Near-real time high-resolution
Flash Flood Impact Forecasting

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Introduction

- Problem:

Existing flash flood early warning systems typically ***forecast hazard***

- Difficult to interpret by emergency managers

  ➡ sub-optimal decisions

- During event, they combine hazard forecast with exposure and vulnerability

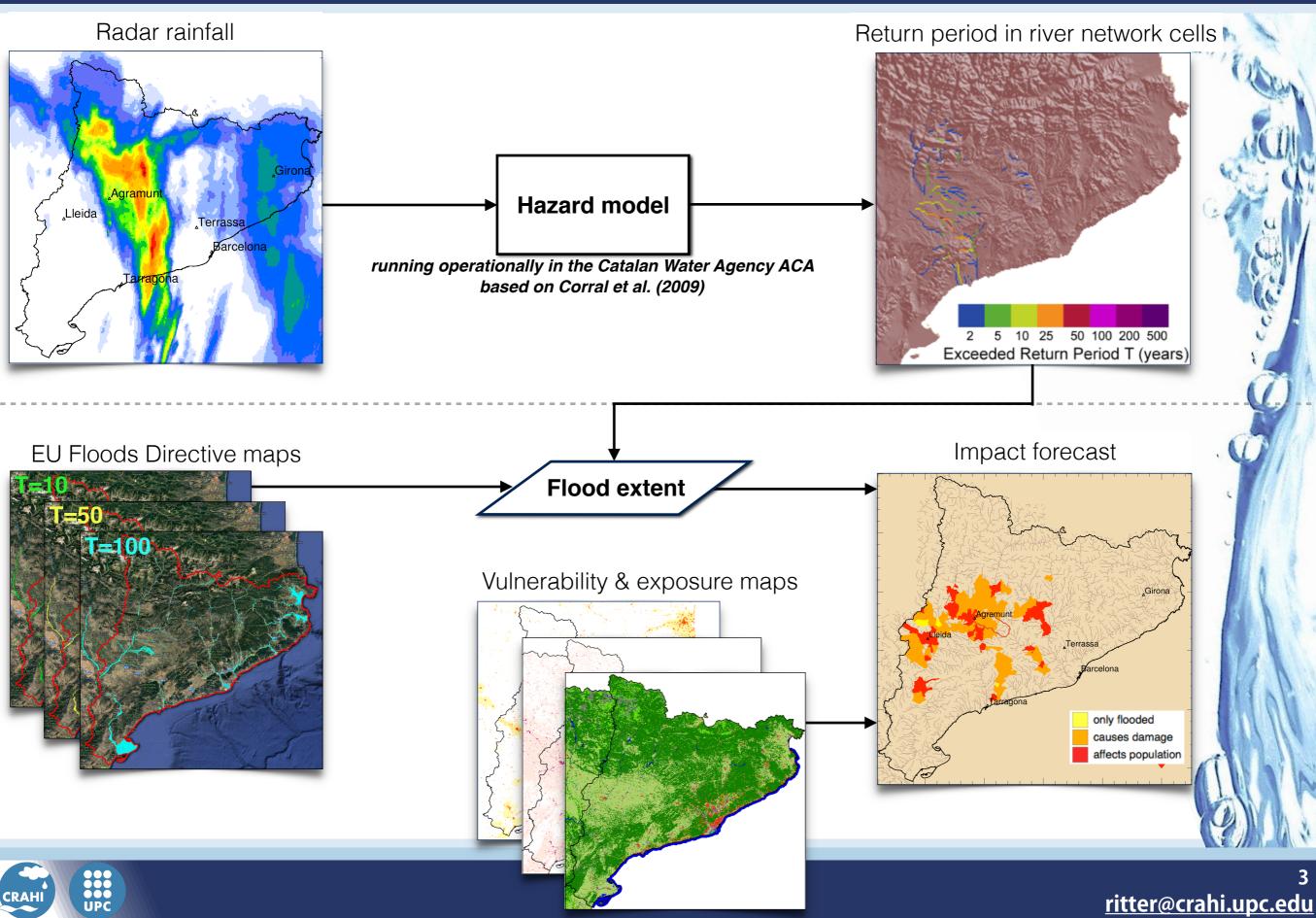 ➡ reduced time to coordinate flood response measures

- Solution:

Automatic combination of hazard, exposure and vulnerability at near-real time and high resolution to ***forecast impact***

Methodology in real time

Radar rainfall

Hazard model

running operationally in the Catalan Water Agency ACA
based on Corral et al. (2009)

Return period in river network cells

| 2 | 5 | 10 | 25 | 50 | 100 | 200 | 500 |

Exceeded Return Period T (years)

EU Floods Directive maps

T=10
T=50
T=100

Flood extent

Vulnerability & exposure maps

Impact forecast

- only flooded
- causes damage
- affects population

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Source: El Imparcial (2015)

Source: El Periodico (2015)

- Impacts:
  - 5 casualties
  - Significant economic damage

- Emergency management:
  - 02:21 UTC:
    High water levels reported 10 km upstream
  - 03:00 UTC:
    River starts to flood parts of the town
  - 03:03 UTC:
    Elderly home informed by fire brigades
  - 03:05 UTC:
    112 call, too late to evacuate basement
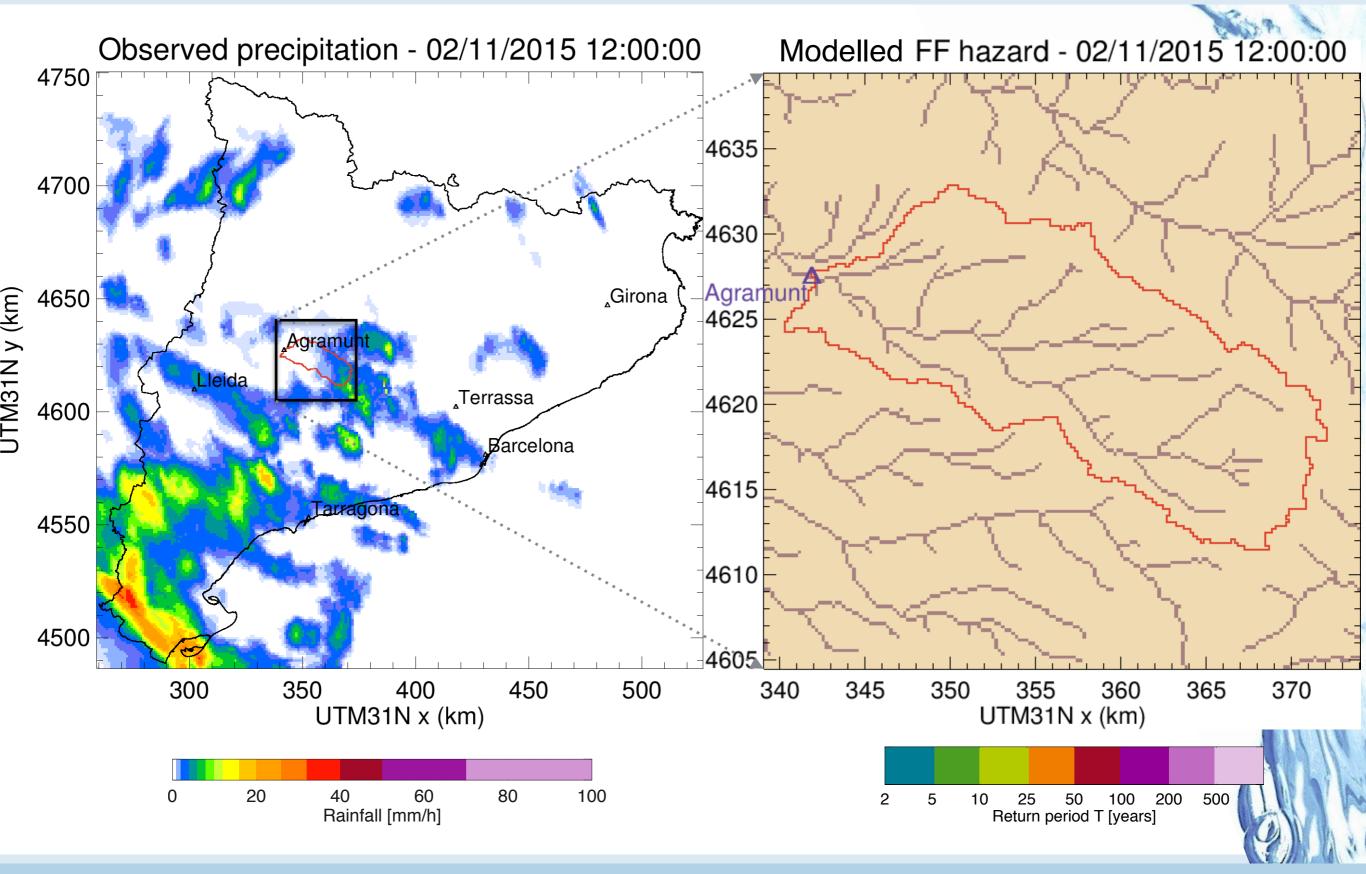
Modelled hazard

Observed precipitation - 02/11/2015 12:00:00

Modelled FF hazard - 02/11/2015 12:00:00

Rainfall [mm/h]

Return period T [years]
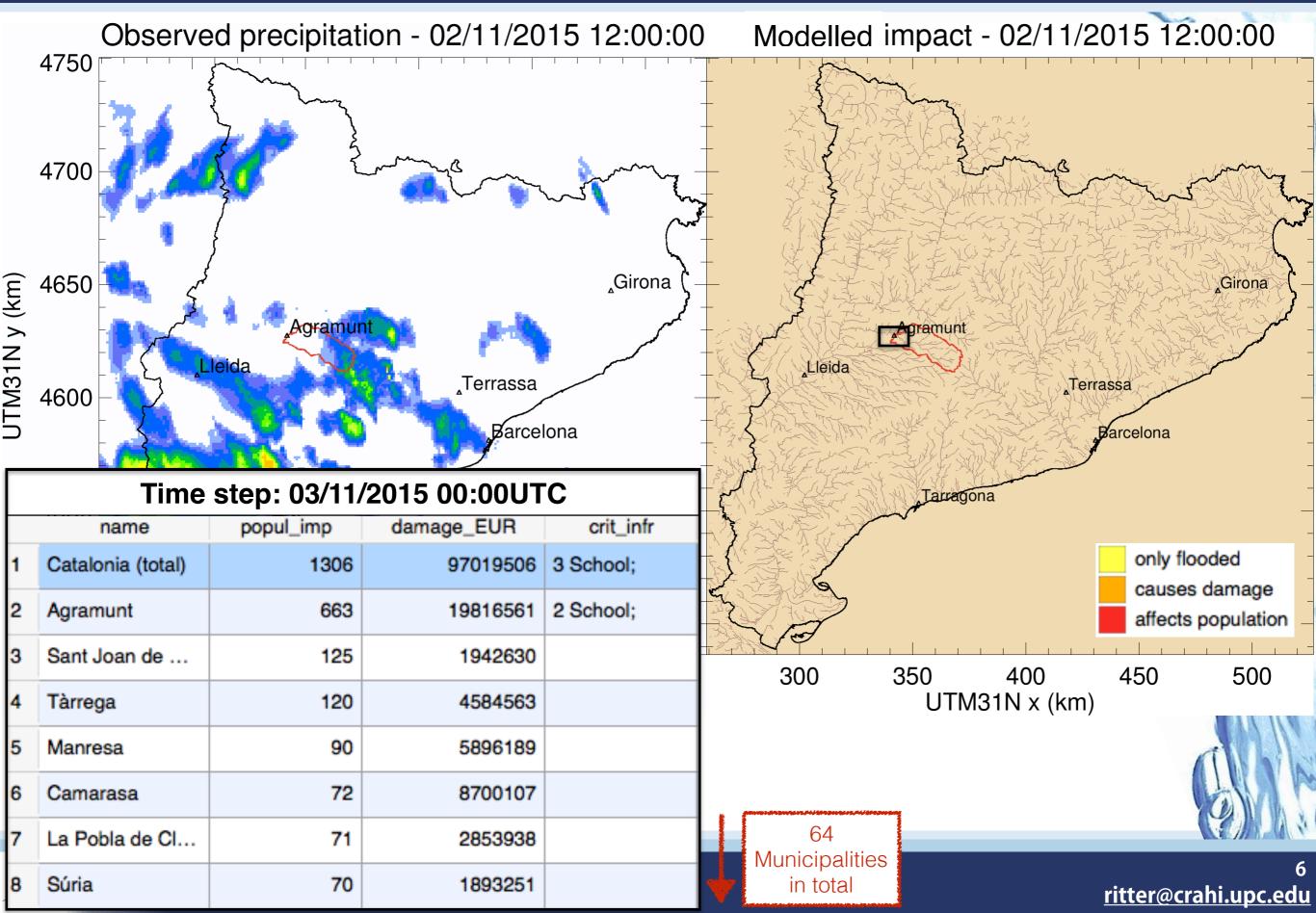
Modelled impact by municipality

Observed precipitation - 02/11/2015 12:00:00

Modelled impact - 02/11/2015 12:00:00

Time step: 03/11/2015 00:00UTC

	name	popul_imp	damage_EUR	crit_infr
1	Catalonia (total)	1306	97019506	3 School;
2	Agramunt	663	19816561	2 School;
3	Sant Joan de …	125	1942630	
4	Tàrrega	120	4584563	
5	Manresa	90	5896189	
6	Camarasa	72	8700107	
7	La Pobla de Cl…	71	2853938	
8	Súria	70	1893251	

- only flooded
- causes damage
- affects population

64 Municipalities in total
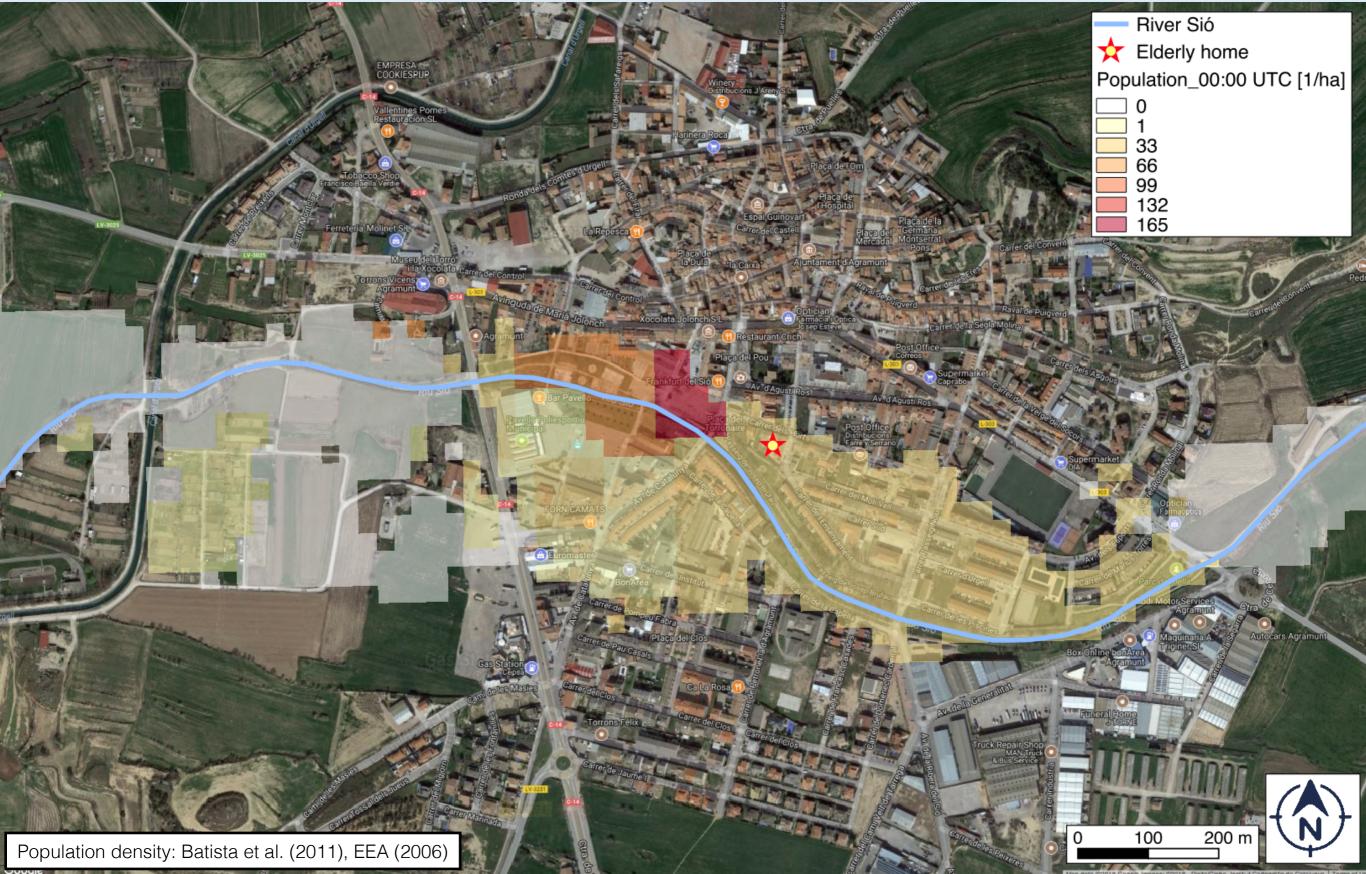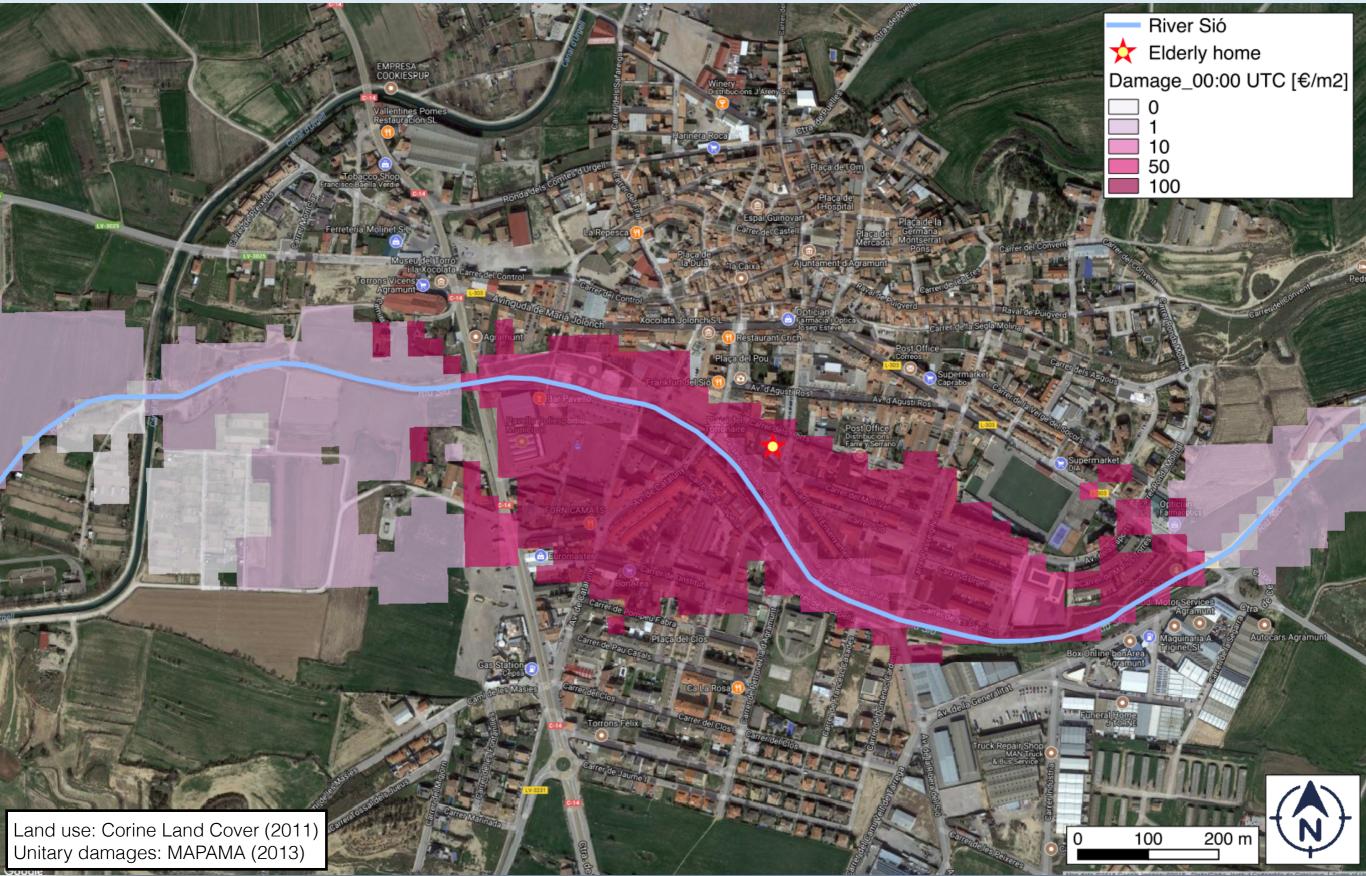
Population in flood zone 00:00 UTC (modelled)

Legend:
- River Sió
- ★ Elderly home
- Population_00:00 UTC [1/ha]
  - 0
  - 1
  - 33
  - 66
  - 99
  - 132
  - 165

Population density: Batista et al. (2011), EEA (2006)

0   100   200 m

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Legend:
- River Sió
- ⭐ Elderly home
- Damage_00:00 UTC [€/m2]
  - 0
  - 1
  - 10
  - 50
  - 100

Land use: Corine Land Cover (2011)
Unitary damages: MAPAMA (2013)

0 100 200 m

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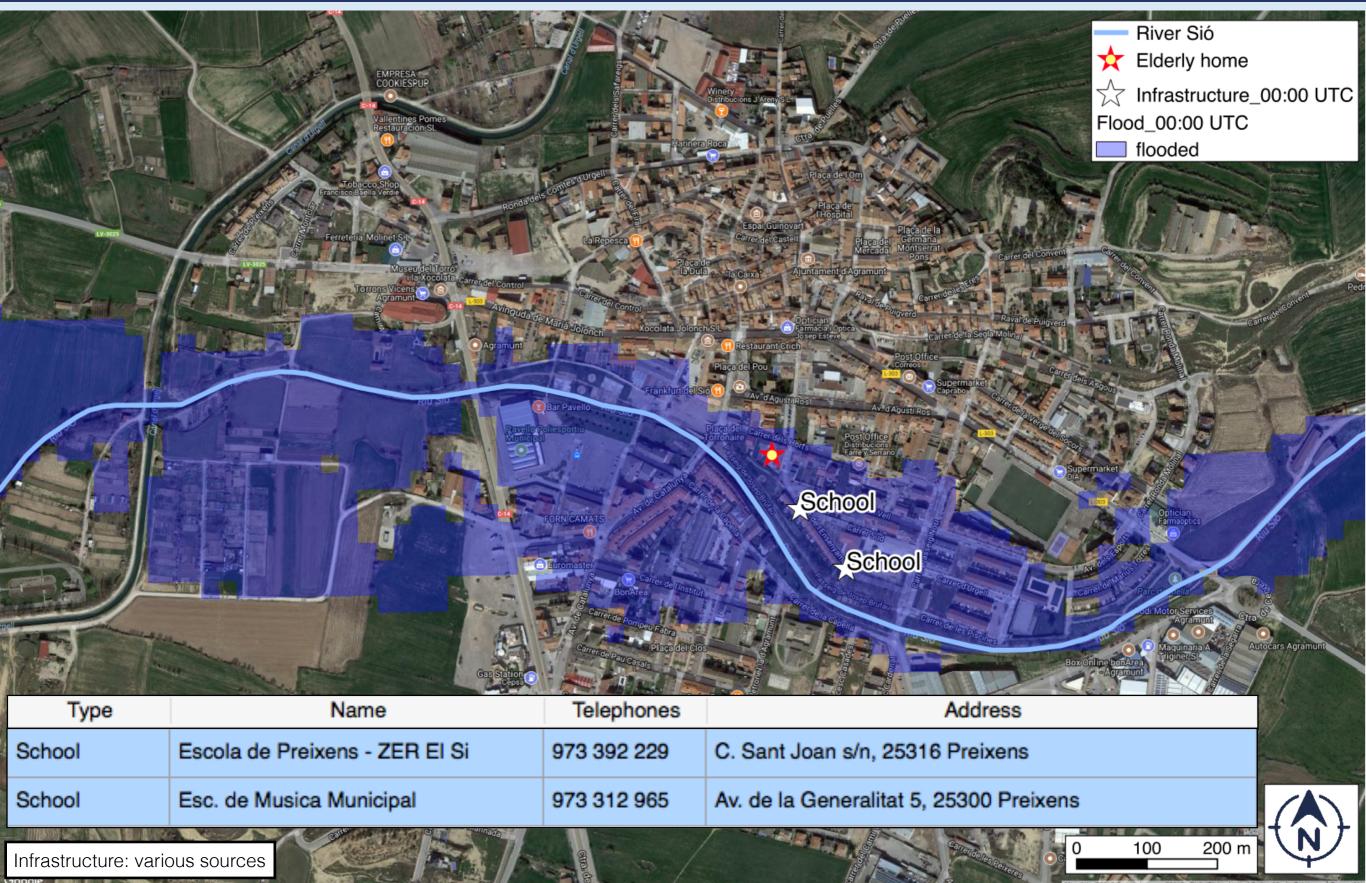
Legend:
- River Sió
- ★ Elderly home
- ☆ Infrastructure_00:00 UTC
- Flood_00:00 UTC
- flooded

Infrastructure: various sources

Type	Name	Telephones	Address
School	Escola de Preixens - ZER El Si	973 392 229	C. Sant Joan s/n, 25316 Preixens
School	Esc. de Musica Municipal	973 312 965	Av. de la Generalitat 5, 25300 Preixens

After event impact summary

Legend:
- only flooded
- causes damage
- affects population

UTM31N x (km)

Reported damages in Agramunt

- 421.000 € in **public** infrastructure
- ca. 50 **private** houses
- ca. 50 destroyed cars

Sources: LleidaDiari, Nova Tàrrega (2015)

- 2 schools
- 1 elderly home

Work in progress:
- Damage overestimation
- Missing infrastructure layers

Modelled damages in Agramunt

- 20 M € in Agramunt
- 2 schools

	name	popul_imp	damage_EUR	crit_infr
1	Catalonia (total)	1405	134701266	3 School
2	Agramunt	663	19816561	2 School:
3	Tàrrega	152	5018438	
4	Sant Joan de Vila…	125	1942630	
5	Manresa	90	5896189	

98 Municipalities in total

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Conclusions

- Method automatically combines hazard, exposure and vulnerability at near-real time and high resolution [25m], as decision support for emergency managers.

- Tested on flash flood event with significant impacts
  - Locations of high impact were identified
  - Quantitative impact models require further calibration

- For operational application, the tool is coupled to a nowcasting algorithm

  ➡ *Forecast impacts* with up to 3 hours in advance

Outlook

- Additional critical infrastructure layers (elderly homes, main roads, …)

- More differentiated impact estimation
  (using flood depth and flow velocity from hydraulic simulations)

- Dynamic exposure and vulnerability

- Operational implementation in real time

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Thank you for you attention!

Questions?

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