il clima nelle città…
…anche in periferia, va la’

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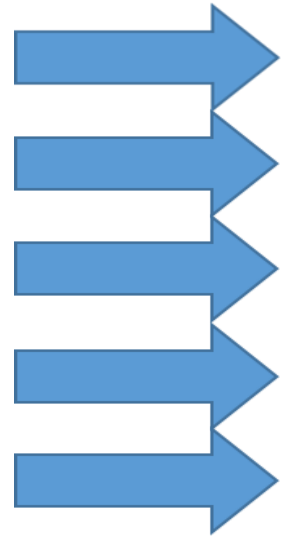
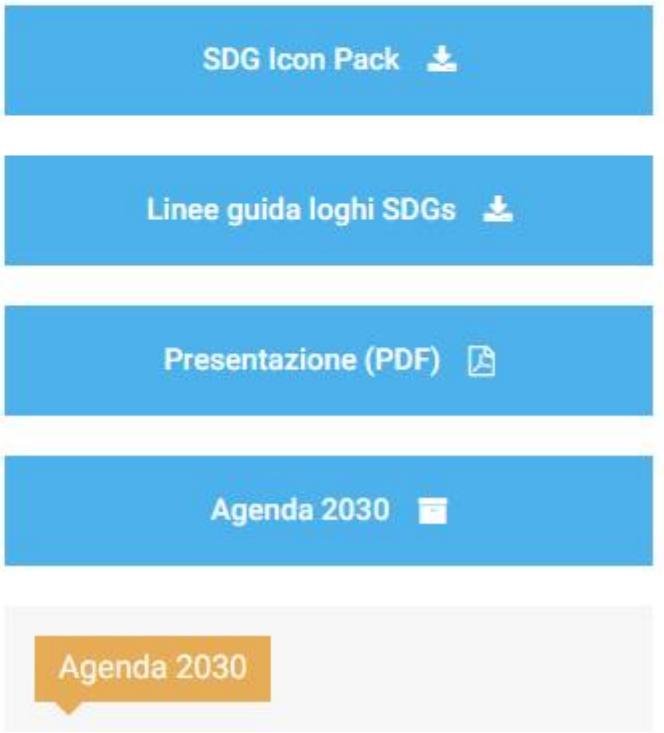
teodoro.georgiadis@ibe.cnr.it

Il mio personale punto di vista

- Fisica ambientale
- Climatologia urbana
- Pianificazione territoriale
- Strutture e sotto-servizi
- Economia del progetto e modello di business



https://unric.org/it/agenda-2030/



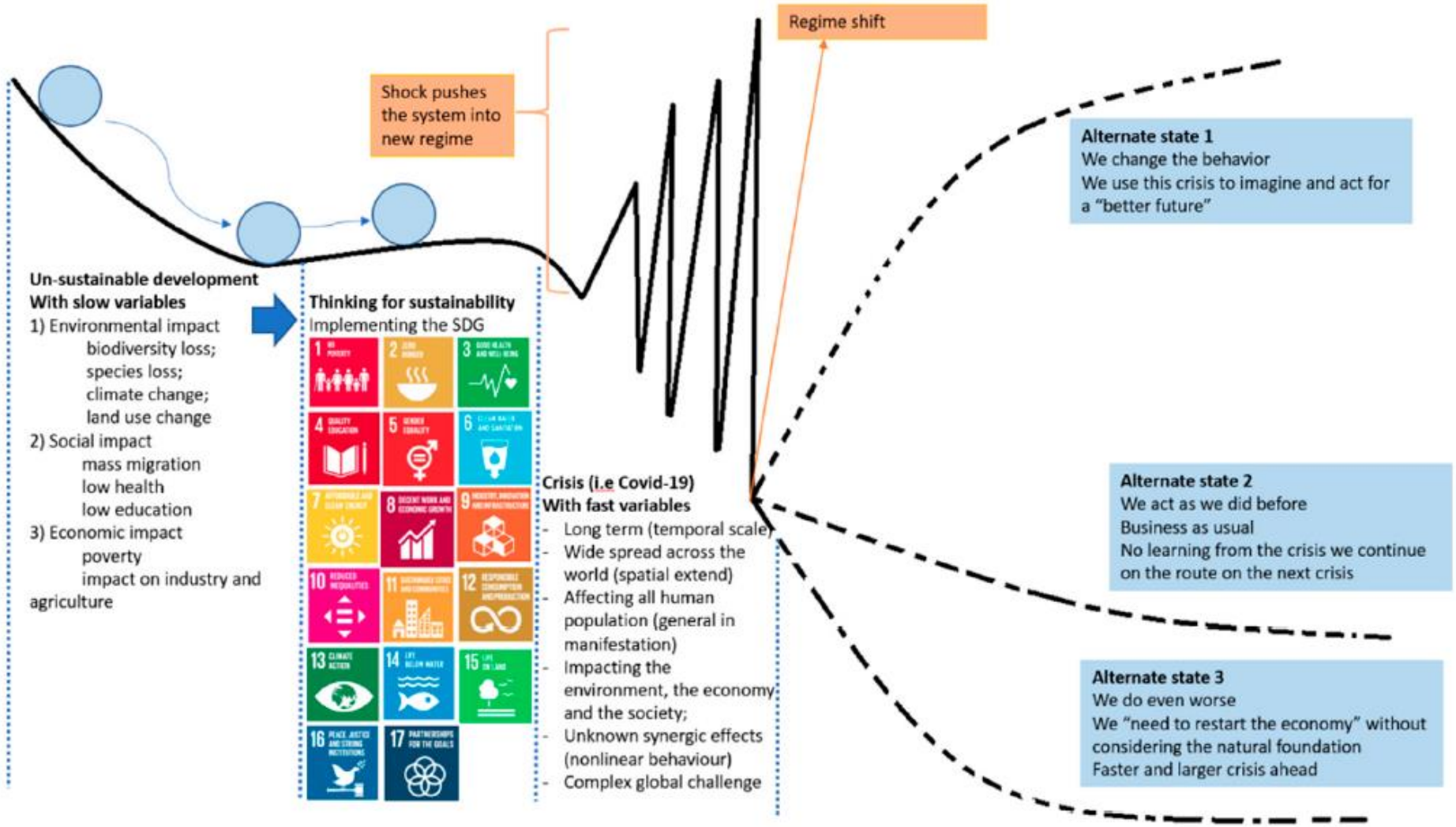
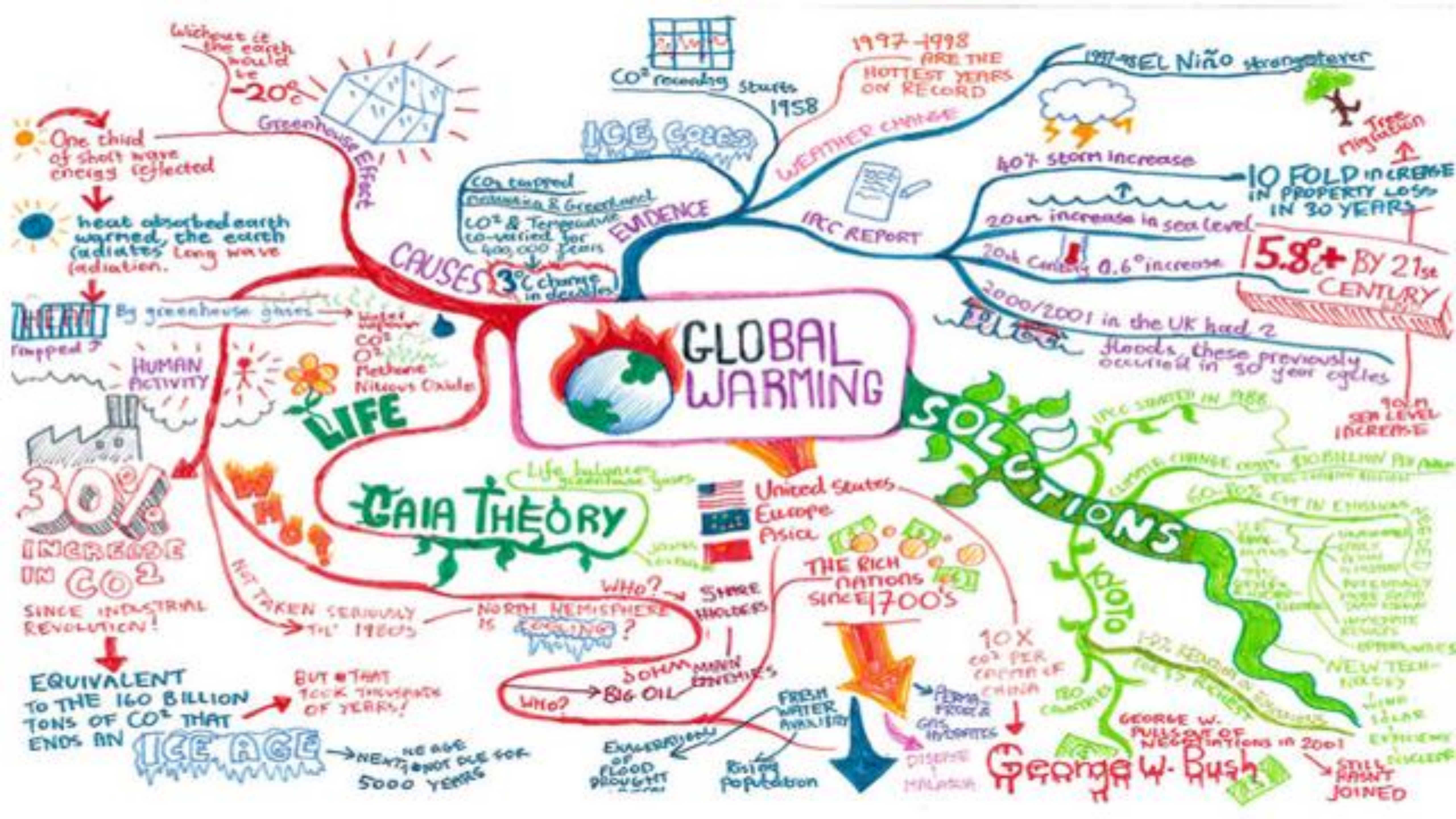


Figure 8. Possible regime shifts due to the combined impact of slow and fast variable on the system dynamics.

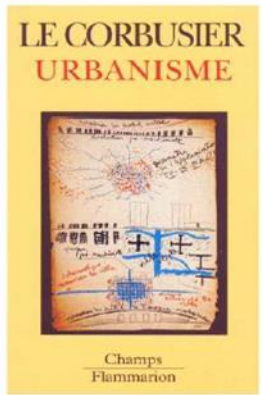

GLOBAL WARMING
CAUSES
Greenhouse Effect
Without it the earth would be -20°c
One third of short wave energy reflected
heat absorbed earth warmed, the earth radiates long wave radiation.
HEAT trapped ?
By greenhouse gases
Water vapour
CO2
O3
Methane
Nitrous Oxide
HUMAN ACTIVITY
30% INCREASE IN CO2 SINCE INDUSTRIAL REVOLUTION!
EQUIVALENT TO THE 160 BILLION TONS OF CO2 THAT ENDS AN
ICE AGE
NEXT ICE AGE NOT DUE FOR 5000 YEARS
BUT THAT TOOK THOUSANDS OF YEARS!
EVIDENCE
ICE CORES
CO2 recording starts 1958
CO2 & Temperature co-varied for 400,000 years
3°C change in decades
1997-1998 ARE THE HOTTEST YEARS ON RECORD
WEATHER CHANGE
EL Niño
40% storm increase
10 FOLD increase IN PROPERTY LOSS IN 30 YEARS
IPCC REPORT
20cm increase in sea level
20th Century 0.6° increase
5.8°c+ BY 21st CENTURY
2000/2001 in the UK had 2 floods these previously occurred in 30 year cycles
Tree migration
90cm SEA LEVEL INCREASE
LIFE
GAIA THEORY
WHO?
NOT TAKEN SERIOUSLY TIL' 1980's
NORTH HEMISPHERE IS COOLING ?
United States
Europe
Asia
THE RICH NATIONS SINCE 1700's
SHARE HOLDERS
BIG OIL
10 X CO2 PER CAPITA OF CHINA
FRESH WATER AVAILABILITY
EXAGGERATION OF FLOOD DROUGHT
Rising population
PERMA FROST & GAS HYDRATES
DISEASE MALARIA
SOLUTIONS
KYOTO
180 COUNTRIES
GEORGE W. PULLS OUT OF NEGOTIATIONS in 2001
George W. Bush
STILL HASN'T JOINED
NEW TECHNOLOGY
WIND
SOLAR

CALATI JUNCU CA PASSA LA CHINA

PEOPLE ARE MOVING…urbanizing

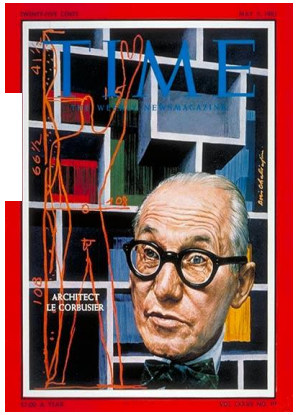
Le Corbusier 1924

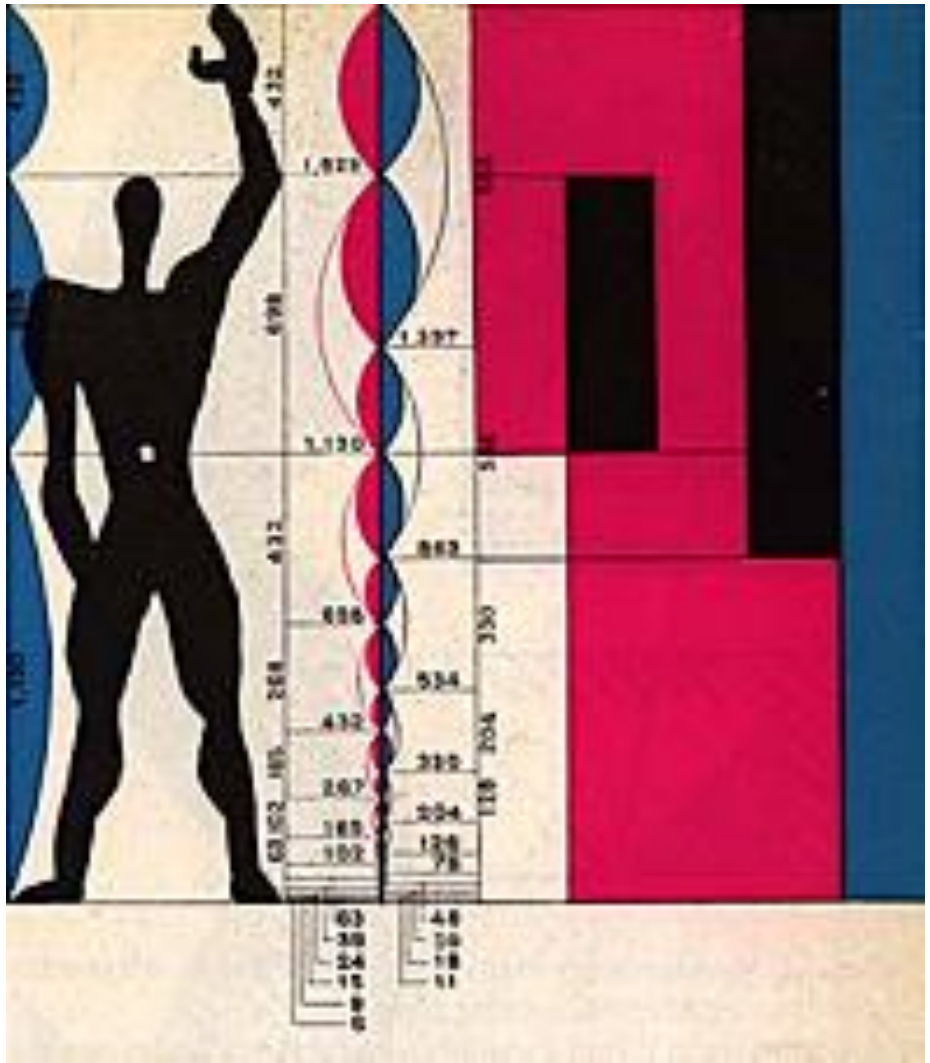
"La ville est un outil de travail. Les villes ne remplissent plus normalement cette fonction. Elles sont inefficaces : elles usent le corps, elles contrecarrent l'esprit. Le désordre qui s'y multiplie est offensant.

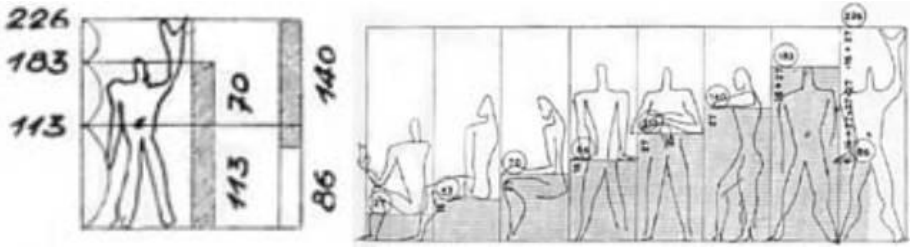


leur déchéance blesse notre amour-propre et froisse notre dignité. Elles ne sont pas dignes de l'époque: *elles ne sont plus dignes de nous*."

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







Le Modulor

Une nouvelle mesure humaine


Social
Bearable
Equitable
Sustainable
Environment
Economic
Viable

Figure 3a: Typical Daily Summer Rural Energy Balance

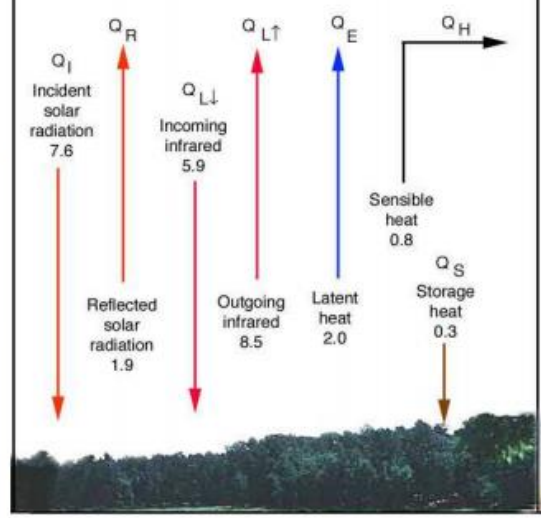
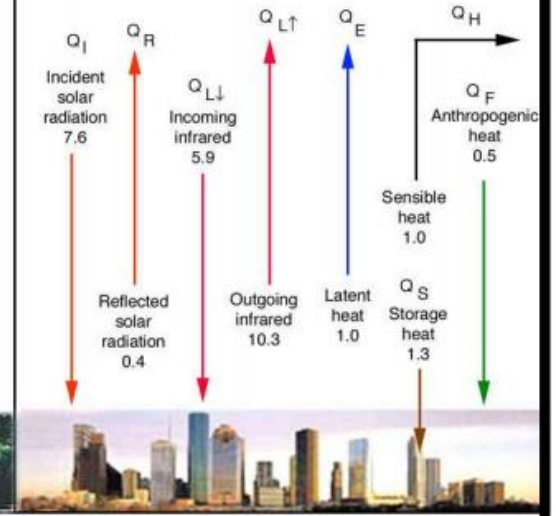
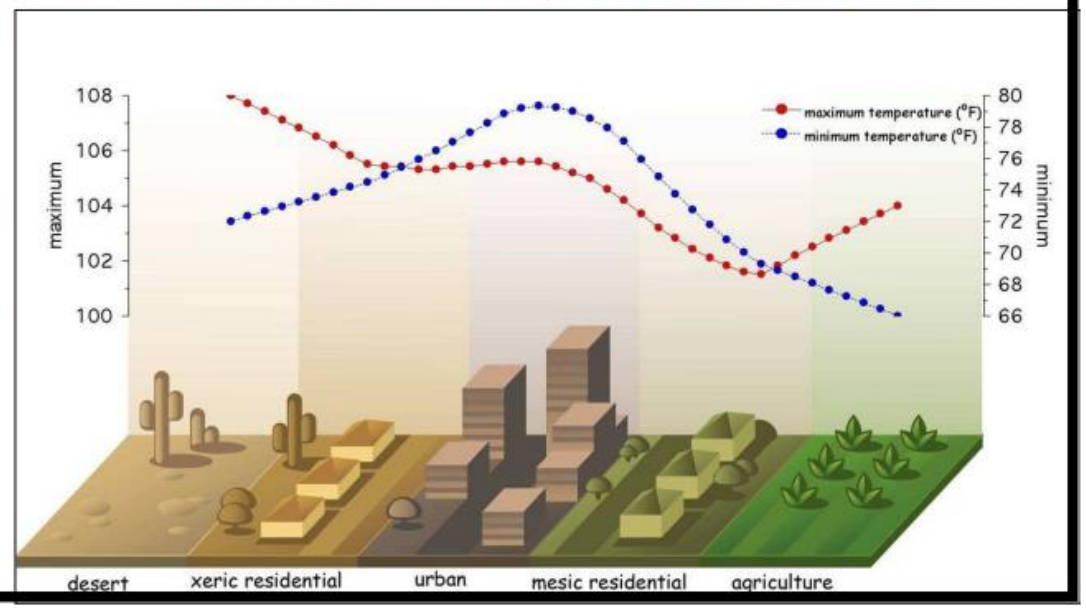


Figure 3b: Typical Daily Summer Urban Energy Balance





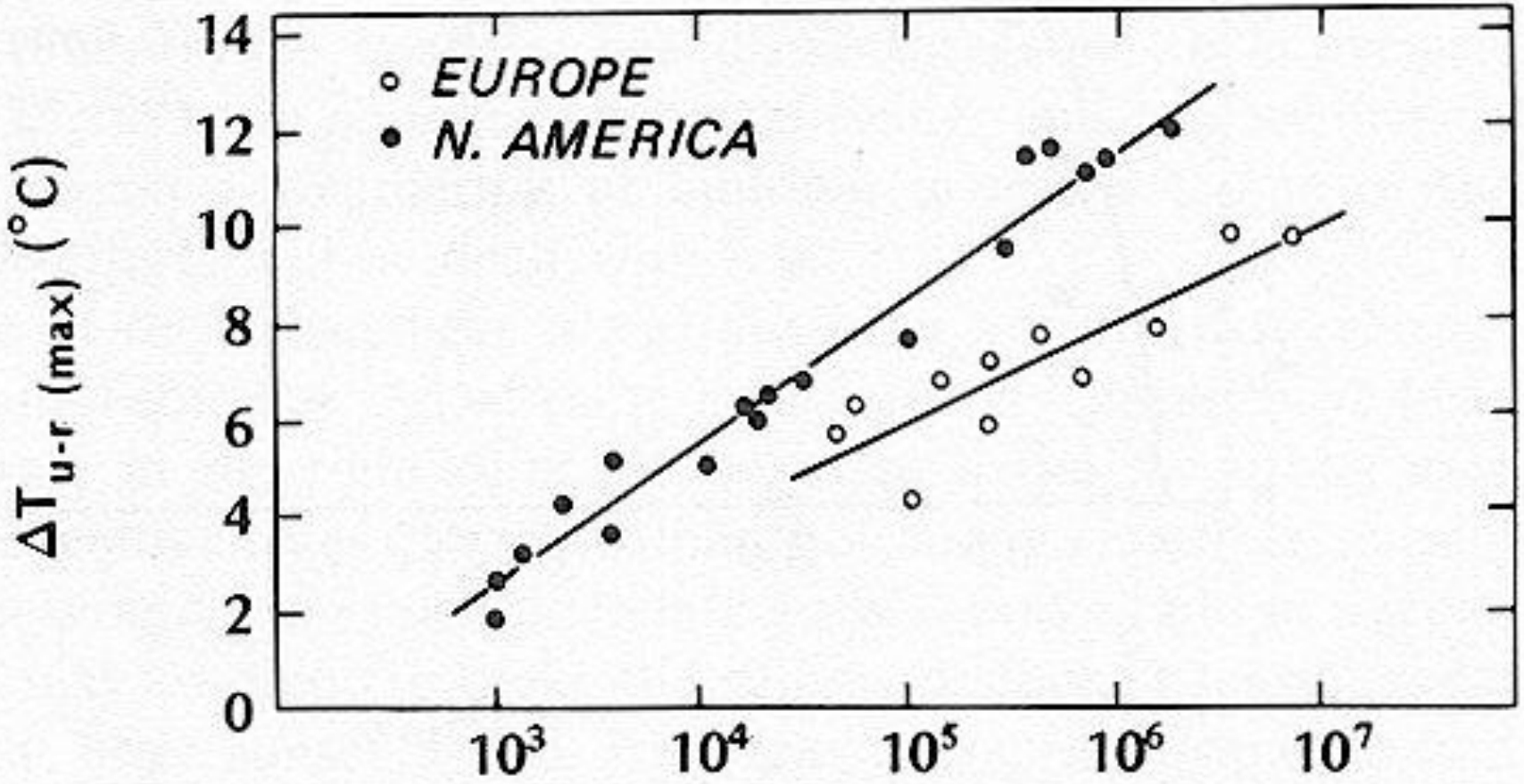
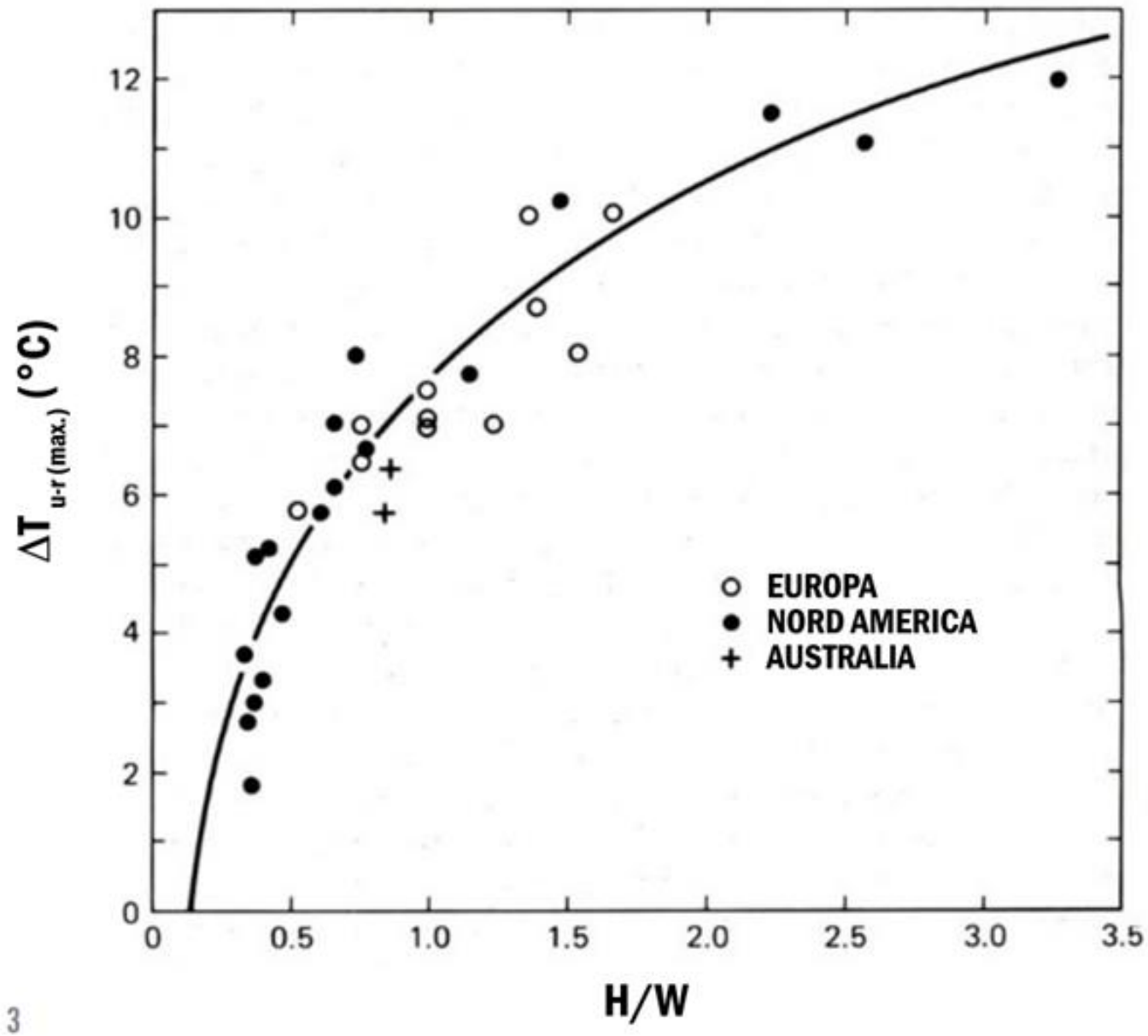
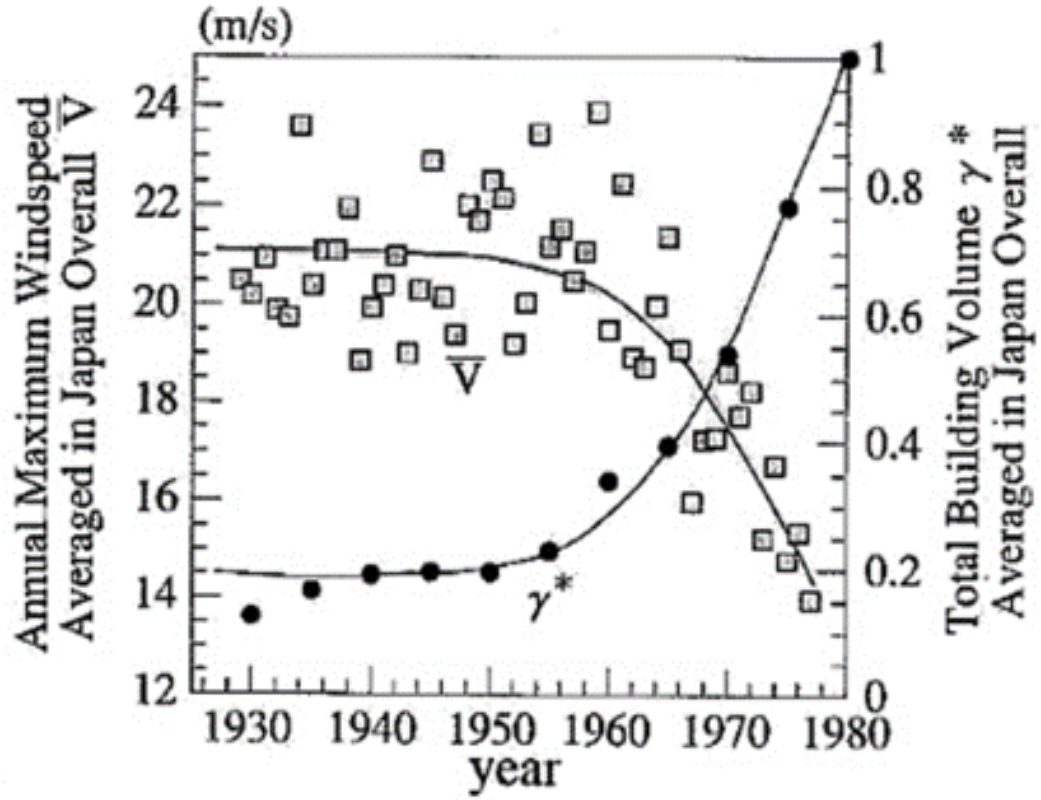
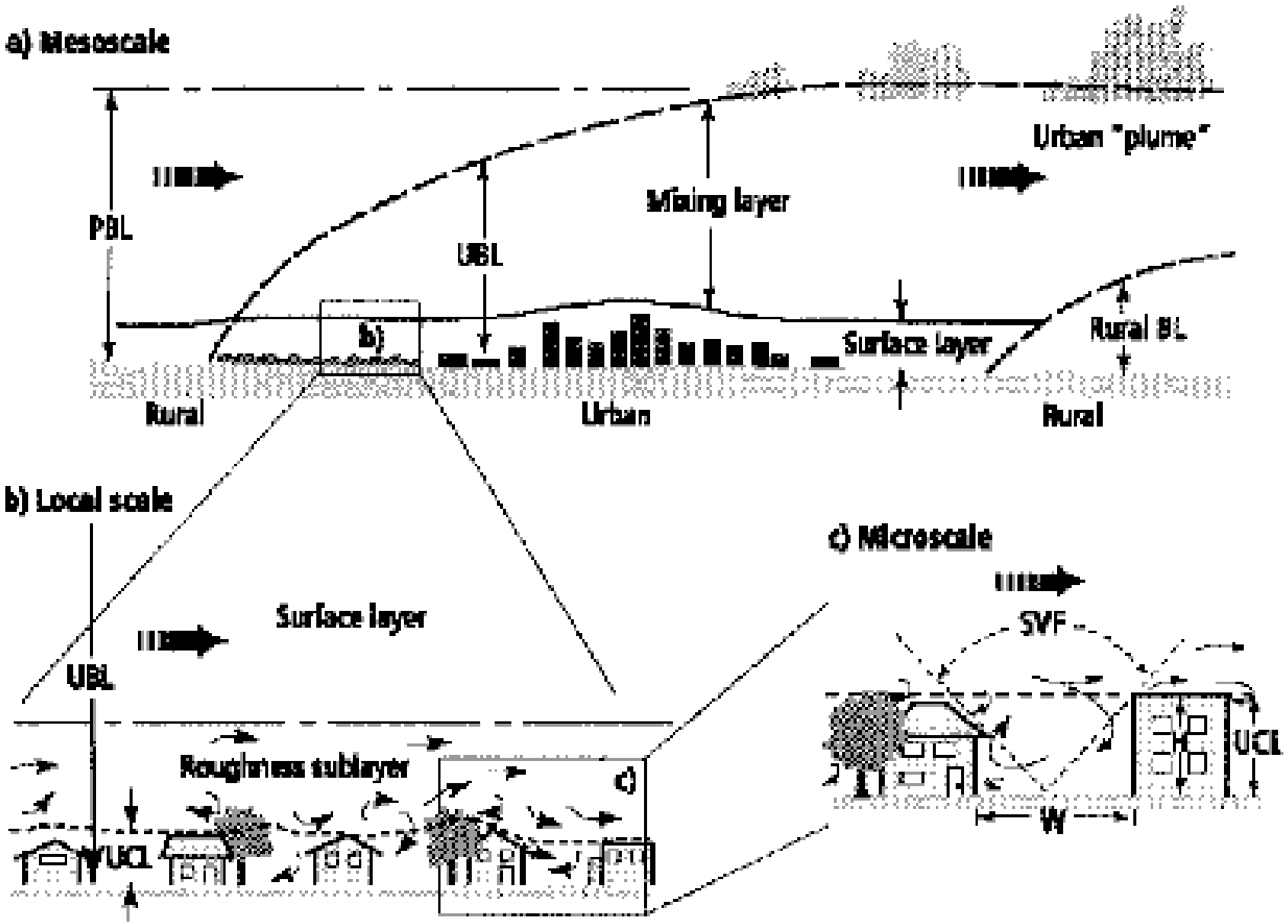
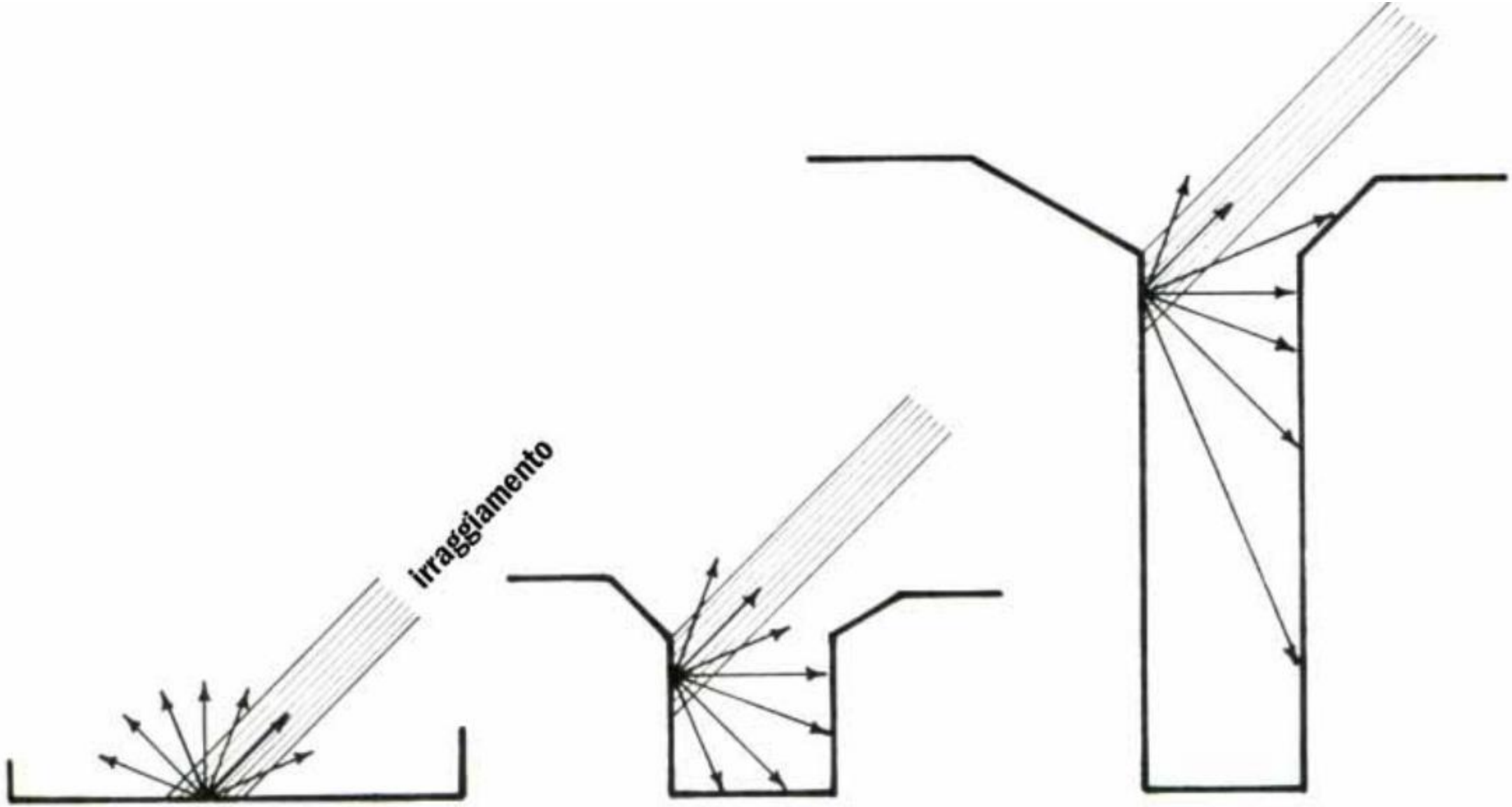


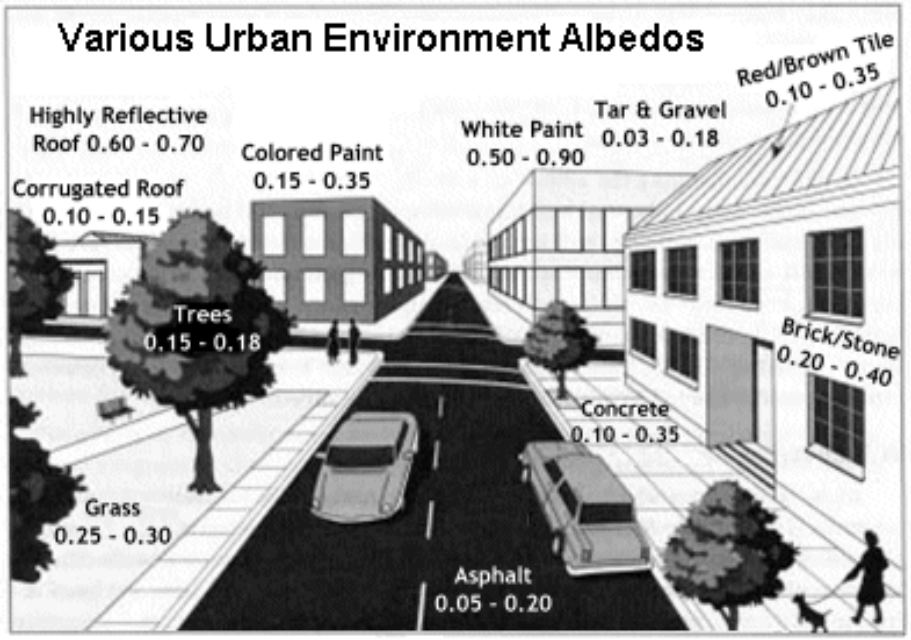
Figure 8.15 Relation between maximum observed heat island intensity ($\Delta T_{u-r(max)}$) and population (P) for North American and European settlements (modified after Oke, 1973).

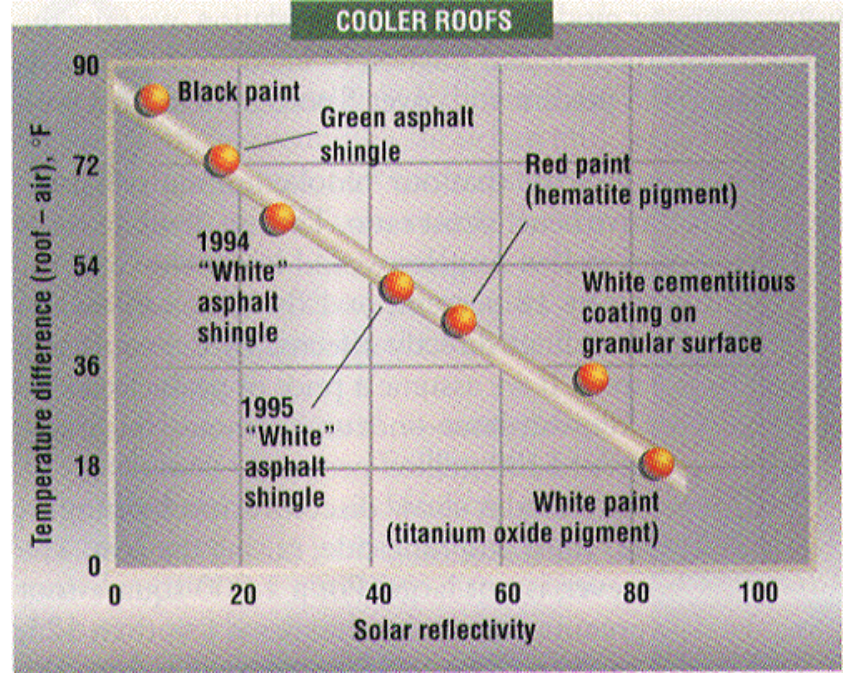

$\Delta T_{u\text{-}r\,(max.)}$ (°C)
12
10
8
6
4
2
0
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
H/W
EUROPA
NORD AMERICA
AUSTRALIA

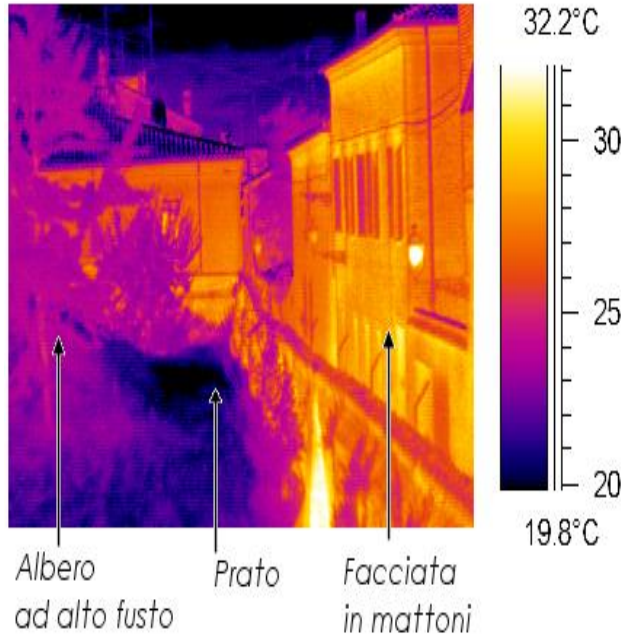

(m/s)
Annual Maximum Windspeed
Averaged in Japan Overall $\overline{V}$
24
22
20
18
16
14
12
$\overline{V}$
γ^*
1
0.8
0.6
0.4
0.2
0
Total Building Volume γ^*
Averaged in Japan Overall
1930
1940
1950
1960
1970
1980
year

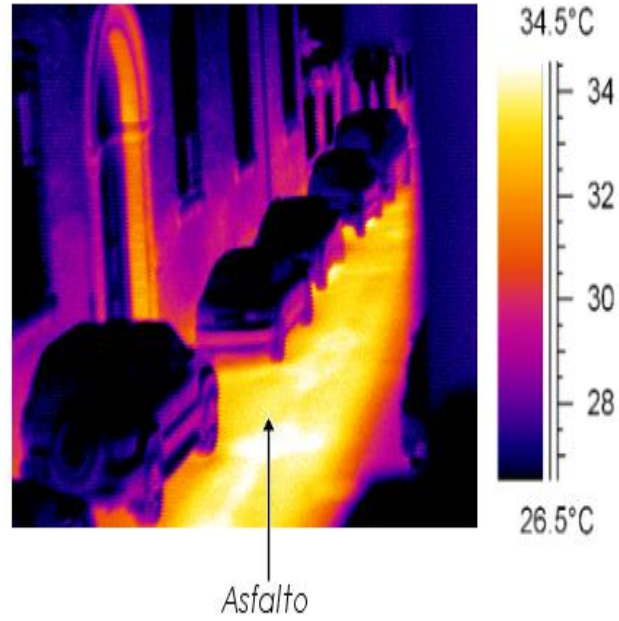

a) Mesoscale
Urban "plume"
PBL
UBL
Mixing layer
b)
Surface layer
Rural BL
Rural
Urban
Rural
b) Local scale
Surface layer
UBL
Roughness sublayer
c)
UCL
c) Microscale
SVF
UCL
W

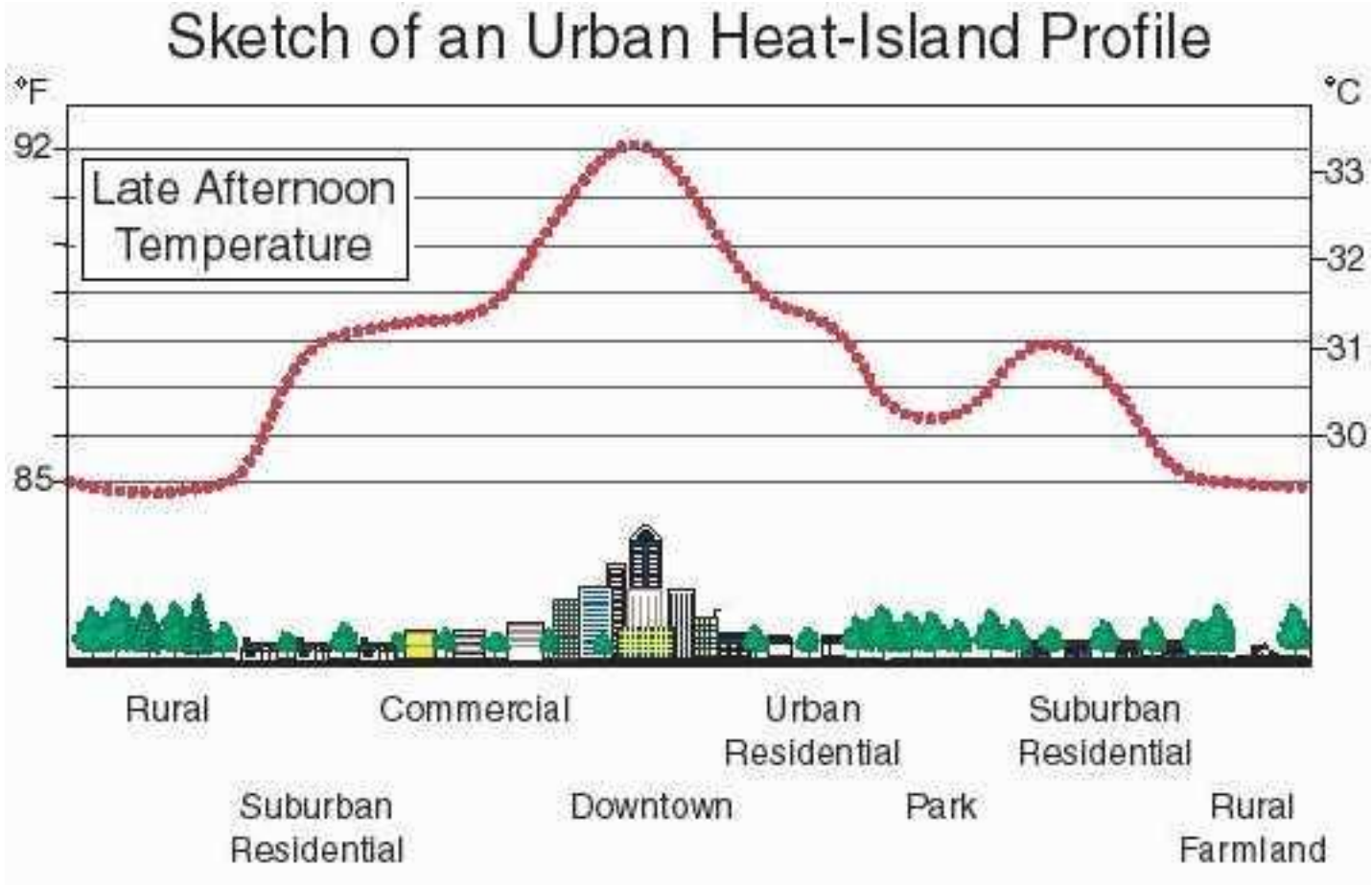

irraggiamento


Various Urban Environment Albedos
Highly Reflective Roof 0.60 - 0.70
Corrugated Roof 0.10 - 0.15
Colored Paint 0.15 - 0.35
White Paint 0.50 - 0.90
Tar & Gravel 0.03 - 0.18
Red/Brown Tile 0.10 - 0.35
Trees 0.15 - 0.18
Brick/Stone 0.20 - 0.40
Concrete 0.10 - 0.35
Grass 0.25 - 0.30
Asphalt 0.05 - 0.20

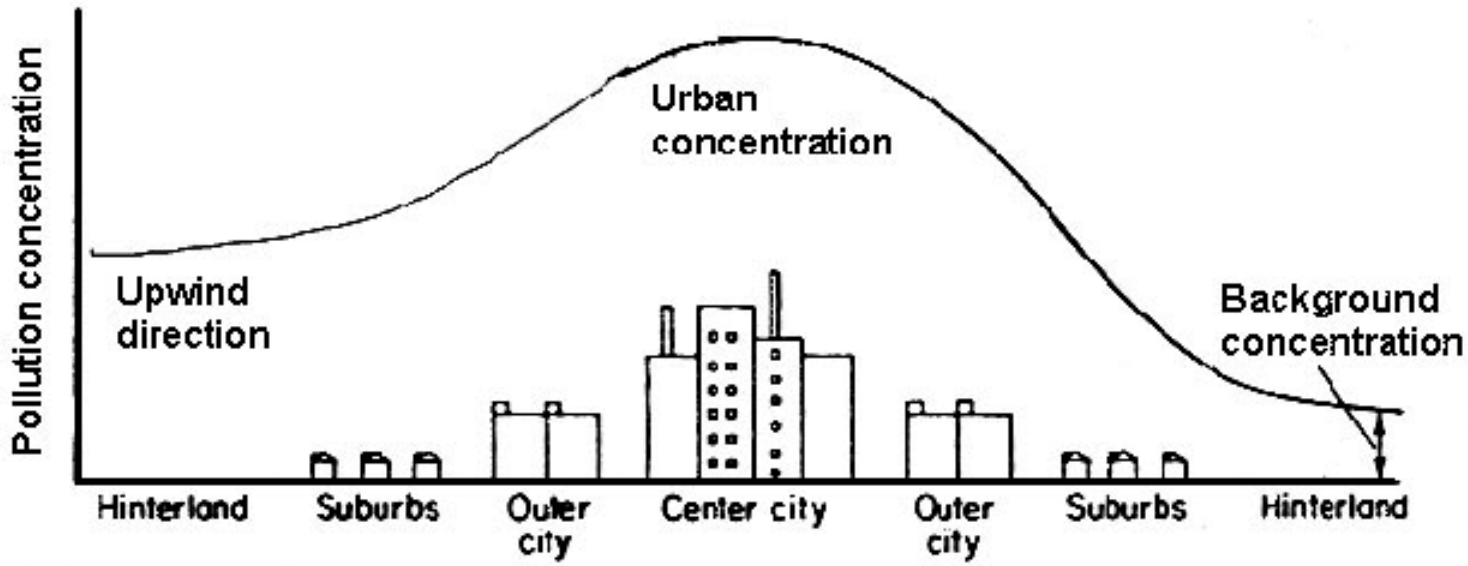

COOLER ROOFS
Temperature difference (roof – air), °F
90
72
54
36
18
0
Black paint
Green asphalt shingle
Red paint (hematite pigment)
1994 "White" asphalt shingle
White cementitious coating on granular surface
1995 "White" asphalt shingle
White paint (titanium oxide pigment)
0
20
40
60
80
100
Solar reflectivity


32.2°C
30
25
20
19.8°C
Albero ad alto fusto
Prato
Facciata in mattoni


34.5°C
34
32
30
28
26.5°C
Asfalto


Sketch of an Urban Heat-Island Profile
°F
°C
92
85
33
32
31
30
Late Afternoon Temperature
Rural
Suburban Residential
Commercial
Downtown
Urban Residential
Park
Suburban Residential
Rural Farmland

Urban Pollution Bubble

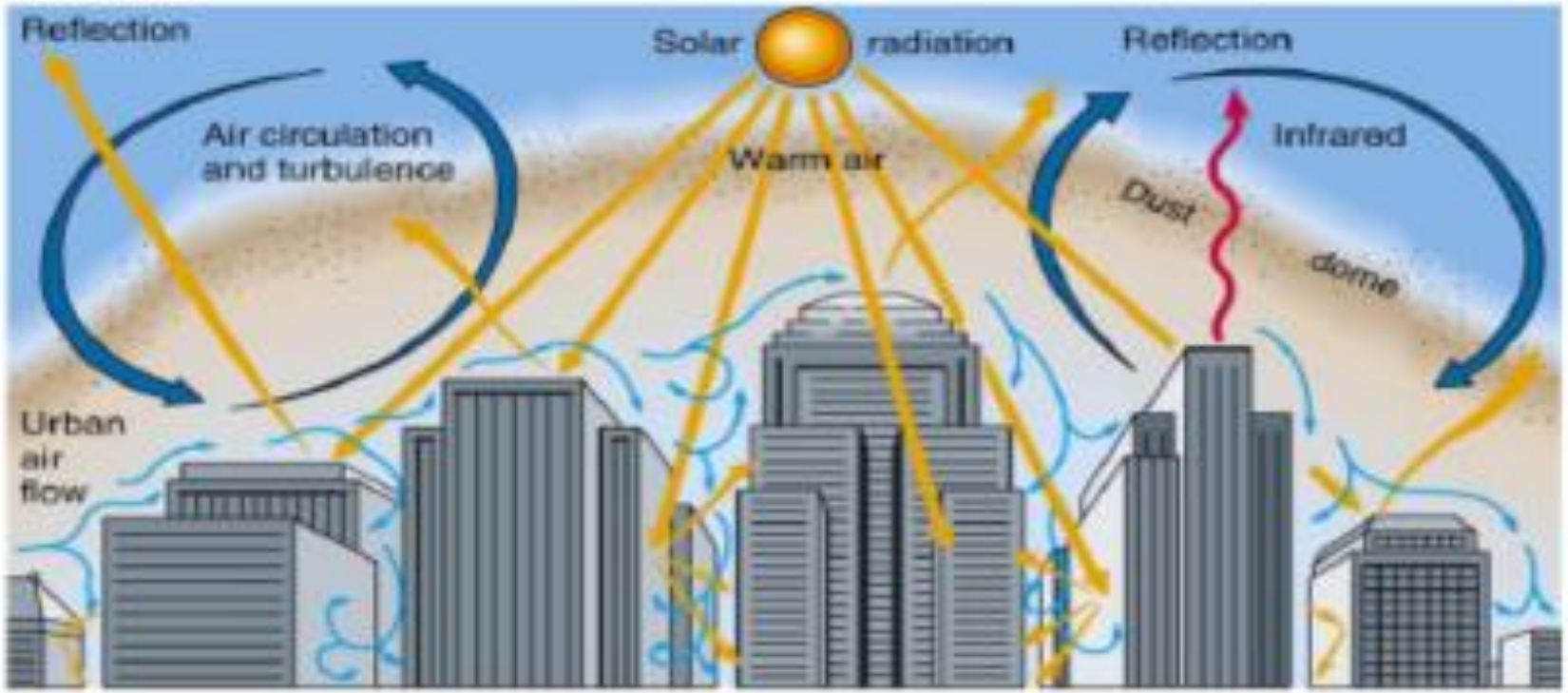


Annual average pollution concentration over an urban area

Factors that increase urban air pollution:

- **High concentration of vehicles, factories, homes.**
- **Lower wind speeds due to greater surface roughness.**
- **Basin drainage (many cities located in valleys).**
- **Temperature inversions common from heat island effect.**

Properties of the urban environment



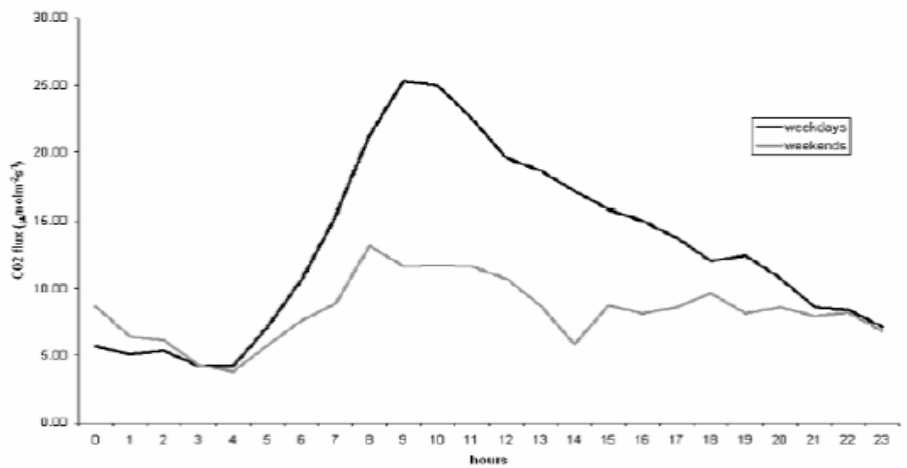


Figura 3: Flusso orario di CO_2 osservato a Roma.

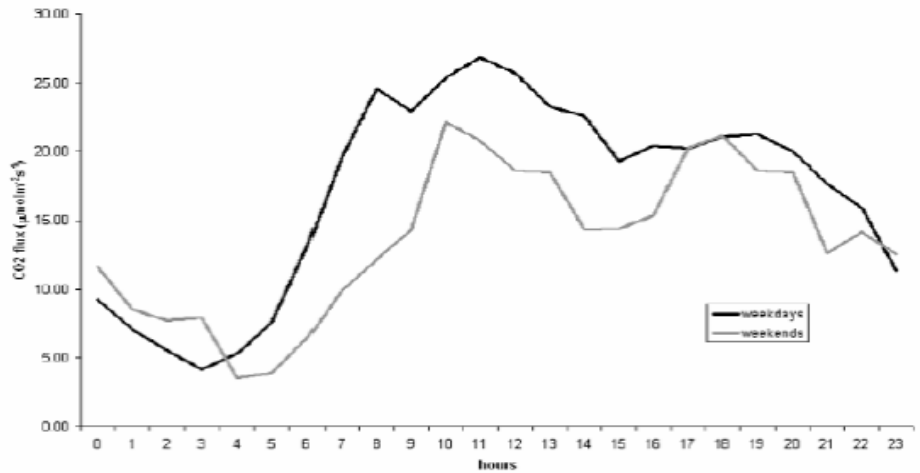
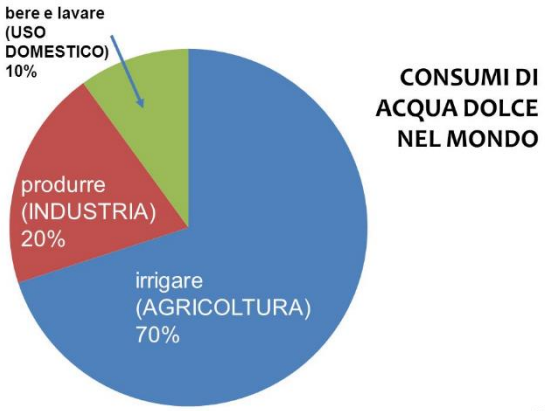
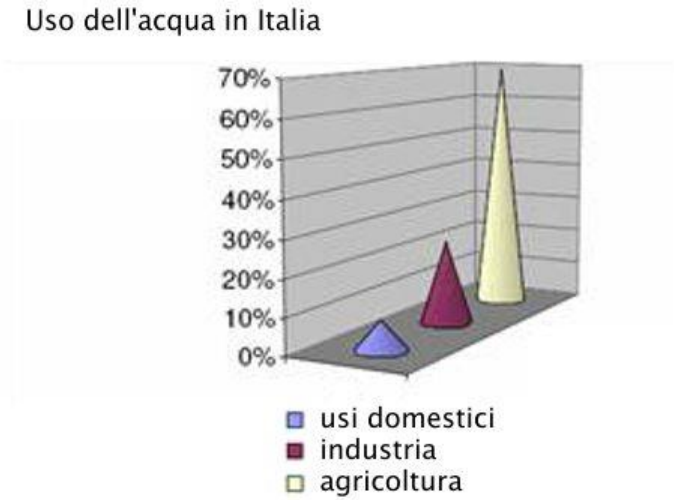


Figura 4: Flusso orario di CO_2 osservato a Firenze.



CONSUMI DI ACQUA DOLCE NEL MONDO



Extreme Temperatures, Water Scarcity, Flooding, Sea Level Rise, Droughts, Storms, Ice and Snow

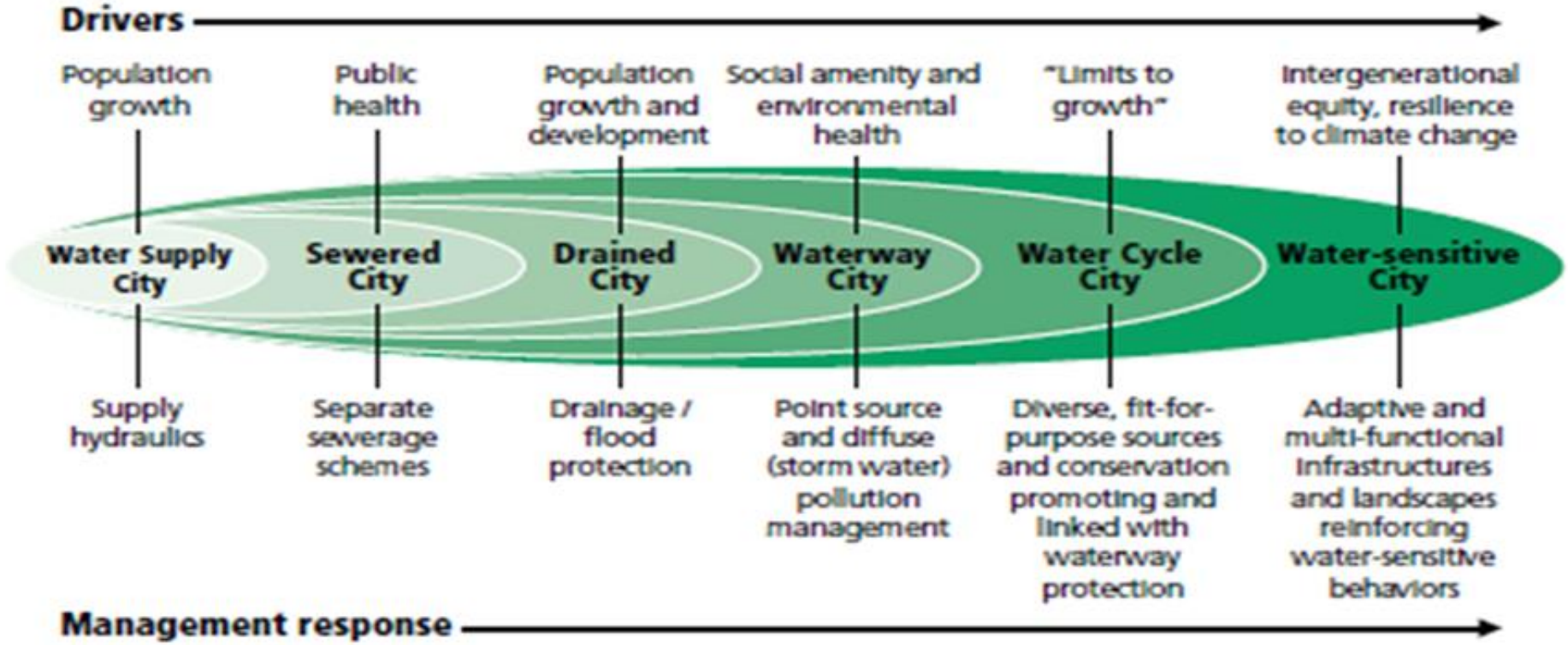

RIMINI
TODAY

da Progetto DERRIS

Il 90% delle PMI che subisce interruzioni nella produzione superiori ad una settimana a causa di danni procurati da eventi eccezionali fallisce in meno di UN ANNO

Water-Sensitive Cities Framework

Urban water transition phases



Source: Based on T. Wong and R. R. Brown. 2009. The Water Sensitive City: Principles for Practice. Water Science and Technology *60(3):673–682.*

The main causes of illness and death during a heatwave are **respiratory and cardiovascular diseases**. Additionally, there are specific heat-related illnesses including:

- **heat cramps** – caused by dehydration and loss of electrolytes, often following exercise
- **heat rash** – small, red, itchy papules
- **heat oedema** – mainly in the ankles, due to vasodilation and retention of fluid
- **heat syncope** – dizziness and fainting, due to dehydration, vasodilation, cardiovascular disease and certain medications
- **heat exhaustion** – is more common. It occurs as a result of water or sodium depletion, with non-specific features of malaise, vomiting and circulatory collapse, and is present when the core temperature is between 37°C and 40°C – left untreated, heat exhaustion may evolve into heatstroke
- **heatstroke** – can become a point of no return whereby the body's thermoregulation mechanism fails. This leads to a medical emergency, with symptoms of confusion; disorientation; convulsions; unconsciousness; hot dry skin; and core body temperature exceeding 40°C for between 45 minutes and eight hours. It can result in cell death, organ failure, brain damage or death. Heatstroke can be either classical or exertional (eg in athletes)

Long-term or severe illness

People with long-term or severe illness are likely to be at particular risk, including the following conditions:

- respiratory disease
- cardiovascular and cerebrovascular conditions
- diabetes and obesity
- severe mental illness
- Parkinson's disease and difficulties with mobility
- renal insufficiency
- peripheral vascular conditions
- Alzheimer's or related diseases

Gli studi epidemiologici presentano due approcci principali:
1. Effetti a breve termine: osservabili a pochi giorni di distanza dai picchi di esposizione
2. Effetti a lungo termine: osservabili dopo esposizioni di lunga durata e a distanza di tempo (anni)

Gli effetti a **breve termine** vengono generalmente valutati osservando le fluttuazioni dello stato di salute della popolazione sia con co-morbilità che senza, **durante i "picchi" di inquinamento**, come si verificano ad esempio annualmente durante la stagione calda: in questo frangente si assiste ad un aumento della mortalità per cause cardiache e respiratorie.
Gli effetti a **lungo termine** vengono invece studiati attraverso **studi di coorte**: osservando lo stato di salute di soggetti che vivono in contesti diversi, si valutano a livello individuale alcuni fattori di rischio che possono essere "confondenti" rispetto agli inquinanti atmosferici, come il fumo di tabacco e l'esposizione lavorativa; i soggetti arruolati vengono poi seguiti nel tempo e viene valutata la mortalità e la morbosità in relazione alla diversa esposizione ambientale.
Il particolato atmosferico è ritenuto ad oggi l'indicatore che più coerentemente si associa con gli esiti sulla salute, specialmente quando è misurato in termini di particelle inalabili (PM10) o respirabili (PM2,5); sempre più rilevanza assume il monitoraggio del particolato ultrafine (PM0,1).
L'indicatore maggiormente utilizzato negli ultimi anni è stato il **PM2,5**, corrispondente alle particelle di diametro aerodinamico medio pari a 2,5 micron o inferiori.
Nel complesso, a carico della mortalità naturale, le stime di rischio disponibili riportano, per ogni incremento di **10 µg/m^3 della concentrazione di PM2,5 a breve termine, un aumento della mortalità compreso tra 0,3-0,5%** (nel giro di pochi giorni successivi ad incrementi di breve durata) e a lungo termine un aumento del 6%-7% (nell'arco di 10-15 anni in presenza di incrementi di lunga durata). Per quanto riguarda le stime di impatto su scala nazionale, nel nostro Paese il 7% circa di tutte le morti per cause naturali è stato imputato all'inquinamento atmosferico. Tra le cause di morte in eccesso rientrano parte delle **patologie cardiovascolari, respiratorie e tumorali, in primis il tumore del polmone**. A rafforzare la cancerogenicità vi sono considerazioni in relazione alla presenza di molti cancerogeni nel particolato, con il polmone come organo bersaglio: gli IPA, ma anche i metalli pesanti, quali cromo, arsenico, nichel, e le fibre di amianto. Evidenze epidemiologiche robuste indicano quindi effetti dannosi per l'apparato respiratorio dovuti ad esposizione ad inquinanti atmosferici, anche per valori ambientali inferiori a quelli consentiti dagli standard internazionali.

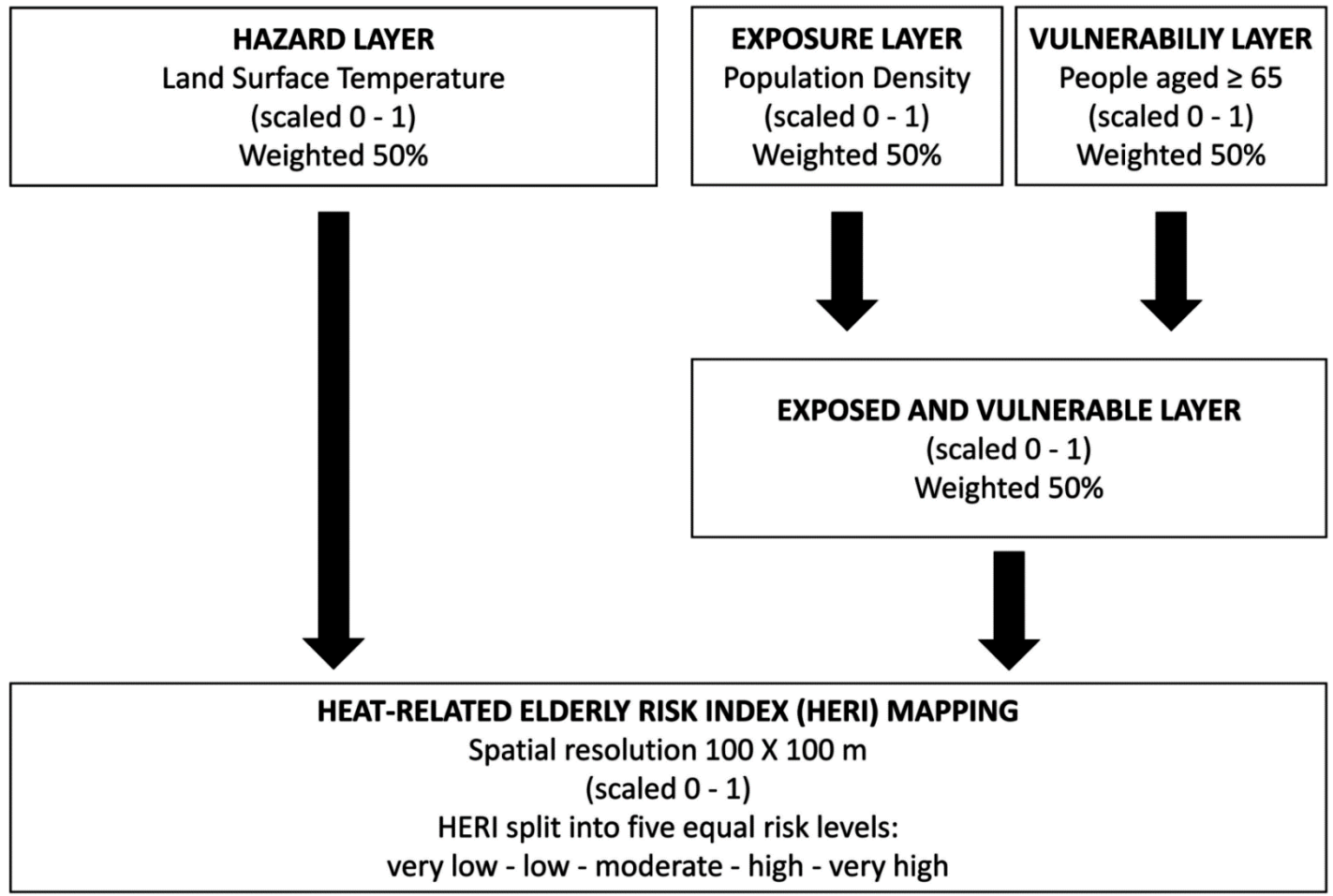
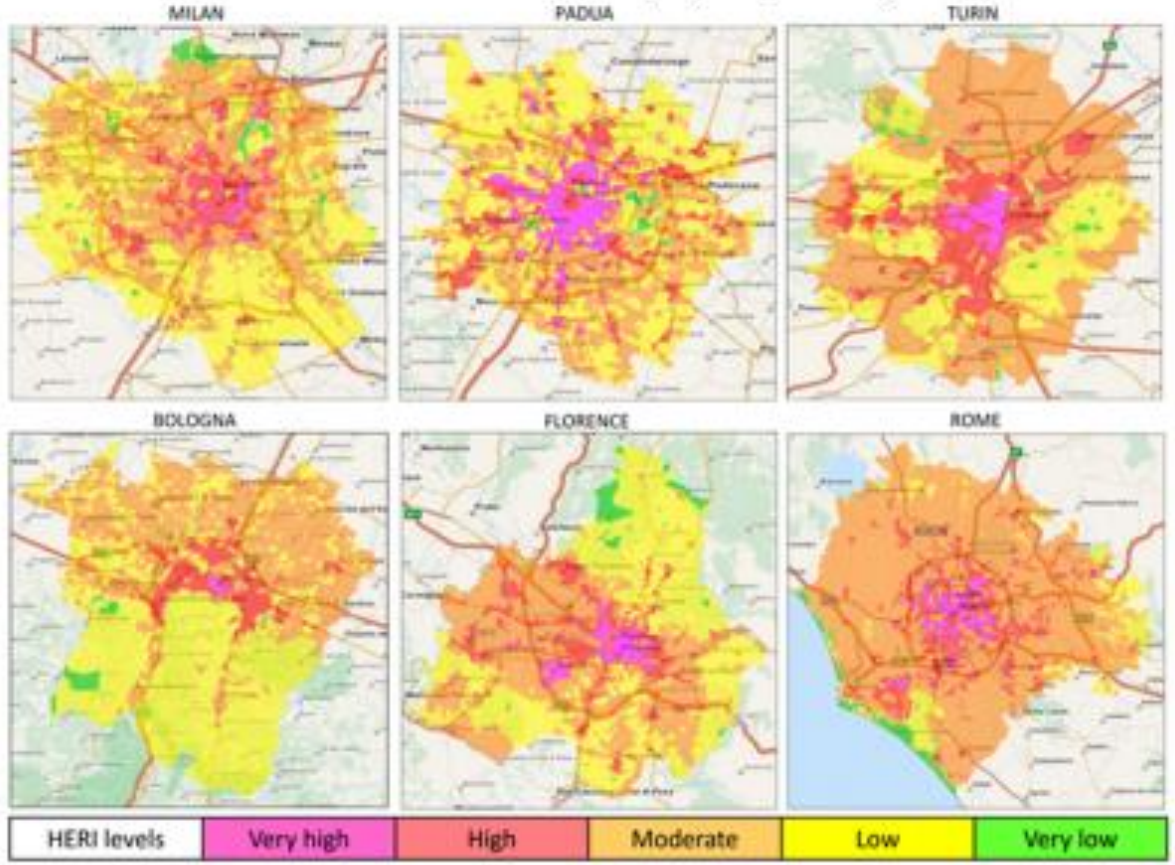

HAZARD LAYER
Land Surface Temperature
(scaled 0 - 1)
Weighted 50%
EXPOSURE LAYER
Population Density
(scaled 0 - 1)
Weighted 50%
VULNERABILIY LAYER
People aged ≥ 65
(scaled 0 - 1)
Weighted 50%
EXPOSED AND VULNERABLE LAYER
(scaled 0 - 1)
Weighted 50%
HEAT-RELATED ELDERLY RISK INDEX (HERI) MAPPING
Spatial resolution 100 X 100 m
(scaled 0 - 1)
HERI split into five equal risk levels:
very low - low - moderate - high - very high

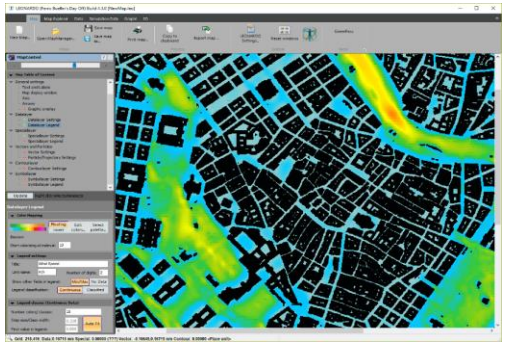
Fig 2. Maps of daytime heat-related elderly risk levels in the main inland Italian cities during the 2001–2013 summers (May-September).



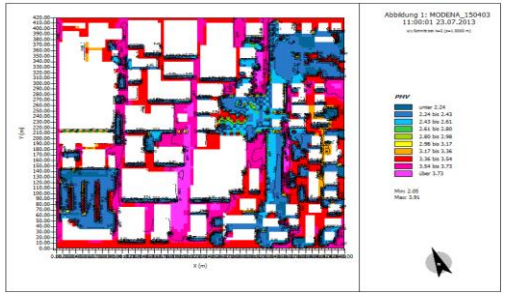
Morabito M, Crisci A, Gioli B, Gualtieri G, Toscano P, et al. (2015) Urban-Hazard Risk Analysis: Mapping of Heat-Related Risks in the Elderly in Major Italian Cities. PLoS ONE 10(5): e0127277. doi:10.1371/journal.pone.0127277
http://127.0.0.1:8081/plosone/article?id=info:doi/10.1371/journal.pone.0127277

Modelling what?

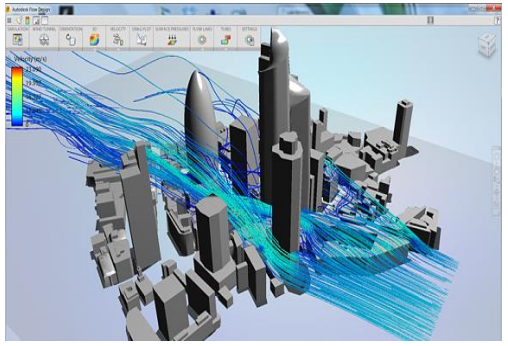
- **HEAT**



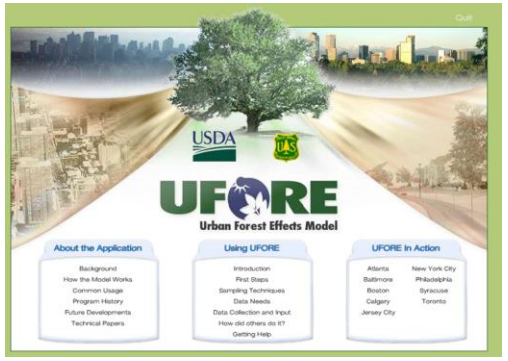
- **WELLNESS**



- **AIR-FLOW**



- **ECO-SYSTEM SERVICES**



WMO Session "Guide for Integrated Urban Weather, Environment and Climate Services (IUWECS)":

How it Can Best Meet the Needs of Researchers and Stakeholders?

Introduction to the Guide

by A. Baklanov, WMO

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Box 3: Urban Services

Urban Services, in the traditional sense, and in the context of city management (by mayors and other city agencies), refers to transportation, housing, water management, waste management, snow clearance, etc.

In this document, *Urban Integrated Services* refers to the provision of WMO *Member* weather, climate, hydrology and air quality infrastructure (data, observations, predictions) that may be used to support traditional (and new) urban services. These services may be provided directly through *Member* operations or indirectly through stakeholders or partners in public and private agencies.

Services include weather forecasts, due thunderstorms, typhoons, costal inundation, flooding, air quality, health-related stress as well as to climate services for building codes, zoning, planning and design.

Urban Integrated Services are inherently high resolution and are provided at the roughly the spatial scale of the urban footprint and smaller. However, it is highly dependent on the application, their requirements, local and regional factors. The urban domain is defined by local governments and may include nearby cities, the area and road in-between, rural water sheds, location of industries in order to capture their impact. Urban planners may include surrounding areas as planning in major metropolitan area will impact housing, transportation and recreation in those areas.

Box 8: Nature Based Solutions

Nature Based Solutions are the best solutions for cities.
Blue and Green solutions, an eco-systems approach (blue refers to adding water elements, green for adding trees and parks) for urban design, need weather, climate, hydrological and air quality information for their design and management at the sub-urban scale. Basic knowledge on processes, models, and existing solutions are fundamental and therefore capacity building is a basic step for the adoption of the *Urban Integrated Services* concepts by different professionals (Architects, Engineers, Urbanists, Policy makers, etc.) concerned about resilience of cities. Understanding of the tools available from the scientific community, are also crucial and must be included as part of academic curricula for urban design. Databases and existing models should be organized in order to furnish a clear state of the art to professionals. Knowledge of the repositories of data and models, on existing examples of applications are needed and organized to promote direct access to such tools.

Urban Services and City Design
Water: forecast of water resources availability (both in terms of flow and precipitation) is fundamental in managing the functioning of Blue solutions and to activate them during dangerous occurrences;

Heat: to foster Green design over a city to activate secure pathways for fragile populations, to furnish warnings, including climate watch advisories, to design a proper texture of the city itself (where to place hospitals, schools, commercial centers);

Ecology: ecological pathways within cities are not only a biological issue but interactions between the air-flow and the urban environment affects the transport of biological materials (pollens, spores, small insects);

City texture and materials: during the design phase, weather and climate information are fundamental to properly design and plan future city structures (open spaces and living spaces, knowns as “agorà”). Also, to be considered is the increased quantity of permeable surfaces to increase water retention and therefore decrease runoff and flood peaks.

Hydrological Example
Knowledge of the amount and location of water, their pathways and urban floodplains is needed to for Integrated Flood Management (see Environmental aspects of Integrated Flood Management http://www.floodmanagement.info/portfolio-item/environmental-aspects-of-integrated-flood-management/). Also, see the World Wildlife Federation Flood Green Guide (https://www.worldwildlife.org/publications/natural-and-nature-based-flood-management-a-green-guide), that was developed with major input from the Associated Programme on Flood Management.

http://climate-adapt.eea.europa.eu/countries-regions/countries/italy

Climate-ADAPT-Sharing adaptation information across Europe

European Climate Adaptation Platform

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Item	Status	Links
National adaptation strategy	Approved	National Adaptation Strategy
Action plans	National Adaptation Plan (PNAC) being developed due 2016 Sectoral Adaptation Plans are being developed	
Impacts, vulnerability and adaptation assessments	National Vulnerability Assessment	National Vulnerability Assessment
Research programs	Established	see chapter research.
Climate services / Met Office	Established	• CNMCA • CMCC
Web portal	Established /national platform ongoing	Web portal
Monitoring, Indicators, Methodologies	Being developed	• ISPRA-Banche Dati • LTER-Italia • Polaris-IRPI-CNR • Italia Sicura • Rendis-ISPRA
Training and education resources	Being developed	
National Communication on the UN Framework Convention on Climate Change	Last National Communication Submitted (2014)	6th National Communication under the UNFCCC

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…My eye recognizes as perfect the shape of Parthenon even my feeling advice me that this agnation comes out from a tautology: firstly I've acquired that Parthenon is the model of perfection, after that I saw the original one and I compared it with the model. As in a mental mirror castle I attributed the perfection to a building just because it is equal to is own image.

The beauty is a strange quality Sergio Valzania

Frank Lloyd Wright "Fallingwater"

Grazie per l'attenzione, domande?