

# Hydrological response of a headwater catchment in southeastern Brazil Part I: Patterns of rainfall-runoff and stormflow

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## Abstract

Headwater basins are central for meeting water management and, in humid tropical areas, essential to understand the baseflow, the discharge component that maintains water availability during the dry season, and the stormflow generated from recurrent convective clouds that can lead to flash floods. We measured field data in a typical headwater basin and four sub-basins, in subtropical climate region of Serra da Mantiqueira/South-East Brazil, with a multi-instrument hydrometeorological set (precipitation, streamflow, baseflow, stormflow, soil moisture SM, water table depth WTD), towards providing regional data, to our knowledge, hitherto non-existent, on hydrological response patterns, and variation of stormflow generation with boundary conditions and scale. Precipitation recovered in September and peaked in January concurrently with streamflow. Baseflow responded for most of the streamflow during the dry season and about half in the wettest months, and peaked ahead in March, highly covariating with WTD. In contrast, SM described a longer yearly memory, that recovered 3 months earlier than streamflow, and depleted 2 months latter in March. The monthly scale stormflow responded significantly to rainfall although with low predictability. At the event scale, revealing patterns for all basins showed thresholds of precipitation ( $[?] \geq 10$  mm), SM ( $[?] \geq 45\%$  to  $57\%$ ) and WTD  $[?] \geq 135$  cm, below which stormflow was modest. The event stormflow coefficient (eSC) reached up a maximum of 25%, albeit with large variance and little seasonality of the median. Estimates of eSC with double mass and SM thresholds showed pronounced spatial and temporal differences (3.2 to 9.6% in drier conditions and 7.7 to 15.4% wetter conditions). Mean streamflow and runoff coefficient were quite lower at the main basin (21% compared to about  $[?] \geq 32\%$  between sub-basins), where there possibly exists groundwater flux exportation, that discharge on a larger spatial scale, by water exiting the basin without passing through the surface outlet.

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