Supplement of Hydrol. Earth Syst. Sci., 18, 3481–3498, 2014
http://www.hydrol-earth-syst-sci.net/18/3481/2014/
doi:10.5194/hess-18-3481-2014-supplement

Hydrology and Earth System Sciences
Open Access

Supplement of

Validating a spatially distributed hydrological model with soil morphology data

T. Doppler et al.

Correspondence to: C. Stamm (christian.stamm@eawag.ch)

The following tables show the values of the maximum likelihood parameters. We are aware that these are effective parameters. Some of them are outside a physically meaningful range because they compensate for structural deficits in the model.
The column "Calibration" indicates if a parameter was calibrated or kept fixed at a given value. The columns "min" and "max" show the minimum and maximum values of the parameters that were allowed during calibration.

Table S1: Parameters of the paved area module

Prameter name	Unit	Value	Calibration	min	max
S_{paved_min}	mm	1.5	no	-	-
k_{paved}	h^{-1}	3.0	no	-	-
m_{paved}	-	3.5	no	-	-
paved area	m^2	18888.5	yes	2000	∞

Table S2: Parameters of the unsaturated zone module
Some of the parameters of the unsaturated zone module did not differentiate into the spatially distributed unsaturated zones but remained at the value of the optimum from the calibration with the homogeneous unsaturated zone (see Sect. 2.5.4). These parameters are indicated with * in the Calibration column.
The brackets indicate to which unsaturated zone the parameter belongs. [s1] to [s7] are the seven soil water regime classes, [sett] refers to settlement areas and [forest] to forested areas. [lw] indicates that all seven water regime classes share the same parameter, no indication in brackets means the same parameter for the whole unsaturated zone.

Parameter name	Unit	Value	Calibration	min	max
S_{uns_max} [s1]	mm	1400.99	yes	10	5000
S_{uns_max} [s2]	mm	814.819	yes *	10	5000
S_{uns_max} [s3]	mm	1106.35	yes	10	5000
S_{uns_max} [s4]	mm	814.819	yes *	10	5000
S_{uns_max} [s5]	mm	1546.85	yes	10	5000
S_{uns_max} [s6]	mm	814.819	yes *	10	5000
S_{uns_max} [s7]	mm	814.819	yes *	10	5000
S_{uns_max} [sett]	mm	4875.22	yes	10	5000
S_{uns_max} [forest]	mm	1104.93	yes	10	5000
fc [s1]	-	0.670762	yes	0	1
fc [s2]	-	0.796285	yes	0	1
fc [s3]	-	0.797603	yes	0	1
fc [s4]	-	0.793688	yes	0	1
fc [s5]	-	0.665779	yes *	0	1
fc [s6]	-	0.665779	yes *	0	1
fc [s7]	-	0.787419	yes	0	1
fc [sett]	-	0.664554	yes	0	1
fc [forest]	-	0.781458	yes	0	1
k_{uns} [s1]	h^{-1}	0.717911	yes *	0	1
k_{uns} [s2]	h^{-1}	0.717911	yes *	0	1
k_{uns} [s3]	h^{-1}	0.717911	yes *	0	1
k_{uns} [s4]	h^{-1}	0.717911	yes *	0	1

k_{uns} [s5]	h^{-1}	0.717911	yes *	0	1
k_{uns} [s6]	h^{-1}	0.717911	yes *	0	1
k_{uns} [s7]	h^{-1}	0.989107	yes	0	1
k_{uns} [sett]	h^{-1}	0.717911	yes *	0	1
k_{uns} [forest]	h^{-1}	0.717911	yes *	0	1
k_{pref} [s1]	-	0.880871	yes *	0	1
k_{pref} [s2]	-	0.880871	yes *	0	1
k_{pref} [s3]	-	0.880871	yes *	0	1
k_{pref} [s4]	-	0.880871	yes *	0	1
k_{pref} [s5]	-	0.880871	yes *	0	1
k_{pref} [s6]	-	0.880871	yes *	0	1
k_{pref} [s7]	-	0.880871	yes *	0	1
k_{pref} [sett]	-	0.880871	yes *	0	1
k_{pref} [forest]	-	0.880871	yes *	0	1
e_{pref} [s1]	-	2.43903	yes	1	5
e_{pref} [s2]	-	4.90072	yes	1	5
e_{pref} [s3]	-	2.70257	yes	1	5
e_{pref} [s4]	-	1.99827	yes *	1	5
e_{pref} [s5]	-	1.99827	yes *	1	5
e_{pref} [s6]	-	1.99827	yes *	1	5
e_{pref} [s7]	-	1.99827	yes *	1	5
e_{pref} [sett]	-	4.73838	yes	1	5
e_{pref} [forest]	-	4.99867	yes	1	5
k_{et} [s1]	-	0.87514	yes *	0	1
k_{et} [s2]	-	0.87514	yes *	0	1
k_{et} [s3]	-	0.87514	yes *	0	1
k_{et} [s4]	-	0.87514	yes *	0	1
k_{et} [s5]	-	0.87514	yes *	0	1
k_{et} [s6]	-	0.87514	yes *	0	1
k_{et} [s7]	-	0.963509	yes	0	1
k_{et} [sett]	-	0.87514	yes *	0	1
k_{et} [forest]	-	0.87514	yes *	0	1
μ_0[lw]	$h^{-1} * K^{-1}$	0.000824	yes *	10^{-7}	1
μ_0[sett]	$h^{-1} * K^{-1}$	0.0001	no	-	-
μ_0 [forest]	$h^{-1} * K^{-1}$	0.000824	yes *	10^{-7}	1
T_0 [lw]	K	10.4255	yes	0	15
T_0 [sett]	K	5.0	no	-	-
T_0 [forest]	K	12.1983	yes	0	15
$m_{uns,max}$ [lw]	-	1.01632	yes	1	20
$m_{uns,max}$ [sett]	-	3.0	no	-	-
$m_{uns,max}$ [forest]	-	1.42395	yes	1	20
k_{decay}	$h^{-1} * K^{-1}$	0.00001	no	-	-
$m_{uns,min}$	-	0.5	no	-	-
Initial state of S_{uns}					
S_{uns_init} [s1]	-	0.498083	yes	0	1
S_{uns_init} [s2]	-	0.415475	yes	0	1
S_{uns_init} [s3]	-	0.654671	yes	0	1

S_{uns_init} [s4]	-	0.414843	yes *	0	1
S_{uns_init} [s5]	-	0.593526	yes	0	1
S_{uns_init} [s6]	-	0.891386	yes	0	1
S_{uns_init} [s7]	-	0.414843	yes *	0	1
S_{uns_init} [sett]	-	0.965453	yes	0	1
S_{uns_init} [forest]	-	0.63688	yes	0	1

Table S3: Parameters of the saturated zone module

Prameter name	**Unit**	**Value**	**Calibration**	**min**	**max**
m_{sat}	-	1.0	no	-	-
K_{sat}	$m * h^{-1}$	0.002386	yes	0	∞
r_{dr}	-	4.32867	yes	0	7
m_{dr}	-	5.76481	yes	1	6
p_{eff}	-	0.1089	yes	0	1
Sp_{dr}	m	17.0	no	-	-
Draindepth	m	1.5	no	-	-
Initial state of groundwater level					
shift from initial groundwater map	m	-0.47762	yes	-2	2

Table S4: Parameters of the calibration

These are the standard deviations at the measurement locations used for calibration (see Sect. 2.5.4). Theoretically these are measurement errors. However in reality they certainly include model errors.

Parameter name	**Unit**	**Value**	**Calibration**	**min**	**max**
σ [Piezo 1]	m	0.371875	yes	0.05	2.5
σ [Piezo 2]	m	0.406586	yes	0.05	2.5
σ [Piezo 3]	m	0.107557	yes	0.05	2.5
σ [Piezo 4]	m	0.059275	yes	0.05	2.5
σ [Piezo 5]	m	0.757373	yes	0.05	2.5
σ [Piezo 6]	m	0.668431	yes	0.05	2.5
σ [Piezo 7]	m	0.736764	yes	0.05	2.5
σ [Piezo 8]	m	0.159669	yes	0.05	2.5
σ [Piezo 9]	m	0.411092	yes	0.05	2.5
σ [Piezo 10]	m	0.94531	yes	0.05	2.5
σ [Piezo 11]	m	1.40036	yes	0.05	2.5
σ [Q_transformed]	$(l\ s^{-1})^{1/3}$	0.411153	yes	0.05	2.5

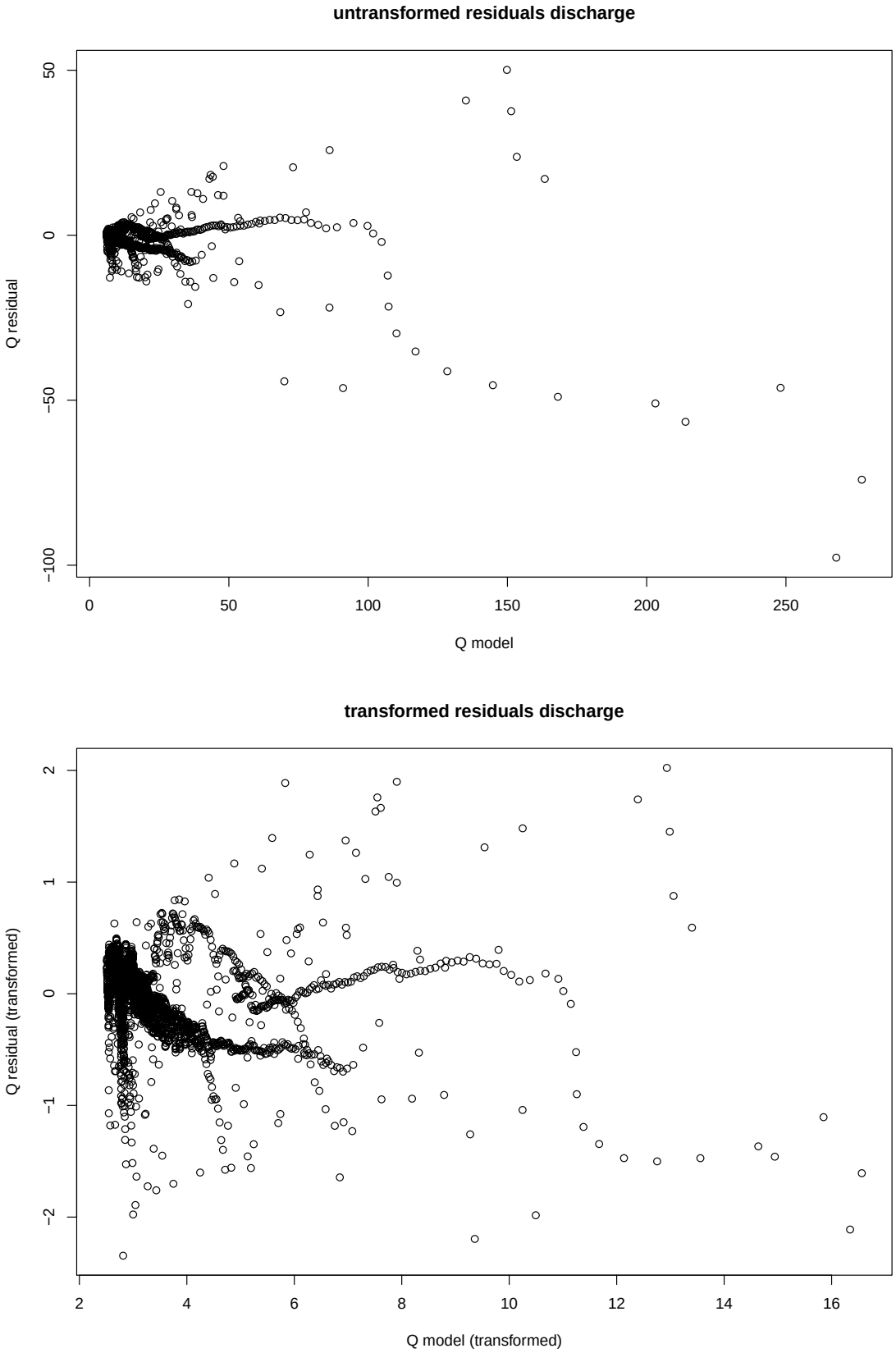

Figure S1: Dischage residuals (from the calibration period) as a function of simulated discharge in untransformed and transformed space.

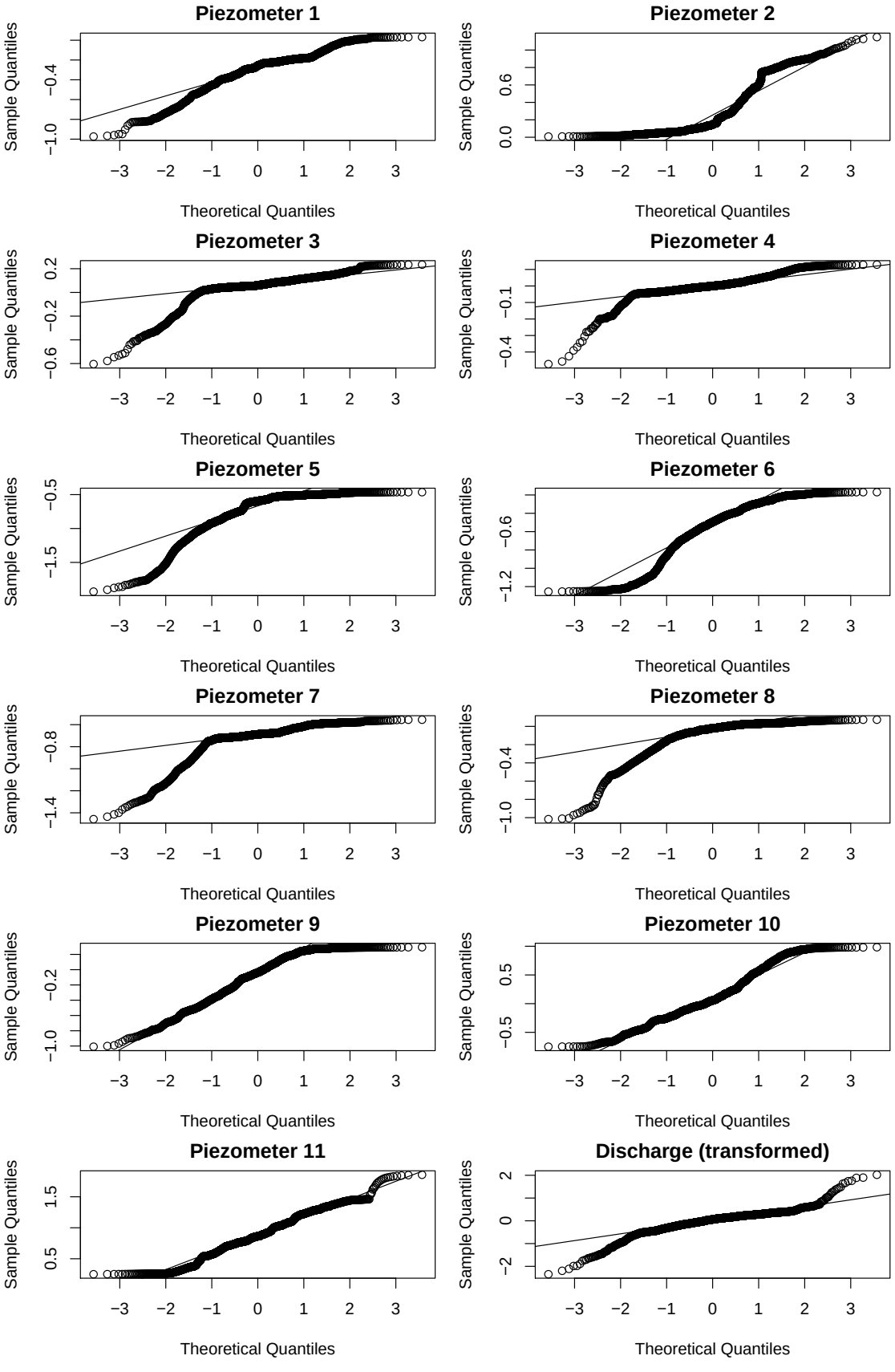

Figure S2: QQ-plots of the residuals from the calibration period against a normal distribution.

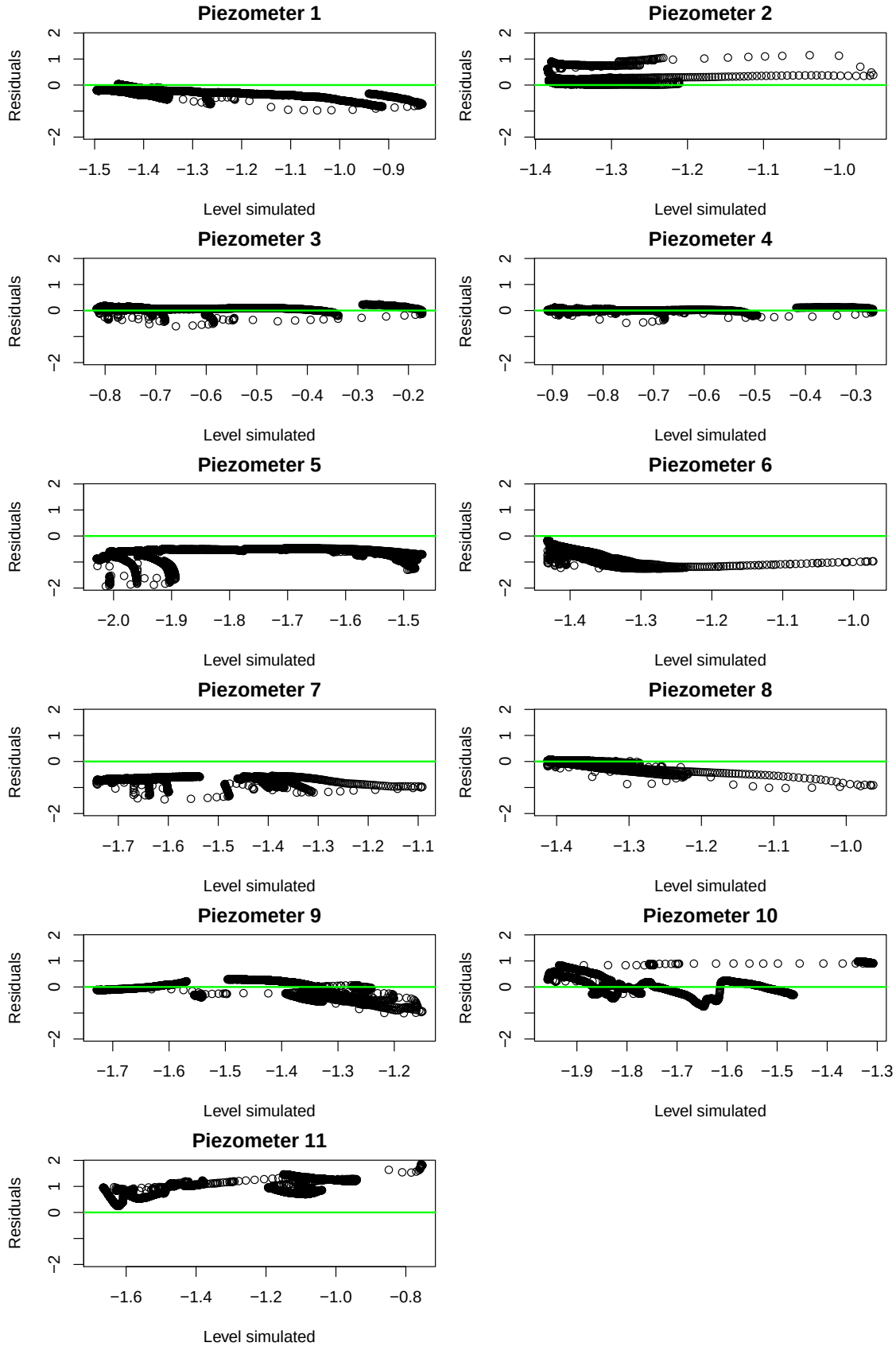

Figure S3: Water level residuals at the 11 piezometers (from the corresponding calibration periods) as a function of simulated water level.

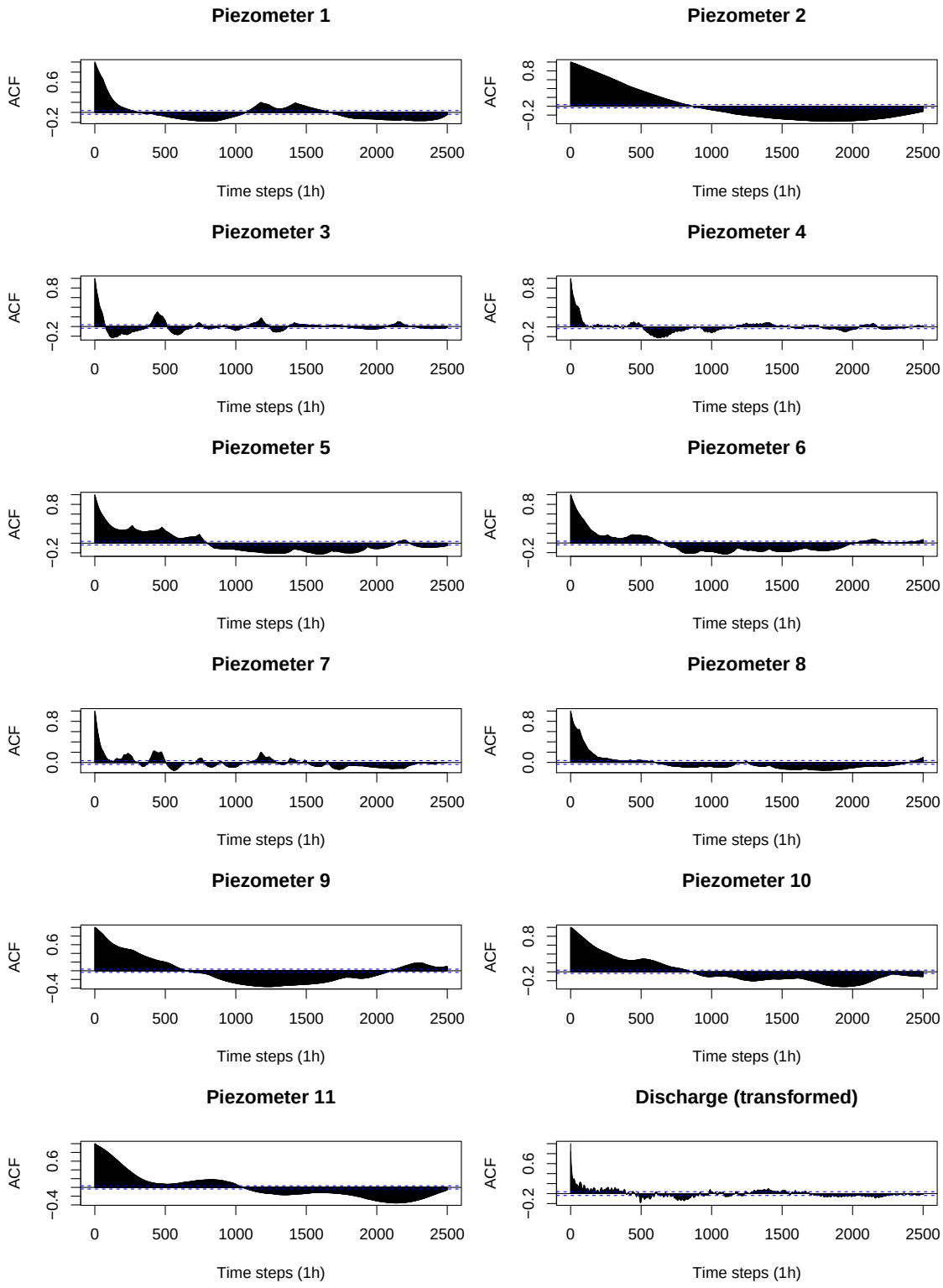

Figure S4: Autocorrelation coefficients of the residuals from the calibration period.