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The national flood risk management policy is evolving

Faced with the catastrophic consequences of floods in Europe in recent decades, the European Commission responded in 2007 by adopting a directive on the assessment and management of flood risks¹. This directive defines a working method to enable areas exposed to flood risks to reduce their impact on human health, the environment, cultural heritage and economic activity. In this context, preliminary flood risk assessments or PFRA were conducted in 2011 by government departments in each of the 14 river basin districts².

When the European directive was transposed into French law³, the Government and Parliament wished to go further and define a national strategy for managing flood risks. This should contain precise, consistent guidelines for identifying priorities for action and allocating resources across the whole country. This involves first producing a national assessment of flood risks based on a synthesis of local data and focusing also on events of national importance, taking into account significant floods that have occurred in the past and are likely to recur. This preliminary assessment of flood risks at a national level provides a complete and standardised image of current exposure in France.

The PFRA method includes two stages. The first involves defining potentially flood prone areas or EAIPs (enveloppes approchées des inondations potentielles). Two kinds of areas have been defined: those subject to any phenomena in which water courses break their banks and run-off flows along thalwegs; and those subject to coastal flood risks, taking into account the potential effects of climate change, by considering a potential rise in sea levels of a metre by 2100. The second stage involves identifying the issues at stake in these areas. This means evaluating the potential adverse consequences of a flood using indicators based on the impact on human health, housing, economic activity, the environment and cultural heritage (e.g. numbers of inhabitants, jobs, hospitals, area of built heritage etc.). For the first time, the risk of flooding is considered through the prism of what is at stake rather than just the chances of a flood occurring.

The first preliminary risk assessment on a national scale presented here should provide better knowledge to enable better action. Once shared, knowledge of the risks places responsibilities on each actor and makes it possible to focus action where the scope for progress appears greatest.

The limits of this assessment

The standardised approach of the PFRA method inevitably leads to simplifications and approximations. The presence of an issue at stake in the EAIP does not necessarily mean it is vulnerable or that it will have negative consequences if flooding occurs. Neither does the method allow the importance of these consequences, or the indirect effects of the flooding, to be evaluated. Each issue is thus dealt with in exactly the same way, and the potential seriousness of flood impacts is simply deduced from the number of issues concerned. Finally, this assessment takes no account of the effects of the policy in place up to now.

¹ Directive 2007/60/EC.

² District: unit of management instituted at European level for the application of the water framework directive and used for the application of the flood directive. A river basin district is the equivalent of a large river basin or group of basins.

³ National Commitment to the Environment Act (known as LENE) of 12 July 2010.

The negative consequences of flooding

What is a flood?

A flood is the fast or slow submersion of an area that is not normally under water.

The hydrological characteristics of water bodies are being increasingly modified, and flood mechanisms are influenced by the changes made by humans (building on flood plains, adjustment and removal of river meanders, flood protection dykes, dams and changes of land use encouraging run-off). Floods can also arise from weaknesses in these structures (dykes or dams breaking, for example).



For human health

The first risks to people caused by flooding are accidents (drowning, falls, electrocution), with the seriousness varying according to the intensity and rapidity of the phenomena. A slow, long event can lead to health risks associated with shortages of drinking water, failures in

health provision etc. The health impacts also include the psychological consequences of the disaster for people who find themselves far from home and lose their belongings or their jobs because of the interruption to economic activity.



For economic activity

Floods can paralyse a territory's economic activity. Repairing or rebuilding the private or public property destroyed and the damage to transport, telecommunications, water and energy networks generates major costs for society. Floods also have consequences for economic activity, as

they can lead to production stoppages and heavy financial losses (damage to buildings and tools, lost stocks or harvests etc.). The vulnerability of a business also depends on its insurance cover, which varies for different types of loss.



For the environment

Floods can have positive effects for the environment, such as topping up groundwater, fertilising soil by depositing sediments, promoting biodiversity in alluvial areas and helping to protect deltas against erosion by providing sediments. They also have negative impacts, as they can be responsible for massive erosion, especially

in coastal areas, and can hit sources of pollution such as industrial sites or soils containing pollution or pesticides, which then affect all the land that is flooded. They can also cause major technological accidents when they strike technological facilities such as nuclear sites.



For cultural heritage

Heritage and cultural assets, whether material or immaterial, embody irreplaceable universal values. Floods can also damage or destroy heritage through damp, mould and salt deposits and facilitate looting. The impact can also be

indirect: the loss of cultural assets is traumatic for a population, as heritage is part of a society's cultural identity. The economic activities associated with heritage can also suffer from the disappearance of cultural assets.

Understanding the past to anticipate future events

Although recent events may seem dramatic, France has not experienced exceptional floods generalised to one or more river basin districts for 60 years. The repeated large floods of the nineteenth century affected vast territories, or even almost the whole country (1856), and the last major events date from before the war (1940 in the Eastern Pyrenees). These recent decades of "hydrological rest" thus coincided with the biggest urban development in areas subject to flooding. Despite being relatively localised, recent events have thus had dramatic consequences, such as the Xynthia storm and the events in Var in 2010 and 2011. The big floods of past centuries would therefore have a considerable impact today due to the growing density of the stakes and the increase in their value, vulnerability and interdependence.

An insurance regime undervalued in comparison with the past

The average annual cost of the damage caused by floods in France paid by the national solidarity fund for natural disasters is estimated at about 400 million

euros a year, half of the actual economic damage over the last 30 years (650 to 800 million euros a year). Though this average cost includes the most recent events (floods in Gard in 2002, the lower Rhône in 2003 etc.), it does not take account of the fact that no major events have occurred during the recent period. The additional cost of a potential major disaster would raise the average annual cost of the economic damage caused by floods to an amount between 1 and 1.4 billion euros a year.

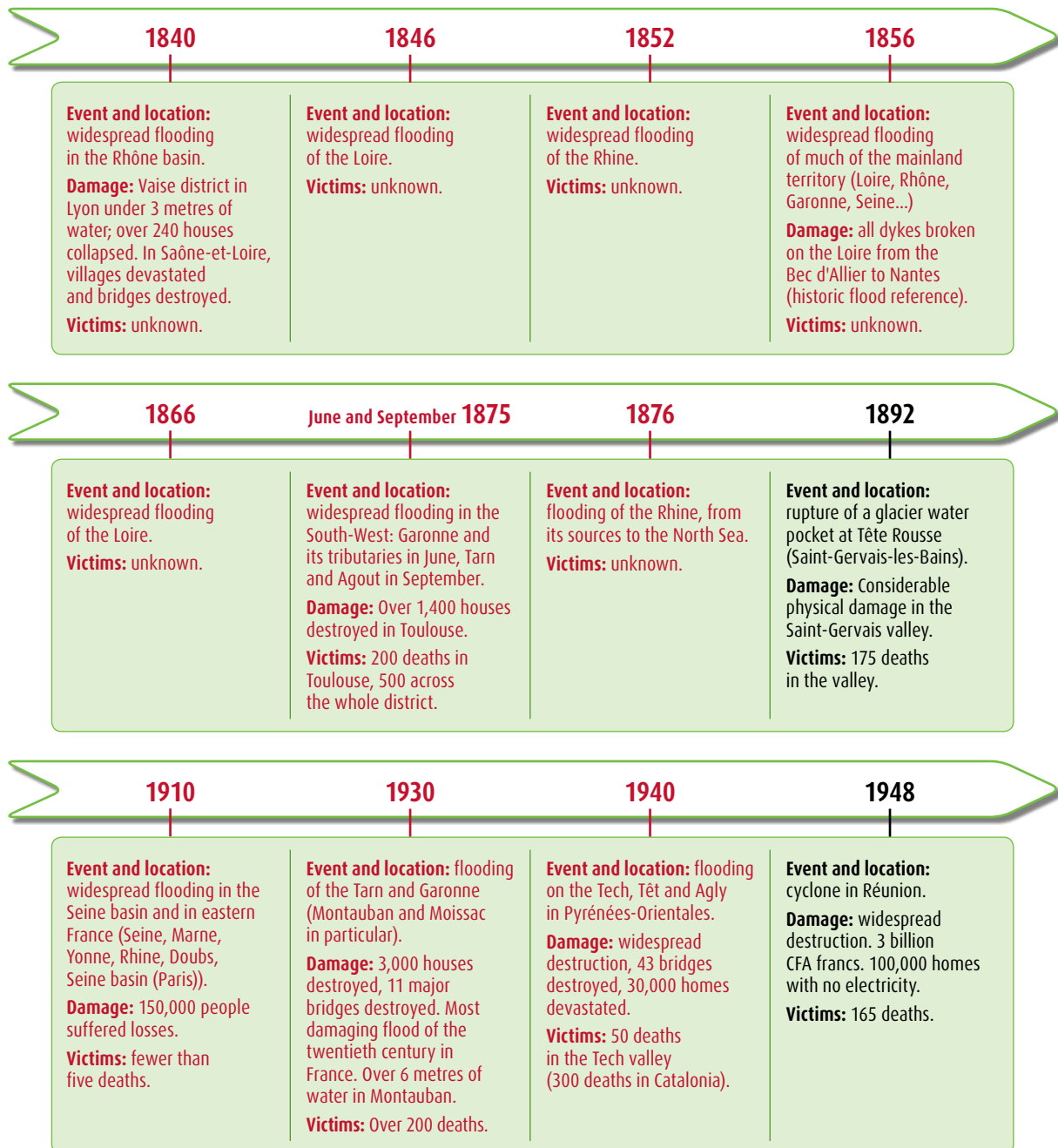
Rising population exposure

Two factors must be taken into account in assessing future risks. First, climate change involves a rise in sea levels and a worsening of coastal flood risks. In this assessment, we have adopted the hypothesis of a one-metre rise by 2100. The impact of climate change on river floods is not yet sufficiently clear for us to have taken it into account in the 2011 assessment. In addition, population growth is evaluated at +15% by 2040, with a strong concentration of this growth overseas and on the coasts, which may account for 40% of the population in 2040.

What would happen if the 1910 flood in Île-de-France happened today?

The 1910 flood is the only centennial flood recorded in the Seine basin during the twentieth century. It paralysed Paris, and restoring activity took two months. The cost of the direct damage caused by a similar flood today is estimated at 17 billion euros (not counting damage to transport, electricity and telecommunications networks etc.). The total cost could thus reach 30 to 40 billion euros. Four to five million people would be impacted to various degrees, and nearly 170,000 companies would be affected.

Significant past events*



- **Widespread flooding:** flooding of particular intensity and geographical extent.
- **More localised flooding events.**

1953

Event and location: North Sea storm submerging Dunkirk and Calais.

Damage: destruction of coastal dykes between Sangatte and the Belgian border.

Victims: no deaths.

1958

Event and location: flooding in Gard and Hérault.

Victims: 35 deaths in Gard.

1959

Event and location: flooding on the Argens and failure of the Malpasset dam (Fréjus).

Damage: homes destroyed, roads, networks, farmland and airport devastated. 7,000 people suffered losses.

Victims: 423 deaths.

1980

Event and location: Cyclone Hyacinthe in Réunion

Damage: world rainfall records. 8,000 people suffered losses.

Victims: 25 deaths.

1987

Event and location: overflow of the Borne torrent in Grand-Bornand (Haute-Savoie).

Damage: 107 million euros**.

Victims: 23 deaths.

1988

Event and location: torrential rain in Nîmes (Gard).

Damage: 500 million euros.

Victims: 10 deaths.

1992

Event and location: flooding in Vaucluse (Vaison-la-Romaine, Ardèche and Drôme).

Damage: over 500 million euros.

Victims: 47 deaths, including 34 in Vaison-la-Romaine.

1995

Event and location: 43 departments affected by exceptional rainfall in Brittany and Ile-de-France.

Damage: 610 million euros.

Victims: 15 deaths.

1999

Event and location: floods in Aude, Tarn, Pyrénées-Orientales and Aveyron.

Damage: structures damaged (railway embankments). 533 million euros.

Victims: 36 deaths.

Event and location: Lothar and Martin storms.

Damage: many homes and infrastructure elements flooded in Charente-Maritime and Gironde. Incident at the Blayais nuclear power station.

Victims: 17 deaths.

2001

Event and location: rises in the water table in Somme, Oise and Eure.

Damage: over 3,400 homes flooded, over 600 towns affected. Lasting effects, several months of flooding.

Victims: no deaths.

2002

Event and location: floods in Gard and neighbouring departments.

Damage: 1.2 billion euros.

Victims: 23 deaths.

2003

Event and location: flooding of the lower Rhône, the upper Loire, the Tarn, the Lot...

Damage: over 1.5 billion euros. Over 1,500 towns affected.

Victims: fewer than 10 deaths.

2007

Event and location: Cyclone Gamede in Réunion. Sea flooding.

Damage: 100,000 homes with no electricity (800,000 inhabitants). 100 million euros of damage.

Victims: no deaths.

2010

Event and location: Xynthia storm causing sea flooding.

Damage: 11 departments affected, especially Vendée, Charente-Maritime, Deux-Sèvres and Vienne. Over 1 billion euros.

Victims: 47 deaths.

2010

Event and location: torrential flooding in the department of Var.

Damage: nearly 1 billion euros, 1,000 companies suffered losses.

Victims: 25 deaths, including 14 in Draguignan.

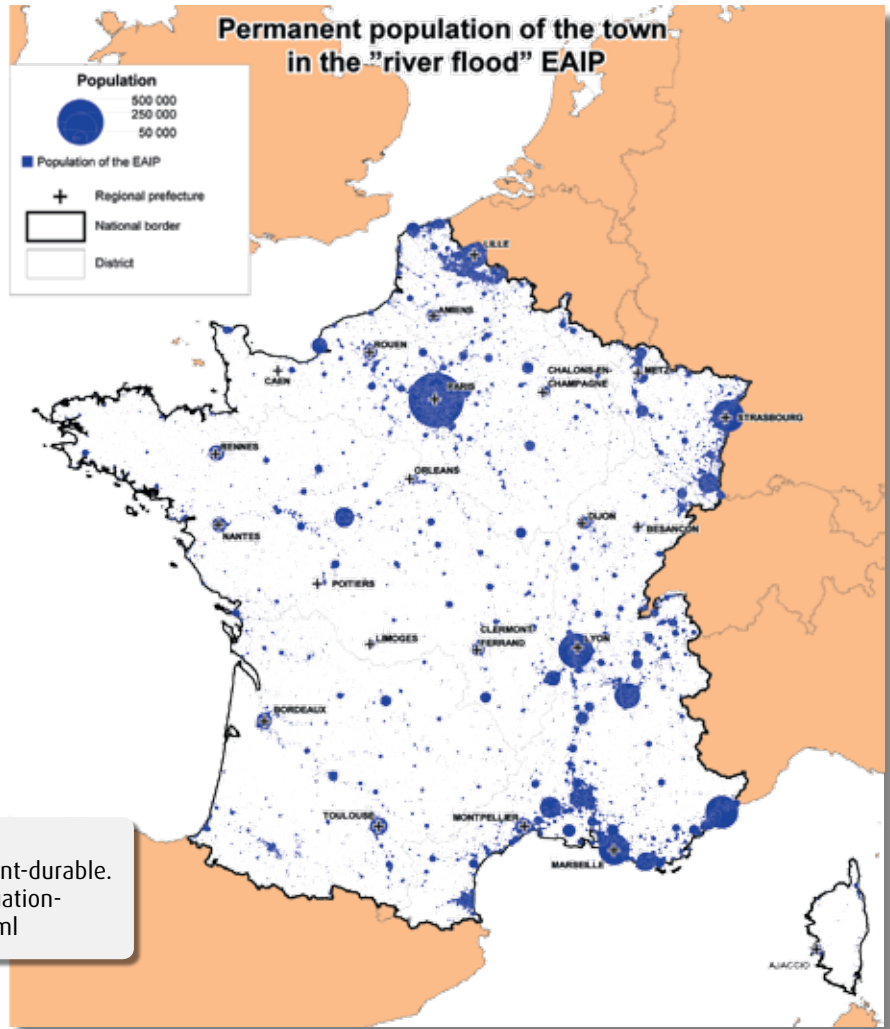
** Non-exhaustive list for illustration only ** Starting from 1987, the estimated costs are expressed in constant euros; to reflect values expressed in francs in today's euros.

Snapshot of the main results of the national PFRA

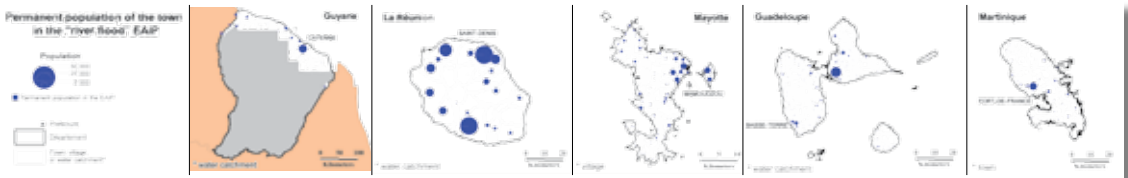
Six impact indicators

The national PFRA evaluates the potential negative consequences of a flood using six impact indicators: population (permanent residents), number of hospitals, number of jobs, area of single-storey housing, area of construction (and proportion of business buildings), area of notable built heritage exposed. The "population" indicator represents the major issues at stake (economic, cultural etc.) due to the concentration of the population and thus of activity.

Population exposed to river floods



Find all the maps at:
www.developpement-durable.gouv.fr/L-EPRI-evaluation-preliminaire-des.html





Key points

One inhabitant in four exposed to the risk of flooding

Previous assessments, which estimated the number of exposed inhabitants at eight million, were based on main water courses and only counted average events (of about hundred-year magnitude). The number of inhabitants exposed to a flood risk is now estimated at 17 million. This exposure is quantitative rather than qualitative. It may correspond to frequent events with high water levels or, at the other extreme, it may only be concerned with rarer events with lower water levels. However, the impact can be major with only 20 cm of water.

Heavily exposed towns

The chosen assessment method and type of representation highlight the main cities where economic activity, cultural heritage etc. are concentrated. The Mediterranean arc, the Rhône valley and the Paris region, all densely populated, appear to be heavily exposed. Towns in Alsace and Nord-Pas-de-Calais also stand out. For these two relatively flat regions, the districts that could be affected by extreme events extend over a wide area, in the absence of very precise knowledge about how these areas would flood following extreme events.

Territories with unequal exposure

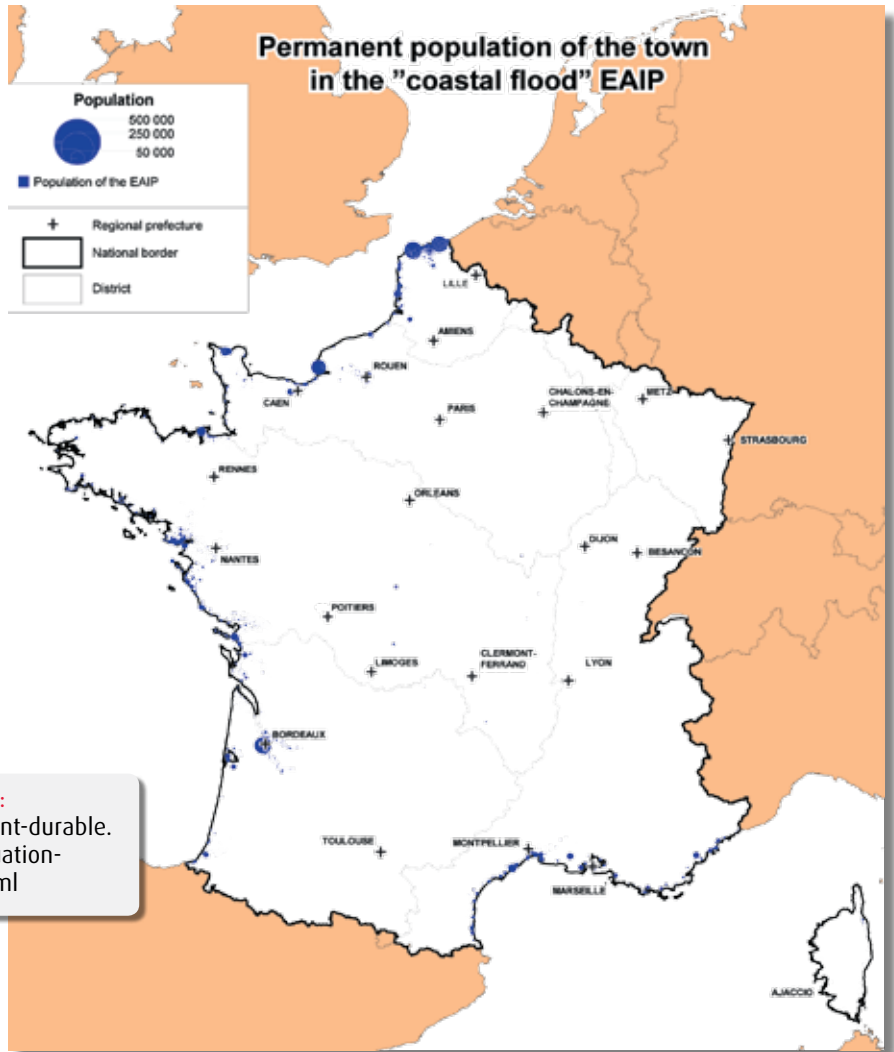
This representation should not obscure the fact that some events, particularly high water levels in large rivers, can affect a very wide area and that their consequences will go well beyond the towns identified here. If the Loire broke its banks, for example, it would cut across many of the country's north-south links and affect the whole national territory.

In addition, this representation does not highlight territories exposed to danger to human life. The risk of mortality is most commonly linked to warning and evacuation times that are too short. This may be the case in zones that are subject to flash floods (which usually affect towns with smaller populations than those shown on these maps) or protected by structures which can still be overtopped (these structures are not shown on these maps).

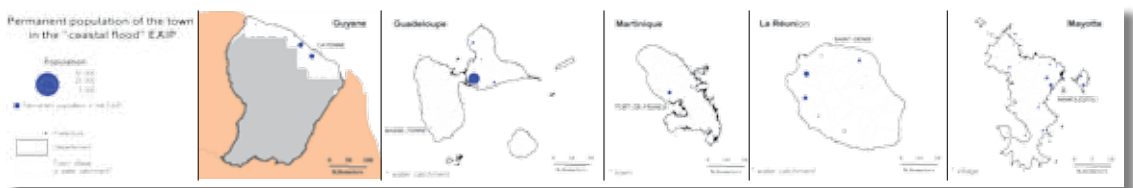
Finally, this absolute exposure of territories disguises local disparities in the relative scale of the flood risk: not all territories are equal in the face of the risks. Some departments appear to have little exposure at national scale, but are highly exposed in relative terms. Despite their low exposure at national level, 50% of the population of Ariège and 40% of the population of Mayotte are potentially exposed to rivers overflowing.

Finally, the study does not take account of the seasonal population, which can be high on the Mediterranean coast and in mountainous regions.

Population exposed to coastal floods



Find all the maps at:
www.developpement-durable.gouv.fr/L-EPRI-evaluation-preliminaire-des.html





Key points

1.4 million people exposed to the risk of coastal floods

Exposure to coastal floods is lower than exposure to river floods. However, it deserves special attention for a number of reasons.

The study does not take into account the seasonal population, which can be significant. At the height of the tourist season, the population of some coastal areas can double (such as in Vendée, Charente-Maritime, Pyrénées-Orientales, Corsica etc.). This seasonal population concentrated along the coast is particularly vulnerable, as they are not always aware of the risks they are exposed to or well-informed about safety precautions.

The sea coasts also attract long-term residents. Coastal towns house over 7.6 million permanent inhabitants, and this population is growing strongly. Coastal areas could account for nearly 40% of the population by 2040.

Diffuse exposure

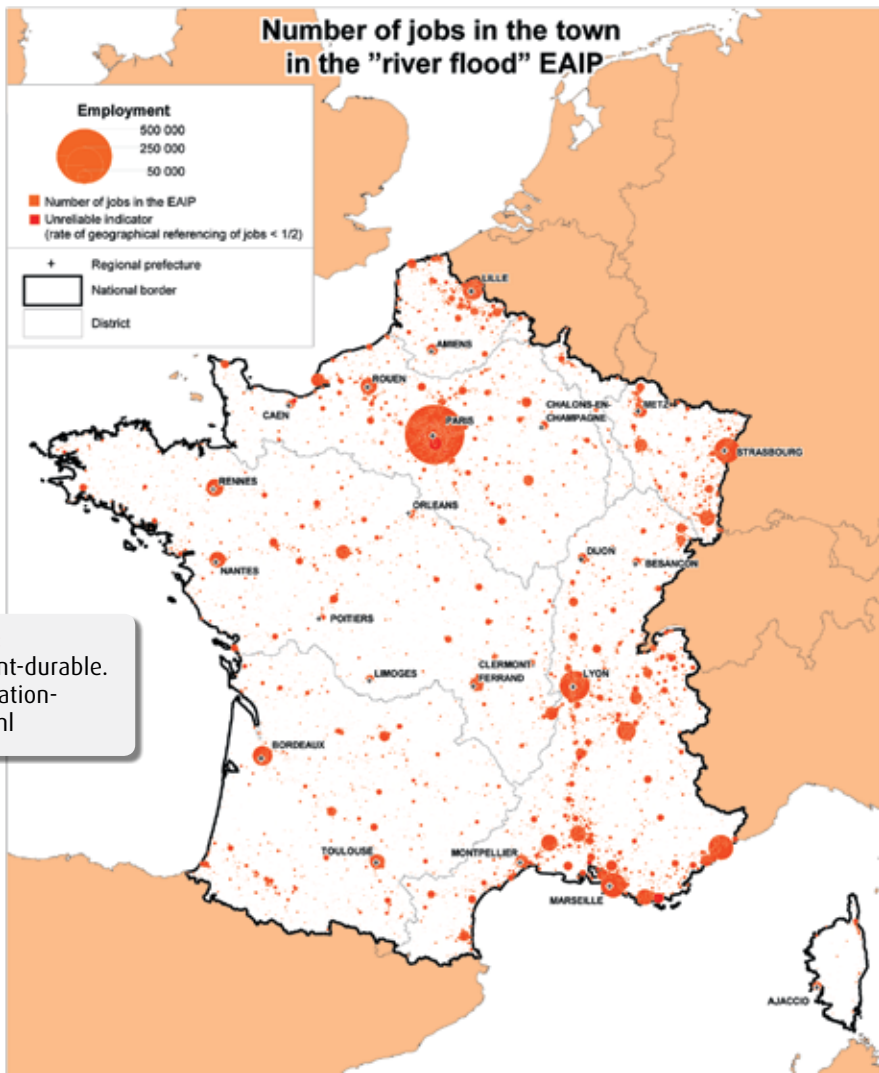
The representation highlights the main towns in the estuaries and large polders of Nord-Pas-de-Calais, where the districts potentially subject to coastal floods extend far inland (no account has been taken of protective structures, such as in polder areas).

However, the maps also show continuous exposure along most of the mainland coasts outside these towns, particularly on the Languedoc-Roussillon, Vendée and Channel/North Sea coasts.

Certain departments more vulnerable

Fifteen percent of Mayotte's population is counted as being exposed to the risk of coastal floods. Martinique, Gironde, Charente-Maritime, Vendée, Manche and Pas-de-Calais are also very exposed (10% of the permanent population).

Employment exposed to river floods



Find all the maps at:
www.developpement-durable.gouv.fr/L-EPRI-evaluation-preliminaire-des.html

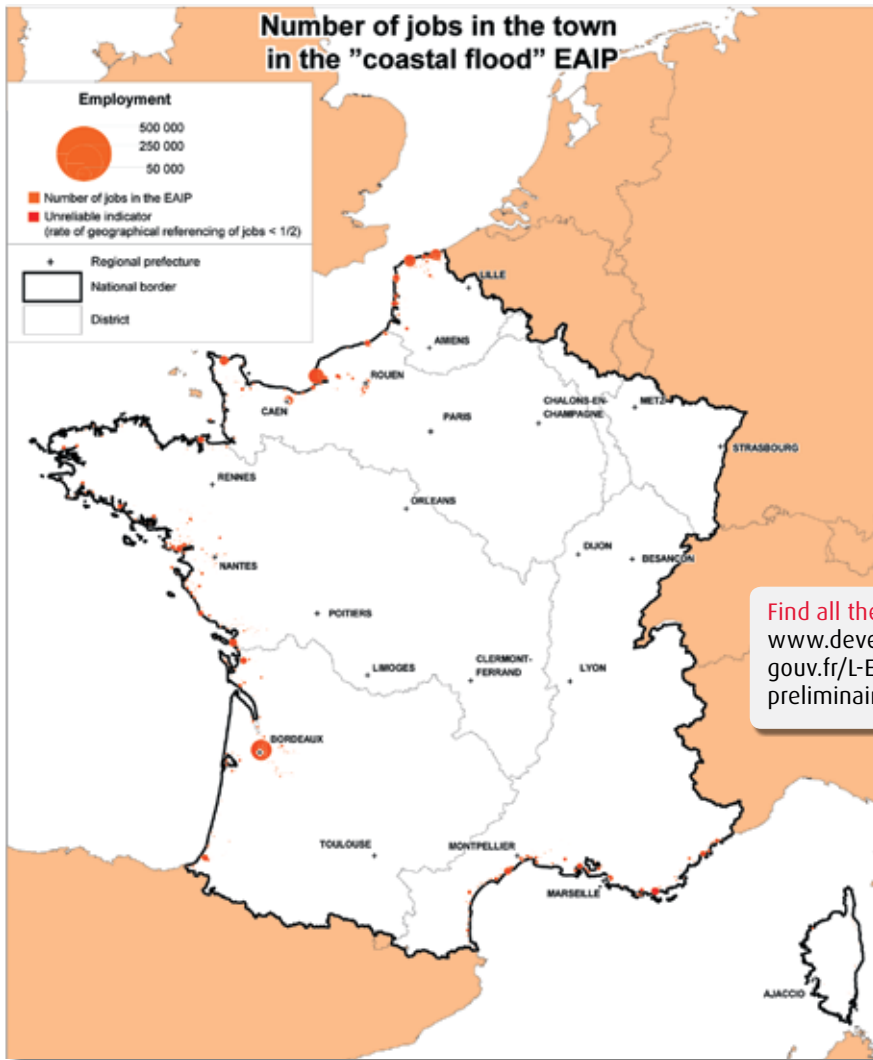


Key points

It was only possible to calculate the number of jobs potentially exposed to river and coastal floods for mainland France. The distribution obtained has certain similarities with the permanent

population exposed, with the difference that jobs are even more concentrated in the large exposed towns than populations. Over nine million jobs are directly exposed to river floods.

Employment exposed to coastal floods

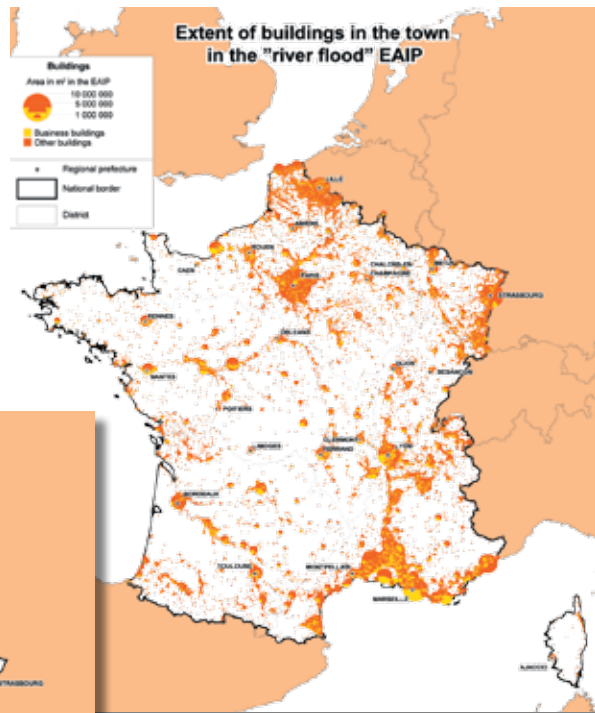
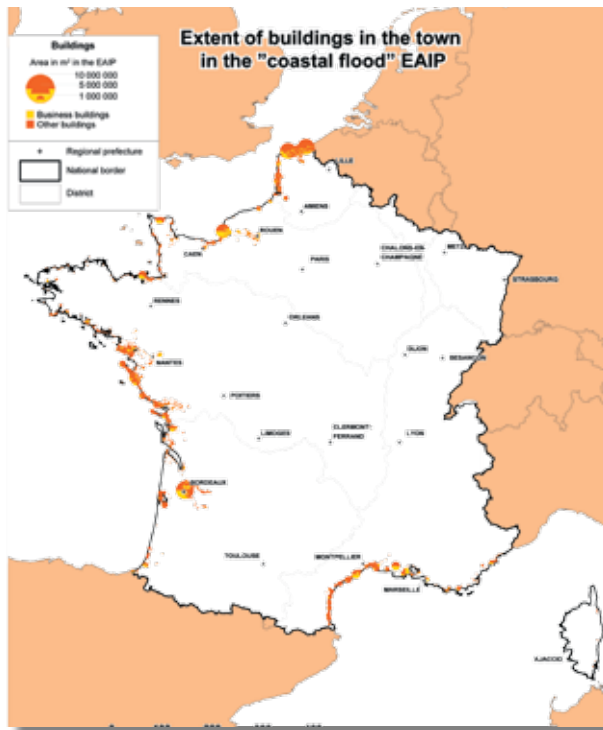


Key points

More than 850,000 jobs are exposed to coastal floods. Adding these to the nine million jobs exposed to river floods, nearly one job in three could be directly affected by flooding. It should be remembered

that if a major event occurs, jobs could be affected well beyond the flooded areas following disruptions to networks or economic activity (supply problems, drop in demand etc.).

Construction exposed to marine submersion



Construction exposed to river floods



Key points

The extent of building in the areas subject to potential flooding reveals the continuity of exposure along the main water courses and sea coasts.

For overflowing water courses, the Rhône valley, the Mediterranean

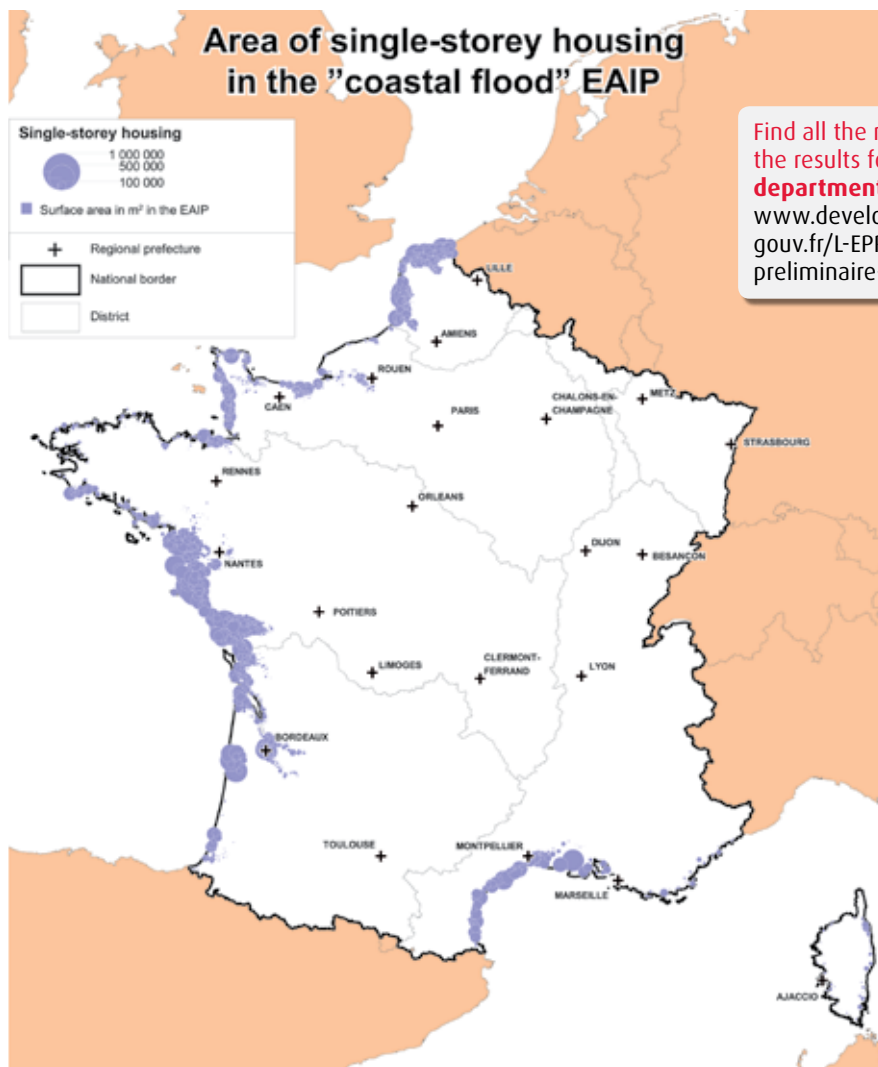
arc and the Alsace, Nord-Pas-de-Calais and Paris regions appear to be heavily exposed. The Loire, Garonne and Seine valleys appear clearly on this representation.

For marine submersion, the coasts of Languedoc-Roussillon, Vendée

and the Channel/North Sea show continuous exposure.

In the overseas departments, apart from overflowing water courses in Réunion, exposure is very concentrated in certain sectors.

Exposure of single-storey housing to coastal floods



Find all the maps and the results for **overseas departments** at this address: www.developpement-durable.gouv.fr/L-EPRI-evaluation-preliminaire-des.html



Key points

Single-storey housing involves a high degree of vulnerability for belongings (as all belongings are subject to potential flooding) but above all for people. Householders may find themselves trapped in their

homes, with no way of seeking refuge on a floor above the water level. For example, the assessment shows the high exposure along the Vendée coast, echoing the recent dramatic events during the Xynthia storm.

The key figures of the assessment

- **17.1 million** permanent residents exposed to the various consequences of river floods, including 16.8 in mainland France
- **1.4 million** inhabitants exposed to the risk of coastal floods
- Over **9 million** jobs exposed to river floods and over 850,000 jobs exposed to coastal floods
- **20%** of homes exposed to coastal floods are single-storey

All the preliminary flood risks assessments (national and by district) are available at: <http://www.developpement-durable.gouv.fr/-Gestion-des-risques-d-inondations-.html>



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