



SPACE AS A CONTEXT IN THE CLASSROOM

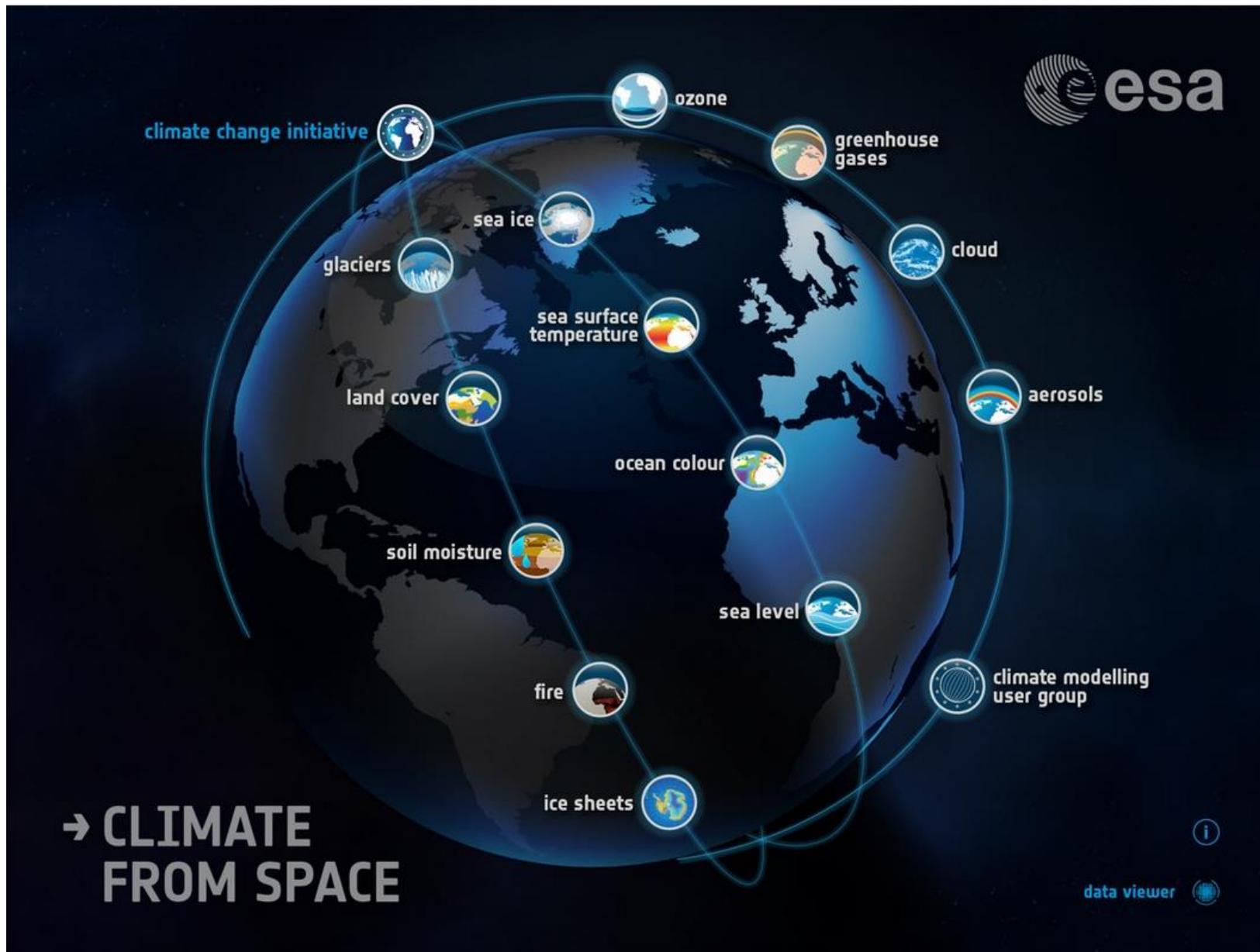
Cristina Stancu

ESERO Romania – Deputy Manager
Romanian Space Agency (**ROSA**)



INTRODUCTION

- Climate from Space
- Research on the ISS
- Research in the classroom
- ESA Education Portfolio on EO Educational Activities (case studies)
- Astro Pi
- Climate Detectives (project)
- Mission X (Train like an astronaut)
- CanSat
- Exo-Ro



<http://cci.esa.int/content/tablet-app>

EXPERIMENTS ON PLANTS IN SPACE



Arabidopsis thaliana
(also known as Thale
Cress)

model organism for
plant biology and
genetics.

first plant to ever have
its genome fully
sequenced

grown on the
International Space
Station and first
flowered in the 1982s
aboard Soviet Salyut
7.

**Arabidopsis is
critical to** spaceflight
plant biology research.

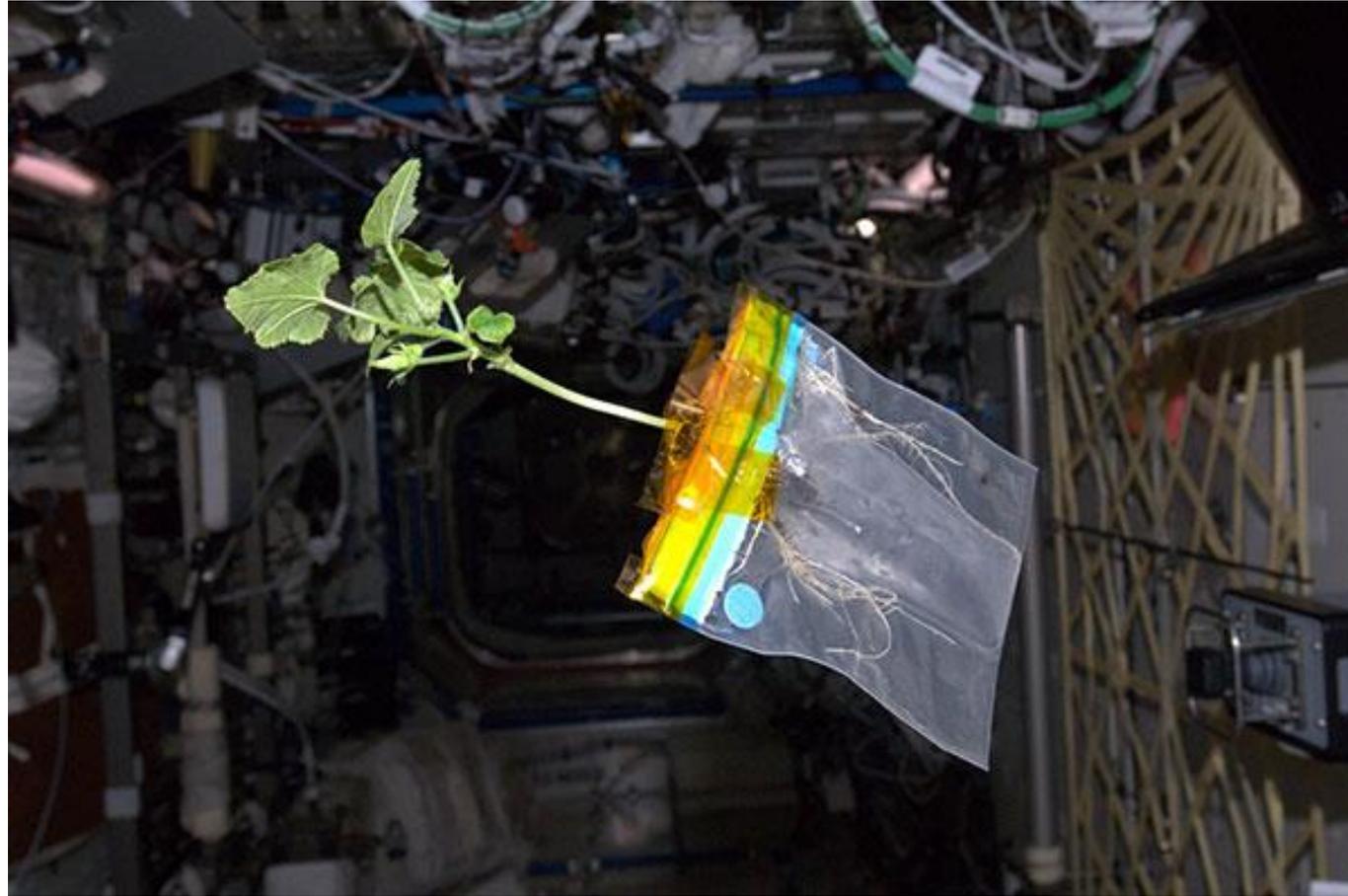
small genome (5 chr,
27k genes)

first plant genome
sequenced

small size

rapid lifecycle (6
weeks)

DIARY OF A SPACE ...



Credit: https://blogs.nasa.gov/letters/2012/04/03/post_1333471169633/

VEGETABLES AND LETTUCE ON ISS



Credit: NASA astro Peggy Wilson with a lettuce

GROWTH SYSTEMS

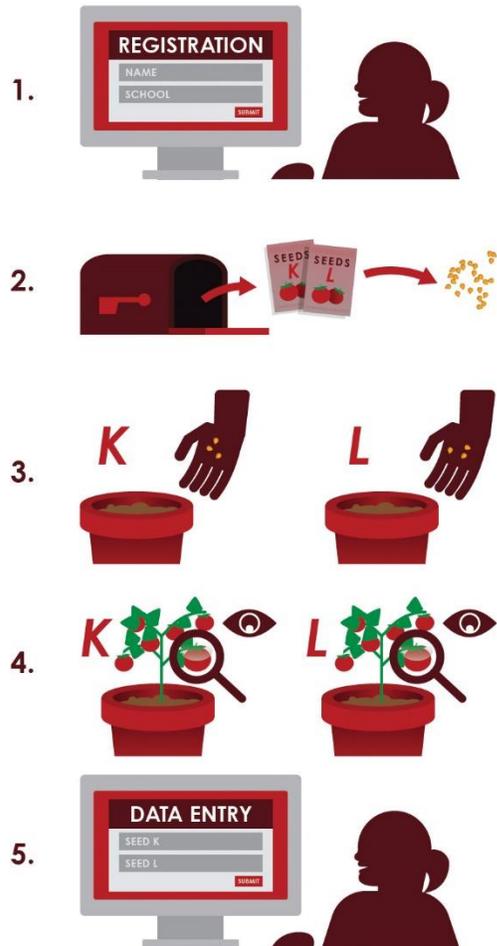


credit: verge.com



TOMATOSPHERE™

TOMATOES ON ISS



credit:NASA/ESA

BEAN SPROUTS ON EARTH



Credit: Consula Coltan's facebook page



SEND YOUR CODE TO THE ISS

- **Mission Zero**, the simpler level of the Astro Pi Challenge, also offers you the chance to have your code run on the ISS, in the form of a simple program that displays a message to the astronauts on-board.
- **Mission Space Lab** gives you the chance to have your scientific experiment run on the ISS. Your challenge is to design and code an experiment using the environmental sensors and cameras of the Astro Pi computers, called Ed and Izzy, aboard the ISS.



CLIMATE DETECTIVES



→ CLIMATE DETECTIVES

- School project for 8-15 years old.
- to 'make a difference' in understanding and protecting Earth's climate.
- Identify a climate problem by observing their local environment and also using available **Earth Observation data** or take measurements on the ground.
- Based on their investigation, teams will propose a way to help reduce the problem. The students will learn about climate on Earth as a complex and changing system and the importance of respecting our environment.

EDU SPACE

esa eduspace European Space Agency

ESA Education **Home** Weather and Climate Global Change Natural Disasters

09-May-2019

About Eduspace

- What is Eduspace? ▶
- What tools does it offer? ▶
- Choose your language... ▶

Remote Sensing Principles

- What is remote sensing? ▶
- Remote sensing in depth ▶
- History of Earth observation ▶
- Mapping and satellite data ▶
- Satellite orbits ▶
- Earth observation satellites ▶

Resources...

Multimedia

- Image Gallery ▶
- Video Gallery ▶

Services

- Contact us ▶
- Search in Eduspace ▶

Search

What tools does it offer?

Eduspace introduces Earth observation techniques and applications to secondary school students with the help of a catalogue containing EO imagery, as well as a sophisticated image processing software package known as LEOWorks. ArcExplorer is a software package also used in some of the case studies.

Image Catalogue Viewer

The Eduspace Image Catalogue Viewer allows the user to perform multi-mission inventory searches on some of ESA's supported missions. Multiband imagery from different regions of the electromagnetic spectrum, including infrared, active microwave, and visible, can be downloaded.

You can access the Eduspace Image Catalogue application by clicking on the link on the right. A tutorial, which provides a quick-start guide to using the catalogue, is also available.

LEOWorks

LEOWorks is an important feature of Eduspace. It allows secondary school students to do actual processing of satellite imagery. LEOWorks is able to perform basic and advanced processing operations, such as geometric correction, pan-sharpening and image classification. Several tools are available, such as Geographical Information Systems (GIS) functionalities that enable the displaying, drawing and managing of information layers as points, lines and polygons, on top of images.

LEOWorks is a didactical tool with extensive help pages and an all-inclusive tutorial (see right of page). With the assistance of this documentation, students will be able to experiment with their own imagery and undertake their own processing. LEOWorks is compatible with data collected by several Earth Observation missions, and can read most standard image formats (e.g. jpg, tif, bmp, png).

Resources

- Eduspace Image Catalogue
- Eduspace Image Catalogue Viewer Tutorial
- LEOWorks 3
- LEOWorks 3 Tutorial
- LEOWorks 4 Tutorial
- LEOWorks 4 QuickStart (pdf)
- LEOWorks 4 (MacOS)
- LEOWorks 4 (Windows)
- LEOWorks 4 (Linux)
- ArcExplorer
- ArcExplorer Tutorial

credit: ESA

EO BROWSER

The screenshot displays the EO Browser interface. On the left, a sidebar contains the following elements:

- EO Browser logo and a Login button.
- Navigation tabs: Search, Results, Visualization (active), and Pins.
- Dataset: SENTINEL-3 OLCI.
- Date: 2019-05-06.
- Rendering options:
 - Custom: Create custom rendering.
 - Sentinel 3 - True color.
 - Sentinel 3 - OTCI: OLCI Terrestrial Chlorophyll Index, Based on combination of bands (B12 - B11)/(B11 - B10).
 - Sentinel 3 - Tristimulus (highlighted).
 - Sentinel 3 - RGB (17,5,2).
- Free sign up for all features.
- Powered by Sinergise with contributions from the European Space Agency v2.17.5.

The main map area shows a satellite image of Cluj, Romania, with various locations labeled: Zălău, Jibou, Boclean, Dej, Gherla, BISTRITA, Mureșin, CLUJ-NAPOCA, Sârmașu, Reghin, Cămpia Turzii, Luduș, Iernut, TÂRGU MUREȘ, Miercurea Nirajului, Sângeorgiu de Pădure, Sovata, Cămpeni, Baia de Arieș, Ocna Mureș, Alud, Târnaveni, and Cristuru. The search bar at the top right contains 'Cluj, Romania'. A vertical toolbar on the right side includes icons for search, home, location, print, image, and video. At the bottom, there are links for 'About EO Browser', 'Contact us', and 'Get data', along with coordinates (Lat: 47.203, Lng: 21.616) and a 20 km scale bar.

https://apps.sentinel-hub.com/eo-browser/?lat=46.810&lng=23.354&zoom=9&time=2019-05-06&preset=3_TRISTIMULUS&datasource=Sentinel-3%20OLCI

PRIMARY RESOURCES

Primary



From the ground and from the sky – Analysing and understanding images of planet earth taken from space | Teach with space PR10



The ice is melting – How can we investigate the effects of melting ice? | Teach with space PR13



Earth under the lid - Understanding the greenhouse effect | Teach with space PR15



One year on Earth - Understanding seasons | Teach with space PR45



Nose up high in the sky - Observing and measuring weather conditions | Teach with space PR48

SECONDARY RESOURCES

Secondary



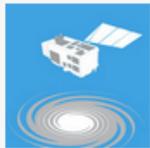
Highways of the Oceans - Sea currents and the connection to climate| TEACH WITH SPACE G02



The greenhouse effect and its consequences - Investigating global warming | Teach with space G03



Infrared Webcam Hack - Using infrared light to observe the world in a new way | Teach with space P15



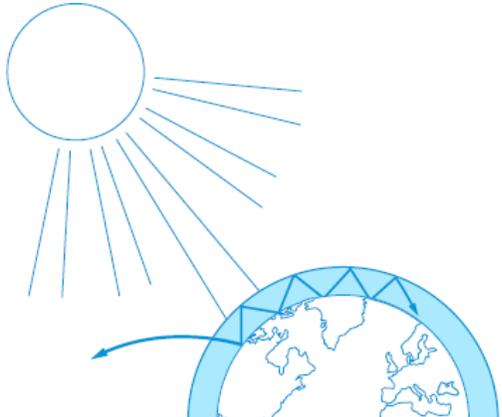
After the storm – Tracking Hurricane Matthew and analysing its impact | Teach with space G05

GREENHOUSE EFFECT

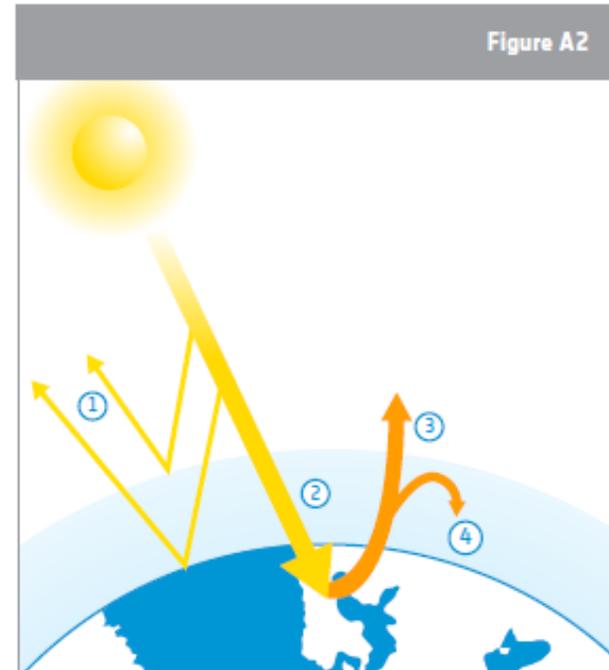
Geography | 603 

teach with space

→ THE GREENHOUSE EFFECT AND ITS CONSEQUENCES
Investigating global warming



teacher guide & student worksheets 



↑ Earth's radiation budget.

1 - Some radiation is reflected by the atmosphere, clouds and Earth's surface.

2 - Some radiation is absorbed by the atmosphere, clouds and most of it is absorbed by the land and oceans, heating the Earth.

3 - Infrared radiation is emitted by Earth's surface. Some of this radiation escapes to space.

4 - Some is trapped by the greenhouse gases in the atmosphere.

GREENHOUSE EFFECT

→ THE GREENHOUSE EFFECT AND ITS CONSEQUENCES

Investigating global warming

Fast facts

Subject: Geography, Physics, Science

Age range: 12-15 years old

Type: hands-on student's activity

Complexity: easy

Lesson time required: 45 minutes per activity

Cost: low (0 – 10 euros)

Location: indoors and outdoor

Includes the use of: computer, internet, infrared thermometer

Keywords: Greenhouse effect, Carbon dioxide, Global warming, Sea level, Albedo, Climate, Geography, Physics, Science

Brief description

This set of activities includes hands-on experiments and the interpretation of satellite images for better understanding the overall effects of global warming. In activity 1 students will make a model to demonstrate the greenhouse effect by showing that a higher level of carbon dioxide (CO₂) means a higher temperature. The experiment will be complemented by the interpretation of satellite images showing the Earth's CO₂ levels at different time periods. Students will then learn about some of the consequences of an increased greenhouse effect – ice melting and changing albedo values. Students will explore these topics in activities 2 and 3.

Learning objectives

- What the greenhouse effect is and how human activity changes the energy balance in Earth's atmosphere.
- The potential effects of increased levels of carbon dioxide on the Earth's climate.
- Possible consequences of the increased greenhouse effect.
- The different consequences of flooding and rising sea water level due to melting sea-ice and melting ice sheets and glaciers.
- What albedo is and how the reflectivity of different surfaces affect temperature.
- How Earth observation can be used to monitor Earth's climate.

→ Summary of activities

Summary of activities					
	Title	Description	Outcome	Requirements	Time
1	Greenhouse effect – what is that?	Students produce the greenhouse gas CO ₂ through a simple chemical reaction, measure the effect of the gas on air temperature, and relate their conclusions to the greenhouse effect in our atmosphere.	Understanding CO ₂ 's role as a greenhouse gas and what the greenhouse effect is.	None	45 minutes
2	Sea level as an indicator of global warming	Students explore by means of hands-on activities the effects of the melting of land ice and sea ice.	Understanding the effect on flooding from melting sea ice versus melting glaciers and ice sheets.	None	45 minutes
3	How changes in albedo can affect the climate	Students measure the reflectivity of different surfaces and investigate how the reflection from surfaces of different colour affects their temperature.	Better understanding of albedo and its role in the Earth's energy budget.	None	45 minutes

AFTER THE STORM

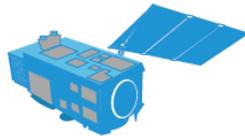
Geography | G05



teach with space

→ AFTER THE STORM

Tracking Hurricane Matthew and analysing its impact



→ AFTER THE STORM

Tracking Hurricane Matthew and analysing its impact

Fast facts

Subject: Geography, Science

Age range: 12 – 15 years old

Type: student activity

Complexity: easy

Lesson time required: 1 hour

Cost: low (0-10 Euros)

Location: indoors

Includes the use of: computer and internet

Keywords: Earth observation, Climate, Extreme weather, Hurricane, Geography, Science

Brief description

These activities use the example of Hurricane Matthew to explore the applications of Earth observation data in tracking hurricanes and assessing their aftermath. Students will learn how a hurricane develops and the impact that extreme weather can have on the society. They will do this by comparing satellite images.

The activity could be completed either in an ICT suite in which students complete independent learning about the images or could be taught using a more active learning style in the classroom.

Learning objectives

- Explain how hurricanes develop.
- Understand the impact that extreme weather can have on society.
- Understand how Earth observation can be used to track incoming weather and assess the damage caused by extreme weather.
- Understand how countries work together to supply aid and relief to affected areas.

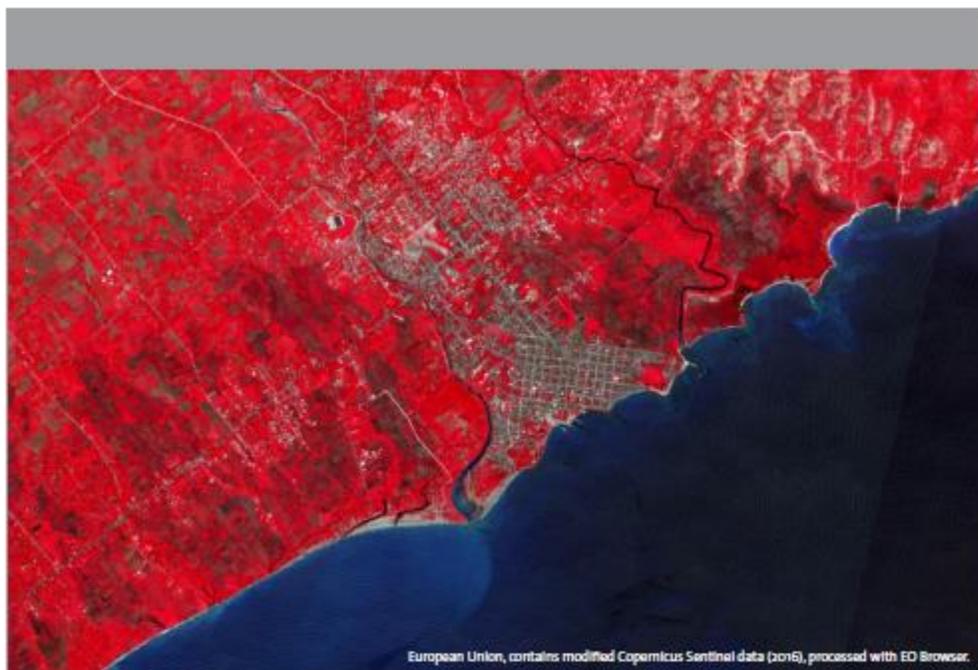
AFTER THE STORM

→ Summary of activities

Summary of activities					
	Title	Description	Outcome	Requirements	Time
1	Track the hurricane	This activity uses satellite images to develop students' Earth observation skills. The task is to investigate the development of Hurricane Matthew.	Students will learn: <ul style="list-style-type: none"> • How a hurricane develops • How Earth observation can enable weather tracking and predictions of its effects 	None	20 minutes
2	Impacts of Hurricane Matthew	This activity is based upon remotely sensed data and encourages students to investigate how Earth observation can be used to examine the impacts of natural disasters such as Hurricane Matthew. By annotating images and identifying changes, students will develop their geographical skills of observation and analysis.	Students will learn: <ul style="list-style-type: none"> • The impact that an extreme weather event can have on society • The extent of the damage caused by extreme weather • The potential for Earth observation to be used to help recovery after an extreme weather event 	Completion of activity 1	40 minutes

28 th September 2016 14:30	5 th October 2016 18:30	7 th October 2016 16:00	8 th October 2016 18:20	9 th October 2016 15:45
				
D	A	B	E	C
<p>Tropical storm evident.</p> <p>Movement – west in the direction of Haiti.</p> <p>Location – centre of circulation just east of the Lesser Antilles.</p> <p>Weather – Strong thunderstorms surrounding the centre with heavy clouds in the Caribbean Sea.</p> <p>Wind speeds are around 80km/h.</p>	<p>Hurricane now visible.</p> <p>Movement – north-west direction towards the Bahamas.</p> <p>Location – eye is visible north of Cuba and heading toward the Bahamas.</p> <p>Weather – the anticlockwise spiralling of cloud is visible. This produces high winds, gusts and heavy downpours for the areas affected. Haiti, the Dominican Republic, Jamaica and Cuba continue to be affected. Weather warnings issued for the Bahamas.</p>	<p>Category 3 hurricane.</p> <p>Movement – north-west direction heading toward the US coast.</p> <p>Location – central vortex is visible off the coast of Florida. Here, there is high density cloud and a clear hurricane structure.</p> <p>Weather conditions – strong winds of around 180km/h affecting Florida and Georgia.</p>	<p>Hurricane Matthew becomes a post-tropical cyclone with a visible change in structure.</p> <p>Movement – north-easterly direction along the SE coast of the USA.</p> <p>Location – off the coast of North Carolina.</p> <p>Weather conditions – winds of around 130km/h with some stronger gusts and heavy rainfall. Conditions will only begin to improve over the next 48 hours.</p>	<p>Post-tropical cyclone.</p> <p>Movement – now being absorbed by a cold front along the US Eastern Seaboard as evidenced by the decreased cloud density.</p> <p>Location – around 320km east of North Carolina.</p> <p>Weather conditions – winds beginning to weaken.</p>

AFTER THE STORM



↑ Les Cayes, Haiti before the hurricane.

European Union, contains modified Copernicus Sentinel data (2016), processed with EO Browser.



↑ Les Cayes, Haiti after the hurricane.

European Union, contains modified Copernicus Sentinel data (2016), processed with EO Browser.

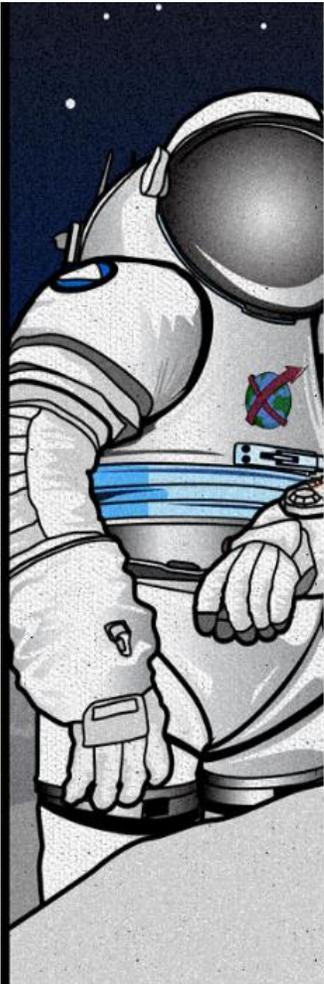
MOON CAMP CHALLENGE



→ MOON CAMP

- focus on learning-by-design and science experimentation.
- develop a number of curricular scientific experiments related to the Moon and apply the acquired knowledge in an interdisciplinary manner to design a Moon Camp using a 3D modelling tool (Tinkercad or Fusion 360).

MISSION X: TRAIN LIKE AN ASTRONAUT



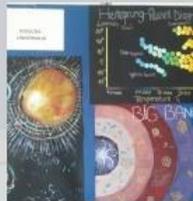
Romania News

SCOALA GIMNAZIALA CONSTANTIN BRANCUSI

Wed, 03/09/2016 - 12:38 – sirius



ALTE ACTIVITATI DESFASURATE IN CADRUL MISSION X



SHARE

Like 0

SCOALA GIMNAZIALA CONSTANTIN BRANCUSI

Wed, 03/09/2016 - 12:31 – sirius



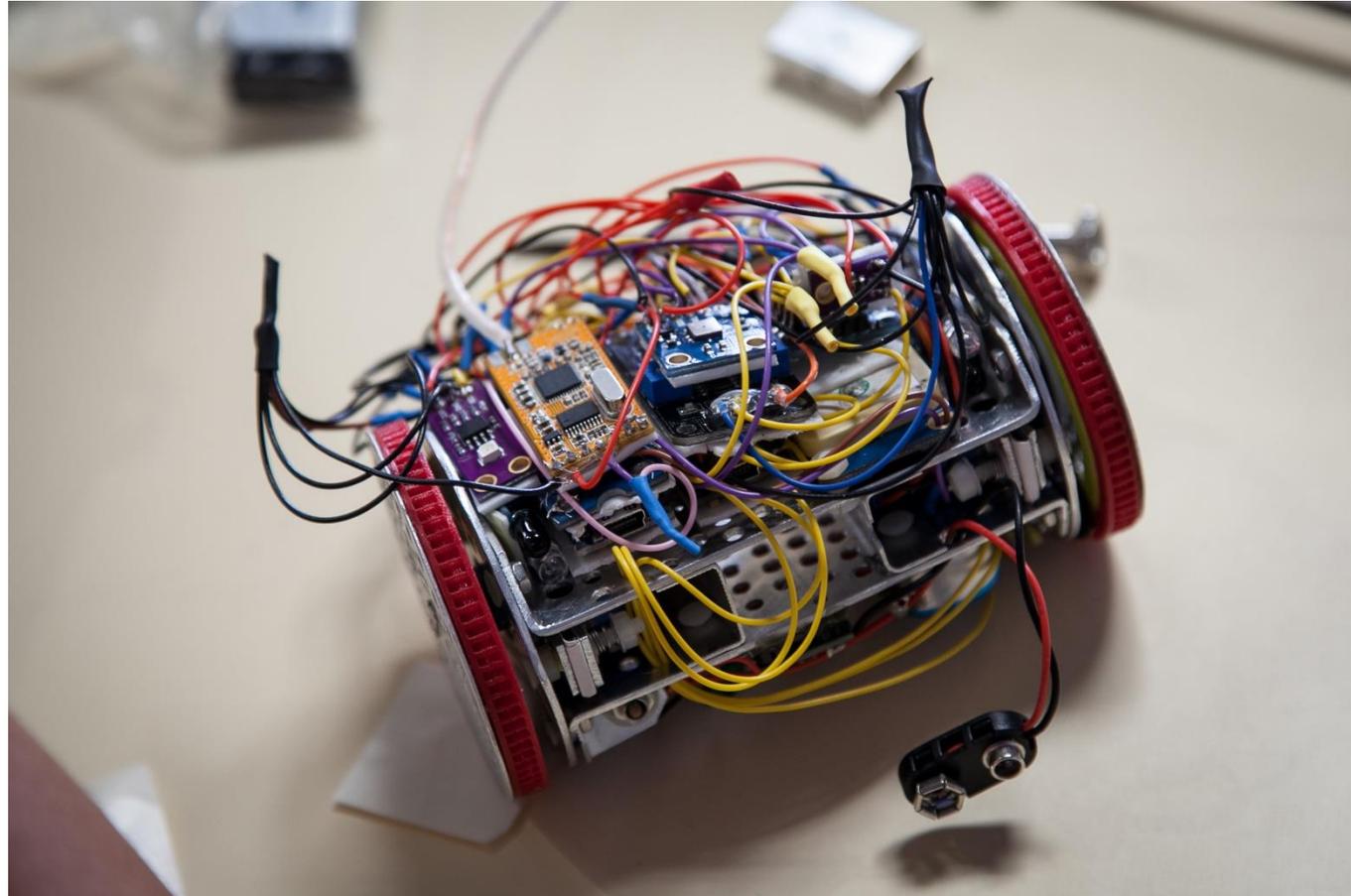
FORMAREA ECHIPAJULUI



ROMANIAN NATIONAL CANSAT COMPETITION



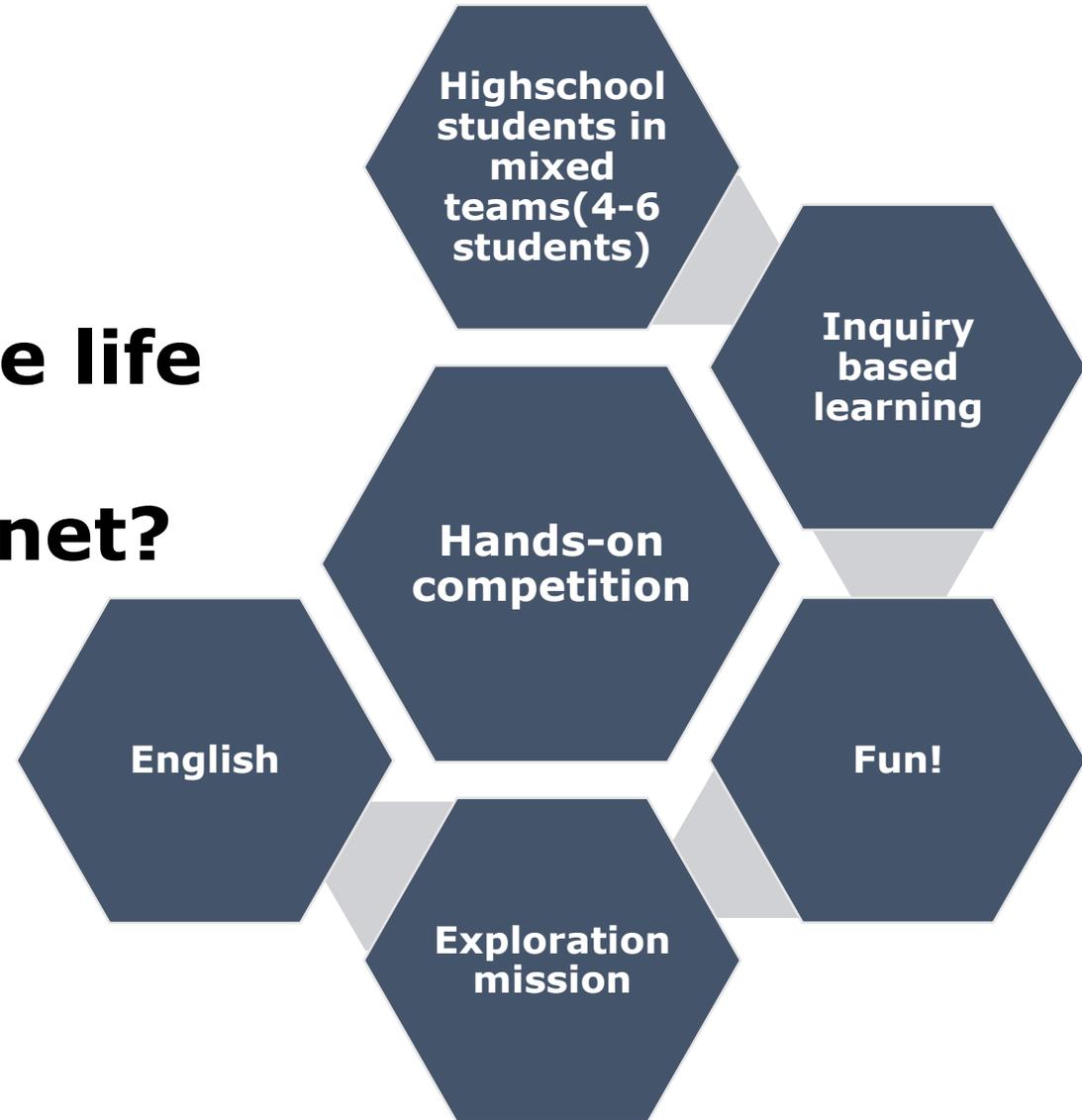
WHAT IS A CanSat?



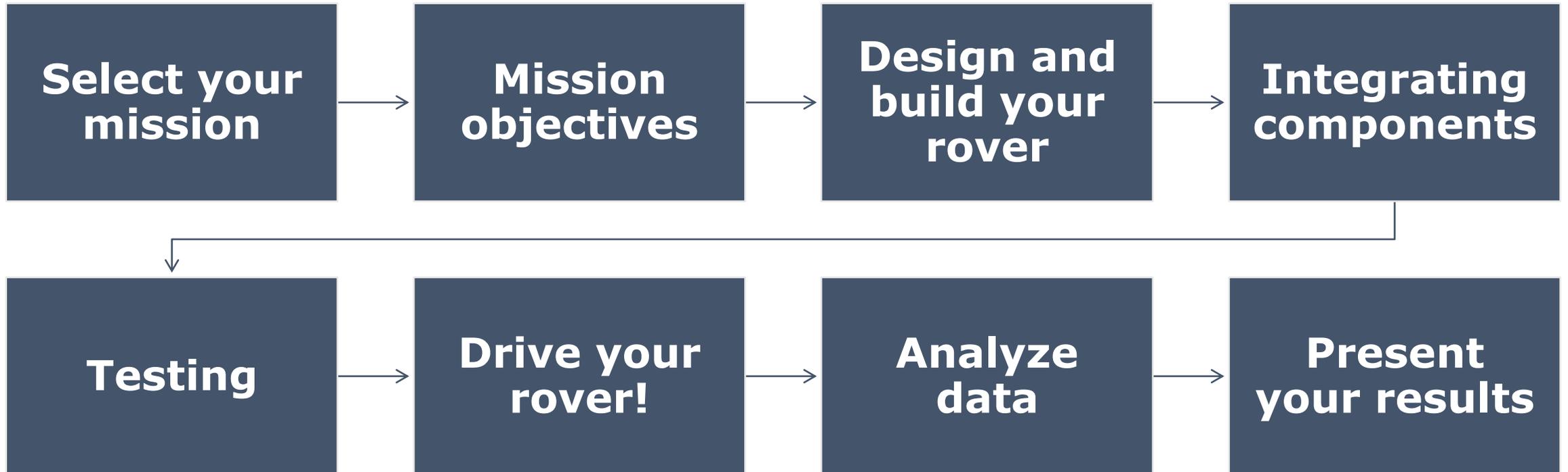
THE ADVENTURE BEGINS...



**Is there life
on an
exoplanet?**



THE ADVENTURE BEGINS...



THE ADVENTURE BEGINS...

DIMENSIONS

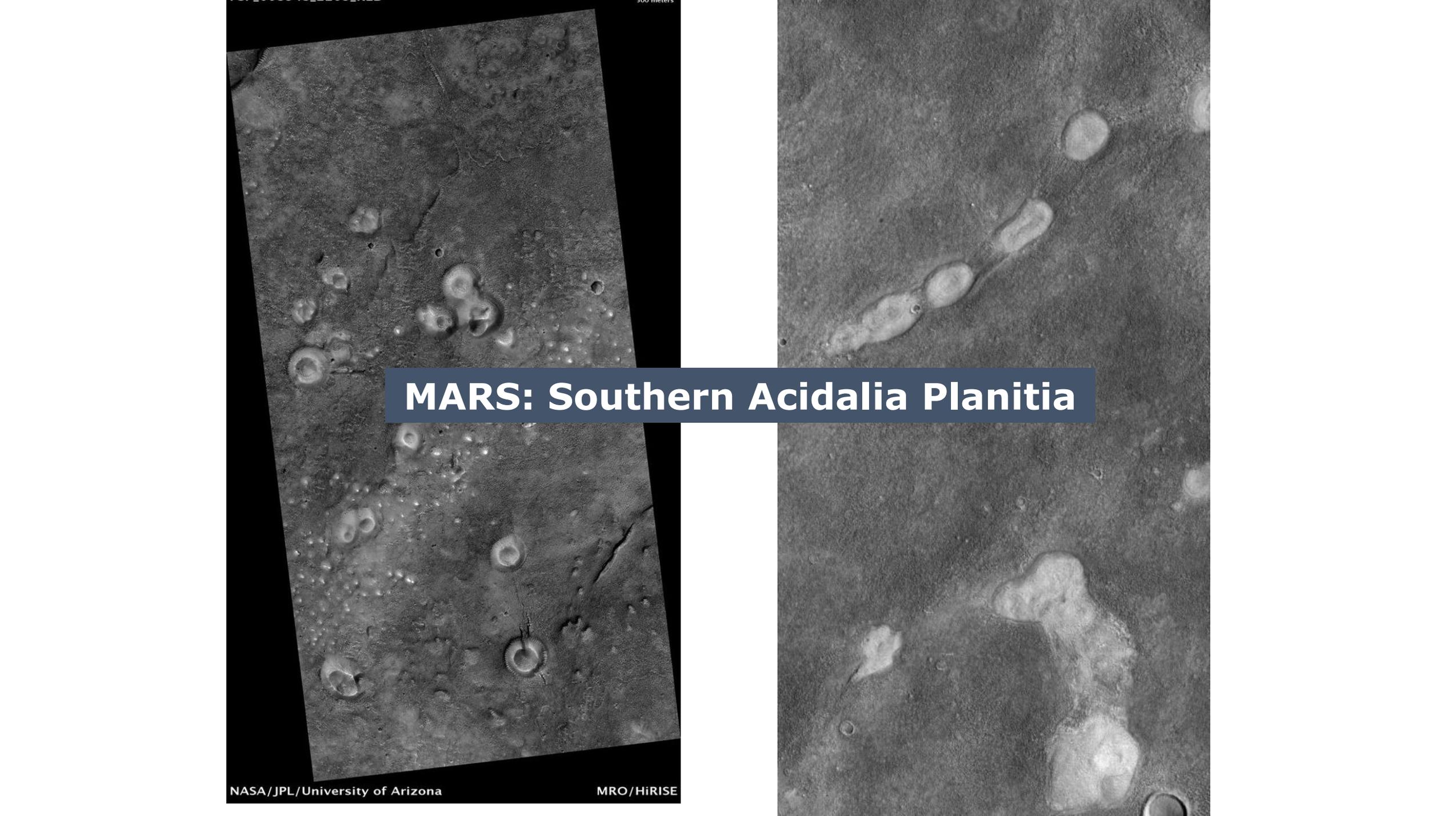
- Weight: 2.5 kg
- Length 40 cm
- Height 30 cm
- Width 20 cm

MAIN MISSION

- moving the rover by remote-control to a fixed point
- measurement of parameters (atmospheric pressure and temperature of the environment)
- sending images.

SECONDARY MISSION

- Collect samples
- Measure other environmental parameters using an array of sensors



MARS: Southern Acidalia Planitia



**ROMANIA: MUDDY
VOLCANOS, BUZAU COUNTY
2015**

FIRST EDITION: MUDDY VOLCANOS, BUZAU COUNTY 2015

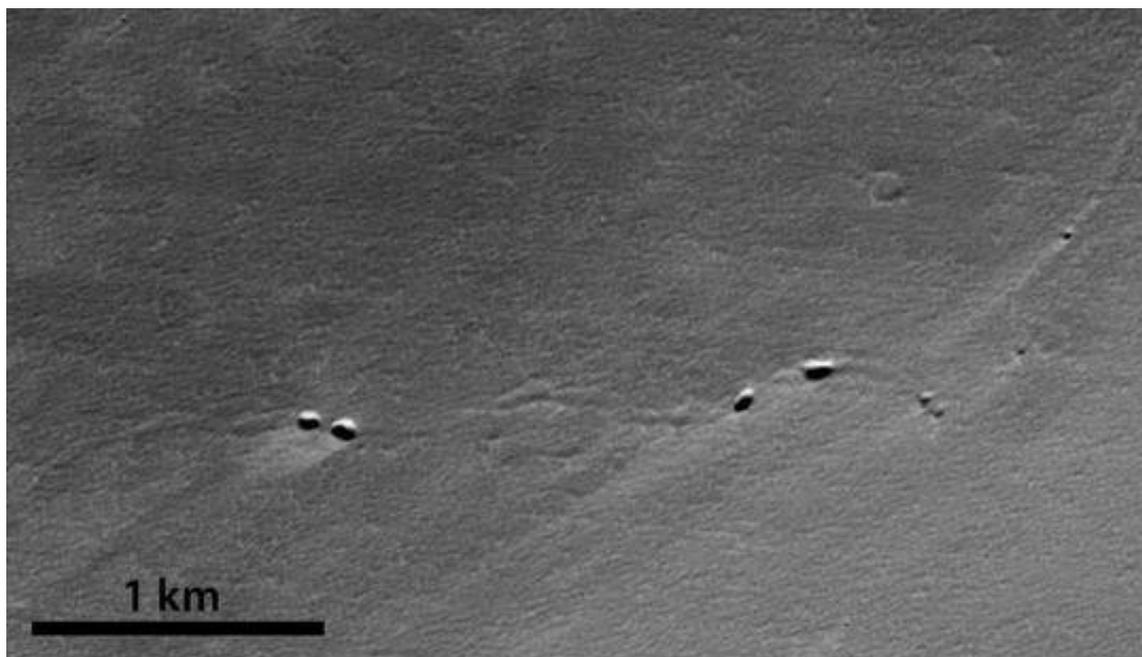


- Harsh environmental conditions
- Dynamic atmospheric data
- Naked eye navigation
- Robotic arm soil sampling

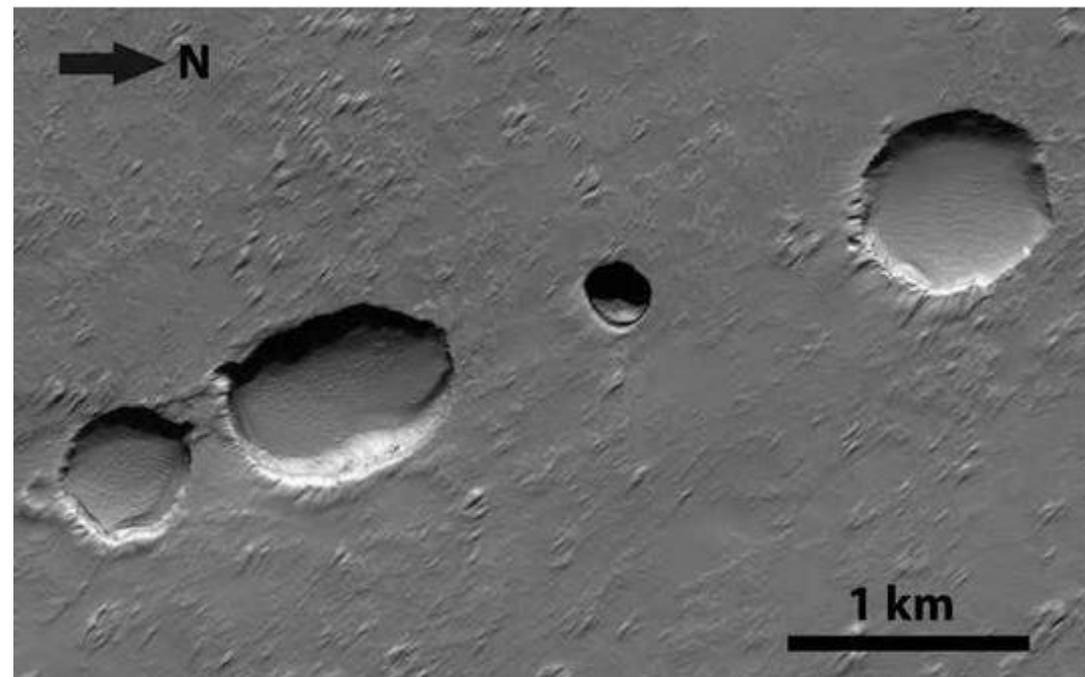
DRIVE YOUR ROVER!



SECOND EDITION: SALTMINE



A skylight in between two atypical pit craters on the southern flanks of Arsia Mons. The skylight is around two hundred meters wide and 80 meters deep. (credits NASA/JPL/University of Arizona)



A typical overcrusted lava tube on the northern side of Arsia Mons in the Tharsis volcanic province of Mars. The dark circle are skylights open on the underground conduit. (credits NASA/JPL/University of Arizona)

Exploring inner space for outer space

SECOND EDITION: SALTMINE, TG. OCNA, BACĂU COUNTY 2017



- **Controlled environmental conditions**
- **Slight dynamic atmospheric data**
- **Bling navigation (only through the optical instruments on board)**
- **Improved maneuverability**

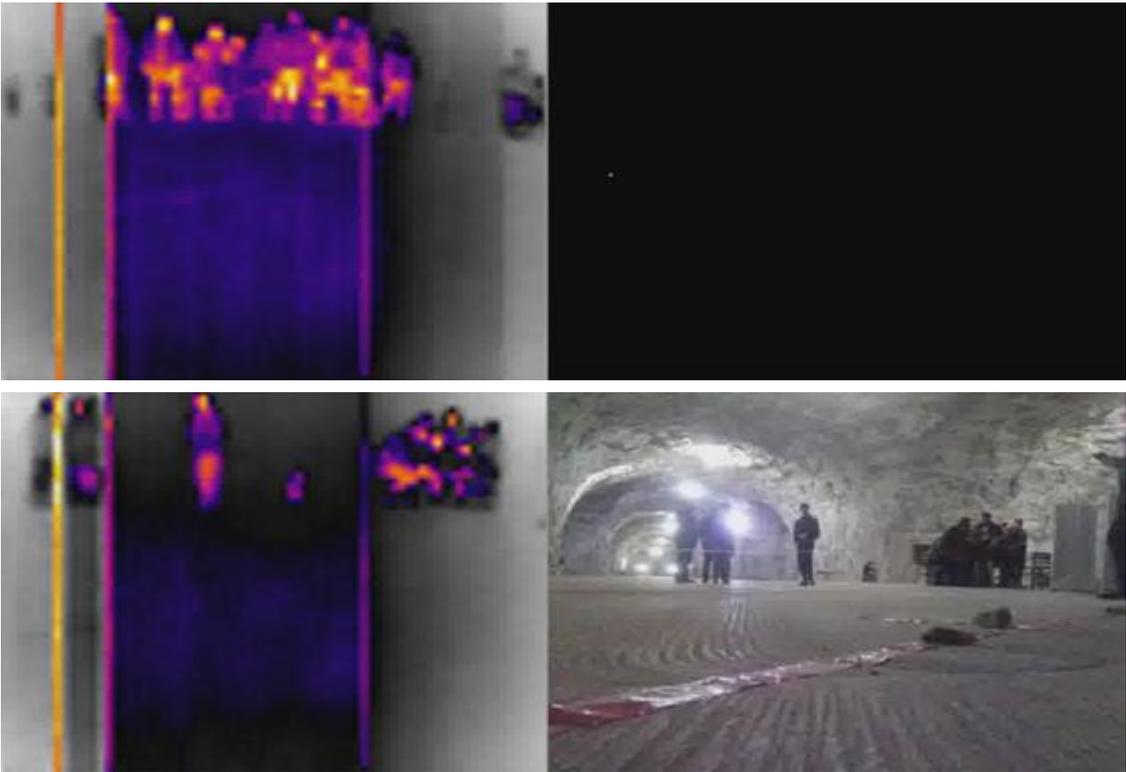
SECOND EDITION: SALTMINE, COORDINATES



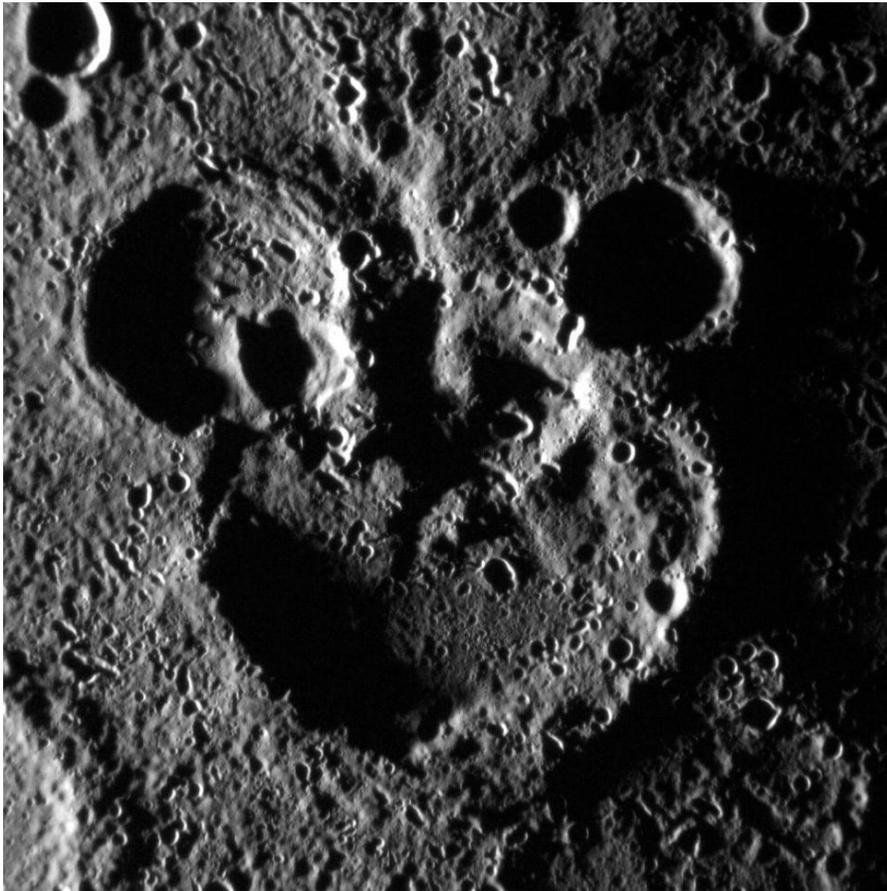
ENVIRONMENTAL CHARACTERISTICS:

- temperature between 12-13 degrees
- distance to starting point = 3.1 km
- vertical depth = 240 m
- level difference from entry point = 136 m
- altitude above sea level = 138 m
- usable area = 8900 sqm
- useful volume = 6100 m³
- room height = 8m

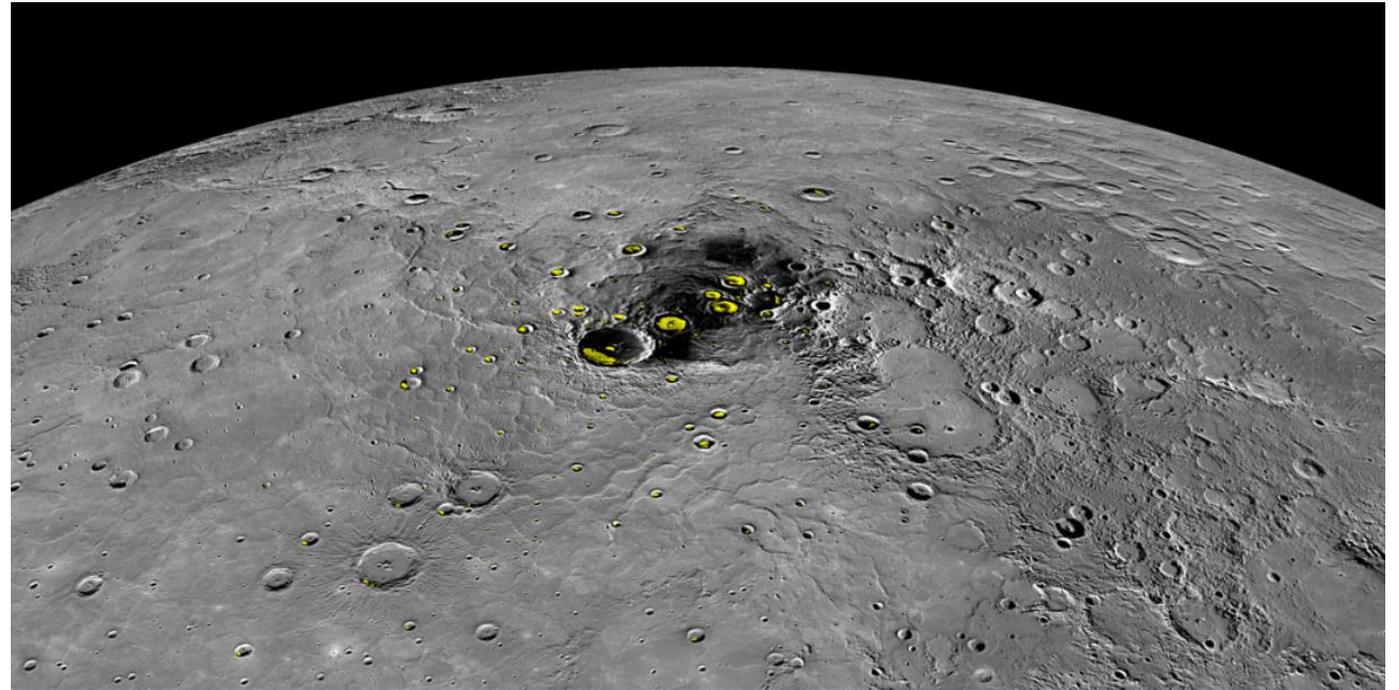
SECOND Edition: SALTMINE



THIRD EDITION: WATER CRATER 2018



(Image: © NASA/Johns Hopkins University Applied Physics Laboratory/Carnegie Institution of Washington 2012)



Instrument: Messenger Mercury Dual Imaging System (MDIS)

Arecibo Radar Image: In yellow (Harmon et al., 2011, *Icarus* 211, 37-50)

Credit: NASA/Johns Hopkins University Applied Physics Laboratory/Carnegie Institution of Washington

THIRD EDITION: WATER BASIN, TIMISOARA, TIMIS COUNTY 2018



- Harsh environmental conditions
- Water present in solid and liquid state
- Dynamic atmospheric data
- Blind navigation (only through the optical instruments on board)
- Trouble with maneuverability
- Sample collection

THIRD EDITION: WATER BASIN, TIMISOARA, TIMIS COUNTY 2018



THANK YOU!

Contact @ rosa.ro and esero.ro