



EXTREME WEATHER AND CLIMATE CHANGE

**A flexible
course module
for middle schools.**

Information on the topic

Heat Waves, Storms, Floods: Extreme weather events and climate change

“African summers with temperatures of up to 38 °C”, “Hundreds of thousands die worldwide due to extreme weather”, “Passau experiences a millennium flood”: these were some of the headlines in German newspapers in 2013. Sensational headlines like these get people’s attention. But they can also elicit fear in many school children and students, and raise questions: “Will we have to expect more frequent storms, heat waves and floods? Is this related to climate change? Are we humans to blame? And: Is there anything I can do about it?” These kinds of questions are not easy to answer. Reputable scientists are still studying the causes, the extent and the effects of climate change.

It is clear that climate change will considerably increase the risk of extreme weather events in the future. However, we don’t have to ask “Is this due to climate change?” every time an abnormal weather event takes place. Scientists cannot determine whether current weather events are already due to the impact of global warming. It is impossible to ascribe individual weather events to climate change. To what extent weather extremes are related to global warming is always a matter of probability. Experts like to compare it to a game of loaded dice: a six can be rolled every once in a while; nobody knows when. But now a six is rolled much more frequently, because we humans have changed – loaded – the dice.

The state of climate science

It has been scientifically proven that the Earth’s climate is changing – and that it is human induced. The chief cause of global warming is greenhouse gas emissions, in particular carbon dioxide (CO₂). Levels of carbon dioxide in the atmosphere are higher than they have ever been before. According to the report by the Intergovernmental Panel on Climate Change (IPCC) released in autumn 2013, the average global temperature increased by 0.85 degrees Celsius between 1880 and 2012. And it is not just the temperature in the lower part of the atmosphere that is increasing, even the oceans are getting warmer, glaciers are melting, permafrost soils are warming, and ice sheets are losing mass.

Glaciers are the Earth’s thermometers

Mountain glaciers are particularly good indicators of how much and how fast the Earth’s temperature is rising; they are considered the Earth’s thermometers. Even conservative scientists are surprised by how rapidly these huge masses of ice are melting. Glaciers are very sluggish; temporary weather conditions have less of an effect on them than long-term climate changes. If we look at them as a whole, they make good indicators for long-term temperature trends. In the Alps, glaciers have lost about one third of their surface area and half of their mass since the beginning of the Industrial Revolution in the mid 1800s.

As a result of thawing glaciers and ice sheets and the expansion of warming ocean waters, the average global sea level has risen by about 19 cm in the period between 1901 and 2010.

An insight into methods used for climate research

Climate scientists can use three methods to draw conclusions regarding the link between extreme weather events and climate change: physical principles, statistical analysis and climate models created by computer simulations. Firstly, basic physical principles already suggest that the warming of the atmosphere leads to more extreme weather conditions; for example, warm air can hold more moisture before its saturation point is reached and the humidity is suddenly released as rain. Secondly, statistical time series analysis can be used to identify trends, but the period of time has to be long enough to be able to draw definitive conclusions as natural fluctuation also occurs. And thirdly, detailed computer simulations can confirm the connection between global warming and record temperatures and precipitation. However, the more complicated computer models become and the bigger the computers, the more questions arise regarding the details. And one thing must always be considered: models are just a simulation of reality and never perfect.



Three types of extreme weather events

The scientists on the Intergovernmental Panel on Climate Change warn that the effects of extreme weather and natural disasters as a result of climate change have been vastly underestimated. It is still difficult for these experts to directly attribute individual events to climate change because abnormal weather conditions have always existed; they are a natural phenomenon. However, it is possible to identify a connection between global warming and the increase in extreme weather events. The Intergovernmental Panel on Climate Change Special Report on Extreme Events (IPCC SREX) of 2011 distinguishes between three types of extreme events: an increase in extreme weather and climate events; an increase in damages from weather extremes; and novel extreme events resulting from global warming. There have been recent examples of all three types. Fuelled by greenhouse gas emissions, the forces of nature have been unleashed, lashing out in storms, gale-force winds and torrential rains. Experts also fear that extreme weather conditions could happen in such rapid succession that affected regions would not be able to recover.

According to the Intergovernmental Panel on Climate Change it is virtually certain that there will be more frequent hot and fewer cold temperature extremes. It is very likely that heat waves will occur more often and last longer. Moreover, over most land areas in the middle latitudes and in the tropics

extreme precipitation will become more intense and frequent over the 21st century. Stefan Rahmstorf of the Potsdam Institute for Climate Impact Research also says, "Evidence, including statistical analyses of observed data and climate models indicate that extreme events – particularly heat waves and precipitation – increase greatly in a warmer climate and have already done so."

The Intergovernmental Panel no longer believes that tropical cyclones will increase. However, they predict that the strongest hurricanes could become even stronger. Developing countries will suffer the worst effects of climate change, but Europeans will also have to face more frequent heat waves. In industrialized countries, projected extreme weather events would be felt mostly in terms of high cost – for example, for the reconstruction of infrastructure. In contrast, in developing countries, extreme weather would cost many people their lives.

But there still is hope:

The World Climate Report of 2013 once again emphasized that it is not too late. It is still in our hands. Assuming a very ambitious climate protection scenario, simulations show that temperature increases can be kept below the dangerous threshold of 2 degrees Celsius, thus mitigating the effects of global warming. But if we continue on the present course, we face the threat – even in Germany – of drastic climate change.



Greenpeace is an international environmental organization that uses non-violent action to fight for the protection of the earth's life support base. Greenpeace is non-partisan and completely independent of politics, parties and industry. More than half a million people in Germany donate to Greenpeace, ensuring that we are able to carry out our everyday work in protecting the environment.

Impressum

Published by: Greenpeace e.V., Hongkongstr. 10, 20457 Hamburg, Tel. +49 40 30618-0, mail@greenpeace.de. Responsible for content: Lydia Seiler and Thomas Hohn. Educational consultants, editing and design: neuekoordinaten GmbH & Co. KG, Cover: Heike Grasser, Ex-Press, Greenpeace, Printed by: Reset Grafische Medien GmbH, Virchowstraße 8, 22767 Hamburg, Circulation: 500

Disclaimer: We expressly declare that we have no influence on the design and contents of the of the linked websites, and do not adopt their contents as our own.

Printed on 100 % recycled paper.
As at 12/2016



© Stegfried Libutzki, Greenpeace



The Causes Of Climate Change

➔ **Climate scientists study the causes, the extent and the impact of climate change.** Es It is generally accepted as scientifically proven and well documented by studies that climate change is caused by humans (anthropogenic climate change). Ninety-seven percent of scientists are convinced that climate change is man-made.

The Earth's climate has changed throughout history; this is nothing new. But past climate changes happened very slowly so that animals and plants had enough time to adapt to the new conditions. Today, we are facing very rapid warming. The rise in temperature between 1880 and 2012 was already 0.85 degrees Celsius. Climate scientists now estimate that the average global temperature could increase by 1.5 to 5 degrees Celsius by 2100.

The reason for this is the modern lifestyle in industrialized countries. The burning of coal, gas and oil as well as deforestation and intensive animal farming release huge amounts of greenhouse gases. We exploit natural resources that took hundreds of millions of years to form for our machines, factories, cars, airplanes, computers and mobile phones. We burn large amounts of coal, oil and natural gas, producing carbon dioxide (CO₂), a greenhouse gas. It is released into the atmosphere, intensifying the natural greenhouse effect. Just a few countries, China, the USA, the countries of the European Union and Russia, are responsible for more than half of the emissions released.

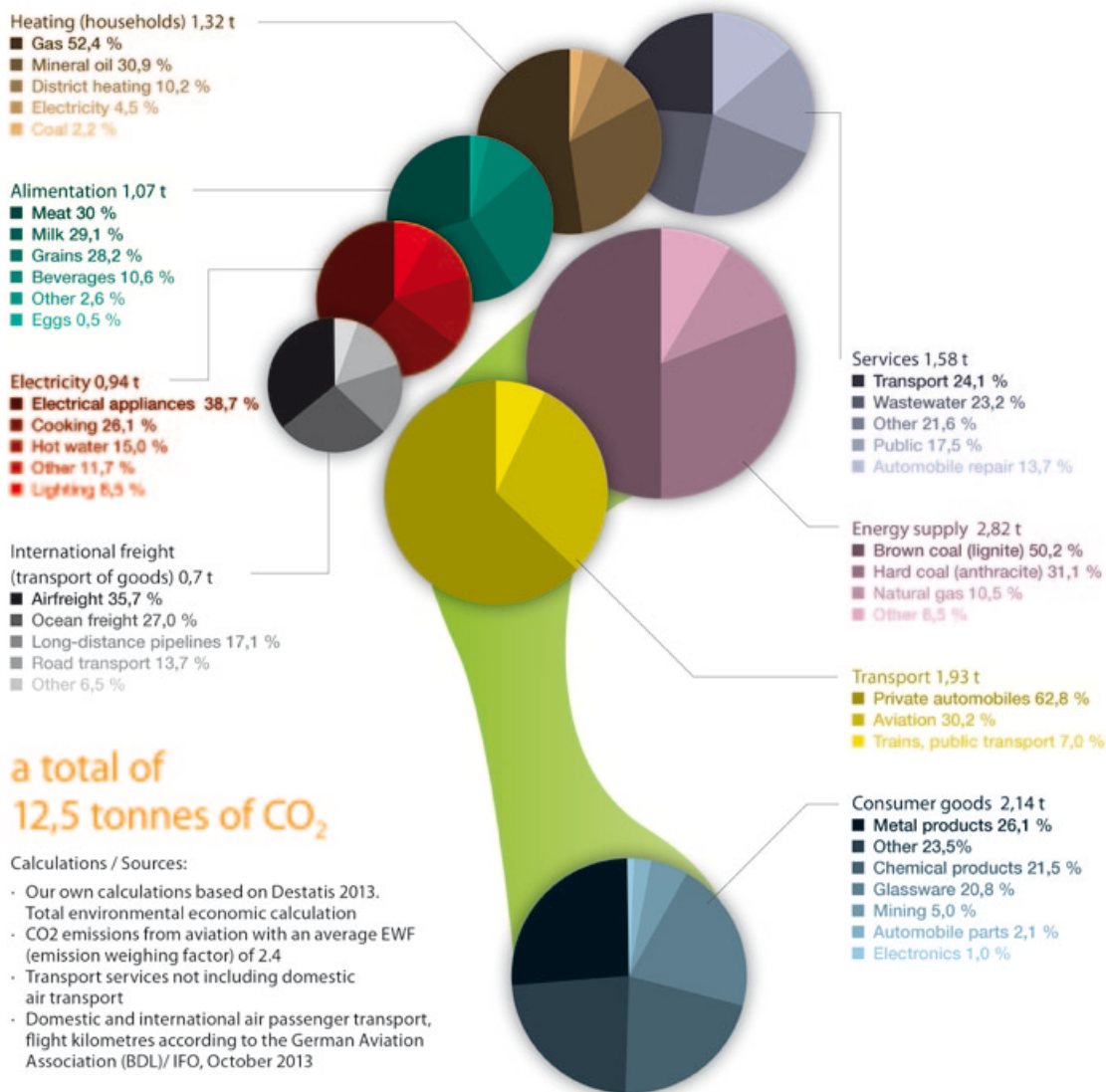
However, our high-energy consumption is not the only problem. Modern industrial agriculture with intensive animal farming and the extensive use of chemical fertilizers also impact our climate. The clearing of old-growth forests is destroying our natural CO₂ sinks. Moreover, our so highly prized mobility is another contributing factor. In Europe 20 percent of CO₂ emissions are caused by transport.



© Marizilda Cruppe, EVE, Greenpeace

**EXTREME
WEATHER
AND CLIMATE
CHANGE**

The Causes Of Climate Change



Graph © Greenpeace e.V.

Tasks:

- Describe since when and why the concentration of greenhouse gases in the atmosphere has increased.
- Explain why climate change is anthropogenic rather than natural. Provide figures to back up your explanation.

- Explain the concept of the carbon footprint using the chart above. Which areas do you think offer the most potential for cutting back on CO₂ emissions?

- Class discussion moderated by a teacher. If you think of what you've done today: how have you already released CO₂? (at home, eating, on your way to school, at school). Can you think of any climate-friendly alternatives?

Find out more:

Background information on a person's average carbon footprint in Germany:

www.greenpeace.de/co2fussabdruck

Do more:

Calculate your own CO₂ footprint (the greenhouse balance of your consumption) and find out more about how you can shrink your carbon footprint.

http://uba.klimaktiv-co2-rechner.de/de_DE/popup/

Dunkeltheater: Find products at supermarkets that have a particularly large carbon footprint (long transport routes and storage, highly processed and overly packaged, meat and dairy products in general). Then in the supermarket (in pairs with previously assigned roles), start an argument with your partner about whether or not you should buy a particular product. Make yourselves heard and attract attention, so that, ideally, other customers join in the discussion. The goal is to inform as many people as possible about climate-damaging consumption habits and, as a first step, to encourage them to give the issue some thought.

EXTREME WEATHER AND CLIMATE CHANGE

Information on the Process

Introducing the topic

Climate Witnesses (Lesson 1)

Learning goal: Students will understand and feel that climate change is already the cause of major problems in many places today.

There are eight sets of cards and each set consists of three cards: a portrait of a climate witness, a description of the climate event and a photo of the event; the sets tell the personal story of eight persons from various parts of the world. There are two cards for each type of weather event (cyclone, drought, rise in sea level and floods). The students will reproduce these events.

The cards are mixed and laid out on a table that can be accessed from all sides.

Task: "Take your time and look at the cards, read them all. Then, in groups of two or three, find three cards that belong together."

While the students are busy with the cards, the teacher has time to draw the basic mind map (Figure 1, Mind Map, red areas) on the board leaving the bubbles blank. The map will then be ready for use with the short follow-up presentations.

Task: "Now report to the class on the climate event described in your cards. What happened to whom, and where? What did this event mean for the person concerned?"

Once all sets have been found, the students summarize each set and give a brief presentation to the class. If there is not enough time to talk about all the climate witnesses, only one should be chosen for each type of weather event. Good choices would be, for example, Greenland, India, Hallig Langeneß, the Amazon, and the American Gulf Coast/ New Orleans.

The most important information is entered into the mind map on the board (Figure 1, Mind Map, black areas). The students copy the mind map on the board in their notebooks.

Important: As the class will continue working on the mind map during the entire process, please note that a double page will be needed.

At this stage it is important that the students become aware of and feel how existentially important the issue of climate change has already become in many parts of the world.

The exact contexts are not yet important. At this point the following question can be brought up: To what extent does prosperity protect against the consequences of climate change? The cards include climate witnesses from both poor and richer countries.

Laying the Groundwork: Climate change – Causes and Consequences (Lesson 2)

Learning goal:

Work sheet 1 – Causes:

Students understand how industry, combustion engines and meat consumption are related to CO₂ emissions and global warming.

Work sheet 2 – Glacier melt and rising sea level:

To help students understand the connection between green house effect, global warming, glacier melt, rising sea level, flooding of coastal regions and destruction of habitable land.

Worksheet 2 is now handed out to the class and the students work on it (silent work). Task: Which word belongs at the centre of the mind map? Tasks 1 and 2 on the back of the worksheet lend themselves to the follow-up class discussion.



Worksheet 1 is handed out as homework. Task: "Fill in the causes of climate change on the mind map." (Figure 1, Mind Map, green areas). Students are asked to provide written answers for questions 1 and 2.

Consolidation: Extreme weather and climate change (Lessons 3 and 4)

Learning goals

Work sheet 3 – The impact of human activity on our climate: The students understand that climate scientists study climate and not weather. They are familiar with the most important conclusions of the IPCC report of 2013 (IPCC = Intergovernmental Panel on Climate Change).

Work sheet 4 – Floods:

The students know the causes and extent of European river flooding and the various precautionary measures.

Work sheet 5 – Heat waves:

The students understand that hot weather and drought adversely affect crop yields, leading to an increase in the food prices. Sub-Saharan regions are particularly affected by this development, resulting in dramatic famines.

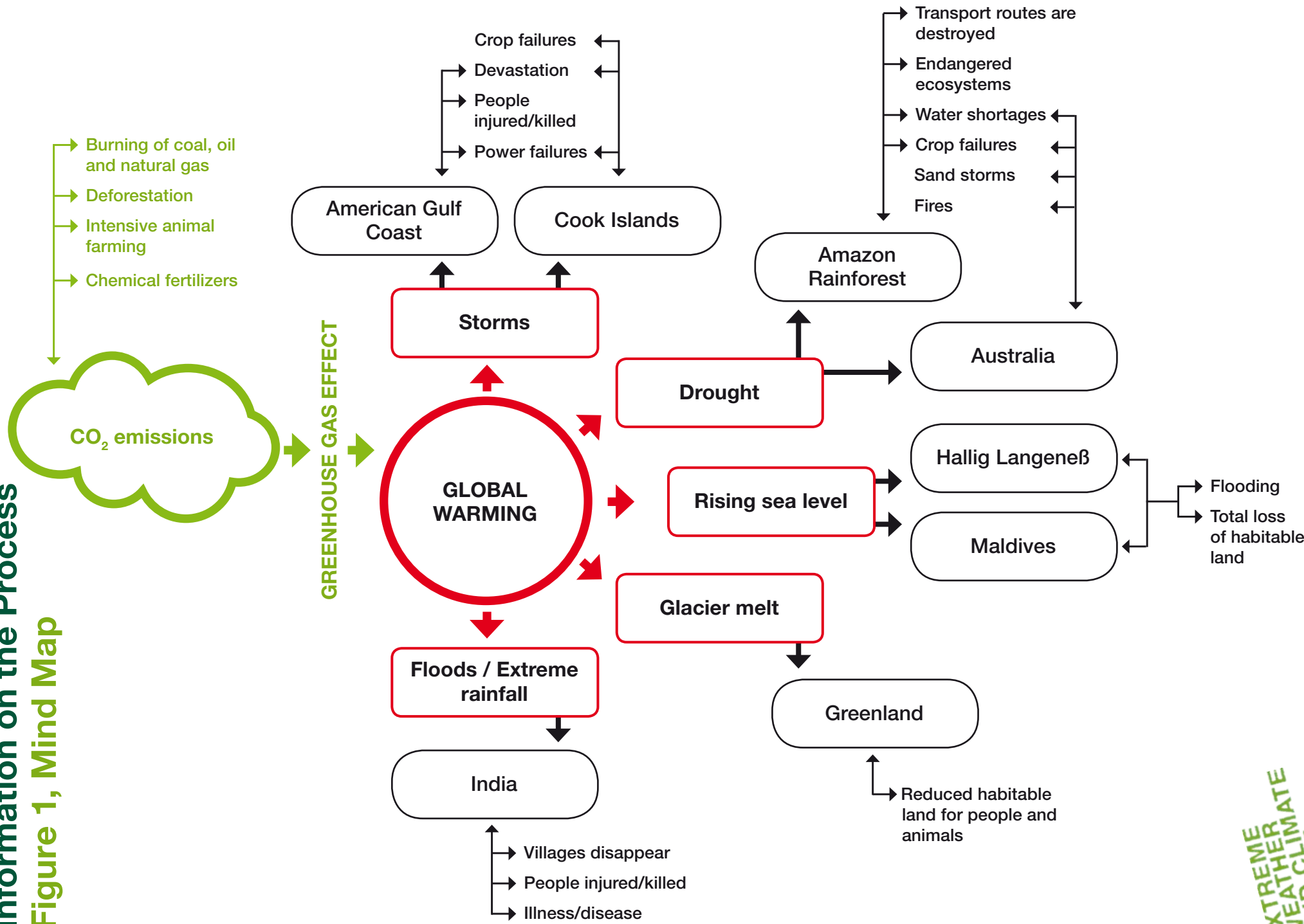
Work sheet 6 – Severe storms:

The students understand how cyclones form. They get an idea of how strong and destructive cyclones are. They gain insight into the controversial connection between severe storms and climate change.


**EXTREME
WEATHER
AND CLIMATE
CHANGE**

Information on the Process

Figure 1, Mind Map



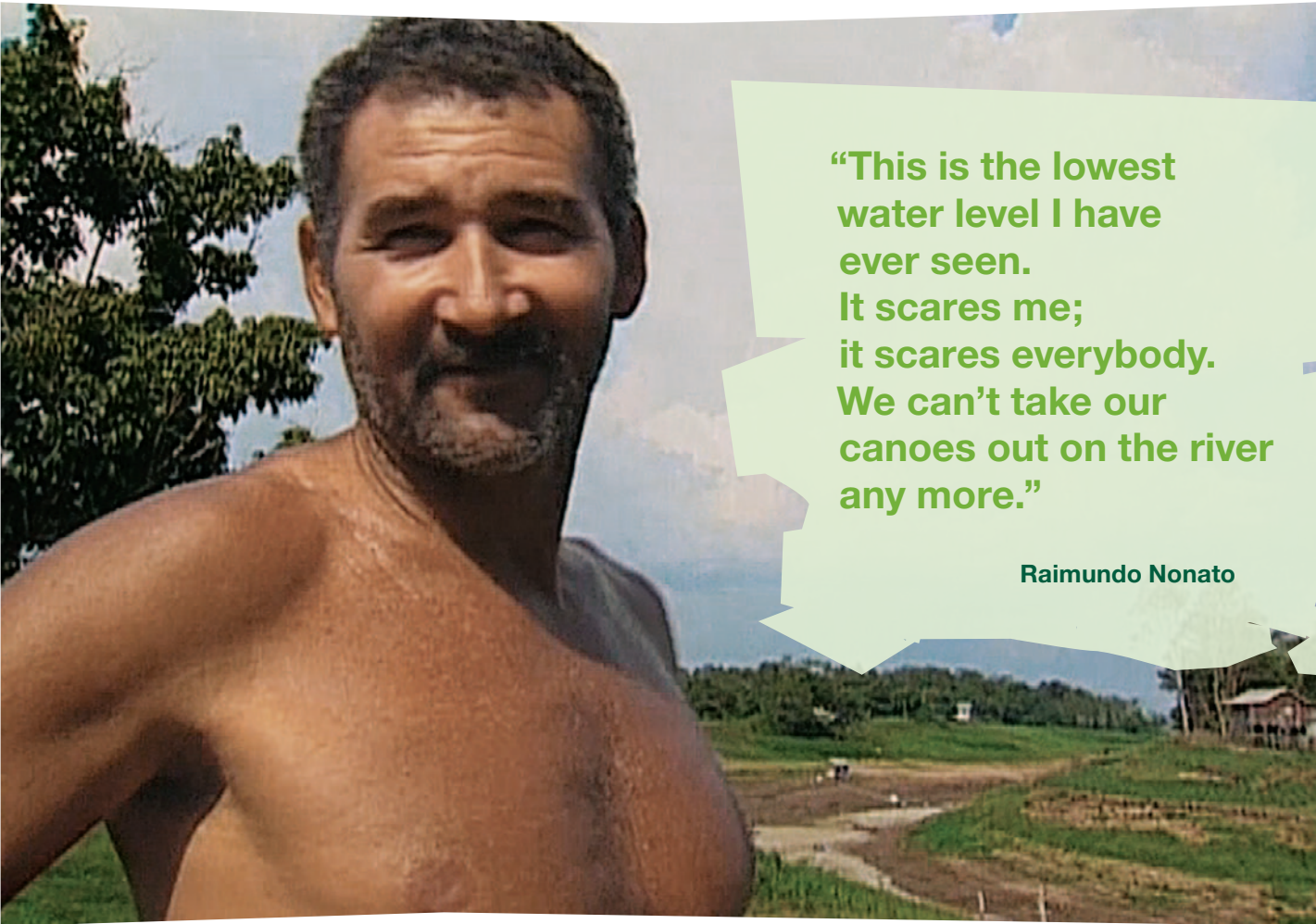
**EXTREME
WEATHER
AND CLIMATE
CHANGE**



“We are the last generation that can solve the climate crisis; not only for our own sake, but for the sake of our children and grandchildren. They should be able to enjoy Australia as we know it today, and the beautiful city of Sydney too.”

Amanda McKenzie


© Greenpeace



“This is the lowest water level I have ever seen. It scares me; it scares everybody. We can’t take our canoes out on the river any more.”

Raimundo Nonato


© Greenpeace

A close-up portrait of Sharon Hanshaw, a woman with long, straight, reddish-brown hair. She is wearing a dark top and several necklaces, including a prominent white cross necklace. Her expression is thoughtful as she looks slightly to the side.

**“Can you imagine?
You go back to a place you
used to really know well
and everything’s gone?
All the plants...
the landscape,
all gone, the houses
all blown away!”**

Sharon Hanshaw

© Greenpeace

A close-up portrait of Tuakan Neiao, an elderly woman with short, curly, grey hair. She is wearing a light blue top and has a gentle, slightly sad expression. The background is blurred, showing green foliage.

**“We don’t want to put up
with this weather for a
moment longer. I don’t
want my children to have
to move away from this
island. I love this island.
I live here. I like it here
because of the
community; we pray
and eat together
like a family.”**

Tuakan Neiao

© Greenpeace



Südwestaustralien, © Dean Sewell, Oculi, Agence VU, Greenpeace



Amazonas, Brasilien, © Ana Claudia Jatthy, Greenpeace



New Orleans, USA, © Christian Aslund, Greenpeace



Cookinseln, Pazifik, © Greenpeace



Langeneß, Deutschland, © Greenpeace



Sunderbans, Indien, © Peter Catton, Greenpeace



Kangerlussuaq, Ostgrönland, © Maarten van Rouw, Greenpeace



Malediven, Indischer Ozean, © Daniel Beltrá, Greenpeace