Supplementary Tables and Figures

Supplementary Table 1: List and sources for the spatial and climatic datasets used in the J2000 Model for the Koshi River Basin

SN	Data	Data Sources
1	Digital Elevation Model (DEM)	ASTER GDEM
2	Land use map	Uddin et al. (2016)
3	Soil map	SOTER
4	Geology map	DMG (1994)
5	Meteorological data (stations numbers)	
	i. Precipitation (160)	DHM, IMD, APHRODITE
	ii. Temperature (60)	DHM, IMD, CFSR
	iii. Relative humidity (73)	DHM, IMD, CFSR
	iv. Wind (66)	DHM, IMD, CFSR
	v. Sunshine hours (4)	DHM

Notes:

1: ASTER GDEM: Advanced Spaceborne Thermal Emission and Reflection Radiometer. https://asterweb.jpl.nasa.gov/gdem.asp

2: Uddin et al. (2016) http://rds.icimod.org/Home/DataDetail?metadataId=9224

3: SOTER: Soil and Terrain Databases, Food and Agriculture Organization of the United Nations (FAO). http://www.fao.org/soils-portal/soil-survey/soil-maps-and-databases/regional-and-national-soil-maps-and-databases/en/

4: DMG, Department of Mines and Geology, Nepal (based on a physiographic division of Nepal)

5: DHM: Department of Hydrology and Meteorology, Nepal.

6: IMD: Indian Meteorological Department, India.

7: APHRODITE: Asian Precipitation – Highly-Resolved Observational Data Integration Towards Evaluation of Water Resources. (V1101) http://www.chikyu.ac.jp/precip/english/

8: CFSR: Climate Forecast System Reanalysis https://climatedataguide.ucar.edu/climate-data/climate-forecast-system-reanalysis-cfsr

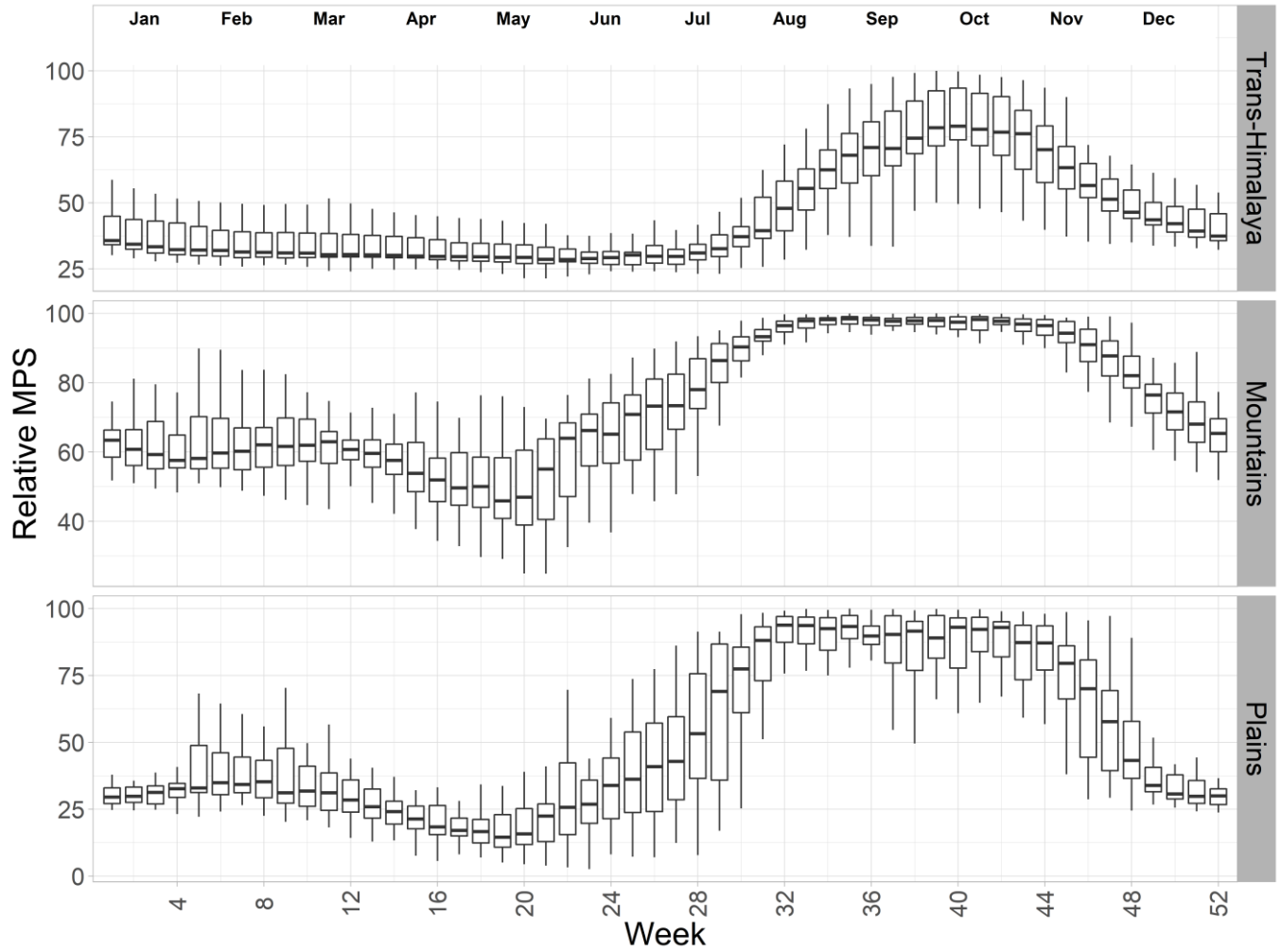
Supplementary Table 2: Monthly climatology for precipitation and temperature in three regions of the Koshi River basin, 1980–2007

Month	Precipitation [mm]			Temperature [ºC]		
	Trans-Himalaya	Mountains	Plains	Trans-Himalaya	Mountains	Plains
Jan	9.7	18.9	12.8	-13.2	6.8	16.1
Feb	15	28.4	13.3	-12.6	8.6	19.2
Mar	20.3	43.7	13.8	-8.8	12.5	23.9
Apr	24.3	92.1	41.9	-4.7	16	28.4
May	36.5	185.7	112.3	0.2	18.1	30
Jun	69.7	337.2	247.4	4.4	19.9	30.4
Jul	137.8	540.6	481.3	7.1	20.2	29.4
Aug	147.2	462	358.8	6.7	20.2	29.5
Sep	78.8	314.7	259.6	4.2	19.1	28.8
Oct	22.9	84.6	75.7	-1.3	16.1	26.9
Nov	5.8	14.2	5.4	-7.7	11.9	22.7
Dec	7.1	16.4	9.7	-11.1	8.5	18.2
Annual	575	2139	1632	-3.1	14.8	25.3

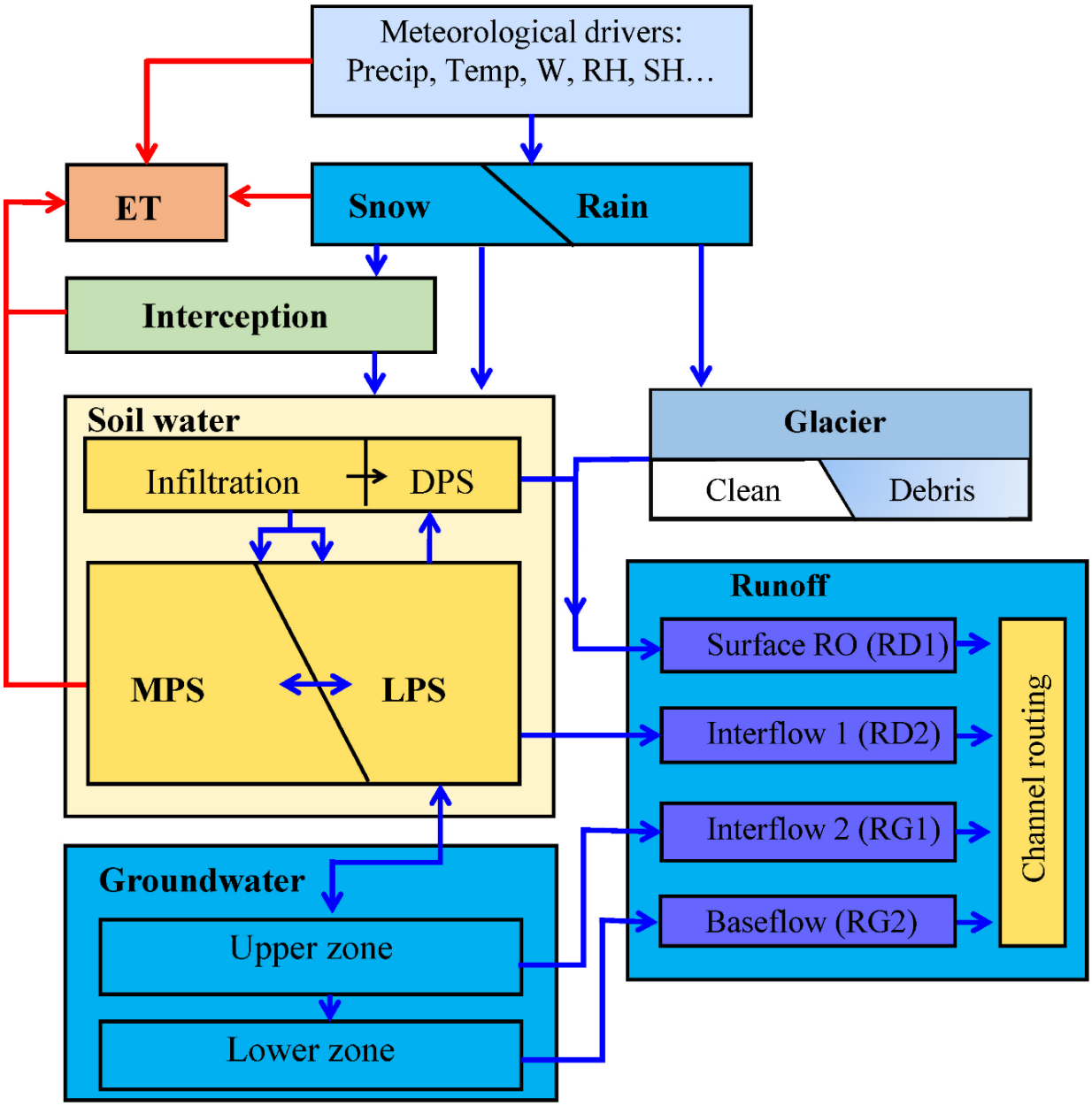
Supplementary Table 3: Calibration parameters in the J2000 hydrological model

Parameter	Description	Calibrated value	Normal range	Units
Precipitation distribution				
Trs	Base temperature	0	−1 to +1	°C
Trans	Parameter range for mixed rain and snow	2	−2 to +2	°C
Interception module				
a_rain	Interception storage for rain	1	0–5	mm
a_snow	Interception storage for snow	1.28	0–5	mm
Snow module				
CritDens	Critical density of snow	0.381	0–1	%
ColdContent	Cold content of snowpack	0.0012	0–1	NA
BaseTemp	Threshold temperature for snowmelt	0	−5 to +5	°C
Tfactor	Melt factor by sensible heat	2.84	0–5	NA
Rfactor	Melt factor by liquid precipitation	0.21	0–5	NA
Gfactor	Melt factor by soil heat flow	3.73	0–5	NA
Glacier module				
meltFactorIce	Melt factor for ice melt	0.5	0–5	NA
alphaIce	Radiation melt factor for ice	0.1	0–5	NA
kIce	Routing coefficient for ice melt	15	0–50	NA
kSnow	Routing coefficient for snowmelt	10	0–50	NA
kRain	Routing coefficient for rainfall–run-off	5	0–50	NA
debrisFactor	Debris factor for ice melt	5	0–10	NA
glacierTbase	Threshold temperature for snowmelt	−1	−5 to +5	°C
Soil module				
soilMaxDPS	Maximum depression storage	2	0–10	mm
soilLinRed	Linear reduction coefficient for actual evaporation	0.6	0–1	
soilMaxInfSummer	Maximum infiltration in summer	45	0–200	mm
soilMaxInfWinter	Maximum infiltration in winter	50	0–200	mm
soilMaxInfSnow	Maximum infiltration in snow-covered areas	40	0–200	mm
soilInpLT80	Infiltration for areas less than 80% sealing	0.5	0–1	NA
SoilDistMPSLPS	MPS–LPS distribution coefficient	0.27	0–10	NA
SoilDiffMPSLPS	MPS–LPS diffusion coefficient	0.1	0–10	NA
soilOutLPS	Outflow coefficient for LPS	7	0–10	NA
soilLatVertLPS	Lateral vertical distribution coefficient	0.05	0–10	NA
soilMaxPerc	Maximum percolation rate to groundwater	30	0–100	mm
soilConcRD1Flood	Recession coefficient for flood event	1.1	1–10	NA
soilConcRD1Flood threshold	Threshold value for soilConcRD1Flood	500	0–500	NA

soilConcRD1	Recession coefficient for overland flow	1.5	1–10	NA
SoilConcRD2	Recession coefficient for interflow	1.8	1–10	NA
Groundwater module				
gwRG1RG2dist	RG1–RG2 distribution coefficient	20	0–5	NA
gwRG1Fact	Adaptation factor for RG1 flow	0.05	0–10	NA
gwRG2Fact	Adaptation factor for RG2 flow	0.18	0–10	NA
gwCapRise	Capillary rise coefficient	0.01	0–10	NA
Reach routing				
flowRouteTA	Flood routing coefficient	30	0–100	NA



Supplementary Figure 1: Variation in weekly soil moisture for the Koshi River basin, 1980–2007



Supplementary Figure 2: Conceptual layout of the J2000 hydrological model
Sources: Adapted from Krause (2002), Krause et al. (2009) and Nepal et al. (2014)

Notes: ET = evapotranspiration, Precip = precipitation, Temp = air temperature, W = wind speed, RH = relative humidity, SH = sunshine hours, LPS = large pore storage, MPS = middle pore storage, DPS = depression storage, RO = runoff