza.

**Ofek Vilkerstone**

My name is Ofek Vilkerstone and I'm 17 years old. I am a troop leader in the scouts and I love music. I play the bassoon, clarinet, saxophone, ukulele, guitar and piano. I enjoy reading as well as traveling.

# Study area

**1. The Kinneret (the Sea of Galilee):**

The Kinneret is Israel's largest freshwater lake. It is locate around 212 meters below sea level, and considered to be the lowest (elevation) freshwater body in the world. The water level of the Kinneret changes every year and depends on climate.

**2. Mediterranean Sea (Ashdod):**

The Mediterranean sea is an intercontinental sea located between the continents of Asia, Africa, and Europe. Because it is a closed sea, it is more vulnerable to pollution. There are also many ports and industrial areas around the shoreline that contribute to pollution.

**3. Negev Desert (Be'er Sheva):**

The Negev desert is characterized by 195 mm/year of rain (250 mm/year in Lahav Forest). Beer Sheva is located arround 280 meters above sea level. The area is characterized primarily by desert vegetation, though there are also managed forests (planted by the Jewish National Fund - KKL).

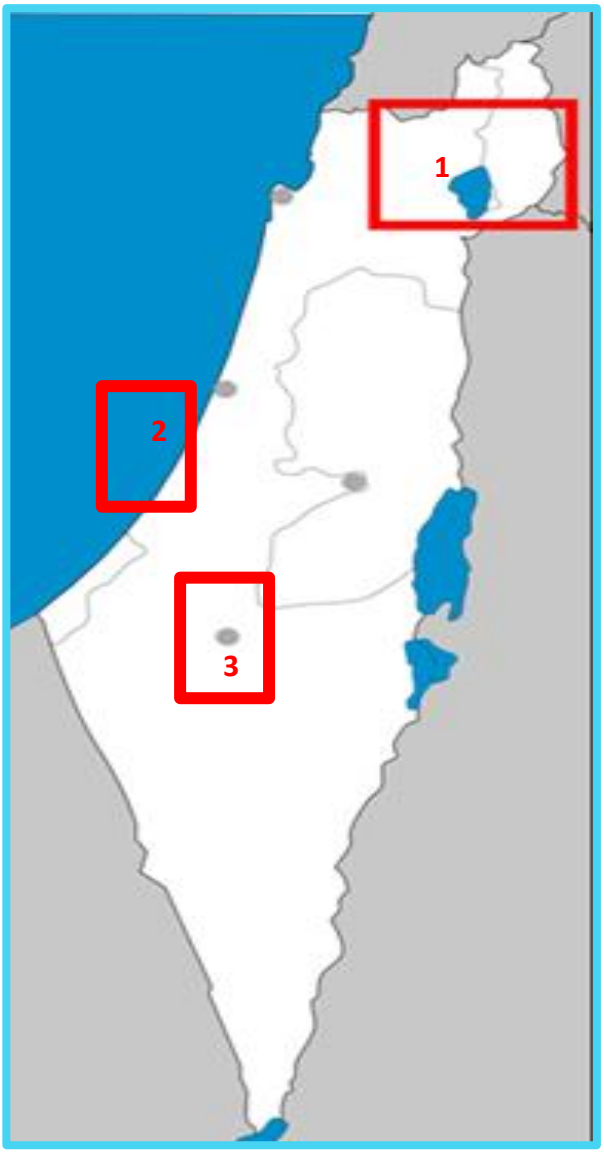


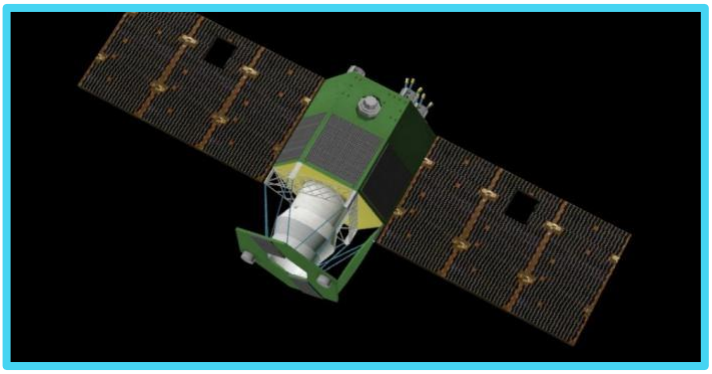

**Figure 1.** A map of Israel with our study areas outlined in red. 1) Kinneret, Sea of Galilee, 2) Mediterranean Sea, 3) Negev Desert – Be'er Sheva – Yatir Forest.

# Venμs satellite

Venμs is an Israeli research satellite created in collaboration with the French Space Agency and launched in August of 2017. The significant advantages of the satellite are:

1. Spatial resolution: 10 m/pixel
3. Spectral resolution : 12 bands between 423.9 nm – 908.7 nm
2. Radiometric resolution: 10 bit
3. Temporal resolution (revisit time): 2 days

These advantages aided our research as follows: because of the satellite's radiometric resolution we can detect small spectral changes, thanks to the satellite's research focus on plant health we were better able to try and investigate the presence of algae in the water of the Sea of Galilee, the spatial resolution is high enough that we were able to sub-set large areas and look for local differences, and, finally, the 2-day revisit time might help us in the future to develop this work into a study investigating more detailed changes over shorter time-periods than seasonal differences.



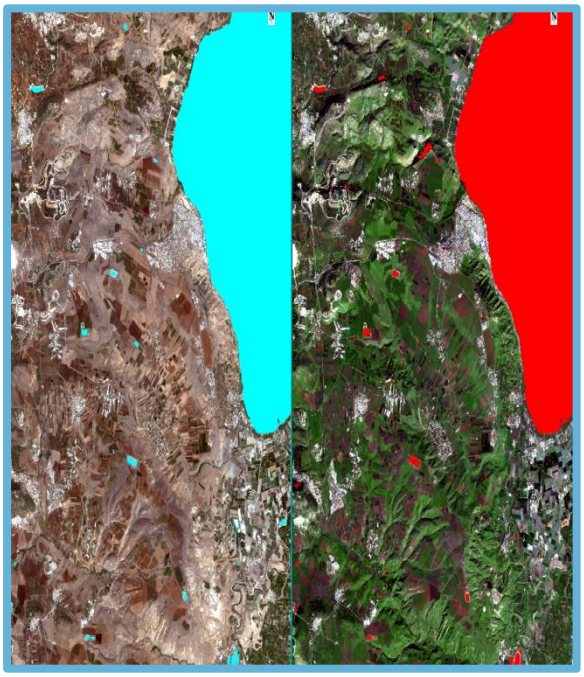
www.space.gov.il

## Water Quantity in The Kinneret between seasons

(By shira Maimon)

In this project we looked for changes in water quantity between summer and winter. We used ENVI software in order to mark the area of natural and man made water reservoirs in the Kinneret and around it. Since water has low reflectance values in the infrared region, we chose band 12 and assumed that low pixel values will be attributed to water sources. We created a region of interest based the first 70 lowest pixel values of the histogram in two images, one from September 2018 (Summer) and the second from January 2018 (Winter). We than compared the number of pixels attributed to water sources between the two images.

The colored polygons (red, blue) mark the areas identified as water, both the man-made agricultural reservoirs and the natural reservoirs. The red polygons indicate the areas identified as water in winter, and the blue in summer. Comparing the number of pixels between the two sets of polygons, you can see in the table below that summer has fewer pixels attributed to water than winter, but the results overall are similar for both seasons

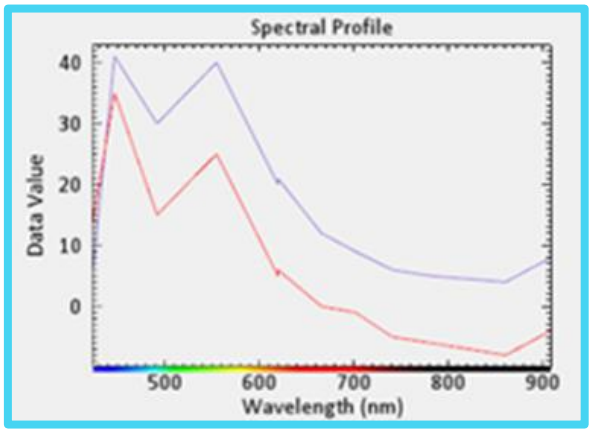


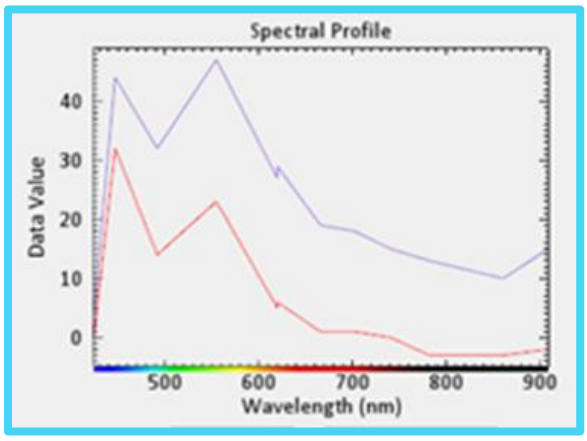
| Summer pixel count | Winter pixel count |
|---|---|
| 1588933 | 1598820 |

# Research results

## Comparing water in The kinneret between years

(By Nikol Melechnikiv)




In order to find whether there are differences between years, we compared the water's spectral signature in 2018 and 2019. The result is presented in the figure above.

The x-axis represents the wavelength between 400 and 900 nm, where there are two domains: the visible range (between 400-700 nm) and the near - infrared (700 – 900 nm). The y-axis is the amount of reflected light.

There are two graphs of spectral signatures from 2018 and 2019. The purple graph describes the spectral signature in 2019 and the red graph symbolizes the spectral signature in 2018. The reflectance in the two graphs is higher in the blue band , which signifies water and than we see a decrease and again an increase between green and red and again a sharp decrease toward the near-infrared. You can see the difference between the purple graph (2019) and the red graph (2018) as the purple graph has higher overall reflectance, but the two graphs show the same trend.

These differences can be seen mainly because of the flow of streams that occured in 2019 and caused the flow of different substances to the Sea of Galilee. Substances in the water could cause changes in the reflectance, but these results could also be due to the lighting conditions on the day that image was taken.

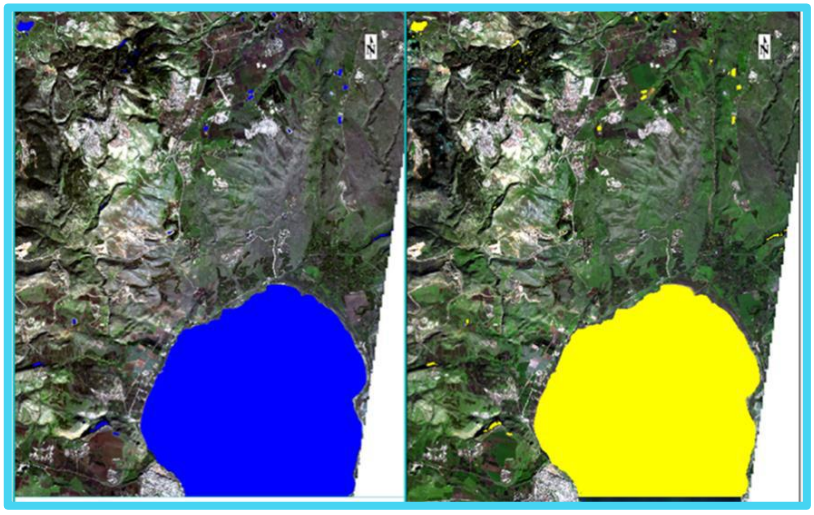
# Research results

We also determined that 2019 (yellow) has more pixels of water than 2018 (blue) at a margin of over 4000 pixels.

In 2019 there are 1087756 pixels and in 2018 there are 1083591 pixels .

*The results represent only the northern part of the Sea of Galilee.

*We found all the water bodies in the northern part of the Sea of Galilee, and did not isolate these water bodies.

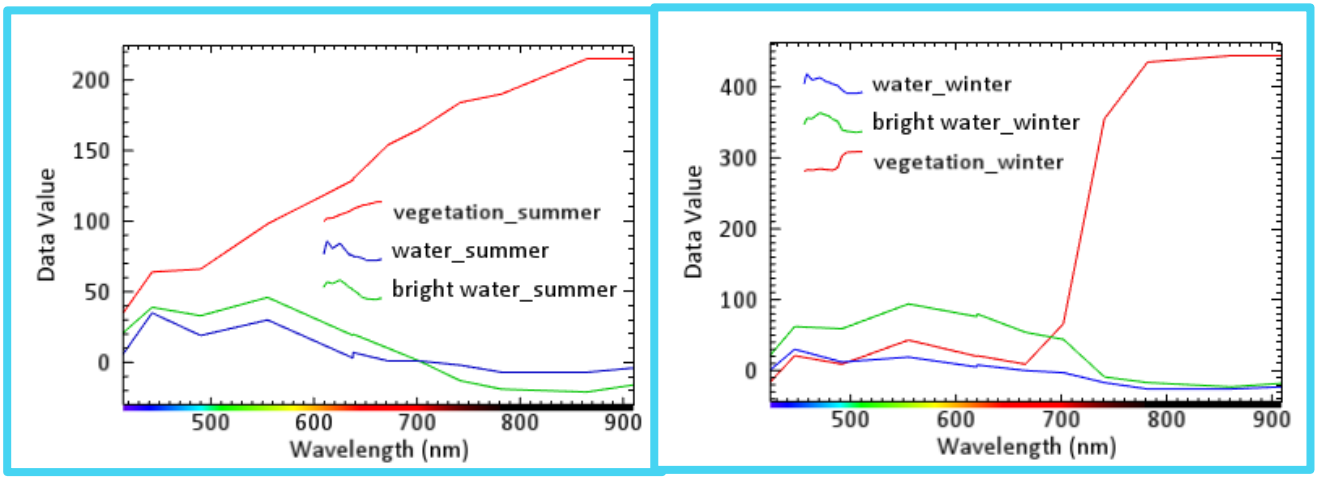


| 2018 pixel count | 2019 pixel count |
|---|---|
| 1083591 | 1087756 |

# Research results

## Water Quality in The kinneret

(By Rony Rubin)




During the project we studied the water quality of the Kinneret by examining whether there are algae in the water at two time stamps – winter (January) and summer (September). We analyzed two Venμs satellite images of the Kineret and its surroundings. Three points were selected to try to identify the algae – healthy vegetation (field), deep water, and water close to the shore ('bright water'). The assumption was that the bright water is, in fact, water that contains algae. Otherwise this may be water with sediment in it. Two methods were conducted- 1] spectral signatures and 2] NDVI (Normalized Difference Vegetation Index), to identify vegetation or, in this case, to identify algae.

# Research results

The first method, spectral signatures, enables the identification of materials based on their reaction to electromagnetic radiation. According to the signatures from the three points, in both of the two seasons, the bright water was very different from the vegetation signature and more like the deep water signature.

NDVI enables the classification of healthy vegetation using the ratio between the red and near-infrared (NIR) wavelengths. The results of the index are between -1 to 1, when values close to 1 are healthy vegetation and negative values are soil or water. Based on the results of the index from the two images, both in the winter and in the summer, the bright water values were the same as the deep water (-1).

From the results of the two methods, we found no differences between the two seasons and no similarity between the bright water and the vegetation. Therefore, we assume that the bright water does not contain algae and probably a different material discolored the water. Based on literature knowledge, it is known that algae does exist in the Kineret, but we were unable to identify them using Venμs images or the spectral signature and NDVI methods.

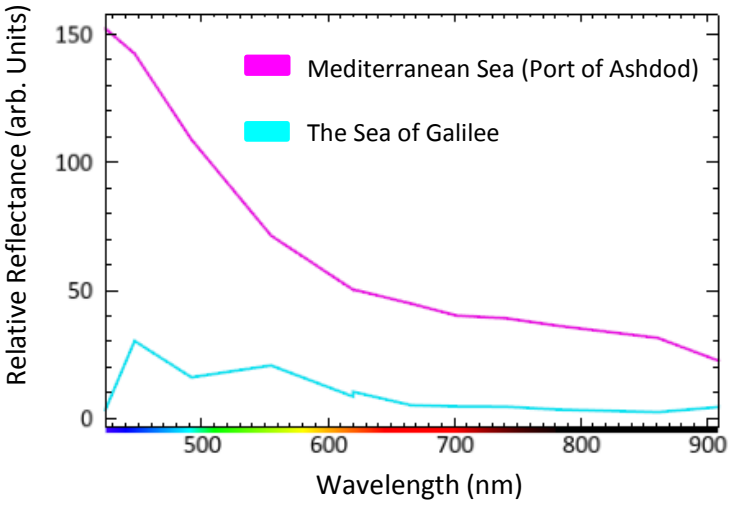
## Comparison between water in the kinneret Mediterranean sea

(By Ofek Vilkerstone)

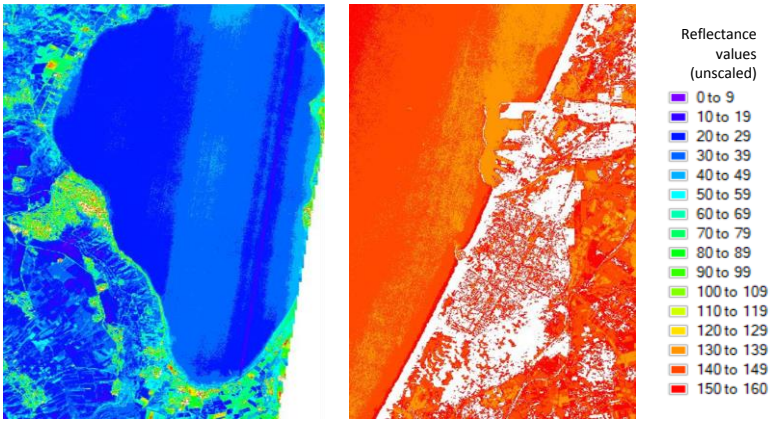
In the Mediterranean Sea, the water near the port of Ashdod has lower reflectance in the blue wavelengths than deeper in the water (as the region is farther from the shore, the reflectance is higher).

In the Sea of Galilee there is a stripe from north to south of higher reflectance, this may be caused by an error in the satellite sensors or from a flow of contaminated water.

Spectral signatures of the Sea of Galilee and the Mediterranean Sea




Band 2 (446.9 nm) colorized, unscaled reflectance differences




The Sea of Galilee

Mediterranean Sea
Port of Ashdod

# Research results

These differences may result from:

- Elevation of the water – the Sea of Galilee is 213 meters below sea level
- Depth of the water – the Sea of Galilee's average depth is 26 meters and the Mediterranean Sea is deeper as it gets further from the shore (a few meters near the shore, up to 60 meters deep at the edge of the image).
- Salinity – in the Sea of Galilee the salt concentration is 0.25% and in the Mediterranean Sea near Israel, it is 3.9%
- Sediments in the water – other than salt there are more sediments in different concentrations in both water bodies.

Conclusions:

- Reflectance values are higher over the Mediterranean than over the Sea of Galilee, the biggest difference being in Channel 2 (446.9 nm).
- There are no significant differences in the spectral signatures of different areas of the Sea of Galilee and the Mediterranean.
- The differences between fresh and salt water are clearly detectable using the VENuS satellite.

# Research results

## Comparison between the Sea of Galilee and the Negev

(By Meshi Sarusi)

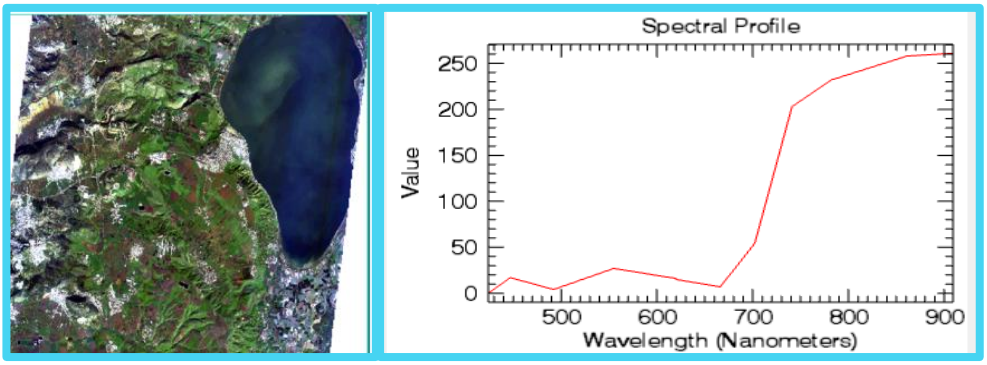
In our project we used the ENVI program in order to learn about the differences in vegetation health and climate in the Sea of Galilee and the Negev.

Regular satellite imagery shows that the Negev is a very dry, arid area and has almost no agricultural land, in contrast to the Sea of Galilee. In the satellite photo, it can be seen that the Sea of Galilee is rich in many vegetated areas. We observe this mainly in the color variation (indicating a large amount of rainfall).

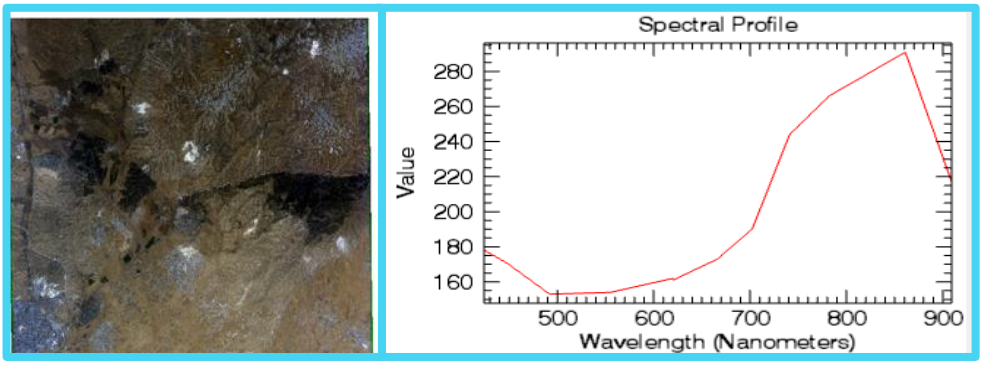
In our project we focused on a comparison between the Lahav forest in the Negev and the Birya Forest located in the Sea of Galilee area.

We got a result that we did not expect. To our surprise, the overall reflectance in the Lahav forest area was higher than that from around the Sea of Galilee. We expected the highest reflectance from plants. This can be explained by the fact that there are probably differences in the types of land in the Lahav Forest area that affect the result.

**Birya forest**




**Lahav forest**



# Conference call...

## Many people supported us along the way and for that we are most grateful!

Jessica Spott - Senior Program Administrator, STEM Center for Outreach, Research & Education at Texas Tech University.

Olga Achourkina- Director of Office of College Connect, Division of Diversity, Equity & Inclusion at Texas Tech University.

Dr. Volker Kratzenberg-Annies and Sebastian Kleim from the Deutsches Zentrum fuer Luft- und Raumfahrt (DLR).

Adi Nahum Yosi Ron and the entire Beit Yatziv staff.

Markus Woltran – Programme Officer at United Nations Office for Outer Space Affairs.

Avi Blasberger - director general of the Israel Space Agency.

Avital Moyal - Education and community relations adviser, Israel Space Agency.

Jacob Cohen - Chief Scientist, NASA Ames research center.

Heftzi Zohar Deputy Mayor of Beer Sheva, who holds the Education and Welfare Portfolios, Beer Sheva Municipality.

A special thanks to

Dr. Sivan Isaacson, Dr .Nitzan Swet, Roi Shilo (PlanetWatchers) and Tzahi Zissu

for all their cooperation and empowerment of our girls!

# Thank you!