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## **A forensic hydrometeorological and geomorphological reconstruction of the catastrophic flash flood occurred in Mallorca (Spain) on October 9th, 2018**

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An extraordinary convective rainfall event –unforeseen by most numerical weather prediction models– led to a devastating flash flood in the town of Sant Llorenç des Cardassar, eastern Mallorca, on 9th October 2018. Four people died inside the village, while the total death toll was of 13 and economic damages amounted to 91 M€. The observed flooded extension inside the town by the Copernicus Emergency Management Service –based on Sentinel-1 imagery– far exceeded the extension for a 500-year return period flood. This extreme event has been reconstructed by implementing an integrated flood modelling approach over the semi-arid and small-sized Ses Planes basin up to Sant Llorenç (23.4 km<sup>2</sup>). This procedure is based on three components: (i) generation of high spatial and temporal resolution radar-derived precipitation estimates; (ii) modelling of the hydrologic response based on post-flood peak discharge estimates; and (iii) hydraulic simulation and mapping of the affected areas based on high water marks. Radar-derived rainfall estimates and the simulated flooding extent and water depths highly correlate with observations. The hydraulic simulation has revealed that water reached a depth of 3 m at some points inside Sant Llorenç and that water velocity greatly increased at bridges' locations close to the town centre. Even if the catastrophic flash flood was not a debris flow, the flood bore eroded enough material to change channel geomorphology. This study also highlights how the concurrence of the very low predictability of this type of extreme convective rainfall events and the very short hydrological response times typical of small Mediterranean catchments still challenges the implementation of early warning systems, which effectively reduce people's exposure to flash flood risk in the region.