

# Cambiamenti climatici ed effetti sulle città

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# GLOBAL WARMING

## CAUSES

**Greenhouse Effect**

Without it the earth would be  $-20^{\circ}\text{C}$

One third of short wave energy reflected

heat absorbed earth warms, the earth radiates long wave radiation.

By greenhouse gases

**HEAT** Trapped?

**HUMAN ACTIVITY**

30% INCREASE IN  $\text{CO}_2$  SINCE INDUSTRIAL REVOLUTION!

Equivalent to the 160 billion tons of  $\text{CO}_2$  that ends an **ICE AGE**

But that took thousands of years!

Next ice age not due for 5000 years

Not taken seriously till 1980's

Life balances greenhouse gases

**LIFE**

Water Vapor  
 $\text{CO}_2$   
 $\text{O}_2$   
Methane  
Nitrous Oxide

## GAI A THEORY

Who? → **NORTH HEMISPHERE IS COOLING?**

Who? → **50MM MAIN ENEMIES**

Who? → **BIG OIL**

EVERYBODY OF FLOOD PROOFING

Rising Population

## ICE CORES

$\text{CO}_2$  recording starts 1958

$\text{CO}_2$  trapped Antarctica & Greenland

$\text{CO}_2$  & Temperature co-varied for 400,000 years

3°C change in decades

## EVIDENCE

**WEATHER CHANGE**

1997-1998 ARE THE HOTTEST YEARS ON RECORD

1977-83 EL Niño strongest ever

40% storm increase

20cm increase in sea level

20th Century 0.6°C increase

2000/2001 in the UK had 2 floods, these previously occurred in 30 year cycles

10 FOLD INCREASE IN PROPERTY LOSS IN 30 YEARS

5.8°C+ BY 21st CENTURY

Tree migration ↑

## IACC REPORT

## SOLUTIONS

United States  
Europe  
Asia

James Lovelock

THE RICH NATIONS SINCE 1700'S

10X  $\text{CO}_2$  PER CAPITA OF CHINA

180 COUNTRIES

George W. Bush

1-2% reduction in emissions for 35 richest

NEW TECHNOLOGY

Wind solar efficiency nuclear

STILL HASN'T JOINED

**Kyoto**

1997

Climate change costs \$10 billion per year per country billion

60-80% cut in emissions

ICE AGE - 10000 years ago

UNWARRANTED - ONLY 1% OF THE WORLD IS CHANGING

POTENTIALLY MORE DANGEROUS THAN KNOWLEDGE

IMMEDIATE REWARDS

OPPORTUNITIES

FRESH WATER AVAILABLE

DISEASE MALARIA

## Global Warming of 1.5 °C

*an IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*

In its [decision](#) on the adoption of the Paris Agreement, the Conference of Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC) at its 21st Session in Paris, France (30 November to 11 December 2015), invited the IPCC to provide a special report in 2018 on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways.

At its [43rd Session](#) (Nairobi, Kenya, 11 – 13 April 2016), the IPCC Panel decided to accept the invitation from the UNFCCC to provide a special report in 2018 on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, and to prepare a Special Report on this topic in the context of strengthening the global response to the threat of climate change, sustainable development and efforts to eradicate poverty.

The scoping meeting that prepared the draft outline for the Special Report was held on 15 – 18 August 2016 in Geneva, Switzerland.

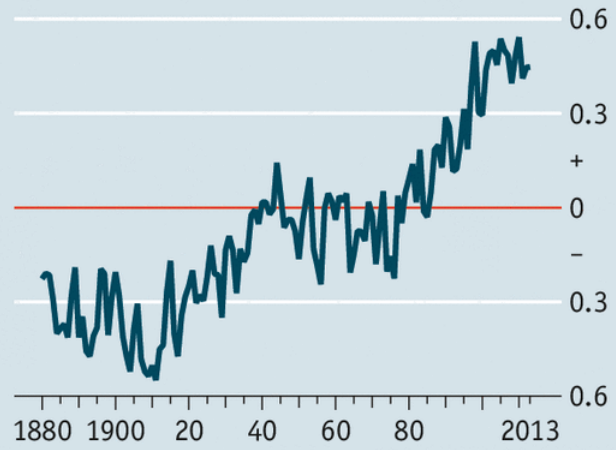
During its [44th Session](#) (Bangkok, Thailand, 17-20 October 2016), the Panel approved the [outline](#) of *Global Warming of 1.5°C, an IPCC Special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*.

The Special Report is being developed under the joint scientific leadership of Working Groups I, II and III with support from WGI TSU.

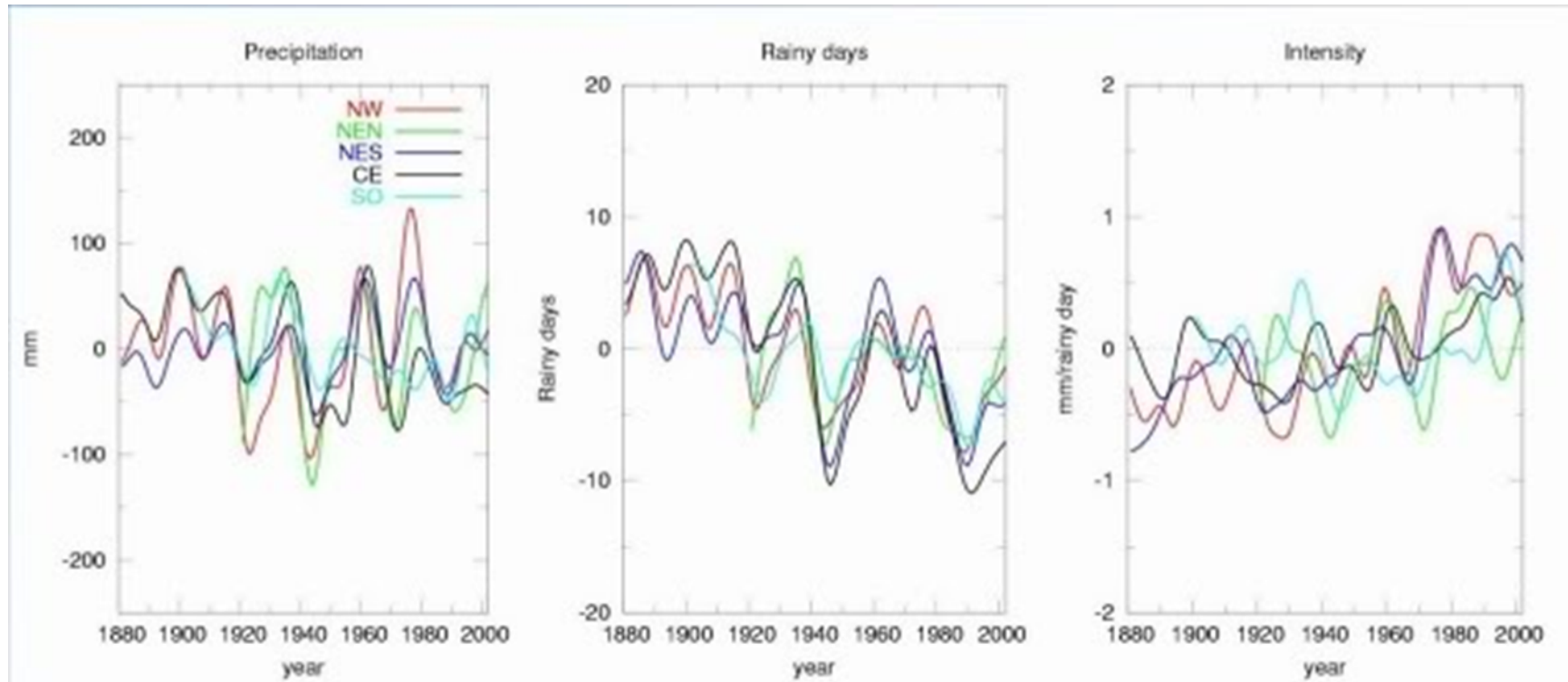
## A third pause

Global surface temperature

Deviation from 1961-1990 mean, °C

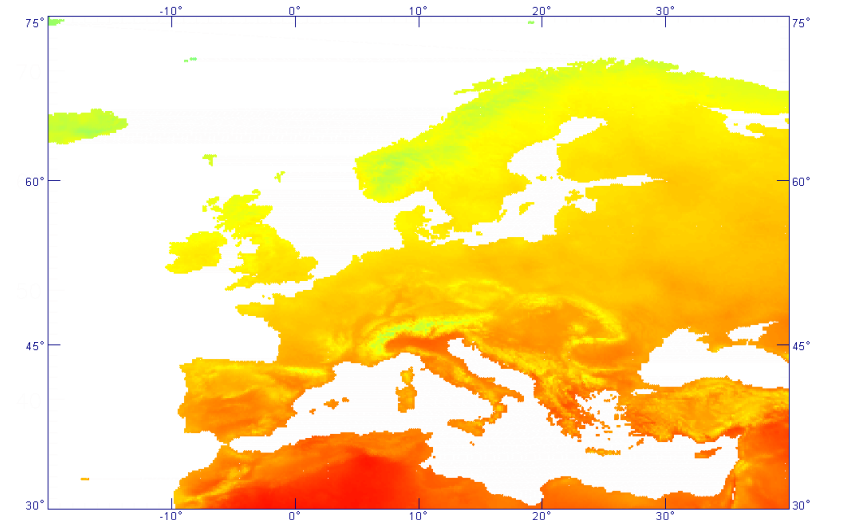
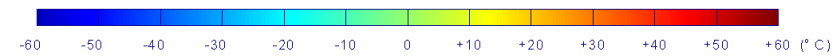
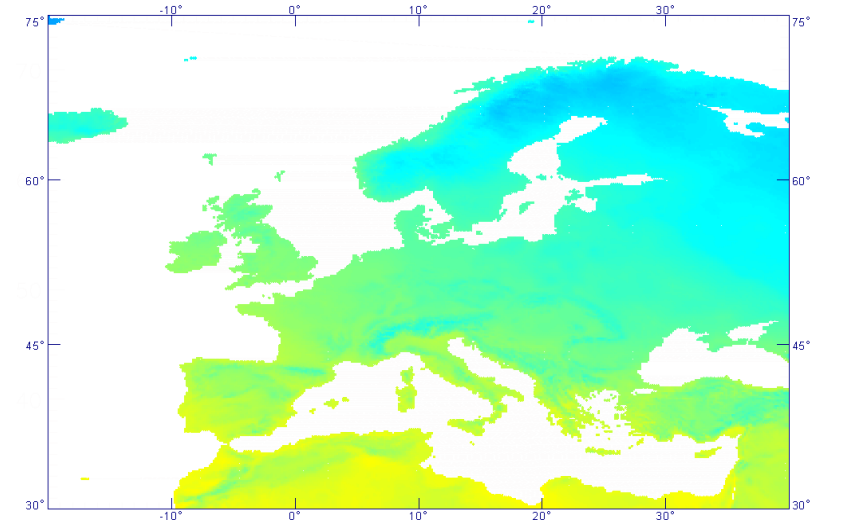


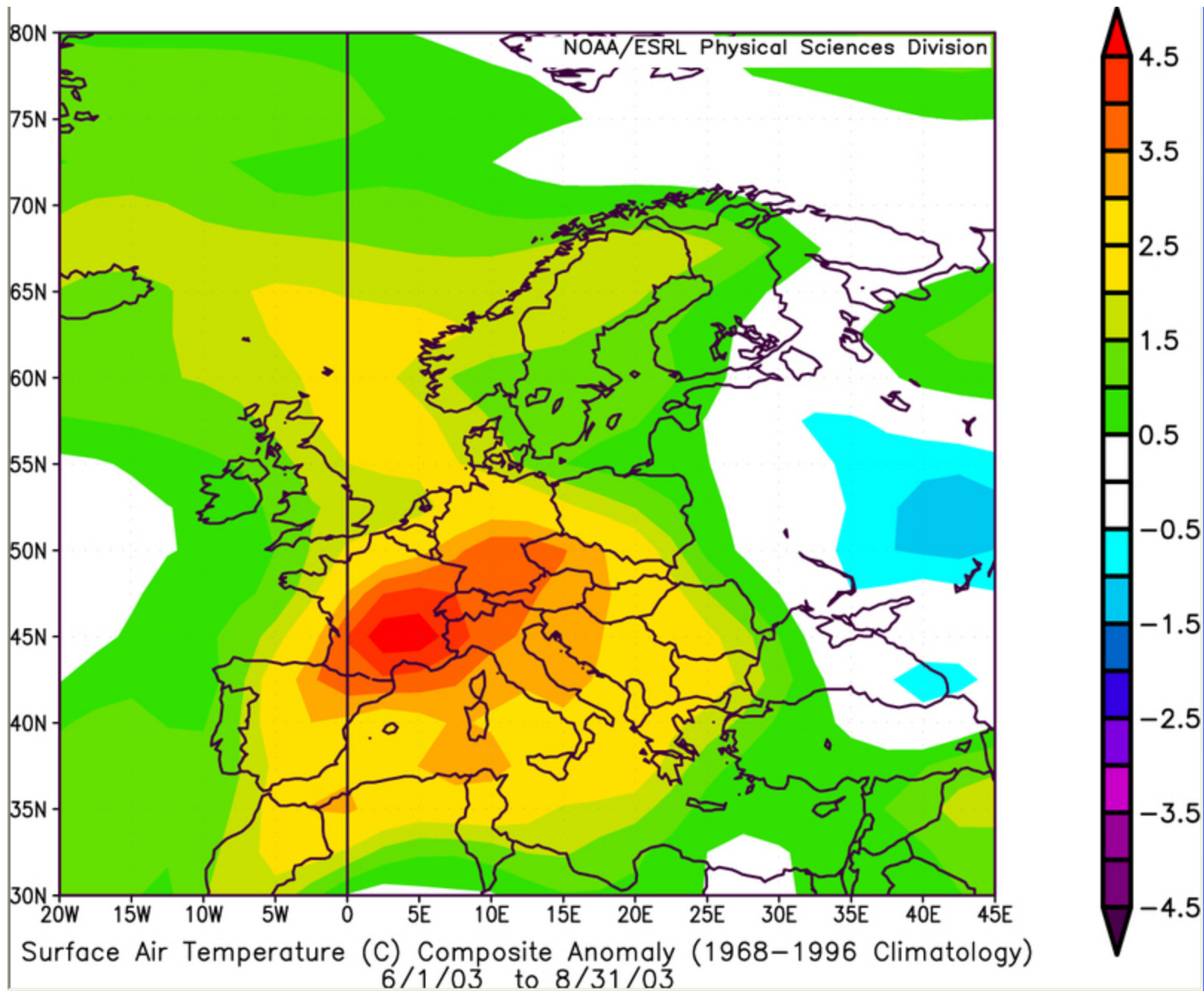
Source: Met Office



Seasonal values of PET for different IPCC-Scenarios for 1960-1990 and 2070-2100  
for Europe

		Winter	Spring	Summer	Autumn
<b>Base</b>	<b>Max</b>	<b>16.0</b>	<b>27.2</b>	<b>43.1</b>	<b>29.8</b>
	<b>Min</b>	<b>-27.6</b>	<b>-15.0</b>	<b>1.2</b>	<b>-13.9</b>
<b>A1F</b>	<b>Max</b>	<b>21.2</b>	<b>34.7</b>	<b>51.6</b>	<b>37.9</b>
	<b>Min</b>	<b>-17.9</b>	<b>-6.9</b>	<b>5.7</b>	<b>-7.0</b>
<b>A2A</b>	<b>Max</b>	<b>20.3</b>	<b>33.4</b>	<b>51.5</b>	<b>36.4</b>
	<b>Min</b>	<b>-19.4</b>	<b>-8.6</b>	<b>5.4</b>	<b>-8.1</b>
<b>B1A</b>	<b>Max</b>	<b>18.4</b>	<b>30.7</b>	<b>48.3</b>	<b>33.8</b>
	<b>Min</b>	<b>-20.8</b>	<b>-10.4</b>	<b>3.8</b>	<b>-10.5</b>
<b>B2A</b>	<b>Max</b>	<b>19.2</b>	<b>31.6</b>	<b>49.5</b>	<b>34.7</b>
	<b>Min</b>	<b>-22.1</b>	<b>-10.7</b>	<b>4.2</b>	<b>-9.2</b>





## **Definizione EPA**

**(agenzia protezione ambientale USA)**

*While there is no universal definition of a heat wave, this indicator defines a heat wave as a four-day period with an average temperature that would only be expected to occur once every 10 years, based on the historical record.*

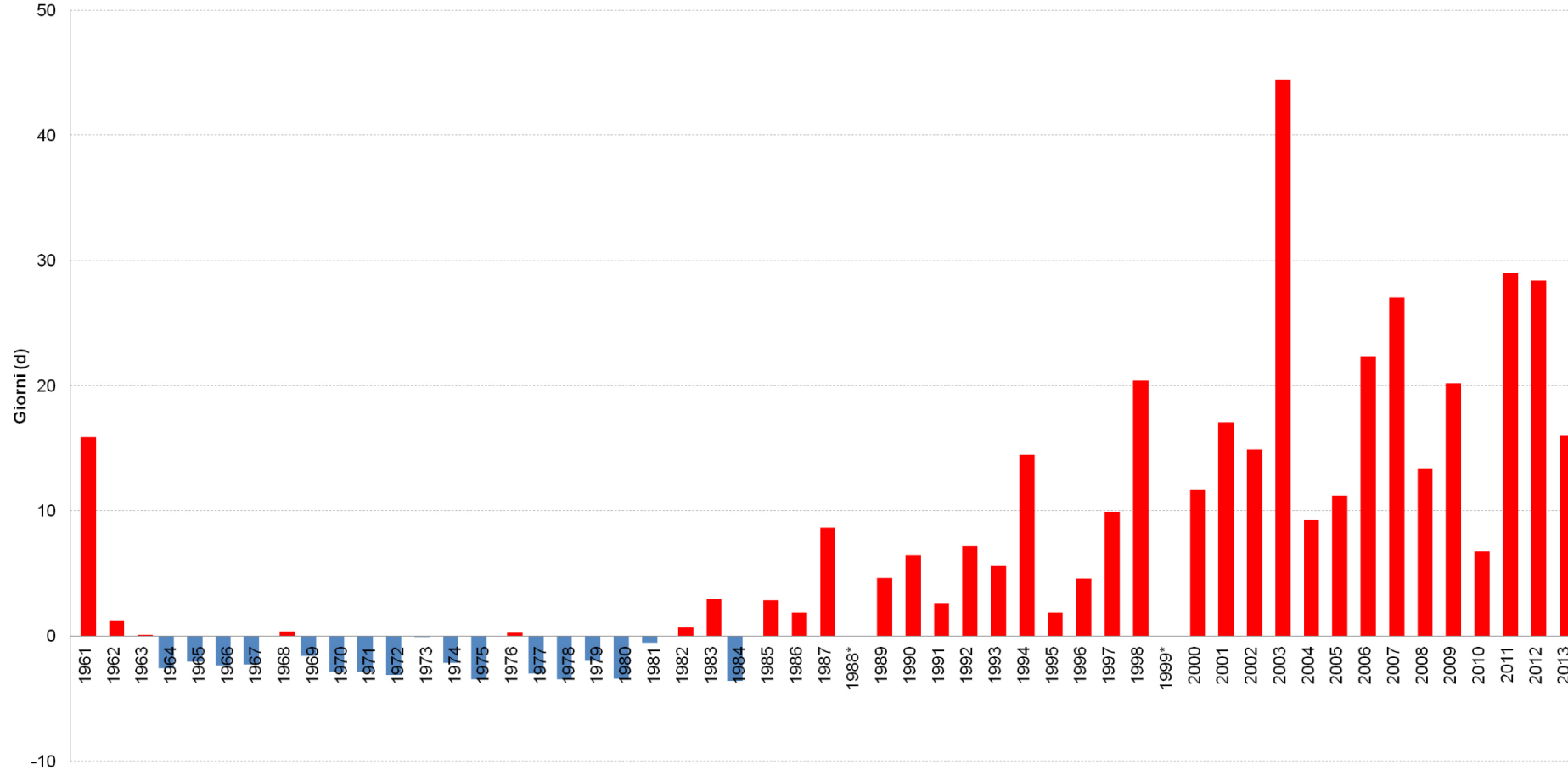
Secondo il **servizio meteorologico francese**, la definizione è applicabile a periodi con temperature massime superiori ai 30 °C

per il **servizio meteorologico britannico** sono sufficienti temperature superiori di almeno 4 °C rispetto alla media del periodo

l'indicatore "onda di calore" definito nel "CCL/CLIVAR Working Group on Climate Change Detection" per l'analisi dei valori estremi di temperatura, identifica un evento della durata di almeno sei giorni consecutivi nei quali la temperatura massima è superiore al 90° percentile della distribuzione delle temperature massime giornaliere nello stesso periodo dell'anno sul trentennio climatologico 1961-1990.

**Per l'Italia** almeno tre giorni con temperature maggiori di 30°C

**file:///C:/Users/utente/AppData/Local/Temp/Minsal\_linee\_guida\_piani\_risposta\_ondate\_calore.pdf**

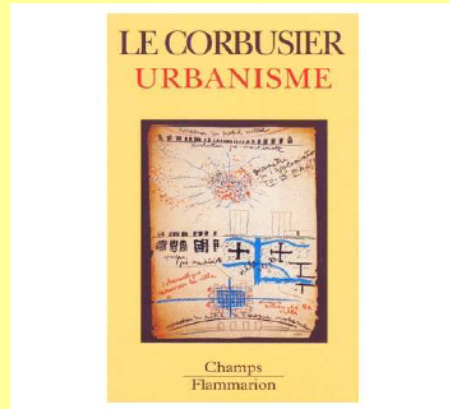


Serie delle anomalie medie annuali del numero di giorni con onde di calore (WSDI) in Italia rispetto al valore normale 1961-1990.



## Le Corbusier 1924

"La ville est un outil de travail. Les villes ne remplissent plus normalement cette fonction. Elles sont inefficaces : elles usent le corps, elles contrecarrent l'esprit. Le désordre qui s'y multiplie est offensant.



leur déchéance blesse notre amour-propre et froisse notre dignité. Elles ne sont pas dignes de l'époque: *elles ne sont plus dignes de nous.*"

Low



Medium

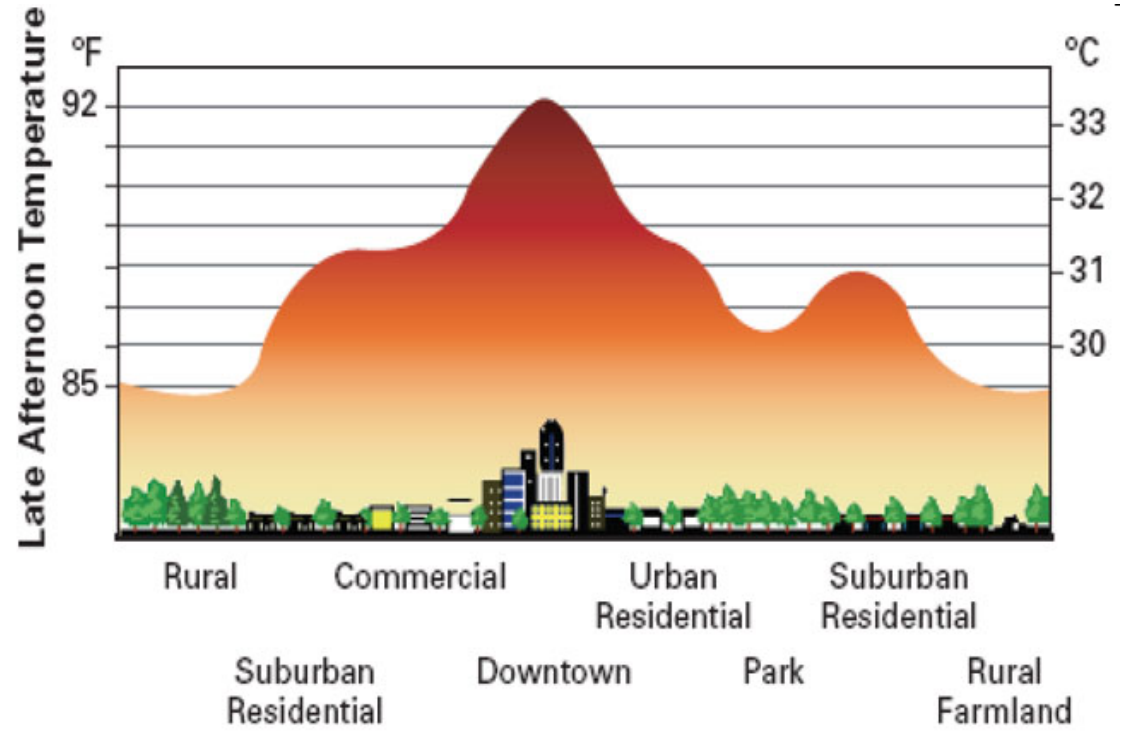
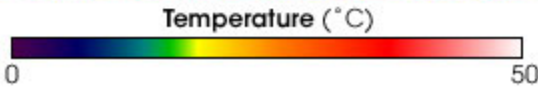


High



High-rise



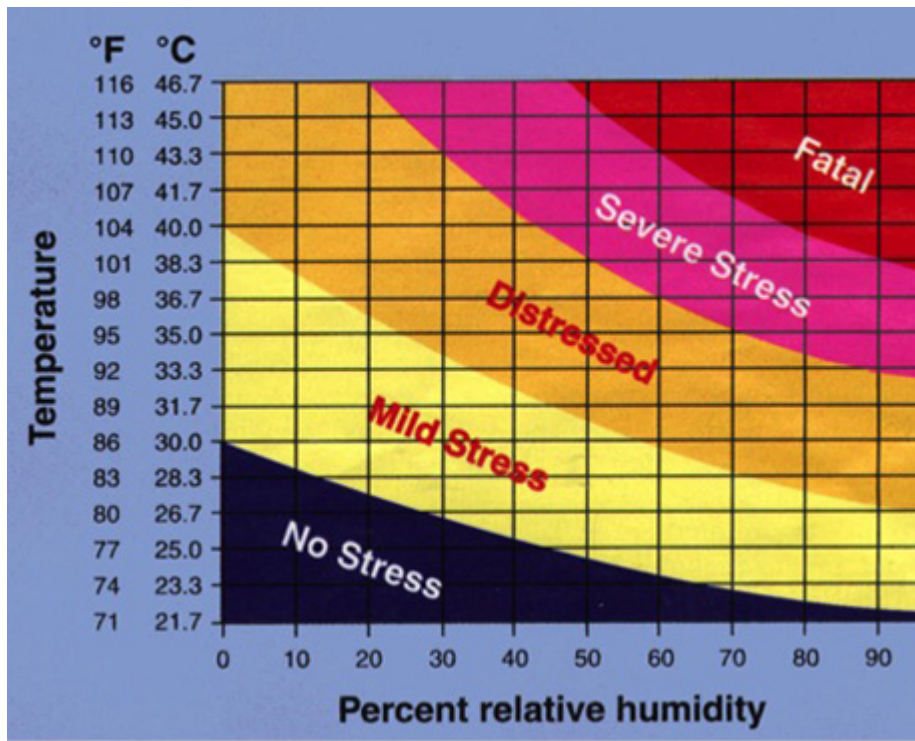


**Centralizziamo il benessere**

# Thermal Comfort

Six factors that affect thermal comfort

- Temperature
- Wind Velocity
- Mean Radiant Temperature
- Humidity
- Clothing Insulation Factor
- Metabolic Heat Rate



PET (°C)	Thermal sensation	Physiological stress level
4	very cold	extreme cold stress
8	cold	strong cold stress
13	cool	moderate cold stress
18	slightly cool	slight cold stress
23	comfortable	no thermal stress
29	slightly warm	slight heat stress
35	warm	moderate heat stress
41	hot	strong heat stress
	very hot	extreme heat stress



Figure 3a: Typical Daily Summer Rural Energy Balance

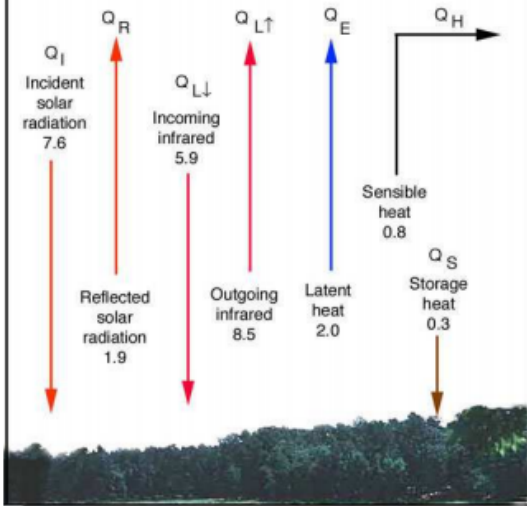
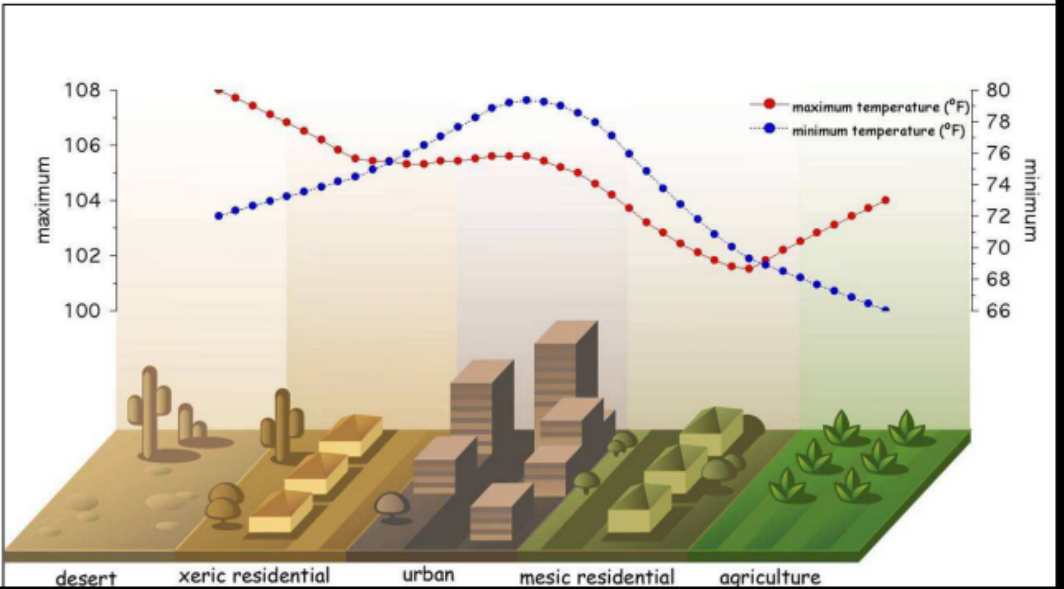
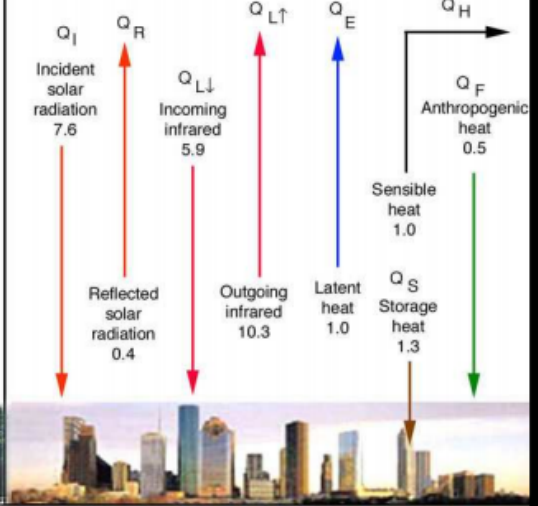


Figure 3b: Typical Daily Summer Urban Energy Balance



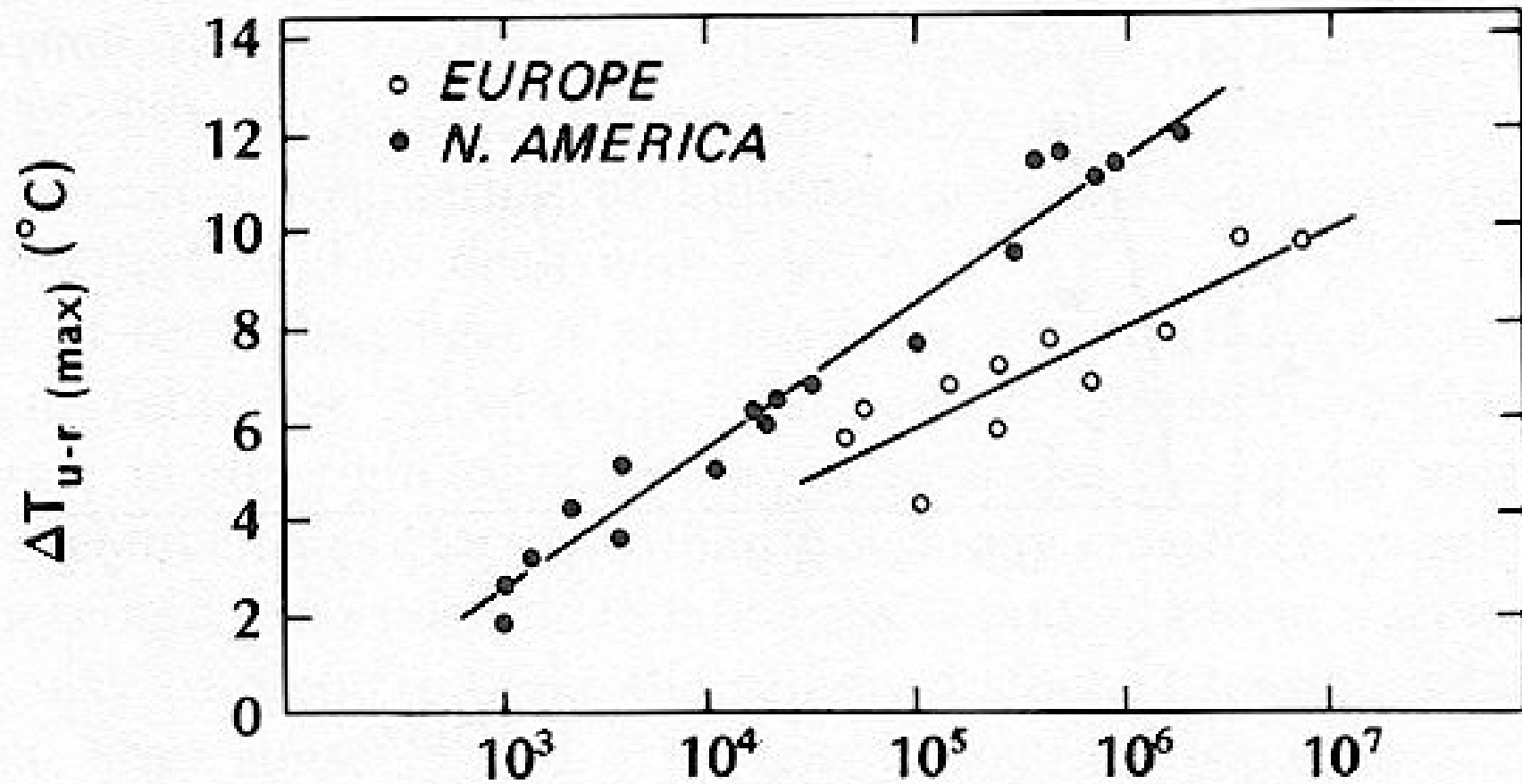
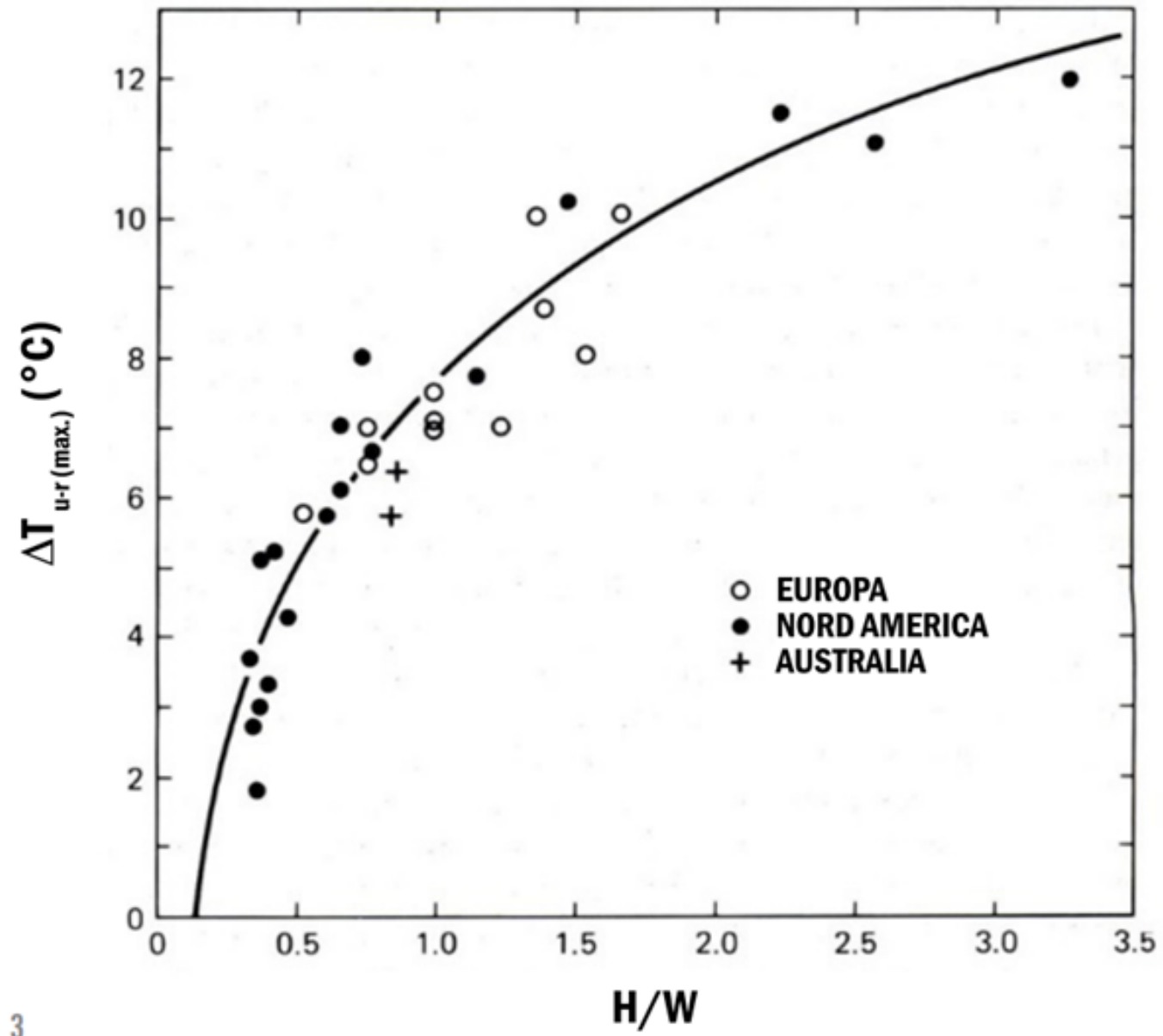
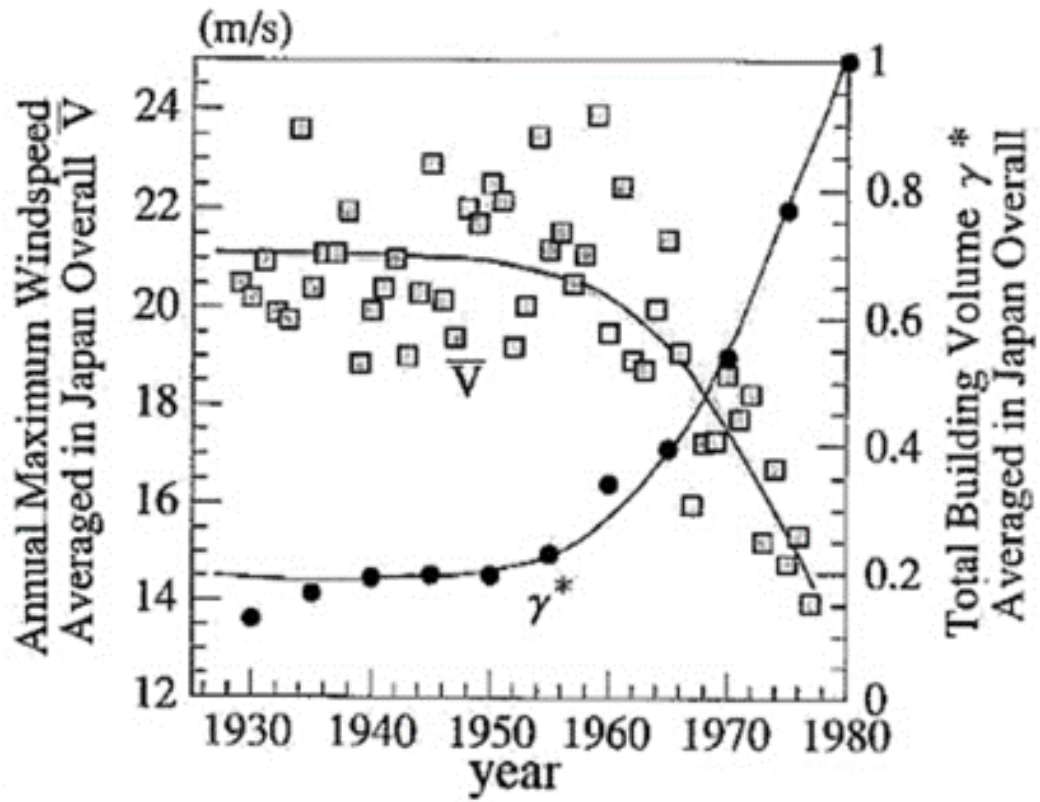


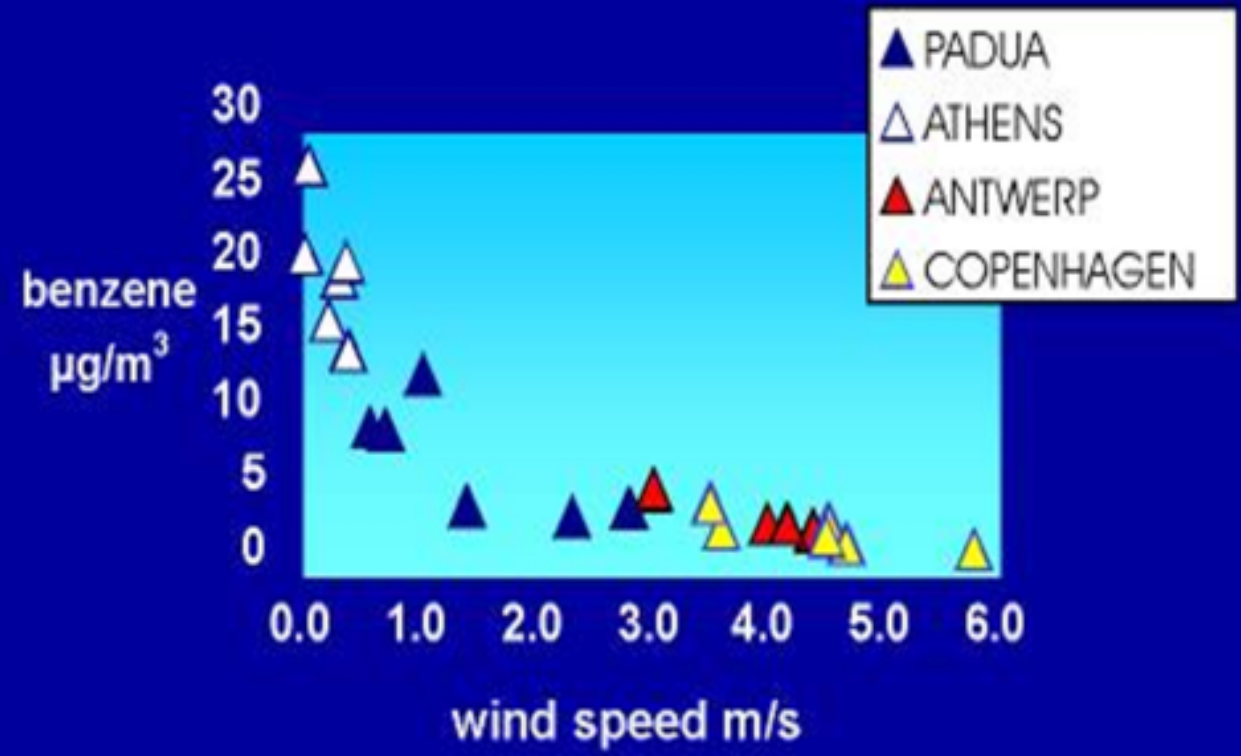
Figure 8.15 Relation between maximum observed heat island intensity ( $\Delta T_{u-r(\max)}$ ) and population ( $P$ ) for North American and European settlements (modified after Oke, 1973).

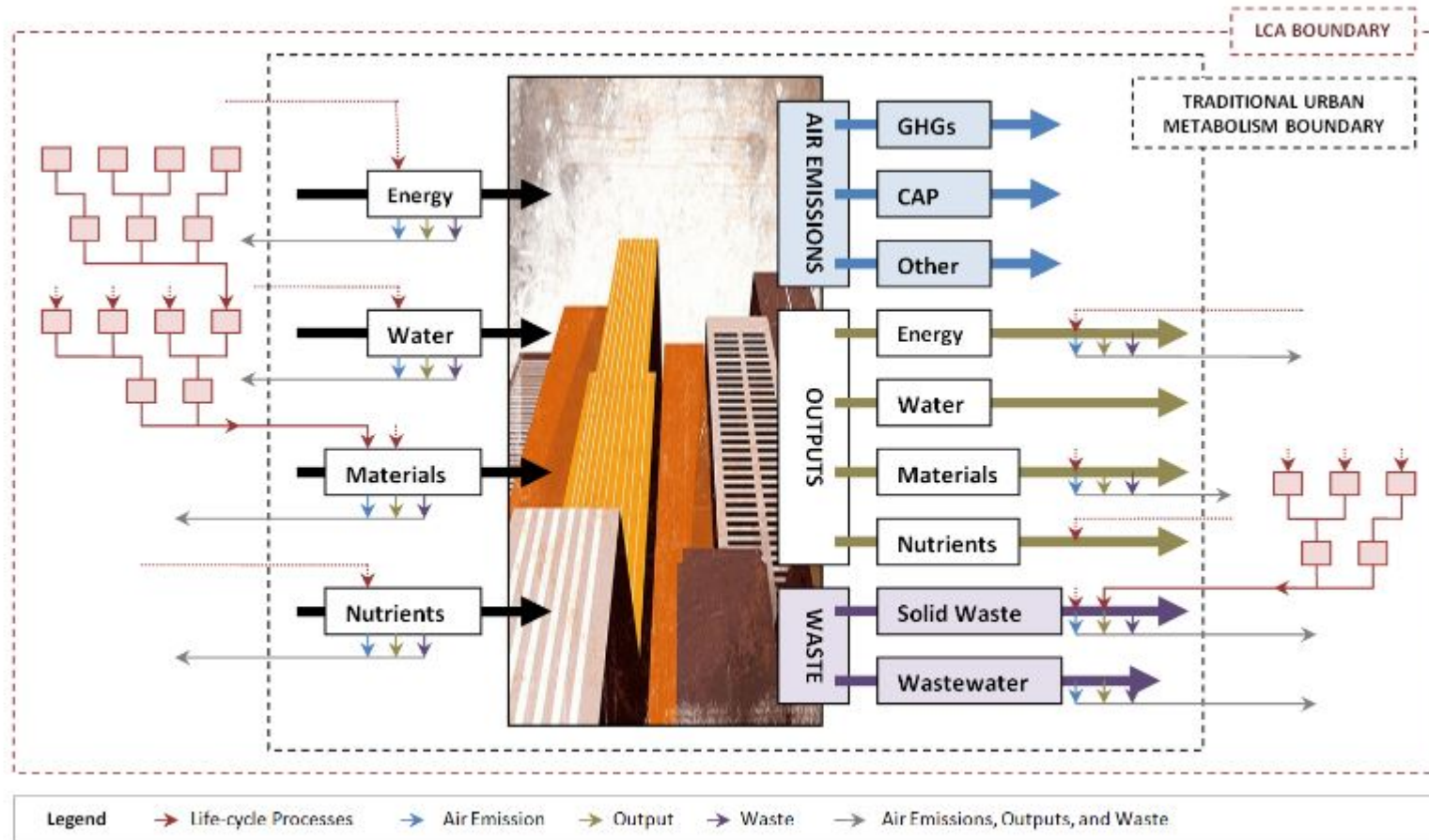






# Wind effect



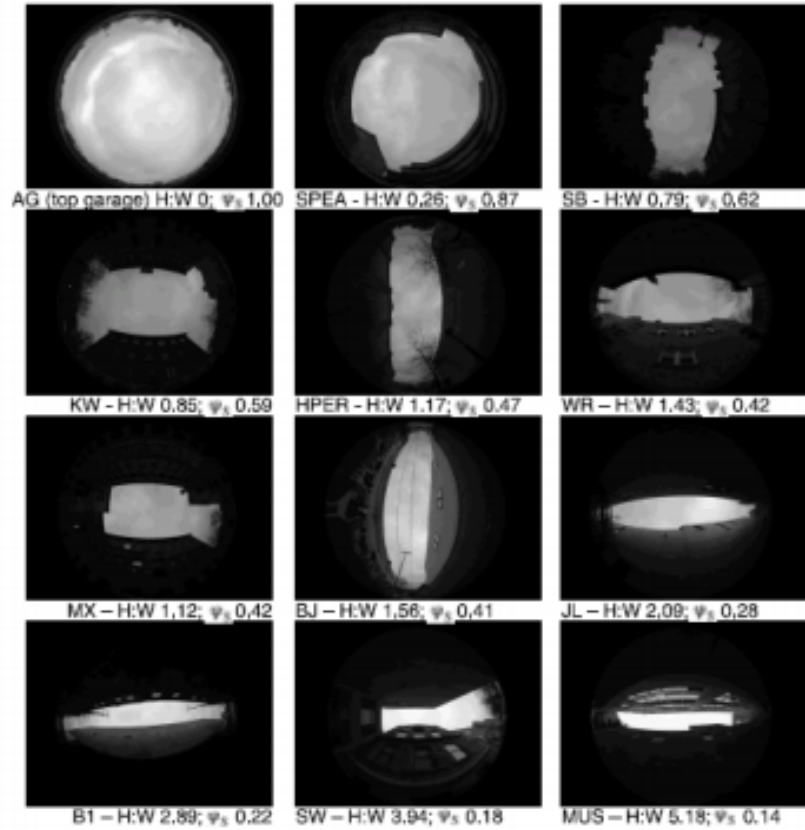


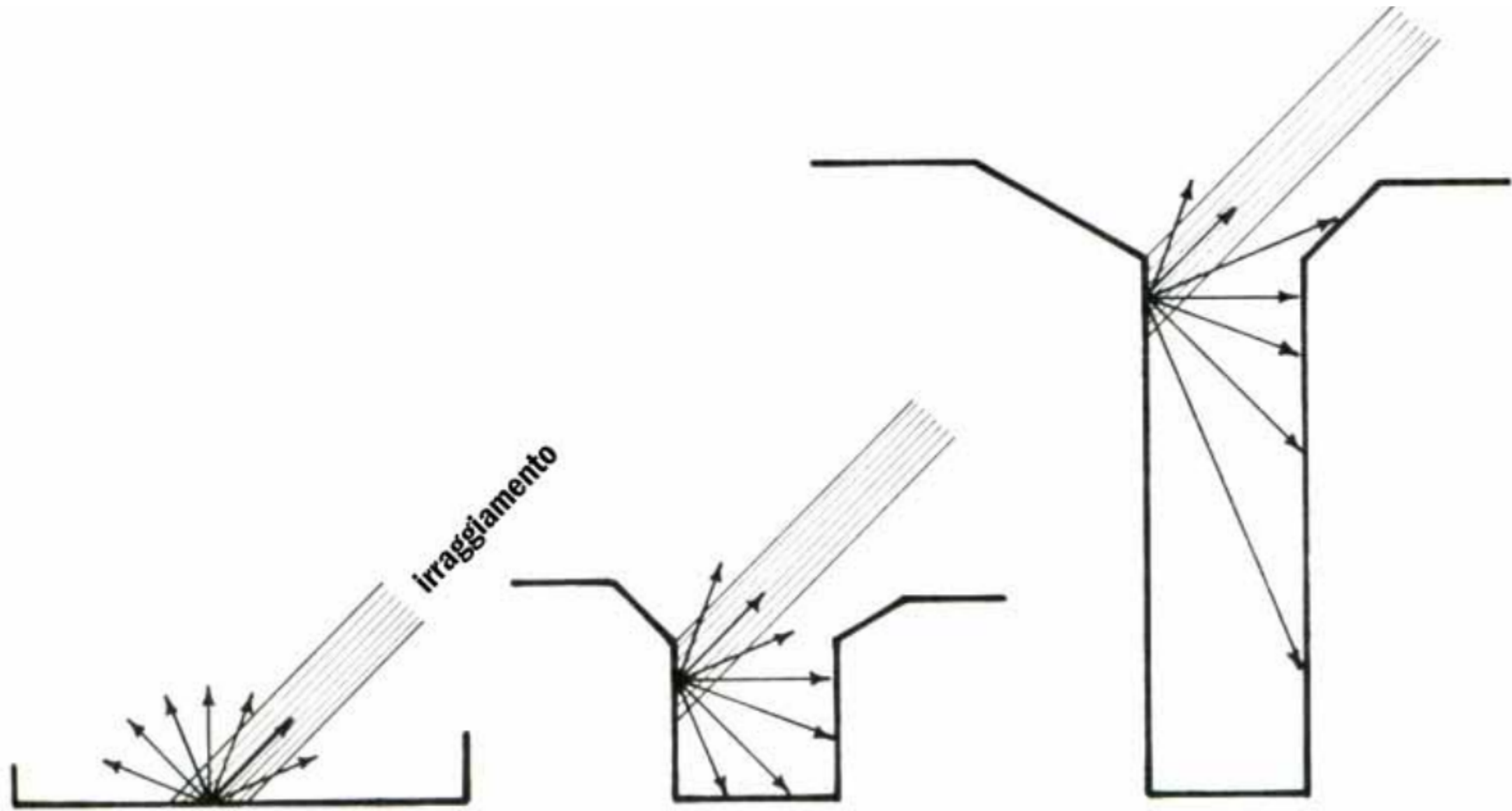
Parliamo di modello di città dal punto di vista fisico...cioè di quella materia che non vi piaceva e che adesso...

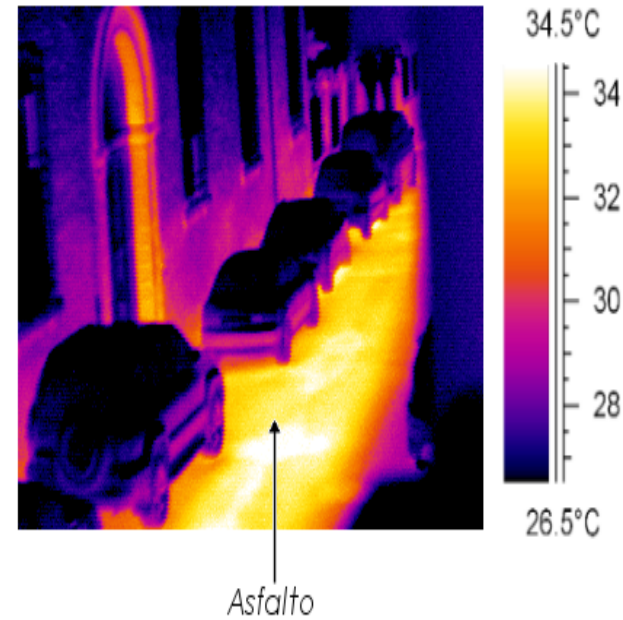
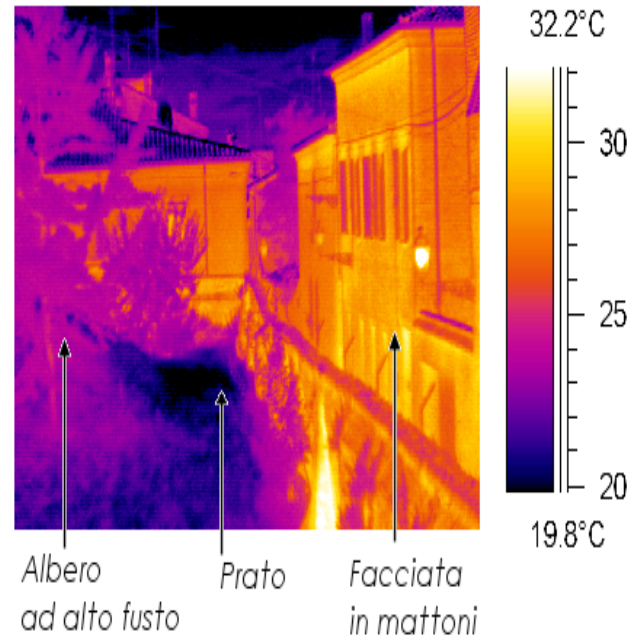
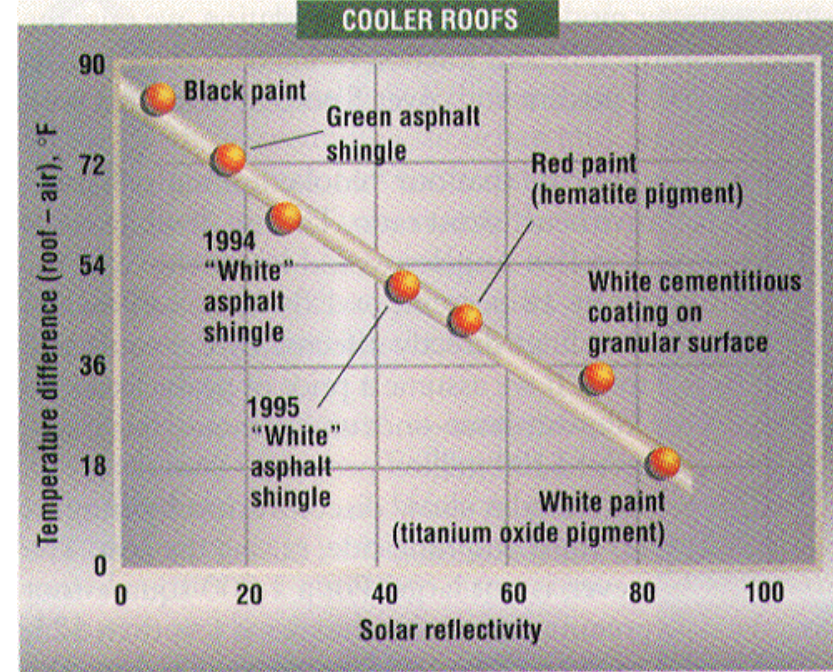
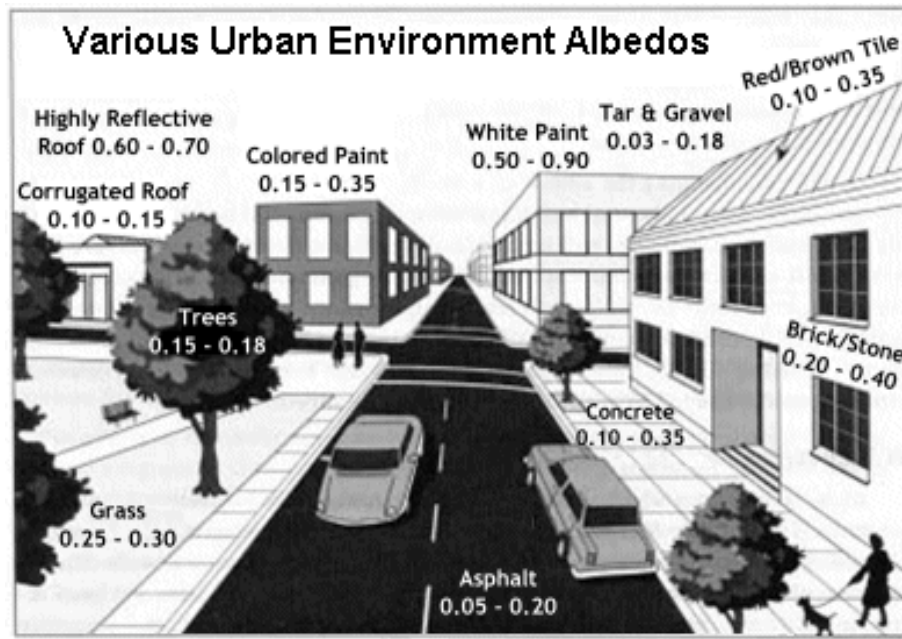
Urban Climate Zone, UCZ <sup>1</sup>	Image	Roughness class <sup>2</sup>	Aspect ratio <sup>3</sup>	% Built (impermeable) <sup>4</sup>
1. Intensely developed urban with detached close-set high-rise buildings with cladding, e.g. downtown towers		8	> 2	> 90
2. Intensely developed high density urban with 2 – 5 storey, attached or very close-set buildings often of brick or stone, e.g. old city core		7	1.0 – 2.5	> 85
3. Highly developed, medium density urban with row or detached but close-set houses, stores & apartments e.g. urban housing		7	0.5 – 1.5	70 – 85
4. Highly developed, low or medium density urban with large low buildings & paved parking, e.g. shopping mall, warehouses		5	0.05 – 0.2	70 – 95
6. Medium development, low density suburban with 1 or 2 storey houses, e.g. suburban housing		6	0.2 – 0.6, up to >1 with trees	35 – 65
6. Mixed use with large buildings in open landscape, e.g. institutions such as hospital, university, airport		5	0.1 – 0.5, depends on trees	< 40
7. Semi-rural development, scattered houses in natural or agricultural area, e.g. farms, estates		4	> 0.05, depends on trees	< 10

Key to image symbols: buildings; vegetation; impervious ground; pervious ground

SKY-VIEW FACTORS ESTIMATION







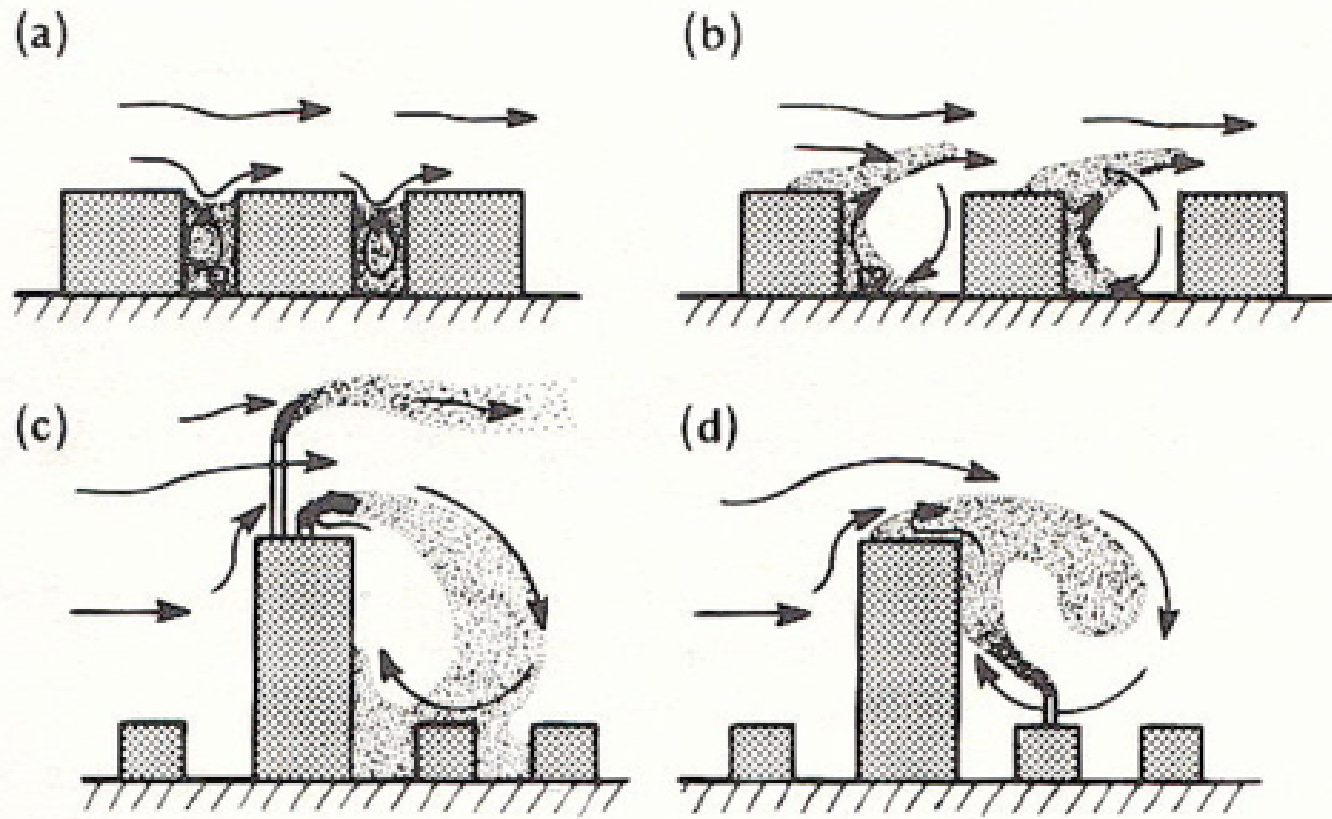
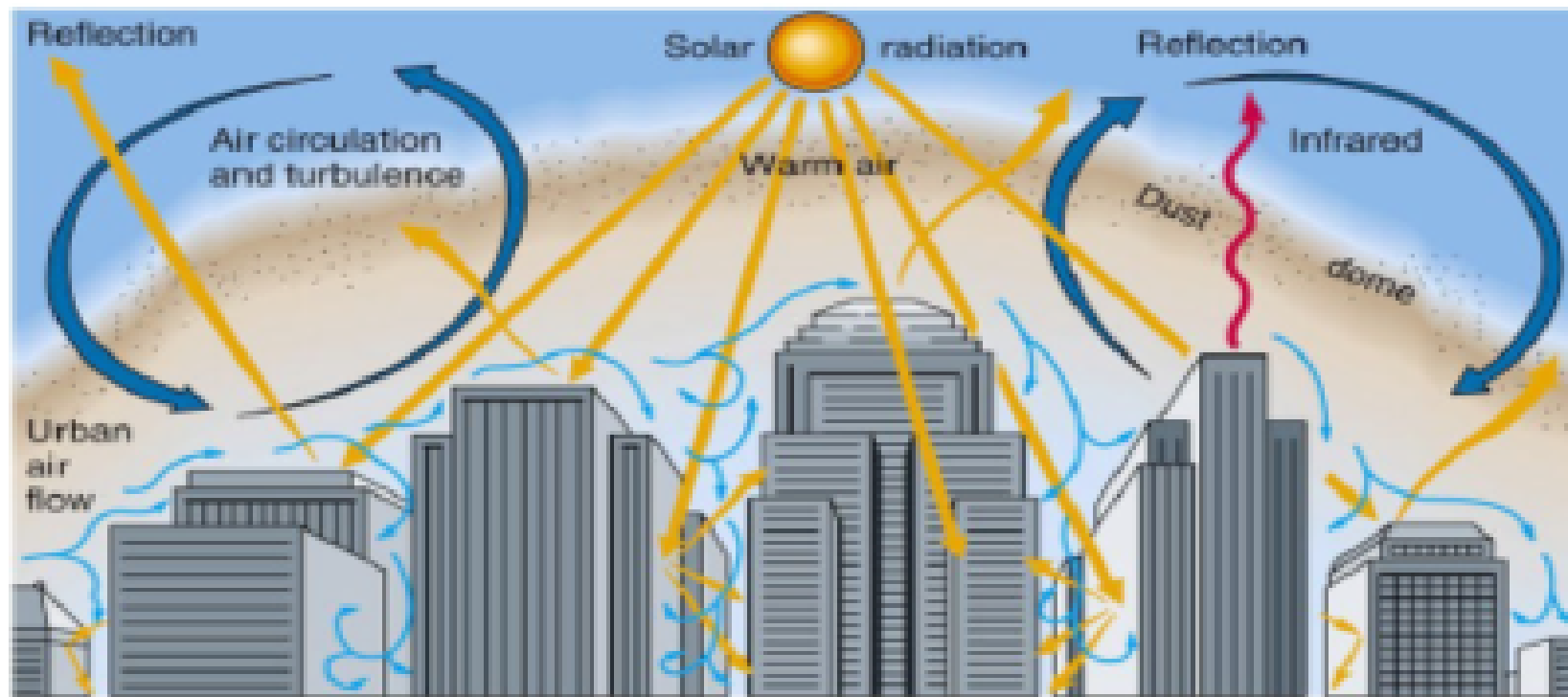


Figure 8.5 The influence of building air flow on pollution dispersion.

# Properties of the urban environment





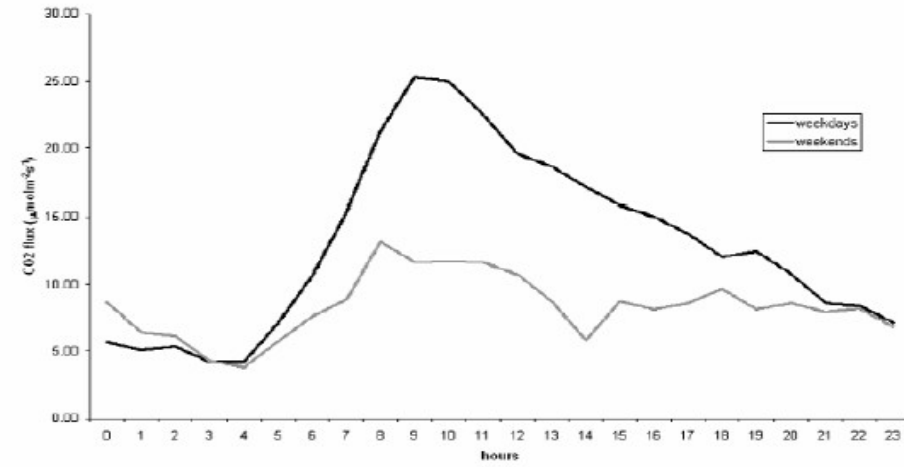


Figura 3: Flusso orario di CO<sub>2</sub> osservato a Roma.

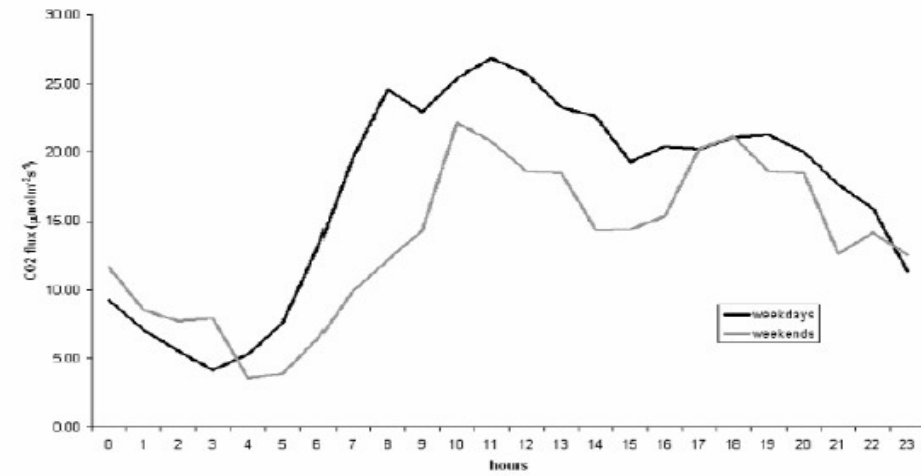


Figura 4: Flusso orario di CO<sub>2</sub> osservato a Firenze.

**E quindi che facciamo? Abbiamo soluzioni tecnologiche? La misurabilità del sistema?**

**Abbiamo abbiamo...**

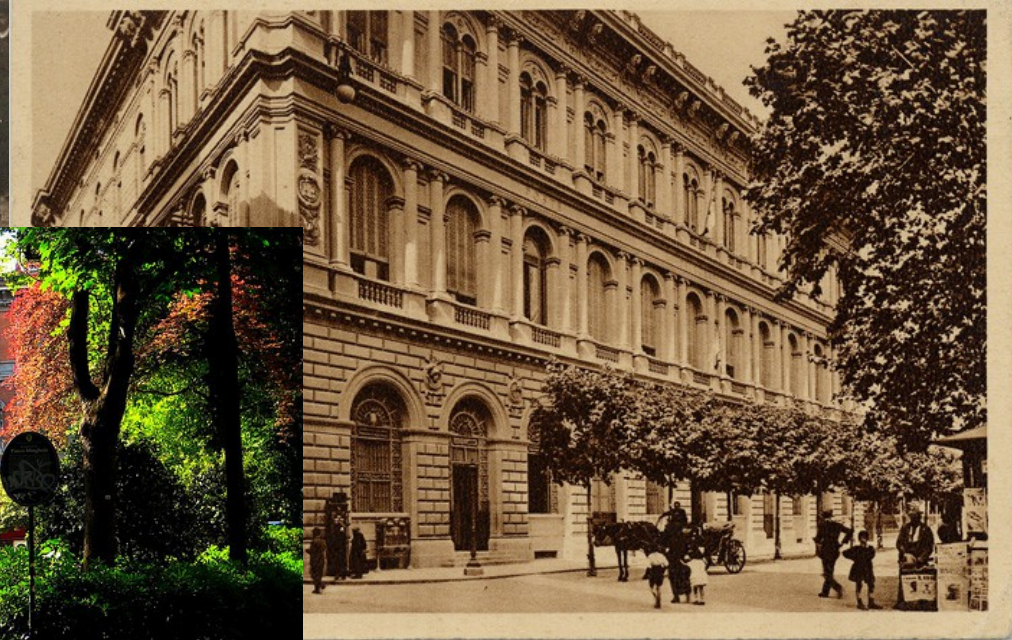
**1- la modellistica fisica ci viene in aiuto**

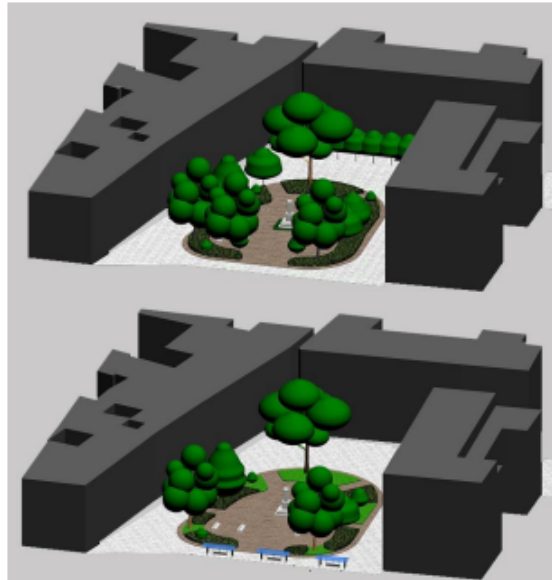
**2- abbiamo soluzioni tecnologiche basate sulle NBS (nature based solutions)**

**3- possiamo misurare ex-ante ed ex-post il progetto**

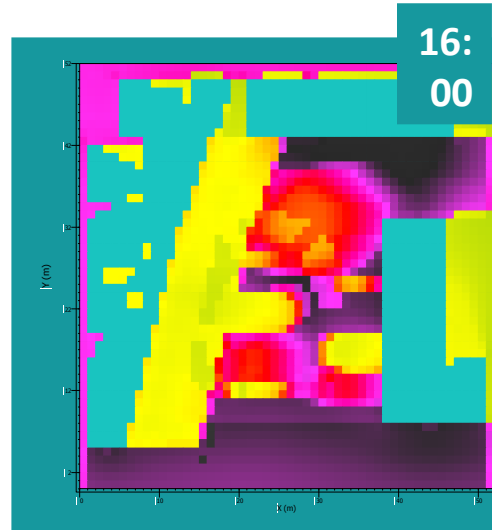
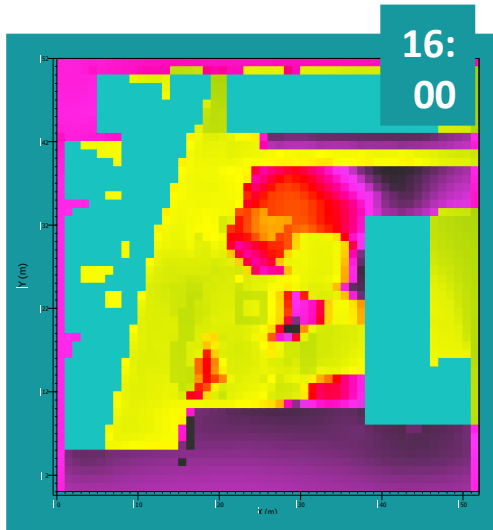
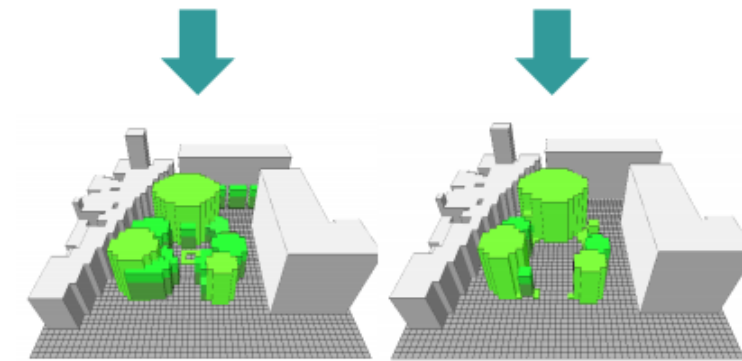
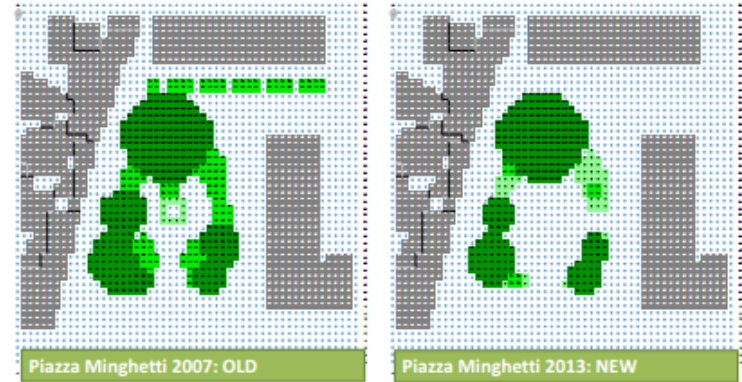
**Perchè senza la misurabilità parliamo di nulla**

*Talvolta la fisica potrebbe aiutare*

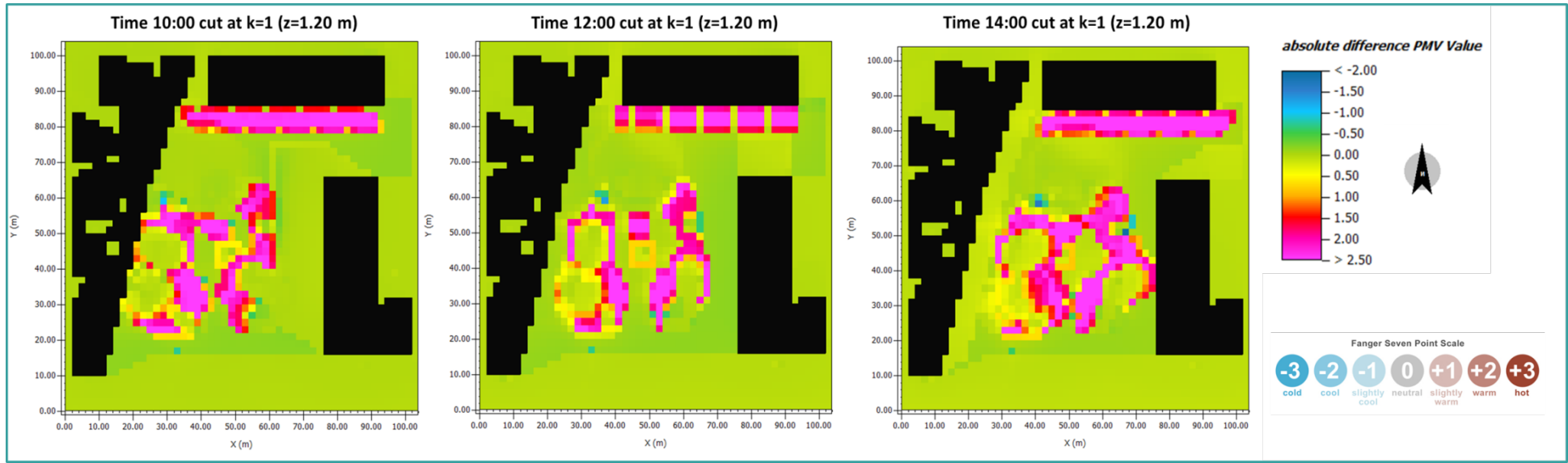
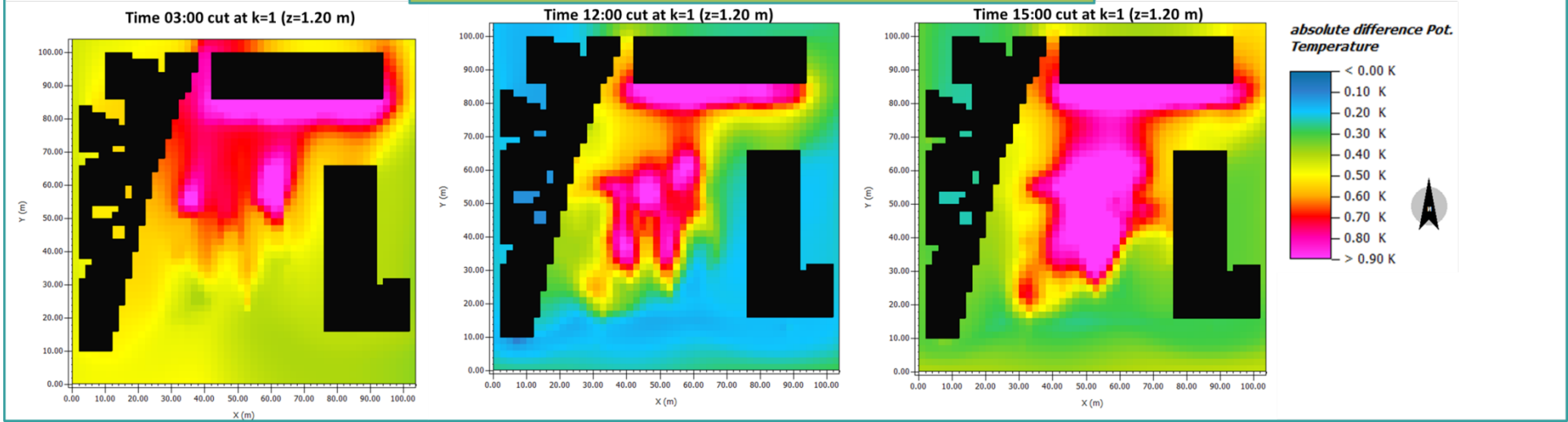




**PIAZZA MINGHETTI ENVI-Met SIMULATION**

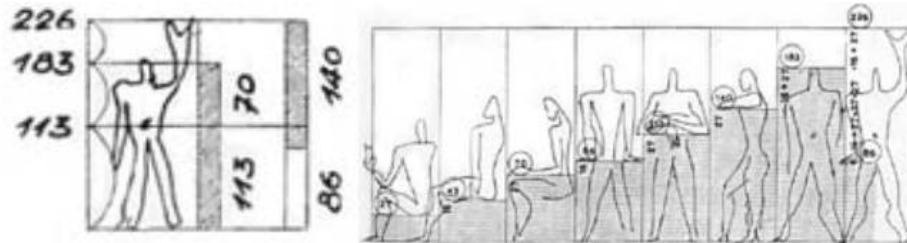
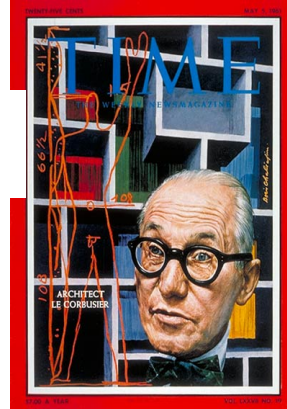


# COMPARISON: NEW (2013)-OLD(2007)



- **"Les matériaux de l'urbanisme sont le soleil, le ciel, les arbres, l'acier, le ciment dans cet ordre et dans cette hiérarchie."**

- Le Modulor



Le Modulor

Une nouvelle mesure humaine

