Supplement of

ORCHIDEE MICT-LEAK (r5459), a global model for the production, transport and transformation of dissolved organic carbon from Arctic permafrost regions, Part 2: Model evaluation over the Lena River basin.

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Table S1: Data type, name and sources of data files used to drive the model in the study simulations.

Data Type	Name	Source
Vegetation Map	ESA CCI Land Cover Map	Bontemps et al., 2013
Topographic Index	STN-30p	Vörösmarty et al., 2000
Stream flow direction	STN-30p	Vörösmarty et al., 2000
River surface area		Lauerwald et al., 2015
Soil texture class		Reynolds et al. 1999
Climatology	GSWP3 v0, 1 degree	http://hydro.iis.u-tokyo.ac.jp/GSWP3/
Potential floodplains	Multi-source global wetland maps	Tootchi et al., 2018
Poor soils	Harmonized World Soil Database map	Nachtergaele et al., 2010
Spinup Soil Carbon Stock	20ky ORCHIDEE-MICT soil carbon spinup	Based on config. in Guimberteau et al. (2018)

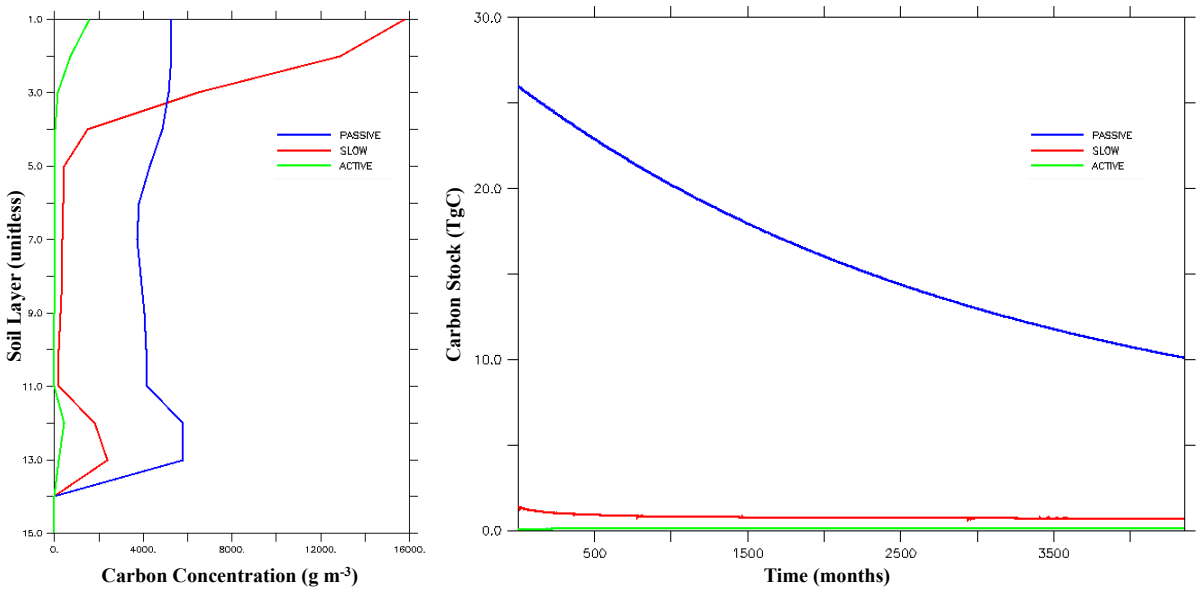
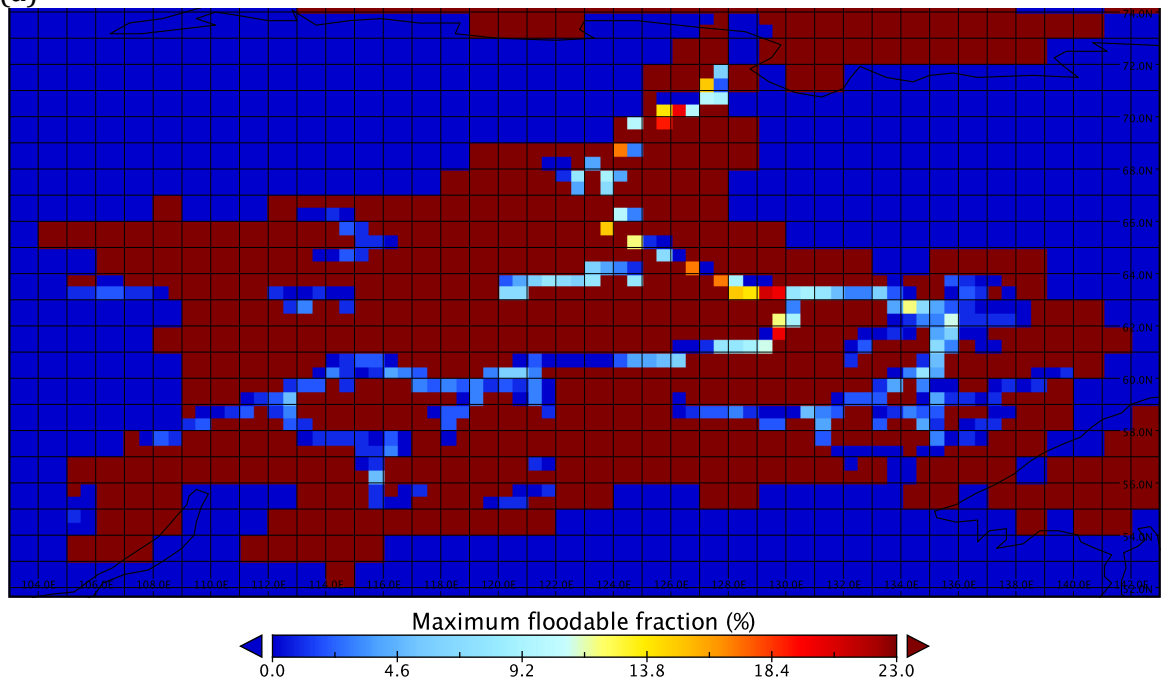


Figure S1: (Left) Soil carbon concentrations per depth level for each soil carbon reactivity pool at the end of the spinup period. (Right) Evolution of each soil carbon pool over the course of the 400-year spinup quasi-eqliuibration period.

(a)



(b)

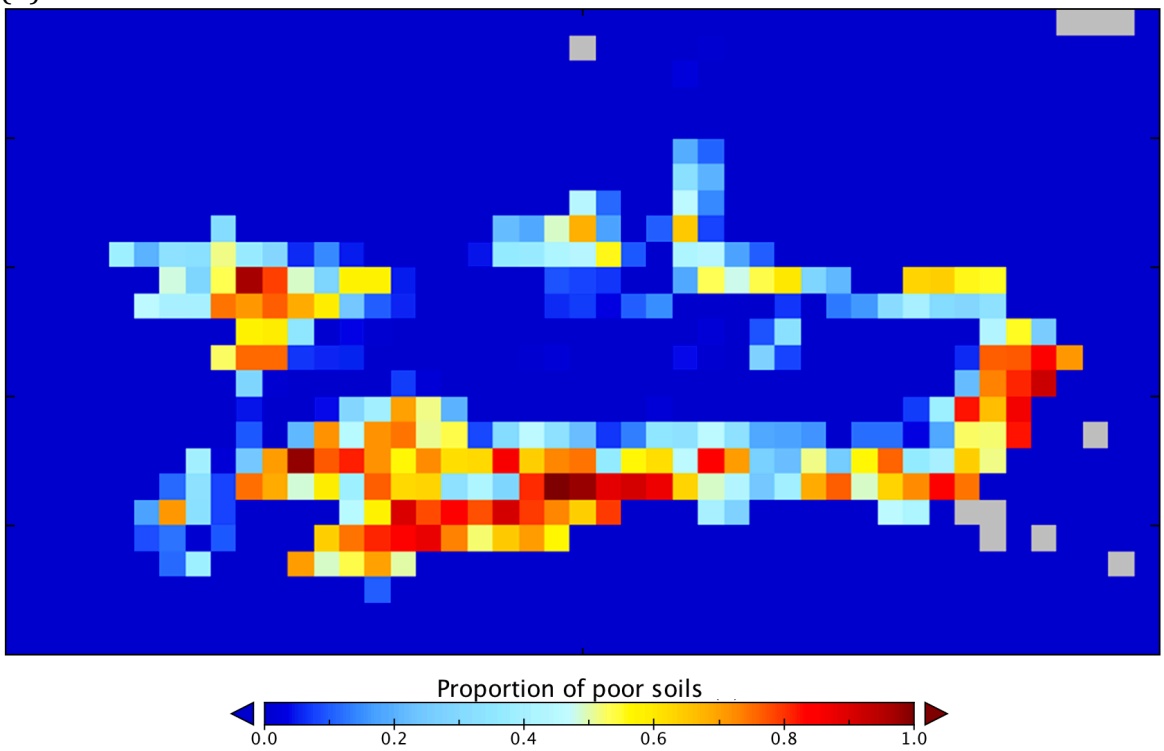


Figure S2: (a) Maximum floodable fraction of grid cells for the Lena basin per the input map from Tootchi et al. (2018). (b) Podzol and Arenosol map (Nachtergaele, 2010) used as input to the 'poor soils' module.

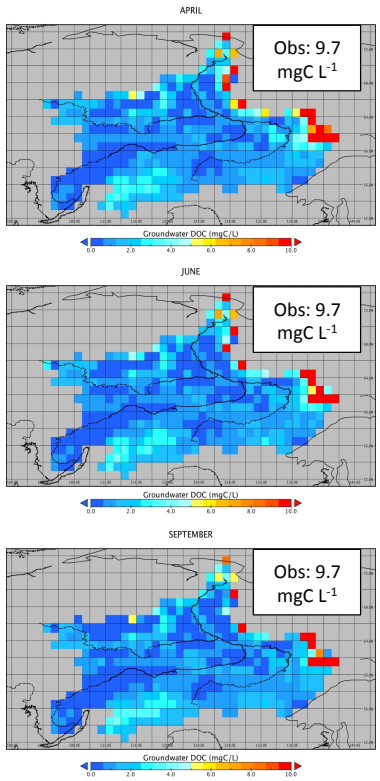
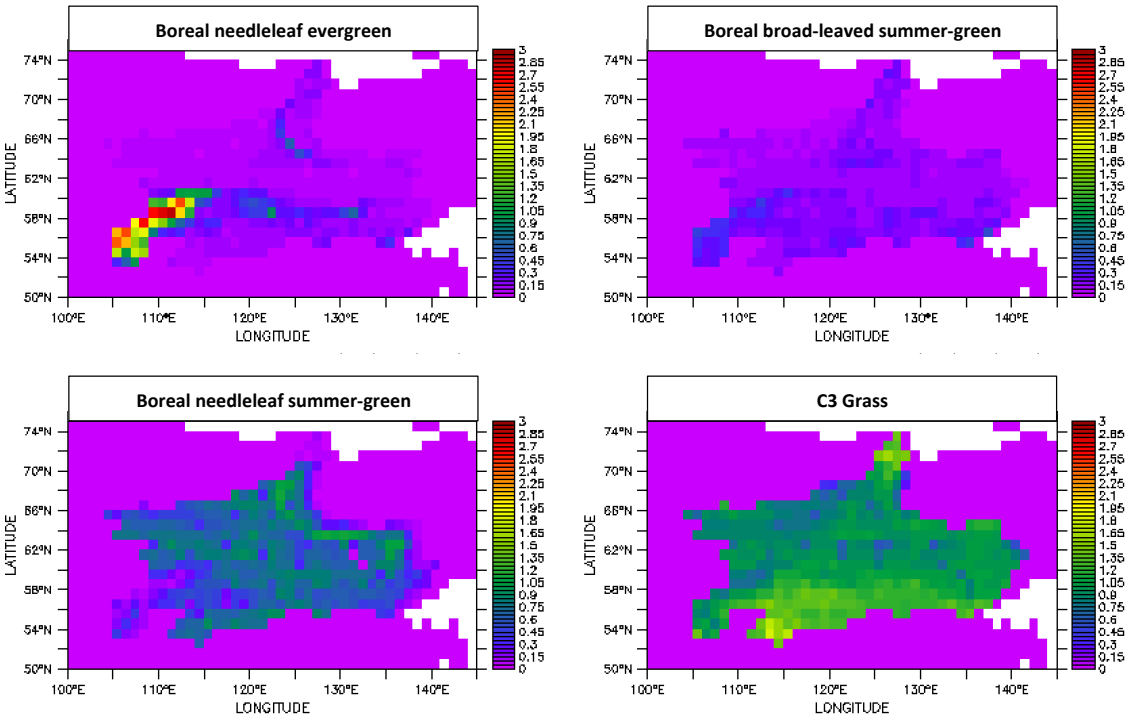
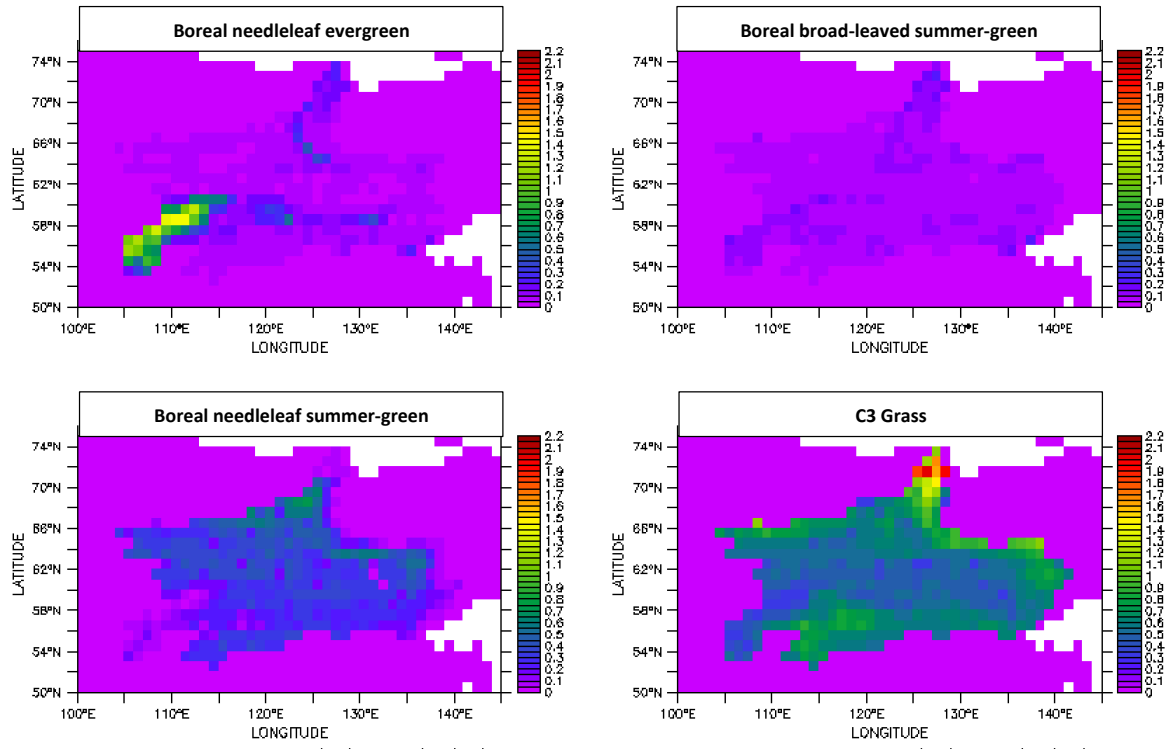


Figure S3: Groundwater DOC concentrations over the Lena basin for April, June and September averaged over 1998-2007, with mean observed concentrations for permafrost groundwater inset.

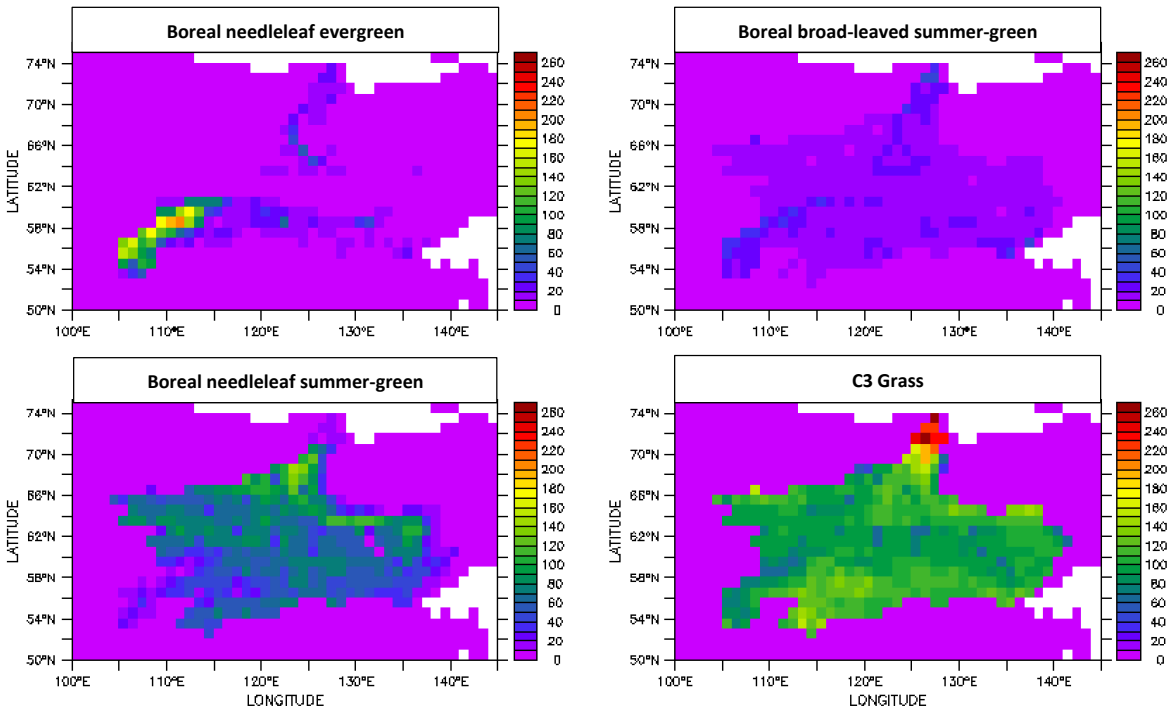
(a)



(b)


Boreal needleleaf evergreen
Boreal broad-leaved summer-green
Boreal needleleaf summer-green
C3 Grass
LATITUDE
LONGITUDE
74°N
70°N
66°N
62°N
58°N
54°N
50°N
100°E
110°E
120°E
130°E
140°E

(c)


Boreal needleleaf evergreen
Boreal broad-leaved summer-green
Boreal needleleaf summer-green
C3 Grass
LATITUDE
LONGITUDE
74°N
70°N
66°N
62°N
58°N
54°N
50°N
100°E
110°E
120°E
130°E
140°E

(d)

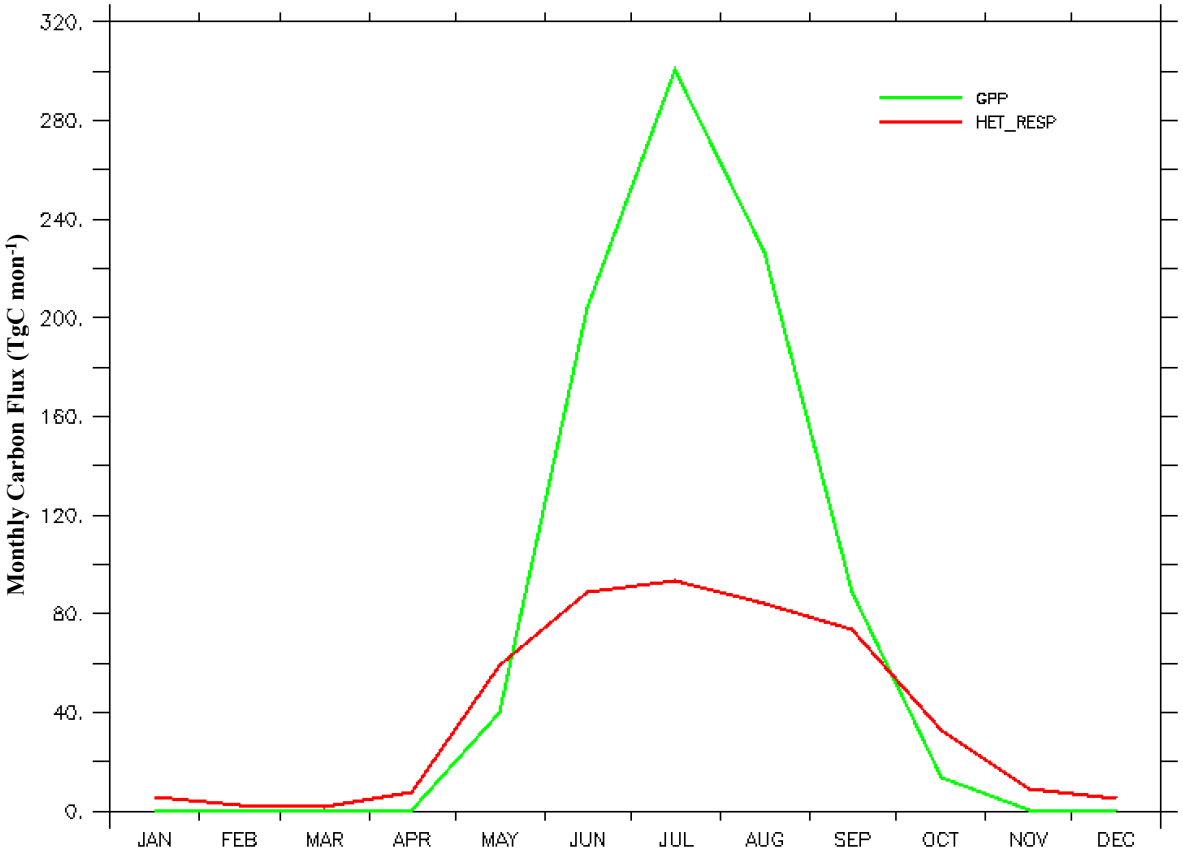


Figure S4: (a) Absolute yearly gross primary productivity (GPP, TgC yr^{-1}) for the four relevant PFT groups over the Lena basin, averaged over 1998-2007. (b) Mean July and August soil heterotrophic respiration rates (g m^2 d^{-1}) for the same PFT groups as in (a), during the period 1998-2007. (c) Average yearly NPP (gC m^2 yr^{-1}) averaged over the period 1998-2007. (d) Mean monthly carbon uptake (GPP) versus its heterotrophic respiration from the soil (Het_Resp) in TgC per month, over the period 1998-2007.

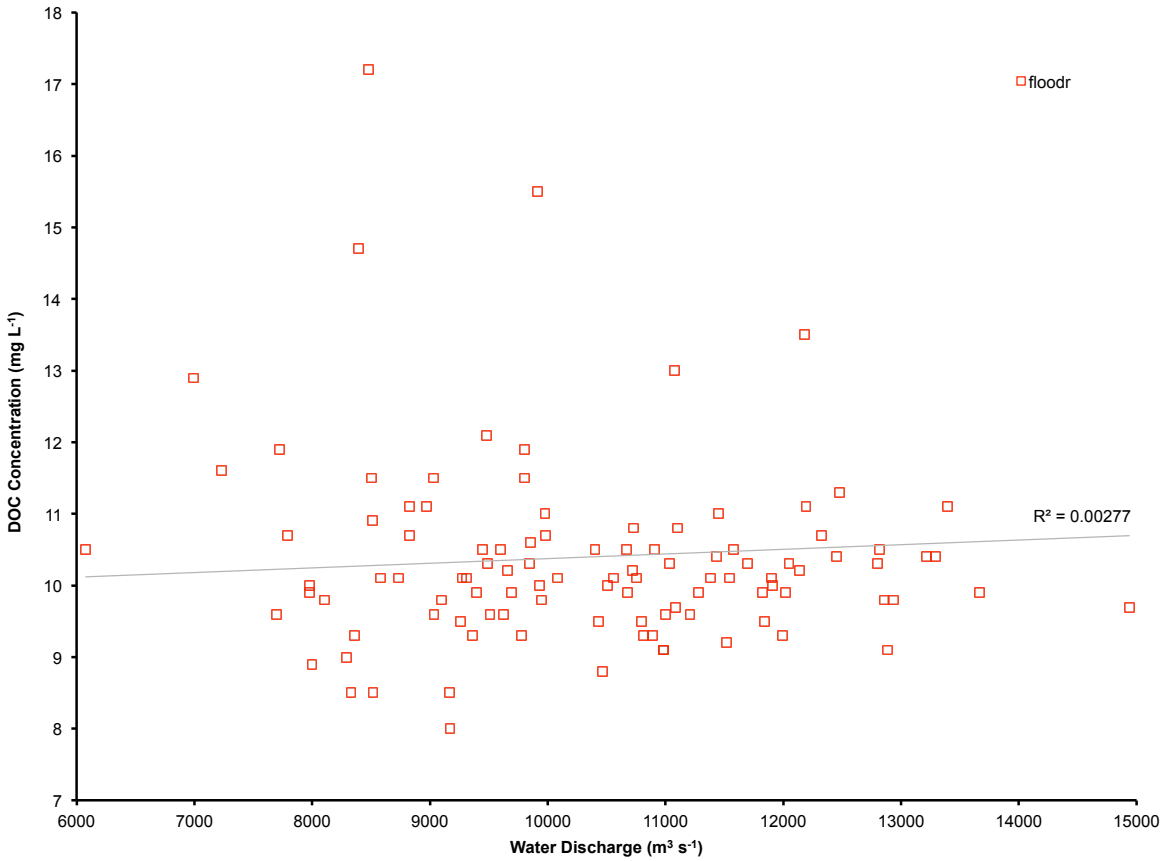


Figure S5: Simulated basin-mean annual DOC concentrations (mg L^{-1}) for the floodplain water pool regressed against mean annual simulated discharge rates at Kusur (m^3 s^{-1}) over 1901-2007. A linear regression with R^2 is plotted.