[Hydrology and Earth System Sciences]

Supplement for

[Similarity and dissimilarity in model-results between single and multiple flow direction simulations based on a distributed ecohydrological model]

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S1 Supporting information

S1.1 Evaluation on leaf area index and net primary productivity

Simulated annual mean leaf area index (LAI) in the shrub-dominated watershed Cleve Creek (Figure 5) averaged 0 29 to 0.31 m^2/m^2 and ranged from 0.19 to 0.45 m^2/m^2during 1991–2012 under four algorithms (Table S2), closing to reported data for similar ecosystems. White et al. (2000) indicated that LAI in shrublands in arid ecosystems averaged 0 22 m^2/m^2 and ranged from 0.21 to 1.09 m^2/m^2. Gibbens et al. (1996) indicated that LAI in shrub communities typically ranged from 0.3 to 0.4 m^2/m^2 in the southwestern USA. The point–intercept–measured LAI for sagebrush-steppe ecosystems in the western USA averaged 0 33 m^2/m^2(Finzel et al., 2012). The simulated net primary productivity (NPP) in the study area averaged 138 to 145 gC/m^2 per year and ranged from 94 to 213 gC/m^2 per year during 1991–2012, also falling within the ranges of reported data in similar ecosystems. Tian et al. (2010) indicated that NPP in shrublands in the southern USA ranged from 0 to 300 gC/m^2 per year. Spatially, LAI and NPP were simulated to be greater in valleys and lower in the ridges of the watershed (Fig. 5), largely as a result of differences in annual mean soil moisture across the watershed (higher in valleys and lower in the ridges, Fig. 3). In addition, simulated LAI and NPP were lowest (zero) for bare ground, lower for shrubs/grasses and higher for conifers. These agreements and patterns indicated that HESS captured well the spatial and temporal patterns of vegetation in the study area (e.g. Fig. S3)

S2 Figures

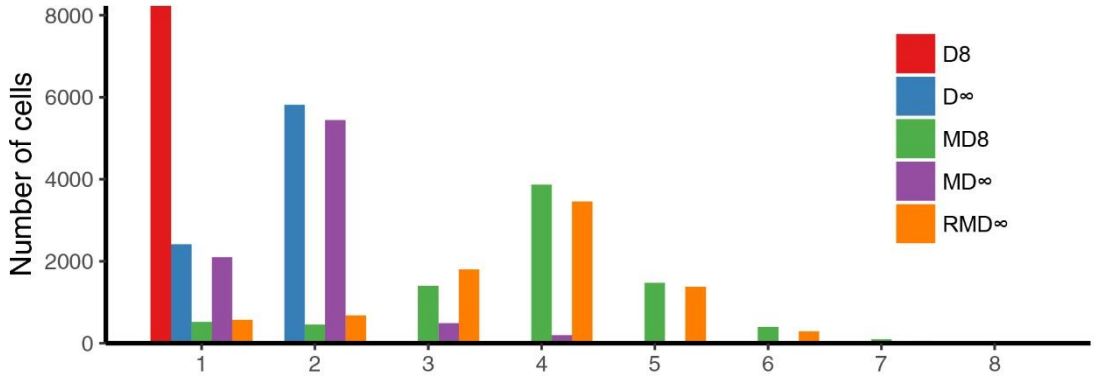

Figure S1. The total number of cells where flow is routed to from 1 to 8 downslope neighbors. The digits in x-axis refers to the number of downslope neighbors receiving water from a center cell.

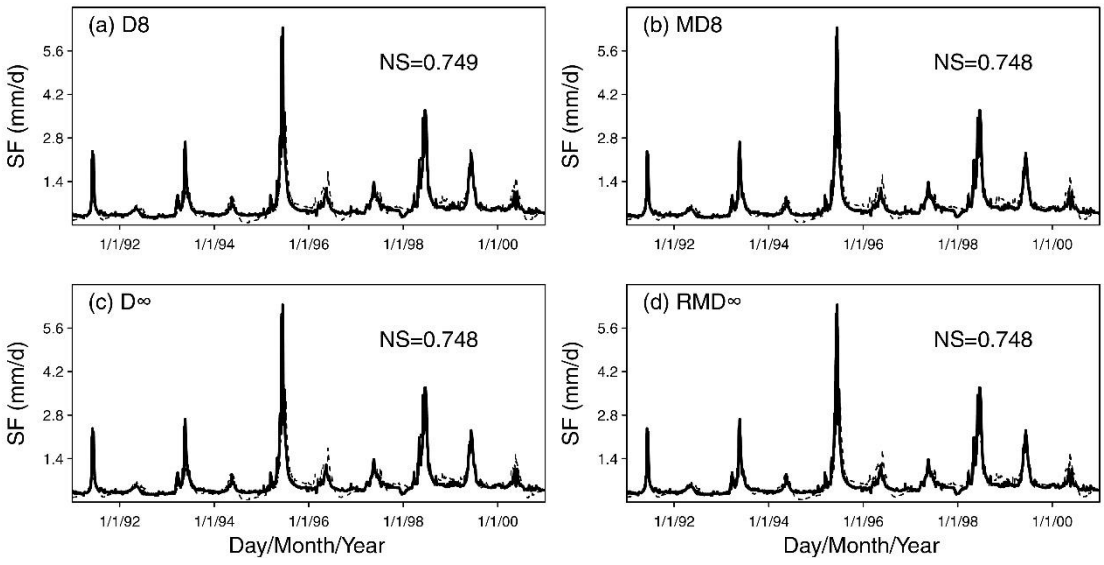

Figure S2. Model's results under four algorithms in calibration of simulated daily streamflow (SF) (dashed line) against observed data (solid line). NS is short for Nash-Sutcliff coefficient.

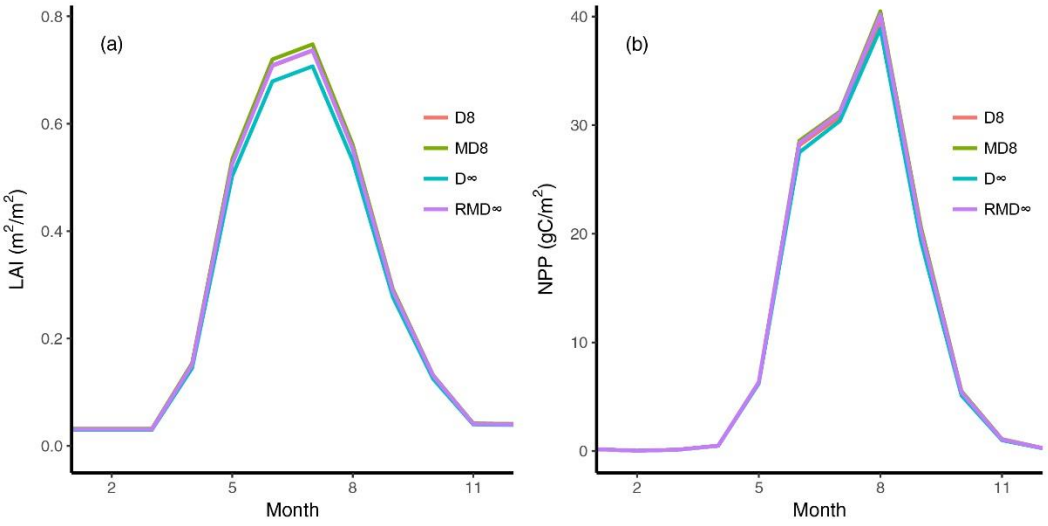

Figure S3 The variation of HESS's simulated monthly mean LAI (m^2/m^2) and NPP (gC/m^2) in a typical year 2005 under four algorithms for the Cleve Creek watershed.

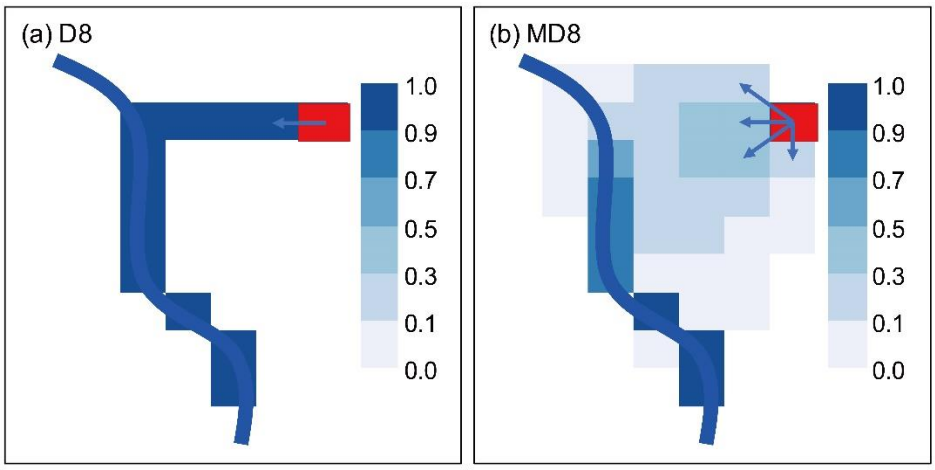

Figure S4. The flow distribution from a typical individual cell (red rectangle with a distance to stream of 400 m) to stream between D8 and MD8 algorithm at cell level. Clearly, flow is in only one direction under D8 while it is distributed more than one cell and in multiple directions under MD8. As a result, the dispersion of flow at cell level is greater under MD8 than that under D8. Differences in flow distribution also result in the accumulated area of flow differ among cells.

S3 Tables

Table S1. Calibration and evaluation of HESS's simulated flow on an annual series

	SF (mm/day)						NS				
Year	Observed	D8	MD8	D∞	RMD∞	SF-σ	D8	MD8	D∞	RMD∞	NS-σ
1991	0.44	0.30	0.31	0.30	0.30	0.00	0.46	0.45	0.46	0.45	0.01
1992	0.32	0.35	0.35	0.35	0.35	0.00	0.93	0.93	0.92	0.93	0.00
1993	0.57	0.48	0.47	0.48	0.47	0.00	0.53	0.51	0.53	0.52	0.01
1994	0.38	0.33	0.34	0.34	0.34	0.00	0.53	0.56	0.52	0.55	0.02
1995	0.99	1.02	1.00	1.03	1.01	0.01	0.82	0.83	0.82	0.83	0.00
1996	0.51	0.58	0.59	0.58	0.58	0.00	-0.66	-0.61	-0.72	-0.67	0.04
1997	0.57	0.58	0.59	0.59	0.59	0.00	0.62	0.62	0.61	0.62	0.00
1998	0.94	1.01	0.99	1.01	1.00	0.01	0.84	0.83	0.84	0.84	0.01
1999	0.74	0.78	0.77	0.77	0.77	0.00	0.89	0.87	0.89	0.88	0.01
2000	0.51	0.54	0.55	0.53	0.55	0.01	-1.17	-1.04	-1.08	-1.10	0.05
2001	0.53	0.38	0.39	0.38	0.39	0.01	0.87	0.88	0.87	0.87	0.00
2002	0.38	0.23	0.24	0.22	0.23	0.01	0.92	0.93	0.92	0.92	0.00
2003	0.43	0.22	0.24	0.22	0.23	0.01	0.83	0.84	0.83	0.84	0.01
2004	0.40	0.39	0.40	0.39	0.39	0.00	0.97	0.97	0.97	0.97	0.00
2005	1.35	1.15	1.12	1.17	1.14	0.02	0.84	0.85	0.85	0.86	0.00
2006	0.81	0.61	0.62	0.62	0.62	0.00	0.84	0.83	0.85	0.84	0.00
2007	0.45	0.43	0.44	0.43	0.44	0.00	0.86	0.87	0.86	0.86	0.00
2008	0.38	0.33	0.34	0.33	0.34	0.00	0.92	0.93	0.92	0.93	0.00
2009	0.48	0.58	0.57	0.58	0.57	0.01	0.90	0.92	0.90	0.91	0.01
2010	0.58	0.54	0.53	0.54	0.53	0.00	0.83	0.82	0.83	0.82	0.01
2011	1.30	0.98	0.95	0.98	0.96	0.01	0.76	0.74	0.77	0.75	0.01
2012	0.45	0.42	0.43	0.42	0.42	0.00	0.88	0.88	0.87	0.88	0.00

*SF is short for observed streamflow; NS is is short for the Nash-Sutcliff coefficient; SF-σ is standard deviation of simulated streamflow under four algorithms; NS-σ is standard deviation of NS under four algorithms.

Table S2. Statistics of HESS's simulated LAI and NPP per year during 1991-2012.

	Leaf area index (m^2/m^2)				Net primary productivity (gC/m^2)			
	Mean	Min	Max	σ	Mean	Min	Max	σ
D8	0.29	0.20	0.44	0.059	141	208	99	30.6
MD8	0.31	0.20	0.45	0.063	145	213	102	31.5
D∞	0.29	0.19	0.43	0.060	138	207	94	31.2
RMD∞	0.30	0.20	0.44	0.063	143	212	100	31.5

*σ is standard deviation of annual data.

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