Urban heat island and thermal confort in the Strasbourg Eurometropole : Case study of the heat peak of June 18-20, 2022

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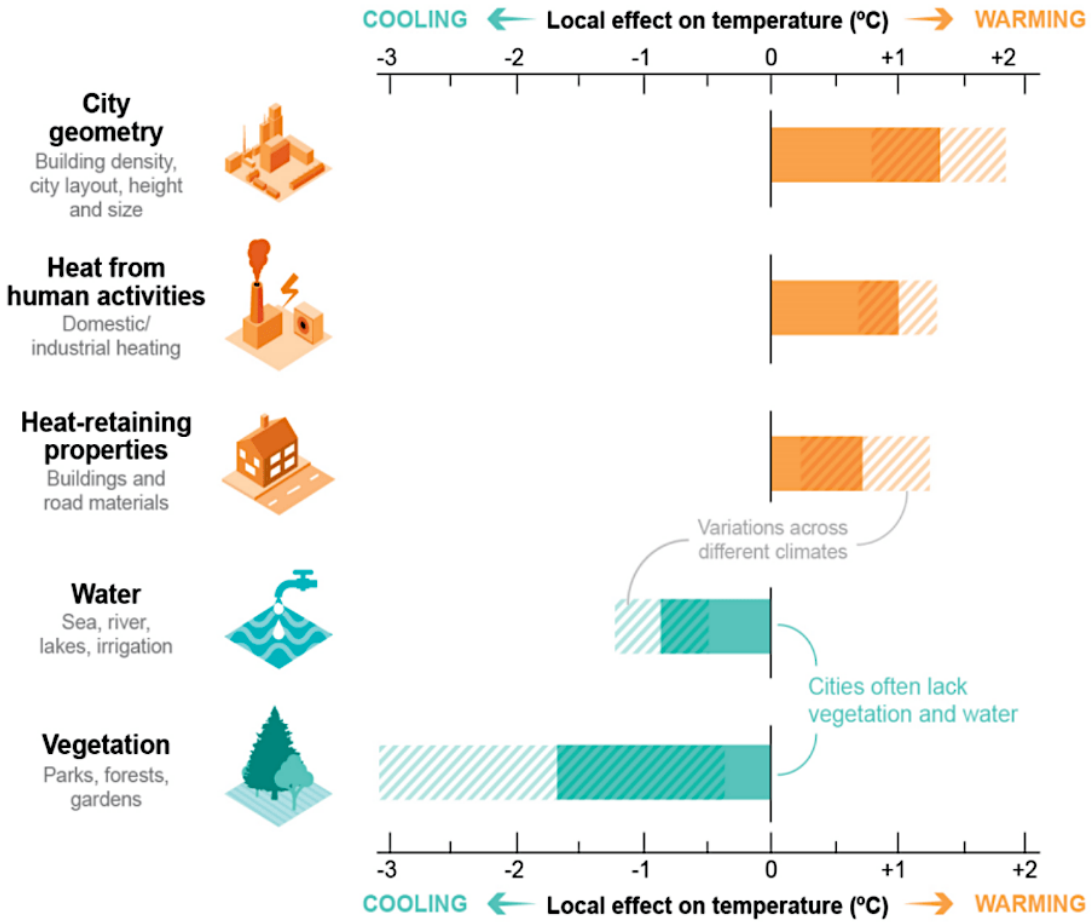
Illkirch innovation park

1. Summary

During the first week of the course, which starts on June 8, 2022, Météo France announces the possibility of a very early heat wave for the season on almost the entire French territory. The anticipation of several days of this heat wave allowed us to set up a measurement campaign within the framework of the training course, in order to evaluate the phenomenon of urban heat island for a part of the Eurometropolis of Strasbourg.

The aim of this article is, in a first part, to illustrate this phenomenon of urban heat island (UHI) with cartographic tools to propose new methods of study and analysis. In the second part, we will discuss a field study conducted during the month of June in the Illkirch innovation park to better understand the urban heat island phenomenon, its impact and its operating dynamics. These data will be put in parallel with those of other sensors on the Eurometropole of Strasbourg and of meteorological stations in the vicinity.



Cities and climate change ; IPCC AR6 Chapitre 10

2. Introduction

The rapid evolution of our climate in recent decades implies major changes in the frequency, intensity, and duration of extreme weather events. In France, and more particularly in the Alsace region, heat waves are no exception to this rule: 11 phenomena observed between 1947 and 1999, against 23 since the beginning of the 21st century. A heat wave is characterized by abnormally hot minimum and maximum temperatures for several consecutive days. It can lead to the implementation of a meteorological vigilance by the services of Météo France.

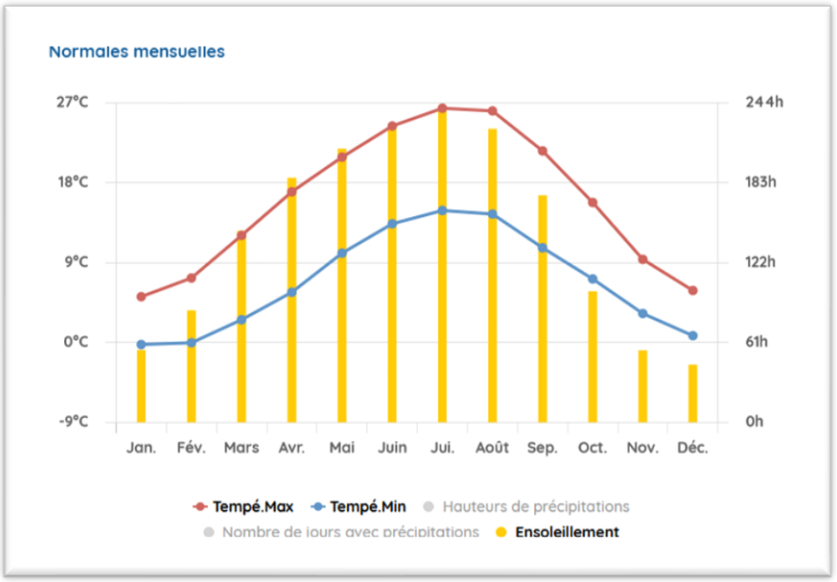
The Clim'Ability Design project has identified that these heat waves in the summer season are the main concern of companies in the region, considering all the meteorological hazards that can impact them. The combination of high heat during the day and tropical nights (temperatures not going below 20°C) is particularly harmful to health, by amplifying heat stress. Vulnerable populations are most affected, but the health of the population can be affected during a severe heat wave. Heat waves have a strong impact on human health: heatstroke, fatigue, concentration difficulties, dehydration. The human resources of the company are therefore very concerned by the increase of this phenomenon and can be affected by the organization of the company.

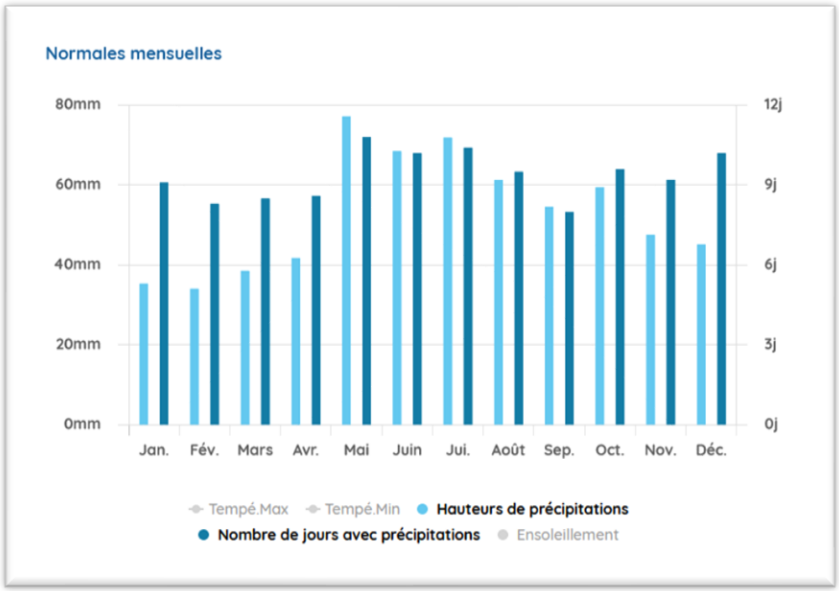
The impacts of heat waves are aggravated in cities by a phenomenon called "urban heat island". The urban heat island is notably due to the absence of vegetation in the city. During the day, in the countryside, vegetation uses water and solar energy for photosynthesis. The vegetation "transpires", evaporating the water present deep in the soil. Thanks to this evapotranspiration, plants and soils do not accumulate the solar energy received during the day. In cities, solar energy is stored in the materials of buildings and the asphalt of roads and parking lots, which are impermeable surfaces that prevent the evaporation of water from the soil. When night comes, this energy is returned to the urban atmosphere. At night, the air above the city cools down less quickly than in the countryside.

It is therefore in the middle of the night that the temperature difference between the city and the countryside is at its maximum. In general, the urban heat island starts to grow in the late afternoon and increases at sunset to reach its maximum in the middle of the night. On a calm night, a sort of "heat bubble" is created over the city.

3. Climate context for the Eurometropole of Strasbourg

The Eurometropole of Strasbourg is located at an altitude of about 150m in the Rhine Gap, between the Vosges mountains to the west and the Black Forest to the east. The Strasbourg region has a semi-continental climate. The summers are hot with a marked thermal amplitude between day and night, and the winters are sometimes harsh, with a higher number of days of frost and snow than in the rest of France. Annual precipitation is low and irregular compared to other French regions. This is due to the presence of a natural protection against the prevailing westerly winds that the Vosges massif constitutes (foehn effect), especially in winter when precipitation is essentially due to disturbances coming from the Atlantic. On the other hand, it rains more in summer because of the predominance of storms. The prevailing winds are from the south and the north, thus parallel to the Rhine Gap.





Monthly normals 1991-2020 for Strasbourg-Entzheim ; Météo France

4. Méthodology

4.1. Urban heat island in the Eurometropole of Strasbourg

This article aims to complement studies already conducted on the phenomenon of urban heat island for the Eurometropole of Strasbourg. Indeed, there are several models of the UHI of Strasbourg as the work of ADEUS in 2019 or those of Pierre Kastendeuch, Georges Najjar, Pierre Lacarrere and Jerome Colin published in 2010.

These works are generally based on the concept of "Local Climate Zones", of which the Eurometropole of Strasbourg has developed a tool that allows to visualize them on its territory. This classification system of urban and rural sites allows to define homogeneous spatial entities according to the land use and the type of buildings if there are any. Each LCZ generates a specific climate on a surface that does not exceed a few square kilometers.

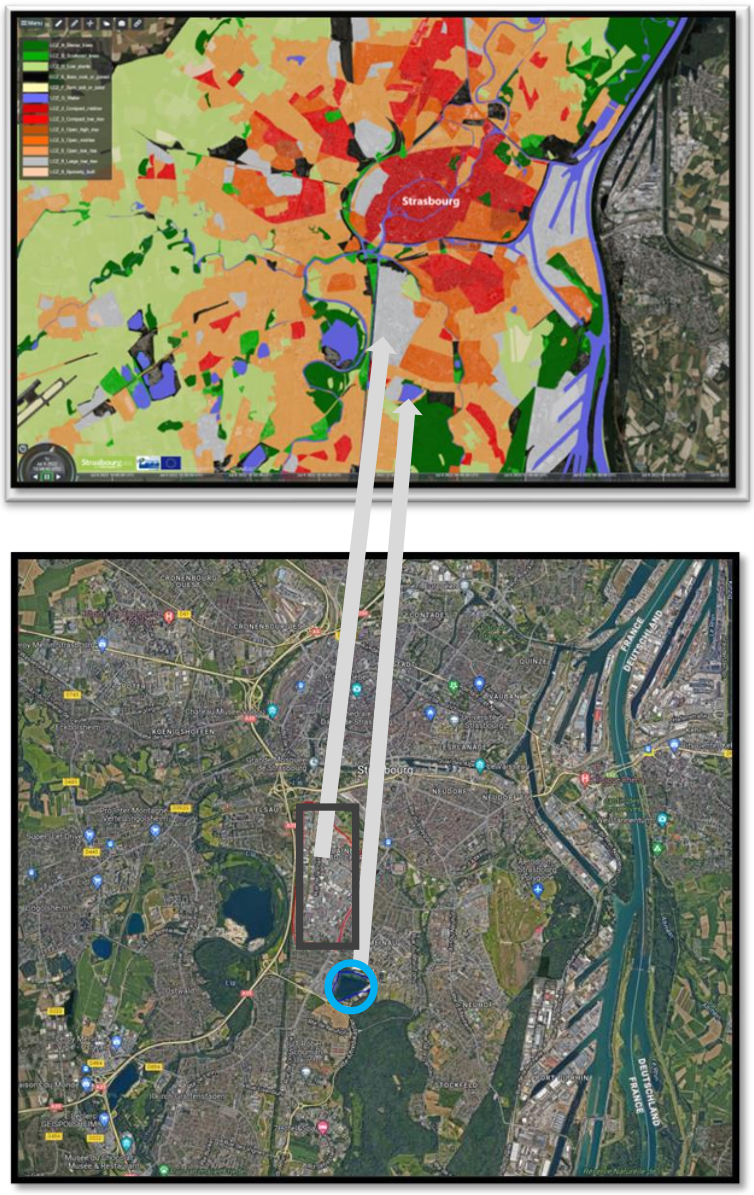
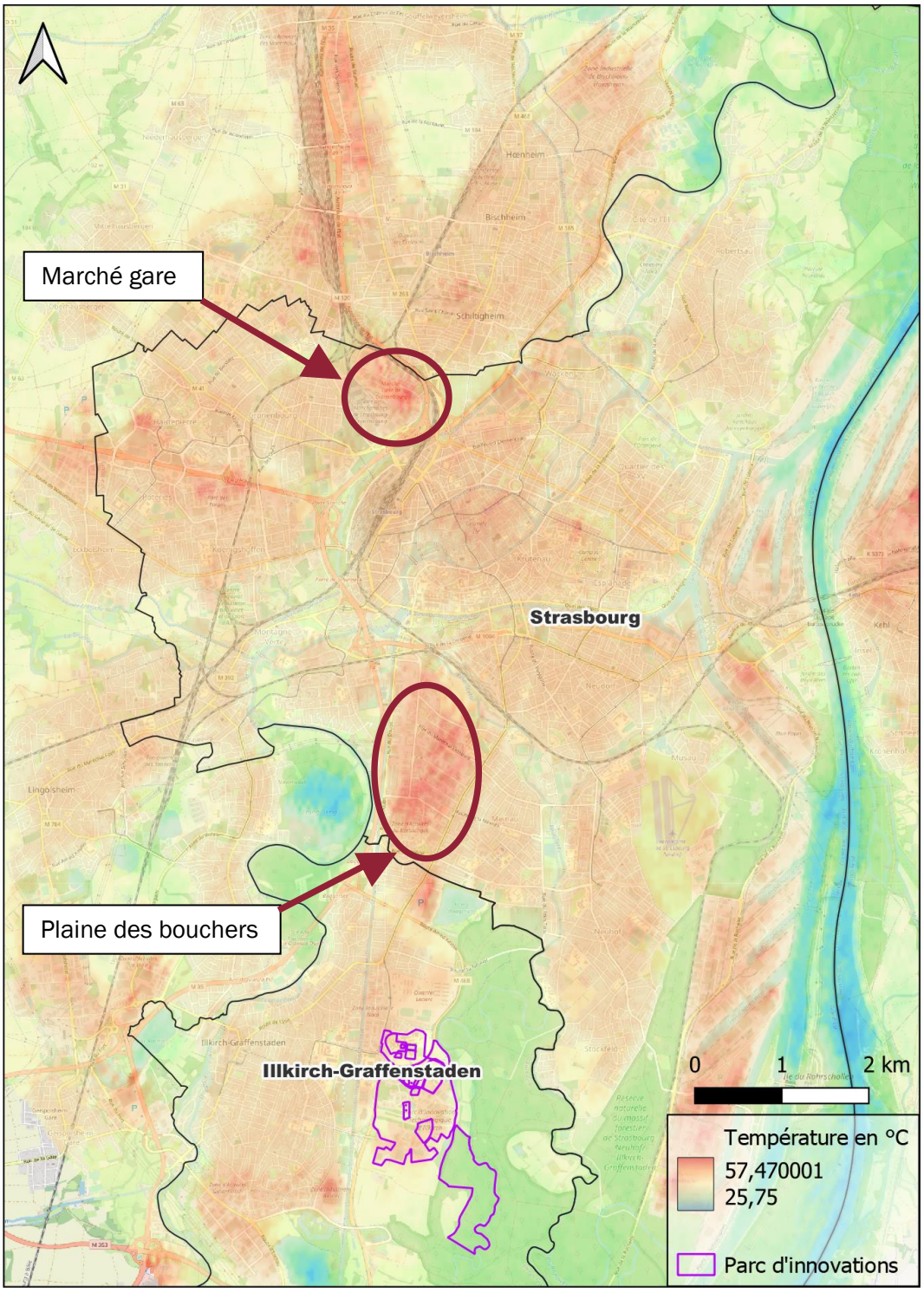


Illustration of the LCZ with the plaine des bouchers (poorly vegetated industrial area with wide but not very high buildings) and the Baggersee lake ; Google Maps



Temperatures measured at the surface on June 15, 2022 at 21 : 23 ; Ecostress

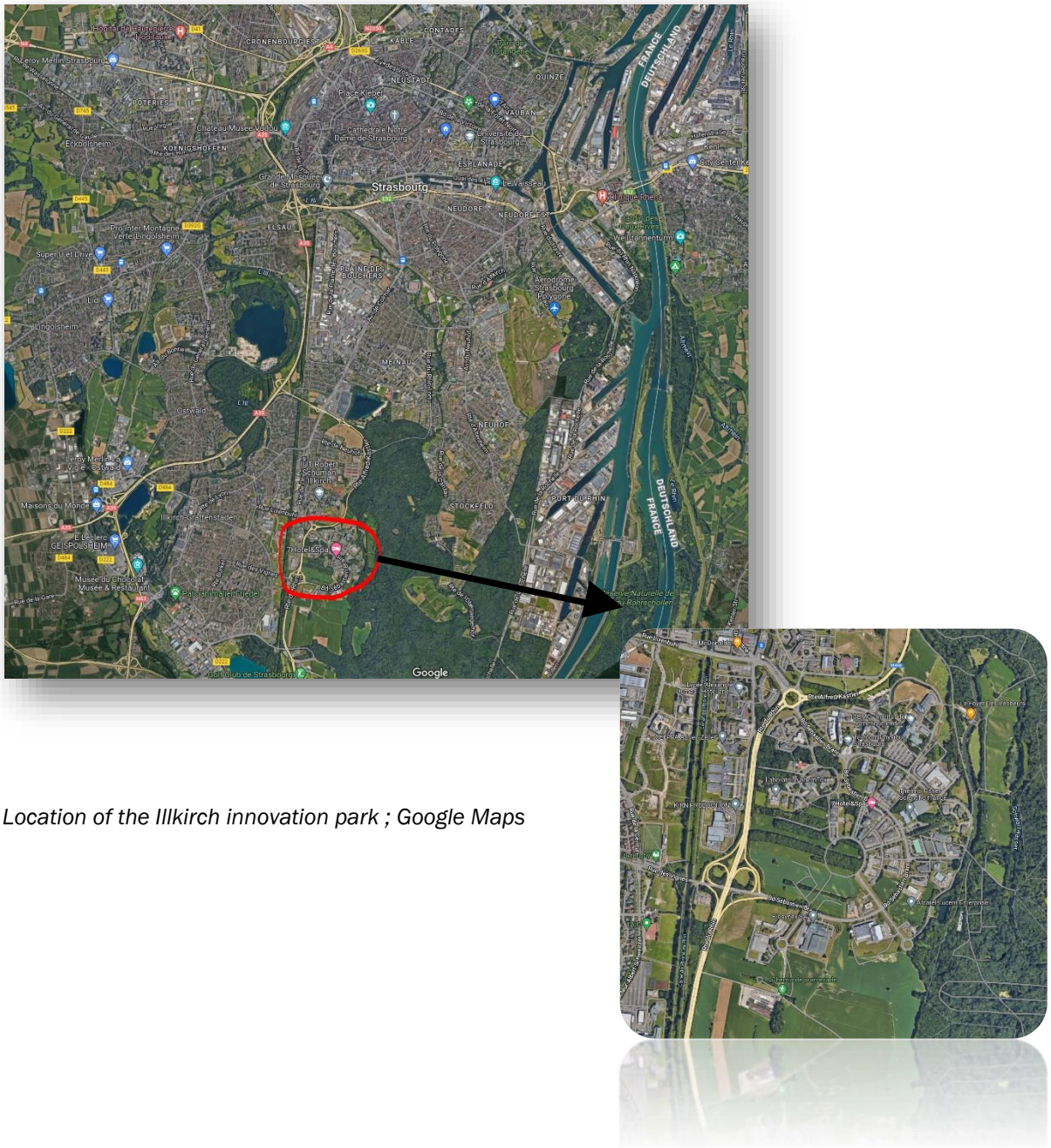
The map above was produced using data from the ECOSTRESS science mission set up by NASA's Jet Propulsion Laboratory. The ECOSTRESS instruments aboard the International Space Station ISS provide accurate and regularly updated surface temperature data. The data were then implemented on a base map using QGIS software.

For the realization of this map, it was relevant to obtain temperature data measured in the early evening. It was therefore necessary to find a recent image, taken in the early evening and without cloud cover. The image used is dated June 15, 2022 and was taken at 9 : 23 pm. The date of June 15 was chosen because of the relatively high daytime temperatures (31.7 °C maximum

measured at the Entzheim airport weather station) even in the late afternoon, which is an important criterion for an urban heat island to appear. The cloud cover was not important, which is necessary to have reliable surface temperature data.

The map highlights the vegetated areas and hydrography and their role in reducing temperatures, represented by blue and green colors. Conversely, the hot spots on the map are in very mineral areas, with a high density of buildings, heat emitting human activities and a lack of water and vegetation. The market station and the industrial zone of the butchers' plain are identified as the hottest places in the early evening and will thus contribute to release a significant amount of heat throughout the night in the neighboring districts.

4.2. Case study for the Illkirch innovation park

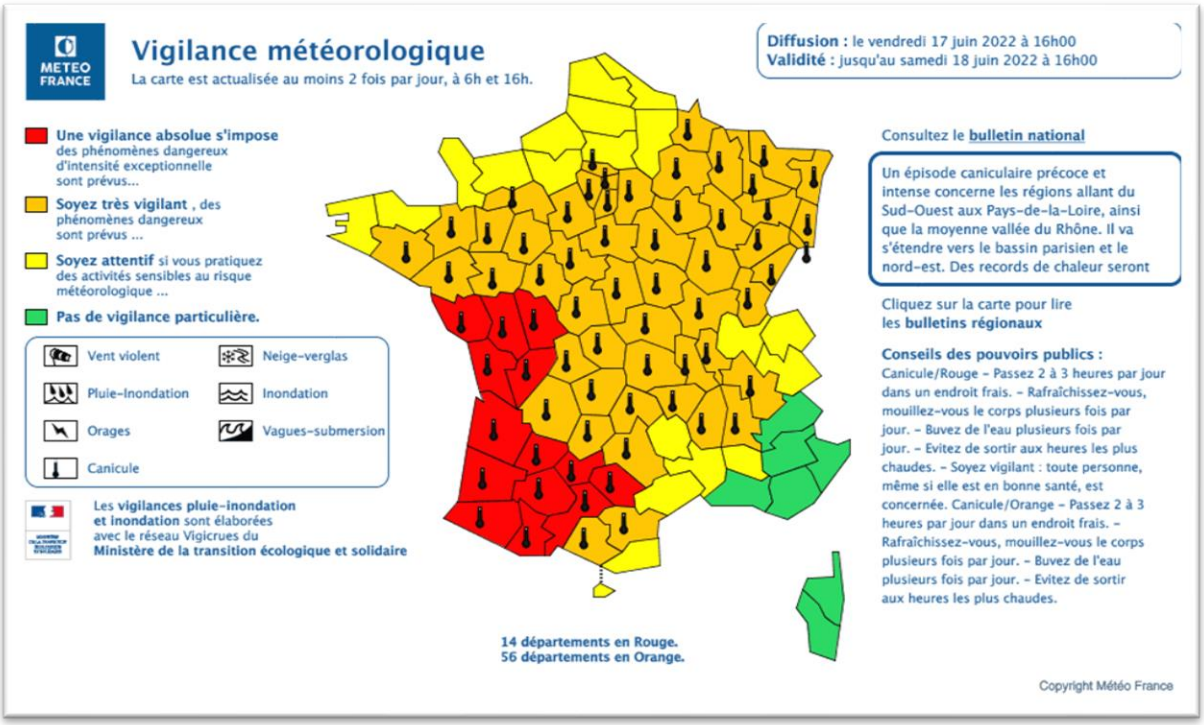


Location of the Illkirch innovation park ; Google Maps

The Illkirch Innovation Park is located a few kilometers south of downtown Strasbourg, in the commune of Illkirch-Graffenstaden. It covers a total area of 170 hectares, including a built-up area of 200,000 m2. About a hundred establishments occupy the land with a total workforce of 8,000 people on site, including 3,000 employees. The companies' sectors of activity are mainly in the life sciences, others in information and communication technologies, the environment and transportation.

The choice of this sector for our study is therefore motivated by the presence of numerous companies in various activities, including Météo France Nord-Est, which has its premises in the innovation park. Indeed, the Clim'Ability Design project works in collaboration with companies (VSEs and SMEs exclusively) in order to identify with them their vulnerabilities in the perspective of climate change. The numerous diagnoses carried out within the framework of the project have shown that most companies in the Upper Rhine region are highly vulnerable to heat waves.

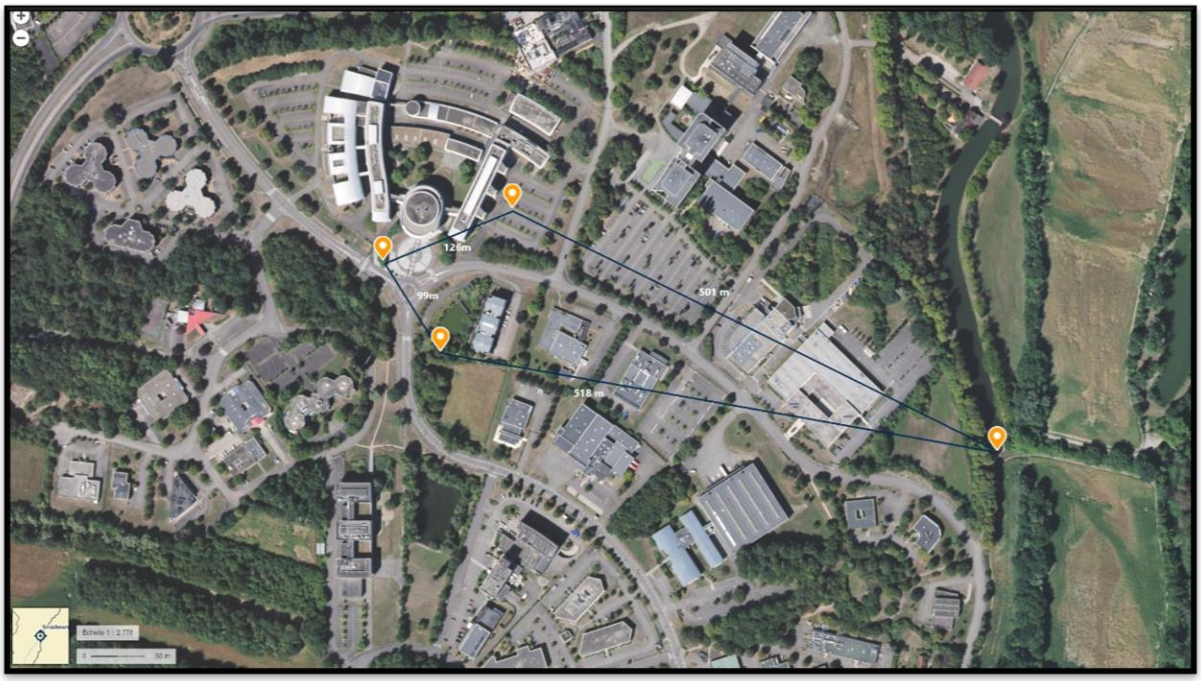
The main objectives are to measure the effects of a heat wave on a local scale for the area of the innovation park, as well as its impacts on human health. To do this, a measurement campaign lasting several days was set up when a heat wave peak was announced in mid-June 2022. An orange heatwave alert was issued at 4:00 pm on Friday, June 17, predicting a heat peak in Alsace with extremely hot temperatures for the season. The meteorological situation was therefore favorable to the realization of our study.



Weather alert issued on Friday, June 17, 2022 at 4 pm ; Météo France

During all the duration of the campaign of measurements, we collected the data of 2 meteorological parameters: the temperature of the air and the humidity of the air. The measurements started on Friday June 17 at 12:00 and ended on Monday June 20 at 12:00, with a time step of one minute between each measurement. In total, 4 sensors were installed on the innovation park, in places where the land use and the environment around the sensors were quite different from each other. The choice of sensor locations was also motivated by the regular presence of people who are potentially exposed to heat stress.

The sensors used were TESTO 174H data loggers, with temperature and humidity measurement accuracies of ±0.5°C and ±3%RH respectively. They were placed in shaded locations, ideally out of direct sunlight, exposed to the wind and about 1.5 m above the ground. The sensors were relatively close to each other, less than 100 meters apart, except for the one placed on chemin du Routoir 500 meters away.



Locations of the 4 sensors on the innovation park ; Géoportail

A first sensor was installed near the picnic tables in the tree-lined area of the premises of Météo-France Nord-Est. It was placed in a tree at about 2 meters above the almost bare ground, at boulevard Gonthier d'Andernach, 67400 Illkirch-Graffenstaden (48° 31' 28.31" N 7° 44' 17.6" E).

Location of the sensor at Météo France ; Google Earth

A second sensor has been installed on the square in front of Télécom Physique Strasbourg, in a tree about 2 meters high and above a small square of grass surrounded by concrete. The address is Pôle API boulevard Sébastien Brant, 67400 Illkirch-Graffenstaden (48° 31' 31.19" N 7° 44' 14.31" E).

Location of the sensor at Télécom Physique ; Google Earth

A third sensor was installed on the parking lot of the École Supérieure de Biotechnologie de Strasbourg (ESBS), at the level of a metallic panel implanted on a high grass alley at about 1.50 meter from the ground, Pôle API, 300 boulevard Sébastien Brant, 67400 Illkirch-Graffenstaden (48° 31' 32.84" N 7° 44' 19.67" E).

Location of the sensor at the ESBS parking ; Google Earth

The fourth and last sensor was installed in a grove at the edge of a body of water, in a tree at 1 meter height chemin du Routoir, 67400 Illkirch-Graffenstaden (48° 31' 25.83" N 7° 44' 42.23" E).

Location of the sensor at chemin du Routoir ; Google Earth

5. Analysis of the results

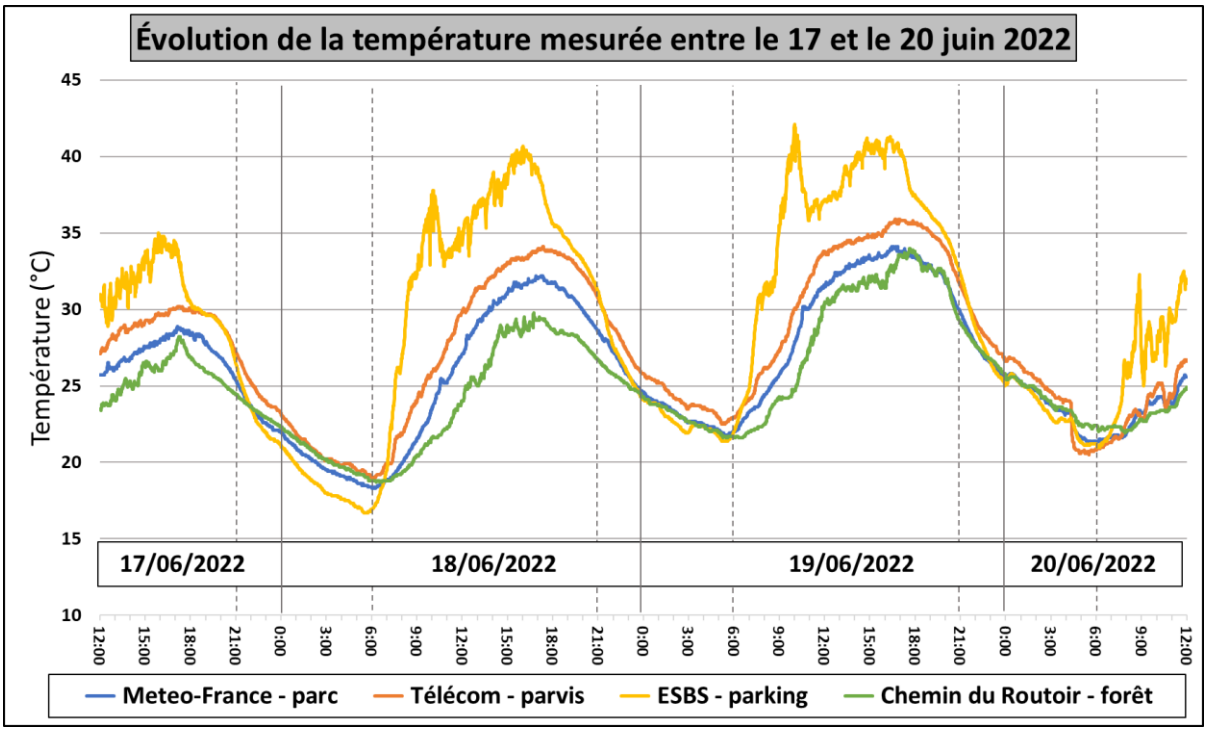
5.1. Temperatures

In this chapter, we present the main results of the measurement campaign conducted on the innovation park. The temperature and humidity data are first compared between sensors and then put into perspective with other measurement data.

The graph below represents the evolution of the temperatures measured by the 4 sensors between June 17, 2022 at 12:00 and June 20, 2022 at 12:00 (local time). We note that except for the evolution of the temperatures of the sensor placed on a panel at the level of the ESBS parking lot, the other curves are relatively regular and coherent compared to the day and night cycle. It is moreover for this same sensor that we observe the greatest thermal amplitude for the day of June 18, with temperatures ranging between 17 °C in the morning and 40 °C in the afternoon.

Overheating is very likely for this sensor because of the metal panel on which it is placed. The phenomenon is particularly visible between 8 am and 6 pm when the sun's rays reach the frame on which the sensor is placed. The temperature rises by more than 10 °C in the space of 2 hours (between 7 and 9 am) on June 18 and 19. The measurements are thus difficult to use during the day. Concerning the night, we note on the contrary that it is the sensor measuring the lowest temperatures before sunrise. This difference is mainly due to the close environment around the sensor: on the parking lot, it is placed on a metal surface which has a high thermal diffusivity. This high thermal diffusivity of the metal translates into its ability to accumulate or, conversely, to quickly release heat accumulated by various physical processes. During the day, the metal surface absorbs part of the incident solar radiation and heats up quickly. At night, this same surface gives back the

heat accumulated during the day, again in a relatively fast way compared to other materials. The 3 other collectors were placed in trees which have a much lower thermal diffusivity than the surface of the panel on the parking lot. The rest of the analysis will not consider this sensor, although it is undoubtedly the hottest area, especially during the day, among the 4 selected for this measurement campaign.



During the day, the lowest temperatures are observed on chemin du Routoir due to the presence of many large trees that limit the penetration of sunlight and a water body. This has the effect of regulating the temperature of the area and limiting the rise in temperature in the afternoon. In contrast, the highest daytime temperatures are measured on the concrete forecourt in front of Télécom Physique with little vegetation.

The table below shows some key values of air temperatures measured by these 3 sensors. The observations at 21 h for the 3 evenings of the measurement campaign show a significant difference in air temperature between the chemin du Routoir which is the coolest area and the Télécom Physique square which is the warmest area. On June 18 at 9 pm, 26.7 °C is recorded on chemin du Routoir and 30.7 °C on the Télécom Physique square, 500 meters away as the crow flies. The temperature drops more easily on the concrete square, which gives back the heat stored during the day to the surrounding air. Nevertheless, on this local scale, we note that this difference in temperature is quickly absorbed. Thus, it becomes even negligible after midnight between the 3 selected sites.

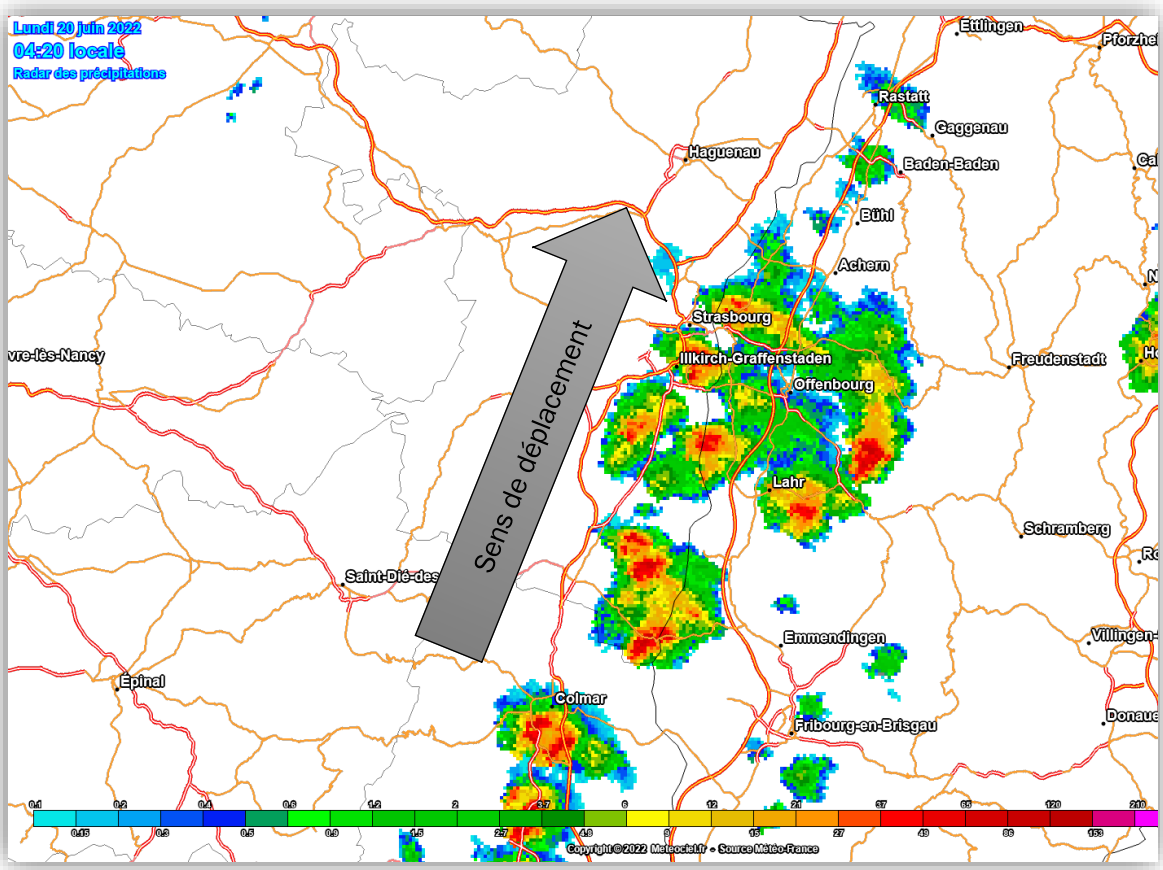
The afternoon of June 18 is marked by the largest differences observed over the entire period of the measurement campaign between the sensors, with a difference of 5 °C between Chemin du Routoir and Télécom Physique at 6 pm. This can be explained by low wind speeds, with gusts not exceeding 20 km/h at the reference weather station at Entzheim airport. The wind has the effect of stirring the air and thus of making the temperatures more uniform, at least on a local scale. This was the case the next day on June 19, when the wind gusts exceeded 40 km/h in the afternoon at Entzheim airport. The temperature differences between the sensors are thus reduced compared to the day before, although they are still visible.

		Chemin du Routoir	Météo France	Télécom Physique
17.06	12h	23.5	25.7	27.2
	15h	26.3	27.5	29.3
	18h	26.9	28.5	30
	21h	24.4	25.4	27.2
18.06	00h	22.3	22	23.2
	03h	20.1	19.5	20.1
	06h	18.8	18.4	19
	09h	20.4	21.5	24
	12h	24	27.1	29.9
	15h	28.9	31.1	33
	18h	28.6	31.7	33.8
	21h	26.7	28.6	30.7
19.06	00h	24.3	24.6	25.8
	03h	22.7	22.6	23.6
	06h	21.7	22	22.9
	09h	24.2	25.7	27.3
	12h	30.5	31.5	33.7
	15h	31.9	33.3	34.8
	18h	33.7	33.4	35.6
	21h	29.1	29.8	31.6
20.06	00h	25.6	25.4	26.6
	03h	23.8	23.8	24.6
	06h	22.4	21.4	20.8
	09h	22.8	23.2	22.9
	12h	24.9	25.6	26.7

Temperatures (°C) for 3 sites between 17.06 12 pm and 20.06 12 pm

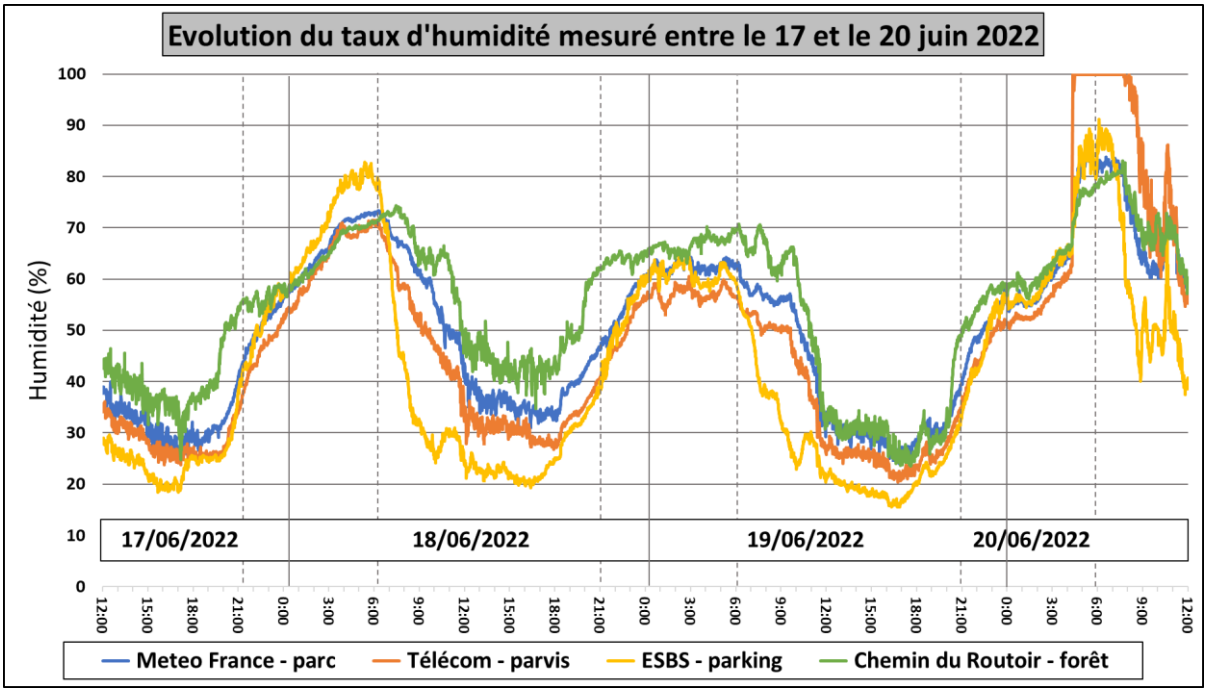
The nights of June 18th to 19th and 19th to 20th can be qualified as "tropical nights", which corresponds to a minimum temperature that does not go below 20°C. For these 2 tropical nights which followed 2 very hot days, the temperature difference between the Routoir and Télécom Physique did not reduce as quickly as for the night of June 17 to 18. The quantity of heat accumulated by the concrete square of Télécom Physique is increased on June 18th and 19th since the daytime temperatures are higher than on June 17th.

Finally, we observe a very rapid drop in temperatures on June 20 around 4 am, which corresponds to the passage of several episodes of rain, quite intense but short-lived, as illustrated by the radar image of precipitation below. This stormy shower caused a drop in air temperature of almost 2 degrees in a few tens of minutes, except for the sensor located on chemin du Routoir where the drop was relatively small, about 0.5°C. It is quite consistent to observe a drop in temperature with the passage of this shower, the rainfall bringing a colder air mass with them. The environment of the sensor on chemin du Routoir is conducive to limiting sudden temperature variations thanks to the large number of trees. Nevertheless, it can also be suggested that the other sensors may have been exposed to raindrops falling directly on the measuring devices. The temperature of these raindrops as well as their evaporation on the sensors can lead to a more important cooling, the sensor on chemin du Routoir being the only one to be completely sheltered from the rain. Finally, the wind could also have caused a drop in temperature that was less noticeable on Routoir Road, where the sensor is more sheltered. However, we cannot look at themeasurement data of the Entzheim airport since the rain shower spared this sector.



Radar image of precipitation on June 20 at 4 :20 am local time ; Météociel

5.2 Humidity and thermal comfort



The previous graph shows the evolution of the relative humidity of the 4 sensors during the campaign of measurements on the innovation park. During the day, we observe that the humidity is higher in the presence of vegetation and water bodies, as is the case on chemin du Routoir. On the contrary, it is lower on asphalt sites such as the Télécom Physique square. The lowest humidity level was observed in the afternoon of June 19, mainly due to high temperatures coupled with gusts of 40 km/h of south wind which contributed to drying the air mass in the innovation park. The increase in wind gusts in the late morning is well illustrated by the sudden drop in humidity at all sensor sites.

The humidity level in the air increases abruptly on June 20 at 4:00 a.m. as thunderstorms move through the area and provide precipitation. The sensor placed on the square of Télécom Physique was not sufficiently well sheltered, which caused a measurement of 100% humidity since raindrops probably remained on the sensor before evaporating around 9 am.

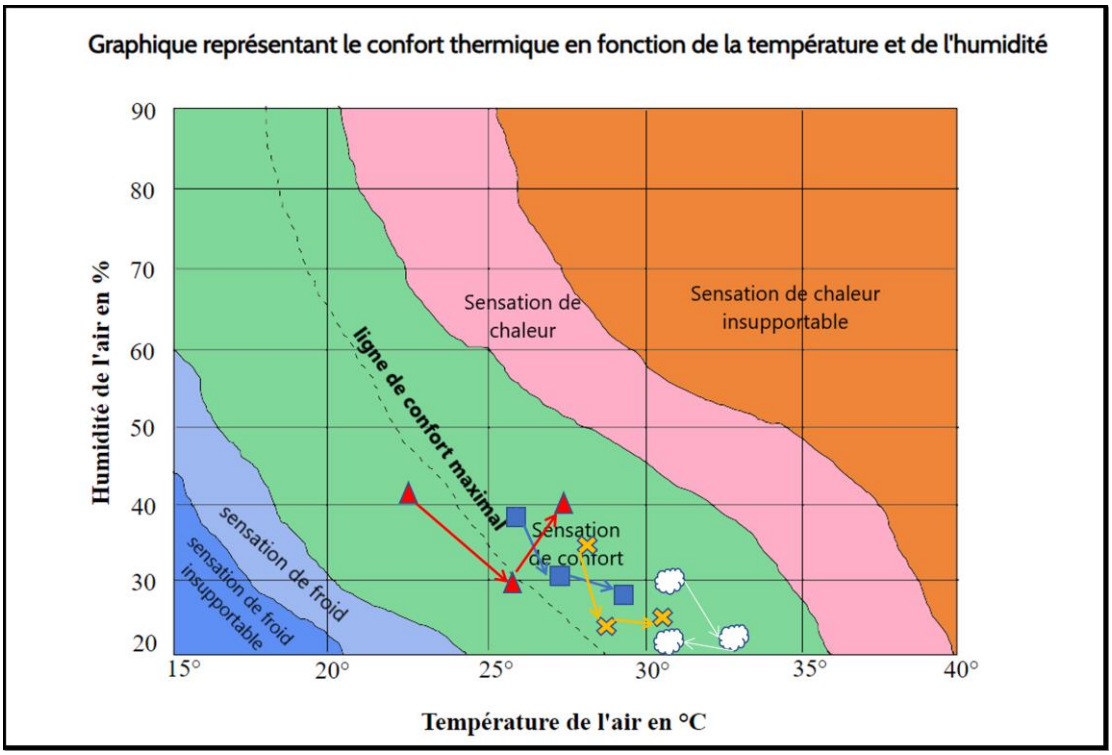
In the remainder of this chapter, we will put these humidity measurements in perspective with the temperature measurements, in order to study the impacts of the local environment on the thermal comfort of users. We will look at whether this heat spike had an impact on the work of the employees of the innovation park, by evaluating the thermal stress they faced during these few days of high heat. Heat stress refers to an accumulation of heat in the body that prevents the worker from maintaining a normal body temperature. The impacts of hot weather also depend on the humidity: for the same temperature, humid heat, especially during stormy weather, is much more difficult to bear than dry heat.

The temperature and humidity data from the sensors have therefore been transposed onto a graph representing the thermal comfort of an individual as a function of these 2 parameters. These graphs are based on the one found in the book "Techniguide de la météo" written by Jean-Louis Vallée. The graphs are composed of temperatures on the abscissa and humidity on the ordinate. Thermal comfort ranges are then created from the feelings of the individuals questioned. It is therefore not a question of measured data but of people's perception of their thermal comfort according to these two parameters. Notable differences can be observed between populations of different countries and even from one individual to another. Moreover, the wind is also an important parameter to consider: a moderate wind allows to limit the thermal stress compared to situations without wind.

	Chemin du Routoir sensor
	Météo France sensor
	Télécom Physique sensor
	ESBS parking sensor

On each graph, the above symbols are represented 3 times and are linked by arrows. These 3 symbols represent 3 measurement dates : 12 h, 15 h and 18 h, 12 h for the first symbol and 15 h and 18 h for those located at the end of the arrows.

The first graph below illustrates the thermal comfort of the individuals for the day of June 17 at 12 h, 15 h and 18 h and on the 4 sites retained for the measurement campaign. Despite the high temperatures, the low humidity level allowed to maintain a good physiological comfort throughout the afternoon and whatever the area of the innovation park.

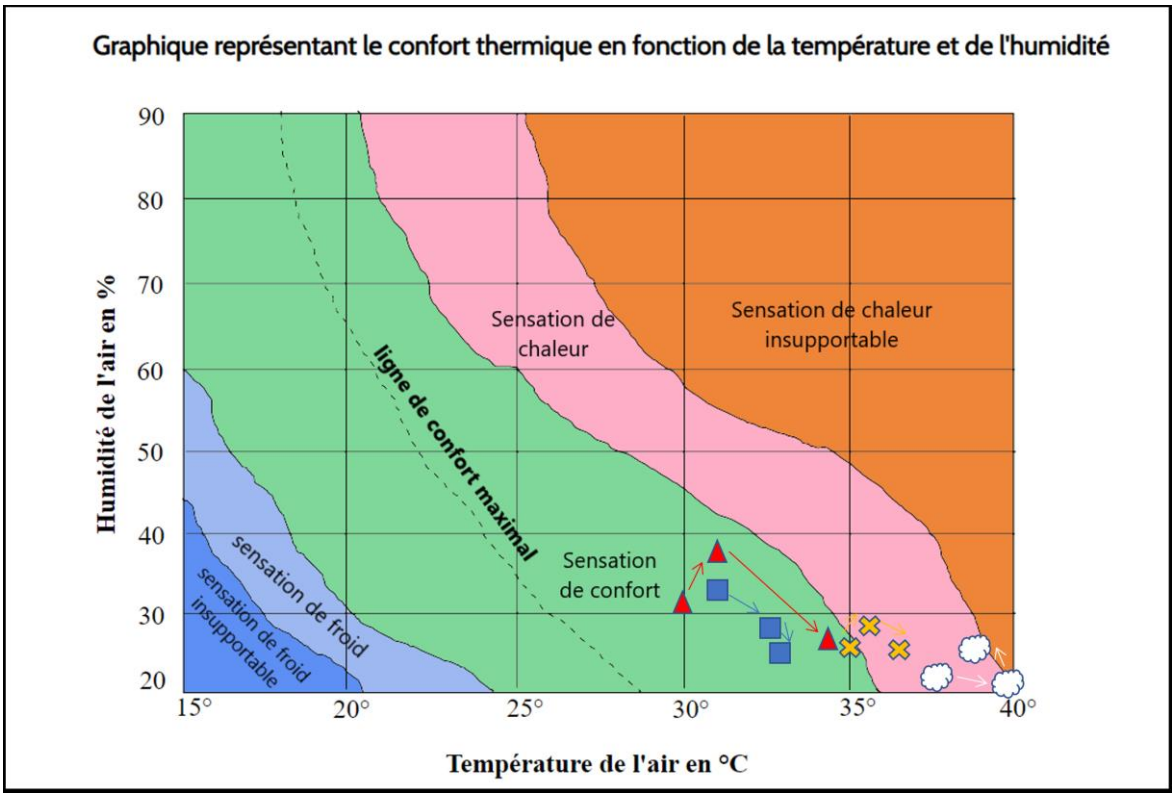


Thermal comfort on June 17, 2022 at 12 :00, 15 :00 and 18 :00 for the 4 sensors

For the day of June 19 on the second graph, maximum temperatures were much higher and humidity remained low throughout the afternoon. The sensors positioned in vegetated areas and near bodies of water maintained a rather pleasant feeling despite the temperature which reached 37.7°C at 5:00 p.m. at the reference weather station at Entzheim airport. The difference is noticeable with 4°C less on chemin du Routoir or in the park at Météo France compared to the airport which is highly exposed to solar radiation. Limiting this incident solar radiation by means of trees allows to significantly reduce the temperature of the nearby environment and thus to avoid thermal stress of the populations.

On the contrary, the sensors located in highly mineralized environments were more affected by the high temperatures of this day of June 19. People exposed to full sun on these sites are potentially subject to high thermal stress that can manifest itself very quickly in health problems. The overheating of the sensor on the ESBS parking lot does not allow us to know the exact temperature at this location, but we can imagine that an individual in full sun on this parking lot probably had an unbearable feeling of heat, to be compared with the thermal comfort conditions on chemin du Routoir 500 meters away which were much more pleasant.

The day of June 20 was more humid than the previous ones, nevertheless the wind was blowing moderately from north which could limit the discomfort felt that day. Indeed, the north wind in Alsace, also called the bise, is often associated with cooler air masses than the south wind.



Thermal comfort on June 19, 2022 at 12 :00, 15 :00 and 18 :00 for the 4 sensors

5.3 Illustration of the UHI during the measurement campaign

In order to measure the urban heat island of the Strasbourg Eurometropolis during this heat peak, other sensors were installed in the city center of Strasbourg, a particularly well exposed area to observe the phenomenon. These are the same sensors as those used in the Innovation Park, for the same period of measurements.

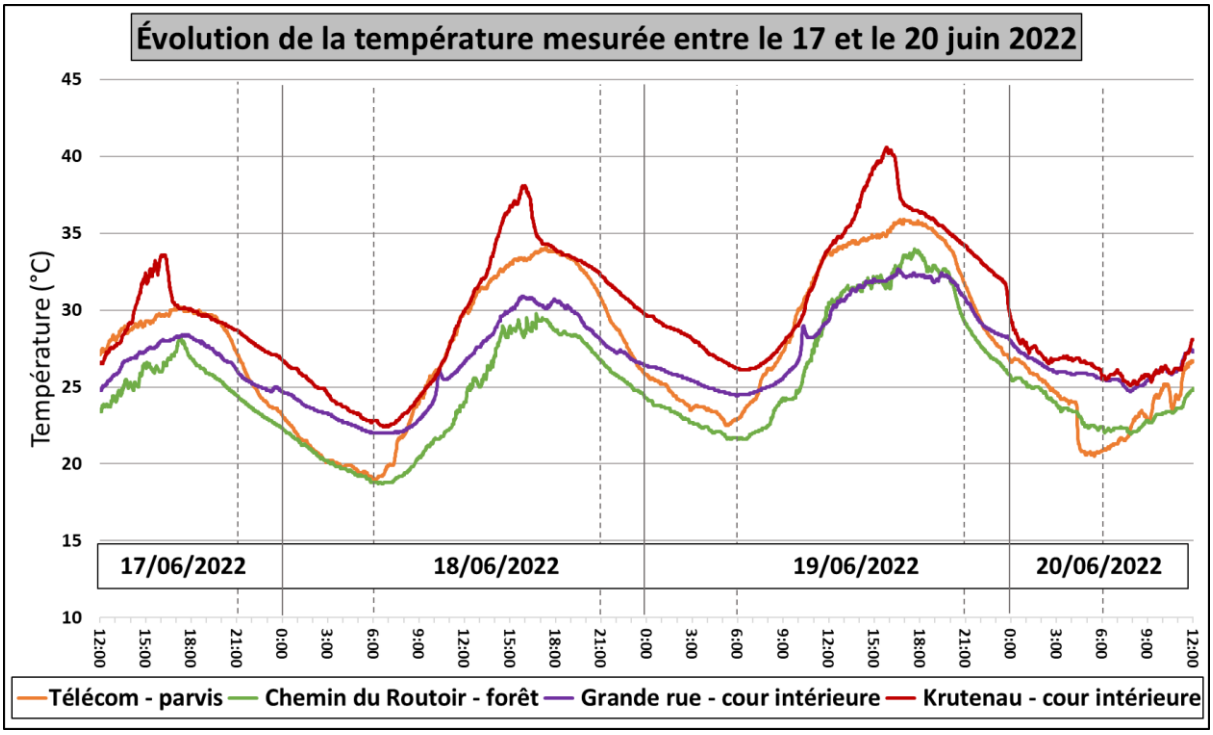
A first sensor was installed in an interior courtyard in the Krutenau district of downtown Strasbourg, on a wall covered with vegetation at a height of about 2 meters.

Location of the sensor in the Krutenau ; Google Earth

A second sensor was installed in an inner courtyard Grande Rue in downtown Strasbourg, against a wall with climbing plants at about 1.5 meters high.

Location of the sensor Grande Rue ; Google Earth

The graph below shows the evolution of the temperatures for the 2 sensors placed in the city center of Strasbourg, as well as the temperatures placed on the chemin du Routoir and on the Télécom Physique square in the innovation park. The main measurements are given in the following table.



		Chemin du Routoir	Télécom Physique	Grande Rue	Krutenau
17.06	12h	23.5	27.2	24.8	26.5
	15h	26.3	29.3	27.3	32.3
	18h	26.9	30	28.2	30
	21h	24.4	27.2	26.1	28.7
18.06	00h	22.3	23.2	24.7	26.8
	03h	20.1	20.1	23.3	24.5
	06h	18.8	19	22	22.8
	09h	20.4	24	22.9	24.3
	12h	24	29.9	26.6	29.9
	15h	28.9	33	30	36.8
	18h	28.6	33.8	30.6	33.9
	21h	26.7	30.7	28	32.2
19.06	00h	24.3	25.8	26.4	29.7
	03h	22.7	23.6	25.4	28.1
	06h	21.7	22.9	24.4	26.2
	09h	24.2	27.3	25.6	27.9
	12h	30.5	33.7	29.4	34
	15h	31.9	34.8	32	39.2
	18h	33.7	35.6	32.3	36.4
	21h	29.1	31.6	30.7	34.2
20.06	00h	25.6	26.6	28	29.4
	03h	23.8	24.6	25.9	26.8
	06h	22.4	20.8	25.5	25.6
	09h	22.8	22.9	25.4	25.8
	12h	24.9	26.7	27.3	28.1

Temperatures (°C) for 4 sites between 17.06 12 :00 and 20.06 12 : 00

Nighttime temperatures are notoriously different between downtown Strasbourg and the Illkirch innovation park, located about 6.5 kilometers apart. The urban heat island phenomenon is particularly noticeable between midnight and 6 a.m. on any night between June 17 and 20. Temperatures struggle to fall in the downtown area, even on the night of June 19-20 when several thunder showers occurred.

Temperature differences between downtown and the Innovation Park at the end of the night exceeded 3 °C, which is significant. The temperature did not go below 25 °C on the morning of June 19 in the Krutenau and Grand Island neighborhoods of Strasbourg, making the nights difficult for its inhabitants. The phenomenon of urban heat island has therefore very different impacts between the city center and suburban sites such as the Innovation Park, but it is also visible on a larger scale. Météo France has a network of very precise measurement stations, including two in the Strasbourg Eurometropolis. One of them is located at the Entzheim airport, 10 km from the city center of Strasbourg, and the other at the botanical garden of the city of Strasbourg, a few hundred meters from the city center. Thus, the minimum temperature on June 19 was 19.7 °C at Entzheim airport while the weather station at the botanical garden measured 22.1 °C minimum, a difference of 2.4 °C.

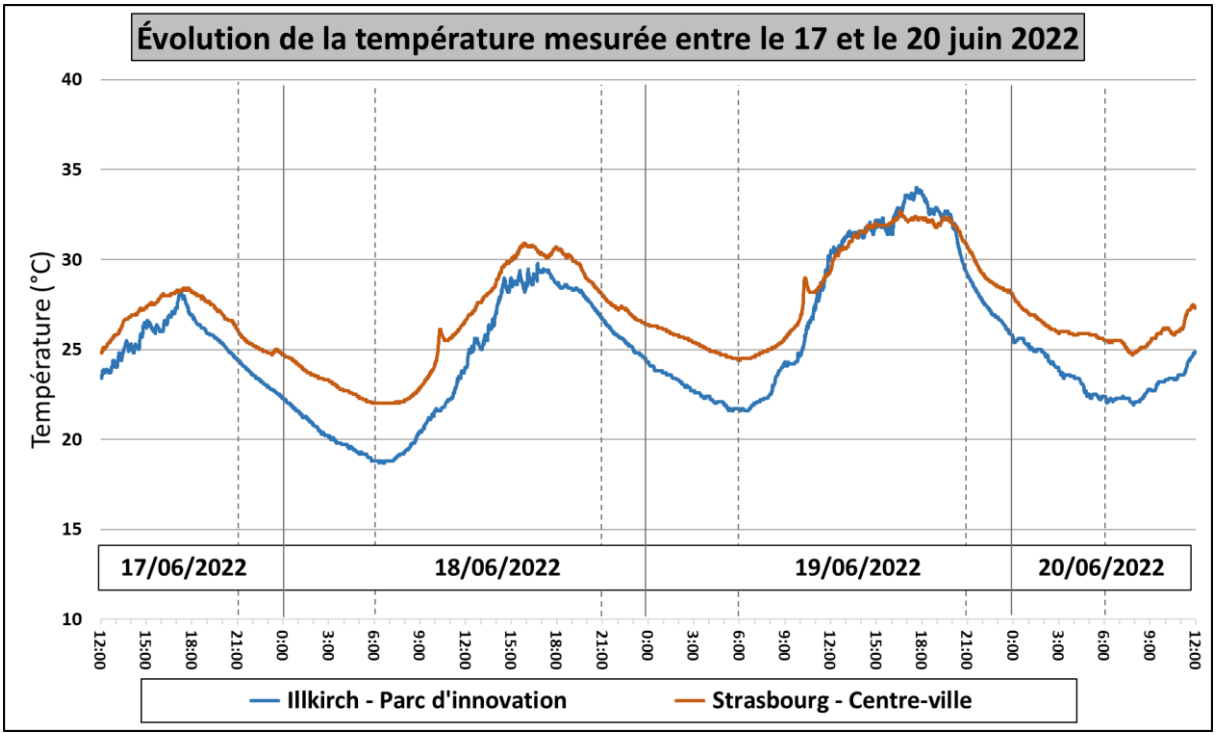
During the day, the temperatures depend very much on the exposure to the incident solar radiation. Thus, the inner courtyard located on the main street is quite small, surrounded by tall and old buildings and decorated with several plants. These characteristics allow it to remain relatively cool throughout the day, with daytime temperatures like those measured on chemin du Routoir in the Innovation Park. The inner courtyard in the Krutenau district is larger, more exposed

to the sun and with a floor mostly covered with asphalt, hence the much higher temperatures on this site compared to the main street courtyard.

The Krutenau sensor area is also partly exposed to the sun in the middle of the afternoon, which explains the high temperature peak observed on the curve between 3:00 and 6:00 pm. It is therefore important to note the very marked warming effect when we are directly exposed to the sun's rays, especially during a heat wave when temperatures in the shade are already very high. This phenomenon, added to that of the urban heat island at night, can lead to difficult sanitary conditions for the people exposed, and in particular the most vulnerable.

The figure below shows the data of the previous graph with the sensor located in the chemin du Routoir in the innovation park of Illkirch and the one placed in an inner courtyard of the Grande Rue in downtown Strasbourg. Despite rather similar daytime temperatures between the heart of the city and the suburbs in the vegetated area, the thermometer does not drop at all at the same speed when the night arrives.

This heat peak of remarkable precocity and intensity before the summer solstice fortunately lasted only 3 days in the Alsace region. Nevertheless, future climate projections indicate a multiplication of heat extremes and in particular heat waves, which will be more frequent, but also more intense and longer. The phenomenon of urban heat island is likely to be exacerbated with these weather conditions and if too few measures are taken to deal with it effectively.



Conclusion

The intensification of climate change aggravates the impacts already visible on the Eurometropolis of Strasbourg, mainly the hot extremes that are exacerbated in cities by the phenomenon of urban heat island. Although the city of Strasbourg does not seem to be the most exposed to this phenomenon in France, the measurement campaign conducted for this article shows a significant difference in nighttime temperatures between the city center of Strasbourg and less dense urban areas with more vegetation.

This difference in temperature between the city and the countryside is justified by several factors: the topography of cities, with many large buildings, which absorb and store heat accumulated during the day and reduce natural ventilation. In addition, there are a large number of heat sources in urban areas and building materials that store heat during the day and release it at night.

The measurement campaign specific to the Illkirch innovation park shows a significant variability of the meteorological parameters on a local scale, for sensors placed a few hundred meters away. The presence of green spaces and bodies of water allows a faster decrease of the temperature during the evening and to observe lower minimum temperatures than in strongly mineralized zones.

The thermal comfort of an employee in a company is therefore very dependent on day and night temperatures. During the day, workers exposed to the sun's rays are subjected to a sensation of heat that is often unpleasant and even dangerous for their health, especially in unventilated areas and when the heat is humid. At night, people living in cities will have to face particularly high night-time temperatures during a heat wave, which can lead to a deterioration in the health of these inhabitants.

This study, conducted during an intense heat peak, is intended to illustrate the benefits of having vegetated areas and water features, even on a small scale. Employees can thus enjoy a break in a cooler place in the immediate vicinity of their companies, such as chemin du Routoir on the edge of the innovation park where several hiking trails exist. The tree-lined area on the Météo France Nord-Est site, which also has a water feature a few meters away, is also a way for employees to enjoy a cooler, shaded area. Otherwise, highly mineralized areas such as parking lots are exposed to very high daytime temperatures, which can deteriorate the thermal comfort of people working nearby. They also contribute to the restitution of heat accumulated during the day and thus limit the drop in temperature in the evening.

Finally, in order to effectively combat the urban heat island, discussions must be conducted on the scale of the entire city and the surrounding agglomerations. Just one month after this measurement campaign, a second heat wave hit France in mid-July, including the Alsace region. On July 20, while the thermometer showed a minimum of 17.2°C at Entzheim airport, the one in the botanical garden in downtown Strasbourg showed 21.1°C. The recurrence of these high temperatures should alert us to the need to mitigate and adapt now to the impacts of climate change on our territory.

To go further

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