Adaptation means anticipation

- Adaptation will require **technical know-how** and **substantial funding**.
- **Adaptation requires also anticipation**, especially in sectors with long-term investments:
  - Water management infrastructure (lifetime: up to 200 years);
  - Energy production and distribution infrastructure (up to 80 years);
  - Transportation infrastructure (50 to 200 years);
  - Natural disaster protections (50 to 200 years);
  - **Urbanism, housing and architecture (25 years to centuries)**.
- These infrastructures represent more than 200% of GDP in developed countries;
- In developing countries, cities and infrastructures are currently being built and it is urgent to take climate change into account.
- Anticipation is difficult, for two reasons.
Adapting to a changing climate

Climate analogues in 2070, Hadley Centre Model, SRES A2

It is neither more difficult nor expensive to design a building for the Cordoba climate than for the Paris climate. But what about a building able to cope with both climates?

Coping with uncertainty

Climate analogues in 2070, Météo-France Model, SRES A2

The « optimal » strategy is very different depending on the model that is used. We need new decision-making methods to cope with this new problem.

After Hallegatte, Ambrosi, Hourcade (2007)
Developing adaptation strategies able to cope with uncertainty
Looking for robustness

- Selecting no-regret strategies that bring benefits even in absence of climate change, and for most climate scenarios:
  - Most Disaster Risk Reduction Actions;
  - Improve building norms;

Several definition for adaptation

<table>
<thead>
<tr>
<th>No climate change</th>
<th>Current situation</th>
<th>Adaptation gap reduction</th>
<th>« optimal » risk level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Constant-level adaptation</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>With climate change</td>
<td>« Optimal» adaptation</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>« Strict » adaptation</td>
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</tbody>
</table>

And it is not a two-stage process, but a dynamic process!
Cost of climate change vs. adaptation cost in Copenhagen

Assuming a homogenous 180 cm protection in Copenhagen.

Flood losses and adaptation in Mumbai

- Adaptation can reduce direct losses below their current level
- Many adaptation options are no-regret.
- Why have these options been neglected so far?
  - Capital market imperfections?
  - Lack of political will or economic weight of marginalized population?
  - Institutional fragmentation?
Looking for robustness

- Selecting no-regret strategies that bring benefits even in absence of climate change, and for most climate scenarios:
  - Most Disaster Risk Reduction Actions;
  - Improve building norms;
- Favoring reversible strategies over irreversible ones (avoid lock-ins):
  - More restrictive land-use plans;

Long term anticipation and « lock-ins »

- 2010 Anticipation of future changes
- AC for vulnerable populations
- Future climate in Paris
- 2010-2025 Adaptation Strategy
- Arrival of information in 2025

Bordeaux

Cordoba

- Limited impacts in 2050
- But investment loss in the 2010-2025 period (sunk costs)

- Urbanism changes; Building retrofitting; Improved building norms

Bordeaux

- Small impacts in 2050
- Large impacts in 2050

Cordoba

- Generalization of AC;
- Energy costs and loss in comfort;
- Lock-in in suboptimal situations

Bordeaux

- Large impacts in 2050
- Generalization of AC;
- Energy costs and loss in comfort;
- Lock-in in suboptimal situations

Cordoba

Small impacts in 2050

Bordeaux

Large impacts in 2050
- Generalization of AC;
- Energy costs and loss in comfort;
- Large investments in building retrofitting;
- Lock-in in suboptimal situations

Cordoba

Very small impacts in 2050
- But investment loss in the 2010-2025 period (sunk costs)
Looking for robustness

- Selecting no-regret strategies that bring benefits even in absence of climate change, and for most climate scenarios:
  - Most Disaster Risk Reduction Actions;
  - Improve building norms;
- Favoring reversible strategies over irreversible ones (avoid lock-ins):
  - More restrictive land-use plans;
- Investing in low-cost “safety margins”:
  - Drainage infrastructures in Copenhagen.
- Reducing investment lifetimes:
  - Housing building quality and lifetime in hurricane-prone areas (“Building strong”?)
- Favoring financial and institutional (“soft”) adaptation over “hard adaptation”:
  - Early warning, evacuation and insurance vs. sea walls and dikes.
  - Changes in norms and regulations.

Looking for robustness

- Selecting no-regret strategies that bring benefits even in absence of climate change, and for most climate scenarios:
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- Looking for synergies between adaptation and mitigation
  - Energy cost and water desalinization.
  - Urban and land-use plans
Looking for robustness

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- Looking for synergies between adaptation and mitigation
  - Energy cost and water desalinization.
  - Urban and land-use plans
- Taking into account other policy goals to get support to adaptation investments

The 2003 heat wave: a chilly 2080 summer?

- Model results
- Observations
We can adapt our cities to higher temperatures

Assuming the implementation of specific measures to limit the urban heat island.

Source: CNRM, Météo-France (V. Masson, G. Pigeon, A. Lemonsu, C. Marchadier)

Trade-offs in urban policies in Paris

- More resilient buildings, promoted by stricter construction norms:
  - Lower energy consumption and carbon emissions;
  - Lower vulnerability to heat waves, and possibly floods;
  - **BUT** Higher construction costs and higher rents, smaller housing surface and more difficulty for modest households to access housing;
  - And transformation of the city of Paris – *Patrimonial and cultural issues.*

- Introduction of additional parks and vegetation:
  - Lower housing density, if buildings are not modified, and larger transportation needs;
  - Amenities from parks and vegetation;
  - Weaker urban heat island and higher resilience to heat waves and heavy precipitations (but not quantified precisely yet…)
  - **BUT** higher land prices, smaller housing surface, and more difficulty for modest households to access housing;

- Many of these trade-offs imply non-market impacts:
  - Multi-criteria decision-making
  - Participatory approaches are needed (top-down will not work)
French National Adaptation Plan

First phase (2008-2009):
- Top-down selection of 2 climate and economic scenarios
- Participatory approach to identify climate change impacts
  - Government, Local authorities, Business unions, Worker unions, NGOs

Second phase (2010):
- Participatory approach to identify adaptation measures
- Participatory assessment with simple methods, with 6 metrics (urgency, monetary, health, biodiversity, quality of life, redistributive impacts).
- Government (detailed) assessment and selection of measures:
  - Consistency with other policy goals
  - Robustness to climate and socio-economic uncertainty
  - If possible and necessary, detailed economic and financial analysis
- Definition of indicators for success

Follow-up:
- Review and revision in 5 (?) years
Which urban plan should we adapt?

-Mumbai has about 18 million inhabitants
-50% of the Mumbai population lives in slum and work in the informal sector
-Dharavi is the largest slum in the World

- Land scarcity and transportation issues are hard to resolve.
- How to act in places with no land tenure?
- Political and economic weight of these populations?

Credit: Joe Harder Buxtehude