



CLIMATE CHANGE
HEADING TOWARDS AN
INCREASED FLOOD RISK IN
FRANCE AND EUROPE?

CEPRI

Centre Européen de
Prévention du Risque d'Inondation

Les collectivités en Europe pour la prévention du risque d'inondation
Communities and local authorities in Europe preventing flood risk

The climate has been warming since the end of the XIXth century

According to the works by the Intergovernmental Panel on Climate Change (IPCC):

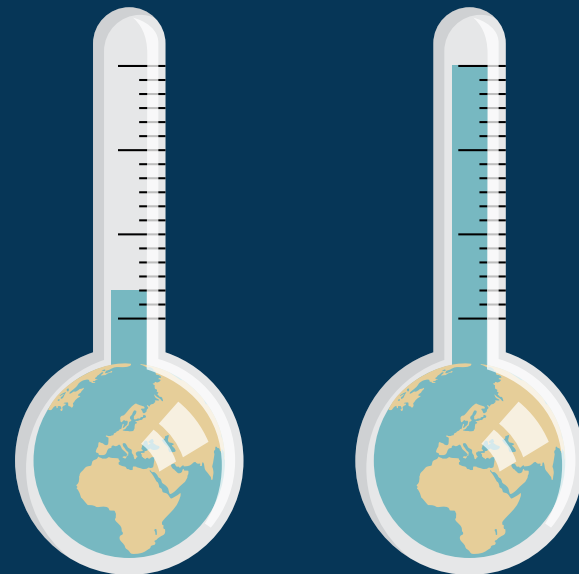
- the globally averaged combined land and ocean surface temperature has warmed by 0.85 °C over the period from 1880 to 2012;
- the main cause of this warming is the increase in concentration of greenhouse gases (GHGs) in the atmosphere, for which human activity appears to be the main contributor.

Indexes show that this phenomenon could escalate. According to the World Meteorological Organization (WMO):

- 2000-2010: the hottest decade since 1881,
- 2014: the hottest year since 1881.

A climate that should continue to warm during the XXith century,

to reach an increase of + 2 °C compared to temperatures in 1880 in the event of a scenario of significantly limited GHG emissions and up to + 6 °C compared to 1880 in the most pessimistic of scenarios in which GHG emissions remain high.



**At least
+ 2 °C
compared to 1880**
(scenario involving reducing
emissions to low levels)

**Up to
+ 6 °C
compared to 1880**
(scenario involving high
emissions)



The Intergovernmental Panel on Climate Change (IPCC)

The IPCC was created in 1988 in view of providing comprehensive assessment reports on the state of scientific, technical and socio-economic knowledge on climate change, its causes, potential impacts and response strategies. This is a centre of expertise aiming at summarising the works conducted by researchers throughout the world.



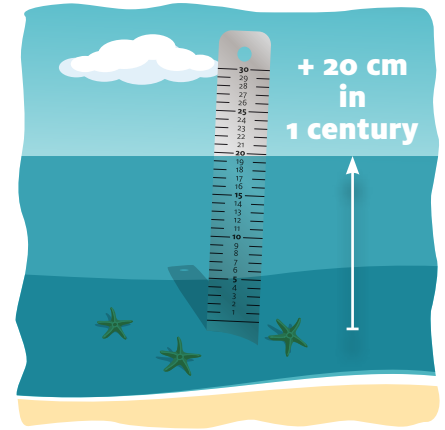
GLOBAL IMPACTS ALREADY MEASURED

HOWEVER OFTEN REMAIN DIFFICULT TO PERCEIVE ON A HUMAN LEVEL

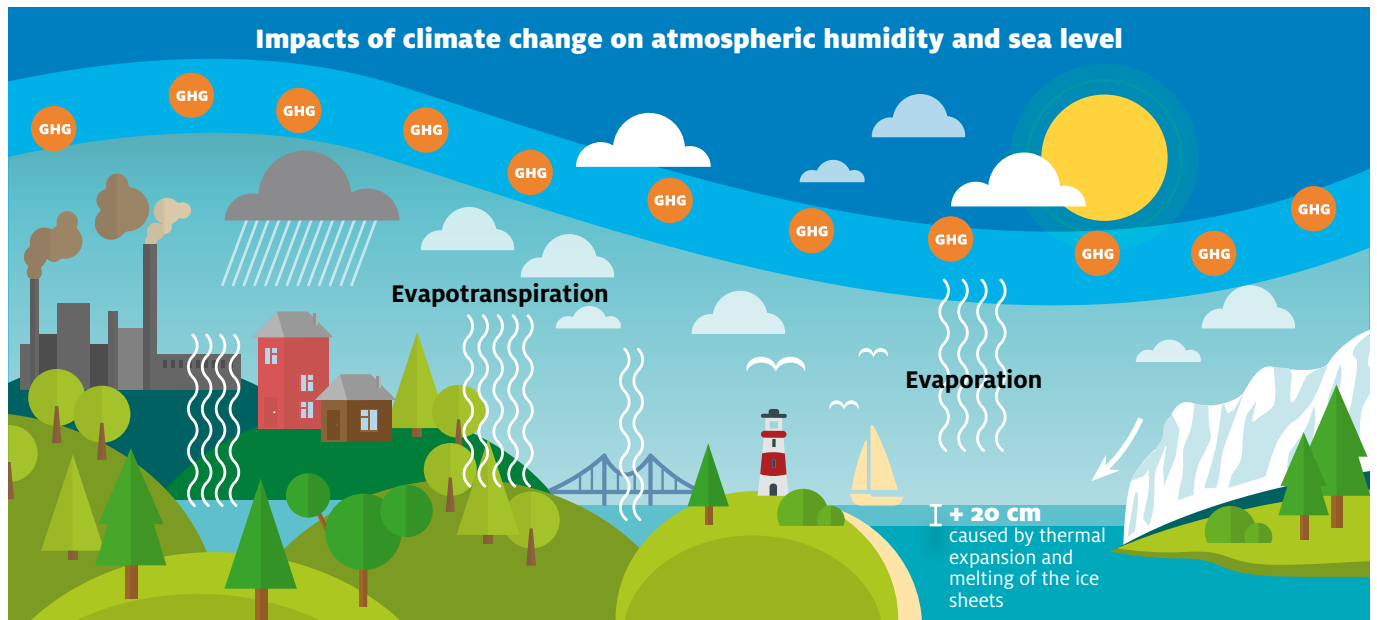
- Increase in atmospheric humidity: a hotter atmosphere becomes more humid. Evapotranspiration and atmospheric water vapour concentrations are increasing.
- Rise in sea level linked to the thermal expansion of the oceans and the melting of the continental ice sheets: a global average of + 20 cm since 1900, often hard to perceive and differentiate from the effects of coastal erosion.



1900



2015





1970



25 TIMES MORE DAMAGES IN 2010 THAN IN 1970



2010

The recent increase in flood damages around the world: a consequence of climate change?

The impact of climate change on the costs resulting from flooding likely still remains marginal on a global scale.

The recent global increase in the costs resulting from flooding is essentially caused by a significant increase over the last few decades in vulnerable assets (populations, goods, activities, etc.) on floodplains, as well as by modifications to land use (surface sealing).



WORRYING PERSPECTIVES FOR THE XXITH CENTURY

Increased frequency of extreme weather events

According to the IPCC, extreme precipitation events will very likely become more intense and more frequent in most continental regions and in particular in the high- and mid-latitude regions. The increased frequency of extreme precipitations could substantially worsen the flood risk from surface run-off in many urban areas.

Further increase in average sea level by 25 to 80 cm:

permanent submersion of certain low-lying coasts, disappearance of certain islands in the Pacific Ocean...



2000



2060



2100



The IPCC grants a "high confidence" level to the prediction of «increased economic losses and people affected by flooding in river basins and coasts, driven by increasing urbanisation, increasing sea levels, coastal erosion, and peak river discharges»



COASTAL FLOOD RISK IN EUROPE

A COASTLINE INCREASINGLY EXPOSED TO FLOODING



The flood risk on low-lying coasts and in estuaries should increase over the XXIth century, in line with the rising sea levels. The risk should also increase due to coastal erosion and, in a less certain manner, with the increased frequency, intensity and duration of events which could result from climate change.

FROM 2050 TO THE END OF THE CENTURY

**400 000 EUROPEANS
COULD LEAVE THEIR HOMES**



AMOUNT OF DAMAGES

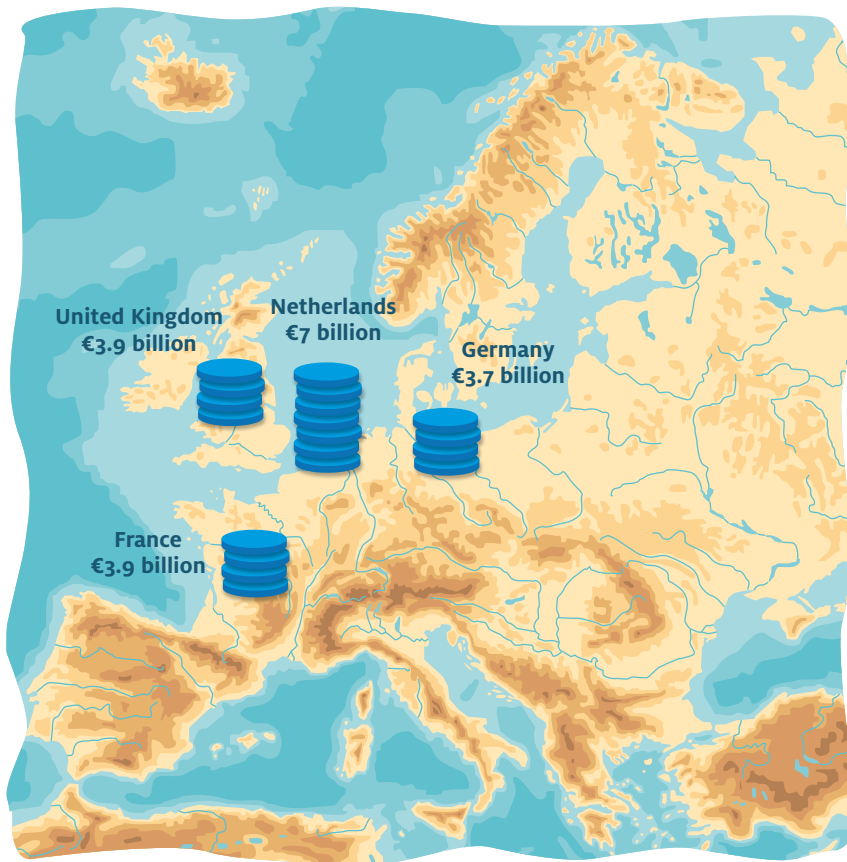
X 5 BY

THE END OF THE CENTURY

Even in the event of reduced greenhouse gas emissions and limited temperature and sea level rises, the coastal flood risk should increase in a significant manner on European coasts, whereby the current average amount of damages of €3 billion per year is at least multiplied by a factor of 5 by the end of the century and in the worst case scenario will reach €38 billion.

Only in the second part of the XXIth century will climate change replace socio-economic changes as the main cause of damages.

THE NETHERLANDS, THE UNITED KINGDOM, GERMANY AND FRANCE WOULD BE THE MOST AFFECTED



Estimated annual amount of damages generated by coastal floods in the European Union by the year 2100.



Focus on France

In 2100: an average annual cost of €3.9 billion, which could reach up to €5 billion in mainland France.

With a sea level rise of one metre, there is a risk that approximately 140,000 homes and 10,000 businesses definitively disappear, respectively representing 80,000 people and 26,000 employees.

1/3 of the French Polynesian islands would be in danger of disappearing by the end of the century due to their permanent submersion as a result of the rise in sea levels.





RIVER FLOODING RISK IN EUROPE

MANY UNCERTAINTIES REGARDING HOW THIS RISK WILL EVOLVE, HOWEVER THE POTENTIAL DAMAGES ARE COLOSSAL

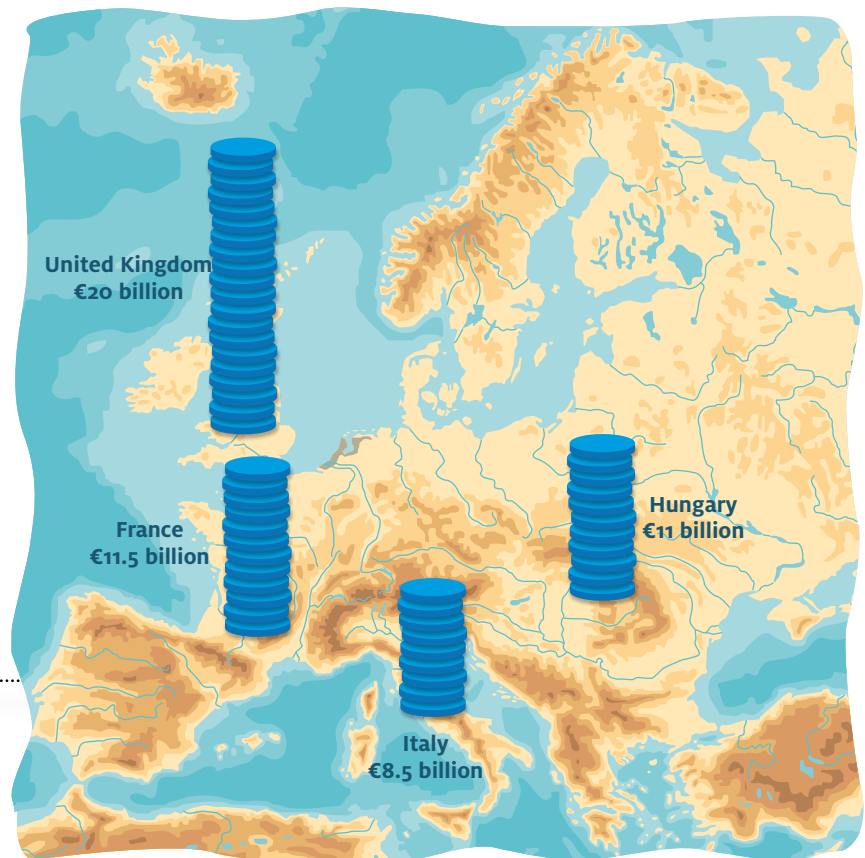
Numerous uncertainties weigh heavily on the magnitude of the impact of climate change on hydrologic cycles and precipitations in Europe

The average annual cost of river flooding, currently estimated to equal 7 billion Euros, could reach several tens of billions by the year 2100, or even reach 100 billion euros by the end of the century according to the most pessimistic hypotheses.

800,000 Europeans could be affected every year.

The United Kingdom, France, Hungary and Italy are the countries the most concerned in the event of an increased risk of flooding from rivers.

Estimated annual amount of damages generated by river floods in the European Union by the year 2100.





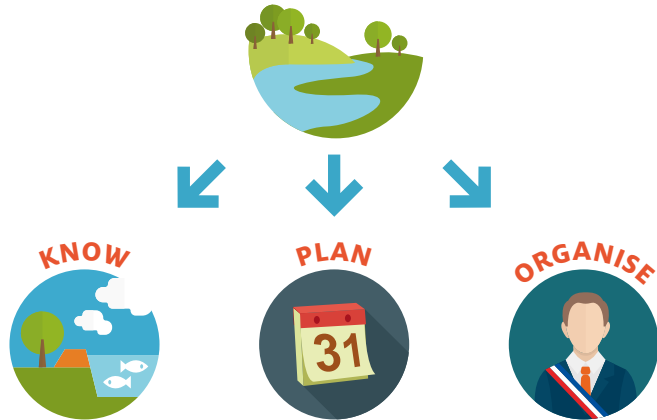
ACT, VIA 2 COMPLEMENTING STRATEGIES

Local stakeholders, and first and foremost the local authorities, can and must prepare for action.

Reducing climate change: reducing greenhouse gas emissions to contain the effects of climate change within limits that do not pose severe or irreversible threats to human activities as well as adapting regions where possible. This is the challenge set by the COP 21.

Regional adaptation: even by significantly reducing greenhouse gas emissions, a further 1 °C globally averaged temperature rise is inevitable by the end of the century. A building built today will suffer the consequences of this. It is therefore essential that the regions adapt to the impacts of climate change.

Unlike other public policies (transport, energy, water resources, etc.) the French national flood management policy still only tackles the issue of climate change effects to a small degree. The magnitude of the potential consequences of a serious increase in flood risk in the regions over the XXIth century at least merits the issue being handled on a national level, in order to assess the extent to which the current general framework of the flood risk management policy should or should not change.



ADAPTING TO THE RIVER FLOODING RISK

Although the damages resulting from river flooding could reach colossal sums in Europe by the end of the century, these predictions remain highly uncertain. The priority for most regions is to firstly adapt to the current risk.

- Improve knowledge of the impacts of climate change on the local flood risk.
- Implement flexible strategies to gradually adapt in line with improved knowledge of the potential impact of climate change on the local flood risk.
- Prioritise «no regret» strategies generating multiple benefits (environmental protection, water resource management, multi-purpose constructions, etc.) and thus having positive effects even in the absence of an increased flood risk.

- Prioritise inexpensive organisational measures (population awareness, preparation for crisis management, planning for continued activity, etc.).
- Prepare for managing exceptional events as per the 2007 Flood Directive which will enable regions to prepare for a potential increase in the flood risk to a certain extent.



ADAPTING TO THE COASTAL FLOOD RISK

The National Integrated Coastal Zone Management Strategy encourages local reflections, in particular on organising the inland relocation of assets the most exposed to coastal risks.

This spatial reorganisation policy for coastal activities and assets nonetheless requires time to convince populations and register operations within spatial planning projects beneficial to local development. With regard to the numerous assets already exposed or which will become so in the short term, their relocation is not a solution that can be generalised in a systematic manner throughout the coastline.

Similarly, the protection of all assets exposed to coastal flooding at any cost does not appear to be a realistic solution that can be applied to the whole coastline, even if this option is generally welcomed by populations and elected officials. Aside from the numerous negative impacts linked to coastal land take, the financing of the operations required on a national scale will be difficult to implement in the context of an economic

crisis and reduced public expenditure. There is therefore an urgent need for these regions to become prepared, and neither the complexity of coastal risk management nor the uncertainties involving the magnitude of the effects of climate change on their intensity are excuses for inaction.

- Reinforce crisis management plans including those required to face extreme events while developing a coastal risk culture within the population, in particular concerning good behavioural practices. These actions must form a first response to the coastal flood risk.
- Do not increase regional vulnerability by controlling the installation of assets in current and future high-risk areas.
- With regard to significant protection operations, prioritise the most densely populated sectors and, in other sectors, privilege «soft management techniques» that are less expensive than structures and often more environmentally-friendly (dune rehabilitation, responsible beach nourishment, etc.).

- Reduce the vulnerability of existing assets and take advantage of real estate acquisition opportunities when they appear to implement relocation measures for the most exposed assets.



SOURCES

Brown S. et al. (2011). *The impacts and economic costs of sea-level rise on coastal zones in the EU and the costs and benefits of adaptation, Summary of sector results from the ClimateCost project, Technical Policy Briefing Note 02, 42 pp.*

CGDD, 2014. *Les déterminants du coût des catastrophes naturelles : le rôle du changement climatique en France. Collection "Études et documents" du Service de l'économie, de l'évaluation et de l'intégration du développement durable (SEEIDD) du Commissariat général au développement durable (CGDD), 32 pages.*

Feyen L. & Watkiss P. (2011). *The impacts and economic costs of river floods in the European Union and the costs and benefits of adaptation, Summary of sector results from the ClimateCost project, Technical Policy Briefing Note 03, 31 pp.*

IPCC, 2014. Climate Change 2014. *Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.*

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