Combining morphological and sedimentological investigation with $\chi$ index and Gilbert metrics for analysis of drainage rearrangement and divide migration in a plateau region

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Drainage rearrangement is a critical process in the dynamic evolution of landscapes. Two approaches have been used to identify, analyze, and describe drainage rearrangement and, consequently, divide migration: classical geomorphological studies based on morphological and sedimentary evidence; and geomorphometric analysis, highlighting the $\chi$ index and Gilbert’s three metrics (gradient, relief, and elevation). The present study uses classical and geomorphometric methods to analyze migration in the drainage divide between the Uruguay and Paraná rivers (two of the largest basins in South America). The study area is the Espigão Range (Santa Catarina State in Brazil), composed of inland plateaus with low relief and low rates of tectonic uplift. The results indicate that the methods express distinct periods of relief evolution. Investigations using classical methods reveal a history of past captures and bidirectional migration of watersheds in low relief areas. In opposition, topographic metrics indicate the current stability trend in drainage migration. After the fluvial channel capture events, there is an adjustment period for the new drainage configuration to reach stability. Therefore, Plateau’s drainage divide suggests a contrast throughout the area with phases of relative stability and phases with more accentuated drainage migration. Finally, the results show that the $\chi$ index and the three Gilbert metrics (gradient, relief and elevation) should be used with caution when evaluating because, in these areas, present, past, and future divide migrations are not unidirectional, and thus may not be correctly modeled by these computation tools. Likewise, the classical geomorphological studies based on morphological and sedimentary evidence should also be used with caution because this method cannot always show the current stability or instability in drainage divide migration.