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Climate For Schools

Teaching resource packs from the Climate Change Initiative

>> HOME >>

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The classroom resources developed under the ESA Climate Change Initiative (CCI) aim to raise students' awareness of climate change and show its impacts around the world.

Ten resource packs tailored to the curricula for primary and secondary education in Europe are freely available from 2021, in five European languages.

The educational resources presented hereafter cover climate topics that the Climate Change Initiative has identified based on analysis of Science, Technology, Engineering and Mathematics topics in eleven educational systems in Europe:

Primary classroom resources

- Country under threat – The role of global warming in sea level rise and flooding of coastal cities and small islands
- Is ozone good or bad? The role of human pollution in destroying the ozone layer.
- The water cycle – The effect of global warming on flood and drought

Lower secondary education

- A passage opens – The threat of melting sea-ice due to global warming
- The carbon cycle – How increased emission of carbon dioxide is affecting forests, oceans and our lives
- Taking the pulse of the planet – How satellite data helps our understanding climate change

Upper secondary education

- Taking the pulse of the planet – How satellite data helps our understanding climate change
- Urban hotspot – How urban areas are increasing the frequency of heat waves
- Biodiversity and habitat loss – How climate change is causing biodiversity and habitat loss
- Planetary heat pumps – How global warming is modulating the role of oceans as heat regulator
- Feeding the growing world – How climate change is threatening food security and crop production

climate change initiative education resource packs for primary and secondary education
https://climate.esa.int/educate/

Promotion resources developed by University of Twente (NL)

The ESA Climate Office welcomes feedback and comments:
https://climate.esa.int/helpdesk/

Produced by the ESA Climate office

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Primary School

Country under Threat

Is Ozone good or bad?

Water cycle

Teaching resource packs from the Climate Change Initiative

>> HOME >>

Teaching Kit

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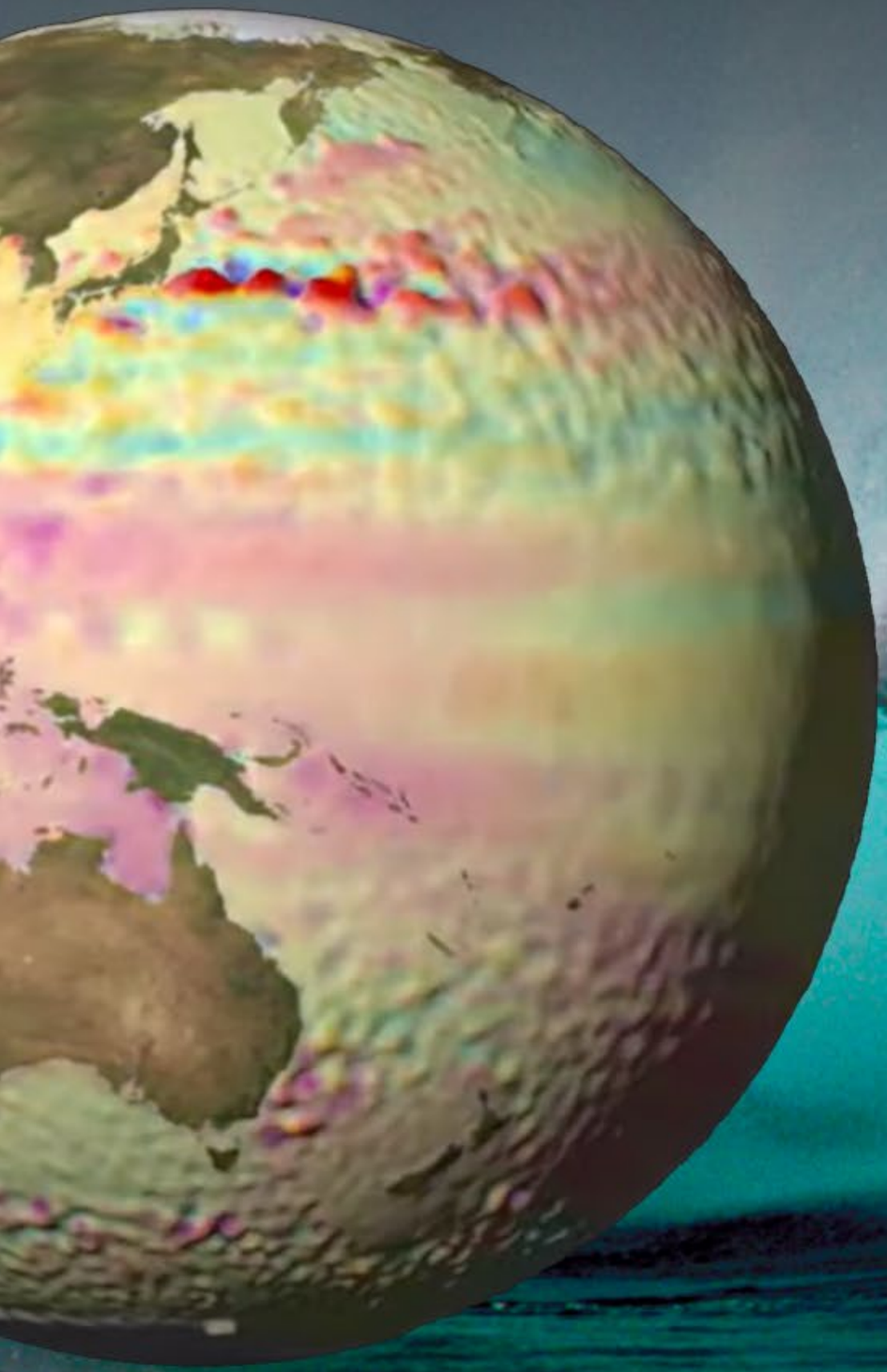
COUNTRY UNDER THREAT

The prospects for life on small islands

Mean sea level is rising across the globe, threatening coastal communities everywhere and the very existence of multiple island nations such as Kiribati or the Maldives.

Global warming is causing polar ice sheets and glaciers to melt, adding more water to the oceans. Warming water also expands, causing the height of the sea's surface to rise. The combination of high tides, sea level rise and storm waves endanger the survival of islands and entire archipelagos all around the world.



Sea Level Anomaly

Learning outcome

In this set of activities, students will learn about the causes and potential impacts of sea-level rise while developing core scientific skills.

Content of the pack

This pack consists of 4 ready-to-use educational activities containing pre-defined learning outcomes, background information and step-by-step implementation guide for teachers, worksheets for students and links to interesting complementary online resources on the topic.

The **first** activity introduces the context by considering the potential future of Kiribati and is linked to an exercise to develop instructional writing skills. The **second** is a practical activity, to explore two of the main contributors to sea-level rise and discuss how models are used in science. In the **final** activity, pupils use real satellite data to explore sea surface temperature, changes in average sea level and the relationship between them.

Quick facts

Topic	Value
Subject(s)	Geography, Science, Earth Science
Level	Primary
Age range	8 – 11 years
Language	English
Type	Reading and practical activities
Format	PDF
Lesson time	2.5 - 4 hours
Location	Indoors
Resources	Ice, water, various containers, food colouring, standard software, internet

Quick overview of the course and content

https://climate.esa.int/educate/

Teaching Kit

The education resource pack: cover; overview; theory; activity; worksheets.

>> HOME >>

Teaching Kit

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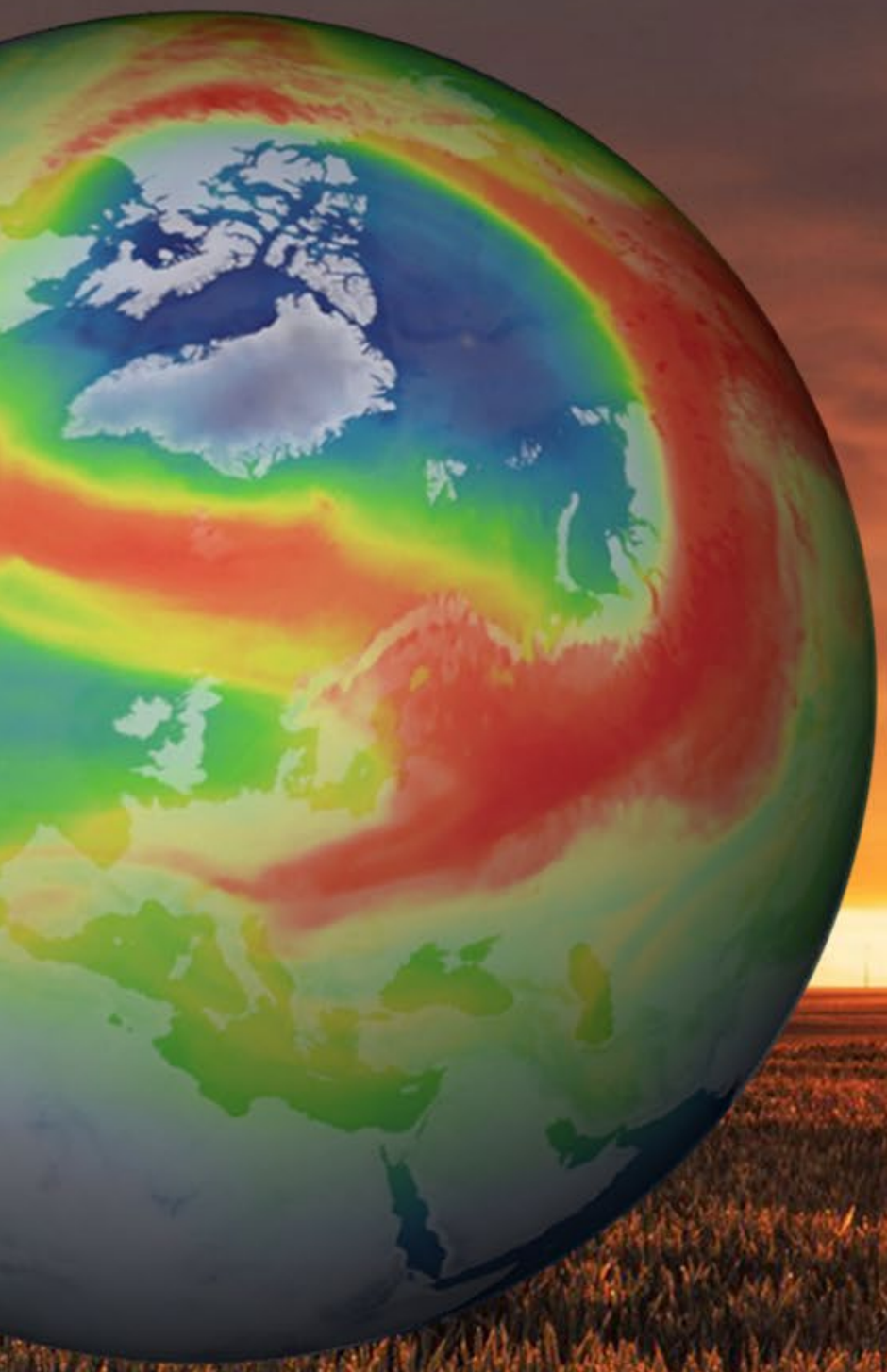
IS OZONE GOOD OR BAD?

The discovery of the Antarctic ozone hole.



The Ozone hole

The layer of ozone high up in the stratosphere is our main defense against the Sun's ultraviolet radiation. Because it absorbs solar radiation, ozone is also a powerful greenhouse gas.

While ozone loss in the stratosphere has been a mayor concern, its presence has been increasing at ground level. Here, ozone associated with transport and industrial pollution is a hazard to human health.

Learning outcome

In this set of activities, students will learn about ozone and the impacts – good and bad – it has on life on Earth.

Content of the pack

This pack consists of 3 ready-to-use educational activities containing pre-defined learning outcomes, background information and step-by-step implementation guide for teachers, worksheets for students and links to interesting complementary online resources on the topic.

The **first** activity gives an overview of these effects, outlines how ozone is measured and introduces the story of the Antarctic ozone hole. The **second** is a practical activity to investigate the effectiveness of sunscreen.
In the **final** activity, students use real satellite data to explore how ozone concentration has varied across the world over the last couple of decades.

Quick facts

Topic	Value
Subject	Geography, science, Earth science
Level	Primary
Age range	8 – 12 years
Language	English
Type	Reading, practical activities
Format	PDF
Lesson time	3 hours
Location	Indoors/outdoors
Resources	Sunscreen, UV beads, Internet access

Quick overview of the course and content

Teaching Kit

The education resource pack: cover; overview; theory; worksheets.

https://climate.esa.int/educate/

>> HOME >>

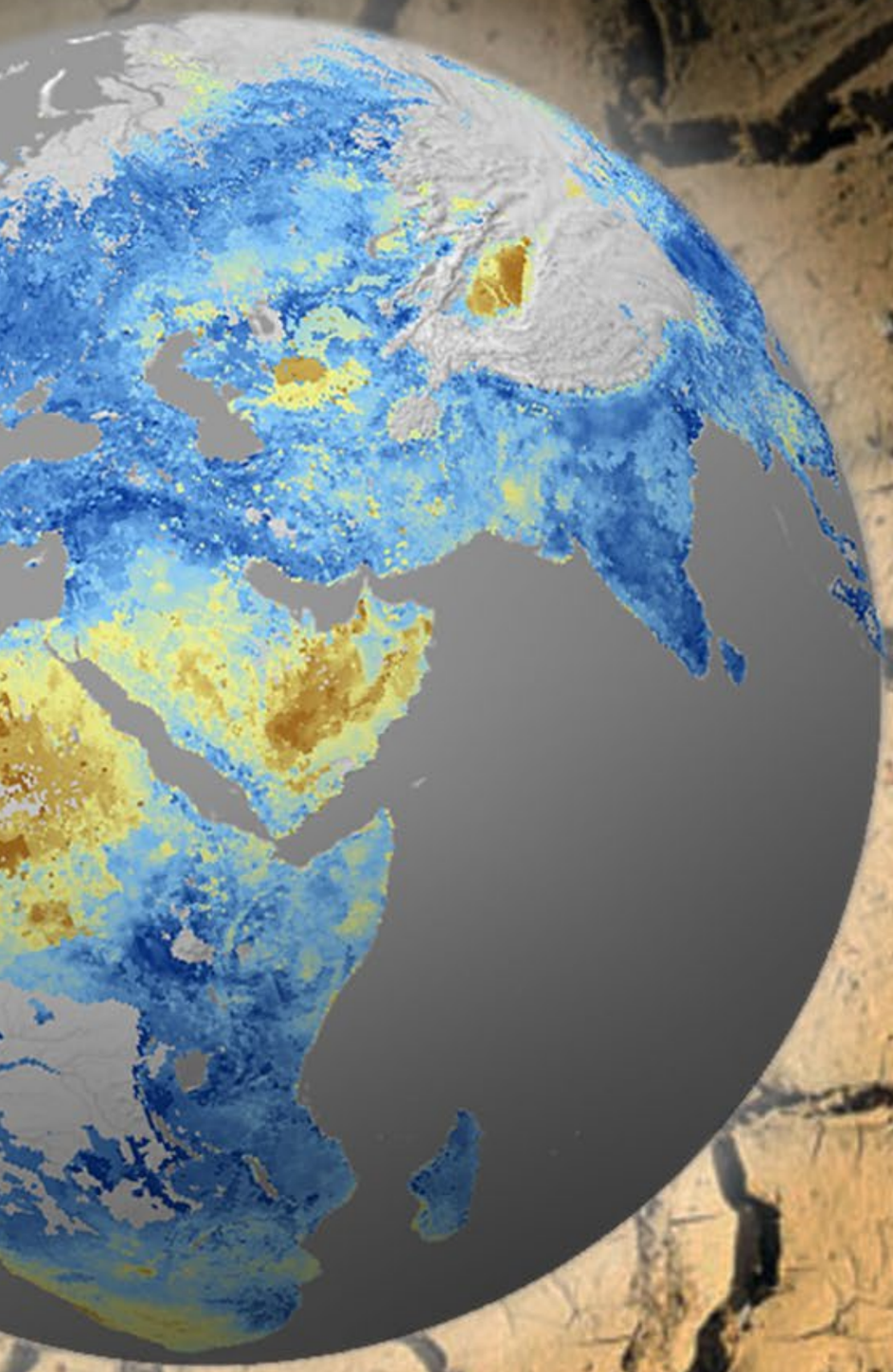
Teaching Kit

esa climate change initiative

THE WATER CYCLE

The water cycle is affects and is affected by the climate in complex ways that vary from place to place around the world.

The water cycle is crucial to sustaining life on Earth. We all depend on the freshwater that cycles through it for hygiene and industry as well as for drinking and growing our food. The effect of global warming on the water cycle involves subtle variations in complex interactions between its different components and it does not always turn out to be what it appears at first.



Spoil moisture

Learning outcome

In this set of activities, students will learn about the water cycle and the impact of climate change on it, focusing in particular, on how water in the soil contributes to the cycle and responds to changes in it.

Content of the pack

This pack consists of 6 ready-to use educational activities containing pre-defined learning outcomes, background information and step-by-step implementation guide for teachers, worksheets for students and links to interesting complementary online resources on the topic.

The **first** activity uses the story of a snowflake to illustrate the watercycle. **Next**, a set of practical activities allow students to look more closely at the processes of evaporation and condensation from free water and water in the soil. **Lastly**, students use real satellite data to explore changes in soil moisture across the world over recent years.

Quick facts

Topic	Value
Subject(s)	Geography, science, Earth Science
Level	Primary
Age range	8 – 11 years
Language	English
Type	Reading and practical activities
Format	PDF
Lesson time	6 hours
Location	Indoors, outdoors
Resources	Soil, water various containers, measuring cylinders, food colouring, standard software, internet access

Quick overview of the course and content

https://climate.esa.int/educate/

Teaching Kit

The education resource pack: cover; overview; theory; activity; worksheets.

>> HOME >>

Climate For Schools

esa climate change initiative

Lower secondary

A Passage Opens

Taking the Pulse of the Planet

Teaching resource packs from the Climate Change Initiative

>> HOME >>

Teaching Kit

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A PASSAGE OPENS

Artic sea ice and climate change.

The polar regions are among the most sensitive to variations in global climate, with the Arctic in particular experiencing rapid change on both sea and land.

The Northwest Passage between mainland Canada and its Arctic islands has been promising for decades as a shorter sea route between Europe and Asia. Yet it has proven to be an impenetrable obstacle, trapped in a frozen sea most of the time. The loss of Arctic sea ice as a result of global warming may however enable shipping to use this route more regularly. But the freeing of the Passage is a worrying signal of changes that affect not only the Arctic region but the climate system of the entire Earth.

Arctic ice

Learning outcome

In this set of activities, students will discover the important role Arctic sea ice plays in the Earth's climate system working in the context of the Northwest Passage.

Content of the pack

This pack consists of 3 ready-to-use educational activities containing pre-defined learning outcomes, background information and step-by-step implementation guide for teachers, worksheets for students and links to interesting complementary online resources on the topic.

The **first** activity is a mathematical investigation into sea ice melt rate to illustrate what is meant by Arctic amplification. In the **second** one, students use the Climate from Space data viewer to explore seasonal and long-term trends in sea ice extent and sea surface temperatures. The **final** activity uses real satellite data to examine ice trends and climate variability in more detail.

Quick facts

Topic	Value
Subject	Geography, science, Earth science, Physics, Chemistry
Level	Secondary
Age range	11 – 14 years
Language	English
Type	Reading, mathematical modelling, data analysis, discussion
Format	PDF
Lesson time	3 hours
Location	Indoors
Resources	Internet access, spreadsheet software

Quick overview of the course and content

https://climate.esa.int/educate/

Teaching Kit

The education resource pack: cover; overview; theory; activity; worksheets.

>> HOME >>

Teaching Kit

esa climate change initiative

TAKING THE PULSE OF THE PLANET

Satellites offer a unique global perspective on the Earth's climate. From them, we now have over three decades of observations describing some of the most important climate variables.

Nowadays, Earth observation satellites take daily images that reveal a wealth of detail about our changing planet. They have become an essential tool to monitor climate at different scales, providing useful information for both setting up climate models and checking their accuracy.

Learning outcome

In this set of activities, students will learn how data is collected by satellite sensors and how it is used to better comprehend and monitor climate on planet Earth.

Content of the pack

This pack consists of 3 ready-to-use educational activities containing pre-defined learning outcomes, background information and step-by-step implementation guide for teachers, worksheets for students and links to interesting complementary online resources on the topic.

First, a text-based activity introduces the concept of remote sensing and looks at how sensors and satellites in different orbits can be matched. This is **followed** by mathematical work exploring factors affecting the amount of detail visible in a satellite image. **Lastly**, students use the Climate from Space web application to explore a range of climate variables during El Niño and La Niña events.

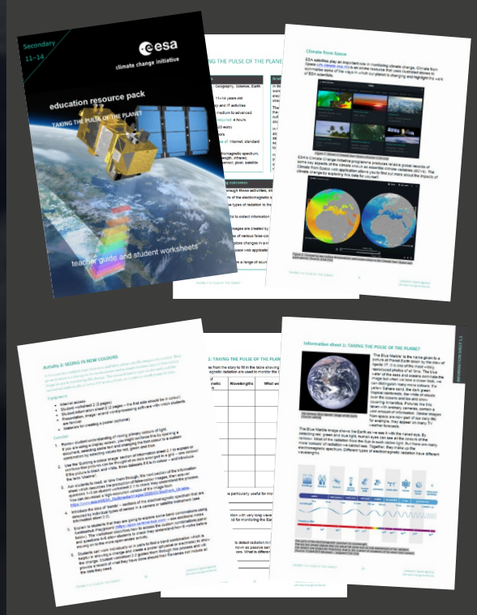
Quick facts

Topic	Value
Subject(s)	Geography, Science, Earth Science
Level	Secondary
Age range	11 – 14 years
Language	English
Type	Literacy and IT activities
Format	PDF
Lesson time	4 hours
Location	Indoors
Resources	Internet, standard software

Quick overview of the course and content

https://climate.esa.int/educate/

Teaching Kit



The education resource pack: cover; overview; theory; activity; worksheets.

Carbon Dioxide Air-Sea Flux

>> HOME >>

Climate For Schools

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Upper secondary

Biodiversity and Habitat Loss

Planetary Heat Pumps

Taking the Pulse of the Planet

The Carbon Cycle

Urban Hotspots

Teaching Kit

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BIODIVERSITY AN HABITAT LOSS

Home to a vast variety of life, the Earth's biosphere is undergoing rapid changes that have an impact on the natural cycles that control climate, as well as more immediate effects on human activities.

We share our planet with millions of other living species. Scientists refer to this variety of life as biodiversity. Global warming, wildfires, deforestation and other human activities, trigger dramatic changes in natural habitats, challenging the adaptation and survival of many of its inhabitants.

Mapping Landcover

Learning outcome

In this set of activities, students will learn about biodiversity and habitat and the grave consequences of human-induced changes on them.

Content of the pack

This pack consists of 3 ready-to-use educational activities containing pre-defined learning outcomes, background information and step-by-step implementation guide for teachers, worksheets for students and links to interesting complementary online resources on the topic.

The **first** activity is a reading assignment that introduces vocabulary and ideas that are key to understand the relationship between climate change and ecosystems. The **second** activity is a field survey to calculate a measure of biodiversity. In the **final** activity, students use the Climate from Space web application to explore how habitats change, leading to potential variations in the population of their species.

Quick facts

Topic	Value
Subject(s)	Geography, science, Earth Science, Biology, Ecology
Level	Secondary
Age range	14 – 16 years
Language	English
Type	Reading, fieldwork, online research
Format	PDF
Lesson time	4 hours
Location	Indoors, outdoors
Resources	Internet, presentation and spreadsheet software, simple surveying equipment

Quick overview of the course and content

https://climate.esa.int/educate/

Teaching Kit

The education resource pack: cover; overview; theory; activity; worksheets.

>> HOME >>

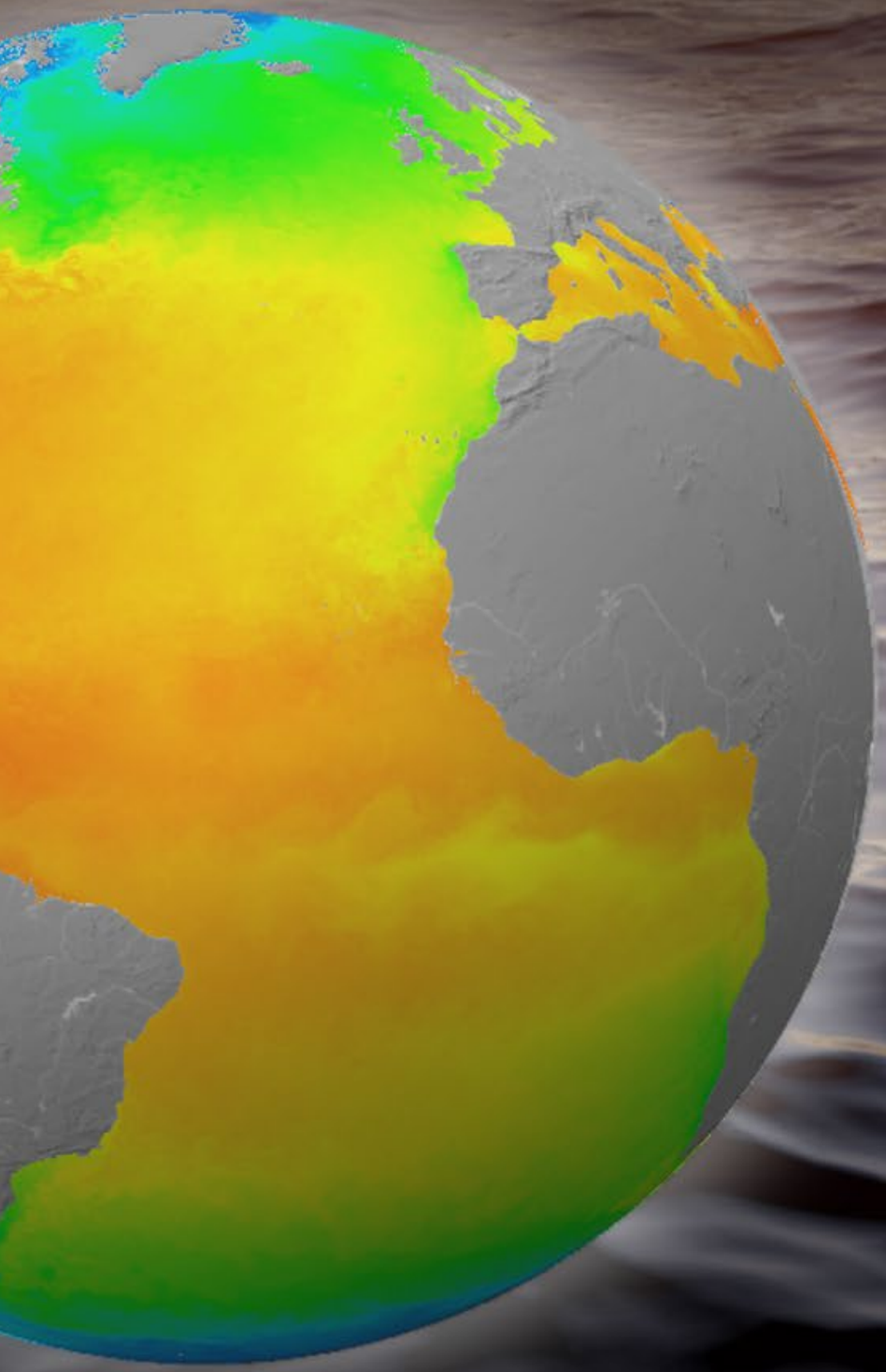
Teaching Kit

climate change initiative

PLANETARY HEAT PUMPS

The ocean and the atmosphere both redistribute energy around the planet. While the atmosphere brings us our weather, oceans are a more stable indicator of climate trends due to their capacity to store heat.

The sea is incredibly good at storing heat. So good, that just the top three meters of the ocean contain as much heat as the entire atmosphere. The ocean's ability to accumulate, transport and slowly release the energy it receives from the Sun is one of the key regulators of weather and climate on our planet.



Sea Surfce Temperature

Learning outcome

In this set of activities, students learn about ocean circulation and its impact on climate.

Content of the pack

This pack consists of 3 ready-to-use educational activities containing pre-defined learning outcomes, background information and step-by-step implementation guide for teachers, worksheets for students and links to interesting complementary online resources on the topic.

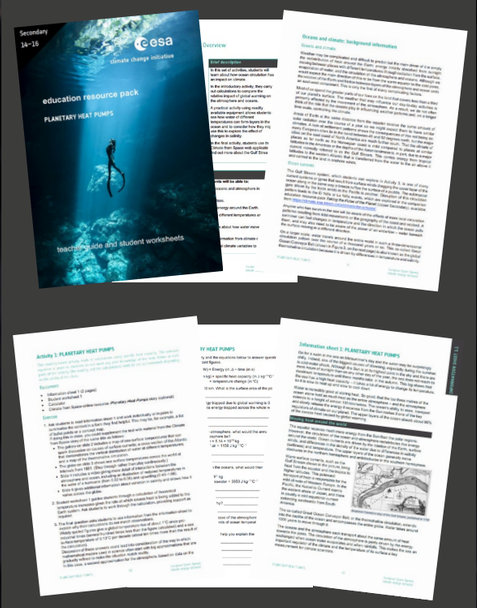
First, students carry out calculations to compare the relative impact of global warming on the atmosphere and oceans. **Then**, they use a model to examine the movement of water at different temperatures. In the **final** activity, students use the Climate from Space web application to find out more about the Gulf Stream.

Quick facts

Topic	Value
Subject(s)	Geography, Science, Earth Science
Level	Secondary
Age range	14 – 16 years
Language	English
Type	Reading, mathematical, investigation, online research
Format	PDF
Lesson time	4 hours
Location	Indoors
Resources	Internet, calculator, spreadsheet software, ice and coloured water

Quick overview of the course and content

Teaching Kit



The education resource pack: cover; overview; theory; activity; worksheets.

https://climate.esa.int/educate/

>> HOME >>

Teaching Kit

esa climate change initiative

TAKING THE PULSE OF THE PLANET

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Nowadays, Earth observation satellites take daily images that reveal a wealth of detail about our changing planet. They have become an essential tool to monitor climate at different scales, providing useful information for both setting up climate models and checking their accuracy.

Learning outcome

In this set of activities, students will learn how electromagnetic radiation is used in remote sensing to detect changes on planet Earth.

Content of the pack

This pack consists of 3 ready-to-use educational activities containing pre-defined learning outcomes, background information and step-by-step implementation guide for teachers, worksheets for students and links to interesting complementary online resources on the topic.

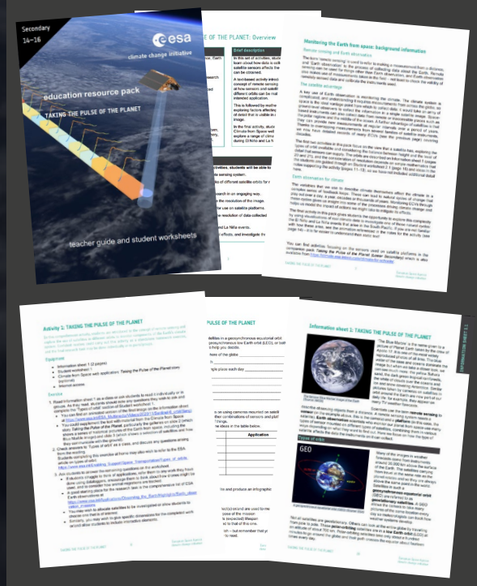
The **first** activity reviews the regions of the electromagnetic spectrum and outlines how they are used in Earth observation. **Next**, students learn about false-colour images and use satellite data to explore a changing region. **Finally**, students combine this technique with climate data from other satellites to produce a report on a major flood or drought.

Quick facts

Topic	Value
Subject(s)	Geography, Science, Earth Science
Level	Secondary
Age range	14 – 16 years
Language	English
Type	Mathematical, IT and research activities
Format	PDF
Lesson time	4 hours
Location	Indoors
Resources	Internet, smartphone/ camera, calculator

Quick overview of the course and content

Teaching Kit



The education resource pack: cover; overview; theory; activity; worksheets.

https://climate.esa.int/educate/

Building the Global Glorophyll map

>> HOME >>

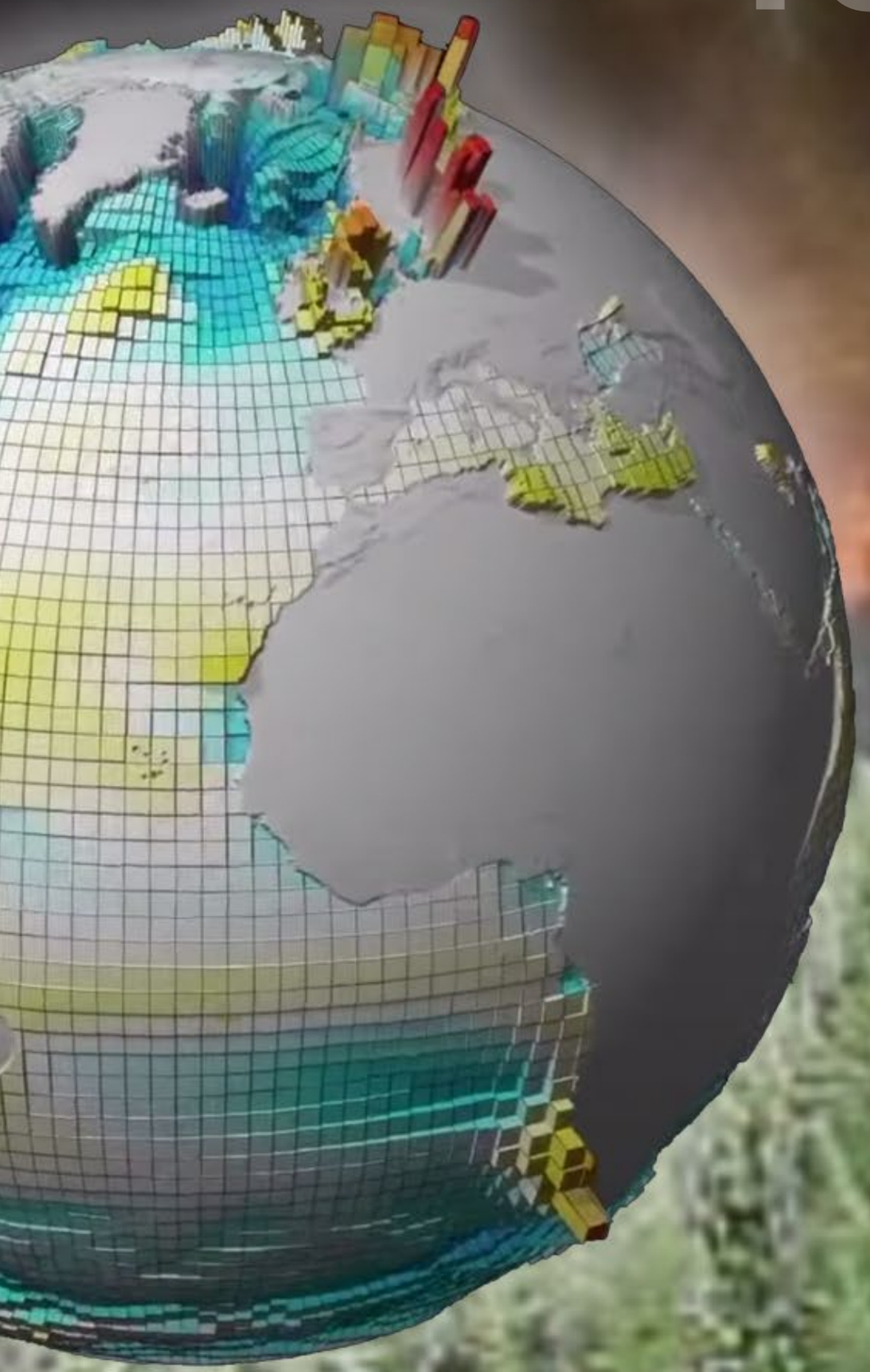
Teaching Kit

esa climate change initiative

THE CARBON CYCLE

The key to controlling climate change is understanding and managing the carbon cycle – increasing the amount of carbon stored in sinks, and cutting down emissions.

Carbon compounds are essential to life. As part of the way planet Earth works as a system, carbon is continuously cycling between the ocean, the land and the atmosphere. This involves a range of different processes, some of which can be observed by satellites. Human activity is disturbing these natural processes and causing a rise in atmospheric carbon dioxide, contributing to global warming and the greenhouse effect.



Carbon Dioxide Ocean Flux

Learning outcome

In this set of activities, students will learn about the carbon cycle and use it to identify actions at the individual and community level to reduce the amount of carbon being emitted to the atmosphere.

Content of the pack

This pack consists of 3 ready-to-use educational activities containing pre-defined learning outcomes, background information and step-by-step implementation guide for teachers, worksheets for students and links to interesting complementary online resources on the topic.

First, an active reading assignment introduce students to the carbon cycle, how human activities are disrupting it, and how this can be mitigated. **Then**, a practical activity considers the impact of ocean acidification. To **finalise**, students use in the Climate from Space web application to investigate a question about one part of the carbon cycle.

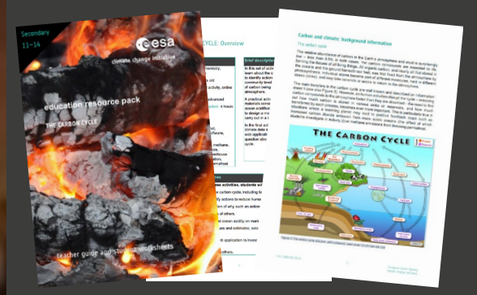
Quick facts

Topic	Value
Subject(s)	Science, Chemistry,Biology, Earth Science
Level	Secondary
Age range	11 – 14 years
Language	English
Type	Reading, practical activity, online research
Format	PDF
Lesson time	4 hours
Location	Indoors
Resources	Internet, presentation and image software, household acids

Quick overview of the course and content

https://climate.esa.int/educate/

Teaching Kit



The education resource pack: cover; overview; theory; activity; worksheets.

>> HOME >>

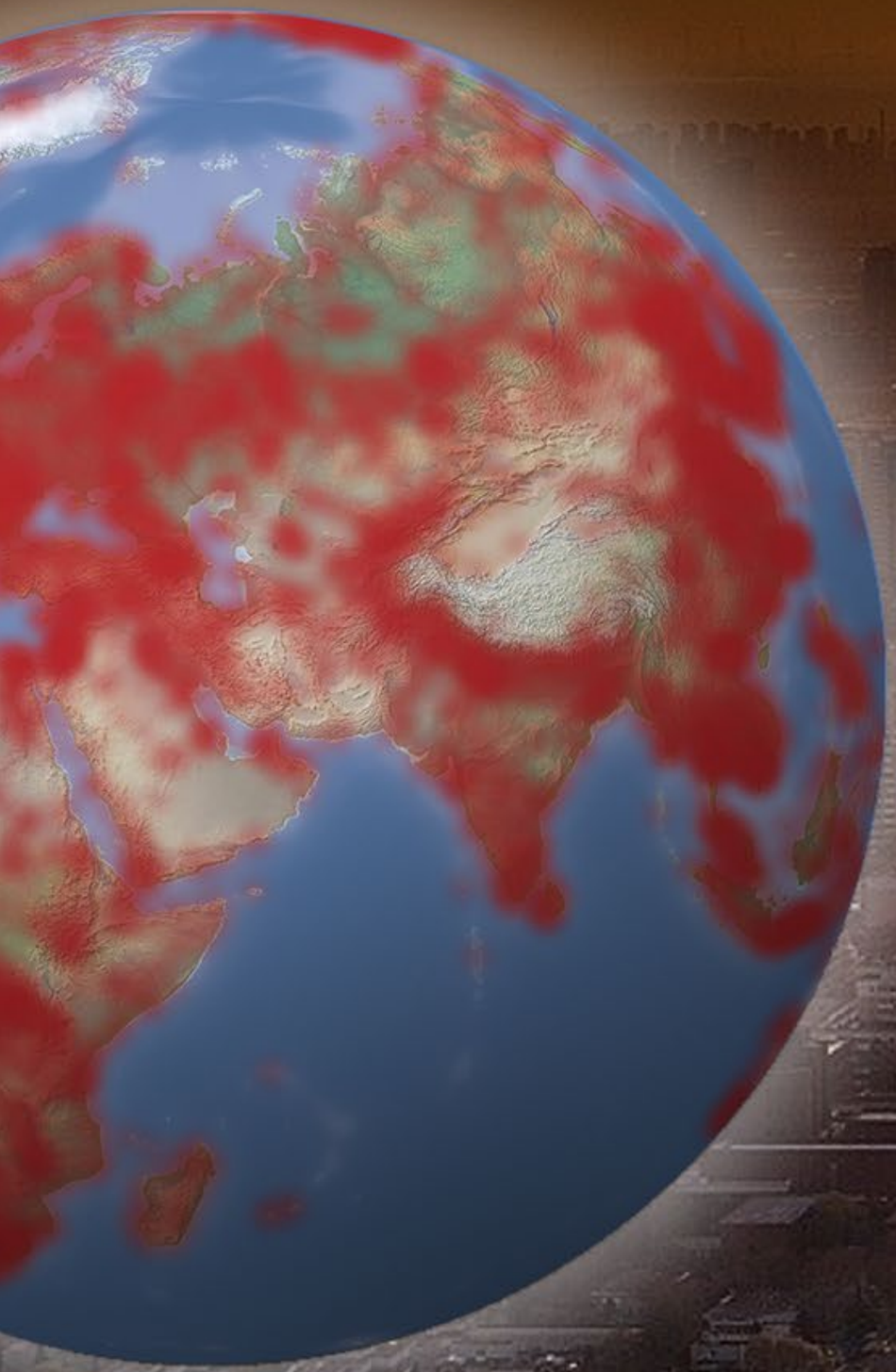
Teaching Kit

climate change initiative

URBAN HOTSPOTS

The potential impact of the urban heat island effect raises increasing concern in a warming world that is becoming progressively more urbanised.

The urban heat island effect is a phenomenon that leads to temperatures in cities often being higher than those in surrounding rural areas. This effect is amplified during heatwaves, as the materials used in built up environments have high heat capacities, limiting the amount of cooling at night-time. Growing urban populations and the effects of climate change mean that more and more people will be affected by this over the coming decades.



Hotspots

Learning outcome

In this set of activities, students will learn how the built environment leads to the urban heat island effect and how Earth observation can be used to monitor this effect and support attempts to reduce it.

Content of the pack

This pack consists of 3 ready-to-use educational activities containing pre-defined learning outcomes, background information and step-by-step implementation guide for teachers, worksheets for students and links to interesting complementary online resources on the topic.

In the **first** activity, students explore temperature data for a city and use it to identify urban heat islands. The **second** activity introduces the concept of land surface temperature and applies this to calculating the effect of using different materials. In the **final** activity, students use the Climate from Space web application to compare temperatures and trends in an urban and rural environment.

Quick facts

Topic	Value
Subject(s)	Geography, Science, Physics, Earth Science
Level	Secondary
Age range	14 – 16 years
Language	English
Type	Reading, mathematical, investigation, online research
Format	PDF
Lesson time	4 hours
Location	Indoors
Resources	Internet, spreadsheet software

Quick overview of the course and content

Teaching Kit

The education resource pack: cover; overview; theory; activity; worksheets.

https://climate.esa.int/educate/

>> HOME >>