

# LESSON A1

## EVIDENCE OF CLIMATE CHANGE ON LAND

### MAIN SUBJECTS

Natural sciences / Geography

### DURATION

- ~ Preparation: 5-10 min
- ~ Activity: 1h

### AGE GROUP

9-15 years

### LEARNING OUTCOMES

Students collect various types of evidence showing that the world climate has been changing over the last decades (global warming, sea level rise, the melting of glaciers, droughts, extreme events, etc.).

They learn that:

- ~ Climate and weather are two different phenomena.
- ~ The climate is an average of the prevailing weather pattern for a particular region. It depends primarily on latitude, altitude and distance from the ocean.
- ~ The weather is the state of the atmosphere at a particular place and time. Temperature and humidity are among the variables that characterise the weather.
- ~ The temperature of the whole planet has been increasing for a century, especially on land. This has led to different impacts, such as melting ice (glaciers and sea ice) and sea level rise.
- ~ Frequency and/or intensity of extreme events – such as floods, storms, and droughts – is increasing.

### KEYWORDS

Climate, weather, global warming, extreme weather events, long timescales, scientific data

### TEACHING METHOD

Documentary analysis



### → TEACHER TIP

In these worksheets, we have included documents catering to different levels of ability. They are sorted into three categories: **“trainees”** is the most accessible level, suitable for 9-10 year olds; the **“curious”** tag gathers documents for 10-11 year olds; whereas the **“expert”** level is suggested for 12+ year-old students. These age ranges are provided for information only. For the youngest students, one worksheet comes with one document only. For more advanced students, several may be given to the same group.

### LESSON PREPARATION

1. Consider groups of 4 students and pick the most suitable documents for their level.
2. Print copies of **WORKSHEETS A1.1** (one for each student), **A1.2**, **A1.3**, **A1.4**, **A1.5**, **A1.6**, **A1.7**, **A1.8** and **A1.9** (one for each group).

### → TEACHER TIP

During this lesson, you should take into account two potential obstacles to student understanding:

- **The timescale of climate change:** The large timescales involved with climate change can be difficult to conceive for a young student, for whom fifty years may seem an eternity. For them it is not easy to comprehend the idea of change on these timescales. Moreover, some changes will be gradual and thus difficult to perceive.
- **The fact that climate change is a worldwide phenomenon:** Even in the era of globalisation and social media, young (and often old!) people will tend to merely perceive events that are directly related to their personal life. Changes and events that occur in other parts of the world are too far away to be real. As a teacher, you can start with events that the students can relate to, events that occur locally and today. Subsequently, you can progressively introduce more global and long-lasting changes. This is why starting with concrete examples brought by the students may help.

Some documents require basic skills in the interpretation of graphs and percentages. Do not hesitate to spend more time on this lesson if the students are confronted with this kind of task for the first time.

### PREPARATION 5-10 MIN

### EQUIPMENT

- **WORKSHEET A1.1** (one for each student).
- **WORKSHEETS A1.2, A1.3, A1.4, A1.5, A1.6, A1.7, A1.8, A1.9.**

## BACKGROUND FOR TEACHERS

### CLIMATE VERSUS WEATHER

The difference between **climate** and **weather** is related to the length of time considered: climate is the average state of the atmosphere over months, years, decades, centuries or more, whereas weather is the state of the atmosphere at a particular place and time and can change hourly, daily or, on average, from one season to another (see page 8 of the Scientific Overview for more detailed definitions).

### WHAT ABOUT CLIMATE CHANGE?

The term “**climate change**” is now commonly used as a synonym to anthropogenic climate change, meaning changes to the climate system resulting from human activities since the Industrial Revolution (see page 13 of the Scientific Overview for further details on anthropogenic impact). Climate change can manifest in several ways and on different timescales: through **changes in the nature of single, short-lived, extreme weather events**, like dust storms or

heatwaves, to **incremental changes that build up over decades**, such as sea level rise. These can interact and reinforce one another (e.g. the impact of more intense or frequent heatwaves is compounded/aggravated by increasing desertification in dry and desert areas). When talking about climate change, people also refer to one of its consequences for our planet, **global warming**. By global warming we mean an increase in the average surface temperature of the whole planet.

Scientists use different types of **evidence** to track climate change and its consequences. In this lesson, we provide a few examples, focused on land. These examples are just some of the different types of evidence that tens of thousands of scientists from all over the world and from all disciplines use to observe, measure and understand climate change and conclude that it is due to **human activity**, and in particular the release of CO<sub>2</sub>, a greenhouse gas (see lesson A2).

## INTRODUCTION 15 MIN

### Case 1: If you live in a region of the world that has a seasonal climate (summer/winter or wet/dry):

Start by asking the students: *How are you dressed today? Are you wearing a t-shirt or a sweatshirt? Shorts, skirts or trousers? Sandals or shoes? Were you wearing the same type of clothes yesterday? What do you carry to school, other than your school-books, lunch box, etc.? (a cap, raincoat or umbrella) What about the week before, last month, or during the last holidays? What guides your choice of clothes/equipment?* They will probably state that it depends on whether the day is sunny or rainy, cold or warm; that it depends on the weather.

*What is it like outside? Was it the same yesterday, the day before, last week, etc.? What about different regions of the world? What temperatures and humidity prevail there? How can you distinguish climate from weather?*

**Case 2: If you live in a place without a seasonal climate:** *Is the weather the same all year round? Is the weather the same as everywhere else in the world? Do other regions have the same temperature and rainfall? How can you distinguish climate from weather?*

1. In order to get a better understanding of the difference between weather and climate, we suggest you do a “moving debate”. Divide the classroom space into two parts: “Weather” and “Climate”.
2. On the whiteboard, write one of the sentences suggested on the next page. Then, the students can move across the classroom according to whether they think it refers to the climate or the weather (for each sentence, you will find the correct category in brackets). Ask why they have chosen one part of the classroom over the other.
3. Choose another sentence and repeat this several times.
4. Then ask your students to explain the difference between climate and weather: they have to understand that **weather is a state of the atmosphere (including temperatures and precipitations)**, at a particular place and time, whereas **climate is an average pattern**. For a given climate, the weather varies daily (even during the day!), whereas the weather on a given day does not describe a given climate: *The climate tells you which clothes to buy and the weather tells you what to wear*. You may now consider asking your students to give an example of other statements concerning climate or weather.

### SUGGESTED STATEMENTS

Look out the window; the sun is shining through the clouds and it looks lovely. (Weather)

My granny says it always snowed in the winter when she was a child. Sometimes she couldn't get to school because of the snow. (Climate)

I wish I lived in New York where it's cold in winter and hot in summer. We could have snowman-building competitions in winter or races in summer. (Climate)

It's going to be cold this weekend. You will have to put on a scarf to go outside. (Weather)

We could dress up as our favourite film characters. There's no way I am dressing up; it's way too cold. (Weather)

My friend in Australia had a water fight at her school fair, but it's always hot there. (Climate)

It rained on May 8. (Weather)

Germany is a cold country. (Climate)

It rains during the monsoon season. (Climate)

### → TEACHER TIP

These statements are only suggestions: you should adapt them according to your local conditions.

### PROCEDURE 40 MIN

1. From the previous activity, students should have noticed that the weather may change quickly. Ask: *Do you think that the climate has changed? Quickly or not? How can we prove it since climate occurs over a long period of time?* They will have to conduct a documentary analysis.
2. Show **WORKSHEET A1.1** to the whole class and distribute one copy to each student: they will have to fill it in at the end of the lesson.
3. Place the students into groups of no more than 4 (you may have different groups working on the same documents) and explain that they are going to be experts on one type of evidence for climate change. Distribute the **WORKSHEETS A1.2** to **A1.9** (one for each group). Using their document(s), they will have to write a short sentence that summarises what they learned (for instance, "The Earth has been getting warmer over the last XX years"). Then, they will have to write this sentence within the corresponding frame of **WORKSHEET A1.1**.



Students analysing data showing the change in annual precipitation.

4. After each group has analysed and discussed its document(s), one member of each group writes the sentence on the whiteboard or presents the findings to the other groups orally, so each student can complete **WORKSHEET A1.1**, gathering evidence that the climate is changing.

### WRAP-UP 5 MIN

Conclude by pointing out that just as the weather varies, so too has the climate over the past century: this is climate change. There is solid scientific evidence that the climate is changing (droughts, early blooming, wildfire frequency increase, glaciers melting, higher temperatures, etc.) in various regions of the world. You can mention the IPCC as one of the most reliable sources of information on climate change.

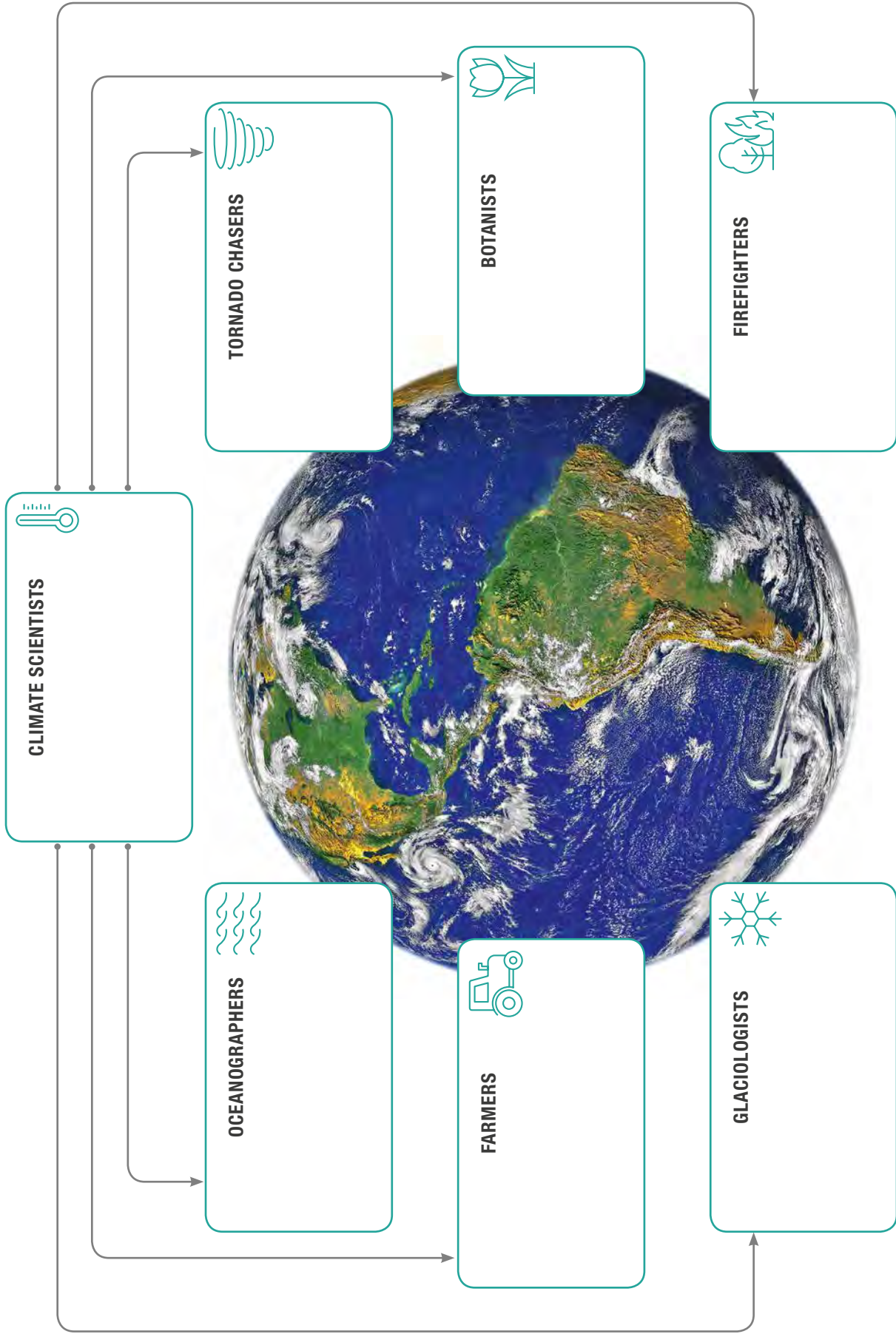
### → TEACHER TIP

You can find teacher-friendly summaries of the latest IPCC reports on the [Office for Climate Education website](#).





## WORKSHEET A1.1



CLIMATE CHANGE EVIDENCES

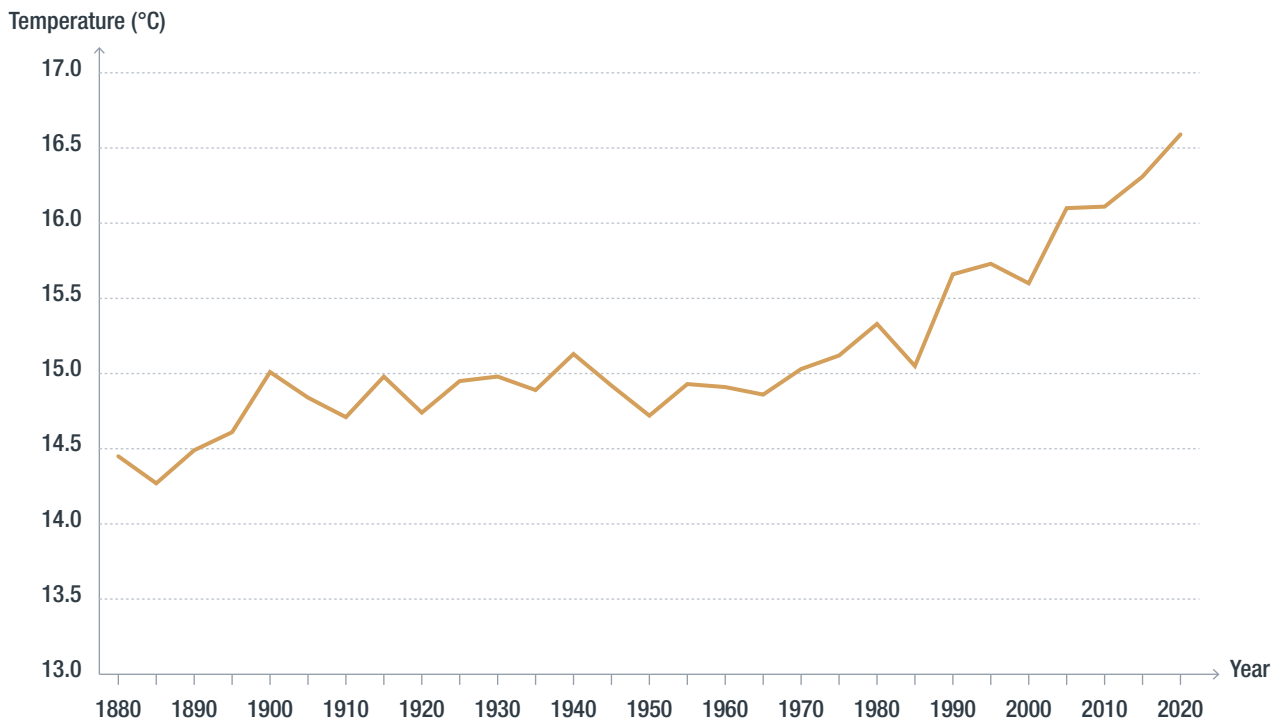


### CLIMATE SCIENTISTS

- ➔ Your mission: As climate scientists, you would like to know how the temperatures have changed over the last century. Using the graph below, describe in a couple of sentences what you notice about the temperature change on Earth since 1880.

This graph shows the change in the Earth's temperature above land since 1880. These measurements come from the NASA website and were obtained using different weather stations across the globe.

#### EVOLUTION OF THE TEMPERATURE ABOVE LAND SINCE 1880



Source : [https://data.giss.nasa.gov/gistemp/graphs\\_v4/](https://data.giss.nasa.gov/gistemp/graphs_v4/)



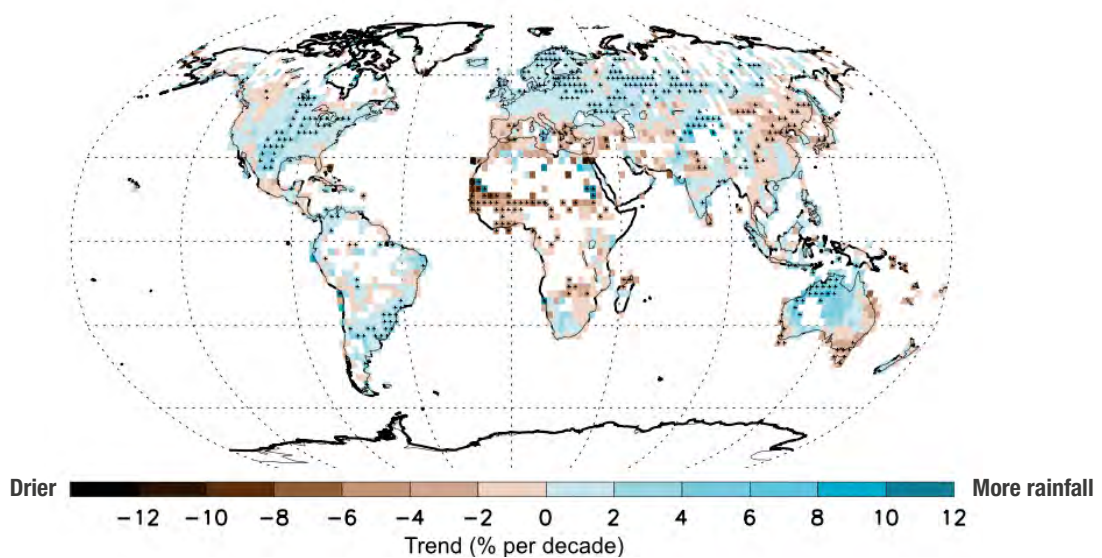


## EXPERT CLIMATE SCIENTISTS

- Your mission: As expert climate scientists, you would like to know how climate has changed over the last century. Using the figures below, describe in a couple of sentences what you notice about precipitation and temperature changes on Earth since 1950.

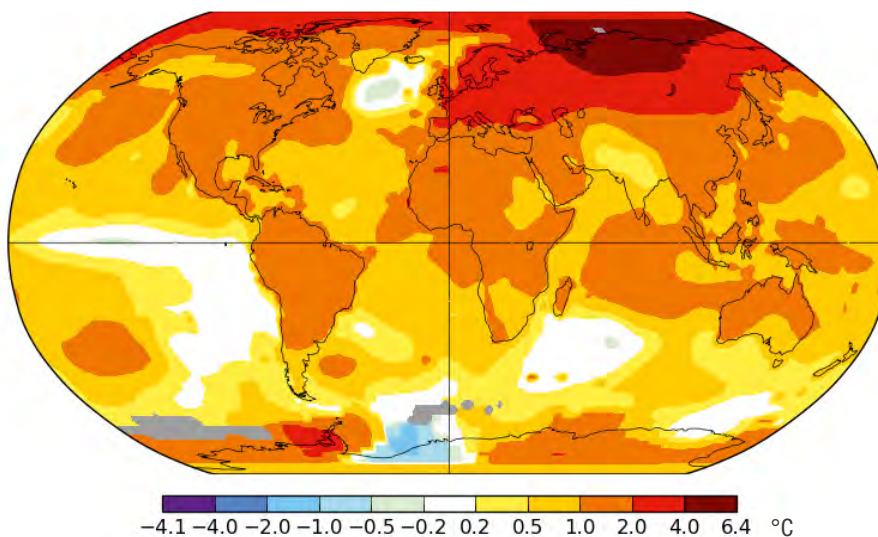
The two figures illustrate the evolution of precipitation between 1951 and 2010 and the changes in temperature between 1950 and 2020.

### TRENDS IN PRECIPITATION OVER LAND BETWEEN 1951 AND 2010



Source: IPCC Assessment Report 5 – WG1

### CHANGES IN MEAN ANNUAL SURFACE TEMPERATURE IN 2020 COMPARED TO THE PERIOD 1950–1980



Source: NASA – [https://data.giss.nasa.gov/gistemp/maps/index\\_v4.html](https://data.giss.nasa.gov/gistemp/maps/index_v4.html)

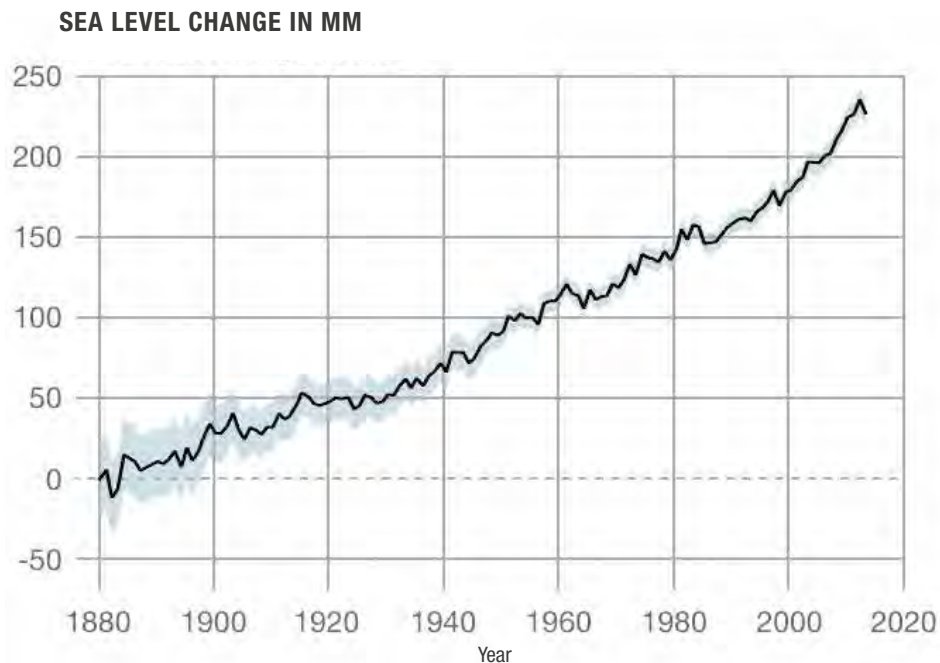
A NASA video is also available to help visualise the increase in temperature since 1880: <https://svs.gsfc.nasa.gov/4882>



### OCEANOGRAPHERS

➔ **Your mission:** As oceanographers, you would like to know how sea level has changed over the last century. Using the graph below, describe in a couple of sentences what you notice about the change in sea level since 1880.

This graph shows sea level variations since 1880. Recent measures were obtained using satellites revolving around the Earth and continuously recording the sea level, whereas the oldest ones come from littoral sea gauges<sup>1</sup>.



Source: data from NASA – <https://climate.nasa.gov/vital-signs/sea-level/>

<sup>1</sup> A sea gauge is a recording device that measures the sea – or river – level in a specific place and for a certain amount of time.



### FARMERS

→ Your mission: As farmers, you are concerned about climate change. Using the following information, write a couple of sentences explaining what a drought is and how the number of people affected has changed since 1960.

The first part describes what a drought is and its consequences. The second focuses on the amount of population experiencing desertification. Desertification occurs when the land is damaged in a dry area; it then becomes more and more arid and looks like a real desert.

#### WHAT IS A DROUGHT?

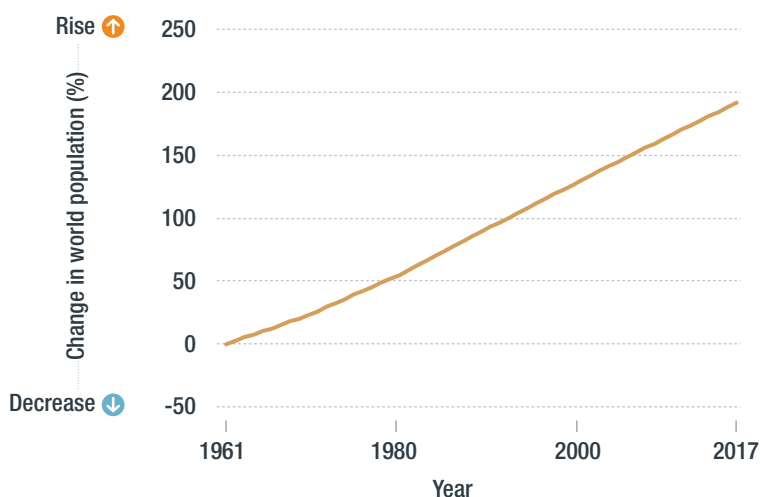
Drought occurs when there is less precipitation (rain) than usual or when the temperature is so high that groundwater reserves begin to run out.

Plants, like all living things, need water to survive and grow. When there is a drought, farming becomes very difficult.

If the drought lasts too long or is very severe, it can lead to desertification.



#### CHANGE IN WORLD POPULATION EXPERIENCING DROUGHT RELATIVE TO 1960



Source: Adapted from the IPCC's Special Report on Climate Change and Land.





## GLACIOLOGISTS

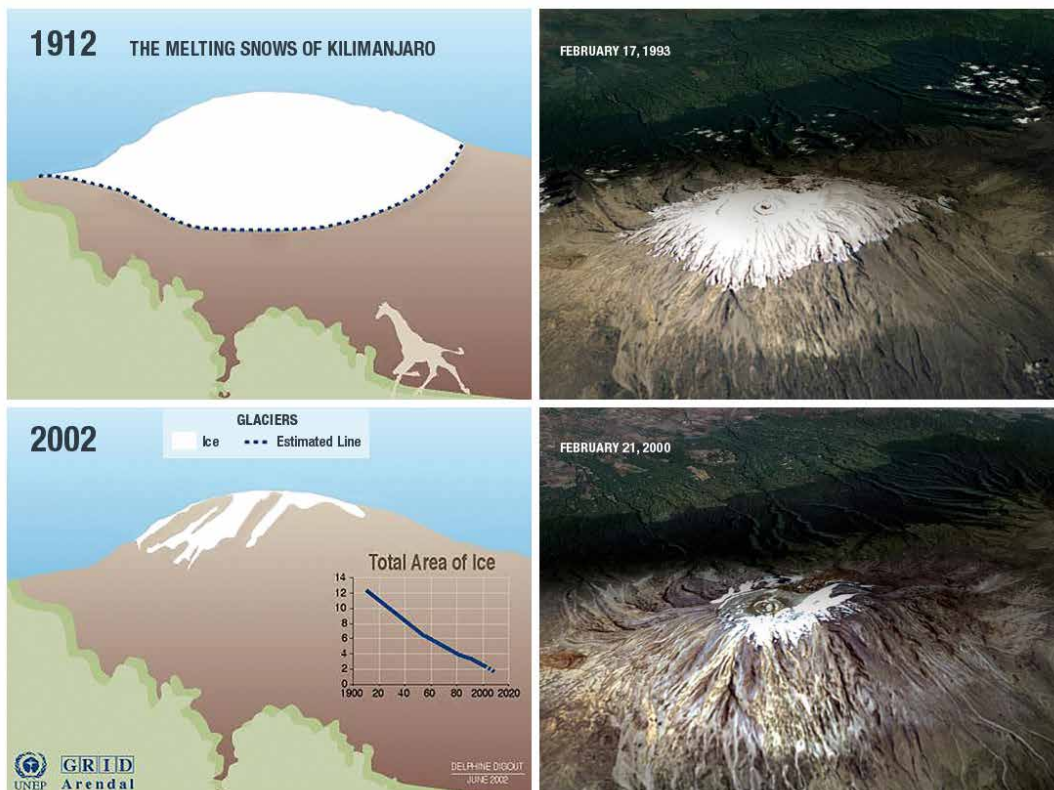
→ Your mission: As glaciologists, you are concerned about climate change, wondering if it will still be possible for you to study glaciers in the future. Using the following article, write a couple of sentences explaining what has happened to the Kilimanjaro glaciers since 1912.

The following article describes how the Kilimanjaro glaciers have changed between 1912 and 2002.



### KILIMANJARO IS DYING!

The glaciers of Mount Kilimanjaro, the highest peak in Africa, which have covered the top of the mountain for the past 11,700 years, are rapidly disappearing: “[...] in 1912, there were about 12.1 square kilometers of ice on the mountain, but a map in 2000 showed only 2.2 sq km of ice remained on the mountain – a loss of 80% of ice since then. [...] Kilimanjaro’s location [...] places it in the tropics. Here, ice fields are particularly susceptible to climate change, and even the slightest temperature fluctuation can have devastating effects.”



Source: Adapted from <http://www.earthkam.org>



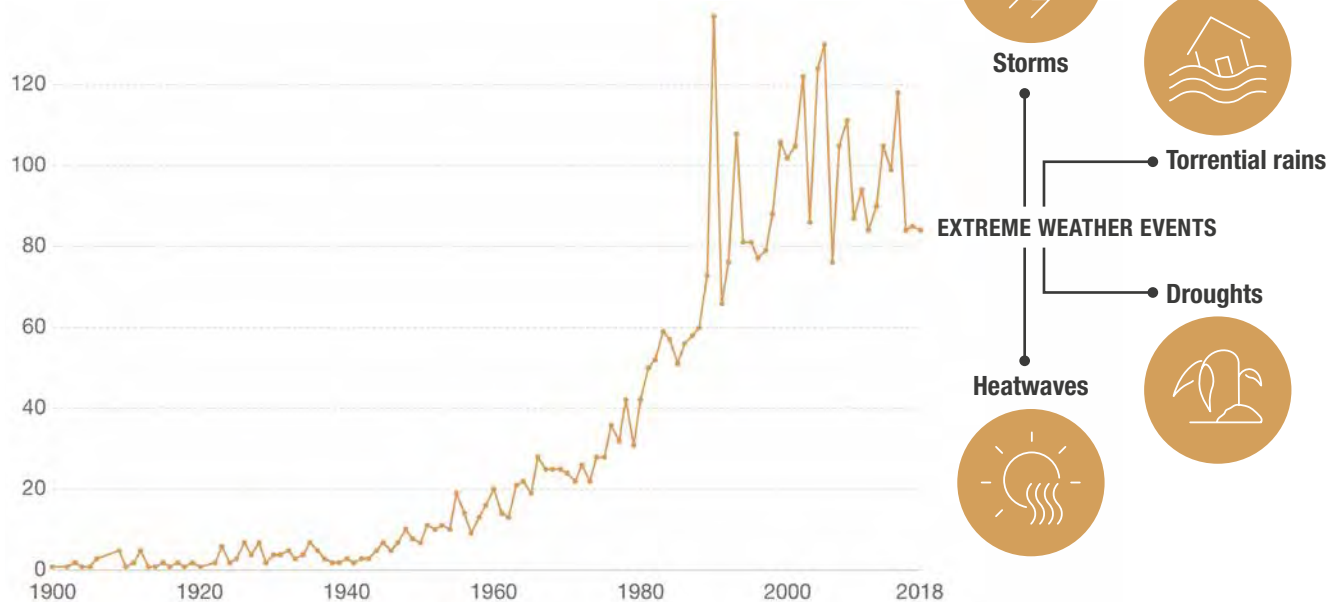
### TORNADO CHASERS

➔ Your mission: As tornado chasers, you wonder if it will still be possible to take pictures of tornadoes, despite climate change. Using the following graph, write a couple of sentences on what extreme weather events are and how their number has changed since 1900.

The following graph shows the change in the number of extreme weather events occurring since 1900. Extreme weather events are those that are out of the ordinary, often because they are more powerful (*e.g.* tornadoes, torrential rains, droughts or heat waves). They can lead to forest fires or floods and cause a lot of damage.



NUMBER OF EXTREME WEATHER EVENTS RECORDED ON THE PLANET



Source: EMDAT (2019): OFDA/CRED International Disaster Database, Université catholique de Louvain, Brussels, Belgium.  
<https://ourworldindata.org/natural-disasters> – CC BY



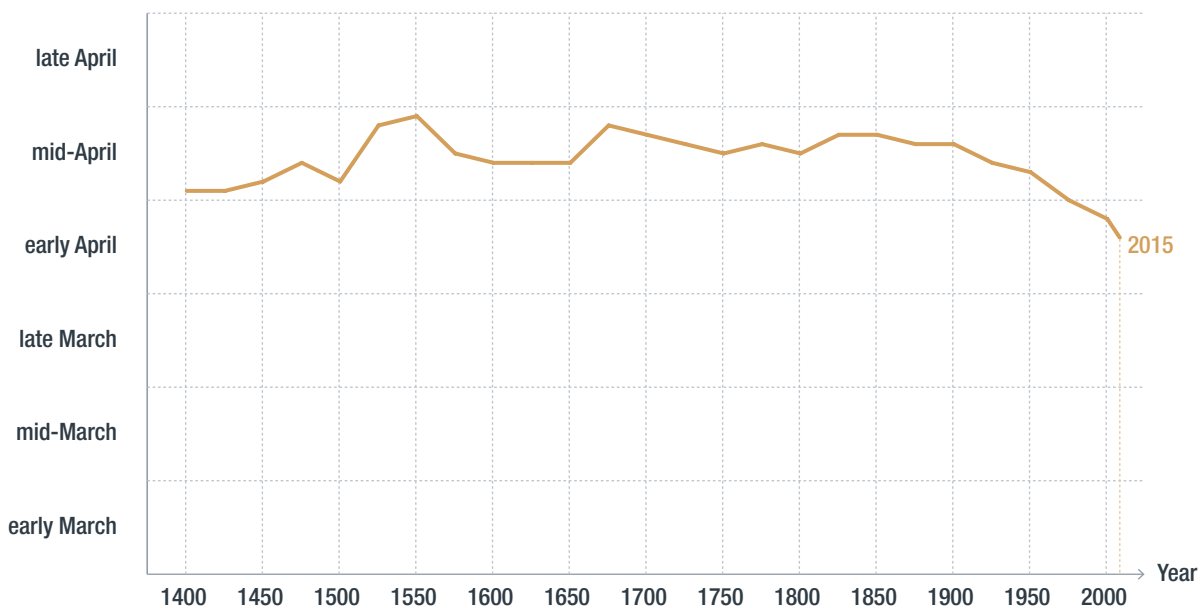
## BOTANISTS

➔ Your mission: As botanists, you wonder how plants will react as the global temperature increases. Using the following graph, write a couple of sentences explaining how the blossoming date has changed over the last 600 years, and how this is related to climate change.

The following graph shows the evolution of the blossoming date of cherry trees in Japan over a period of 600 years. The blooming occurs when temperatures are high enough.



### EVOLUTION OF THE BLOSSOMING DATE



Source: Aono and Kazui, 2008; Aono and Saito, 2010; Aono, 2012; Chikyu Kankyo (Global Environment), 17, 21–29  
<http://atmenv.envi.osakafu-u.ac.jp/aono/kyophenotemp4/>



## FIREFIGHTERS

→ Your mission: As firefighters you are concerned that forest fires may become more frequent with global warming. Using the maps below, write a sentence explaining how the fire season has changed and how it relates to climate change.

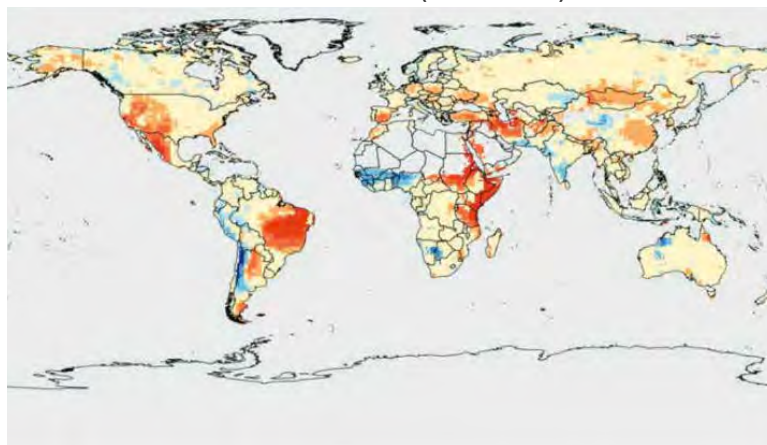
The following maps show the evolution of fires worldwide between 1996 and 2013 compared to 1979-1996. The first one shows the change in the length of the fire weather season, whereas the second shows the change in the frequency of fire events. Wildfires may be caused by humans – willingly or otherwise – but are also more frequent in the case of droughts or heatwaves.



### GLOBAL PATTERNS OF FIRE WEATHER SEASON LENGTH CHANGES FROM 1979 TO 2013

- A. Areas that show modifications in fire weather season length
- B. Regions that have experienced changes in the frequency of long fire weather seasons

A FIRE WEATHER SEASON LENGTH CHANGE (DAY PER YEAR)

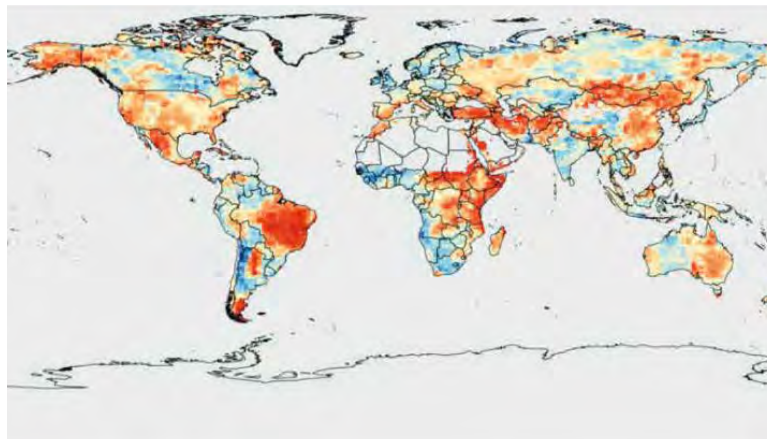


Longer season

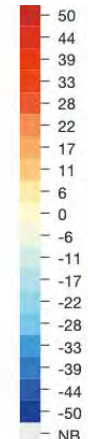


Shorter season

B LONG FIRE WEATHER SEASON EVENT FREQUENCY CHANGE (%)



More frequent



Less frequent

Source: The IPBES assessment report on land degradation and restoration.  
[https://ipbes.net/sites/default/files/2018\\_ldr\\_full\\_report\\_book\\_v4\\_pages.pdf](https://ipbes.net/sites/default/files/2018_ldr_full_report_book_v4_pages.pdf)