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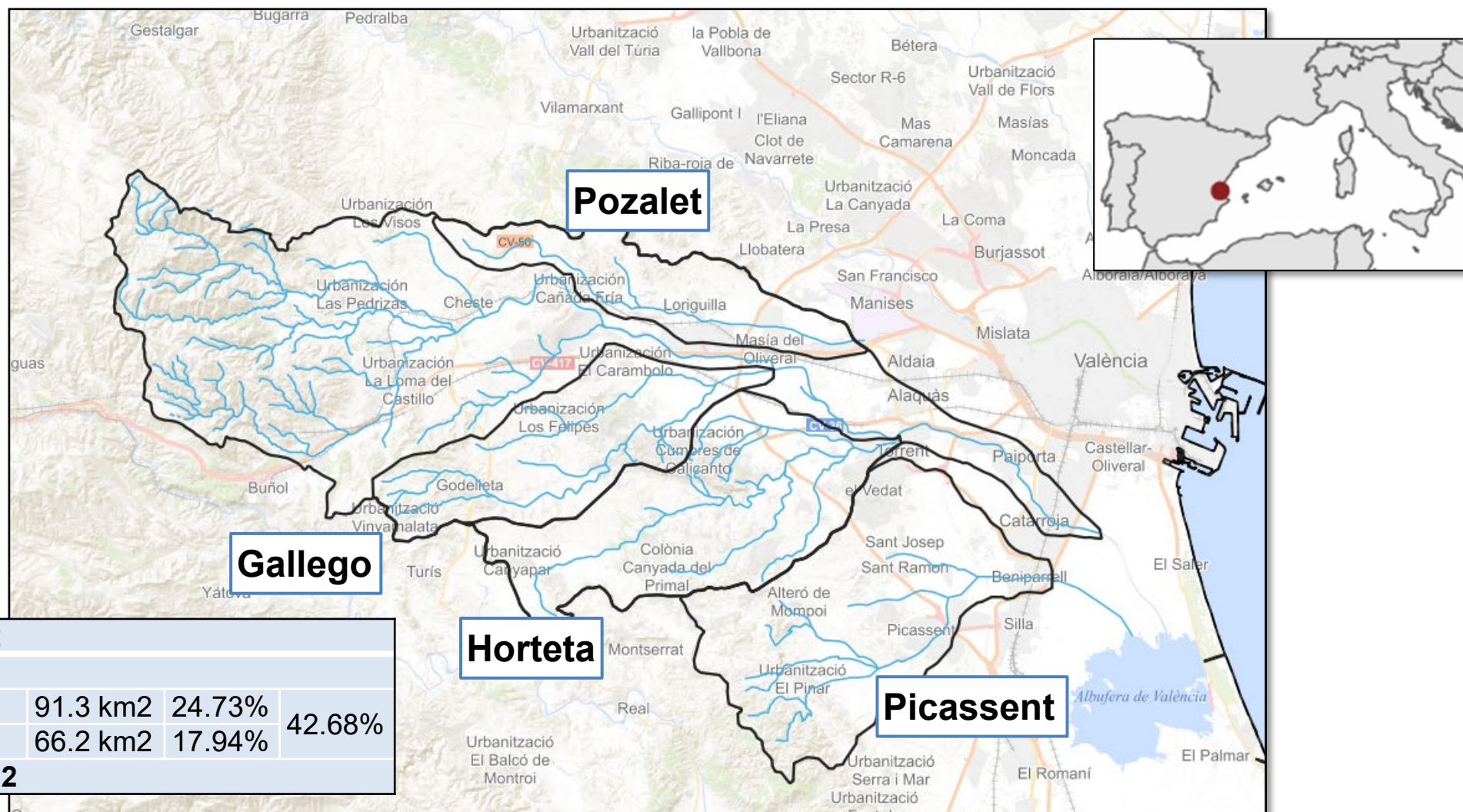
Reconstruction of the October 2024 catastrophic flooding in the southern Valencia Metropolitan Area, Spain

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Research Institute of Water and Environmental Engineering (IIAMA)
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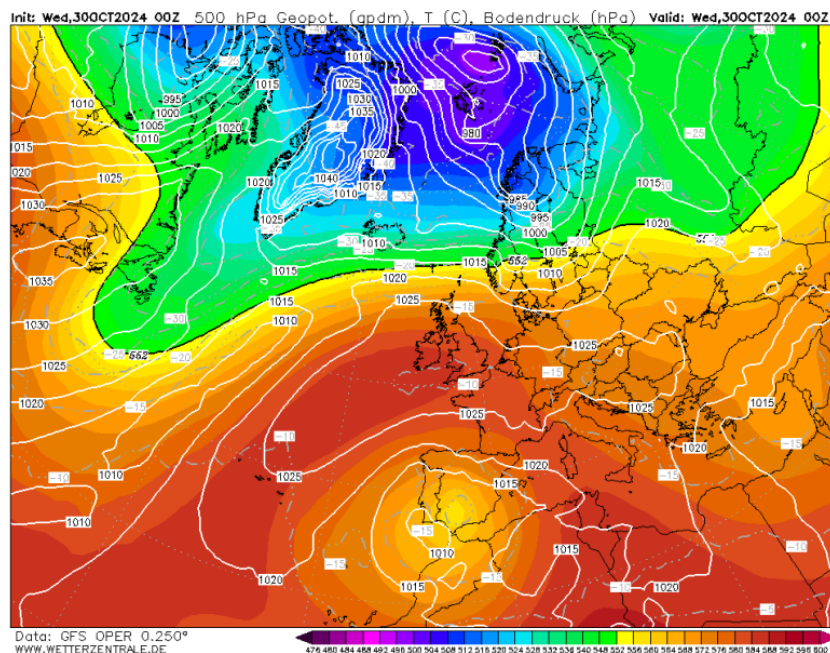


L'Horta Sud River network

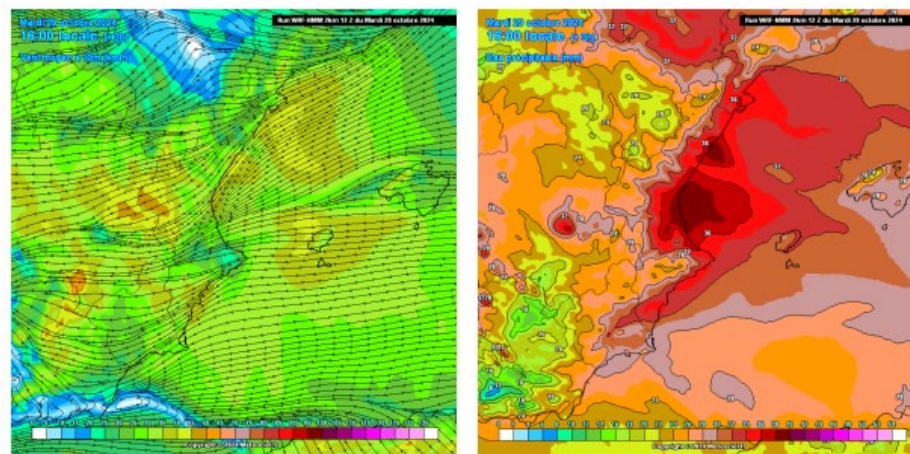


Pozalet	46.2 km2			
Poyo	369 km2			
	Horteta	91.3 km2	24.73%	42.68%
	Gallego	66.2 km2	17.94%	
Picassent	103.4 km2			

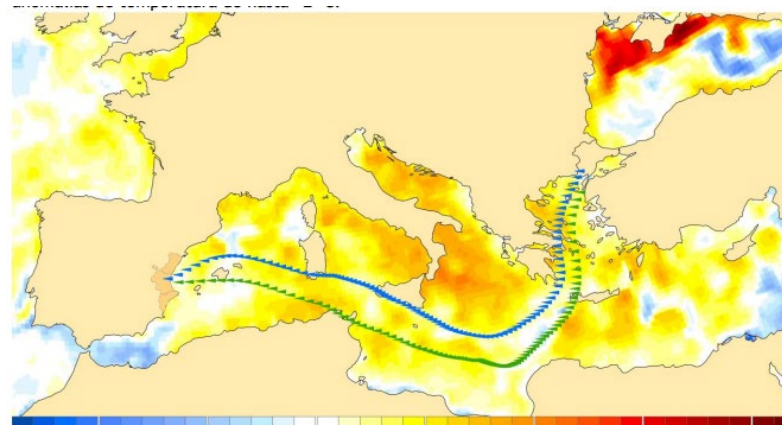
The October 29, 2024 storm



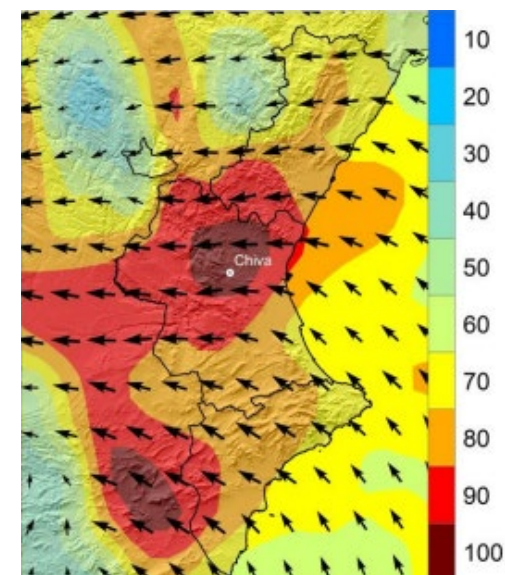
500 hPa geopotential height and surface pressure on October 30, 2024 at 00:00.



(a) 10 m wind and (b) simulated atmospheric water vapor column at 16:00. Source: Meteociel.

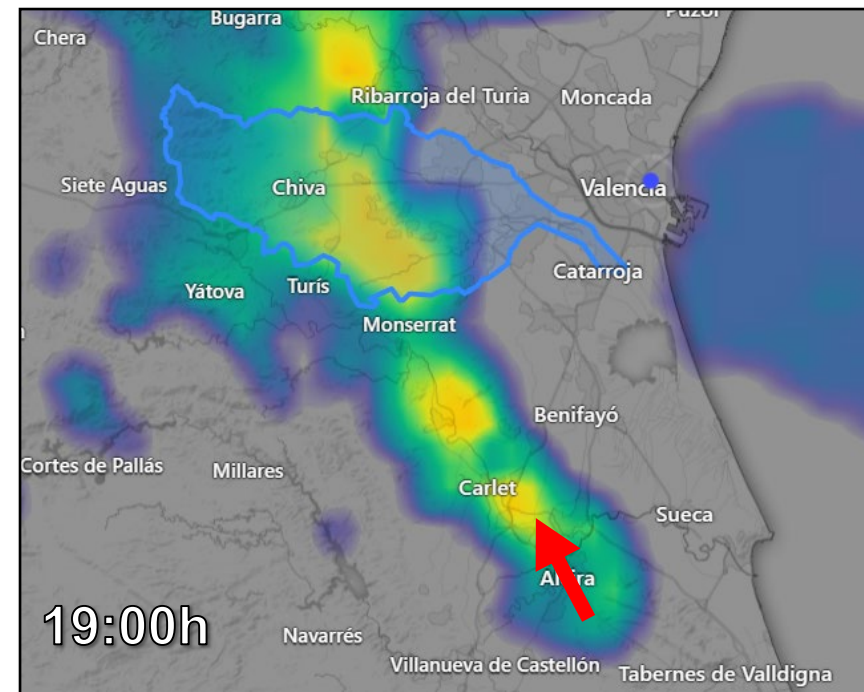
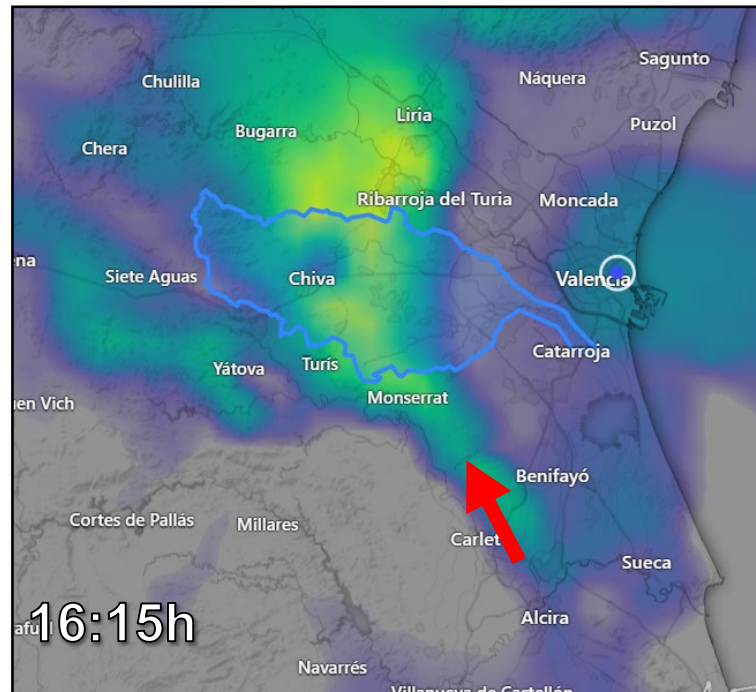
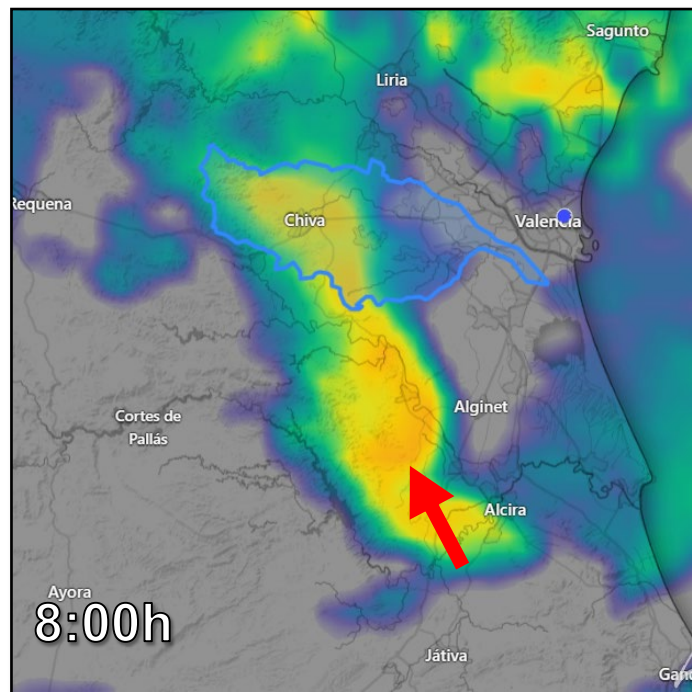


Sea surface temperature anomaly on October 28, 2024 at 12:00 relative to the 1991–2020 average (data source: Copernicus), and air mass back trajectories over the previous 4 days (data source: NOAA HYSPLIT).

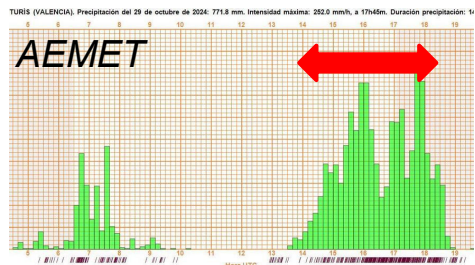


Mean wind at 850 hPa (km/h) on October 29, 2024 at 18 UTC. Data source: ECMWF.

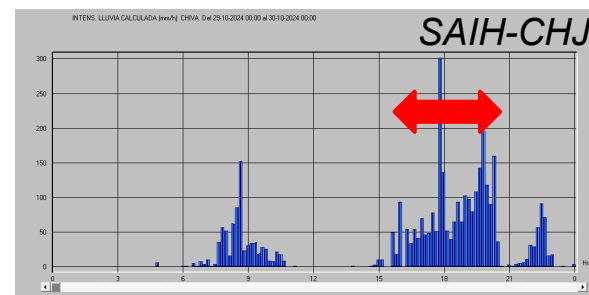
The October 29, 2024 storm



<https://www.windy.com/>



Turís:
 $P_d = 772 \text{ mm}$
 $1\text{h Max} = 185 \text{ mm/h}$
 Storm duration = 5 hours



Chiva:
 $P_d = 606 \text{ mm}$
 Max intensity = 300 mm/h

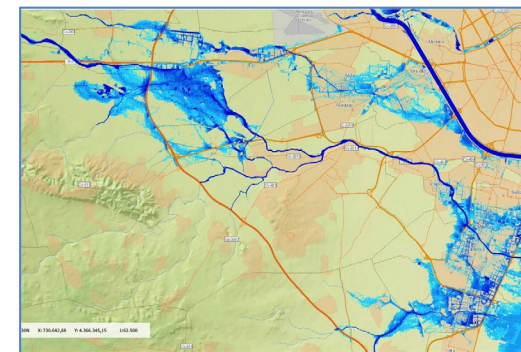
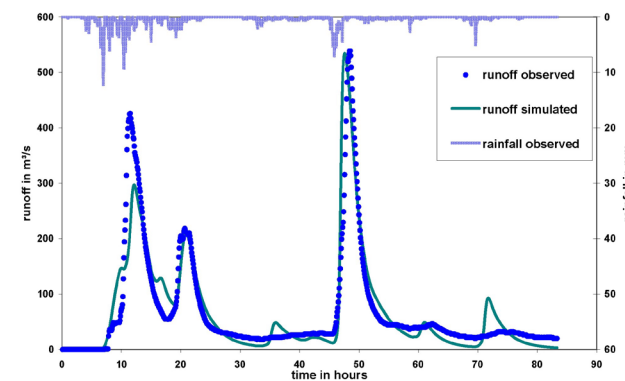
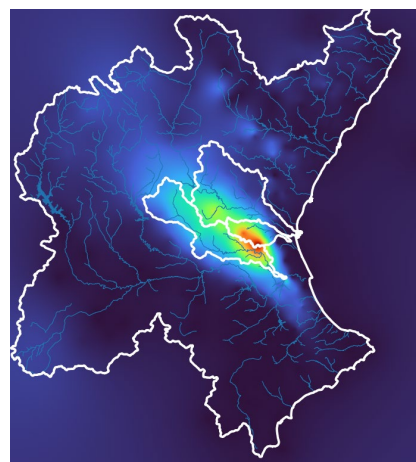
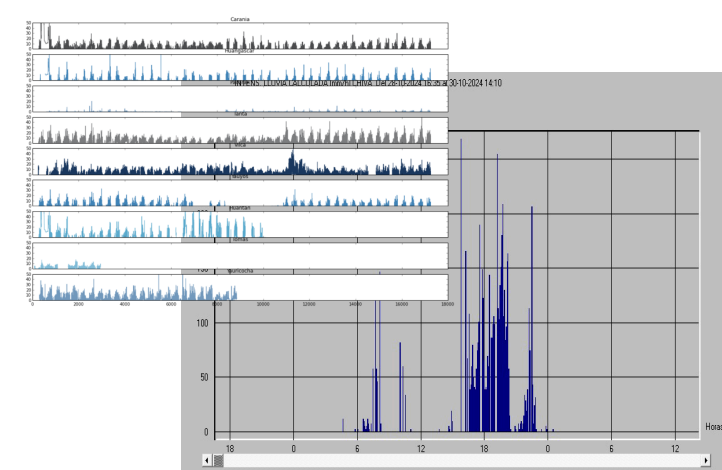


Precipitation
analysis

Precipitation
map

Hydrological
Modelling

Hydraulic
Modelling





Precipitation analysis

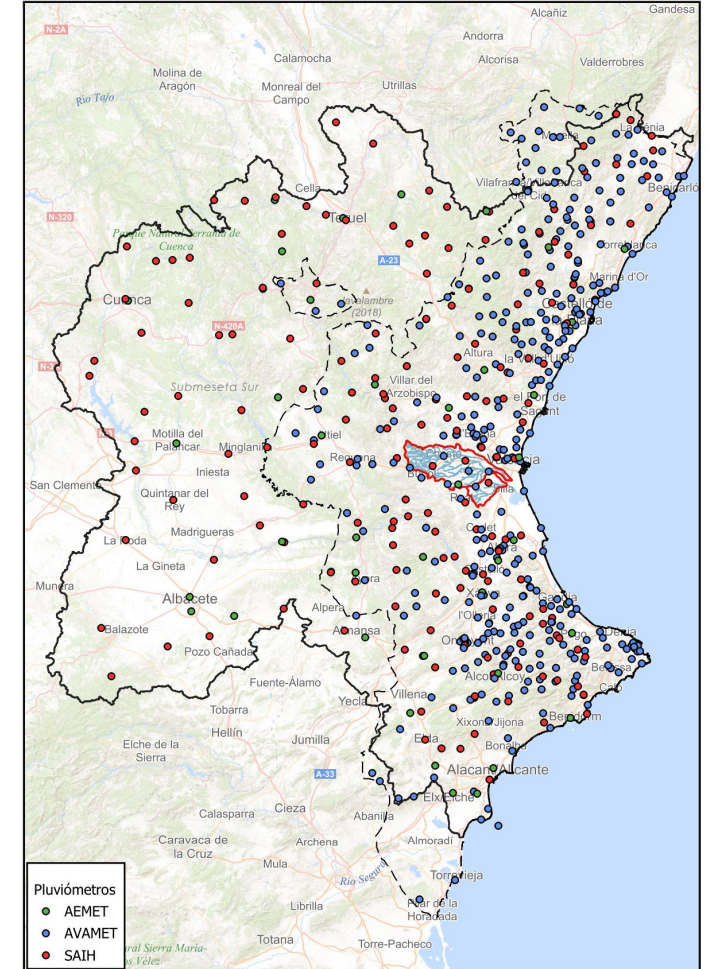
• Sources of information

- AEMET:
 - 48 rain gauges
 - 10min
- SAIH CHJ:
 - 172 rain gauges
 - 5min ->10min
- AVAMET:
 - 355 rain gauges
 - 5min ->10min

**Total: 575
rain gauges**

Data validation (SAIH):

- Corrections for communication failures
- Corrections for rain gauge malfunctions

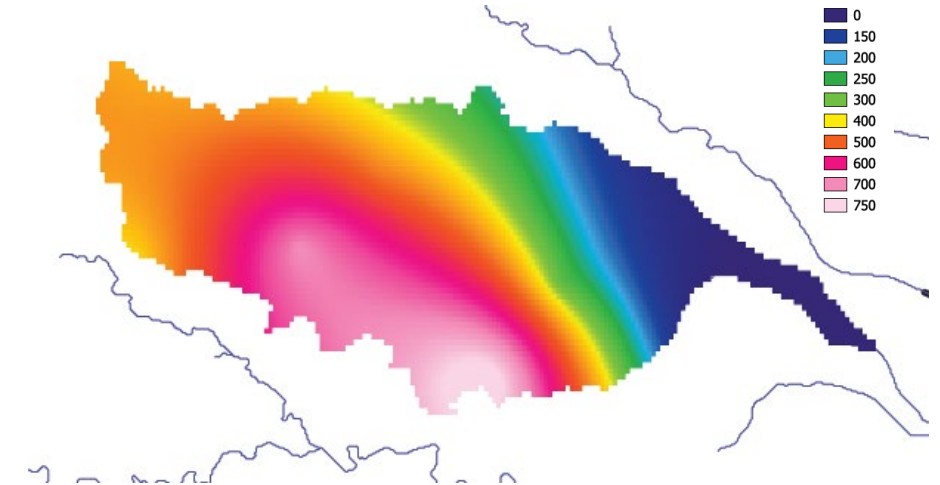
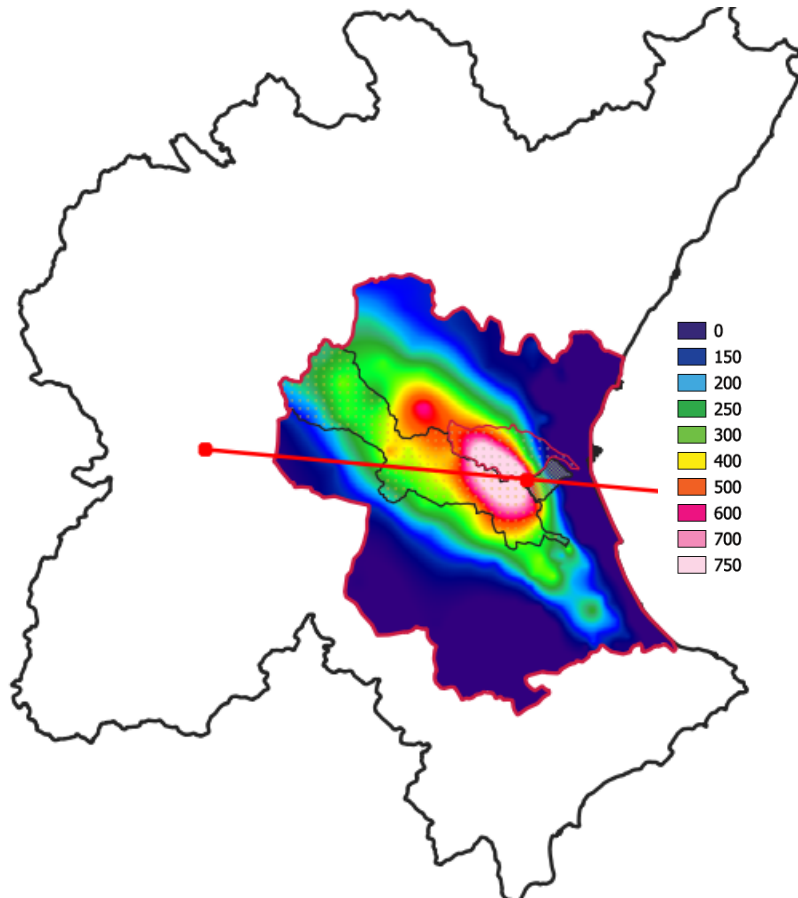




• Spatial interpolation methods

Hourly and daily

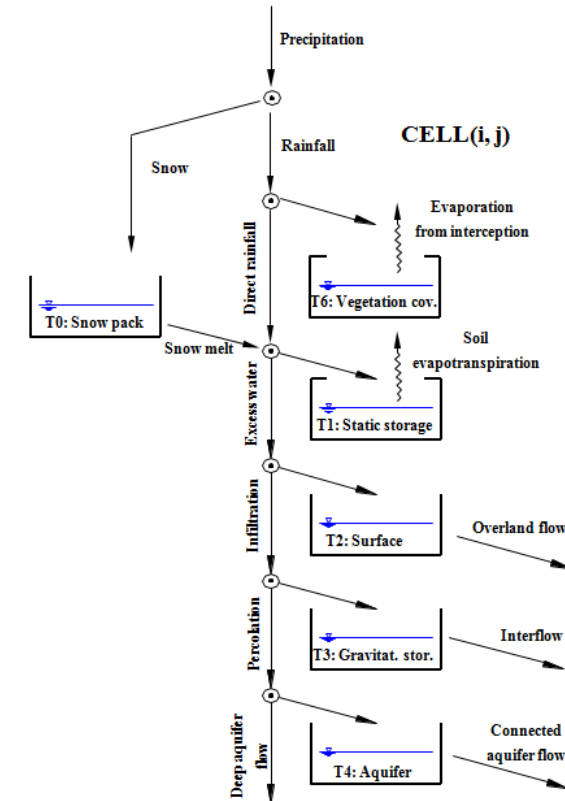
- Inverse Distance Weighted (IDW): $\wedge^2$ & up to 10 rain gauges
- Kriging:
 - Semivariogram
 - **Exponential**
 - Gaussian
 - Spheric



Leave One Out Cross-Validation (LOOCV)

$$P_{\text{areal}} = 348 \text{ mm}, \text{Vol} = 147 \text{ Hm}^3$$

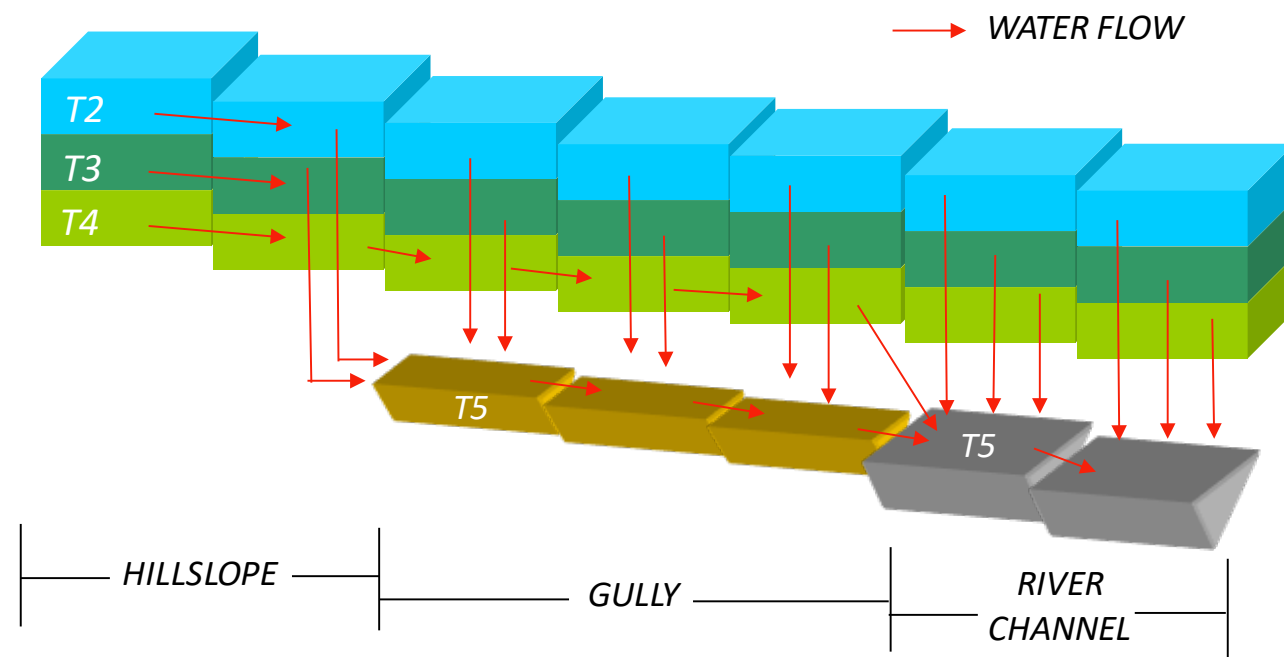
- ❑ Conceptual model with **physically based parameters**, developed by the UPV since 1994 (v9 on the web)
- ❑ **Distributed** in space:
 - Constantly developed by our group since 1994
 - Integral model
 - Parsimonious
 - Reproduces the spatial variability of hydrological cycle
 - Uses all spatial information available
 - Gives results at any point



Conceptual scheme of TETIS model at cell scale

□ Integral model:

- Resources
- **Floods**
- **Sediments**
- Dynamic vegetation
- Nitrogen
- Agricultural production
- Irrigation
- Reservoirs
- **Losses** and intakes in riverbeds
- Snow
- ...



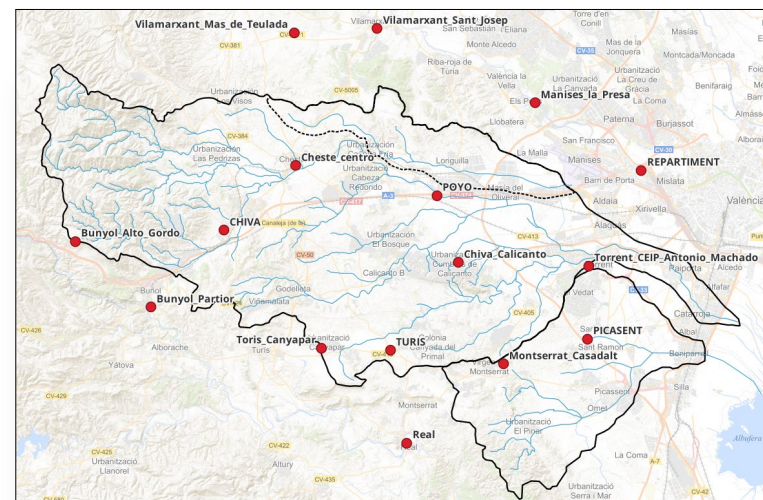
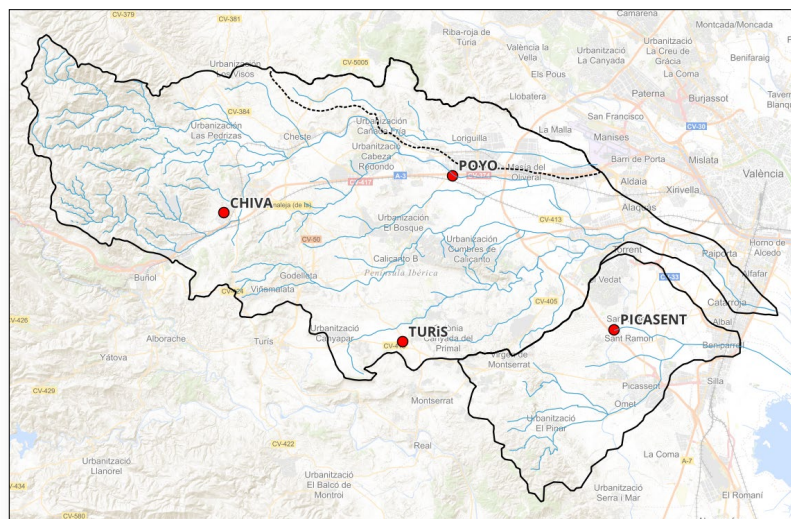
Conceptual scheme of horizontal movement in TETIS (2D simplification)



TETIS: 2 implemented models

- Daily
- 100x100m cells
- 3 rain gauges
- Sediments and microdams
- From 1990 until 28/10/2024: Sed y Hu_{final}

- Δt 10 min
- 100x100m cells
- 17 rain gauges
- Sediments and microdams
- Only el 29/10/2024
- Input Sed y Hu_{initial}



Precipitation
Analysis

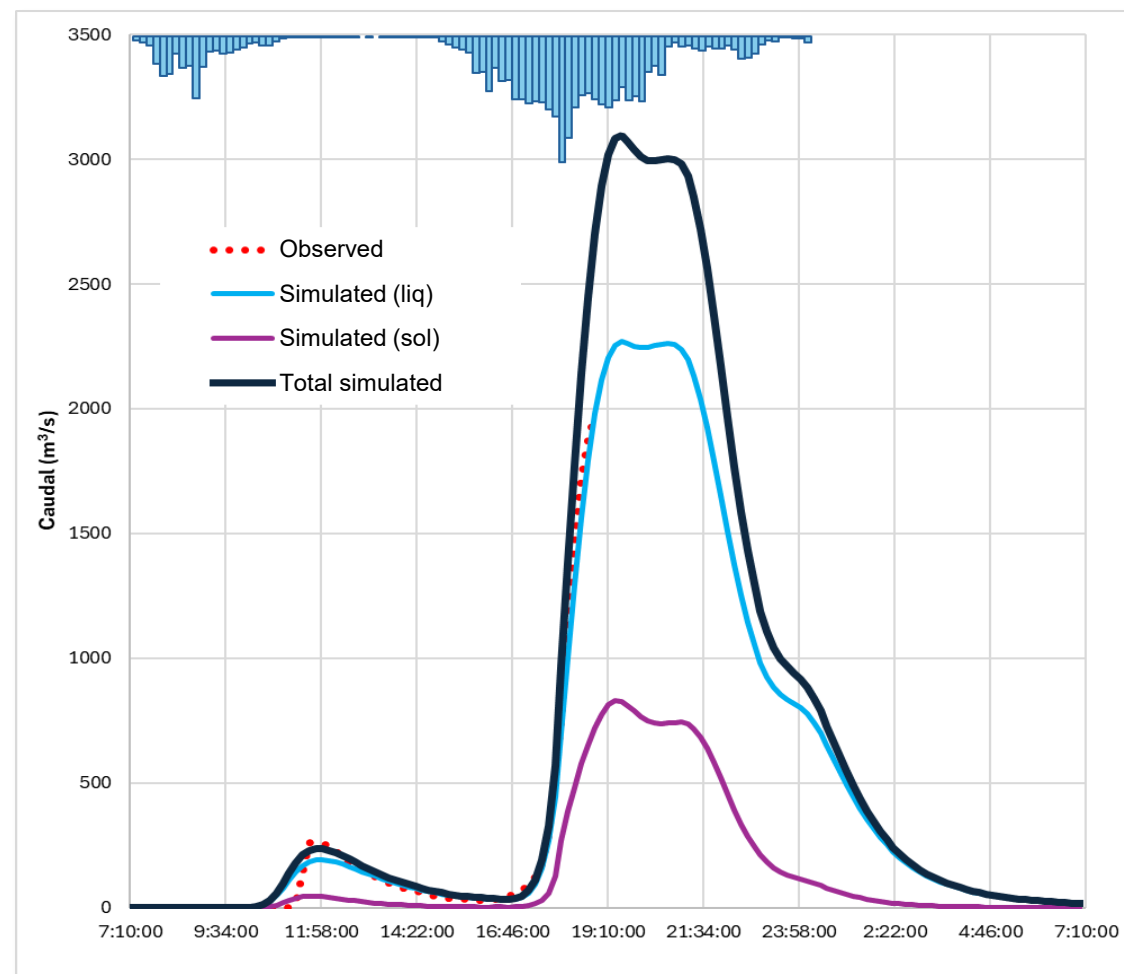
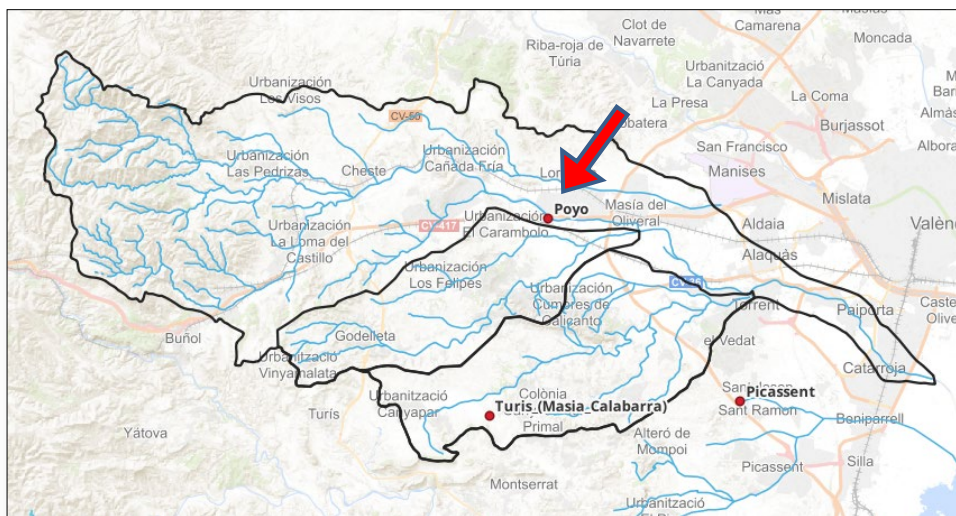
Precipitation
Map

Hydrological
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Results in gauge station:

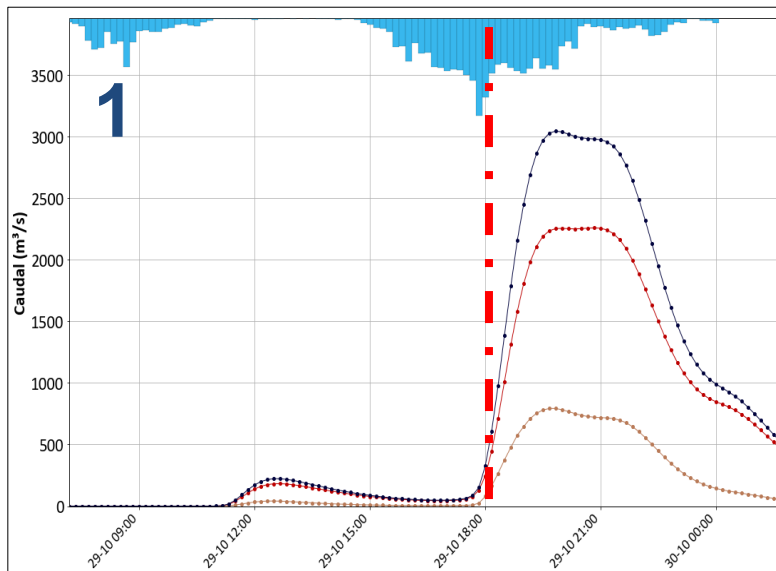
- $Q_p = 3,100 \text{ m}^3/\text{s}$
- 22% sediments of total volume (26% in peak flow)



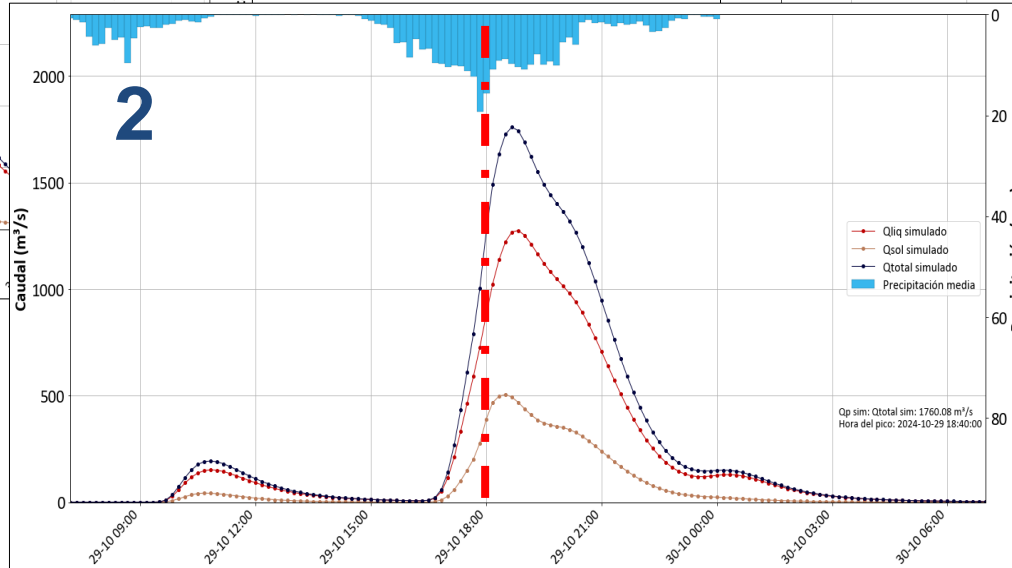
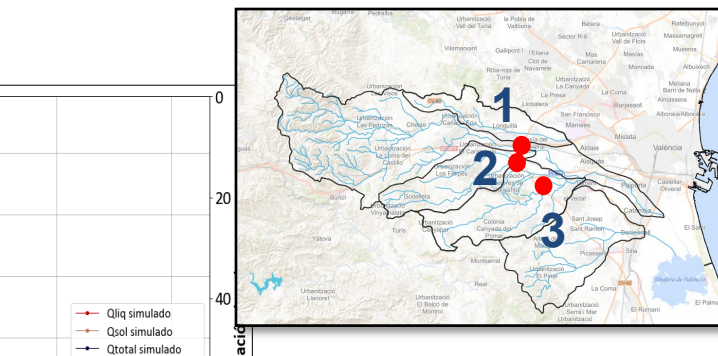


Hydrological Modelling

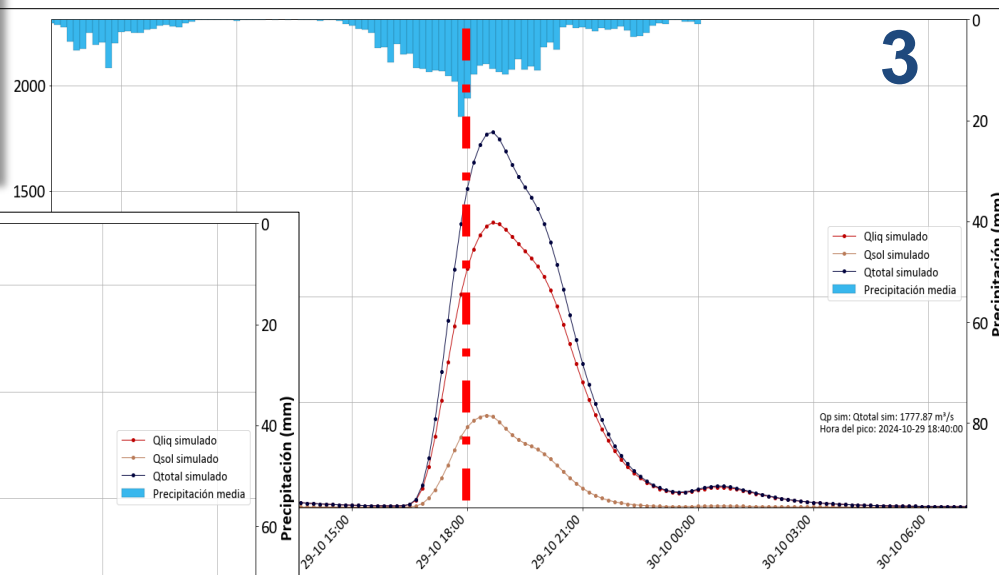
First contributors to the flooding were Horteta and Gallego ravines



Poyo at A-7 motorway



Gallego at A-7 motorway



Horteta at A-7 motorway

18:00 h

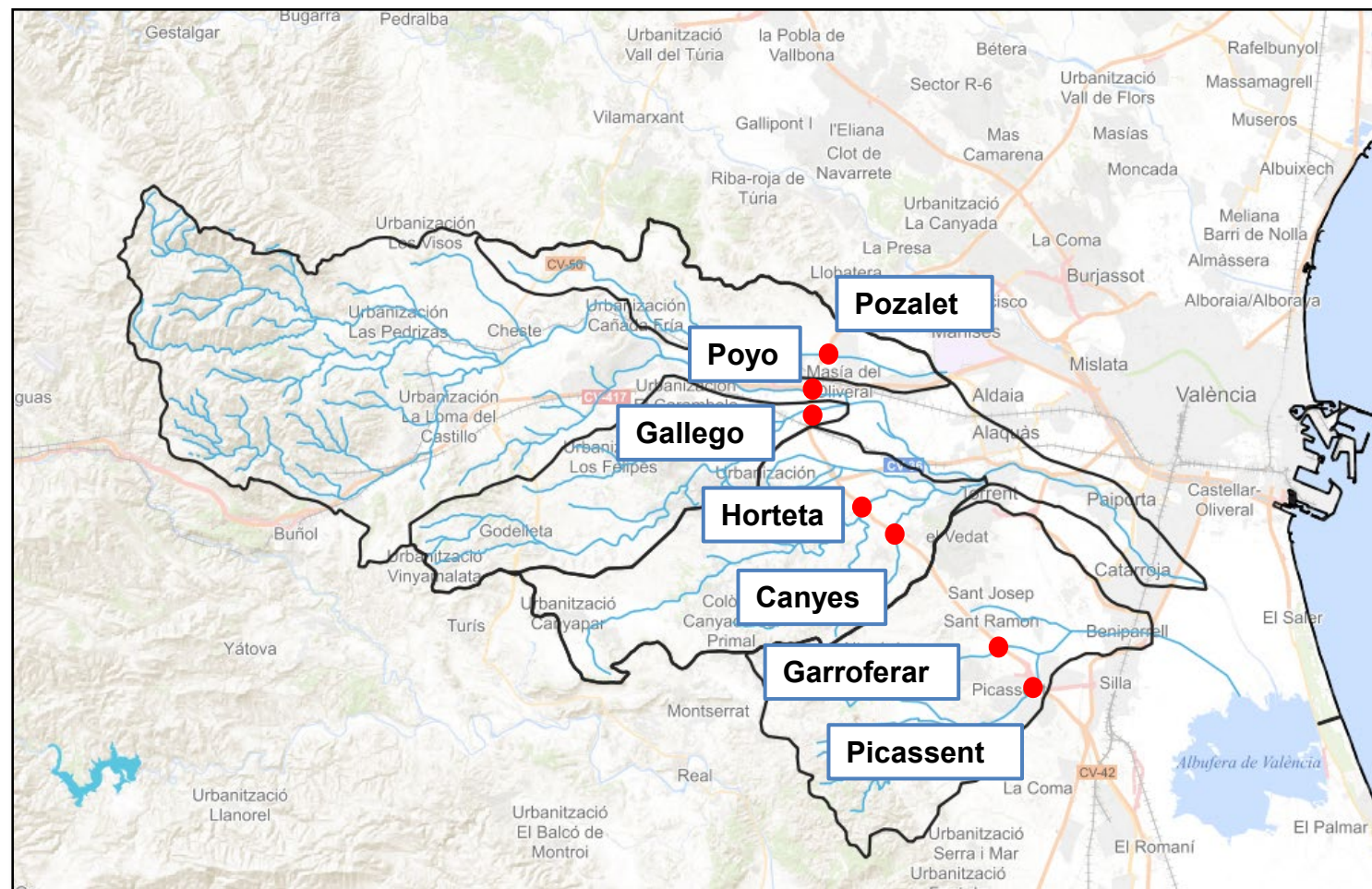
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Modelling

EN A7		
Ravine	Peak flow (m ³ /s)	Time
Pozalet	507	19:10
Poyo	3,044	19:50
Gallego	1,760	18:40
Horteta	1,778	18:40
Canyes	41	19:00
Garroferar	33	19:00
Picassent	1,112	18:30
SUM	8,274	

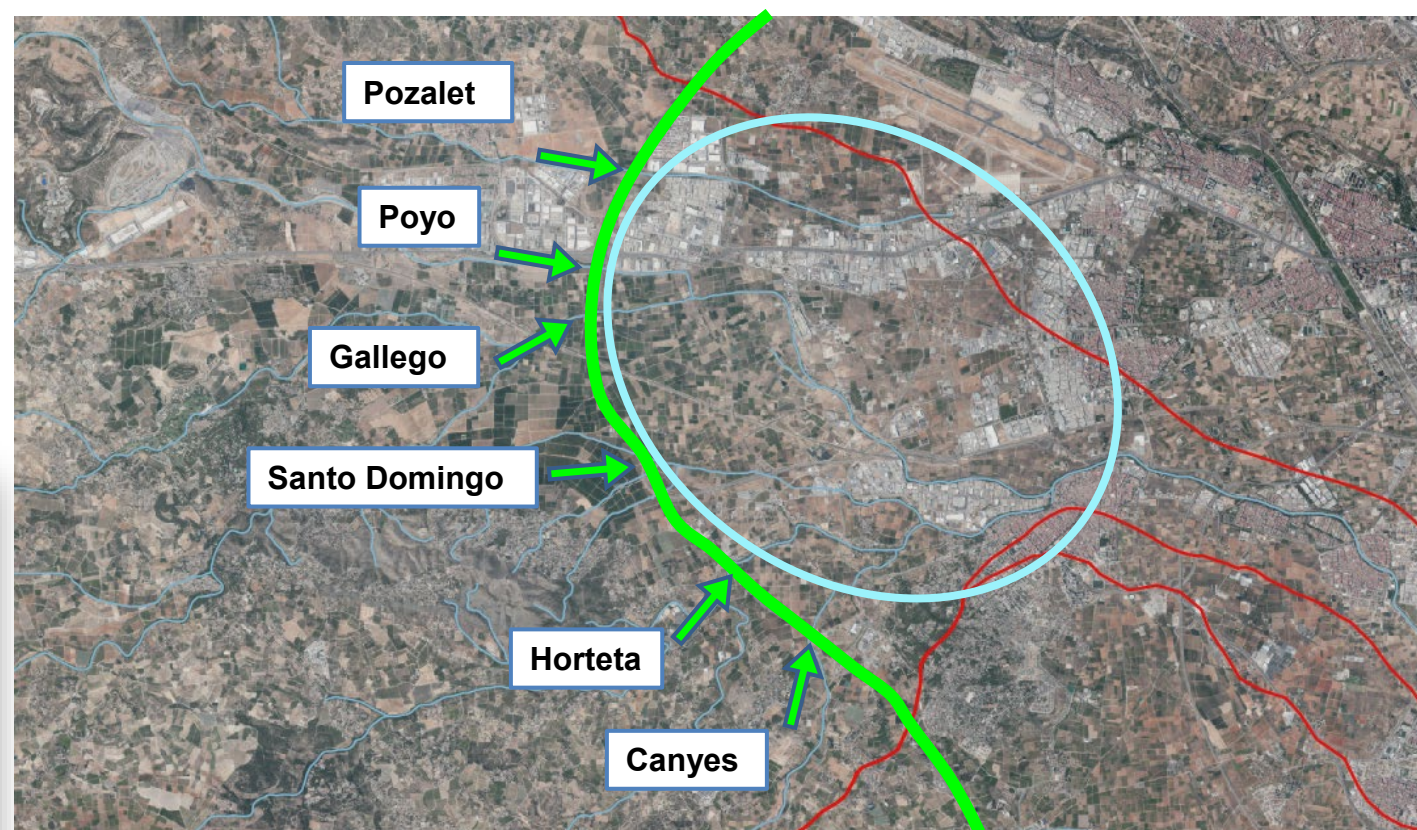
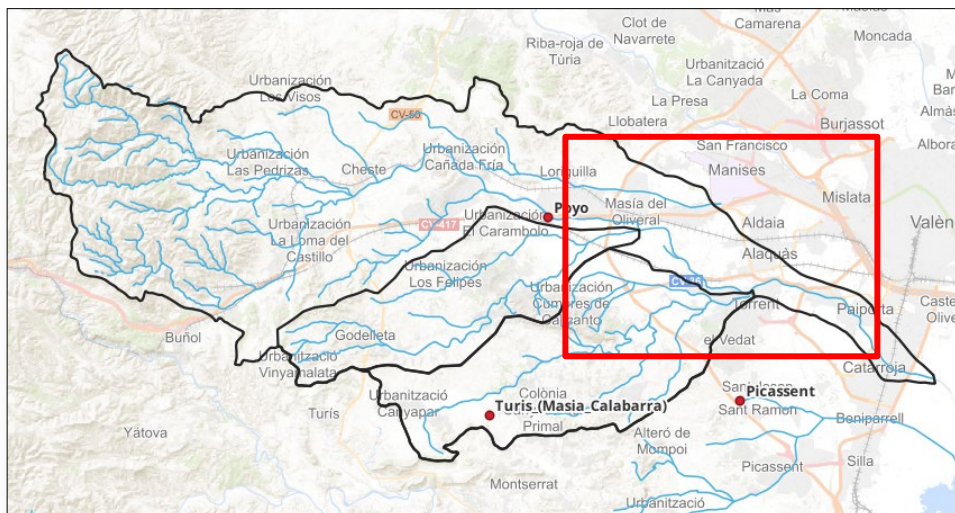


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Pla de Quart

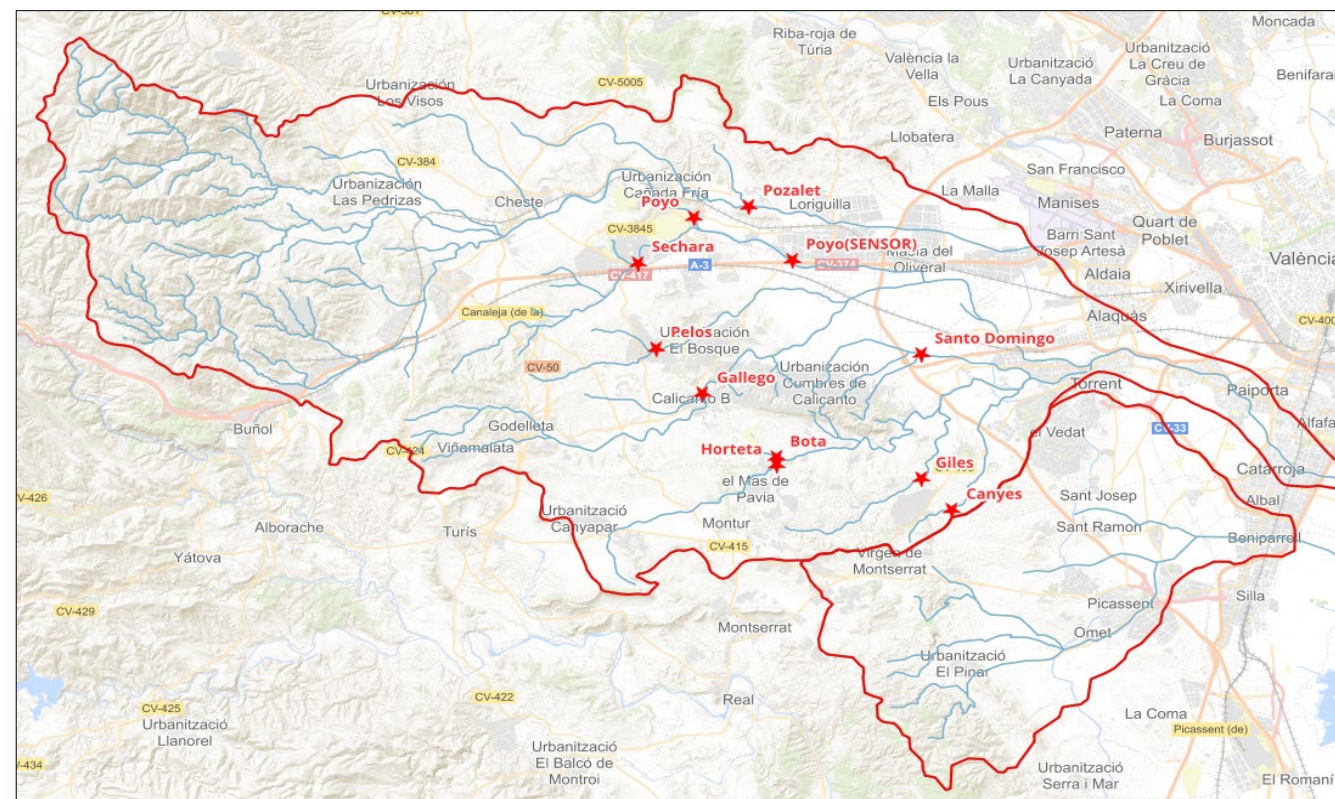
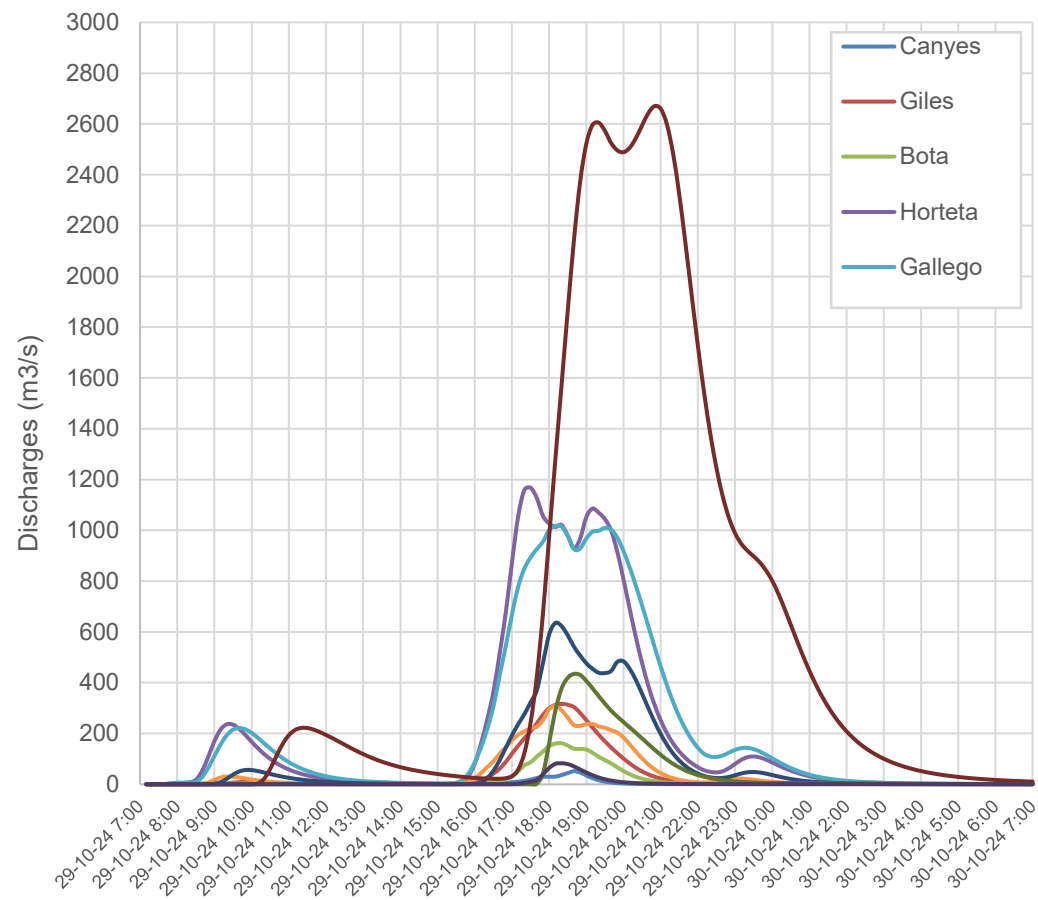
- Floodplain
- Flow attenuation due to overbank flooding
- A-7 motorway (bypass)



Requires hydraulic modelling



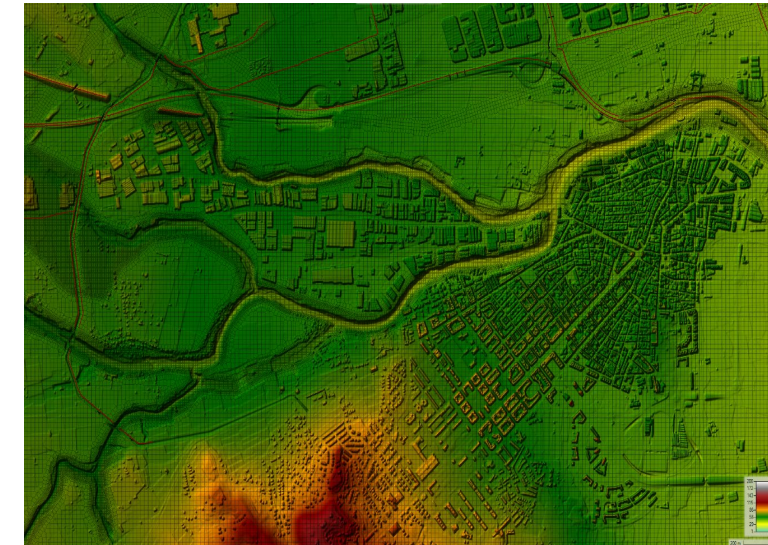
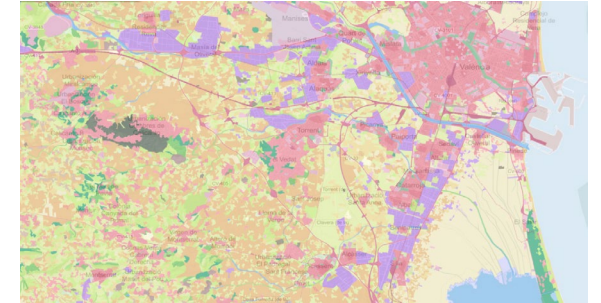
Hydrographs 29/10/2024 (Qliq + Qsol)



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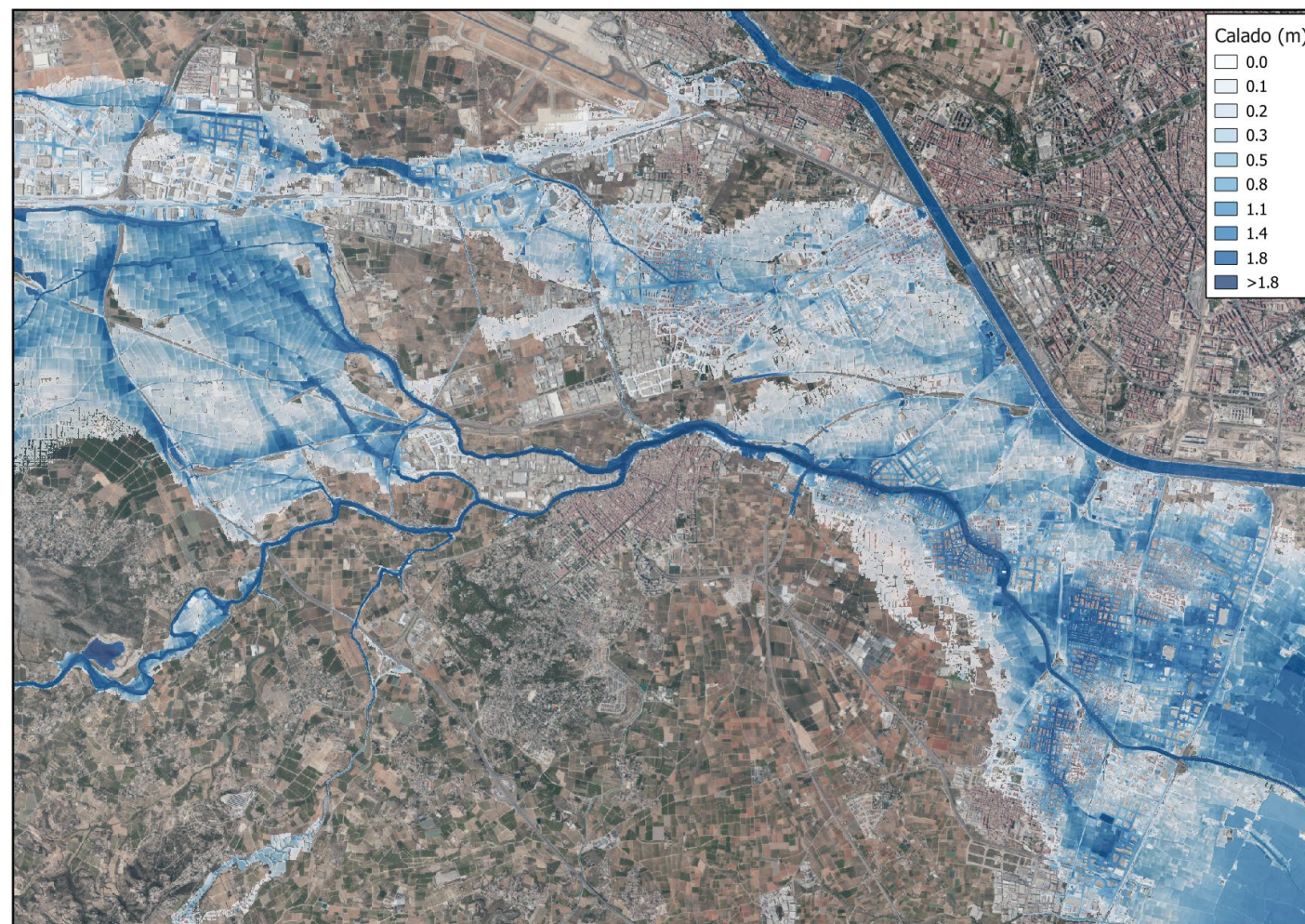


- Overall, a 15x15 m grid resolution was used; however, in more anthropized areas, the mesh was refined to 3x3 m. Within the river channels, a grid size of 2x2 m was adopted
- Approximately 1.2 million cells
- Time step (Δt): 5 seconds; total simulation time: 11 hours
- DEM: 1x1 m, based on LiDAR data from the third coverage.

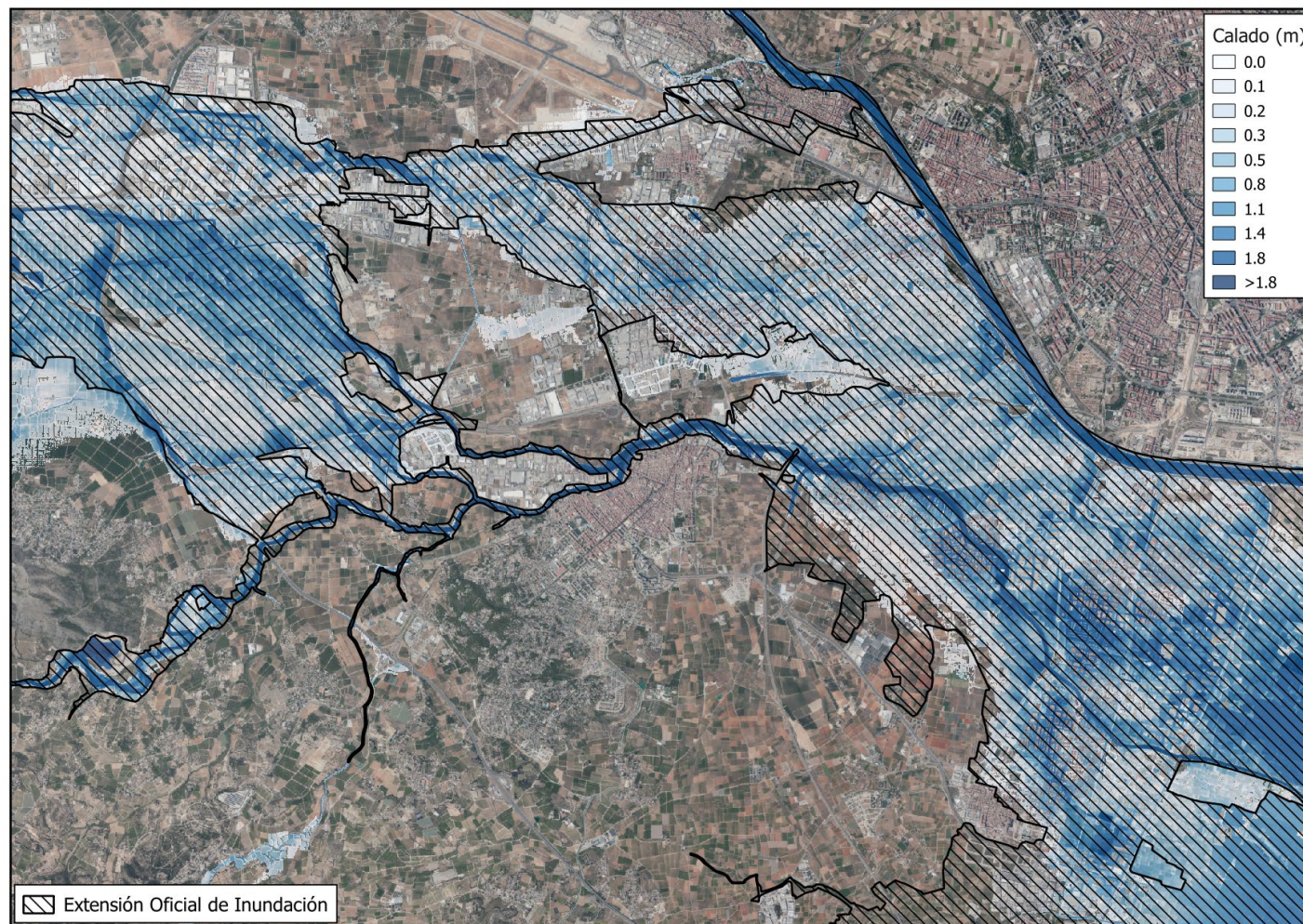


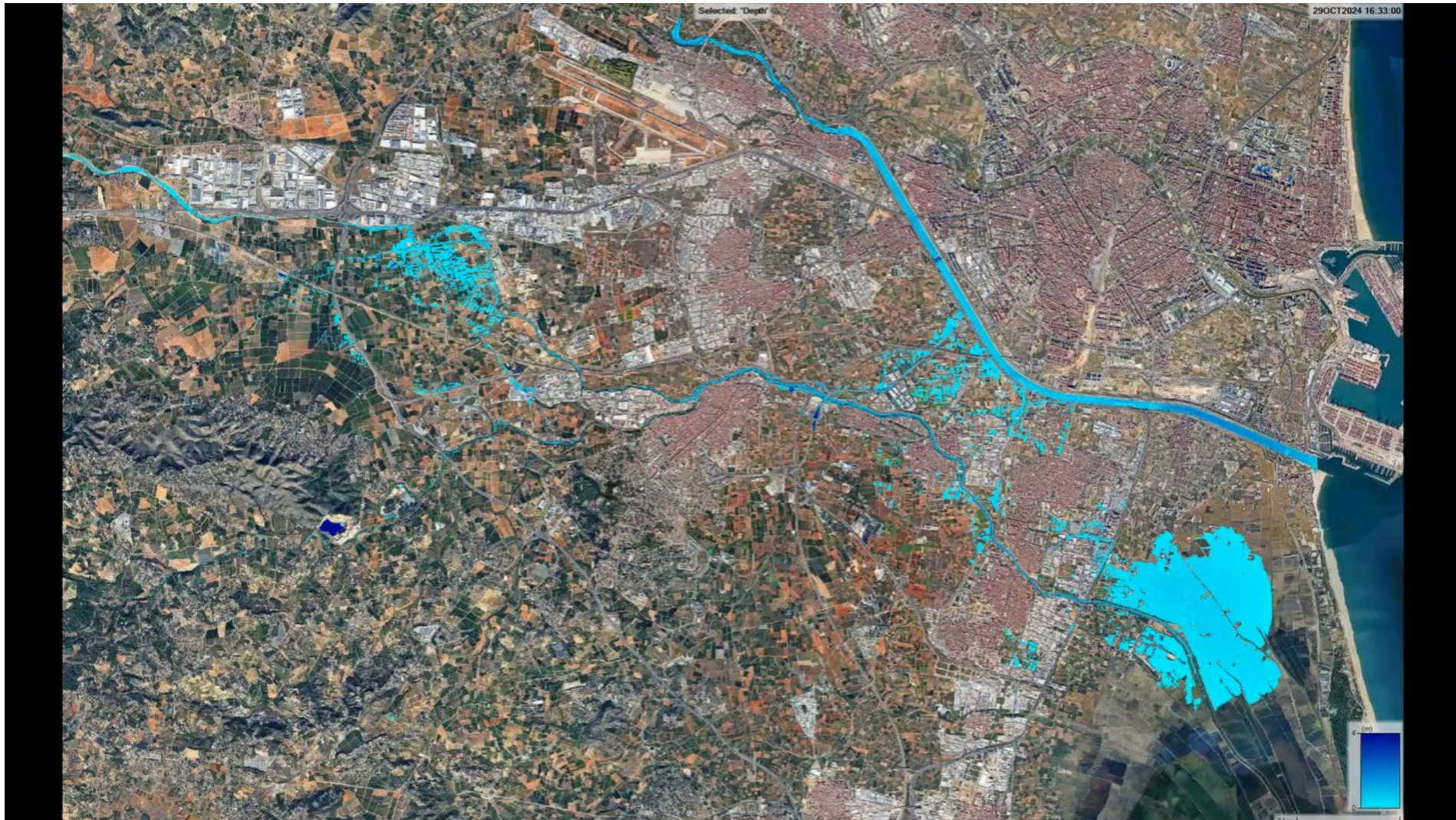


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- Distributed hydrological modeling has made it possible to establish the chronology of the flood, both for the main channel and its tributaries, which proved key to the magnitude of the event.
- A daily model was used to define the initial soil moisture and sediment conditions.
- The peak discharge in the Pla de Quart area is estimated to have exceeded 7,000 m³/s when summing the hydrographs of all contributing ravines.
- The significant contribution of the Horteta and Gallego ravines (outside the sensor's coverage), together with their time to peak, played a crucial role in shaping the temporal evolution of the event.
- Although still under refinement, the hydraulic model adequately reproduces the flood extent and the timing of overbank flows in the main channels.



Thank you for your attention!



Research Institute of Water and Environmental Engineering
Universitat Politècnica de València

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