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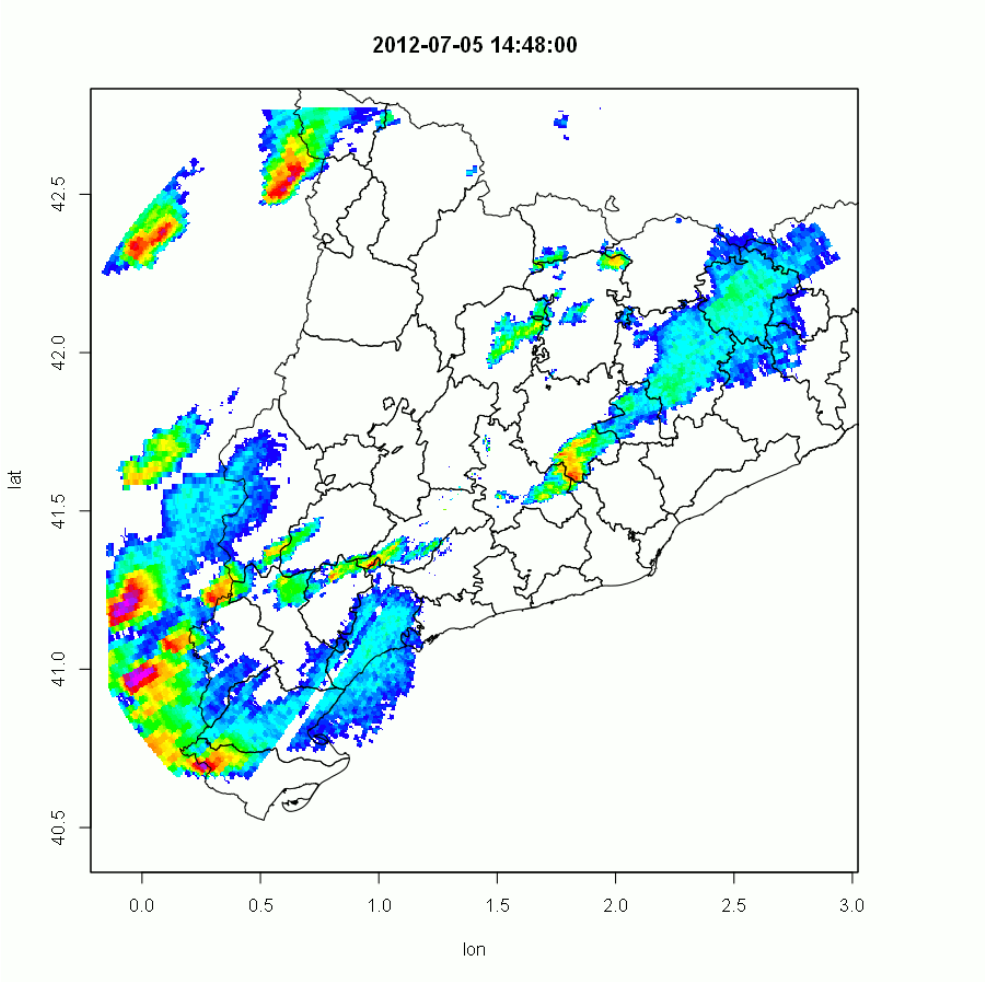
NOWCASTING COMBINING RADAR AND LIGHTNING DATA

Rigo, T., C. Farnell, A. Del Moral, N. Pineda

Introduction

Introduction



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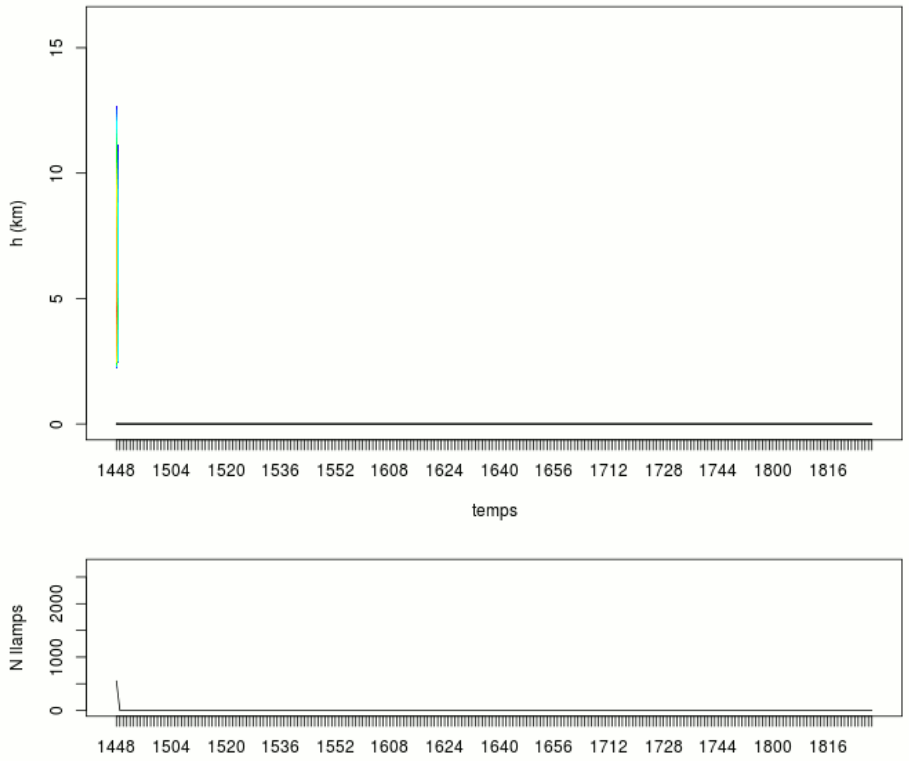

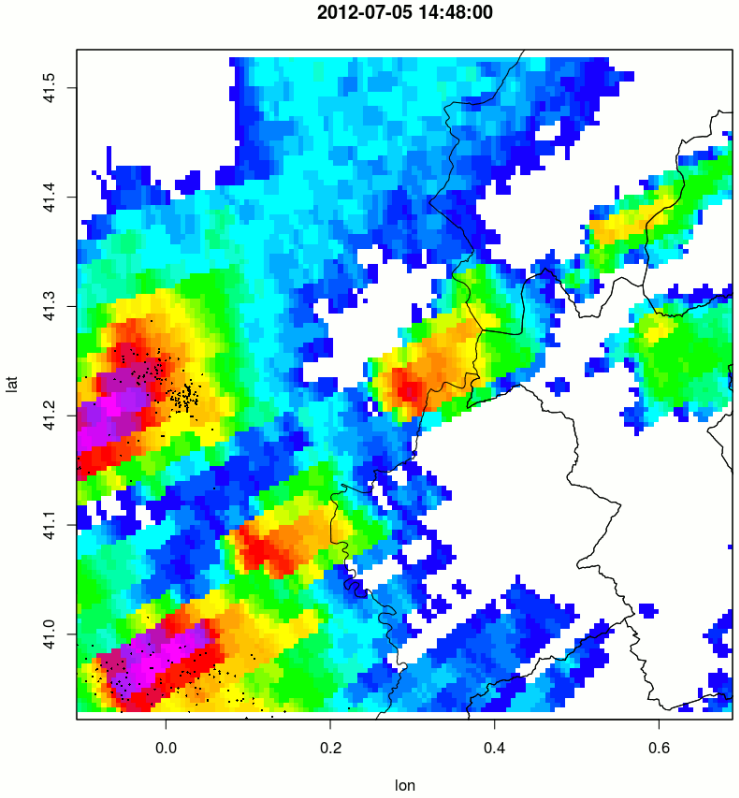

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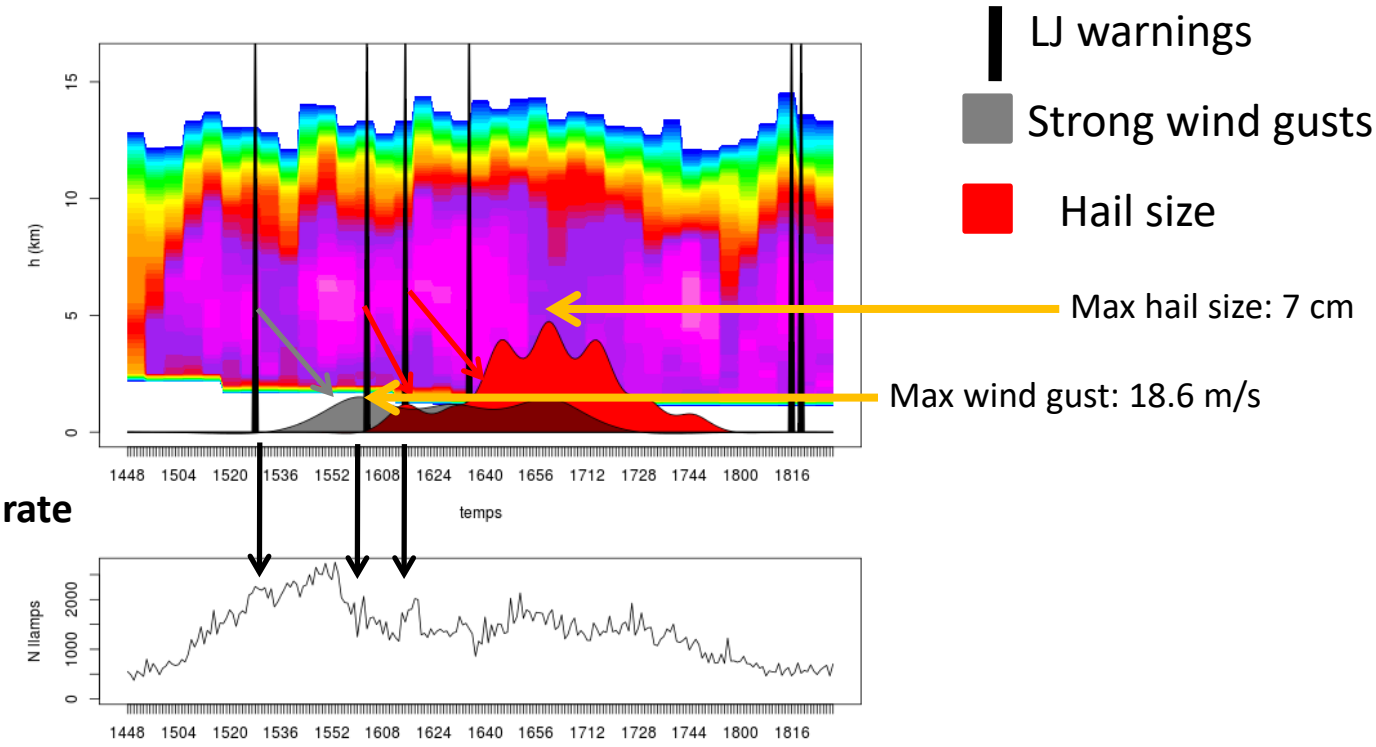
Introduction

Life cycle of a severe thunderstorm

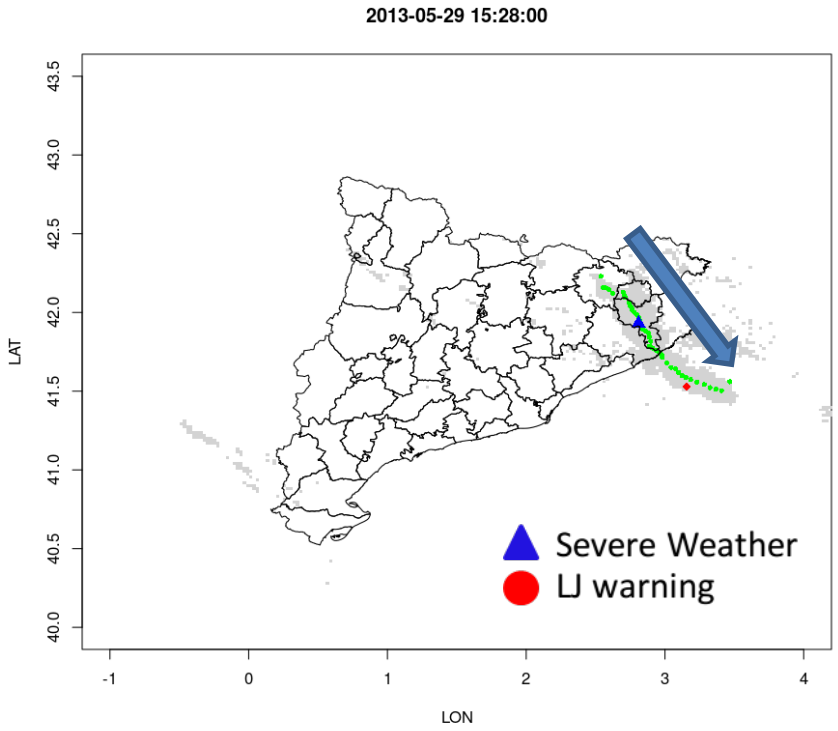
Vertical cross section of the thunderstorm from the point of view of radar

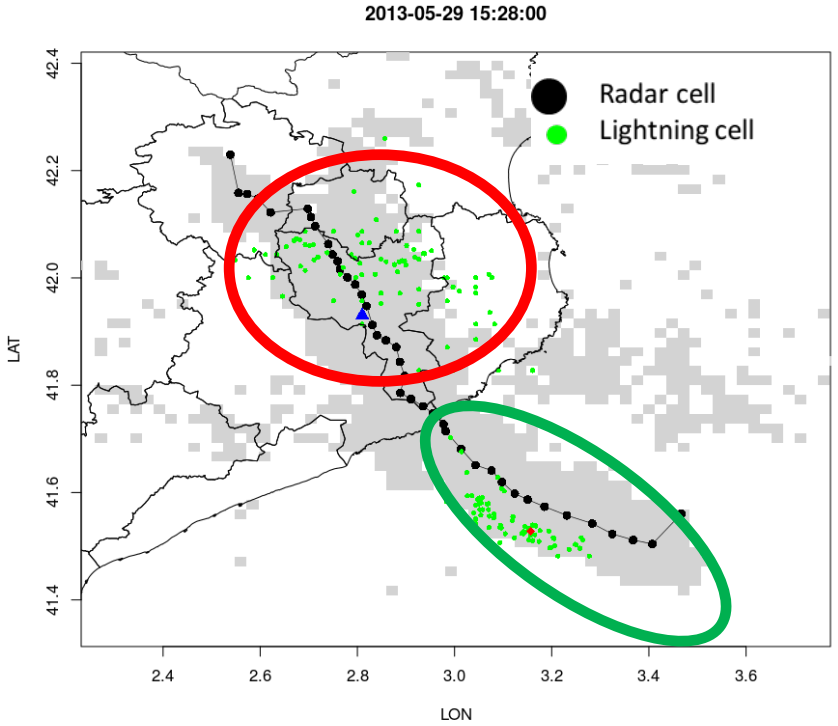


Total lightning flash rate

Relationship between radar and lightning: tracking severe thunderstorms

Tracking severe thunderstorms

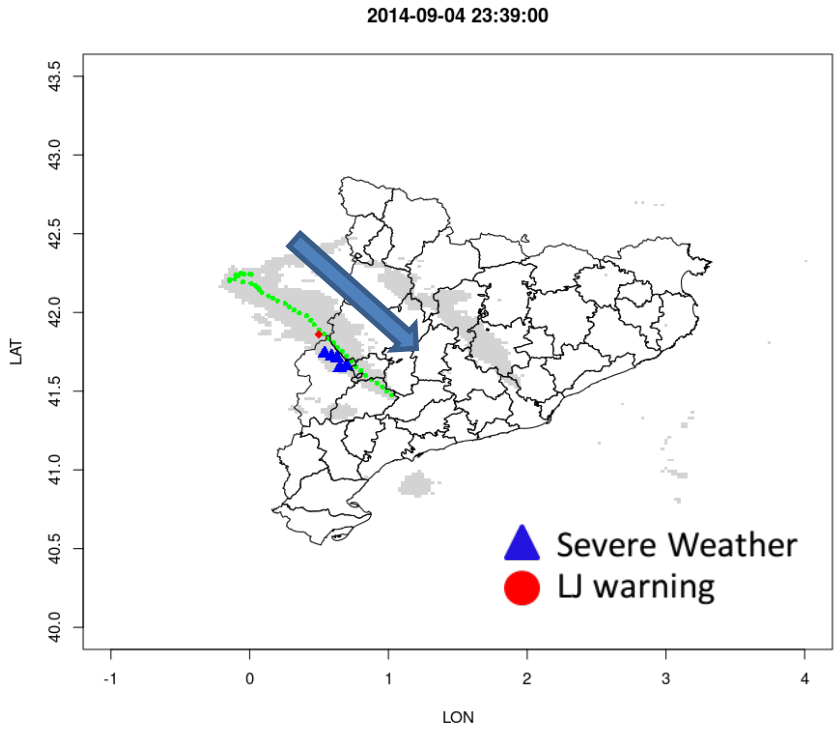


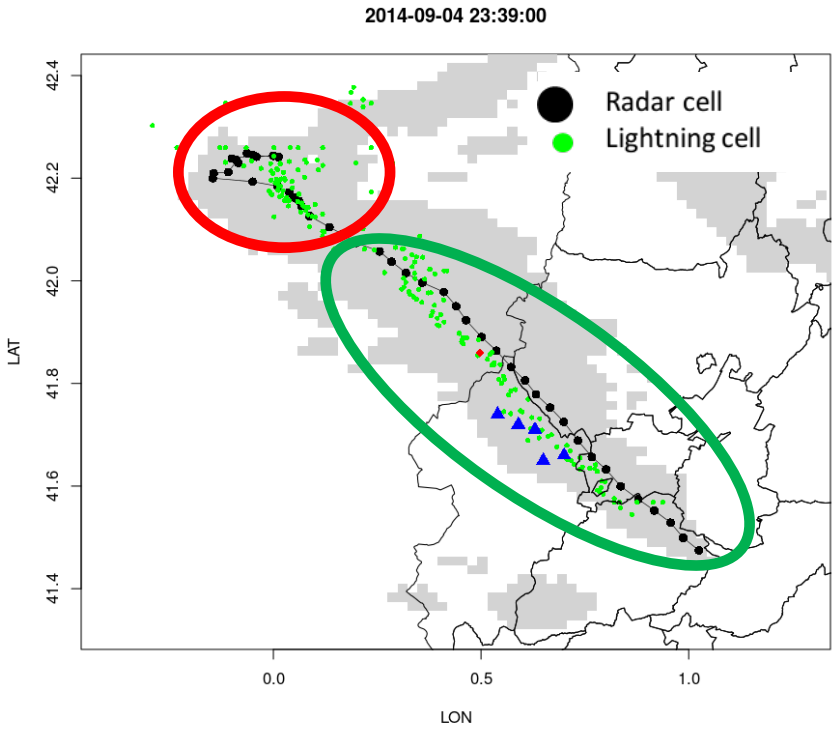


2 considerations:

- Good correlation between lightning and radar paths (GREEN ELLIPSE)
- Excepting for anomalous propagation of cells (RED ELLIPSE)

Tracking severe thunderstorms





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Part I: nowcasting using weather radar

Anomalous motion of severe thunderstorms

Atmospheric Research 185 (2016) 92–100

Contents lists available at ScienceDirect

Atmospheric Research

journal homepage: www.elsevier.com/locate/atmosres

Identification of anomalous motion of thunderstorms using daily rainfall fields

Anna del Moral[a,*], María del Carmen Llasat[a], Tomeu Rigo[b]

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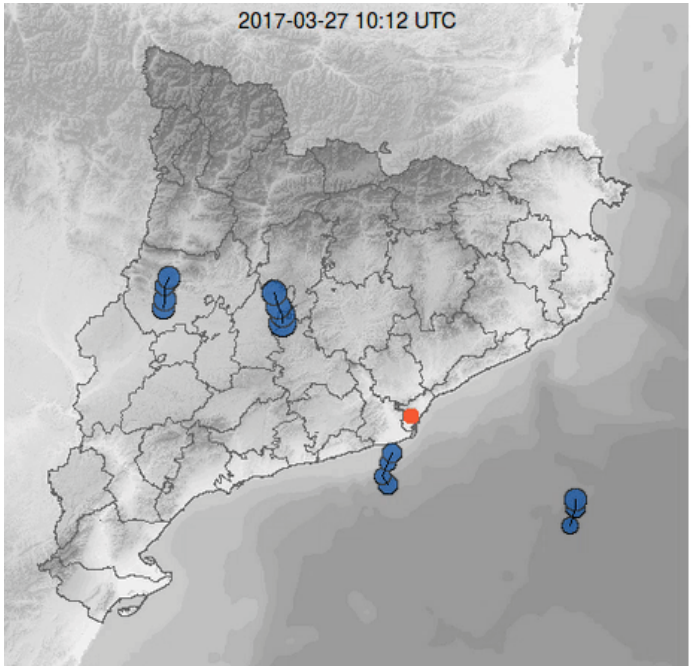
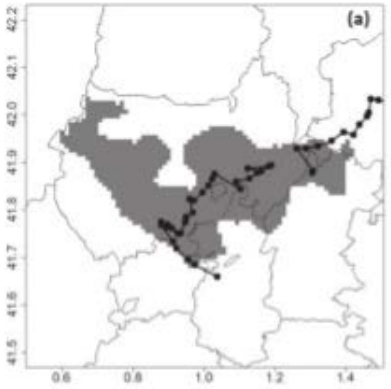
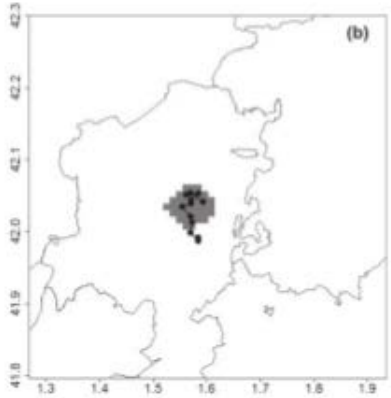
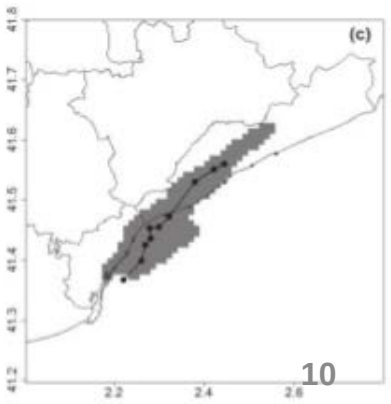
[b] Meteorological Service of Catalonia, c/Berlin, 38-46, Barcelona 08029, Spain









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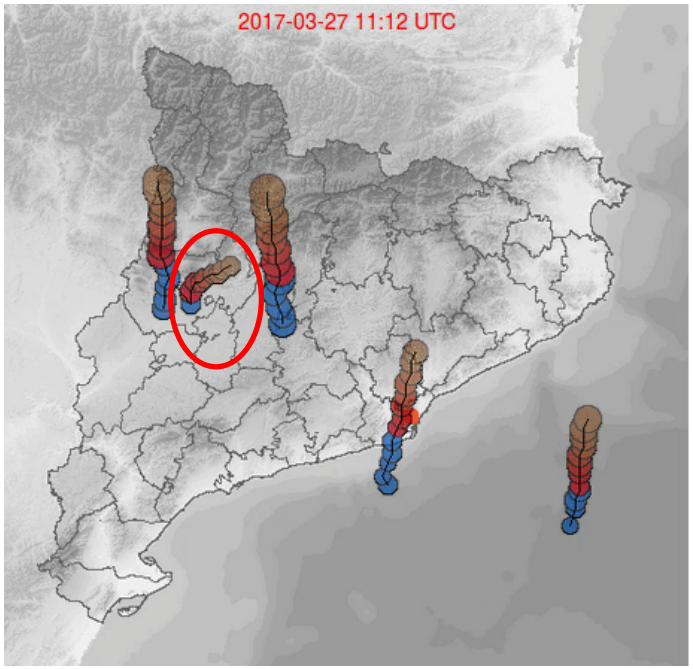
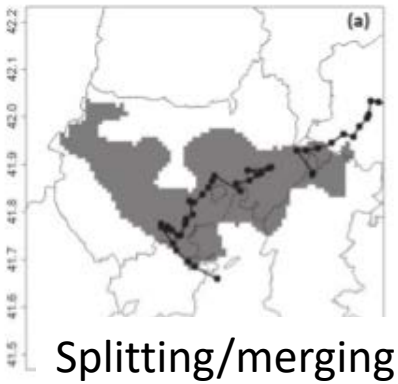
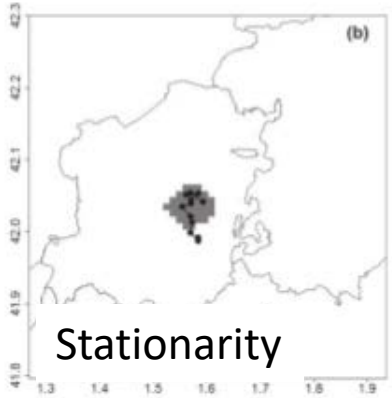
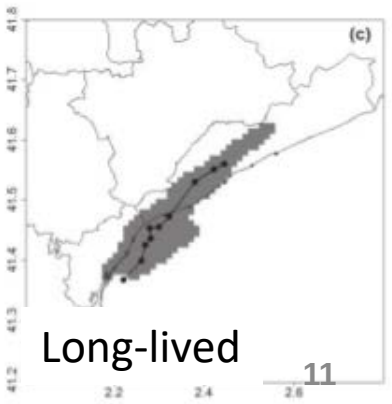




Splitting/merging



Stationarity



Long-lived

Part II: nowcasting using lightning data

Lightning Jump

Adding total lightning information to radar

Atmospheric Research 183 (2016) 130–141

Contents lists available at ScienceDirect

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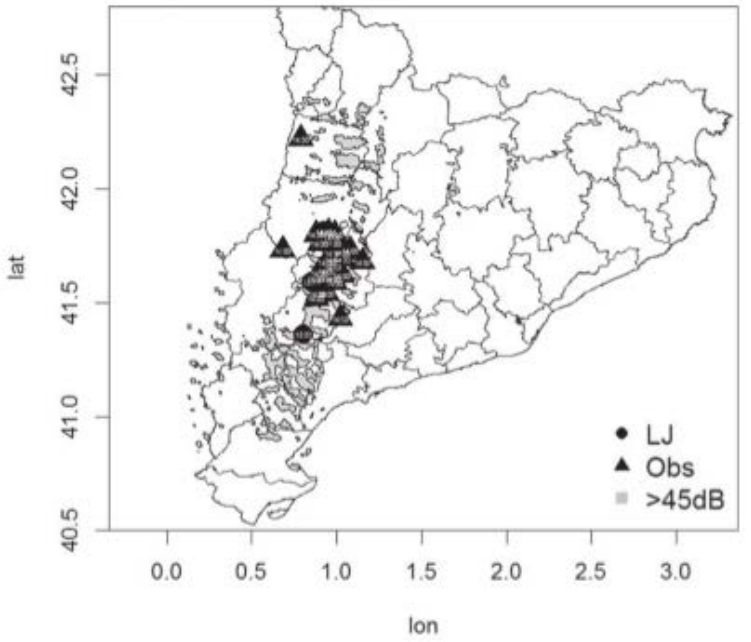
Lightning jump as a nowcast predictor: Application to severe weather events in Catalonia

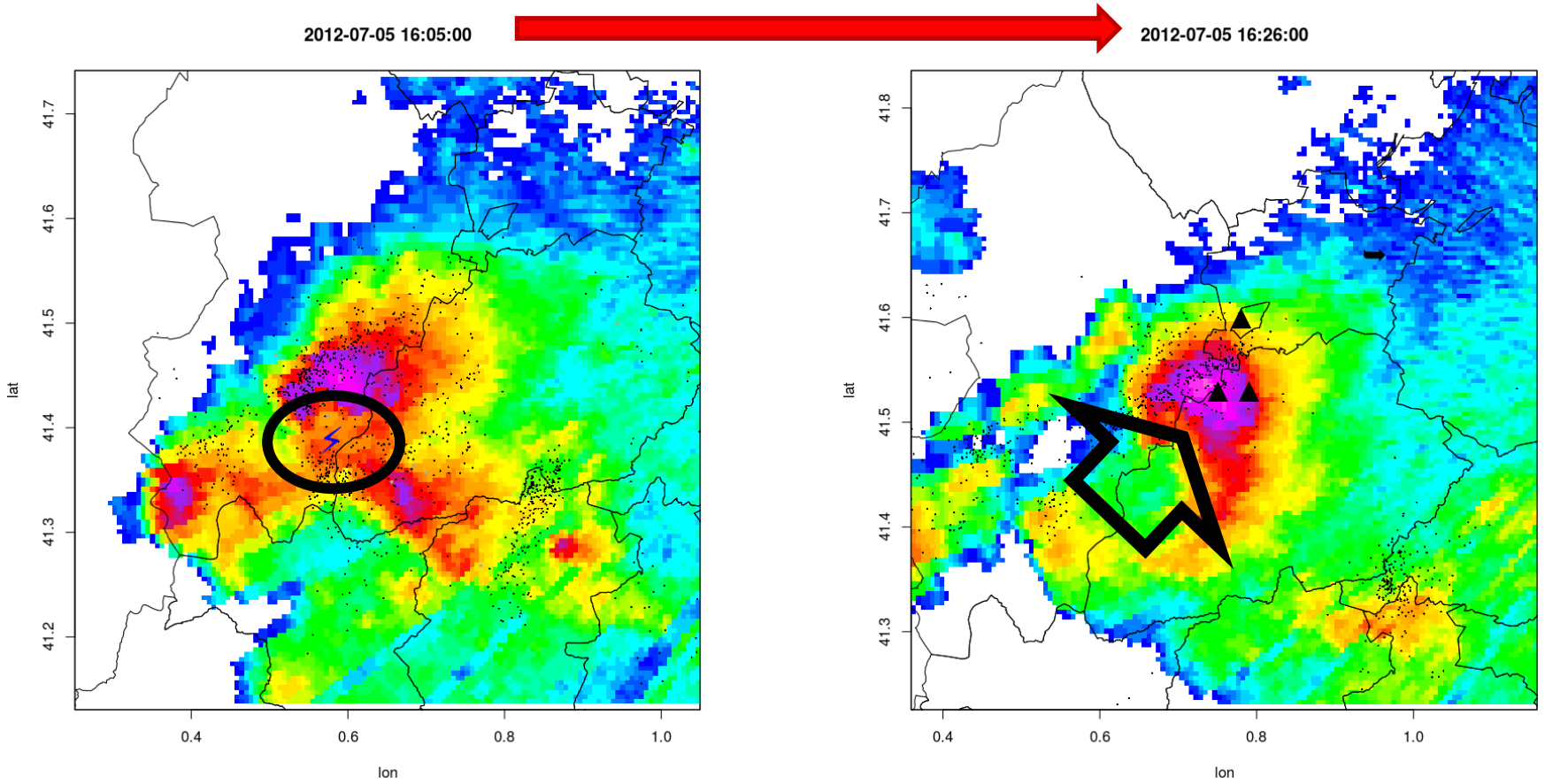
C. Farnell*, T. Rigo, N. Pineda

Meteorological Service of Catalonia, C/Berlin, Barcelona, 38-46, Spain



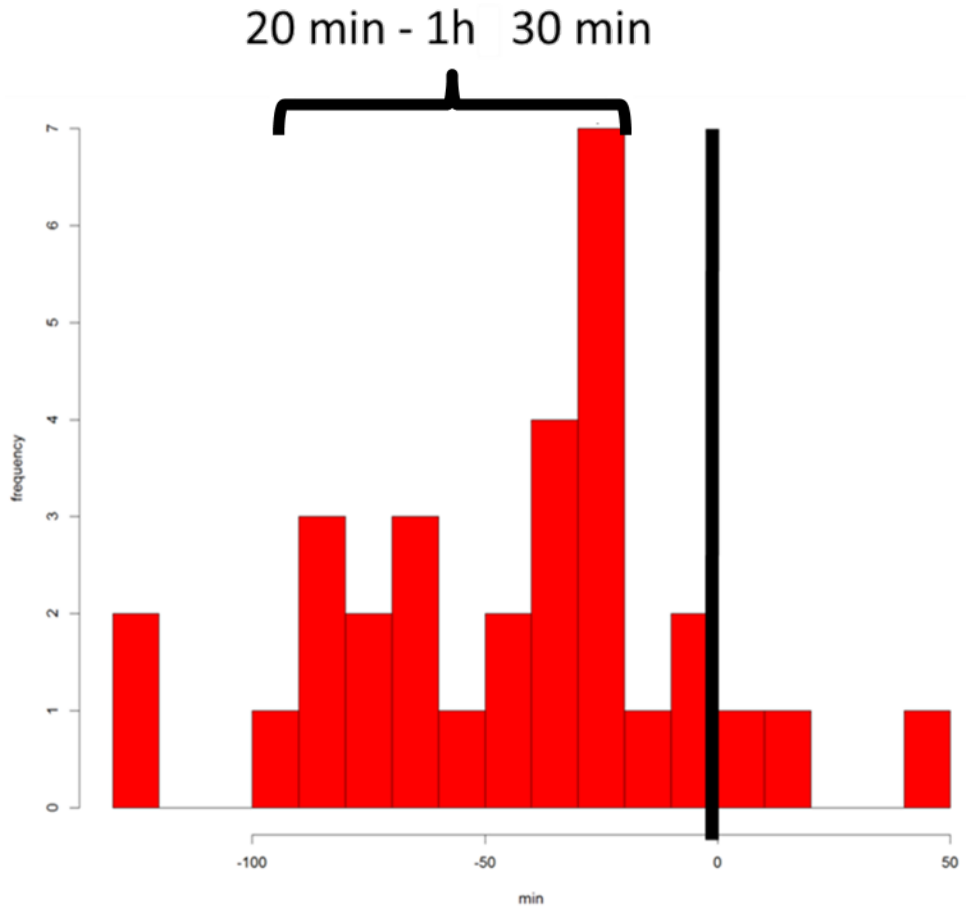
Lightning Jump

Good correlation between LJ warnings and severe weather occurrence



Lightning Jump

Lead time

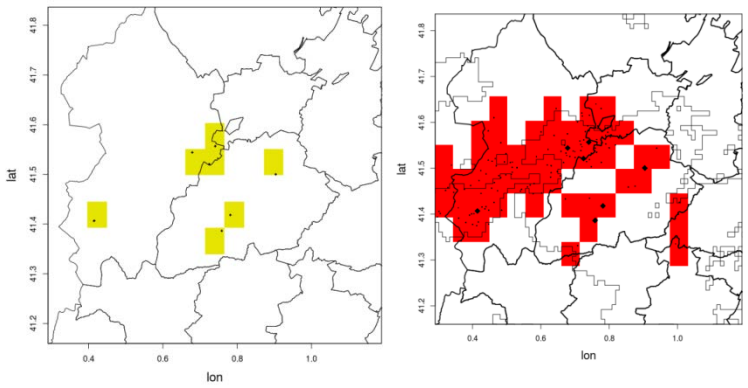


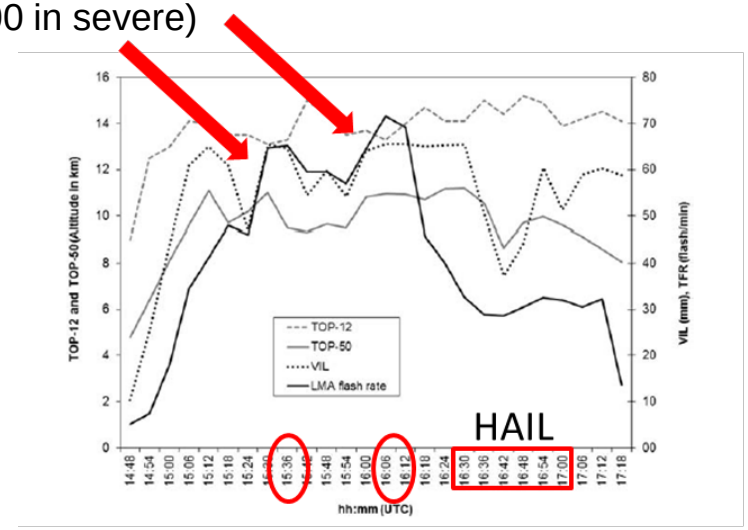
Lightning jump

Definition

- LJ is a sudden increase of the total lightning activity
- Associated with strong updrafts, this is, «powerful» charge separation (Williams 2001).
- Predictor of severe weather, defined as: Hail > 2 cm, downbursts, strong wind gusts, and tornadoes/waterspouts
- TOTAL Lightning is necessary: Cloud-to-ground (CG), plus Intra-cloud (IC)
- **IC are essential** (IC/CG is 1:10 in ordinary cells, 1:100 in severe)

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



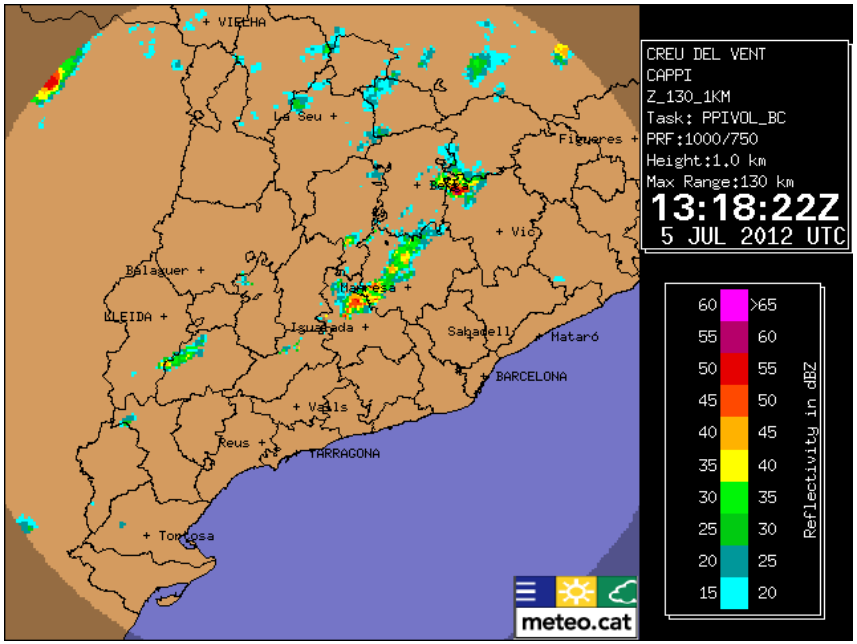


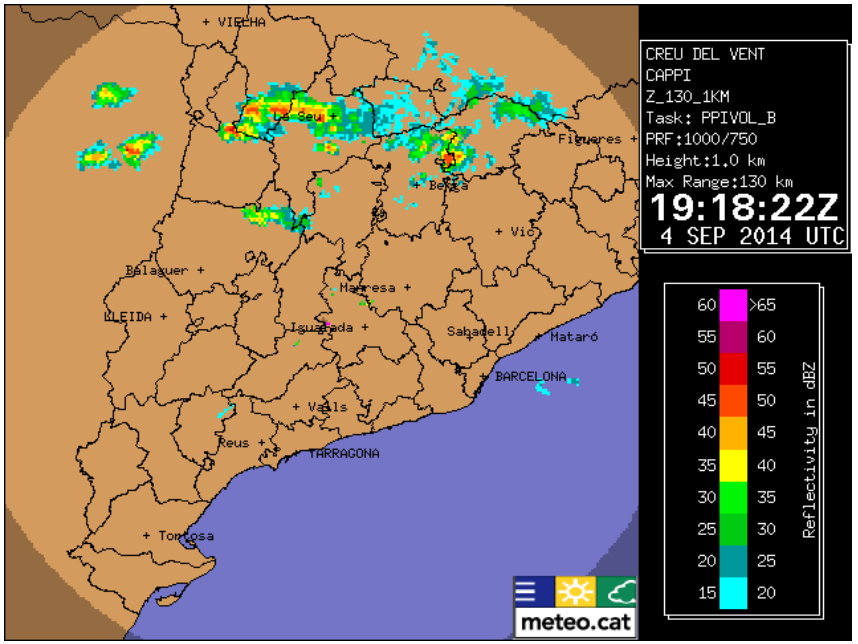
Pineda et al. 2016

Part III: combining both nowcasting techniques

Merging radar and LJ

Improving nowcasting: radar animation (two examples)

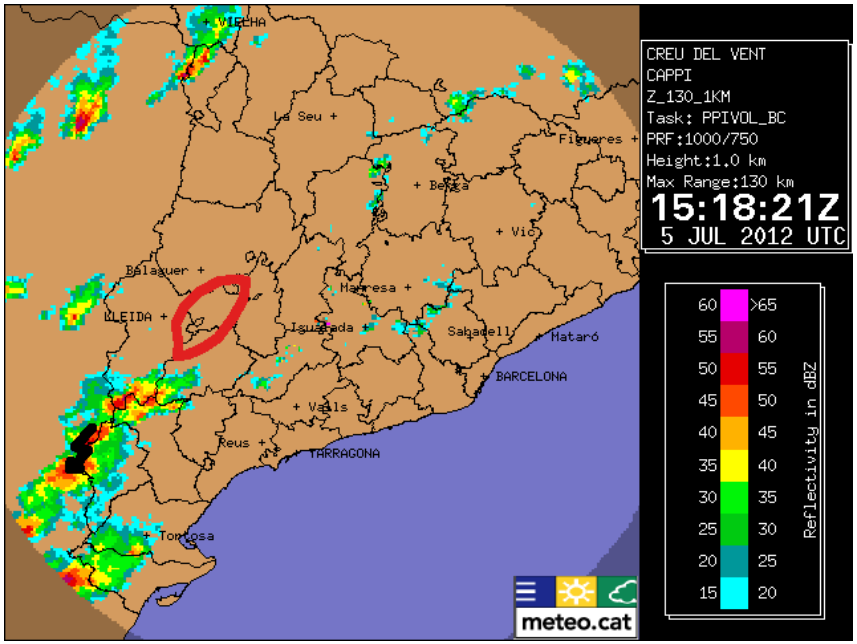


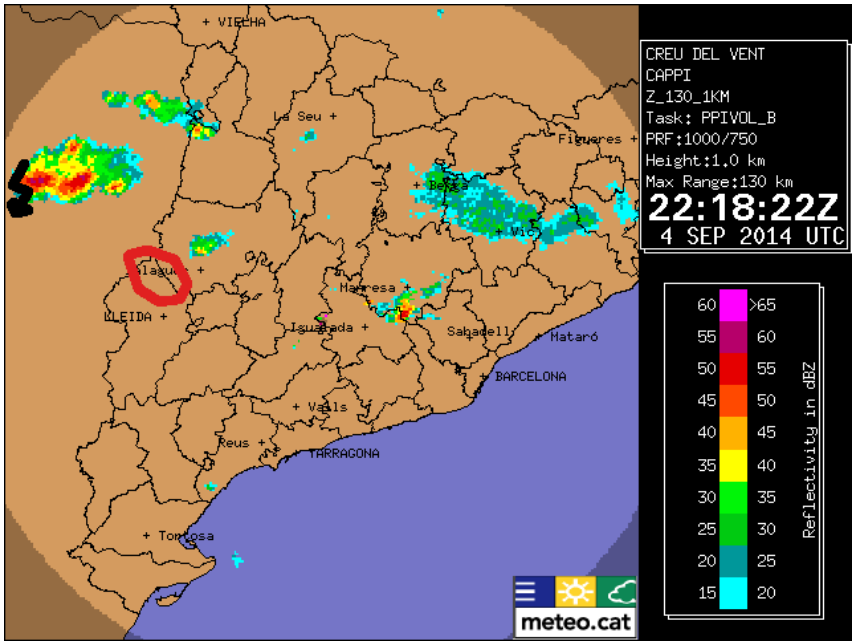


Merging radar and LJ

Improving nowcasting: LJ, radar, and area affected

Lead time in both cases of ~ 2 h, distance LJ SevWea ~ 100 km

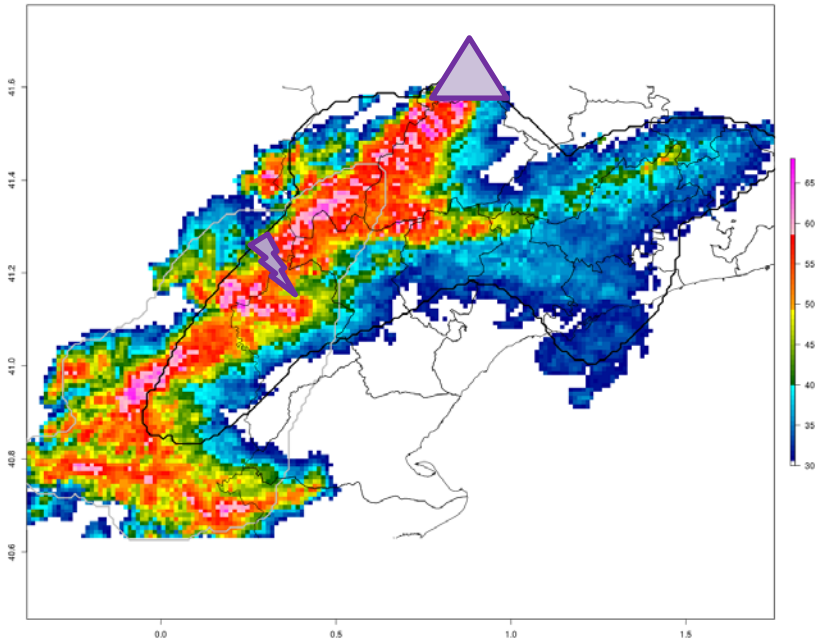


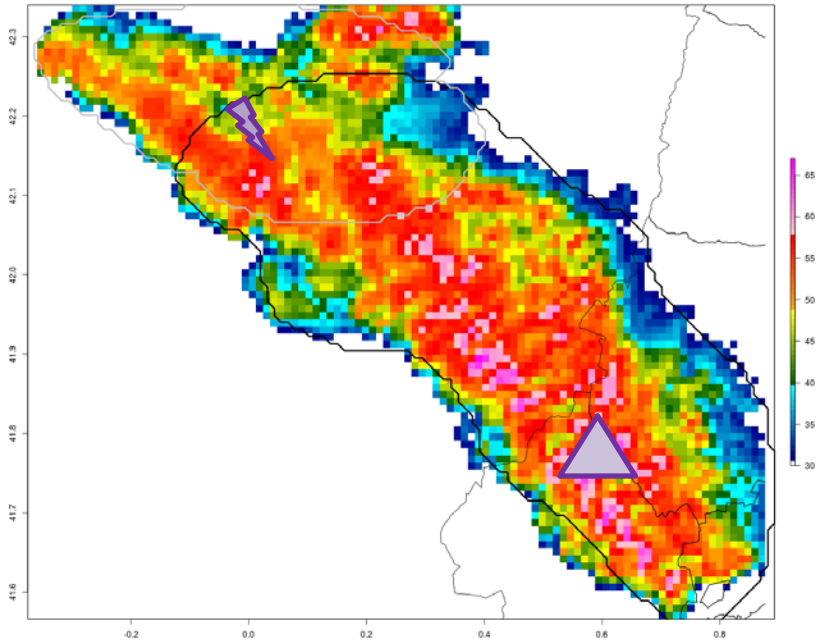


Merging radar and LJ

Improving nowcasting: radar reflectivity «trajectory»

High values of reflectivity in a large path, more or less wide

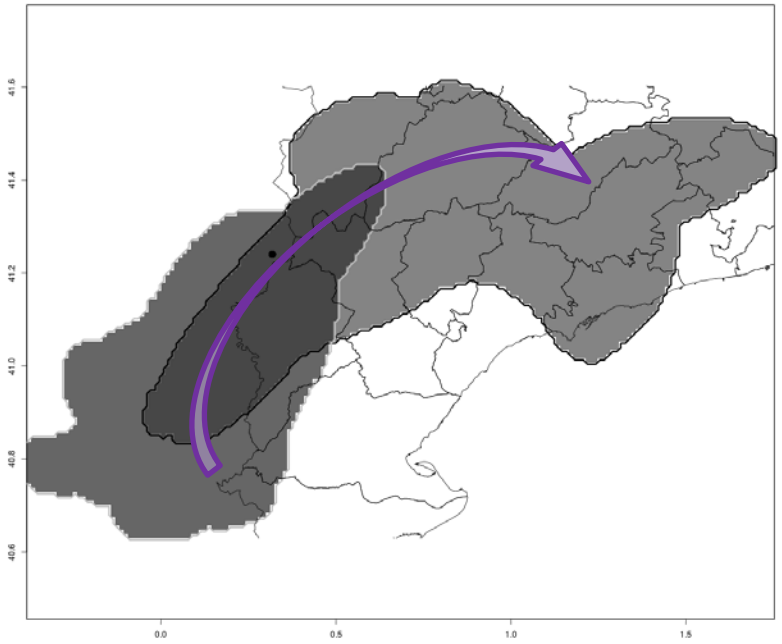


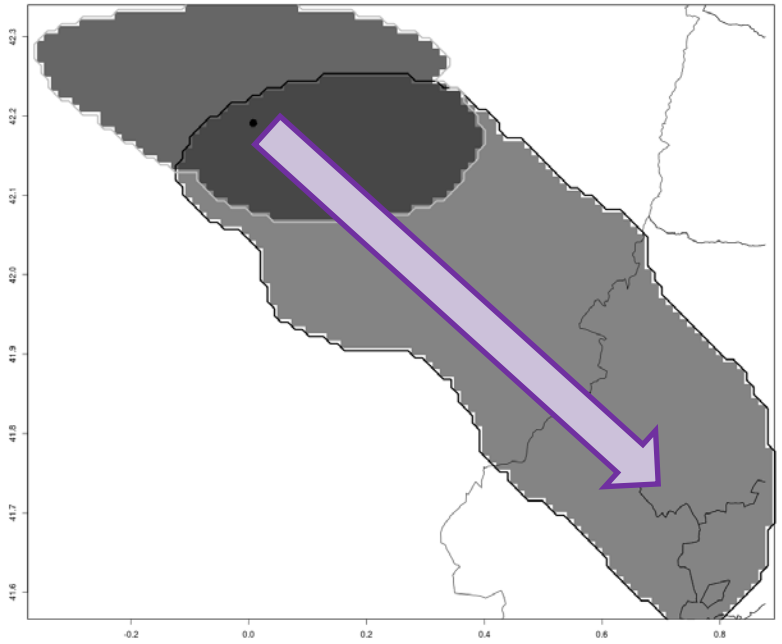


Merging radar and LJ

Improving nowcasting: past (dark) and post (light) areas

A straight path is not always observed!





Conclusions

Conclusions

- Radar and the nowcasting algorithm allows identifying past track and probable future directions…
- However, most of severe thunderstorms have anomalies in their trajectories (del Moral et al.)
- On the other hand, LJ algorithm has revealed as a good forecaster of severe weather with a lead time of 2 hours in some cases (Farnell et al.)

- The combination of both techniques seems to provide more information to forecasters
- In any case, the complete automation of the new technique is not recommended, suggesting the expertise of the human contribution

Hail campaign in Catalonia

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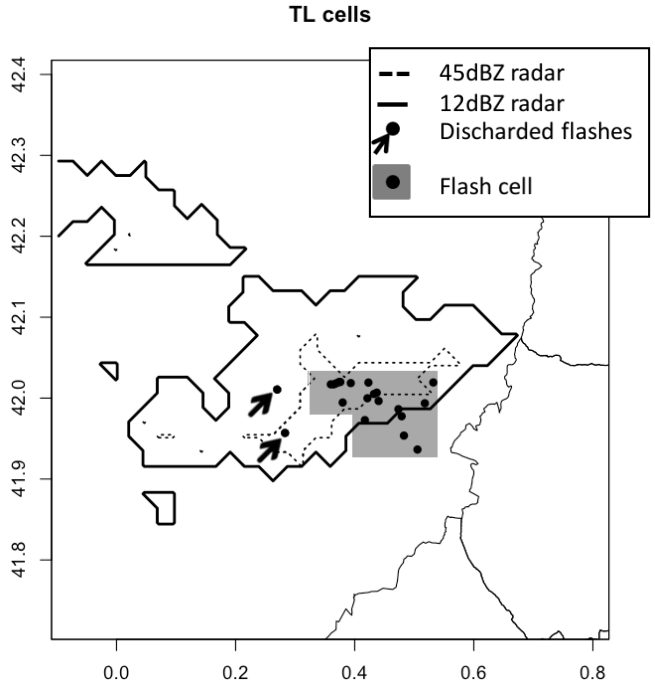
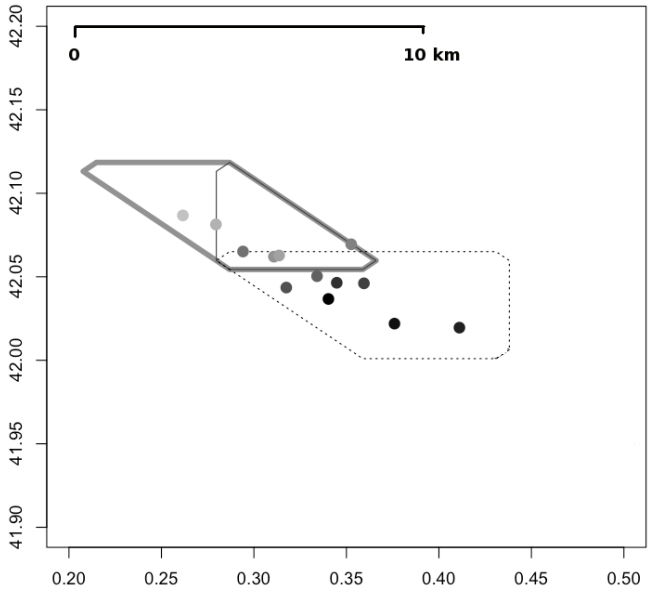
Lightning jump

How it works

- Punctual observations converted to raster.
- Pixels with only one flash are removed
- Grouped by proximity, identified as «cells»



- Tracking of the «cell» position for the last 14 minutes (cell identified each minute)
- Tracks are reliable, because of the high time resolution



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Lightning jump

Real examples