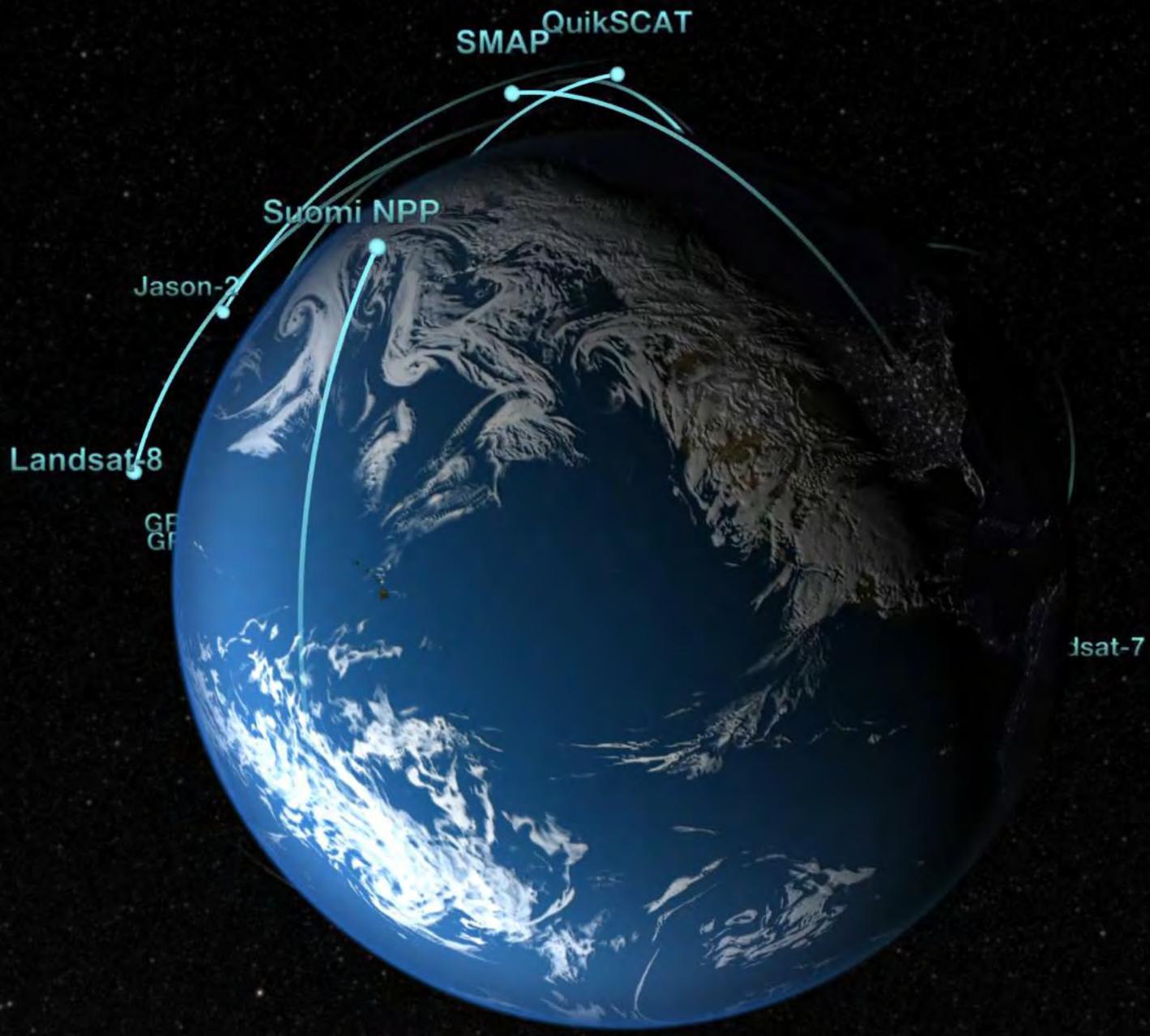
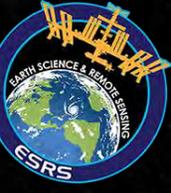




Earth Science & Remote Sensing Unit

Astromaterials Research and Exploration Science

NASA Johnson Space Center



SMAP QuikSCAT

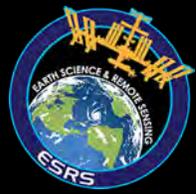
Suomi NPP

Jason-2

Landsat-8

GF
GF

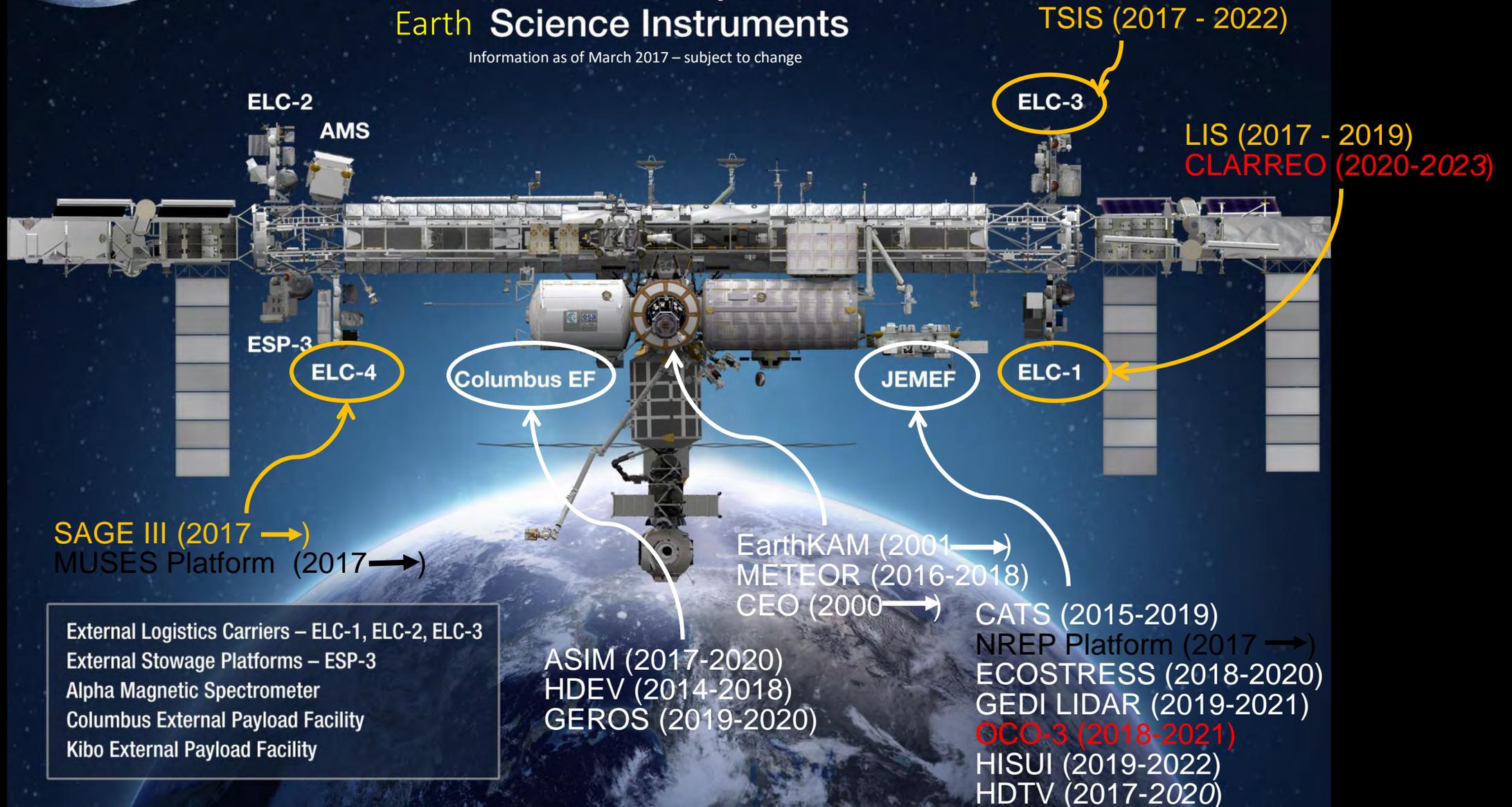
Landsat-7



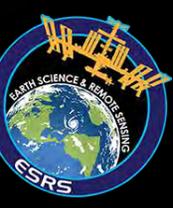
International Space Station

Earth Science Instruments

Information as of March 2017 – subject to change



- External Logistics Carriers – ELC-1, ELC-2, ELC-3
- External Stowage Platforms – ESP-3
- Alpha Magnetic Spectrometer
- Columbus External Payload Facility
- Kibo External Payload Facility





Solar illumination angles



Variable look angles



Fields-of-view



Complements satellite imagery

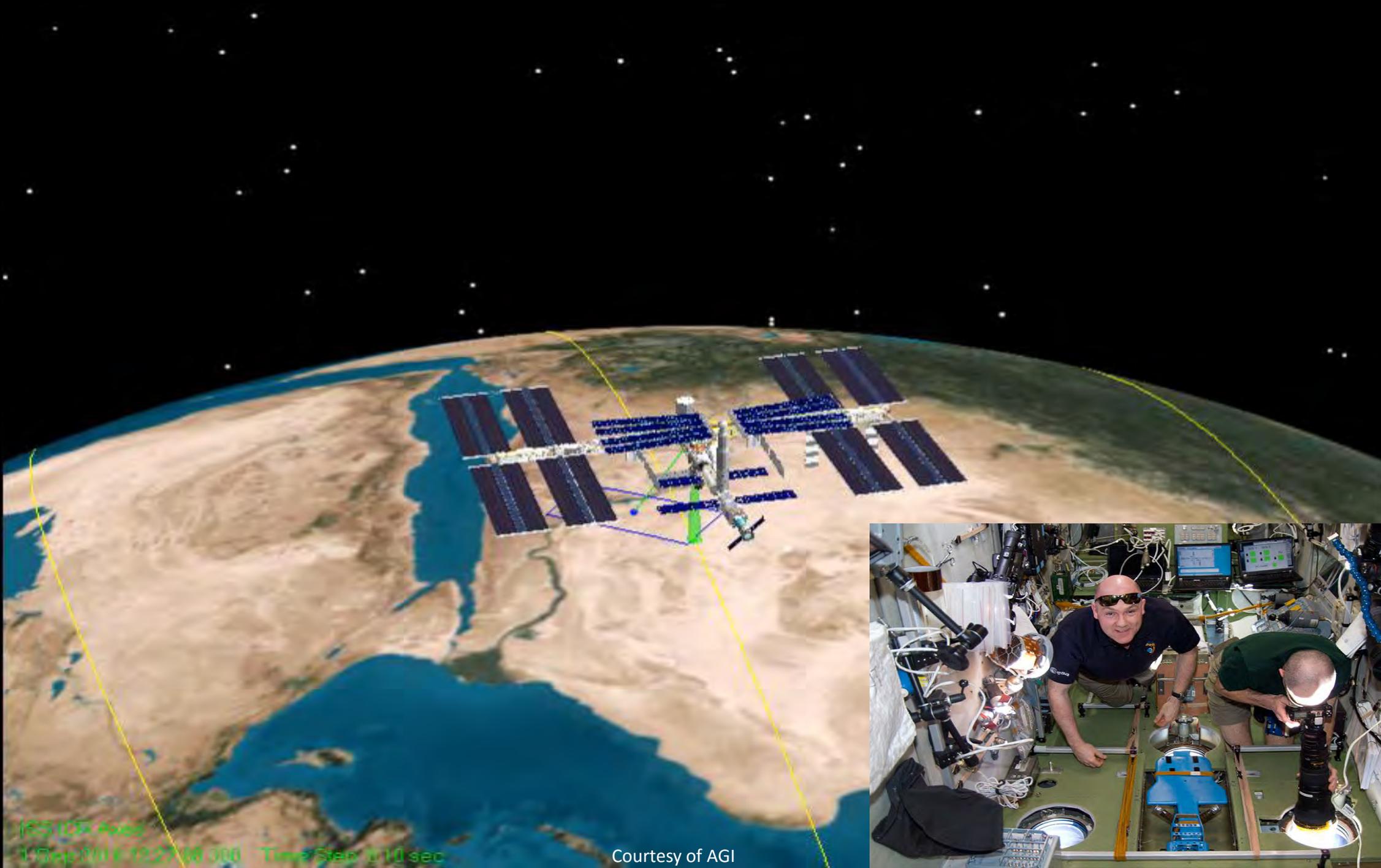
Benefits of Astronaut Photography



Viedma Glacier, EEAB Program



Wildfires near Sydney, Australia, IDC



ISS 105° Azim
15 Sep 2016 12:27:16.000 Time Step 0.10 sec

Courtesy of AGI

A photograph of an astronaut in a red shirt inside a spacecraft module. The astronaut is smiling and looking towards the camera. The background features a large circular window or simulator displaying a starfield pattern. The interior is filled with various equipment, cables, and structural elements of the spacecraft.

What we do: Astronaut Training

Human Impacts



Three Gorges Dam, Yangtze River

Glaciers



Patagonian Ice Fields

Urban Areas



Chicago at night



Planetary analogues

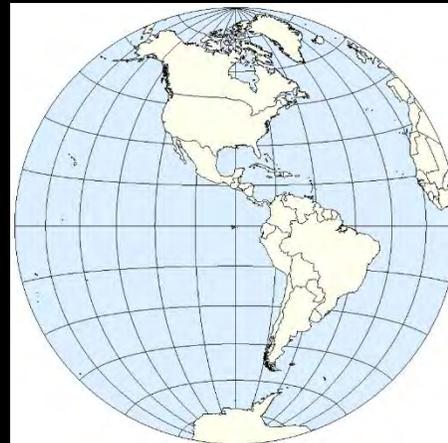


Deltas and coasts

We also train and study



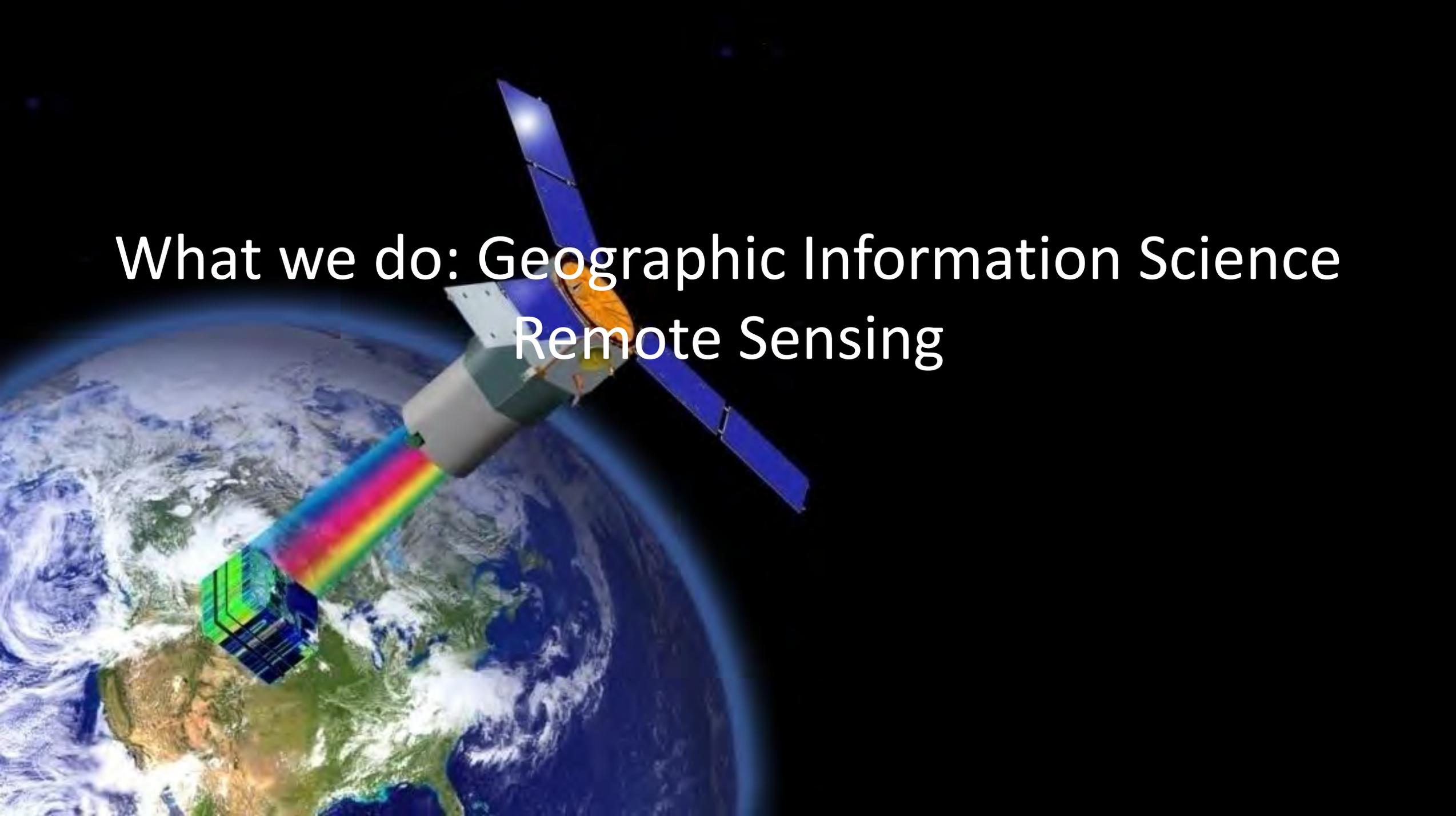
Impact Craters



Geography



Aerosols

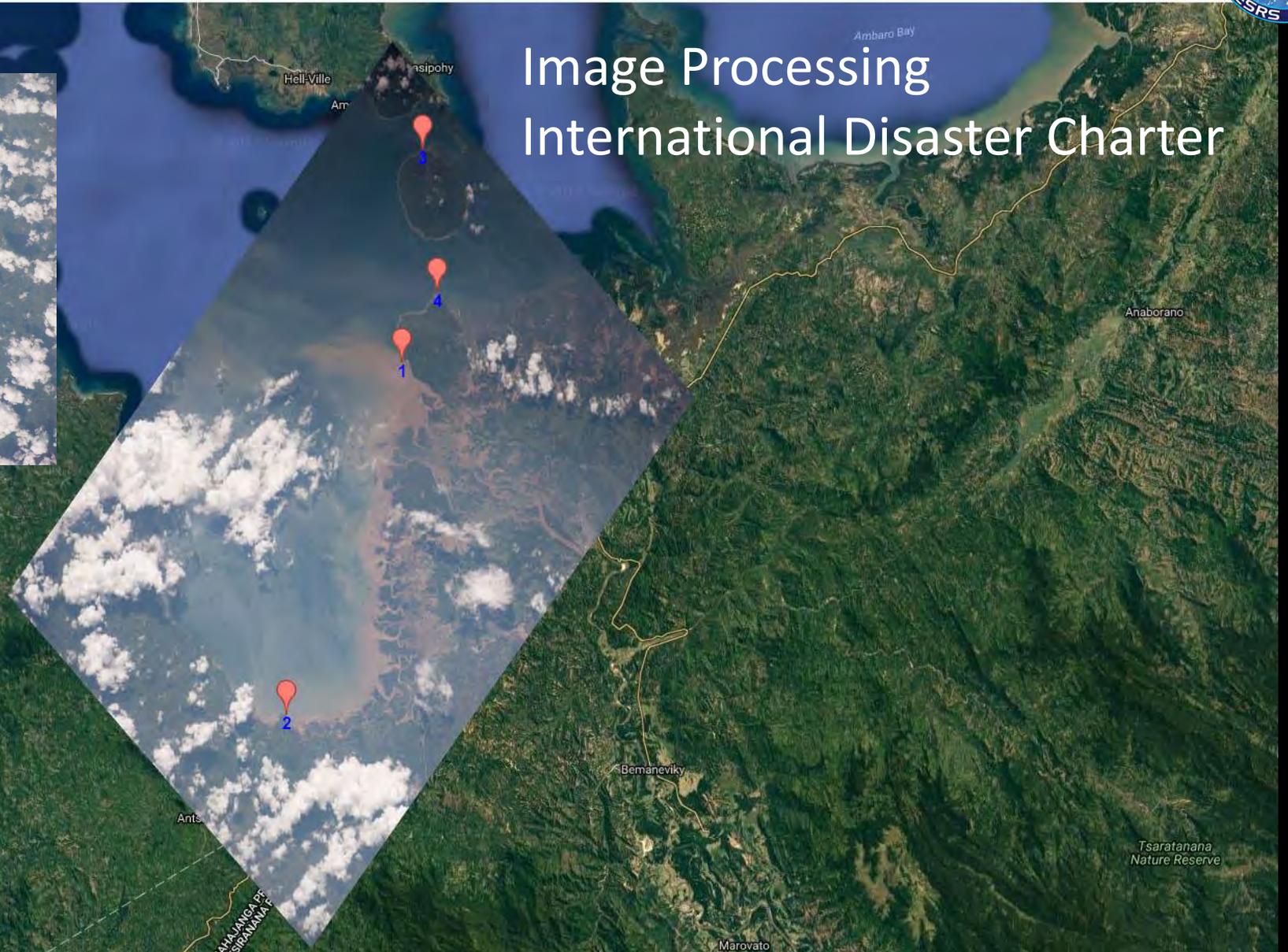
A satellite is shown in orbit above the Earth. The satellite has a central body and two large blue solar panels. A vibrant rainbow beam of light originates from the satellite and points towards the Earth's surface. The Earth below shows swirling white clouds, blue oceans, and green and brown landmasses. The background is the blackness of space.

What we do: Geographic Information Science Remote Sensing

Map Satellite

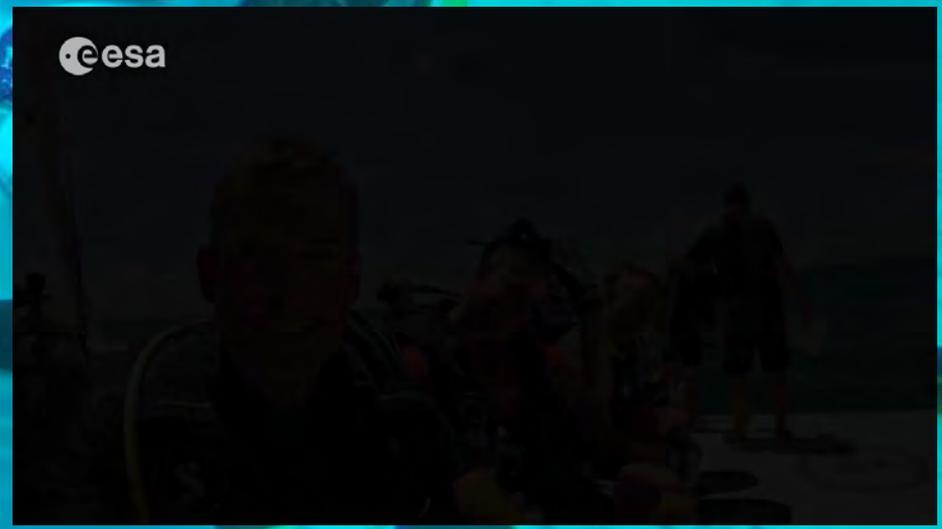


Image Processing International Disaster Charter

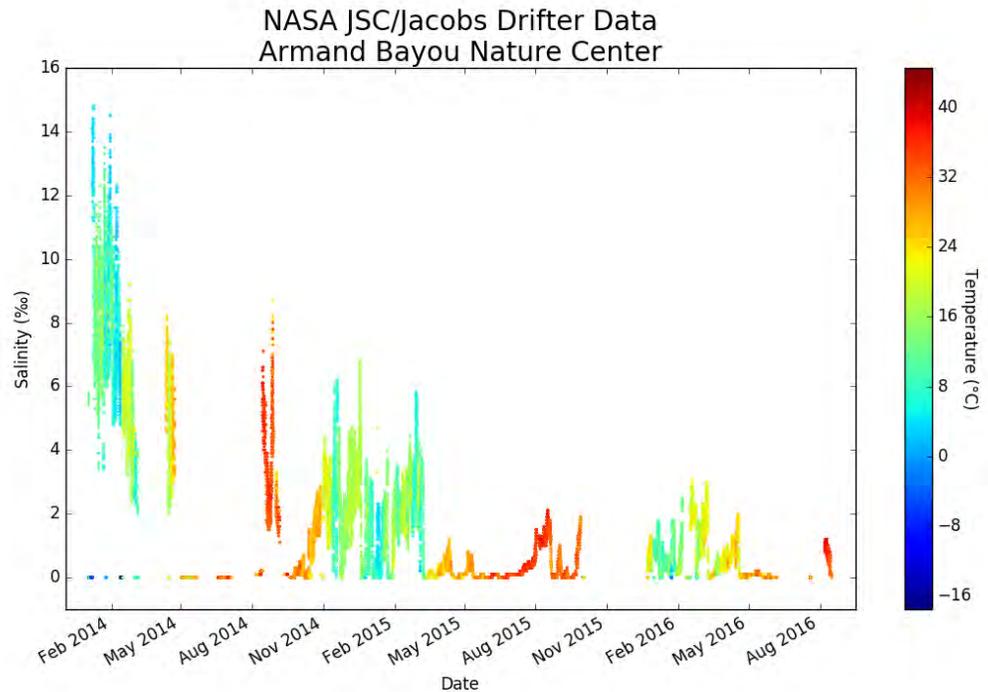




esa



Drifter Project



Tweets by @jscdrifter2



Jacobs
@jscdrifter2

Date:160816,Time:123032.383,Lat:2935.4977N,Longitude:09504.7585W,Conductivity (uS/cm2):84.9240,Temp (Celsius):30.7369



Jacobs
@jscdrifter2

Date:160816,Time:073620.230,Lat:2935.4983N,Longitude:09504.7556W,Conductivity (uS/cm2):148.5960,Temp (Celsius):31.4502

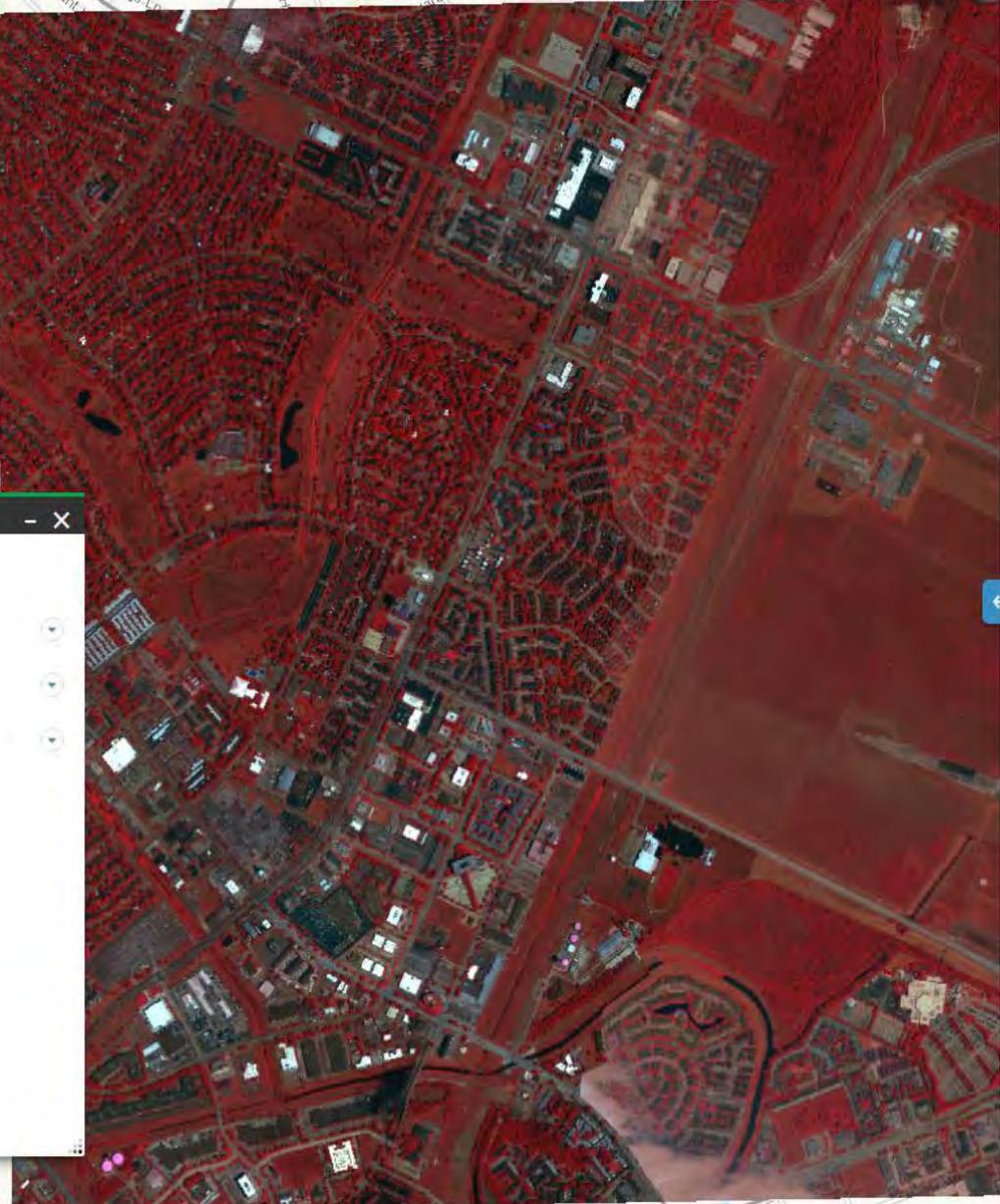


Jacobs
@jscdrifter2

Date:160816,Time:072225.890,Lat:2935.4976N,Longitude:09504.7593W,Conductivity (uS/cm2):148.5960,Temp (Celsius):31.4502



Jacobs
@jscdrifter2



Select the layer you want to swipe

JohnsonSpaceCenter_Veg_2015

Layer List

Operational Layers

- JohnsonSpaceCenter_2015
- JohnsonSpaceCenter_Veg_2015
- JohnsonSpaceCenter_NDVI_2015

29.581 -95.090 Degrees

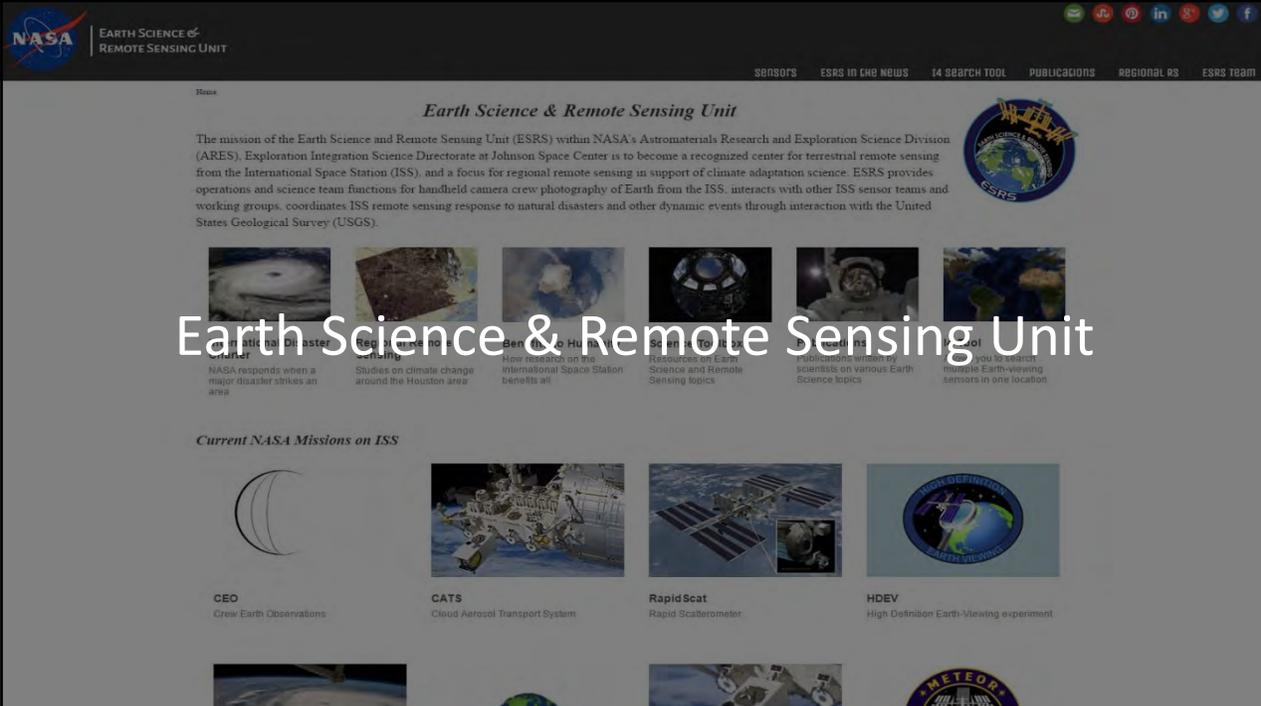
0.3m



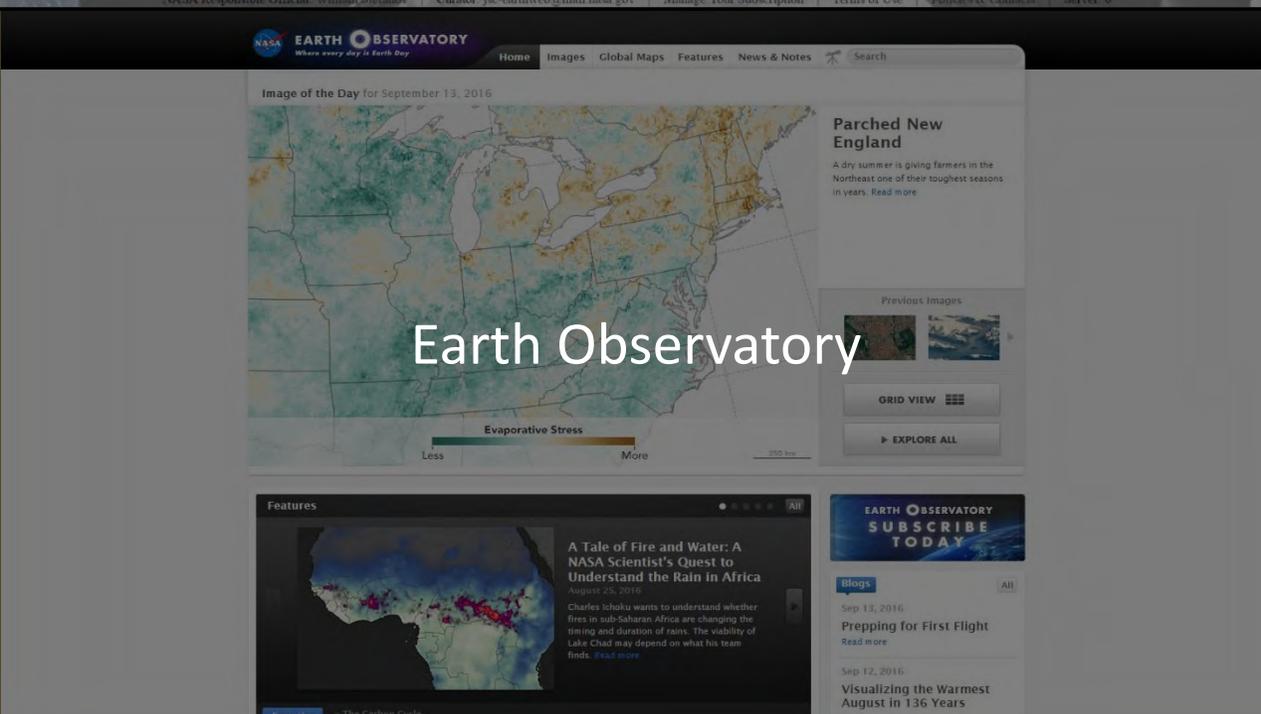




Gateway to Astronaut Photography of Earth



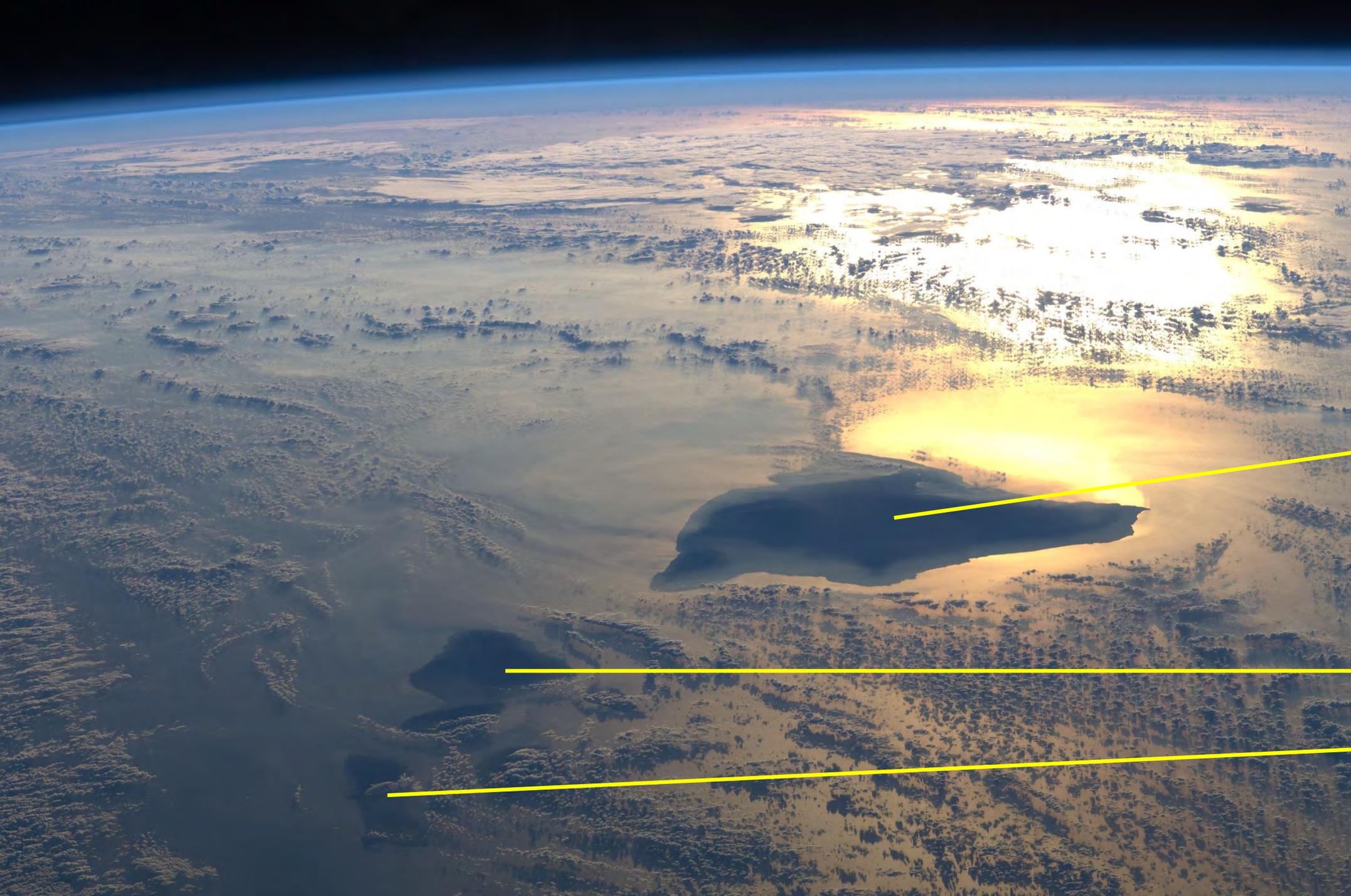
Earth Science & Remote Sensing Unit



Earth Observatory



Google Earth NASA layer



Hawaii

Big Island

Maui

Moloka'i

ISS030-E-86312



Aurora
Borealis

Yukon Territory

British Columbia

ISS030-E-115050

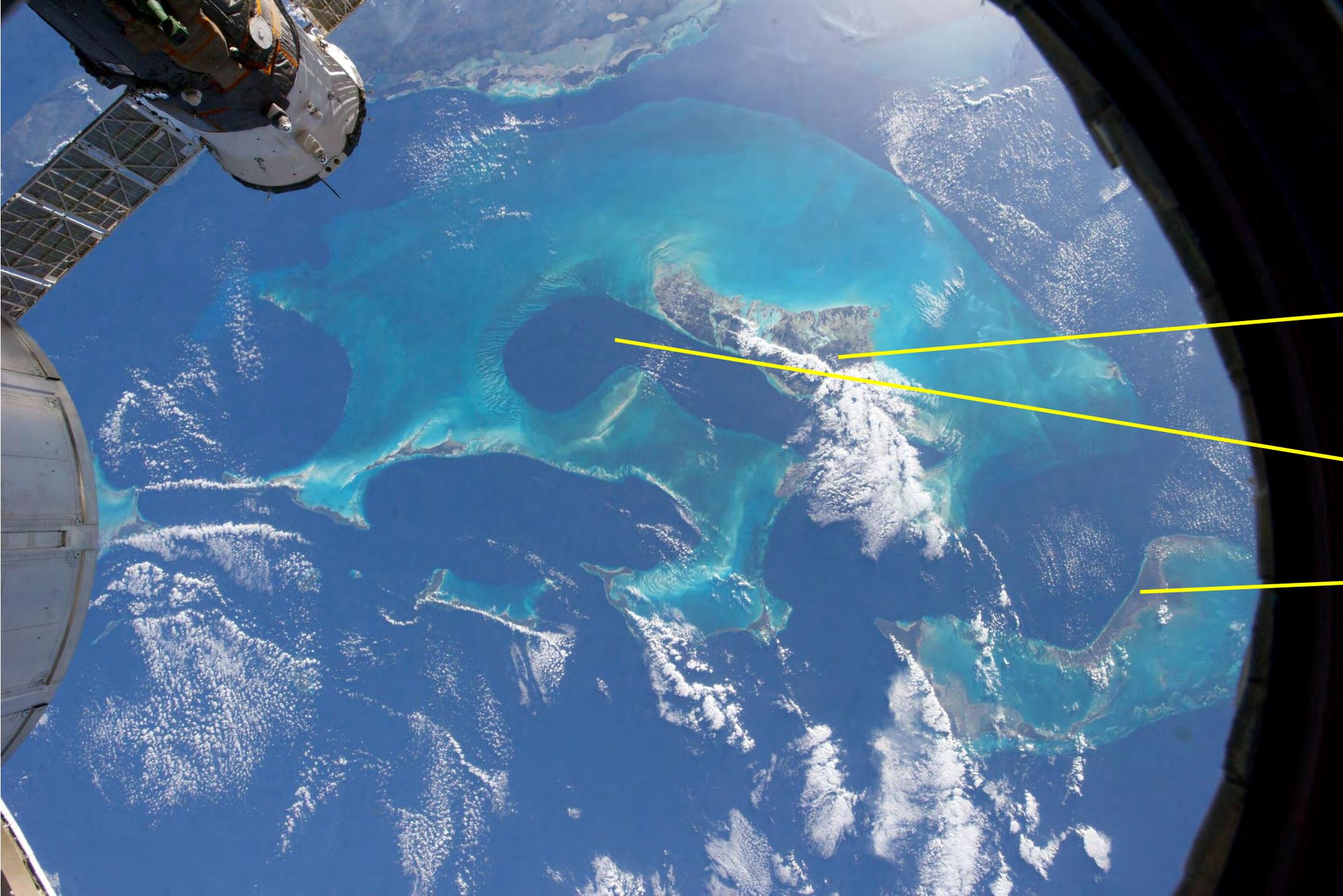


Dubai

Dubai

Palm Jumeirah

ISS030-E-99324



The Bahamas

Andros Island

Tongue of the Ocean

Grand Bahama Island

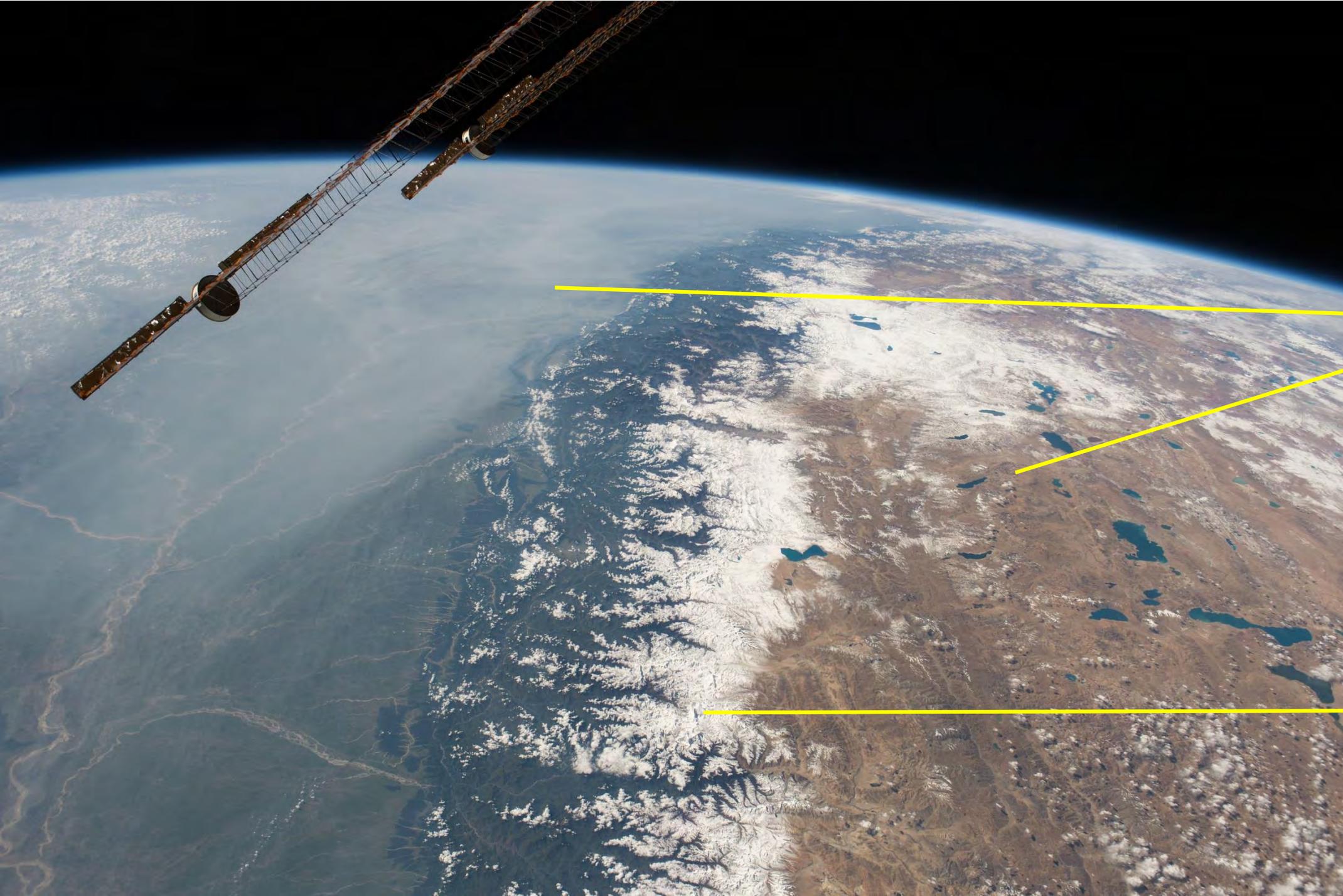
ISS034-E-45877



Morocco at night

Morocco area

ISS044-E-47820



Himalayas

India

China

Mount Everest

ISS041-E-81033



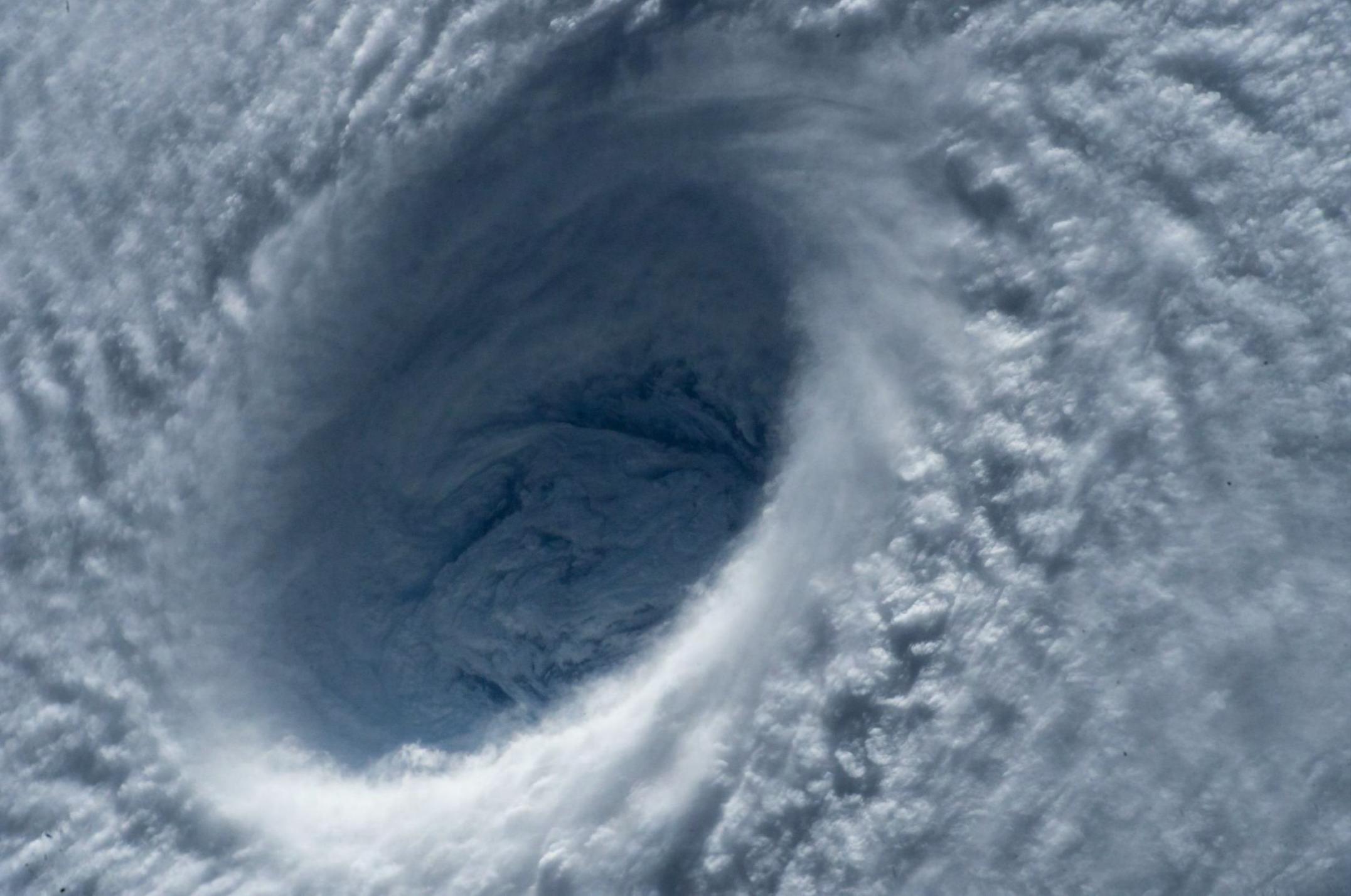
The Sahara
Desert

Tropical Cyclone
Bansi



ISS042-E-135015

Typhoon
Maysak



ISS043-E-78172

Atlantic Ocean
from the Cupola



ISS043-E-303698

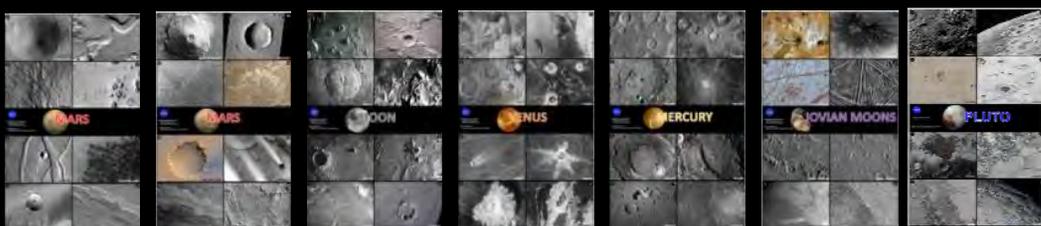
ISS Night Compilation

Videos produced by the Crew Earth Observations group at
NASA Johnson Space Center

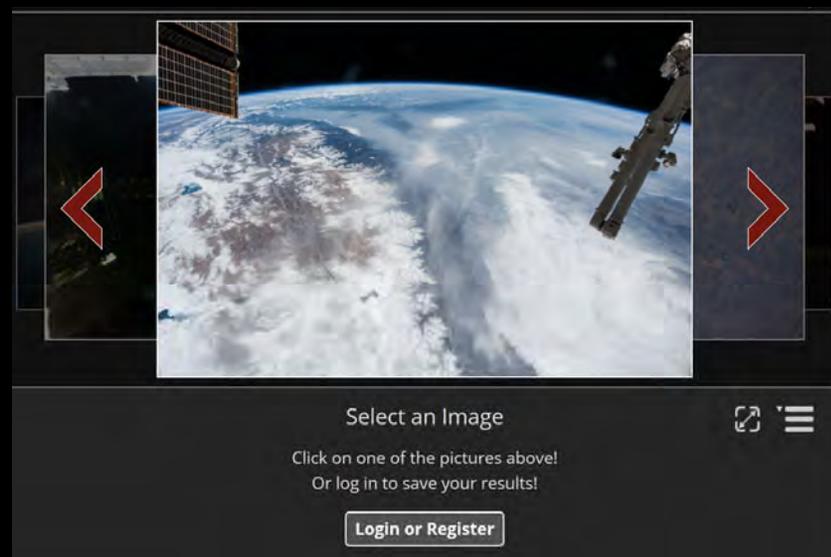
For replication and crediting information, please see our guidelines
on our main video page.

USING ASTRONAUT IMAGERY IN ACTIVITIES FOR FORMAL AND/OR INFORMAL VENUES

1. Blue Marble Matches



2. Image Detective 2.0



USING ASTRONAUT IMAGERY IN ACTIVITIES FOR FORMAL AND/OR INFORMAL VENUES

1. Blue Marble Matches Activity



BLUE MARBLE MATCHES

Using Earth for Planetary Comparisons

1. INTRODUCE IMAGERY TO PARTICIPANTS:

Listen to an image description & try to identify the image being described.



BLUE MARBLE MATCHES

Using Earth for Planetary Comparisons

2. PAIR IMAGES THAT REPRESENT THE SAME GEOLOGIC PROCESS: *(wind, water, impact, volcanic)*



BLUE MARBLE MATCHES

Using Earth for Planetary Comparisons

2. PAIR IMAGES THAT REPRESENT THE SAME GEOLOGIC PROCESS: (*wind, water, impact, volcanic*)

Example: Images 3 & 8 represent the Impact process

Impact

Volcanic

Water

Wind



BLUE MARBLE MATCHES

Using Earth for Planetary Comparisons

2. PAIR IMAGES THAT REPRESENT THE SAME GEOLOGIC PROCESS: (*wind, water, impact, volcanic*)

Example: Images 3 & 8 represent the Impact process

Impact

Volcanic

Water

Wind



BLUE MARBLE MATCHES

Using Earth for Planetary Comparisons

3. DEVELOPING IDENTIFICATION CRITERIA: (wind, water, impact, volcanic)

Part 2: Identification Criteria

You will now make observations of other astronaut photographs of Earth. Your logged observations of these images will help you learn to identify specific features associated with different geologic processes (aeolian, impact, fluvial, and volcanic). The feature charts you will examine include images grouped by process. Information is included on the back of each image to help you. As you make observations, think about how each feature is formed and be prepared to select and create identification criteria for each feature in the tables below.

Once you have a feature chart, you will:

1. Make observations of the different geologic features visible in the images on the feature chart.
2. Use check marks on each table below to indicate which 2 criteria best describe each feature. Make changes or adjustments to listed criteria if you wish.
3. Develop your own descriptions that can be used as an identification criteria for each feature.

AEOLIAN PROCESSES			
Features created by or associated with the effects of WIND			
IDENTIFICATION CRITERIA	SAND DUNES	WIND STREAKS	YARDANGS
Look like a sand dune on the surface			
Has a ripple-like appearance			
Look "out into" the surface forming cross-rows or parallel lines			
Dark sand particles closely grouped together on the surface			
Look like a series of ridges stretched to the surface			
Look like a long ridge of light or dark sand on the surface			
Other:			
Other:			
Other:			
IMPACT PROCESSES			
Features created by or associated with a meteorite hitting the surface			
IDENTIFICATION CRITERIA	IMPACT CRATER		
Circular feature that sometimes has a raised rim and a sunken, flat floor			
Flat, circular feature that looks washed and is sometimes filled or eroded by water			
Other:			
Other:			

Popular Perseus Report: International Research and Planetary Science (IRPS) Mission - Version 1.1
NASA Science Team Center



Aeolian
(Wind)

Fluvial
(Water)

Impact

Volcanic

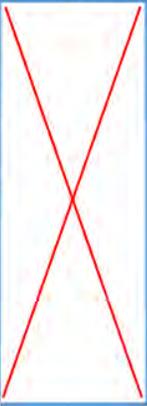
BLUE MARBLE MATCHES

Using Earth for Planetary Comparisons

4. MATCHING IMAGERY AND IDENTIFICATION CRITERIA: EARTH

EARTH IMAGERY & IDENTIFICATION CRITERIA 

1) Place each image card under its associated geologic process.
 2) Put associated key words & FEATURE NAME cards under each image.

EARTH				
<small>(Marsology Board)</small>				
WIND	WATER	VOLCANIC	IMPACT	OTHER
<p>KEY WORDS: Ripple-like, particles ground together</p> <p>SAND DUNES</p>				
	<p>KEY WORDS: Slugg, sandy, wavy, meandering, braided</p> <p>CHANNEL</p>			
		<p>KEY WORDS: Flow-like, irregular, lumpy, bumpy, darker than surrounding surface, uneven etched</p> <p>LAVA FLOW</p>		

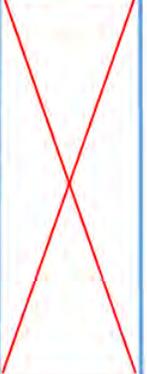
BLUE MARBLE MATCHES

Using Earth for Planetary Comparisons

4. MATCHING IMAGERY AND IDENTIFICATION CRITERIA: EARTH

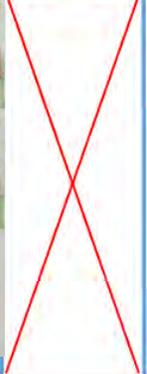
EARTH IMAGERY & IDENTIFICATION CRITERIA

1) Place each image card under its associated geologic process.
 2) Put associated key words & FEATURE NAME cards under each image.

EARTH <small>(Planetary Words)</small>				
WIND	WATER	VOLCANIC	IMPACT	OTHER
KEY WORDS: <small>Apples-like, pointed</small> grouped together SAND DUNES				
	KEY WORDS: <small>Long, narrow, deep</small> meandering channel CHANNEL			
		KEY WORDS: <small>Flowing material</small> Acidic appearance, dark in color surrounding shield, pointed ridges LAVA FLOW		

EARTH IMAGERY & IDENTIFICATION CRITERIA

1) Place each image card under its associated geologic process.
 2) Put associated key words & FEATURE NAME cards under each image.

EARTH <small>(Planetary Words)</small>				
WIND	WATER	VOLCANIC	IMPACT	OTHER
 KEY WORDS: <small>Apples-like, pointed</small> grouped together SAND DUNES	 KEY WORDS: <small>Long, narrow, deep</small> meandering channel CHANNEL	 KEY WORDS: <small>Flowing material</small> Acidic appearance, dark in color surrounding shield, pointed ridges VOLCANO	 KEY WORDS: <small>Crater</small> Circular, bowl-shaped IMPACT CRATER	
 KEY WORDS: <small>Long, narrow</small> meandering channel WIND STREAKS	 KEY WORDS: <small>Flowing material</small> Acidic appearance, dark in color surrounding shield, pointed ridges DELTA	 KEY WORDS: <small>Flowing material</small> Acidic appearance, dark in color surrounding shield, pointed ridges LAVA FLOW	 KEY WORDS: <small>Crater</small> Circular, bowl-shaped IMPACT CRATER	
 KEY WORDS: <small>Flowing material</small> Acidic appearance, dark in color surrounding shield, pointed ridges YARDANGS	 KEY WORDS: <small>Flowing material</small> Acidic appearance, dark in color surrounding shield, pointed ridges DRAINAGE/VALLEY NETWORK	 KEY WORDS: <small>Flowing material</small> Acidic appearance, dark in color surrounding shield, pointed ridges CALDERA		

BLUE MARBLE MATCHES

Using Earth for Planetary Comparisons

4. MATCHING IMAGERY AND IDENTIFICATION CRITERIA: MARS



MARS FEATURE IMAGES



- 1) Use Earth based criteria to help you decide what process/feature is represented in each image.
- 2) Write KEY WORDS & FEATURE on blue card & place under corresponding image.

MARS				
WIND	WATER	VOLCANIC	IMPACT	OTHER
				
Criteria (key words): 1. <u>Entire Structure</u> 2. <u>Cone shaped, looks raised</u> Feature: <u>Volcano</u> Level of Confidence: <u>3</u> (1 = low 3 = very confident)				

BLUE MARBLE MATCHES

Using Earth for Planetary Comparisons

4. MATCHING IMAGERY AND IDENTIFICATION CRITERIA: PLUTO



PLUTO FEATURE IMAGES



- 1) Use Earth based criteria to help you decide what process/feature is represented in each image.
- 2) Write **KEY WORDS & FEATURE** on **blue card** & place under corresponding image.

PLUTO <small>(Dwarfing Mars!)</small>				
WIND	WATER	VOLCANIC	IMPACT	OTHER
				
Criteria (key words): 1. <u>Entire Structure</u> 2. <u>Cone shaped, looks raised</u> Feature: <u>Volcano</u> Level of Confidence: <u>3</u> <small>(1 = low; 3 = very confident)</small>				

BLUE MARBLE MATCHES

Using Earth for Planetary Comparisons

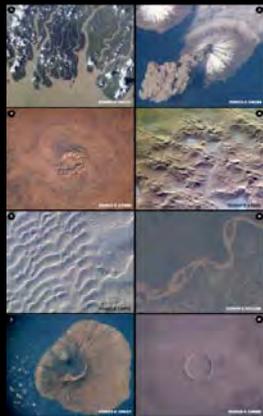
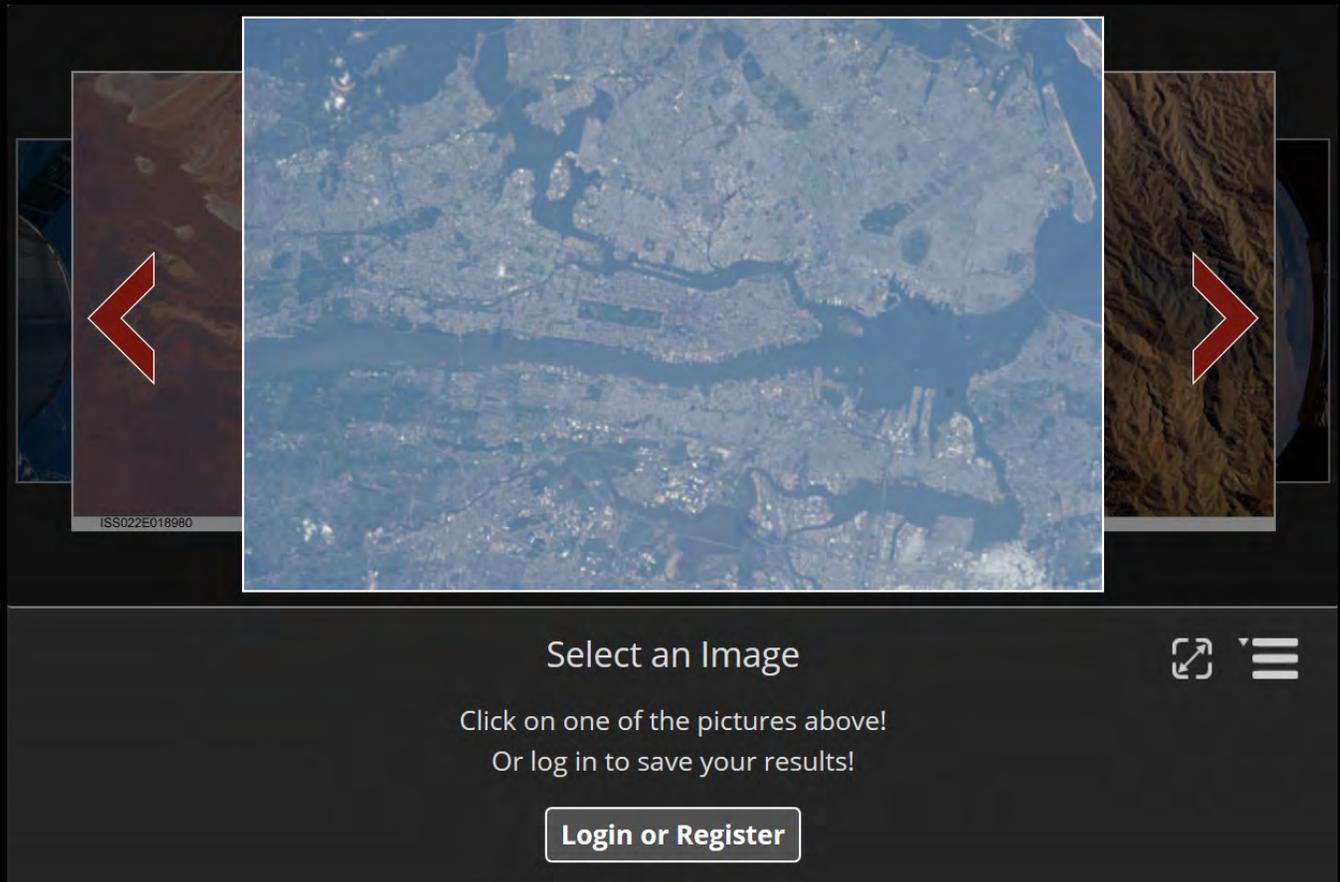


IMAGE DETECTIVE 2.0

CosmoQuest Citizen Science Project

(Currently being tested!)

STEP 1:
SELECT AN
IMAGE



The screenshot displays the user interface for the 'Image Detective 2.0' project. At the top, there are three satellite images. The central image is a large, detailed view of a city with a river. To its left and right are smaller, partially visible images with red arrows pointing towards the center, indicating a carousel of images. Below the images, the text 'Select an Image' is displayed, followed by the instructions 'Click on one of the pictures above!' and 'Or log in to save your results!'. A 'Login or Register' button is located at the bottom center. In the top right corner of the interface, there are icons for a share function and a menu.

Select an Image

Click on one of the pictures above!
Or log in to save your results!

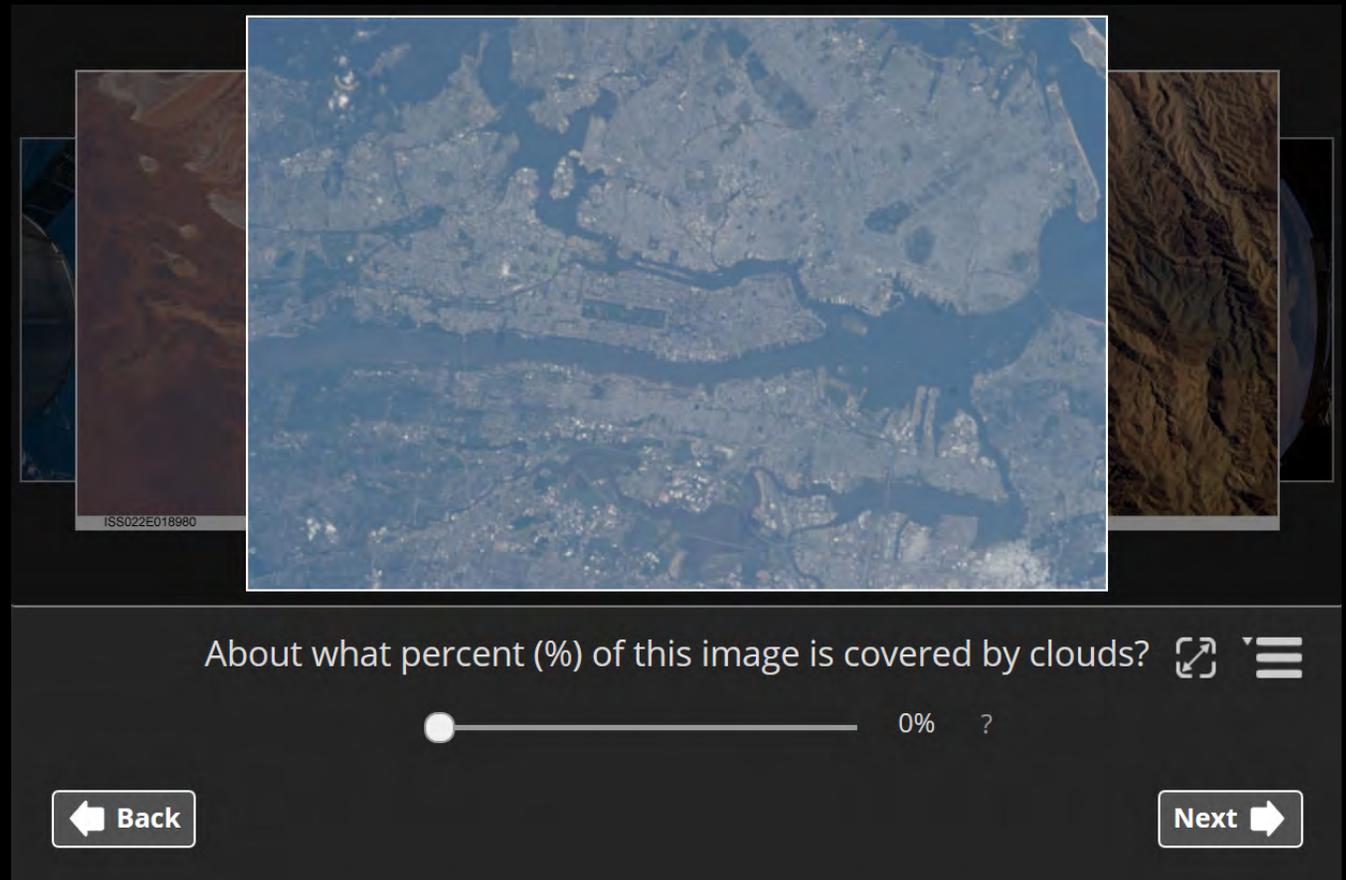
[Login or Register](#)

IMAGE DETECTIVE 2.0

CosmoQuest Citizen Science Project

TASK #1:
DECIDE WHAT PERCENT OF THE IMAGE IS COVERED BY CLOUDS

(click on the “?” for additional information)



ISS022E018980

About what percent (%) of this image is covered by clouds?  

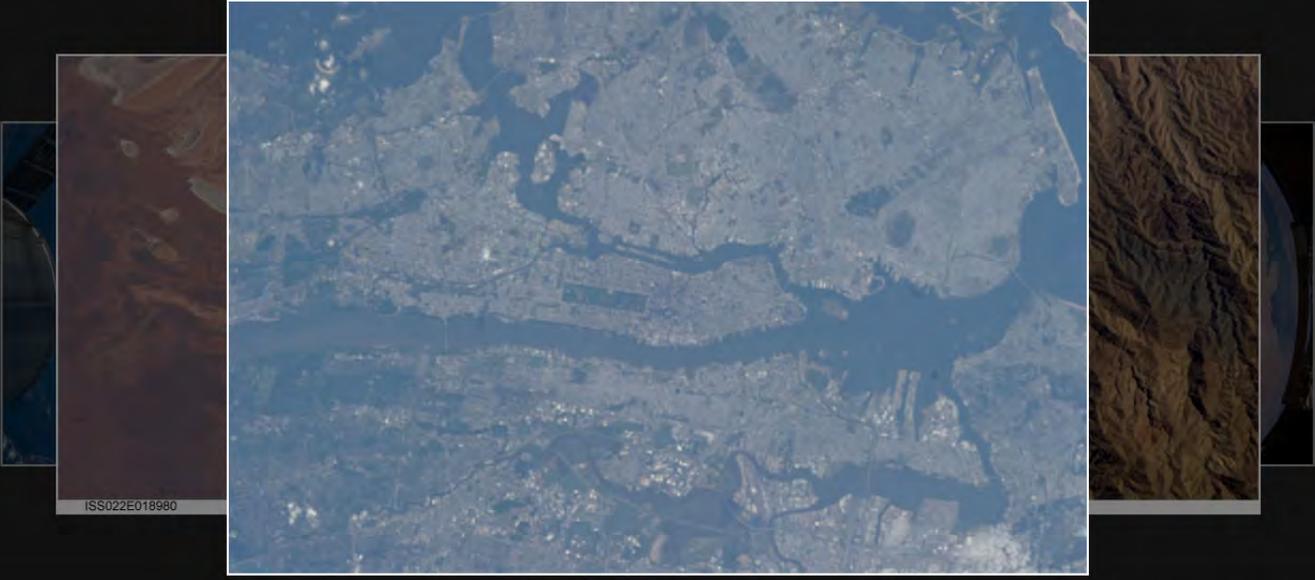
0% ?

 Back  Next 

IMAGE DETECTIVE 2.0

CosmoQuest Citizen Science Project

TASK #2:
SELECT FEATURES
VISIBLE IN THE
IMAGE
(click on the “?” for
additional information)



ISS022E018980

Do you see any of these water features?

<input type="checkbox"/> Ocean ?	<input type="checkbox"/> Lake ?
<input type="checkbox"/> River ?	<input type="checkbox"/> Coastline ?
<input type="checkbox"/> Island/Reef ?	<input type="checkbox"/> Delta ?
<input type="checkbox"/> Snow/Ice ?	<input type="checkbox"/> Glacier ?

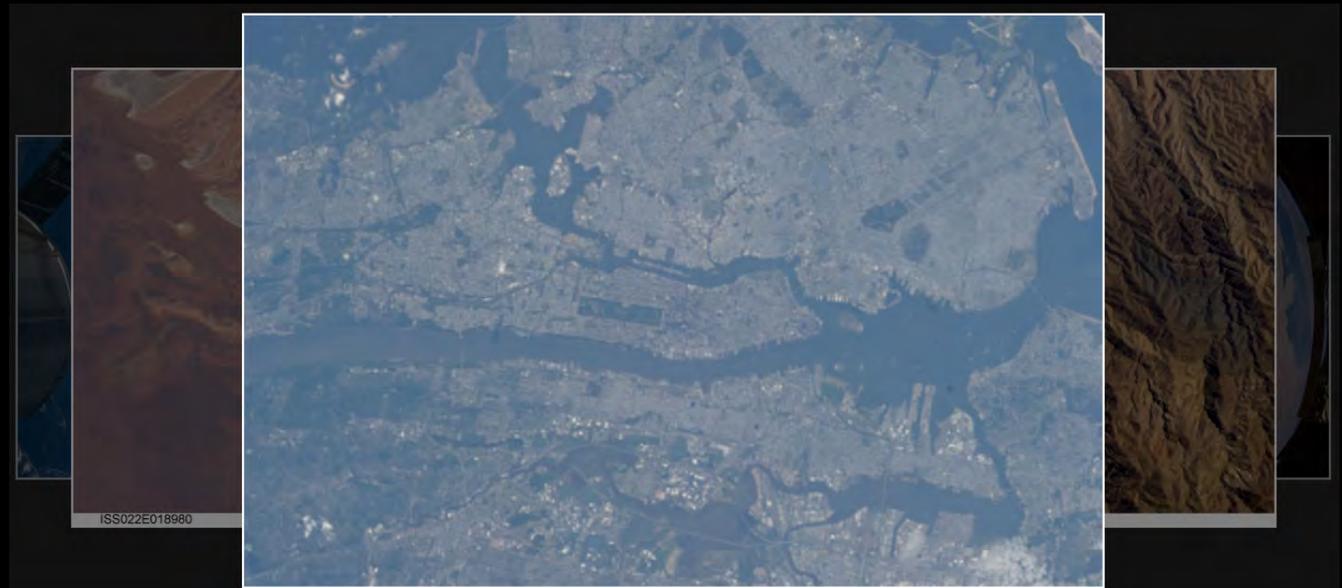
Back

Next

IMAGE DETECTIVE 2.0

CosmoQuest Citizen Science Project

TASK #3:
IDENTIFY THE
CENTER POINT
OF THIS IMAGE
ON EARTH



ISS022E018960

Do you want to try to locate this image?

IMAGE DETECTIVE 2.0

Identifying the Center Point of an Image on a Map of Earth

TIP #1:

- Initial starting location is where the ISS was located above the Earth when the image was taken.

The screenshot displays the Image Detective 2.0 interface. At the top, there are 'Map' and 'Satellite' tabs. The main area shows a satellite map of Earth with a semi-transparent image overlay. The 'Google' logo is visible in the bottom left corner of the map area. In the bottom right corner of the map area, there are icons for a person, a plus sign, and a minus sign. Below the map, there is a control panel with the text 'Try to locate the image on the map.' and three sliders labeled 'Transparency', 'Rotation', and 'Scale'. A 'Back' button is on the left, and a 'FOUND IT!' button is on the right. The bottom right corner of the map area contains small text: 'Map data ©2017 Google Imagery ©2017 NASA, TerraMetrics Terms of Use'.

IMAGE DETECTIVE 2.0

Identifying the Center Point of an Image on a Map of Earth

Map Satellite

MASSACHUSETTS
Providence
CONNECTICUT
RI
New York
New York
Philadelphia
MARYLAND
NEW JERSEY
Washington
DELAWARE
Richmond
Norfolk • Virginia Beach

Google

Map data ©2017 Google Imagery ©2017 NASA, TerraMetrics Terms of Use

Try to locate the image on the map.

Transparency

Rotation

Scale

Back

FOUND IT!

TIP #2:

- Zoom in or out of map
- Try to match up what you are seeing in the photo with features on the map (pattern matching).

IMAGE DETECTIVE 2.0

Identifying the Center Point of an Image on a Map of Earth

Try to locate the image on the map.

Transparency

Rotation

Scale

Back

FOUND IT!

Try to locate the image on the map.

Transparency

Rotation

Scale

Back

FOUND IT!

TIP #3:

- Once you have found an area where you *think* features match, use the **Transparency, Rotation, and Scale** sliders to help you verify the match.
- You will want to match up the **SIZE, LOCATION, and ORIENTATION** of the image with the map.

IMAGE DETECTIVE 2.0

Identifying the Center Point of an Image on a Map of Earth

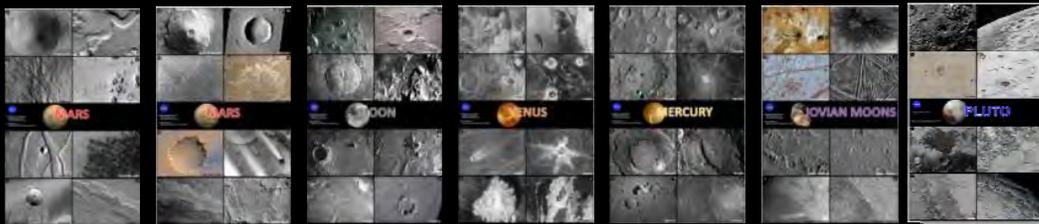


TIP #4:

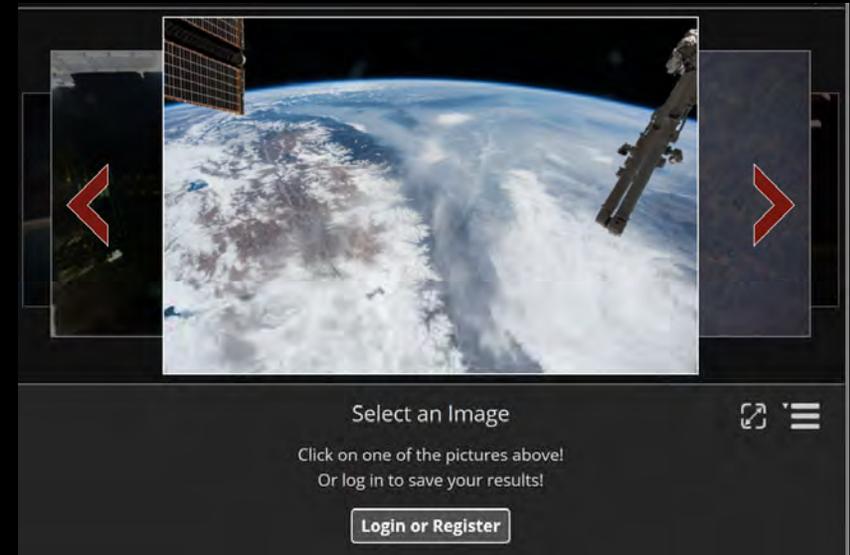
- Once you have used the **Transparency**, **Rotation**, and **Scale** sliders to successfully match up the **SIZE**, **LOCATION**, and **ORIENTATION** of the image with the map, click "FOUND IT".

USING ASTRONAUT IMAGERY IN ACTIVITIES FOR FORMAL AND/OR INFORMAL VENUES

1. Blue Marble Matches



2. Image Detective 2.0



<https://ares.jsc.nasa.gov/interaction/eeab/blue-marble-matches.html>

Interested in becoming a beta-tester?
Contact: beta@cosmoquest.org

A photograph taken from the International Space Station (ISS) showing a sunrise over the Indian Ocean. The sun is a bright, glowing orb on the horizon, creating a lens flare effect. The sky transitions from a deep blue at the top to a bright orange and yellow near the horizon. The curvature of the Earth is visible at the bottom of the frame.

Questions?