EDUCATIONAL BOOKLETS
TÉMOINS POLAIRES
À l'écoute du climat.
MADE BY

UNDER ANTARCTICA EXPEDITION 2025

UNDER ANTARCTICA

Booklet n°5 - Glaciers seen from space

Heïdi

Paco

Matthieu

SPECIAL EDITION

The Antarctica Times

SPECIAL EDITION

Antarctica

10 december 2025

A windy, wintery, birthday!

SOMETIMES A LACK OF WIND, SOMETIMES STRONG GUSTS, ALL OF THIS WITH TEMPERATURES AROUND –35 DEGREES CELSIUS; MORALE IS STILL EXCELLENT!

"On December 4th, Matthieu has celebrated his birthday in the tent! Now 34 years old, this is the second time he has celebrated this very special day in Antarctica. The first time was during his first solo crossing of Antarctica, on his 27th birthday."

Matthieu celebrating his birthday in the tent, accompanied by Heïdi and their loyal companion Paco!

Very cold temperatures, but Paco hang on!

"Every morning, our day begins with the same routine: checking the wind, choosing the sails, turning on the radar, then setting off into the vast white expanse. Every two hours, we take a technical break to check the surface radar data."

"On December 1st, was celebrated the International Antarctica Day, in tribute to the 1959 Treaty that protects this continent for peace, research, and international cooperation."

Here we are! Welcome to the geographic South Pole, one of the most iconic places in the world!

Aren't you exaggerating a little, Matthieu? Why is it so special?

It's the most southern point on Earth. I'm pointing north , no matter which direction I point in! It's also a place full of history and adventure. I even ended up here myself in 2019, when I skied from the coast of Antarctica all the way to the South Pole, alone and self-supported.

A little selfie for the memories! Come on Paco, smile! One... two... three... cheeeeese!

Clic

It's only a 'small ball' surrounded by flags...

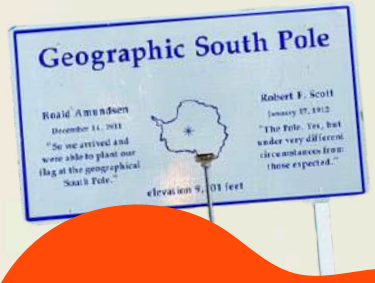
Heidi, Matthieu and Paco at the Geographic South Pole

Find the flags!

On the photo above, the flags you see represent the countries that signed the Antarctic Treaty System. Not all of them are present in the photo, but identify the names of those you can see.

Much more than just a simple ball, this place has an exciting history, Paco!

CHAPTER IV : THE GEOGRAPHIC SOUTH POLE, (90° SOUTH)



In 1911, one of the greatest long-distance duels in the history of polar exploration took place. The British, led by Robert Falcon Scott, announced as early as 1909 that they were going to set out on an expedition to reach the South Pole. In secret, the Norwegians under Roald Amundsen decided in turn to join the race to the South Pole.

Roald Amundsen, 1912

On December 14, 1911, Amundsen and his team became the first men to reach the South Pole. Scott's team, with fewer sled dogs and less training, arrived just one month later, on 16th January, 1912. In addition to not being the first to reach the South Pole, they tragically died of cold and hunger on their return journey.

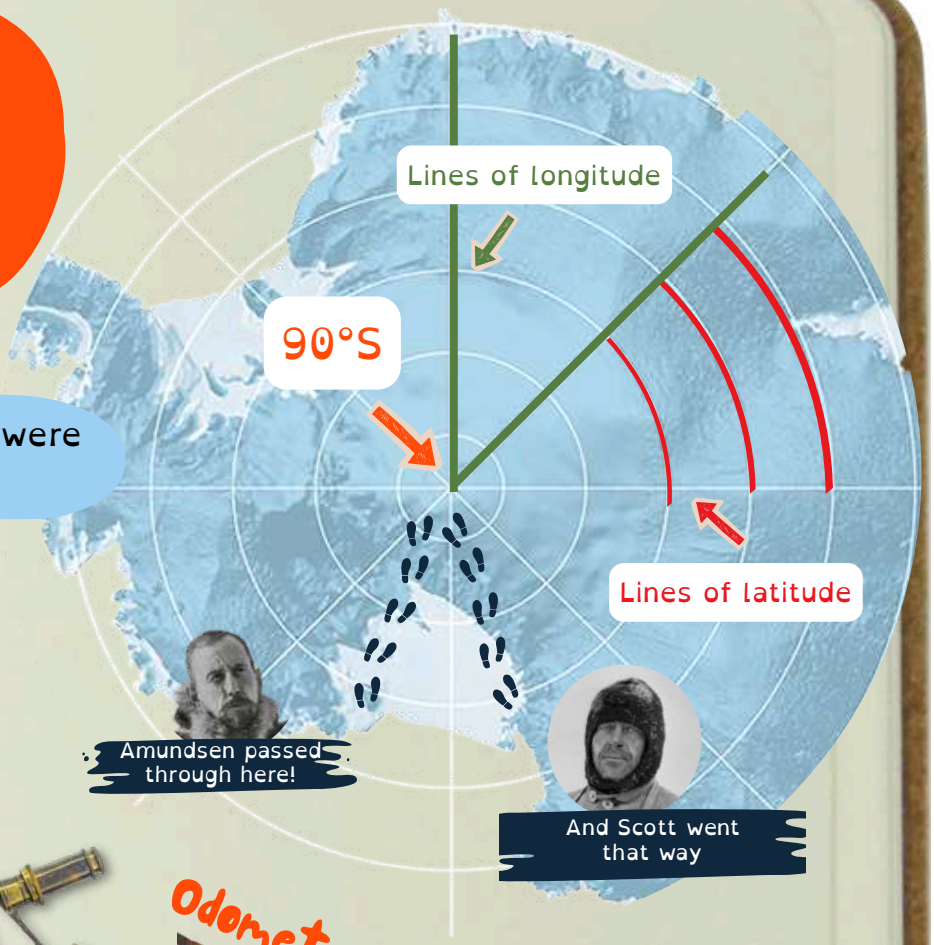
Robert Falcon Scott, 1911

The American Research Station located just nearby was named Amundsen-Scott in their honor.

The South Pole is located at 90° south latitude. It is the place where all the lines of longitude, called meridians, converge. These are used to navigate east to west.

But how did they know they were at the South Pole?

With these precious instruments :



Navigation instrument based on the stars.

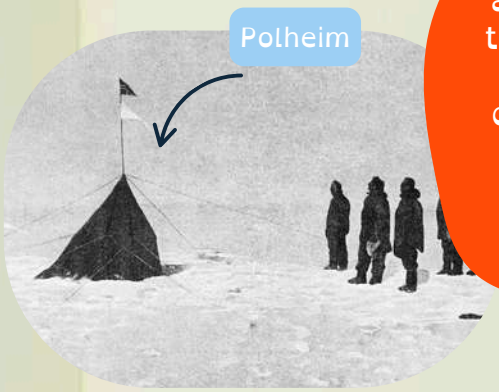
Sextant

Indicates magnetic north and works thanks to the Earth's magnetic field lines.

Compass

Odometer

Mounted on sleds, these wheels allow the distance to be measured. Coupled with a stopwatch, they also make it possible to calculate speed.



Even with their instruments, they couldn't be absolutely certain. At the spot he thought was the South Pole, Amundsen sent each of his men to travel alone for about 20 kms in different directions from the spot they believed was the Soth Pole, to cover the area. In the end, their camp Polheim, the 'House of the Pole,' was located about ten kilometers from the true geographic South Pole.

These days it is much easier to navigate! Thanks to satellites, we are geolocated and know exactly where we are!

The "Global Navigation Satellite System" is a tool is a tool which gives the exact position of a person thanks to signals transmitted by at least three satellites. The best-known system is the American GPS.

GNSS and GPS

A satellite?
Like the Moon, we see up there?

Indeed, the Moon is a natural satellite. Like it, man-made satellites orbit the Earth after being launched by a rocket. There are 13,000 active satellites.

384 000 KM

36 000 KM

300 KM

100 KM

While the coldest temperature measured on the ground in Antarctica is -89.2 °C, what is the lowest temperature ever recorded by satellite?

- ☐ -93,2°C
- ☐ -100,6°C
- ☐ -150°C

Good grief, that's a lot of people up there! What do these funny machines have to do with our expedition?

Satellites make our expedition easier in three ways:

Navigation

Know our exact position

Avoid crevasses thanks to satellite images

Be rescued

Telecommunication

Communicate with our logistical teams

Alert in case of emergency

Access the internet

Weather

Check the weather forecast

Check the temperature

Check the wind direction and its strength

It's dizzying to think that our Earth floats in space, surrounded by satellites and the Moon!

You know, Antarctica was the very last continent to be explored and the last land to be claimed by nations. Its discovery somehow marks the end of large-scale terrestrial exploration.

Thus, a new frontier has opened for humanity: space! And, on Earth, there is a place that somewhat resembles a space mission: Antarctica. This frozen desert, isolated from all human life, is an ideal playground for the men and women preparing for space missions.

As early as 1967, four key NASA members spent a week there, visiting seven scientific stations to study the organization and survival in extreme conditions, as well as the psychological and physical lessons to prepare future astronauts.

An expedition in Antarctica requires rigorous mental preparation: isolation, close quarters, harsh weather conditions... Before our departure, we even underwent conflict resolution training. As in space, if needed, returning home can take several days, even several weeks.

I felt as if I had landed on another planet or in a geological horizon unknown to man, without knowledge or memory.

Richard Byrd, 1938

Quick question...
Can I try the kite-swimming?
It looks so much fun!

The KITE-ski, Paco!
Yes, try it! Maybe one day you could tow us. But watch out for the gusts!

HEÏDIIIIIIII

Heïdi... I have a problem...

Quick, Paco,
grab that radio!

it's playtime!

On this website, you can enter a location and see the wind direction in real time!
P.S.: Check what's happening with our adventurers by using their website to see where they are.

Hello Paco! Can you... hear me? If so, press... the right button! You were launched very high and put into orbit around the Earth.

I hear you, Heidi... I think there was a little gust of wind! It's funny here, I feel like I'm floating!

That's right, you're in zero gravity, you must feel really light! By the way, what does the Earth look like from up there?

Uhh... I think I see another planet... it has a big white spot, while our Earth is the "blue planet".

Yes, that's Earth! There, you can see Antarctica and its sea ice. At the North Pole, it will be different! You'll be there in an hour.

Antarctica: a frozen continent surrounded by a frozen sea (South)

1 hour later...

Ah yes, in the North, it's not a white continent, but a frozen ocean surrounded by frozen lands. From here, it almost looks like a "white planet".

Arctic: a frozen ocean surrounded by frozen lands (North)

But in any case, water that freezes is ice, right?
Why have two different words to say the same thing?

Sea ice and glaciers are two different kinds of ice that don't form in the same way. To help you understand clearly, I'm going to give you their "recipes".

Glacier or ice Cap

Ingredients


Snow


Cold


Ground (mountain)

Preparation

1. Stack a lot of snow.
2. Pack it down until it becomes ice.
3. Wait several hundred years.

Result

Our glacier can reach 5 km in thickness, the record in Antarctica. If a block of ice breaks off and falls into the water, it creates an iceberg!

Sea ice

Ingredients


Sea water


Cold

Preparation

1. Cool an ocean or a sea to −1.8°C.
2. Let the surface freeze and spread.
3. Wait a few weeks if you want a solid layer.

Result

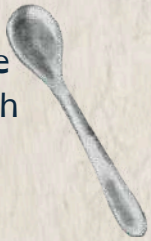
Our sea ice can reach a maximum thickness of 4 meters.

I think I understand now! To summarize:
Antarctica is a continent covered with glaciers, with sea ice around it.
The Arctic is an ocean covered with sea ice, but there are also glaciers on the surrounding lands, like in Greenland.

Help Paco !

Write under each image the corresponding name (glacier, sea ice, or iceberg).

If you taste young sea ice or a piece of glacier, which one will taste salty? What will the iceberg taste like?



Thanks to these vast white expanses formed by glaciers and ice sheets, the polar regions act as real air conditioners for the Earth!

With their white color, glaciers and ice sheets have the power to reflect the Sun's rays like mirrors! The name of this power:

albedo effect

On the other hand, dark surfaces (water or land) absorb the Sun's rays, which makes the temperature rise!

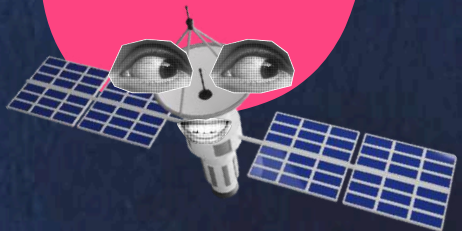
The ice is melting, then there is less white (ice sheets and glaciers) on Earth. So, their is more dark surfaces, which means the Earth absorbs more heat.

Just like when I wear a dark t-shirt in full sunlight!

Shall we play?

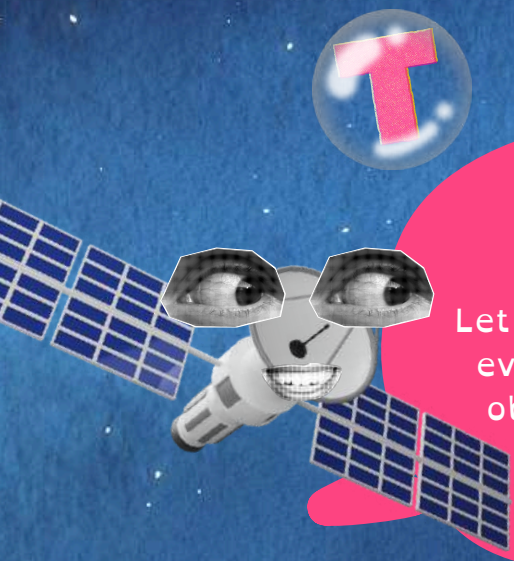
Help Paco connect these causes and consequences using 6 arrows! (the direction of the arrow is important)

Hmm, what's that weird bird over there?

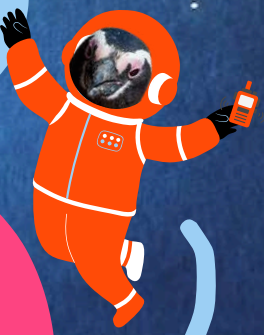


Exactly, and we can see this especially thanks to the satellites I was telling you about earlier.

Oh, but wait, I think I see one coming over there, and it doesn't look happy.

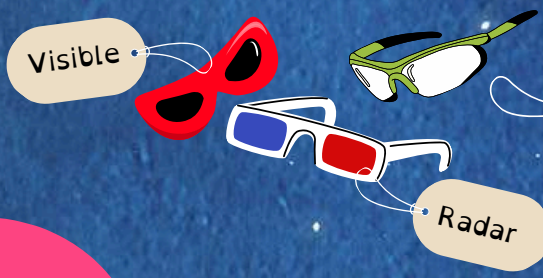


Hmm, yes, I've been hearing you talking about me and my little beloved planet this whole time...
Let me explain how cool I am! From space, I see everything, and thanks to my super-glasses, I observe melting glaciers, forests breathing, and even storms forming.



I can see heat, like a thermal camera.

I can also see in color like your eyes, but with a super zoom!



With them, I can see at night and through clouds.

I admire every day the beauty of your planet... and its fragility.
My data help to understand global warming, anticipate its effects, and protect what can still be saved.
I do my part, and you humans, what are you doing?

I want to become a glaciologist! Maybe we could work together?

Earth observation

Your turn! Match each illustration to what the satellite can monitor from space.

Natural disasters
Oceans
Rivières
Forests
Clouds
Climate
Pollution
Agriculture
Glaciers

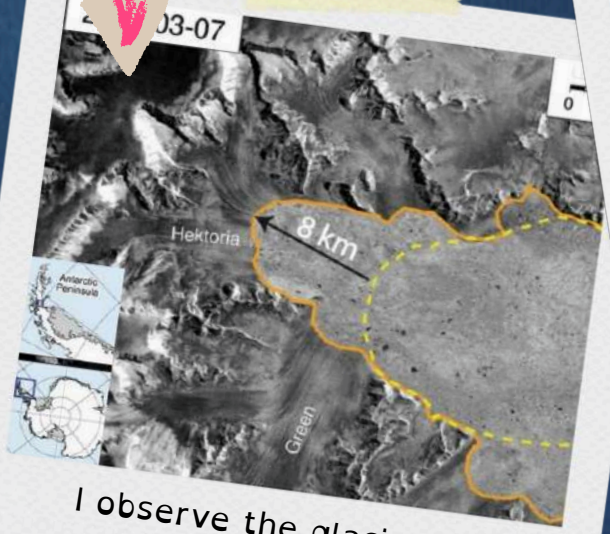
Great idea! Glaciologists love me, because I allow a regular and comprehensive monitoring of the cryosphere (snow, sea ice, glaciers, icebergs), even in inaccessible areas.

Mmmm, I see, will you show me? I want to look through your glasses!

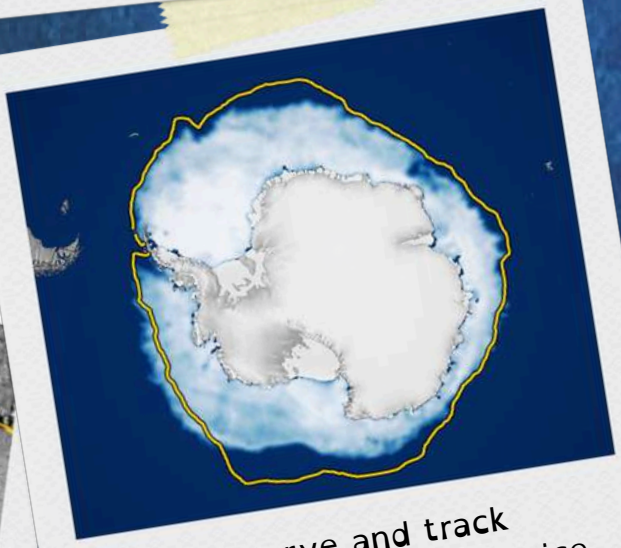
I can detect icebergs.

This one is 130 km long; I found it at night thanks to my radar glasses.

The Hektoria Glacier has retreated 8 km in 2 months!



I observe the glaciers and assess their health.



I observe and track the evolution of the sea ice.

Satellites are also used to support biodiversity; look at these two examples!

Satellite image of a colony: Each brown dot is an emperor penguin.

Not very photogenic from above.

Did you know that thanks to me, we discovered 33 colonies of your emperor penguin cousins? None of your human friends could have found these isolated groups. Plus, from above, we can track their movements safely!

For six months, 170 albatrosses equipped with GNSS trackers roamed the Southern Ocean for me. The result? I spotted hundreds of ships... and more than a third were fishing illegally, for fish, krill, and other resources, without reporting. Without my feathered super-spies, these practices would have remained invisible!

Albatross flying over the ocean, the tracker is on its back!

You are my new hero!

Be careful, this satellite is very flattering, but it doesn't tell you everything! It is certainly important for studying the Earth, yet building and launching it still burns fossil fuels! Moreover, space is becoming a trash dump and is filling up with debris due to the accumulation of all these satellites with various uses: telecommunications (especially them), navigation, science, and military.

Space debris

They can also prevent astronomers from observing the stars.

Light pollution

Then, at the end of their life, they fall back to Earth, burn up in the atmosphere, and pollute it.

Ouch!

Atmosphere pollution

Shall we play?

Every time you use GPS, the cloud, streaming, or online games, satellites are working up there. In your opinion, what can we do to limit the use of this data?

Click here to see the evolution of space debris from 1957 to 2015.

Wow... what an emotional ride!
I almost lost a few feathers, but I'm so happy to be experiencing this adventure with Heïdi and Matthieu. I increasingly feel that I can provide valuable help to the Penguin Council.

Discovering the Geographic South Pole fascinated me.
The albedo effect?! How did I live 8 years without knowing this? It's essential for understanding the climate!

My favorite moment? Without a doubt, my flight into space and my encounter with the show-off satellite. I learned everything we can do with it, especially taking photos (if anyone wants a picture of how handsome I am...😎), but most importantly observing the Earth, protecting biodiversity, and the polar regions I love so much. Very inspiring for my future career!

Alright,
see you soon!

Paco

Shall we play?

1 Crossword puzzle

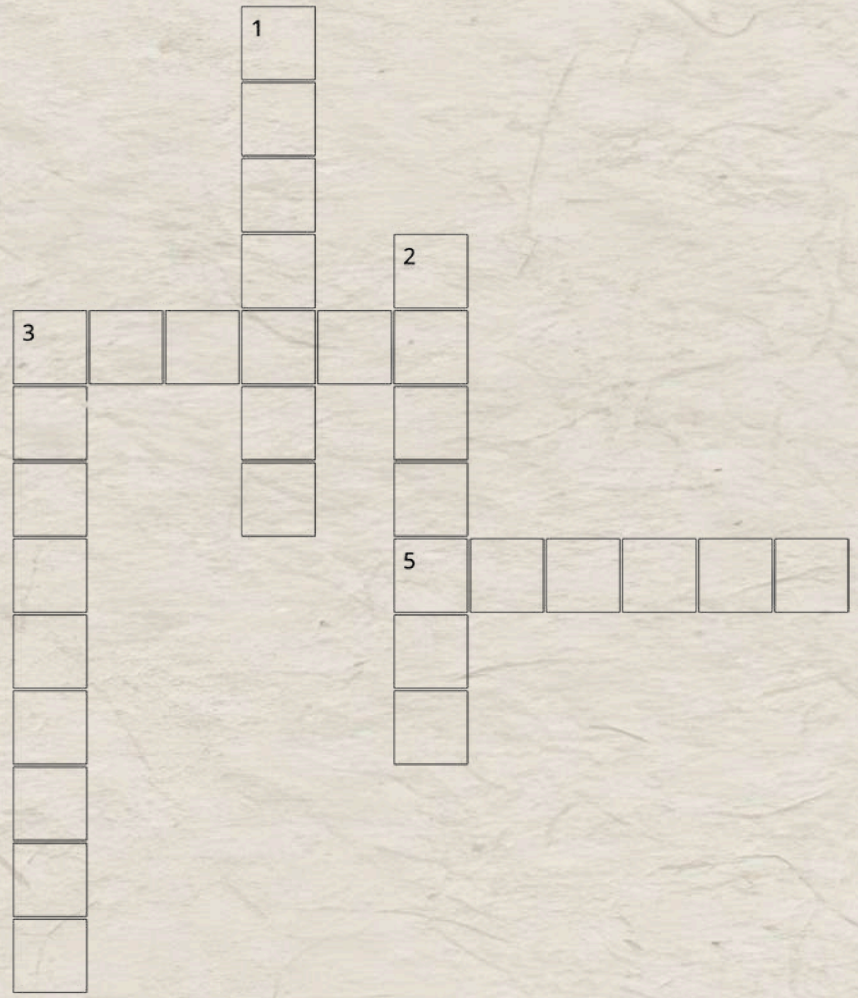
1. Large expanse of ice formed by the accumulation of snow.

2. Navigation instrument based on the stars.

3. (horizontal) Layer of frozen sea that floats on the ocean's surface.

3. (vertical) Object sent into space that orbits a planet to observe, communicate, or collect data.

5. Portion of solar energy reflected by a surface.



2 **Anecdote game:** match the anecdote to the corresponding mage.

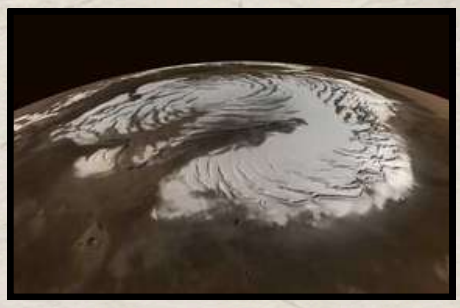
From space, some glaciers take on an astonishing shape, like the Elephant Foot Glacier in Greenland.

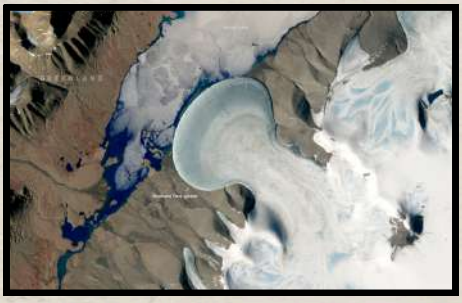
There are glaciers... extraterrestrial. Mars has two polar ice caps, made of water ice and CO_2 ice (called dry ice).

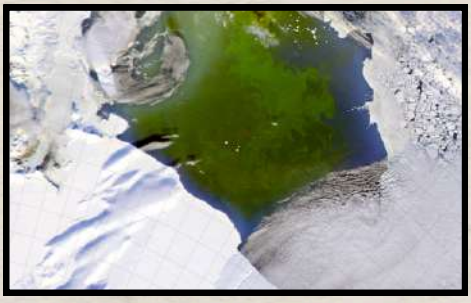
Satellite image showing a massive phytoplankton bloom near Antarctica, a phenomenon that reveals a very rich area where krill feeds.

- A
- B
- C

- 1
- 2
- 3







Lexicon

Albedo: Portion of solar energy reflected by a surface. Ice reflects a very large part of the energy it receives, whereas the ocean retains most of it.

Antarctic Treaty: A treaty is a legal act through which countries agree on common decisions. The Antarctic Treaty was signed by 12 countries in 1959 and promotes Antarctica as a continent dedicated to science and peace. Today, 58 countries have signed it.

Cryosphere: refers to all parts of the Earth where water is in a solid state: ice, snow, glaciers, sea ice, icebergs, and frozen ground.

Latitude: distance, in degrees, north or south of the equator. Lines of latitude (parallels) run east to west, from 0° at the equator to 90° at the poles.

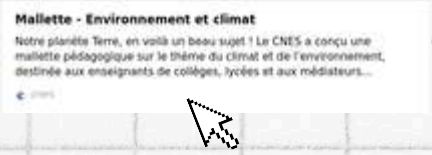
Longitude: distance, in degrees, east or west of the Greenwich meridian (0°). Lines of longitude, called meridians, run from the North Pole to the South Pole.

Orbit: An orbit is the path followed by an object as it travels around another, like a planet around the Sun or a satellite around the Earth.

Satellite: Object that orbits a planet. If it is built and launched into space by humans (artificial satellite), it is used to observe, communicate, or collect data.

Weightlessness/ Zero gravity: the state in which a body (like an astronaut) no longer feels its weight, as if it were floating, because it is in free fall.

To go further



Educational projects on the use of satellites for climate and the environment.

Educational video about satellites

Geographic South Pole

Glaciers ≠ Sea ice

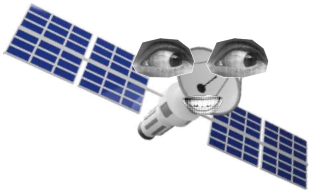
The polar regions air conditioners of the Earth

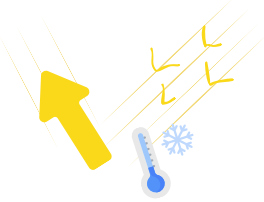
Ross Sea

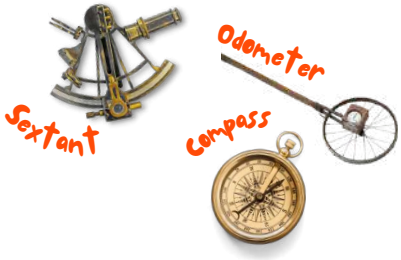
Antarctica

a frozen continent surrounded by a frozen sea

Cut out the images







GAMES SOLUTIONS

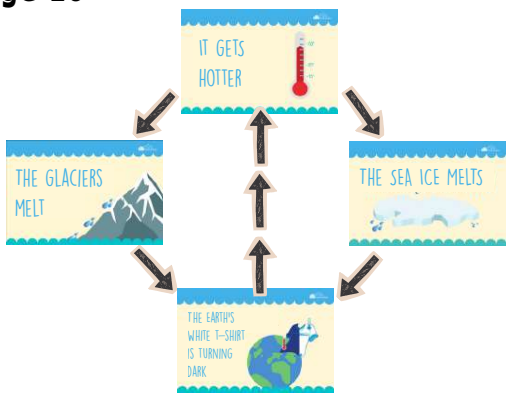
Page 2

From left to right:
South Africa, Belgium, Japan, France, United Kingdom, United States, Norway, Australia, Russia, Chile, Australia, and Argentina.

Page 9

The image on the left is the glacier and the one on the right is the sea ice (which will taste salty). The iceberg comes from the glacier ice, it will taste neutral; it is fresh water.

Page 10



Page 14

We can observe that for the same month of September, the sea ice has decreased in both area and thickness (less white, therefore less old and thick sea ice) over a few decades.

Page 16

1

1. Satellite
2. Albedo
3. Glacier
4. Sea Ice
5. Sextant

2

A → 2
B → 1
C → 3