

Teaching materials about

Summer in Paris

Years 9 - 10

Material for teachers

Project information

These teaching materials were produced as part of the project "Clim4Edu - Development and production of teaching materials for schools on the subject of climate change using satellite data". The Clim4Edu project is funded by the Space Agency of the German Aerospace Centre (DLR) with funds from the Federal Ministry for Economic Affairs and Climate Action on the basis of a resolution of the German Bundestag under the funding code 50 EE 2103A. The overall project objective is to develop a comprehensive range of digital learning materials for use in school lessons. This offer includes interactive learning tools and worksheets that are made available via a learning portal.

The following applies to this teacher's material and the accompanying worksheet: © ESERO Germany (CC BY-NC-ND 2.0 DE)

<https://esero.de/>

<https://fis.rub.de/klimawandel>



Overview

Years

9 10

Difficulty

● ● ● ○ ○

Time required

90 minutes

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Translation

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Goals

The students ...

- explain the concept of an urban heat island and its dangers,
- describe the nature of particularly warm/cool places,
- identify main urban planning problems in relation to urban heat islands,
- explain the effects of measures to reduce the heat island effect,
- evaluate measures to reduce the heat island effect in the context of costs and benefits for the population.

Topics

Urban Heat Island

Climate Change

Urban structures

Thermal imagery

Climate Action

Media & Materials

Work sheet „Summer in Paris“

Teacher material „Summer in Paris“

Slides „SummerInParis_Intro“

App „Columbus Eye“ – Part „Summer in Paris“



Didactical remarks

Relevance of the Topic

We are already seeing an increase in heat waves, which are particularly stressful for people in cities (UBA 2023). Older people in particular suffer, and for some the heat waves have life-threatening consequences (ibid.). Regarding climate change and forecasts that two thirds of the world's population will live in cities by 2050, the urban climate is a topical and relevant issue. The framework plan "Action Recommendations for the Preparation of Heat Action Plans for the Protection of Human Health" is intended to help the German federal states and municipalities take precautionary measures to protect the health of the population (UBA 2020). Research is also being carried out in projects such as "HeatResilientCity" on how heat-friendly urban development can be achieved (ibid.).

References:

Umweltbundesamt 2020: Gesund durch den Sommer in der Stadt. <https://www.umweltbundesamt.de/gesund-durch-den-sommer-in-der-stadt#die-folgen-von-hitze-fur-die-menschliche-gesundheit-ein-brandheisses-thema>

Umweltbundesamt 2023: Gesundheitsrisiken durch Hitze. <https://www.umweltbundesamt.de/daten/umwelt-gesundheit/gesundheitsrisiken-durch-hitze#indikatoren-der-lufttemperatur-heisse-tage-und-tropennachte>

Reference to the core curriculum

The teaching material is aimed at the geography curriculum of the German federal state Northrhine-Westfalia where it fits well into the topic of "priorities of current urban development" that is taught in years 9 or 10.

Recommendations for the promotion of media and methodological competence

It is recommended to use Google Earth Pro for the digital exploration of Paris. Especially the historical images (small clock with backward arrow in the top bar) are useful for this: students can independently explore the development of Paris in terms of greening.

The introductory slide also contains the marker with source information. The marker is not well suited for the app at this size as the map overlay is relative to the image size, but the illustration can be used in plenary. A short discussion of the source information is recommended here. The sources of the image data, download pages and a programme for processing are mentioned, which represents good scientific practice and contributes to the transparency of the data and results. Particularly interested students can also take a look at the websites mentioned.

Requirements

About half of the students should have the app available on their device. The learning units in the app are downloaded from the university cloud Sciebo. If there are problems, you can check here: <https://sciebo.de/de/hilfe/sciebo-news.html>.

The students should have some prior knowledge in the field of light colours from physics classes.

Preparation

Have the students download the app "Columbus Eye" a few days before the planned lesson. To do this, the link can be sent out, the QR code handed out, or simply enter "Columbus Eye" in the search bar of the Play / App Store. The actual download should be carried out by the students in their home wifi, so as not to burden anyone's data volume, if there is no (reliable) school wifi.

Once the app has been downloaded, the data for the "Summer in Paris" part must be added. After that, an active internet connection is no longer required.

To prepare for the lesson, the students are supposed to watch „Die Welt in Infrarot (English subtitles)“ (“The world in infrared”) at <https://youtu.be/k4m-JBzkMXw> or <https://esero.de/materialien/lernfilme>. Of course, another video can be used, as long as it teaches about infrared satellite imagery for plant detection and the NDVI.

Introduction

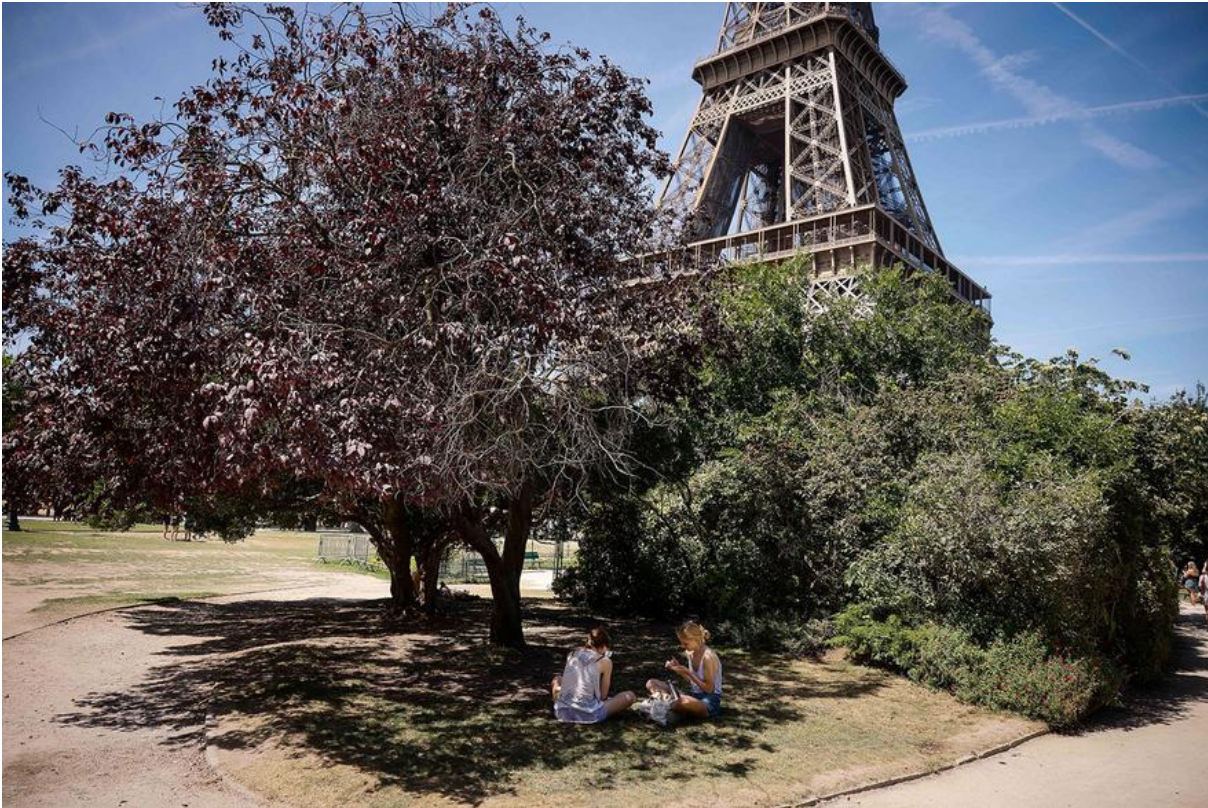


Fig. 1: Paris, the city of love and tourists. In summer, however, it can get far too hot here for plants, animals and human inhabitants: The tree whose shade two young women have sought and the grass on which they sit suffer from the weather even more than they do.

Image source: Thomas Padilla/dpa, <https://www.zeit.de/wissen/umwelt/2022-07/hitzewelle-europa-frankreich-italien-spanien>

Table for task 3b

Location (e.g. southeast of...)	Particularly warm or cool	Description of the area (e.g. type of development, proportion of built-up areas compared to green areas, ...)

Lesson plan – 1. lesson

Time	Stage	Procedure / Methodological-didactic commentary	Class settings	Media
< 5 min	Introduction	Silent image stimulus The students describe the figure and develop the guiding question of the lesson together in plenary: <i>Why do cities affect health in summer and what urban planning measures can be taken to reduce the negative effects of urban heat islands / heat in cities?</i>	Plenary	Beamer or tv
10 min	Activity	Explaining the concept of the <i>Urban Heat Island</i>	Independent	WS No. 1 (Text 1)
< 5 min	Analysis	Partial answer to the first key question	Plenary	
5 min	Activity	Students identify the significance of the satellite images (at least 2 devices with app per group).	Pairs/ groups	WS No. 2a (Marker 1), App
15 min	Analysis	Identification of heat islands in Paris & finding causes → Media & methodological competence	Pairs	WS No. 2b (Marker 1), App, map service
5 min	Abstraction	Students make educated guesses about the causes of the heatwaves.	Pairs	WS No. 2c
5 min	Abstraction	First answer to the key question by discussing the assumptions and as a transition to the next lesson and answering the second part of the key question.	Plenary	
	(homework)	No. 4 as a homework assignment or, if a reliable internet connection is available, in pairs at the beginning of the next lesson.		

Lesson plan – 2. lesson

Time	Stage	Procedure / Methodological-didactic commentary	Class settings	Media
10 min	Introduction	<p>Task No. 4 can be done in pairs or as homework (then only discuss now), depending on the technical equipment.</p> <p>Collecting the characteristics of the three places reveals differences, so that reference is made again to the key question, specifically:</p> <p><i>What urban planning measures can be taken to reduce the negative effects of urban heat islands / heat in cities?</i></p> <p>Transition through key question to No. 5</p>	Pairs Plenary	Mobile device Whiteboard (table, similar to No. 3) WS No. 4
15 min	Activity	Students describe measures to reduce the heat island effect and explain their effects.	Independent	WS No. 5
10 min	Activity Analysis	<p>Students develop further ideas to reduce the heat island effect.</p> <p>Presentation of ideas and short feedback, agreeing on three ideas for No. 7, ideas are numbered.</p>	Pairs / groups Plenary	WS No. 6
10 min	Abstraction & Application	<p>Following the Think-Pair-Share principle, the students evaluate the three ideas/measures in terms of their costs and benefits for the population.</p> <p>Collection of the evaluation is done by means of a coordinate system in which the pupils write the number of the idea in the place where they evaluate the idea.</p> <p>→ The result is an image of the mood, which has a highly stimulating nature if students have different opinions.</p> <p>Afterwards, a few pupils comment on their assessment</p> <p>→ Discussion</p>	Independent / pairs Plenary	WS Nor. 7 Coordinate system

Sample solution

Task 0

Infrared:

- A kind of light that we cannot see and is "past red".
- This light can be seen using satellites and is used to study plants.
- if wavelengths have already been covered in physics lessons: Wavelength range with waves longer, or frequency ranges shorter than red's

Task 1

An urban heat island is a city-sized built-up area that heats up more and stays warmer longer than its rural surroundings due to the urban surfaces and shapes: Stone, concrete and asphalt heat up more than plants and water surfaces. As a result, they also radiate more heat and thus heat up the surroundings even more.

Due to some large buildings, which are impenetrable for the wind, it can no longer reach the city properly and therefore cannot carry the warm, often polluted air away. As a result, heat waves are intensified in summer and there are more tropical nights.

A typical tropical night follows a very long day: During the summer, the sun is up in Paris for about 14 to 16 hours a day and heats up surfaces even more. During the few dark hours of the night, the air and surfaces cool down, but only until sunrise, when the temperatures rise again. So even if the temperature dropped to 22°C in the morning just before sunrise, most of the very short night was much warmer.

Task 2

Due to the persistent heat, people and animals cannot rest and recuperate at night, which leads to increased physical stress and increases the risk of heat-related and other illnesses, even death.

Task 3

- Plant image → greener means more plants or healthy plants,
Thermal → Temperature of surfaces, NOT air temperature (usually measured at 2 m above grass)
- Green areas are heated less than built-up areas. The Seine also stands out clearly as cooler in the thermal image. Areas with large, sealed squares or industrial hall roofs heat up particularly strongly. Large areas that heat up strongly also affect the temperature in the surrounding area.
For people familiar with Paris and a good eye or if you use a map service: The Bois du Boulogne and Bois de Vincennes are two large forested parks in the west and east of the city, respectively, which are significantly cooler than the urban environment, but still significantly warmer than the rural surroundings. If you look closely, you can also see the Jardin du Luxembourg and the Champs de Mars as small, slightly cooler areas. The particularly warm areas include the Paris Expo in the south of the city, a huge commercial area on the northern Seine peninsula, and other industrial and commercial areas on the way to Charles de Gaulle airport. In La Défense, individual buildings can almost be distinguished from the green spaces in between.
- Very dense development covers most of the urban area. Many large squares have little or no greenery. Even large gardens (gardens) hardly help. There are hardly any bodies of water away from the Seine. Large industrial and commercial areas also have little or no green space. Overall, the city is too densely packed with buildings and has too few green spaces and bodies of water.
Advanced: there is hardly any urban ventilation. Hot, stuffy air remains in the streets and residual courtyards. Large buildings can shade areas behind them, but they also reflect light and cause increased heating elsewhere.

Task 4

The students should notice the following:

Paris has many wide streets, avenues and squares, only a few of which are tree-lined. In between, there are many narrow streets without any vegetation at all.

Most of the houses are preserved from the **Haussmann** Restoration or were added later to match it: All have a similar height, zinc roofs, light stone facades with large windows, and are built right up to the street. In the tight urban grid, they completely enclose courtyards against the surrounding streets, and these courtyards are often obstructed. High-rise buildings, especially for living, are only found in a few areas of the city.

La Défense has many modern buildings with glass facades. There are large, sealed squares between the buildings. Although there are more green spaces here than in the city centre, they are still few compared to the sealed squares.

The **Jardin de Tuileries** - like other jardins in Paris - is predominantly covered with grass, as well as some low, decorative hedges and occasional trees. In summer, the grass here is often dried out and thus has no value for the urban climate.

Task 5

- Streets have been turned into pedestrian zones (local recreation).
- Trees have been planted along streets and in parks where previously only grass and ornamental low hedges were present (→higher CO₂ exchange and cooling effect)
- The Metro network will be extended to provide greater connectivity to the suburbs of the metropolitan area, making cars redundant, because everything can be reached quickly by foot or public transport
- Spaces currently occupied by cars will be planted with trees (→higher CO₂ exchange and cooling effect)
- The measures serve to improve the urban climate as well as climate protection. The reduction of CO₂ emissions or higher retention through more large plants such as trees has an indirect effect on summer heat, as it contributes to reducing climate change.

Task 6

Individual solutions.

The most important point is to create more green spaces - but where in such a densely built-up city? For example:

- Convert large parade squares of stone/gravel/sand into parks with lots of trees, or at least plant enough trees to shade the whole square
- Question the preservation of historic buildings: Does the whole historic Haussmann city centre really have to look the same?
- Instead, convert selected neighbourhoods into taller, more efficient residential buildings with greenery and more space for tall plants in between.
- build new or transform old high-rise buildings with green balconies, green roofs, like the vertical forest buildings in Milan (Bosco Verticale)

Other ways to reduce the heat:

- More solar panels and other climate change reducing measures (indirect reduction of heat waves).
- Improve urban ventilation by creating corridors for wind → align houses and avenues along main wind directions

- Create additional large bodies of water (but take up a lot of space)
- Controversial:
 - More air conditioning → good for people in the short term, but heat is only directed outside, higher electricity consumption bad for climate
 - Mist spraying machines → help in the short term, but high installation and maintenance costs
□ wouldn't a tree make more sense here?

Task 7

Individual solutions in the coordinate system:

