# WIND AND THERMAL COMFORT STUDIES IN DENSE URBAN AREAS

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# Plan

- AIRFLOW STUDY – WIND COMFORT AS PART OF AN URBAN DEVELOPMENT PROJECT IN PARIS
- INTRODUCTION TO ENVIMET
- THERMAL COMFORT STUDY – CREATION OF A PROPERTY PROJECT IN THE PARIS REGION
- THERMAL COMFORT STUDY – CREATION OF AN URBAN FOREST IN PARIS

# AIRFLOW STUDY

# WIND COMFORT AS PART OF AN URBAN DEVELOPMENT PROJECT IN PARIS

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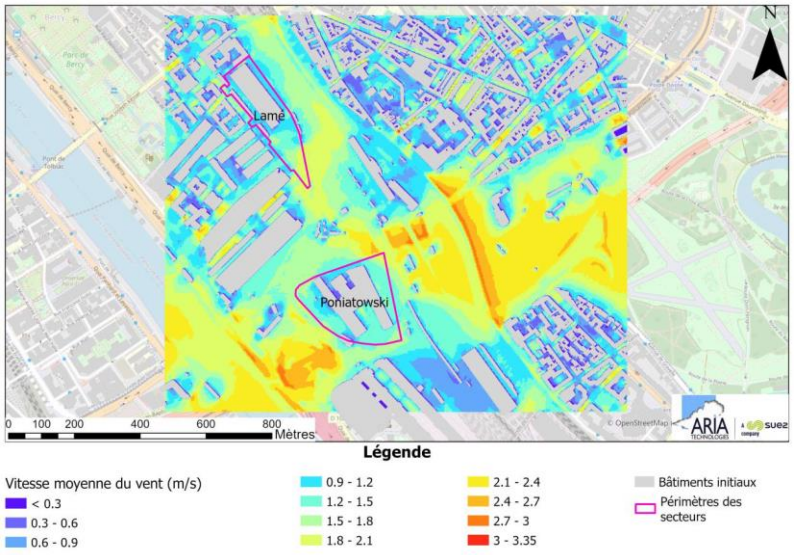
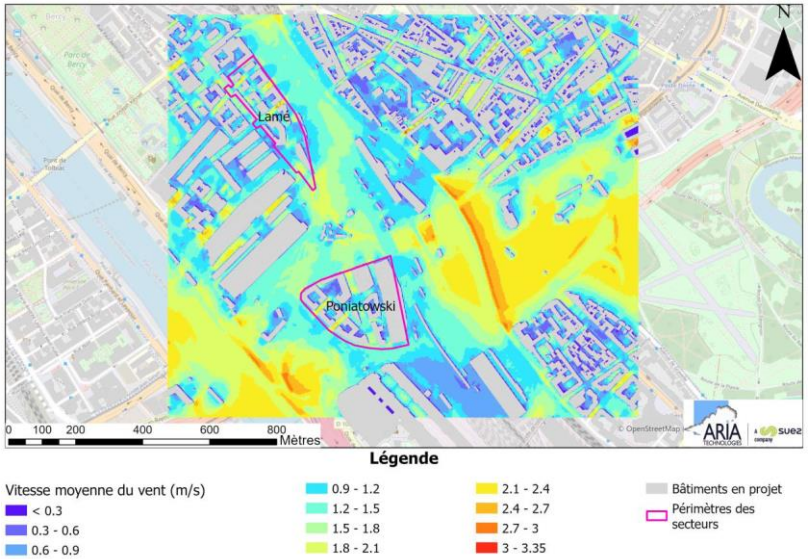
# Airflow study - Wind comfort as part of an urban development project in Paris

- PSWIFT is a weather model that can be used to simulate weather conditions on complex terrain.
- The airflow study was carried out in a district of Paris with the PSWIFT model over one year. Maps of average wind speed and calculations of threshold exceedance frequencies have been produced
- New buildings create a zone where the wind slows down in their wake



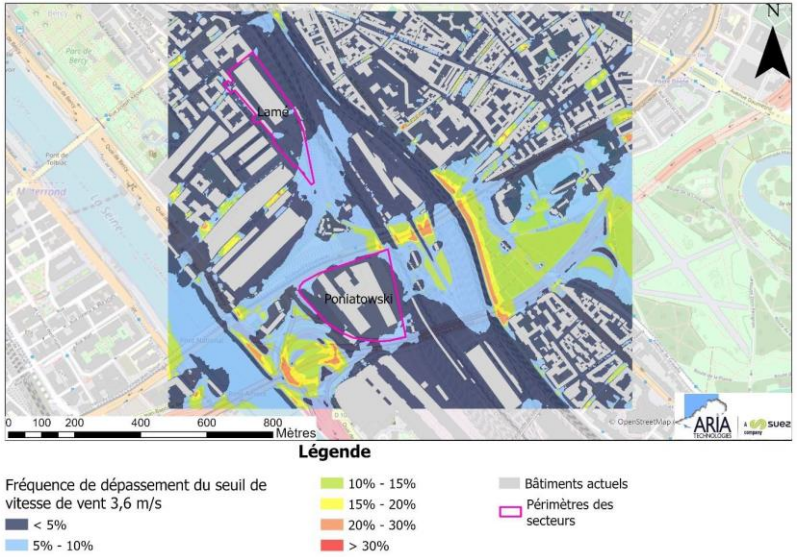

Without project




With project

# Airflow study - Wind comfort as part of an urban development project in Paris

- Frequency map of exceedance of the threshold of 3.6 m/s over the year 2021 corresponding to the frequency of discomfort in the wind
- Dark blue areas are comfortable for standing still, light blue zones are comfortable for normal walking, green and yellow zones are comfortable for fast walking, orange and red areas are uncomfortable in all cases.

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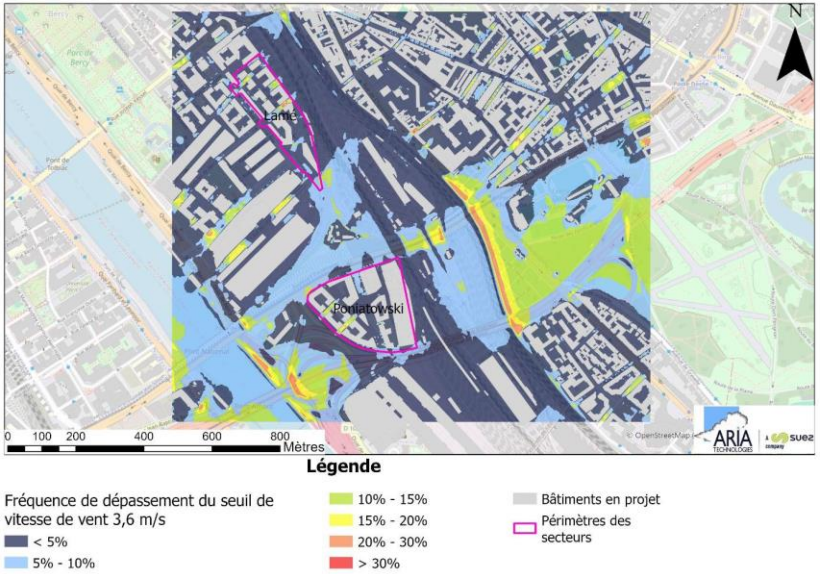
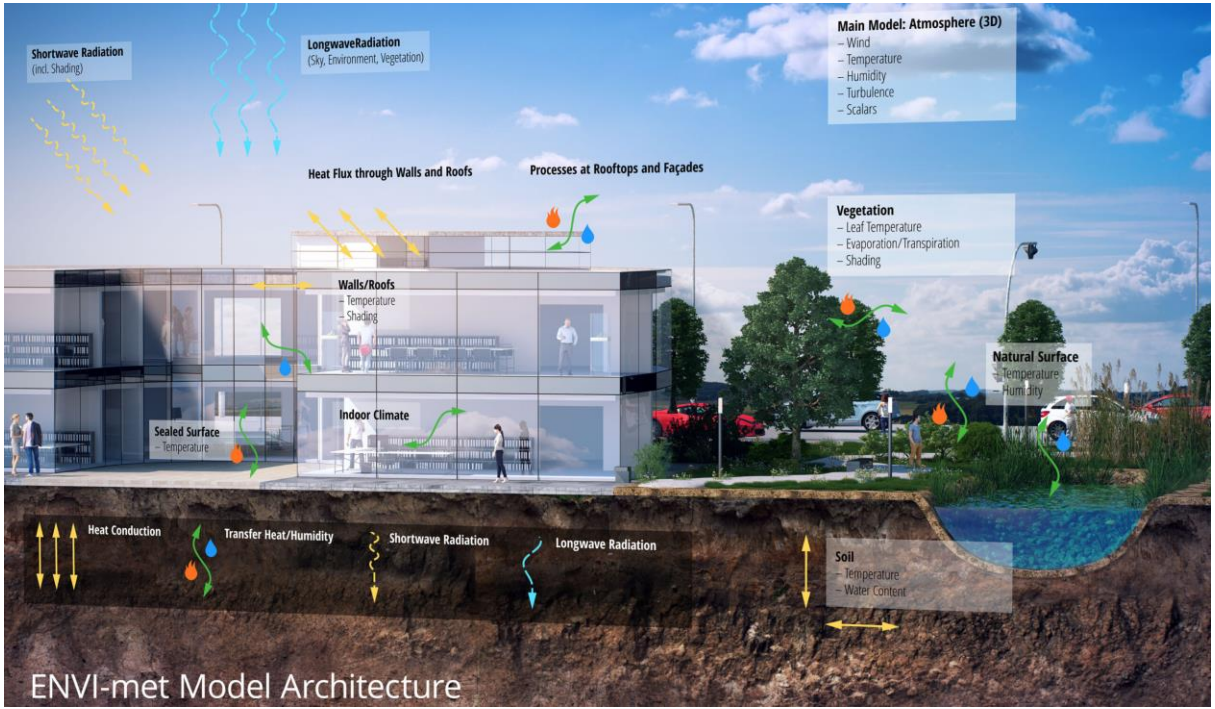



With project

# ENVIMET INTRODUCTION

# Introduction to ENVIMET

- Most models are limited in their ability to take account of vegetation, particularly when determining thermal comfort and the impact of UHI (Urban Heat Index).
- ENVI-MET is CFD program for modelling the urban microclimate on a neighborhood scale. It takes into account vegetation as well as various surface and building materials to calculate their exchanges with the environment.



# THERMAL COMFORT STUDY

# CREATION OF A PROPERTY PROJECT IN THE PARIS REGION

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# Thermal Comfort study - Creation of a property project in the Paris region

- The comfort study was carried out on a residential project in Paris region with the ENVIMET model. The aim of the project was to add new housing to the area.

# Thermal Comfort study - creation of a property project in the Paris region

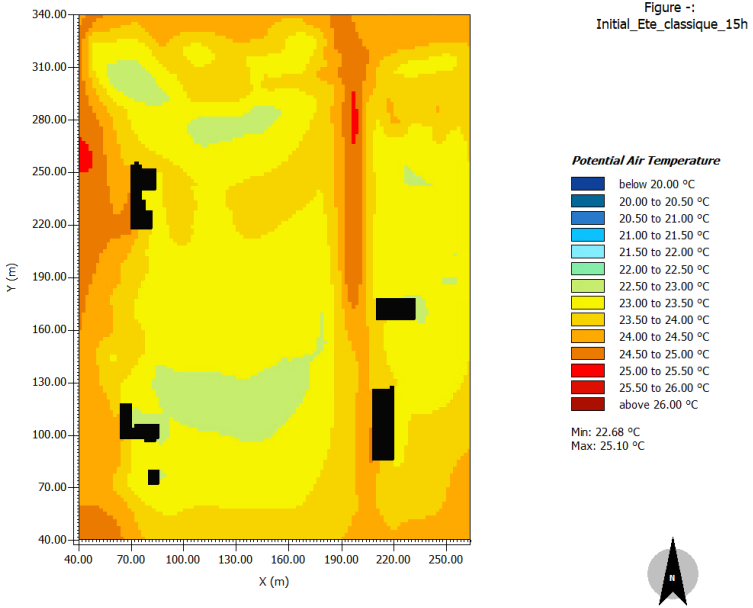
- A comparison with and without the project was carried out to observe the impact on urban comfort.


Without project


With project

# Thermal Confort study - Creation of a property project in the Paris region

- Temperature is an important climatic parameter, particularly for assessing the comfort of residents, as it is the parameter most perceptible to the individual. Temperature maps were produced for daytime at 3pm.
- Buildings cast shadows that create cooler areas. Less warm zones are located in the densest vegetation, corresponding to shrub and tree thickets

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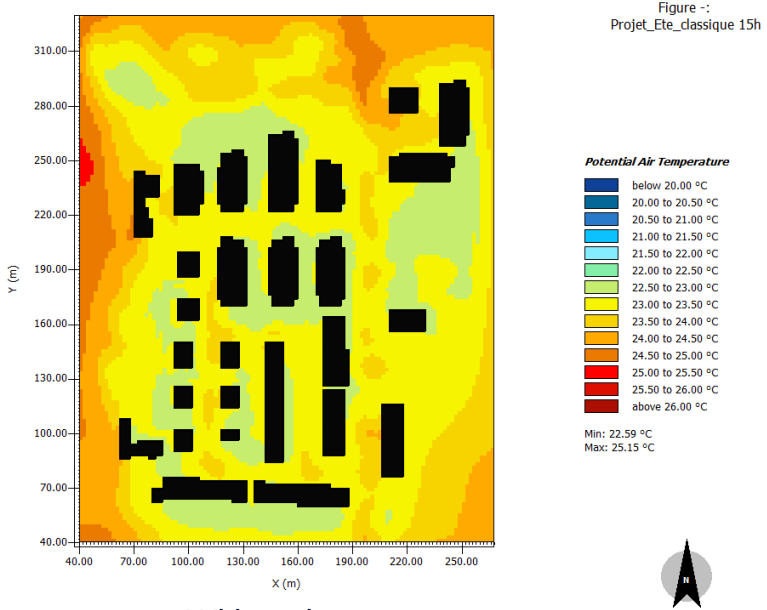
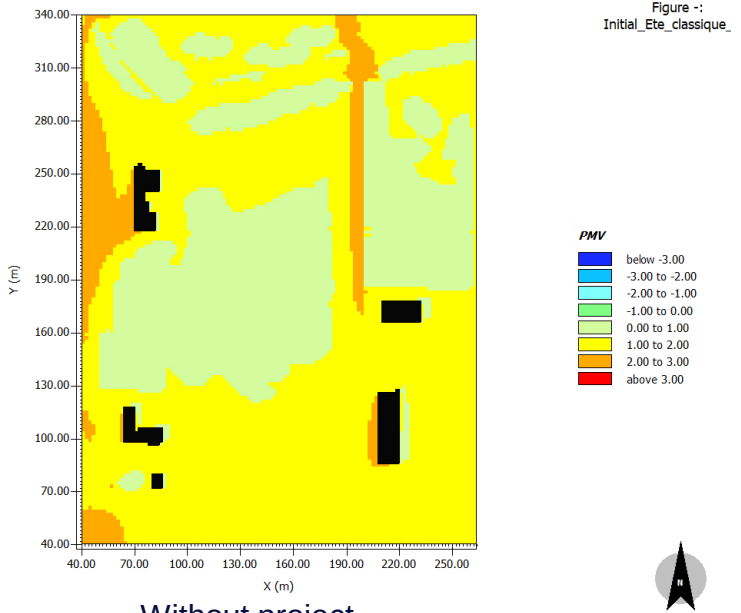



With project

# Thermal Comfort study - Creation of a property project in the Paris region

- The comfort indicator known as PMV (Predicted Mean Vote) is calculated from wind speed, wind direction and average radiant temperature. It is considered pleasant, ranging from slightly cool (-1) to slightly warm (+1). PMV map with and without project are shown below.
- An improvement in the PMV index is observed mainly in the vegetated areas created by the project and in the wake of the buildings due to the turbulence generated by the winds behind the buildings.

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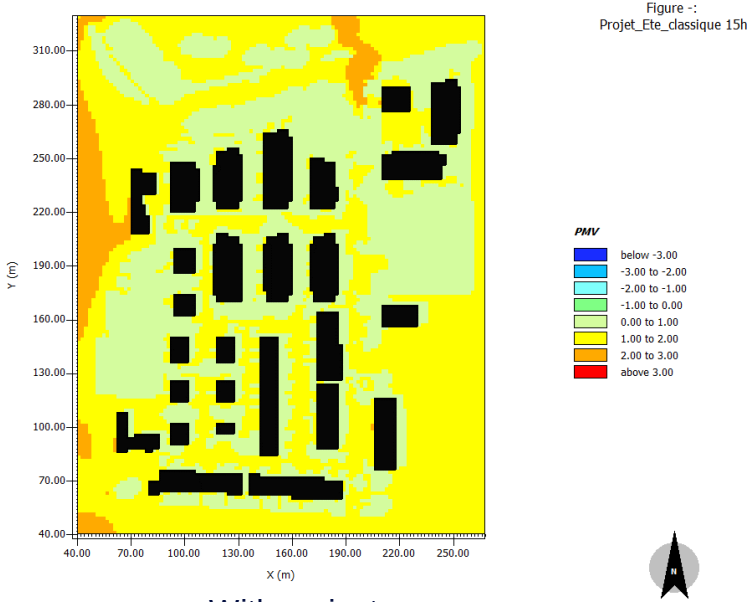


With project

# Thermal Comfort study - Creation of a property project in the Paris region

- The results can be viewed in 3D

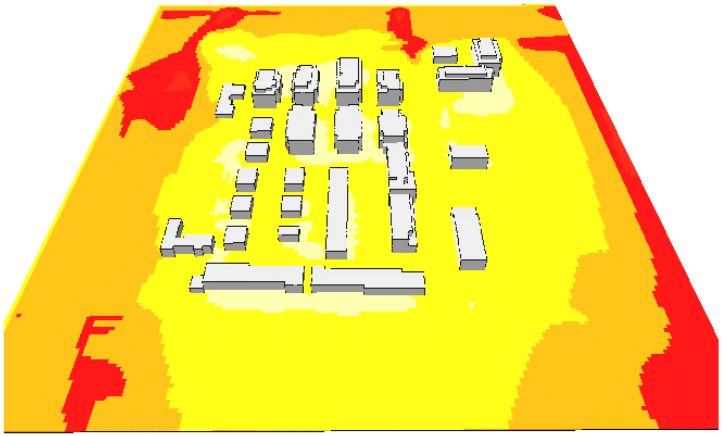

Figure -:
Projet_Ete_classique 15.00.01
01.07.2021
x/y Cut at k=0 (z=0.2000 m)

***Potential Air Temperature***

- below 20.00 °C
- 20.00 to 20.50 °C
- 20.50 to 21.00 °C
- 21.00 to 21.50 °C
- 21.50 to 22.00 °C
- 22.00 to 22.50 °C
- 22.50 to 23.00 °C
- 23.00 to 23.50 °C
- 23.50 to 24.00 °C
- 24.00 to 24.50 °C
- 24.50 to 25.00 °C
- 25.00 to 25.50 °C
- 25.50 to 26.00 °C
- above 26.00 °C

Min: 22.50 °C
Max: 25.69 °C

# THERMAL COMFORT STUDY

# CREATION OF AN URBAN FOREST IN PARIS

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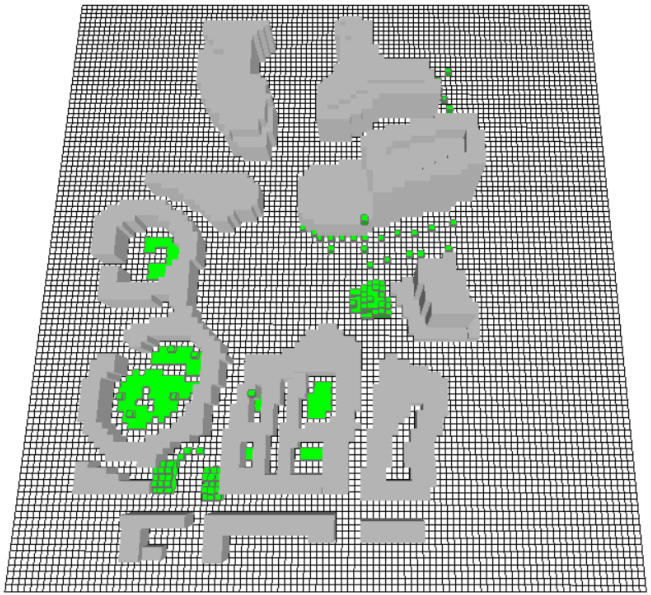
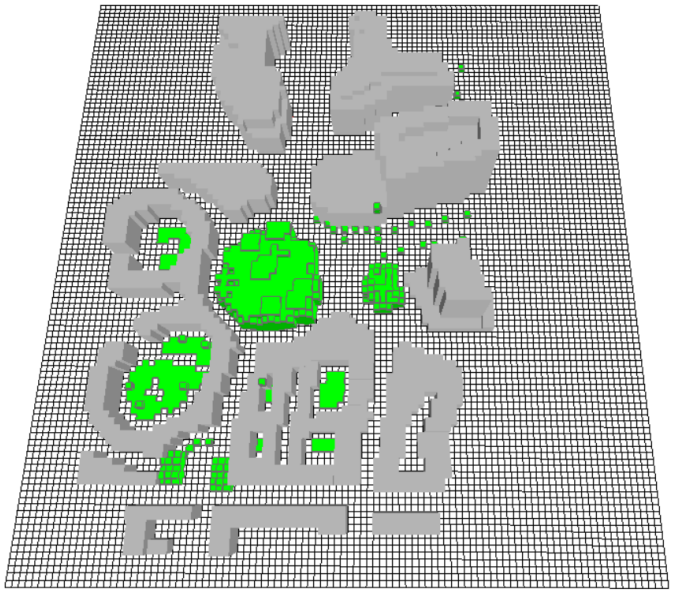
# Thermal Comfort study - Creation of an urban forest in Paris

- The comfort study was carried out in a town square. The aim of the project was to create a forest to replace the square with a fountain in the middle. Pictures bellow represent the square with and without project.



Without project



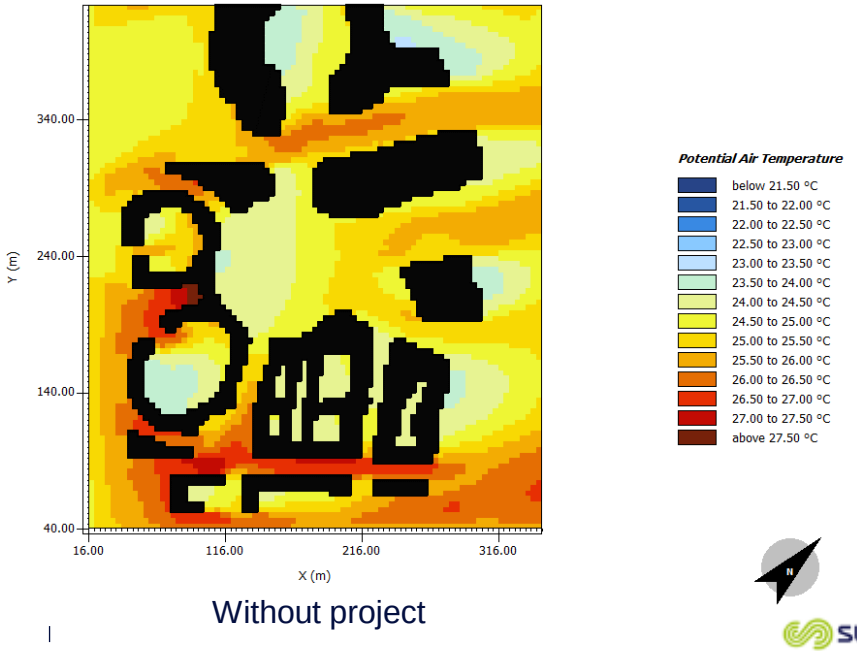
With project

# Thermal Comfort study - Creation of an urban forest in Paris

- Temperature map with and without project are shown below.
- The forest in the center of the square and the fountain refresh the air
- Cooler areas are observed in the courtyards

Figure -: Classique_Initial 15.00.00 25.07.2019

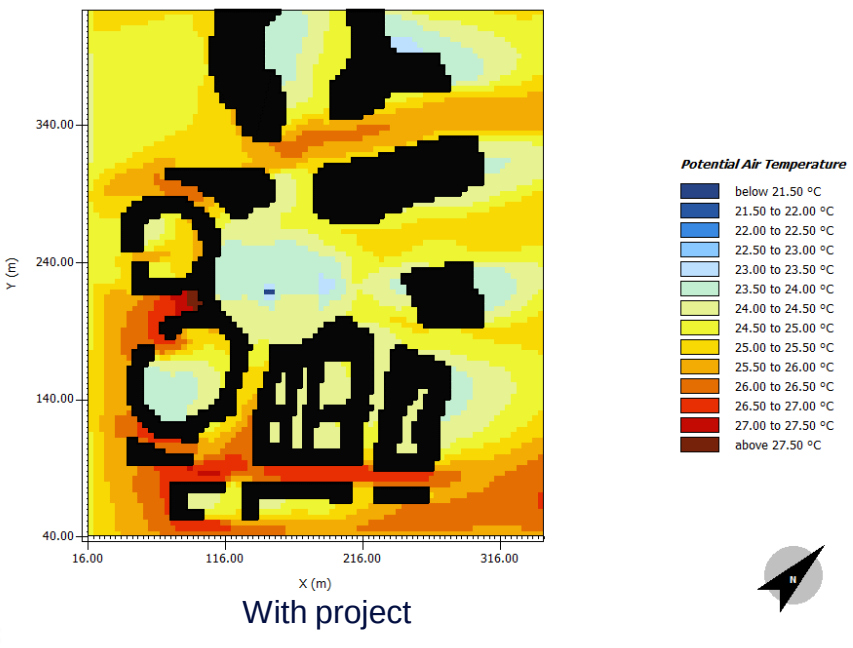
x/y Cut at k=4 (z=1.8000 m)




Without project

Figure -: Classique_projet 15.00.00 25.07.2019

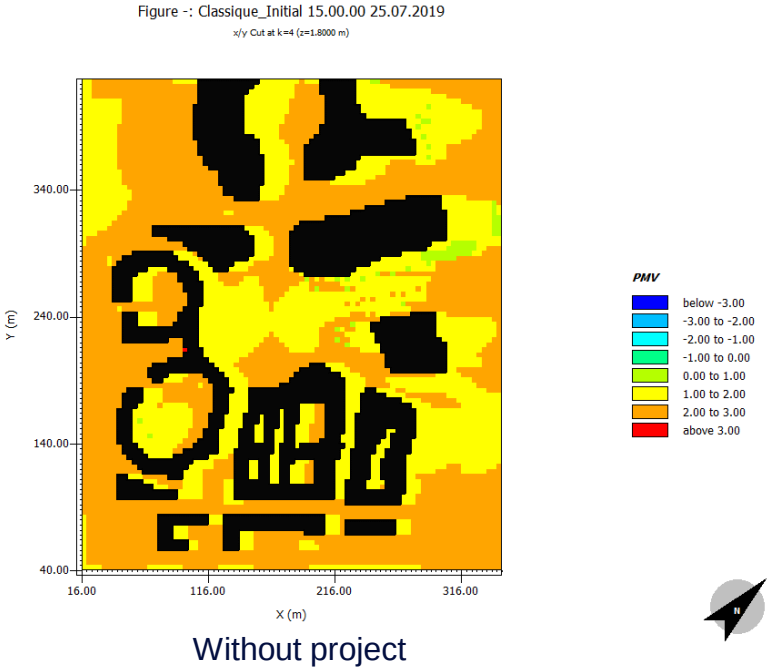
x/y Cut at k=4 (z=1.8000 m) above terrain




With project

# Thermal Comfort study - Creation of an urban forest in Paris

- PMV map with and without project are shown below
- The forest provides shade, creating cooler areas

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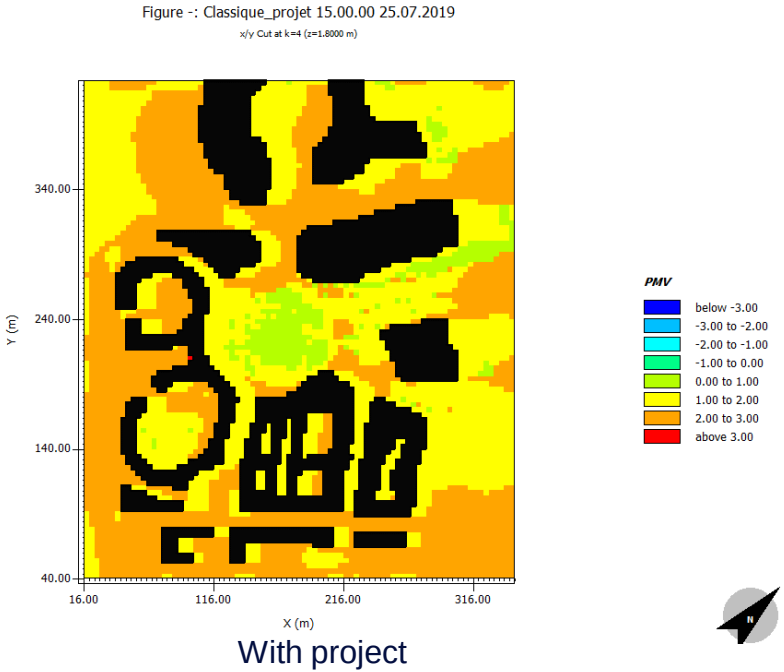


With project

# Conclusion

- PSWIFT model enables wind comfort studies with a low computing time and calculation statistic.

- ENVI-MET model is more suitable for UHI (Urban Heat Index) impact. It enables to carry out urban comfort studies, whether for urban developments, new buildings or changes in materials. But the calculation time is longer.

# THANK YOU