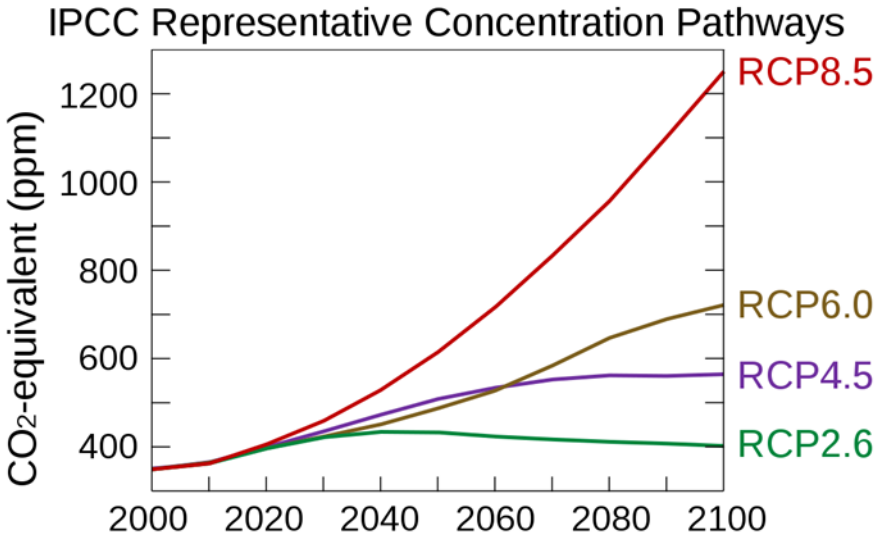
Long term impact of climate change on mortality and morbidity

02/11/2023

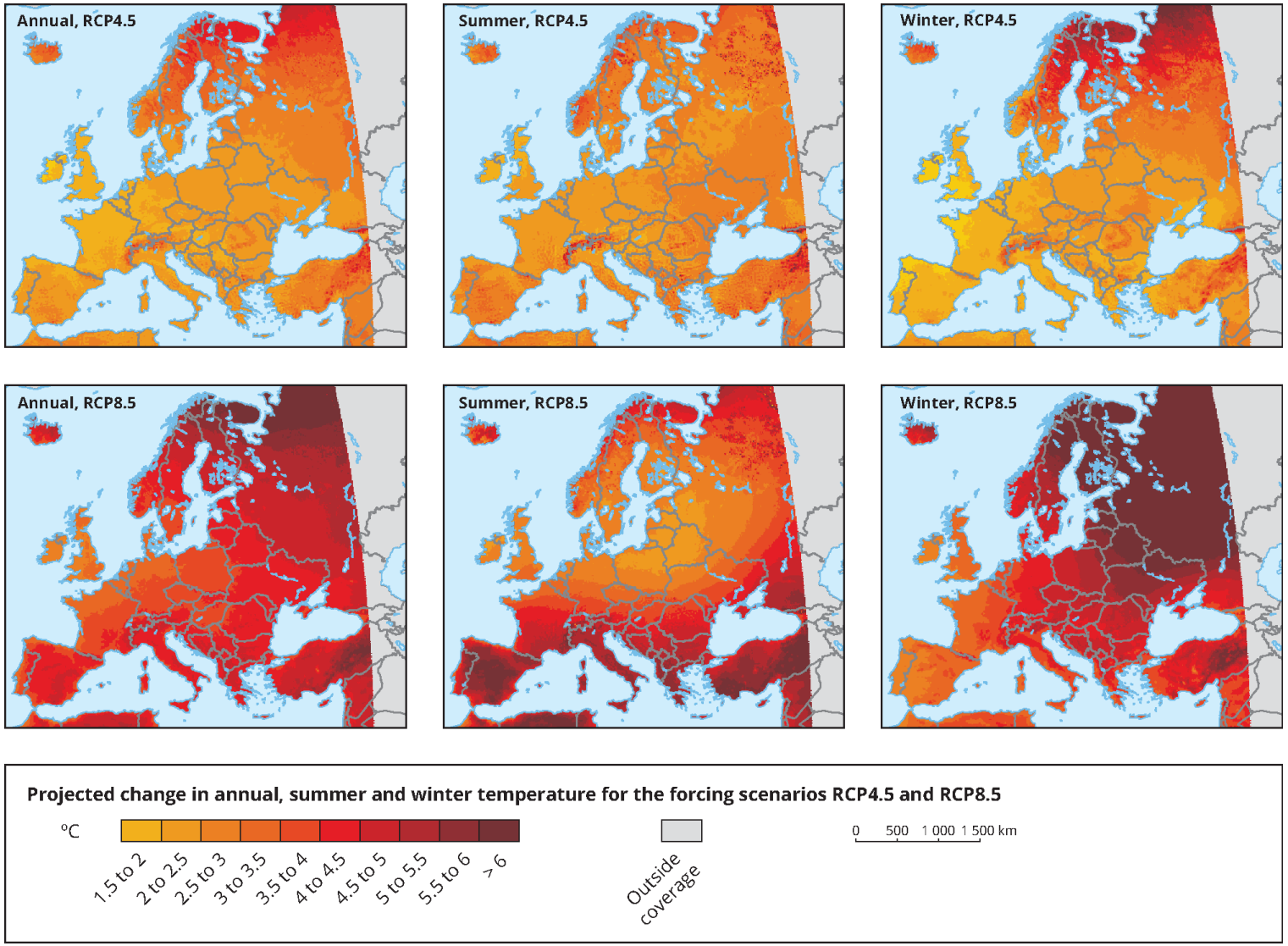
Proprietary & Confidential

Context

- The French Regulator ACPR conducted an exercise in 2020 in which 22 insurance company participated – 75% market share
- Two scenarios were selected for life and health :
  - Vector-borne diseases
  - Atmospheric pollution
- The RCP 8.5 scenario was considered with a horizon of 2050
- For 2023 Aon has improved the 2 existing scenarios and developed “short term” scenarios:
  - Heat wave
  - Dam break
- The RCP 4.5 Scenario is now used – Horizon 2050



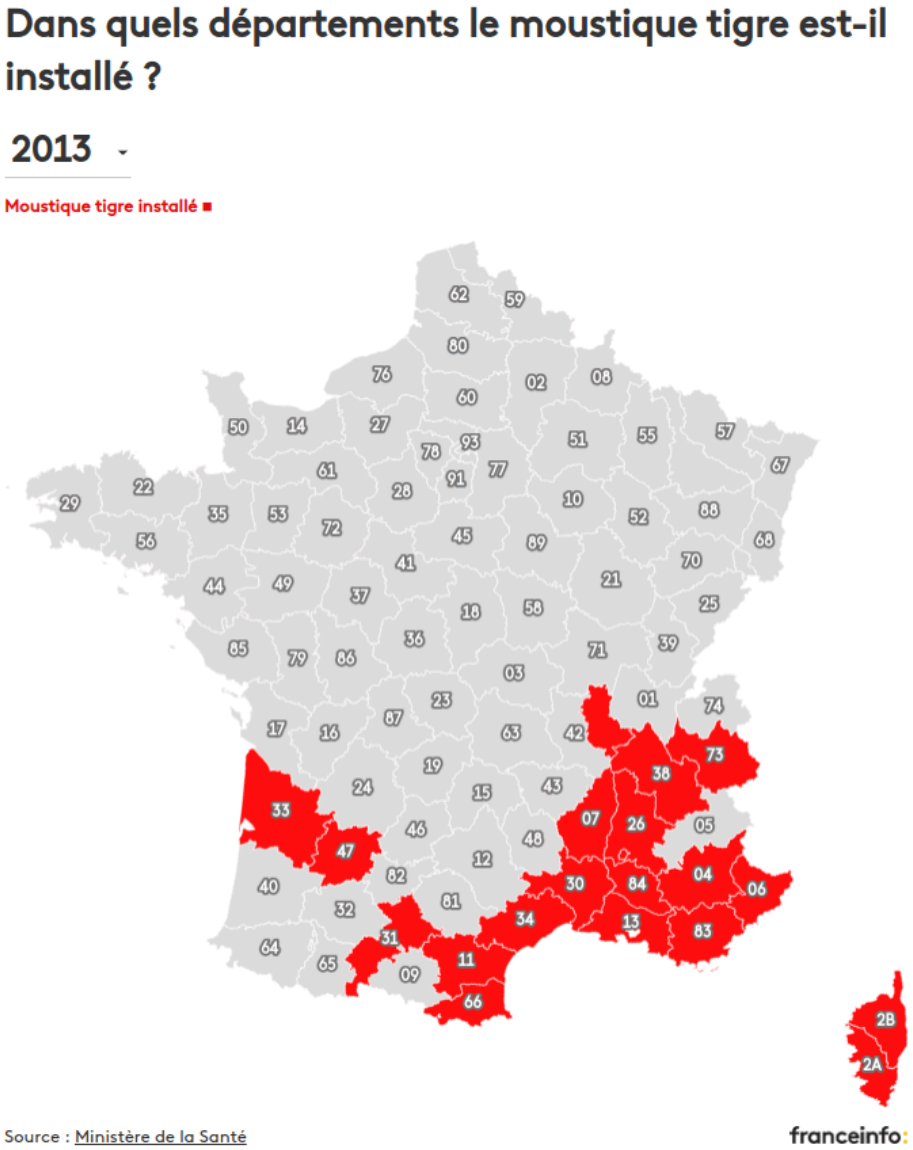
Context

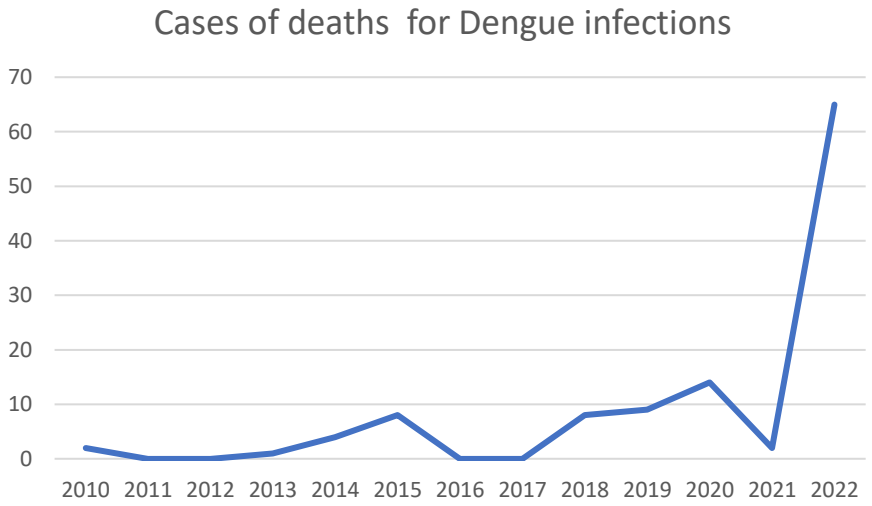


Jacob et al. 2013

Climate Change : Aedes Albopictus

Pandemic Vectors





Modeled with a classical stochastic epidemiologic model SEIR

Pandemic Vectors

According to new research published a few days ago in the Lancet magazine, residents of Attica will have to get used to the presence of **Asian tiger mosquitoes** almost all year round, in addition to common mosquitoes.

The study reports that for the first time, adult Asian tiger mosquitoes were active during the winter season (December 2023 and January 2023) and were detected in relatively large numbers. In previous periods, the tiger mosquito was active in Attica from May to early December, with a peak during the summer months, and only a small number of adults were detected in December. However, last year, the entomological monitoring network detected **99 tiger mosquitoes in 55 traps** during this period. The recording of these species in December 2022 was also very high, with 714 mosquitoes detected, compared to 150 in December 2021 and much fewer in previous years.

https://idalertproject.eu/are-we-losing-the-battle-against-mosquitoes

Pandemic Vectors

- **In Greece: West Nile Virus**
- **51 fatalities in 2018**
- **→ Need to adapt models to local reality**

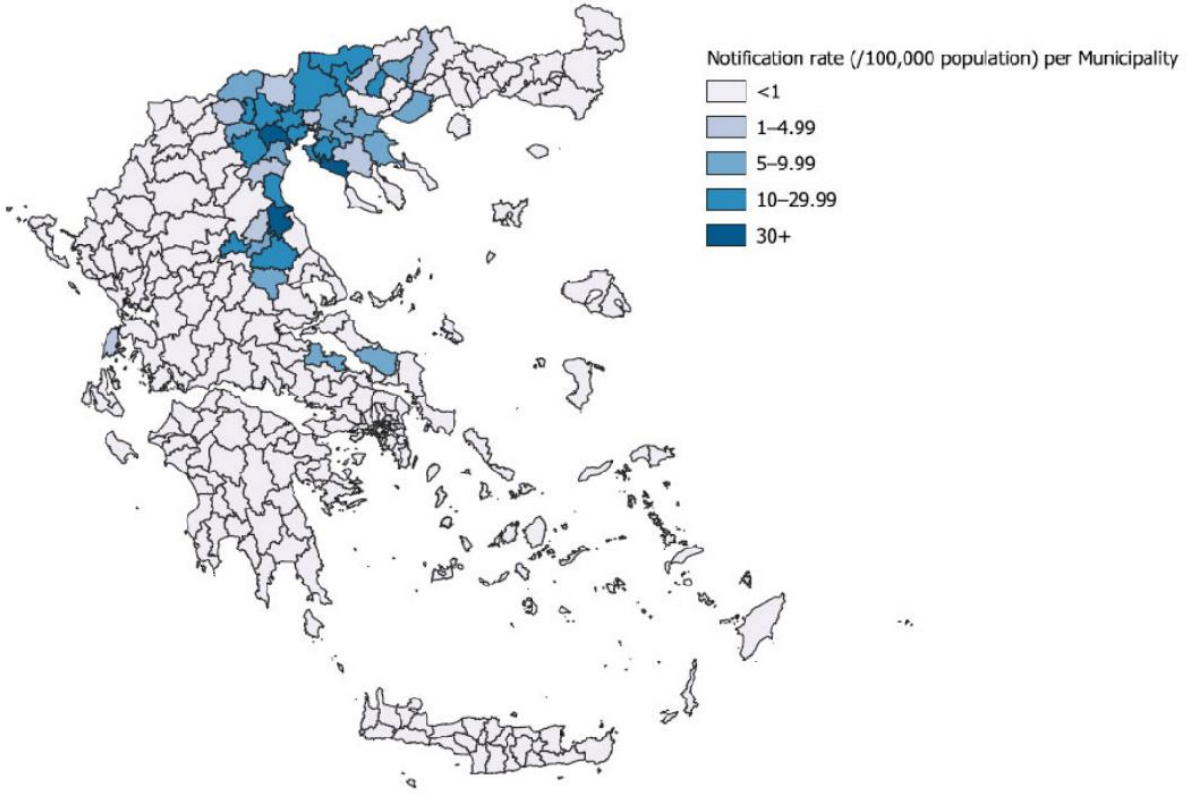


Figure 3. Notification rate (per 100,000 population) of WNND by probable municipality of exposure and geographical distribution of WNND cases, Greece, 2022 (n = 183).

Climate Change : Air pollution

Définition

Air pollution is the co-occurrence of high emissions of pollutants and specific meteorological conditions (high temperatures, no wind, no rain…).

Among these pollutants, fine particles (PM2.5 and PM10), Nitrogen Oxide (NOx) and Ozone (O3) are the most dangerous for public health.

Repeated or prolonged exposure to these particles leads each year to:

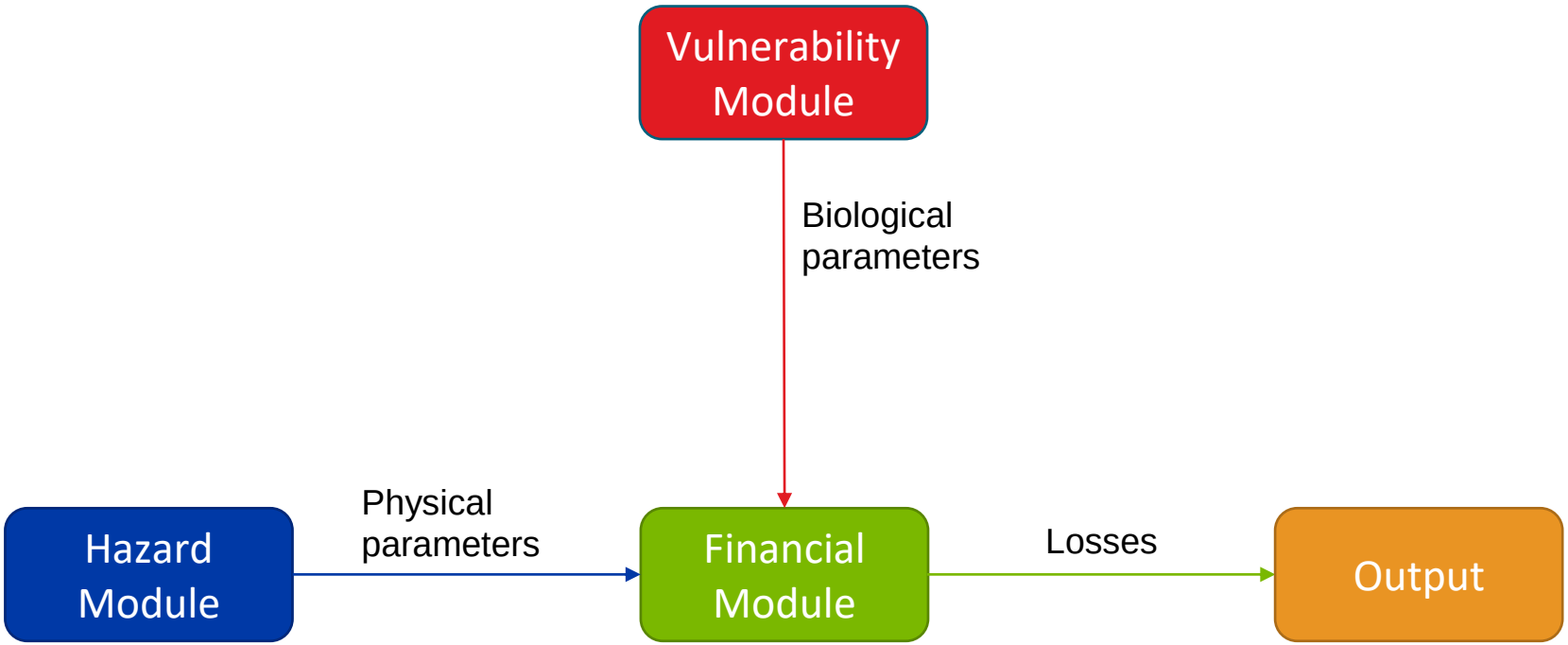
- respiratory diseases,
- cardiovascular diseases,
- cancers,
- Death…

	Effects proven and included	Effects proven but not included	Effects probable but not included
$PM_{10}/PM_{2.5}$	– All cause mortality (chronic)* – Acute mortality* – Infant mortality^ – Work days loss^ – Restricted activity days (minor and net)^ – Chronic bronchitis (COPD)^ – Respiratory hospital admissions^ – Cardiovascular hospital admissions^		Medication use Lower respiratory symptoms Diabetes
Ozone	– Acute mortality* – Respiratory hospital admissions^ – Cardiac hospital admissions^ – Restricted activity days (minor)^	– COPD	– Chronic mortality – Work days loss
NO_2	– Increased mortality risk (long-term)* – Bronchitis in asthmatic children^ – Respiratory hospital admissions^		– Cardiovascular effects – Acute mortality

Source: CE Delft assessment based on (WHO, 2013), Dutch Health Council, 2018, (HEI, 2018), (EPA, 2016), (COMEAP, 2015)

Climate change and pollution – CAT model

Description of a CAT model



Hazard - Climate forecast model

A climate forecast model applied to air quality requires several years of development. Aon decided to use the expertise of CEREA (https://www.cerea-lab.fr) to select publication or existing model which include:

- the variation of pollutant up to 2050
- the RCP 8.5 scenario in 2020, RCP 4.5 in 2023
- An adequate spatial resolution (Longitude/latitude)
- Main cities
- Our model is fully open sources

List of publication

- *Projet français SALUT'AIR (Colette et al., 2013a, b)*
- *Projet A-C HIA (Air-Climate Health Impact Assessment) (Likvar et al., 2015)*
- *Publication de Markakis et al. (2014)*
- *Thèse de Lacressonniere (2012)*
- *Thèse de Lecoeur (2013)*

Hazard - Climate forecast model (Example of Ozone)

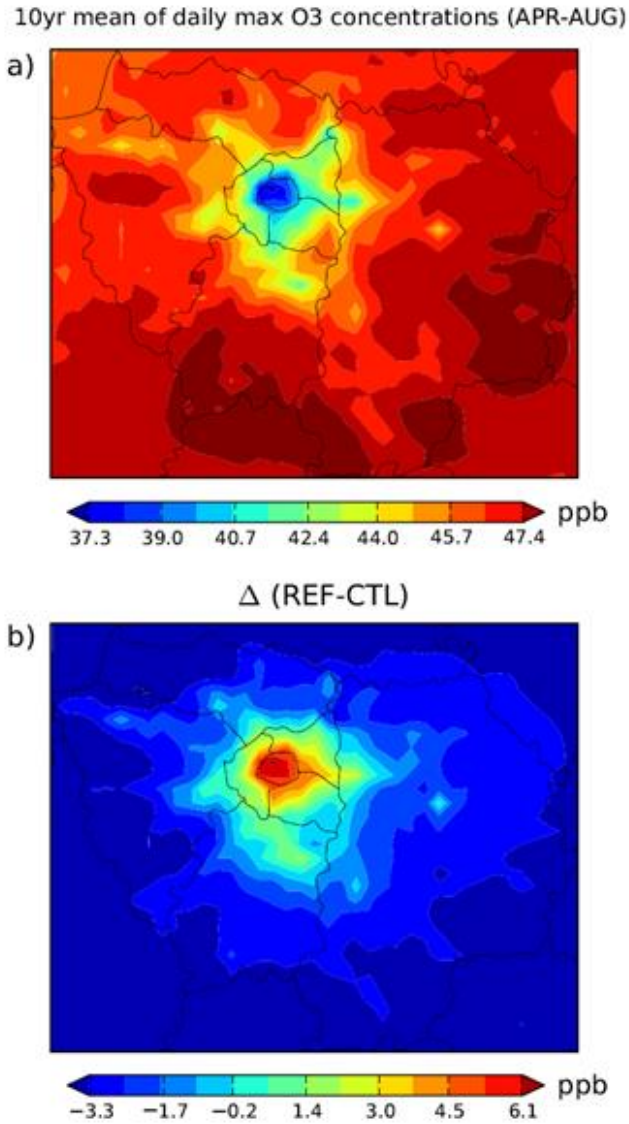
For the historical simulation, the average concentration of O_3 is:

- Paris: 72 à 76 µg.m^{-3}
- Region of Paris: 84 à 100 µg.m^{-3}

For 2050, the concentration will be:

- Paris: +9 à +15 µg.m^{-3}
- Region of Paris: -7 µg.m^{-3}

The scale is important because the concentration of Ozone decreases over the whole territory but increases in the cities.

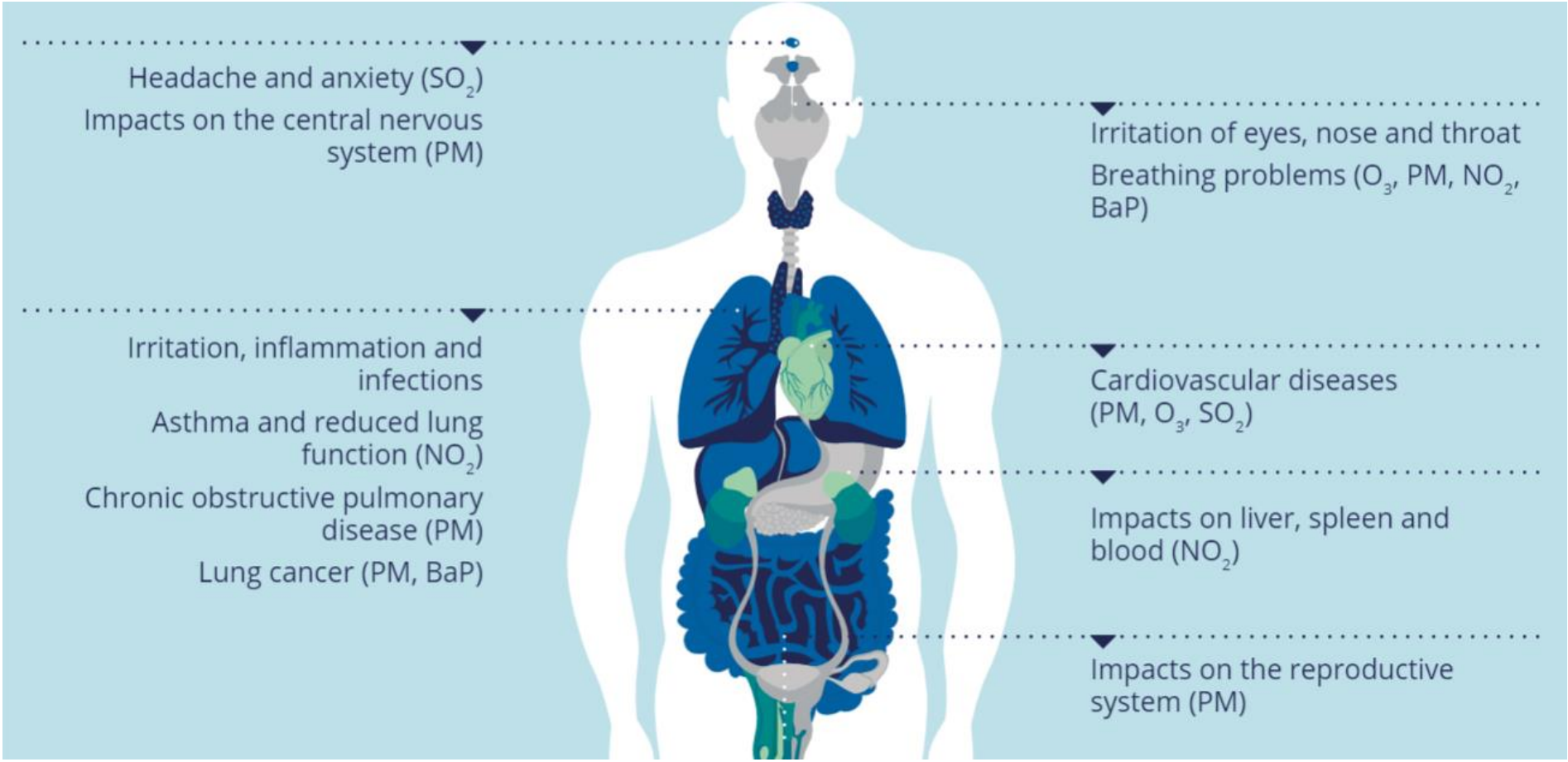


Mesure d'ozone quotidienne maximum observée pendant 8 heures sur la période avril-août (CTL) (a) ; les différences entre cette dernière et la future 2050 (REF) (b). Les valeurs sont exprimées en ppb. Markakis et al (2014).

Vulnerability – Air pollution and Health

Classification of impact:

Death: $PM_{2.5}$ et NO_2
Health: $PM_{2.5}$ et O_3
Disability: PM_{10}



Vulnerability – Air pollution and Health

A 10 µg.m^{-3} increase of NO_2 during a day and the previous day cause a 0.75% increase in non-accidental mortality (1.13% for cardiovascular disease).

During the warm season, a 10 µg.m^{-3} increase of NO_2 during a day and the previous day cause a 2.65% increase in non-accidental mortality (3.05% for cardiovascular disease).

These data are consolidated at WHO level to feed the AIRQ+ database

	POLLUANT	INDICATEUR DE SANTÉ	CODES CIM-10*	ÂGES	RR PAR 10 µg/m³ (IC95%)
Long terme	$PM_{2,5}$	Mortalité totale	A00-Y98	30 ans et plus	1,06 (1,02 – 1,11)
		Mortalité cardio-vasculaire	I00-I99	30 ans et plus	1,12 (1,08 – 1,15)
Court terme	PM_{10}	Mortalité non accidentelle	A00-R99	Tous	1,006 (1,004 – 1,008)
		Hospitalisations respiratoires	J00-J199	Tous	1,0114 (1,0062 – 1,0167)
		Hospitalisations cardiaques	I00-I52	Tous	1,006 (1,003 – 1,009)
	O_3	Mortalité non accidentelle	A00-R99	Tous	1,0031 (1,0017 – 1,0052)
		Hospitalisations respiratoires	J00-J199	15-64 ans	1,001 (0,991 – 1,012)
				65 ans et plus	1,005 (0,998 – 1,012)

(source : impact à court terme du dioxyde d'azote (No2) sur la mortalité dans 18 agglomérations françaises, Santé Publique France Aout 2019)

Vulnerability – Air pollution and Health

AirQ+ is a tool developed by the WHO for quantifying the impact of air pollution on health. Different methodologies are used to assess the effects of long-term (and short-term).

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Home / Publications / Overview / AirQ+: key features

AirQ+: key features

30 September 2016 | Manual

Download (631.8 kB)

Overview

AirQ+ is designed to calculate the magnitude of the impacts of air pollution on health in a given population. It handles long- and short-term exposure to ambient air pollution from several pollutants, and long-term exposure to household air pollution from solid fuel use. AirQ+ can be used for any city, country or region to estimate: 1) How much of a particular health outcome is attributable to selected air pollutants? 2) Compared to the current scenario, what would be the change in health effects if air pollution levels changed in the future? All calculations performed by AirQ+ are based on methodologies and concentration-response functions established by epidemiological studies. The concentration – response functions used in the software are based on the systematic review of all studies available until 2013 and their meta-analysis.

AirQ+: software tool for health risk assessment of air pollution

WHO TEAM

Centre for Environment & Health (BON),
Living & Working Environments (LWE)

EDITORS

World Health Organization. Regional Office for Europe

REFERENCE NUMBERS

WHO REFERENCE NUMBER:

WHO-EURO-2016-4104-43863-61761

New models for 2023

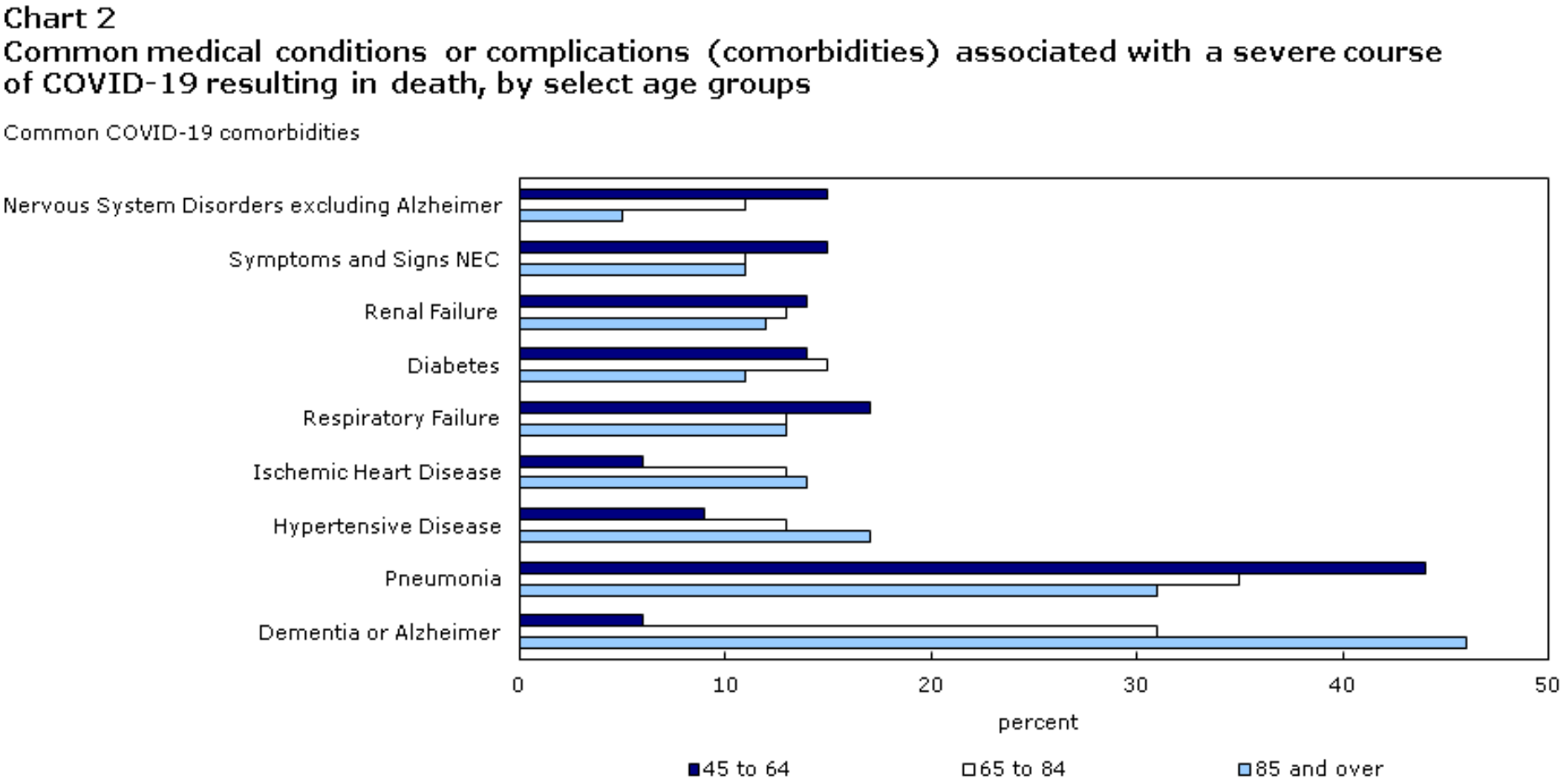
2023 Market exercise

For 2023 market exercise, Aon kept on collaborating with ACPR and modelled for the new French Life stress test, the following scenarios:

- “Cevenol” event and impact on dam break
- Heat Wave
- Correlation between Pandemic event and air pollution on respiratory diseases, asthma and bronchitis
- ACPR retained the first two scenarios – Correlation is still work in progress post COVID.
- We have improved the models by taking into account age classes

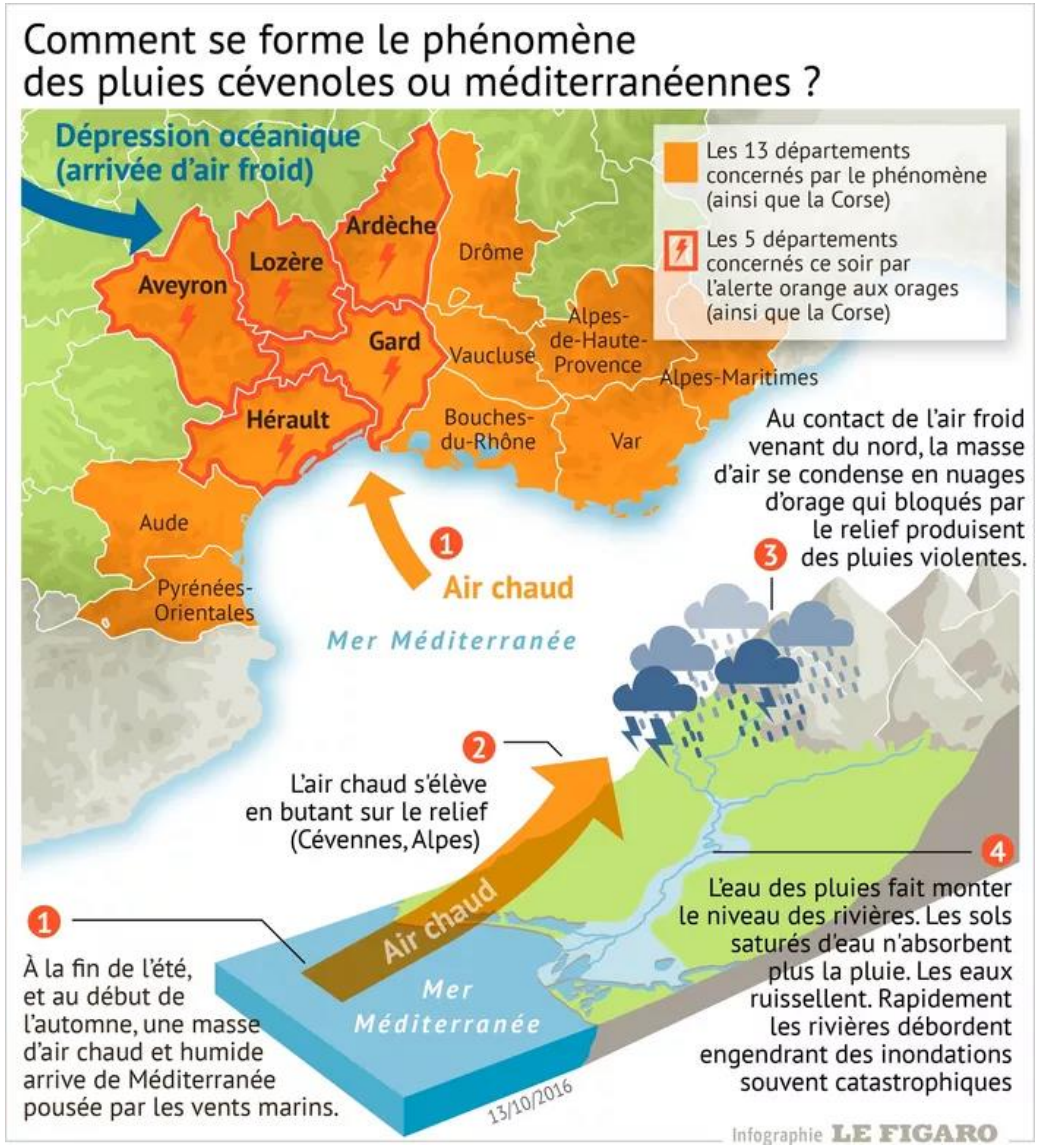
Covid-19 : Comorbidities factors

Chart 2
Common medical conditions or complications (comorbidities) associated with a severe course of COVID-19 resulting in death, by select age groups



Note: Comorbidities for deaths occurring between March 1, 2020 and July 31, 2020, where COVID-19 was involved.
Source: Canadian Vital Statistics – Death Database (2020).

Cevenole event - explanation

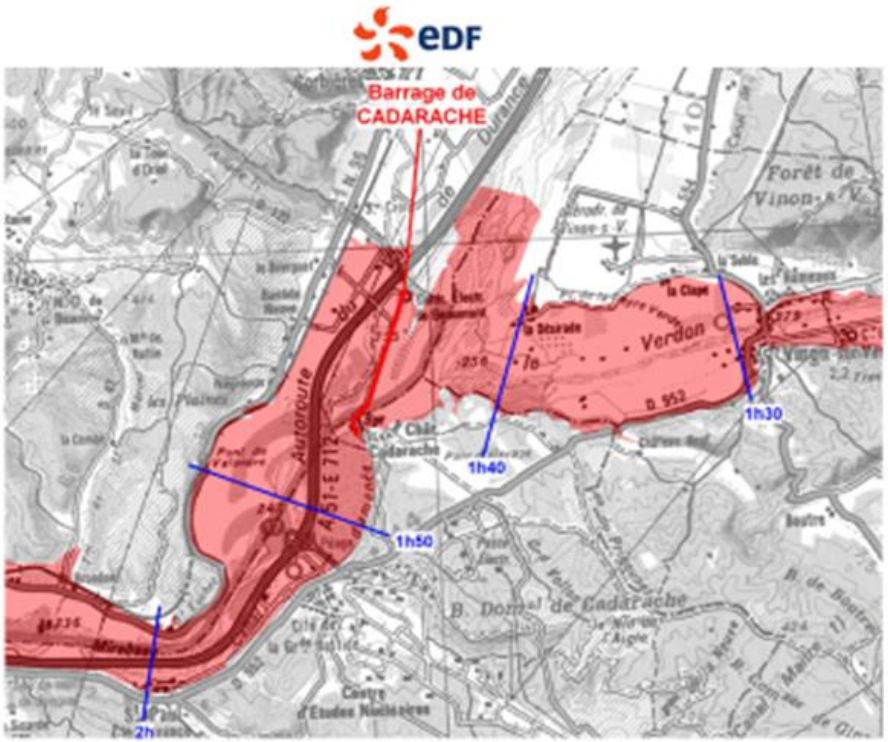


Cevennes event occur in autumn, when the warm and humid wind from the Mediterranean heads north and meets the cold air at higher altitudes.

The rain clouds formed are blocked by the mountains and form again and again. As a result, thunderstorms can last for several hours, causing significant damage.

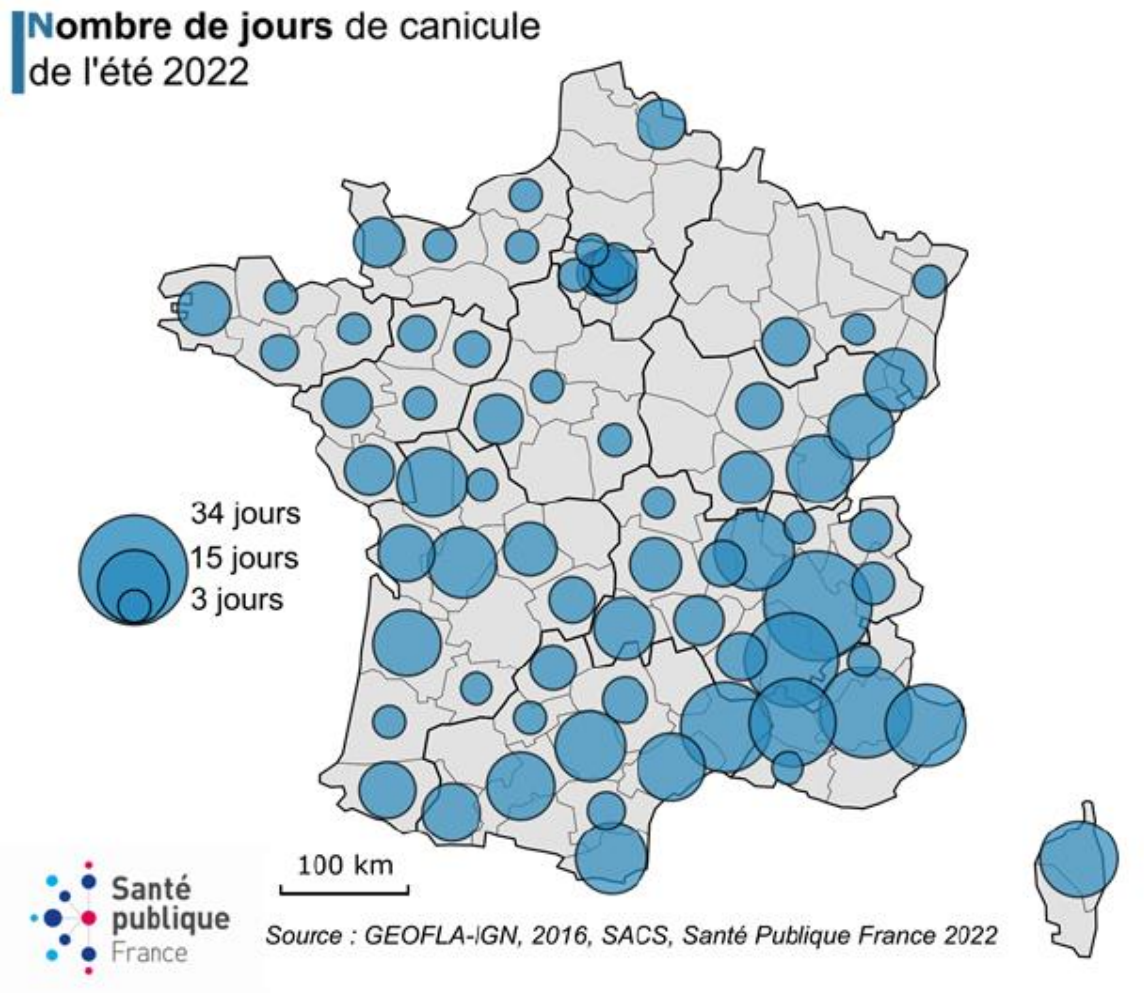
Cevenole event - explanation

EDF : Empreinte rupture de Sainte-Croix / Cadarache (PPI)



Deterministic short term scenario mixing Life and P&C

Heatwave



- 2 816 deaths (+ 16,7 %) in impacted area
- 2 272 deaths only for +75years old (+ 20,2 %).
- +20 000 emergency
- Correlation with Covid-19 : 894 deaths Covid-19 increases heatwave-related mortality and vice-versa

Deterministic short term scenario mixing Life and P&C

Conclusions

- Work in progress: no crystal ball
- Science and reality are evolving very quickly
- Considering only one aspect of the evolution of risk, many more may change the future experience: socio-economics, medicine, politics…
- Important to start the exercise now to develop the adequate risk culture and set the correct indicators.
- Fundamental to educate the insured population to prevent themselves from these emerging risks.

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