



Feedback on the flooding of industrial sites in January 2018 in the Bourgogne- Franche-Comté region

July 2018



DR

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Introduction

In late January 2018, the Bourgogne-Franche-Comté (BFC) region suffered numerous episodes of intense rainfall and flooding. According to Météo-France, the storm Eleanor brought heavy rain and snowfall on January 4 and 5, over eastern France.¹

These weather episodes also had a severe impact on industrial installations. Synthesizing the results of the questionnaires received by DREAL BFC from the operators concerned, this document summarises some of the lessons learnt from these meteorological events with regard to classified facilities.

The questions asked of the industrialists particularly concerned the following:

- Flood warning procedures;
- Water levels reached within the facilities;
- The consequences in terms of the impact on the environment and the company;
- Factors that amplified the flooding phenomenon;
- The areas for improvement envisaged.

The questionnaires were sent out during the month of May to the operators of classified installations subject to authorisation and registration located in the territory of the towns that applied for natural disaster relief, with a response time set for late June.

To be as thorough as possible in the review of severe weather warnings issued by the French government and Météo France, the flood prevention service of the DREAL Auvergne-Rhône-Alpes (Rhône basin delegation) and the archives of the weather alert service were consulted.

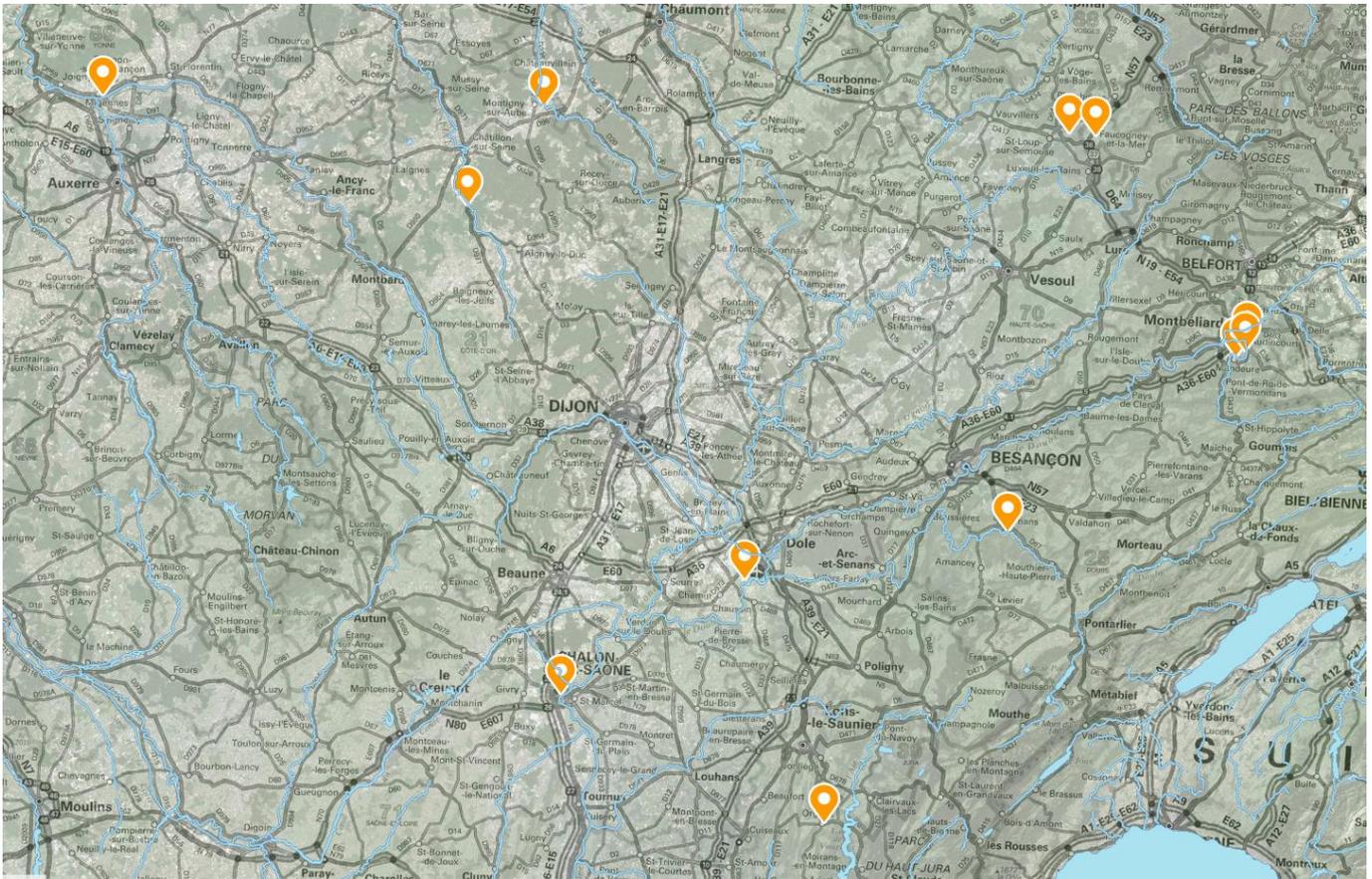
¹ <http://www.meteofrance.fr/actualites/58710117-hiver-2018-pluies-et-inondations>

1. The accident sample

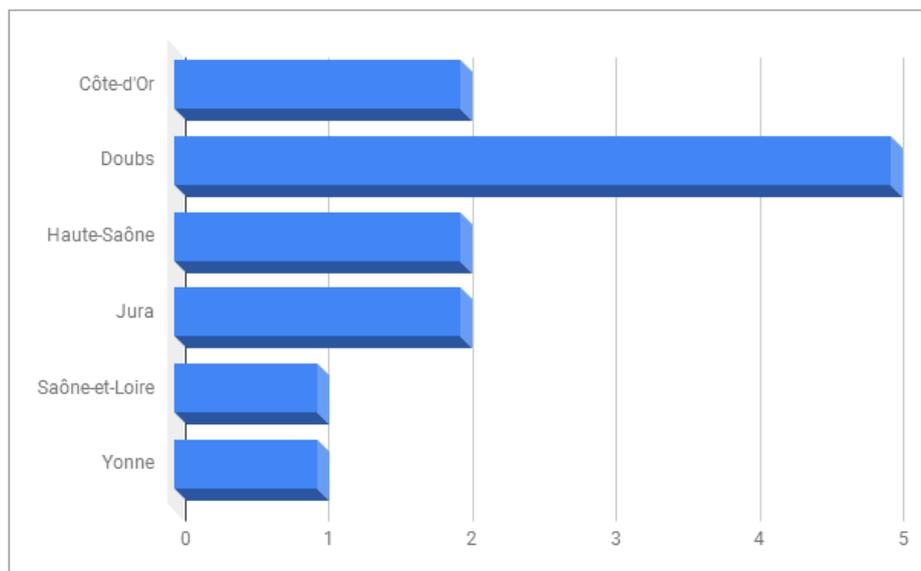
The study is based on a sample of 13 response letters received by DREAL Bourgogne-Franche-Comté in early July 2018. The answers concern the flooding of industrial sites that occurred around January 22, 2018.

1.1. Geographical location of the sites impacted

The sites are located on the map below, accessible on [géoportail](#):



The distribution per county is as follows:



Doubs County appears to be the most affected. This observation seems consistent with the severe weather warnings issued by Météo-France and the rivers that experienced flooding (see paragraph

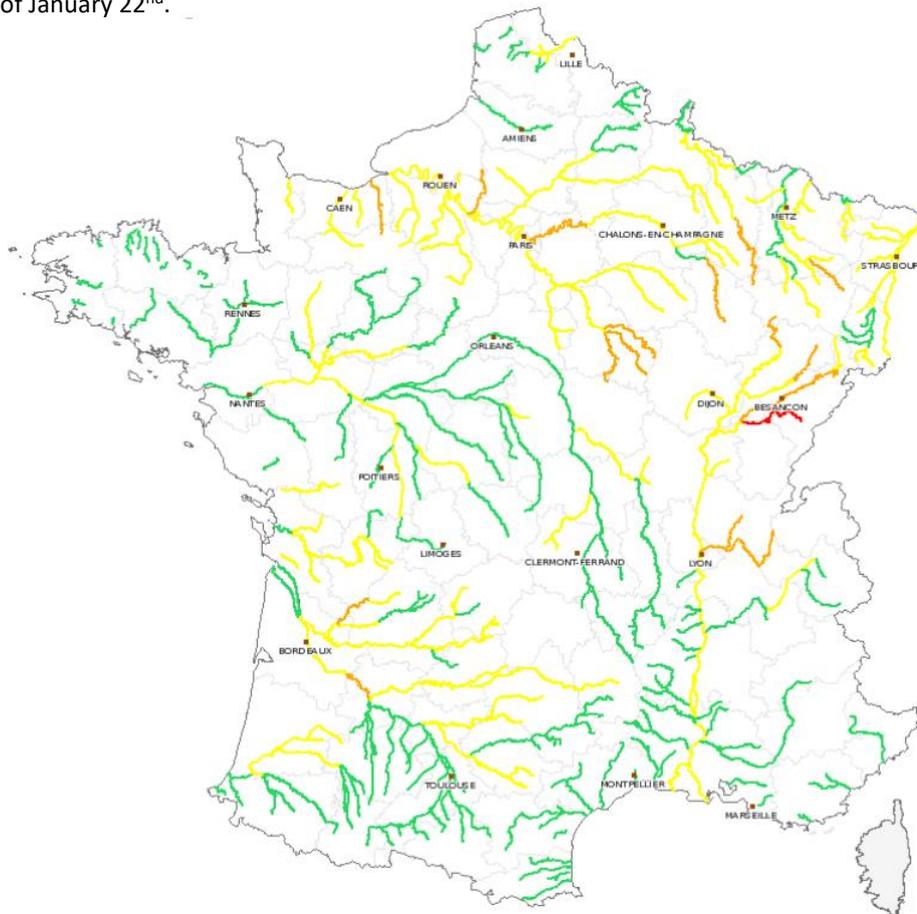
below regarding the meteorological data). Three events are also grouped around the city of Montbéliard. Ten concern the upper Rhone – Saône river basin, and three concern the mid-Seine - Yonne - Loing basin. It should be noted that no site has been identified in the Loire basin at the regional level.

1.2. Meteorological data relative to the BFC region

During the period from January 16th to February 6th, 2018, the amount of flooding in the upper Rhone - Saône basin was exceptional due to the number of segments affected. No less than 20 out of 21 river segments were placed on yellow, orange or red alert. More precisely, 12 out of 20 segments were placed on orange alert and 1 section on Red alert (Loue Valley).

The Doubs and the Jura particularly were in red alert owing rains and flooding. However, their situation was lowered to orange the next day at 6 am. In comparison, the counties of the middle Seine-Yonne-Loing basin were essentially on orange alert when two counties of the upper Rhone Saône basin were in red alert.

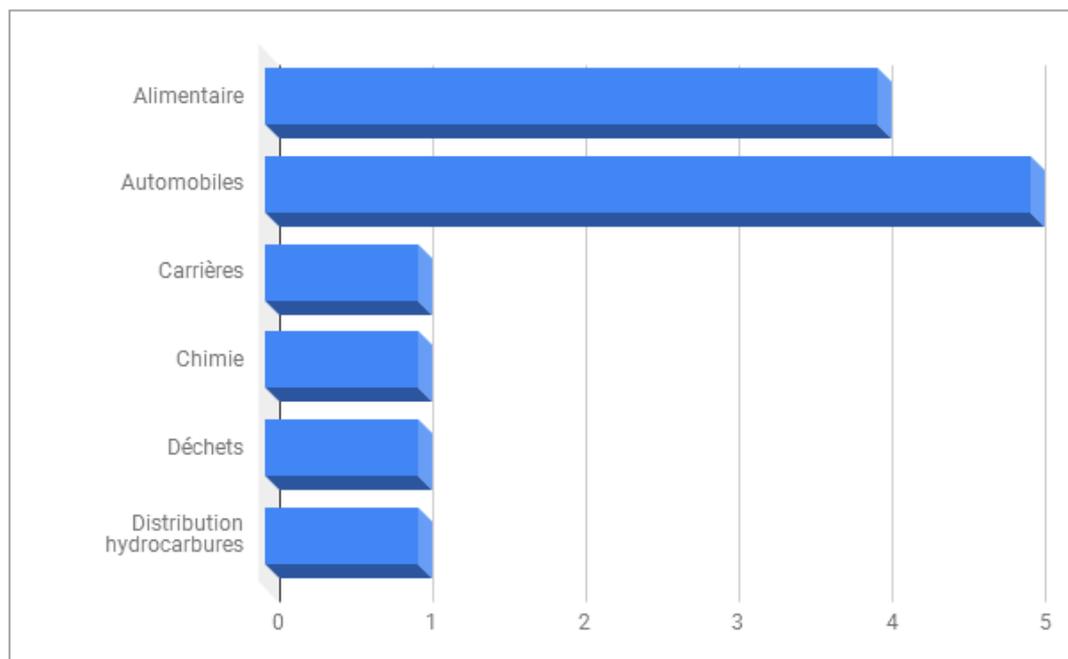
Concerning the chronology and explanation for the phenomena, after a particularly dry autumn and early winter, the storm Eleanor crossed France on January 3rd. In its wake, heavy rains affected the Vosges and Jura mountains between January 3rd and 5th, with accumulations of around 60 mm to 80 mm over 48 hours, and locally up to 130 mm in the Ballon d’Alsace. This rain, combined with the simultaneous melting of snow on these two mountain ranges caused rivers to flood at the head of the basin (Hauts Doubs, Savoureuse, Ognon, Lanterne, Haute Saône). Uprooted trees slowed down the flow of water. The ground was already quite saturated before the arrival of the new rainfall on January 16th, 2018, prompting water runoff and flooding. The map below extracted from the Vigicrues website represents the maximum alert status of each basin segment as of January 22nd.



For informational purposes, peaks in precipitation were also reported on the monthly readings of several stations in the BFC region (Dijon-Longvic, Besançon and Auxerre-Perrigny) as of 22 January.

1.3. Activities of the sites impacted

Breakdown of the number of events by activity sector:



The automotive industry appears to be the most affected, with equipment manufactures affected by the flooding of the Doubs, particularly to the south of Montbéliard. The food sector includes two fish farms: in Veuxhaulles-sur-Aube and in Aisey-sur-Seine, both in the Côte d'Or county in the eastern part of France.

Other companies were indirectly affected by the floods. For example, the flooding of automobile equipment manufacturers in the Montbéliard region had an impact on an automobile manufacturer which had to stop its production lines even though it had not been flooded.

1.4. Typology of flooding encountered

Four types of floods that sometimes occur in combination are generally observed at the national level:

- The overflow of a watercourse from its natural bed;
- Coastal flooding or the case of dam failure;
- Urban stormwater runoff related to soil sealing (asphalt) or stormwater sewer backup;
- The rise of groundwater.

The operators who responded to the survey were all victims of the first type of flooding owing to the location of their site near rivers, except for 2 operators in Orgelet and Corbenay who reported stormwater runoff.

As far as the time period is concerned, the events took place around 22/23 January 2018.

The water levels accumulated on the sites, when known and measured, range from 100 mm (Ornans) to 400 mm (Fougerolles).

2. Elements of industrial accidentology

2.1. Dangerous phenomena observed

Habitually observed during industrial accidents, fires, explosions and/or the release of dangerous or polluting materials did not occur in the study sample. Only 1 case in a service station in Corbenay reported an oil spill (ARIA 51506).

2.2. Root causes of accidents

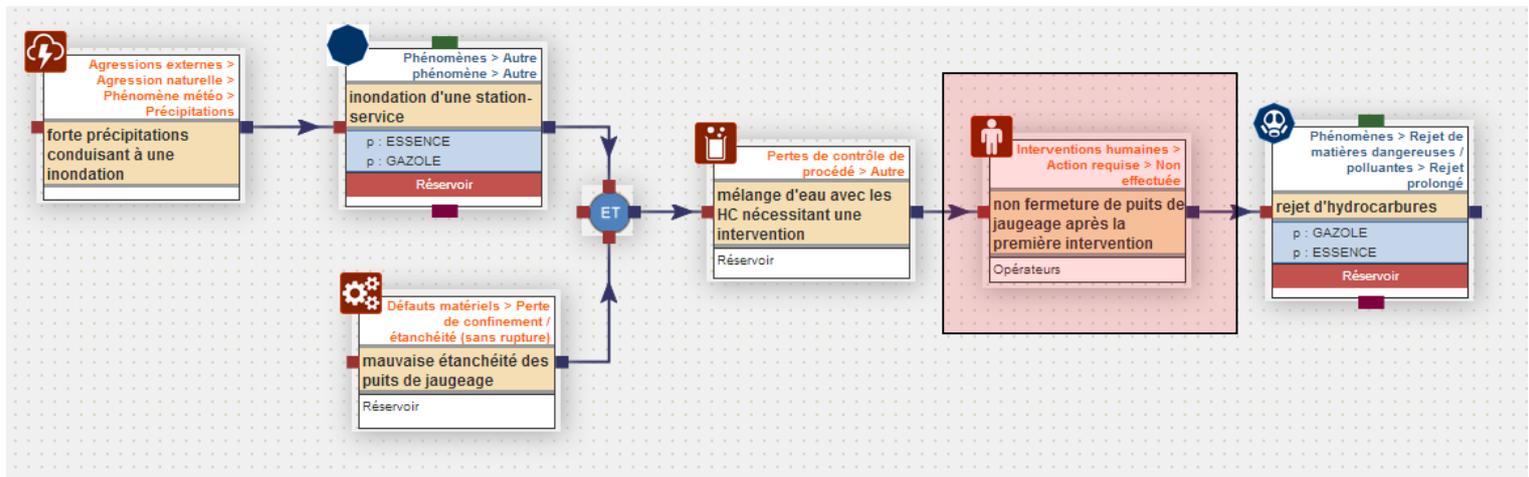
Rain or floods are often just the trigger.

As already highlighted in the study on atmospheric precipitation and flooding prepared by BARPI in 2007,² the root causes of accidents often stemmed from insufficient risk analysis, deficiencies in the design, maintenance and servicing of wastewater facilities or retention systems. In addition, the ARIA database on flood episodes recorded:

- Storage of dangerous or polluting products that were not sufficiently secure;
- Poorly protected electrical devices or circuits;
- Undersizing or malfunctions of pumping equipment;

In the events studied, operators didn't always perform a very thorough analysis of root causes. Nevertheless, some responses allow us to identify some of these causes.

For example, the hydrocarbon discharge in Corbenay originated from organisational and human factors:



Analysis of the causes of the release of pollutants during an event that occurred in Corbenay (ARIA 51506)

More generally, the problems cited by facility operators generally concern:

- In 4 cases, the lack of time to prepare for the rise in water levels due to the lack of a weather watch or alert by the authorities (town hall/ prefecture);
- In 1 case, the problem of regulating rivers at hydraulic structures (sluice gates: upstream control of the flow of the Saône or its tributaries);
- In 1 case, the rise in water levels was much faster than in previous flood episodes (Saône).
- The lack of pumping equipment (the fire brigade is often busy assisting the population);

² https://www.aria.developpement-durable.gouv.fr/wp-content/Files_mf/1373987012SY_precipitationinondation_2007.pdf

- The extensive interaction between subcontractors/car manufacturers;^[br1]
- Blocking of access roads to the site during the highwater phase (1 case) and the inaccessibility of certain parts of the site (2 cases), which reflect an insufficient analysis of the flood risk.

2.3. Consequences of the events

The consequences of the events as mentioned by the industrialists are essentially economic, taking the form of:

- Production stoppages in 6 cases, over a period of 1 to 10 days (for a quarry) and major activity disruptions in 1 case;
- The loss of part of the livestock at a fish farm, impacting the operator's cash flow;
- Periods of technical unemployment for the staff, with the evacuation of the site in 1 case;
- Water damage (equipment).

It should be noted that production stoppages have affected other operators indirectly. The stoppage of production lines at the car manufacturer due to the flooding of its subcontractors represents, according to the press, a production loss of 900 vehicles and nearly 2,000 employees placed on technical unemployment.

In the cases studied, the impact on the environment seems marginal except in the case of an oil spill at a service station (ARIA 51506), but the consequences were limited: the hydrocarbons did not spread into the municipal network and remained confined to the site. Another lesson is the impact of floods on wastewater treatment plants (WWTPs) in Migennes, where the rise in water levels disrupted the operation of a slaughterhouse's WWTP, preventing the discharge of its effluents.

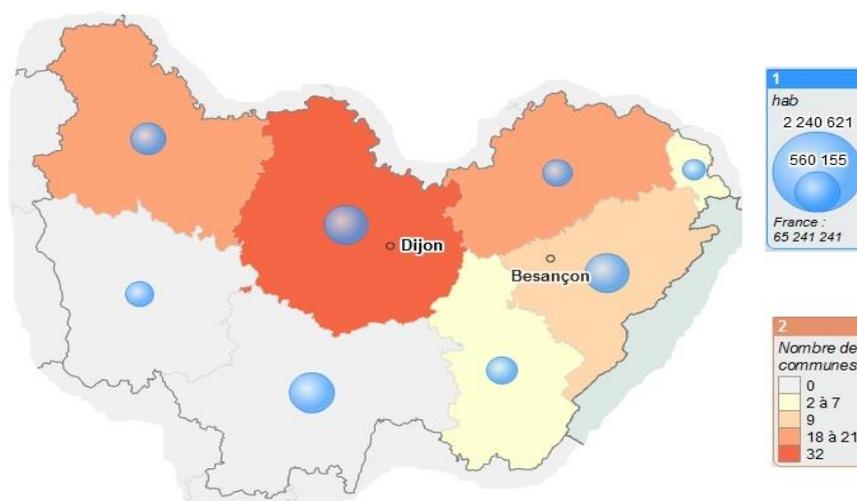
The floods also uprooted trees, leading to damage of nearby structures exposed to the risk of logjams.

The problem of waste – a frequent issue following flooding – was not at all addressed by the operators, making it difficult to measure the extent of the problem.

The consequences of the January 2018 floods appear to have had a greater impact on the northern counties of the region, resulting in a number of municipalities being designated for natural disaster relief (Ministerial Decree of 9 March, 2018):

1 - Population, 2012 - source : Insee

2 - Reconnaissance de l'état de catastrophes naturelles - source : Arrêté ministériel du 9 mars 2018



3. Lessons learnt

3.1. Weather warning and monitoring

In light of the risks induced by weather-related phenomena, it is important to be informed as soon as possible. Several systems have been created to provide severe weather warnings. They range from simple phone calls from authorities (town hall, prefecture) to more sophisticated computer systems allowing alerts via digital media (SMS, e-mail). These systems are sometimes specific to a given type of natural phenomenon (e.g. the Vigicrues site of the Ministry for an Ecological and Solidary Transition for floods or Météorage for lightning storms). Others are more generalist in nature, such as the Météo France website. It is therefore important to choose your severe weather warning system correctly: not all rivers are listed on Vigicrues, for example.

In the events studied, operators' practices were quite varied. Alert by the town hall (3 cases) and regular monitoring of the Vigicrues site (5 cases) were regularly mentioned. Some enhance the analysis with data from weather stations near their site. In contrast, some operators (4 cases) did not seem to use such systems (alert by the guard or they mention the absence of alert from the authorities).

3.2. Prevention and protection measures

The prevention and protection measures put in place by operators in the BFC region include:

- Shutdown of the site's activity with the initiation of flood-response procedures (disconnection of power sources, particularly electricity);
- Closure of access to the facilities;
- Evacuation of personnel and vehicles;
- Placement of storage and IT equipment (computers and inverters) on raised shelves or upper levels;
- Installation of absorbent materials around the points of potential release of polluting products (oils, hydrocarbons);
- Continuous monitoring of rising water or reference points along rivers or streams to determine when water will arrive at the site;
- The use of pumping systems while water is rising in order to limit its impact;
- Ensuring the availability of at least one access road in a non-floodable area;
- Operational instructions to be applied in the event of water levels reaching reference points on and upstream of the site;
- Supervision of the gradual resumption of operations at facilities as the floodwaters subside.

The following areas for improvement have also been identified:

- Improvement of the emergency plan for 2 companies, particularly to avoid being surprised by the speed of the rising water level. It should be noted that this improvement is mandatory in the Rhone Mediterranean basin;
- Need to monitor the building in 1 case (the impact of flood waters on the walls, waterproofing study);
- Cut down the most fragile trees;
- Purchase of additional pumping or protection equipment (cofferdams to protect workshop or storage facility entrances, weight to be placed on sewer manhole covers to prevent water from rising out of them);
- Monitor information on the residing flood waters, particularly with regard to the upstream control of the Saône's flow rate.

3.3. Analogous events recorded in the ARIA database

Flash flooding, lightning, earthquakes: feedback from natural and technological events confirms the need for a global approach to risk management based on 3 pillars:

- Characterisation of the industrial site's exposure to reference natural events;
- Identification of accident sequences;
- Implementation of an appropriate technical and organisational strategy.

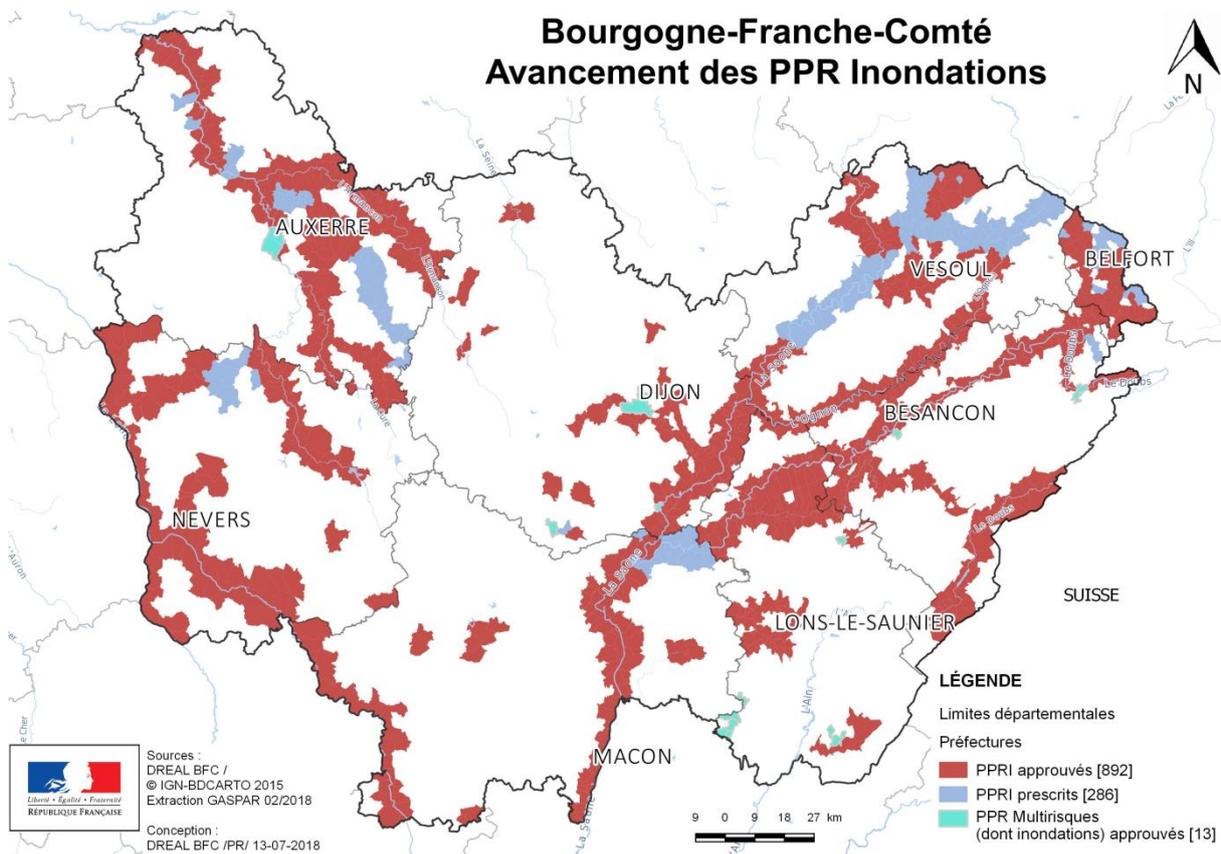
Characterisation of the industrial site's exposure to reference natural events

This approach can be based, for example, on the consultation of geographical information systems (GIS) or flood risk prevention plans (FRPP) with detailed maps of floodable areas. However, accidentology has shown in the past that zones considered non-floodable could nonetheless be flooded (ARIA 35426).

Among the GIS systems, which are available to the general public and freely accessible online, the following is provided for informational purposes only:

<http://www.georisques.gouv.fr/cartes-interactives#/>

or <http://www.orisk-BFC.fr/> (specific to the BFC region)



Status of the requirements for natural risk prevention and floodplains in the BFC region (2018 data)

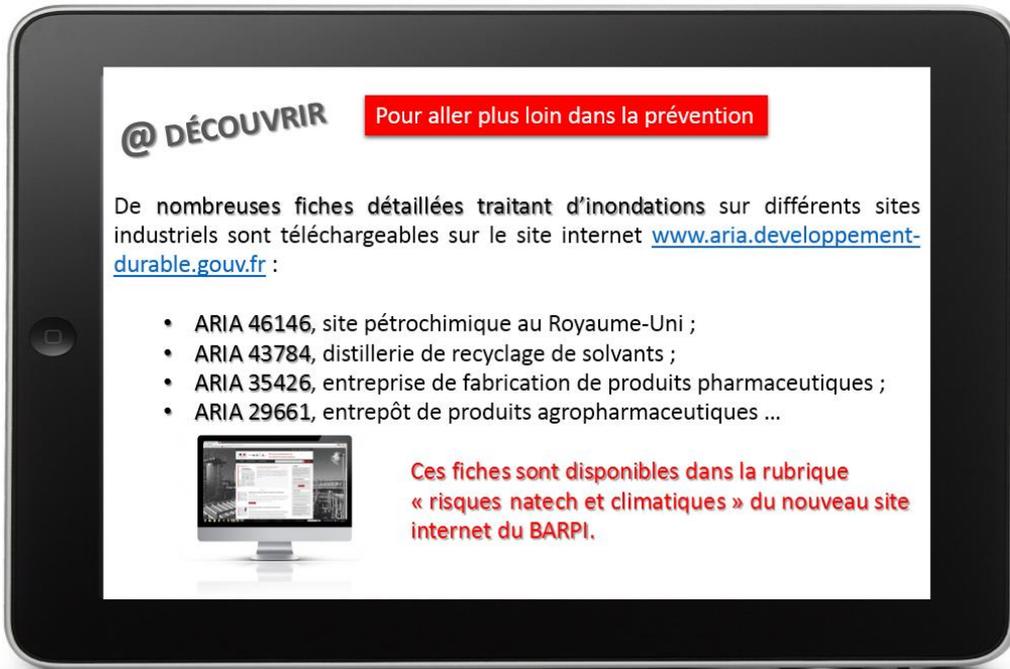
When an industrial site is in a floodplain, a reference flood scenario must also be defined (water levels likely to be reached, time of submersion of the installations, practicable access roads, management of utilities if they must be maintained in operation, etc.).

Identification of accident sequences

The consultation of accidentology databases can, to a certain extent, provide information on potential accident scenarios or difficulties encountered by other operators.

The analysis of events shows in particular the sensitivity of certain units or accessories:

- Building infrastructure;
- Insulated equipment;
- The impact of water on equipment and stocks (beware of products that can react with water!);
- Pipes (risk of differential settling or bending);
- Utility networks (gas, electricity, telecommunications, IT, cooling water, etc.);
- The access roads to the site (essential, for example, if generators must be supplied with fuel).



To take prevention a step further

Many detailed fact sheets on floods at various industrial sites can be downloaded from the website www.aria.developpement-durable.gouv.fr:

ARIA 46146, petrochemical site in the United Kingdom;

ARIA 46784, solvent recycling distillery;

ARIA 35426, a pharmaceutical manufacturing company;

ARIA 29661, agropharmaceutical product warehouse...

These sheets are available in the "natech and climate risks" section of the new BARPI website.

The implementation of an appropriate technical and organisational strategy

The last pillar of site protection, the mitigation measures to be adopted to reduce the effects of a natural phenomenon, are obviously to be defined according to the vulnerability of the facilities. The modalities of event management (crisis management and return to normal phase) must also be anticipated.

In section 3.2, we highlighted measures taken by facility operators to deal with the flooding events in the BFC region in January 2018. In particular, the following can also be added:

- A vulnerability study, notably covering the rollover, floatation and anchoring of equipment (Archimedes' thrust on supporting elements);
- The drafting of a business continuity plan to guarantee continuity of service to the company's customers;
- Oversizing of drainage systems in view of the likely increasing intensity of future rainfall events;
- The definition of a safe fallback phase for facilities where no impact on third parties or the environment is likely to occur;
- A study on the reliability of communication networks (redundancy of PSTN/IP telephony with GSM means, including the use of 3G/4G modems).

Points to remember concerning the BFC flood episode

- Flooding appears to have had a greater impact on companies located in the upper Rhene – Saône basin, where a significant number of Seveso sites are located;
- Flooding scenarios mostly triggered by overflowing rivers, with some cases caused by stormwater runoff;
- The severe weather warning system appears to have accurately determined the areas at risk. However, the various actors need to be better informed. Several operators reported a lack of information or absence of a weather monitoring system;
- The automotive sector seems to have been heavily impacted, particularly due to floods at automotive equipment manufacturers indirectly affecting the car manufacturer;
- The low environmental impact caused by the flooding of industrial facilities;
- The operators' awareness of the need for flood risk prevention probably needs to be improved.

TECHNOLOGICAL ACCIDENTS ONLINE

Safety and transparency are two legitimate requirements of our society.

Since June 2001, the website www.aria.developpement-durable.gouv.fr of the Ministry for an Ecological and Solidarity Transition has been providing professionals and the public lessons learnt from the analysis of technological accidents.

The main sections of the site are presented in French and in English.

Under the general headings, Internet users can, for example, obtain information on government action, have access to extensive extracts from the ARIA database, discover the presentation of the European accident scale, and consult the index relating to hazardous materials released in order to complete the communication "as it becomes available" in the event of an accident or incident.

The description of accidents, the raw material of any feedback process, constitutes an important part of the site's resources: the sequence of the event, consequences, origins, circumstances, proven or presumed causes, follow-up and lessons learnt.

About a hundred detailed and illustrated technical data sheets present accidents selected for the particular interest they afford. Many analyses by theme or industrial sector are also available. The section dedicated to technical recommendations develops different themes: fine chemistry, pyrotechnics, surface treatment, silos, tyre deposits, fire permits, waste treatment, handling, etc. A multi-criteria search provides access to information on accidents that have occurred in France or abroad.

The site www.aria.developpement-durable.gouv.fr is constantly being enriched. Currently, nearly 50,000 accidents are online and new thematic analyses will be conducted regularly.

Summaries of the events presented are available on the website:

www.aria.developpement-durable.gouv.fr

For all comments/suggestions or to report an accident or to obtain permission to use this data for publication:

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