2018 SCIENTIFIC ACTIVITY REPORT

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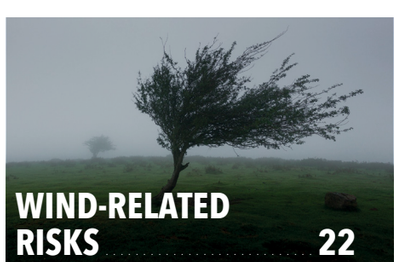
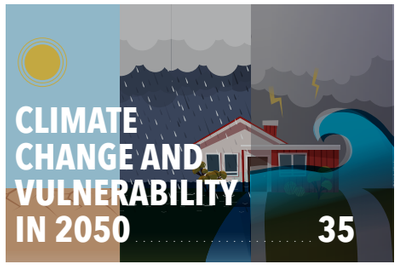
Cover photo: Source: CCR, BD Ortho® IGN/BD Topo® IGN/CCR
Inventory of buildings (in yellow) exposed to erosion risk (red crosshatch) at Sainte-Marie-la-Mer in the Pyrénées-Orientales department.





INTRODUCTION

The Natural Disasters compensation scheme covers since 1982, in France, the main natural hazards: floods, subsidence, earthquakes, coastal flooding and cyclones in overseas territories.

Considered as the cornerstone of this scheme, the Caisse Centrale de Réassurance (CCR) is a public reinsurer offering to its clients, insurance companies operating in France, an unlimited State-guaranteed coverage. In this way, all insured parties—private persons, businesses, local municipalities— are covered for these risks regardless of their exposure.

Issues in terms of improving risk and prevention knowledge are crucial and are a challenge that insurers and reinsurers must carefully anticipate. A situation to which is added the context of climate change and its global impacts on the evolution of hazards and on vulnerability. CCR is largely involve within innovative and multidisciplinary research projects.

This scientific research and related areas of expertise are part of an approach aimed at developing an in-depth understanding of these phenomena, their impact on insured damage and the role of prevention.

Strengthening cooperation with our partners and developing new projects to improve methods for estimating the benefits of preventive measures, are at the heart of this report presenting the research of the year 2018.

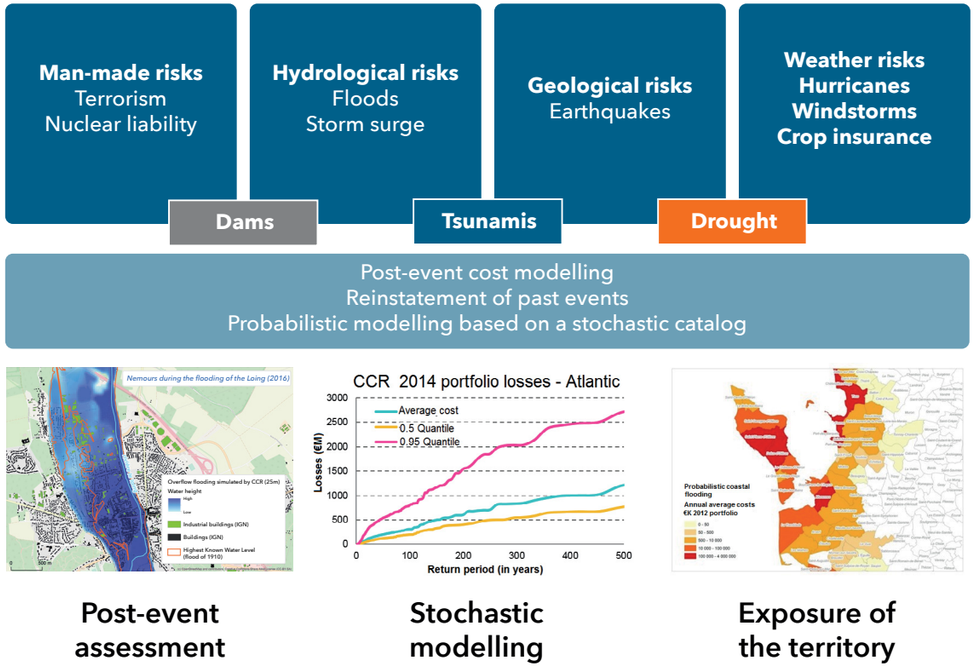
CCR, in partnership with highly-recognized French scientific organizations, is pursuing the development of software models to simulate natural hazards extension (e.g. flooded areas during an event) and their consequences in terms of insured or economic damage in the broad sense (Figure 1).

Over the past years, CCR has shared its expertise and results of its models with its clients (insurance companies), local municipalities and public authorities so as to contribute to the development of national policy on risk prevention and public awareness.

CCR actively strives to promote scientific research through its commitment at both national and European levels by consistently supporting research projects, scientific publications, thesis, conferences and university programs [Insurance and Financial Science Institute (IFSA), Paris School of Engineering, European Institute of Actuaries at Brest (EURIA), and others]. Since 2015, the CCR Outstanding Thesis Award has been committed to awarding an innovative PhD research project dedicated to enhance knowledge on natural disaster risks and on the application of such knowledge to the insurance sector and to risk prevention professions.

The year 2018 was particularly marked by the publication of a new study focusing on the impact of climate change on insured property damage by 2050 as well as by the simulation of major natural events namely, the Seine and Marne floods in January, the Aude flood in October and a drought with significant consequences.

Figure 1 : Developed modelling tools



MODELLING THE MAJOR NATURAL EVENTS OF 2018

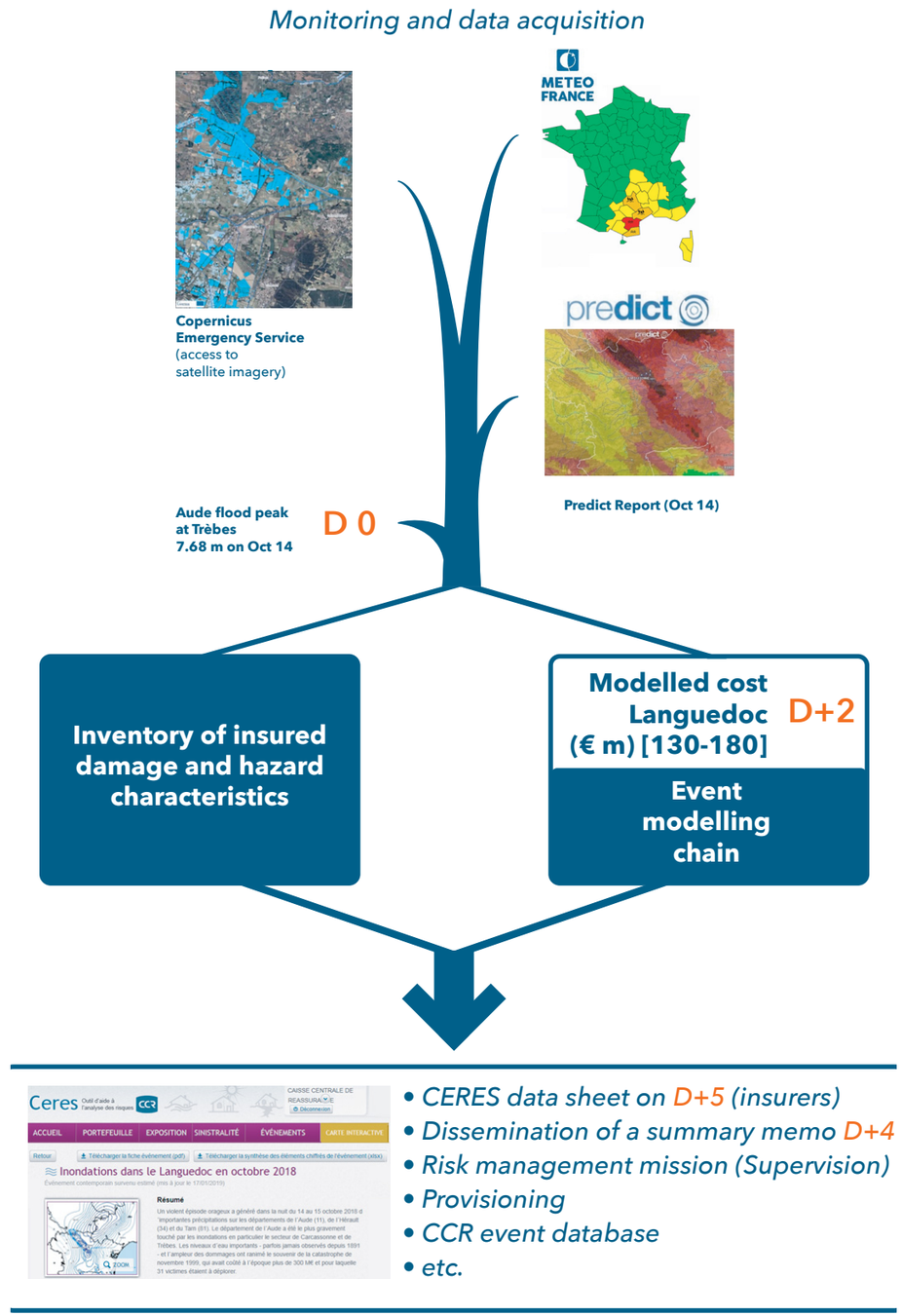
Throughout the year, CCR set up a natural disasters monitoring and modelling activities, to be able to quickly provide estimates of the insured damage of an event occurring in mainland France and overseas territories.

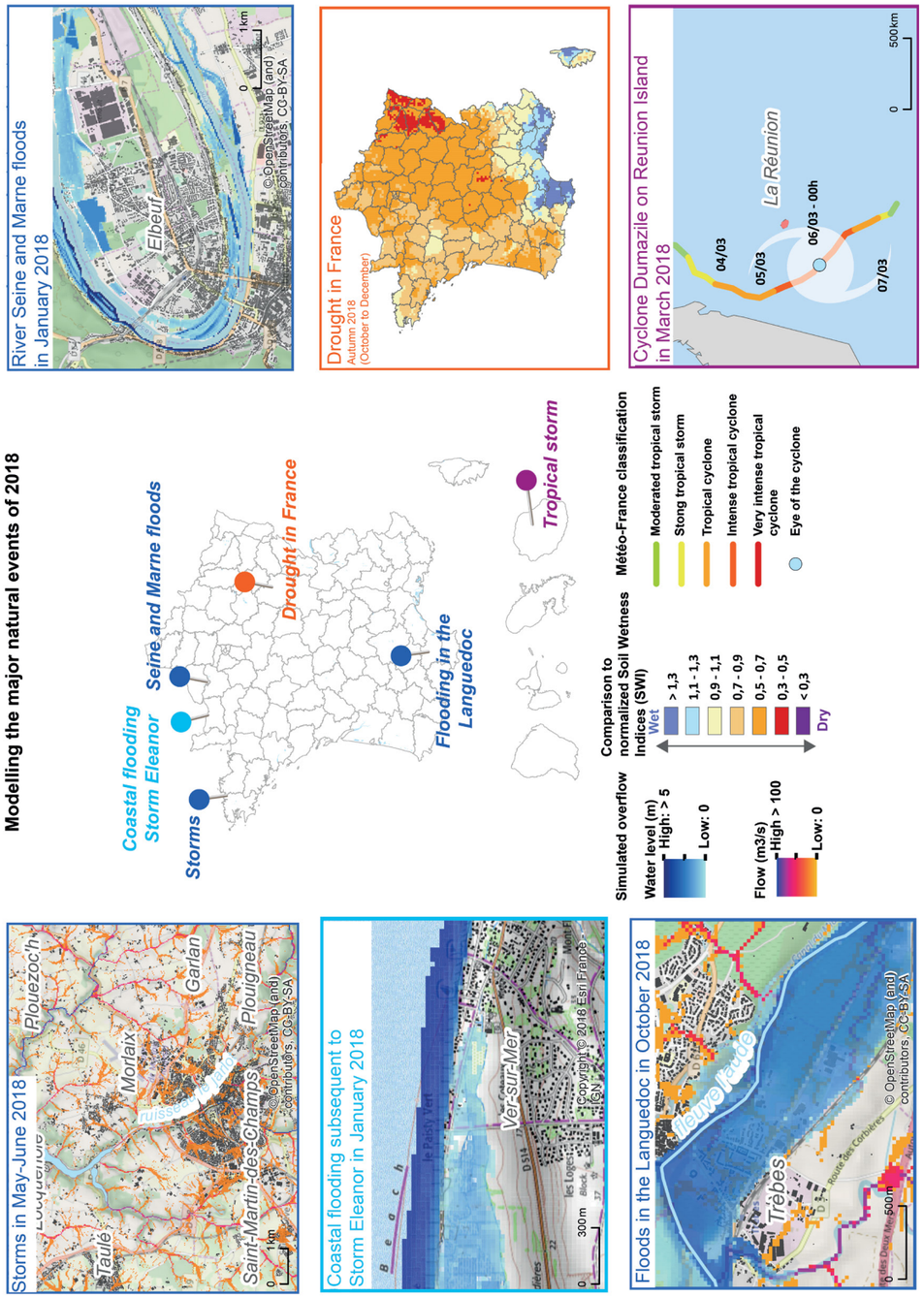
This monitoring activity is conducted in partnership with **Météo-France** and the French company Predict. Data for this activity is provided by **Vigicrue** and the Central Service for Hydrometeorology and Flood Warning Support (**SCHAPI**). The data are collected on a real-time basis for each event and include information on the observed damage (Figure 2).

The Cat Risk Analysis and Modelling Department then performs the simulation of the hazard: maps the hazard extension under geographic information system and assesses the insured damage within five days using the in-house designed models.

After year 2017 marked by hurricanes Irma and Maria that struck the islands of Saint-Martin and Saint-Barthelemy, the first half of 2018 began with a series of storms that caused heavy flooding and storm surge in mainland France.

Figure 2: Event surveillance and modelling processes, example of the Aude floods, October 2018




Modelling the major natural events of 2018
Seine and Marne floods
Drought in France
Tropical storm
Coastal flooding
Storm Eleanor
Storms
Flooding in the
Languedoc
Météo-France classification
Moderated tropical storm
Stong tropical storm
Tropical cyclone
Intense tropical cyclone
Very intense tropical
cyclone
Eye of the cyclone
Comparison to
normalized Soil Wetness
Indices (SWI)
Wet
> 1,3
1,1 - 1,3
0,9 - 1,1
0,7 - 0,9
0,5 - 0,7
0,3 - 0,5
< 0,3
Dry
Simulated overflow
Water level (m)
High: > 5
Low: 0
Flow (m3/s)
High > 100
Low: 0

River Seine and Marne floods
in January 2018
Elbeuf
0
1km
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Drought in France
Autumn 2018
(October to December)

Cyclone Dumazile on Reunion Island
in March 2018
La Réunion
04/03
05/03
06/03 - 00h
07/03
0
500km

Storms in May-June 2018
Ploezoc'h
Morlaix
Garlan
Plouigneau
Taulé
Saint-Martin-des-Champs
0
1km
© OpenStreetMap (and)
contributors, CC-BY-SA

Coastal flooding subsequent to
Storm Eleanor in January 2018
Ver-sur-Mer
le Paisty Vert
les Logest
Mont F
D 514
0
300m
- Copyright © 2018 Esri France -
IGN

Floods in the Languedoc in October 2018
fleuve l'aude
Trèbes
Route des Corbières
0
500m
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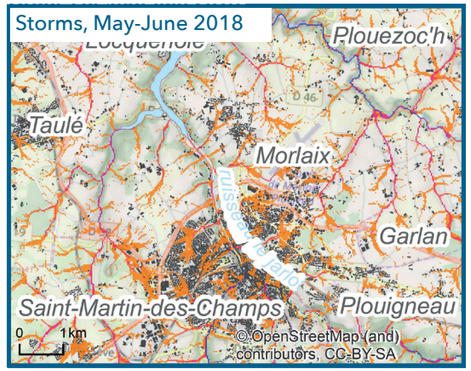
Storms, May-June 2018
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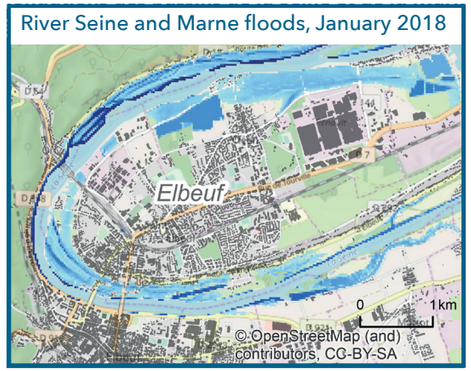
River Seine and Marne floods, January 2018
Elbeuf
0
1km
© OpenStreetMap (and)
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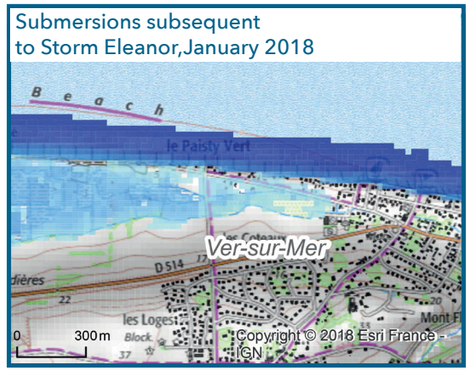
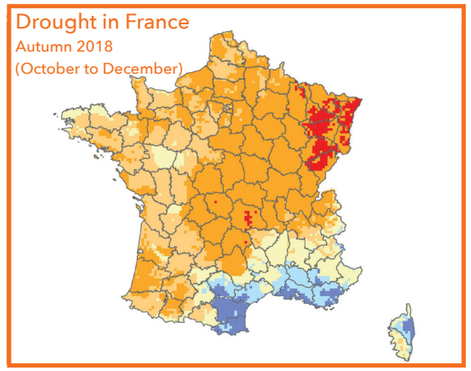
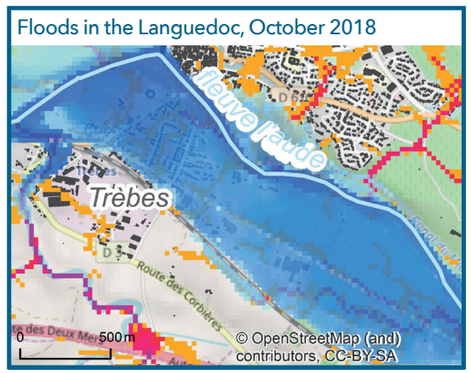

Submersions subsequent
to Storm Eleanor,January 2018
Ver-sur-Mer
le Paisty Vert
les Logest
Mont F
D 514
0
300m
- Copyright © 2018 Esri France -
IGN


Drought in France
Autumn 2018
(October to December)


Floods in the Languedoc, October 2018
fleuve l'aude
Trèbes
Route des Corbières
0
500m
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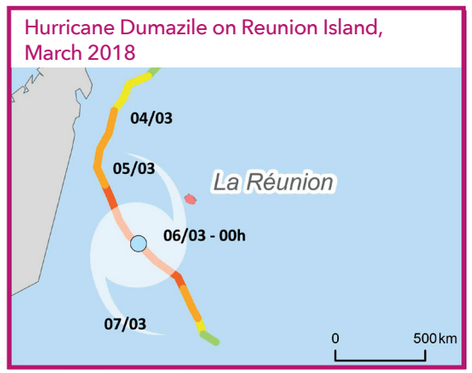

Hurricane Dumazile on Reunion Island,
March 2018
04/03
05/03
La Réunion
06/03 - 00h
07/03
0
500km

Photography: CCR/Onfroy T.

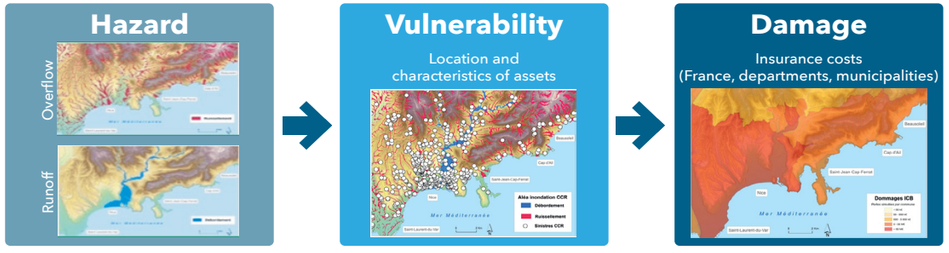
HYDROLOGICAL RISKS

FLOOD MODEL

In mainland France and in its overseas territories, hydrological risks generally include river overflow, surface runoff, especially in urban areas and groundwater table rising. Since 1982, these risks have caused the highest annual losses and the highest extreme losses. At the beginning of 2018, in parallel with the improvement of our simulation tools, we also focused on the use of models to assess the effectiveness of preventive measures and the development of a new operational method to simulate damage due to flash floods.

To perform these assessments, two models are developed for each peril (1) a simulation model based on a catalog of fictive events and (2) the second based on a catalog of real events. The process involves hazard modelling, then vulnerability analysis and finally the estimation of the insured damage (Figure 3). The following section of this chapter presents the latest models developed by the team.

Figure 3 : Master diagram of CCR models



First model developed at CCR, the flood model is updated on an on-going basis. Generally, a new version is put into production once a year1. The runoff model is a hydrological model distributed over a 25-meter grid that simultaneously simulates surface runoff as well as infiltrations and sub-surface flows.

MAPS AND DAMAGE ASSESSMENTS ARE ALSO COMMUNICATED TO PUBLIC AUTHORITIES, PARTNERS AND CLIENTS.

The overflow model can simulate river flows and water levels for the gauged rivers of metropolitan France. Whenever the water level surpasses a predetermined threshold, the flooded area is calculated on the basis of the altitude for each 25-meter grid.

The decision to model these two types of hazards was based on loss experience for floods occurring since 1982 and for which CCR possesses detailed data. This version of the flood model integrates additional features that take into account infiltration and calculate surface runoff. Also, a new method has been included to model the extent of the flood area based on the river altitude for each 25-meter grid. Each of the versions of the flood model is used to completely recalibrate the damage model.

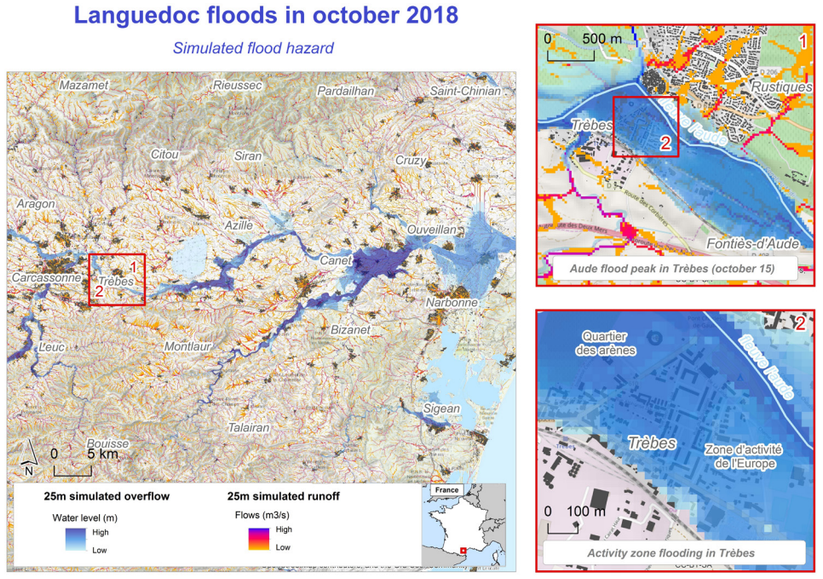
This new version of the flood model was applied:

- to simulate runoff for the flood events occurred in 2018 (in particular the floods occurred in the Île-de- France region in January and February and in the Aude department in October, Figure 4);
- to build new probabilistic hazard maps using rainfall data based on **Météo-France** weather scenarios received in 2018 (actual climate scenario and RCP[2] 8.5 2050 future climate scenario, cf. climate change study).

1 Moncoulon D., Labat D., Ardon J., Leblois E., Onfroy T., Poulard C., Aji S., Remy A. and Quantin A., 2014: Analysis of the French insurance market to floods: a stochastic model combining river overflow and surface runoff. Nat. Hazard Earth System Sci., 14, 2468-2485.

2 The Representative Concentration Pathway (RCP) scenarios are greenhouse gas emission scenarios.

Figure 4 : Overflow and runoff flooding simulated for
the flood event that occurred in the Aude department in October 2018



In parallel to this event simulation method, a probabilistic model had been developed for both hazards: runoff and overflow. The aim is to simulate a major portion of the events that could occur in the whole territory in order to obtain a complete overview of the flood exposure. Figure 5 displays the main objectives for each of the two version of the model: simulation of real events and simulation of fictive events.

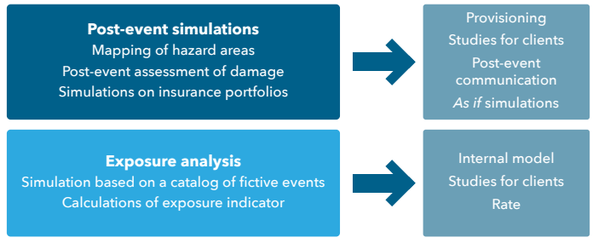


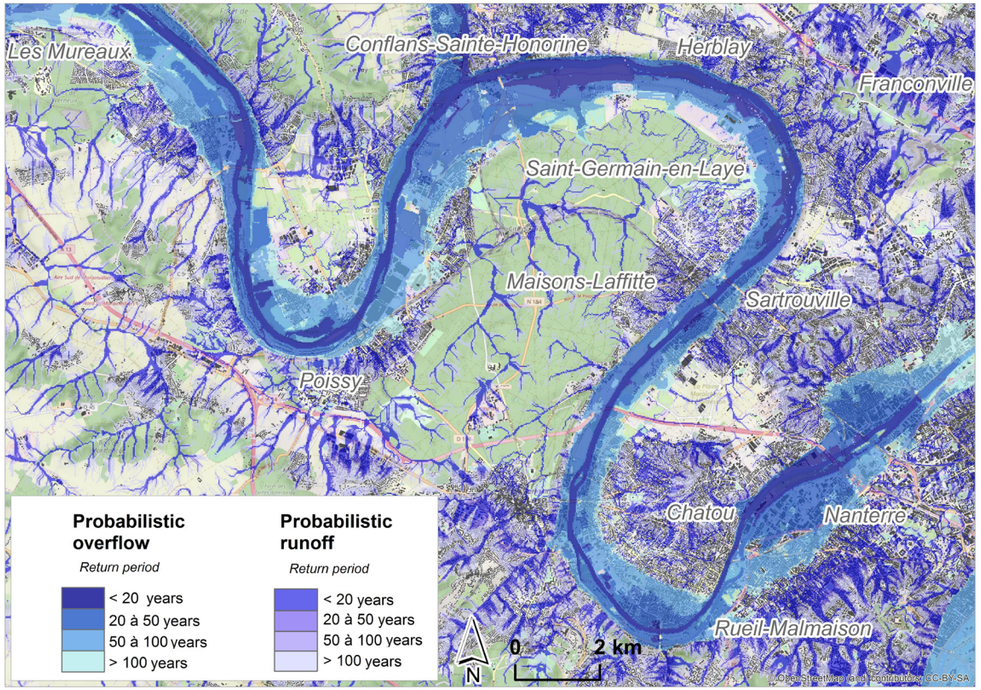
Figure 5 : L'approche probabiliste et déterministe

The fictive overflow simulation method is based on the calibration of statistical laws on historical flow data measured at the hydrometric stations alongside the main rivers of France (data from "Banque Hydro").

On the basis of this data, it is possible to determine the flow quantiles corresponding to each return period. The overflow area calculated using the flow data provides a hazard map for the considered return period. For example, an area impacted by overflow flooding with a 20-year return period is susceptible to being flooded once every 20 years on average (Figure 6).

The fictive runoff flood model is based on a catalog of approximately 1,000 fictive events recorded and simulated using rainfall data from the ARPEGE-Climat weather model developed by **Météo-France**. The ARPEGE-Climat model is a global atmospheric circulation model relying on the SAFRAN database (historical database of daily rainfall for metropolitan France) downscaled to an hourly time step and over a 64 km² grid. The probability of occurrence of runoff is represented by a map displaying the return periods of the hazard

Figure 6 : Fictive overflow and runoff flooding simulated in the Seine basin downstream from Paris



CCR is participating in two research projects related to water hazards: the PICS project sponsored by the French National Research Agency (ANR) and the EU's H2020 NAIAD project. These projects focus on issues such as more effectively anticipating the impacts of flash floods and developing cost-benefit analysis of Nature-Based Solutions (NBS).

REMOTE SENSING IN SUPPORT OF POST-EVENT SIMULATION

As a complementary approach to numerical model based simulations, remote sensing enables researchers to verify the consistency of observed and simulated hazard few days following the occurrence of an event.

Imaging data is used for model validation and damage assessment outputs. Raw images are provided by the **European Space Agency's (ESA)** Copernicus Open Data Hub. The data is acquired by the Sentinel-1 satellite (radar imagery with 10 m spatial resolution) and the Sentinel-2 satellite (optical imagery with 10- to 20-m spatial resolution) and subsequently processed on an internal basis using the ESA remote sensing software Sentinel Application Platform (SNAP). The ensuing results are compared with model's outputs and with a particular attention on high risk-prone sectors and areas most affected by the event.

The benefits that satellite imagery brings to flood research are diverse and range, from mapping the contours of flood, to detecting breaches in dikes and measuring soil wetness.

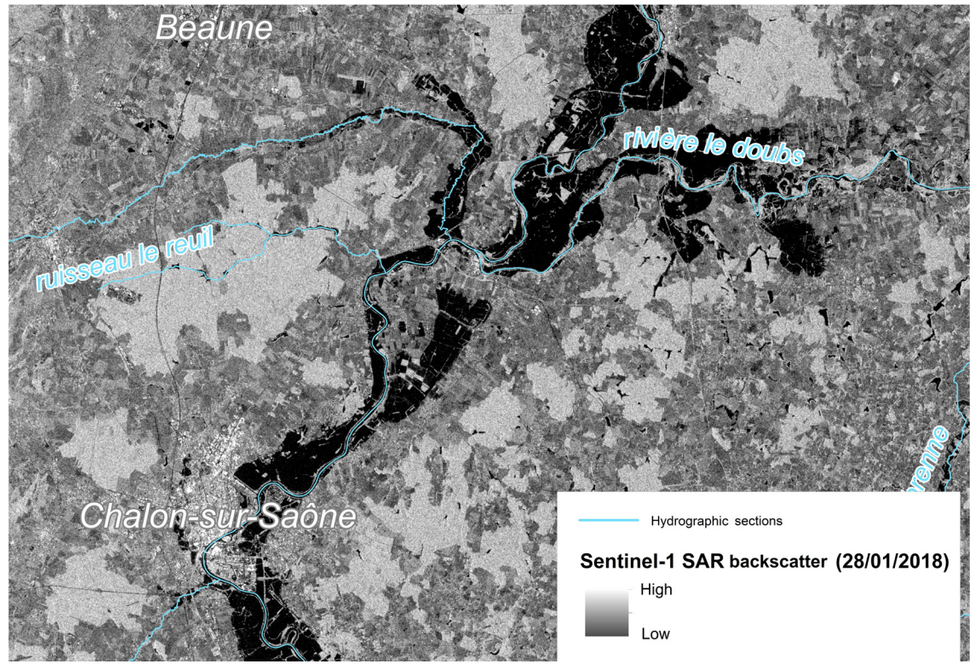
In the framework of a partnership set up since 2013, the **French Department of Regional Image Processing and Remote Sensing** (SERTIT) provides to CCR, in case of major events, GIS data and cartographic analyses relevant to the observed affected areas.

REMOTE SENSING AND RECONSTRUCTION

Remote sensing images also enable experts to monitor the post-disaster evolution. In this context, the **French National Center for Space Research (CNES)** communicated reports on the status of the reconstruction of Saint-Martin and Saint-Barthelemy islands following the occurrence of Hurricane Irma throughout 2018. These satellite images from the Pléiades 1A and 1B satellites—with 70-centimeters spatial resolution—were provided to CCR in the framework of the International Charter on Space and Major Disasters..

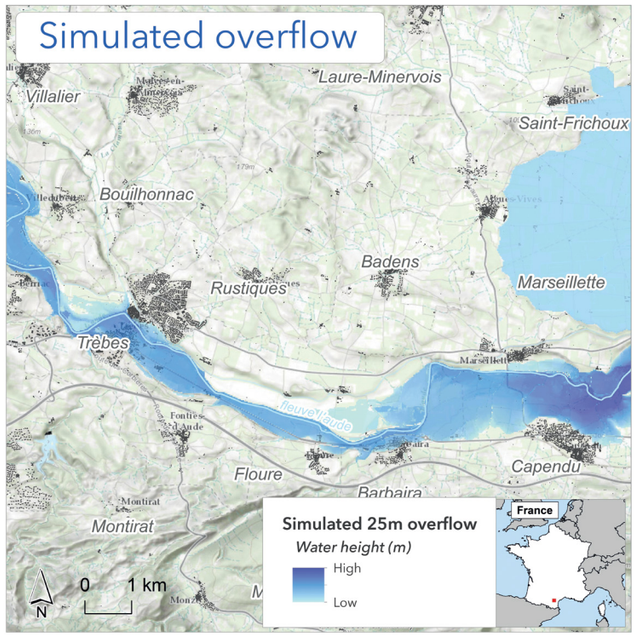
Sentinel-1 (ESA Copernicus) radar satellites allow the observation of the surface of earth through clouds and allow night acquisitions (Figure 7). The system produces high quality images of floods, especially with regard to overflow flooding.

Figure 7 : Sentinel-1 radar image of Saône and Doubs floods in January 2018

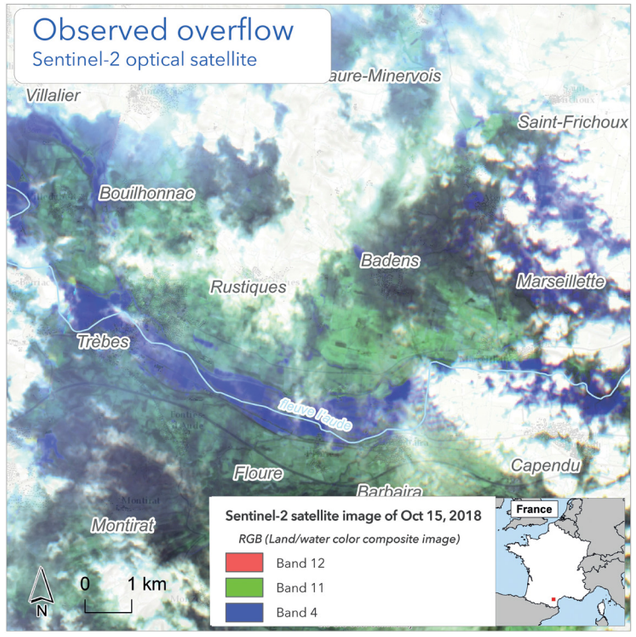


Sentinel-2 (ESA Copernicus) optic satellites with their onboard multispectral sensors can pinpoint the boundaries of flooded areas up to few days after the occurrence of a flood event (Figure 8).

Figure 8 : Aude river overflow in October 2018 in the area of Trèbes:
(a) comparison between the simulated hazard



(b) and observed flooded areas shown on the Sentinel-2 optic image



MODELLING FLASH FLOODS: THE ANR PICS PROJECT

PICS

Integrated nowcasting
of flash floods impacts

www.pics.ifsttar.fr

Modelling flash floods is one of the main objectives of the PICS[1] project (Integrated nowcasting of flash floods impacts). The project, financed by the **French National Research Agency** (ANR), brings together eight French partners: the **Institute of Science and Technology for Transport, Development and Networks** (Ifsttar), the **Institute of Environmental Geosciences** (IGE), the **National Center for Meteorological Research** (CNRM), the **National Institute for Environmental Science and Research** (IRSTEA), the **French Agency for Ecological Transition and Regional Cohesion** (Cerema), **Géosciences Rennes**, **SCHAPI** and CCR. The aim of this project is to develop integrated chain for forecasting and assessing the social and economic impacts of flash floods.

The PICS project is organized around four work packages. The first work package of the PICS project deals with the short-term forecasting of precipitation and discharges. The objective is to assess and improve the forecasting of flash floods on the basis of a meteorological model and radar observations. The second work package aims at developing flood cartography methods. CCR is participating in the third package that deals with modelling flood impacts. These impacts may be assessed in terms of damage to property and to persons depending on their behavior and movements. In order to attract potential users of the tools under development, a fourth work package was introduced to foster knowledge sharing and awareness of the project's value among prevention and risks management' experts. Users include mayors' offices, flood forecasting services, firefighters, EDF (French electricity provider) SNCF (French national rail operator) and insurers.

1 Implemented over a 4-year period (2018-2022) and coordinated by Ifsttar. Contact CCR: jnaulin@ccr.fr

COST-BENEFIT ANALYSIS OF NATURE-BASED SOLUTIONS: THE H2020 NAIAD PROJECT

www.naiad2020.eu

The resilience of the territories to natural risks and climate change is the principal issue of the NAture Insurance Value: Assessment and Demonstration (NAIAD[1]) project. The NAIAD project brings together 23 partners, including four French partners [the French Geological Survey (BRGM), the National Institute for Environmental Science and Research (IRSTEA), the University of Nice Sophia Antipolis and CCR]. The project aims to assess and demonstrate the relevance of Nature-Based Solutions (NBS) and their use as preventive measures to mitigate water-related risks, especially floods and droughts. Nine demonstration sites (DEMOs) are dedicated to assess NBS implementation and to compare various planning scenarios based or not on natural infrastructures.

Over and above the aim of fostering general acceptance of NBS as protective measures, the project embraces important research in hazard modelling, co-benefit assessment, local workshops, the development of economic and financial instruments, on the differences between European Natural Disasters Insurance Systems[2] and on vulnerability assessment. This project is dedicated to continue over the long term not only among the project's partners but also among local actors. As partner of the project, CCR also participates in efforts to define strategic economic and financial instruments that support a risk management framework based on natural infrastructures.

This project is based on a sharing of expertise in the modelling of river overflow and urban runoff flooding.

This year, working in cooperation with the French Geological Survey and the research institute IRSTEA, improvements have been made to the current floods model. The two French DEMOs are exposed to different types of risks :

- Lez (Montpellier): Severe urban runoff due to rainstorms from the Cevennes region,
- Bragues (Antibes/Biot): Cascading effect of wildfires followed by torrential rains (Figure 9)).

1 Implemented over a 3-year period (2016-2019) and coordinated by the Duero Hydraulic Confederation (Spain). Contact CCR: rmarchal@ccr.fr

2 Marchal R., Piton G., Tacnet J-M., Zorrilla-Miras P., Lopez-Gunn E., Moncoulon D., Altamirano M., Matthews J., Joyce J., Nanu F., Groza I., Peña K., Dartée K., Pengal P., Cokan B., Van der Keur P., Burke S., Graveline N., 2017, European Survey on Insurance Systems and Natural Assurance Scheme (NAS), EU Horizon 2020 NAIAD Project.

In the first time, the objective is to model flood risk in urban Mediterranean areas based on the Cevennes events of 2014 and the storms that occurred in 2015. Research conducted in the context of this project will be used to help improve the flood model by integrating more precise information for the territory and by making changes in calibration.

The comparison between detailed cartographic data and market data is essentially aimed at enhancing prevention capabilities. Indeed, research efforts focus on model calibration to better understand the vulnerability of urban areas before implementation of NBS. Then, it enables the definition of NBS scenarios and the comparison of solutions' effectiveness in terms of reducing hazard impact and the related avoided damage (Figure 10). The project partners, for their part, are interested in the co-benefits of natural infrastructures. The approach provides decision makers multi-criteria analysis that may be used to define locally adapted NBS which simultaneously meet technical, economic and environmental constraints.

Figure 10 : Insurance value of ecosystems

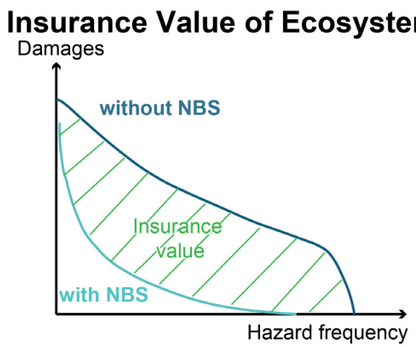
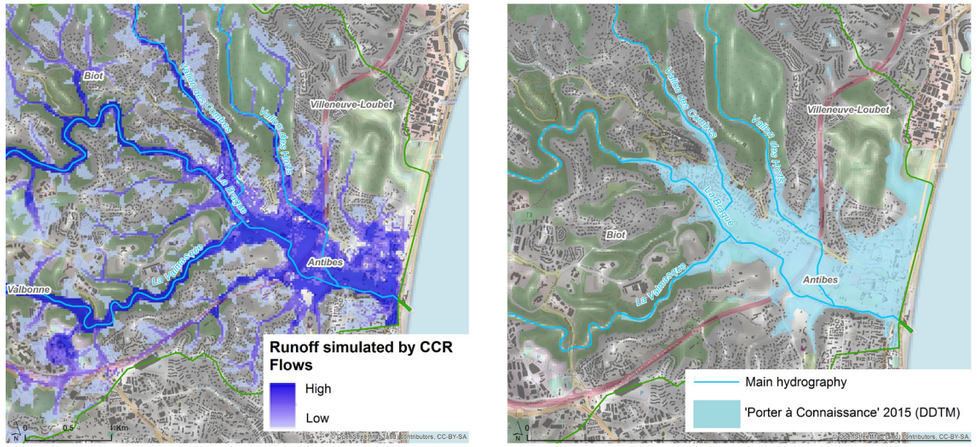


Figure 9 : Comparison between the simulated hazard (a) and the actual flooded area (b)



Photography: CCR/Desarthe J.

COASTAL RISKS

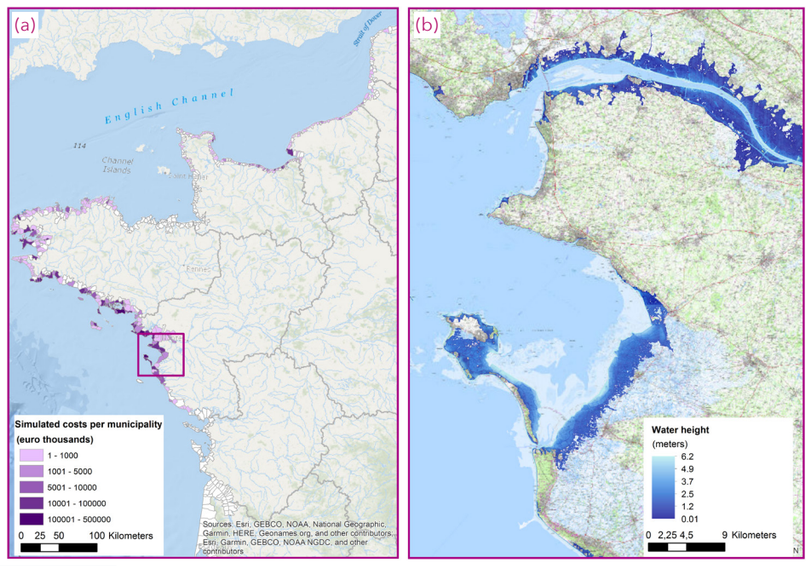
COSTAL FLOODING

At the interface between land and sea, the coastline is an area exposed to many risks and has a high concentration of properties and people. Over the past several years, CCR has developed a coastal flooding model to estimate the impact of storm surge. Three developments concerning this phenomenon have been realized in 2018: a study to estimate the storm surge model's uncertainty, a first version of a tsunami model and an evaluation of coastline erosion issues in France.

The coastal flooding model can assess the impact of inundations that occur during a storm. The assessment of this hazard, as explained in Naulin et al (2016)[1], is a three-step process. The first step involves estimation of tides and atmospheric pressure increases. It is based on the hydrodynamic modelling of the phenomenon using Telemac 2D (Telemac-Mascaret[2]) model. Once the water levels have been estimated, the ocean waves are modeled using the Tomawac model, a component part of the same software package. These two steps may also be replaced by using the outputs from the models developed in the context of the Modelling and Analysis for Coastal Research (MARC[3]) project.

The third step estimates the impact of inland flooding. This is done by uploading the ocean water levels and the waves' characteristics into a 2D hydraulic model that simulates the floodwaters using a digital elevation model (DEM). Recent developments in the model enabled the replacement of the Intermap DEM by the BD Alti® DEM of the French Mapping Agency (IGN) with a resolution of 25m. The model may also be used on the Litto3D® DEM with a 5m resolution in the French Antilles and on Reunion Island. As shown in Figure 11, the hazard model produces an estimate of the maximum water levels of inland flooding and is used to model the resulting damage.

Figure 11 : Example of a result using the coastal flooding model for a fictive event based on the storm of 1987. Losses estimation per municipality (a) and water levels estimation during the event (b)



1 Naulin J. P., Moncoulon D., Le Roy S., Pedreros R., Idier D., and Oliveros C. 2016, Estimation of Insurance-Related Losses Resulting from Coastal Flooding in France. Natural Hazards and Earth System Sciences 16, no. 1: 195 207. https://doi.org/10.5194/nhess-16-195-2016

2 Hervouet, J.-M., and L. Van Haren, 1996, TELEMAC2D Version 3.0 Principle Note. Electricité de France. Chatou Cedex: French National Hydraulics Laboratory.

3 MARC data are available on: https://marc.ifremer.fr/resultats/vagues

ASSESSING SOURCES OF UNCERTAINTY IN THE COASTAL FLOODING MODEL

The results of the impact models contain a number of uncertainties related to the quality of the topographical and meteorological data used, to the simplification of the effects in the physical models and to imperfections in the insurance data. To take these uncertainties into consideration, the calculated costs are generally accompanied by confidence intervals. However, these intervals only reflect the overall uncertainties and it may be interesting to identify more precisely the sources of uncertainty. This process would enable the identification of the functionalities that can be improved in the models. A PhD thesis was started in 2018, in cooperation with the French Geological Survey and the National School of Higher Education in Mining at Saint-Etienne, to identify the uncertainties in the coastal flooding modelling chain.

Use of meta-modeling to estimate sources of uncertainties in the coastal flooding modelling chain

PhD student: Élodie Perrin

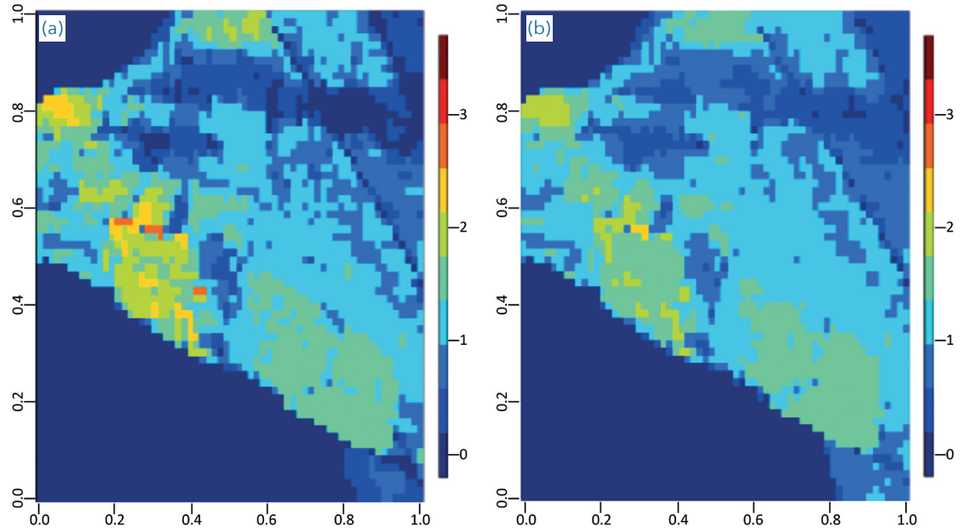
Director and Co-Directors: Olivier Roustant (National School of Higher Education in Mining at Saint Etienne), Jérémy Rohmer (French Geological Survey), David Moncoulon (CCR)

The approach proposed in this thesis is based on the creation of meta-models to replace the physical models used initially

Meta-models are adjusted mathematical models using a sampling of simulations and which can be much more rapidly implemented than other models. Rapid implementation enables researchers to generate a considerable number of simulations, to test variations in a number of parameters and to calibrate the models.

The resulting meta-model is based on an analysis approach broken down by functional principal component analysis (FPCA) using both a wavelets decomposition technique and kriging process regression. The meta-model is applied simultaneously to the CCR hazard model and the model developed by the French Geological Survey in the Boucholeurs sector of the Charente-Maritime department (Figure 12). This meta-model is also tested on the Reunion Island in the context of coastal flooding caused by cyclones. Lastly, work has also been conducted to propagate uncertainty in the modelling chain so as to understand the influence that an error in the entry data can have on the final outcome.

Figure 12 : Comparison between simulated water levels using the coastal flooding model (a) and the meta-model (b) in the Boucholeurs sector (Charente-Maritime)



MODELLING TSUNAMIS

Tsunamis rank high among the most destructive natural disasters the world has witnessed over the past fifty years. The tsunami that occurred in Japan in 2011 was the second costliest tsunami of all time causing 38 billion dollars of insured losses and 18,451 victims[1].

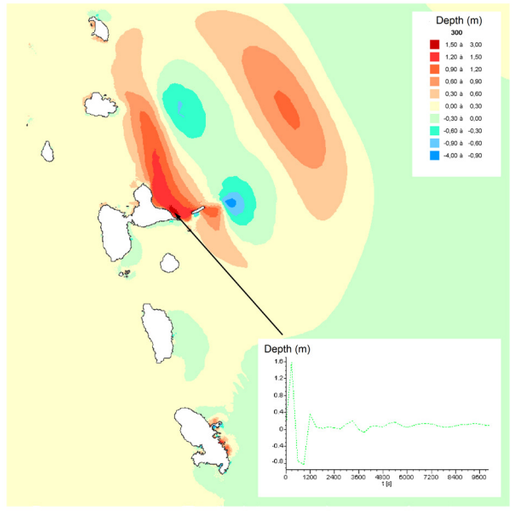
France is exposed to tsunami risk, in particular in the Antilles and, to a lesser extent, along the Mediterranean coast. In order to estimate the impact that an event of such magnitude could have on the natural disasters compensation scheme, a pilot damage model was developed. The model was tested and calibrated by a Master student' internship using Indian Ocean and Japan Sea data before being tested in the Antilles[2].

Three events have been selected and tested: the 2004 tsunami in Indonesia, the 2011 tsunami in Japan and the 1843 tsunami in the Antilles. The latter was caused by the most severe earthquake on record in the Antilles region occurring off the coasts of Guadeloupe and Antigua and caused severe damage. The tsunami, however, was of moderate magnitude..

Tsunamis are shallow ocean waves generated by a telluric shock such as an earthquake, a volcanic eruption or a landslide. Eighty-one percent of all tsunamis are generated by earthquakes and these types of tsunamis are the most destructive of all.

As no loss data is available for this type of event, a tsunami damage model was developed based on the research work of Suppasri et al (2013[3]) on the damage caused by the 2011 tsunami in Japan. By applying the model to the 1843 tsunami (Figure 13), the total amount of insured damage is estimated to be between 18 and 47 million euros. This research will be pursued in 2019 by coupling the tsunami model with the earthquake probabilistic model. The coupling of the two models will enable simulation of fictive extreme events so as to analyze the Antilles region's exposure to this type of risk.

Figure 13 : Simulated ocean water level five minutes after 1843 tsunami outbreak off the Guadeloupe coast according to Feuillet et al.2011's scenario



1 Swiss Re, 2018, Sigma: Natural catastrophes and man-made disasters in 2017: A year of record-breaking losses.
2 Roudon A., 2018, (in French) Development of a pilot tsunami risk model for the French Antilles, Final Dissertation (Sorbonne University).
3 Suppasri Anawat, Erick Mas, Ingrid Charvet, Rashmin Gunasekera, Kentaro Imai, Yo Fukutani, Yoshi Abe, and Fumihiko Imamura. Building Damage Characteristics Based on Surveyed Data and Fragility Curves of the 2011 Great East Japan Tsunami. Natural Hazards 66, no. 2 (March 2013): 319-41. https://doi.org/10.1007/s11069-012-0487-8.

ASSESSING THE IMPACT OF COASTLINE RETREAT

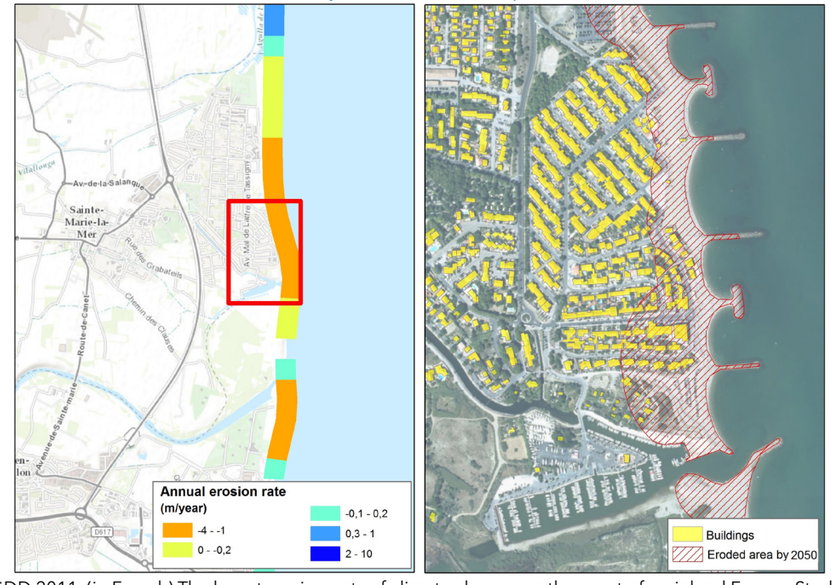
In France, erosion affects approximately 27% of all coastlines. The phenomenon is amplified by the occurrence of heavy storms.

The increase in sea level resulting from climate change could accelerate coastline erosion in particular by limiting beach nourishment between storm periods and by modifying wave regimes[4]. Research was therefore conducted, in parallel to the CCR-**Météo-France** climate study, to assess the impact of coastal erosion in 2050. The developed methodology is based on the national coastline erosion indicator as well as on the annual rate of change in the coastline provided by the CEREMA[5]. This indicator have been used to extrapolate the position of the coastline. The results enabled to estimate the coastal boundaries in 2050 and to identify the coastal areas that may disappear (Figure 14).

During the winter of 2013-2014, some areas lost 40 meters of beach. On the basis of these results, an inventory of the expected number of buildings affected by erosion was made. A total of 444 buildings were identified[6] within the eroded area by 2050 and 2,778 buildings were found to be directly exposed to erosion risk being located less than 20 meters from the eroded area. These estimates are relatively consistent with CEREMA ones which estimates that 300 buildings will be exposed to erosion risk by 2040 and 2,000 by 2100. The underlying question is whether or not these continual episodes of erosion will increase the impact of coastal flooding. **However, it is difficult to answer such a question as available models do not as yet enable the simulation of the erosive impact of these events.**

EROSION IS DEFINED AS AN INCREASE IN SEA SURFACE OVER LAND MASS CONTRARY TO ACCRETION WHICH IS AN INCREASE IN LAND MASS OVER SEA SURFACE

Figure 14 : Inventory of buildings exposed to erosion risk at Sainte-Marie-la-Mer in the Pyrénées-Orientales department.



4 CGDD 2011, (in French) The long-term impacts of climate change on the coast of mainland France, Study and Document no. 55.
5 Hédou F., Roche A., Trmal C., Moraud S., et Deniaud Y., (in French) Development of a national indicator for coastal erosion. In XVèmes Journées, La Rochelle, 647 54. Editions Paralia, 2018. https://doi.org/10.5150/jngcgc.2018.075
6 The buildings used are the property of BD Topo of the French National Geographical Institute (IGN).

Photo : unsplash.com

WIND-RELATED RISKS

MODELLING WINDSTORMS

The Natural Disasters compensation scheme does not cover windstorms as this peril is covered under the Storm-Hail-Snow guarantee. CCR is particularly interested in this peril, often associated with coastal flooding, so as to perform a complete assessment of losses when these events arise.

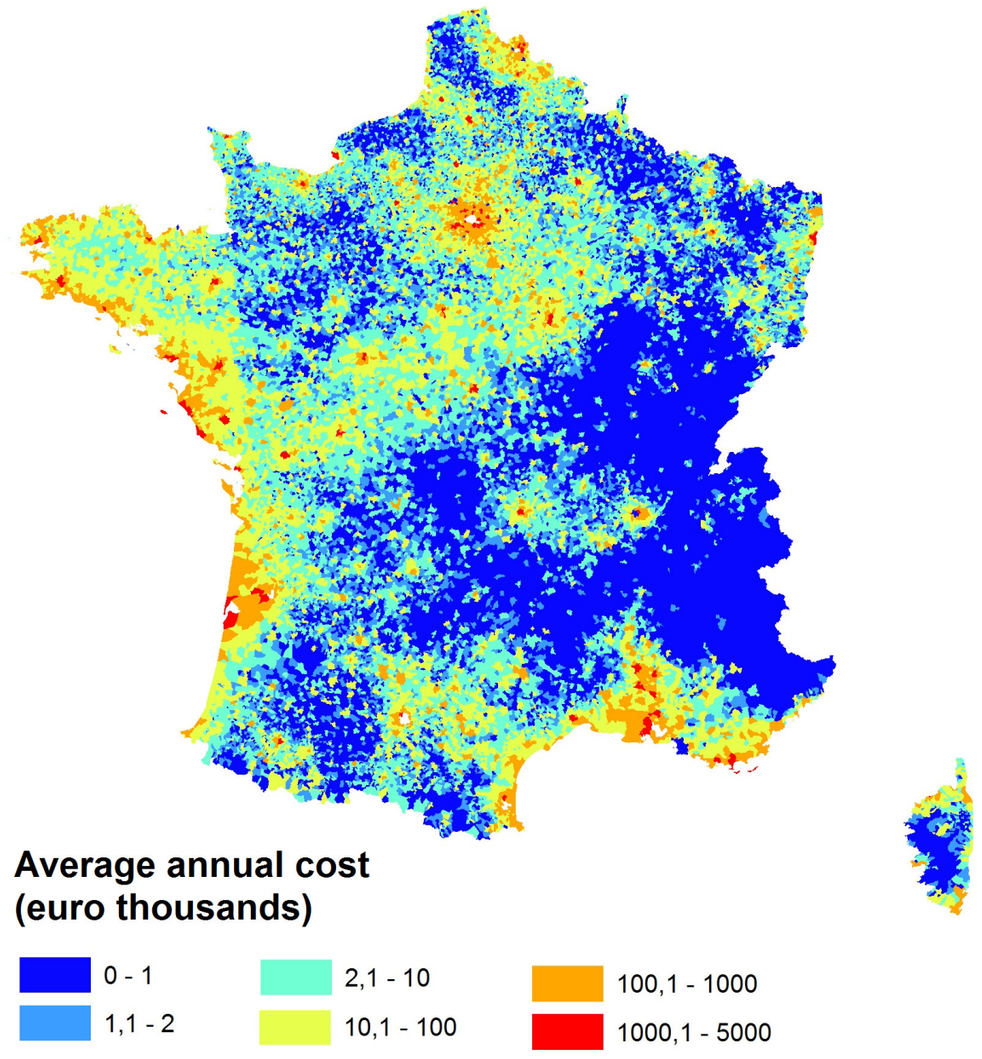
Several works were conducted in 2016 to develop a model capable of estimating the cost of a storm soon after its occurrence. Studies also focused on estimating the exposure of the French territory using an approach based on the ARPEGE Climat weather model developed by **Météo-France**.

In 2018, the source of the data has been changed and tested in the objective to improve the model. The approach was no longer based on wind speed data, but on a stochastic method that relies on actual observations provided by weather stations. The observation database used is the Global Surface Summary of the Day (GSOD) operated by the National Ocean and Atmospheric Administration (NOAA), available throughout the globe. This approach could also be extended to other countries depending on the availability of weather stations.

According to the damage model results, the average annual cost is 800 million euros compared to 1 billion euros using the observations available between 1998 and 2017. These estimates are highly dependent on the major events Lothar and Martin of 1999. When these events are not taken into account, the average annual cost amounts to 587 million euros. Given the exceptional character of these high-intensity windstorms, the average annual estimate of 800 million euros in losses appears coherent.

The distribution of losses, in respect of their return period, is similar to the observed loss distribution and attests to the presence of events of intensity similar to Lothar and Martin events. A map of average annual losses was also produced in order to identify the at-risk areas to storm events (Figure 15). The map indicates that the model tends to underestimate the hazard in regions with little to no weather stations, especially in mountainous areas. The probabilistic storm model chain could be improved in the future by acquiring additional meteorological data.

Figure 15 : Map of average annual losses modeled by municipality

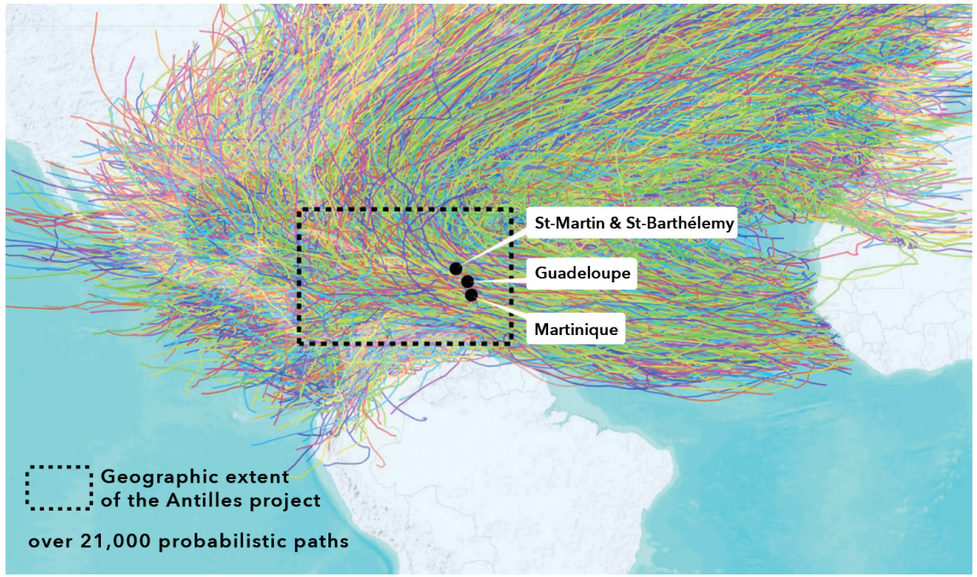


MODELLING OVERSEAS CYCLONIC RISKS

Initiated in 2013 and conducted in cooperation with the software modelling company JBA Risk Management (Figure 16), the aim of this project is to establish a probabilistic distribution of the cost of cyclonic winds and the associated flood and coastal flooding hazards.

In 2018, loss experience and insured value data recorded by CCR following Hurricane Irma (wind speeds, areas of impact, location and amount of losses) provided the opportunity to improve the existing model for extreme events present in the distribution. The project was carried out in July and August 2018. It enabled the recalibration of the damage curve for the model, conducted on the 2018 overseas territories market portfolio.

Figure 16 : Map of hurricane paths in the North Atlantic



SHARING LEARNING FROM POST-DISASTER RESEARCH IN THE NORTHERN LESSER ANTILLES

The ANR TIREX project was launched in 2018. The objectives of the project are to improve the hurricane alert system, to identify the inherited vulnerability factors, to reinforce adaptation capacities and responses of territories and societies in the northern Lesser Antilles in a context of climate change.

The Project for Sharing Learning from Scientific Research (TIREX[1]) is financed by the **French National Research Agency** (ANR) and brings together seven partners: **Governance, Risks, Environment and Development** (GRED), **Geoscience and Energy Research Laboratory** (LARGE), **Caribbean Laboratory of Social Sciences** (LC2S), **Laboratory of Physical Geography** (LGP): **Littoral, Environment and Societies** (LIENS), **Météo-France**, **Antilles-Guyana Inter-Regional Directorate** (DIRAG) and CCR.

The French Antilles were significantly impacted by Hurricanes Irma, Jose and Maria in 2017. The objective is to analyze these impacts and strengthen the monitoring of local reconstruction by performing a comparative analysis of the territories in the northern Lesser Antilles, using ongoing scientific feedback analysis.

CCR is concentrating its efforts on improving its knowledge of historical hurricanes (chronology, severity, and incurred damage) and on estimating insured losses caused by the most recent events.

THE PROJECT ALSO SEEKS TO DEVELOP INNOVATIVE EDUCATION TOOLS, BEST PRACTICES BASED ON PARTICIPATORY APPROACHES, REAL-LIFE SITUATION AND ON-LINE/INTERACTIVE DIGITAL TOOLS

Beyond these aspects, the TIREX project offers pre-operational accompaniment for risk management actors, experts in reconstruction and the local population.

1 Implemented over a 3-year period (2018-2021) and coordinated by GRED. Contact CCR: jdesarthe@ccr.fr

Photo : unsplash.com / AFP

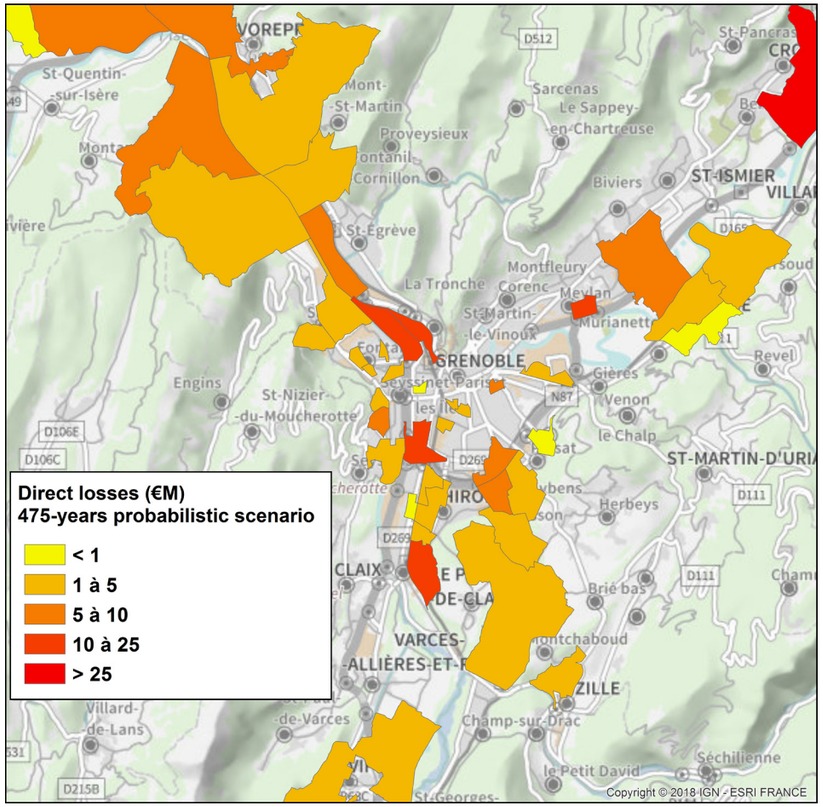
GEOLOGICAL RISKS

SEISMIC RISK

In the framework of a multi-annual agreement (2014-2021), CCR and the French Geological Survey (BRGM) are developing a model to assess earthquake impact.

The research program has already enabled the development of specific modules for mainland France and its overseas territories that provide highly detailed characteristics of the hazard, of the vulnerability and of the damage to residential buildings and business areas. A double scale analysis has been conducted. A department scale has been applied on largest seismic activity areas (the West Indies, the Pyrenees, the Provence-Alpes-Côte d'Azur region, the Alps, etc.) and a regional scale on zones with less exposure (Paris Basin and Aquitaine Basin). In 2018, the scope of the model has been was extended in order to include industrial buildings (Figure 17).

Figure 17 : Simulation of damage to the industrial facilities of the Grenoble Basin according to the French regulatory seismic zoning system



The model has been completed for mainland France and can be used to estimate damage related to earthquake for all usual insurance lines of business: individual homeowners risk, industrial risks and other forms of business risks (shops and craftsmen). Today, the model operates on a deterministic basis whereas the consequences of an earthquake are assessed on the basis of a group of physical parameters (magnitude, location, etc.). Also within the framework of this research and development program, CCR and the French Geological Survey pay particular attention to the uncertainties that are quantified and propagated throughout a new global simulation tool used to assess the consequences of earthquakes.

A PhD financed by CCR and conducted at the research consortium Research for Integrative Numerical Geology (RING) of the Ecole Nationale Supérieure de Géologie at Nancy / University of Lorraine has been launched in 2018.

The objective of the research work is to improve the global vision of the consequences of earthquakes in France. Special attention will be given to improving the stochastic earthquakes generator by performing the in-depth characterization of seismicity in France (Figure 18). The other improvement axis is the simulation of propagation of seismic waves over the study areas so as to calibrate the attenuation relations of the waves used in the seismic risk models.

(In French) Multi-scale approach to the propagation of seismic waves aimed at developing a stochastic model of the impact of earthquakes in France
PhD student: Corentin Gouache
Director and Co-Directors: Jean-Marc Montel (University of Lorraine), François Bonneau (University of Lorraine), Pierre Tinard (CCR)

The propagation of seismic waves (Figure 19) is performed using 3D spectral element methods (RegSEM, Cupillard et al, Geophys. J. Int, 2012). For the coming year, the objective will be to integrate the advancements made in the context of the doctoral thesis along with those of the model co-developed by CCR and BRGM to provide a global vision of the impact of earthquakes–in the framework of the Natural Disasters Compensation scheme–for mainland France and the overseas territories.

Figure 18 : Density of seismicity in France 1980-2015 after re-analysis and seismo-tectonic zoning (in green)

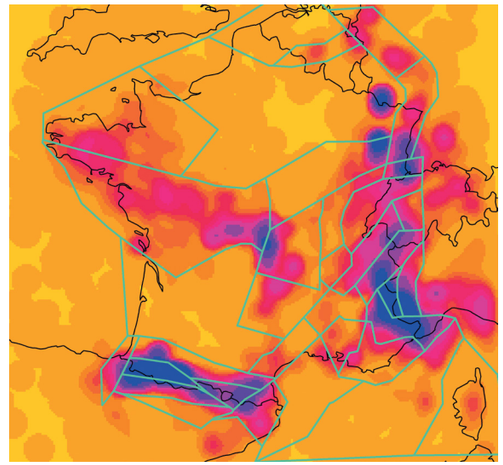
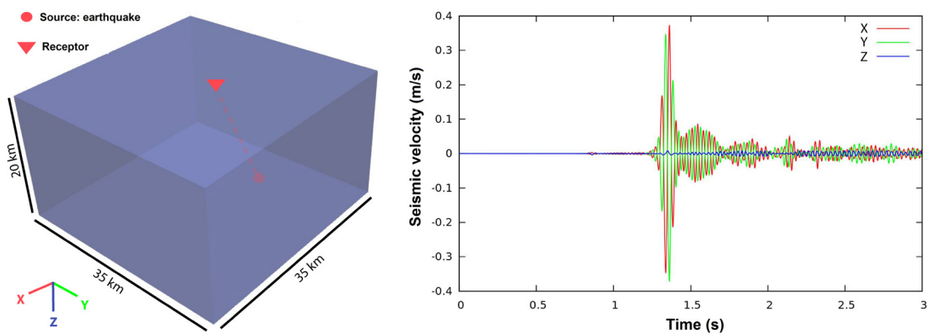


Figure 19 : Simulation of seismic waves using the RegSEM model (Cupillard et al, Geophys. J. Int, 2012)



MODELLING THE SHRINKING-SWELLING CLAY

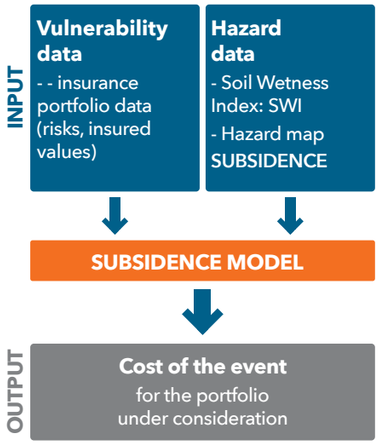
In parallel to the development of models based on the physical hazard modelling, mathematical or statistical approaches have been developed on several topics. Two approaches are considered: machine learning and meta-modelling.

MODELLING SUBSIDENCE: CURRENT MODEL

Subsidence, or the shrinking-swelling clay, to be distinguish from agricultural drought, is one of the most expensive risks covered by the French Natural Disasters compensation scheme. It is also one of the least well-known of all natural risks. Subsidence losses represent 33% of total losses—excluding motor losses—covered by the scheme from 1982 to 2017.

The physical model used to characterize soil movement below and near building foundations is still in the research domain (cf. SEC 2008 & 2015 symposiums, ARGIC projects 1 & 2).

Figure 20 : Outline of the hazard and damage model developed for the shrinking-swelling clay



The simulation model (Figure 20) is based on a catalog of fictive subsidence events, on meteorological indicators (**Météo-France** Soil Wetness Index), geological indicators (French Geological Survey subsidence hazard maps) and the characteristics of insurance policies and of claims recorded by the company.

The model uses a statistical approach: for a given subsidence event, an assessment is made by regression in order to forecast the probability that a municipality files a request for recognition of a Natural Disaster due to subsidence, the probability that a loss incurs for each risk as well as the destruction rate in case of claim. Furthermore, the probabilistic version of the model (Figure 21) enables the modeler to assess the impact of fictive subsidence events that have not yet occurred but are physically plausible. The fruit of efforts undertaken in the context of the doctoral thesis sponsored by CCR and the **University of La Rochelle** (Ardon, 2014[1]), this model generates subsidence events in a stochastic manner while integrating historic soil wetness data and is based on spatio-temporal correlations for the overall mainland France. Finally, the model generates a catalog of 10,000 events that may be used to estimate, among other things, annual average losses or losses over long return periods, such as 100 years at the municipal level.

1 Ardon J., 2014, Doctoral thesis, (in French) Probabilistic model of spatial-temporal dependence applied to the study of subsidence risk in the framework of the French Natural Disasters compensation scheme, University of La Rochelle/CCR.

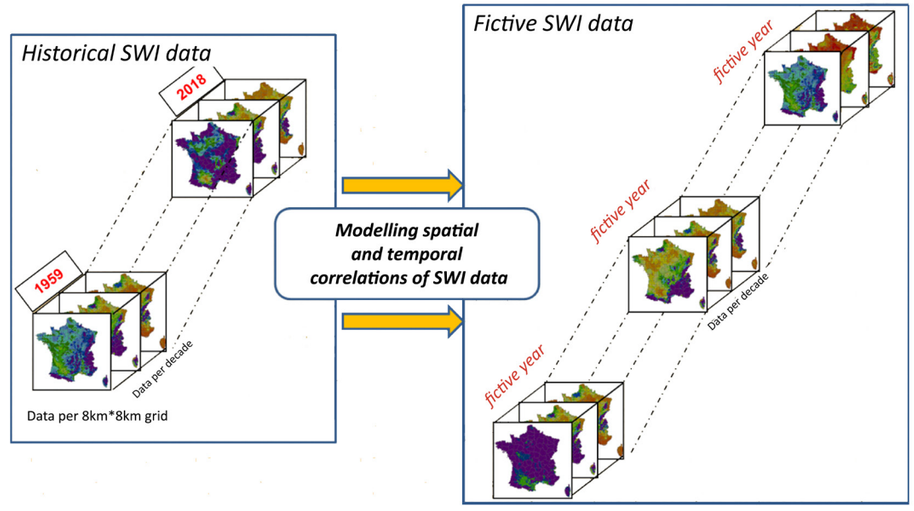


Figure 21: Illustration of stochastic subsidence generator

New Natural Disasters recognition criteria

In 2018, the members of the Natural Disasters Inter-Ministerial Commission, in which CCR participates as secretary, worked to introduce new Natural Disasters recognition criteria.

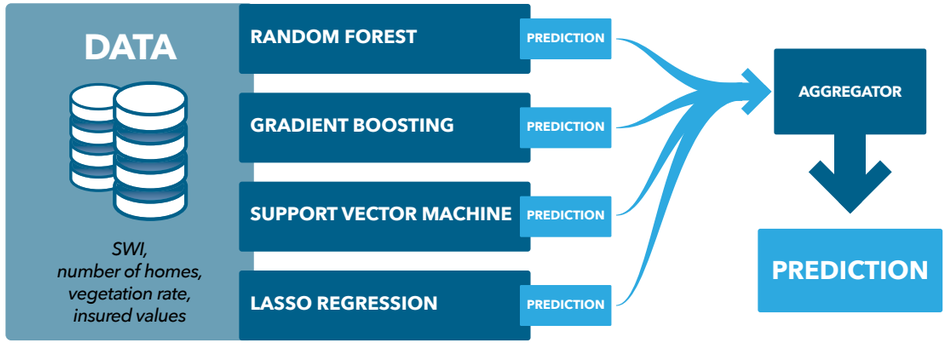
The conducted work enables the updating of the model representing physical processes governing water in the soils (SIM2 – **Météo-France**). A common approach for all subsidence typologies, for the entire year was proposed while ensuring the fair treatment of future subsidence episodes.

A NEW APPROACH: MACHINE LEARNING

An innovative approach using machine learning is ongoing (Figure 22) to estimate destruction rates and model damages at the municipal level. For a given year, costs are estimated for each municipality that has been recognized as Natural Disaster and then aggregated to obtain the total cost for the year. The approach selected for statistical learning—or stacking process, enables to generate four subsidence cost predictions for a given municipality.

These predictions serve as inputs to the final algorithm, called the "aggregator". It aims at estimating—for a given municipality—the cost of a subsidence event taking into consideration, on one hand, the four first algorithms' predictions and, on the other hand, the characteristic of the hazard. Thus, the aggregator may, depending on the hazard, determine the more accurate model able to provide the best estimate.

Figure 22 : Machine learning algorithms



A thesis has been launched in 2018, in partnership with the University of Paris-Descartes. This thesis deepens the stacking approach and enhances the destruction rate estimation by assessing it at the risk scale and not at the municipality.

(In French) Machine learning and targeted learning applied to Natural Disasters

PhD student: Geoffrey Ecoto

Director and Co-Moderator: Antoine Chambaz (MAP5), Thierry Cohignac (CCR)

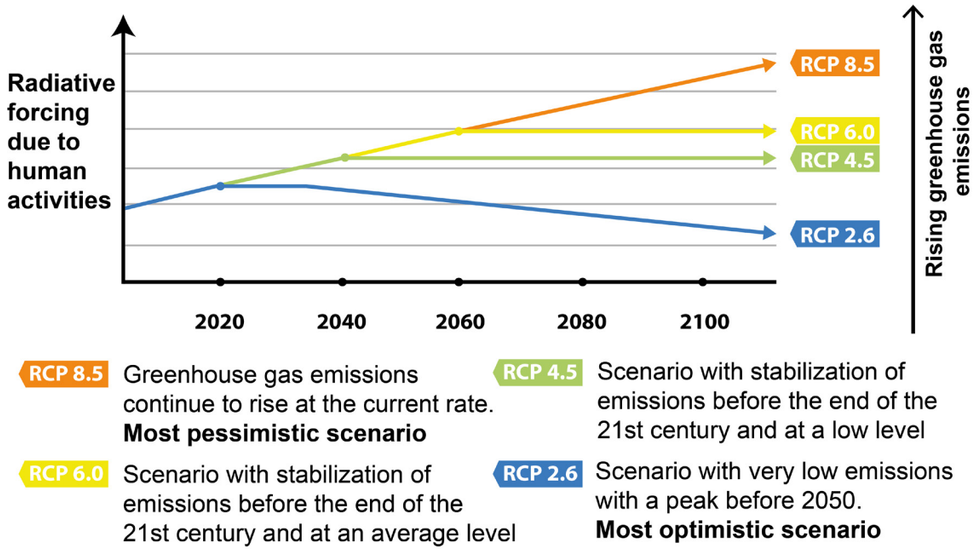
Spark and H_2o frameworks will be used to process high dimension data and to deploy machine learning algorithms. The objective is to propose a method capable of forecasting the risks impacted by a subsidence event (claim's probability) and of estimating the number of municipalities that would request recognition of a natural disaster. The theory of targeted learning will also be considered to estimate quantiles of the market cost distribution..

CLIMATE CHANGE AND VULNERABILITY IN 2050

For the Conference of Parties (COP) 21 led in 2015 in Paris CCR partnered with **Météo-France** in the aim of assessing the consequences of climate change on the cost of natural disasters arising in France on the basis of the RCP 4.5 scenario developed by the Intergovernmental Panel on Climate Change (IPCC). The partnership was extended in 2018 with efforts focusing on the RCP 8.5 which is considered a pessimistic yet realistic scenario.

This scenario considers that greenhouse gas emissions will continue to increase at the present rate. According to the IPCC, the resulting increase in global temperatures should be between 1.4° C and 2.6° C by 2050 and between 2.6° C and 4.8° C by 2100. Sea levels are expected to rise by approximately 20 centimeters by 2050 (Figure 23).

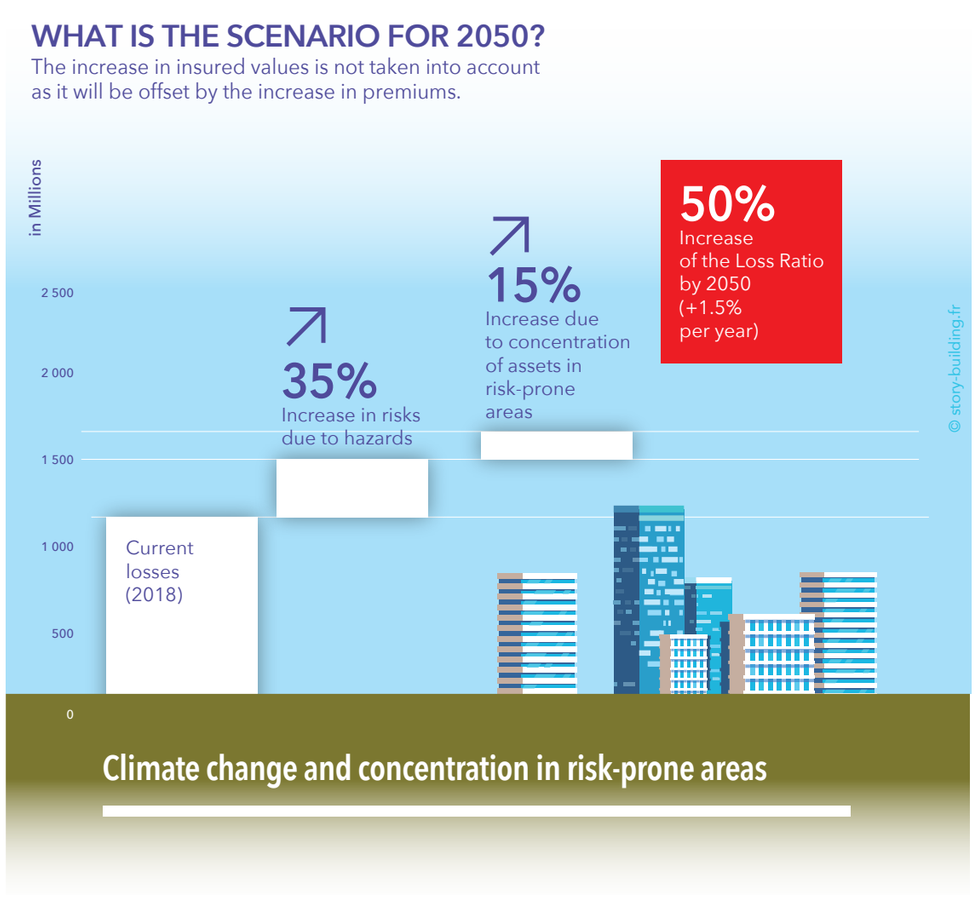
Figure 23: Representative Concentration Pathways (RCPs)



To accurately estimating the cost of insured damage in 2050, consideration was given for growth in insured property over the period from now until 2050. Resultantly, on the basis of demographic projections provided by INSEE, prospective research was conducted and an insured property portfolio was created for 2050.

The results of future climate models developed by **Météo-France** using the ARPEGE Climat weather model were input to CCR's) hazard (flood, subsidence and submersion and damage models. Results of this modelling chain indicate that total losses will increase by approx. 50% (expressed as the ratio of premiums to losses). Of the 50%, 35% is due to the frequency and the severity of the events and 15% is due to the concentration of assets in risk-prone areas (Figure 24).

Figure 24 : Development of average annual losses for 2050

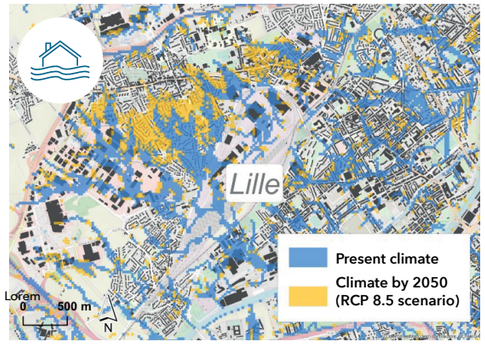


The results highlight the difference in loss experience increases depending on the type of hazard. The increase in the Loss Ratio by 2050 for flooding will come to 38%, for coastal flooding 82% and for subsidence 23% (Figure 25).

The analysis of the results also indicates significant disparity among the territories with a high exposure of the Atlantic coast and Paris region. The analysis also revealed the issues that must be taken into account in prevention policy, namely the concentration of property in future risk-prone areas and the high recurrence of certain events (Figure 26).

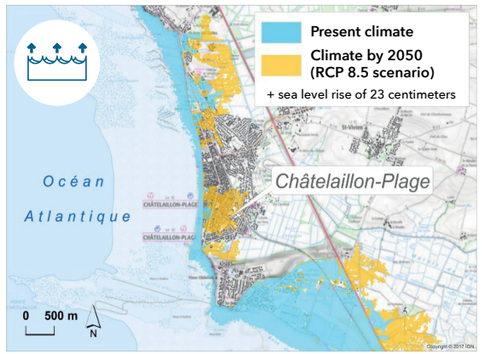
The French overseas territories were not included in this study and a similar study will be made in 2019 in cooperation with Météo France and Metigate company. The study will provide an assessment of the overseas territories exposure in 2050.

Figure 25 : Development of annual average loss by hazard, increase in damage for mainland France



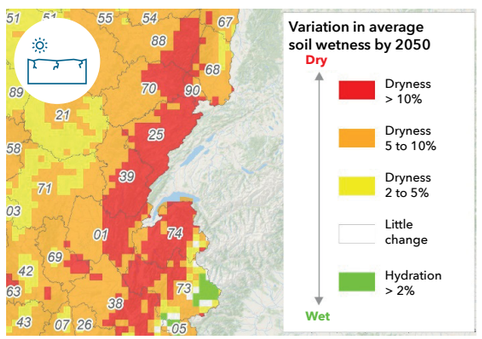
Extension of areas impacted by surface runoff

+ 38 %



Extension of areas submersed by the sea

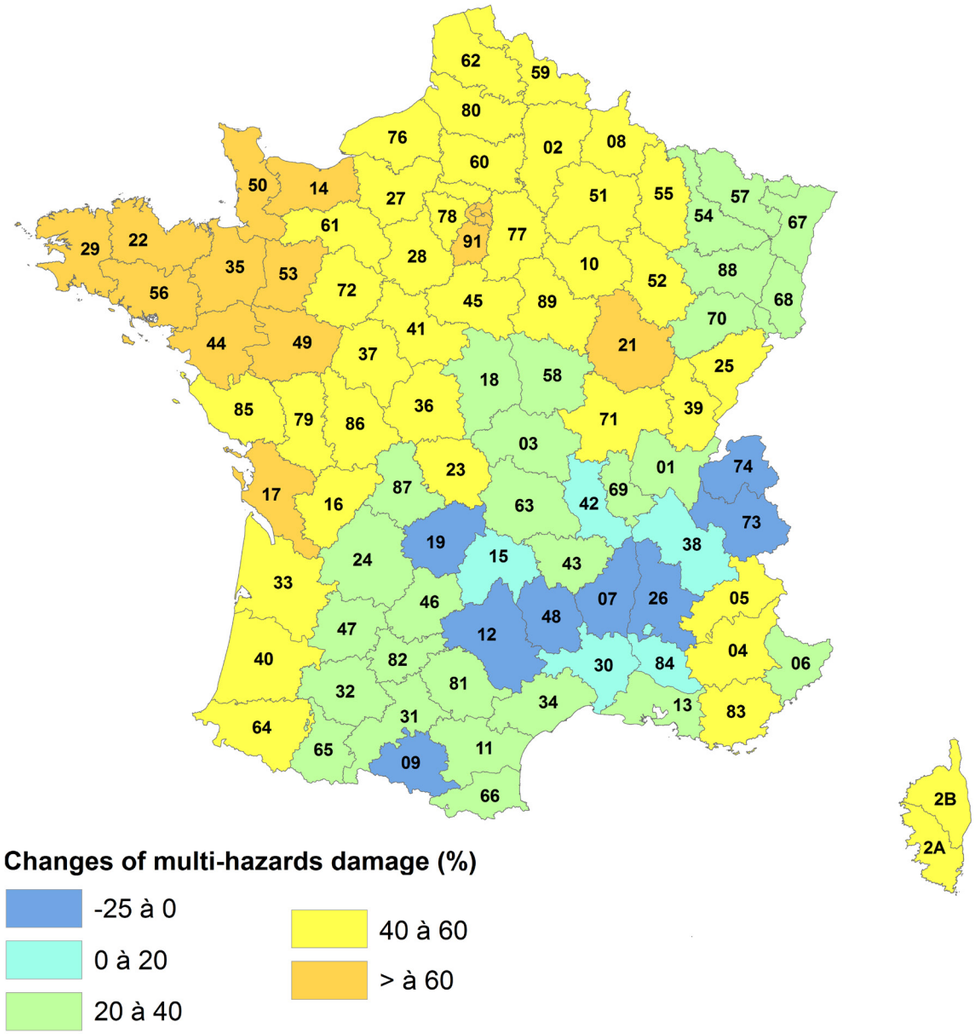
+ 82 %



More significant drying of soils in summer periods

+ 23 %

Figure 26 : Development of damage for all perils between 2018 and 2050



Download the full version of the study:

Photo : unsplash.com

OTHER ON-GOING CCR RESEARCH & DEVELOPMENT PROJECTS

IMPACT OF CLIMATE RISKS ON AGRICULTURAL CROPS

MODELLING RESEARCH

Agricultural holdings in Europe are exposed to many types of risks, including climatic risks. These risks affect the yields and the quality of the productions. Risk management, for the individual farmer, it consists of reducing the farm' level of exposure to make it acceptable. Several strategies can be implemented and the use of insurance solutions is one of those strategies.

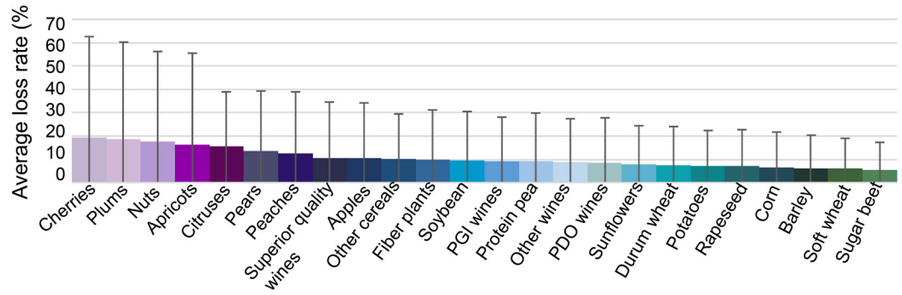
Since 2013, CCR has been developing a model able of assessing the impacts of natural events on agricultural yields. In 2018, a PhD research project has been launched with the aim of determining the impact of extreme climatic events by 2050 on the main crop productions in France.
The project is jointly conducted by **AgroCampus Ouest** and the **SMART-LERECO laboratory** specialized in the study of the agricultural farms' structures and the latter's opportunities for future development in the context of today's public policies. The purpose is to study the impact of extreme climate risks (water excess, drought, frost) on field crops, wine growing and tree growers. Once agro-climatic indicators will be established for the French departments, an impact model will be developed on yield losses and economic damage. Then, the scale of farms will be integrated by creating scenarios of the evolution of agricultural holdings in economic terms.

(In French) Modelling the impact of extreme climate events on crop production in France by 2050.
PhD student: Dorothée Kapsambelis
Director and Co-Director: Jean Cordier (AgroCampus Ouest), David Moncoulon (CCR)

The agro-climatic indicators will be projected to 2050 in order to analyze the crops and farms' vulnerability. This thesis follows several master reports of agricultural engineers, conducted at CCR and focused on the study and modelling of yield losses on mainland France[1]. One of the objectives of these research were to analyze crops' vulnerability (field crops, wine growing and tree growers) to climate risks. The databases used in the studies are public and published by the **French Ministry of Agriculture and Food** [the Agreste database and the Farm Accountancy Data Network (FADN)]. The results enabled, the creation of a classification of the main crops based on their average rate yield losses over the period 2000-2016. The average annual loss rate is a determining factor for calculating insurance coverage costs (with volatility due to extreme conditions and commercial charges). In particular, this approach underscores the high exposure of fruit crops (Figure 27).

1 Kapsambelis D., 2018: (in French) *Analysis of crop losses at the agricultural holding scale in the framework of themulti-risks weather insurance market in mainland France*. Master's thesis in agricultural engineer (Montpellier SupAgro)

Figure 27 : Average loss rate for agricultural holdings by crop type in mainland France for the period from 2000 to 2016 and quantiles [10-90]



CROP INSURANCE MONITORING MISSION

The French Ministry of Agriculture and Food assigned to CCR the mission of monitoring the French crop insurance market for a period of five years (2017-2022). In this context, CCR had conducted a fact-based study of crop insurance portfolio and of insured claims for mainland France.

Efforts focused on establishing indicators to monitor the development of crop insurance at regional, department and municipal levels. An analysis is performed using several indicators that include: the distribution of the surface areas and of the insured capital, the eligible contributions, the penetration rates, the premium rates, the number of policies, etc. CCR is also a participating member of the steering committee for the assessment of the National Program for Risk Management and Technical Assistance (PNGRAT) with the French Ministry of Agriculture and Food.

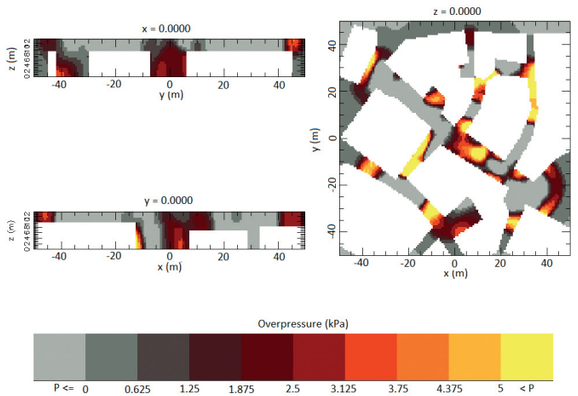
MAN-MADE RISKS

CCR has been working in cooperation with Aria Technologies since 2011 to develop a model able of assessing the impact of terrorist attacks using NBCR (Nuclear, Biological, Chemical or Radiological) weapons. Research has been primarily focused on dirty bomb type radiological attacks that have a potential impact on insured losses of several billion euros. Hundreds of reference scenarios were carried out in the proximity of main landmarks throughout France.

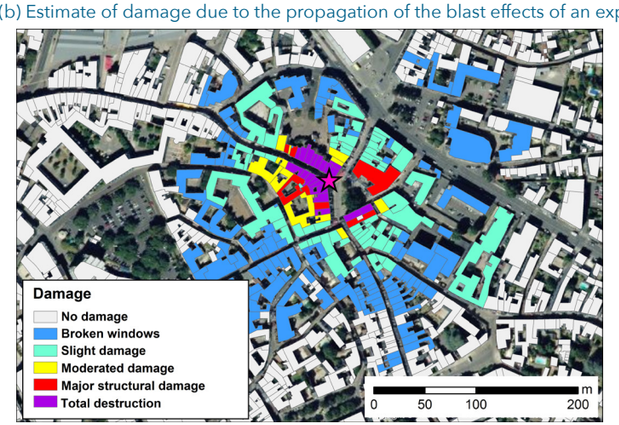
The use of explosives in terrorist attacks has always been taken into account in the model. However, this was done by using a simplified approach based on the blast impact without taking into account the structure of nearby buildings. The approach is based on the use of US military data (Structures to Resist the Effects of Accidental Explosions, TM 5-1300, 1990).

In terms of modelling, an in-depth investigation had been made in 2018[1] on the possibility of integrating CFD ProSAir (Compressible Fluid Dynamics Propagation of Shocks in Air) module developed by Cranfield University (UK) that gives consideration for the blast effects of an explosion using numerical simulations. These advances in the model enable more realistic simulation of explosions by taking into account the 3D geometry of the buildings with which the shock waves would interact by way of channeling, reflection or absorption (Figure 28).

Figure 28 : (a) Simulation of the blast effects propagation of an explosion in an urban environment with multiple interactions between the shock waves and the buildings.



(b) Estimate of damage due to the propagation of the blast effects of an explosion



1 Saad D., 2018: (in French) Modelling terrorism risk: blast effects of an explosion. First year Master's thesis [Centre-Val de Loire National Institute of Applied Sciences (INSA)]

AUTOMATIC TEXTUAL ANALYSIS OF UNSTRUCTURED DATA

In the context of its missions on behalf of the French State and as secretary to the French Inter-Ministerial Commission, CCR receives a number of documents in .pdf format whose contents are extracted manually.

CCR is in charge of the accounting and financial management of several public funds, including the National guaranty fund for agricultural disasters (FNGRA). CCR is secretary to the French Inter-Ministerial Commission which prepares the decision of Ministers for Natural Disaster recognition

In order to reduce errors and minimize processing time, CCR has launched a Proof of Concept (POC) which uses image processing and textual analysis techniques in order to help the user in extracting information from unstructured data. If a document is a scanned image, image processing is used to divide the document into zones, where Optical Character Recognition (OCR) is applied to extract text. Then, a supervised learning model is applied using a Recurrent Neural Network (RNN). It help to associate each zone with its context. Subsequently, the text is analyzed to extract the desired information. Lastly, results are aggregated and checked with respect to reference lists.

BIG DATA APPROACH TO INSURED VALUE ASSESSMENT

(In French) Insured value estimation by using Big Data methodology

PhD student: Luc Rongiéras

Director and Co-Directors: Hans Wackernagel (Mines de Paris), Émilie Chautru (Mines de Paris), Georges Farah (CCR)

In the framework of its contractual relations with its clients, CCR gathers and stores data on insured properties. These data sometimes include information on insured values. However, this information is not always reliable and some data may be incomplete. These data are voluminous, some databases may contain up to several hundred millions of lines.

A thesis is ongoing, with MINES ParisTech, to explore geostatistical and learning methods for assessing insured value. The objectives of this thesis are to assess insured values of a property at a specific address, estimate insured values on an aggregate basis [within a polygon, a municipality, an urban area, a specific radius, etc.], and to cope with uncertainties related to explanatory variables.

OUTLOOK

In 2018, much progress was made to improve CCR's risk knowledge on the covered hazards or on which the State would like to be better informed.

The research and development performed by CCR, in cooperation with its scientific partners, enables the company to assess the effectiveness of existing compensation schemes and preventive measures, to identify ways of improving risk resilience and also to consider all available solutions.

Work accomplished in the area of natural disasters for nearly twenty years had enabled the company to apprehend its understanding of the financial consequences of these risks and to respond to issues that were not addressed at the outset of the Natural Disasters compensation scheme in 1982. It is especially the case of the perils that have seldom or never been modeled, such as urban surface runoff, coastal flooding and the shrinking-swelling clay:

- What would be the amount of damage resulting from an event that has just occurred?
- What is the likely financial exposure of the different stakeholders (insurers, reinsurers, CCR, the State)?
- How is the risk exposure distributed among the French territories?

Beyond the compensation scheme, this knowledge enables us to enhance risk culture, to identify prevention and crisis management best practices.

Several major projects must still be carried out. Some examples include:

- The improvement of knowledge is likely to influence both the behavior of the different actors and the mutual solidarity system retained by the French State for covering natural disasters. How may we maintain this model that has proven its success with the emergence of more and more sophisticated software tools? To address this issue, CCR actively supports the Program on the Apprehension of Risks and Uncertainties chair (PARI).
- The apparent accuracy of model outputs may give the misleading impression of strong risk management and of shared commitments. The occurrence of events, even low intensity events, brings up a number of uncertainties: losses in areas that were previously considered as few exposed, aggravating factors impacting claims' amount, etc. Therefore, if uncertainties are inherent in the models for events with relatively short return periods, what about extreme events far exceeding the intensity of past observations? This question must be thoroughly explored to better identify the uncertainties at each stage of the modelling processes and their propagation and to be able to define relevant risk measures to better understand extreme events.
- These uncertainties associated with today's climate will be ever more important in the future. Beyond the limits of the existing models, are added uncertainties associated with climate change and increasing values of insured properties over the long term. It is in this context that CCR is pursuing its efforts in 2019 in partnership with **Météo-France** to analyze the French overseas territories exposure to climate change by 2050.
- Lastly, the work carried out by CCR enabled a better understanding of the impacts in terms of insured property damage and business interruption losses. However, much improvements still must be done in order to assess all the economic consequences of natural disasters, e.g. damage to communication networks, potential domino effects and more.

These are the major issues that must be addressed in 2019 and over the next years, so that CCR may fulfill its mission of ensuring the insurance systems' efficiency and the prevention of extraordinary risks.

Antoine Quantin
Chief Underwriting Officer - Public Reinsurance and Guaranty Funds

2018 AT A GLANCE

CCR Groupe
@CCR_Groupe

D-2 Scientific day

@MeteoClimat Panel discussion with @DMoncoulon 'How should the financial sector evolve to make possible transformations towards 1.5°C scenario?' #JS2018 #ClimateChange

CCR Groupe
@CCR_Groupe

According to our estimate, the four lake-reservoirs would have reduce 2018 flood #damage by nearly 90 €M. Given the importance of these #floods, how to better anticipate, to preserve and prevent risks?
bit.ly/2N9klku

CCR Groupe - Caisse Centrale de Réassurance
3 750 abonnés
5 mois

1st to 2nd Oct. 2018 CCR has organized the Damage Modelling Workshop for the @NAIAD2020 project, Laurent Montador has opened the two-days workshop.To know more about NAIAD: https://www.ccr.fr/naiad #climaterisks #NBS #NBsolutions

The Damage Modelling Workshop is organized by CCR the 1st and 2 nd October 2018
ccr.fr

Photo : unsplash.com

2018 AT A GLANCE

JANUARY 15-17

Orleans, Symposium on Uncertainty Quantification in Computational Geosciences, French Geological Survey

Presentation of uncertainties quantification in the floods model.

JANUARY 30

Paris, Geohistory of "natural" risks, One-day study conference, the Ceres portal, École Normale Supérieure

Presentation on "The history of hurricanes in the French overseas departments (17th to 20th century)".

MARCH 29-30

Château Dauzac, Bordeaux, Les journées IARD (Property and Casualty conference)

This conference hosted by the French Institute of Actuaries provides actuaries with a forum for exchange, discussion and feedback on current issues such as: "Bodily injury loss experience, risk management and predictive models". This year CCR made a presentation on "Multi-model solutions and Natural Disaster risk exposure".

MAY 25

French National Horticulture Society, Paris, Higher Council for Meteorology (CSM)

For the 48th plenary meeting of the Higher Council for Meteorology, a conference was organized on the theme of "The meteorological service; meeting the demands of sustainable agriculture". CCR made a presentation entitled "Meteorology, Risks and Calamities".

MAY 29

French National Assembly, Paris

Study group on "Flooding, natural risks and agricultural calamities" Presentation entitled "Floods, territories and agricultural risks (17th to 20th century)".

MAY 29 - JUNE 2

Lecce, Italy, 11th Hydrological cycle in the Mediterranean Experiment (HyMex) Workshop

This 11th international conference on Hydrological risks modelling was the occasion to present a poster explaining the objectives of the ANR PICS project "Integrated nowcasting of flash floods and related socio-economic impacts"

JUNE 5

Châteauform' City George V, Paris, 9th annual Journée CCR CAT

Considered as one of the most important annual meetings of the French insurance market, this event provides the opportunity to share knowledge on Natural Disasters and their consequences. This year the theme "Climate Change and Natural Disasters" attracted some 250 participants from the global insurance sector and the scientific community including numerous experts on catastrophic risks. The CCR Outstanding Thesis Award, another important issue of the day, was attributed to Kenji Fujiki who defended his doctoral thesis on a prospective study of the societal impacts of a major flood in the Ile-de-France region.

JULY 2018

Lyon, France, ANR PICS project (2018-2021) kick-off meeting.

This new project entitled "Integrated nowcasting of flash floods and related socio-economic impacts" (PICS) aims to improve flash flood modelling tools and the assessment of losses due to adverse meteorological events in the Cevennes region.

OCTOBER 10

Les Docks de Paris, Aubervilliers, SIG 2018; ESRI Francophone Conference

SIG 2018 is the premier francophone meeting on geographic information systems (GISs). It presents a variety of examples of using GIS-softwares. Innovative developments presented at the conference, have been demonstrated in particular with the presentation on "The contribution of satellite imagery data to flood modelling" as a new area of research.

OCTOBER 1-2

Paris, NAIAD Damage Modelling Workshop

Highly involved in the H2020 NAIAD European project, CCR hosted this two-day conference. Forty-five participants shared ideas and debated various topics associated with damage modelling and water-related risk prevention through the implementation of Nature-based Solutions.

OCTOBER 8

Bucharest, Romania, International Catastrophic Risks Forum (ICAR)

Organized by Xprimm and Business Development Group Romania, the ICAR conference is the annual meeting of the Eastern European insurance market. The 2018 climate study was presented in the context of the first session entitled "Is climate change driving a change in the property insurance business?" The latest NAIAD project results obtained by CCR were presented at the workshop "Gathering forces to improve resilience to the increasing weather-related risk: Nature-based Solutions for catastrophic risk management opportunities for the insurance sector".

NOVEMBER 15

Avignon University, French Hydro-Technical Society (SHF) Conference, "From flood prevention to crisis management".

Two topics provided the groundwork for this conference, scientific and operational advances on flood forecast and in crisis management preparation. Within the context of flood prevention, the following study was presented "The Seine floods of June 2016 and January 2018: Modelling the damage resulting from these events and an economic assessment of the Seine reservoir lakes."

NOVEMBER 21

Hôtel de l'industrie, Paris, One-day scientific conference hosted by Météo et Climat

Official partner of the Journées Scientifiques de Météo et Climat, CCR staff participated in the 11th scientific conference organized on the topic "Limiting global warming to 1.5° C: How and why?"

2018 PUBLICATIONS

CCR, Disaster Modeling and Analysis Department 2018. (in French) “The consequences of climate change on insured damage in France in 2050”, in (in French) Extreme meteorological events in a context of climate change, National Observatory on the Effects of Climate Change (ONERC), to be published.

CCR, Analysis and disaster Modelling Department 2018. (in French) Consequences of climate change on the cost of natural disasters in France by 2050.

CCR, Analysis and disaster Modelling Department 2018. Overview of the floods of January and February 2018, modelling damage and assessing prevention action.

Gouache C., Bonneau F., Tinard P. 2018. Representative seismic zone-dependent catalog for France. RING Meeting 2018, ASGA.

Moncoulon, D., Desarthe, J., Marchal, R., Naulin, J-Ph., Onfroy, T., Wang, Z-X. 2018. (in French) The Seine floods of June 2016 and January 2018. Modeling the damage resulting from these events and assessing the effect of prevention measures.La Houille Blanche.

Montador, L., & Moncoulon, D. 2018. (in French) The French Natural Disaster compensation scheme in the face of climate change. Revue Risques, Les cahiers de l’assurance.

Moncoulon, D., & Onfroy T. 2018. (in French) Measuring the effects of climate change and taking action to prevent it. Préventique n°161, ISSN 2262-2144.

Quantin, A. 2018. (in French) New skills for the insurance industry. Préventique n°161, ISSN 2262-2144.

Photo : CCR/Marchal R.

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