Identifying runoff sources across scales in Amazon watersheds: an LBA synthesis effort

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End member mixing analysis (EMMA) can be used to identify the sources of water that contribute to streamflow and to quantify source dynamics both over seasons and during individual storm events. This approach assumes that the chemistry of stream water is the product of a mixture of discrete "source" solutions within catchments whose solutes behave conservatively as they travel to the stream. We used EMMA to examine sources of streamflow across watersheds of different scales and land covers at various LBA and other Amazon sites, for which stream water and flowpath hydrochemistry data from previous studies were available. These included watersheds at Nova Vida, Nossa Senhora, and Rancho Grande in Rondônia, Juruena in Mato Grosso, Paragominas in Pará and La Cuenca in Perú. We were interested in identifying the hydrological flowpaths that deliver water and solutes from land to streams and rivers of the Amazon Basin, and in changes in flowpaths with changes in land cover and across a range of soil characteristics, particularly the presence or absence of a layer of low hydraulic conductivity. We identified a consistent pattern across sites in which groundwater and soil solution end members emerged as the main sources to stream flow. The relative contribution of these two sources varied with discharge, as the relative contribution of groundwater increased significantly with increasing discharge during baseflow on most sites. During storm flow, the magnitude of contributions by source was independent of discharge rate. Overland flow contributions to stream flow were identified at most sites, although the relative importance of overland flow diminished in streams draining larger watersheds. Patterns associated with land cover transformation were identifiable at the smaller order watersheds because of an increase in water yields due to increased overland flow in pastures relative to forest. Patterns across soils characteristics could not be clearly established with the current datasets, as they mostly originate at sites under Ultisols, while Oxisols were underrepresented (1 site). Our results show that: 1) the EMMA approach can be applied for multi-site comparisons, and 2) some consistent patterns of hydrological functioning across scales can bolster the predictive power of modeling efforts aimed at quantifying how changes to land cover influence basin-wide hydrological and biogeochemical processes across the Amazon.

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