

Do mountains matter for global erosion and weathering?

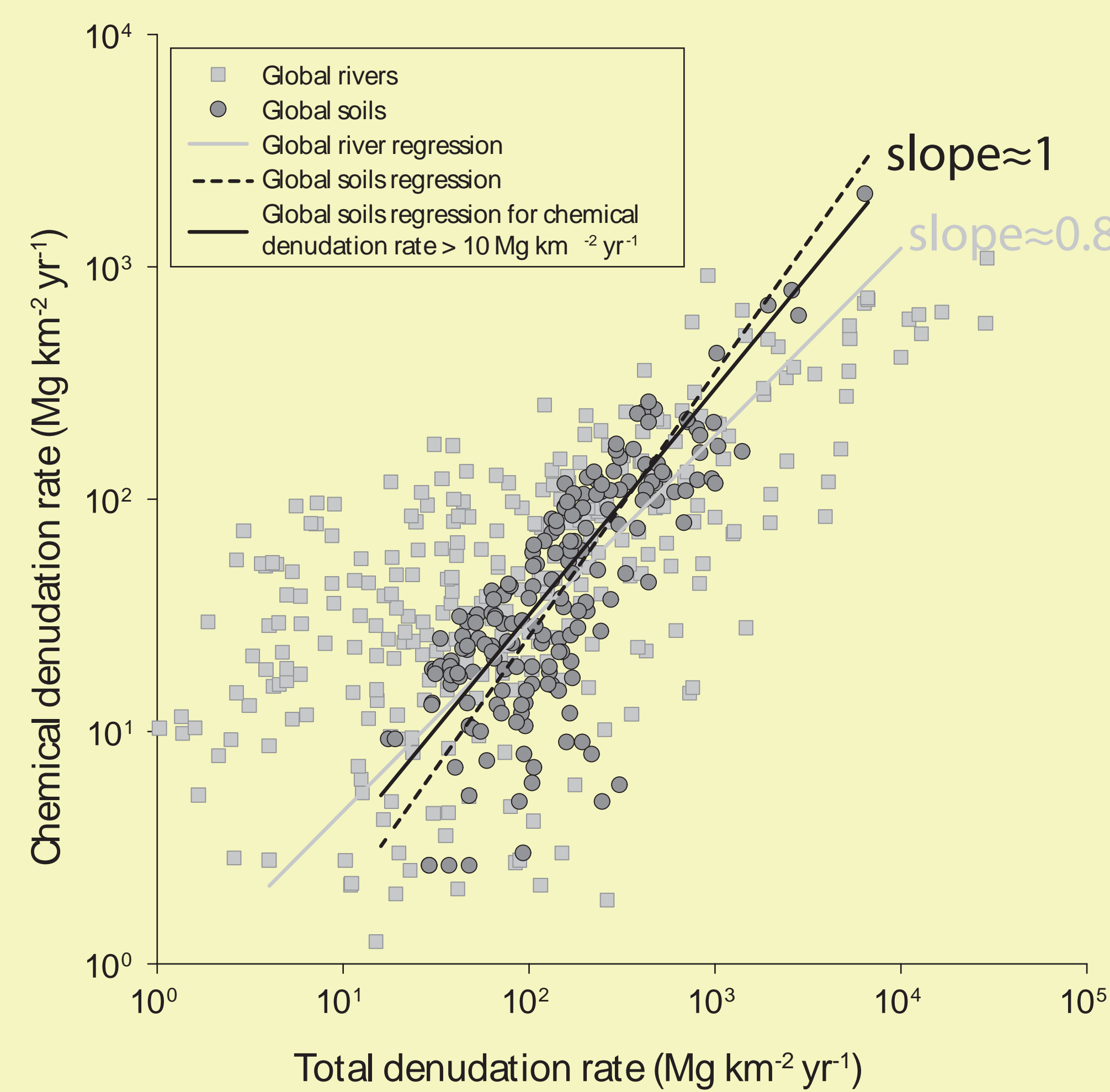
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Introduction

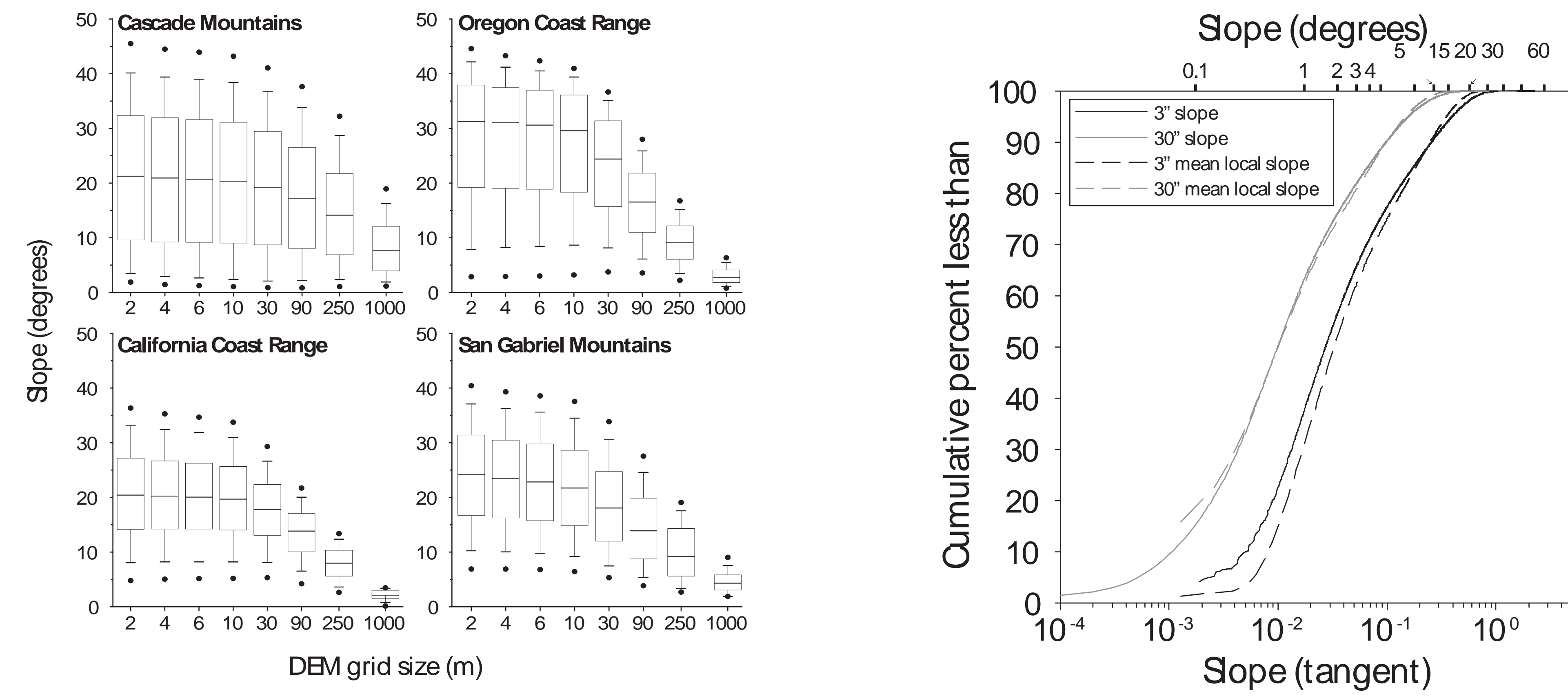
Re-vitalization of interest in T.C. Chamberlin's (1899) uplift-climate hypothesis has produced intense debate over the role mountains play in the physical and chemical denudation of Earth's surface. Recent challenges to the uplift-weathering hypothesis include model results that suggest most of Earth's sediment is generated from areas with gently sloping topography, rather than steep mountains (Willenbring et al., 2013). Here we show that the conclusions of Willenbring et al. (2013) are based on inappropriate use of a coarse-scale DEM to calculate global slope angles and demonstrate that mountains dominate sediment and solute fluxes to Earth's oceans.

Methods

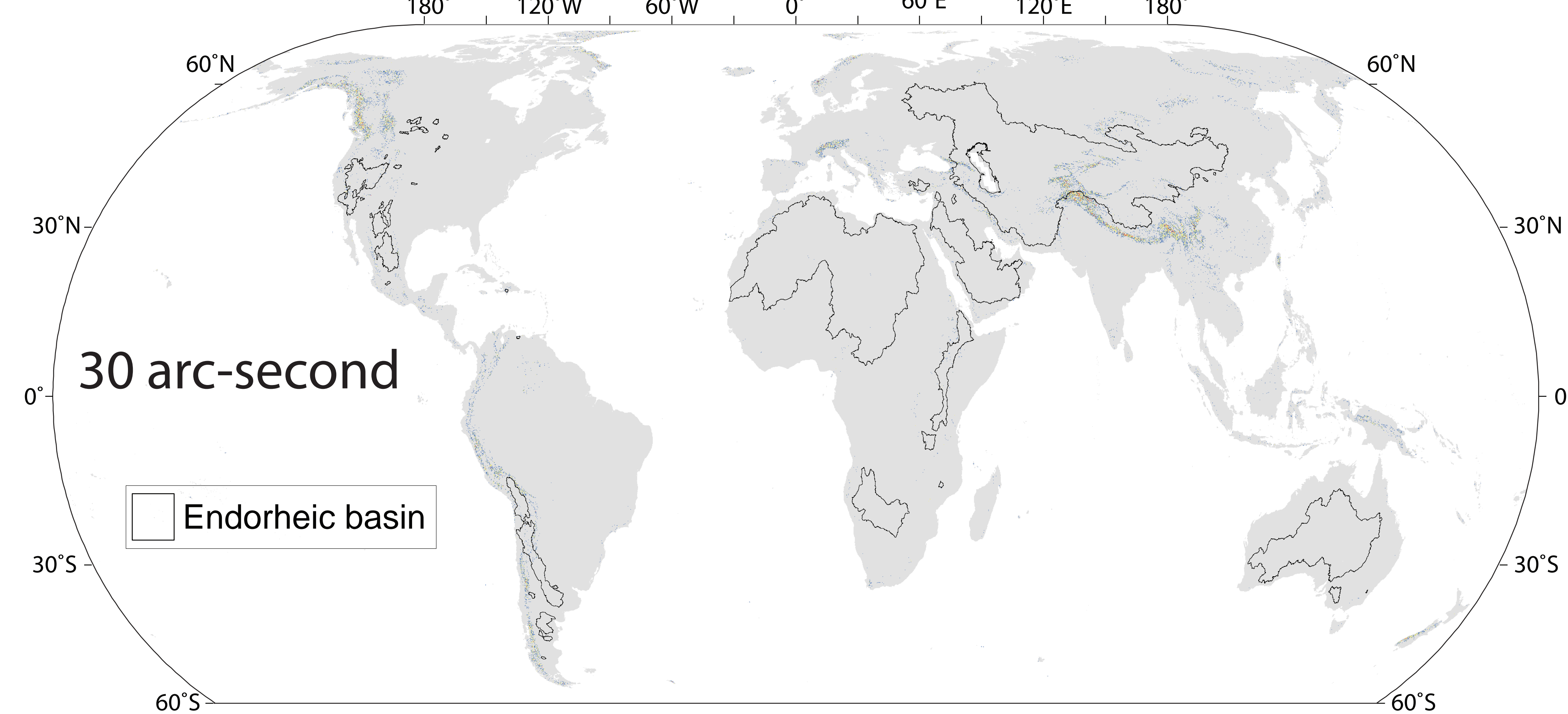
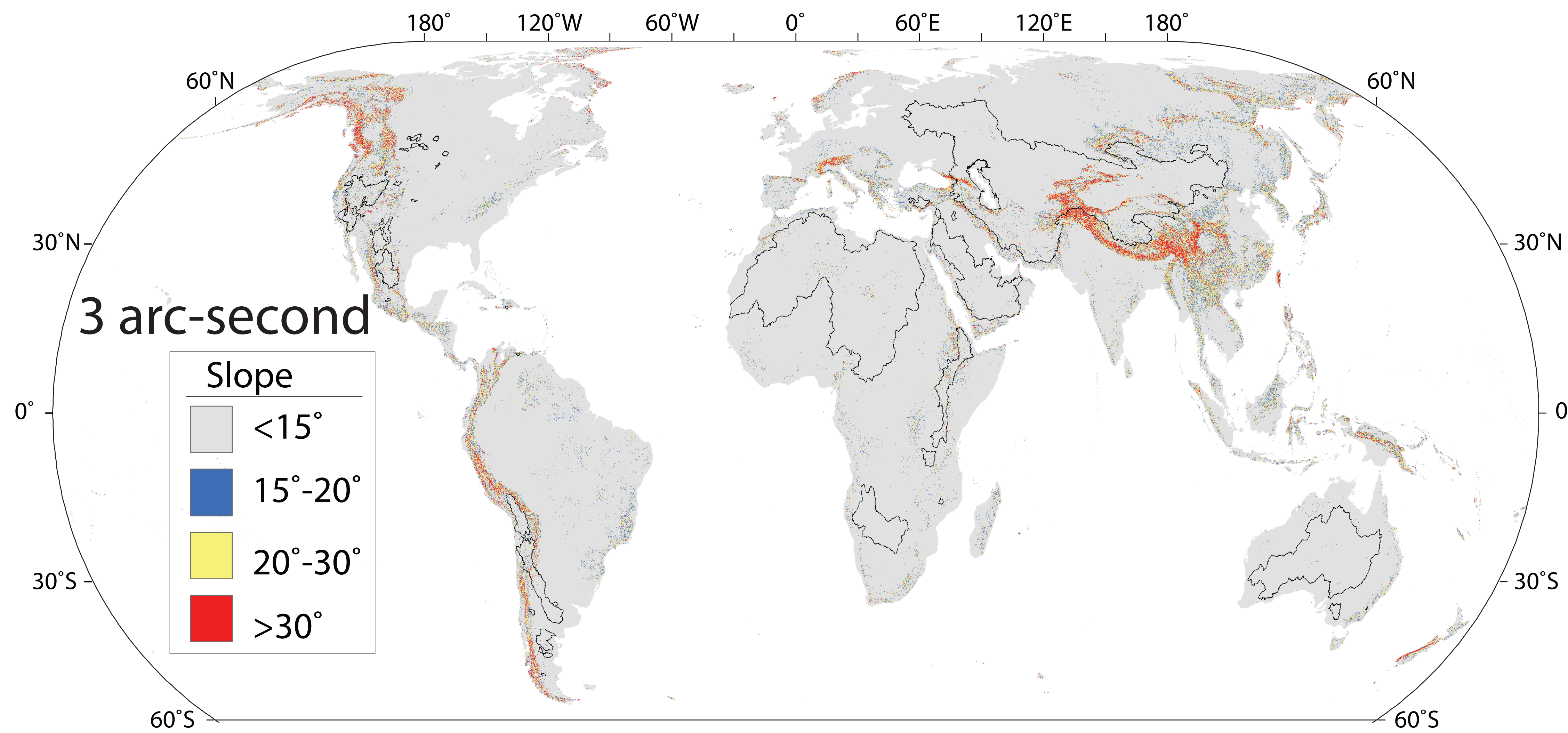
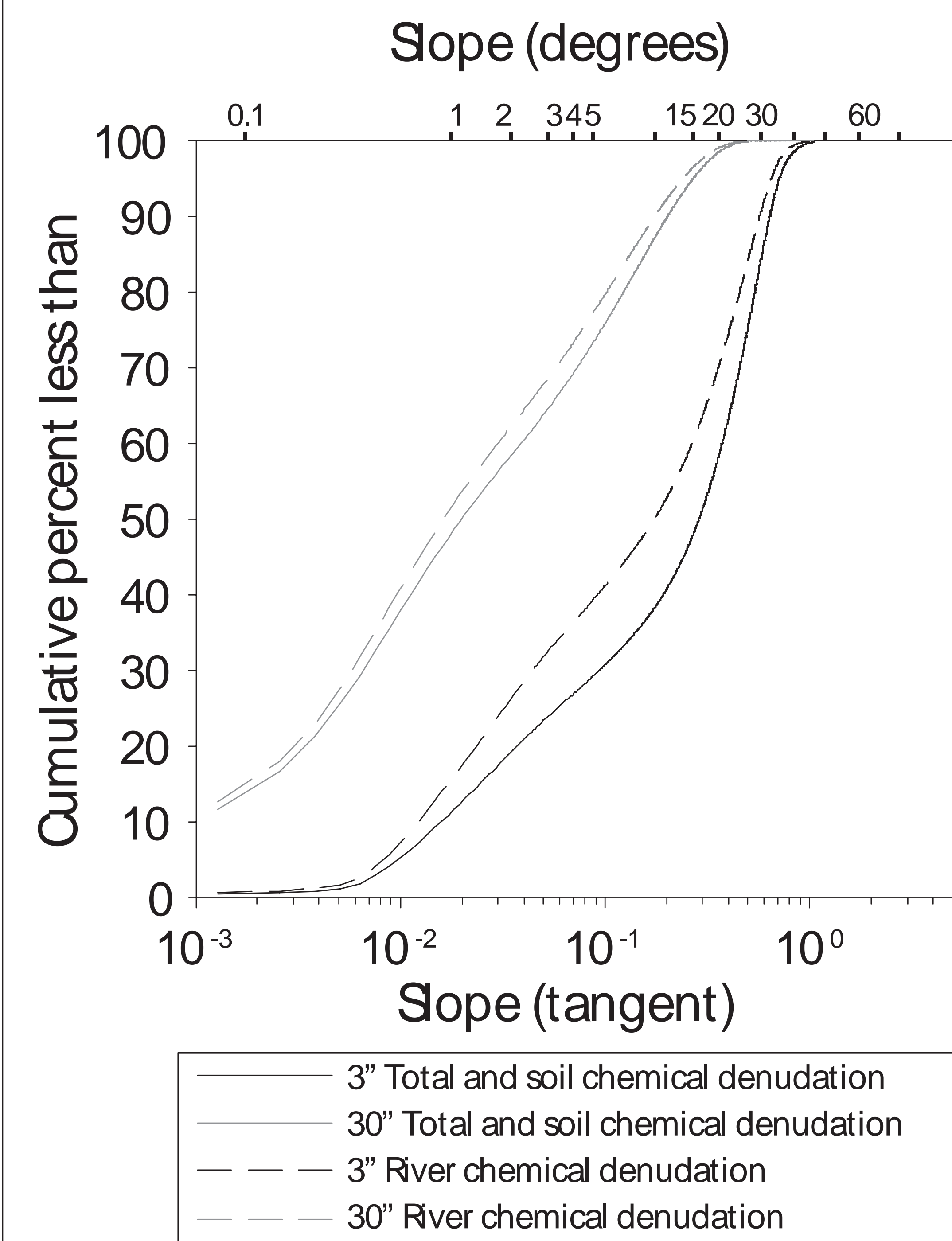
- Generated slope distributions from 2, 4, 6, 10, 30, 90, 250, and 1000 m resolution DEMs derived from LiDAR topographic data at four sites in the western U.S.
- Calculated global slope at both 3 (≈90 m) and 30 (≈1000 m) arc-second resolution
- Modeled global denudation as a function of slope using Willenbring et al.'s relationship based on ¹⁰Be measurements and 3 arc-second slope angles
- Modeled chemical denudation as a function of total denudation using two empirical relationships



Results- DEM scale matters for slope



Results- Slope matters for denudation



Flux to global ocean			
DEM	Total denudation rate (Gt yr ⁻¹)	Chemical denudation rate: soils (Gt yr ⁻¹)	Chemical denudation rate rivers (Gt yr ⁻¹)
3 arc -second			
Globe	12.74	4.46	3.36
Exoheric	10.58	3.70	2.76
30 arc -second			
Globe	5.67	1.98	1.94
Exoheric	4.57	1.60	1.55

Conclusions

YES-mountains dominate the delivery of sediment and solutes to Earth's oceans.