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Observing and conceptualising runoff generation mechanisms in an alpine environment: from hillslopes to catchments.

Understanding runoff generation mechanisms and associating these with water residence times and surface/subsurface flow paths is crucial for catchment modelling under PUB conditions. In recent years, field applications of environmental tracers and tracer-based models, combined with hydrometric measurements, have proved to be effective to discriminate between different dominating runoff generation processes at the hillslope and headwater catchment scale. However, with increasing spatial scale, plot- and hillslope-scale processes from disparate topographic elements combine to produce an integrated response. The integration process incorporates non-linearities (typically thresholds and hysteretic behaviours), that are intensity-dependent and occur at different levels of complexity. Consequently, understanding and deconvolving the interplay of the various processes and water flow pathways emerges as a major challenge when aiming to transpose information across locations and scales. The presentation builds upon observations of runoff generation mechanisms in a network of small alpine watersheds located in the Italian Dolomites, ranging in size from 0.0033 km^2 to 109 km^2, where isotopic, soil moisture, piezometric and hydrometric data are available for a number of rainfall-runoff events. These observations offer an opportunity to examine three main questions: i) how topographic information may be exploited to characterize the hillslope controls on subsurface flow and to identify homogeneous runoff generation areas within the catchment; ii) how the hysteretic storage/runoff relationship varies in time and changes with the magnitude of the runoff events; and iii) how the conceptualization of processes observed at the hillslope and headwater catchment scale may be up-scaled to larger basins.