

DECODING

A PRESS OFFICE EXTRA

Understanding and anticipating
Flood Risk

INRAE

SUMMARY

Millions of people across Europe are at risk of flooding. Each year, in France, damage caused by floods costs between 650 and 900 million euros, and lives continue to be lost. The enormity of the risk posed by flooding was recognised in October 2007 by the publication of the European Flood Directive, requiring each of the EU's member states to formulate flood risk management plans.

Understanding, anticipation and protection are the three pillars on which flood risk reduction is built. For many years, INRAE's scientists have used their research skills and expertise to improve understanding of the processes and events associated with flooding and to devise tools and methods to protect society from its impacts.

INRAE's hydrology and hydraulics experts are working alongside geomechanical and civil engineers at the institute's Lyon, Aix-en-Provence and Antony centres to tackle the physical aspects of this complex issue. It is also important to measure the economic impacts of flooding and build flood-aware communities with the capacity to navigate the associated risks. Research on these dimensions is being pursued by our teams of economists, sociologists and political scientists, particularly in Montpellier. Our experts must also be ready to advise on international emergencies when the call goes out.

An important part of this work is the provision of support to public authorities, not least through SCHAPI, France's National Hydrometeorological and Flood Forecasting Centre, overseen by the Minister for Ecology. Our teams also create tools used by local risk managers, helping them to fulfil the major duties devolved to the French regions through GEMAPI, the water management and flood prevention powers conferred under French law.

From the provision of rainfall data to the management of rivers and reservoirs that could endanger both humans and infrastructure, from the integration of structural resistance to the socio-economic dimensions of risk, INRAE is working in close collaboration with its long-standing partners such as Météo France, Cerema and Gustave Eiffel University to devise practical solutions.

Here, we draw on INRAE's cutting-edge work to provide a snapshot of key issues for flood risk management in the regions.

GLOSSARY

Dams and weirs: water-retention structures of various sizes constructed across water courses to regulate flow, for example.

Dykes/embankments: raised structures, usually very long (several hundred metres or tens of kilometres), which block the passage of water or channel it. Constructed along a watercourse or the seashore.

Flood: a flood is a natural phenomenon that does not necessarily endanger dwellings or infrastructures. For example, in river flooding, water levels naturally rise when flows increase, and the river may leave its usual channel, spreading out across its flood plain. When flooding occurs, zones that are not usually underwater become inundated. In France, flood events are classified as:

- **Slow:** occurring over a period of several days on large rivers.
- **Fast:** occurring over periods of around 12 hours in small catchments.
- **Sudden:** occurring in small steep catchments within a few minutes or hours (≤ 6 hours) often known as 'flash flooding'.
- **Extreme:** an event that is rare in terms of both intensity and frequency (categorised by the probability of its occurrence in any one year. A flood is considered extreme if its return period is one-in-a-thousand or more).

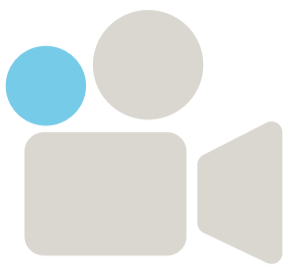
Flood risk: the combination of the probability of the occurrence of the natural hazard and the physical and social vulnerability of the place (people, houses, businesses, roads, fields).

Flood-risk awareness: how community members understand and conceive the risk of flooding. Needs to be maintained as it influences how people take (or fail to take) steps to protect themselves against a risk that is both present and known, because it is recurrent.

Inundation: the rapid or slow submersion of a zone that is not usually under water. In English, the term 'inundation' is largely used in a technical context. In particular, 'extent of inundation' is an important parameter for flood modelling. Inundation can occur:

- **by overtopping** - the watercourse leaves its channel (fluvial flooding);
- **by overland flows** - rainwater cannot or can no longer infiltrate the ground (pluvial or surface-water flooding);
- **by a rise in the water table** - the water then rises out of the ground (groundwater flooding);
- **by immersion beneath the sea** - the sea level rises (coastal flooding).

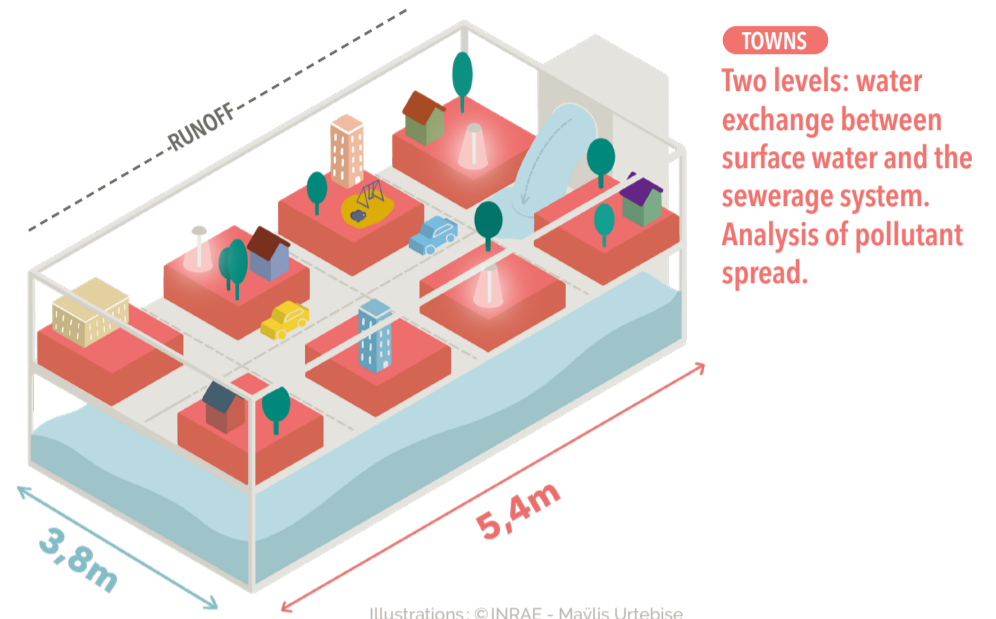
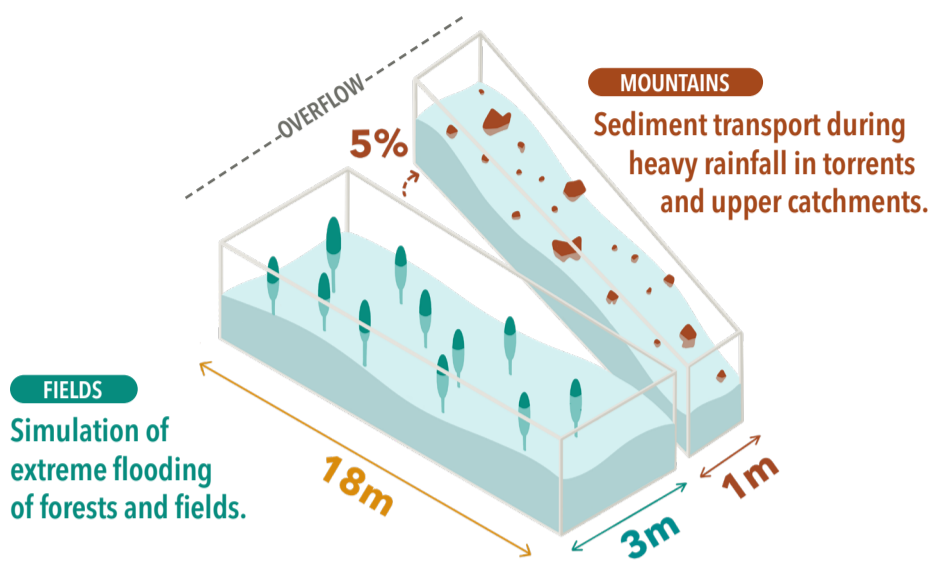
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Working models

Hydraulics and hydromorphology laboratory, INRAE Lyon-Villeurbanne.

Over 300 m² of world-class laboratory models to simulate different flood types.

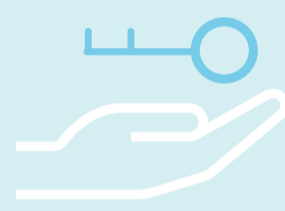


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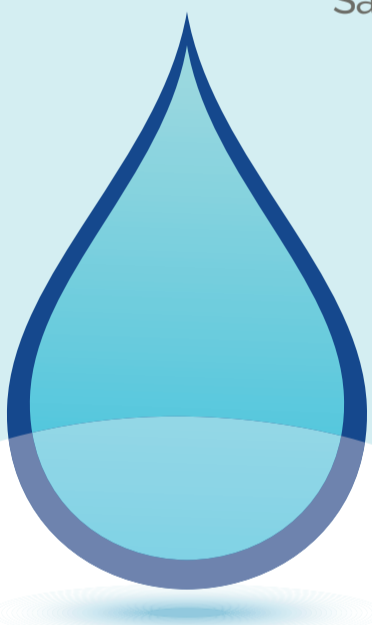
Insights

- DEUFI project:** 9 French and international partners. **Purpose:** To study water exchanges between streets and buildings down to the individual building level. **How?** Physical, field and hydrodynamic models of a town to simulate flooding and assess damage and human exposure.
- Digue 2020:** follow-up to the DignesELITE project (2013-2017). **Purpose:** To stress test the use of a soil-chalk mixture within a coastal dyke as a means to improve mechanical resistance in a maritime environment. **How?** Creation and monitoring of a real-life experimental maritime dyke near Salin-de-Giraud in the Camargues.



Solutions

- Vigicrues:** government flood-warning website and app for individuals and communities. 4 alert levels (red, orange, yellow, green) for gauged rivers. A simulation tool developed by INRAE. www.vigicrues.gouv.fr
- Vigicrues Flash:** government flood-warning service for prefectures and municipalities at risk from sudden floods on ungauged watercourses linked to an open access virtual platform providing real-time information. Forecasting model developed by INRAE. apic-vigicruesflash.fr
- BDHI:** historical database containing information on major floods that have caused significant damage in France from the Middle Ages to the present day. The database is managed by INRAE on behalf of the French Minister for Ecology. bdhi.developpement-durable.gouv.fr



FLOOD RISK

#1 natural risk in France

Monitor



20,000 km of gauged watercourses

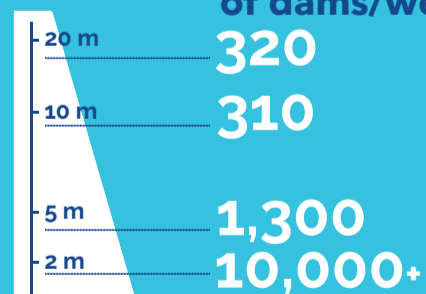


Protect



9,000 km of dykes, including 1,000 km along coasts

Height



Engage



25% of French population at risk



35% of deaths occur in vehicles

Overview of floods in France since the 20th century



Paris
January 1910
Slow-rising flood
1.6 billion euros of damage equivalent to > 30-40 billion today
16 deaths

Vendée
February 2010
Storm Xynthia
2.5 billion euros of damage
47 deaths

Hauts-de-France
May-June 2016
Slow-rising flood
1.1 billion euros of damage
1 death

Alpes-Maritimes
October 2020
Flash flood
1.1 billion euros of damage
18 deaths

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Centre-siège Paris-Antony

Service Presse

Tél. : +33 (0)1 42 75 91 86

presse@inrae.fr

Find us on



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**French national research institute for
agriculture, food & environment**



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