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Supplement of

Geomorphic indicators of continental-scale landscape transience in the Hengduan Mountains, SE Tibet, China

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Supplement

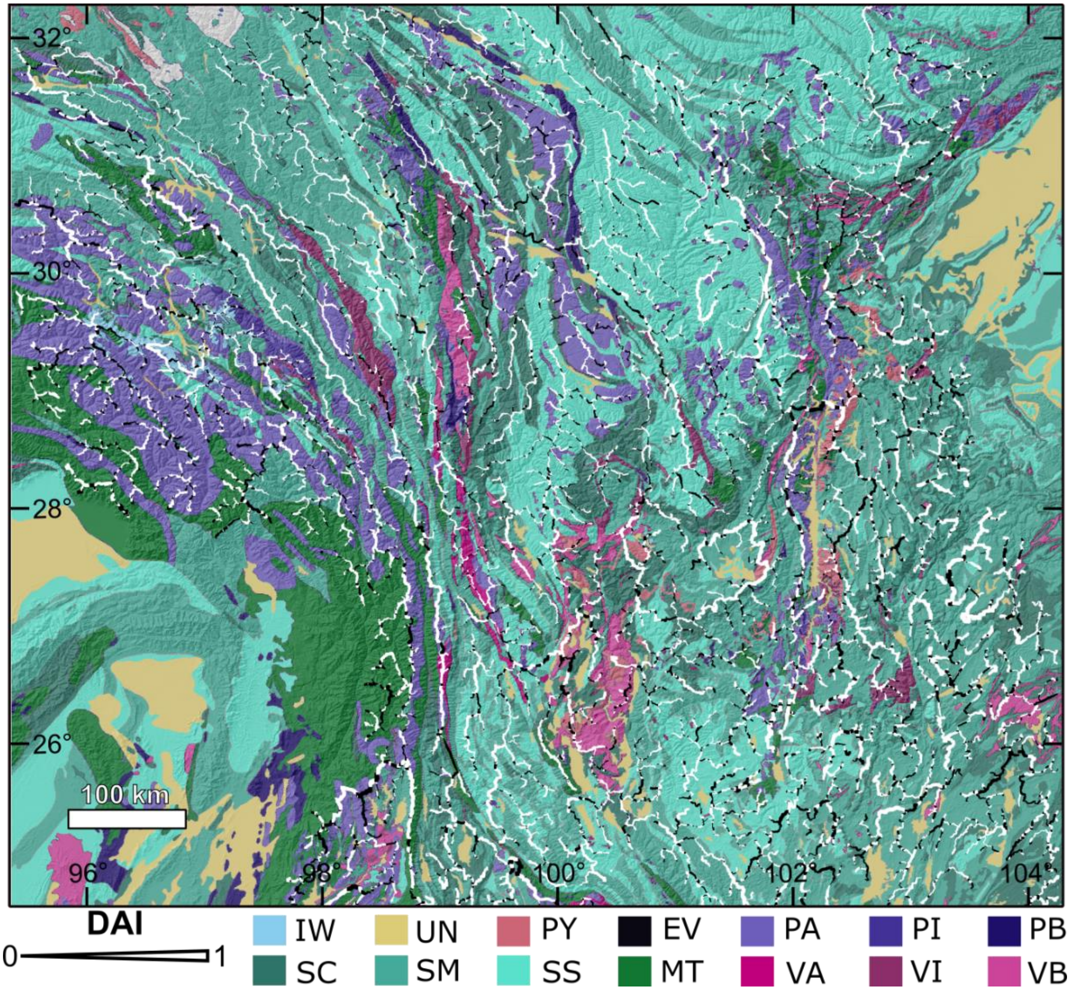

Figure S1: Spatial comparison of HDM lithology and χ_P asymmetry magnitude and agreement with local-scale metrics shows no clear patterns between lithology and strong divide asymmetry or migration direction disagreement. Lines represent drainage divides with line thickness corresponding to χ_P DAI. Divide segments where migration directions in χ_P and a majority of local-scale metrics (2+/3) agree are white; segments where χ_P indicates a divide migration direction contrary to 2 or more local-scale metrics are black. Lithology abbreviations are ice/water (IW), unconsolidated sediments (UN), pyroclastic rocks (PY), evaporites (EV), acidic plutonic rocks (PA), intermediate plutonic rocks (PI), basic plutonic rocks (PB), carbonate sedimentary rocks (SC), mixed sedimentary rocks (SM), siliciclastic sedimentary rocks (SS), metamorphic rocks (MT), acidic volcanic rocks (VA), intermediate volcanic rocks (VI), and basic volcanic rocks (VB). Lithologic data are from the GLiM global lithologic map (Hartmann and Moosdorf 2012a).

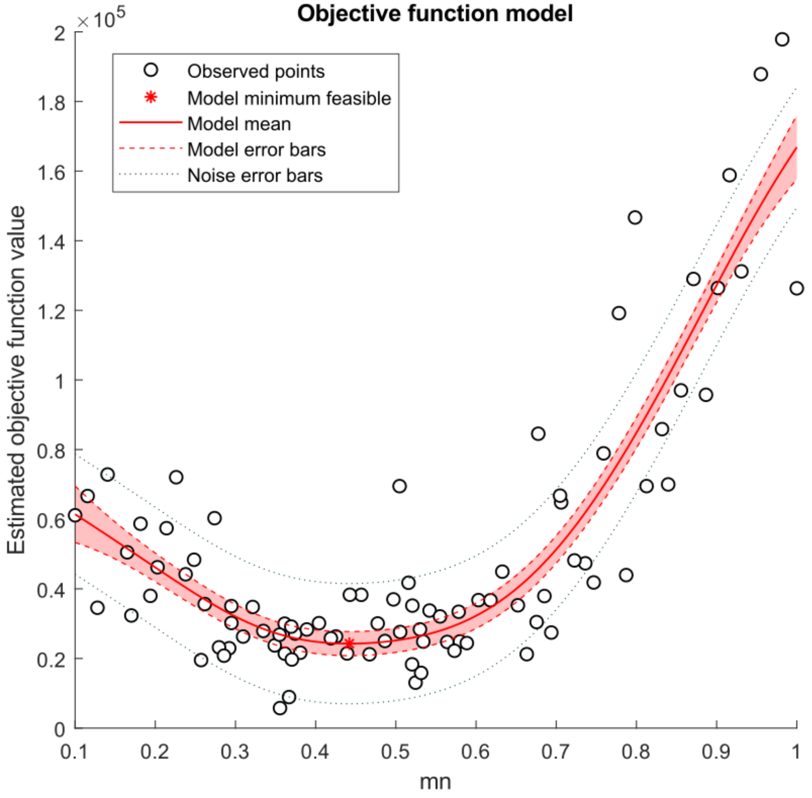

Figure S2: Plot of results showing best-fit θ_{ref} of ~0.45 ("model minimum feasible;" red star) determined through Bayesian optimization with the *mnoptim* function in Topotoolbox. White circles mark calculated θ *(m/n)* values and their corresponding estimated objective function values for each of the 100 model iterations. The model mean is shown with a solid red line and its corresponding error is shown with a dashed red line. The dotted grey line is the noise error bars.

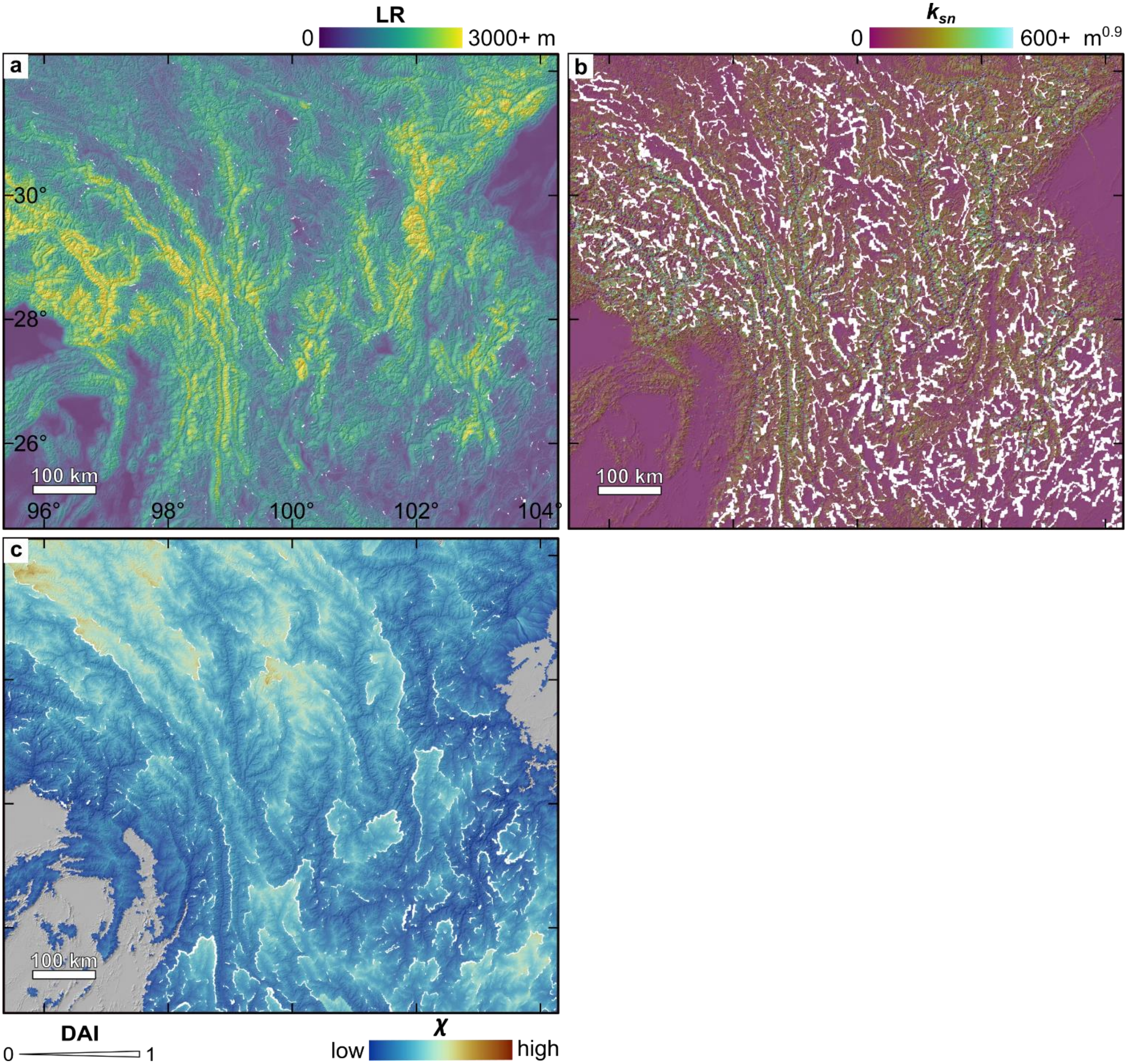

Figure S3: Maps of geomorphic metrics across the HDM and corresponding divide asymmetry for metrics not included in main text. Panels show local relief (LR; a), normalized channel steepness without precipitation correction (k_{sn}; b), and χ without the precipitation correction (χ; c). White lines are drainage divides, with thicker lines indicating a higher divide asymmetry index (DAI) for the specific metric.

Table S1: Statistics for drainage divide asymmetry magnitude (DAI) by metric. STDV is standard deviation and IQR is interquartile range. High and low asymmetry thresholds for each metric correspond to the 95th and 5th percentiles, respectively.

Metric	Mean	STDV	Median	IQR	Min	5th Percentile	95th Percentile	Max
CRR	0.0543	0.0559	0.0305	0.0544	1.80E-05	0.0040	0.1623	0.9674
LR	0.0385	0.0322	0.0305	0.0728	1.10E-05	0.0033	0.1004	0.9674
HSG	0.0704	0.0644	0.0520	0.0728	1.00E-06	0.0054	0.1984	0.6057
k_{sn}	0.2111	0.1735	0.1691	0.2250	4.40E-05	0.0155	0.5609	1.0000
k_{snP}	0.2117	0.1738	0.1694	0.2255	1.00E-05	0.0152	0.5641	1.0000
χ	0.0734	0.0696	0.0752	0.0752	8.00E-06	0.0052	0.2180	0.6878
χ_P	0.0744	0.0670	0.0498	0.0752	7.00E-06	0.0048	0.2077	0.6448

Total number of segments: 22,837

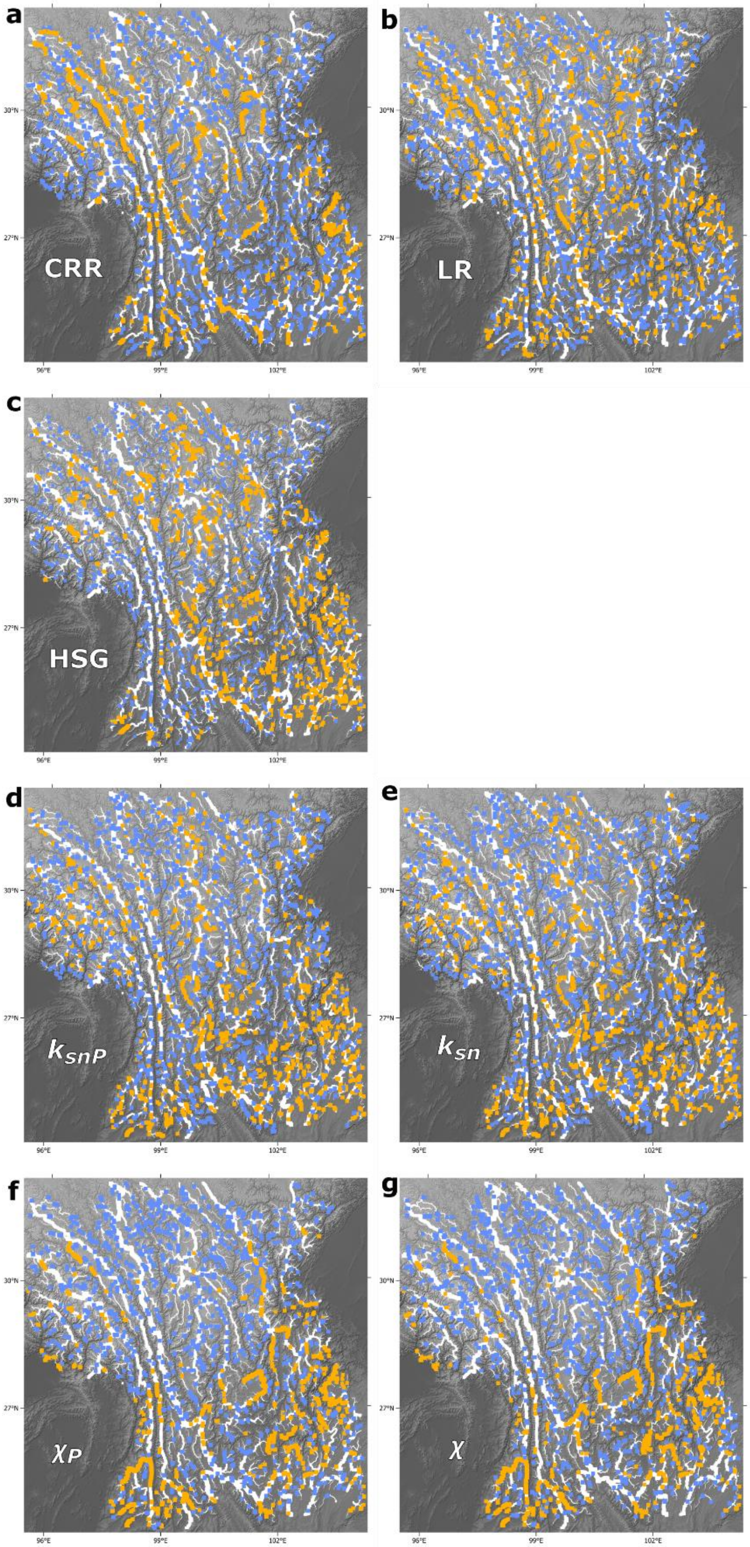

Figure S4: Locations of drainage divides with high (orange) and low (blue) asymmetry by geomorphic metric. White drainage divides are not classified as having high or low asymmetry, where divide line thickness increases with divide Strahler order (4-10). High and low asymmetry divides have a uniform line thickness for increased visibility. Panels include (a) catchment-restricted relief (CRR), (b) local relief (LR), (c) hillslope gradient (HSG), (d,e) k_{sn} with (k_{snP}) and without (k_{sn}) the precipitation correction, and (f,g) χ with (χ_P) and without (χ) the precipitation correction. Metric-specific thresholds for high and low DAI can be found in Table S1.

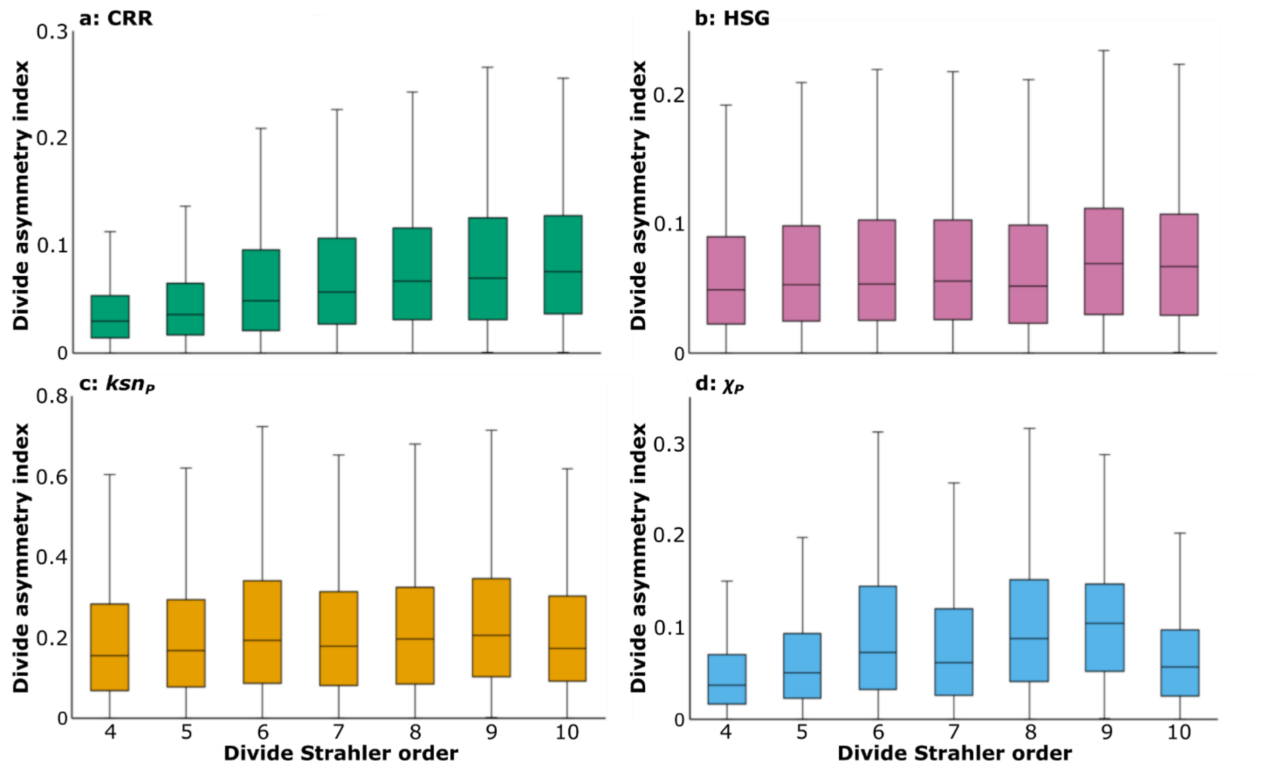

Figure S5: Boxplots of divide asymmetry magnitude (DAI) by drainage divide Strahler order for (a) CRR, (b) HSG, (c) k_{snP}, and (d) χ_P. Median DAI value is designated by a black horizontal lines in each box. DAI generally increases with divide order in all four metrics, though this trend is clearest in CRR.

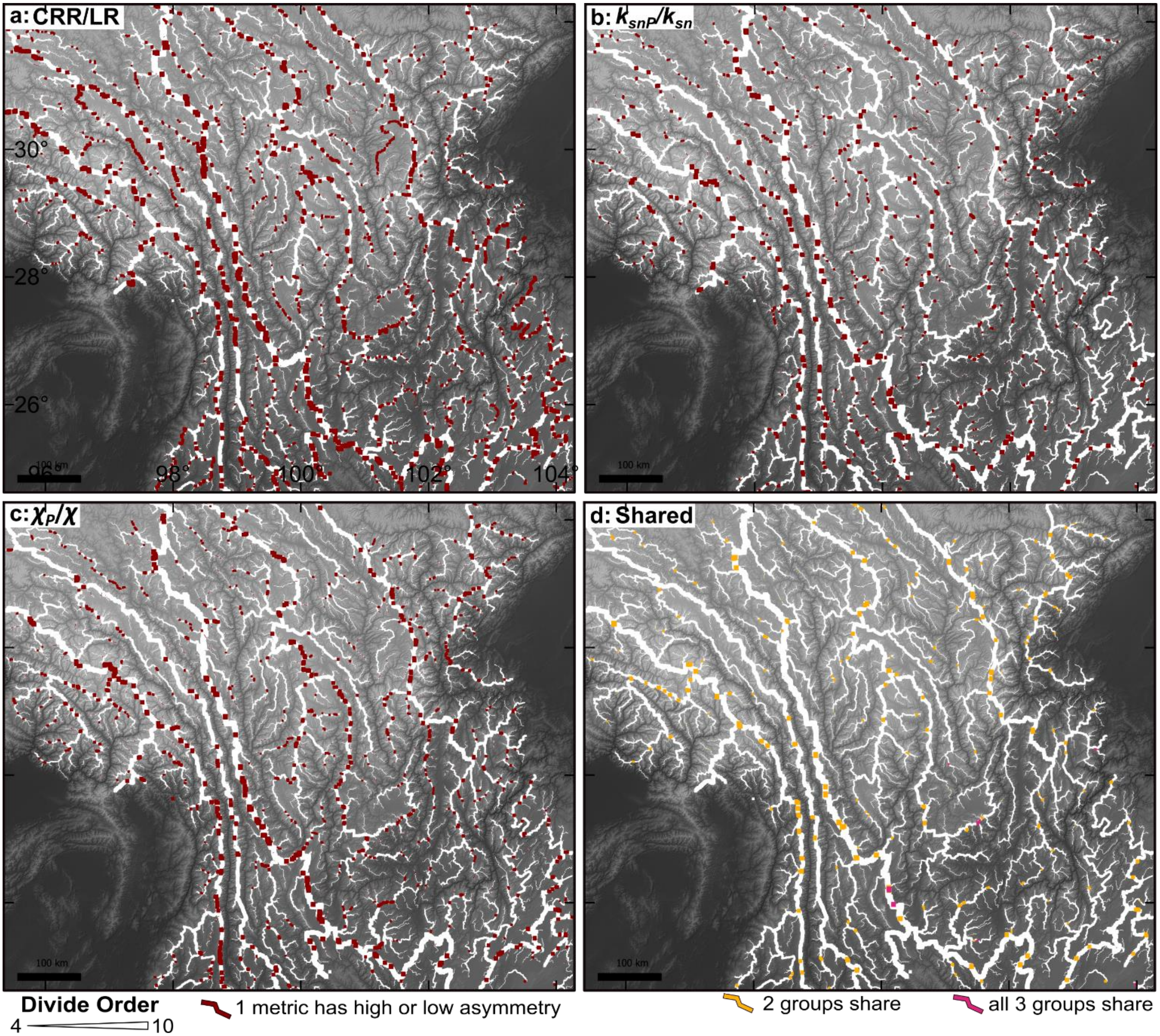

Figure S6: Locations of drainage divides that have do not have consistently high or low asymmetry between two similar geomorphic metrics (i.e., one metric has high asymmetry when the other does not) are marked in red. Divide line thickness increases with divide Strahler order (4-10). Panels include (a) CRR vs. LR, in which 2,533 divide segments (11%) have conflicting asymmetry classifications, (b) k_{snP} vs. k_{sn}, in which 1,313 divide segments (6%) have conflicting asymmetry classifications, and (c) χ_P vs. χ, in which 1,599 divide segments (7%) have conflicting asymmetry classifications. In no instance in a-c does any metric have low asymmetry when its counterpart has high asymmetry. Panel (d) shows the locations of divide segments for which all of the metric pairs in a-c have conflicting asymmetry classifications (pink, 11 divides) and of divide segments for which two of the metric pairs have conflicting asymmetry classifications (orange, 342 divides). Metric-specific thresholds for high and low DAI can be found in Table S1.

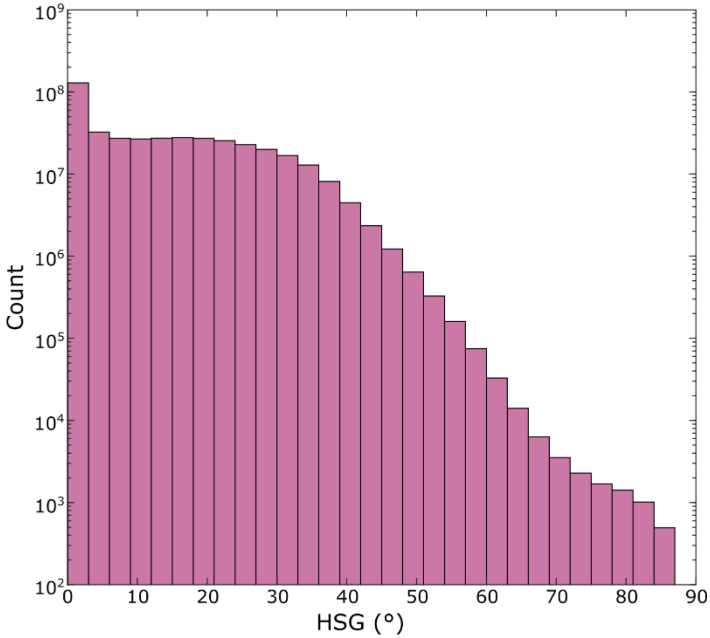

Figure S7: Histogram showing the distribution of hillslope gradient (HSG) values in the HDM. The data indicate an abrupt decline in the frequency of HSG values above ~30°, suggesting that hillslopes in the study region may reach a threshold steepness around this point.

Table S2: Shows where highly asymmetric drainage divides are coincident with landscape features discussed in the main text. When divides with high asymmetry are only present over a portion of a catchment or basin drainage boundary, the orientation of those divides is given with a cardinal direction. “Some” means that highly asymmetric divides are present, but cover only a small portion of the area.

	Highly Asymmetric Divides?						
Feature	**CRR**	**LR**	**HSG**	k_{sn}	k_{snP}	χ	χ_P
Eastern Himalayan syntaxis	Yes	Some	Yes	Yes	Yes	Some	Yes
Three Rivers	Yes	Some	No	Some	Some	Yes	Yes
Daxue Shan	Yes	Yes	Some	No	No	Yes	Yes
Yuqu River	Yes	Yes	Yes	SW side	SW side	SW side	SW side
Liqui River	Yes	Yes	N & W sides	Some	Some	E side	E side
Li River	W side	N & W sides	S side	Yes	Yes	W side	W side
Yanyuan Basin	Yes	N side	N & S sides	NW side	NW & SE sides	Yes	Yes
Anning River	No	No	No	Some	Some	Yes	Yes
Upper Heng River	Yes	Yes	Yes	Yes	Yes	Yes	Yes

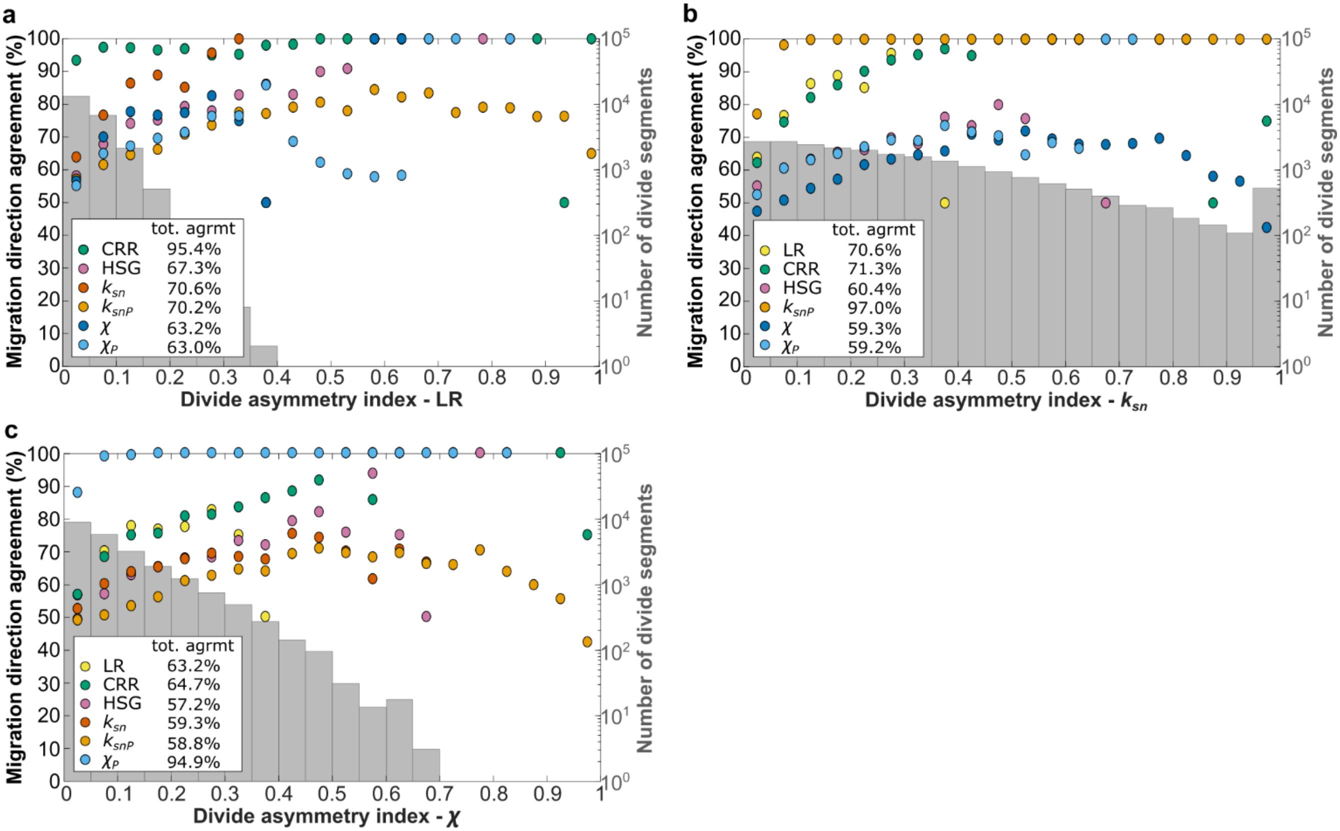

Figure S8: Plots of percent agreement in divide migration direction between LR (a), normalized channel steepness without precipitation correction (b), and χ without the precipitation correction and all calculated metrics (points), binned by corresponding divide asymmetry index (DAI) for indicated metric in intervals of 0.05. Grey histograms show the distributions of DAI values in log-scale for each metric. Higher DAI corresponds with increased agreement in migration direction between metrics. Histograms show variability in DAI distributions in different metrics.