Adaptation to climate change and uncertainty:

Do not count on climate scientists to do you work!

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C.I.R.E.D.

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Summary

- **Adaptation can be efficient to reduce (some) climate change impacts.**
- But adaptation is not an easy task:
  - In several economic sectors with long timescales, **climate change should already be included in decision-making frameworks.**
  - There is a large uncertainty in future climate change at the local scale. This uncertainty has no reason to decrease in the next decades.
  - Because of uncertainty, inadequate adaptation strategy can worsen the situation compared with a no-adaptation scenario.
  - **Innovative strategies that improve robustness to climate change must be developed by the users of climate information.** A few ones are proposed in this presentation.
- Adaptation should be a priority for future research. This research cannot be done by climate scientists alone: **closer collaborations between stakeholders** (businesses, governments, local authorities, etc.) and climate scientists are needed.

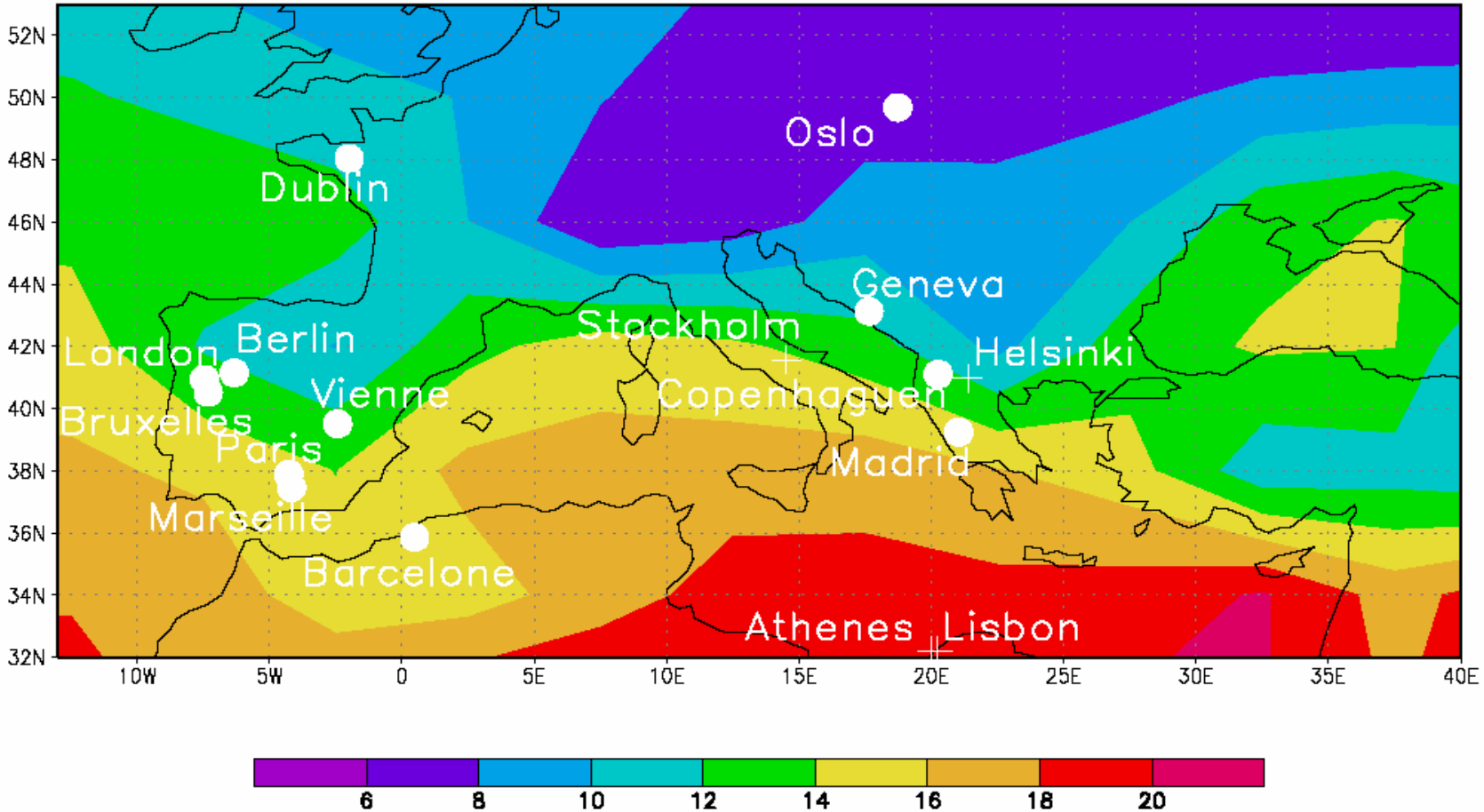
1. Adaptation, timescales and uncertainty

Adaptation is not an easy task

- 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 to 150 years).
- These infrastructures represent more than 200% of GDP in developed countries; in France, more than 1000 billion euros will be invested in these sectors in the next 10 years.
- In developing countries, these 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 it is more difficult (and more expensive) to design a building able to cope with both climates.

After Hallegatte, Ambrosi, Hourcade (2007)

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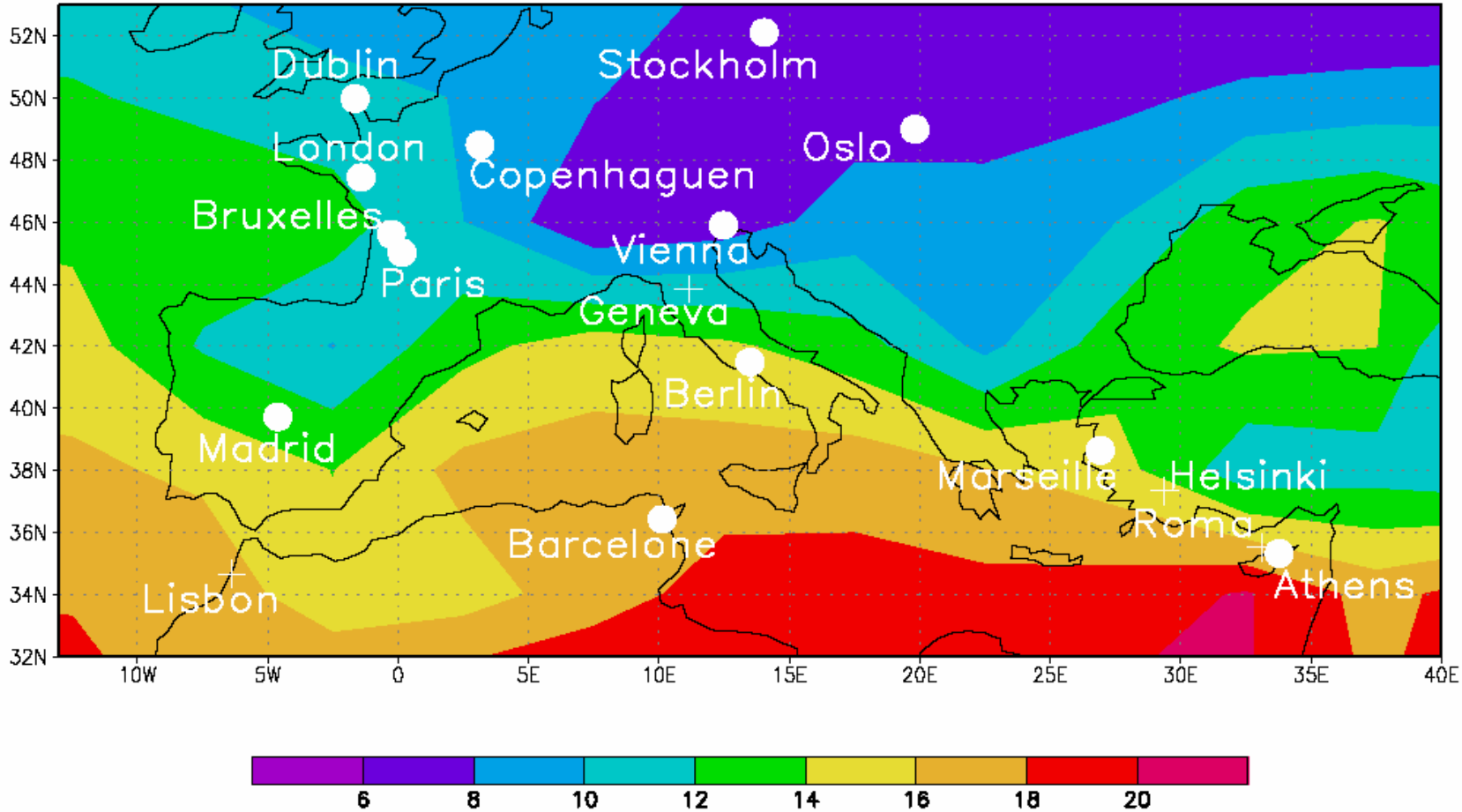
Coping with uncertainty

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



After Hallegatte, Ambrosi, Hourcade (2007)

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**.

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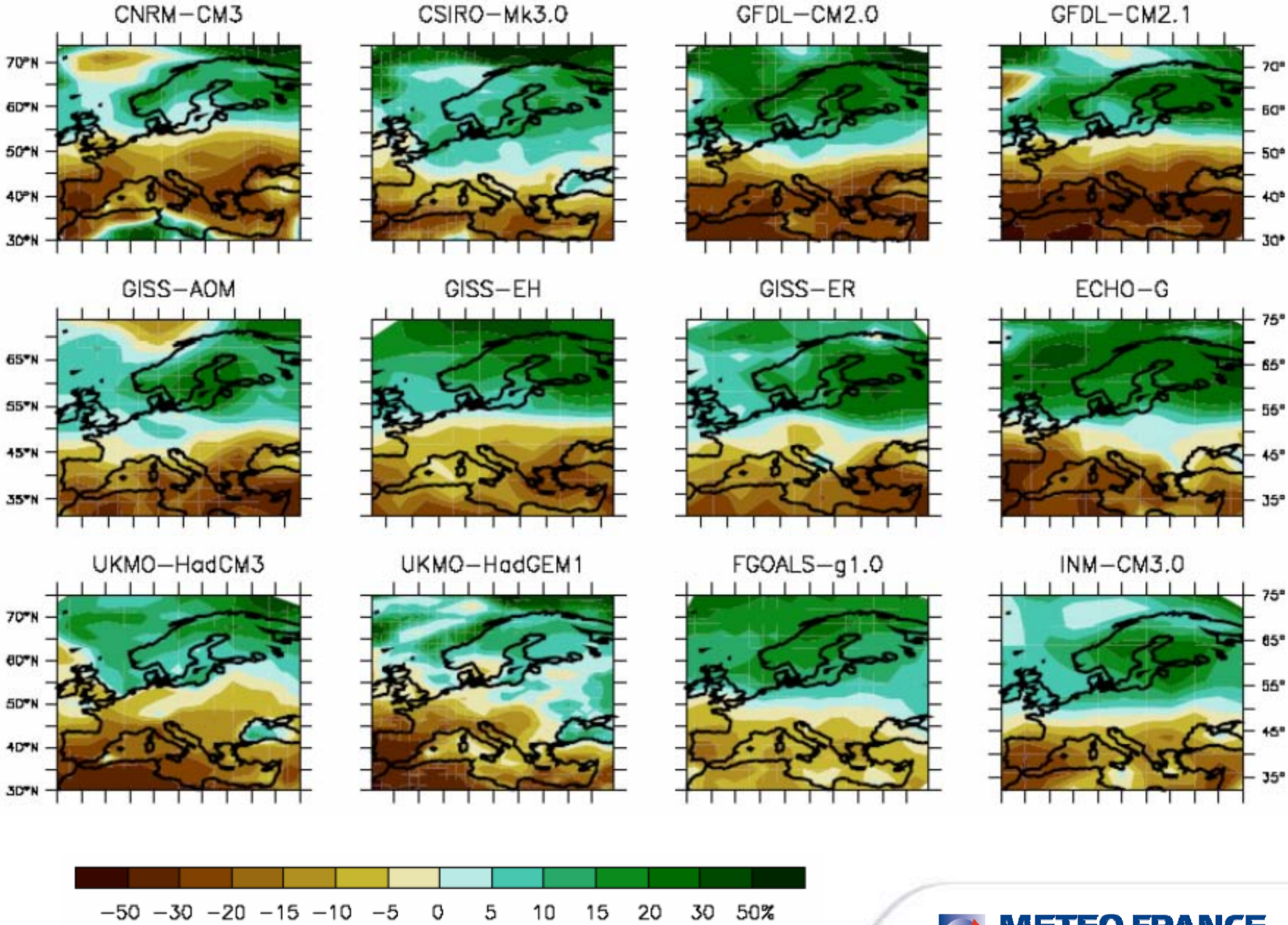

IPCC, 2007

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2. Developing adaptation strategies able to cope with uncertainty

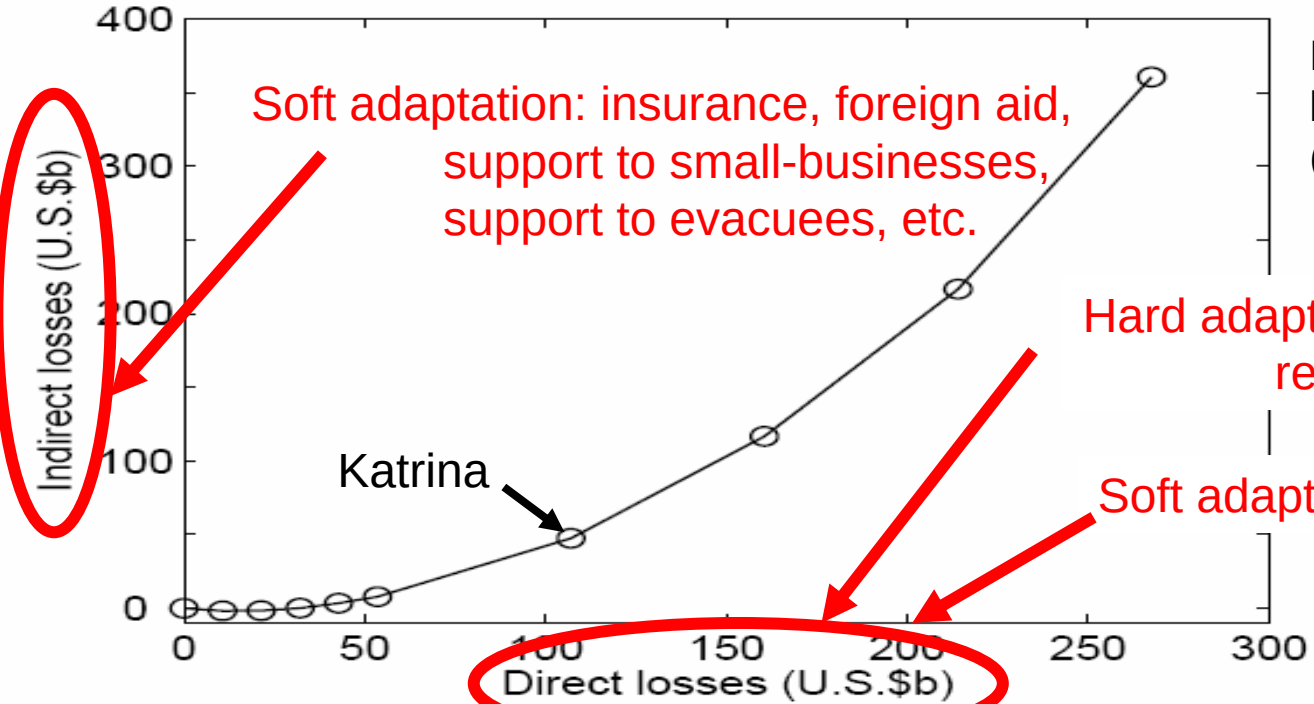
Looking for robustness

- **Selecting no-regret strategies that bring benefits even in absence of climate change:**
  - Most Disaster Risk Reduction Actions;
  - Improve building norms;
  - More restrictive land-use plans;
- **Favoring reversible strategies over irreversible ones:**
  - More restrictive land-use plans;
- **Investing in low-cost "safety margins":**
  - Drainage infrastructures in Copenhagen.
- **Reducing investment lifetimes:**
  - Forestry sector and tree rotation time;
  - Housing building quality and lifetime in hurricane-prone areas.
- **Favoring financial and institutional ("soft") adaptation over "hard adaptation":**
  - Early warning, evacuation and insurance vs. sea walls and dikes.
  - The "institutionalization" of long-term planning horizons: the California Water Plan and its compulsory 25-year planning exercises.
- **Taking into account synergies and conflicts between adaptation strategies and between adaptation and mitigation**
  - Dikes and biodiversity in coastal areas;
  - Snow-making and water availability in mountain areas;
  - Uncertainty on future energy cost and water desalinization.
  - Urban and land-use plans

Soft vs. Hard adaptation: Natural Disasters

Direct losses:
1. Casualties and injuries
2. Direct economic losses

Indirect losses:
1. Emergency costs (Katrina: $8 billion)
2. Business interruption, supply-chain disruption, and propagations
3. Lost production during the (long) reconstruction period
4. Macro-economic feedbacks and political destabilization
5. Psychological trauma & social network disruption



Direct losses vs. Indirect losses in Louisiana, Hallegatte (2008, Risk Analysis)

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- Adaptation should be a priority for future research. This research cannot be done by climate scientists alone: **closer collaborations between stakeholders** (businesses, governments, local authorities, etc.) and climate scientists are needed.
- **Slowing down climate change through emission reductions would make adaptation much easier.**

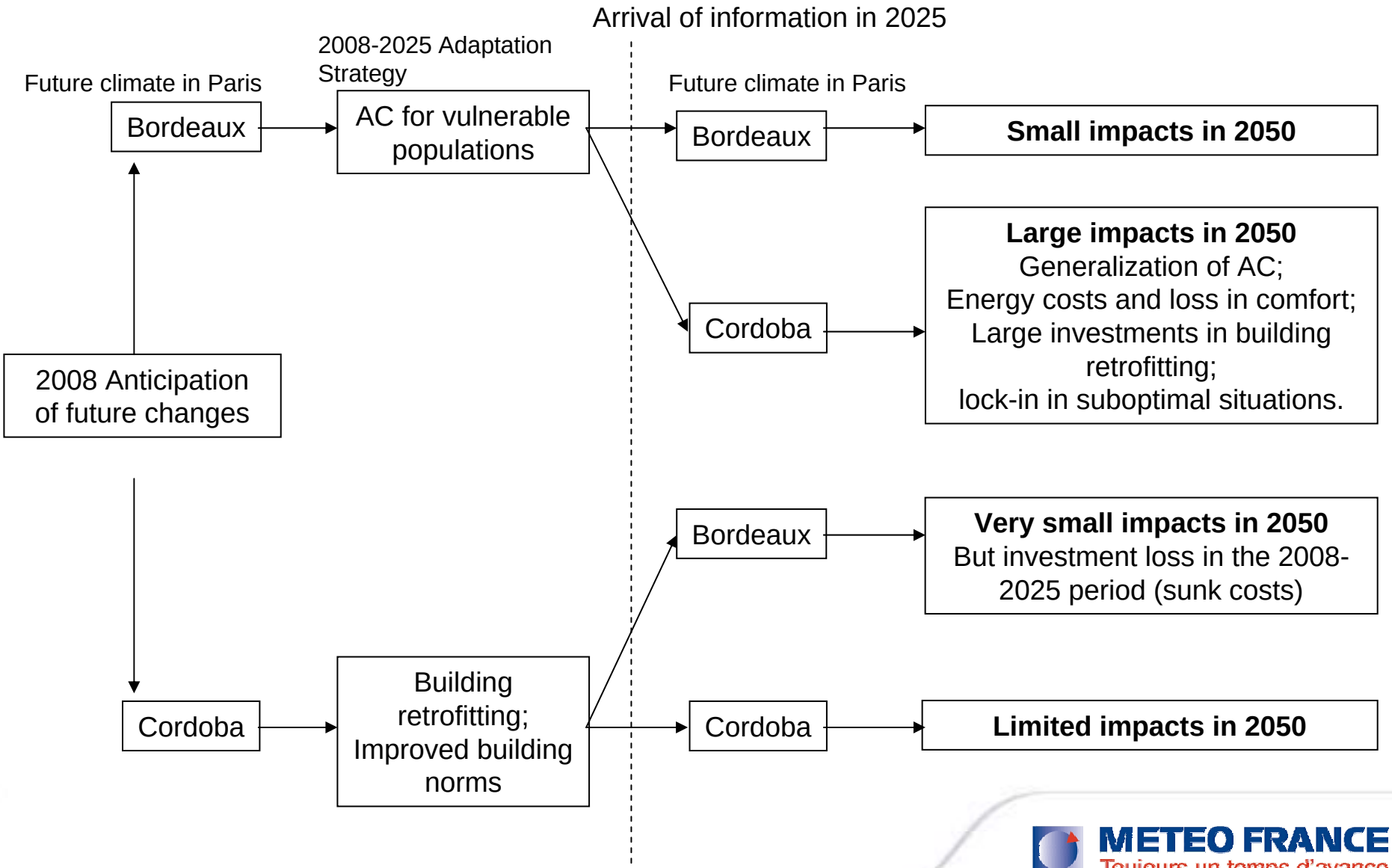
Gains from increased insurance penetration

- Case study on Mumbai and the July-2005 floods within an OECD project with RMS, Météo-France, and CIRED (still preliminary results).

- The July-2005 floods: US$1.5 billion of direct losses
- According to the model: US$350 million of value-added loss
  (indirect cost equals 23% of direct loss)
- Assumed insurance penetration in Mumbai:
  - 25% for households
  - 45-55% for businesses

- With 0% insurance penetration, but access to credit:
  - indirect cost increases by US$69 million (about 20%)
- With 100% insurance penetration:
  - Indirect cost decreases by US$76 million (about 20%)

Prospective, anticipation, et « lock-ins »



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Impact assessments are not convincing

- From W. Nordhaus to N. Stern, the economic losses caused by a 2°C warming have always been estimated around a few percent of the world GDP. Some estimates (R. Tol, R. Mendelsohn) even predict net gains from climate change up to 2°C.

- The IPCC has always been very careful about these figures, and for good reasons:
  1. Impact assessment are **incomplete** and involve **value judgment** on which there is no consensus.

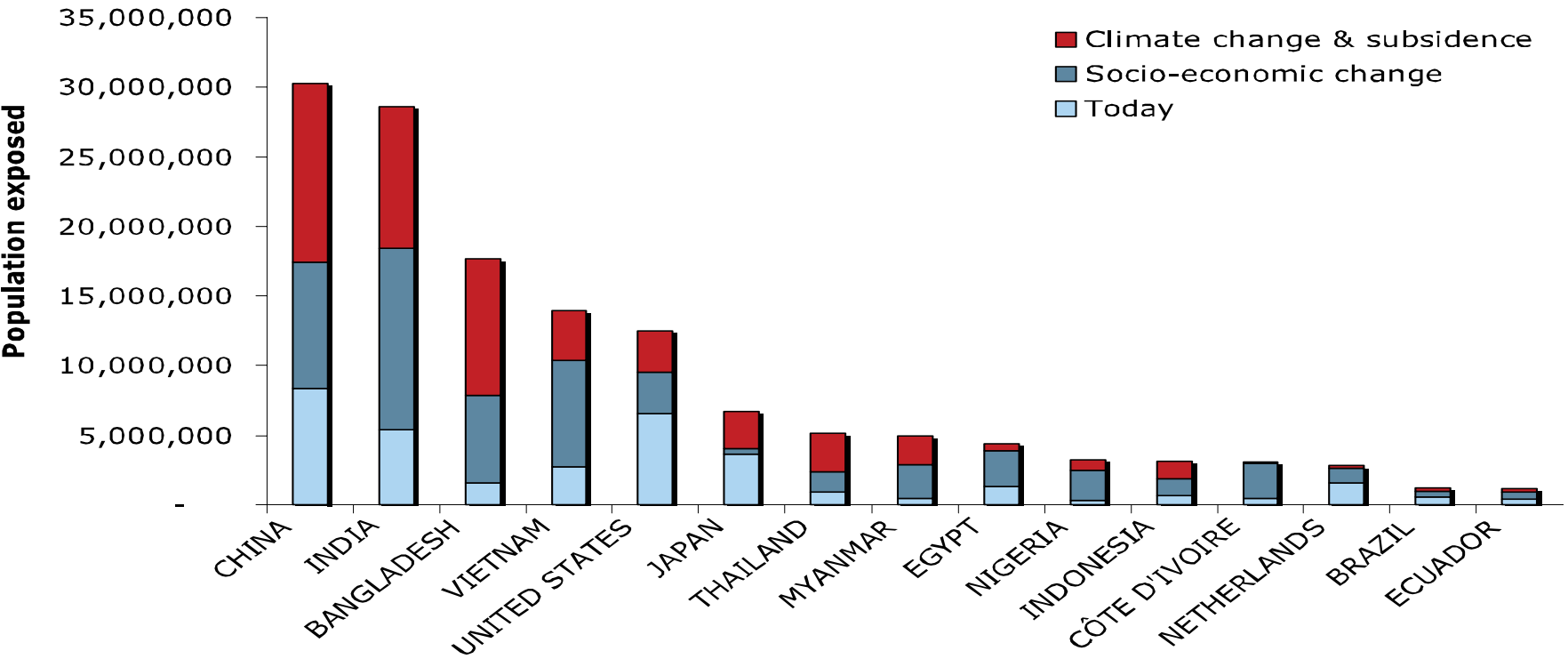
     e.g., what is the value of a landscape, of an animal species?
  2. The methodologies used in these assessment are not able to capture **the effects of shocks like natural disasters.**

     e.g., would one Katrina per year in the U.S. be a problem?
  3. Climate change could **create political instabilities**, especially between different groups within countries.
  4. These methodologies are not able to capture **adaptation, including practical difficulties and obstacles.**

1. How adaptation can reduce climate change impacts: illustration on coastal flooding

Climate change will increase natural hazards

Example: Population exposed to the 100-yr flood today and in the 2070's, with a 50cm sea level rise.



OECD Report on the exposure of large coastal cities to storm surges, Nicholls et al. (2007)

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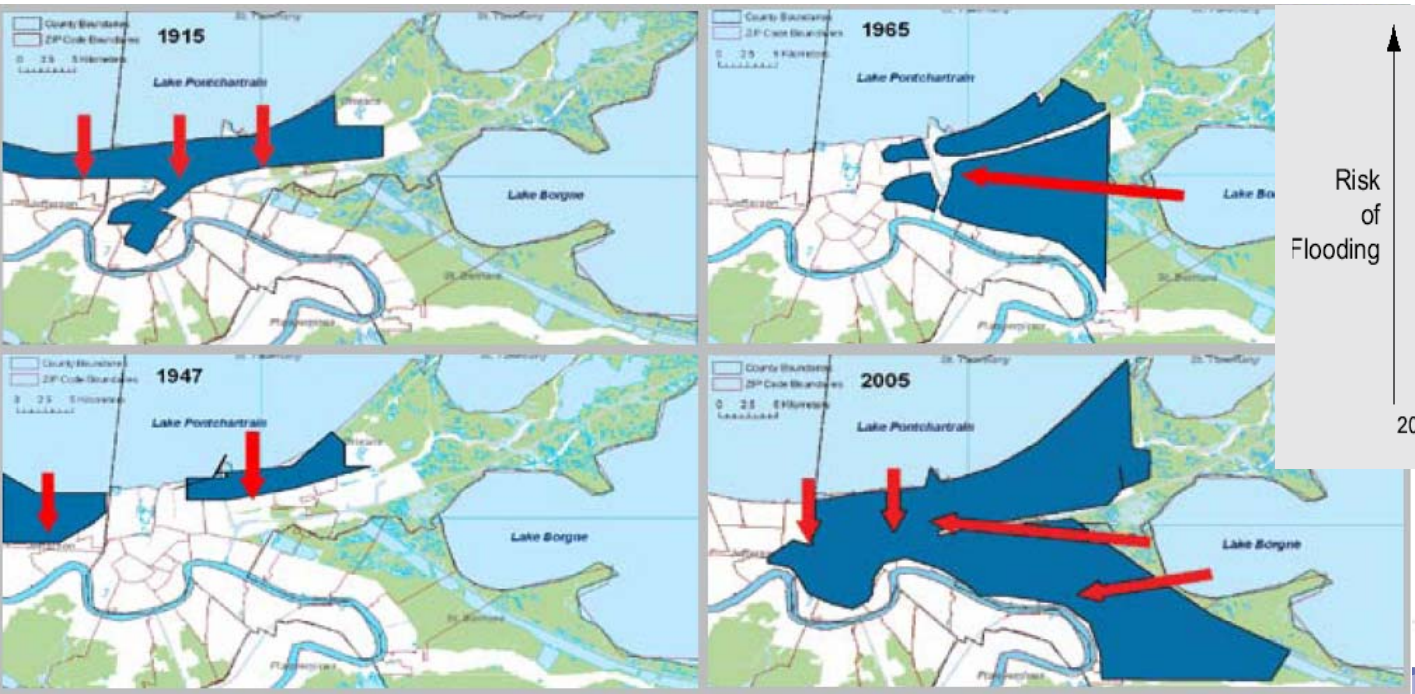
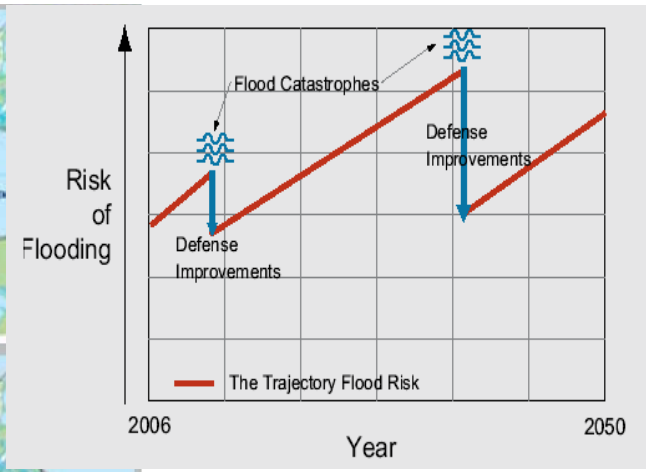
An example of increasing risks: New Orleans

- Sea level rises in New Orleans by 50 cm/century, increasing the risk of coastal flooding;
- After each floods, flood defenses have been improved
- **But no systematic risk management practice has been implemented**;
- The 2005 flood affected 80 percent of the city and killed 1800 people.



Historical flooding in New Orleans in 1915, 1947, 1965 and 2005



From Muir-Wood et al. (2006)

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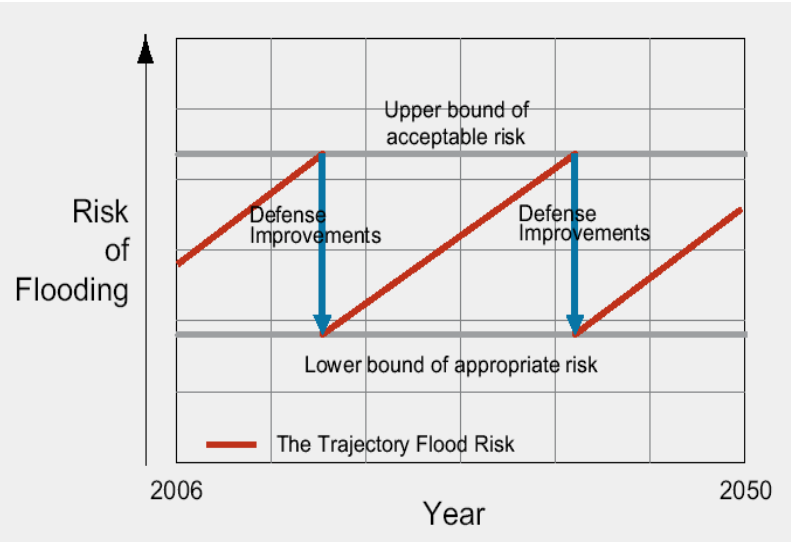
Another example of increasing risks: The Netherlands

- Sea level rises in the Netherlands (by 0.2m/century);
- After the 1953 great flood, **institutional and legal innovations** were implemented to manage future risks.
- Flooding risks are now monitored and managed on a regular basis.
- **Climate change is naturally taken into account**



From Muir-Wood et al. (2006)

Depending on how they are managed, increasing risks can translate, or not, into series of large-scale disasters.

Risk management is not (only) a financial an technical issue, it also requires institutional capacity.