Figures

Figure S1: (a) Soil and (b) Land use/Land cover maps of the Satluj river catchment, India; sub-catchment boundaries up to Kasol gauge.
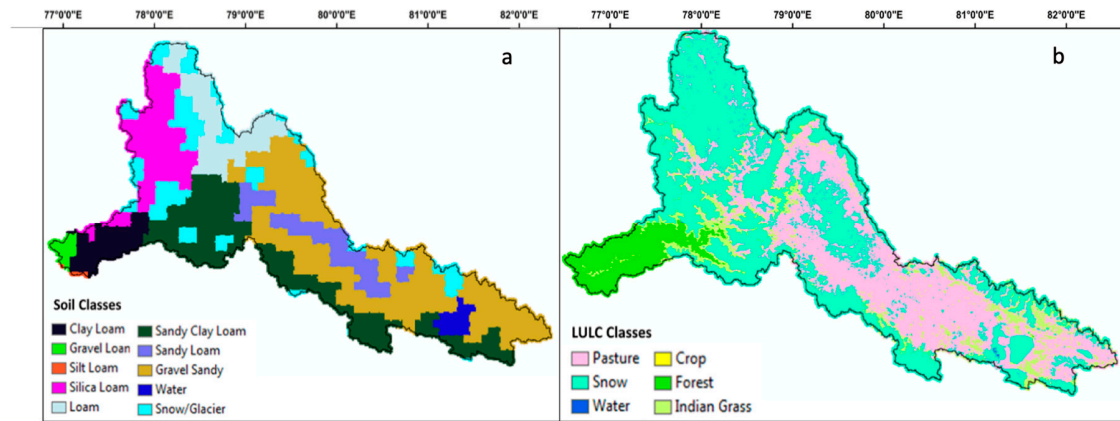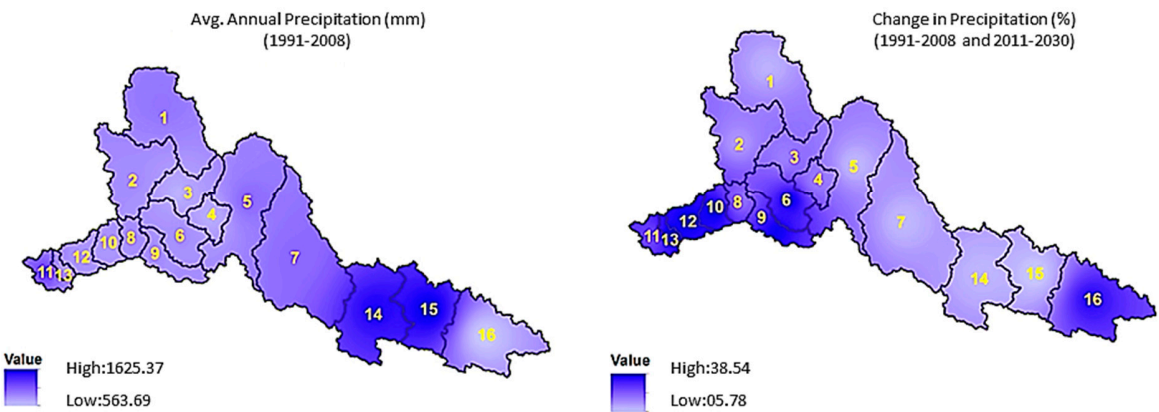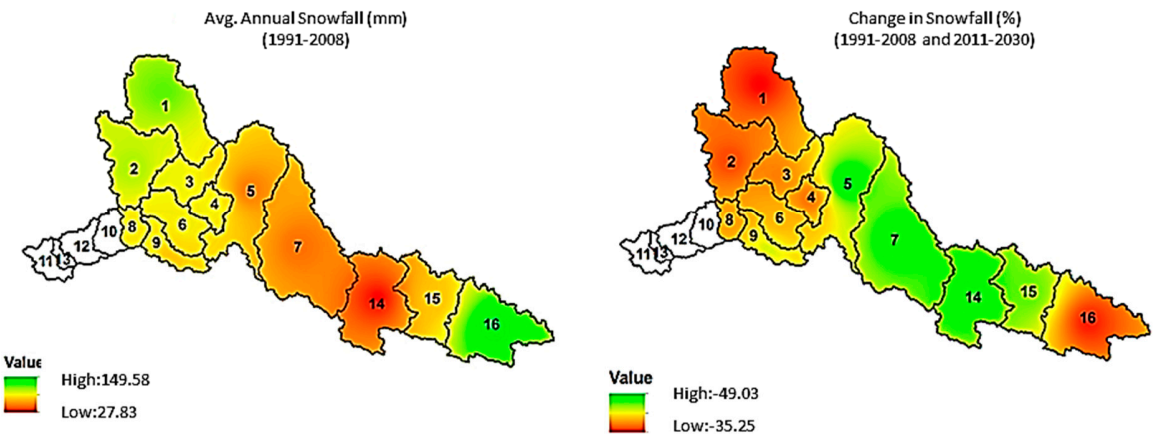
Figure S2. Changes and inter annual comparisons in average annual (a) precipitation, (b) snowpack/snowfall, (c) snowmelt, (d) water yield (due to snow) and (e) total water yield (snowmelt and rainfall runoff) over the study area in different temporal climate domains (1991-2030).

(a)

(b)

(c)

Avg. Annual Snowmelt (mm)
(1991-2008)

Change in Snowmelt (%)
(1991-2008 and 2011-2030)

Value
High:108.77
Low:21.14

Value
High:-31.03
Low:27.06

(d)

Avg. Annual Water Yield due to snow (mm)
(1991-2008)

Change in Water Yield due to snow (%)
(1991-2008 and 2011-2030)

Value
High:1104.58
Low:234.18

Value
High:37.18
Low:13.95

(e)

Avg. Annual Total Water Yield (mm)
(1991-2008)

Change in Total Water Yield (%)
(1991-2008 and 2011-2030)
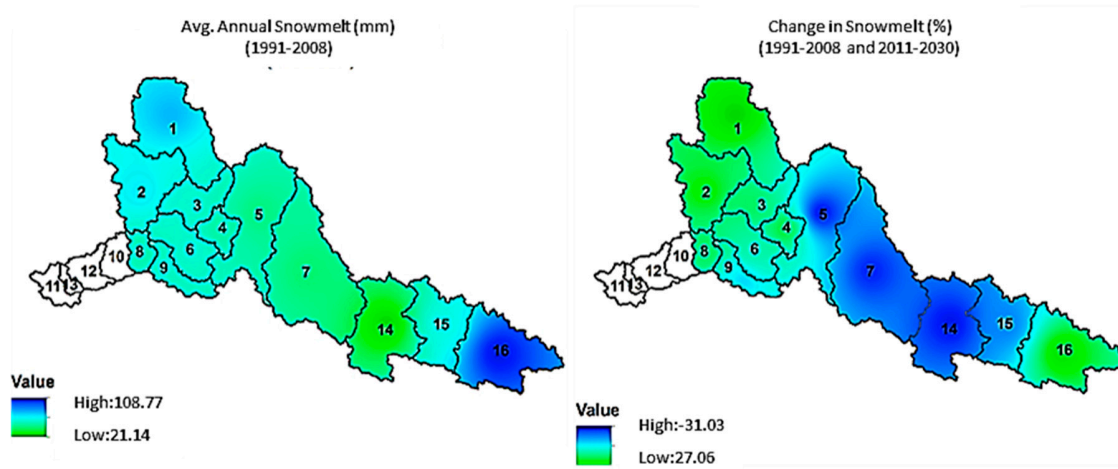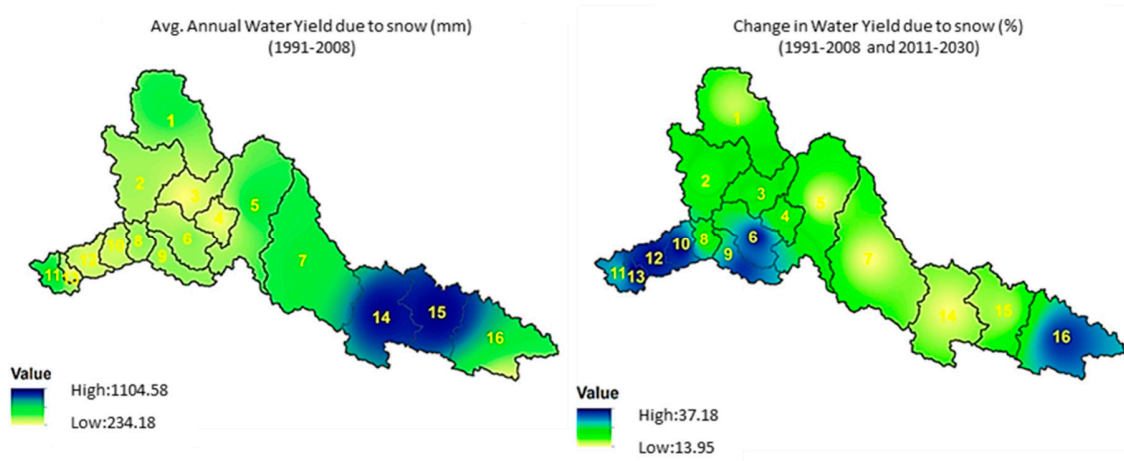
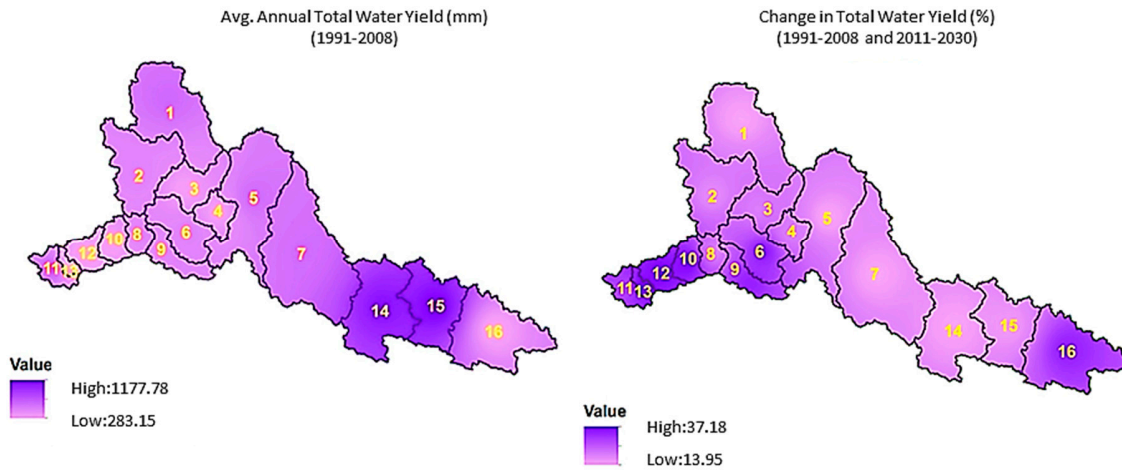Value
High:1177.78
Low:283.15

Value
High:37.18
Low:13.95

Tables

Table S1: Description of model calibration parameters

Streamflow parameters selected for calibration and validation	Description
SNOCOVMX.bsn	Minimum snow water content
HRU_SLP.hru	Average slope steepness
SOL_K.sol	Soil hydraulic conductivity
SNO50COV.bsn	Fraction of snow volume
PLAPS.sub	Precipitation lapse rate
SFTMP.bsn	Snowfall temperature
GWQMN.gw	Threshold depth of water in shallow aquifer required for return flow
CH_N2.rte	Manning roughness coefficient for main channel
SOL_BD.sol	Moist bulk density
SOL_AWC.sol	Available water capacity of the soil layer
GW_REVAP.gw	Groundwater 'revaporation' coefficient
SMTMP.bsn	Snowmelt base temperature
ALPHA_BF.gw	Baseflow alfa factor coefficient
SMFMN.bsn	Melt factor for snow on December 21st
SOL_Z.sol	Depth from soil surface to bottom layer
GW_DELAY.gw	Groundwater delay time
TLAPS.sub	Temperature lapse rate
CH_K2.rte	Effective hydraulic conductivity
SMFMX.bsn	Melt factor for snow on June 21st
CN2.mgt	Curve number coefficient

Table S2: Aggregate parameters values, their ranges and global sensitivity results

SI. No.	Parameter	Fitted Value	Minimum Value	Maximum Value	t-Stat	P-Value
			Daily results			
1	A__SNOCOVMX.bsn	300.0	0.0	500.0	-2.1	0.03
2	R__HRU_SLP.hru	0.2	0.2	0.2	-0.2	0.9
3	R__SOL_K.sol	0.3	0.0	1.3	-0.2	0.8
4	R__SNO50COV.bsn	0.4	0.0	50.0	-0.2	0.8
5	A__PLAPS.sub	277.0	100.0	300.0	0.3	0.8
6	A__SFTMP.bsn	-1.7	-1.8	1.0	-0.4	0.7
7	V__GWQMN.gw	1.0	0.8	1.1	-0.4	0.7
8	V__CH_N2.rte	0.3	0.2	0.3	0.5	0.6
9	R__SOL_BD.sol	1.4	1.2	1.5	0.7	0.5
10	R__SOL_AWC.sol	0.6	0.6	0.7	0.7	0.5
11	V__GW_REVAP.gw	0.12	0.0	0.5	0.9	0.4
12	V__SMTMP.bsn	-0.5	-2.7	2.0	-0.9	0.4
13	A__ALPHA_BF.gw	0.12	0.06	0.19	-1.4	0.2
14	V__SMFMN.bsn	2.4	4.0	7.7	-1.4	0.2
15	V__SOL_Z.sol	2813.7	100.0	4000.0	1.6	0.1
16	V__GW_DELAY.gw	10.5	8.0	50.0	-2.1	0.02
17	A__TLAPS.sub	-4.1	-7.0	2.5	-2.2	0.01
18	V__CH_K2.rte	27.0	22.1	75.0	2.4	0.0
19	V__SMFMX.bsn	4.5	3.5	6.5	6.4	0.0
20	R__CN2.mgt	0.03	0.0	0.1	-8.6	0.0
			Monthly results			
1	R__SOL_BD.sol	1.0	0.9	1.6	-0.1	0.9
2	V__SMFMN.bsn	2.1	2.0	7.2	0.3	0.8

3	A__PLAPS.sub	337.0	100.0	350.0	-0.3	0.7
4	V__GW_REVAP.gw	0.1	0.1	0.2	-0.4	0.7
5	V__TLAPS.sub	-4.6	-6.2	2.5	0.4	0.7
6	V__GWQMN.gw	1.6	0.8	1.7	0.7	0.5
7	R__SOL_AWC.sol	0.5	0.5	0.9	-0.8	0.4
8	V__SOL_Z.sol	1295.8	1264.5	4388.4	-0.8	0.4
9	V__ALPHA_BF.gw	0.11	0.0	1.7	0.8	0.4
10	V__SNOCOVMX.bsn	100.0	50.0	500.0	-1.0	0.3
11	V__SMTMP.bsn	0.7	0.6	1.7	1.1	0.3
12	V__SFTMP.bsn	1.4	1.0	1.9	1.4	0.2
13	V__SMFMX.bsn	4.4	33	5.5	-1.8	0.1
14	R__SOL_K.sol	0.5	0.6	1.3	2.1	0.0
15	V__GW_DELAY.gw	20.1	7.0	250.0	2.6	0.0
16	R__CN2.mgt	0.02	0.0	0.1	-4.6	0.0
17	V__SNO50COV.bsn	0.2	0.0	1.0	-11.7	0.0