Supplement of Hydrol. Earth Syst. Sci., 21, 2301–2320, 2017
http://www.hydrol-earth-syst-sci.net/21/2301/2017/
doi:10.5194/hess-21-2301-2017-supplement

Hydrology and Earth System Sciences
Open Access

Supplement of

Effects of uncertainty in soil properties on simulated hydrological states and fluxes at different spatio-temporal scales

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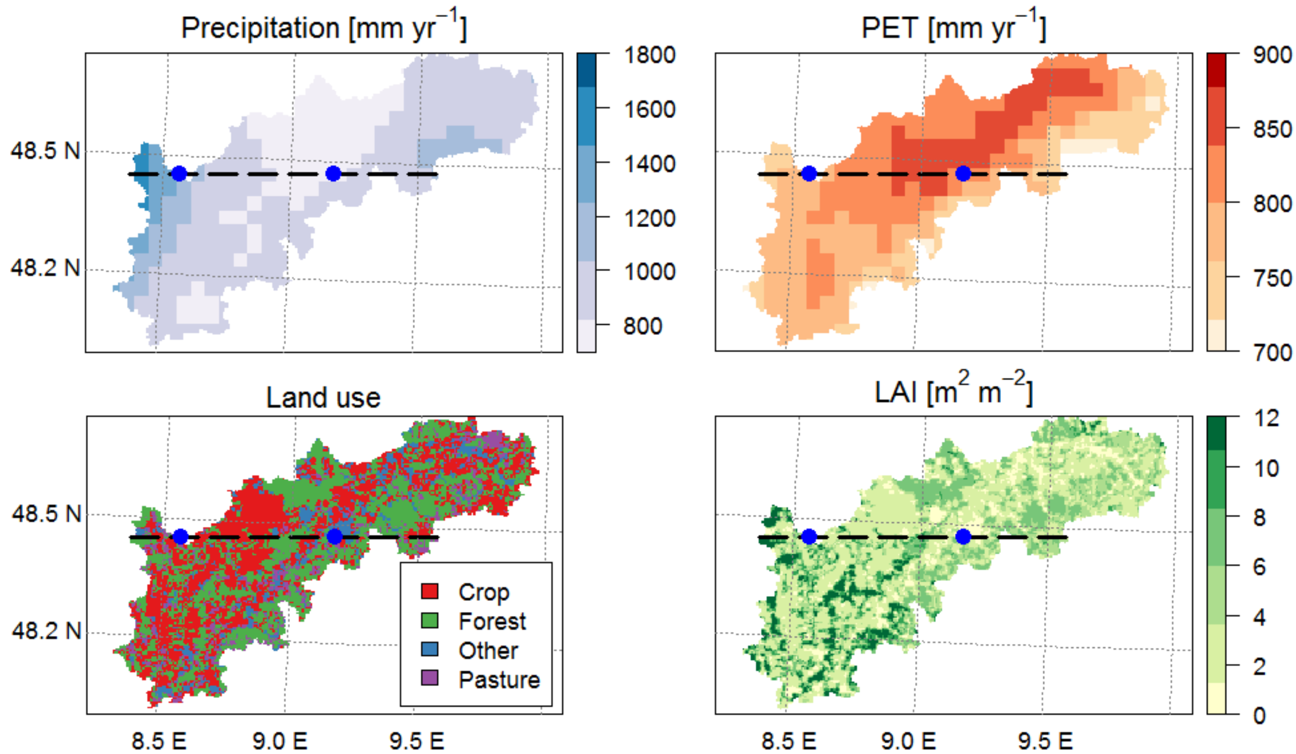

Figure S1. Cumulative precipitation [mm yr^{-1}] and cumulative potential evapotranspiration PET [mm yr^{-1}] during the simulated year (1990); main land use within the catchment; mean leaf area index (LAI [m^2 m^{-2}]) over the same simulated year (1990). Transect (dashed black line) and locations of the two grid cells are also depicted.

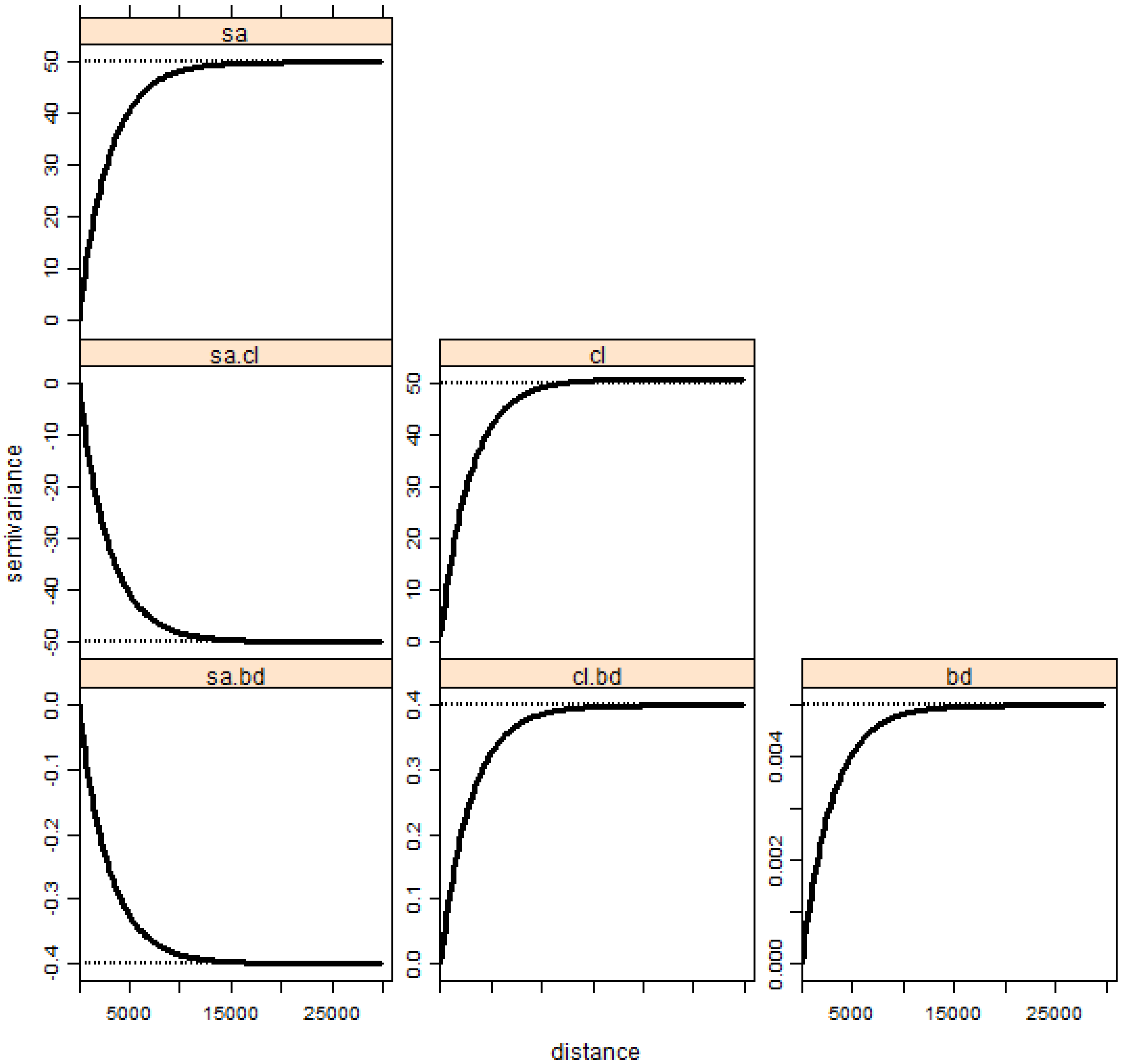

Figure S2. Semivariograms and co-semivariograms models used in the spatially correlated method for sa = Sand [%], cl = Clay [%], bd = bulk density [g cm^{-3}], respectively. Distance is in meters.

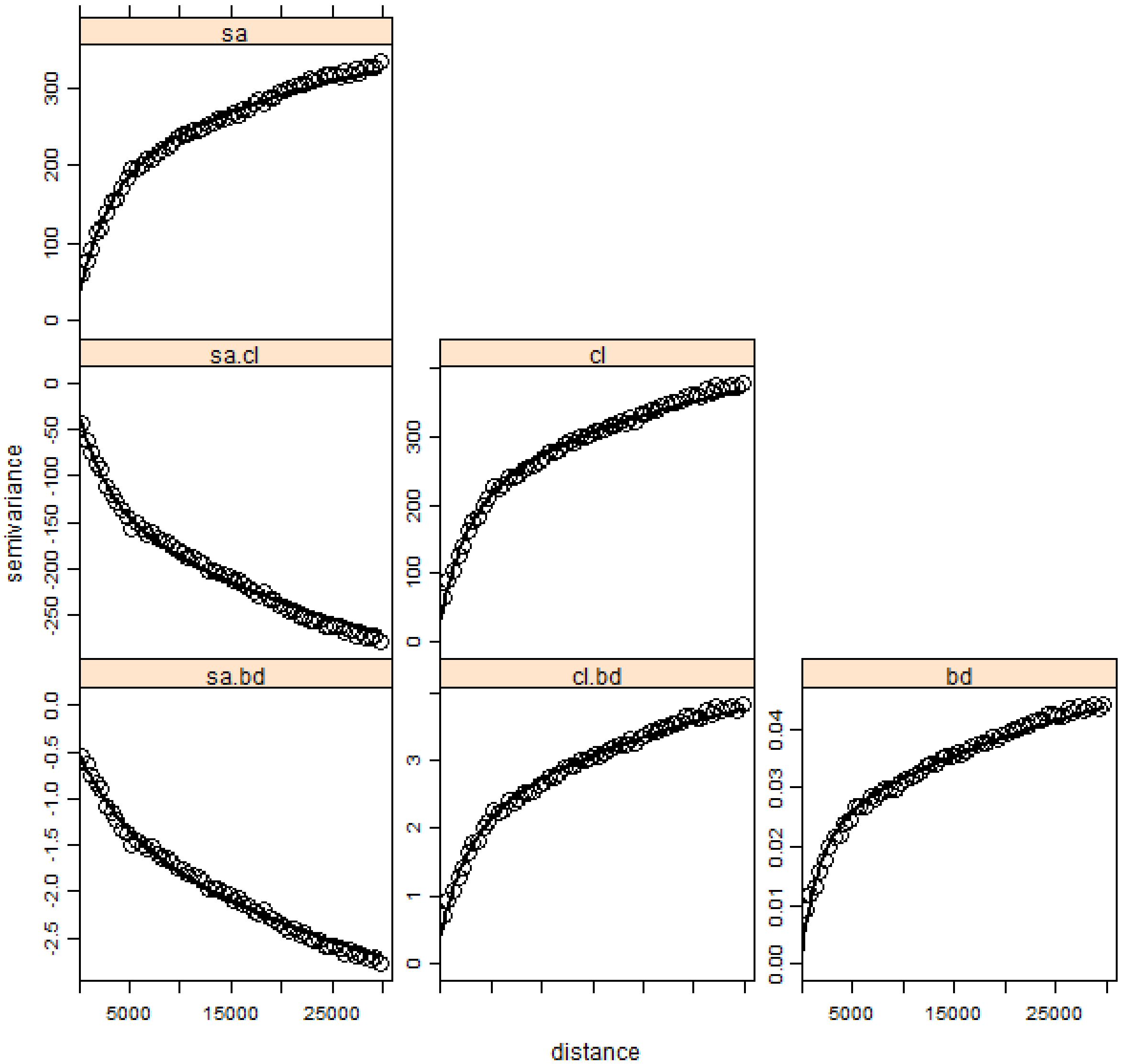

Figure S3. Experimental semivariograms and co-semivariograms (circle) and fitted models (black line) used for the conditional points method for sa = Sand [%], cl = Clay [%], bd = Bulk density [g cm^{-3}], respectively. Distance is in meters.

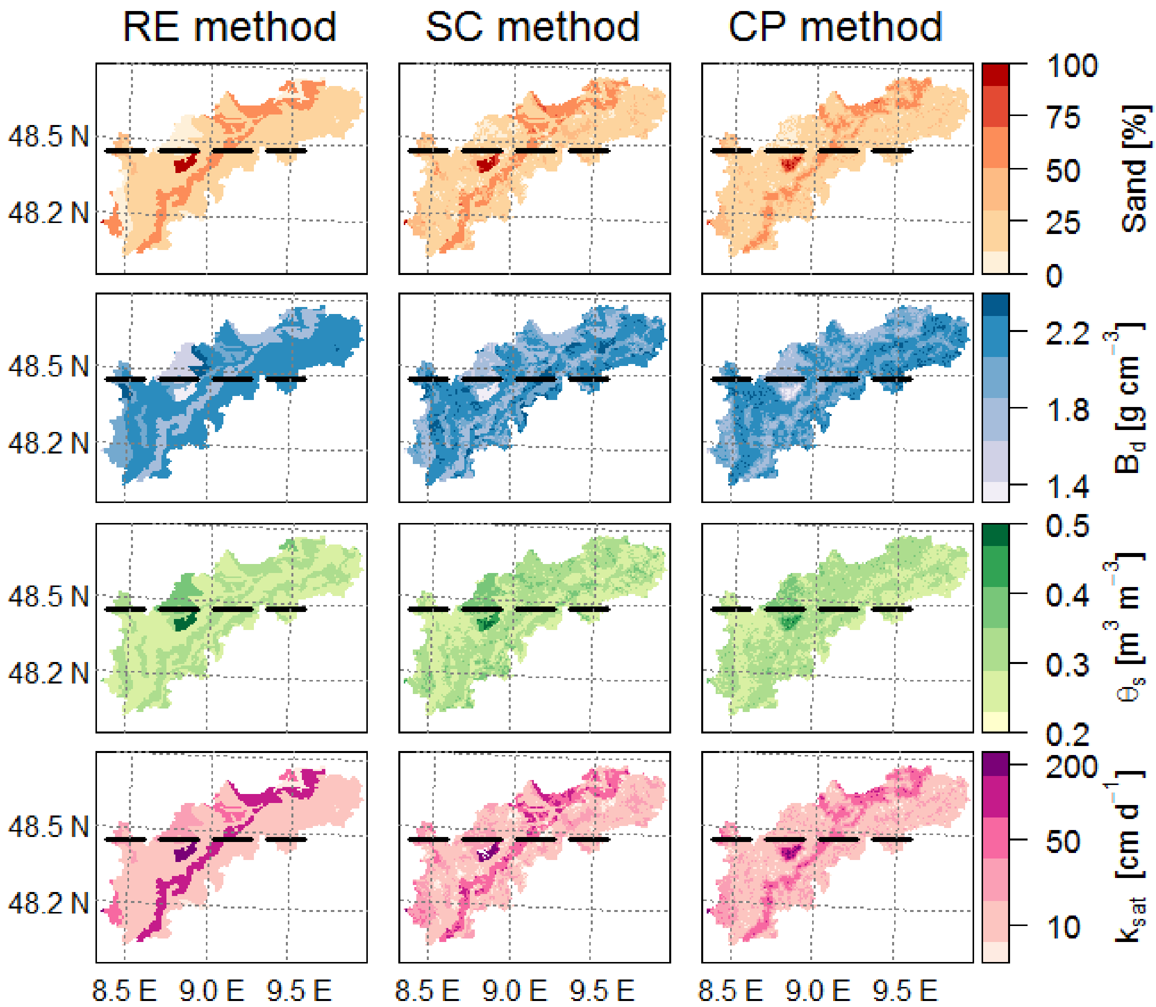

Figure S4. From top row, single realization of sand [%], bulk density B_d [g cm^{-3}], saturated water content θ_s [m^3 m^{-3}] and saturated hydraulic conductivity k_{sat} [cm d^{-1}] based on the Random Error method (RE, left column), Spatially Correlated method (SC, middle) and Conditional Points method (CP, right column). Please note that a log scale was used to for the saturated hydraulic conductivity (fourth row).

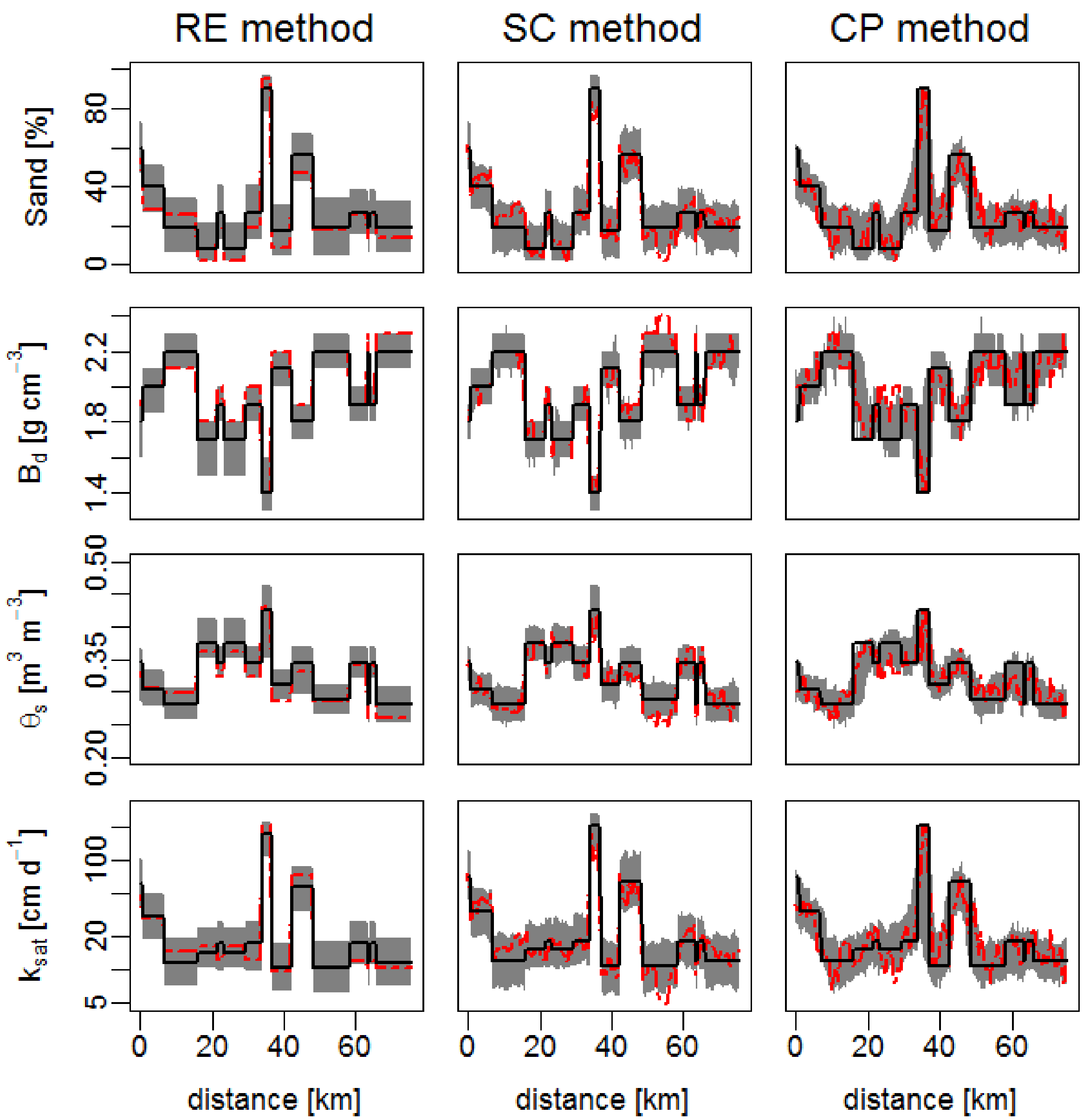

Figure S5. From top row, spread of the 100 realizations of sand [%], bulk density B_d [g cm^{-3}], saturated water content θ_s [m^3 m^{-3}] and saturated hydraulic conductivity k_{sat} [cm d^{-1}] by using the 5th and 95th percentile (gray area) for the selected transect. The red line depicts one realization, whereas the black line shows the values based on the original soil map. Please note that a log scale was used to for the saturated hydraulic conductivity (forth row).

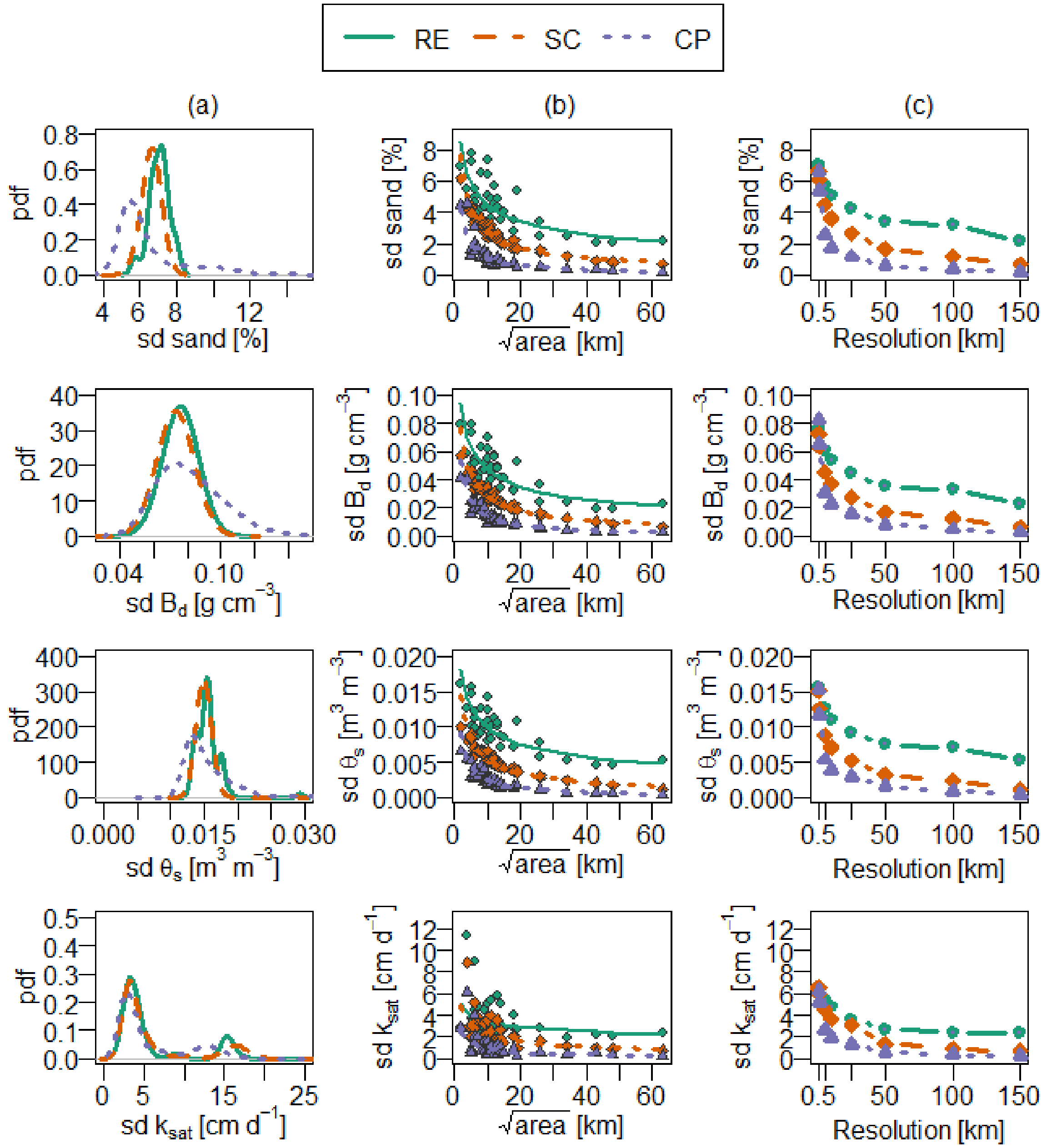

Figure S6. (a) Probability distribution of the standard deviation (*sd*) of the soil properties (sand [%], bulk density B_d [g cm^{-3}],) and soil hydraulic parameters (saturated water content θ_s [m^3 m^{-3}] and saturated hydraulic conductivity k_{sat} [cm d^{-1}]) based on 100 realizations calculated for all grid cells and each method (RE = Random Error method; SC = Spatially Correlated method; CP = Conditional Points method). (b) Standard deviation (*sd*) calculated by aggregating the values at subcatchments with different size. (c) Standard deviation (*sd*) calculated by aggregating the values at different grid resolutions.

Table S1. Regionalization functions of the soil hydraulic parameters[a].

Parameter	Regionalization function	Description/reference
Residual water content	$\theta_r = 0$	Parameters of the soil retention curve (van Genuchten, 1980) estimated based on Zacharias and Wessolek (2007)
Saturated water content	$\theta_s = \gamma_1 + \gamma_2\, P_{clay} + \gamma_3\, B_d$ if $P_{sand} < 66.5\%$ $\theta_s = \gamma_4 + \gamma_5\, P_{clay} + \gamma_6\, B_d$ if $P_{sand} \geq 66.5\%$	
Shape parameter	$n = \gamma_7 + \gamma_8 (P_{sand})^{\gamma_9} + \gamma_{10} \left(P_{clay}\right)^{\gamma_{11}}$ if $P_{sand} < 66.5\%$ $n = \gamma_{12} + \gamma_{13} (P_{sand})^{\gamma_{14}} + \gamma_{15} \left(P_{clay}\right)^{\gamma_{16}}$ if $P_{sand} \geq 66.5\%$	
Shape parameter	$ln(\alpha) = \gamma_{17} + \gamma_{18} P_{sand} + \gamma_{19}\, P_{clay} + \gamma_{20}\, B_d$ if $P_{sand} < 66.5$ $ln(\alpha) = \gamma_{21} + \gamma_{22} P_{sand} + \gamma_{23}\, P_{clay} + \gamma_{24}\, B_d$ if $P_{sand} \geq 66.5\%$	
Shape parameter	$m = 1 - \frac{1}{n}$	
Soil moisture at wilting point	$\theta_{wp} = \frac{\theta_s - \theta_r}{[1 + (\alpha h)^n]^m}$	with *h* the matric potential at -1500 [kPa]
Soil moisture at field capacity	$\theta_{fc} = \theta_s\, n^{\gamma_{25} log_{10}(q_{fc}/k_{sat})}$	Based on Twarakavi et al. (2009) and assuming that the drainage flux q_{fc} is 0.01 [cm d^{-1}]
Saturated hydraulic conductivity	$log_{10}(k_{sat}) = \gamma_{26} + \gamma_{27} * P_{sand} + \gamma_{28} * P_{clay}$	Cosby et al. (1984)

[a] Percentage of sand (P_{sand}), percentage of clay (P_{clay}), bulk density [g cm^{-3}] (B_d). Coefficients (γ_i) used for establishing those functional relationships are regarded as calibration parameters in mHM.