



Teaching materials about

Summer in Paris

Years 9 - 10

Material for students

Tasks

0. Preparatory Homework:

- Download the app "Columbus Eye" from the Google Play Store or the Apple App Store. The app requires camera and file access to work. No personal data is collected. Open the app and also download the part "Summer in Paris". The app does not stream anything and can be used without internet after downloading the part.

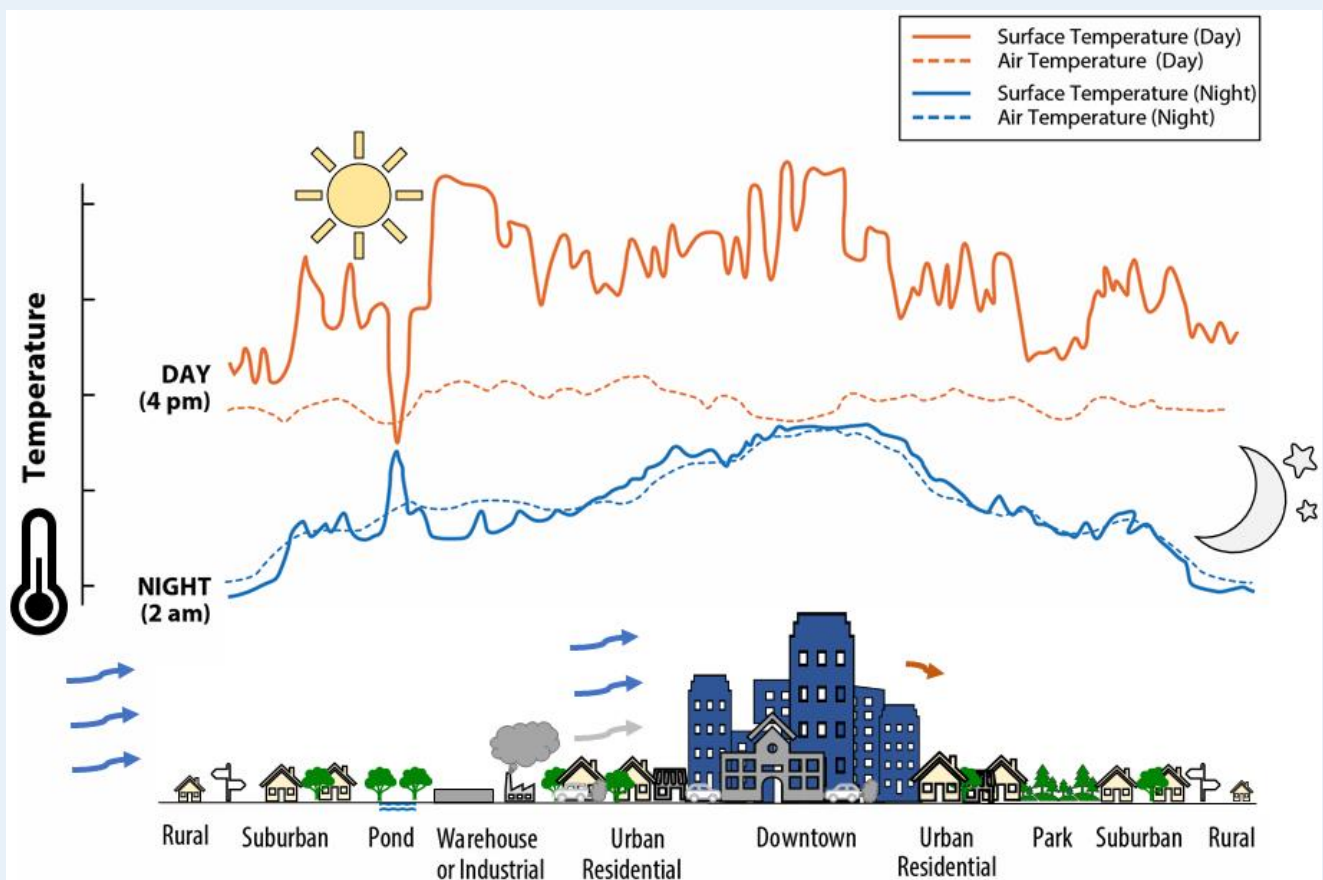
The figure designated as **Marker** is to be used with the app.



- Watch the video „Die Welt in Infrarot (english subtitles)“ („The world in Infrared“) at <https://youtu.be/k4m-JBZkMXw> and explain shortly what infrared is.

- Use the figure (marker 1) to explain what an urban heat island is and how the temperature curves are affected by the city in the cross-section [M1: Of Heat Islands and Tropical Nights; marker 1].
- List the dangers posed by urban heat islands like Paris [M1: Of Heat Islands and Tropical Nights].
- Use the app and point your rear camera at marker 1 "Urban Heat Island". At the top switch, you can toggle between Paris city and Paris with its hinterland. Below that you can switch borders and labels on and off. Using the slider at the bottom, you can compare three satellite images with each other and have information texts on each satellite image displayed when tipping on the i-buttons.
 - Work in pairs: Describe what can be seen in a (A) plant image or (B) thermal image and explain it to the person sitting next to you [texts in the app (i-buttons)].
 - Describe which areas are particularly warm and which are particularly cool. Compare the satellite images with each other. In addition to the app, use a map service of your choice to get a better orientation.
 - Speculate about what the main urban planning problems are in relation to the summer heat [images and text in the app (i-button under true colour image)].
- Use a search engine with the following terms in image search mode: "Paris Haussmann" (with two S!), "Paris La Défense", "Paris Tuileries". Also look at Paris in a map service using the satellite image overlay. Name the characteristics of the surfaces (extent of buildings, streets, squares, planting, surface material) for the locations.
- List measures against the urban heat island effect that have been and are being taken in Paris and explain the effects of these measures [M2: The Tree, the Car and the Metro, M3: Bringing Life to the Concrete Jungle]
- Propose further measures to reduce the heat island effect in Paris, also considering the social challenges and rising temperatures in climate change.
- Evaluate the measures implemented, planned and proposed in class in terms of their costs and benefits for the population in a coordinate system. Think beyond financial costs.

Marker 1



Marker 1: Urban Heat Island (Source: modified according to EPA 2008), in AR: satellite images of Paris and surroundings (Sources: Copernicus and NASA).

References:

U.S. Environmental Protection Agency 2008: Reducing urban heat islands: Compendium of strategies. Draft. <https://www.epa.gov/heat-islands/heat-island-compendium>.

Copernicus: Sentinel data 2022, downloaded from <https://scihub.copernicus.eu/> and processed in ESA SNAP.

NASA: ECOSTRESS Land Surface Temperature and Emissivity Daily L2 Global 70m V001. DOI: [10.5067/ECOSTRESS/ECO2LSTE.001](https://doi.org/10.5067/ECOSTRESS/ECO2LSTE.001), downloaded from: <https://search.earthdata.nasa.gov/>

M1: Of Heat Islands and Tropical Nights

In summer, Paris attracts hordes of tourists - but the Parisians themselves flee the city if they can, preferring to spend the hot summer at the French seaside. As a result, tourists and remaining Parisians alike are faced with closed shops and sights. As early as the 19th century, those who could afford it fled the hot and stuffy summers in the city, and that has not changed to this day.

Today's hot urban summers have a name: The urban heat island effect. An urban heat island is an urban area that is significantly warmer than its surroundings due to its built-up area. The effect is particularly pronounced at night. Paris is one of the most severely affected cities in Europe: On average, summer nights are up to 4°C warmer in the city than in the surrounding rural areas, summer days "only" up to 2°C.

What does not sound like much at first, however, signifies a high burden for the people and animals living there: Heat waves with tropical nights, when the temperature does not drop below 20°C even at night, become more frequent and longer in the city. For Example: If the temperature in the surrounding area drops to 18°C at night, it will not drop below 22°C in the middle of Paris, even during the coldest hour of the night. Considering climate change, the number of such nights will increase faster in cities than in rural areas.

In the reference period 1971-2007, Paris had an average of six tropical nights per year and already stood out clearly from the surrounding area, which experienced an average of one tropical night per year. Depending on the climate change scenario, an average of 35 to 50 tropical nights per year is expected in Paris by the end of the century, and 15 to 26 in the surrounding area.

Heat waves increase the risk of heat exhaustion, especially for people with pre-existing conditions: From heat cramps to heat death, there are many dangers. Heat islands often also have poorer air quality: particulate matter, carbon monoxide and nitrogen oxides stay in the air longer and also have a negative impact on the health of residents.

References:

ECMWF: Urban heat islands and heat mortality - Demonstrating heat stress in European cities. <https://stories.ecmwf.int/urban-heat-islands-and-heat-mortality/index.html>

Lemonsu et al. 2013: Evolution of the Parisian urban climate under a global changing climate. <https://doi.org/10.1007/s10584-012-0521-6>

Possega et al. 2022: Observational evidence of intensified nocturnal urban heat island during heatwaves in European cities. <https://doi.org/10.1088/1748-9326/aca3ba>

M2: The Tree, the Car and the Metro

Once upon a time, Paris was a dirty city with dirty air. Wide streets took up the banks of the Seine (river in Paris, pronounced "sayn") and wound tightly around the city, so that the asphalt of the streets made the summer heat even worse. The car took first priority, even over the health of the inhabitants.

This changed a while ago and the banks of the Seine are now known as a promenade full of artists, small bookshops and gardens. But it was only with Mayor Anne Hidalgo that the liberation from the car really took off: under her leadership since 2015, streets in the city centre have been transformed into green pedestrian zones, trees have been planted in parks and along streets, and the metro network has been expanded.

To this end, the "Grand Paris Express" project was launched - the largest urban development project in Europe! For more than 36 billion euros, over 60 new train stations will be built and connected by 2030. These will be built mainly in the banlieus (pronounced "bun-lyuhs"), the suburbs that are practically already part of Paris, as there is hardly any free space left for housing or green areas in Paris itself. Paris' mayor hopes this will facilitate a move away from cars and repurpose streets as green space to reduce the heat island effect. This would improve the health of citizens in the long term.

Although only few of the plans have been implemented so far, positive effects on the urban climate are already evident: Where streets have been converted and closed to car traffic, the burden of heat in summer is lessened for local residents. Every tree planted on former roadways and car parks provides shade so that the ground and buildings heat up less, cools the environment by evaporating water from its leaves and filters pollutants from the air. In addition to the local climate in the city, these measures also help in the fight against climate change by reducing pollutants of climate-damaging gases and binding them instead through plants.

References:

Google Earth Pro: Paris – Historical Imagery (2001 – 2023).

Tramuta 2020: How Mayor Anne Hidalgo Plans to Reinvent Paris. <https://www.cntraveler.com/story/how-mayor-anne-hidalgo-plans-to-reinvent-paris>

City of Paris: Paris Climate Action Plan. <https://cdn.paris.fr/paris/2020/11/23/257b26474ba3ba08ee02baa096f9c5dd.pdf>

Société du Grand Paris: Paris Grand Express. <https://www.societedugrandparis.fr/>

AIRPARIF - Air quality in the Paris region in 2020: Summary – October 2021

https://www.airparif.asso.fr/sites/default/files/documents/2021-10/BilanQA_IDF_2020_UK.pdf

M3: Bringing Life to the Concrete Jungle

Under the climate action plan drawn up by the Paris city government, the planting of about 170,000 trees is planned, in addition to the approximately 500,000 trees already in Paris. Most of these (about 300,000) are distributed between the two urban forests, Bois du Boulogne (pronounced "bwah duh boo-lohn-yuh") and Bois de Vincennes (pronounced "bwah duh van-sen"). Several new small urban forests are to be created on large squares and in schoolyards; roads and parking spaces are to be reduced and replaced by trees. This is costing the city of Paris quite a bit - it can cost about €2,000 to plant and raise a tree until it can survive on its own. The reason lies in the city ground, which makes it difficult for the trees to gain a foothold and must first be broken up and replaced with more fertile soil.

In return, the tree gives back a lot to the residents: it provides shade and helps to cool the air. It also filters the air and can reduce flood damage caused by heavy rainfall. In addition, it binds CO₂, which counteracts climate change. In total, this saves about €4.50 in costs for the city and residents for every euro spent on trees. So, trees are more than just great against the summer heat.

References:

CHZ/DPA: Paris pflanzt 170.000 Bäume für ein besseres Klima <https://weather.com/de-DE/wissen/umwelt/news/2021-10-16-paris-pflanzt-170000-baume-fur-ein-besseres-klima>

Henley 2023: 'We need trees': green vision struggles to take root in Europe's cities <https://www.theguardian.com/cities/2023/jan/16/trees-green-vision-europe-cities>