Learning lessons from deaths & injuries due to lightning in Western Europe

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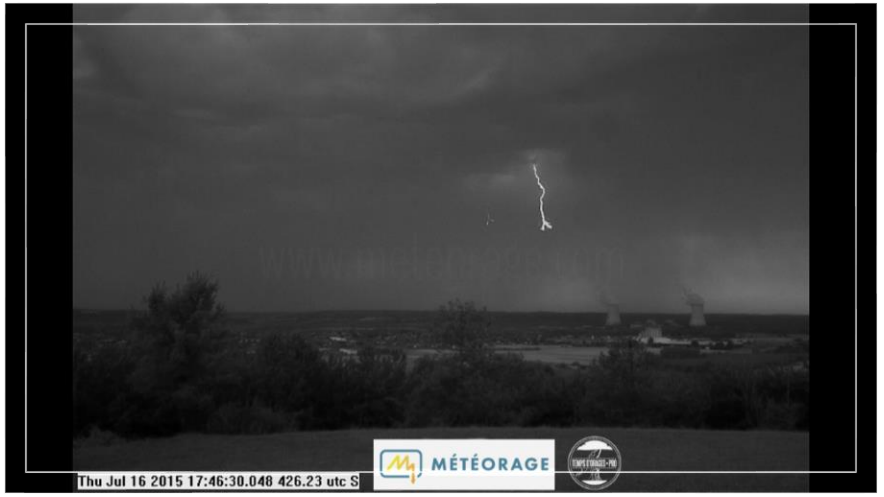

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Context

- A lot of private or public agencies (Met Offices, Lightning protection institutes or firms, civil security,...) run awareness campaigns to reduce lightning fatalities.

- Delivering an effective message requires us to:
  - have an objective idea in terms of **thunderstorm accidentology**.
  - check whether **accidents** are usually due to unpredictable or sudden events or **could be anticipated**.

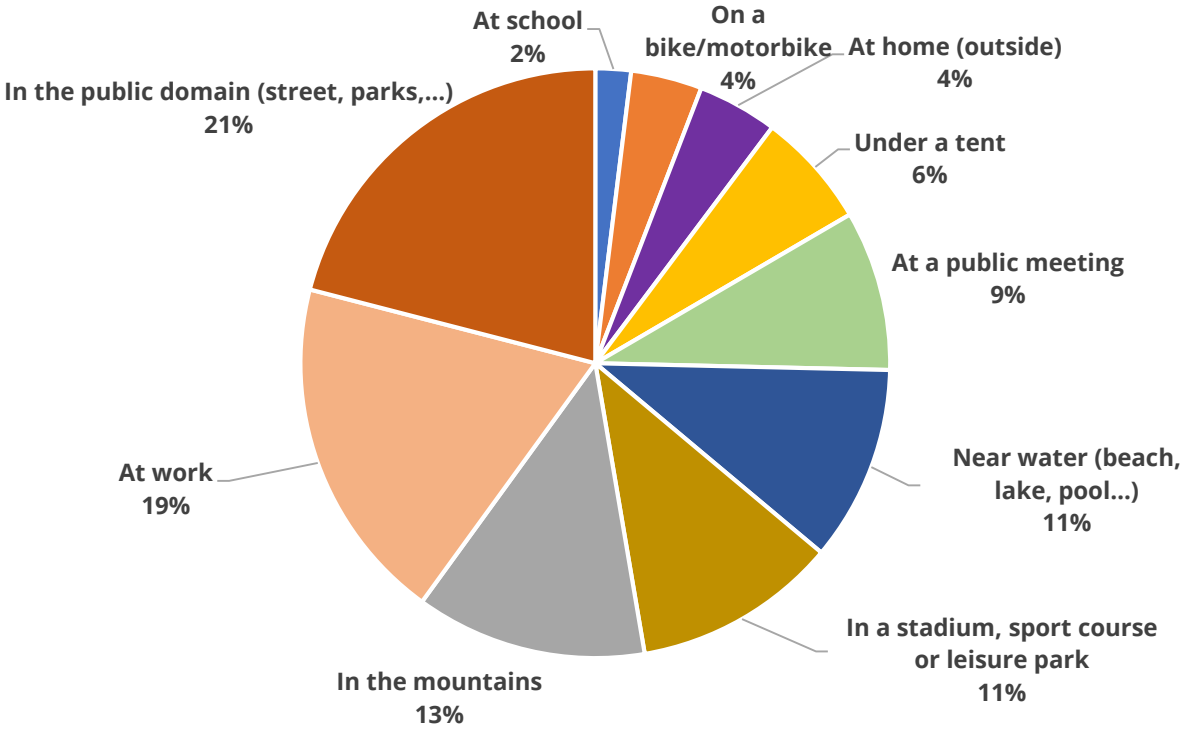
Method

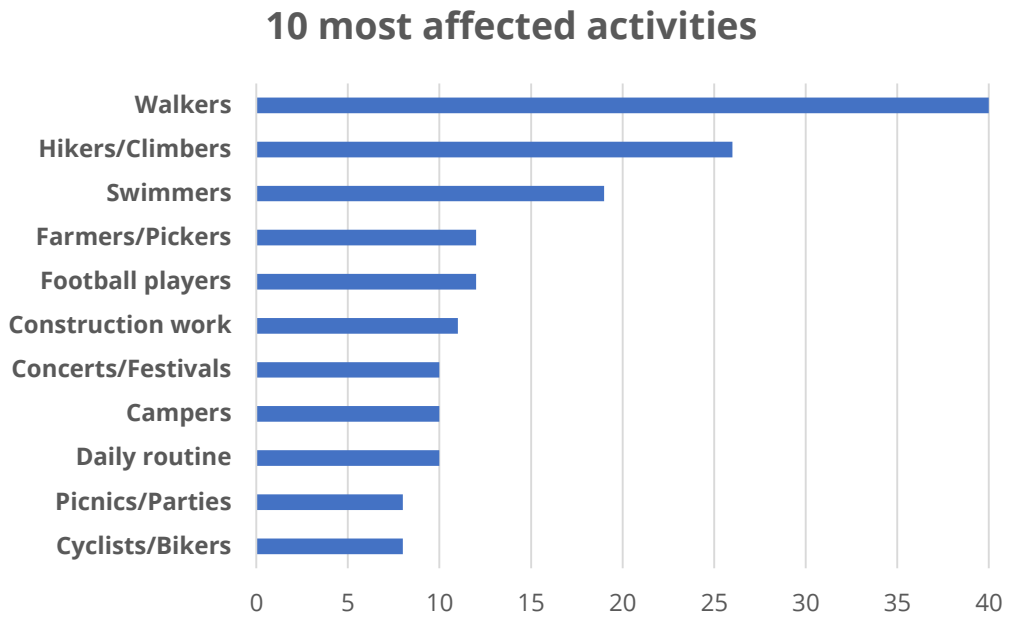
- We analysed **212 cases at random throughout Europe** during the **2010-2019** period, obtained via press alerts and the European Severe Weather Database (https://www.eswd.eu/).

- Beyond a simple statistical approach, we especially analysed each case to:
  - determine whether these events were predictable and **calculated the lead time** for each of them.
  - Try to figure out some typical behaviour before, during and after the accidents.

Results: « lessons from accidentology »

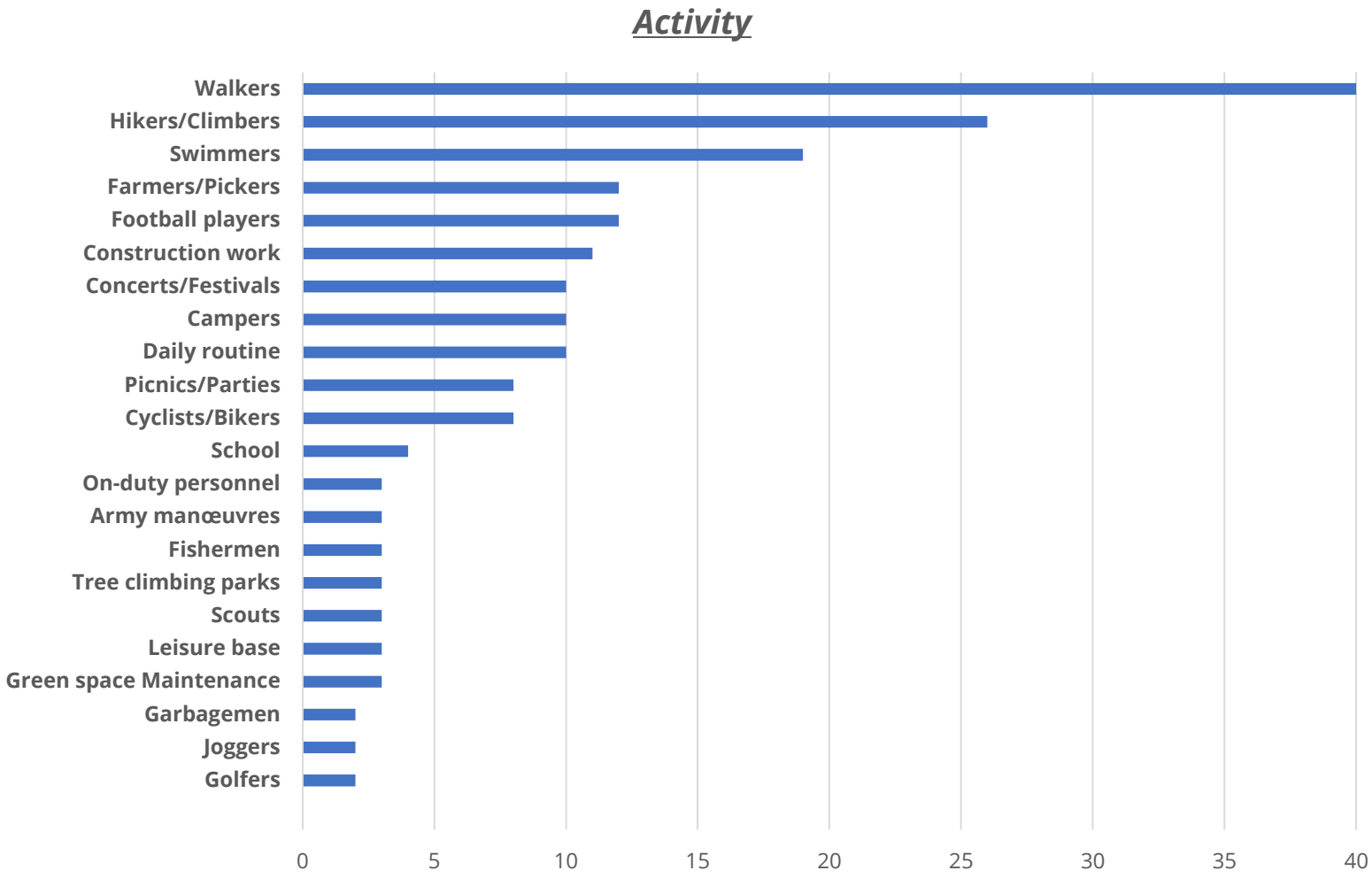
- Who and When? Interesting but expected results and limited interest to improve awareness campaigns: males are overrepresented (2 deaths out of 3), accidents mostly occurred in July (almost 30% of the cases), etc…
- What and Where? More interesting, in particular to argue against common beliefs (e.g. “the golfer myth”) or to confirm some of the current key advice (e.g. in around 1 accident out of 3, people are under or near trees or sheltering in an insecure refuge)





These results are also useful to raise awareness among public authorities, firms or organizations and not only individuals.

Results: « lessons from accidentology »



More than 30 different types of activities were affected with 80% exhibiting more than 1 case.

There were as many accidents on a golf course as during garbage collection…

Method: « Unpredictable and sudden? »

- We used lightning information from the EUCLID network covering Europe
- For each of the accidents, our study consisted in:
  - Correlating the localisation of the victim and a cloud-to-ground stroke (CG)
  - Considering the closest CG as being responsible for the accident, checking the compatibility of the schedule with the accident report
  - Checking whether a previous lightning flash had been detected within a 20 km area to determine the Probability of detection (POD) or the failure to warn (FTW)
  - Calculating the time difference between the first lightning flash detected within a 20 km area and the CG considered as being responsible for the accident, to determine the lead time.

Example:

Report incident date	Date and distance of the closest CG		Date of the first flash within a 20km area	Lead time		Activity of the victims	GPS coordinates		Press article
16h45	0,1	16h44	14h57	>1 heure	France	Promeneur/badaud	43,95	4,85	https://www.20minutes.fr/faits_divers/2275515

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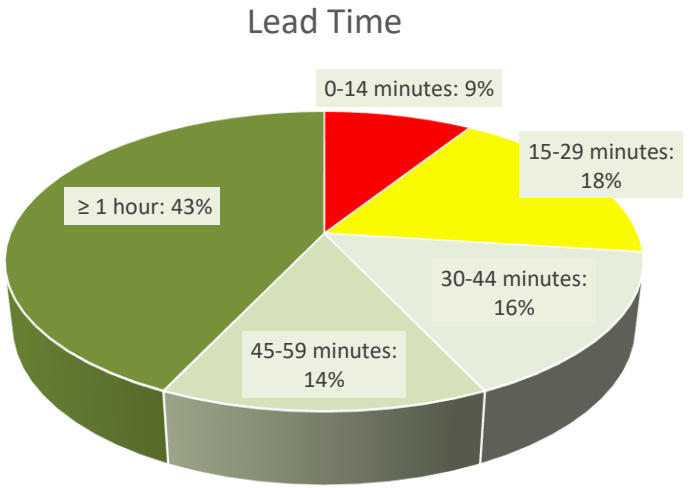
Results: « Unpredictable and sudden? »

- A confirmation of our previous studies based, this time, on real situations: 7% of the thunderstorms developing overhead with a lead time (LT) below 10 minutes.

- Several lead time were then calculated, and we obtained:
  - a 91% POD15'
  - a 73% POD30'
  - ...and in more than half of these situations, the LT exceeded 50'



- These results are also valid for the mountain cases: POD30' of 73% and POD45' of 65% despite more sudden situations (a lead time lower than 10' in 15% of the cases)

Results: « Unpredictable and sudden? »

- A complementary study was also made on the 55 French cases, in order to determine whether these thunderstorms had a similar configuration which could let us think that accidents were due to a specific thunderstorm “signature”.

- Our results revealed that we are faced with:
  - different configurations (multicell, supercells, elevated convection, MCS,…),
  - different weather conditions (cyclonic southwesterly flow, convection in cold air, flat low,…),
  - a slow or moderate lightning activity in general (63% of the cases)
  - **a slow or moderate speed of propagation for most of them (85% of the cases)**

- The analysis of several similar cases encourages us to think that accidents were more due to a lower vigilance by the victims (probably a belief that the thunderstorm was coming to an end or passed by their location), rather having been taken by surprise by a sudden formation.

unpredictable and sudden….really?

And what about behavior?

A more detailed analysis revealed some other disturbing lessons:

- *Before the event: do weather forecasts give a right perception?*
  - We consulted the vigilance archive data for the 55 French accidents (http://vigilance-public.meteo.fr/) to try to determine if the victims could have been informed of the risk.
  - For all of them, a vigilance was ongoing, but **82% of them were "yellow" ones** ("stay attentive") and only **~10% were related to severe thunderstorms ("orange").**

- *During the event: underestimating the danger!*
  - Excepting some extreme situations, most of these accidents occurred **while thunderstorms had been active in the area for more than 30 minutes before**.
  - Some cases suggest that **thunderstorms were still active** despite a decrease of lightning activity some minutes before which could have misled the victims!
  - Many of the victims **maintained a risky outdoor activity or shelter under trees** (~30% of the cases) **or wooden refuges even when access to a nearby shelter was available.**

- *After the event: a fatalistic conclusion…*
  - Victims but also authorities' statements are usually fatalistic: these accidents are often considered as **"improbable and unpredictable"**
  - The real danger of thunderstorms is often underestimated in their excuses: *"The storm had been announced, but did not seem violent", It was a mild storm with only a few thunderclaps" or "If the storm would have presented a danger to the spectators, the show would have been cancelled".*

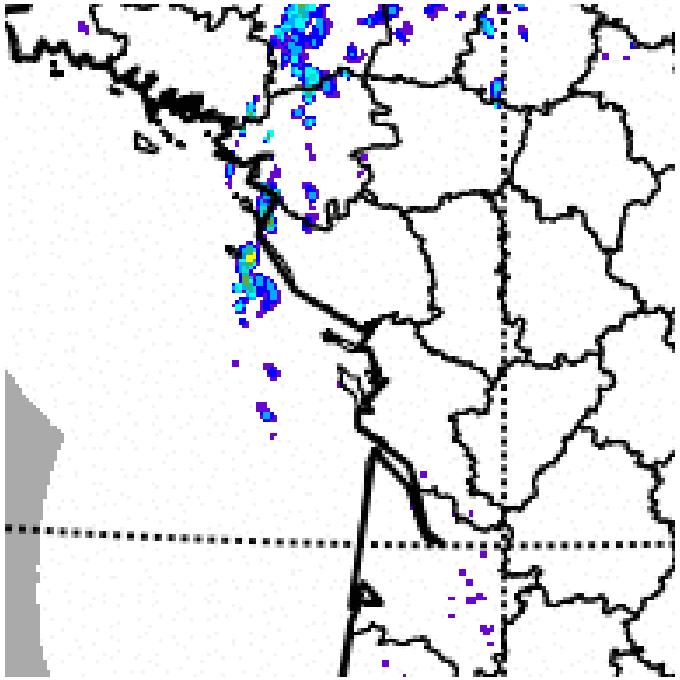
Conclusion

- **Nearly 9 out 10 accidents due to lightning could technically be avoided by using nowcasting techniques**, complementary to weather forecasts or vigilance which is not always sufficient or adapted in real-time.

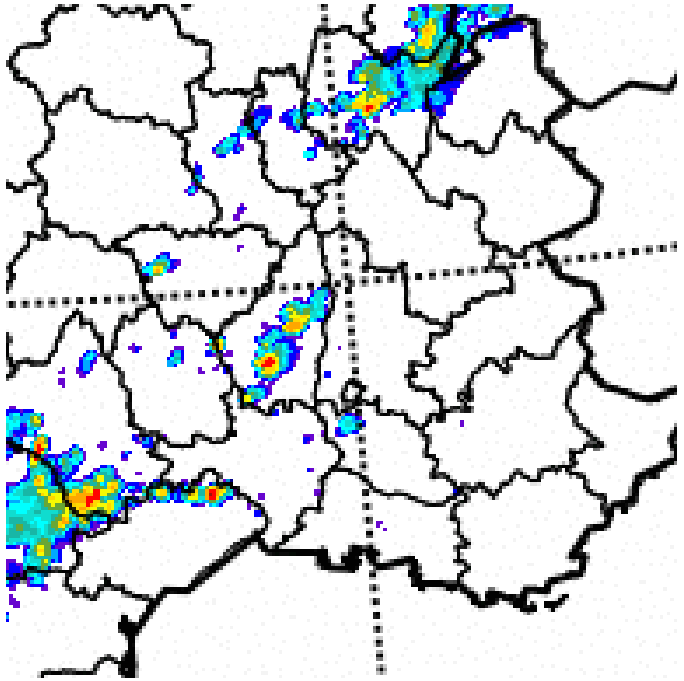
- Beyond the technical issues (telecom capabilities, access to lightning information,...), there are still **improvements to be made in terms of general public communication**, both **vigilance instructions**, reminder of the **behaviour to adopt**, and **awareness of organizations** as much, if not more, than individuals.

- Reducing the number of accidents by a factor of 3 is technically conceivable...

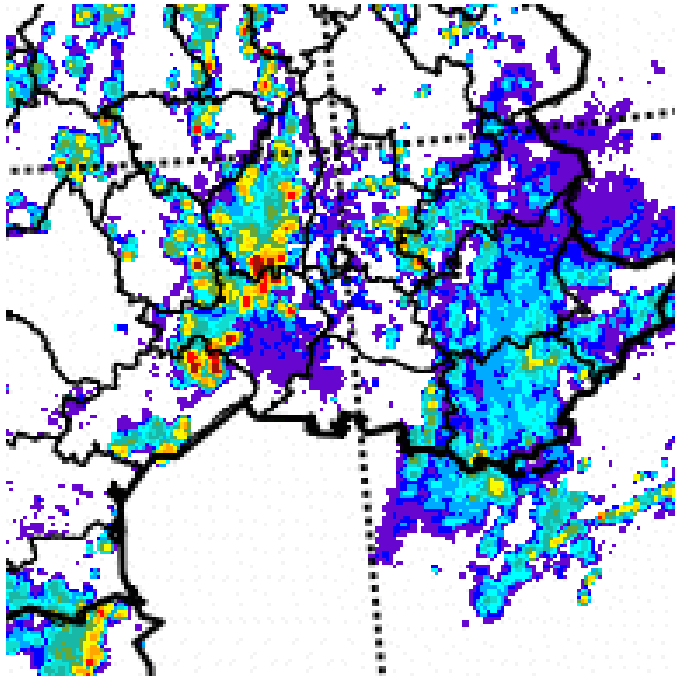
Thanks for listening !



Oléron : sudden



Drôme : preventable



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