

Supplement of 'A process-based diagnosis of catchment coevolution in volcanic landscapes: synthesis of Newtonian and Darwinian approaches'

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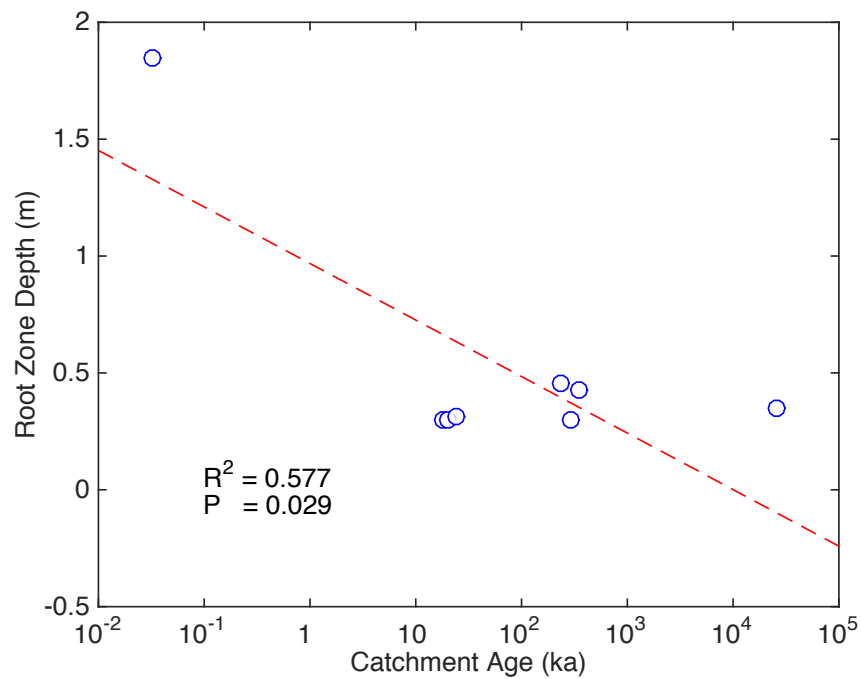


Figure S 1: The relation between the root zone depth and the catchment age. Although the correlation is significant for the entire data set, no significant variability can be observed when the youngest catchment is removed.

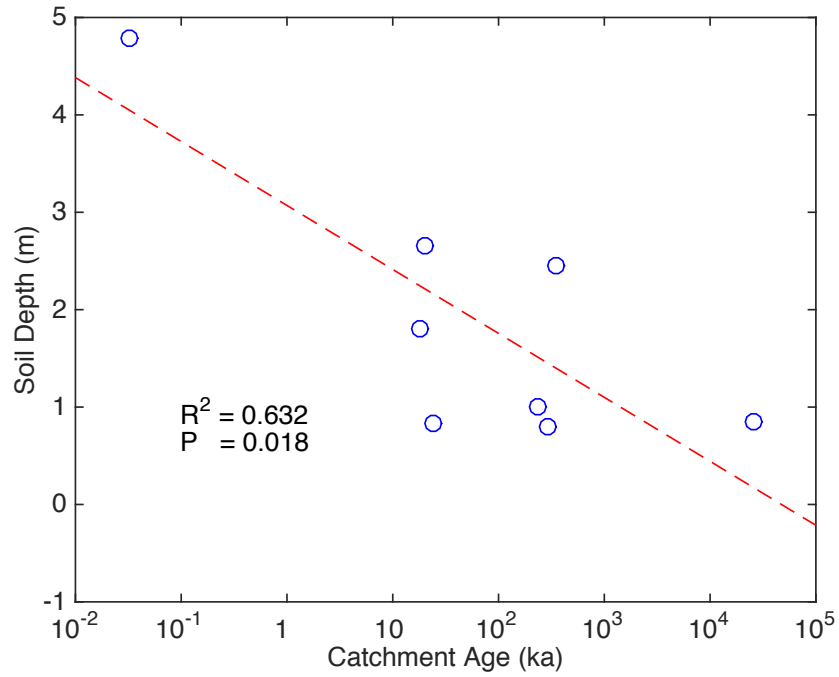


Figure S 2: The soil depth decreased with the catchment age. Note that the youngest catchment controls the relationship and the correlation without it is not significant.

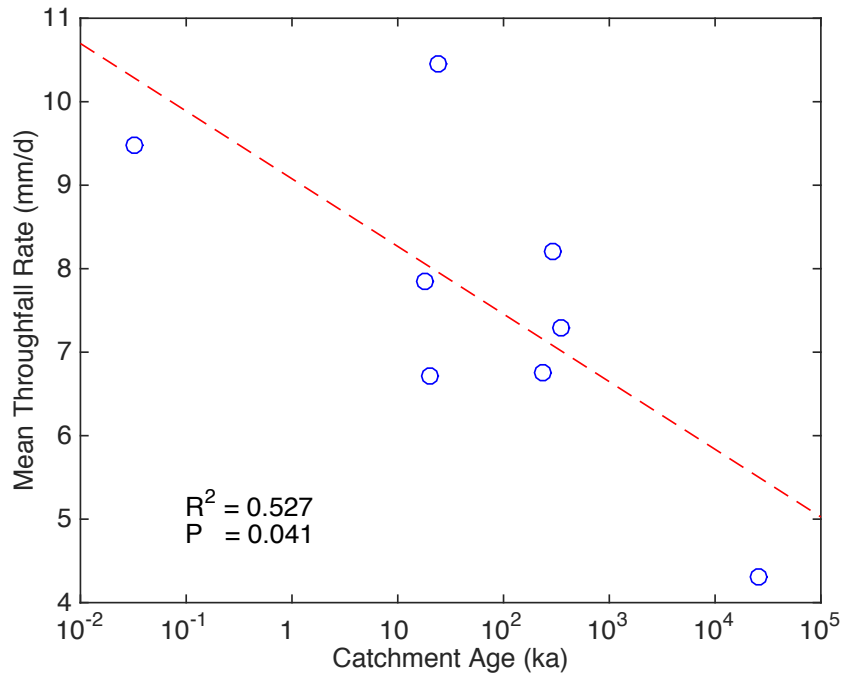


Figure S 3: The mean throughfall rate declined with the catchment age, although the climate characteristics should be independent of the catchment age.

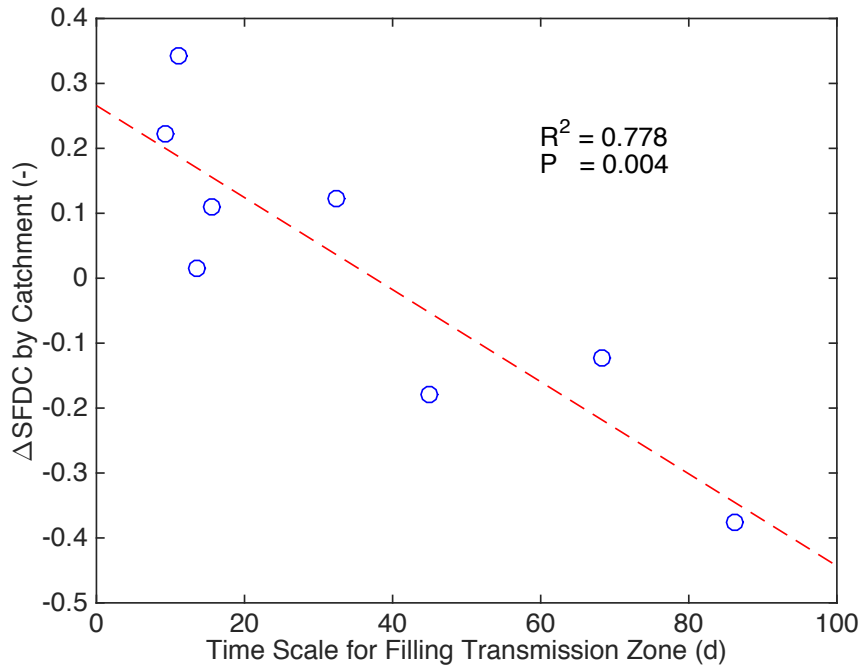


Figure S 4: Time scale for filling the transmission zone explains 77.8 % of the variability in the mean $\Delta SFDC$ by catchment.

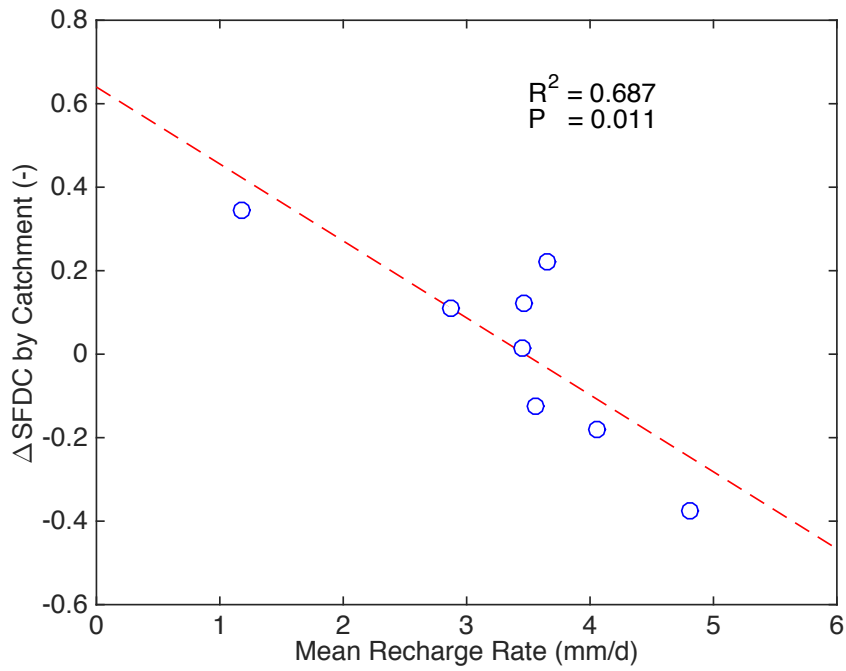


Figure S 5: The mean $\Delta SFDC$ by catchment is significantly correlated with the mean recharge rate to the deep aquifer.

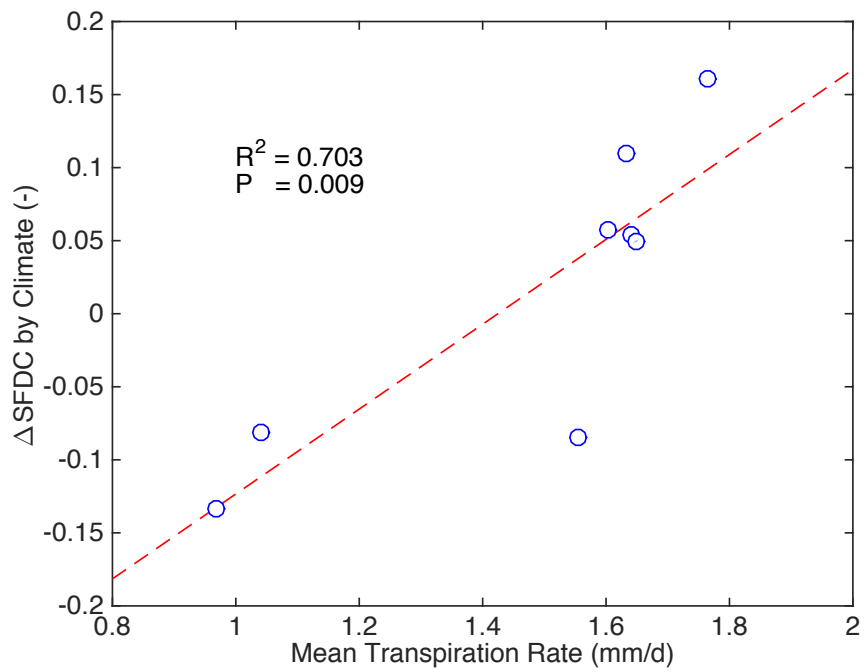


Figure S 6: The only parameter that showed significant correlation with the mean $\Delta SFDC$ by climate is the mean transpiration rate.

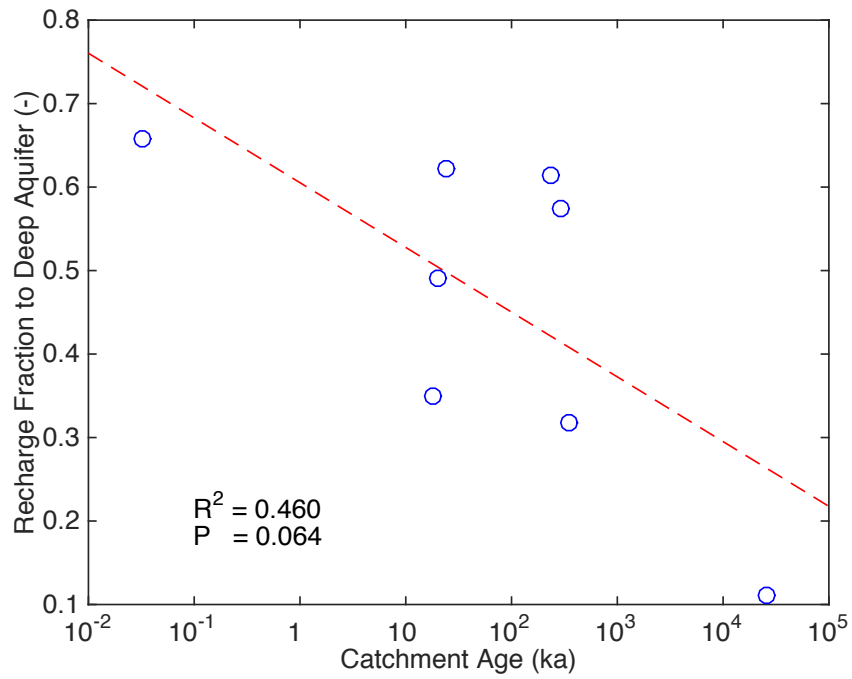


Figure S 7: The recharge fraction to the deep aquifer declined with the catchment age. Although the correlation is not significant with respect to the threshold of 5 % significant interval, the relationship corroborates the hypotheses of coevolution of landscape and hydrological responses in volcanic catchments; i.e., clay accumulation due to chemical weathering in the subsurface impedes vertical flux of water as time progress

Table S 1: Linear regressions between the catchment age and the climate characteristics and simulated fluxes. Stars indicate significance ($p < 0.05$).

Climate properties and simulated fluxes	p	R^2	R
Aridity index (-)	0.033*	0.558	0.747
Seasonal index (-)	0.881	0.004	0.064
Mean inter-storm duration (d)	0.756	0.017	-0.132
Mean storm duration (d)	0.692	0.028	0.168
Mean throughfall rate (mm/d)	0.041*	0.527	-0.726
Mean snowmelt rate (mm/d)	0.336	0.154	-0.393
Mean drainage rate from transmission zone (mm/d)	0.158	0.302	-0.55
Mean drainage rate from root zone (mm/d)	0.156	0.305	-0.552
Mean recharge rate to deep aquifer (mm/d)	0.003*	0.794	-0.891
Mean transpiration rate (mm/d)	0.516	0.073	0.271

Table S 2: Linear regressions of the mean $\Delta SFDC$ by catchment and the model parameters. Stars indicate significance ($p < 0.05$).

Parameters	p	R^2	R
Surface saturation conductivity (cm/d)	0.0348	0.5514	-0.7426
Saturation conductivity in root zone (cm/d)	0.1197	0.354	-0.595
Saturation conductivity in transition zone (cm/d)	0.0100*	0.6963	-0.8344
Recharge fraction to deep aquifer (-)	0.2227	0.2357	-0.4855
Moisture content at wilting point (-)	0.4077	0.1167	0.3415
Moisture content at critical point (-)	0.2244	0.2341	0.4839
Vegetation height (m)	0.1998	0.257	-0.5069
Root fraction (-)	0.5463	0.0638	-0.2525
Light use efficiency (-)	0.5214	0.0717	-0.2678
Root zone depth (m)	0.0827	0.419	-0.6473
Transition zone depth (m)	0.0239*	0.6004	-0.7749
Deep aquifer release a (-)	0.0324*	0.5614	0.7493
Drainable porosity (-)	0.5900	0.0512	-0.2263
Slope (-)	0.3496	0.1463	0.3825
Lateral hydraulic conductivity (cm/d)	0.6494	0.0367	0.1916
Deep aquifer release b (-)	0.5065	0.0767	-0.277
Soil depth (m)	0.0172*	0.6392	-0.7995

Table S 3: Linear regressions between the mean $\Delta SFDC$ by catchment and the characteristics time scales and dimensionless numbers (see Carrillo et al., 2011 for details). Stars indicate significance ($p < 0.05$).

Characteristics time scales and dimensionless numbers	p	R^2	R
Filling root zone storage by rainfall (d)	0.2154	0.2422	-0.4921
Filling root zone storage by snow melt (d)	0.2242	0.2343	-0.4841
Emptying root zone storage by drainage (d)	0.0987	0.3885	-0.6233
Emptying root zone storage by transpiration (d)	0.0867	0.411	-0.6411
Filling transmission storage (d)	0.0038*	0.7777	-0.8819
Emptying transmission storage (d)	0.0209*	0.6166	-0.7852
Advection-driven flow in perched aquifer (d)	0.0668	0.4542	-0.674
Diffusion-driven flow in perched aquifer (d)	0.6031	0.0478	0.2185
Peclet number (-)	0.3112	0.1693	0.4115
Reservoir constant (-)	0.0137*	0.6647	-0.8153

Table S 4: Linear regressions between the mean $\Delta SFDC$ by catchment and the climate characteristics and simulated fluxes. Stars indicate significance ($p < 0.05$).

Climate properties and simulated fluxes	p	R^2	R
Aridity index (-)	0.0686	0.45	0.6708
Seasonal index (-)	0.6529	0.036	0.1896
Mean inter-storm duration (d)	0.8455	0.0069	-0.0828
Mean storm duration (d)	0.7849	0.0134	0.1157
Mean throughfall rate (mm/d)	0.1437	0.3203	-0.5659
Mean snowmelt rate (mm/d)	0.2886	0.1842	-0.4292
Mean drainage rate from transmission zone (mm/d)	0.3945	0.1229	-0.3506
Mean drainage rate from root zone (mm/d)	0.4616	0.0934	-0.3056
Mean recharge rate to deep aquifer (mm/d)	0.0110*	0.6868	-0.8288
Mean transpiration rate (mm/d)	0.16	0.2999	0.5476

Table S 5: Linear regressions between the mean $\Delta SFDC$ by climate and the climate characteristics and simulated fluxes. Stars indicate significance ($p < 0.05$).

Climate properties and simulated fluxes	p	R^2	R
Aridity index (-)	0.2842	0.1873	0.4328
Seasonal index (-)	0.4191	0.1114	0.3338
Mean inter-storm duration (d)	0.9945	0	0.0029
Mean storm duration (d)	0.9638	0.0004	0.0193
Mean throughfall rate (mm/d)	0.5866	0.0521	-0.2283
Mean snowmelt rate (mm/d)	0.3278	0.159	-0.3988
Mean drainage rate from transmission zone (mm/d)	0.9966	0	0.0018
Mean drainage rate from root zone (mm/d)	0.8022	0.0113	0.1063
Mean recharge rate to deep aquifer (mm/d)	0.1315	0.3368	-0.5804
Mean transpiration rate (mm/d)	0.0093*	0.7034	0.8387