
Indre, 04/08/2021. L. Guilpain


Bihucourt, 24/10/2022. M.Libert


Bihucourt, 23/10/2022. C. Slojewskj


Hautmont, 04/08/2008. La Gazette nord


Arles, 15/10/2019, AFP G. Julien


Creuse, 09/03/2023, Twitter JM. Velleine

TORNADOES IN FRANCE SINCE 1900: CHRONOLOGY AND SPATIAL ANALYSIS

Matthieu LACROIX [1], Yanni GUNNELL [1], Saïda KERMADI [1]

(1) Laboratoire EVS UMR 5600 CNRS, Université Lumière Lyon 2, 5 Avenue Pierre Mendès-France, 69500 Bron, France.

Introduction.

Tornadoes in France are underestimated phenomena that deserve to be monitored. A better current understanding of their spatial and temporal distributions should lead to a better understanding of future developments.

In this study, we present:
- their spatial distribution and monthly evolution in France,
- a synthesis of the areas where thunderstorms are formed,
- a tornado risk map of France.

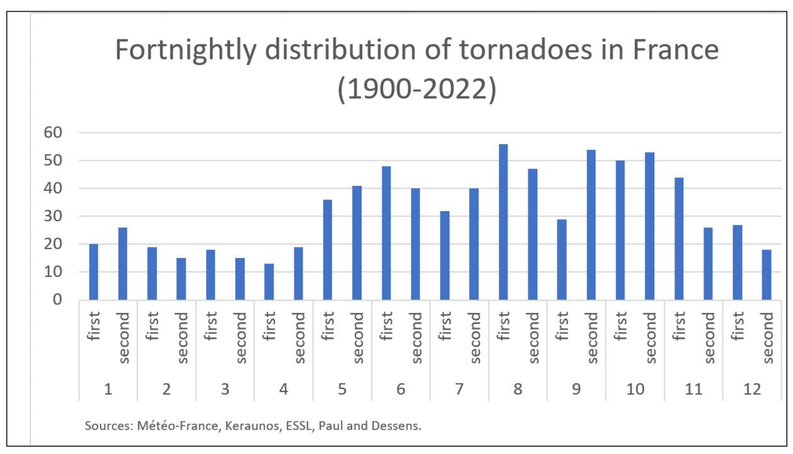
Tornadoes databases

- **BDEM** of Météo-France (*database of significant events*)
- **European Severe Weather Database** of the European Severe Storm Laboratory
- **Private database (Paul and Dessens, Keraunos)**

Census of **786 tornadoes for the period 1900 to 2022**.

Methods

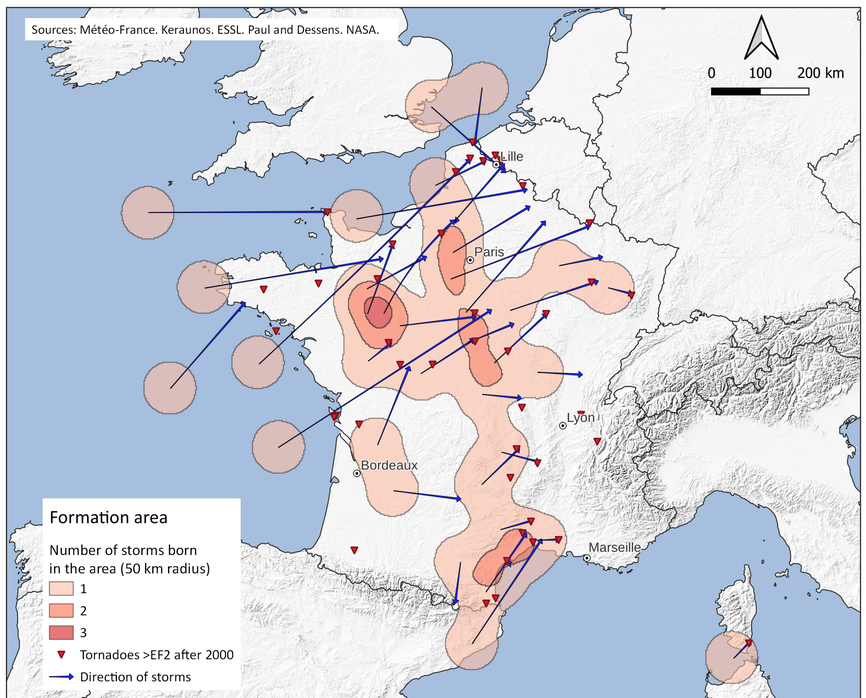
- Use of **Kernel Density estimation,**
- **Visual interpretation** of development areas based on IMERG data,
- Use of **Analytic Hierarchy Process (AHP)** for tornado risk map.



The number of tornadoes varies according to month and season :
- The **minimum is in the first half of April.**
- The **maximum is in the first half of August**, especially in the northernmost France.

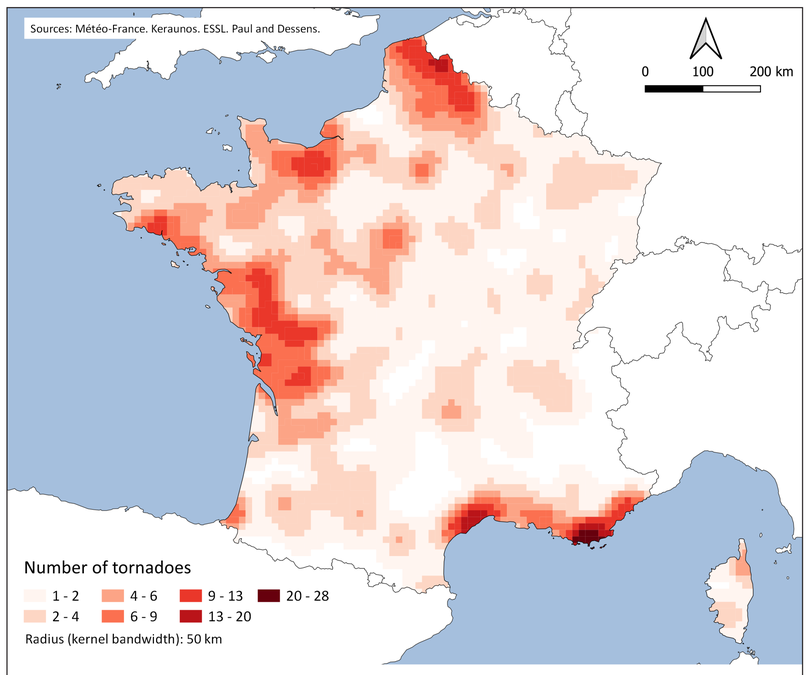
3. Formation area of tornadic storm in France

- **30 tornadoes studied**, intensity from EF1 to EF4 between 2000 and 2022.
- **South-west to north-east** trajectories for the majority of storms.
- Time between formation and tornado is **about 4 hours**.
- Storms **form between 11 and 12 am** local time.
- Better result expected with **increased number of samples.**



Formation area of tornadic storms in France (2000-2022)

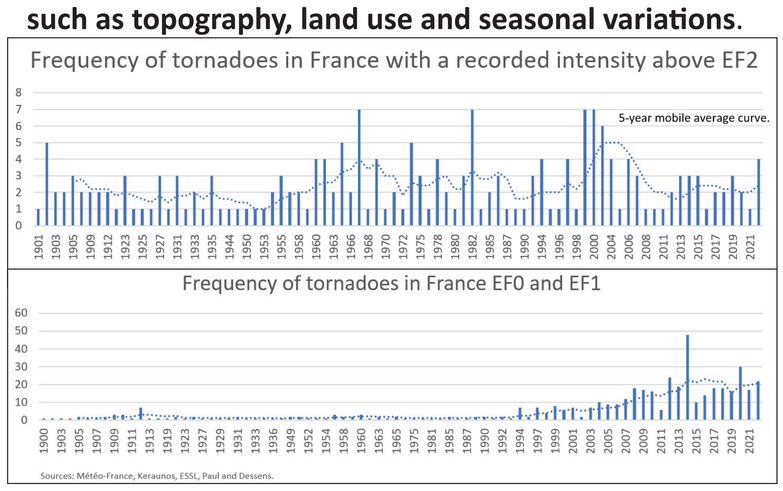
1. Spatial distribution: mostly near a coast



Spatial distribution of tornadoes in France since 1900

Four distinct areas:
- **northernmost France** (Flanders)
- **Lower Normandy**
- **Poitou, Charentes and southern Brittany**
- The **Mediterranean coastline (Languedoc, Provence)**

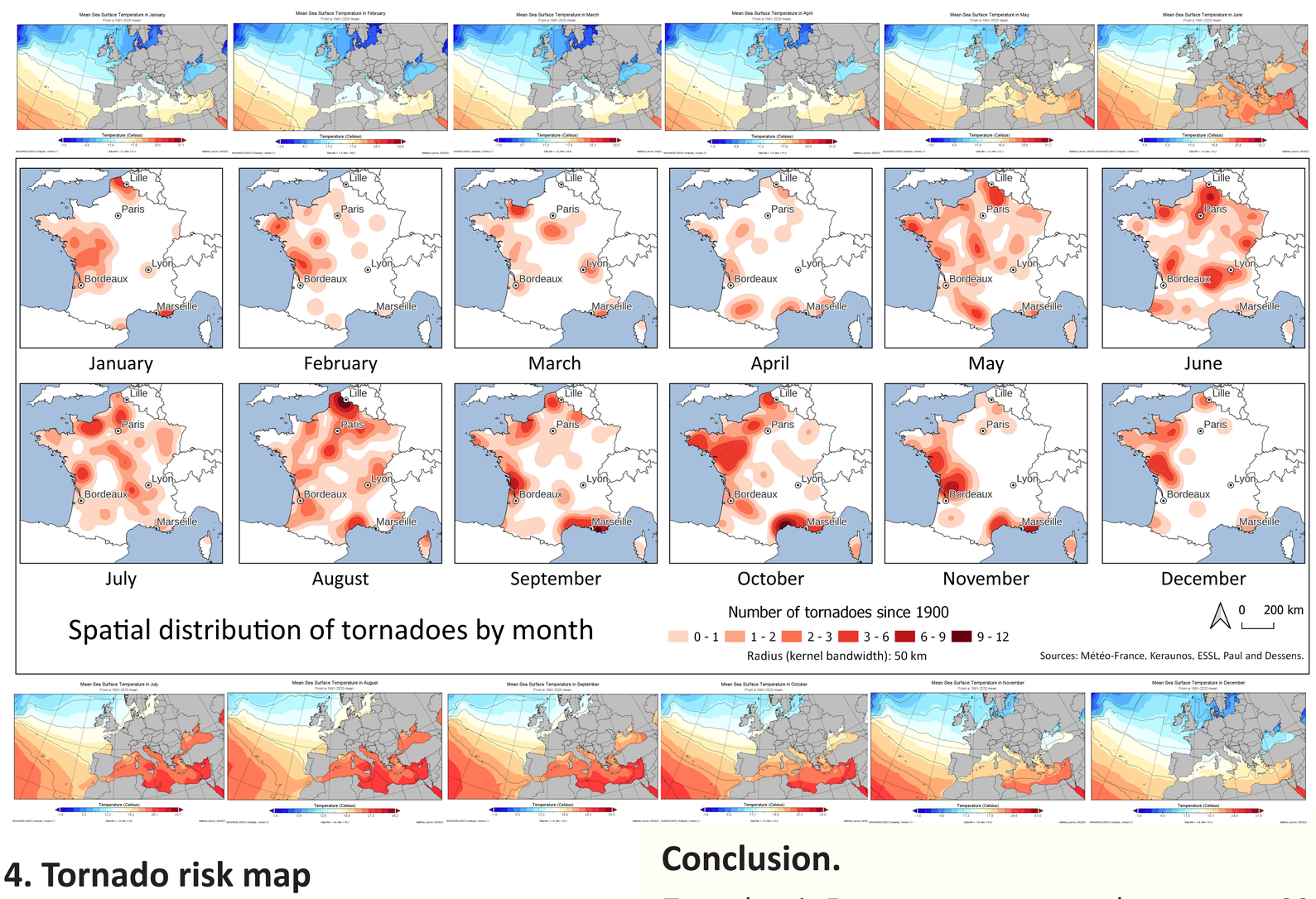
These distributions are **influenced by environmental factors such as topography, land use and seasonal variations**.



- EF2 intensity tornadoes **show an increase in frequency** of years with a number of 2 EF2 tornadoes and more : **9 between 1900-1961** and **23 from 1962 to 2022**.
- Tornadoes with a weak intensity (EF0 and EF1) show a positive evolution since 1994 : observational biais due to internet, social media and a better reporting system of this phenomenon?

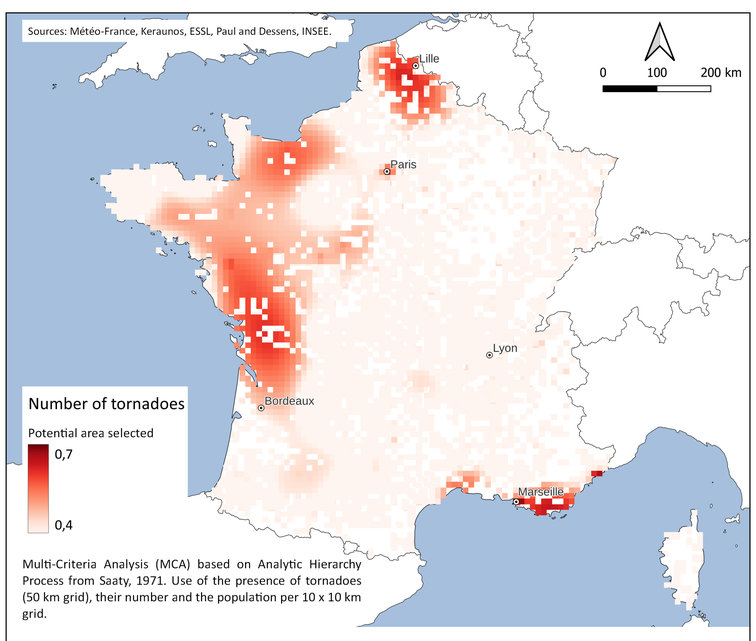
2. Uneven spatial distribution, linked with season and SST?

- A **winter period** mostly prevalent in the **west of France** (oceanic climate).
- A **summer period** affecting **inland areas**.
- An **autumn period** with an increase on the **Mediterranean coast**.



Spatial distribution of tornadoes by month

4. Tornado risk map



Tornado risk in France

Conclusion.

Tornadoes in France are a recurrent phenomenon; 20 tornadoes every year for the period 2000-2022. Their number fluctuates annually: for example whereas 2002 recorded only 4 cases, 2014 recorded 51. Coincidence or upward trend? 2014 was one of the warmest year in France since 1900 (+1.2 °C compared to the 1981-2000 normal). The improvement in means of communication and information sharing has thus increased the visibility of tornadoes, but ***the occurrence of medium and high intensity tornadoes is becoming more regular****. Is this an effect of climate change or just an observational bias?*

References

Antonescu B., Schultz D., Holzer A. and Groenemeijer P., *Tornadoes in Europe: An Underestimated Threat*, Bulletin of the American Meteorological Society, 98.4 (2017), 713–728.

Dessens J. and Snow J., *Tornadoes in France*, Weather and Forecasting, 4.2 (1989), 110–132.

Groenemeijer P. and Kühne T., *A Climatology of Tornadoes in Europe: Results from the European Severe Weather Database*, Monthly Weather Review, 142.12 (2014), 4775–4790.

Saaty R.W, *Analytic Hierarchy Process (AHP)*, (1971).

Contact

matthieu.lacroix@univ-lyon2.fr

@LaxMatthieu

Matthieu Lacroix

European Conference on Severe Storms

Université Lumière Lyon 2

Environnement, Ville, Société UMR 5600