S1 These scenarios in Table S1 are the combination of RCP's projecting the magnitude and extent of climate change (van Vuuren et al., 2011; Taylor, Stouffer and Meehl, 2012) and SSP'S (Hausfather, 2018) based on worlds of various levels of challenges to adaptation and mitigation (van Vuuren et al., 2014).

Table S1 LUH2 future scenarios and models

Scenarios	Models
RCP2.6 SSP1	IMAGE
RCP3.4 SSP4	GCAM
RCP4.5 SSP2	MESSAGE-GLOBIOM
RCP6.0 SSP4	GCAM
RCP7.0 SSP3	AIM
RCP8.5 SSP5	REMIND-MAGPIE

Table S2 LUH2 LULC classes remapped to VIC LULC cover classes

LUH	VIC
Forested primary land	Deciduous Broadleaf forest (DBF)
Non forested primary land	Deciduous Broadleaf forest (DBF)
Potentially forested secondary land	Deciduous Broadleaf forest (DBF)
Potentially non-forested secondary land	Deciduous Broadleaf forest (DBF)
Managed pasture	Grassland (GL)
Rangeland	Grassland (GL)
Urban land	Urban/built up (UB)
C3 annual crops	Cropland (CL)
C3 perennial crops	Cropland (CL)
C4 nitrogen-fixing crops	Cropland (CL)
Water	Water body (WB)

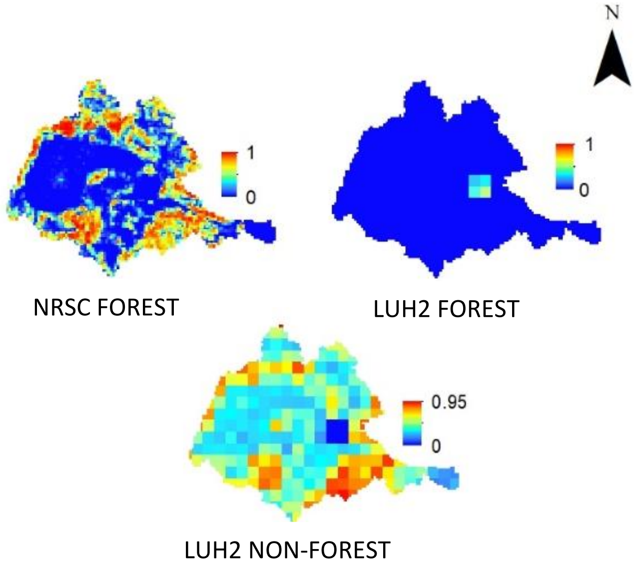


Figure S1 Forested areas in NRSC, 'Potential Non-Forested areas' in LUH2 and 'potentially forested areas' in LUH2. 'Potential Non-Forested areas' in LUH2 is comparable with the Forested areas in NRSC, through visual inspection. Therefore, both the 'potentially forested area' and 'potentially non-forested area' are combined and mapped as forest.

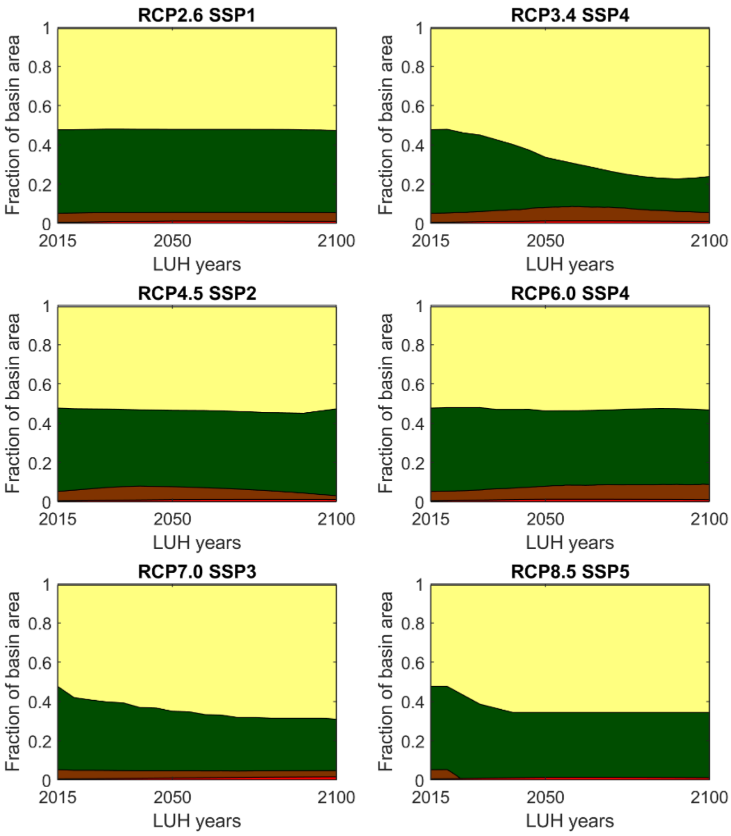


Figure S2 Land cover changes and fractional area covered in all LUH2 scenarios

Table S3 Landcover area change in the sub catchments of Mahanadi river basin

LULC classes (%)	Baseline 2005	Present 2015	Near Future 2050	Far Future 2100	All Cropland	All Forest	All Grassland
				Basantpur			
CL	40	54	69	78			
F	54	41	23	16			
GL	0	4.4	6.3	4.3	94	94	94
w	4.5	0.5	0.5	0.5			
U	0.5	0.6	1.2	1			
				Kantamal			
CL	51	44	58	70			
F	44	51	33	25			
GL	0	5.3	7.6	5	95	95	95
w	5.4	0	0	0			
U	0	0	0	0.8			
				Kesinga			
CL	44	50	62	73			
F	50	45	30	22			
GL	0	5	7	5	94	94	94
w	5.4	0.1	0.1	0			
U	0	0	0.8	0.6			
				Salebhata			
CL	29	67	77	83			
F	50	29	17	15			
GL	0	3.5	4.3	2	79	79	79
w	5	0	0	0			
U	0	0	0.7	0.5			
				Sundergarh			
CL	34	61	73	83			
F	61	34	19	11			
GL	0	0.5	7.1	5	95	95	95
w	3.5	0	0	0			
U	0	0	0.5	0.5			

Table S4 Range of NSE'S for the daily calibration and validation at all subcatchments

Subcatchments	Calibration (1990-2000)	Validation (2001-2010)
Ba	0.63- 0.83	0.55-0.76
Ka	0.74-0.86	0.60-0.83
Ke	0.60-0.78	0.55-0.73
Sa	0.21-0.58	0.40-0.63
Su	0.56-0.70	0.12-0.69

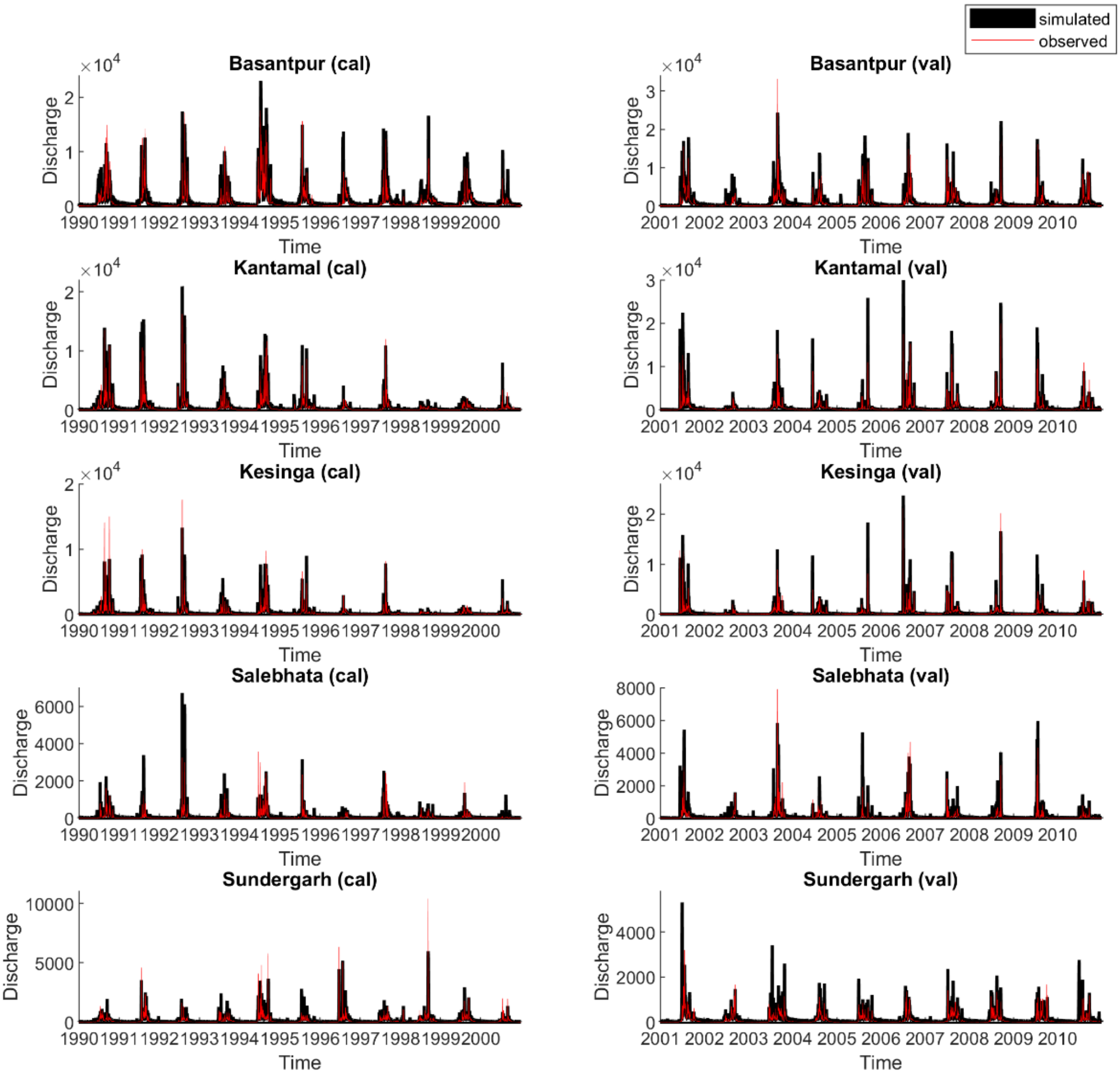


Figure S3 Comparison of daily discharge obtained from 101 'best' ensemble models with the observed discharge at different subcatchments in both calibration and validation period.

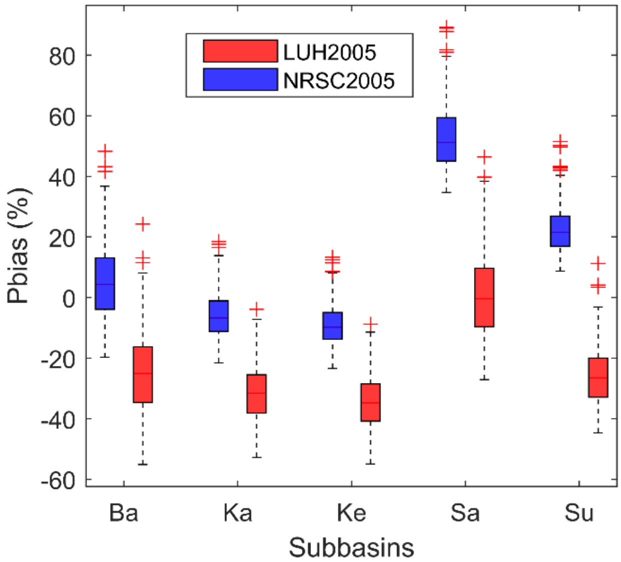


Figure S4 Percent bias plot of simulations using land cover maps from two distinct sources, LUH2005 and VIC2005

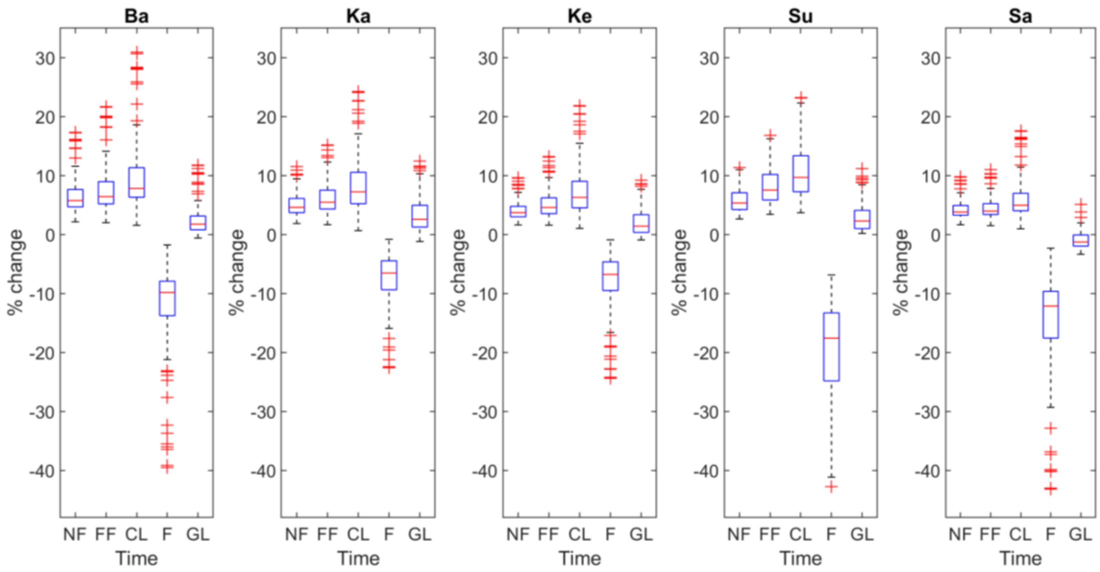


Figure S5 Percent change in mean annual flows of all scenarios with respect to baseline land cover condition from 2005 for each catchment. The results are shown for the 101 'best' model simulations obtained through calibration

Table S5 showing change in flows and percent change in extreme and mean annual flows in all the scenarios with respect to the baseline scenarios.

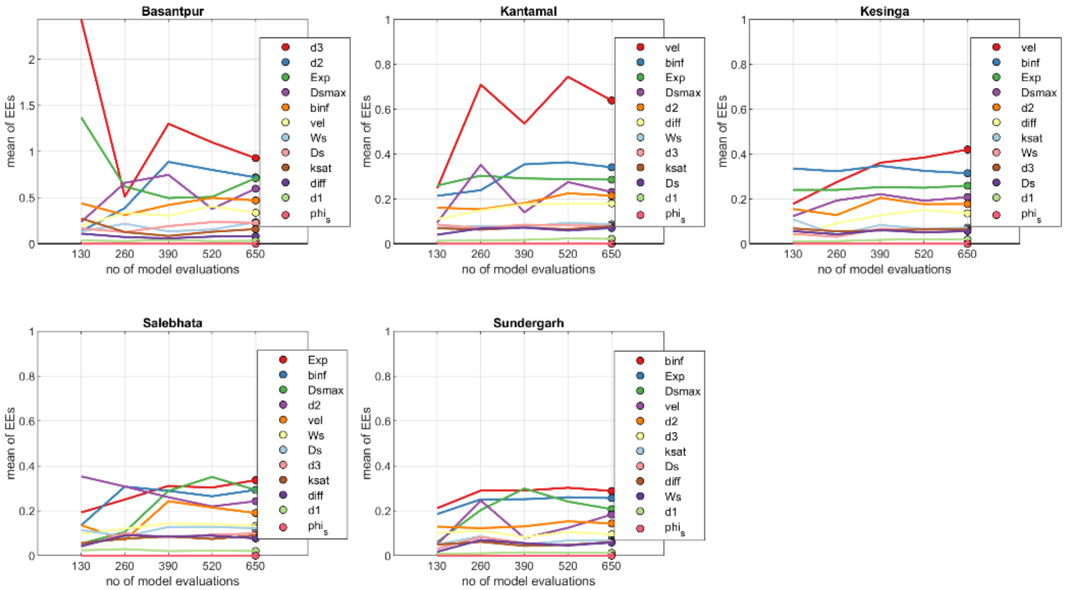
Mean annual flow	Ba	Ka	Ke	Su	Sa
			Near future		
Change (%)	2.2 to 17.4	1.9 to11.6	1.6 to 9.7	2.7 to 11.4	1.7 to9.8
change (cumecs)	15.5 to 53.2	6.5 to 22.2	3.7 to 11.2	2.5 to 7.4	1.3 to 3.8
			Far future		
Change (%)	2 to 21.7	1.7 to 16	1.6 to 13.2	3.4 to 17	1.5 to 11
change (cumecs)	13 to 66.6	5.8 to 29.1	3.7 to 15.4	1.3 to 4.3	2.5 to 10.9
			Cropland		
Change (%)	1.6 to 31	0.7 to 24.2	1 to 21.2	3.7 to 23.2	1 to 17.7
change (cumecs)	11.24 to 95	2.3 to 46	2.3 to 25	3.5 to 7	0.75 to 15
			Forest		
Change (%)	-1.7 to -39.4	-0.8 to -22.6	-0.9 to -24.3	-6.8 to -42.8	-2.3 to -43.2
change (cumecs)	-12.5 to -121	-2.7 to 43	-1.9 to -28	-6.5 to - 28	-1.8 to -17
			Grassland		
Change (%)	-0.6 to 11.8	-1.7 to 12.5	-0.9 to 9.2	0.20 to	-3.3 to 5.1
Change (cumecs)	-4.2 to 52.3	-4 to 29	-2 to 13.8	0.16 to 2.8	-1.6 to 8.3
Mean annual extreme	**Ba**	**Ka**	**Ke**	**Sa**	**Su**
			Near future		
Change (%)	0.68 to 15.5	0.31 to 8.4	0.34 to 7.3	0.9 to 8.9	0.4 to 7.7
change (cumecs)	42.32 to 401.7	12.42 to 175.5	8.8 to 97.15	8.2 to 50.5	3.7 to 32.4
			Far future		
Change (%)	0.62 to 20.5	0.15 to11.8	0.25 to 10.8	1.2 to 13.7	0.4 to 9.2
change (cumecs)	39 to 532	6 to 246	6.62 to 143	10.7 to 78	3 to 39
			Cropland		
Change (%)	0.46 to 32	0.2 to 21	0.05 to 20	0.13 to 20	1.37 to 17
change (cumecs)	29 to 830	-17 to 443	-3 to 260	12 to 115	1.2 to 74
			Forest		
Change (%)	-0.3 to 38.5	0.5 to -20	0.41 to -21	-0.22 to -33	-2.4 to -40
change (cumecs)	-20 to 1026	-17.7 to -419	10.8 to -282	-187 to	-2 to -168
			Grassland		
Change (%)	-1.4 to 12	-1.9 to 11	-1.87 to 9	-0.9 to 9	-3 to 3
change (cumecs)	-88 to 343.8	-79 to 233.4	-47 to 117	-7.5 to 57	-17 to 20

S2 Morris, (1991) implemented in SA for Everybody (SAFE) Toolbox (Pianosi, Sarrazin and Wagener, 2015). Morris, (1991) proposed two sensitivity measures : (1) mean of the Elementary Effects(EE) , μ which highlights the overall effect of the input parameter on a given output and (2) standard deviation of the EE's ,σ , which estimates the interactions between one parameter and the other.

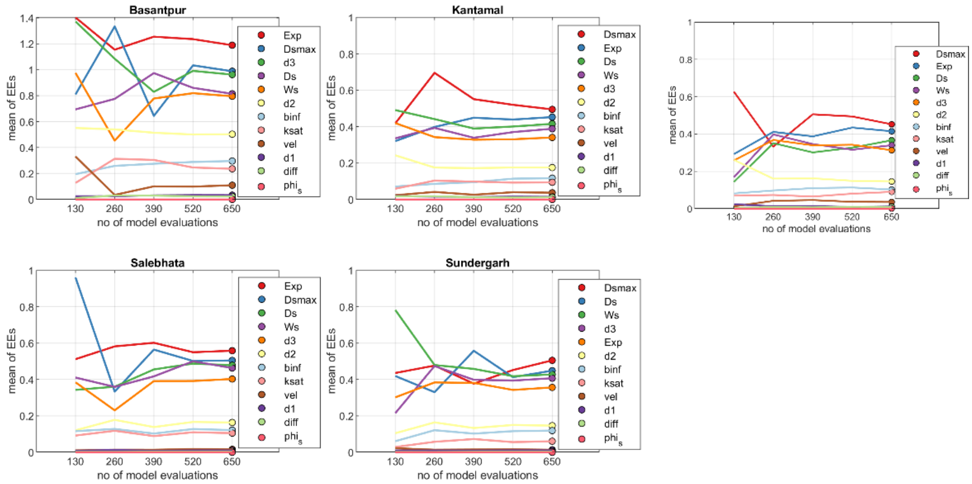
The number of model evaluations needed for convergence of the sensitivity indices i.e 'N' is a function of the number of model parameters i.e 'M' (13 in this case) and a base sample size 'n' shown in Eq S1. The base sample size of '50' is chosen based on some experiments conducted by (Saltelli *et al.*, 2008; Sarrazin, Pianosi and Wagener, 2016)

$$N = n\,(m+1), \qquad \text{(S1)}$$

Therefore, 650 model parameter sets are formed using the Latin Hypercube Sampling Method (LHSM) and the same number of simulations are performed for SA.
Convergence here means that the sensitivity indices would converge after a certain point after which there is almost no change or minimal change in the SA results (Sarrazin, Pianosi and Wagener, 2016).



(a)



(b)

Figure S6 Convergence plot below represents the sensitivity indices (mean of Elementary Effects) of the VIC model parameters estimated using an increasing no of model simulations upto 650 simulations computed for Global Sensitivity Method (GSA) with (a) objective function, NSE and (b) objective function, lnNSE. The Elementary Effects are computed for all the objective functions, NSE, KGE and lnNSE. The results were quite similar for NSE and KGE, hence the convergence plots of only NSE and lnNSE are shown here. The lines in the plot are the bootstrap means of the sensitivity indices.

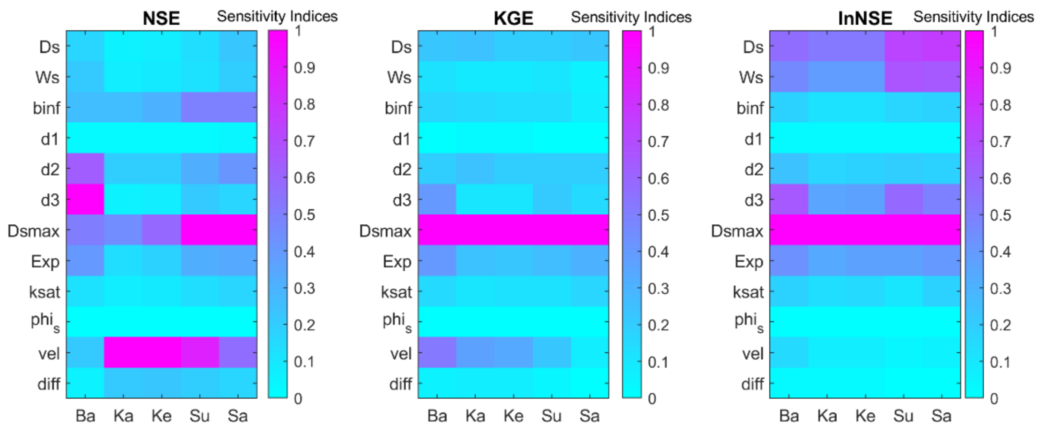


Figure S7 Sensitivity indices (normalised standard deviation) of EET method for VIC model parameters for all the subcatchments and objective functions. Colour bar on the right side indicates sensitivity of the model parameters to the streamflow. ‘0’ indicates least sensitive and ‘1’ indicates most sensitive.

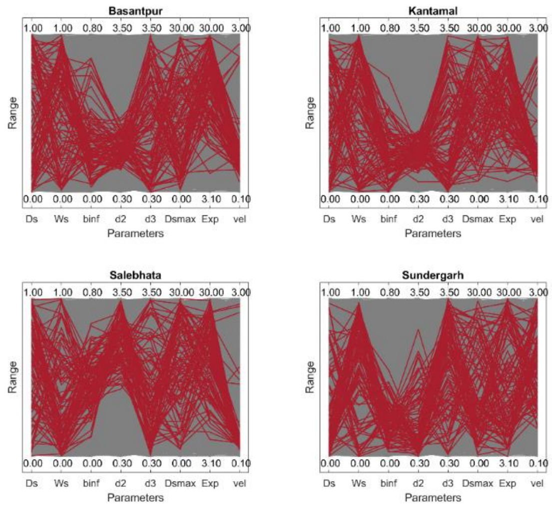


Figure S8 Parallel coordinate plot showing soil parameters that had resulted in best simulations (top 1%) during model calibration for each catchment.