

A photograph taken from space showing the Earth's horizon. The sky is dark with a green aurora borealis visible above the horizon. The Earth's surface is blue and white, showing clouds and landmasses. A portion of a spacecraft or satellite is visible at the top of the frame.

# Observing Earth from Space: Astronaut Photography

*Webinar with Earth Science & Remote Sensing  
(ESRS) Team Members from Astromaterials  
Research & Exploration Science (ARES) at the  
NASA Johnson Space Center*



# Earth Day!

In honor of Earth Day, we are going to talk about

- Astronaut photography of Earth
  - Brief history
  - What makes astronaut photos useful and unique
- Viewing "climate"/weather regions from space
- Changes to Earth's surface over time
- Resources and tools for public use



The Earth Day flag created by John McConnell, the founder of Earth Day, uses this image of Earth, famously named *The Blue Marble*, taken on Apollo 17



# Who am I?

## Background

- Born and raised in Ohio
- Studied engineering in school and joined NASA through the Pathways Intern Program
- PhD student studying geology when I'm not working

## Experiences at NASA

- Studied meteorites from Mexico
- Worked on multiple experiments flown to the International Space Station (ISS)
- Lead, ISS Crew Earth Observations Facility





# Earth Science and Remote Sensing at NASA Johnson Space Center



We're a creative team of Earth scientists, GIS analysts, and computational scientists that work with astronaut photos of Earth

- Support NASA International Space Station (ISS) Program Office
  - Payload operations for Crew Earth Observations facility
- Curate and host astronaut photography of Earth online database
  - Website: <https://eol.jsc.nasa.gov/>

# ISS Program Support



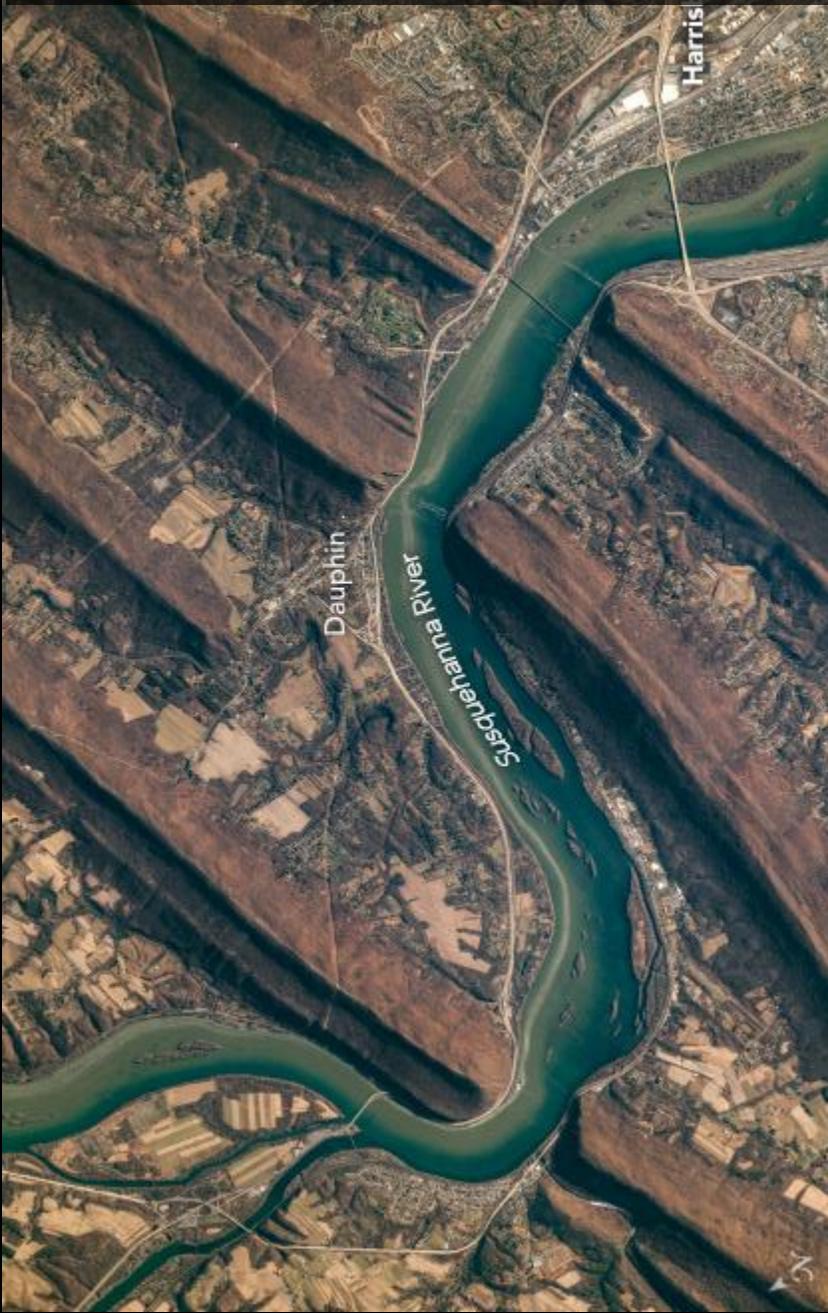
# Imagery Requests



# Disaster Response



# Weekly Articles



# Machine Learning



# Photo Database



# Brief History of Astronaut Photography of Earth

- We curate over 4 million photos astronauts have taken of Earth since the 1960s

Apollo missions



AS07-8-1897, 10/1968

Shuttle missions



Space Shuttle Atlantis –  
07/10/2011

ISS missions



ISS064-E-49249 – 3/29/2021

# Brief History of Astronaut Photography of Earth

- We curate over 4 million photos astronauts have taken of Earth since the 1960s

**QUESTION:** Out of 4 million photos, about how many have been taken from the ISS?  
*(put your answers in the chat)*

Apollo missions



AS07-8-1897, 10/1968

Shuttle missions



Space Shuttle Atlantis –  
07/10/2011

ISS missions



ISS064-E-49249 – 3/29/2021

# Brief History of Astronaut Photography of Earth

- We curate over 4 million photos astronauts have taken of Earth since the 1960s

**ANSWER:** Out of 4 million photos, about 3.5 million have been taken from the ISS!

Apollo missions



AS07-8-1897, 10/1968

Shuttle missions



Space Shuttle Atlantis –  
07/10/2011

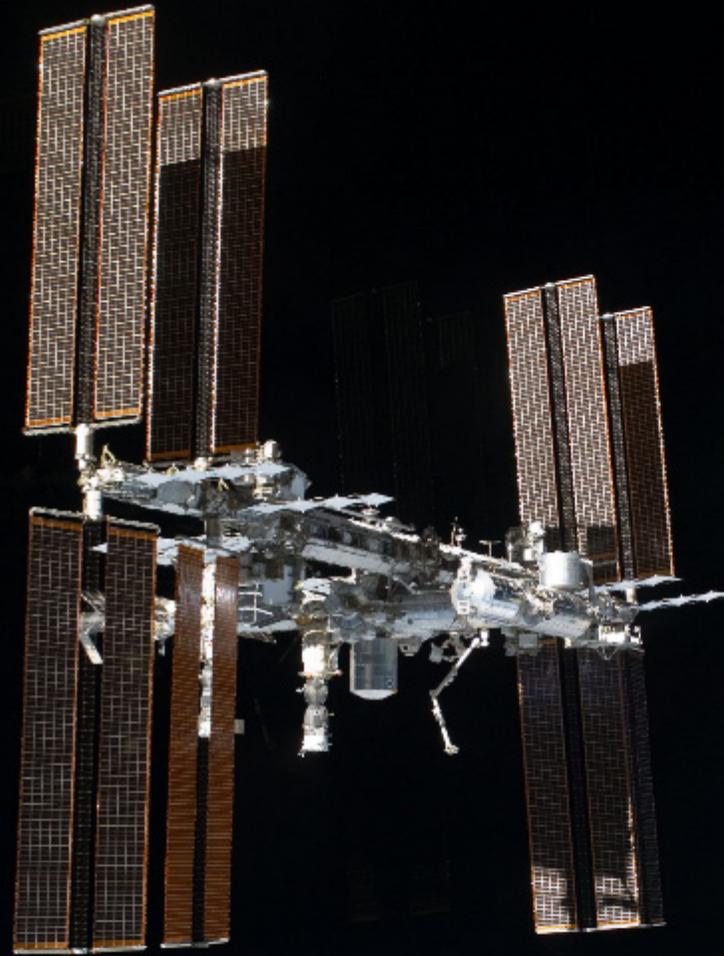
ISS missions



ISS064-E-49249 – 3/29/2021

# International Space Station (ISS)

- Astronauts have lived continuously on board since 2000
- Orbits Earth ~16 times every day –that’s every 90 minutes!
- Orbits ~250 miles above Earth’s surface
- Only possible with international collaboration: USA, Russia, Europe, Japan, Canada, and many more



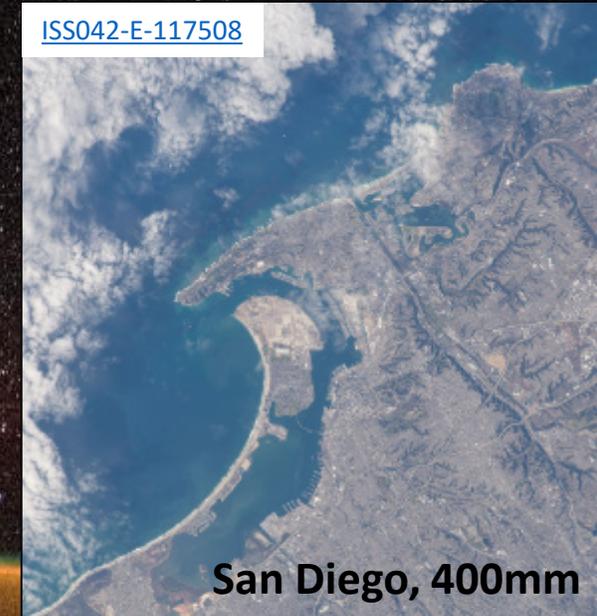


There are a lot of camera lenses to choose from!



# Different Fields of View

- Shorter camera lens sizes take broad and wide pictures
- Longer lens sizes take more zoomed in photos





- There are a variety of satellites orbiting Earth gathering very useful data and imagery of Earth.
- These satellites pass over the same area of Earth the same time every day.



**QUESTION:** What are the benefits of astronaut photography of Earth?  
*(put your answers in the chat.)*





## Benefits of Astronaut Photography:

### 1) Variable Solar Illumination Angles

- Can see the same locations at any time of night or day

*Italy at day and night*



Benefits of Astronaut Photography  
2) Variable Look Angles

- See the same locations from different directions and orientations





Astronauts can use different camera lens sizes to zoom in on a place

This example shows different photos zooming into Venice, Italy



# Crew Earth Observations

- Astronauts on the International Space Station (ISS) photograph Earth from their unique point of view in low Earth orbit
- We provide daily targets on Earth for astronauts to take photos of
- Daily targets are evaluated based on:
  - ISS location
  - Lighting conditions
  - Weather (cloudiness)



*NASA astronaut Christina Koch looking out the ISS Cupola windows*

# Images Help Support:

## 1. Science

- a. Change over time
- b. Urban Growth
- c. Light Pollution & more!



## 2. Disaster Response

- a. Fires
- b. Hurricane Damage
- c. Flood Assessment & more!



*And so much more! These are just a few examples.*

NASA astronaut Christina Koch looking out the ISS Cupola windows



# HOW MIGHT YOU USE THIS ASTRONAUT IMAGE?

A) What would this image help support? *Science? Disaster Response?*

B) What type of information could you obtain from this image or images like this?

*(put your answers in the chat.)*



2018 California wildfires

## 1. Science

- a. Change over time
- b. Urban Growth
- c. Light Pollution
- d. Other

## 2. Disaster Response

- a. Fires
- b. Hurricane Damage
- c. Flood Assessment
- d. Other

# Collecting and Delivering Disaster Response Imagery

- Raw camera files georeferenced
- Georeferenced imagery delivered to U.S. Geological Survey



ISS056-E-129891, 116mm



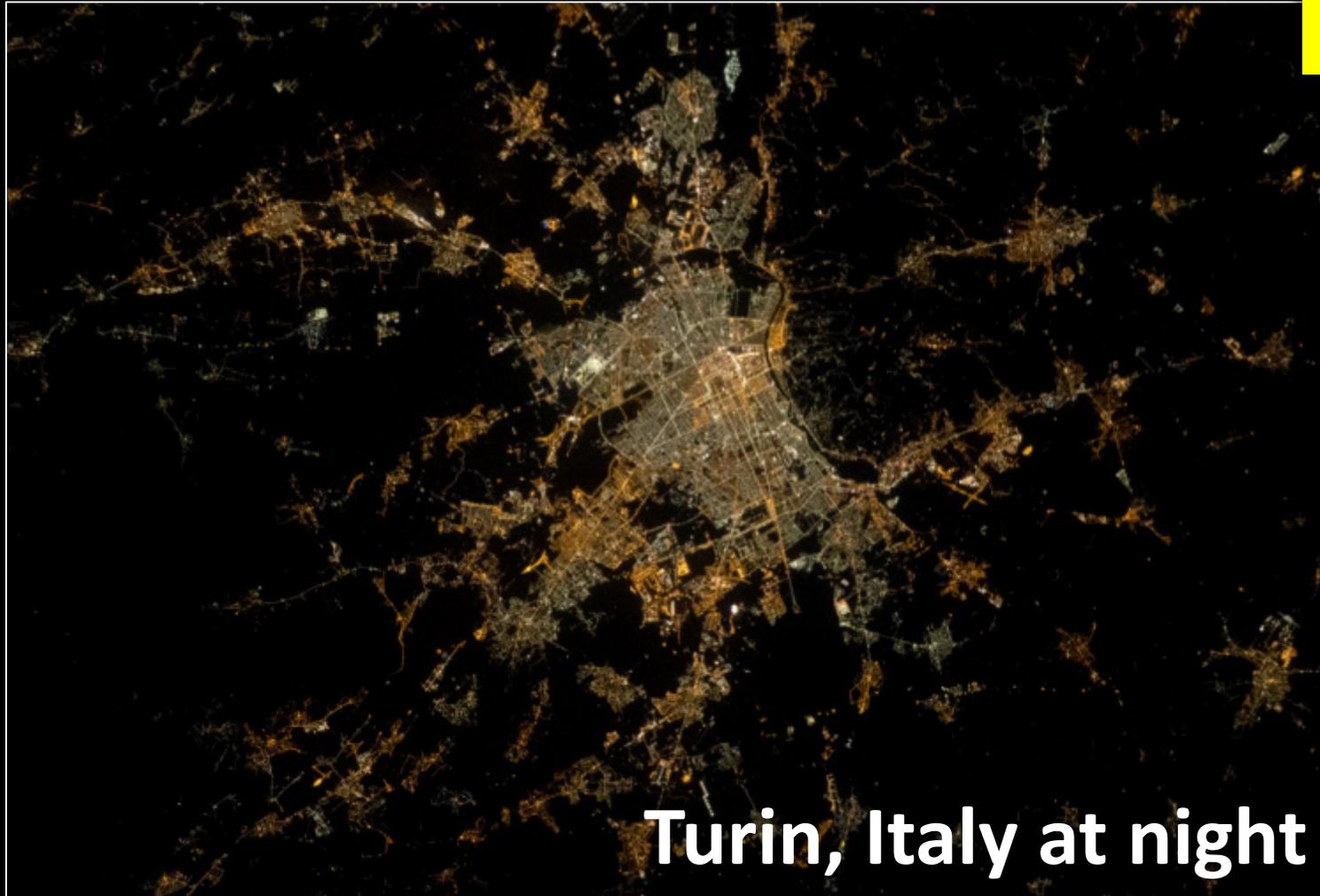
Georeferenced data product

# HOW MIGHT YOU USE THIS ASTRONAUT IMAGE?

A) What would this image help support? *Science? Disaster Response?*

B) What type of information could you obtain from this image or images like this?

*(put your answers in the chat.)*



**Turin, Italy at night**

## **1. Science**

- a. Change over time
- b. Urban Growth
- c. Light Pollution
- d. Other

## **2. Disaster Response**

- a. Fires
- b. Hurricane Damage
- c. Flood Assessment
- d. Other

A vibrant aurora borealis in shades of green and yellow against a starry night sky. The aurora is a bright, glowing band of light that curves across the upper portion of the frame. The background is a dark, starry sky with numerous small, bright stars and a few larger, more prominent stars. The overall scene is a beautiful representation of the Earth's atmosphere from space.

Now that you have learned astronaut  
photography basics, let's look at  
climate regions and how Earth  
changes over time!

**QUESTION:** How many different climate regions can you see in this photo? Support/Describe your observations. *(put answers in the chat)*



ISS041-E-81033



## India

- Warm, humid
- Rivers, vegetation

## Himalayas

- Block moisture from traveling North

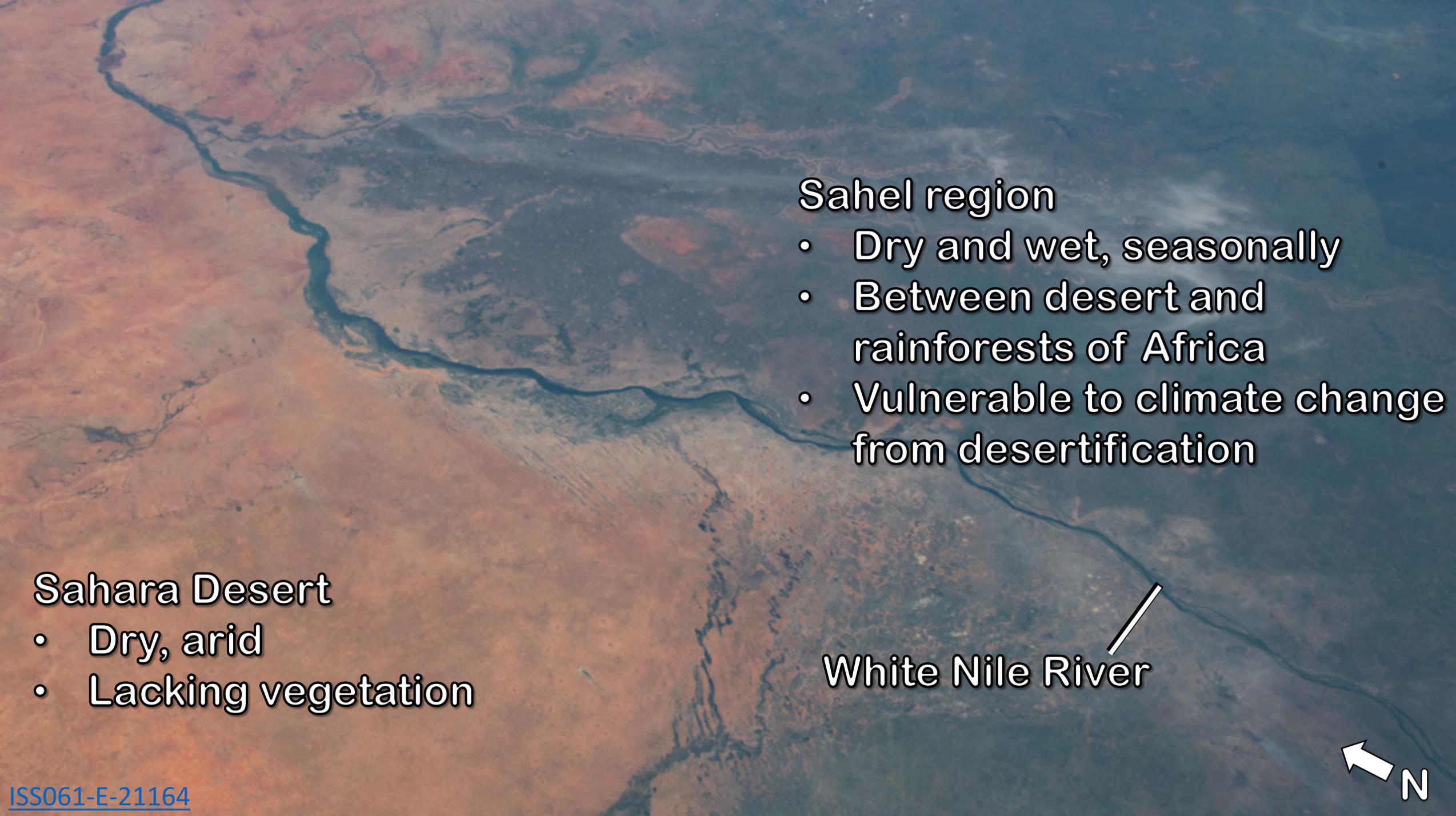
## Tibetan Plateau

- Dry, arid
- Lack of vegetation
- Lakes



**QUESTION:** How many different climate regions can you see in this photo? Support/Describe your observations. *(put answers in the chat)*





## Sahel region

- Dry and wet, seasonally
- Between desert and rainforests of Africa
- Vulnerable to climate change from desertification

## Sahara Desert

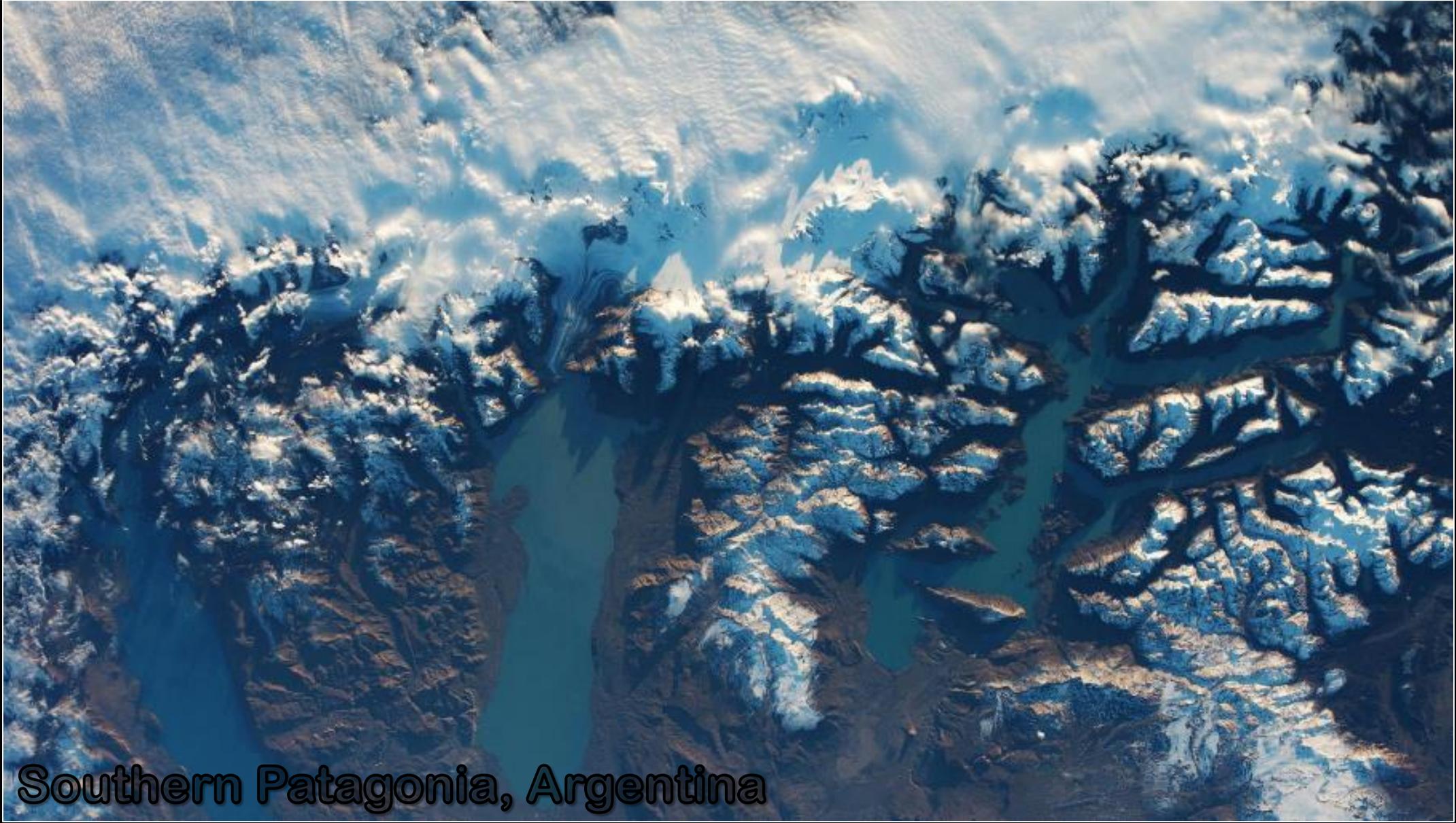
- Dry, arid
- Lacking vegetation

White Nile River



**QUESTION:** What features do you see in this photo?

*(put your answers in the chat.)*



Southern Patagonia, Argentina

Southern Patagonia, Argentina

clouds &  
snow

glaciers

lakes



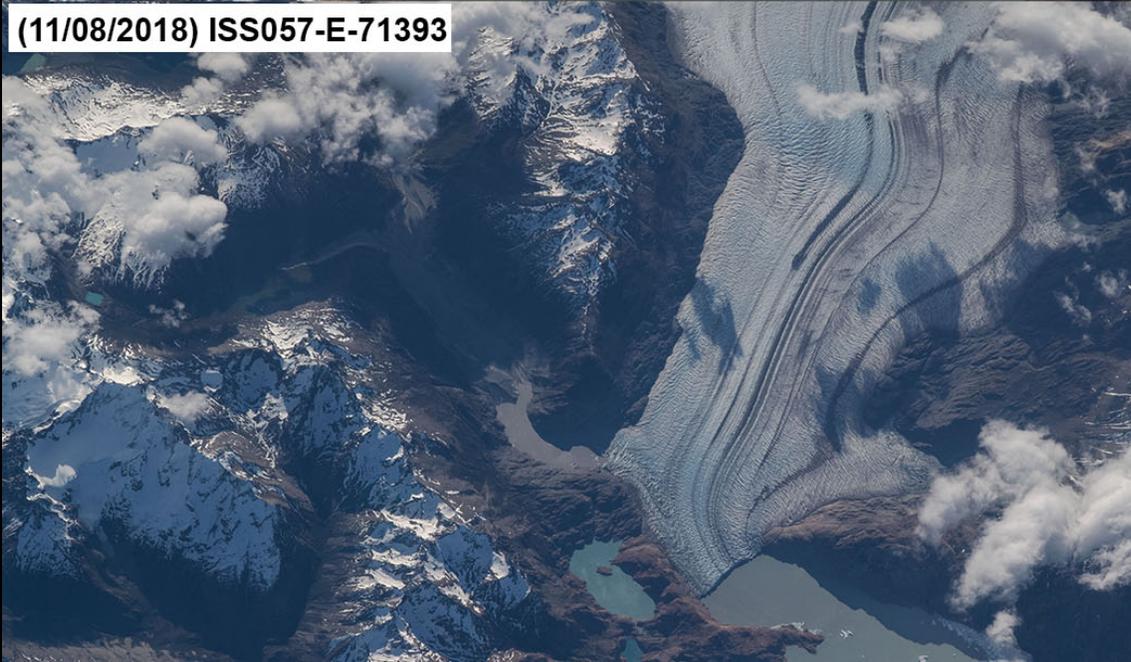
(10/09/2007) ISS015-E-33587



(03/24/2016) ISS047-E-18778



(11/08/2018) ISS057-E-71393

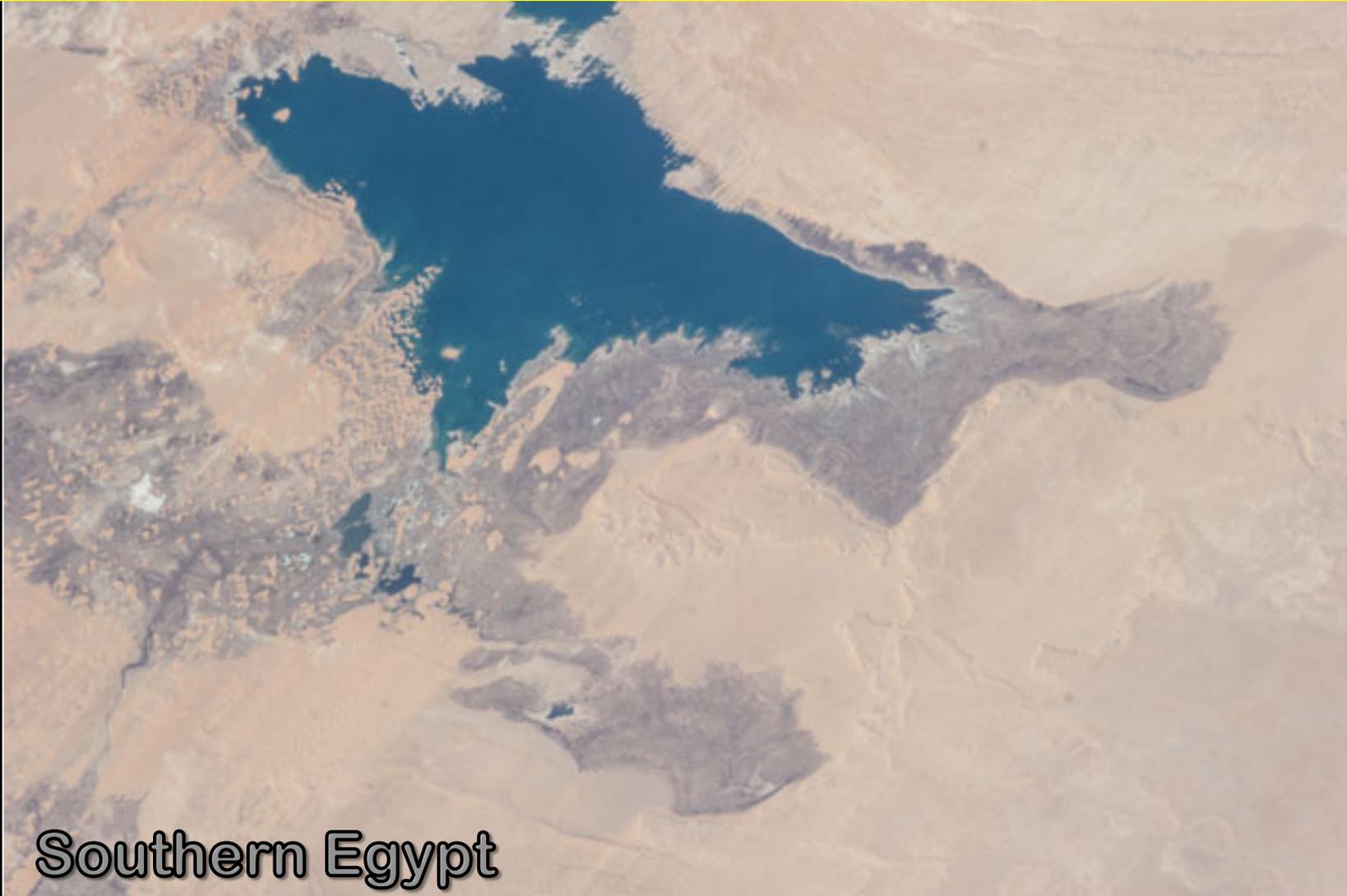


## Viedma glacier, South Patagonia icefields

Measurable glacial tongue retreat over past decade  
from astronaut photography

**QUESTIONS:** 1) List features you see in this photo AND  
2) Describe how you might use images of this area for research?

*(put your answers in the chat.)*

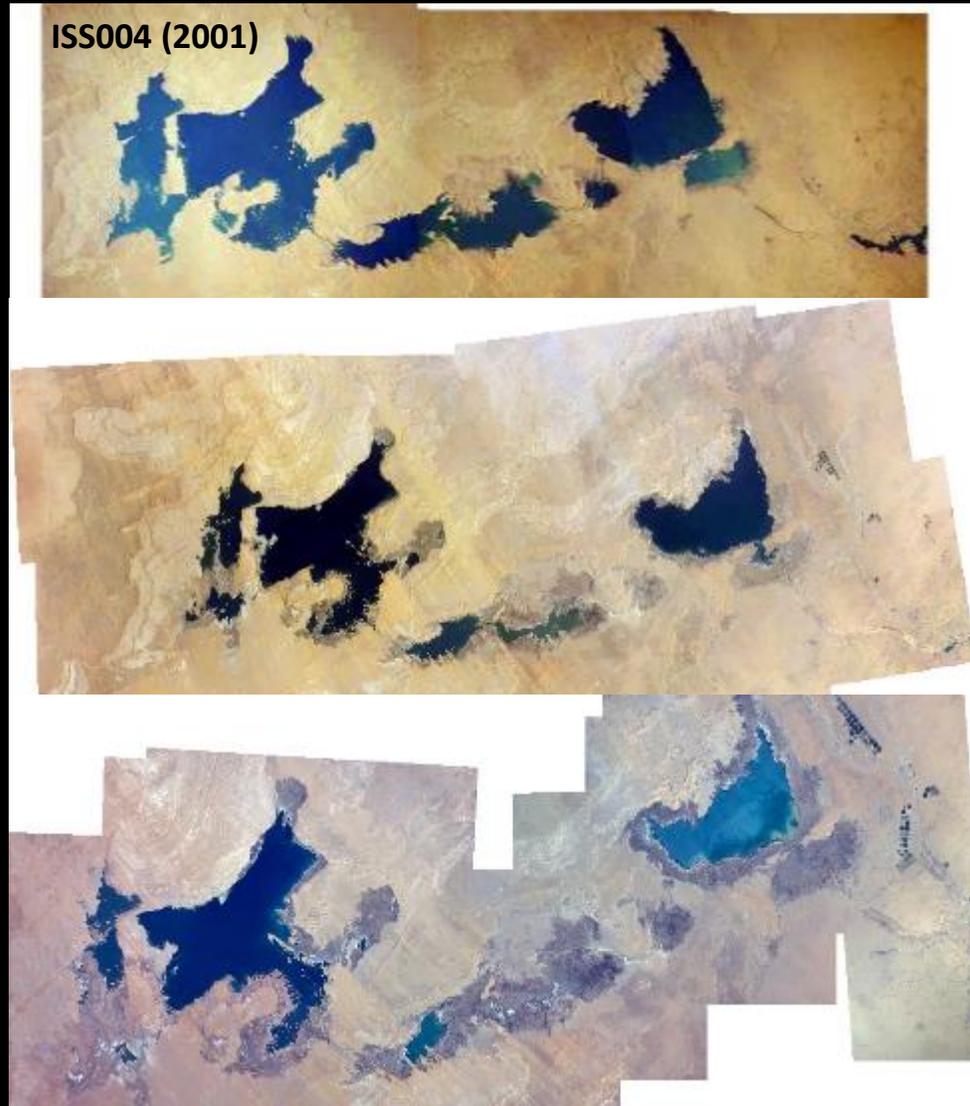


Southern Egypt



Toshka Lakes, Southern Egypt

# Astronaut photography over time: shrinking Toshka Lakes, Egypt



Learn more about the Toshka Lakes over time here:

<https://earthobservatory.nasa.gov/images/78531/toshka-lakes-southern-egypt>

A view from space showing the Earth's horizon and a starry sky. The Earth's surface is visible as a curved line with a thin atmosphere, glowing with a mix of orange, yellow, and green. The sky is filled with numerous stars of varying brightness. In the foreground, the dark, metallic structure of a spacecraft or satellite is visible, including what appears to be a solar panel array on the right side.

Freely available resources

# Gateway to Astronaut Photography of Earth

<https://eol.jsc.nasa.gov/>



GATEWAY TO ASTRONAUT PHOTOGRAPHY OF EARTH

SEARCH PHOTOS

COLLECTIONS

BEYOND THE PHOTOGRAPHY

CREW EARTH OBS

REQUEST NEW IMAGERY

LATEST ISS IMAGERY

TOOLS

FAQ

Over 4 million images of Earth taken by astronauts

# Astronaut photos of Earth are freely available to view & download

*ISS060-E-7325*



<i>NASA Photo ID</i>	ISS060-E-7325
<i>Focal Length</i>	78mm
<i>Date taken</i>	2019.07.13
<i>Time taken</i>	11:35:31 GMT

*Resolutions offered for this image:*

[5568 x 3712 pixels](#) [640 x 427 pixels](#)

*Cloud masks available for this image:*

Zoom image at cursor

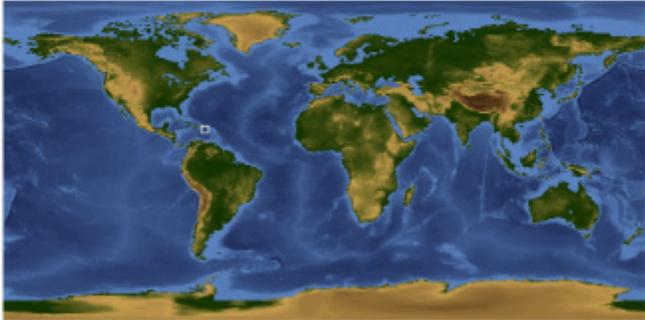
[Map Location](#) [Image Details](#) [Camera Information](#) [Download Options](#)

*Spacecraft nadir point:* 19.0° N, 69.9° W

*Photo center point:* 18.0° N, 67.0° W

*Nadir to Photo Center:* East

*Spacecraft Altitude:* 220 nautical miles (407km)



# NASA Earth Observatory

- New articles on NASA images published daily
- Once a week on astronaut photos

Lake Van, Turkey



September 12, 2016

JPEG

Dust Over Seas



June 10, 2020

JPEG

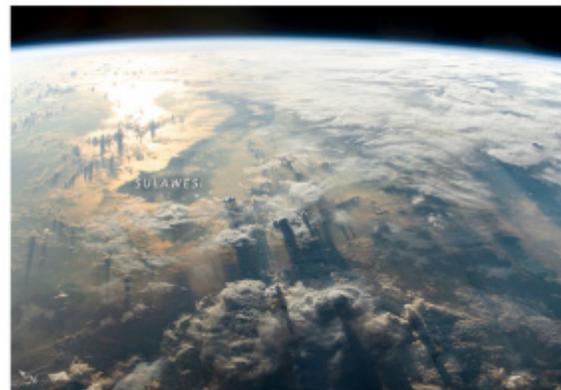
Frozen Moonrise



December 12, 2019

JPEG

Cloudy Sulawesi



May 10, 2019

JPEG

## Wide-Eyed Over Mexico



March 23, 2020

JPEG

A dark, starry night sky with a green aurora-like glow at the bottom. The text "Questions?" is centered in the upper half of the image.

Questions?