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Quantifying hydrological impacts of land-use change in the Southern Amazon at different spatial scales

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Most of deforestation in the Brazilian Amazon has occurred due to agricultural expansion, which is primarily associated with the conversion of forest to pasture. When assessing the impacts of deforestation on the water balance components in this region, studies usually report basin wide effects. However, the impact assessments of land-use change at such large scales normally do not comprehensively represent fragmented changes in the landscape. In order to show the influence of scale, we first compared the water balance of paired micro-catchments (<1 km²) with contrasting land uses (forest and pasture), using empirical data from field measurements (from 2013 to 2014). Subsequently, we simulated the hydrological behaviour of the macro-catchment (Tapajós river subbasin, 37 400 km^2), using a hydrologic model (SWAT). For the setup, calibration and validation of SWAT, we used a gradual land-use change parameterization, field assessments, and available regional data, and then simulated a land-use change scenario in order to quantify the changes in the water balance components due to deforestation. Empirical data from the micro-catchments show a higher runoff coefficient in the pasture catchment (0.67) than in the forest catchment (0.28), and higher evapotranspiration (ET) in the forest than in the pasture catchment (63%). Baseflow indices were 0.76 and 0.88 for the pasture and forest catchments, respectively, showing a higher baseflow contribution in the forest catchment. Simulation results at the macro-scale show a 2% increase in discharge (Q), a 3% decrease in ET, and a 5% reduction of baseflow contribution to total Q after a 22% conversion of forest to pasture in the macro-catchment. We conclude that although the change in baseflow contribution was the most noticeable change at both scales, hydrological responses due to land-use change are scale dependent.