How important are sediments in the flood peaks generated by a Mediterranean Catchment?

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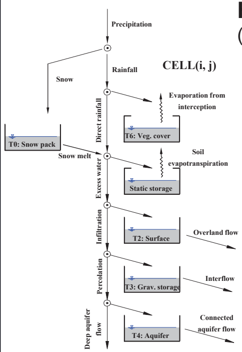
1. INTRODUCTION

The importance of **soil erosion and sediment yield** is their impact on:

- The increase in flood peaks.
- The sedimentation in reservoirs, channels and flooded urban areas.

Aim of the study: evaluating the importance of the incorporation of sediment cycle to hydrological models in order to improve the reliability of the simulated floods.

2. TETIS MODEL



Hydrological sub-model (Francés et al., 2007)

- Distributed conceptual model with tank distribution.
- Physically-based parameters.
- Distinction between slope, gully and channel cells.
- Propagation through the geomorphologic kinematic wave.

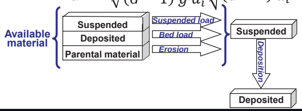
Sediment sub-model (Bussi et al., 2013, 2014)

- Slope erosion processes
  - └→ Modified Kilinc-Richardson equation

$$Q_h = 23210\, S_0^{1.66} \left(\frac{Q}{W}\right)^{2.035} \frac{K}{0.15}\, C\, P$$

- Gully and channel processes
  - └→ Engeland-Hansen equation

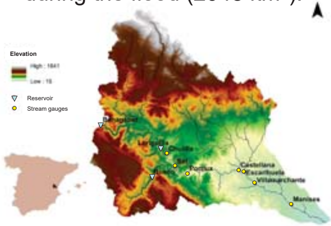
$$C_{W_i} = 0.05 \frac{G}{G-1} \frac{v\, S_f}{\sqrt{(G-1)\, g\, d_i}} \sqrt{\frac{R_h\, S_f}{(G-1)\, d_i}}$$



3. STUDY CASE

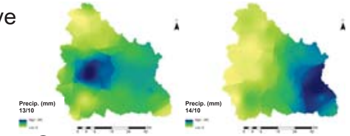
Study area

- Turia river basin (6350 km²)
  - └ Only the catchment downstream the Benagéber reservoir was active during the flood (2048 km²).

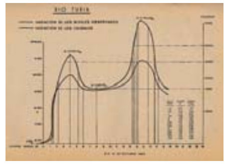


1957 Valencia's flood

- Precipitation (García and Carrasco, 1958)



- Hydrograph (Cánovas, 1958)
- Peak flows: 2700 m³/s, 3700 m³/s



- Consequences (Gómez-Guillamón, 1958)
  - 1.98 hm³ of sediments were deposited in the city.
  - High material damage.
  - 81 dead and thousands homeless.

4. EVENT RECONSTRUCTION

Hydrological sub-model implementation

- Current basin situation.
- Event model:
  - Time step: 1 hour.
  - 2 calibration events, 9 validation events.
  - NSE on water discharge: 0.6 (calibration), 0.6-0.8 (validation).
- Daily model:
  - Computation of the initial conditions of the hourly model.
  - NSE on water discharge: 0.81 (calibration), 0.64 (validation).

Land use changes

- Stationary hypothesis of the correction factors.

Reconstruction of the precipitation at hourly discretization

- 27 rain gauges.
- Based on the city hourly hyetograph of the storm.

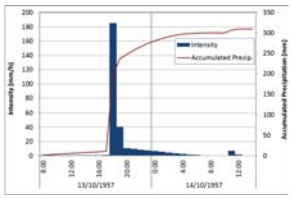
Sediment sub-model calibration

- Calibration based on the sediments volume deposited in the city.
- Observed: 1.98 hm³
- Calibrated: 2.01 hm³

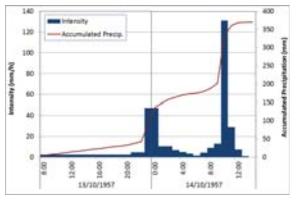
5. RESULTS

Hyetographs of the storm at hourly discretization

- Medium basin:

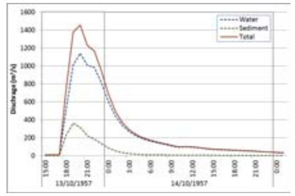


- Lower basin:

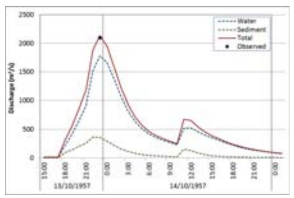


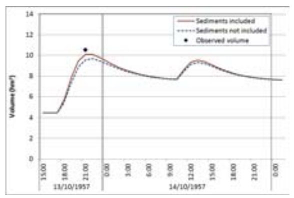
Maximum sediment contribution

- 31%

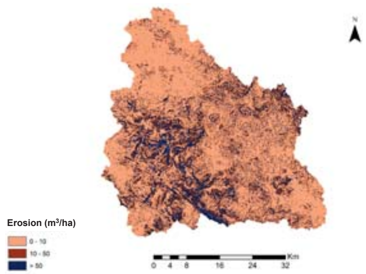


Upstream observed data

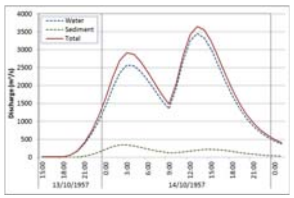


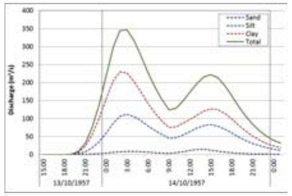


Erosion



City hydrograph and sediment graph





Sediment results

- Erosion: 53.15 hm³
- Deposited volume: 35.15 hm³
- Sediment yield: 18 hm³
- Water discharge: 192 hm³

6. CONCLUSIONS

The incorporation of a sediment cycle to the hydrological model:

- **Not important in the flood simulation in the city** (the city is on the coast). Upstream the maximum contribution was a 31%.
- **Crucial to comply** the upstream **observed data**.
- From the point of view of **sociologic and economic damages**, it was not negligible.

7. REFERENCES

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