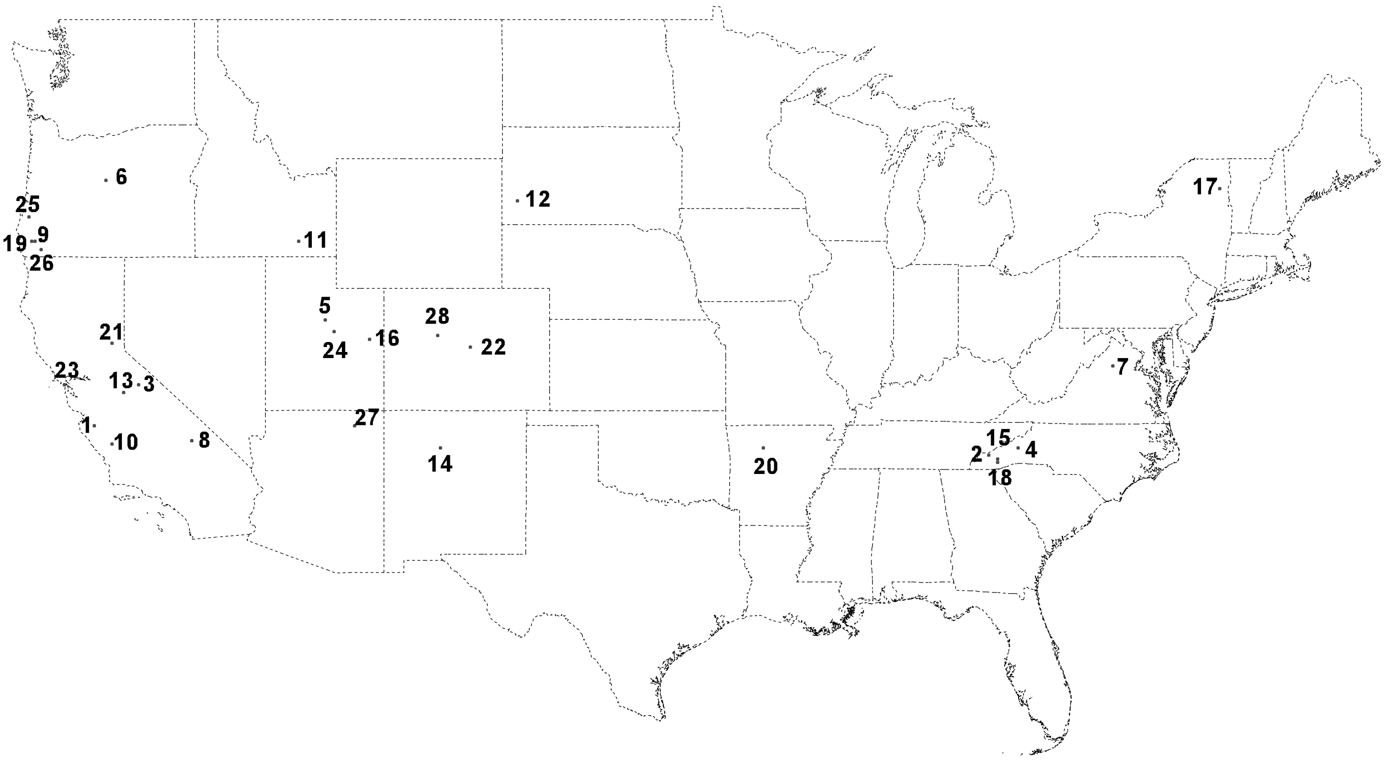

Figure DR1. Locations of USGS 7.5' Quadrangles used in this study:

(1) Mt Johnson, CA	(2) Silers Bald, NC	(3) Falls Ridge, CA	(4) Mt Mitchell, NC
(5) Spanish Fork Peak, UT	(6) Hensley Butte, OR	(7) Old Rag Mtn, VA	(8) Ballarat, CA
(9) Hobsons Horn, OR	(10) Stockdale, CA	(11) Bannock Peak, ID	(12) Iron Mtn, SD
(13) Buckhorn Peak, CA	(14) Jemez Springs, NM	(15) Sylva N, NC	(16) Black Knolls, UT
(17) Keene Valley, NY	(18) Sylva S, NC	(19) Brandy Peak, OR	(20) Lurton, AR
(21) Cisco Grove, CA	(22) McCurdy Mtn, CO	(23) San Rafael, CA	(24) Scofield, UT
(25) Daniels Creek, OR	(26) Selma, OR	(27) Marsh Pass SE, AZ	(28) Seven Hermits, CO.

APPENDIX DR1: NUMERICAL MODEL

We consider a landscape defined on a square domain consisting of hillslopes, Ω, that are bounded internally by a fixed channel network, $\partial\Omega_{\mathrm{riv}}$, and externally by the domain edges, $\partial\Omega_{\mathrm{edge}}$. The channel network incises at a constant rate U, and hillslope elevations, $z(\vec{x})$, are referenced to the channel network. Topographic steady state relative to the incising reference frame requires that the divergence of the sediment flux $\vec{Q}$ must balance the relative uplift U, i.e.

$$\vec{\nabla}\cdot\vec{Q} = U\ ,\ \vec{x}\in\Omega\ . \qquad (1)$$

We compute the equilibrium landscape topography as the solution to the boundary value problem specified by equation 1 with fixed elevation conditions imposed on the internal and external boundaries

$$z = z_{\mathrm{riv}}\ ,\ \vec{x}\in\partial\Omega_{\mathrm{riv}} \qquad (2a)$$

and

$$z = 0\ ,\ \vec{x}\in\partial\Omega_{\mathrm{edge}}\ . \qquad (2b)$$

We discretize equation 1 with a standard finite volume discretization on a 3.84-km-long square mesh with 30m cell size. We assume that the channel network (equation 2a) is well established and does not change significantly as a result of hillslope processes. We specify channel cells, $\partial\Omega_{\mathrm{riv}}$, as all cells exceeding a threshold drainage area (~50,000 m^2) in a 3.84-km-long (128-cell-long) square subsection of the Bannock Peak, Idaho, DEM. Channel-network elevations z_{riv} are computed by using an equilibrium stream profile, given by $S \sim A^{-\omega}$ ($\omega = 1/2$, Whipple and Tucker, 1999), zero elevation along the edges of the square domain, and a total stream-network relief of 20 m. The channel network is held constant over all simulations.

The solution is complicated by the fact that the sediment flux $\vec{Q}$ is nonlinearly coupled to topography, i.e.

$$\vec{Q} = -K_0\left(\left[1-\left(\left\|\vec{\nabla}z\right\|/\mu\right)^n\right]^{-1} + \left(A/A_{\mathrm{c}}\right)^m\right)\vec{\nabla}z\ , \qquad (3)$$

which depends on z through $\left\|\vec{\nabla}z\right\|$ and A. Consistent with our assumption of a well-established channel network, we linearize wash transport by taking A from the initial DEM and assuming it to be fixed. To some extent this assumes that drainage directions are quickly established and stay entrenched and constant thereafter (e.g., Fagherazzi et al., 2002). For large values of the wash number, this approach effectively increases drainage density: channels that are implicit in the specified A field but not explicitly assigned to $\partial\Omega_{\mathrm{riv}}$ become carved into the simulated landscape. Nonlinearity due to failure is accounted for with a damped Newton method (e.g., Press et al., 1992). For all simulations, $m = 1.4$, $n = 2$, $K_0 = 1$ m^2/yr, and $\mu = 1$.

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