FONDAZIONE ENI ENRICO MATTEI

Adapting Cities to Climate Change

Challenges for urban policy innovation

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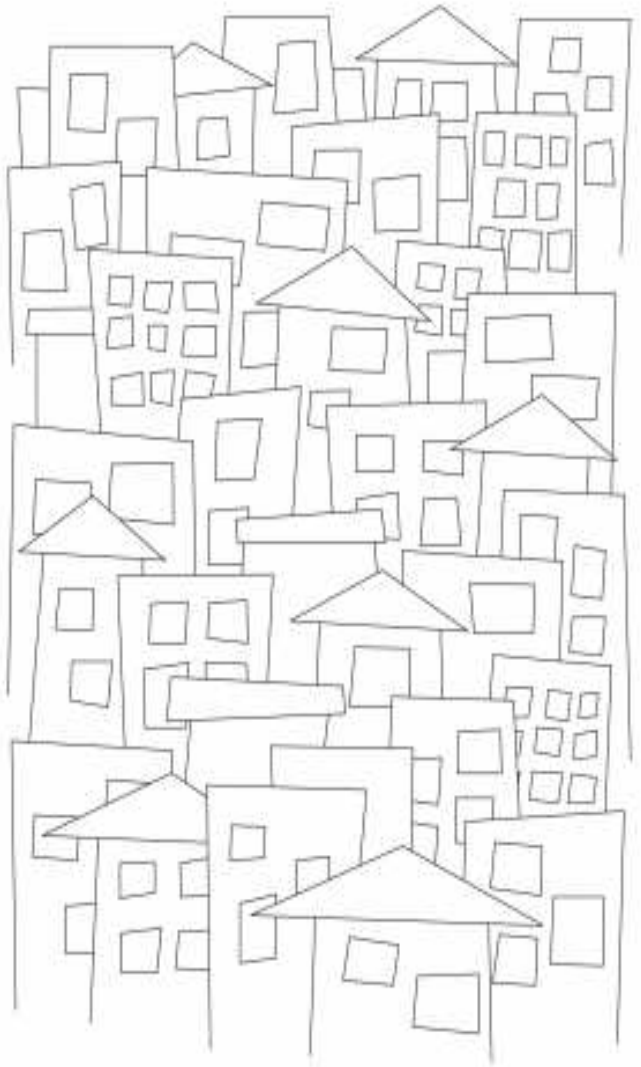
FEEM

Venice, 24 May 2012

Outline

1. Why focus on urban areas?
2. Which climate impacts most affect urban areas?
3. What does adaptation mean in the context of urban policies?
4. What is the role of assessment and valuation?
5. Conclusions
6. What is next? Outlook on further research



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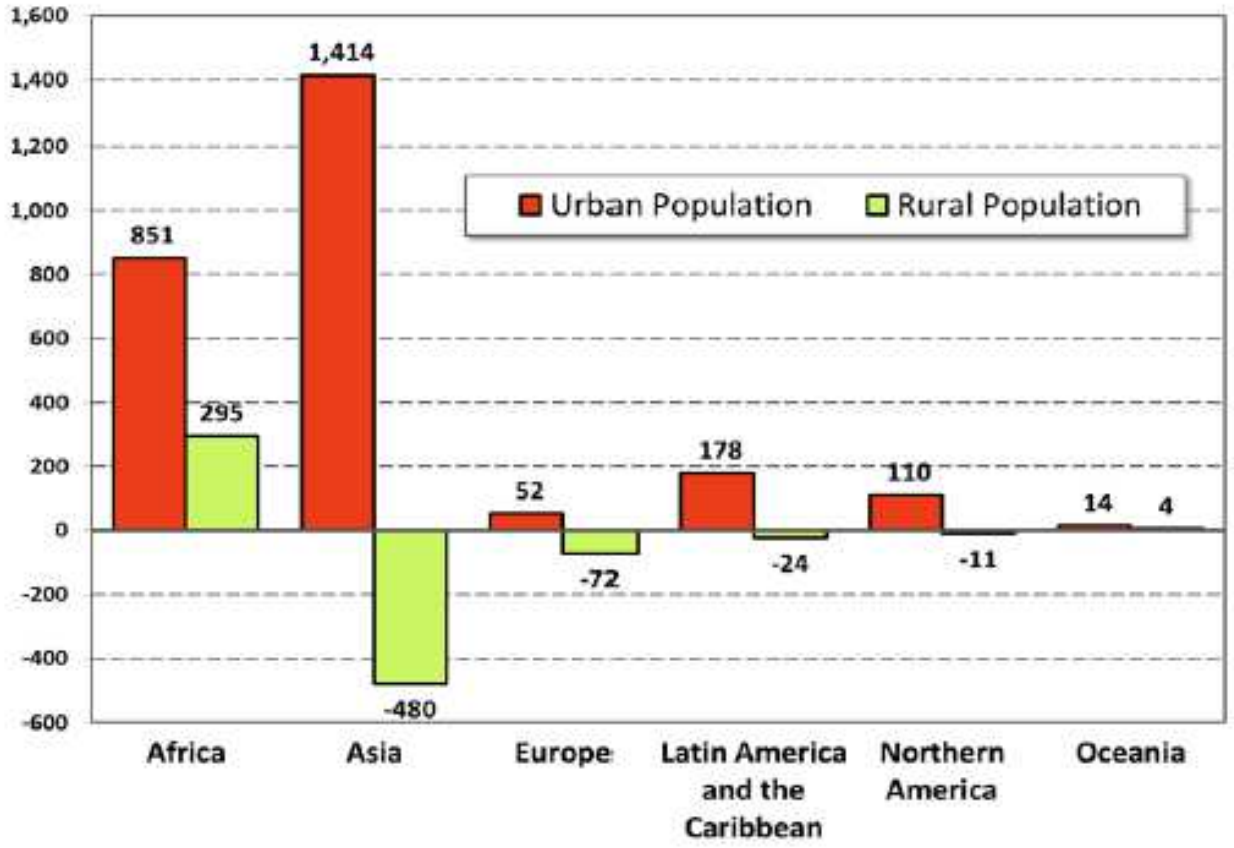
Why focus on urban areas?

- **Cities are growing –** over ½ of the world's population currently lives in cities; by 2050 this will increase to ¾ of the population
- **Cities consume** >2/3 of the world's energy & are responsible for >70% of global CO_2 emissions
- **Cities are vulnerable** to climate change due to the concentration of population, values, and assets; this is worrisome as cities ability to function is often crucial for the wellbeing of national economies

Why focus on urban areas?

Cities are growing:

Changes in urban and rural population by major area between 2011 and 2050 in millions



http://esa.un.org/unpd/wup/pdf/WUP2011_Press-Release.pdf

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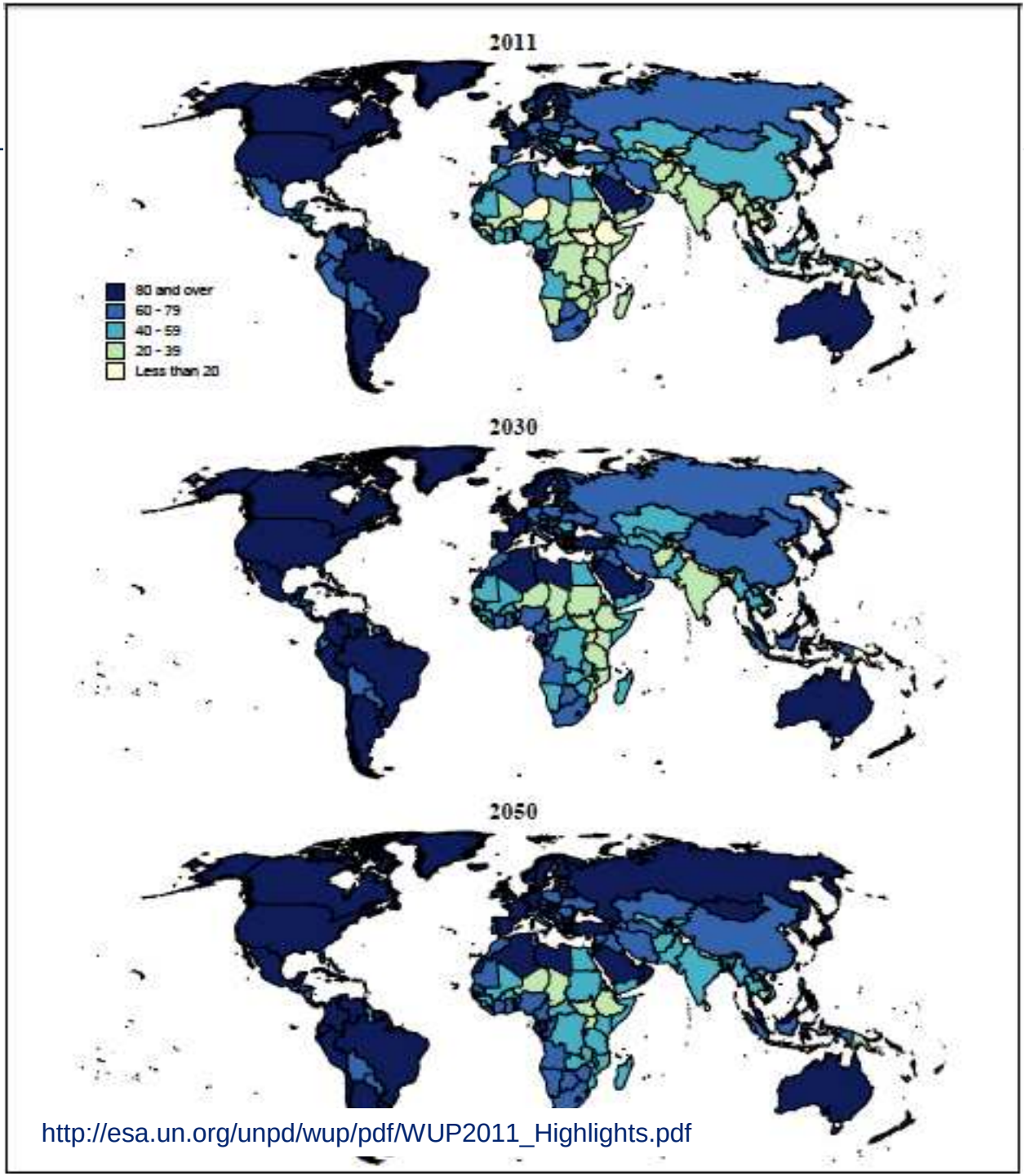
Why focus on urban areas?

Cities are growing:

Projected % of the population living in urban areas in 2011, 2030 & 2050



http://esa.un.org/unpd/wup/pdf/WUP2011_Highlights.pdf

1

Why focus on urban areas?

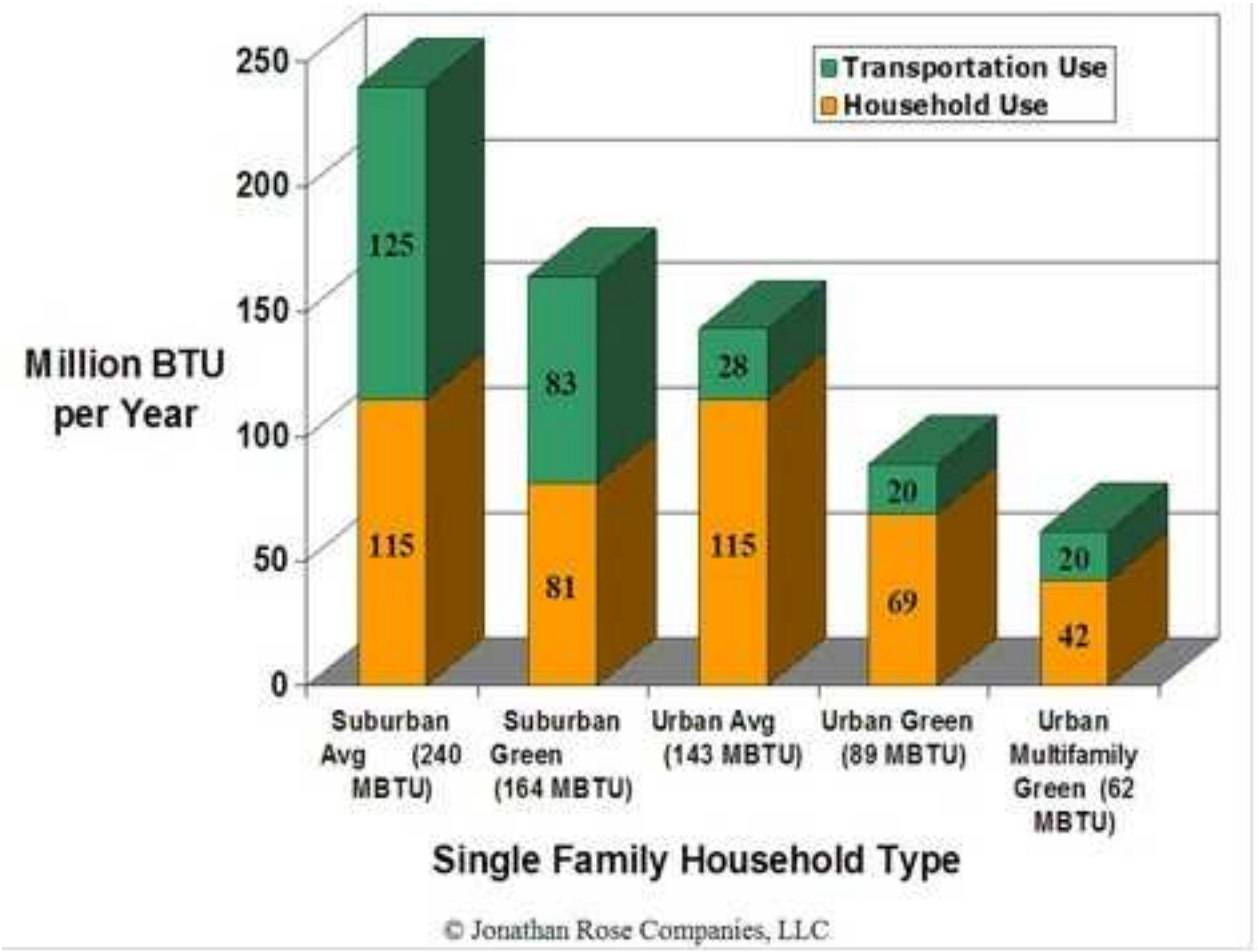
Consumption & source of emissions in C40 cities:

- **Transport:** >300 million tons of CO_2 per year
- **Buildings:** accounts for 45% of cities' carbon emissions
- **Water:** use per capita ranges from 450 liters/day (USA & Canada) to 100 liters/day (Africa)
- **Waste management:** globally waste accounts for ~3% of GHG emissions
- **Energy supply:** consumption of fossil fuels is the main sources of GHG emissions
- **Food & urban agriculture:** globally agricultural production accounts for 14% of GHG emissions
- **Planning & urban land use:** decisions taken today about urban land use can have an impact over many decades

1

Why focus on urban areas?

Urban areas consume energy, but have also a great potential for energy saving



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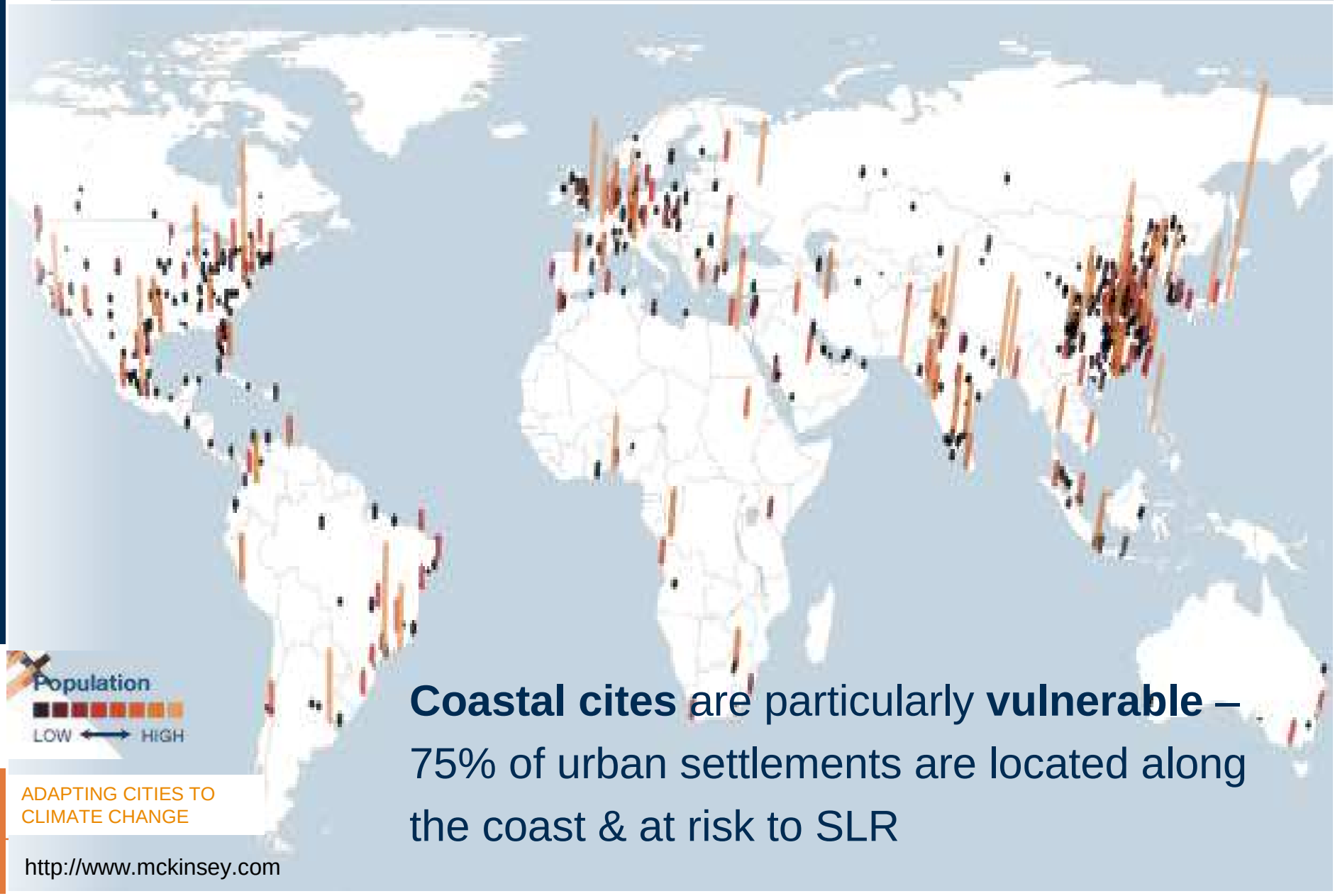
Why focus on urban areas?



Coastal cites are particularly **vulnerable** – 75% of urban settlements are located along the coast & at risk to SLR

http://www.mckinsey.com

Why focus on urban areas?

Cities are able to act:

- Concentration of population and activities within cities = strong **potential for innovation** and **impact**
  - Cities are held accountable by citizens, local businesses, schools & institution (direct policy impacts)
  - Cities with common profiles participate in international networks, collaborate, and disseminate best practices

C40 CITIES
CLIMATE LEADERSHIP GROUP

2

Which climate impacts most affect urban areas?

A. Coastal erosion & flooding

B. Flash floods

C. Urban heat island effect

D. Drought

Which climate impacts most affect urban areas?

A. Coastal erosion and flooding

- Rising sea levels will affect low-lying coastal areas
- **13%** of the world's population **lives less than 10 meters above sea level**

Which climate impacts most affect urban areas?

B. Flash floods

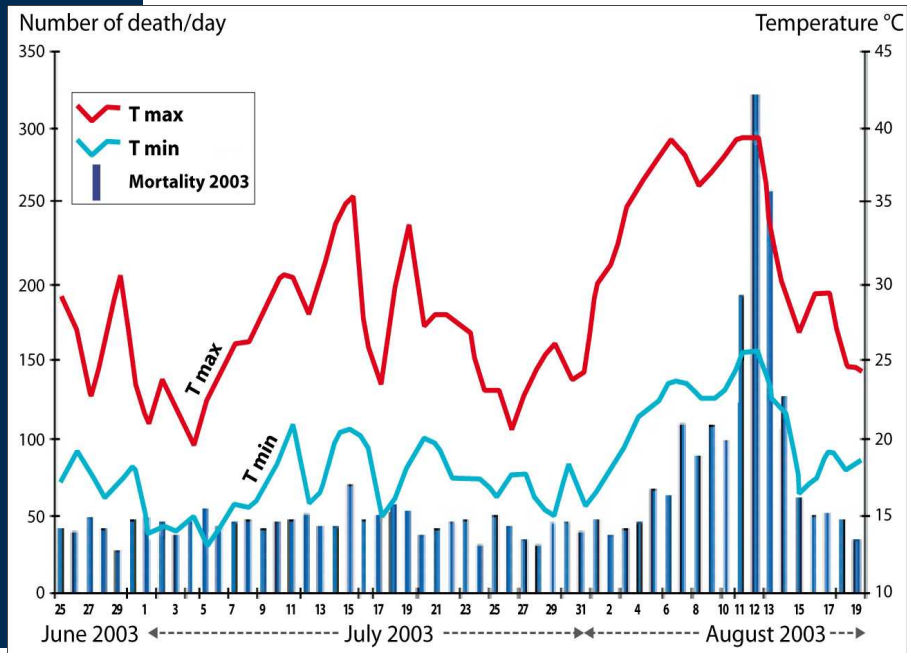
Urban areas are subject to flash flooding caused by short, intense rainfall events and rapid run-off due to soil sealing

Genova, 2010

Which climate impacts most affect urban areas?

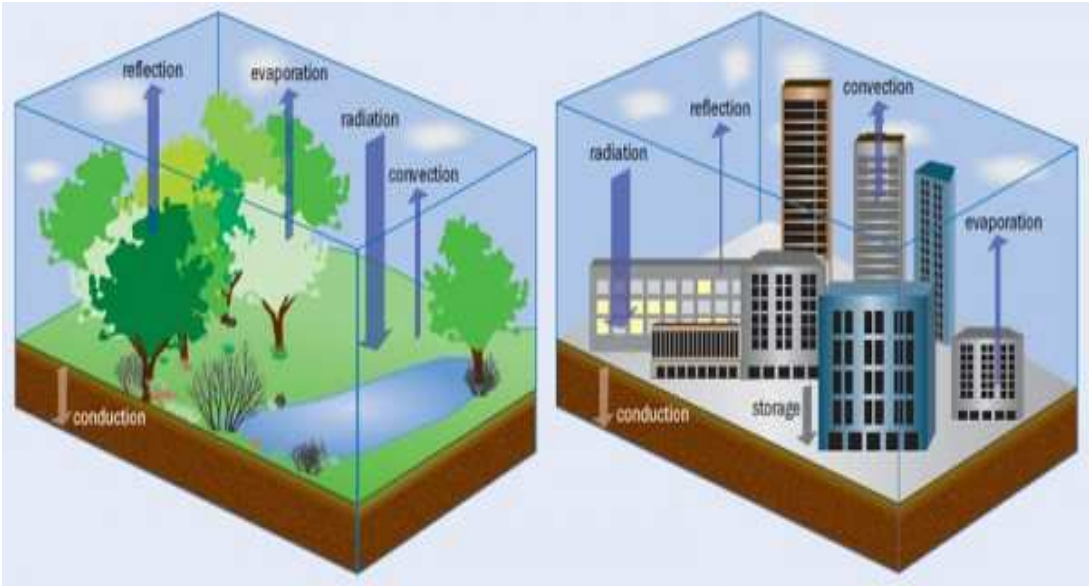
C. Urban heat islands

Dense urban areas store heat and atmospheric conditions due to pollution deteriorate health conditions -



Surface air temperature from an urban park, and mortality during the summer of 2003 in the Paris region (*source IVS 2003*, Dousset et. al. 2011)

Ex. Approximately 5,000 deaths in Paris during the 2003 heat wave



Which climate impacts most affect urban areas?

D. Drought

- A problem of water management and energy security that will become more severe in many urban areas

San Diego County Water Authority

Greater London Council

2

Which climate impacts most affect urban areas?

So what's new?

- Scale of problems are changing, but many problems are already existing (erosion, flooding, drought)
- Time frames are changing
- New policies will need to tackle both changes in scale and urgency

3 What does adaptation mean for urban policy?

- **Infrastructure dimensioning**: protection measures mainly for flooding and erosion;
- **Land use planning,** zoning, urban greening, managing urban growth
- Institutional changes:
  - "Soft" adaptation measures for increasing resilience (insurance, early warning systems and capacity building)
  - Changes in forms of governance (public private partnership, participation)
  - Relationships between levels of governance

EGIS BCEOM, 2011

3 What does adaptation mean for urban policy?

Technical infrastructure

Ex. Thames Barrier in London, UK (1982)

- One of the largest movable flood barriers in the world, protecting125km^2 of central London from tidal flooding
- Run and maintained by the National Environment Agency

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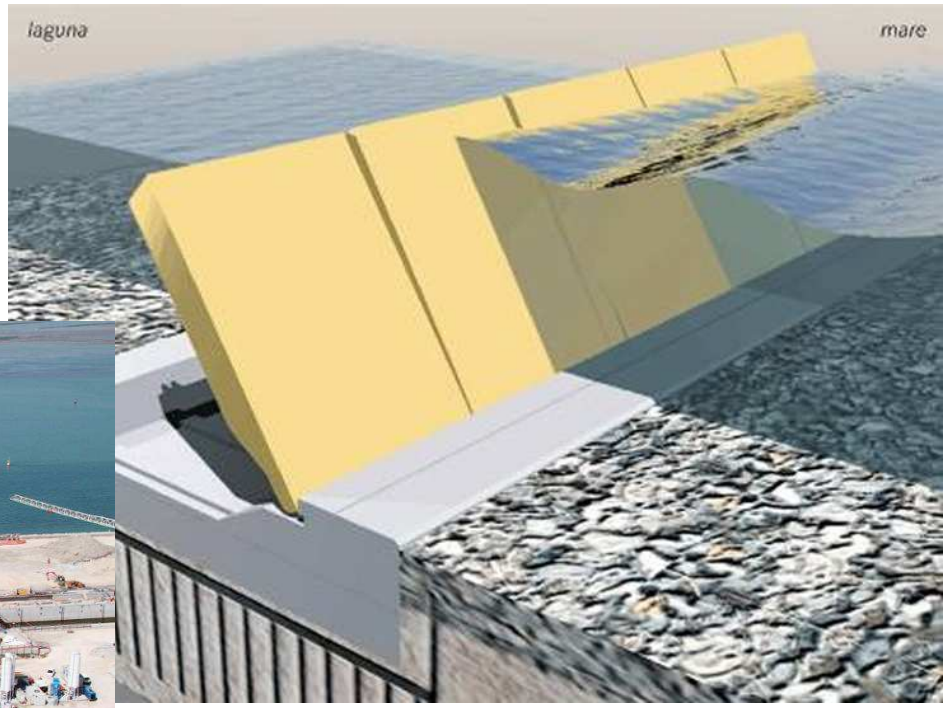
3 What does adaptation mean for urban policy?

Technical infrastructure

Ex. Mose: 4 mobile dikes protecting 550 km2 of the Venice lagoon and the cities of Venice and Chioggia from tidal flooding

Built and financed by the Italian Ministry for Infrastructures



http://www.environment-agency.gov.uk

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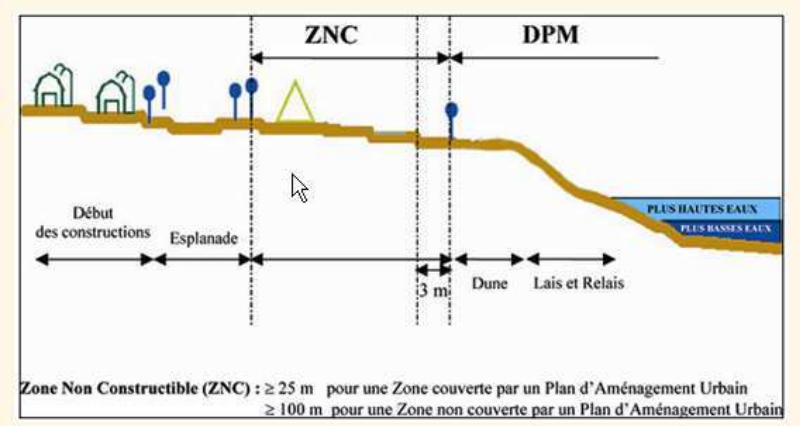
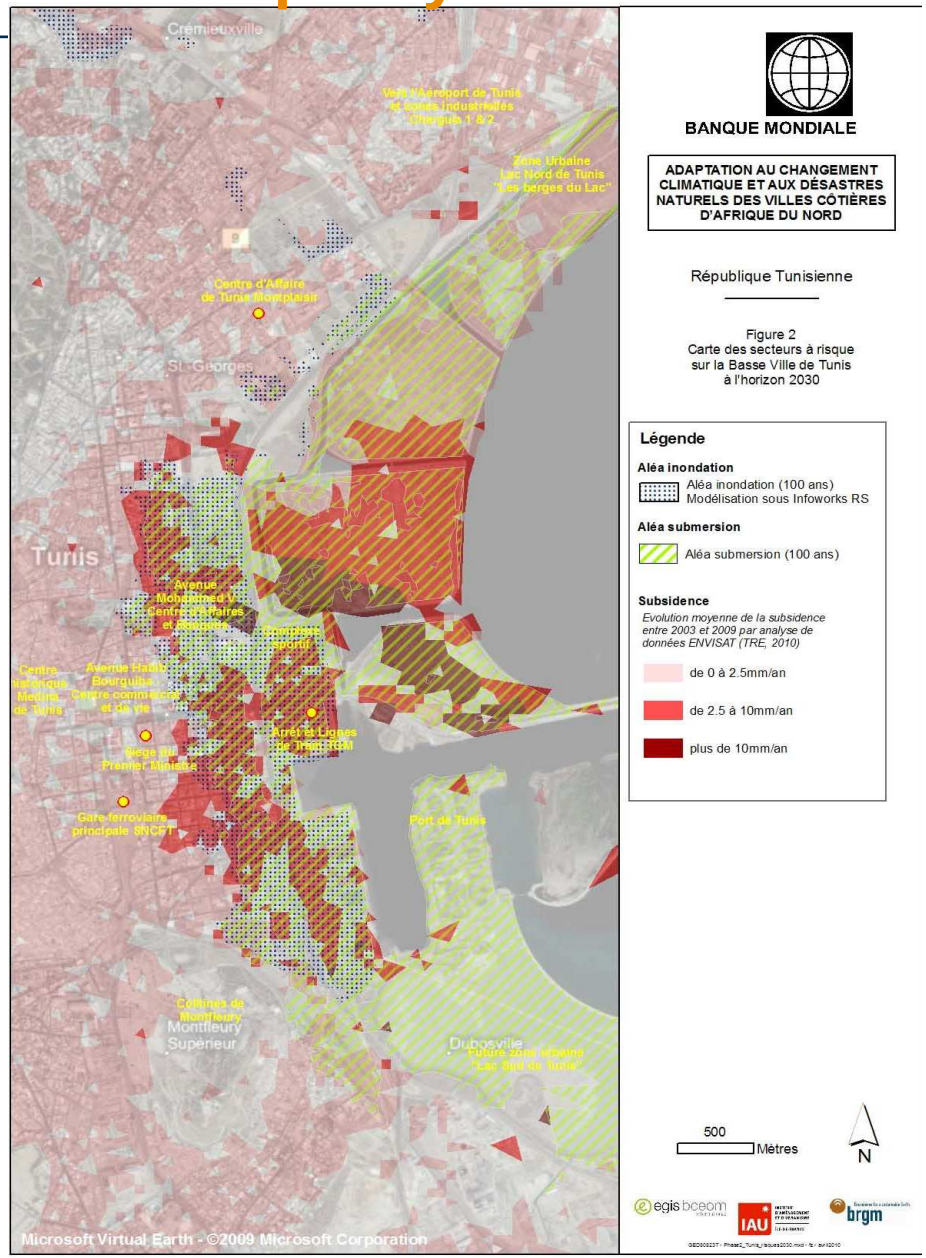
What does adaptation mean for urban policy?

Land use planning

Mapping of areas of flood risk in Tunis

Study financed by World Bank (EGIS-BCEOM, 2011)



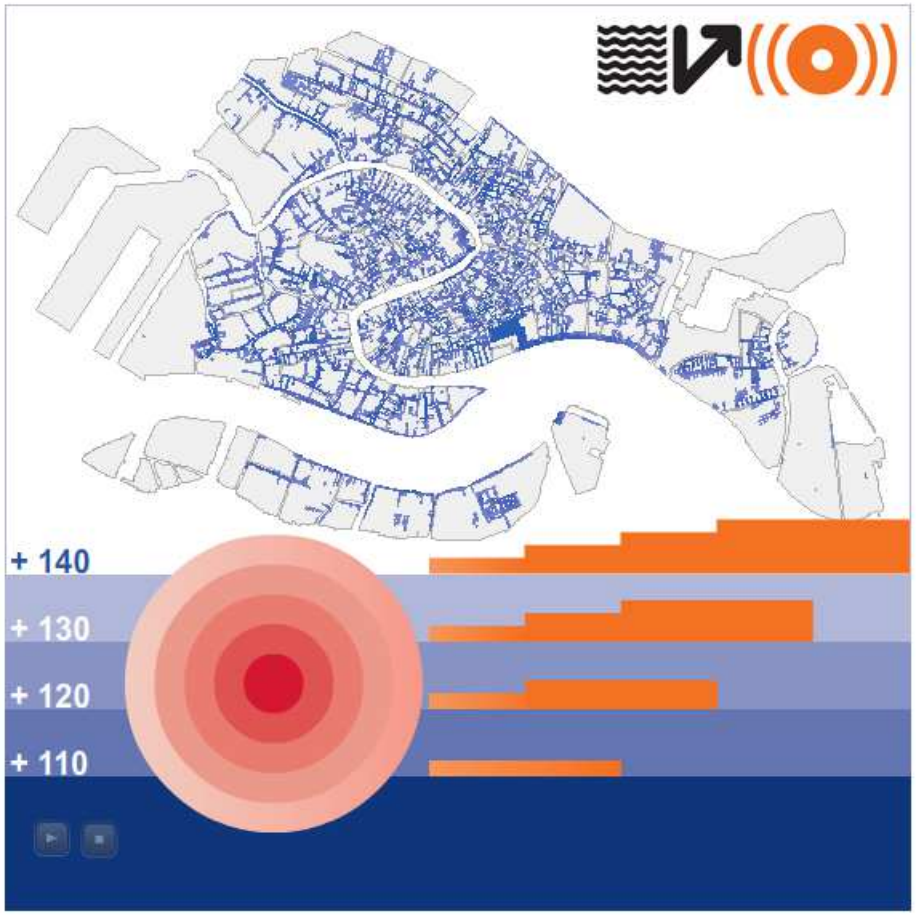


What does adaptation mean for urban policy?

Institutional Measures

Early warning systems

Ex. Venice flood alert system



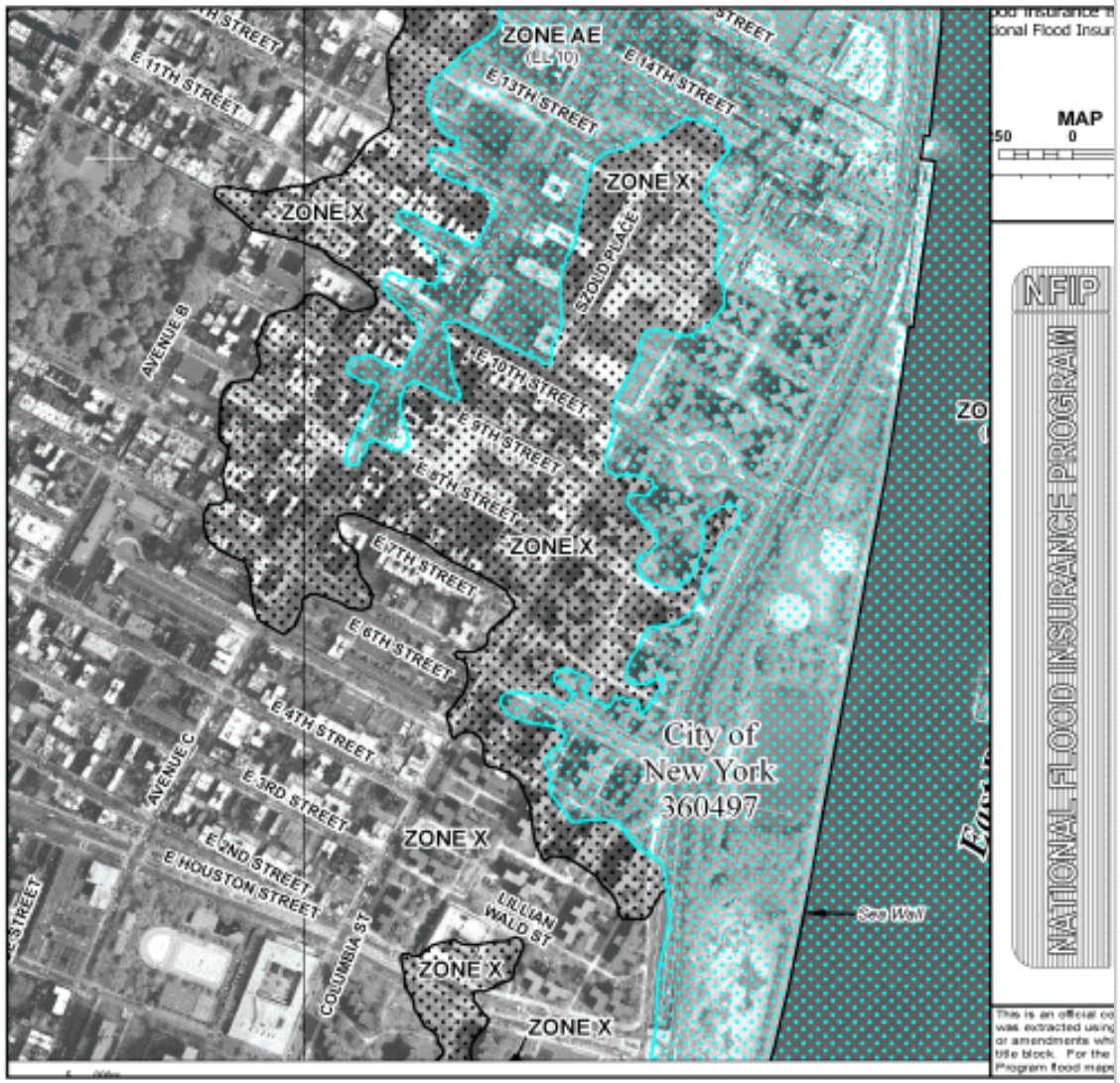
What does adaptation mean for urban policy?

Ex. US National Flood Insurance Program:

1. **Floodplain management** - requirements for zoning, subdivision or building, and special-purpose floodplain ordinances
2. Federally backed **flood insurance** for homeowners, renters, and business owners
3. **Flood hazard mapping** - creates broad-based awareness of the flood hazards and provides the data needed for floodplain management programs and to actuarially rate new construction for flood insurance

3 What does adaptation mean for urban policy?

Flood hazard mapping



Ex. NYC (East Village, Manhattan)

LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

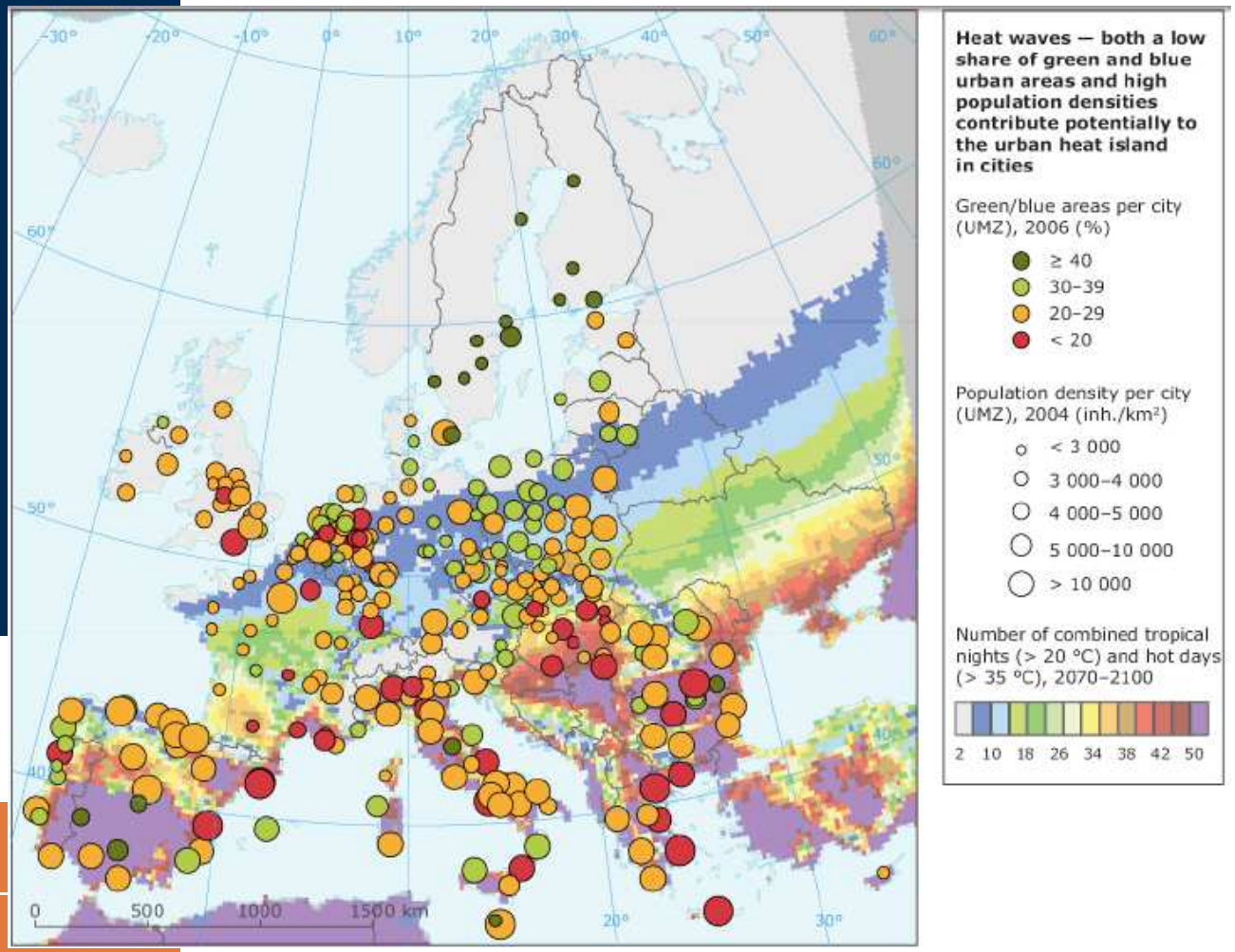
CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

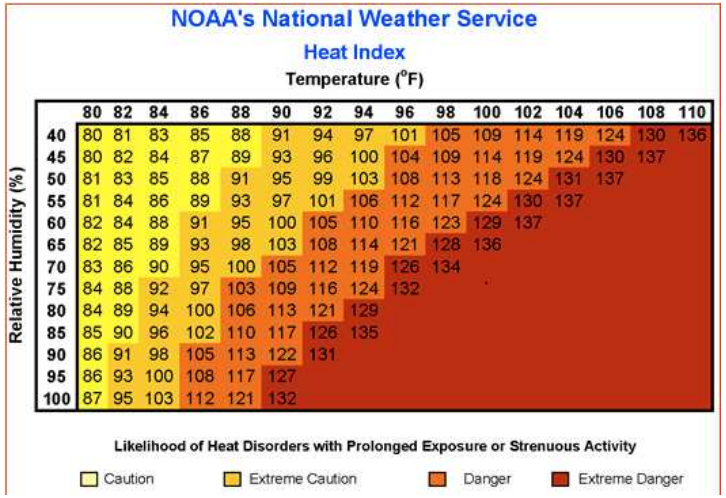
1% annual chance floodplain boundary

3 Adaptation and urban policy

Research and monitoring

Ex. Heat waves





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What's the role of assessment?

(limited) role of cost benefit analysis

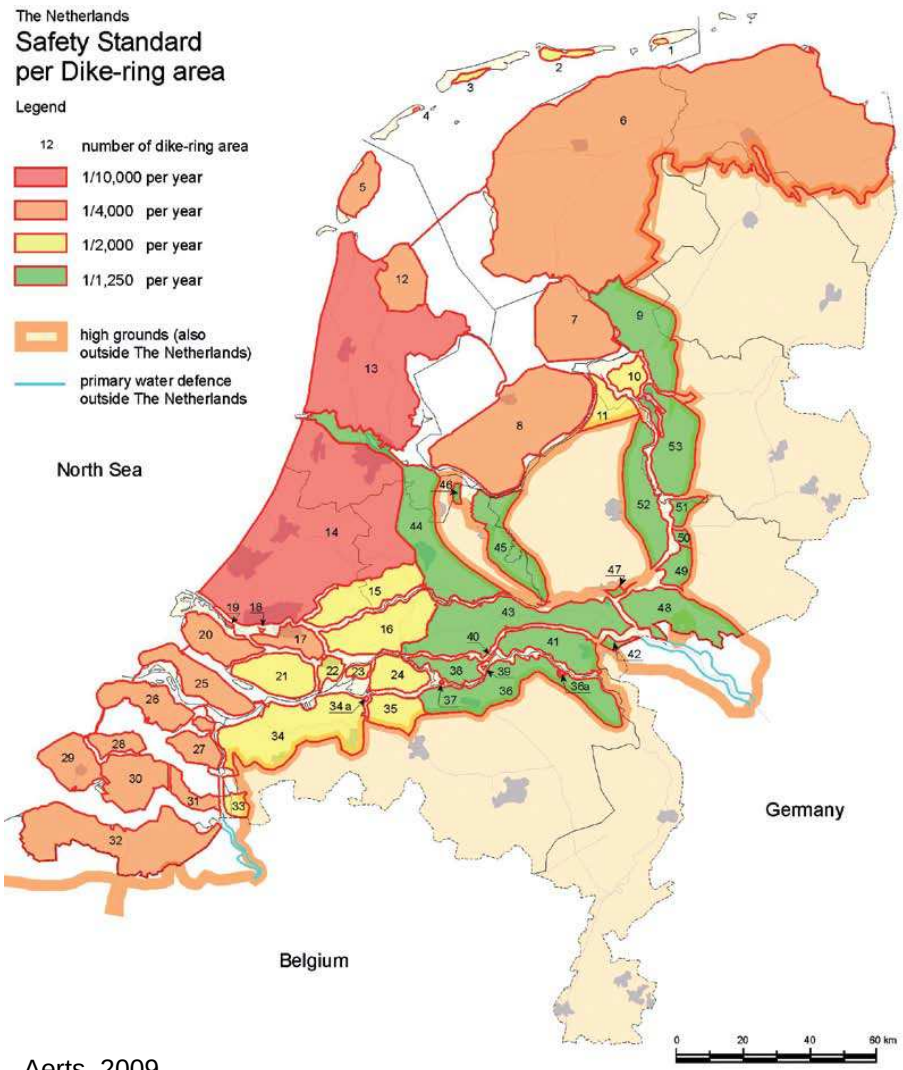
- Calculate potential benefits to prove the **economic viability** of adaptation measures

OR

- Provide support for decision making for **choice between different adaptation options** and different time horizons for implementation

What's the role of assessment?

Eg. The Netherlands
Quantities of values at risk and inhabitants determine the safety level of flood protection measures

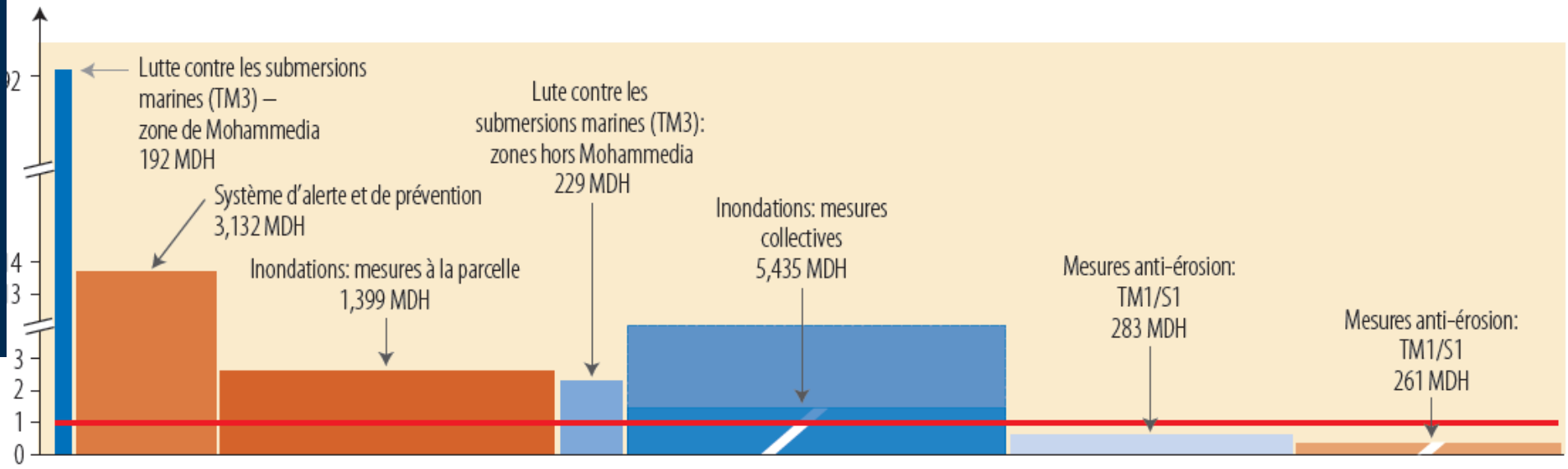


Aerts, 2009

What's the role of assessment and valuation?

Ex. Casablanca (Moroc) visualization of results of CBA for Adaptation measures

- CB-relation for single measures,
- break even point, above which benefits, under current conditions, outweigh costs (red line)



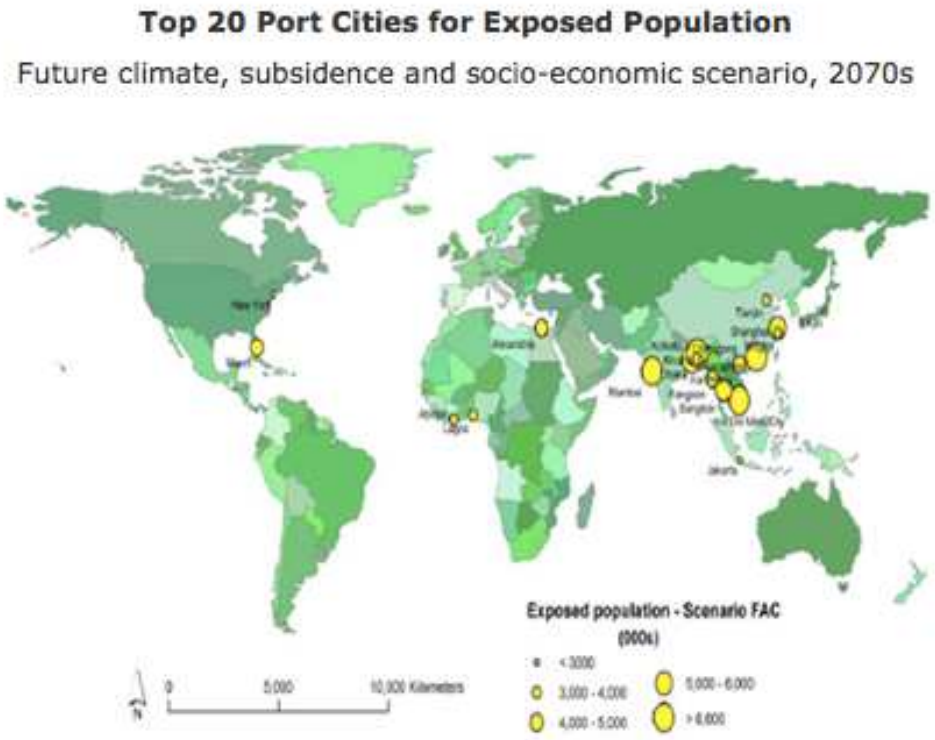
(EGIS BCEOM, 2011)

4 What's the role of assessment and valuation?

Issues:
Top-down vs. bottom up assessment strategies

Bottom up feasible only for local contexts; time consuming, expensive;
ex. EGIS-BCEOM, assessment for North African cities 2011

***Top down*:** useful for screening
•Ex. Nicholls et al. 2008, Ranking vulnerability of port cities



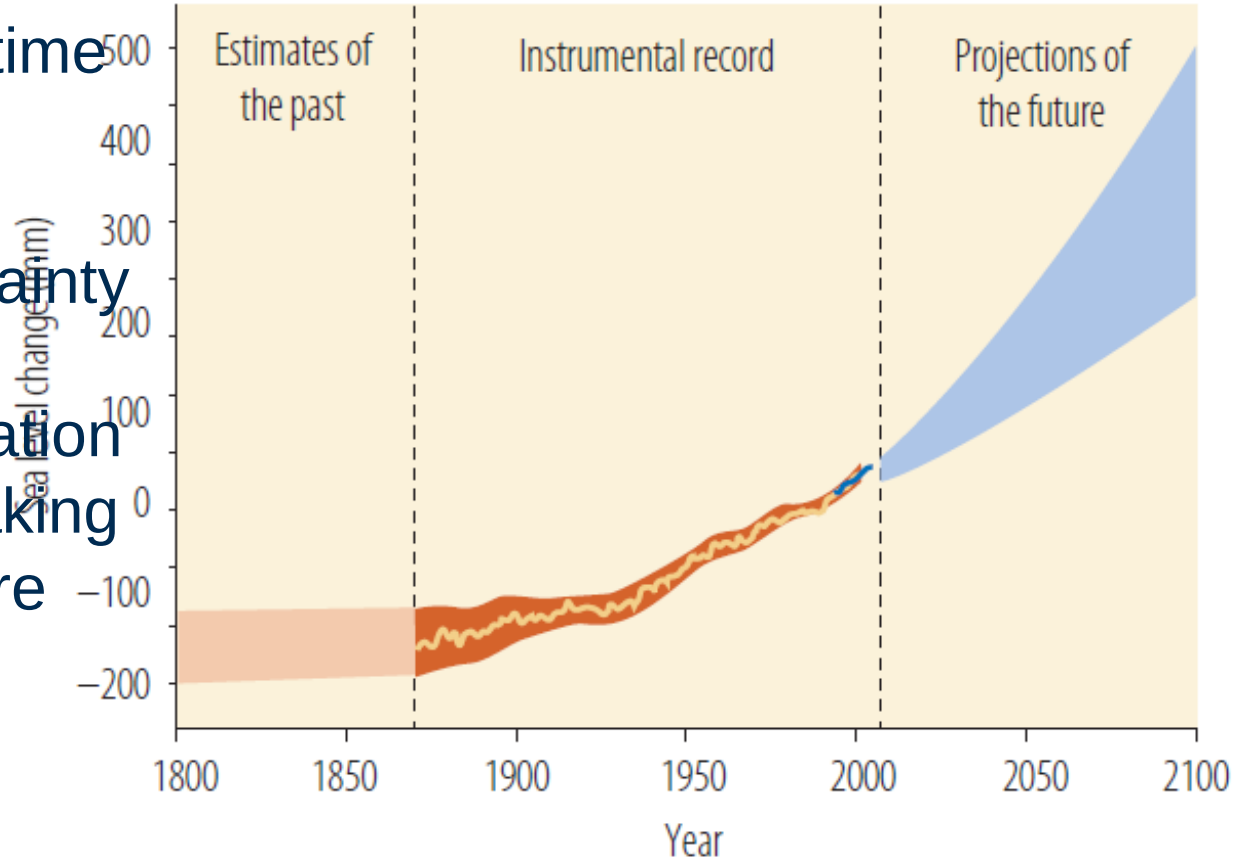
Source: Nicholls, R. et al. (2008), "Ranking Port Cities with High Exposure and Vulnerability to Climate Extremes", OECD Environment Working Paper Series, No. 1, OECD, Paris.

4 What's the role of assessment and valuation?

Issues:

Uncertainty and time horizons

- Scientific uncertainty
- Time horizons
- Timing of adaptation
- Discounting – taking into account future values



Projections for the 21st century carry uncertainty, but even at the low end of the range, sea level rise will compound current risks for North African coastal cities. (Source: WRI)

EGIS BCEOM, 2011

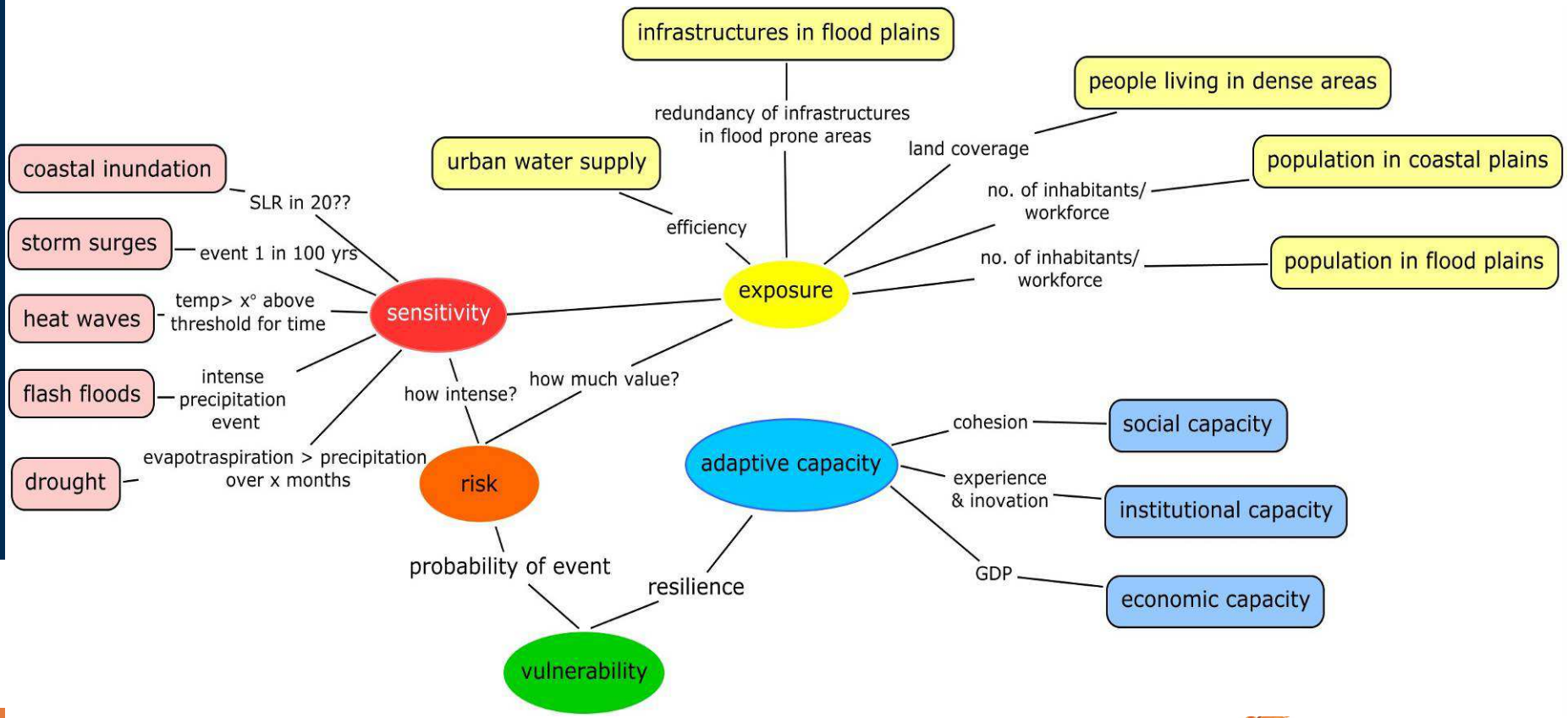
5 Conclusions

Research gaps result from a lack of clarity on the economics and financing of urban adaptation.

- Economic aspects of public infrastructure provision, urban transformation (i.e. land use changes), and private adaptation are not yet well understood or properly addressed
- Methods to assess adaptation options, the mitigation potential of adaptation measures, and sources and strategies of funding need further consideration

What's next?

Conceptualizing urban vulnerability



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What's next?

New research project

- Combine climate and economic data for a national context (Italy)
- Assess vulnerability and adaptation options
- Focus coastal cities
  - Impacts: SLR and coastal flooding, flash flooding, heat waves
  - Indicators: Urban density and land uses, green areas, level above sea, social demography,
  - Climate drivers: Sea level rise, storm surge, precipitation, extreme temperature

What's next?

Case study on Italian coastal cities > 200,000 inhabitants:

- Genova
- Roma
- Napoli
- Messina
- Palermo
- Catania
- Bari
- Venezia
- Trieste


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