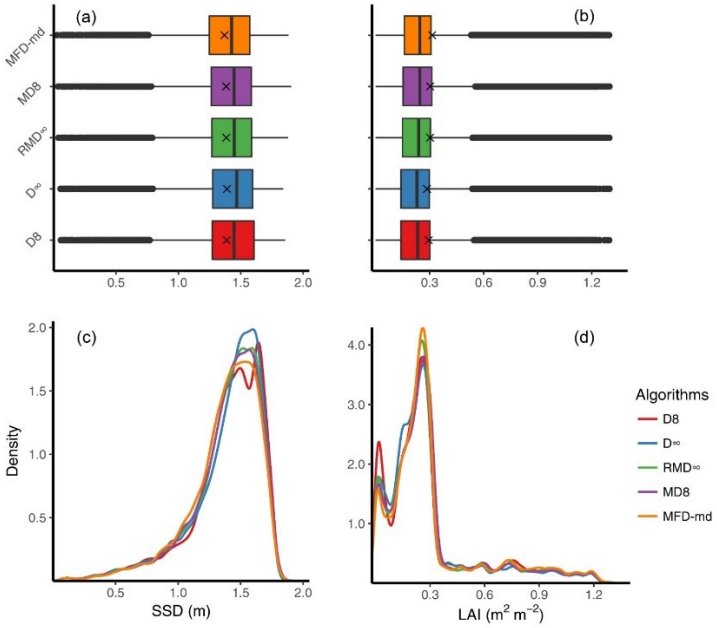

Figure S1. The boxplot and density plot of average soil saturation deficit and leaf area index among the five routing algorithms during 1991-2012. The oblique cross-shaped patterns in (a) and (b) are mean values for each data set.

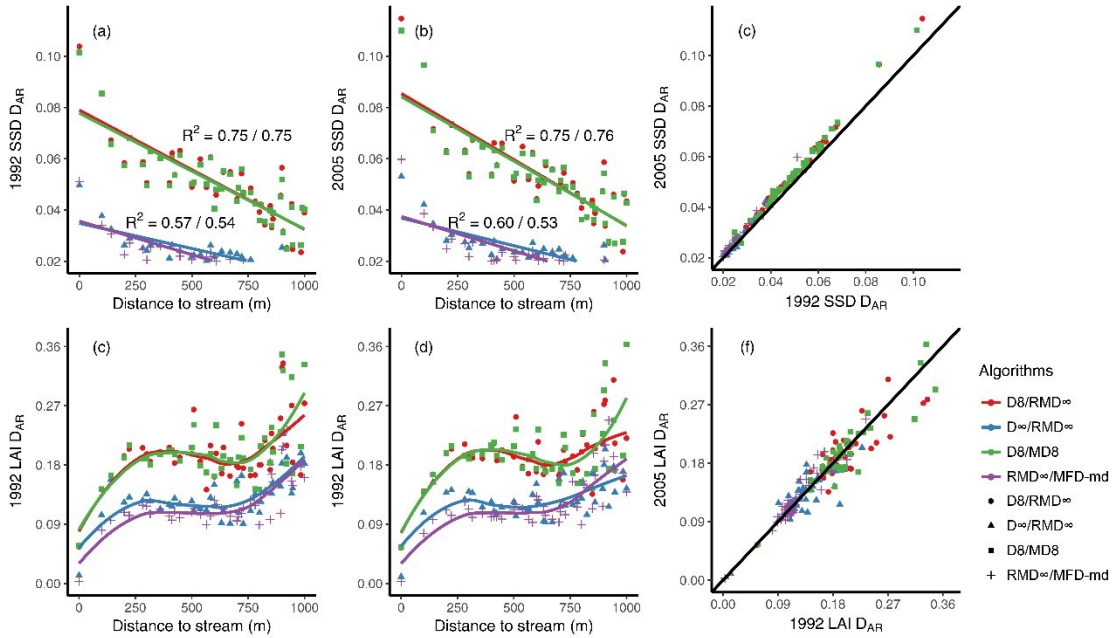

Figure S2. Changes in the averaged relative deviation (D_{AR}) of soil water saturation deficit (SSD) and leaf area index (LAI) as distances from channel increase under four pairs of compared algorithms for the 1992-dry and 2005-wet year. D_{AR} are averaged D_R for each distance (integer number) by Eq. 9. The p-value is less than 0.01 in all linear regression models.

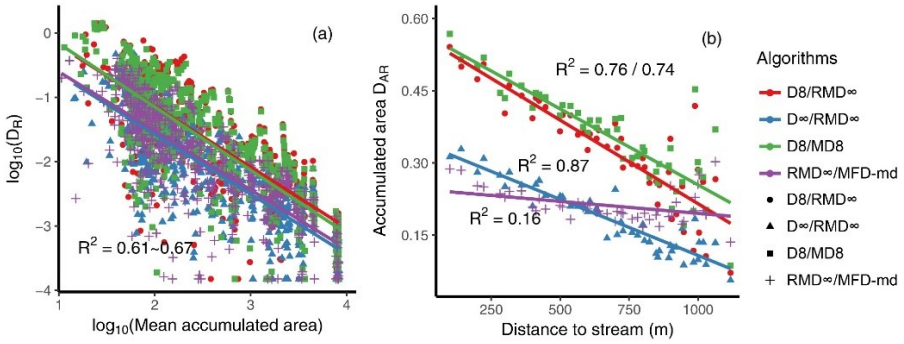

Figure S3. (a) Changes in relative deviations (D_R) of stream-type cells in accumulated area of flow under different algorithms' simulations decrease apparently as flow moves from the head to the outlet of the watershed and (b) Changes in the average relative deviation (D_{AR}) of accumulated area of flow between simulations increases significantly as the distance of cells to channels increases under four compared algorithms. the p-value is less than 0.01 in all linear regression models.

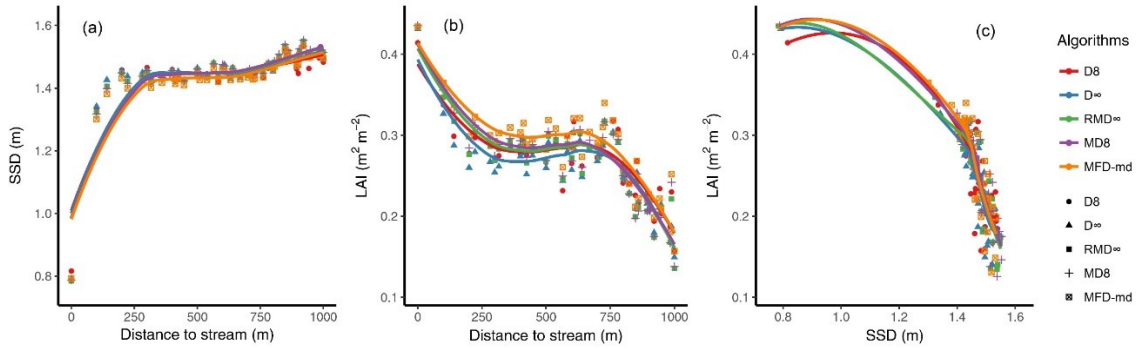

Figure S4. Relationships of average soil saturation deficit (SSD) and leaf area index (LAI) to "distance to stream" (a, b) as well as relationship between SSD and LAI (c) under five routing algorithms.

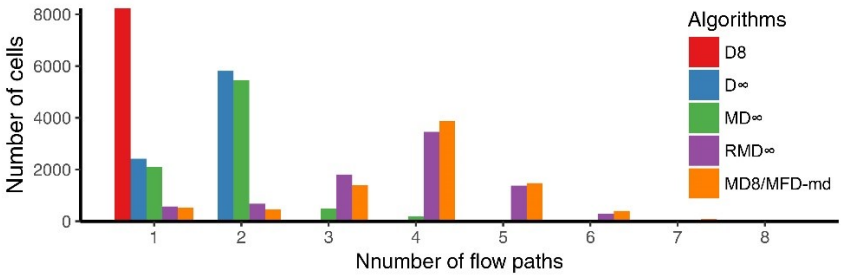

Figure S5. The total number of cells where flow is routed to from 1 to 8 downslope neighbors. The digits in x-axis refers to the number of flow paths to downslope neighbors from a center cell.

Table S1. Parameterizations of major soil parameters used in the model simulations.

Variables		Unit	Soil texture		
			Gravelty loam	Fine sandy loam	Fine sandy
m*	D8	DIM	0.235	0.205	0.195
	D∞		0.232	0.202	0.192
	RMD∞		0.240	0.210	0.200
	MD8		0.246	0.216	0.206
	MFD-md		0.244	0.214	0.204
K_{sat_0}*		m day^{-1}	128.36	109.56	132.73
Porosity		%	0.451	0.475	0.485
Soil depth		m	4.8	5.0	5.2
Active zone depth		m	10.0	10.0	10.0
Albedo		DIM	0.32	0.20	0.37
Sand		%	0.68	0.60	0.82
Clay		%	0.15	0.22	0.10
Silt		%	0.17	0.18	0.8

*m is the decay rate of hydraulic conductivity with depth. $K_{sat_0}$is saturated hydraulic conductivity at the surface; m were manually calibrated against observed streamflow and derived baseflow at the USGS gauge station under five algorithms respectively.

Table S2. Comparisons of modeled soil saturation deficit and leaf area index among the four routing algorithms averaged for the watershed.

	Soil saturation deficit					Leaf area index				
	D8	D∞	RMD∞	MD8	MFD-md	D8	D∞	RMD∞	MD8	MFD-md
Min	0.058	0.026	0.036	0.054	0.038	0.000	0.000	0.000	0.000	0.000
Max	1.856	1.840	1.879	1.905	1.882	1.297	1.298	1.299	1.298	1.296
Mean	1.387	1.389	1.384	1.383	1.369	0.294	0.285	0.303	0.302	0.314
σ	0.290	0.290	0.285	0.283	0.281	0.265	0.253	0.260	0.267	0.271

*Statistics are calculated based on mean daily values averaged for the study period 1991-2012 at cell level.

Table S3. Comparisons of the spatial autocorrelation (measured by Moran's I) of modeled values among the five routing algorithms

	Soil saturation deficit			Leaf area index		
Algorithms	1992	2005	1991-2012	1992	2005	1991-2012
D8	0.418	0.414	0.425	0.417	0.436	0.424
D∞	0.433	0.425	0.436	0.414	0.431	0.419
RMD∞	0.487	0.479	0.494	0.445	0.462	0.451
MD8	0.507	0.500	0.515	0.456	0.474	0.463
MFD-md	0.528	0.516	0.535	0.462	0.483	0.467
p			< 0.01			

Table S4. Comparisons of cell-level D_R averaged for the watershed between compared algorithms

		Soil saturation deficit			Leaf area index		
Algorithms compared		1992	2005	1991-2012	1992	2005	1991-2012
D8	D∞	0.063	0.068	0.065	0.181	0.184	0.178
D8	RMD∞	0.062	0.067	0.064	0.174	0.174	0.177
D8	MD8	0.062	0.067	0.063	0.175	0.175	0.175
D8	MFD-md	0.065	0.070	0.067	0.169	0.172	0.176
D∞	RMD∞	0.027	0.029	0.028	0.114	0.116	0.108
D∞	MD8	0.034	0.037	0.035	0.132	0.134	0.124
D∞	MFD-md	0.043	0.046	0.044	0.154	0.156	0.147
RMD∞	MD8	0.014	0.015	0.014	0.061	0.062	0.054
RMD∞	MFD-md	0.026	0.028	0.026	0.098	0.098	0.089
MD8	MFD-md	0.020	0.022	0.021	0.080	0.081	0.072