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Analysing the role of abandoned agricultural terraces on flood generation in a set of small Mediterranean mountain research catchments (Vallcebre, NE Spain)

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The Vallcebre research catchments are located in NE Spain, in a middle mountain area with a Mediterranean sub-humid climate. Most of the bedrock consists of continental red lutites that are easily weathered into loamy soils. This area was intensely used for agriculture in the past when most of the sunny gentle hillslopes were terraced. The land was progressively abandoned since the mid-20th Century and most of the fields were converted to meadows or were spontaneously forested.
Early studies carried out in the terraced Cal Parisa catchment demonstrated the occurrence of two types of frequently saturated areas, ones situated in downslope locations with high topographic index values, and the others located in the inner parts of many terraces, where the shallow water table usually outcrops due to the topographical modifications linked to terrace construction. Both the increased extent of saturated areas and the role of a man-made elementary drainage system designed for depleting water from the terraces suggested that terraced areas would induce an enhanced hydrological response during rainfall events when compared with non-terraced hillslopes.
The response of 3 sub-catchments, of increasing area and decreasing percentage of terraced area, during a set of major events collected during over 15 years has been analysed. The results show that storm runoff depths were roughly proportional to precipitations above 30 mm although the smallest catchment (Cal Parisa), with the highest percentage of terraces, was able to completely buffer rainfall events of 60 mm in one hour without any runoff when antecedent conditions were dry. Runoff coefficients depended on antecedent conditions and peak discharges were weakly linked to rainfall intensities. Peak lag times, peak runoff rates and recession coefficients were similar in the 3 catchments; the first variable values were in the range between Hortonian and saturation overland flow and the two last ones were in the range of saturation overland flow as described elsewhere.
Field observations during major events evidenced that water flow bypassed many man-made structures. For example overland flow ran across the terraces or infiltrated near the external edges and quickly exfiltrated at the bottom of the wall of the terraces located below. Some drainage ditches were even overflowed by waters that sought to follow the original water paths. In the three basin outlets, outstanding foam was observed during major events, evidencing soil organic matter leaching.
In spite of the conspicuous implications of terraces on hillslope hydromorphology, there were therefore no clear evidences of any effect on the characteristics of major runoff events when the sub-catchments with different fractions of terraced areas were compared. These soil conservation structures undoubtedly suffer a great geomorphic stress during overland flow events, nevertheless, most of the terrace collapses in the area were caused by soil resistance failures during an extraordinary long-lasting rainfall event (November 1982) which did not cause noticeable overland flow landforms on hillslopes.