Servei Meteorològic de Catalunya

Generalitat de Catalunya

First results of the 2016 Operational Campaign using the LJ algorithm.

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Servei Meteorològic de Catalunya (SMC).

Introduction

Definition

- The LJ is a **sudden increase of the total number of lightning rate** (Williams et al. 1999).

- It is a consequence of strong updraft which favours the crash between ice particles and a higher separation of the charge (Williams, 2001).

- This tool is used for forecasting **SEVERE WEATHER**
  - Hail > 2 cm
  - Tornados / Waterspout
  - Downburst
  - Strong gust wind

Algorithm

Adjustment

- The tool is an adaptation with some different requirements of research algorithms developed in the USA (Schultz, Gatlin…)

- The original algorithm takes into account **Radar** + **Lightning Data**.

We only consider **Lightning Data**.

Why?

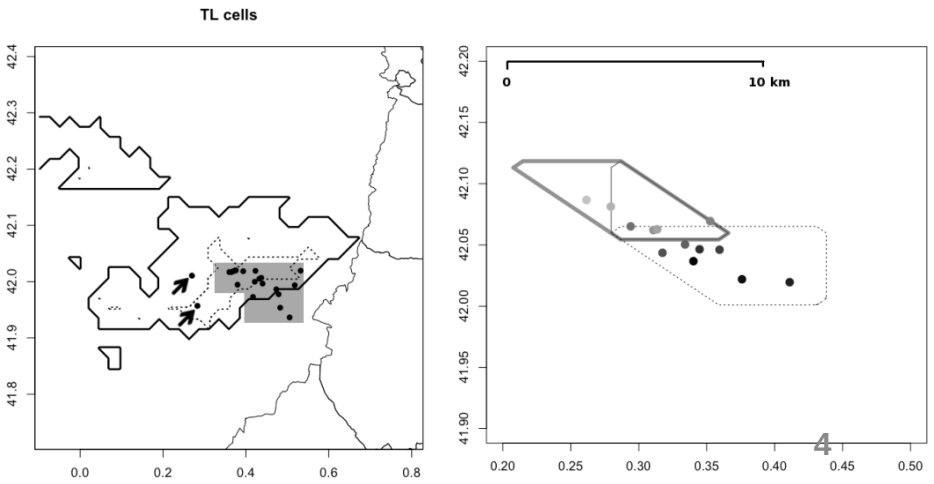
- The **Lightning Data** allow us to execute the algorithm every minute.

In contrast, we obtain **Radar Data** every 6 minutes.

Algorithm

Requirements

- The isolated flashes are discarded.
- Flashes positions (points) are converted into matrix, merging those adjacent pixels in clusters.
- A cluster must have continuity in space and time.
- In this way, we detect the active cell



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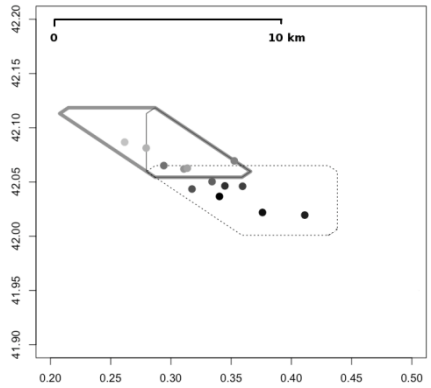
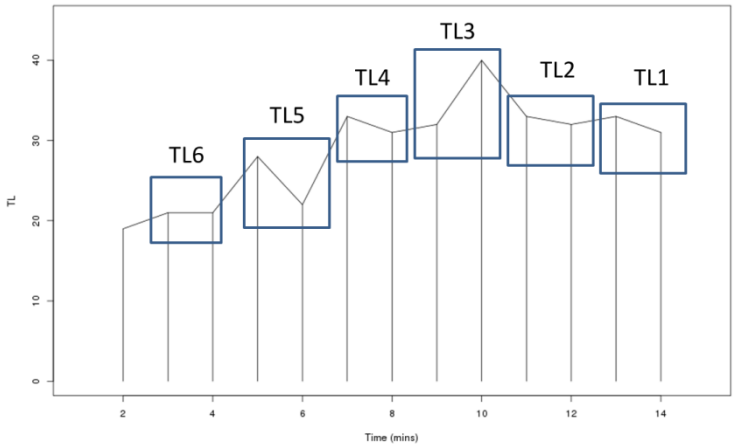
Algorithm

How it works

- Once we detect the active cell, we study the flashes from 14 minutes before current time.

- This period is divided into periods of 2 minutes. Then, we calculate the average of Total Lightning (TL) of each period.





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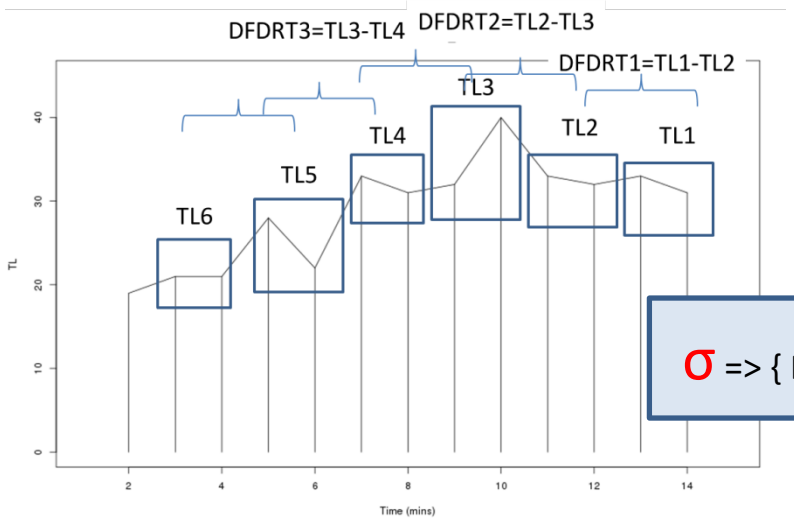
Algorithm

How it works

- The averages are subtracted sequentially between them



It is calculated
the standard deviation
of all DFRDT

σ => { DFDRT1, DFDRT2, DFDRT3, DFDRT4, DFDRT5, DFDRT5, DFDRT6 }

σ*2 < DFRDT 1

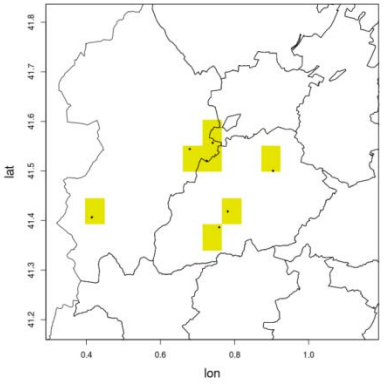
LJ

Characteristics

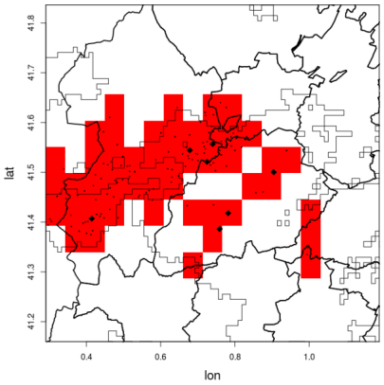
Total Lightning (TL)

- This tool needs the TL (intra-cloud (IC) + cloud-to-ground (CG)) to work well.

Lightning	Only CG	CG+IC (TL)
Nº alerts (2006 – 2013)	**6**	**630**



CLOUD TO GROUND

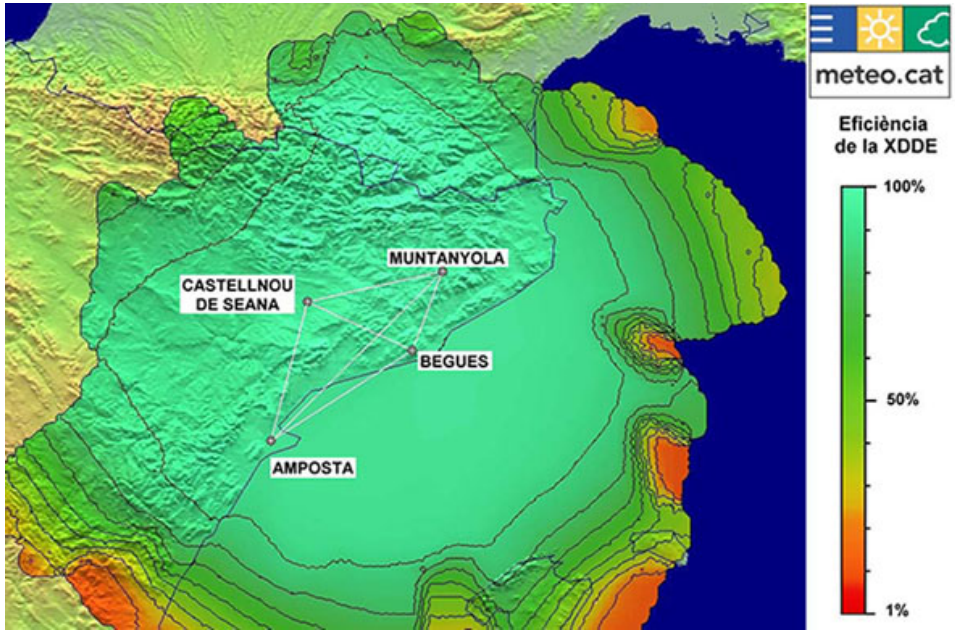


TOTAL LIGHTNING

Characteristics

Lightning Location System (LLS)

- The LLS of the SMC operates in both frequencies, LF and VHF, allowing the detection of IC and CG flashes.
- Few networks in Europe have this capability (IC detection)
- The LLS is composed by 4 detectors, with a efficiency of > 90% over the territory

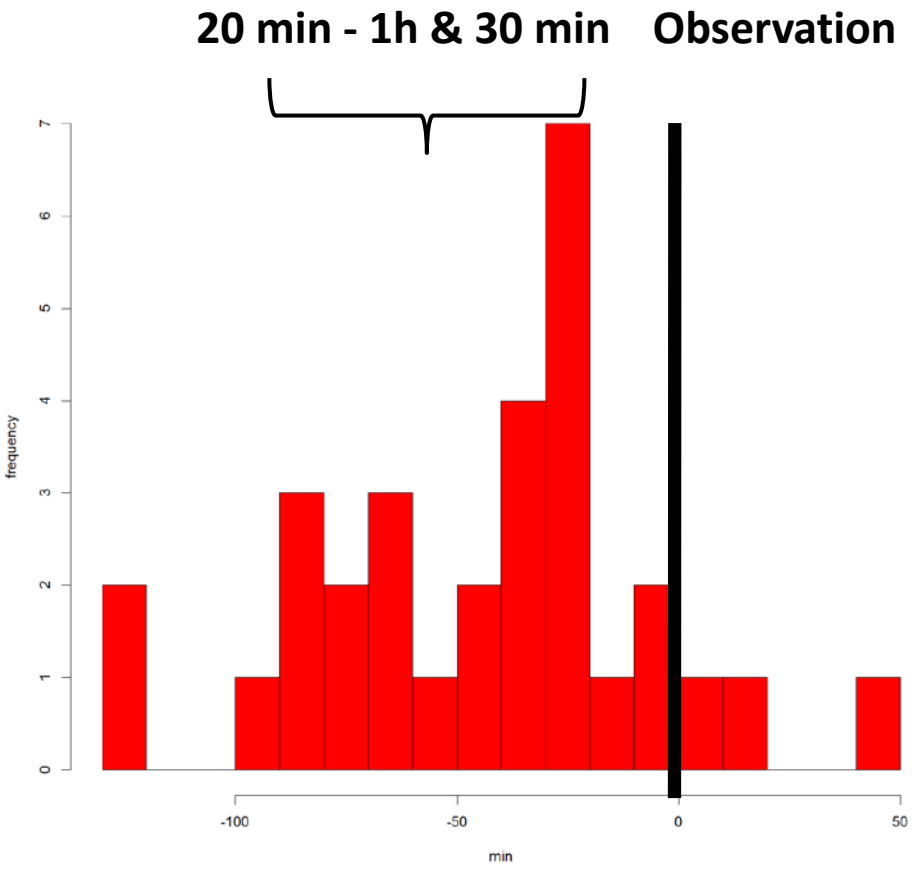


Characteristics

Lead Time

- The Lead Time is the difference of the time between LJ and Observation.

- In the majority of the episodes, the LJ took place between 1h 30’ and 20’ before the observation was recorded.



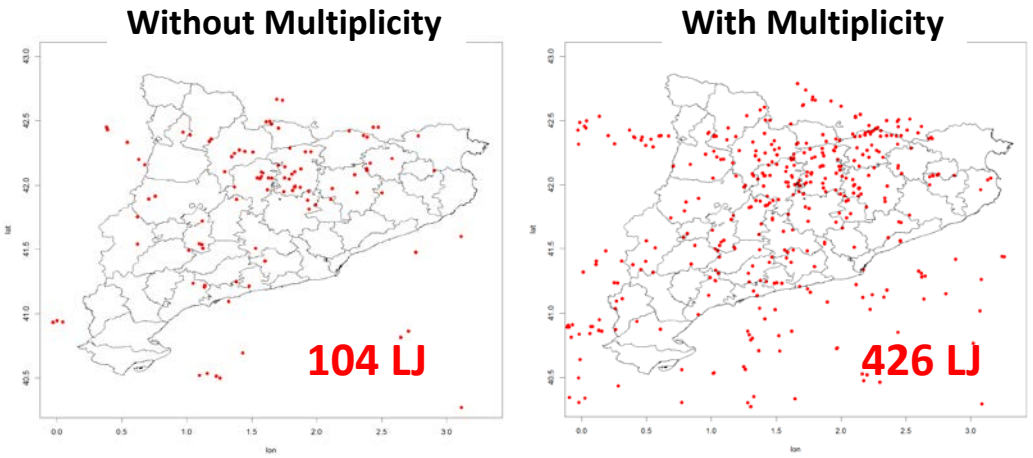
Characteristics

Multiplicity

- The multiplicity is a capability of the LLS network to detect several nodes of the IC flashes.

- The number of LJ taking into account multiplicity is higher than not considering the multiplicity (only the first node of IC).

Type Of LJ	Without Multiplicity	With Multiplicity
Nº alerts (2016)	**104**	**426**



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Characteristics

Multiplicity

- The Lead Time with multiplicity is larger than whithout multiplicity. In any case, we have obtained a good result for both methods.

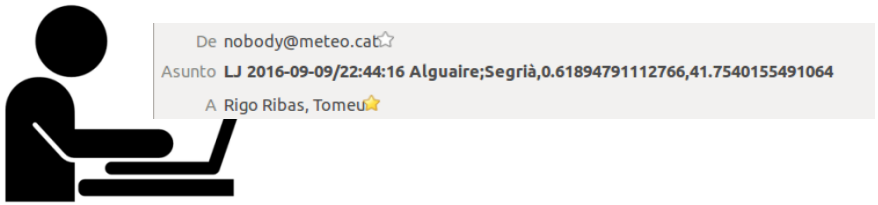
- The LJ with multiplicity allows us to detect episodes related to :

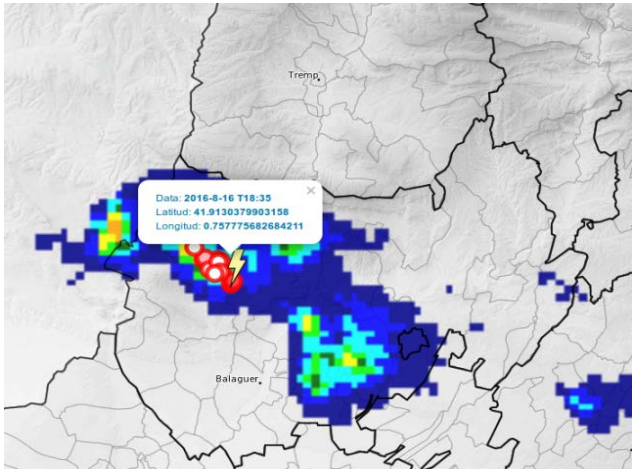
  - Severe weather
  - Small hail (0,5 – 2 cm)
  - Heavy rainfall

Operability in Meteorological Service of Catalonia (SMC)

Steps

- The tool was launch in SMC in summer of 2016
- When the alert is activated, the forecasters recive an email. They can see a map where the LJ is located.
- Also, they can see some characteristics of the LJ like latitude, longitude, and the time, among others.





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Severe Episodes 2016

On 16th August

LJ - 18:36 UTC
Observation – 19:15 UTC
Lead Time 39 min
3 cm to Linyola and Palau d'A. village.


SEGRE

ESPORTS | PÀG. 22-26

Quart or, el segon en piragüisme

Cooper guanya en K1 1.000 i Craviotto debuta avui en K2 200

DIMECRES 17 D'AGOST DEL 2016

www.segre.com

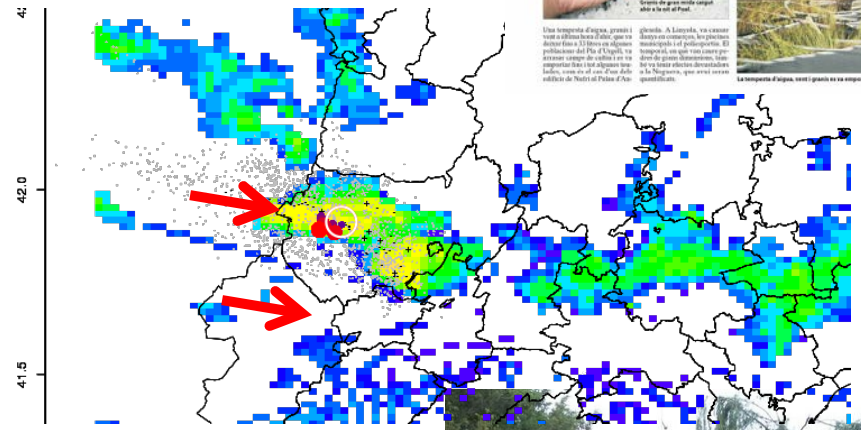
Una tempesta arranca teulades i arrasa fruita al Pla d'Urgell

Camp | Van caure pedres de la mida de monedes de 2 euros i es va acarnissar amb pera, poma i panís

Poblacions | A Linyola, alguns comerços van haver de buidar aigua i al Palau va afectar la plantà de Nufri

Afectació | Els efectes devastadors van arribar també a la Noguera, tot i que fins avui no se sabien les hectàrees

Una tempesta d'aigua, granís i vent a última hora d'ahir, que va deixar fins a 33 litres en algunes poblacions del Pla d'Urgell, va arrasar camps de cultius i es va emportar fins i tot algunes teulades, com els del cas d'una dels edificis de Nufri al Palau d'Anglesola. A Linyola, va causar danys en comerços, les piscines municipals i el poliesportiu. El temporal, un dels més forts dels darrers deu anys, també va tenir efectes devastadors a la Noguera, que avui seran quantificats.



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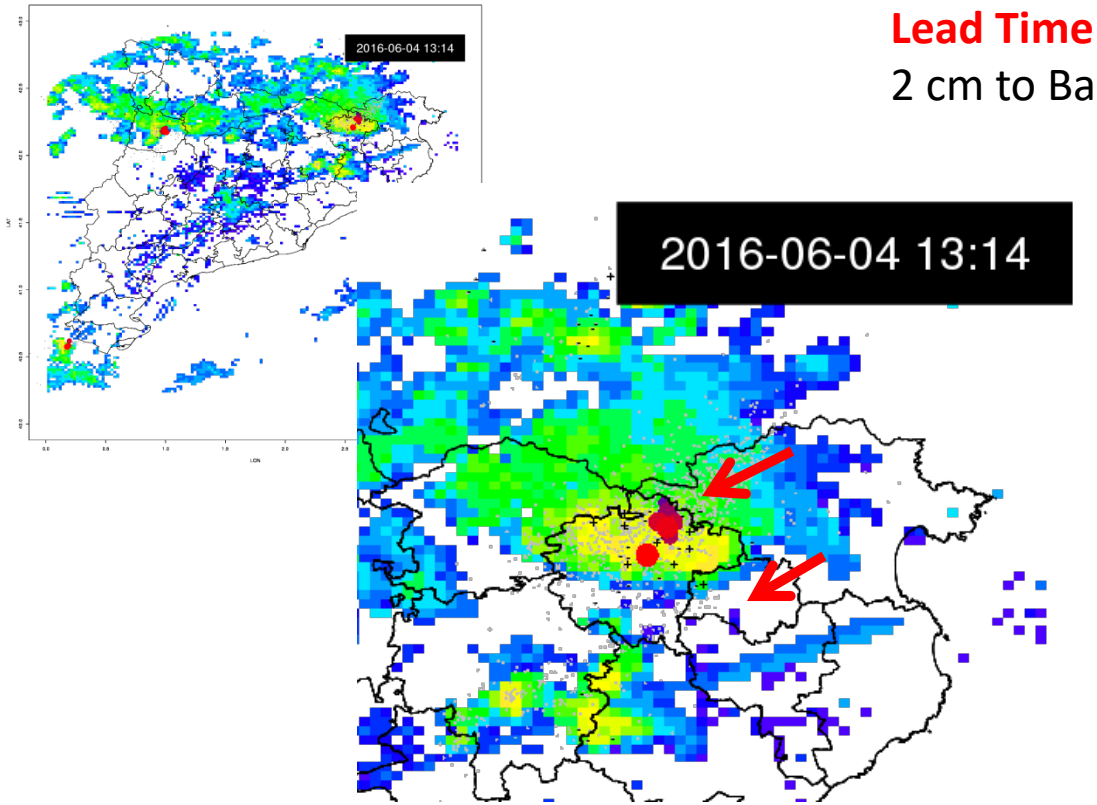
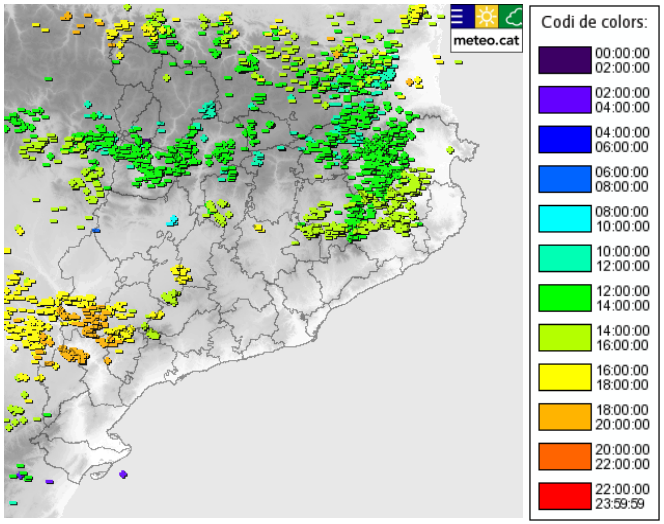
Severe Episodes 2016

On 04th June.

LJ - 13:14 UTC
Observation - 13:45 UTC
Lead Time 30 min
2 cm to Banyoles village





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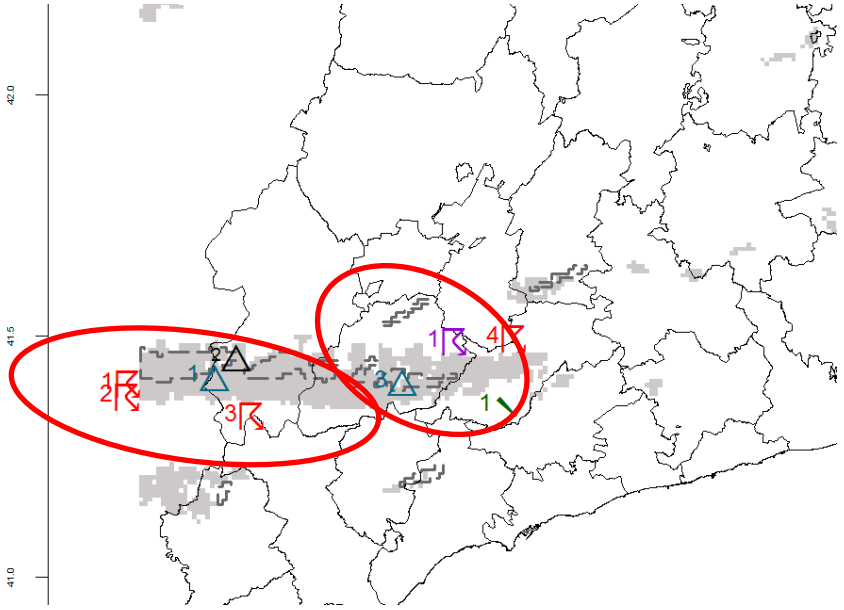
Severe Episodes with or without Multiplicity

On 22nd May

- LJ algorithm with multiplicity (LJWM) produces more warnings than without multiplicity (LJWOM).
- LJWM alerts forecasted the small hail (non severe).
- LJWOM only forecasted severe weather.

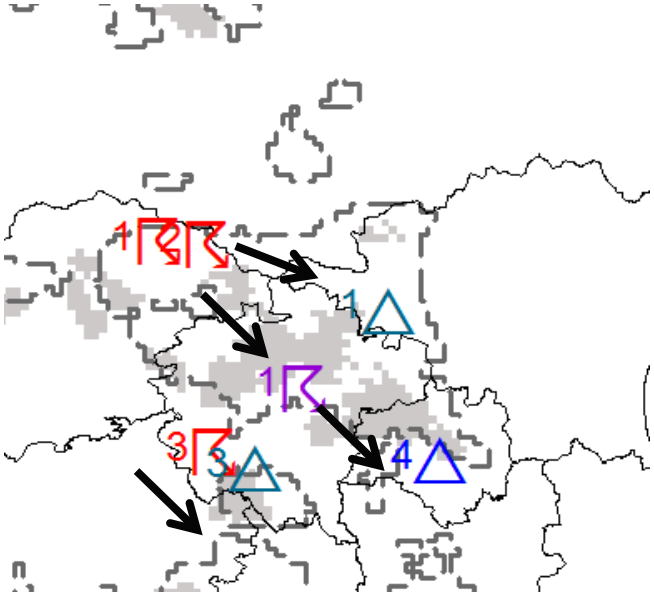


LJ WOM	LJ WM	Small Hail	Downburst	Lead Time (min)
	12:37			53
	12:40			50
	13:19	13:30		21
		14:00		
13:48	14:07		14:30	42
				23

Severe Episodes with or without Multiplicity

On 04th June

- The same characteristics were observed in most of the events occurred during 2016.



LJ WOM	LJ WM	Small Hail	Severe Hail	Lead Time (min)
	12:36			24
	12:43	13:00		13
13:14	13:19		14:00	46
				41

Conclusions

- TL (IC flashes) is necessary for the application of the LJ algorithm (without IC flashes, the number of warnings is residual).

- Lead time between alert and occurrence of the phenomena moves between 20 minutes and 1 hour and half, and it depends on the type of thunderstorm.

- The algorithm has been shown as a very useful tool for nowcasting severe weather.

- Considering multiplicity of IC flashes, the tool improves short term forecasting for cases with small hail and/or heavy rain rate.

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Thank you for your attention

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