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# Flood-related mortality across the Mediterranean basin
# Results from the MEditerranean Flood Fatalities (MEFF) DB

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# Introduction : database and objectives

- MEFF-DB started from the FLOODHYMEX data base as a complementary DB on flood related fatalities

- Life protection is the highest requirement in the flood prevention issue

- Emergency services are focused on the protection of human life

- European Directive on floods (2007) requirements

Objectives of the MEFF_DB:

→ To provide an accurate DB on flood related fatalities

→ To monitor long term evolution of weather related mortality in context of CC

→ To assess and adjust the long term efficiency of prevention

# Introduction : database and objectives

- Objectives of this presentation :

→ To go further in the analysis of MEFF_DB (GIS)

→ To map a « fatality rate » to compare mortality at different scale.

- Schedule of the presentation

→ Reminder on the MEFF_DB

→ General features of the DB and the studied regions

→ The Fatality rate

→ Spatial distribution of the mortality (different scales)

→ Further developments

# Introduction : database and objectives

We start from **flood related deaths**

- We believe that loss of life during floods is not hazardous, not casual :
It is due to hazards factors, exposure, vulnerability of people, bad behavior, lack of alert lack of prevention…

- Good indicator to monitor long term flood impacts and to assess flood prevention

→ time-independant and comprehensive

*Source : municipality of Draguignan, L. Boissier 2013*

# Introduction : database and objectives

Selected fatalities

| DEATH | immediate | differed |
|---|---|---|
| direct | weak uncertainty | high uncertainty |
| indirect | Medium uncertainty | Very high uncertainty |

*Degree of uncertainty in information for FRF*

Sheet for direct flood related fatalities census

1- PROFILE OF DEAD PEOPLE

- NAME : .....
- FIRST NAME : .....
- Date of birth : .....
- Age : .....
- Gender : Male ☐ Female ☐
- Nationality : .....
- living place : .....
- disable people ? YES ☐ NO ☐ If YES kind of disability? .....
- observations : .....

.....

2- CIRCONSTANCES OF DEATH

Date of flood event : .....

Day (Monday, Tuesday…) : .....

Date of death : .....

Time of death (please note a range of uncertainty) : .....

If no precise hour : Morning ☐ Afternoon ☐ Evening ☐ Night ☐

Place of death :

- Commune : .....
- Adress: .....
- river : .....

Clinical causes of decease :

- drowning ☐
- Hypothermia ☐
- Injury, physical trauma ☐
- Heart attack ☐
- Poisoning with carbon monoxid ☐
- Others ☐ please give detail : .....

Circonstances of death :

- At home ☐
- home surroundings (garden…) ☐
- other building than home☐
- Outdoor (street…)☐
- Vehicule ☐

*First page of FRF census*

Sources of data :

- newspapers, websites

+ field survey near :
rescue services, municipalities, neighbouring

Information collected :

- Circumstances of death
- Profile of died people

# Introduction : database and objectives

The MEFF (MEditerranean Flood Fatalities) database
Database of victims caused by floods in 6 Mediterranean AREAS : Catalonia, Balearic Islands, South of France, Calabria, Greece, Turkey


Data sources: press archives
Study period: 39 years, 1980-2018
Space resolution: municipal scale
Time resolution: year, month, day, hour


→ *Petrucci O. et al. (2018) MEFF: the database of Mediterranean Flood fatalities (1980 to 2015) Journal of flood risk management. DOI:10.1111/jfr3.12461*

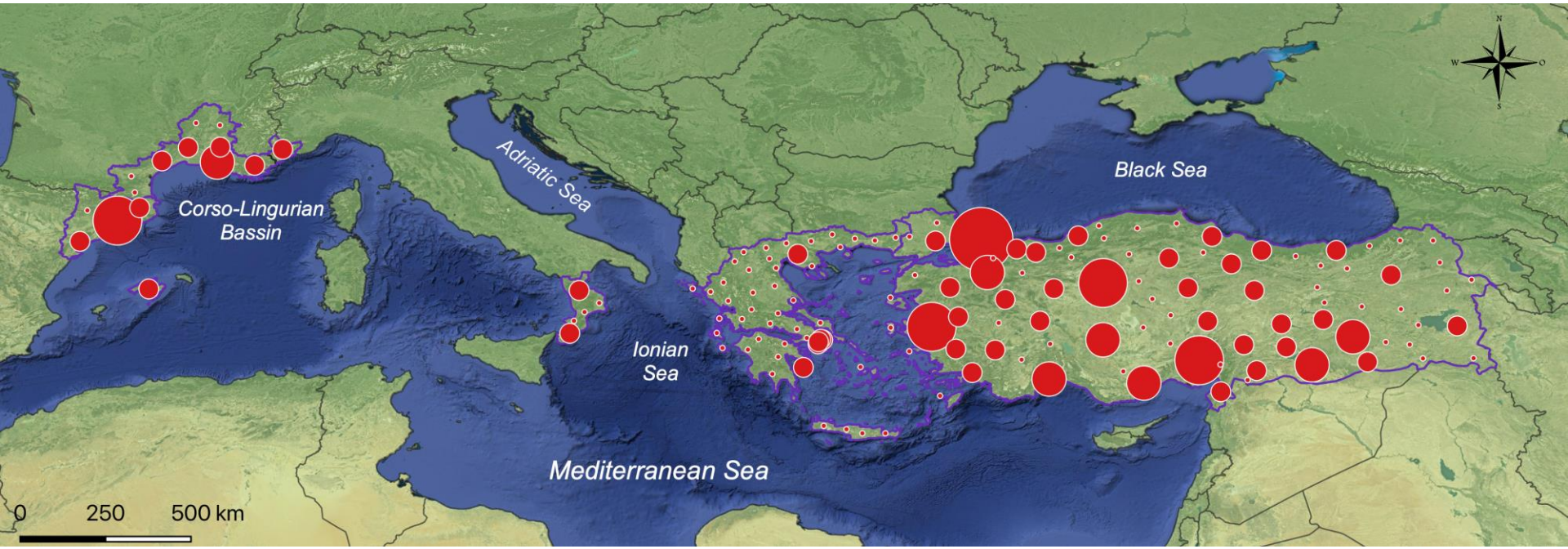
→ *Petrucci O. et al. (2018)* People-flood interaction: victims throughout four mediterranean countries in 35 years. *PICO EGU conference Vienna April 2017*

General data on the different countries participating to MEFF-DB

| Area | Number of fatalities | Population (2000) |
|---|---|---|
| Turkey | 1242 | 66 890 000 |
| France – Mediterranean South of France | 275 | 7 233 580 |
| Greece | 132 | 10 780 000 |
| Spain - Catalonia | 100 | 6 293 440 |
| Italy - Calabria | 40 | 2 028 630 |
| Balearic I. | 20 | 823 401 |
| **Whole study area** | **1809** | **94 050 000** |

*Sources : Socioeconomic Data and Applications Center (SEDAC) and Eurostat*

## The population of the study area in 2000




*Sources : Socioeconomic Data and Applications Center (SEDAC) and Eurostat*

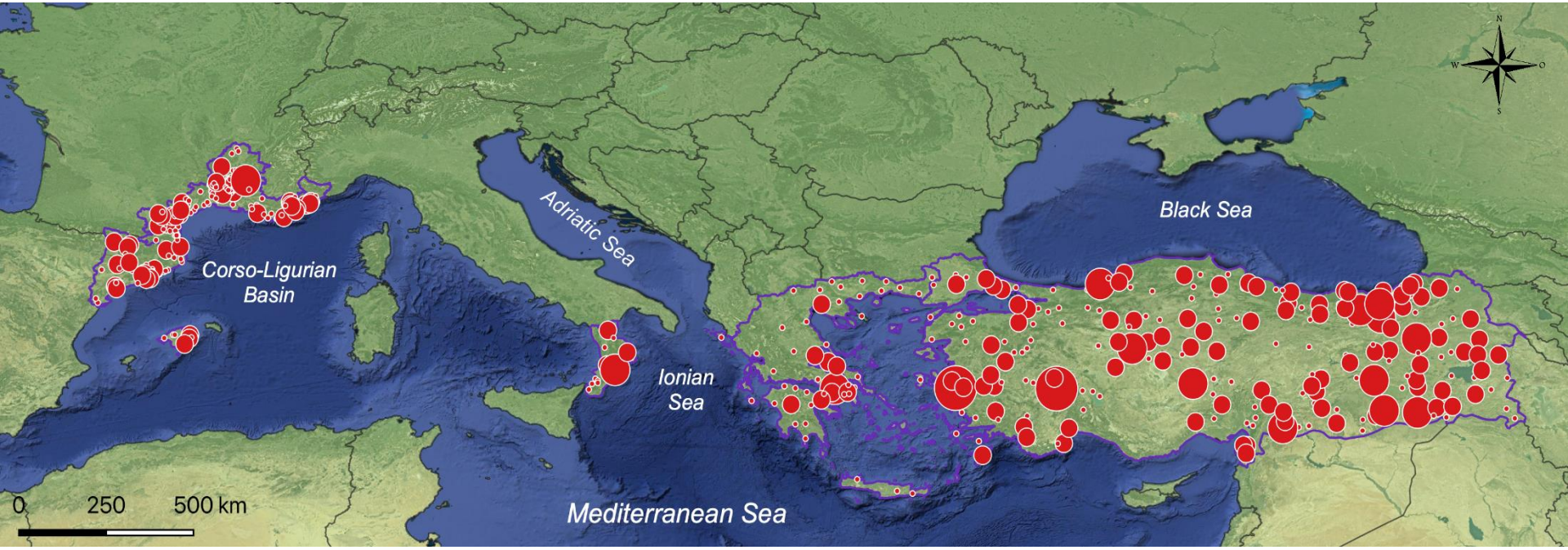
| | Number of NUTS 3 |
|---|---|
| Spain | 4 |
| Balearic I. | 1 |
| France | 10 |
| Italy | 5 |
| Greece | 52 |
| Turkey | 81 |

NUT3 administrative unit

Population per NUTS3 region (2000)
- 20 000 - 500 000
- 500 000 - 1 200 000
- 1 200 000 - 2 000 000
- 2 000 000 - 5 000 000
- 5 000 000 - 10 075 652

# 1- General features, methods and data

1809 flood related deaths in the MEFF DB




*Sources : MEFF DB and Socioeconomic Data and Applications Center (SEDAC) and Eurostat*

Number of fatality per municipality

- 1 - 2
- 2 - 11
- 11 - 46
- 46 - 74

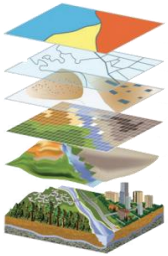
# 1- General features, methods and data

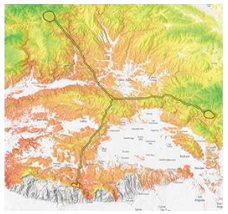
*French Data*
*Spanish Data*
*Balearic I. Data*
*Greek Data*
*Italian Data*
*Turkish Data*
*…/…*

Statistical analysis
*Petrucci et al. (2017)*

Building of the DB

Spatial analysis (GIS)
georeferencing





Calculation and downscaling analysis of Fatality rate

By country

By NUTS 3 region

By grid

By watershed area

**Input data :**
- *Hazard data*
- *Population*
- *Land use*
- *Prevention measures*

*…*

Comparisons, explanation and outcomes for prevention

## 2- A fatality rate to mesure flood risk

The flood-related fatality rate is the annual number of fatalities per million of inhabitants

$$F = \frac{(N_f * Pop^{-1}) \times 1000000}{N_y}$$

F = fatality rate

$N_f$ = number of fatality per spatial entity

Pop = Population in 2000

$N_y$ = number of years of the record period (39)

128 regions (NUTS3) out of 153 (84%) got fatalities through the period

Median rate Fm = 0,27 (Fm = 0,406 if we exclude Nf = 0)

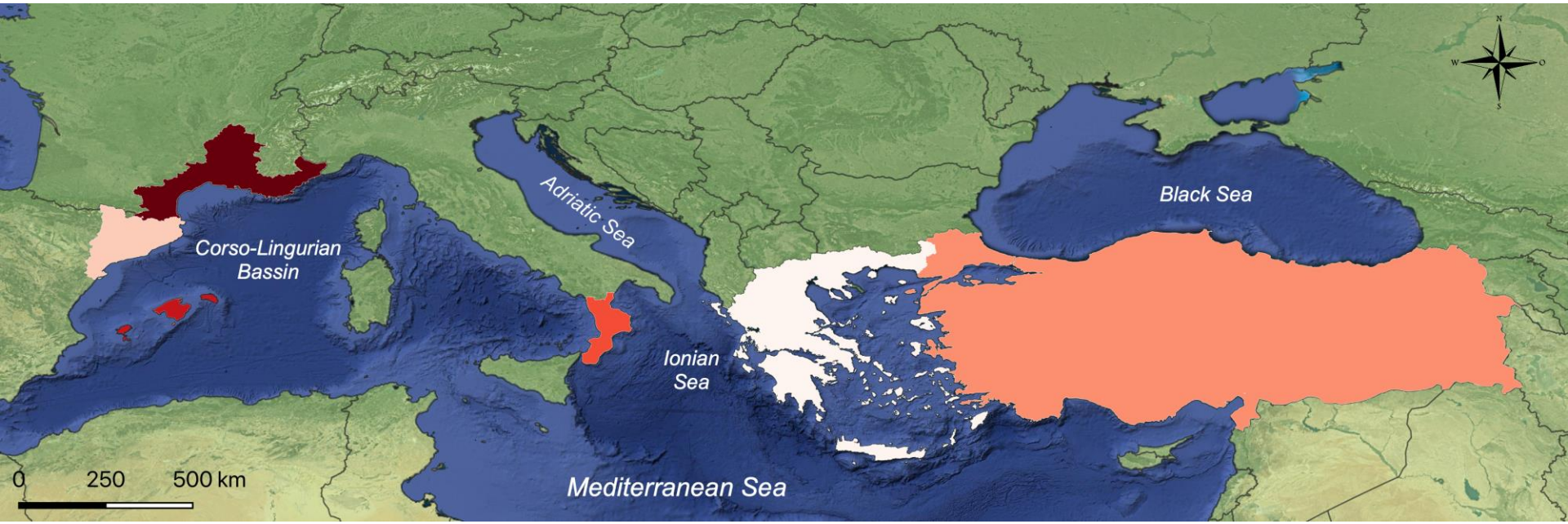
Max F = 16,482 Trabzon (Turkey)

# 2- A fatality rate to mesure flood risk

| Area | Number of fatalities | Population (2000) | Fatality rate<br>Number of death / year / 1M inhabitants |
|---|---|---|---|
| Turkey | 1242 | 66 890 000 | 0,476 |
| France (Mediterranean Side) | 275 | 7 233 580 | 0,975 |
| Greece | 132 | 10 780 000 | 0,314 |
| Spain (Catalonia) | 100 | 6 293 440 | 0,407 |
| Italy (Calabria) | 40 | 2 028 630 | 0,506 |
| Spain (Balearic I.) | 20 | 823 401 | 0,623 |
| **Study area** | **1809** | **94 050 000** | **0,49** |

# 3- Spatial distribution of the mortality (differents scales)

## Mapping of Flood related mortality rate per country



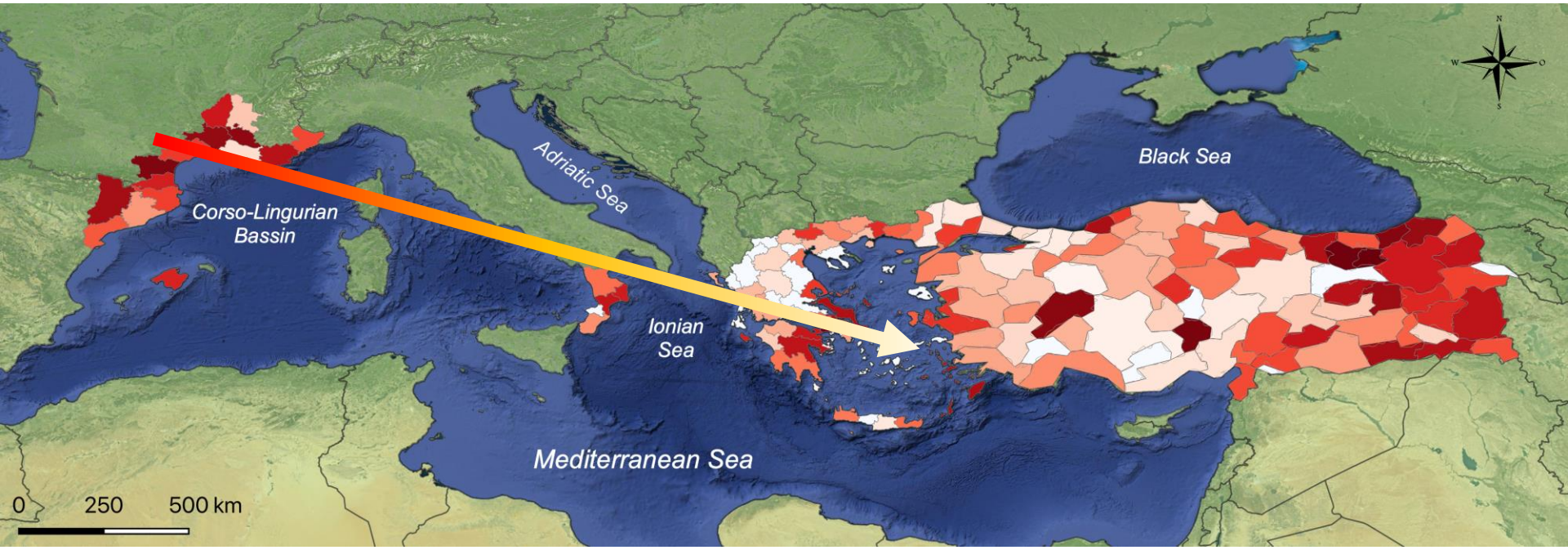

*Sources : MEFF DB and Socioeconomic Data and Applications Center (SADAC) and Eurostat*

Fatality rate
*(fatality / year / 1M inhabitants)*

- 0,314 (Greece)
- 0,407 (Catalunia)
- 0,476 (Turkey)
- 0,506 (Calabria)
- 0,623 (Balearic I.)
- 0,975 (South of France)

# 3- Spatial distribution of the mortality (differents scales)

Mapping of Flood related mortality rate per NUTS 3 region




*Sources : MEFF DB and Socioeconomic Data and Applications Center (SADAC) and Eurostat*

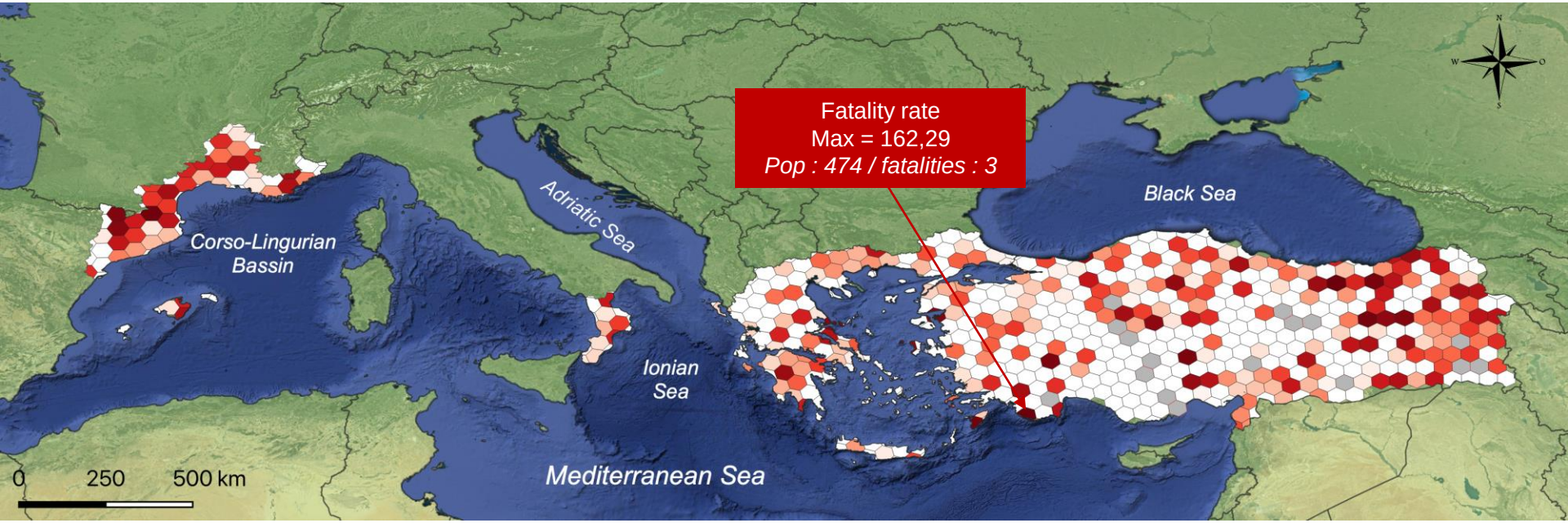
A decreasing gradient of mortality from West to east

Fatality rate *(fatality / year / 1M inhabitants)*

*0* — *16,482*

# 3- Spatial distribution of the mortality (differents scales)

Mapping of Flood related mortality rate per grid (50*50 km = 2 165,06 km2)




*Sources : MEFF DB and Socioeconomic Data and Applications Center (SADAC) and Eurostat*

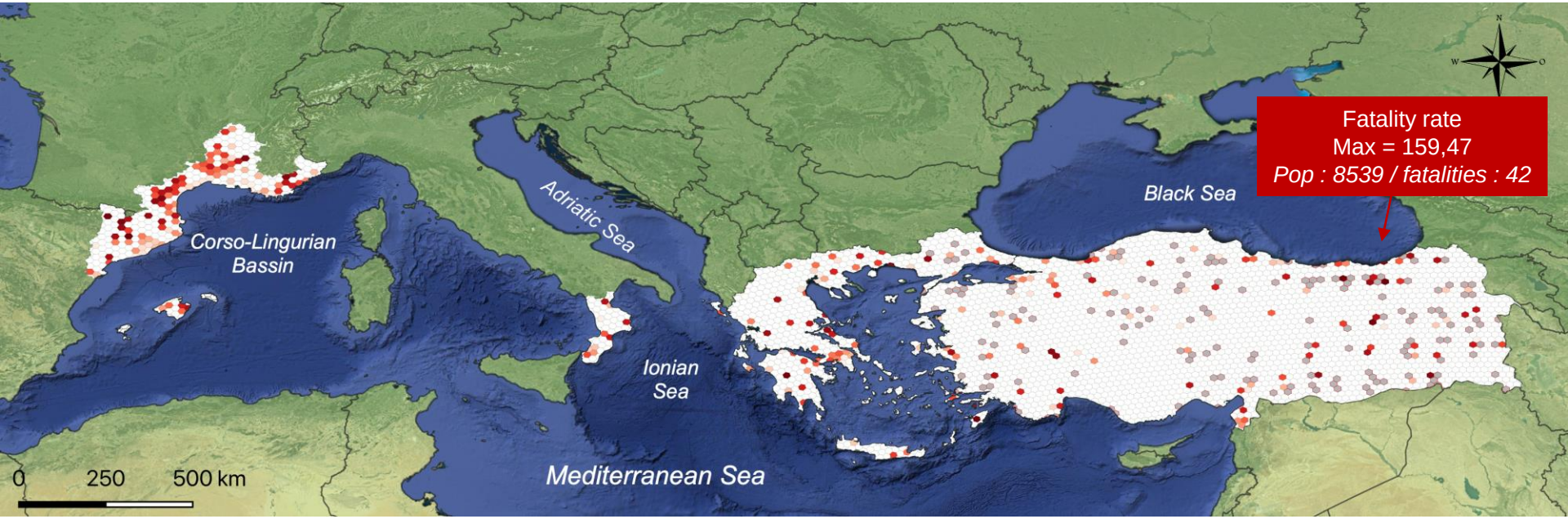
Fatality rate *(fatality / year / 1M inhabitants)*

*0* — *162,29*

No population data

# 3- Spatial distribution of the mortality (differents scales)

## Mapping of Fatality rate per grid (20*20 km = 346,41 km2)




*Sources : MEFF DB and Socioeconomic Data and Applications Center (SADAC) and Eurostat*

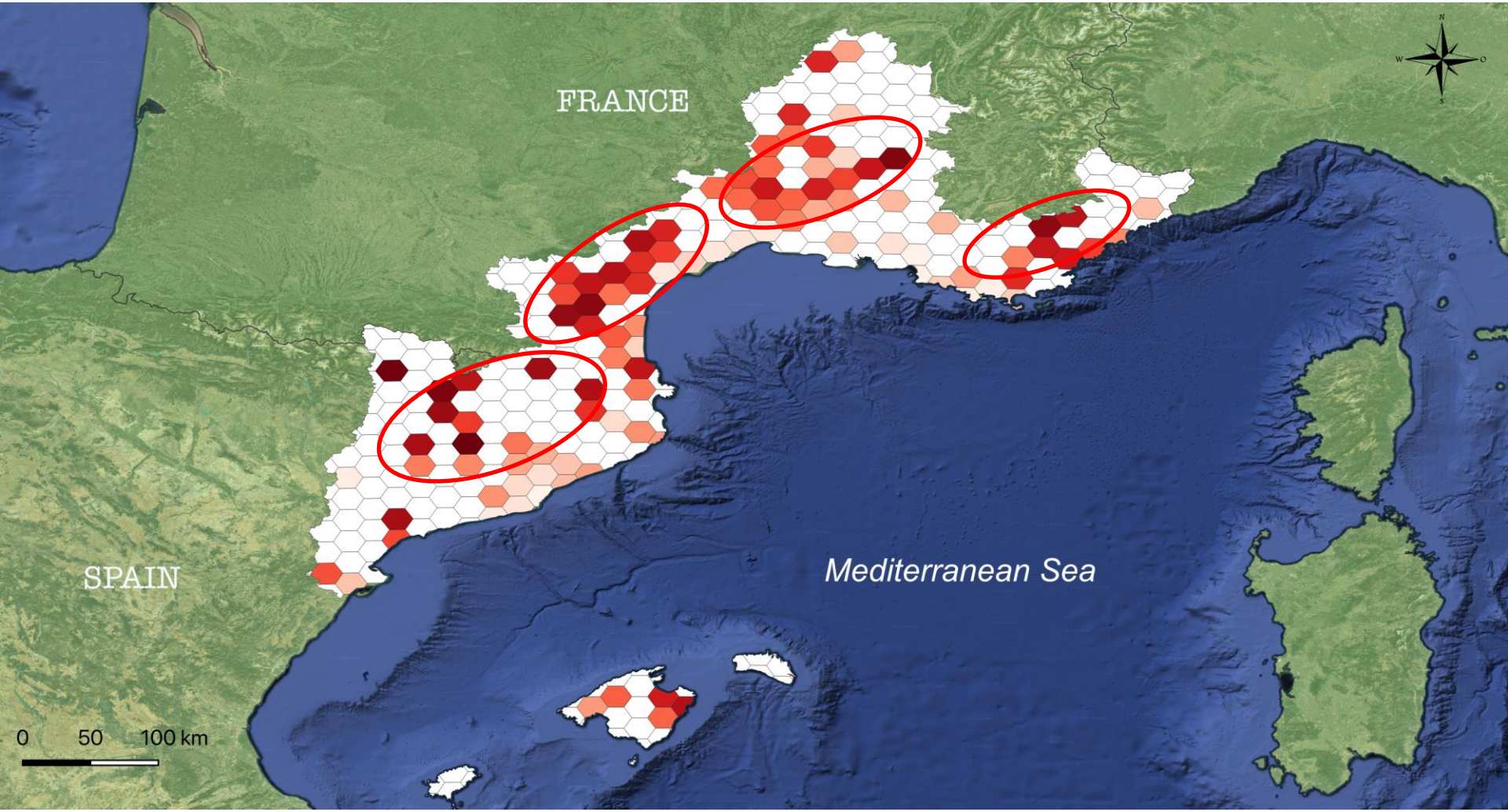
| Area | Number of cell | Number of blank cell (0 fatality) | % of blank cell |
|---|---|---|---|
| Spain | 119 | 87 | 73 % |
| Baléaric I. | 17 | 12 | 71 % |
| France | 214 | 146 | 68 % |
| Italy | 68 | 58 | 85 % |
| Greece | 573 | 517 | 90 % |
| Turkey | 2454 | 2185 | 89 % |

Fatality rate *(fatality / year / 1M inhabitants)*

*0* — *159,47*

No population data

# 3- Spatial distribution of the mortality (differents scales)



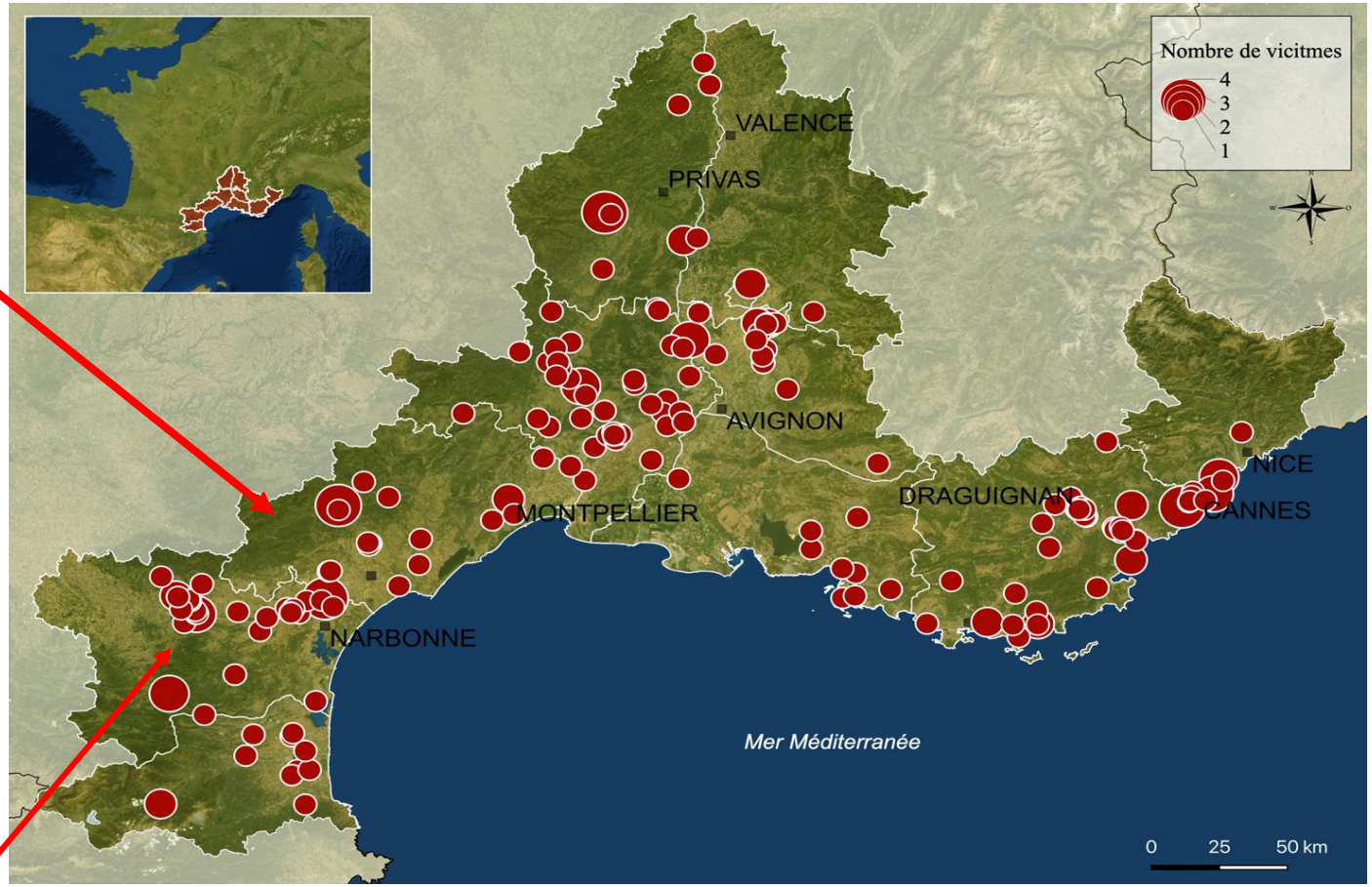

foothills and hinterland are prone to highest mortality

Fatality rate *(fatality / year / 1M inhabitants)*

*0* *95,58*

# 3- Spatial distribution of the mortality (differents scales)

Low mortality on upstream lands




High mortality in the medium part of catchments :

- High density of population
- Narrow valleys (lack of flat field)
- High speed flow

Map of Flood related fatalities in Southern France (1980-2018)

# 3- Spatial distribution of the mortality (differents scales)

Mapping of Fatality rate per watershed

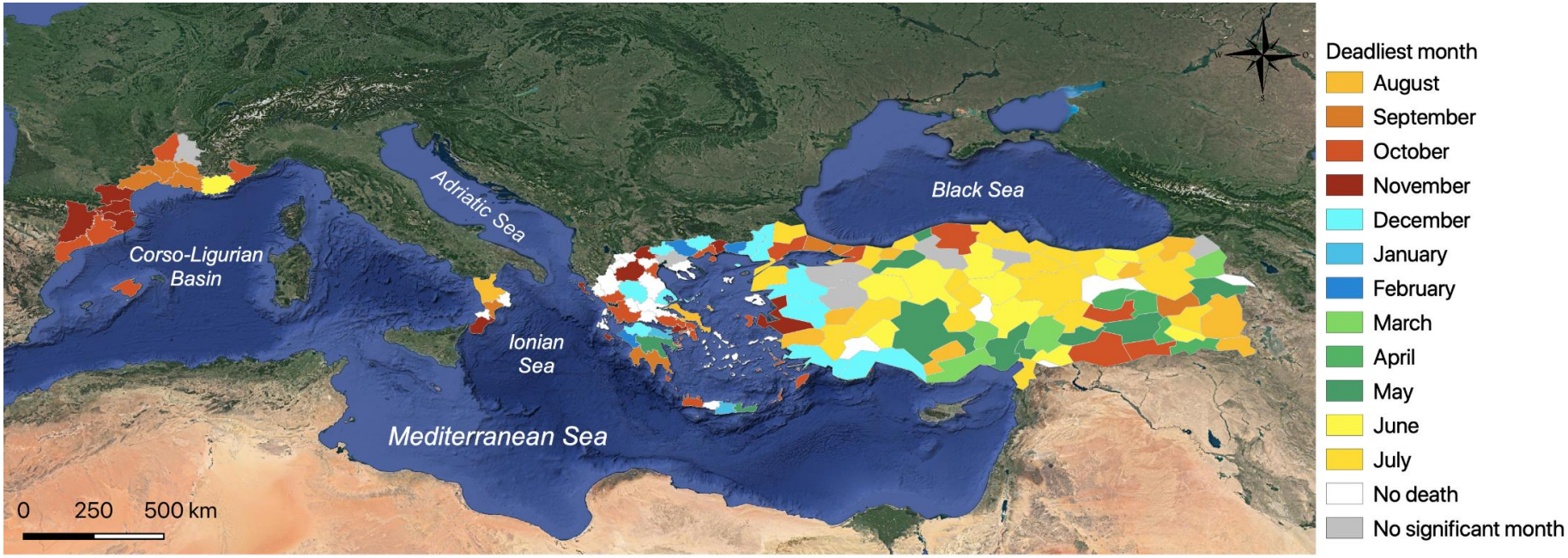

Median F = 1,008 *(if we exclude Nf = 0)*

Fatality rate *(fatality / year / 1M inhabitants)*

*0* *140,28*

# 4- Seasonal distribution of FRD

Mortality is consistant with seasonality of intense rainfall




*Vinet et al. Water 2019*

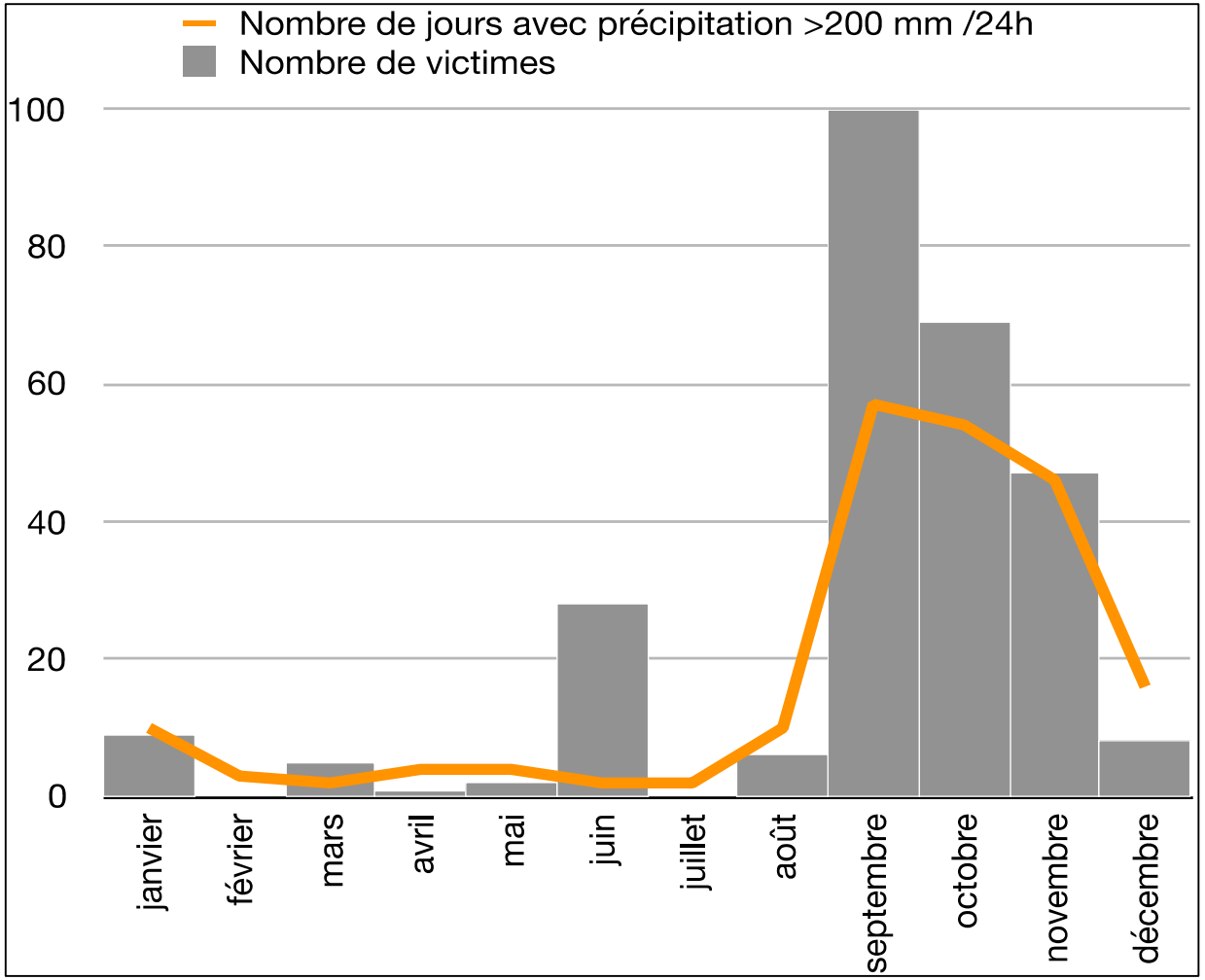
Early fall season in western mediterranean basin

End of fall season in eastern mediterranean basin

Spring in southern turkey

Summer in continental turkey (non mediterranean climate)

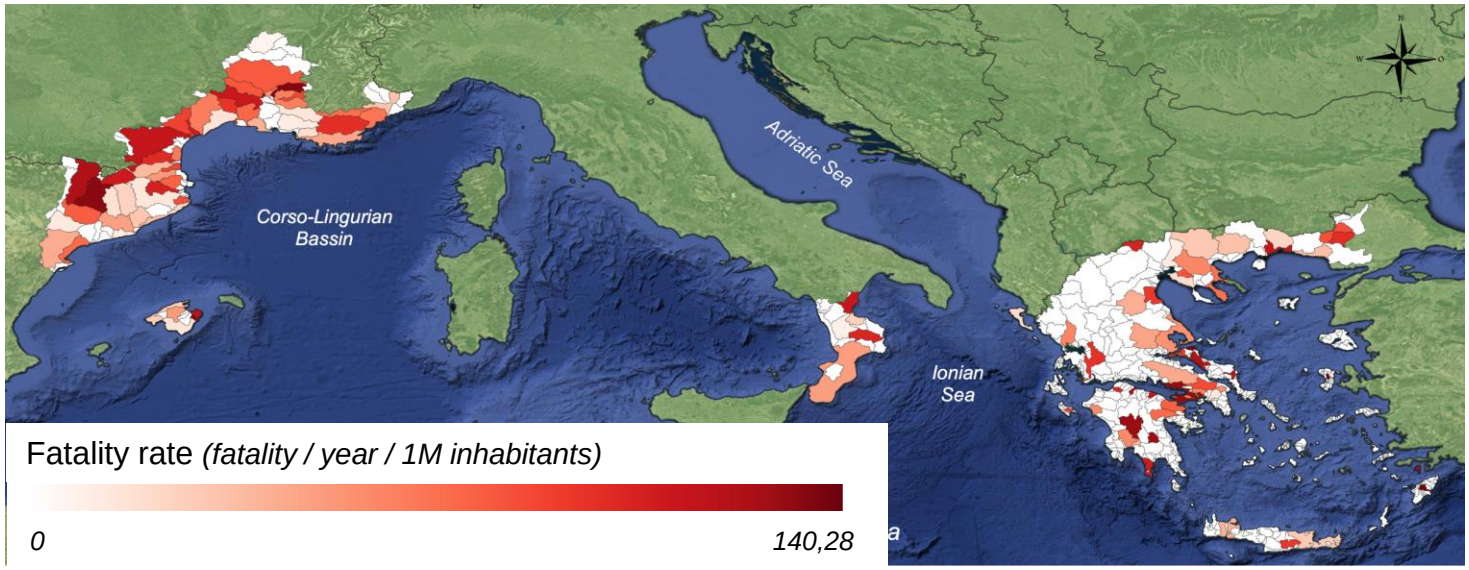
# 4- Seasonal distribution of FRD

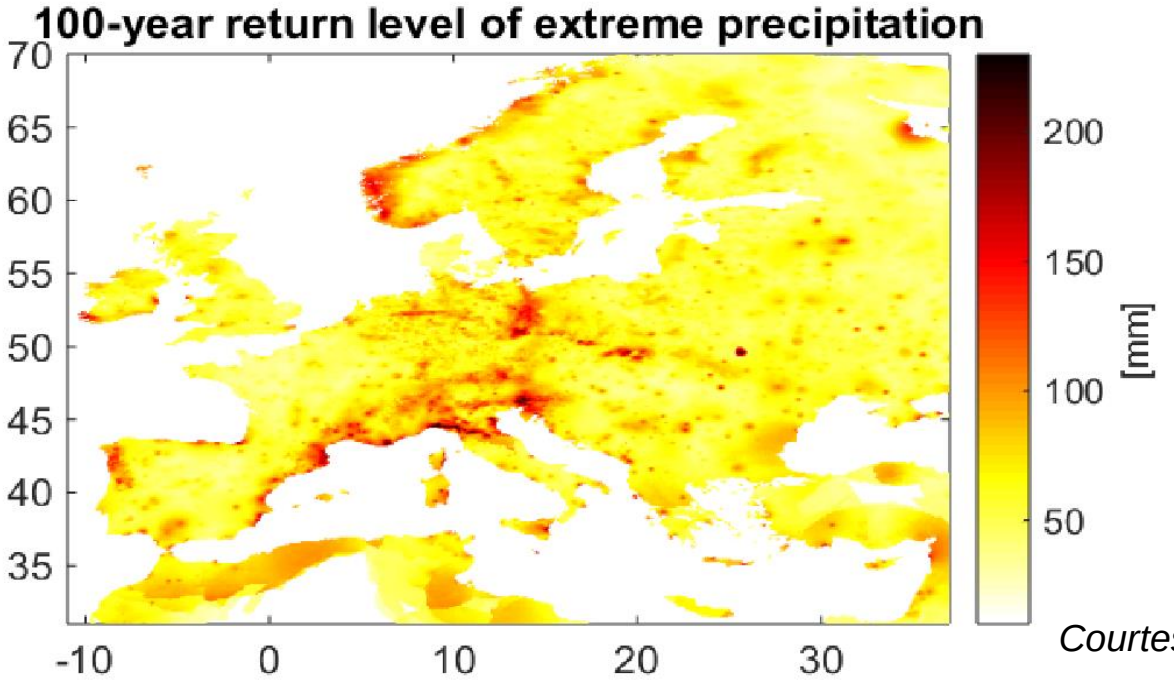


# 4- Seasonal distribution of FRD

Past trends of F (fatality rate)

# 5- Discussion and further developements (comparison with rainfall data)




*Courtesy from Y. Tramblay et al.*

# 5- Discussion and further developments

Mortality is a multi factor driven phenomenon explained by anthropic factors (population….) and hazard drivers (?)

Geographical discepancies e.g. between western and eastern mediterranean basin.

→ To collect data on neighbouring countries (e.g. Valencia region, Tunisia, Israel…)

→ See Petrucci et al. 2019 on European Flood fatalities EUFF DB

→ To develop a fine grained analysis of mortality e.g. to see differencies between inland regions and coastal zone.

→ To collect or to build data on exposure (people in flood prone zone…)

→ To connect mortality with other hazards data

*Thank you for your attention*

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