

## Societal and Economic Impacts of Sea Level Rise

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12/07/2013

### Sea Level Rise

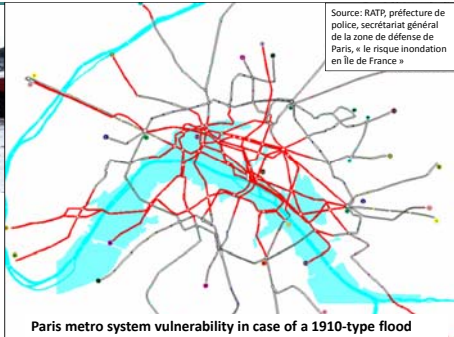


Fire Horse Leo

- **Locally, SLR can have impacts on a wide range of sectors :**
  - Health issues and casualties, destructions, decrease in business activity, biodiversity losses etc.
  - Economic losses can affect areas much larger than locations directly affected by the hazard

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### Sea Level Rise



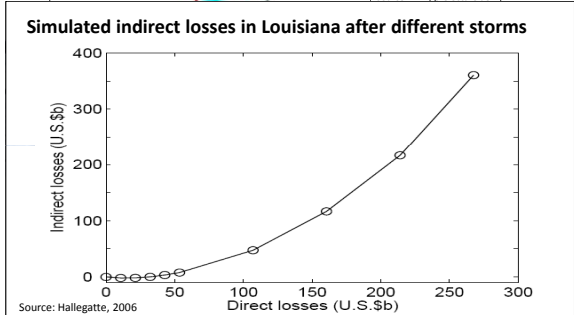
Paris metro system vulnerability in case of a 1910-type flood

Source: RATP, préfecture de police, secrétariat général de la zone de défense de Paris, « le risque inondation en Ile de France »

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### Sea Level Rise



Simulated indirect losses in Louisiana after different storms

Source: Hallegatte, 2006

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### Sea Level Rise



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  - Health issues and casualties, destructions, decrease in business activity, biodiversity losses etc.
  - Economic losses can affect areas much larger than locations directly affected by the hazard
- **SLR can also induce global issues:**
  - International migrations, wars, breaks in international trade etc.



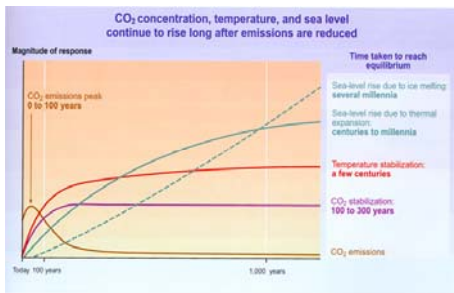
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### Adaptation

- **Why is Sea Level Rise (SLR) an issue?**
  - It is an issue if the society cannot **adapt** to it
  - What are the main constraints to adaptation?
- **A continuous process**
- **Uncertainties**
- **Bifurcations**

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1/3 Adaptation is not an easy task : a continuous process



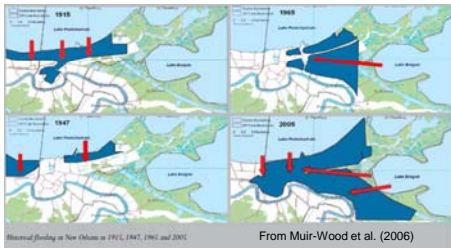
We need to be adapted in 2100, but also in 2030, in 2050 ...  
 And in 2120, 2150...  
 We have to adapt to a **perpetually changing climate**

Reactive vs. Anticipatory adaptation

- **Climate change adaptation can be reactive**
  - Reacting ex post to adverse impacts of climate change when they occur
- **Climate change adaptation can be anticipatory**
  - Taking action before impacts occur

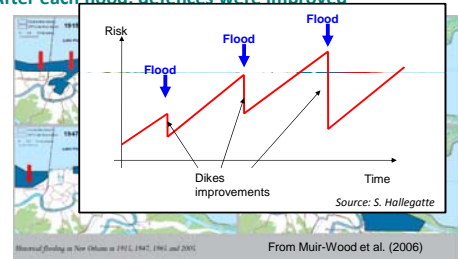
Reactive adaptation

- In New Orleans, Sea Level has locally increased by 50cm during XXth century
- After each flood, defences were improved



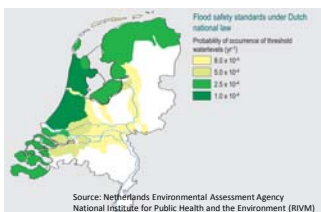
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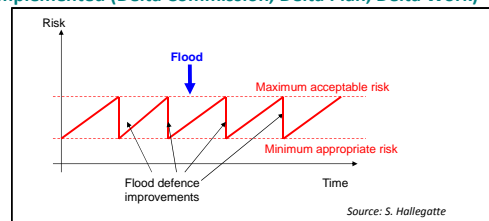
Anticipatory adaptation

- In Netherlands, Sea Level has locally increased by 20cm during XXth century (in average)
- After 1953 floods, risk management process have been implemented (Delta Commission, Delta Plan, Delta Work)



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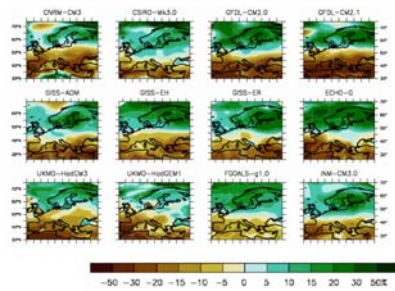
2/3 Adaptation is not an easy task : inertia and uncertainty

- An important part of SLR impacts can be caused by badly adapted infrastructures
- Infrastructures are 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).
- For infrastructures to be adapted at the end of the century, we have to begin to act now



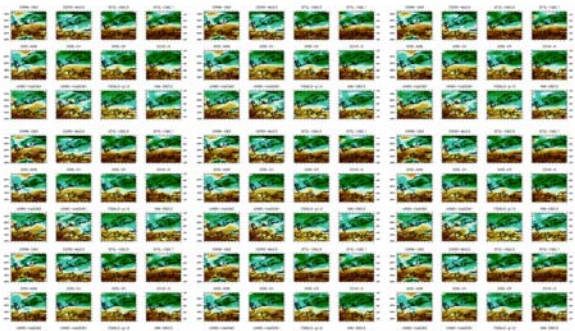
Photo: milan.boeng

2/3 Adaptation is not an easy task : inertia and uncertainty



In each scenario, "optimal policy" can be very different

2/3 Adaptation is not an easy task : inertia and uncertainty



3/3 Adaptation is not an easy task : bifurcations

- It may be too costly or technically impossible to adapt "at the margin" while maintaining the same activities or services under a new climate.
  - Adapting to climate change therefore may require "bifurcations" towards new activities and/or towards new locations
- Should we protect the coast or let water go inland?
  - It might be underoptimal trying to preserve these activities at high cost
  - Bifurcations are often difficult to trigger and drive
- Such a decision is extremely complex
  - Difficult to do an efficient economic analysis
  - What matters is a vision of the future and the development strategies

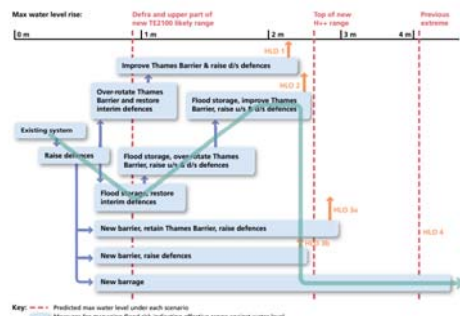


Photo: ThomasCoody

ROBUST STRATEGIES

Example: Thames Estuary 2100 project

Source: UK Climate Projections science report: Marine & coastal projections



### 1. « no regret » measures

- Most of climate change impacts will be an acceleration of problems that exist already
  - We are not perfectly adapted to present-day climate
  - Coastal flood risk, for instance
- Dealing with these already existing issue therefore decreases our vulnerability to future climate change impact
  - It is called a "no regret" measure
  - The co-benefits alone justify the implementation of the measure
  - It is useful in all possible scenarios

Single family houses exposed to flood risk (in 2006)

France average: 9.5 %  
From MRN, 2010, after INSEE, 2006 and AZI

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### 1. « no regret » measures

Loss from a 100-yr flood in different adaptation scenarios in Mumbai

Source: Hallegatte et al., 2010

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- Dealing with these already existing issue therefore decreases our vulnerability to future climate change impact
  - It is called a "no regret" measure
  - The co-benefits alone justify the implementation of the measure
  - It is useful in all possible scenarios
- However, there are reasons why these options have not been implemented before
  - we need to understand these reasons and possible solutions.

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### Action on socio-economic trends leading to vulnerability increase

- Population and capital exposed to risk tend to increase, due to migrations towards flood-prone zones

Taux de croissance des surfaces urbaines entre 2000 et 2006

Source: "L'environnement en France", French ministry of environment

22

### Action on socio-economic trends leading to vulnerability increase

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Population exposed to 100 year-flood risk in 2070

Source: Nicholls et al. 2007

23

### Action on socio-economic trends leading to vulnerability increase

- Current and future vulnerabilities are the result of underlying socio-economic drivers
  - land scarcity,
  - urban-rural migrations,
  - lack of land tenure,
  - lack of building norms
  - Coastal zones attractivity
  - ...
- In addition to policies aiming at reducing vulnerability ex post, it is also possible to act on these underlying drivers

➔ It is possible to act on causes instead of symptoms

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## 2. Other robust strategies (Hallegatte 2008)

- **Favoring reversible strategies over irreversible ones:**
  - More restrictive land-use plans;
- **Favoring financial and institutional (“soft”) adaptation over “hard adaptation”:**
  - Early warning, evacuation and insurance vs. sea walls and dikes.
- **Investing in low-cost “safety margins”:**
  - Drainage infrastructures in Copenhagen.
- **Reducing investment lifetimes:**
  - Housing building quality and lifetime in flood-prone areas.

25

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## Conclusion

- **Societal and Economic Impacts of Sea Level Rise will depend on the way we adapt to them**
  - SLR is an issue only if the society cannot adapt to it
  - To this respect, analysis of sea level rise potential impacts shows great similarities with the analysis of climate change potential impacts on other sectors
- **Adaptation is not an easy task**
  - it is difficult to design an optimal mix of policies, especially because the target is moving
  - And because we have to deal with uncertainty
- **However, this is not an excuse for inaction**
  - No-regret measures, reversible policies... are tools which enable to design robust strategies

26

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