Q4231.00
Annexes

Prepared for:

RIZA and BfG

Water balance Maxau-Rhine branches

Phase 2: Water balance analyses between the main hydrometric stations

Annexes

July, 2007

WL | delft hydraulics

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Water balance Maxau-Rhine branches

Phase 2: Water balance analyses between the main hydrometric stations

Dr.Ir. A.H. Weerts & Ir. M. Mens

Annexes

July, 2007

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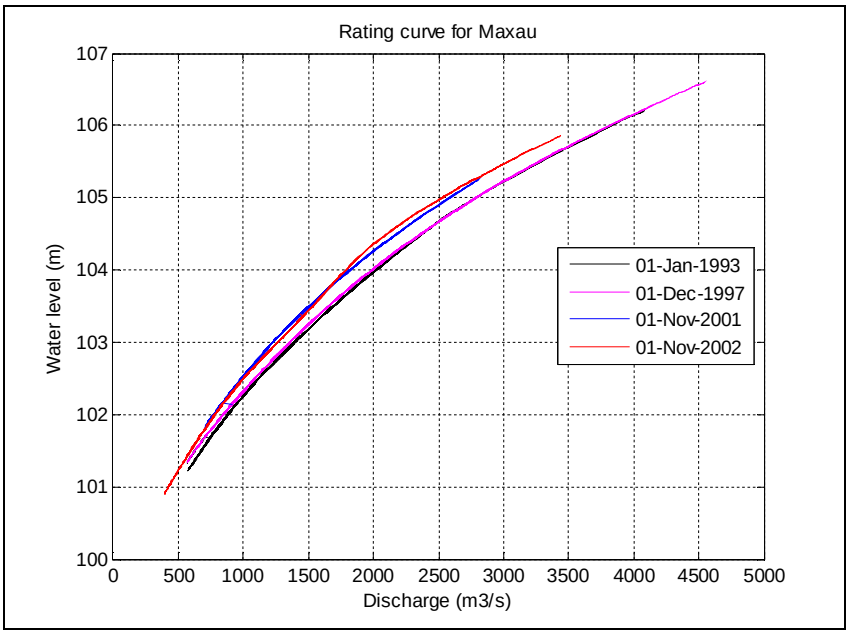

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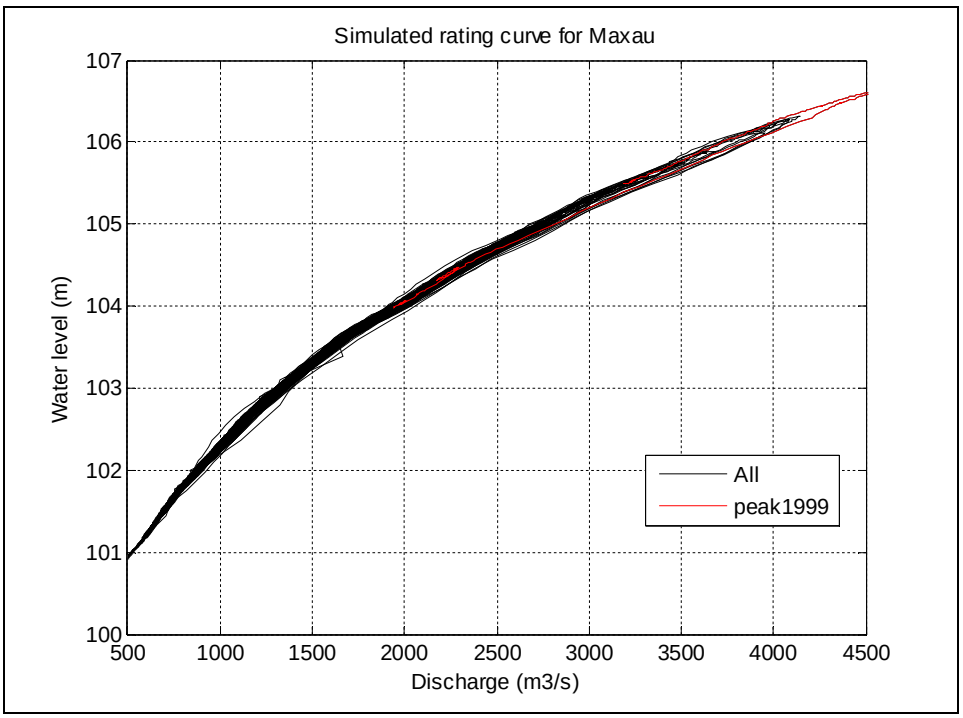

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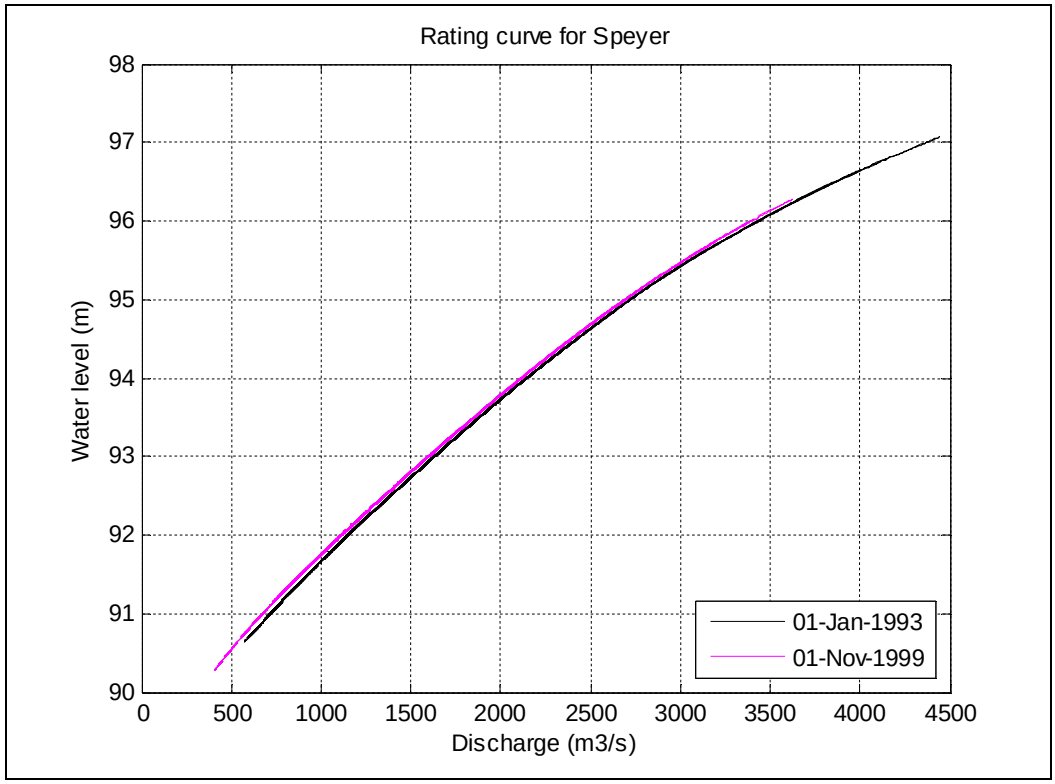

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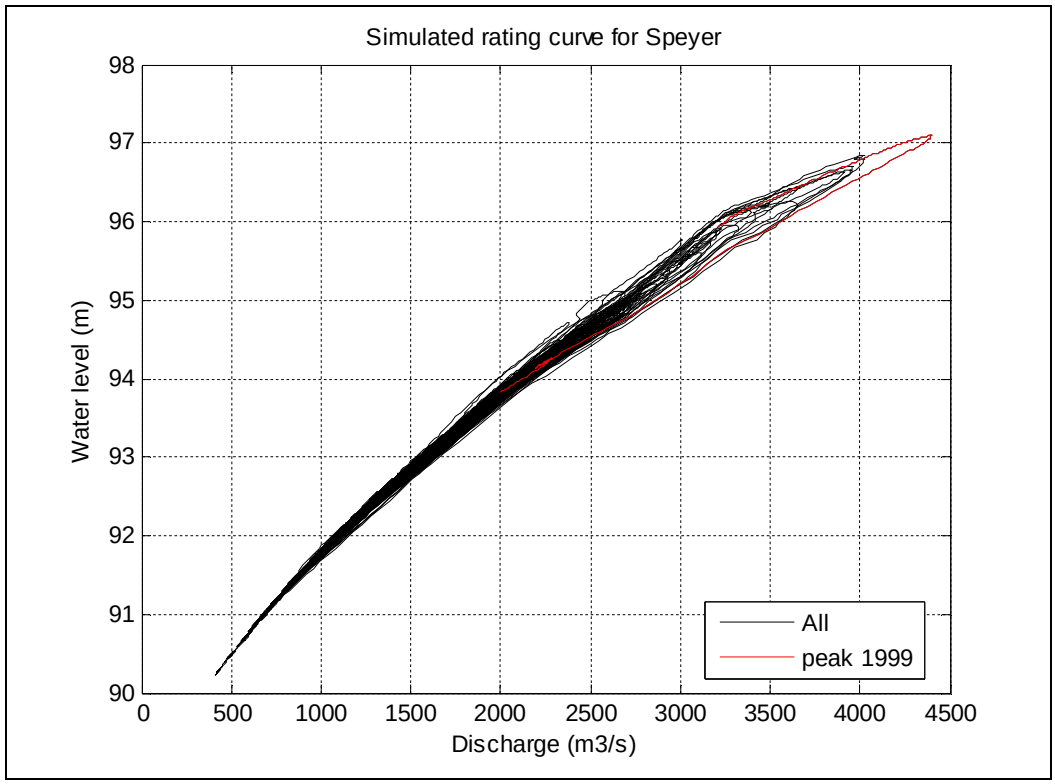

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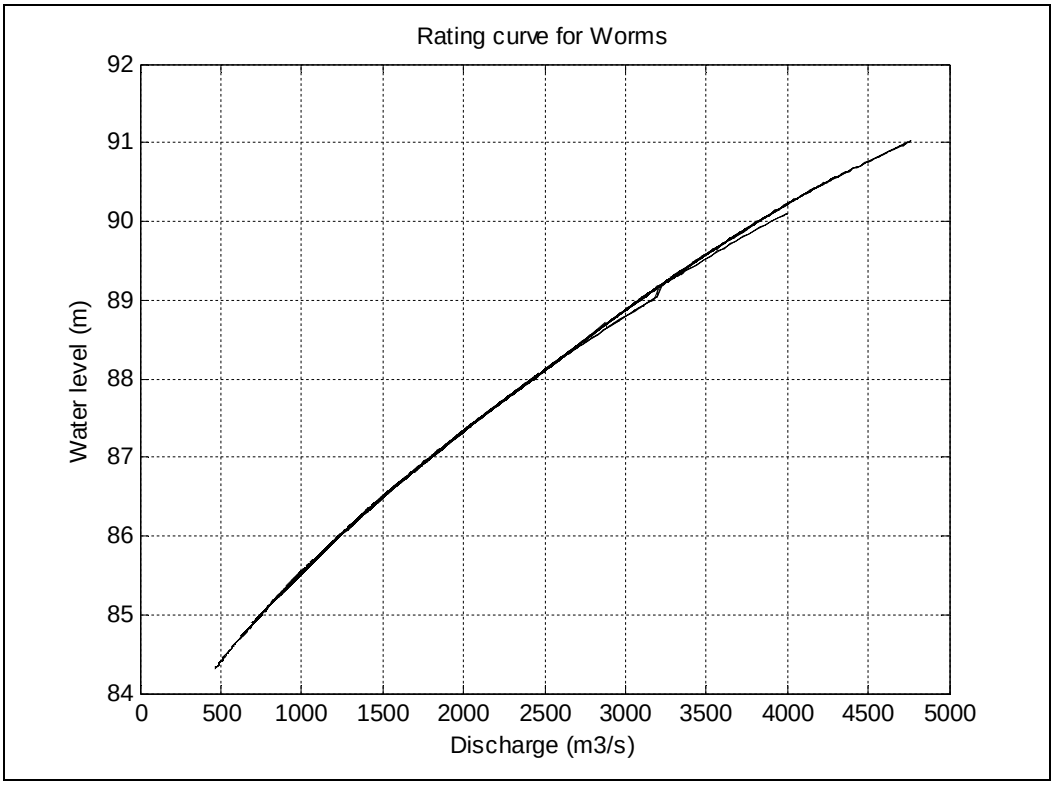

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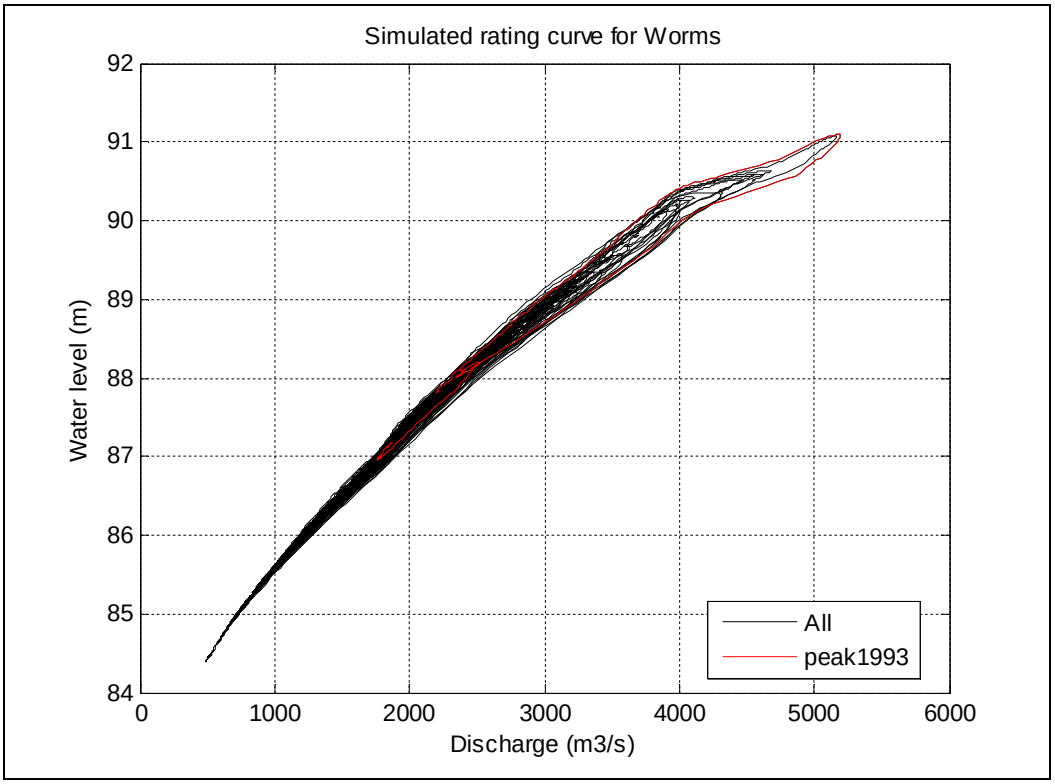

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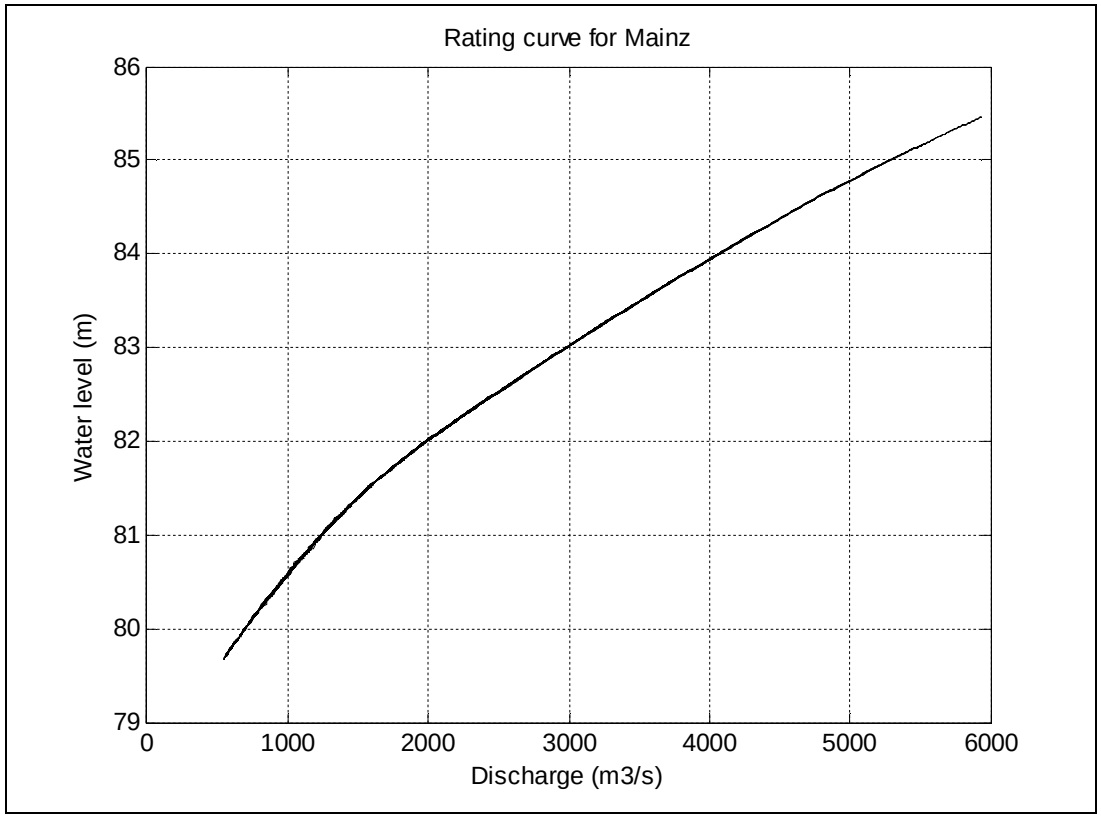

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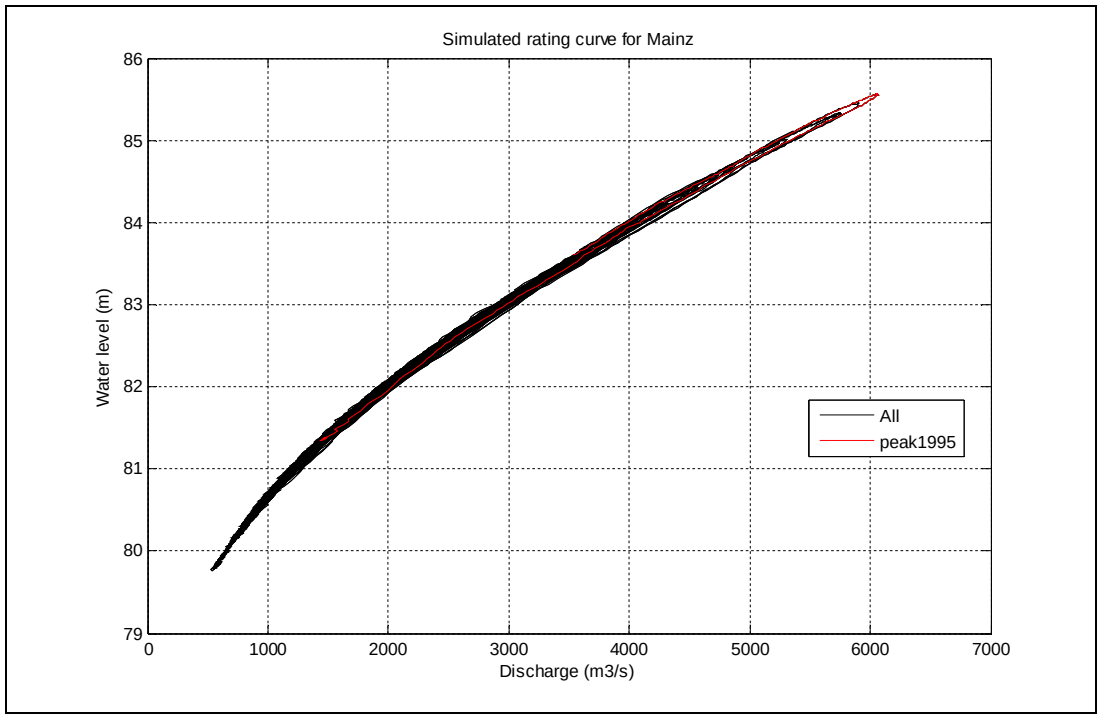

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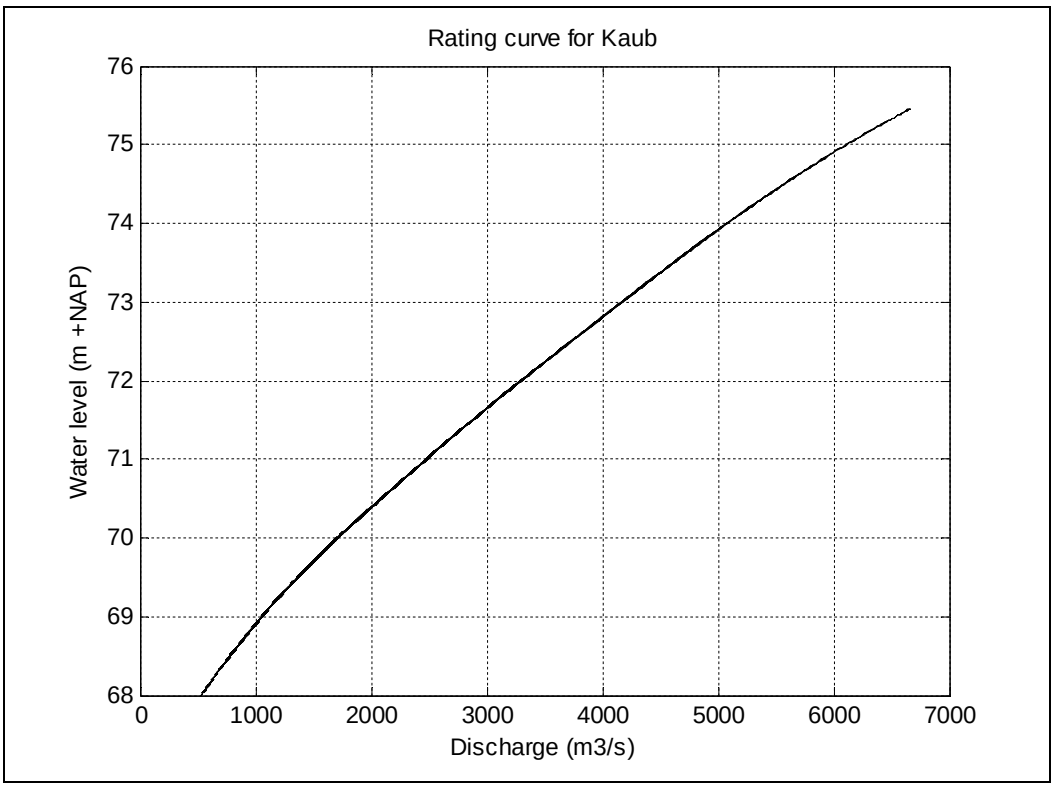

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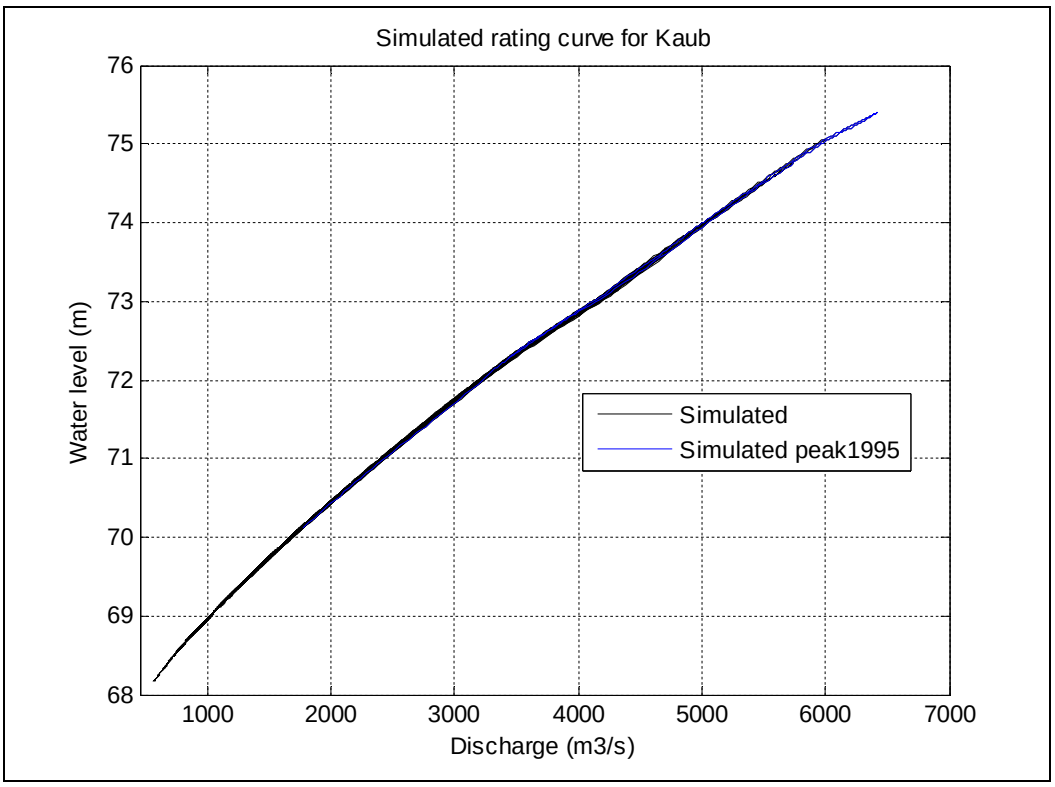

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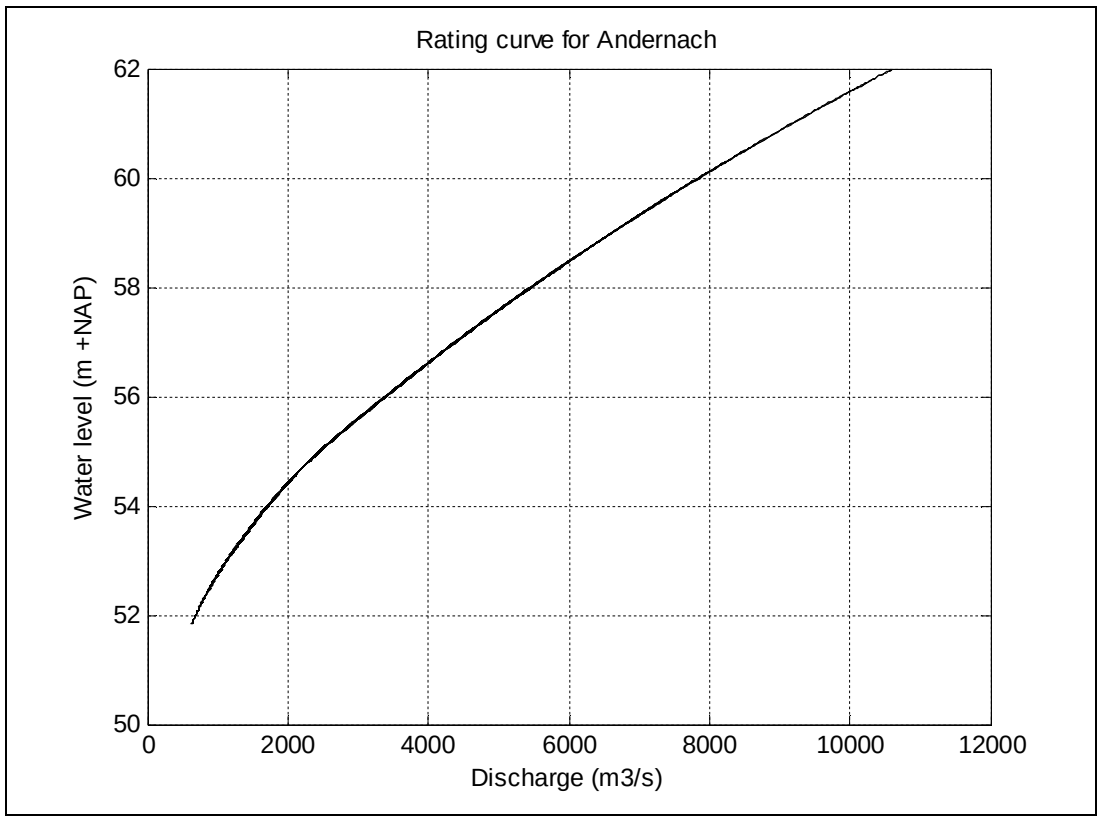

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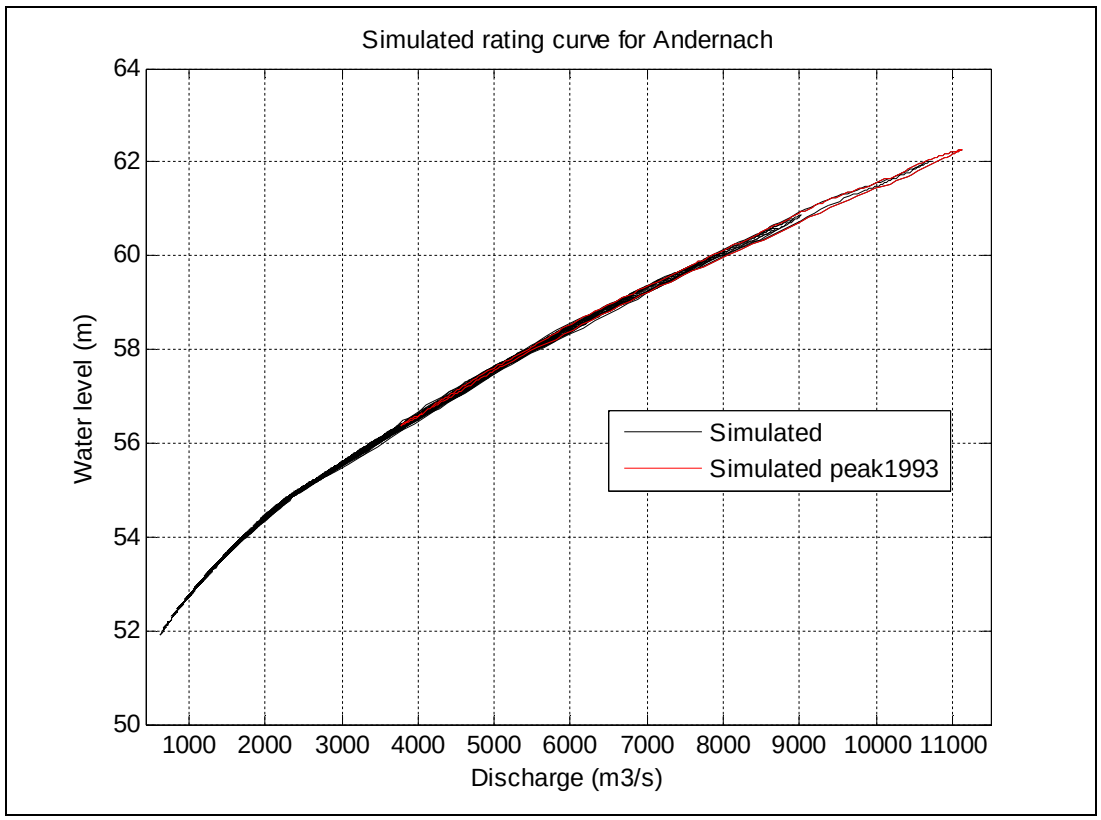

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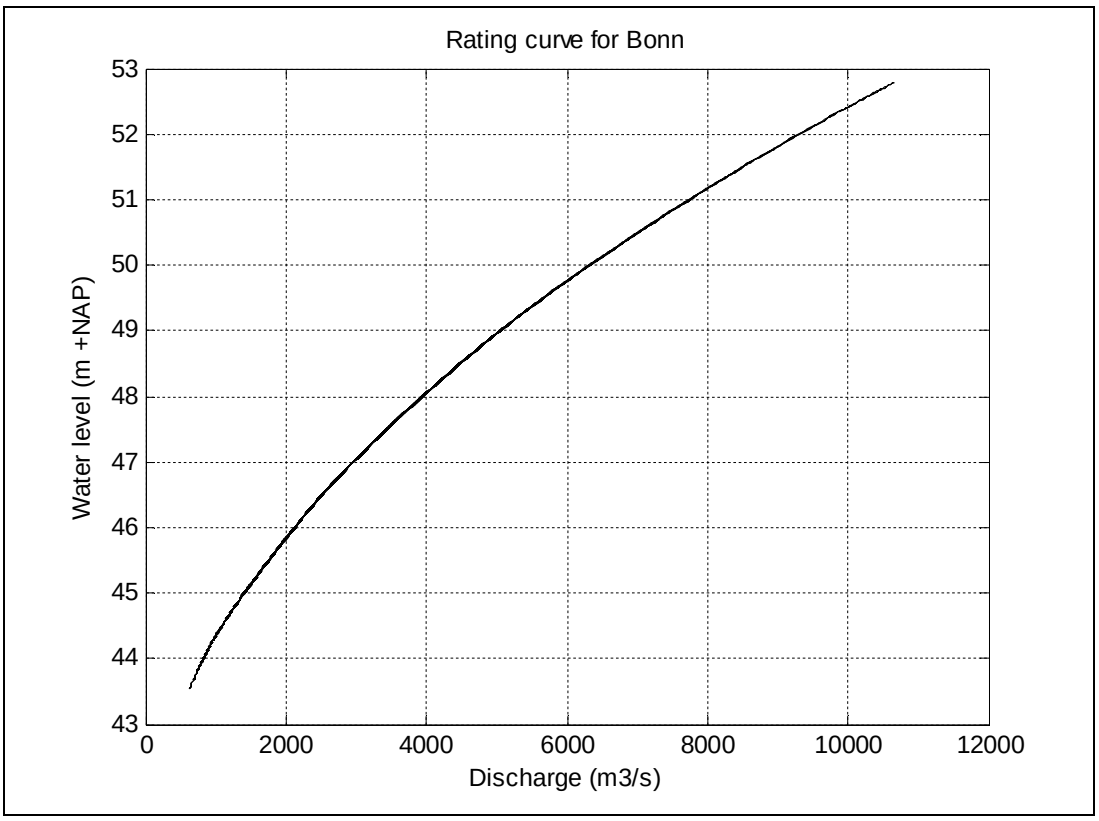
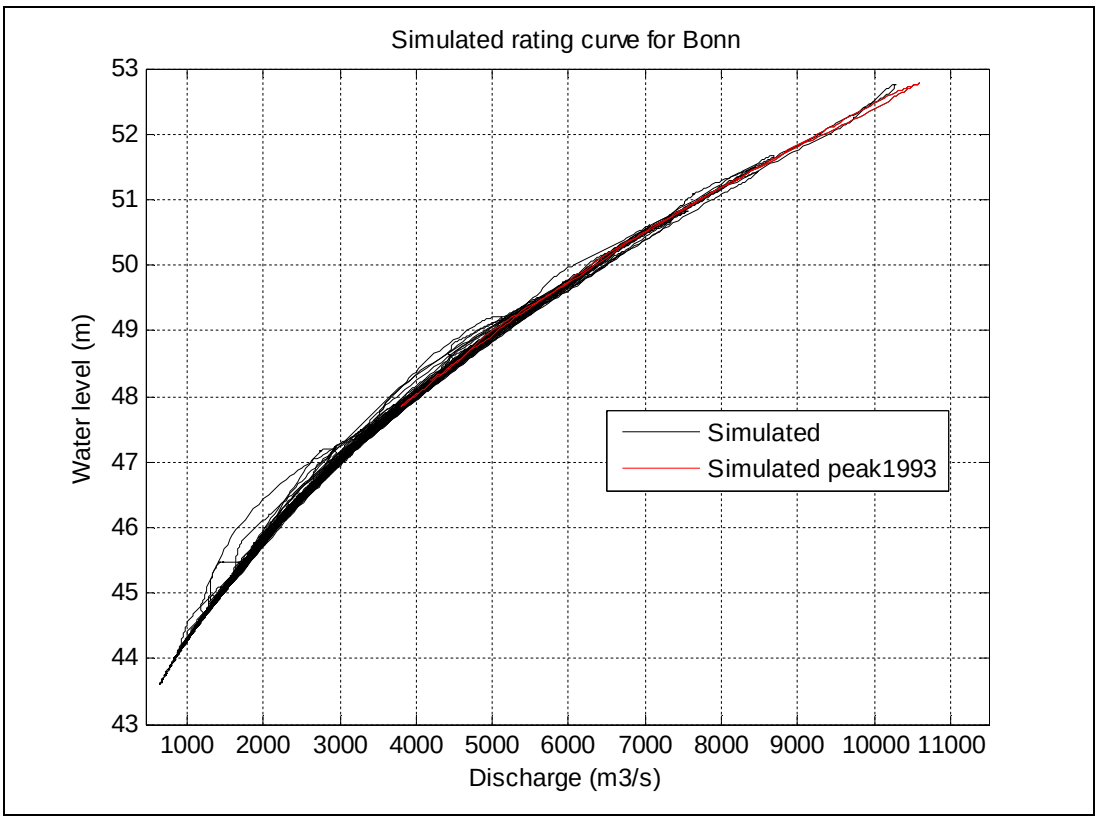


Figure A.13. Rating curve at Bonn.



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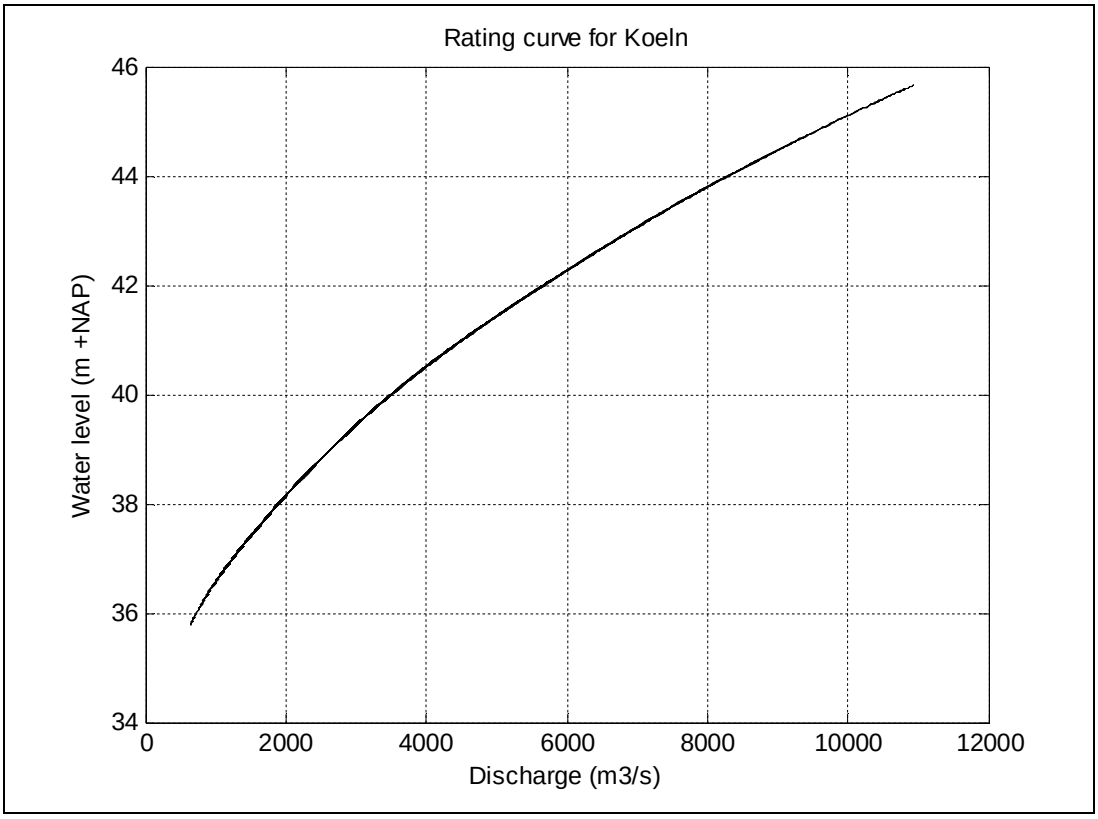

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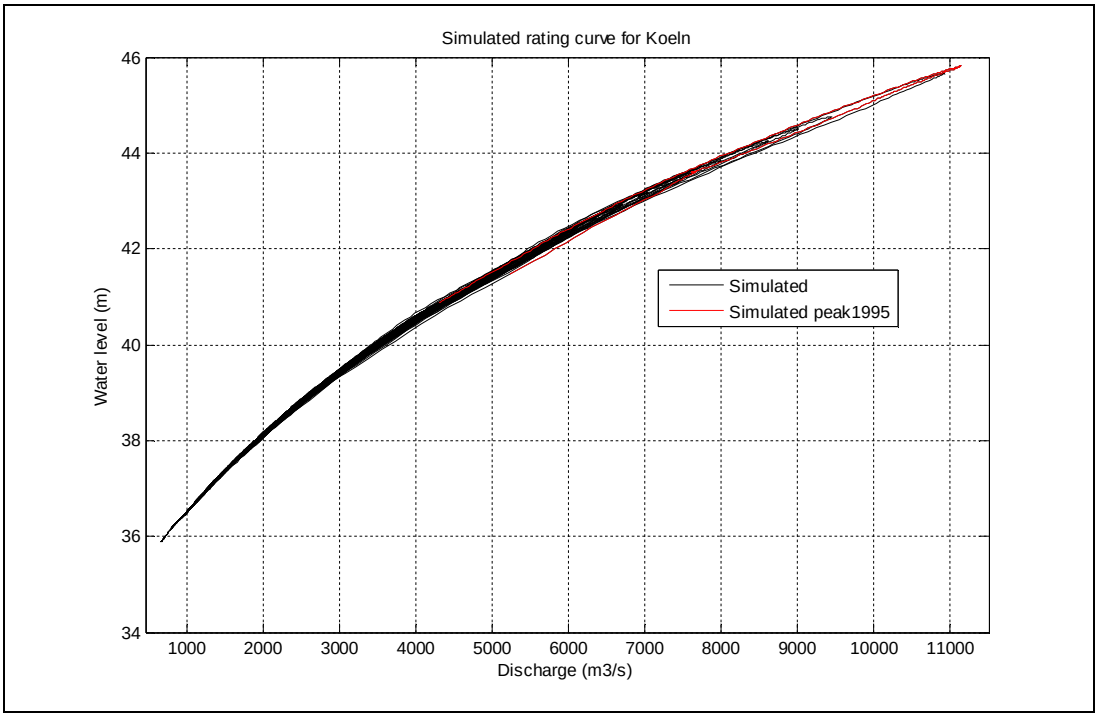

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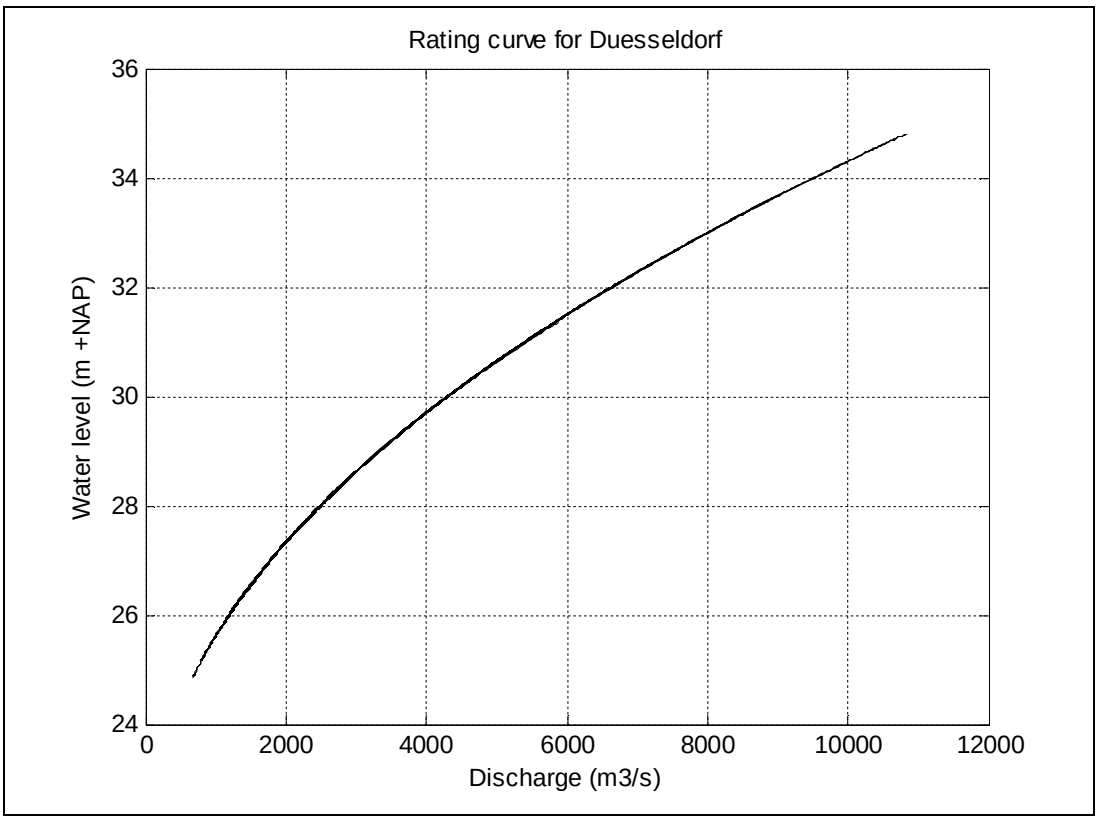
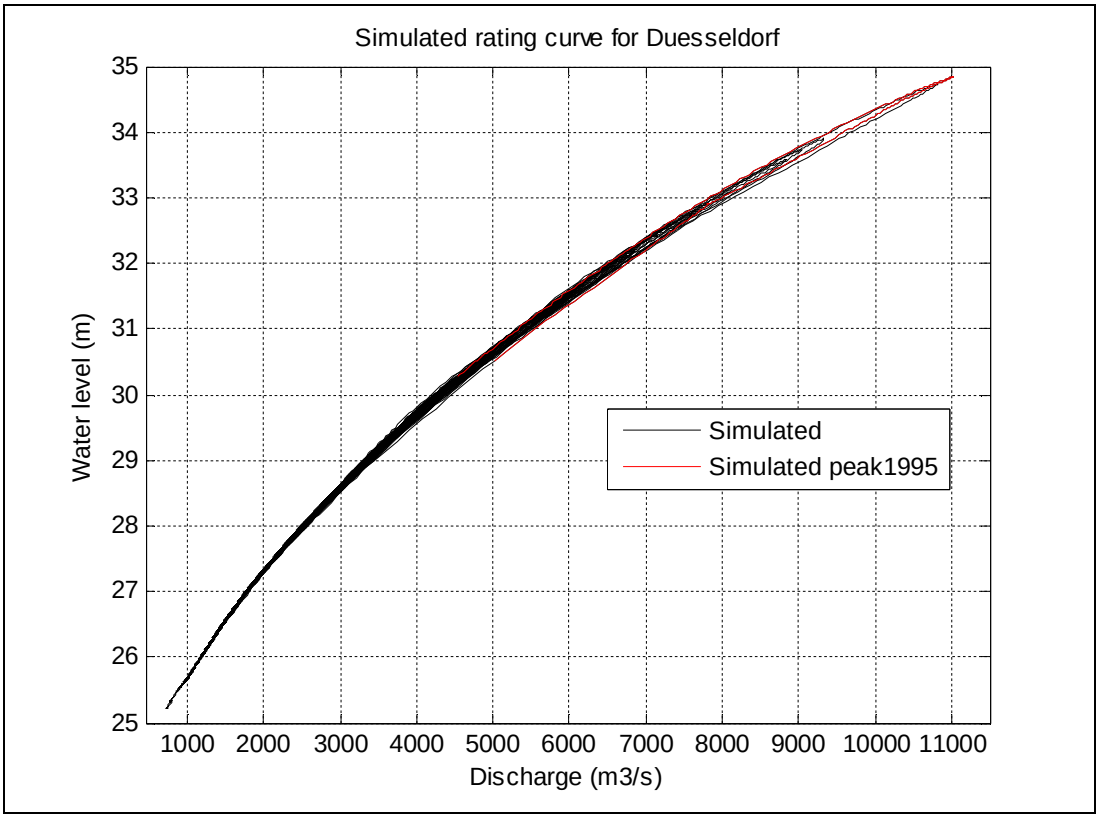


Figure A.17. Rating curve at Düsseldorf.



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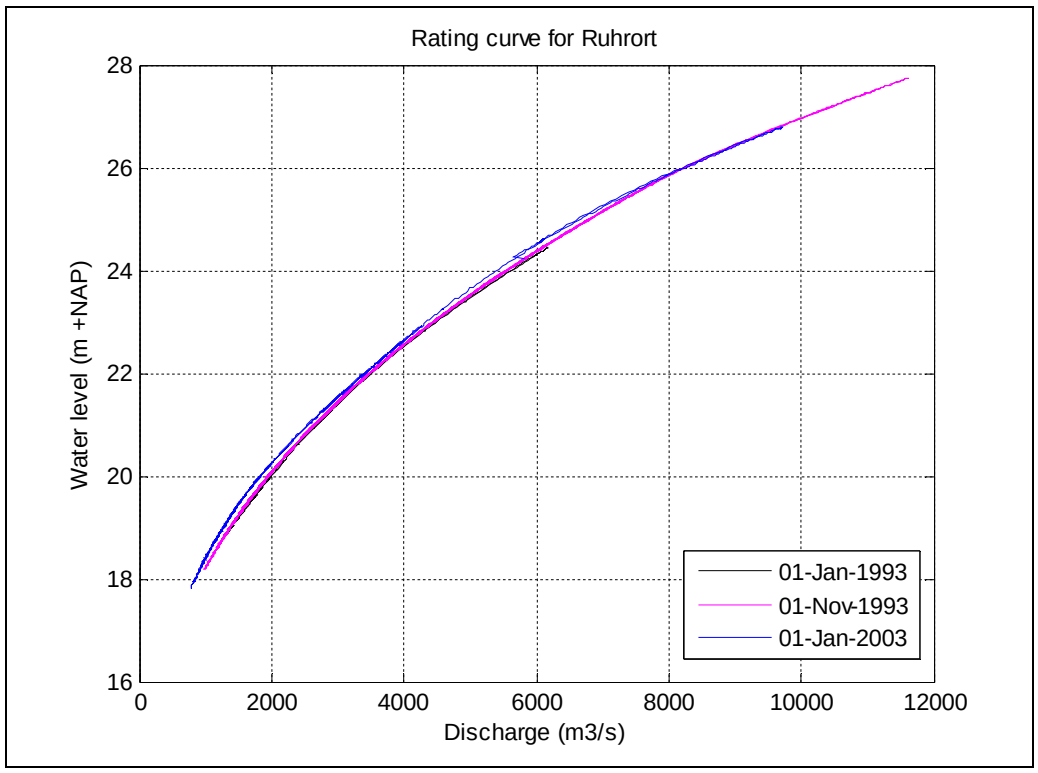

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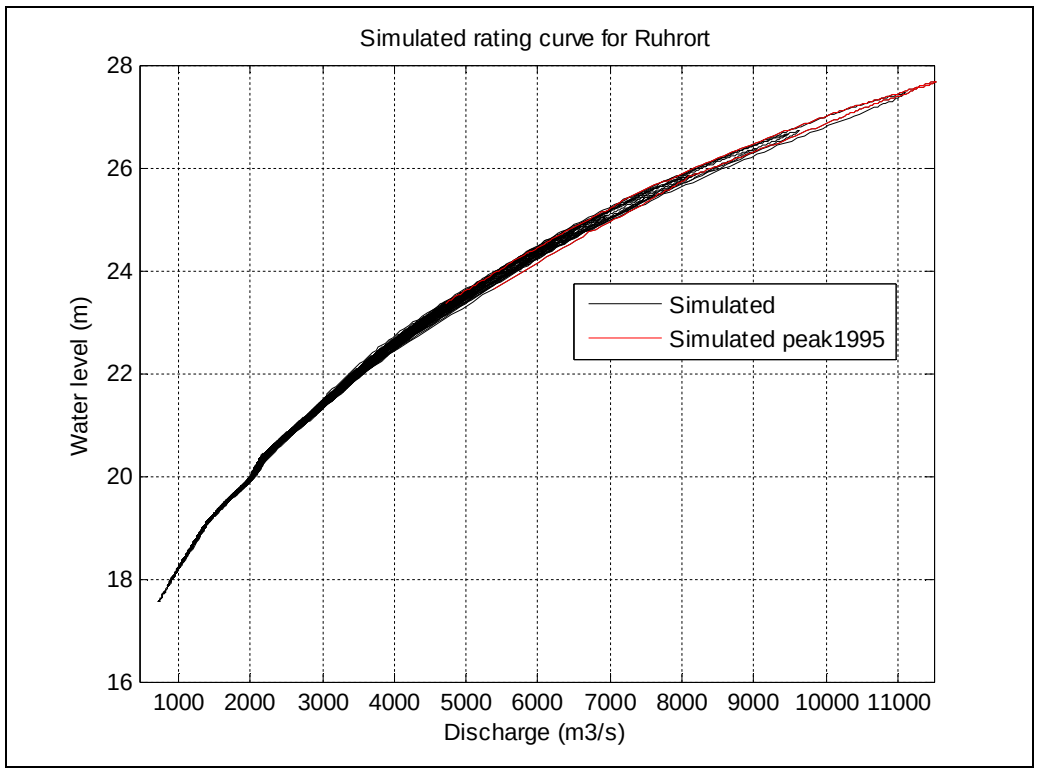

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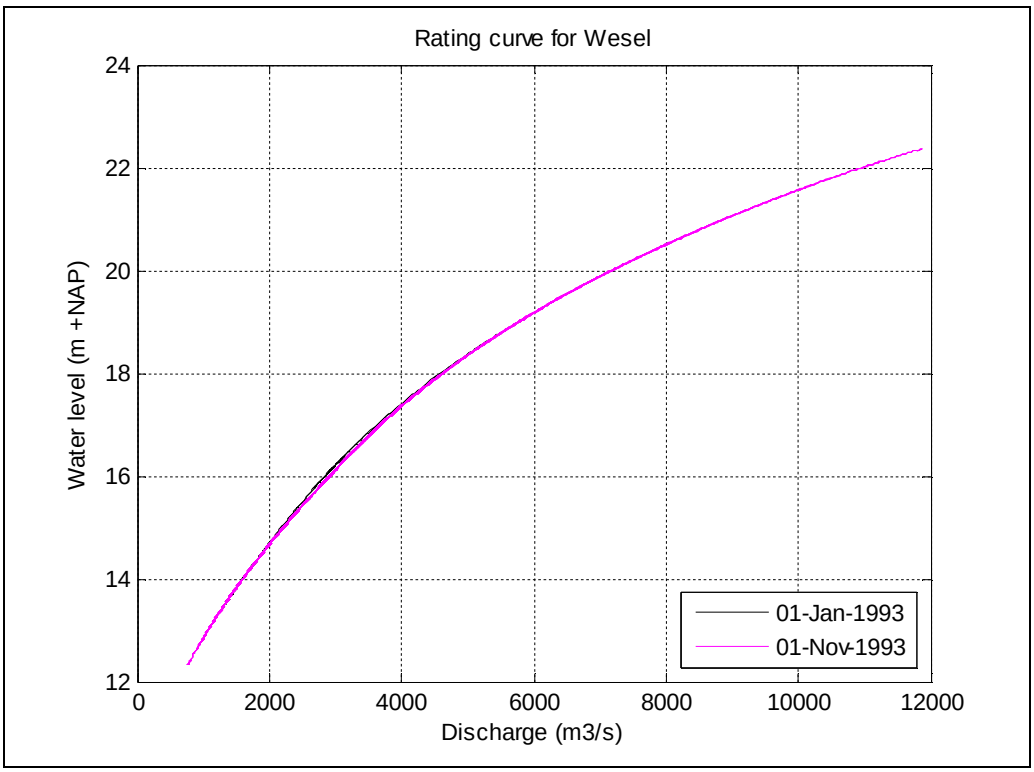
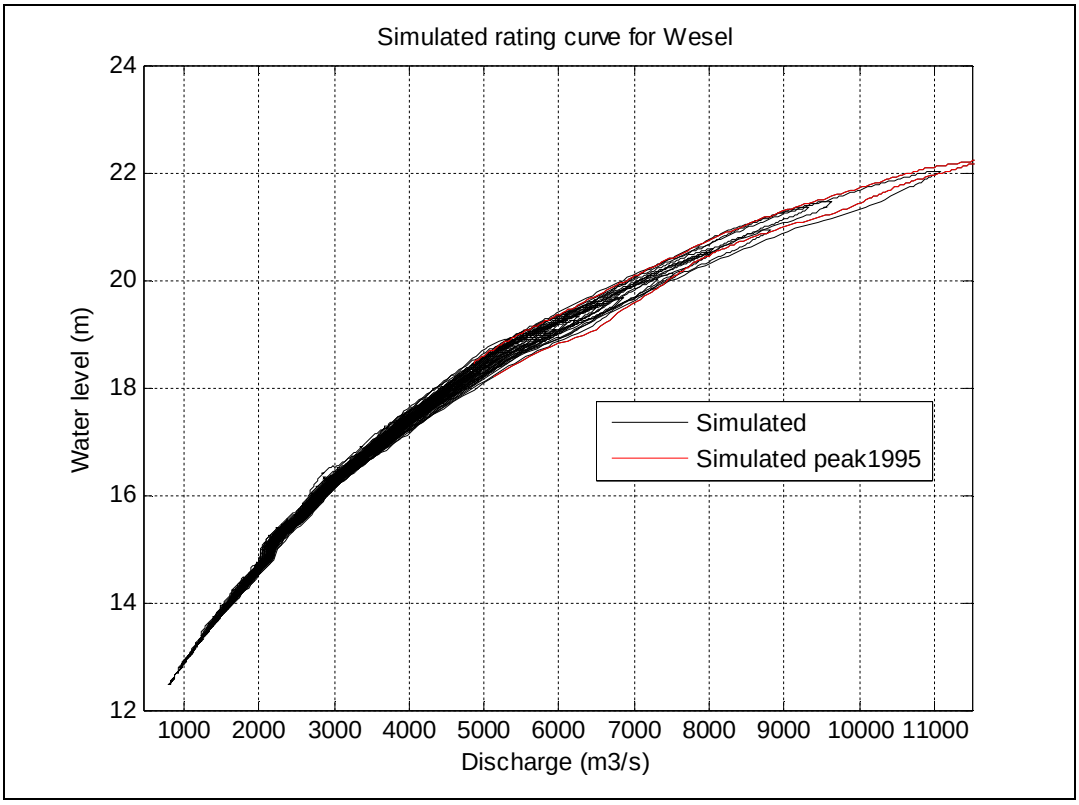


Figure A.21. Rating curve at Wesel.



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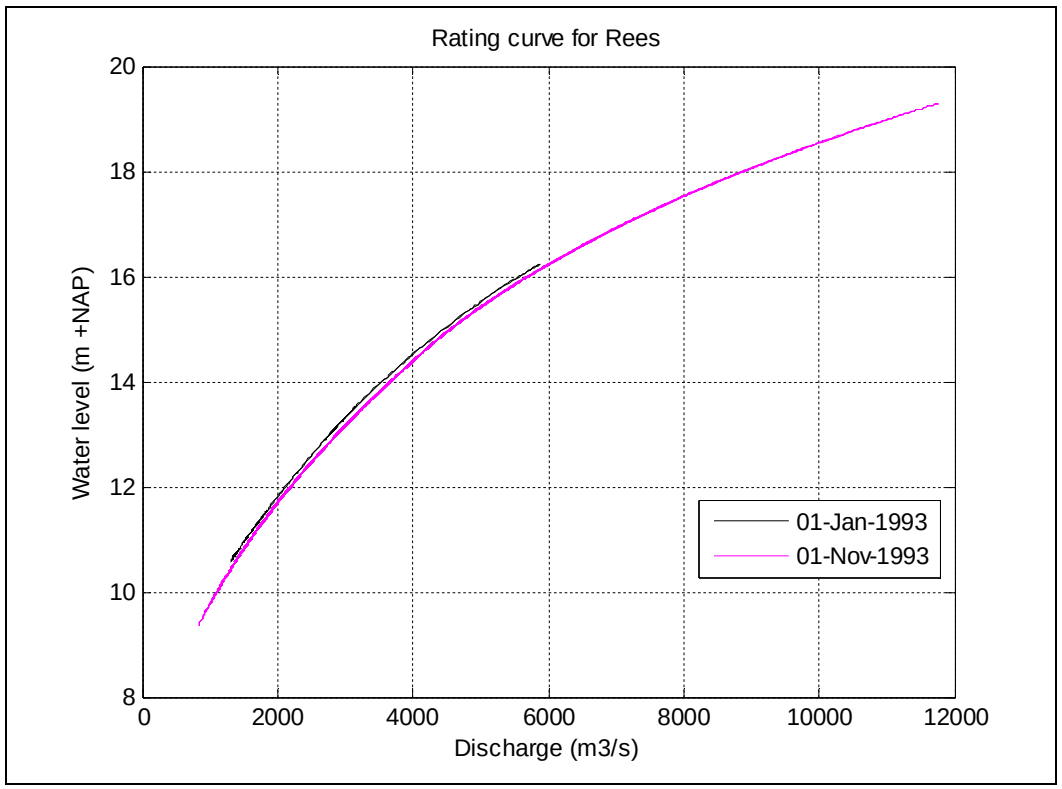

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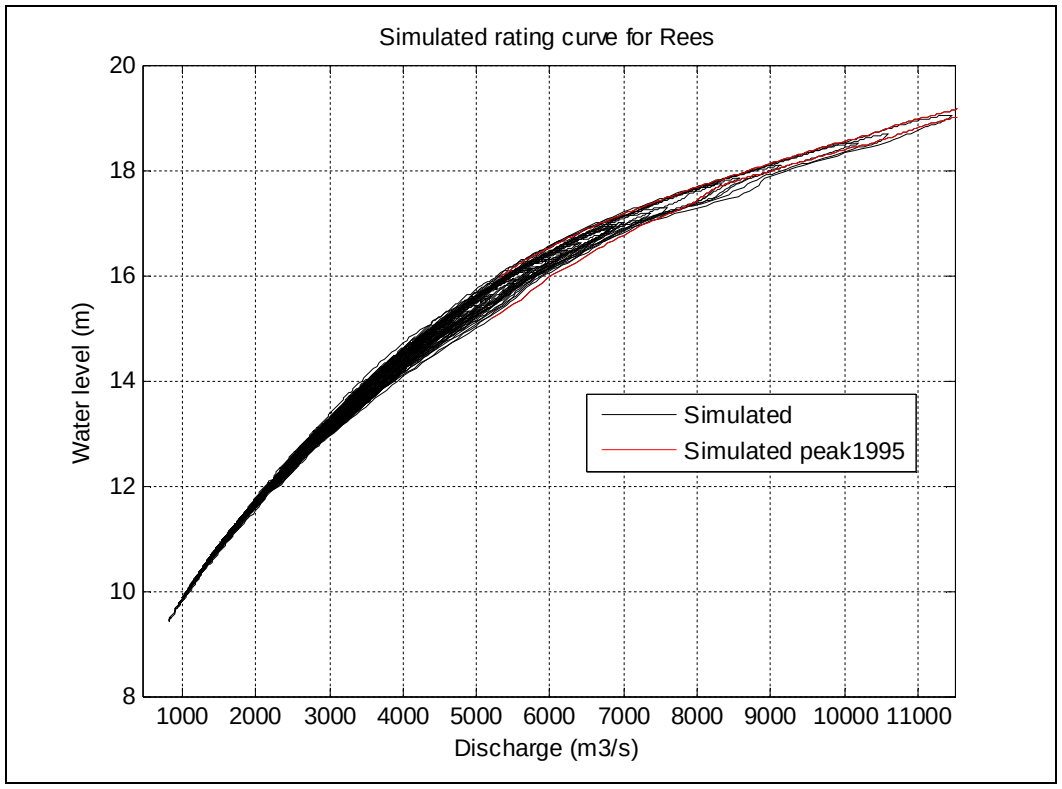

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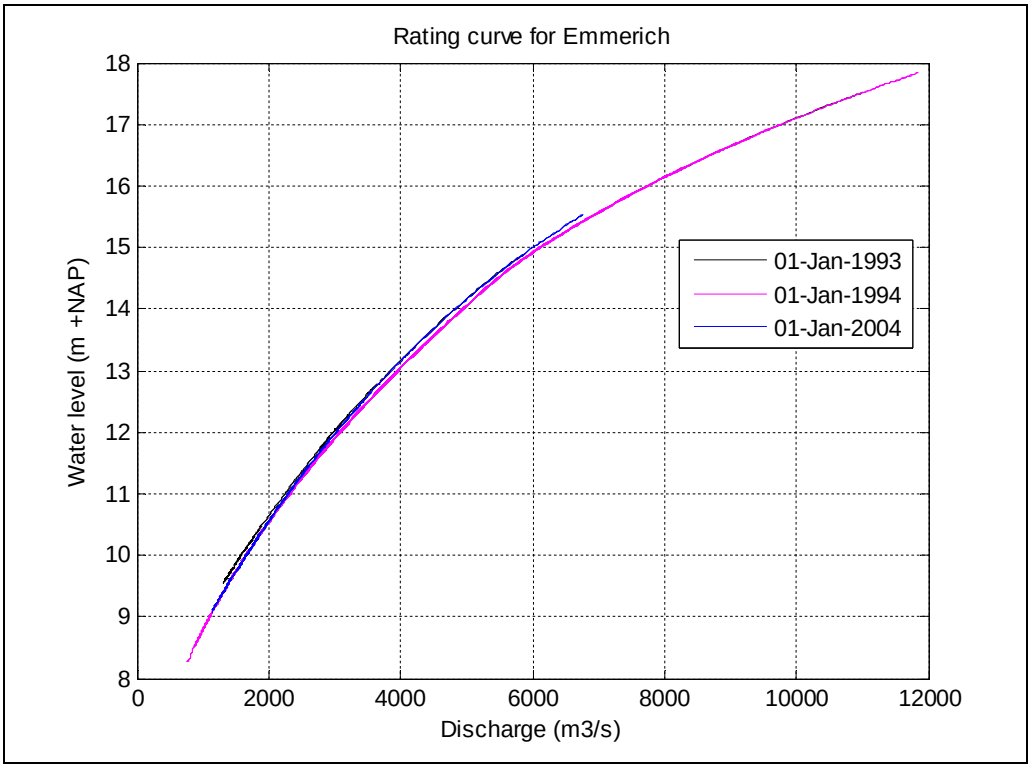

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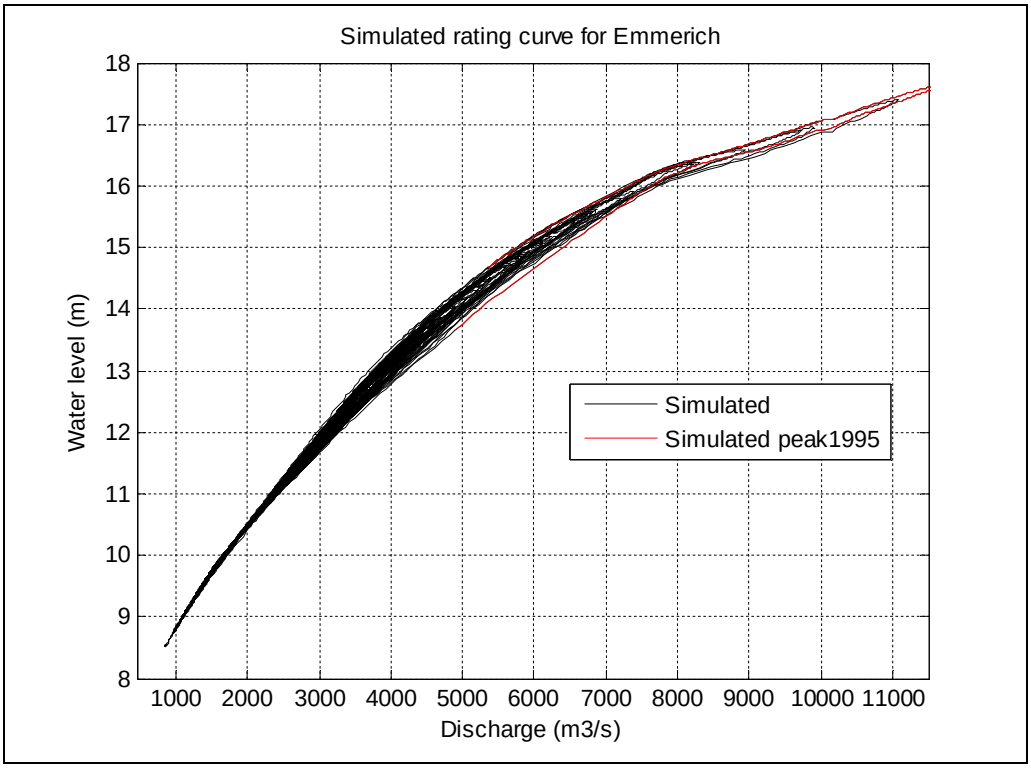

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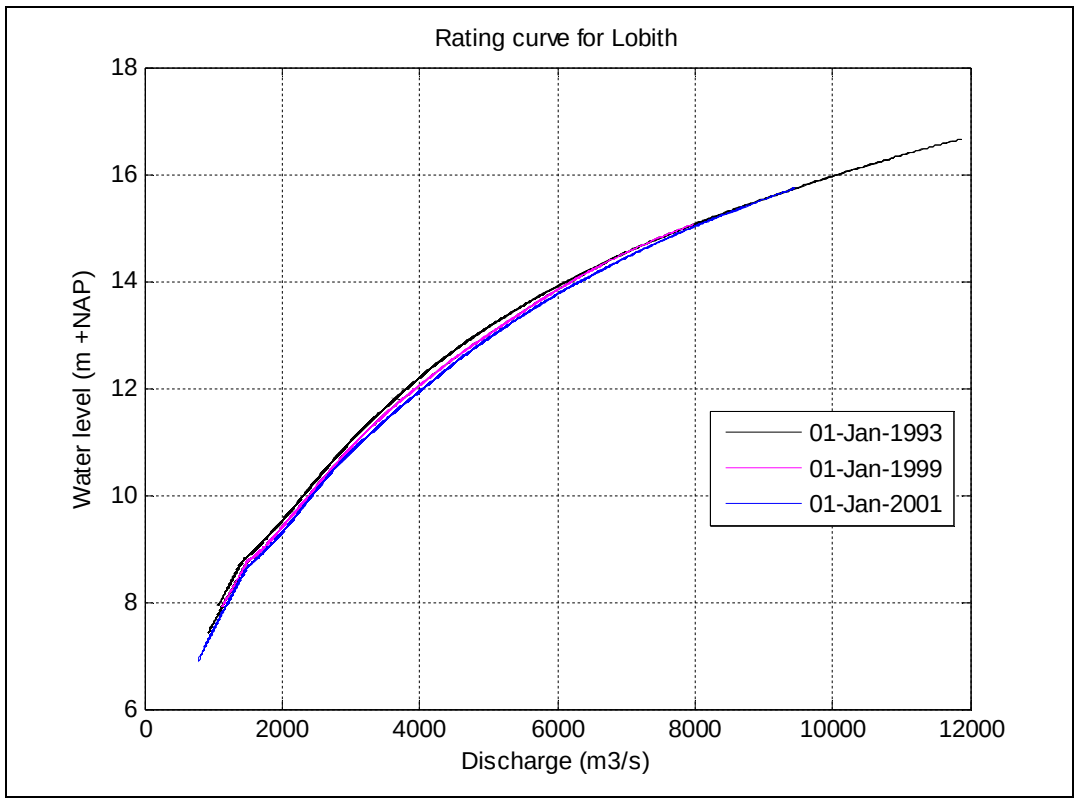

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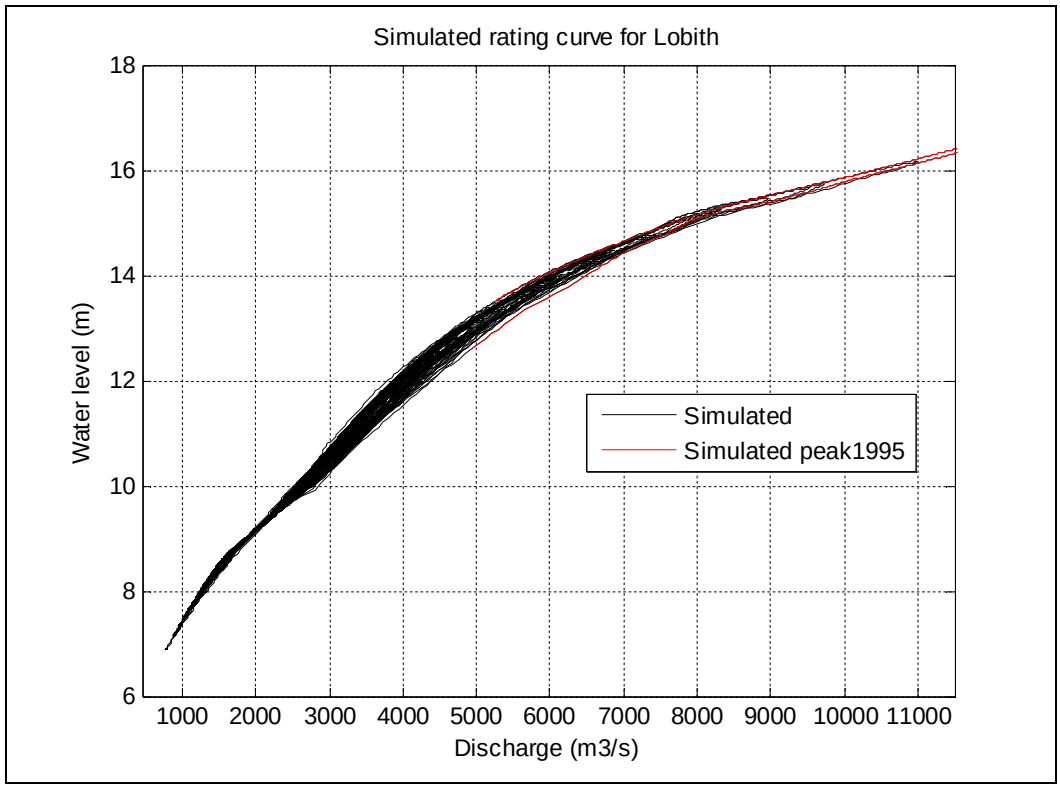

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B Periods of Interest

B.1 Section 1: Maxau-Speyer

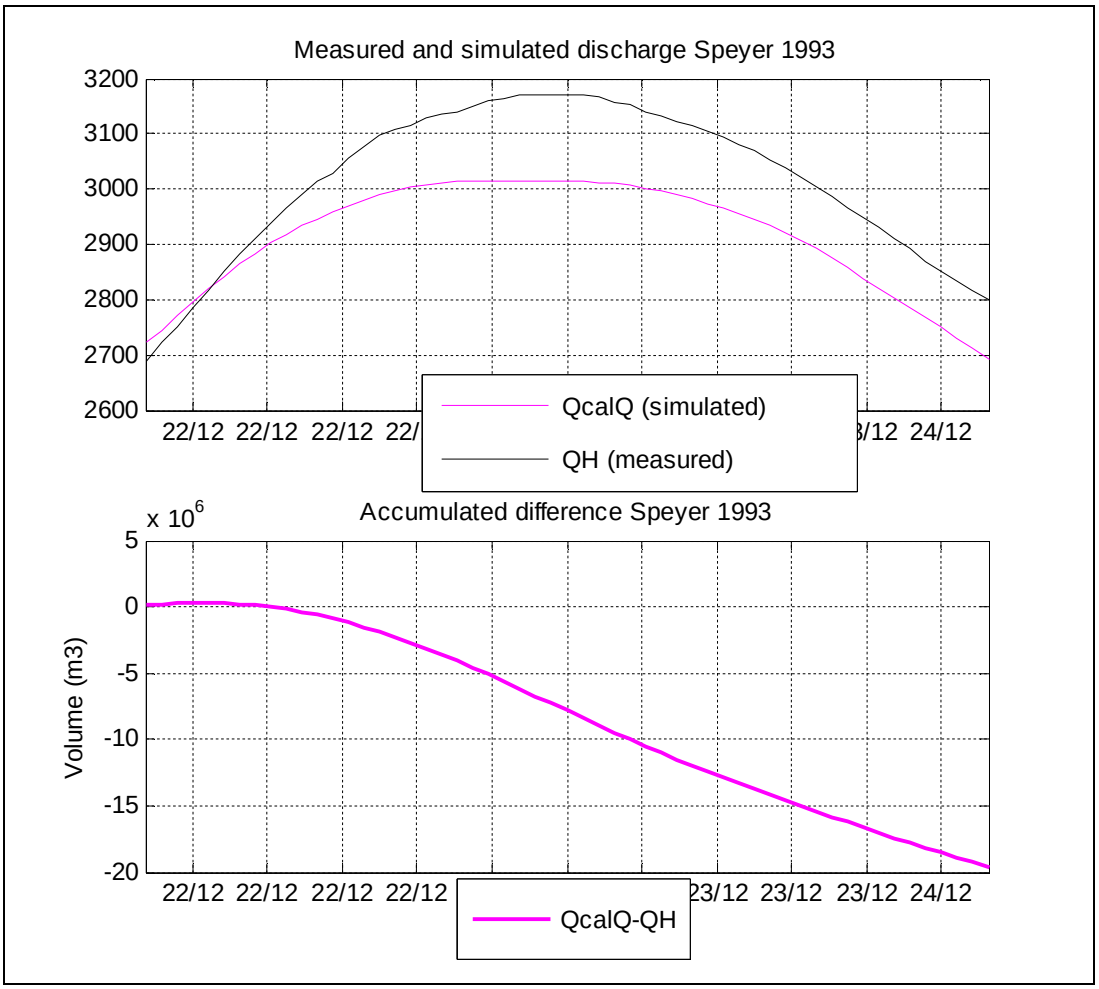

Figure B.1 (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Speyer, (b) accumulated difference at Speyer for both the calibration set and the HBV set.

Table B.1 Overview waterbalance section 1: Maxau-Speyer for the flood period of December 1993 (in B$m^3=10^9$ m^3) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6$ m^3) are the laterals from the calibration set and the HBV set, respectively.

Section 1: Maxau-Speyer Flood period: 21/12/1993 21:00 – 24/12/1993 03:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Speyer (%)**		
Maxau	0.55			91.54		
Speyer	0.60			100.00		
Sum of Laterals	0.02			2.75		
I+SoL-O[1]	-0.03			-5.71		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Speyer (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Maxau	0.55			91.54		
Speyer	0.58			96.71		
Sum of Laterals	0.02			2.75		
I+SoL-O[1]	-0.01			-2.42		
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Berghausen	2.55			15.54		
Ettlingen	3.37			20.57		
Siebeldingen	1.73			10.54		
Neustadt	1.32			8.05		
Rheinzabern	7.43			45.30		
Sum of Laterals	16.41			100.00		

[1] I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

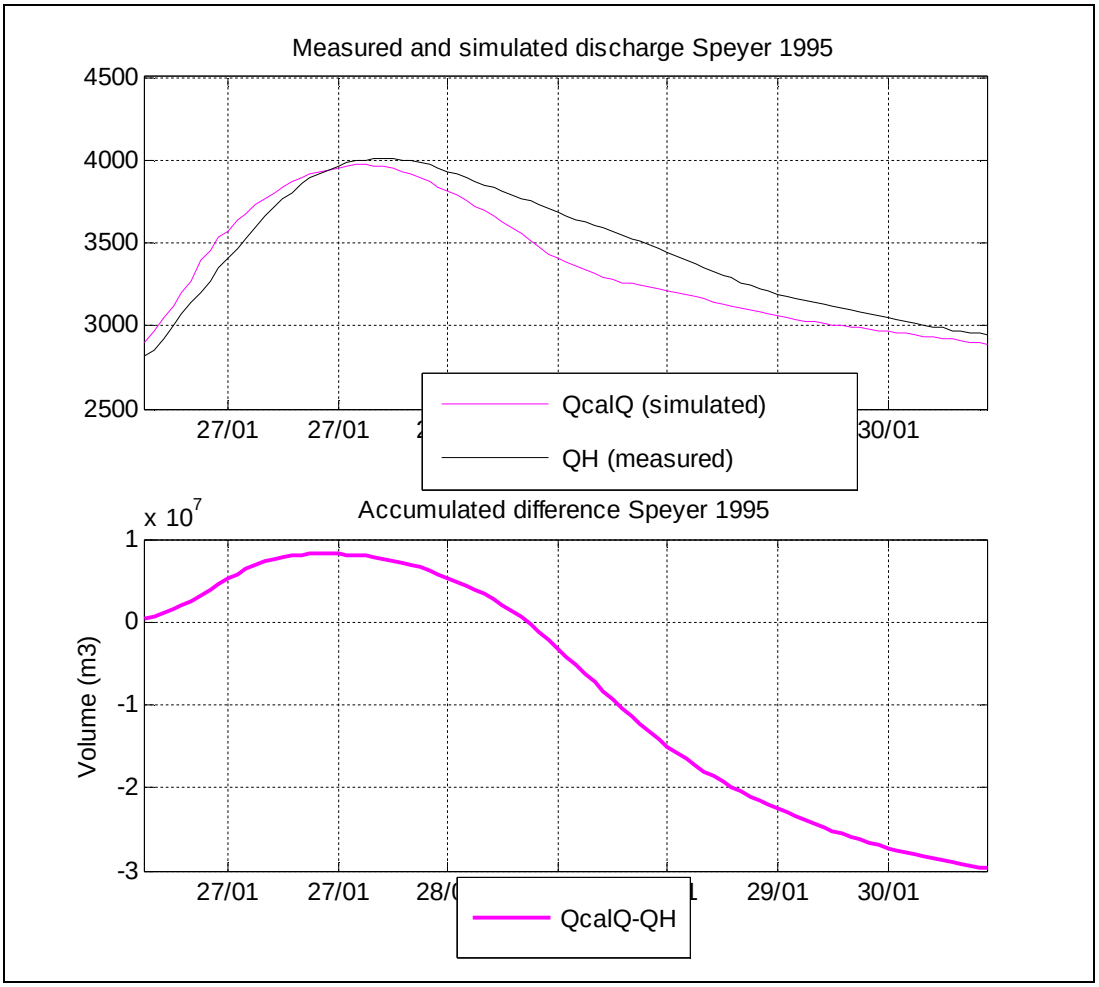

Figure B.2. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Speyer, (b) accumulated difference at Speyer for both the calibration set and the HBV set.

Table B.2 Overview waterbalance section 1: Maxau-Speyer for the flood period of January 1995 (in B$m^3=10^9$ m^3) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6$ m^3) are the laterals from the calibration set and the HBV set, respectively.

Section 1: Maxau-Speyer Flood period: 26/01/1995 15:00 – 30/01/1995 11:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Speyer (%)**		
Maxau	1.09			93.89		
Speyer	1.16			100.00		
Sum of Laterals	0.02			1.83		
I+SoL-O[1]	-0.05			-4.28		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Speyer (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Maxau	1.09			93.89		
Speyer	1.13			97.43		
Sum of Laterals	0.02			1.83		
I+SoL-O[1]	-0.02			-1.71		
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Berghausen	2.38			11.26		
Ettlingen	2.90			13.71		
Siebeldingen	1.53			7.20		
Neustadt	2.17			10.24		
Rheinzabern	12.20			57.59		
Sum of Laterals	21.19			100.00		

[1] I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

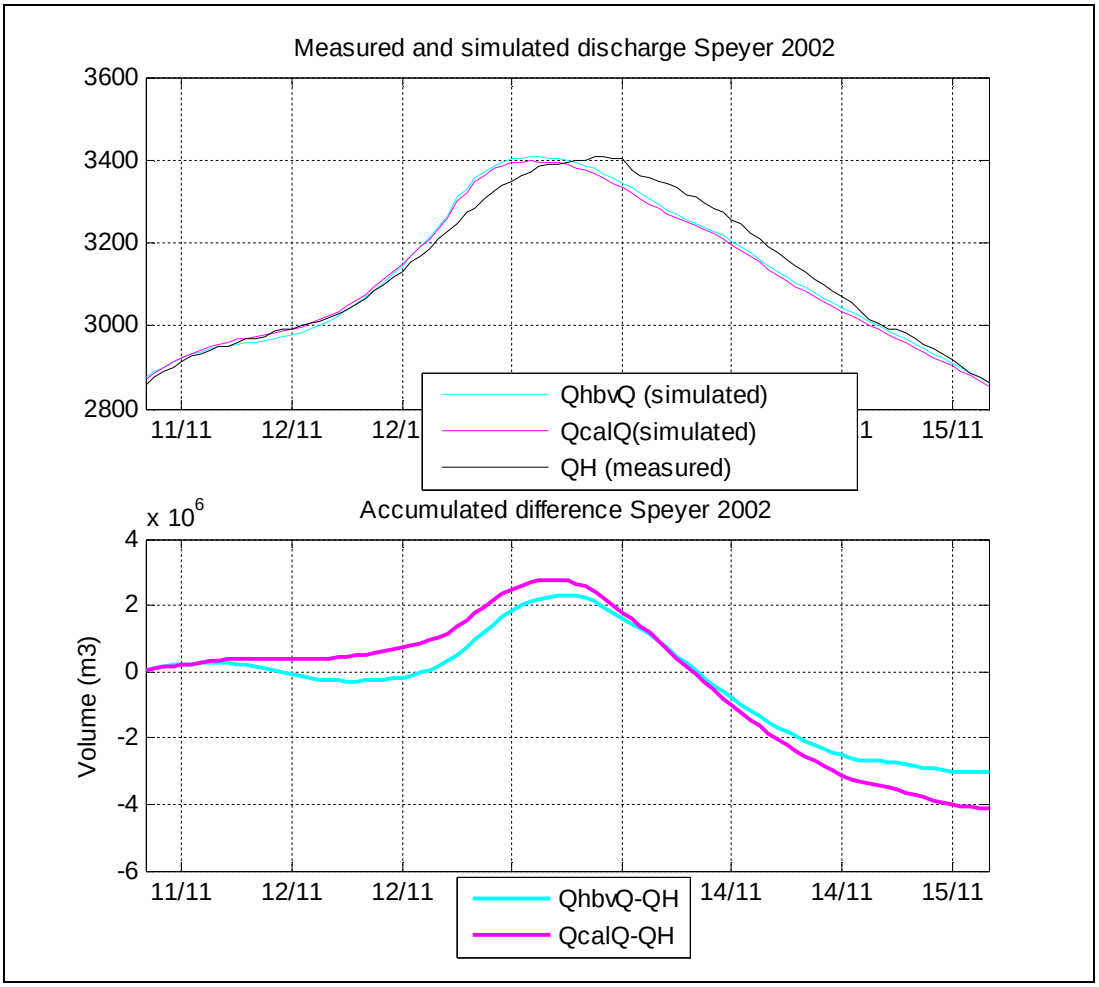

Figure B.3. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Speyer, (b) accumulated difference at Speyer for both the calibration set and the HBV set.

Table B.3. Overview waterbalance section 1: Maxau-Speyer for the flood period of November 2002 (in B$m^3=10^9$ m^3) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6$ m^3) are the laterals from the calibration set and the HBV set, respectively.

Section 1: Maxau-Speyer Flood period: 11/11/2002 08:00 – 15/11/2002 04:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Speyer (%)**		
Maxau	1.02			97.57		
Speyer	1.05			100.00		
Sum of Laterals	0.01			1.30		
I+SoL-O[1]	-0.01			-1.13		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Speyer (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Maxau	1.02	1.02	0	97.57	97.57	0
Speyer	1.05	1.05	0.00	99.61	99.71	0.11
Sum of Laterals	0.01	0.01	0.00	1.30	1.43	0.13
I+SoL-O[1]	-0.01	-0.01	0.00	-0.73	-0.71	0.02
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Berghausen	1.71	3.00	1.29	12.57	22.03	9.46
Ettlingen	3.09	1.91	-1.18	22.68	14.04	-8.64
Siebeldingen	0.78	0.47	-0.32	5.73	3.41	-2.32
Neustadt	1.34	0.73	-0.62	9.87	5.34	-4.53
Rheinzabern	6.70	8.88	2.18	49.15	65.12	15.98
Sum of Laterals	13.63	14.98	1.36	100.00	109.95	9.95

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

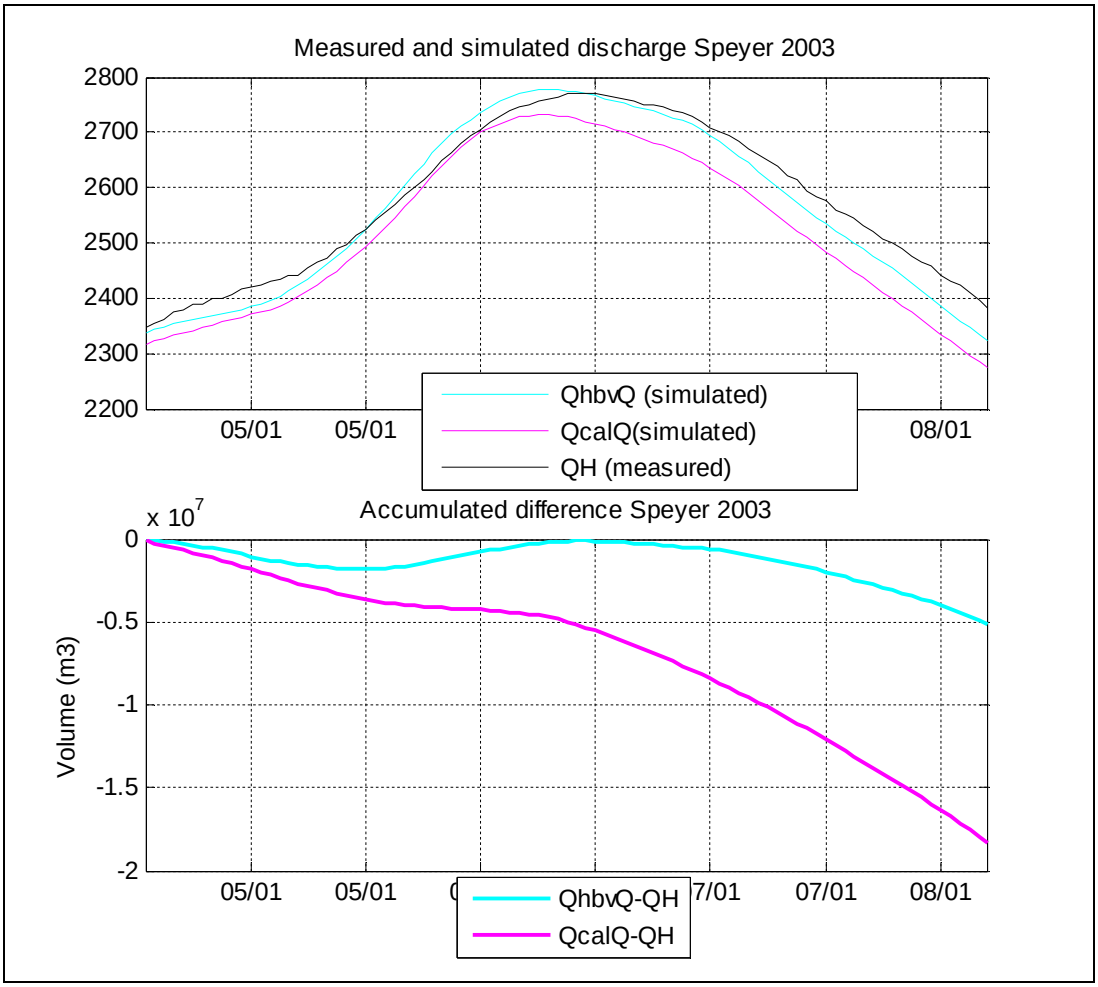

Figure B.4. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Speyer, (b) accumulated difference at Speyer for both the calibration set and the HBV set.

Table B.4. Overview waterbalance section 1: Maxau-Speyer for the flood period of January 2003 (in B$m^3=10^9$ m^3) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6$ m^3) are the laterals from the calibration set and the HBV set, respectively.

Section 1: Maxau-Speyer Flood period: 04/01/2003 13:00 – 08/01/2003 05:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Speyer (%)**		
Maxau	0.79			95.07		
Speyer	0.83			100.00		
Sum of Laterals	0.02			2.42		
I+SoL-O[1]	-0.02			-2.51		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Speyer (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Maxau	0.79	0.79	0	95.07	95.07	0
Speyer	0.81	0.82	0.01	98.04	99.60	1.56
Sum of Laterals	0.02	0.03	0.01	2.42	4.07	1.65
I+SoL-O[1]	0.00	0.00	0.00	-0.55	-0.46	0.09
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Berghausen	2.54	5.98	3.44	12.69	29.87	17.18
Ettlingen	3.23	3.76	0.53	16.14	18.78	2.64
Siebeldingen	1.25	1.01	-0.24	6.25	5.06	-1.19
Neustadt	2.04	1.59	-0.46	10.21	7.92	-2.29
Rheinzabern	10.95	21.29	10.34	54.70	106.35	51.65
Sum of Laterals	20.02	33.64	13.61	100.00	167.98	67.98

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

B.2 Section 2: Speyer-Worms

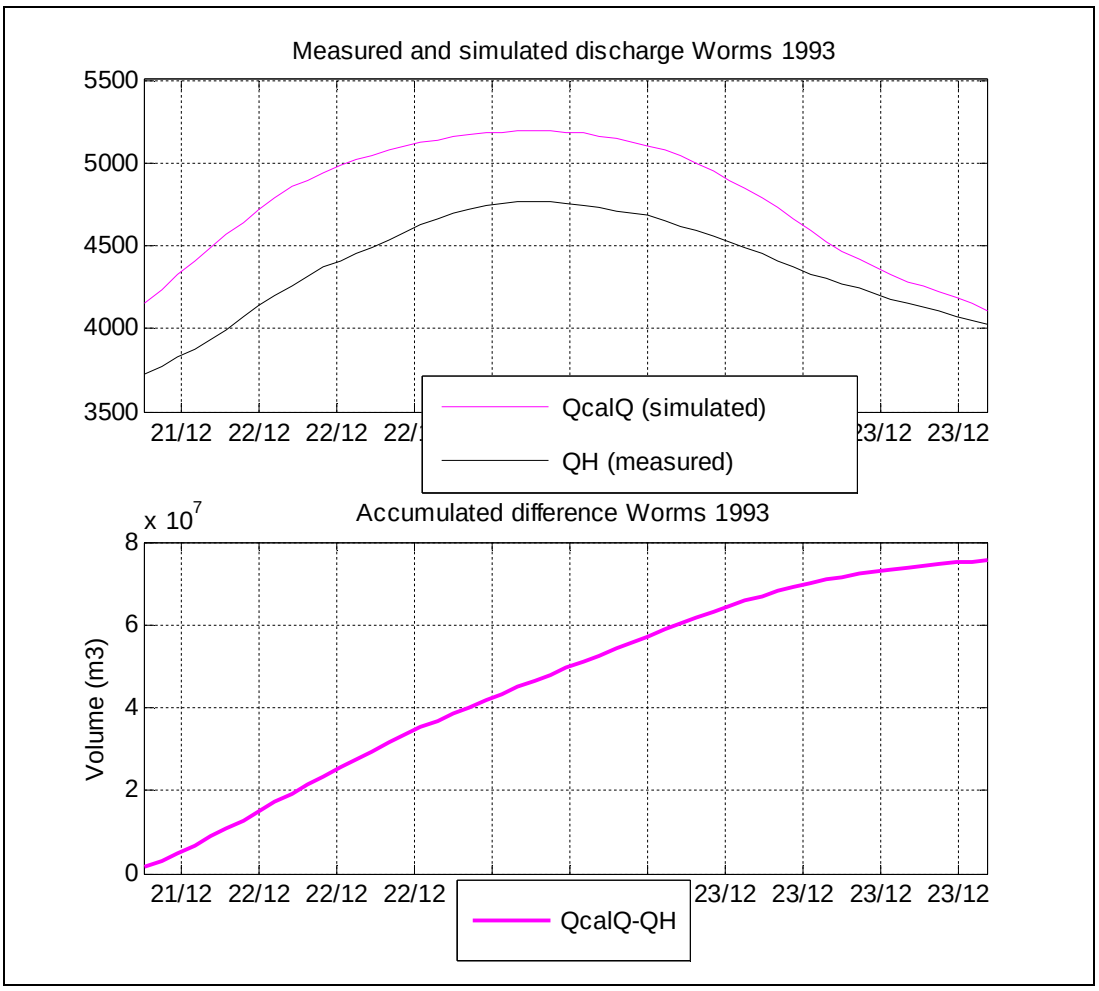

Figure B.5. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Worms, (b) accumulated difference at Worms for both the calibration set and the HBV set.

Table B.5. Overview waterbalance section 2: Speyer-Worms. The waterbalance is calculated for the flood period of 1993 (in B$m^3=10^9$ m^3) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6$ m^3) are the laterals from the calibration set and the HBV set, respectively.

Section 2: Speyer- Worms Flood period: 21/12/1993 – 23/12/1993						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Worms (%)**		
Speyer	0.57			68.44		
Worms	0.84			100.00		
Sum of Laterals	0.34			40.07		
I+SoL-O[1]	0.07			8.51		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Worms (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Speyer	0.57			68.44		
Worms	0.91			109.04		
Sum of Laterals	0.34			40.07		
I+SoL-O[1]	0.00			-0.53		
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Ubstadt	2.02			0.60		
Meckesheim	3.30			0.98		
NE1_Itter	3.98			1.19		
NE1_ZWE5/I	2.83			0.84		
NE1_ZWE5/II	2.71			0.81		
NE1_ZWE5/III	0.17			0.05		
NE1_ZWE5/IV	1.66			0.49		
NE1_ZWE5/V	1.56			0.47		
Wiesloch	1.04			0.31		
Monsheim	7.01			2.09		
Rockenau	309.10			92.16		
Sum of Laterals	335.38			100.00		

[1] I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

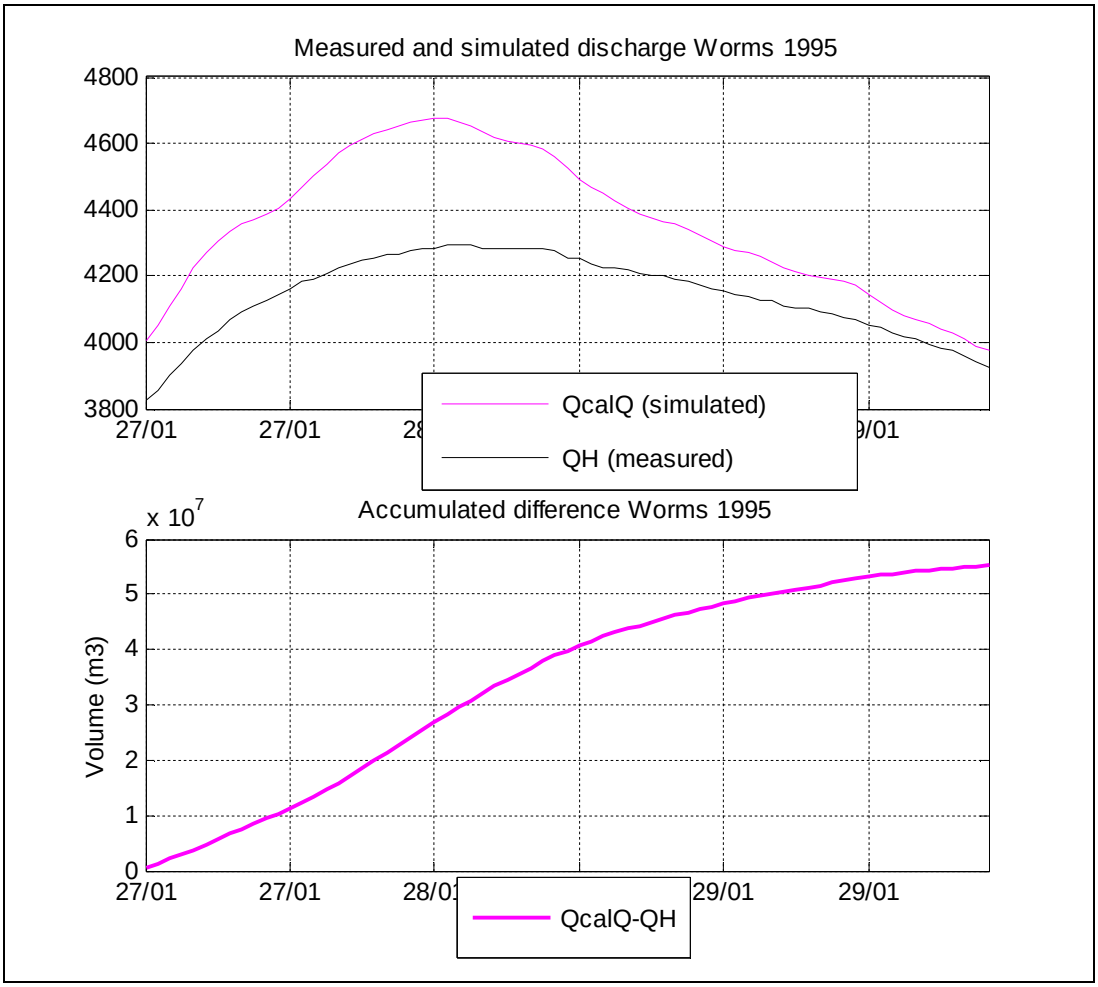

Figure B.6. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Worms, (b) accumulated difference at Worms for both the calibration set and the HBV set.

Table B.6. Overview waterbalance section 2: Speyer-Worms. The waterbalance is calculated for the flood period of January 1995 (in B$m^3=10^9\ m^3$) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6\ m^3$) are the laterals from the calibration set and the HBV set, respectively.

Section 2: Speyer- Worms Flood period: 27/01/1995 – 29/01/1995						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Worms (%)**		
Speyer	0.92			86.89		
Worms	1.06			100.00		
Sum of Laterals	0.19			18.14		
I+SoL-O[1]	0.05			5.03		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Worms (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Speyer	0.92			86.89		
Worms	1.11			105.22		
Sum of Laterals	0.19			18.14		
I+SoL-O[1]	0.00			-0.19		
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Ubstadt	1.04			0.54		
Meckesheim	1.46			0.76		
NE1_Itter	6.64			3.46		
NE1_ZWE5/I	4.72			2.46		
NE1_ZWE5/II	4.52			2.36		
NE1_ZWE5/III	0.28			0.15		
NE1_ZWE5/IV	2.76			1.44		
NE1_ZWE5/V	2.60			1.35		
Wiesloch	0.54			0.28		
Monsheim	7.36			3.83		
Rockenau	160.10			83.37		
Sum of Laterals	192.04			100.00		

[1] I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

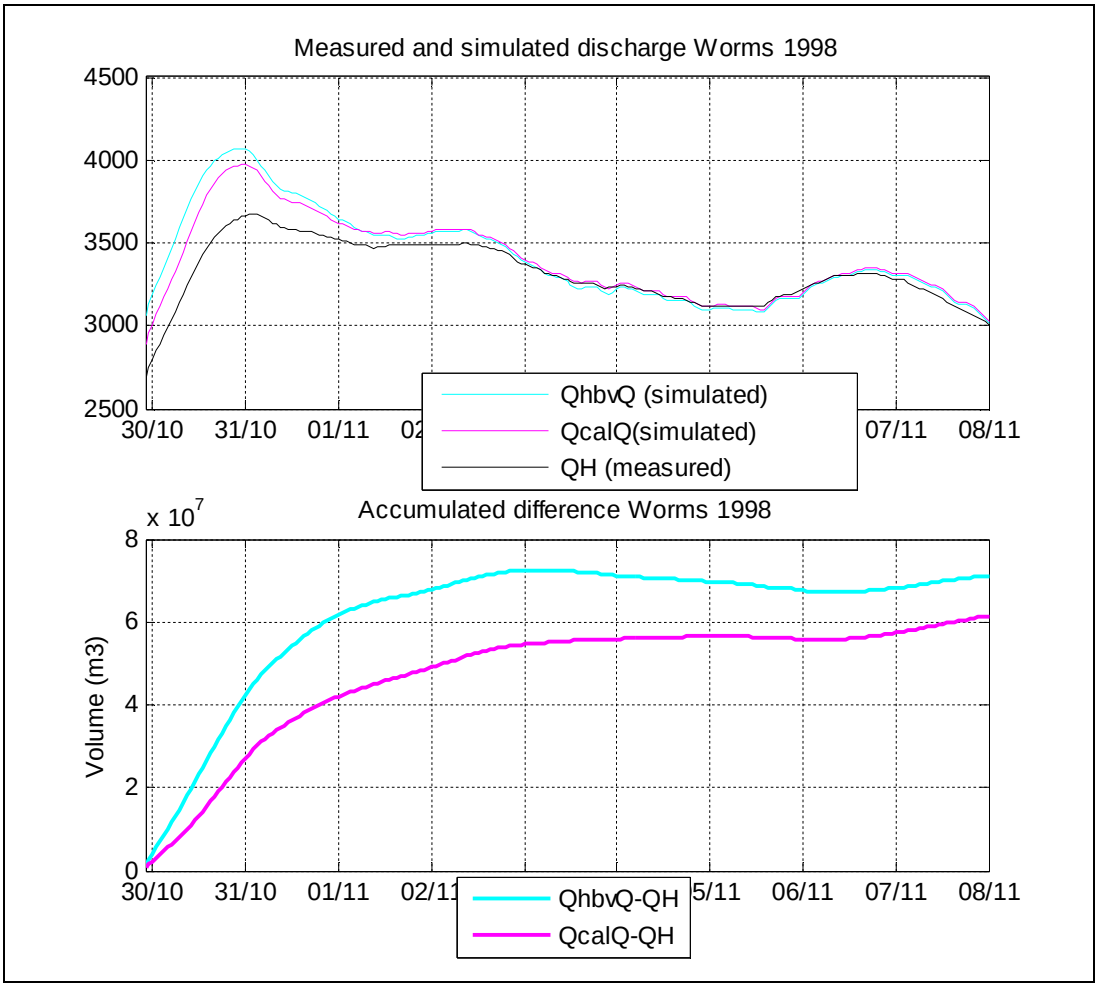

Figure B.7. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Worms, (b) accumulated difference at Worms for both the calibration set and the HBV set.

Table B.7. Overview waterbalance section 2: Speyer-Worms. The waterbalance is calculated for the flood period of 1998 (in B$m^3=10^9$ m^3) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6$ m^3) are the laterals from the calibration set and the HBV set, respectively.

Section 2: Speyer- Worms Flood period: 29/10/1998 22:00 – 08/11/1998 00:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Worms (%)**		
Speyer	2.09			79.98		
Worms	2.62			100.00		
Sum of Laterals	0.58			22.33		
I+SoL-O[1]	0.05			2.31		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Worms (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Speyer	2.09	2.09	0	79.98	79.98	0
Worms	2.68	2.69	0.01	102.26	102.71	0.45
Sum of Laterals	0.58	0.59	0.00	22.33	22.43	0.10
I+SoL-O[1]	0.00	-0.01	-0.01	0.05	-0.30	-0.34
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Ubstadt	2.77	0.50	-2.27	0.47	0.09	-0.39
Meckesheim	5.68	17.41	11.73	0.97	2.98	2.01
NE1_Itter	10.81	8.20	-2.61	1.85	1.40	-0.45
NE1_ZWE5/I	7.69	9.63	1.94	1.32	1.65	0.33
NE1_ZWE5/II	7.36	9.16	1.80	1.26	1.57	0.31
NE1_ZWE5/III	0.46	0.43	-0.03	0.08	0.07	0.00
NE1_ZWE5/IV	4.49	4.28	-0.22	0.77	0.73	-0.04
NE1_ZWE5/V	4.23	4.07	-0.17	0.72	0.70	-0.03
Wiesloch	1.73	0.97	-0.77	0.30	0.17	-0.13
Monsheim	8.93	2.16	-6.77	1.53	0.37	-1.16
Rockenau	530.04	530.04	0.00	90.73	90.73	0.00
Sum of Laterals	584.19	586.84	2.65	100.00	100.45	0.45

[1] I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

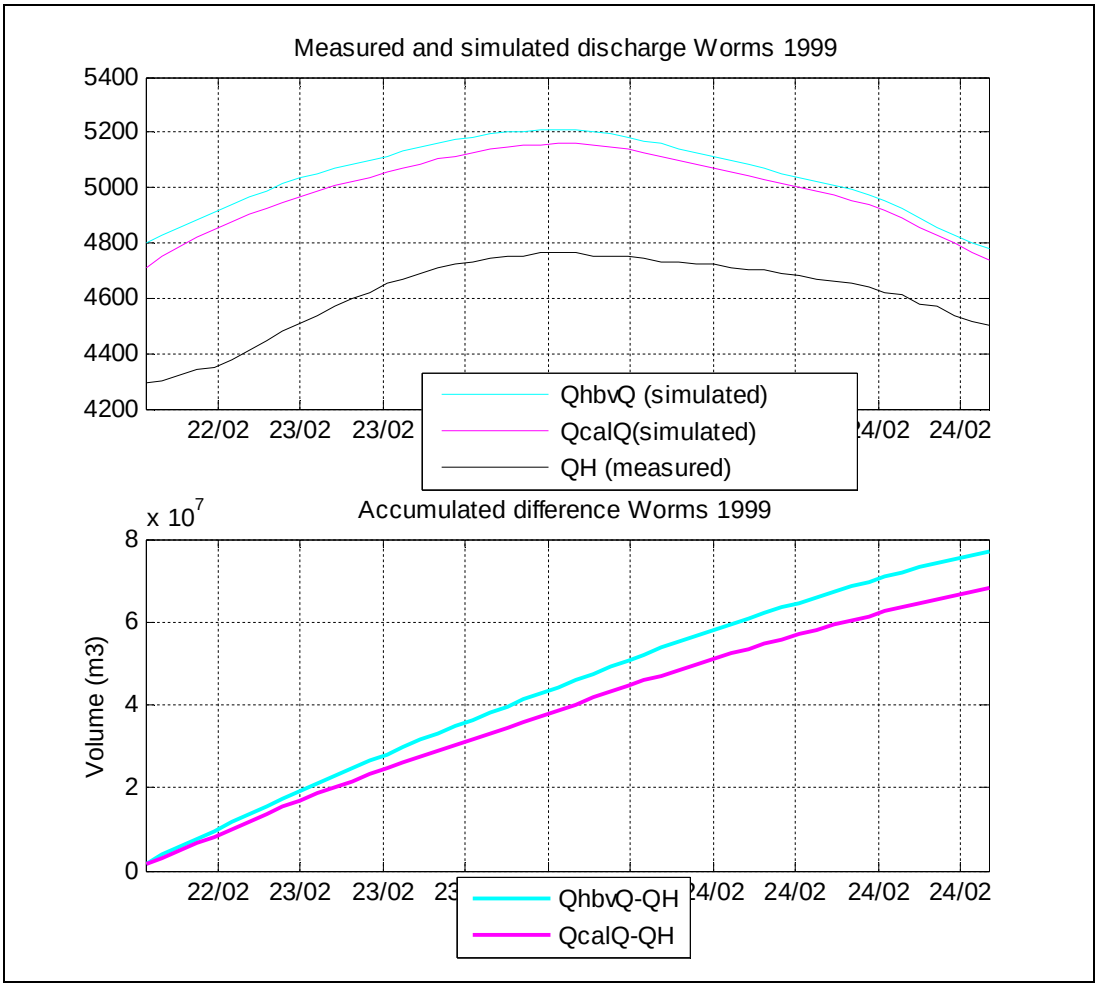

Figure B.8. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Worms, (b) accumulated difference at Worms for both the calibration set and the HBV set.

Table B.8. Overview waterbalance section 2: Speyer-Worms for the flood period of 1999 (in B$m^3 = 10^9 m^3$) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3 = 10^6 m^3$) are the laterals from the calibration set and the HBV set, respectively.

Section 2: Speyer- Worms Flood period: 22/02/1999 15:00 – 24/02/1999 16:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Worms (%)**		
Speyer	0.72			86.69		
Worms	0.83			100.00		
Sum of Laterals	0.17			20.99		
I+SoL-O[1]	0.06			7.68		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Worms (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Speyer	0.72	0.72	0	0.72	0.72	0
Worms	0.90	0.91	0.01	108.12	109.29	1.17
Sum of Laterals	0.17	0.18	0.01	20.99	21.92	0.93
I+SoL-O[1]	0.00	-0.01	0.00	-0.44	-0.68	-0.24
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Ubstadt	1.30	1.02	-0.28	0.74	0.58	-0.16
Meckesheim	2.52	6.30	3.78	1.44	3.61	2.17
NE1_Itter	1.99	1.64	-0.35	1.14	0.94	-0.20
NE1_ZWE5/I	1.41	1.93	0.51	0.81	1.10	0.29
NE1_ZWE5/II	1.35	1.83	0.48	0.77	1.05	0.28
NE1_ZWE5/III	0.08	0.09	0.00	0.05	0.05	0.00
NE1_ZWE5/IV	0.83	0.86	0.03	0.47	0.49	0.02
NE1_ZWE5/V	0.78	0.81	0.04	0.45	0.47	0.02
Wiesloch	0.73	1.98	1.24	0.42	1.13	0.71
Monsheim	1.77	4.05	2.28	1.02	2.32	1.31
Rockenau	161.69	161.69	0.00	92.68	92.68	0.00
Sum of Laterals	174.45	182.18	7.74	100.00	104.43	4.43

[1] I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

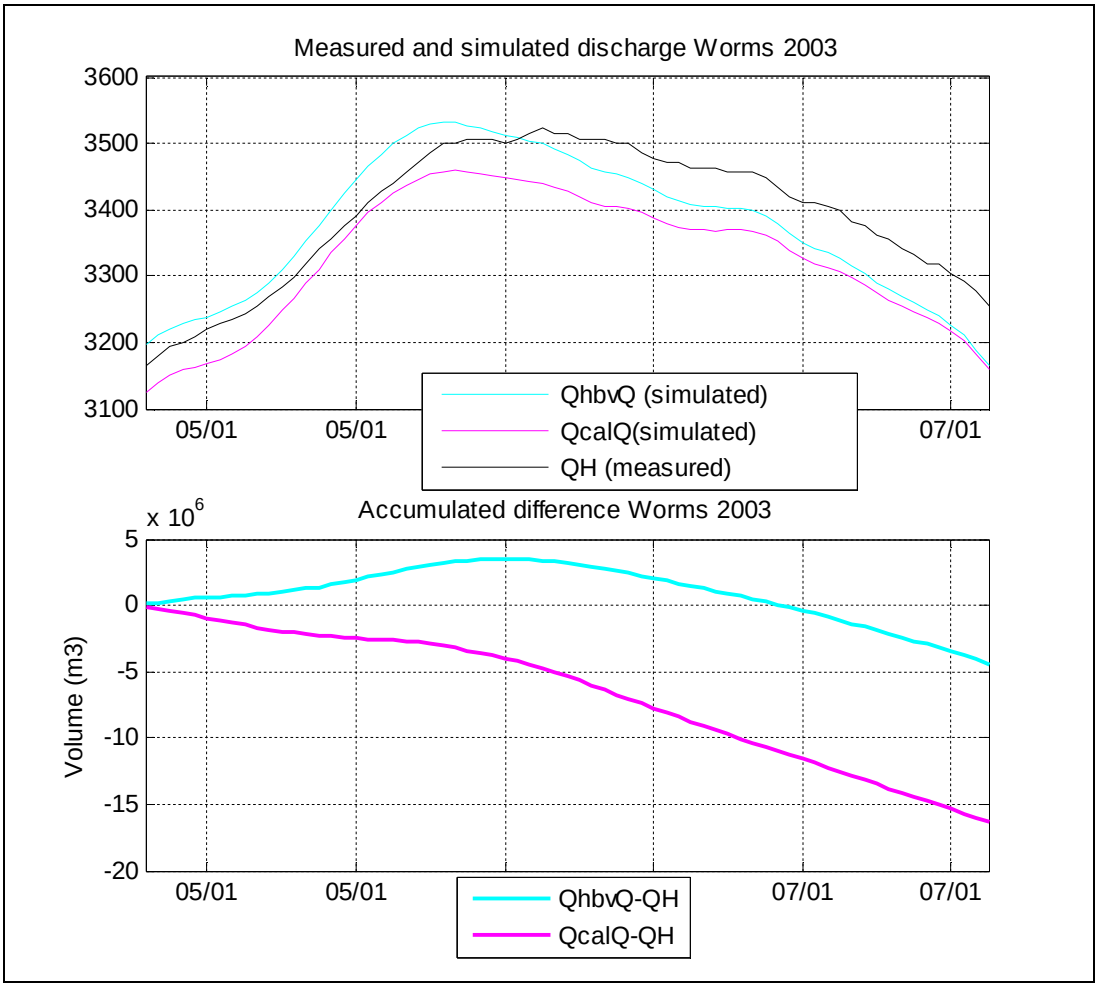

Figure B.9. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Worms, (b) accumulated difference at Worms for both the calibration set and the HBV set.

Table B.9. Overview waterbalance section 2: Speyer-Worms. The waterbalance is calculated for the flood period of 2003 (in B$m^3=10^9$ m^3) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6$ m^3) are the laterals from the calibration set and the HBV set, respectively.

Section 2: Speyer- Worms Flood period: 04/01/2003 14:00 – 07/01/2003 15:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Worms (%)**		
Speyer	0.65			77.25		
Worms	0.84			100.00		
Sum of Laterals	0.18			21.14		
I+SoL-O[1]	-0.01			-1.61		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Worms (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Speyer	0.65	0.65	0	77.25	77.25	0
Worms	0.83	0.84	0.01	98.06	99.47	1.42
Sum of Laterals	0.18	0.19	0.01	21.14	22.25	1.11
I+SoL-O[1]	0.00	0.00	0.00	0.34	0.02	-0.31
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Ubstadt	1.97	0.99	-0.98	1.11	0.56	-0.55
Meckesheim	3.17	10.85	7.68	1.78	6.09	4.31
NE1_Itter	2.83	2.43	-0.39	1.59	1.37	-0.22
NE1_ZWE5/I	2.01	2.86	0.85	1.13	1.60	0.48
NE1_ZWE5/II	1.92	2.72	0.80	1.08	1.53	0.45
NE1_ZWE5/III	0.12	0.13	0.01	0.07	0.07	0.00
NE1_ZWE5/IV	1.17	1.27	0.10	0.66	0.71	0.05
NE1_ZWE5/V	1.11	1.21	0.10	0.62	0.68	0.06
Wiesloch	1.10	1.92	0.82	0.62	1.08	0.46
Monsheim	4.86	5.19	0.33	2.73	2.91	0.19
Rockenau	157.91	157.91	0.00	88.63	88.63	0.00
Sum of Laterals	178.17	187.49	9.31	100.00	105.23	5.23

[1] I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

B.3 Section 3: Worms-Mainz

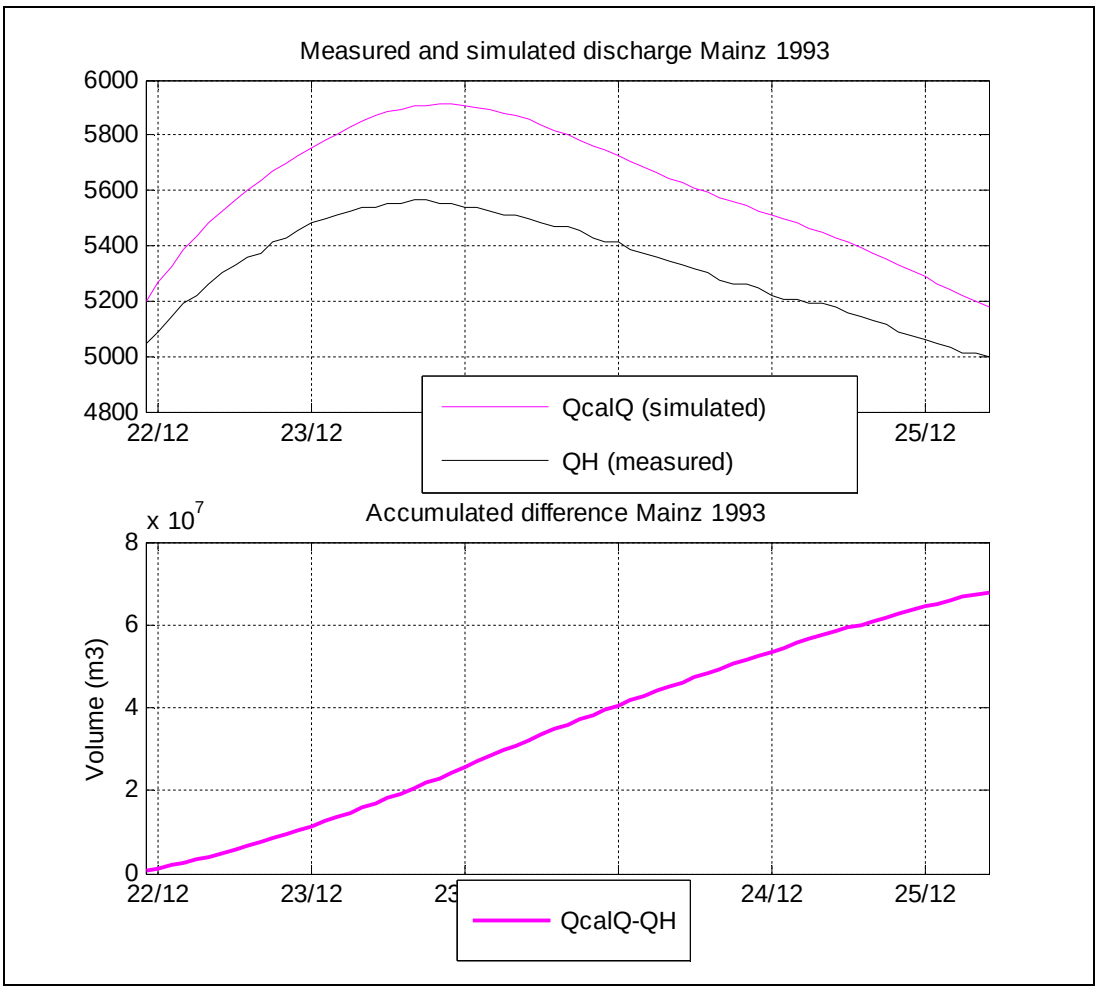

Figure B.10. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Mainz, (b) accumulated difference at Mainz for both the calibration set and the HBV set.

Table B.10. Overview waterbalance section 3: Worms- Mainz. The waterbalance is calculated for the flood period of 1993 (in B$m^3=10^9\ m^3$) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6\ m^3$) are the laterals from the calibration set and the HBV set, respectively.

Section 3: Worms-Mainz Flood period: 22/12/1993 11:00 – 25/12/1993 05:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Mainz (%)**		
Worms	0.99			77.28		
Mainz	1.28			100.00		
Sum of Laterals	0.34			26.60		
I+SoL-O[1]	0.05			3.88		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Mainz (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Worms	0.99			77.28		
Mainz	1.35			105.29		
Sum of Laterals	0.34			26.60		
I+SoL-O[1]	-0.02			-1.41		
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Monsheim	3.05			0.89		
Lorsch	1.90			0.56		
Eberstadt	0.49			0.14		
Naunheim	2.97			0.87		
Eppstein	0.99			0.29		
Raunheim	332.35			97.25		
Sum of Laterals	341.76			100.00		

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals;

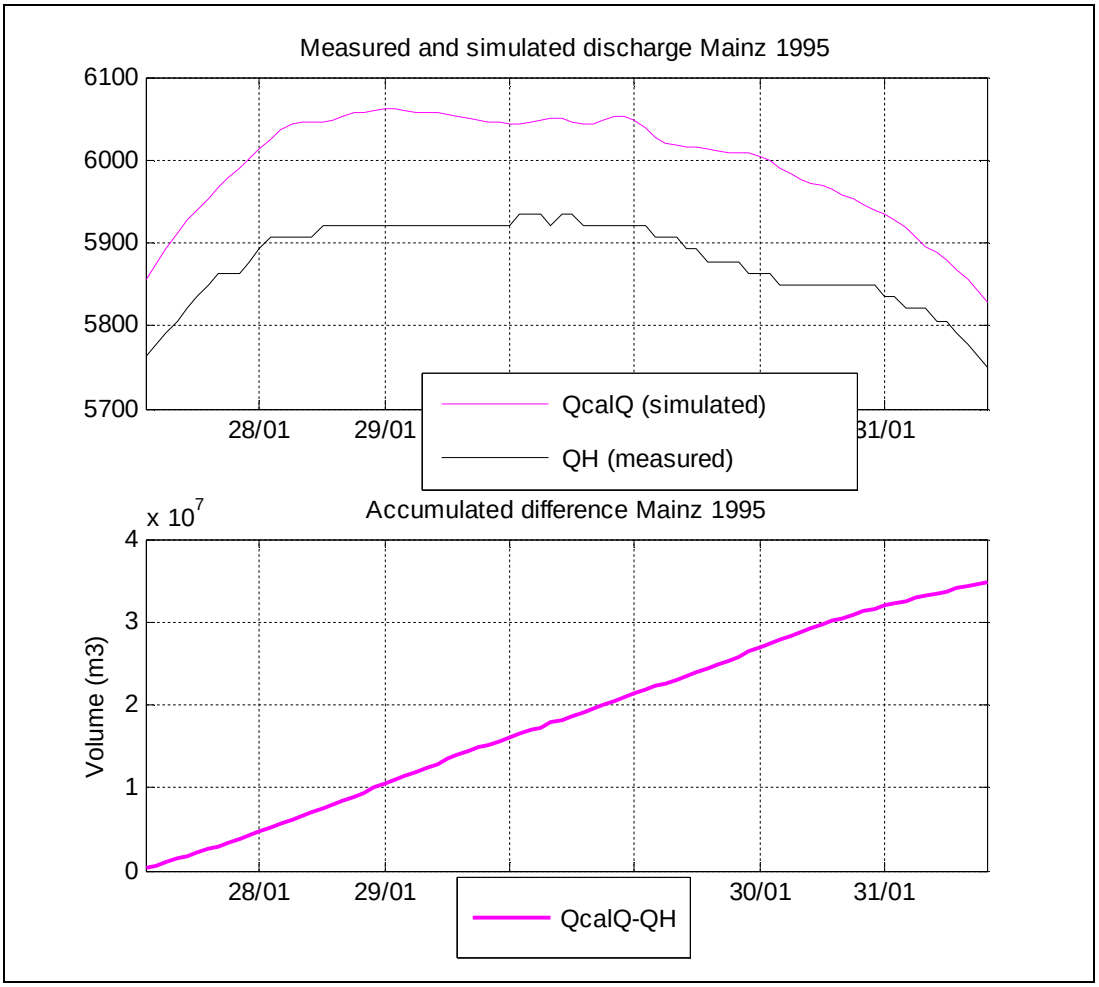

Figure B.11. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Mainz, (b) accumulated difference at Mainz for both the calibration set and the HBV set.

Table B.11. Overview waterbalance section 3: Worms- Mainz. The waterbalance is calculated for the flood period of 1995 (in B$m^3=10^9\ m^3$) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6\ m^3$) are the laterals from the calibration set and the HBV set, respectively.

Section 3: Worms-Mainz Flood period: 28/01/1995 01:00 – 31/01/1995 10:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Mainz (%)**		
Worms	1.17			67.41		
Mainz	1.74			100.00		
Sum of Laterals	0.58			33.57		
I+SoL-O[1]	0.02			0.97		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Mainz (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Worms	1.17			67.41		
Mainz	1.77			102.01		
Sum of Laterals	0.58			33.57		
I+SoL-O[1]	-0.02			-1.03		
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Monsheim	3.75			0.64		
Lorsch	4.62			0.79		
Eberstadt	0.95			0.16		
Naunheim	3.49			0.60		
Eppstein	1.32			0.23		
Raunheim	568.30			97.57		
Sum of Laterals	582.43			100.00		

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals;

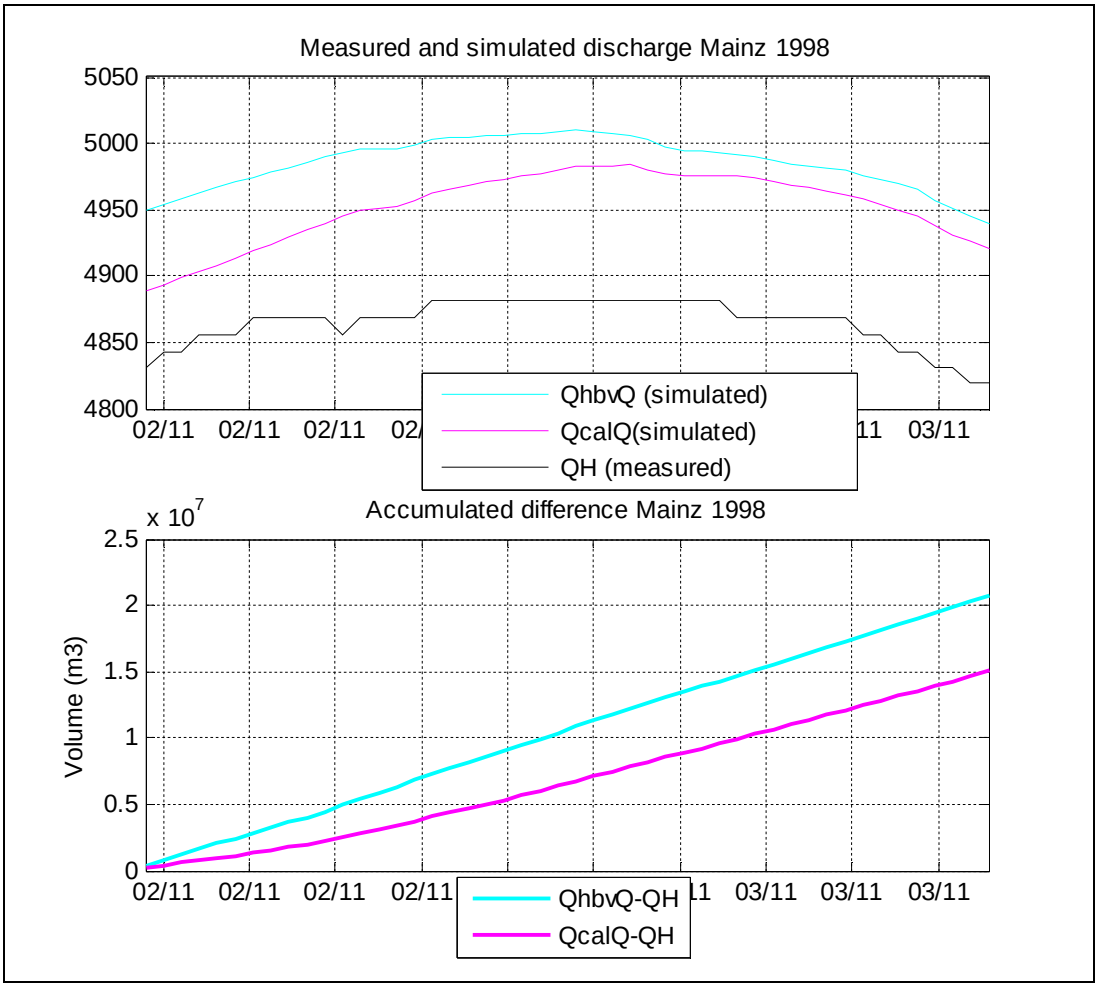

Figure B.12. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Mainz, (b) accumulated difference at Mainz for both the calibration set and the HBV set.

Table B.12. Overview waterbalance section 3: Worms- Mainz. The waterbalance is calculated for the flood period of 1998 (in B$m^3=10^9\ m^3$) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6\ m^3$) are the laterals from the calibration set and the HBV set, respectively.

Section 3: Worms-Mainz Flood period: 01/11/1998 23:00 – 03/11/1998 22:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Mainz (%)**		
Worms	0.58			69.52		
Mainz	0.84			100.00		
Sum of Laterals	0.27			31.53		
I+SoL-O[1]	0.01			1.05		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Mainz (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Worms	0.58	0.58	0	69.52	69.52	0
Mainz	0.86	0.86	0.01	101.79	102.47	0.68
Sum of Laterals	0.27	0.27	0.00	31.53	31.99	0.46
I+SoL-O[1]	-0.01	-0.01	0.00	-0.74	-0.96	-0.21
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Monsheim	1.00	3.22	2.22	0.38	1.22	0.84
Lorsch	1.92	0.14	-1.77	0.72	0.05	-0.67
Eberstadt	0.40	0.03	-0.36	0.15	0.01	-0.14
Naunheim	1.45	5.49	4.04	0.55	2.07	1.52
Eppstein	0.45	0.22	-0.22	0.17	0.08	-0.08
Raunheim	259.81	259.81	0	98.03	98.03	0
Sum of Laterals	265.03	268.92	3.90	100.00	101.47	1.47

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals;

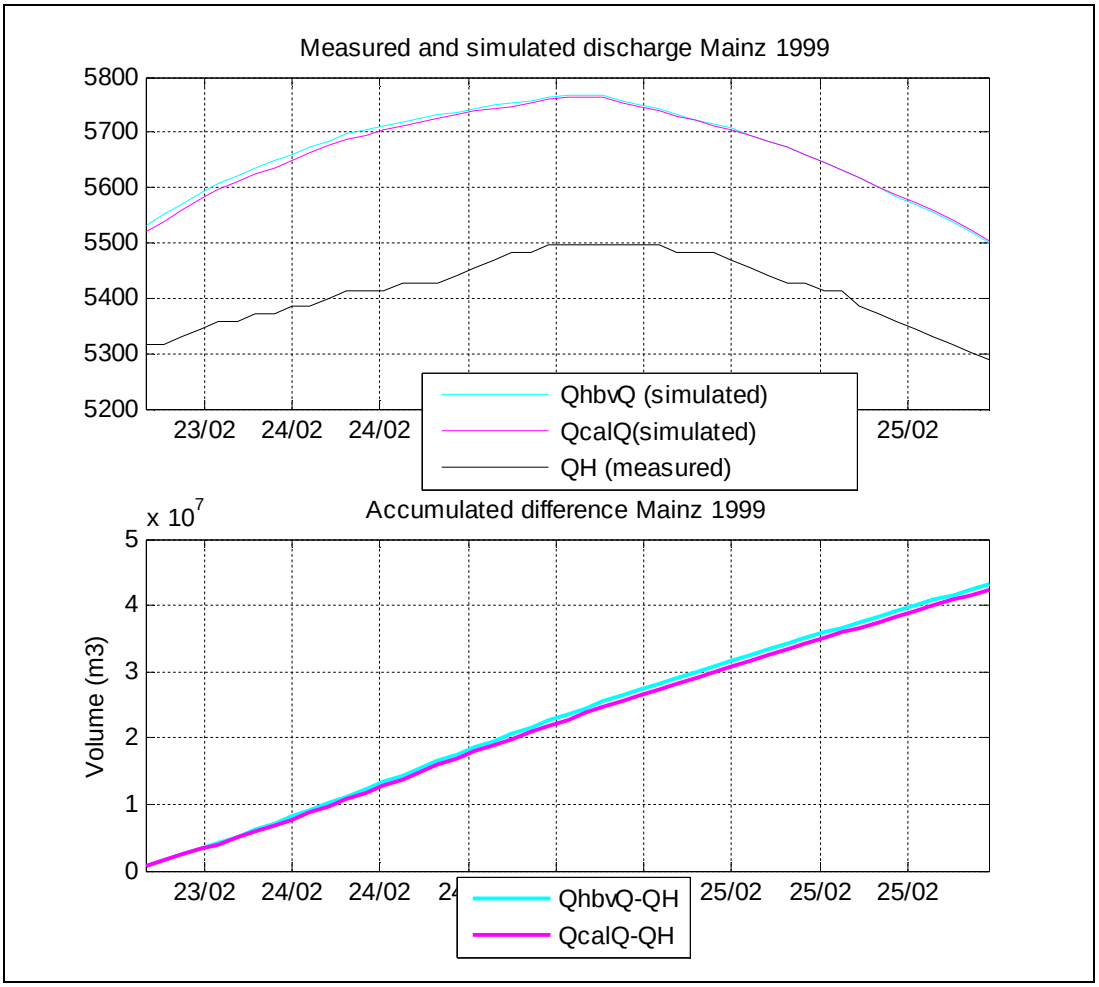

Figure B.13. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Mainz, (b) accumulated difference at Mainz for both the calibration set and the HBV set.

Table B.13. Overview waterbalance section 3: Worms- Mainz. The waterbalance is calculated for the flood period of 1999 (in B$m^3=10^9\ m^3$) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6\ m^3$) are the laterals from the calibration set and the HBV set, respectively.

Section 3: Worms-Mainz Flood period: 23/02/1999 16:00 – 25/02/1999 14:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Mainz (%)**		
Worms	0.76			83.02		
Mainz	0.92			100.00		
Sum of Laterals	0.19			20.72		
I+SoL-O[1]	0.03			3.74		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Mainz (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Worms	0.76	0.76	0	83.02	83.02	0
Mainz	0.96	0.96	0.00	104.62	104.70	0.08
Sum of Laterals	0.19	0.19	0.00	20.72	20.68	-0.04
I+SoL-O[1]	-0.01	-0.01	0.00	-0.88	-1.00	-0.12
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Monsheim	0.70	1.15	0.45	0.37	0.61	0.24
Lorsch	1.68	0.36	-1.32	0.88	0.19	-0.70
Eberstadt	0.31	0.08	-0.23	0.17	0.04	-0.12
Naunheim	1.26	1.96	0.70	0.66	1.03	0.37
Eppstein	0.24	0.29	0.05	0.13	0.15	0.03
Raunheim	185.62	185.62	0	97.79	97.79	0
Sum of Laterals	189.81	189.46	-0.35	100.00	99.82	-0.18

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals;

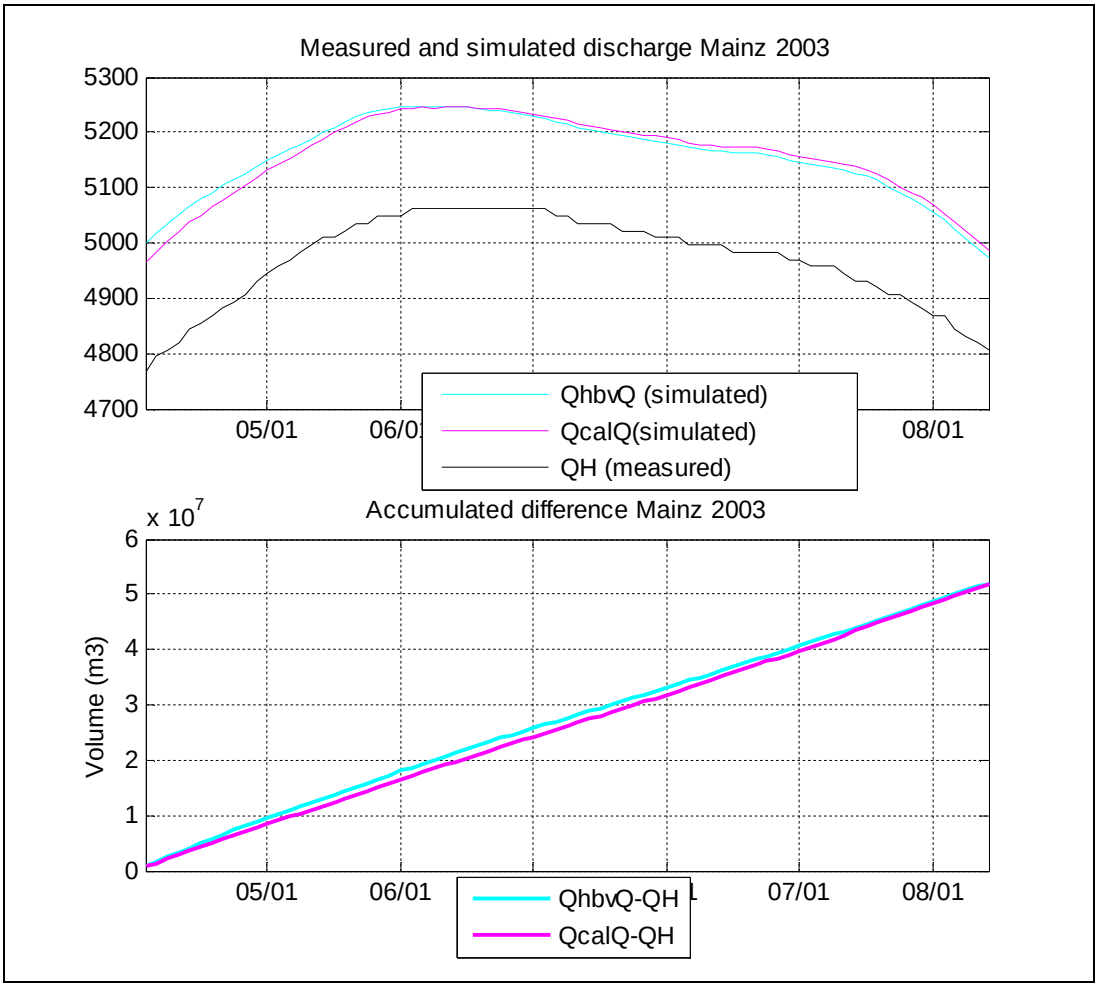

Figure B.14. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Mainz, (b) accumulated difference at Mainz for both the calibration set and the HBV set.

Table B.14. Overview waterbalance section 3: Worms- Mainz. The waterbalance is calculated for the flood period of 2003 (in B$m^3=10^9\ m^3$) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6\ m^3$) are the laterals from the calibration set and the HBV set, respectively.

Section 3: Worms-Mainz Flood period: 05/01/2003 01:00 – 08/01/2003 05:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Mainz (%)**		
Worms	0.93			67.77		
Mainz	1.38			100.00		
Sum of Laterals	0.50			36.20		
I+SoL-O[1]	0.05			3.97		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Mainz (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Worms	0.93	0.93	0	67.77	67.77	0
Mainz	1.43	1.43	0.00	103.76	103.77	0.01
Sum of Laterals	0.50	0.50	0.01	36.20	36.66	0.45
I+SoL-O[1]	0.00	0.01	0.01	0.21	0.66	0.44
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Monsheim	2.44	2.72	0.28	0.49	0.55	0.06
Lorsch	2.71	0.69	-2.01	0.54	0.14	-0.40
Eberstadt	0.65	0.16	-0.49	0.13	0.03	-0.10
Naunheim	4.76	4.63	-0.14	0.96	0.93	-0.03
Eppstein	0.40	9.01	8.60	0.08	1.81	1.72
Raunheim	487.76	487.76	0	97.80	97.80	0
Sum of Laterals	498.74	504.97	6.24	100.00	101.25	1.25

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals;

B.4 Section 4: Mainz-Kaub

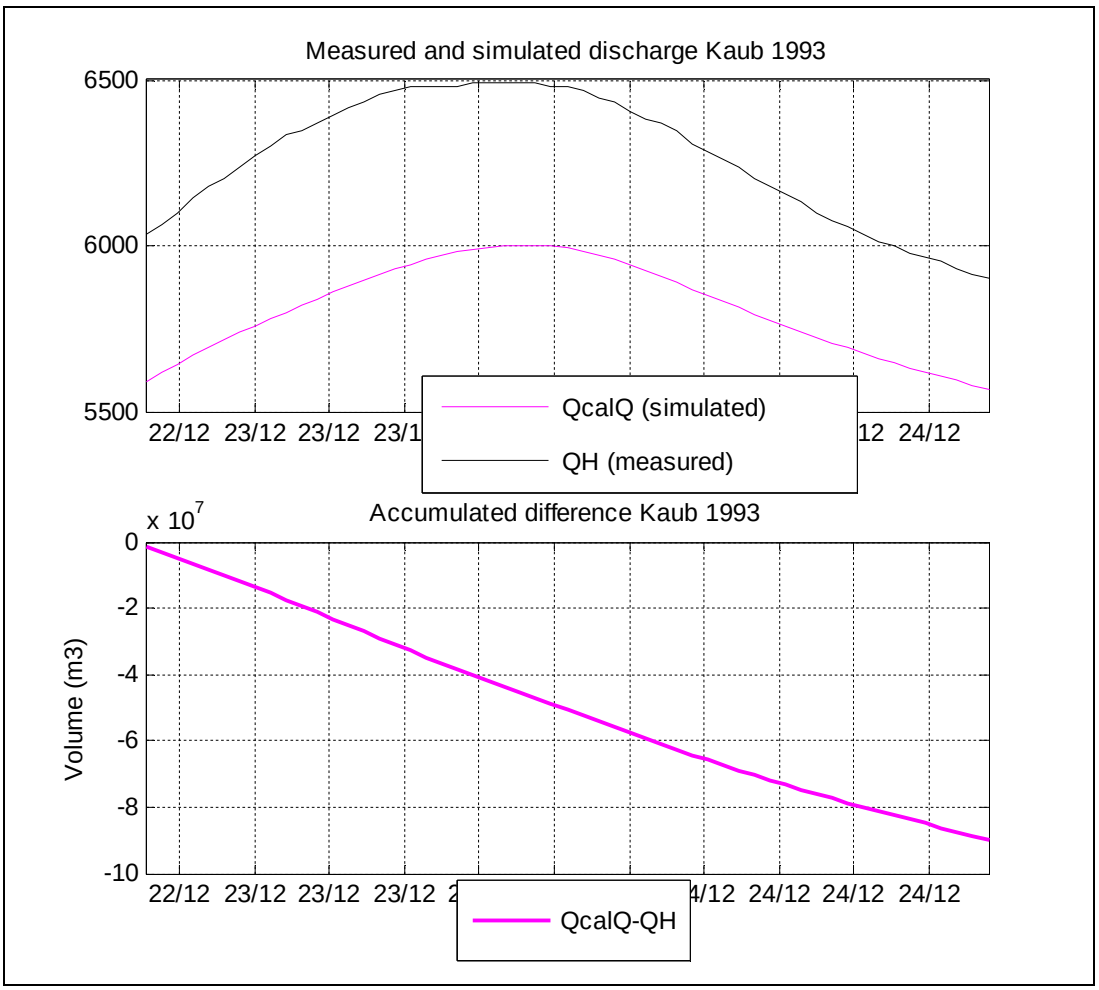

Figure B.15. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Kaub, (b) accumulated difference at Kaub for both the calibration set and the HBV set.

Table B.15. Overview waterbalance section 4: Mainz-Kaub for the flood period of 1993 (in B$m^3=10^9$ m^3) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6$ m^3) are the laterals from the calibration set and the HBV set, respectively.

Section 4: Mainz-Kaub Flood period: 22/12/1993 17:00 – 24/12/1993 23:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Kaub (%)**		
Mainz	1.06			85.74		
Kaub	1.24			100.00		
Sum of Laterals	0.08			6.78		
I+SoL-O[1]	-0.09			-7.48		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Kaub (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Mainz	1.06			85.74		
Kaub	1.15			92.76		
Sum of Laterals	0.08			6.78		
I+SoL-O[1]	0.00			-0.24		
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Oberingelheim	0.44			0.52		
MidRhine1a (ZWE)	3.87			4.60		
MidRhine1b (ZWE)	1.66			1.98		
Pfaffenthal	2.66			3.16		
Grolsheim	75.48			89.74		
Sum of Laterals	84.11			100.00		

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

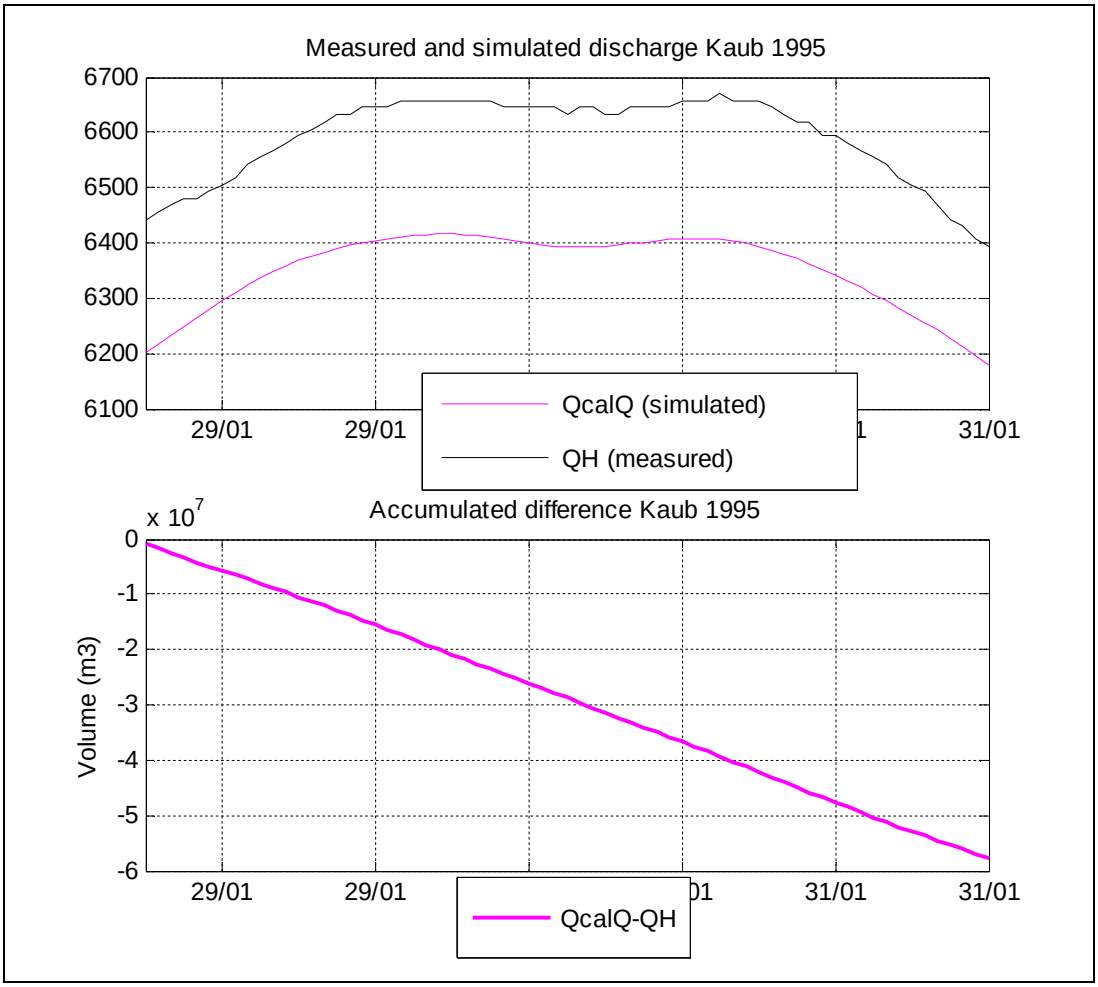

Figure B.16. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Kaub, (b) accumulated difference at Kaub for both the calibration set and the HBV set.

Table B.16. Overview waterbalance section 4: Mainz-Kaub for the flood period of 1995 (in B$m^3=10^9$ m^3) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6$ m^3) are the laterals from the calibration set and the HBV set, respectively.

Section 4: Mainz-Kaub Flood period: 28/01/1995 18:00 – 31/01/1995 12:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Kaub (%)**		
Mainz	1.42			89.17		
Kaub	1.59			100.00		
Sum of Laterals	0.11			7.01		
I+SoL-O[1]	-0.06			-3.83		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Kaub (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Mainz	1.42			89.17		
Kaub	1.53			96.37		
Sum of Laterals	0.11			7.01		
I+SoL-O[1]	0.00			-0.20		
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Oberingelheim	0.43			0.38		
MidRhine1a (ZWE)	2.72			2.45		
MidRhine1b (ZWE)	1.17			1.05		
Pfaffenthal	1.87			1.68		
Grolsheim	105.18			94.44		
Sum of Laterals	111.38			100.00		

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

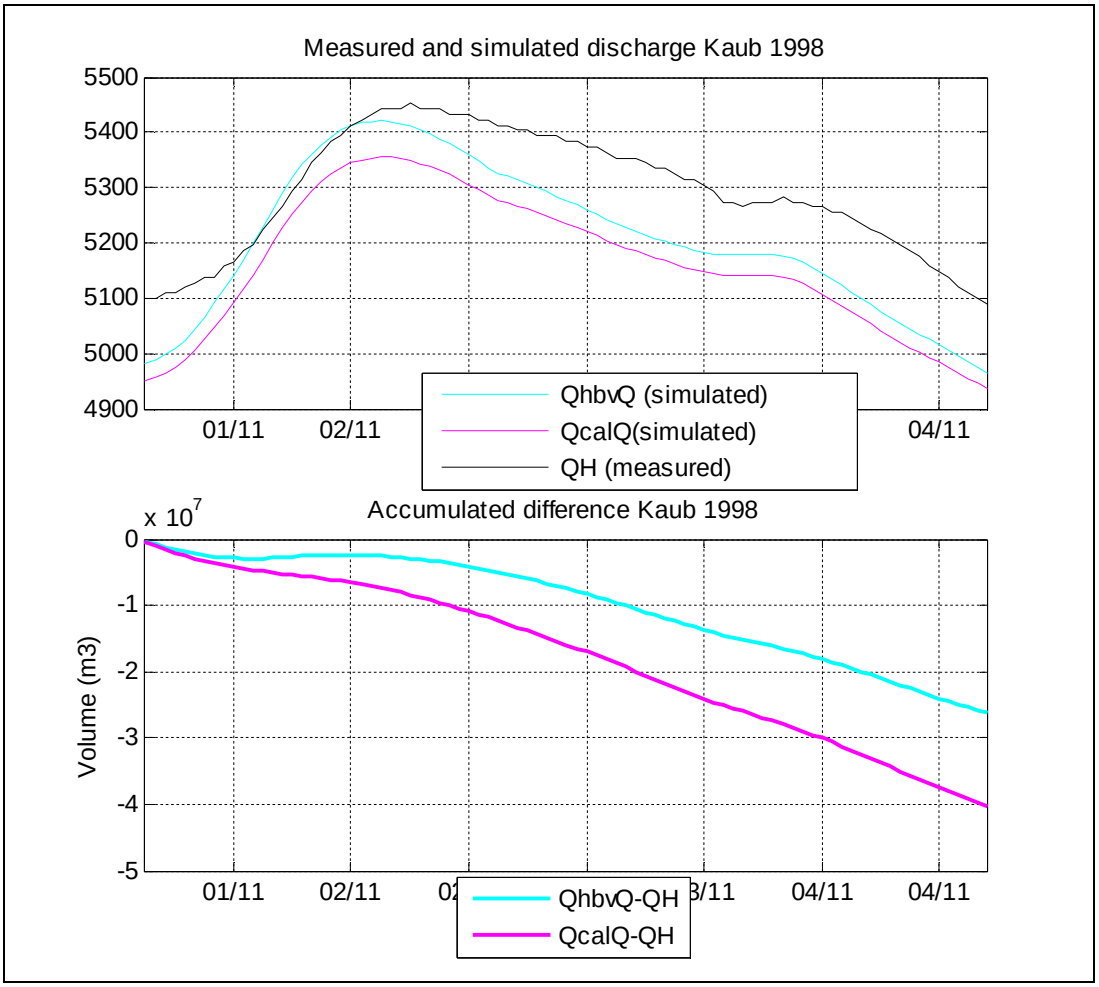

Figure B.17. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Kaub, (b) accumulated difference at Kaub for both the calibration set and the HBV set.

Table B.17. Overview waterbalance section 4: Mainz-Kaub for the flood period of 1998 (in B$m^3=10^9$ m^3) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6$ m^3) are the laterals from the calibration set and the HBV set, respectively.

Section 4: Mainz-Kaub Flood period: 01/11/1998 03:00 – 04/11/1998 17:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Kaub (%)**		
Mainz	1.51			91.16		
Kaub	1.66			100.00		
Sum of Laterals	0.11			6.36		
I+SoL-O[1]	-0.04			-2.48		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Kaub (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Mainz	1.51	1.51	0	91.16	91.16	0
Kaub	1.62	1.63	0.01	97.57	98.42	0.84
Sum of Laterals	0.11	0.12	0.01	6.36	7.20	0.84
I+SoL-O[1]	0.00	0.00	0.00	-0.05	-0.05	0.00
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Oberingelheim	0.33	3.02	2.70	0.31	2.87	2.56
MidRhine1a (ZWE)	3.21	9.86	6.64	3.05	9.35	6.30
MidRhine1b (ZWE)	1.38	4.03	2.64	1.31	3.82	2.51
Pfaffenthal	2.21	4.19	1.99	2.09	3.98	1.89
Grolsheim	98.31	98.31	0	93.24	93.24	0
Sum of Laterals	105.43	119.41	13.97	100.00	113.25	13.25

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

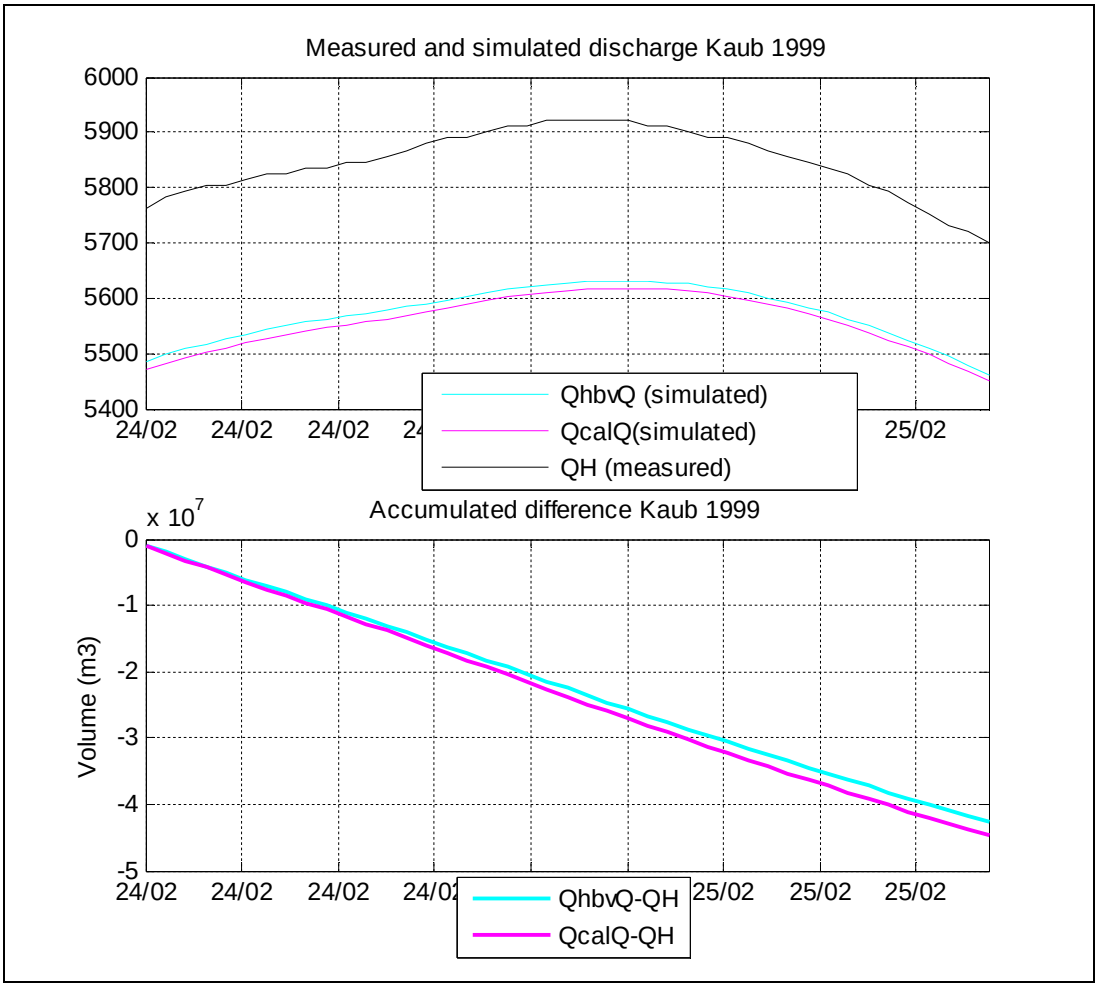

Figure B.18. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Kaub, (b) accumulated difference at Kaub for both the calibration set and the HBV set.

Table B.18. Overview waterbalance section 4: Mainz-Kaub for the flood period of 1999 (in B$m^3=10^9$ m^3) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6$ m^3) are the laterals from the calibration set and the HBV set, respectively.

Section 4: Mainz-Kaub Flood period: 24/02/1999 00:00 – 25/02/1999 18:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Kaub (%)**		
Mainz	0.84			92.54		
Kaub	0.90			100.00		
Sum of Laterals	0.02			2.32		
I+SoL-O[1]	-0.05			-5.14		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Kaub (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Mainz	0.84	0.84	0	92.54	92.54	0
Kaub	0.86	0.86	0.00	95.06	95.30	0.24
Sum of Laterals	0.02	0.02	0.00	2.32	2.54	0.23
I+SoL-O[1]	0.00	0.00	0.00	-0.20	-0.22	-0.01
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Oberingelheim	0.15	0.80	0.65	0.70	3.82	3.12
MidRhine1a (ZWE)	1.57	2.53	0.96	7.48	12.08	4.60
MidRhine1b (ZWE)	0.67	1.03	0.36	3.22	4.93	1.72
Pfaffenthal	1.08	1.14	0.07	5.14	5.45	0.31
Grolsheim	17.49	17.49	0	83.47	83.47	0.00
Sum of Laterals	20.95	23.00	2.04	100.00	109.75	9.75

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

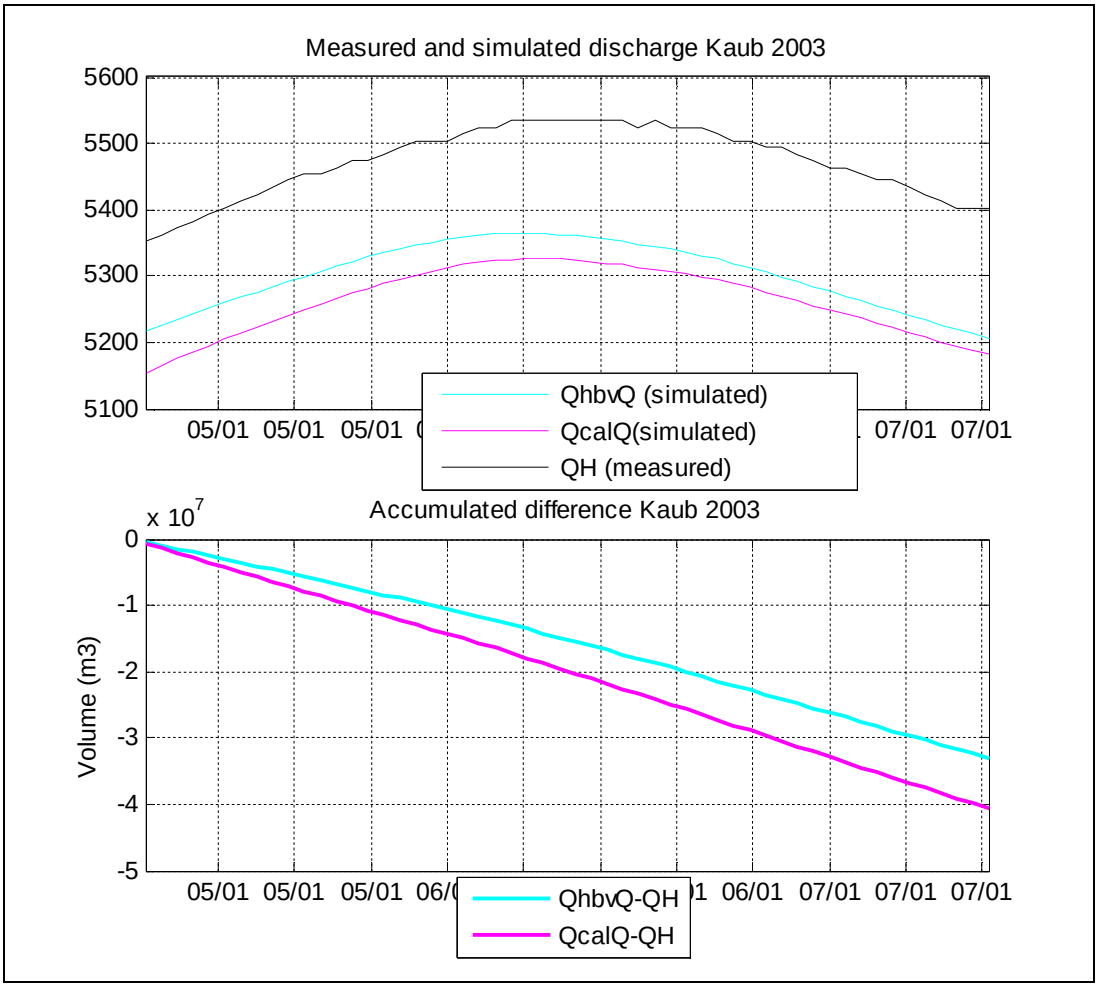

Figure B.19. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Kaub, (b) accumulated difference at Kaub for both the calibration set and the HBV set.

Table B.19. Overview waterbalance section 4: Mainz-Kaub for the flood period of 2003 (in B$m^3=10^9$ m^3) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6$ m^3) are the laterals from the calibration set and the HBV set, respectively.

Section 4: Mainz-Kaub Flood period: 05/01/2003 05:00 – 07/01/2003 10:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Kaub (%)**		
Mainz	0.97			91.48		
Kaub	1.06			100.00		
Sum of Laterals	0.05			4.96		
I+SoL-O[1]	-0.04			-3.56		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Kaub (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Mainz	0.97	0.97	0	91.48	91.48	0
Kaub	1.02	1.03	0.01	96.18	96.89	0.71
Sum of Laterals	0.05	0.06	0.01	4.96	5.61	0.65
I+SoL-O[1]	0.00	0.00	0.00	0.26	0.19	-0.07
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Oberingelheim	1.00	3.25	2.25	1.89	6.16	4.26
MidRhine1a (ZWE)	1.65	4.53	2.88	3.12	8.58	5.46
MidRhine1b (ZWE)	0.71	1.85	1.14	1.34	3.51	2.16
Pfaffenthal	1.13	1.74	0.61	2.15	3.30	1.15
Grolsheim	48.28	48.28	0	91.49	91.49	0.00
Sum of Laterals	52.77	59.65	6.88	100.00	113.04	13.04

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

B.5 Section 5/6: Kaub-Andernach

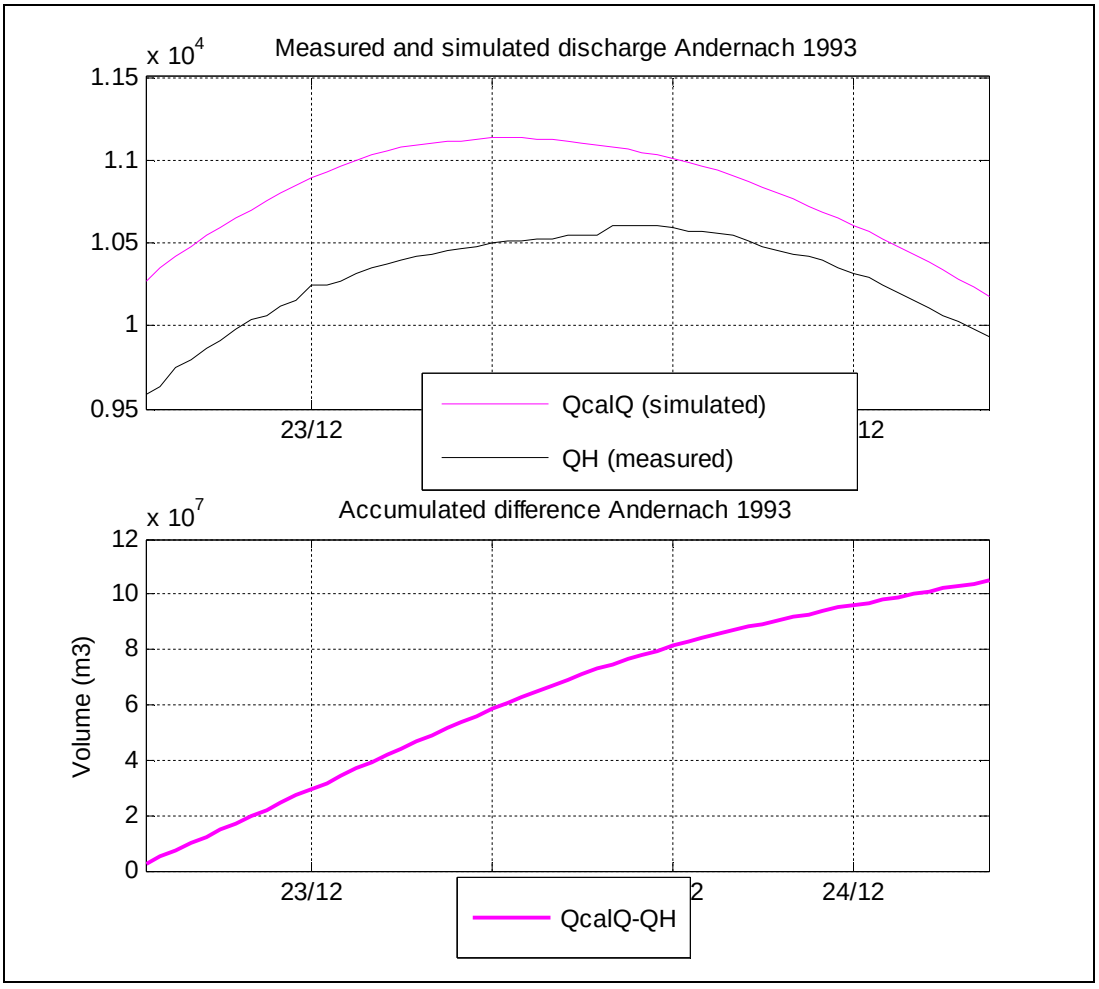

Figure B.20. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Andernach, (b) accumulated difference at Andernach for both the calibration set and the HBV set.

Table B.20. Overview waterbalance section 5/6: Kaub-Andernach. The waterbalance is calculated for the flood period of 1993 (in B$m^3=10^9\ m^3$) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6\ m^3$) are the laterals from the calibration set and the HBV set, respectively.

Section 5/6: Kaub – Andernach Flood period: 22/12/1993 13:00 – 24/12/1993 21:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Andernach (%)**		
Kaub	1.28			60.74		
Andernach	2.11			100.00		
Sum of Laterals	0.92			43.68		
I+SoL-O[1]	0.09			4.42		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Andernach (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Kaub	1.28			60.74		
Andernach	2.22			104.96		
Sum of Laterals	0.92			43.68		
I+SoL-O[1]	-0.01			-0.54		
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Umos4	0			0		
Schulmuehle	1.39			0.15		
Weinaehr	3.11			0.34		
Kalkofen	99.63			10.79		
Pfaffenthal (ZWE)	5.11			0.55		
Saynbach	3.60			0.39		
Friedrichsthal	11.59			1.26		
Nettegut	3.14			0.34		
Weinaehr (ZWE)	3.38			0.37		
Saynbach (ZWE)	2.03			0.22		
Cochem	790.20			85.60		
Sum of Laterals	923.17			100.00		

[1] I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

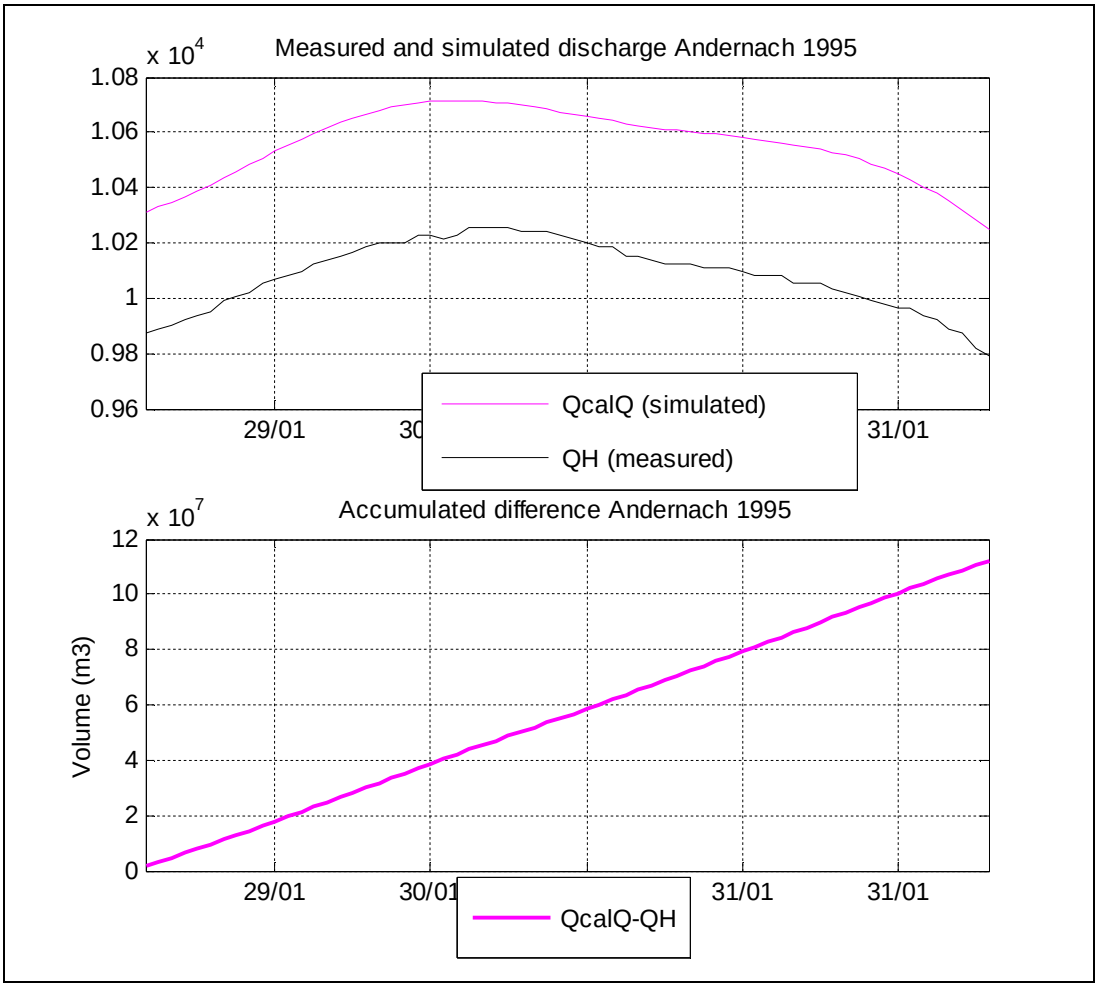

Figure B.21. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Andernach, (b) accumulated difference at Andernach for both the calibration set and the HBV set.

Table B.21. Overview waterbalance section 5/6: Kaub-Andernach. The waterbalance is calculated for the flood period of 1995 (in B$m^3=10^9\ m^3$) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6\ m^3$) are the laterals from the calibration set and the HBV set, respectively.

Section 5/6: Kaub – Andernach Flood period: 29/01/1995 02:00 – 31/01/1995 19:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Andernach (%)**		
Kaub	1.56			65.12		
Andernach	2.40			100.00		
Sum of Laterals	0.95			39.46		
I+SoL-O[1]	0.11			4.58		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Andernach (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Kaub	1.56			65.12		
Andernach	2.51			104.68		
Sum of Laterals	0.95			39.46		
I+SoL-O[1]	0.00			-0.10		
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Umos4	0			0		
Schulmuehle	0.85			0.09		
Weinaehr	3.81			0.40		
Kalkofen	123.48			13.06		
Pfaffenthal (ZWE)	3.20			0.34		
Saynbach	4.75			0.50		
Friedrichsthal	15.30			1.62		
Nettegut	3.34			0.35		
Weinaehr (ZWE)	4.14			0.44		
Saynbach (ZWE)	2.67			0.28		
Cochem	784.01			82.92		
Sum of Laterals	945.55			100.00		

[1] I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

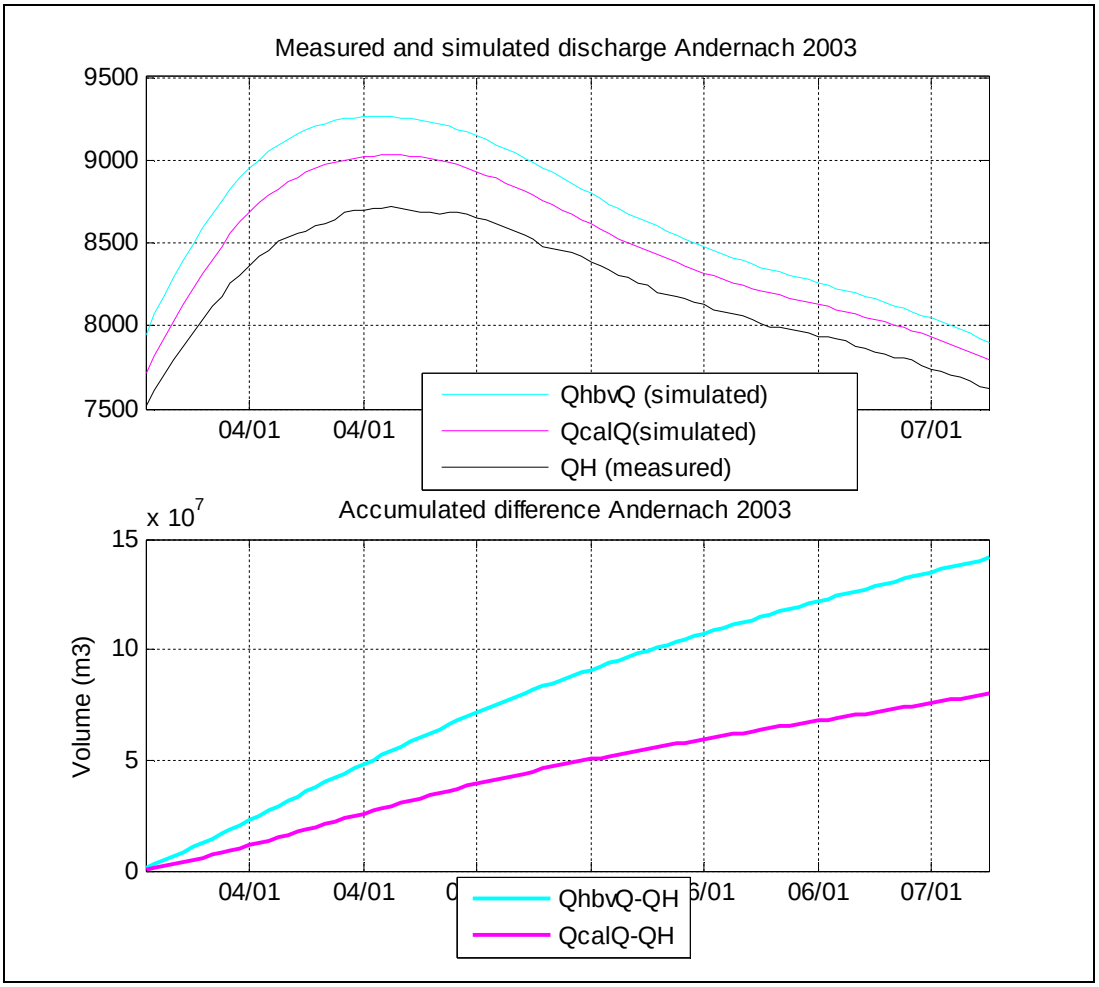

Figure B.22. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Andernach, (b) accumulated difference at Andernach for both the calibration set and the HBV set.

Table B.22. Overview waterbalance section 5/6: Kaub-Andernach. The waterbalance is calculated for the flood period of 2003 (in B$m^3=10^9\ m^3$) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6\ m^3$) are the laterals from the calibration set and the HBV set, respectively.

Section 5/6: Kaub – Andernach Flood period: 03/01/2003 13:00 – 07/01/2003 06:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Andernach (%)**		
Kaub	1.71			64.20		
Andernach	2.66			100.00		
Sum of Laterals	1.03			38.78		
I+SoL-O[1]	0.08			2.98		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Andernach (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Kaub	1.71	1.71	0	64.20	64.20	0
Andernach	2.74	2.81	0.06	102.99	105.31	2.31
Sum of Laterals	1.03	1.09	0.06	38.78	40.99	2.21
I+SoL-O[1]	0.00	0.00	0.00	-0.02	-0.12	-0.10
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Umos4	0	42.63	42.63	0	4.13	4.13
Schulmuehle	2.01	2.90	0.89	0.19	0.28	0.09
Weinaehr	4.39	3.72	-0.66	0.42	0.36	-0.06
Kalkofen	151.30	151.30	0	14.64	14.64	0
Pfaffenthal (ZWE)	4.56	11.41	6.86	0.44	1.10	0.66
Saynbach	4.45	3.22	-1.23	0.43	0.31	-0.12
Friedrichsthal	14.33	14.33	0	1.39	1.39	0
Nettegut	4.03	13.47	9.45	0.39	1.30	0.91
Weinaehr (ZWE)	4.77	4.08	-0.69	0.46	0.39	-0.07
Saynbach (ZWE)	2.50	4.26	1.76	0.24	0.41	0.17
Cochem	840.96	840.96	0	81.39	81.39	0
Sum of Laterals	1033.30	1092.30	58.99	100.00	105.71	5.71

[1] I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

B.6 Section 7: Andernach-Bonn

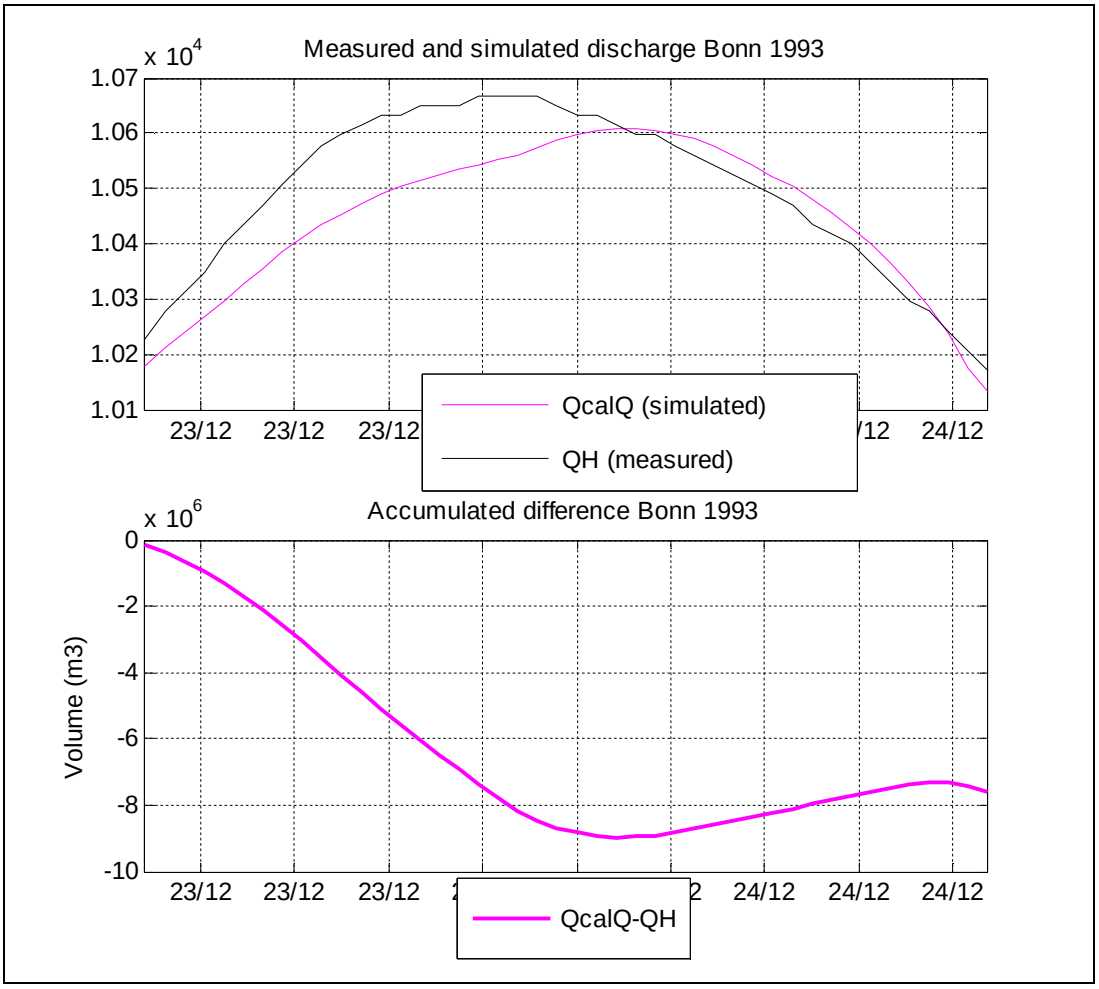

Figure B.23. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Bonn, (b) accumulated difference at Bonn for both the calibration set and the HBV set.

Table B.23. Overview waterbalance section 7: Andernach-Bonn for the flood period of 1993 (in B$m^3=10^9$ m^3) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6$ m^3) are the laterals from the calibration set and the HBV set, respectively.

Section 7: Andernach – Bonn Flood period: 23/12/1993 02:00 - 24/12/1993 21:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Bonn (%)**		
Andernach	1.64			98.95		
Bonn	1.66			100.00		
Sum of Laterals	0.01			0.75		
I+SoL-O[1]	-0.01			-0.30		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Bonn (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Andernach	1.64			98.95		
Bonn	1.65			99.54		
Sum of Laterals	0.01			0.75		
I+SoL-O[1]	0.00			0.15		
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Ahr	12.38			100		
MidRhine3	0			0		
Sum of Laterals	12.38			100		

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

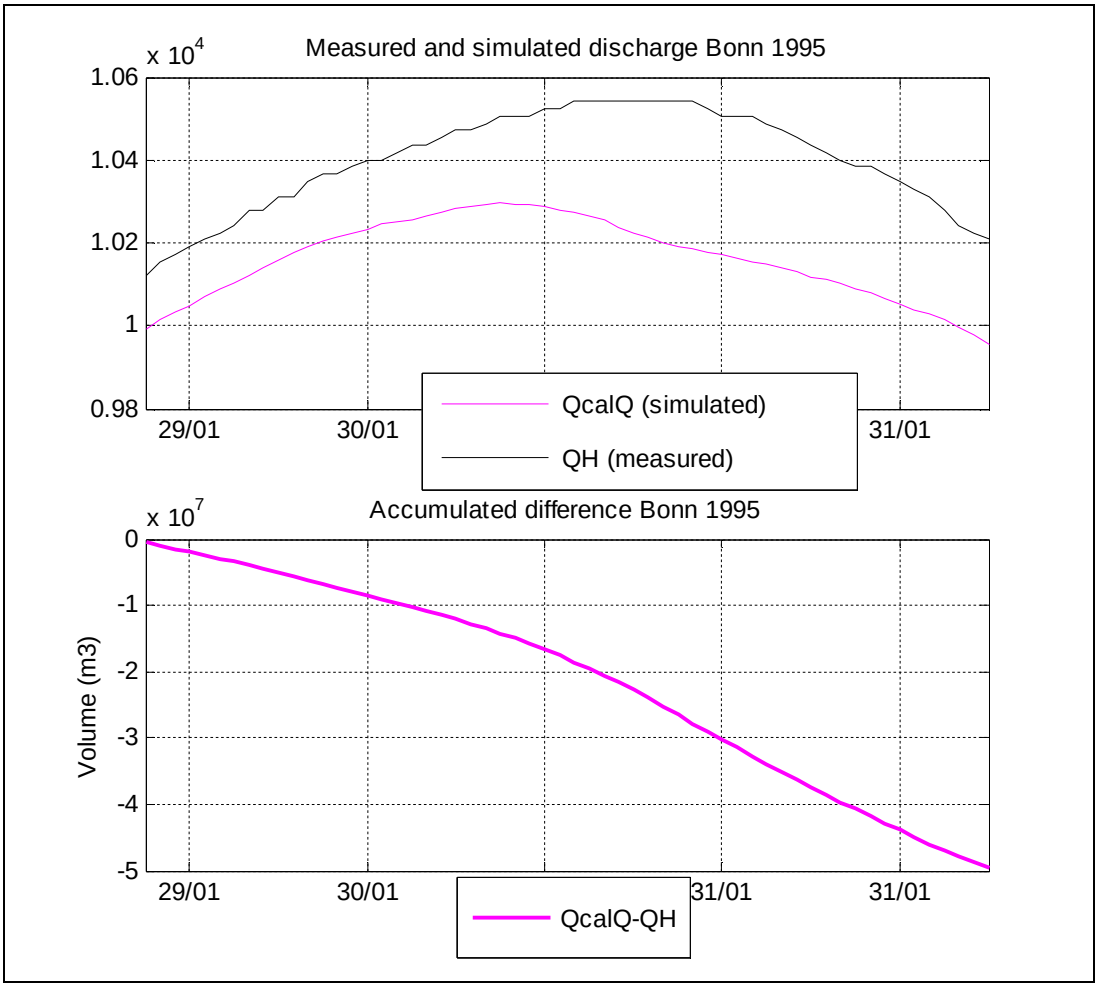

Figure B.24. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Bonn, (b) accumulated difference at Bonn for both the calibration set and the HBV set.

Table B.24. Overview waterbalance section 7: Andernach-Bonn for the flood period of 1995 (in B$m^3=10^9\ m^3$) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6\ m^3$) are the laterals from the calibration set and the HBV set, respectively.

Section 7: Andernach – Bonn Flood period: 29/01/1995 09:00 - 31/01/1995 18:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Bonn (%)**		
Andernach	2.11			97.13		
Bonn	2.17			100.00		
Sum of Laterals	0.02			0.80		
I+SoL-O[1]	-0.04			-2.06		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Bonn (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Andernach	2.11			97.13		
Bonn	2.12			97.71		
Sum of Laterals	0.02			0.80		
I+SoL-O[1]	0.00			0.22		
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Ahr	17.45			100		
MidRhine3	0			0		
Sum of Laterals	17.45			100		

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

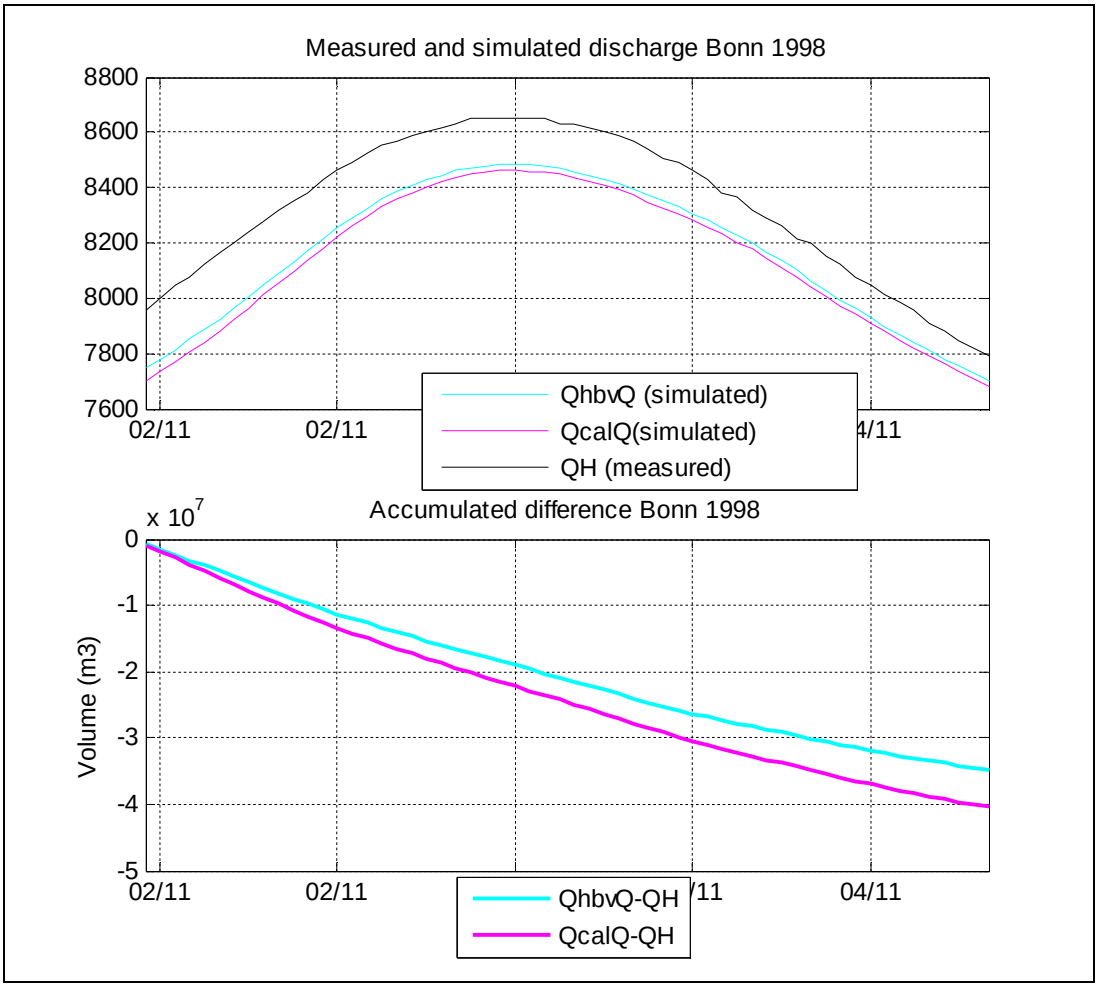

Figure B.25. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Bonn, (b) accumulated difference at Bonn for both the calibration set and the HBV set.

Table B.25. Overview waterbalance section 7: Andernach-Bonn for the flood period of 1998 (in B$m^3=10^9\ m^3$) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6\ m^3$) are the laterals from the calibration set and the HBV set, respectively.

Section 7: Andernach – Bonn Flood period: 01/11/1998 23:00 - 04/11/1998 08:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Bonn (%)**		
Andernach	1.70			97.44		
Bonn	1.74			100.00		
Sum of Laterals	0.01			0.50		
I+SoL-O[1]	-0.04			-2.06		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Bonn (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Andernach	1.70	1.70	0	97.44	97.44	0
Bonn	1.70	1.70	0.01	97.68	98.00	0.32
Sum of Laterals	0.01	0.01	0.01	0.50	0.80	0.30
I+SoL-O[1]	0.00	0.00	0.00	0.27	0.25	-0.02
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Ahr	8.72	7.26	-1.45	100	83.33	-16.67
MidRhine3	0	6.71	6.71	0	76.99	76.99
Sum of Laterals	8.72	13.97	5.26	100	160.32	60.32

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

B.7 Section 8: Bonn-Köln

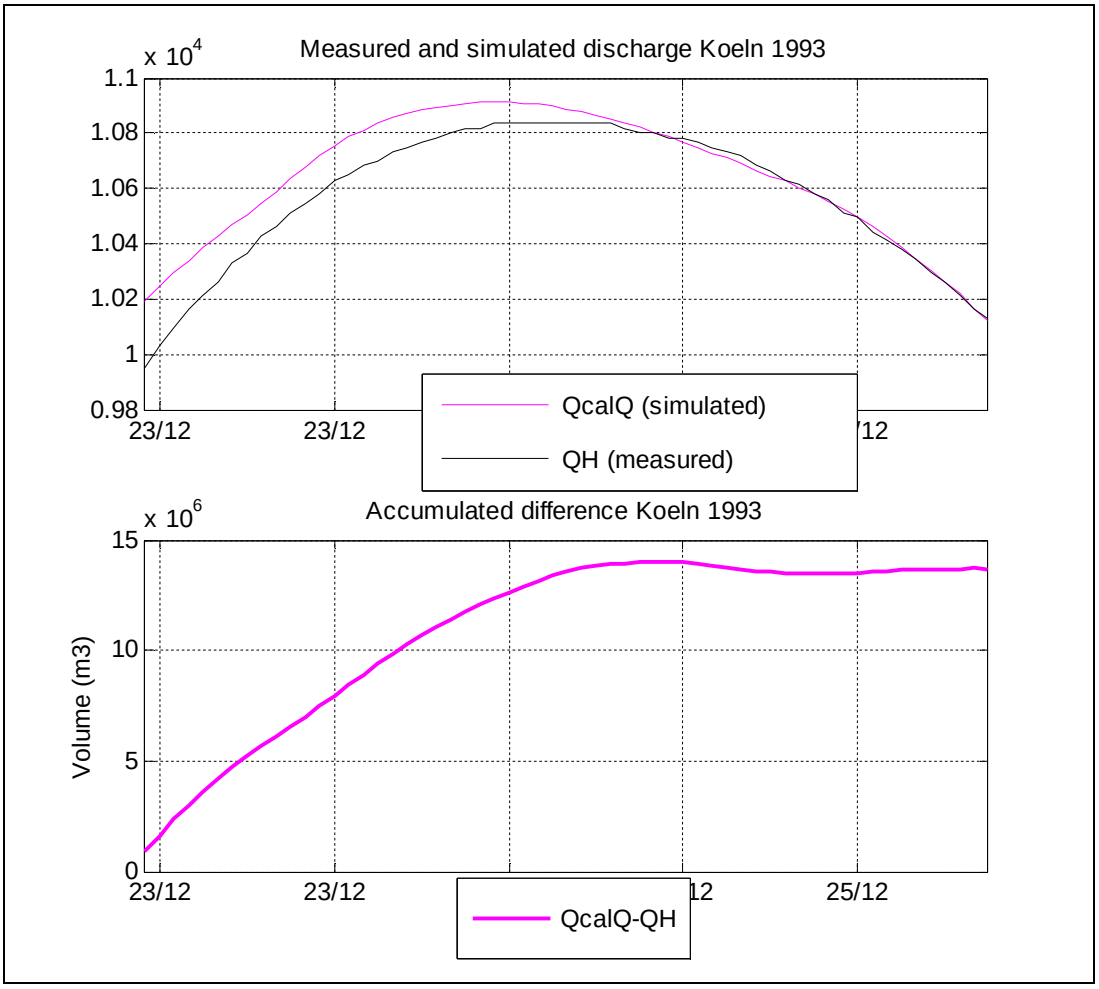

Figure B.26. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Köln Köln, (b) accumulated difference at Köln for both the calibration set and the HBV set.

Table B.26. Overview waterbalance section 8: Bonn-Köln for the flood period of 1993 (in B$m^3=10^9$ m^3) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6$ m^3) are the laterals from the calibration set and the HBV set, respectively.

Section 8: Bonn – Köln Flood period: 22/12/1993 23:00 – 25/12/1993 09:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Köln (%)**		
Bonn	2.20			97.83		
Köln	2.25			100.00		
Sum of Laterals	0.07			2.96		
I+SoL-O[1]	0.02			0.79		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Köln (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Bonn	2.20			97.83		
Köln	2.26			100.61		
Sum of Laterals	0.07			2.96		
I+SoL-O[1]	0.00			0.18		
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Menden	66.47			100		
MidRhine4	0			0		
Sum of Laterals	66.47			100		

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

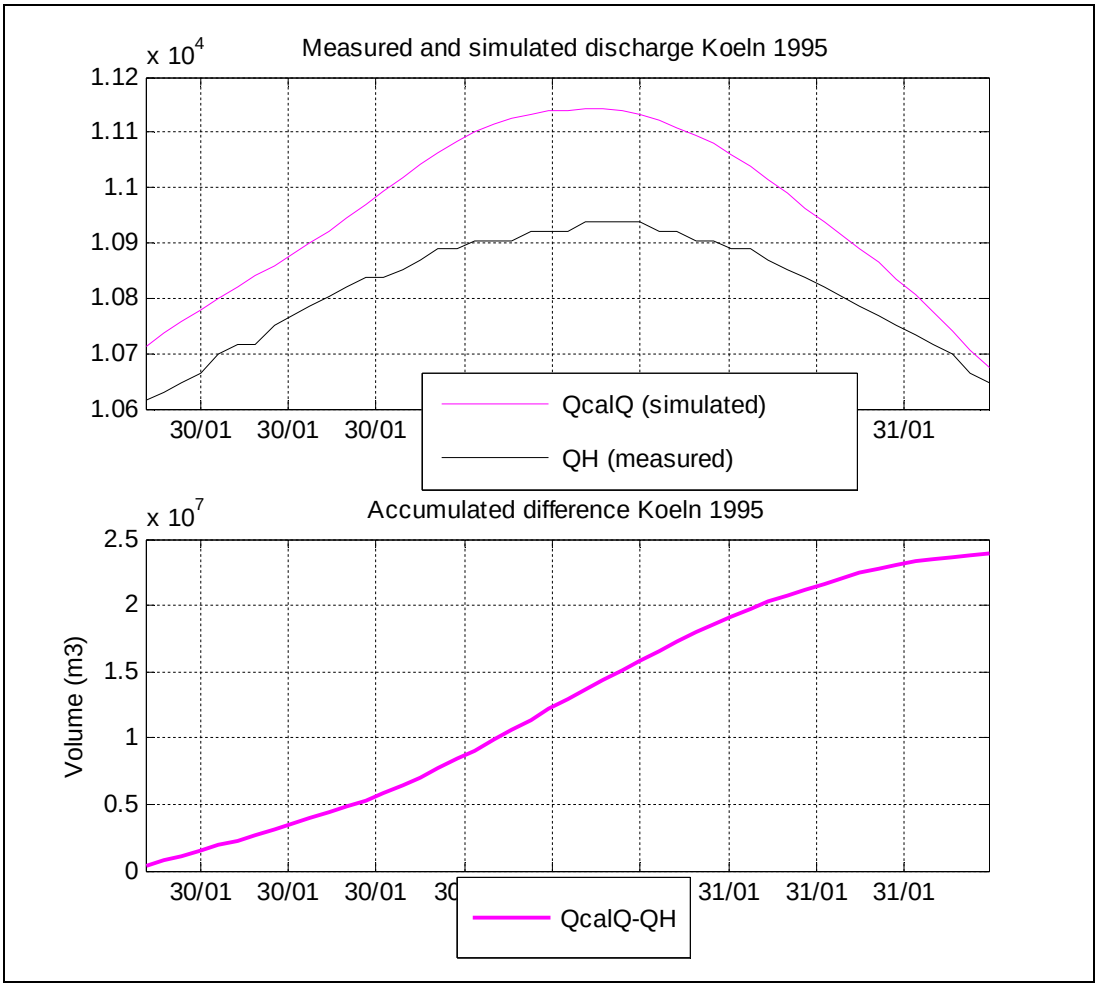

Figure B.27. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Köln Köln, (b) accumulated difference at Köln for both the calibration set and the HBV set.

Table B.27. Overview waterbalance section 8: Bonn-Köln for the flood period of 1995 (in B$m^3=10^9$ m^3) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6$ m^3) are the laterals from the calibration set and the HBV set, respectively.

Section 8: Bonn - Köln Flood period: 29/01/1995 21:00 – 31/01/1995 19:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Köln (%)**		
Bonn	1.77			96.44		
Köln	1.83			100.00		
Sum of Laterals	0.09			5.13		
I+SoL-O[1]	0.03			1.57		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Köln (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Bonn	1.77			96.44		
Köln	1.85			101.31		
Sum of Laterals	0.09			5.13		
I+SoL-O[1]	0.00			0.26		
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Menden	93.86			100		
MidRhine4	0			00		
Sum of Laterals	93.86			100		

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

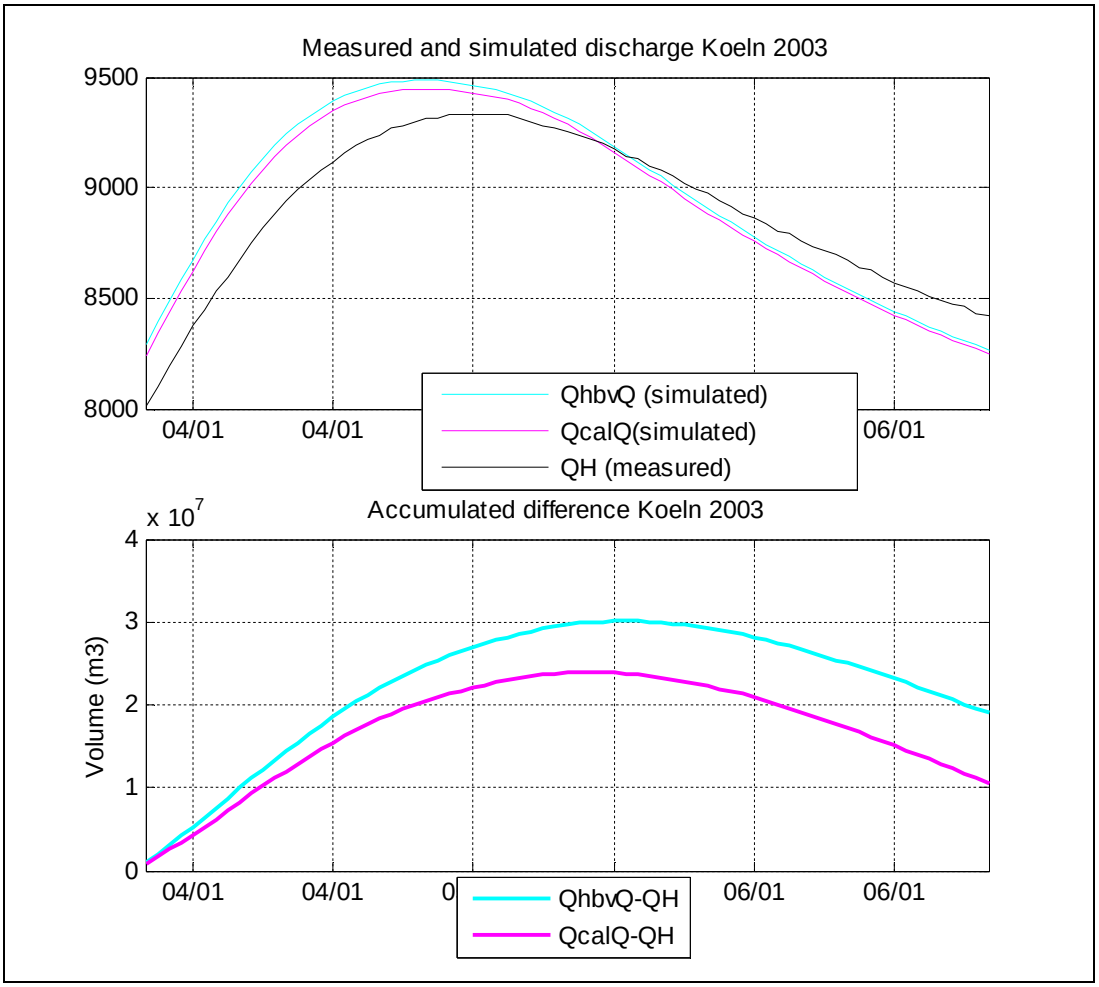

Figure B.28. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Köln Köln, (b) accumulated difference at Köln for both the calibration set and the HBV set.

Table B.28. Overview waterbalance section 8: Bonn-Köln for the flood period of 2003 (in B$m^3=10^9\ m^3$) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6\ m^3$) are the laterals from the calibration set and the HBV set, respectively.

Section 8: Bonn - Köln Flood period: 03/01/2003 20:00 – 06/01/2003 20:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Köln (%)**		
Bonn	2.26			96.62		
Köln	2.34			100.00		
Sum of Laterals	0.10			4.14		
I+SoL-O[1]	0.02			0.76		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Köln (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Bonn	2.26	2.26	0	96.62	96.62	0
Köln	2.35	2.36	0.01	100.45	100.81	0.36
Sum of Laterals	0.10	0.10	0.01	4.14	4.49	0.34
I+SoL-O[1]	0.01	0.01	0.00	0.31	0.29	-0.02
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Menden	96.86	96.86	0	100	100	0
MidRhine4	0	8.05	8.05	0	8.31	8.31
Sum of Laterals	96.86	104.91	8.05	100	108.31	8.31

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

B.8 Section 9: Köln-Düsseldorf

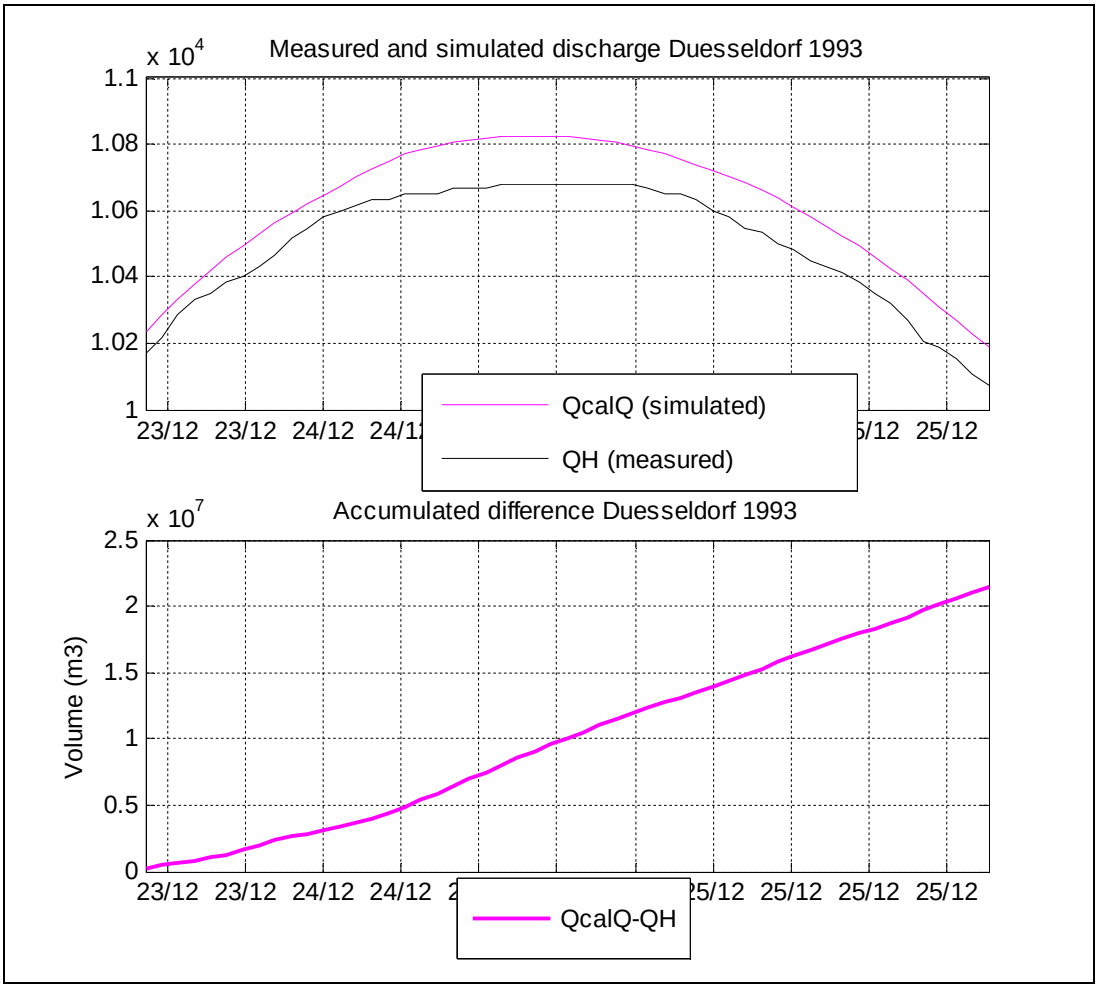

Figure B.29. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Düsseldorf, (b) accumulated difference at Düsseldorf for both the calibration set and the HBV set.

Table B.29. Overview waterbalance section 9: Köln-Düsseldorf for the flood period of 1993 (in B$m^3=10^9$ m^3) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6$ m^3) are the laterals from the calibration set and the HBV set, respectively.

Section 9: Köln - Düsseldorf Flood period: 23/12/1993 13:00 – 25/12/1993 17:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Düsseldorf (%)**		
Köln	2.00			100.04		
Düsseldorf	2.00			100.00		
Sum of Laterals	0.02			1.18		
I+SoL-O[1]	0.02			1.22		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Düsseldorf (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Köln	2.00			100.04		
Düsseldorf	2.02			101.07		
Sum of Laterals	0.02			1.18		
I+SoL-O[1]	0.00			0.15		
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Opladen	17.92			76.10		
Neubrueck	5.63			23.90		
LowRhine1	0			0		
Sum of Laterals	23.55			100		

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

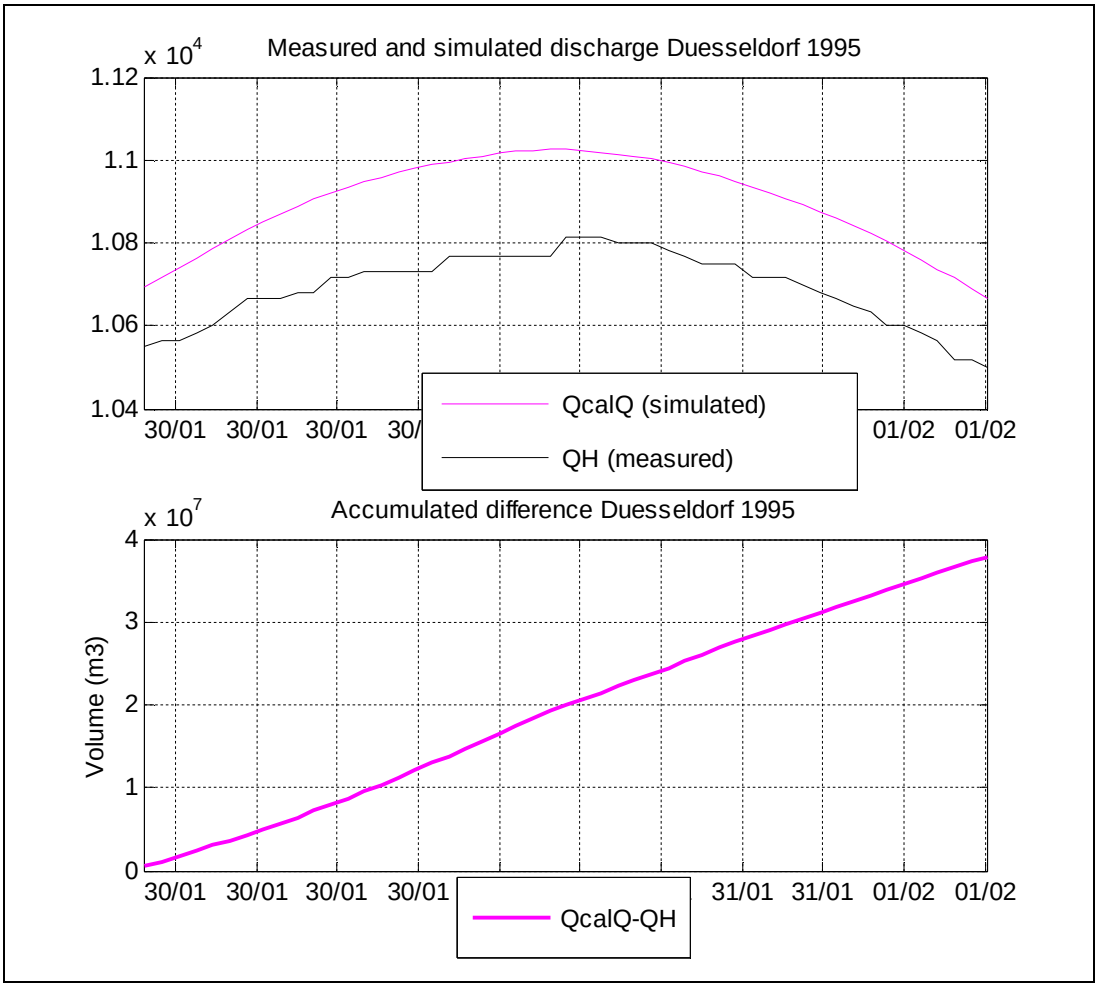

Figure B.30. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Düsseldorf, (b) accumulated difference at Düsseldorf for both the calibration set and the HBV set.

Table B.30. Overview waterbalance section 9: Köln-Düsseldorf for the flood period of 1995 (in B$m^3=10^9$ m^3) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6$ m^3) are the laterals from the calibration set and the HBV set, respectively.

Section 9: Köln - Düsseldorf Flood period: 30/01/1995 03:00 – 01/02/1995 05:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Düsseldorf (%)**		
Köln	1.97			100.54		
Düsseldorf	1.96			100.00		
Sum of Laterals	0.03			1.55		
I+SoL-O[1]	0.04			2.09		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Düsseldorf (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Köln	1.97			100.54		
Düsseldorf	2.00			101.93		
Sum of Laterals	0.03			1.55		
I+SoL-O[1]	0.00			0.16		
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Opladen	26.02			85.75		
Neubrueck	4.33			14.25		
LowRhine1	0			0		
Sum of Laterals	30.35			100		

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

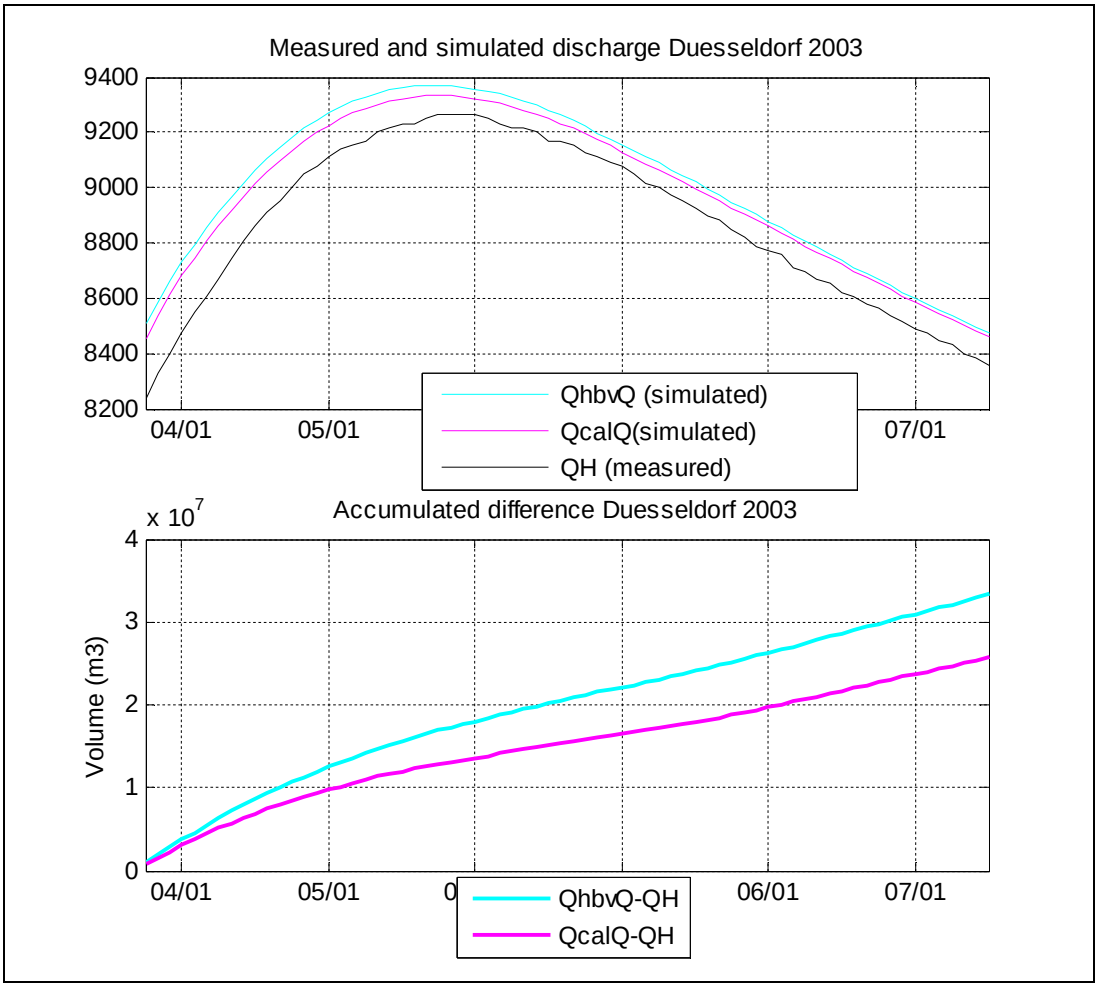

Figure B.31. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Düsseldorf, (b) accumulated difference at Düsseldorf for both the calibration set and the HBV set.

Table B.31. Overview waterbalance section 9: Köln-Düsseldorf for the flood period of 1995 (in B$m^3=10^9$ m^3) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6$ m^3) are the laterals from the calibration set and the HBV set, respectively.

Section 9: Köln - Düsseldorf Flood period: 04/01/2003 09:00 – 07/01/2003 06:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Düsseldorf (%)**		
Köln	2.24			100.16		
Düsseldorf	2.24			100.00		
Sum of Laterals	0.03			1.17		
I+SoL-O[1]	0.03			1.32		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Düsseldorf (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Köln	2.24	2.24	0	100.16	100.16	0
Düsseldorf	2.26	2.27	0.01	101.15	101.49	0.34
Sum of Laterals	0.03	0.03	0.01	1.17	1.52	0.36
I+SoL-O[1]	0.00	0.00	0.00	0.17	0.19	0.02
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Opladen	21.39	21.39	0	82.09	82.09	0
Neubrueck	4.67	4.67	0	17.91	17.91	0
LowRhine1	0	7.96	7.96	0	30.55	30.55
Sum of Laterals	26.06	34.02	7.96	100	130.55	30.55

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

B.9 Section 10: Düsseldorf-Ruhrort

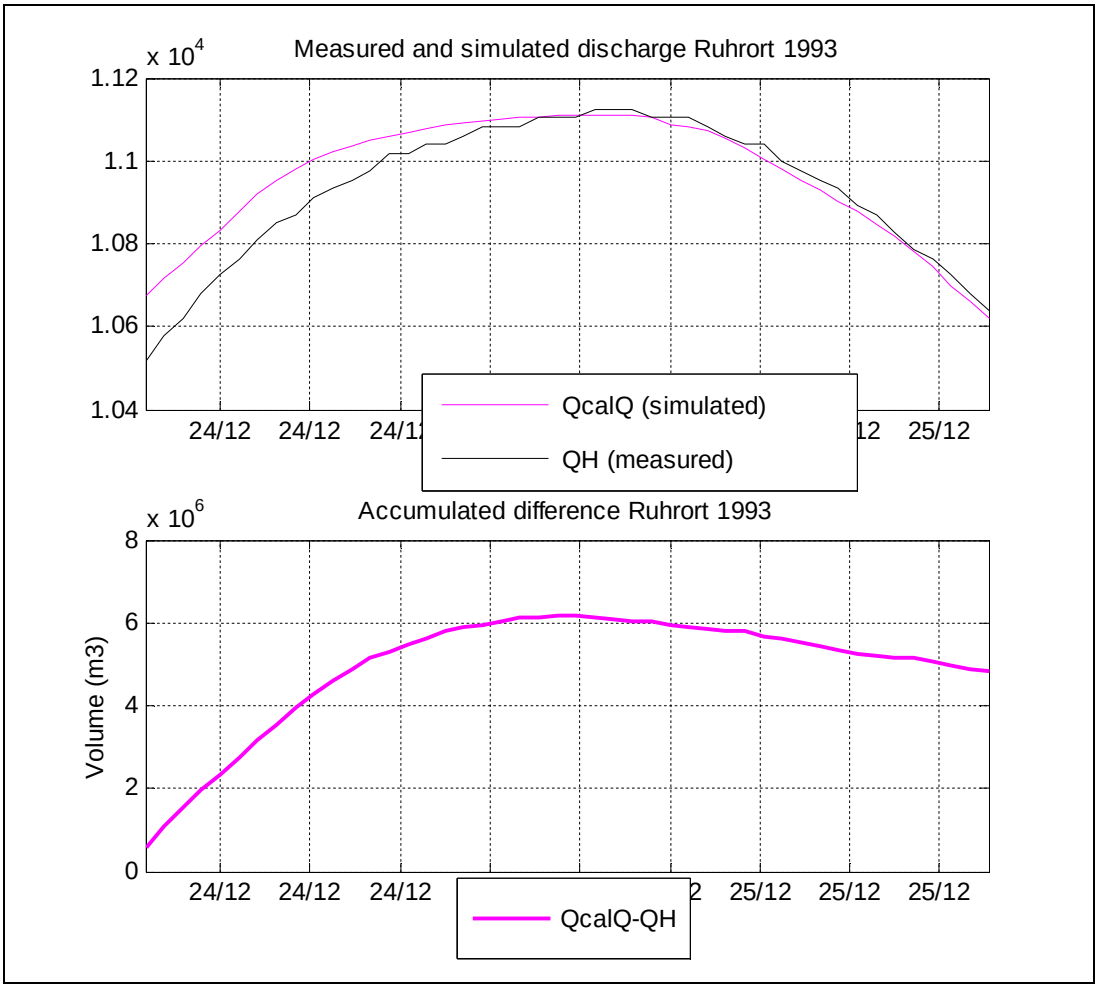

Figure B.32. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Ruhrort, (b) accumulated difference at Ruhrort for both the calibration set and the HBV set.

Table B.32. Overview waterbalance section 10: Düsseldorf-Ruhrort for the flood period of 1993 (in B$m^3=10^9$ m^3) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6$ m^3) are the laterals from the calibration set and the HBV set, respectively.

Section 10: Düsseldorf – Ruhrort Flood period: 23/12/1993 20:00 – 25/12/1993 17:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Ruhrort (%)**		
Düsseldorf	1.74			96.23		
Ruhrort	1.81			100.00		
Sum of Laterals	0.08			4.52		
I+SoL-O[1]	0.01			0.75		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Ruhrort (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Düsseldorf	1.74			96.23		
Ruhrort	1.82			100.27		
Sum of Laterals	0.08			4.52		
I+SoL-O[1]	0.01			0.48		
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Hattingen	81.83			100		
LowRhine2	0			0		
Sum of Laterals	81.83			100		

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

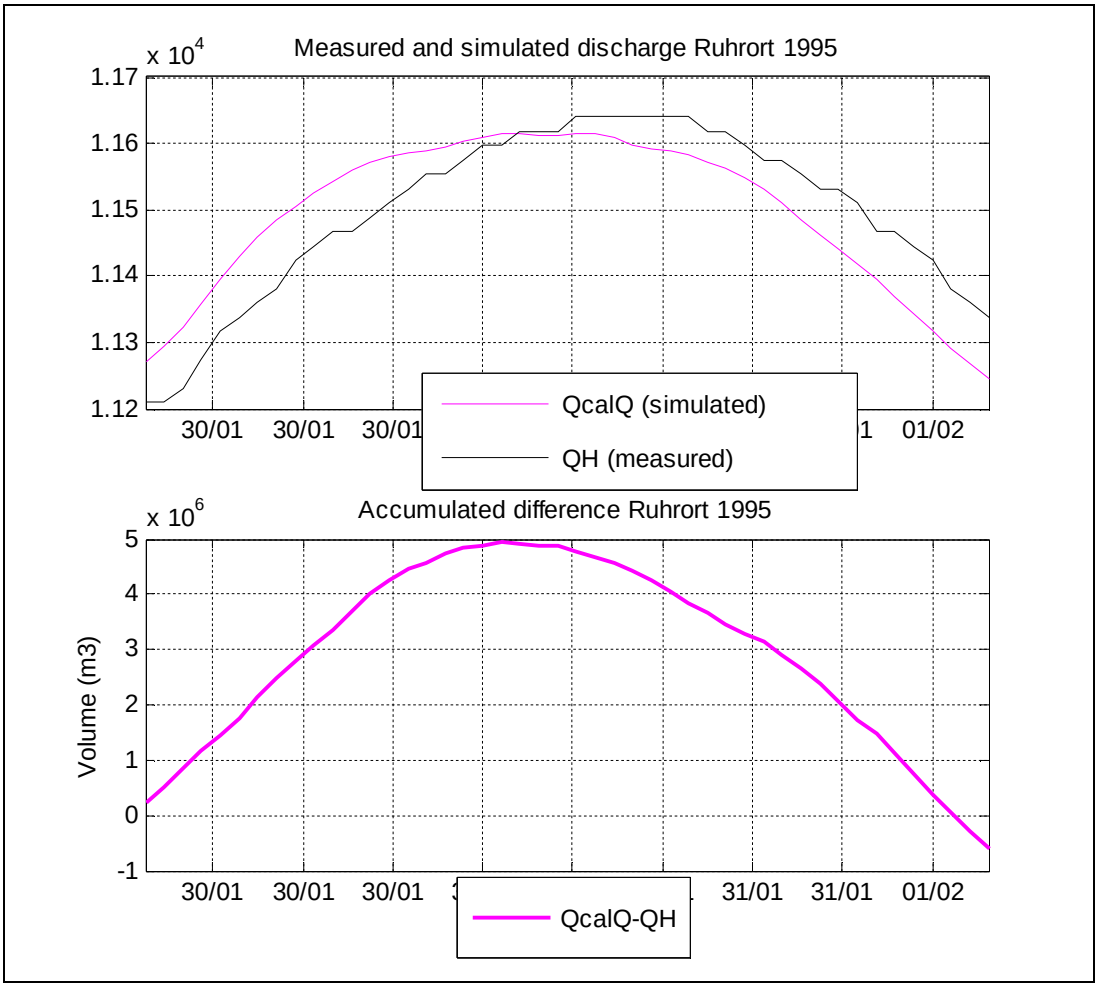

Figure B.33. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Ruhrort, (b) accumulated difference at Ruhrort for both the calibration set and the HBV set.

Table B.33. Overview waterbalance section 10: Düsseldorf-Ruhrort for the flood period of 1995 (in B$m^3=10^9$ m^3) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6$ m^3) are the laterals from the calibration set and the HBV set, respectively.

Section 10: Düsseldorf – Ruhrort Flood period: 30/01/1995 06:00 – 01/02/1995 03:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Ruhrort (%)**		
Düsseldorf	1.77			93.13		
Ruhrort	1.90			100.00		
Sum of Laterals	0.14			7.30		
I+SoL-O[1]	0.01			0.44		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Ruhrort (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Düsseldorf	1.77			93.13		
Ruhrort	1.90			99.97		
Sum of Laterals	0.14			7.30		
I+SoL-O[1]	0.01			0.47		
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Hattingen	139.04			100		
LowRhine2	0			0		
Sum of Laterals	139.04			100		

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

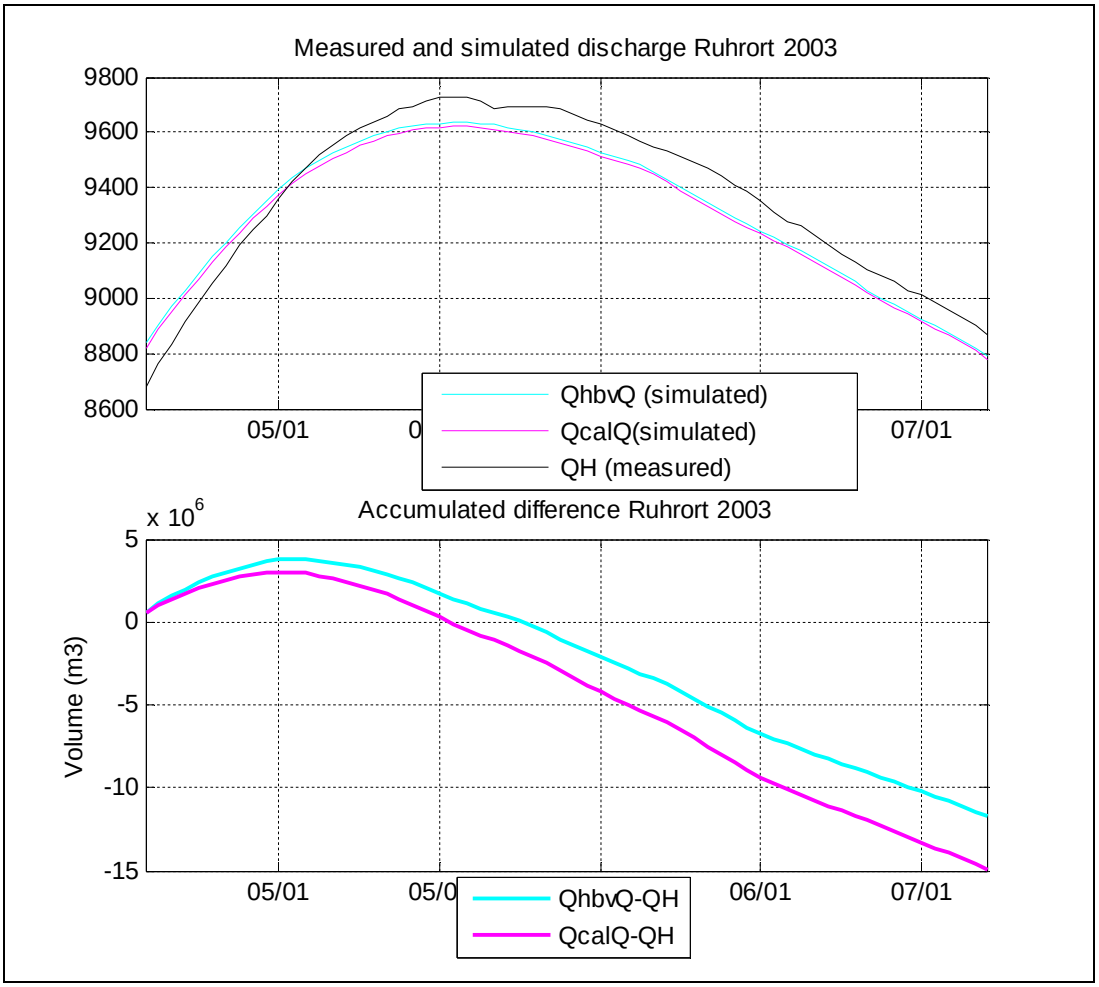

Figure B.34. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Ruhrort, (b) accumulated difference at Ruhrort for both the calibration set and the HBV set.

Table B.34. Overview waterbalance section 10: Düsseldorf-Ruhrort for the flood period of 2003 (in B$m^3=10^9$ m^3) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6$ m^3) are the laterals from the calibration set and the HBV set, respectively.

Section 10: Düsseldorf – Ruhrort Flood period: 04/01/2003 14:00 – 07/01/2003 05:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Ruhrort (%)**		
Düsseldorf	2.06			95.26		
Ruhrort	2.16			100.00		
Sum of Laterals	0.10			4.75		
I+SoL-O[1]	0.00			0.01		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Ruhrort (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Düsseldorf	2.06	2.06	0	95.26	95.26	0
Ruhrort	2.14	2.15	0.00	99.31	99.46	0.15
Sum of Laterals	0.10	0.11	0.00	4.75	4.93	0.18
I+SoL-O[1]	0.02	0.02	0.00	0.71	0.73	0.03
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Hattingen	102.59	102.59	0	100	100	0
LowRhine2	0	3.82	3.82	0	3.72	3.72
Sum of Laterals	102.59	106.41	3.82	100	103.72	3.72

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

B.10 Section 11: Ruhrort-Wesel

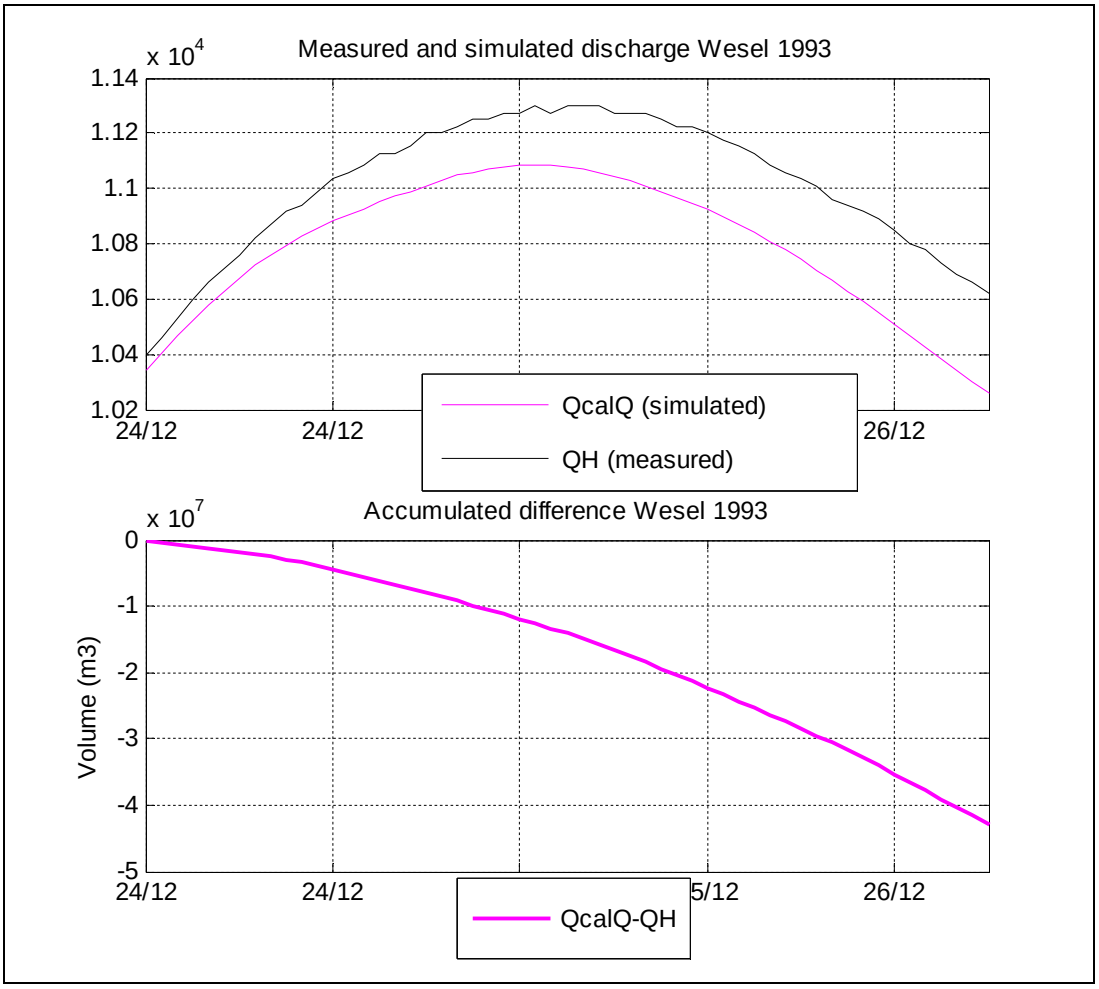

Figure B.35. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Wesel, (b) accumulated difference at Wesel for both the calibration set and the HBV set.

Table B.35. Overview waterbalance section 11: Ruhrort-Wesel for the flood period of 1993 (in B$m^3=10^9$ m^3) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6$ m^3) are the laterals from the calibration set and the HBV set, respectively.

Section 11: Ruhrort - Wesel Flood period: 24/12/1993 00:00 – 26/12/1993 06:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Wesel (%)**		
Ruhrort	2.14			98.09		
Wesel	2.18			100.00		
Sum of Laterals	0.01			0.41		
I+SoL-O[1]	-0.03			-1.51		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Wesel (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Ruhrort	2.14			98.09		
Wesel	2.14			98.03		
Sum of Laterals	0.01			0.41		
I+SoL-O[1]	0.01			0.46		
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Königstrasse	8.88			100		
LowRhine3a	0			0		
Sum of Laterals	8.88			100		

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

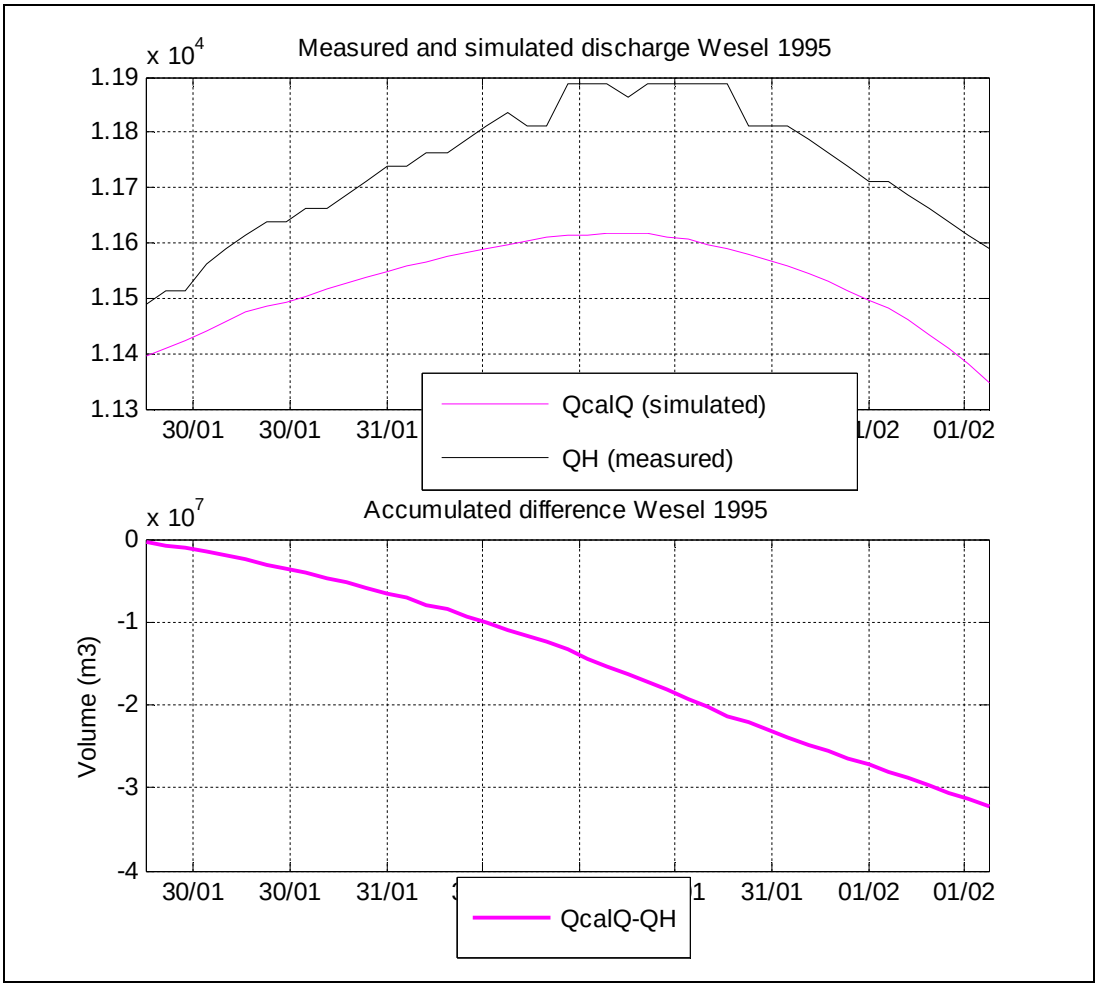

Figure B.36. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Wesel, (b) accumulated difference at Wesel for both the calibration set and the HBV set.

Table B.36. Overview waterbalance section 11: Ruhrort-Wesel for the flood period of 1995 (in B$m^3=10^9$ m^3) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6$ m^3) are the laterals from the calibration set and the HBV set, respectively.

Section 11: Ruhrort - Wesel Flood period: 30/01/1995 12:00 – 01/02/1995 06:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Wesel (%)**		
Ruhrort	1.78			98.08		
Wesel	1.82			100.00		
Sum of Laterals	0.01			0.57		
I+SoL-O[1]	-0.02			-1.35		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Wesel (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Ruhrort	1.78			98.08		
Wesel	1.78			98.23		
Sum of Laterals	0.01			0.57		
I+SoL-O[1]	0.01			0.43		
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Königstrasse	10.44			100		
LowRhine3a	0			0		
Sum of Laterals	10.44			100		

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

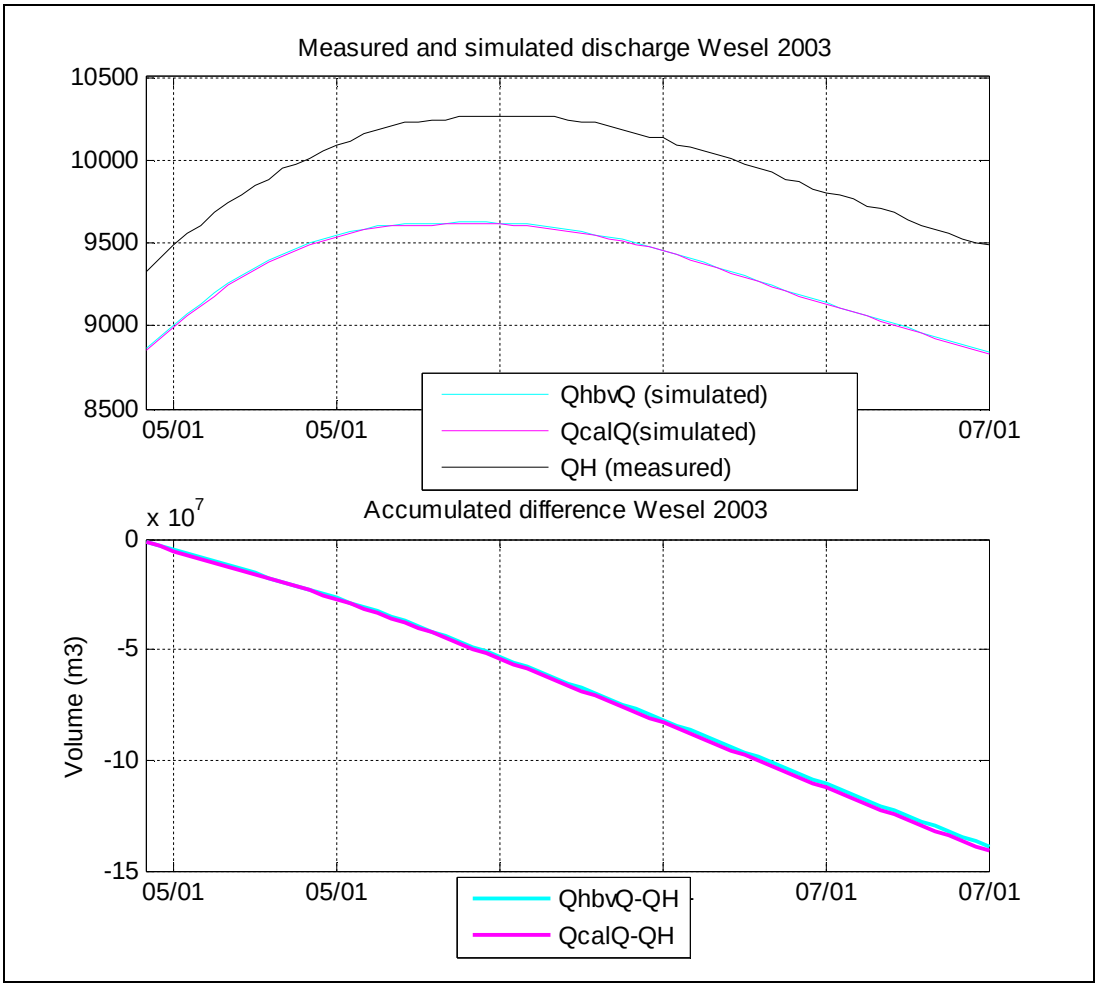

Figure B.37. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Wesel, (b) accumulated difference at Wesel for both the calibration set and the HBV set.

Table B.37. Overview waterbalance section 11: Ruhrort-Wesel for the flood period of 2003 (in B$m^3=10^9$ m^3) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6$ m^3) are the laterals from the calibration set and the HBV set, respectively.

Section 11: Ruhrort - Wesel Flood period: 04/01/2003 22:00 – 07/01/2003 12:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Wesel (%)**		
Ruhrort	2.12			94.02		
Wesel	2.26			100.00		
Sum of Laterals	0.01			0.31		
I+SoL-O[1]	-0.13			-5.67		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Wesel (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Ruhrort	2.12	2.12	0	94.02	94.02	0
Wesel	2.11	2.12	0.00	93.74	93.83	0.09
Sum of Laterals	0.01	0.01	0.00	0.31	0.36	0.05
I+SoL-O[1]	0.01	0.01	0.00	0.60	0.56	-0.04
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Königstrasse	7.09	7.09	0	100	100	0
LowRhine3a	0	1.06	1.06	0	15.02	15.02
Sum of Laterals	7.09	8.15	1.06	100	115.02	15.02

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

B.11 Section 12: Wesel-Rees

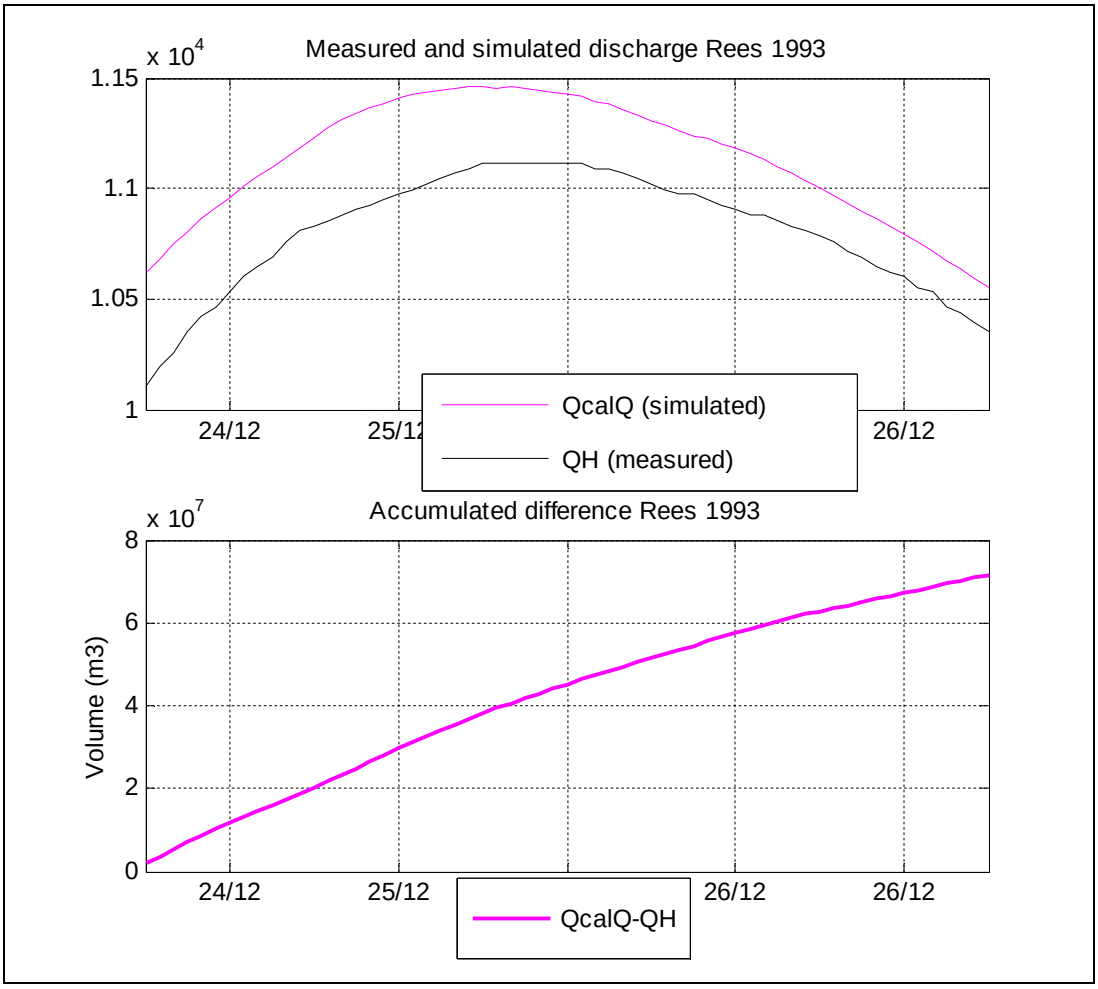

Figure B.38. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Rees, (b) accumulated difference at Rees for both the calibration set and the HBV set.

Table B.38. Overview waterbalance section 12: Wesel-Rees for the flood period of 1993 (in B$m^3=10^9$ m^3) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6$ m^3) are the laterals from the calibration set and the HBV set, respectively.

Section 12: Wesel – Rees Flood period: 24/12/1993 06:00 – 26/12/1993 18:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Rees(%)**		
Wesel	2.39			100.88		
Rees	2.37			100.00		
Sum of Laterals	0.05			2.31		
I+SoL-O[1]	0.08			3.19		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Rees (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Wesel	2.39			100.88		
Rees	2.44			103.02		
Sum of Laterals	0.05			2.31		
I+SoL-O[1]	0.00			0.17		
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Schermbeck	54.91			100		
LowRhine3b	0			0		
Sum of Laterals	54.91			100		

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

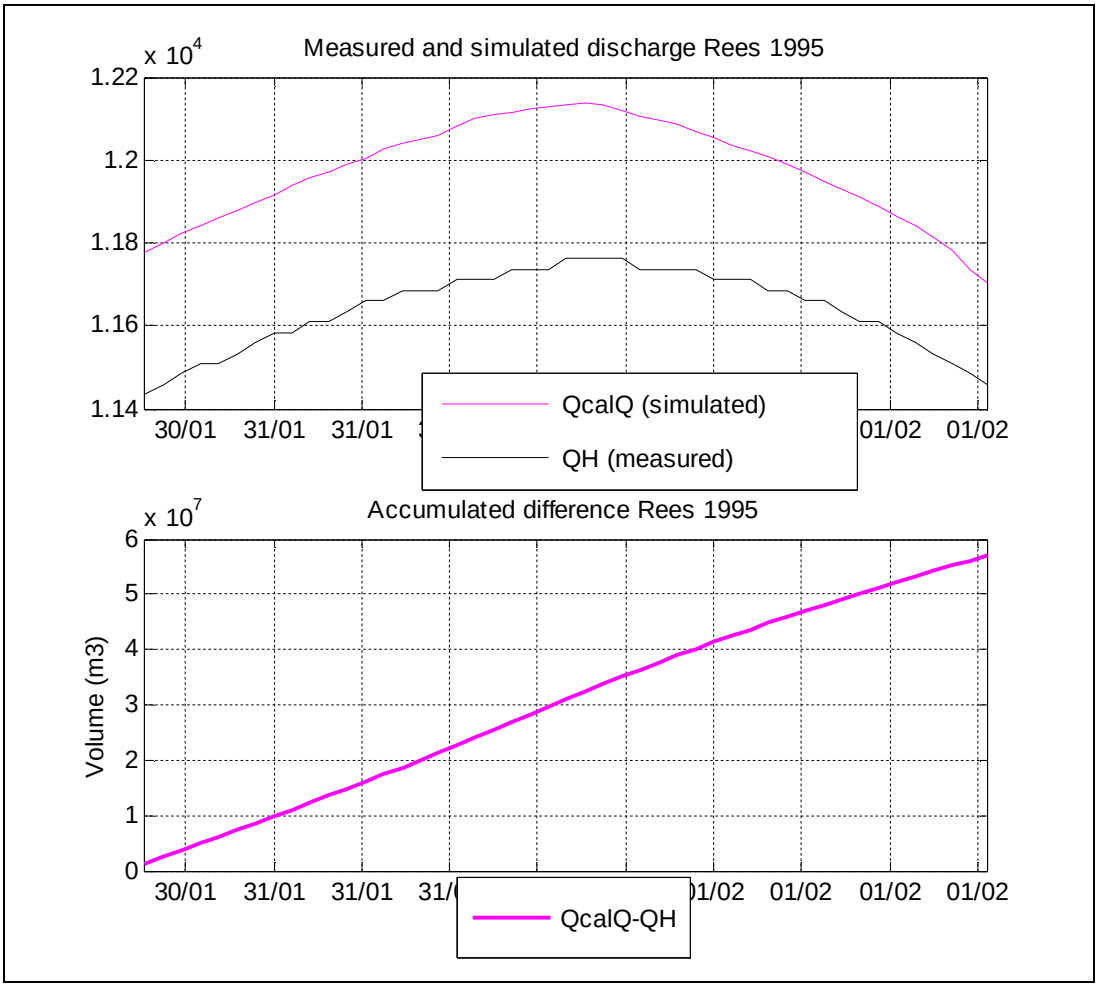

Figure B.39. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Rees, (b) accumulated difference at Rees for both the calibration set and the HBV set.

Table B.39. Overview waterbalance section 12: Wesel-Rees for the flood period of 1995 (in B$m^3=10^9$ m^3) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6$ m^3) are the laterals from the calibration set and the HBV set, respectively.

Section 12: Wesel – Rees Flood period: 30/01/1995 17:00 – 01/02/1995 15:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Rees(%)**		
Wesel	1.98			100.41		
Rees	1.97			100.00		
Sum of Laterals	0.06			2.82		
I+SoL-O[1]	0.06			3.23		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Rees (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Wesel	1.98			100.41		
Rees	2.03			102.89		
Sum of Laterals	0.06			2.82		
I+SoL-O[1]	0.01			0.33		
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Schermbeck	55.52			100		
LowRhine3b	0			0		
Sum of Laterals	55.52			100		

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

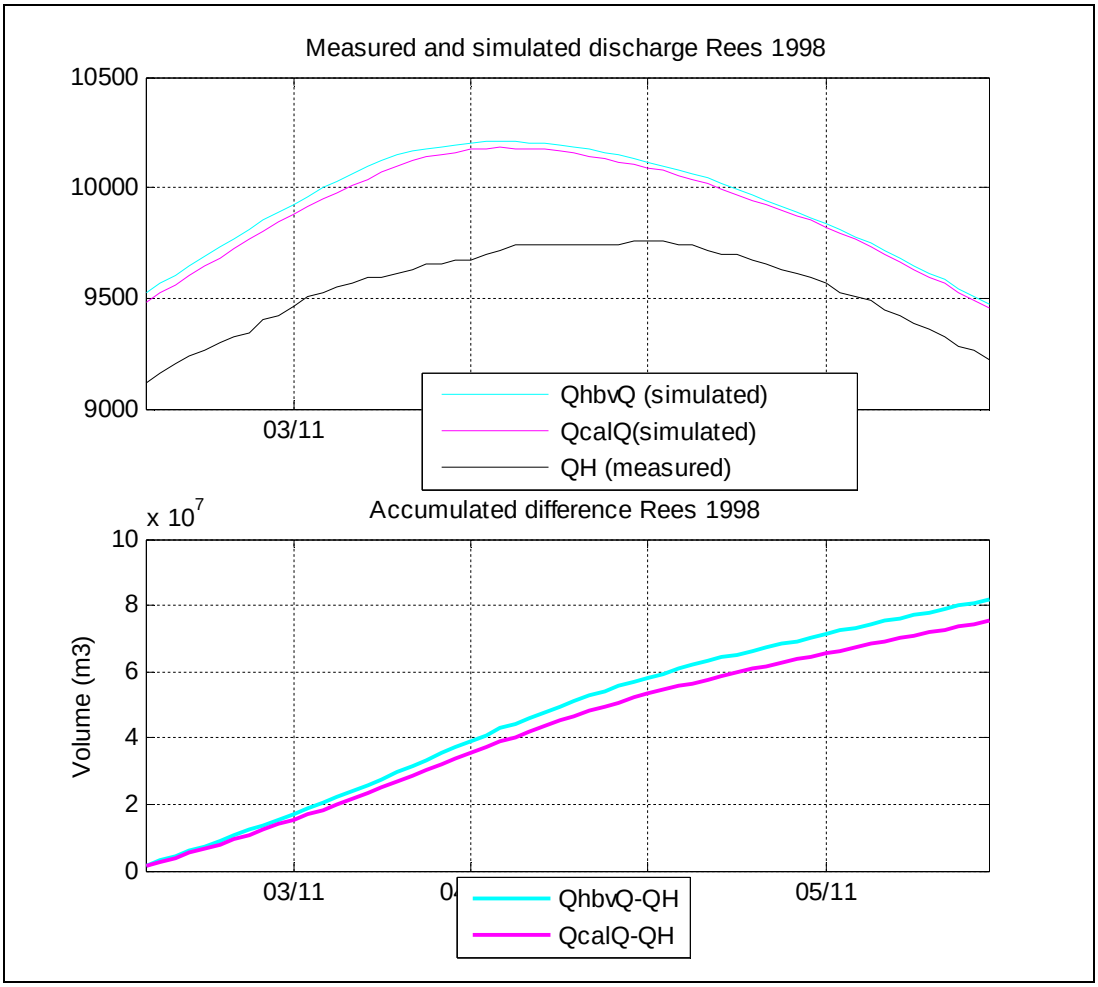

Figure B.40. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Rees, (b) accumulated difference at Rees for both the calibration set and the HBV set.

Table B.40. Overview waterbalance section 12: Wesel-Rees for the flood period of 1998 (in B$m^3=10^9$ m^3) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6$ m^3) are the laterals from the calibration set and the HBV set, respectively.

Section 12: Wesel – Rees Flood period: 03/11/1998 02:00 – 05/11/1998 11:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Rees(%)**		
Wesel	2.00			100.34		
Rees	1.99			100.00		
Sum of Laterals	0.08			3.84		
I+SoL-O[1]	0.08			4.18		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Rees (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Wesel	2.00	2.00	0	100.34	100.34	0
Rees	2.07	2.07	0.01	103.78	104.10	0.32
Sum of Laterals	0.08	0.08	0.01	3.84	4.14	0.30
I+SoL-O[1]	0.01	0.01	0.00	0.40	0.38	-0.02
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
Schermbeck	76.47	76.47	0	100	100	0
LowRhine3b	0	6.06	6.06	0	7.92	7.92
Sum of Laterals	76.47	82.52	6.06	100	107.92	7.92

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

B.12 Section 13: Rees-Emmerich

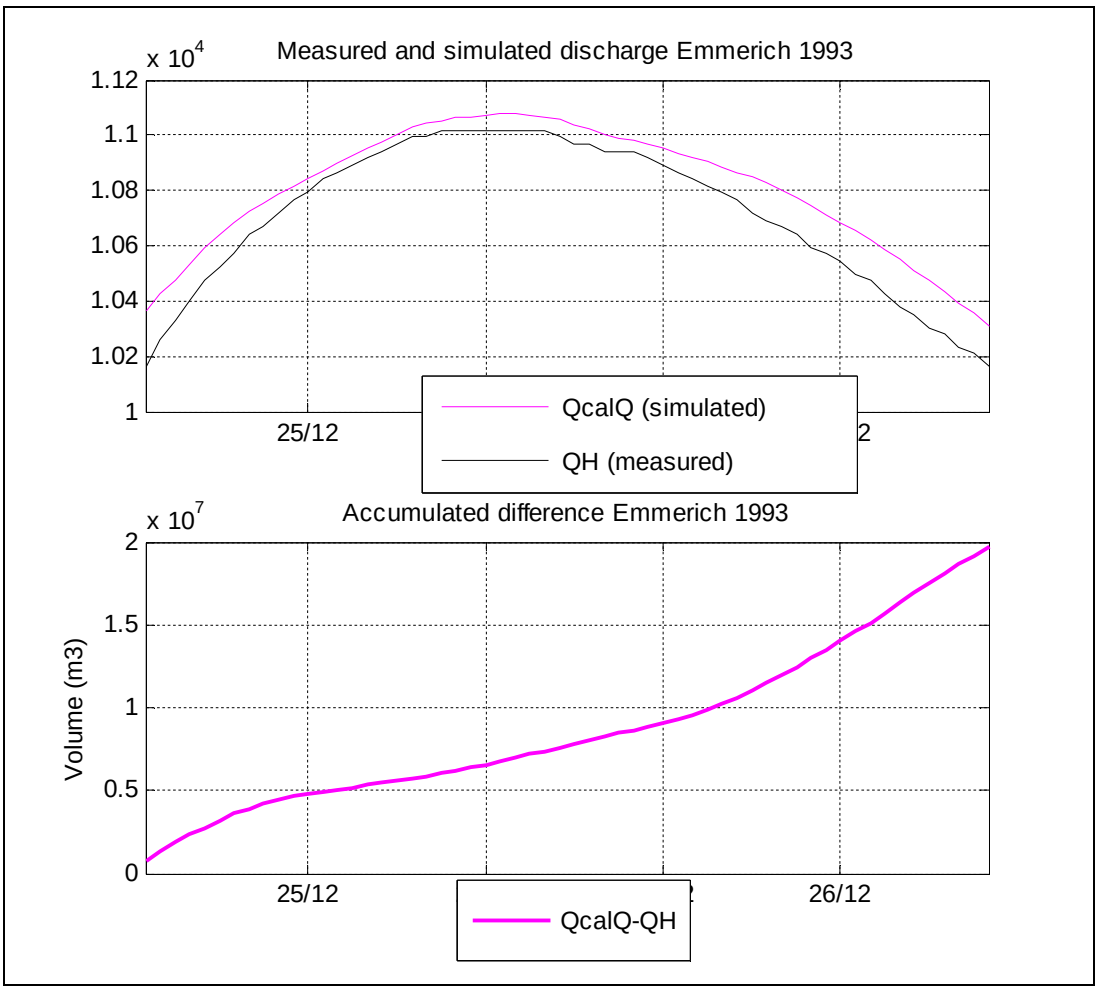

Figure B.41. (a)` Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Emmerich, (b) accumulated difference at Emmerich for both the calibration set and the HBV set.

Table B.41. Overview waterbalance section 13: Rees-Emmerich for the flood period of 1993 (in B$m^3=10^9\ m^3$) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6\ m^3$) are the laterals from the calibration set and the HBV set, respectively.

Section 13: Rees - Emmerich Flood period: 24/12/1993 13:00 – 26/12/1993 22:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Emmerich(%)**		
Rees	2.26			100.91		
Emmerich	2.24			100.00		
Sum of Laterals	0			0		
I+SoL-O[1]	0.02			0.91		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Emmerich (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Rees	2.26			100.91		
Emmerich	2.26			100.88		
Sum of Laterals	0			0.00		
I+SoL-O[1]	0.00			0.02		
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
LowRhine4	0			-		
Sum of Laterals	0			-		

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

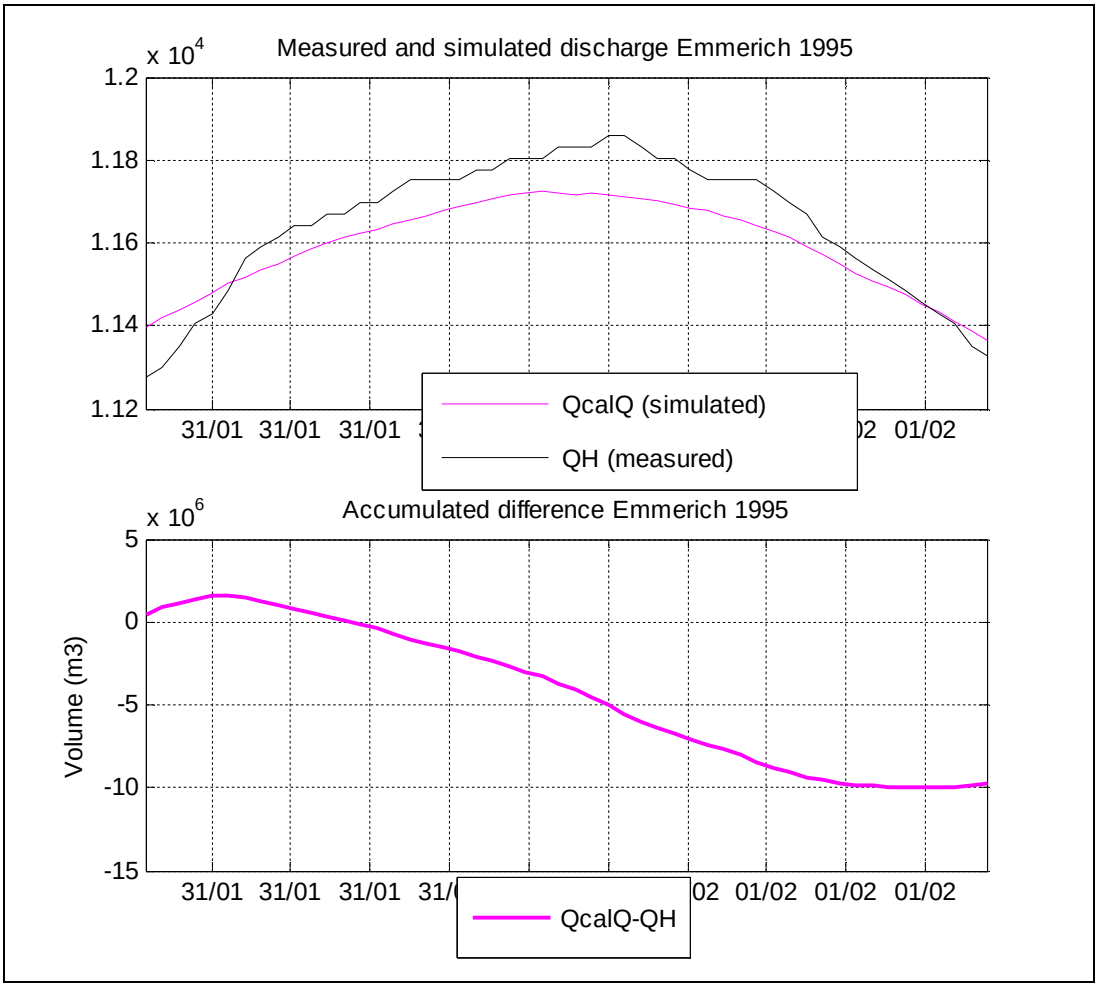

Figure B.42. (a)` Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Emmerich, (b) accumulated difference at Emmerich for both the calibration set and the HBV set.

Table B.42. Overview waterbalance section 13: Rees-Emmerich for the flood period of 1995 (in B$m^3=10^9$ m^3) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6$ m^3) are the laterals from the calibration set and the HBV set, respectively.

Section 13: Rees - Emmerich Flood period: 30/01/1995 20:00 – 01/02/1995 23:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Emmerich(%)**		
Rees	2.17			99.60		
Emmerich	2.18			100.00		
Sum of Laterals	0			0		
I+SoL-O[1]	-0.01			-0.40		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Emmerich (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Rees	2.17			99.60		
Emmerich	2.17			99.55		
Sum of Laterals	0			0.00		
I+SoL-O[1]	0.00			0.04		
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
LowRhine4	0			-		
Sum of Laterals	0			-		

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

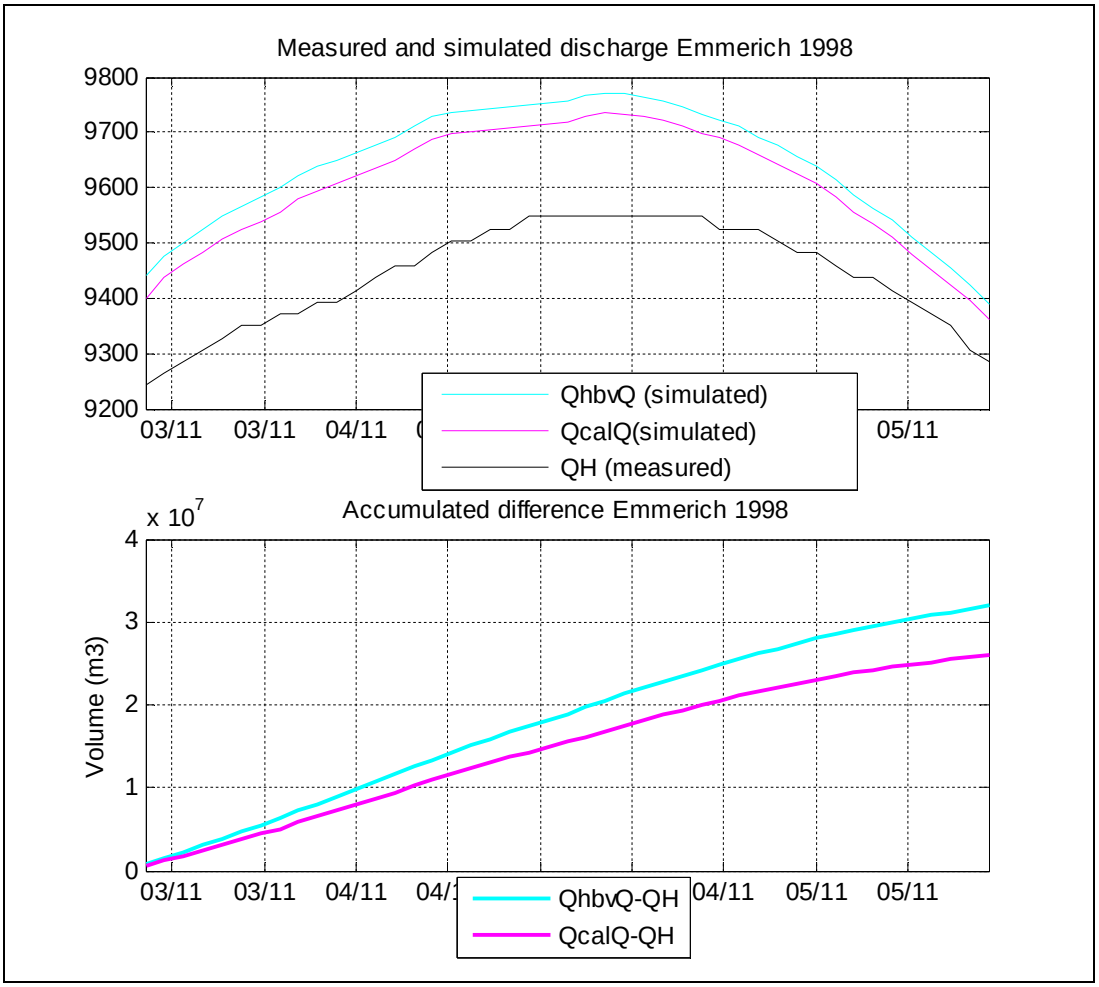

Figure B.43. (a)` Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Emmerich, (b) accumulated difference at Emmerich for both the calibration set and the HBV set.

Table B.43. Overview waterbalance section 13: Rees-Emmerich for the flood period of 1998 (in B$m^3=10^9\ m^3$) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6\ m^3$) are the laterals from the calibration set and the HBV set, respectively.

Section 13: Rees - Emmerich Flood period: 03/11/1998 13:00 – 05/11/1998 09:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Emmerich(%)**		
Rees	1.56			101.87		
Emmerich	1.53			100.00		
Sum of Laterals	0			0		
I+SoL-O[1]	0.03			1.87		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Emmerich (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Rees	1.56	1.56	0	101.87	101.87	0
Emmerich	1.56	1.56	0.01	101.70	102.09	0.39
Sum of Laterals	0	0.00	0.00	0.00	0.32	0.32
I+SoL-O[1]	0.00	0.00	0.00	0.17	0.10	-0.07
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
LowRhine4	0	4.89		-	-	
Sum of Laterals	0	4.89		-	-	

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

B.13 Section 14: Emmerich-Lobith

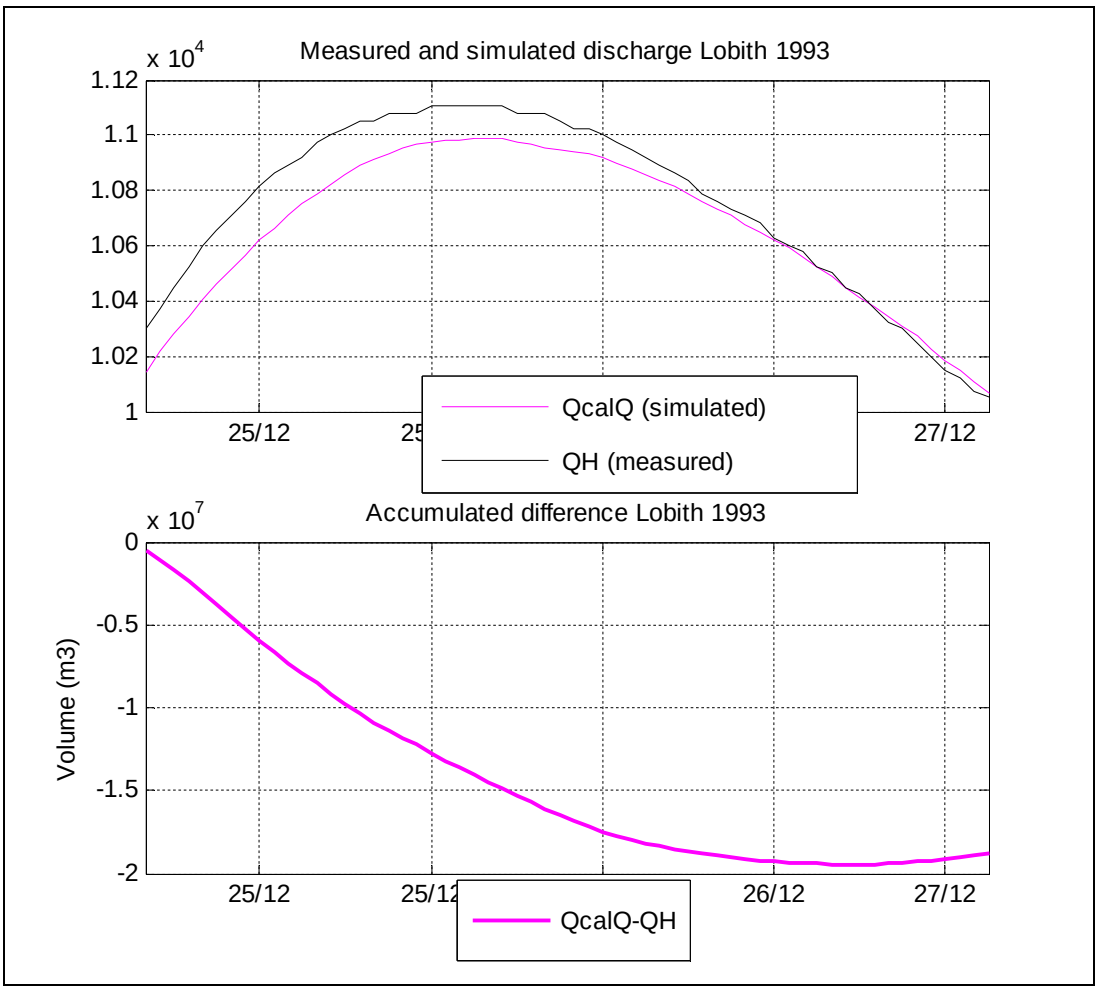

Figure B.44. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Lobith, (b) accumulated difference at Lobith for both the calibration set and the HBV set.

Table B.44. Overview waterbalance section 14: Emmerich-Lobith for the flood period of 1993 (in B$m^3=10^9\ m^3$) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6\ m^3$) are the laterals from the calibration set and the HBV set, respectively.

Section 14: Emmerich - Lobith Flood period: 24/12/1993 16:00 – 27/12/1993 03:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Lobith (%)**		
Emmerich	2.30			99.18		
Lobith	2.32			100.00		
Sum of Laterals	0			0		
I+SoL-O[1]	-0.02			-0.82		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Lobtih (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Emmerich	2.30			99.18		
Lobith	2.30			99.19		
Sum of Laterals	0			0.00		
I+SoL-O[1]	0.00			-0.01		
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
LowRhine4	0			-		
Sum of Laterals	0			-		

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

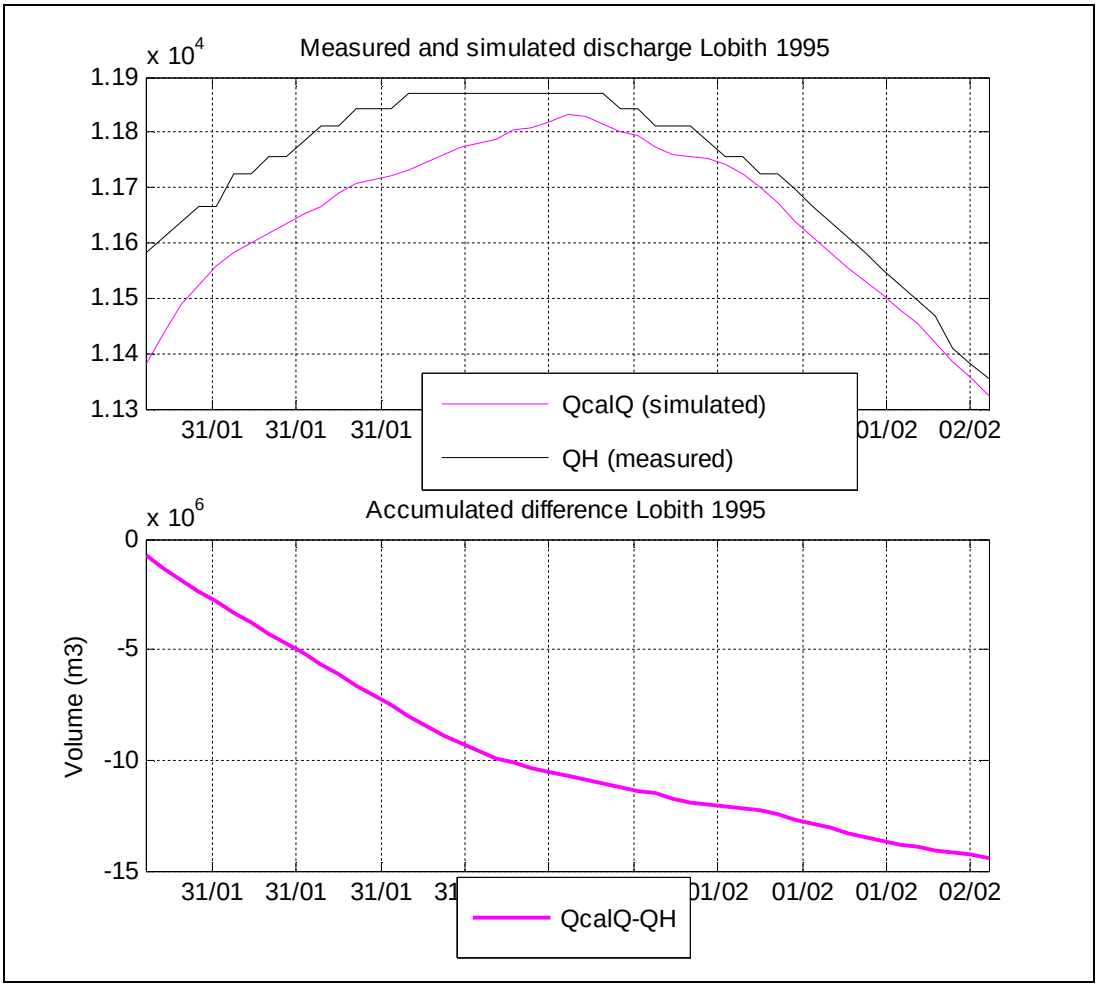

Figure B.45. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Lobith, (b) accumulated difference at Lobith for both the calibration set and the HBV set.

Table B.45. Overview waterbalance section 14: Emmerich-Lobith for the flood period of 1995 (in B$m^3=10^9\ m^3$) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6\ m^3$) are the laterals from the calibration set and the HBV set, respectively.

Section 14: Emmerich - Lobith Flood period: 31/01/1995 01:00 – 02/02/1995 01:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Lobith (%)**		
Emmerich	2.05			99.29		
Lobith	2.07			100.00		
Sum of Laterals	0			0		
I+SoL-O[1]	-0.01			-0.71		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Lobtih (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Emmerich	2.05			99.29		
Lobith	2.05			99.30		
Sum of Laterals	0			0		
I+SoL-O[1]	0.00			-0.01		
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
LowRhine4	0			-		
Sum of Laterals	0			-		

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

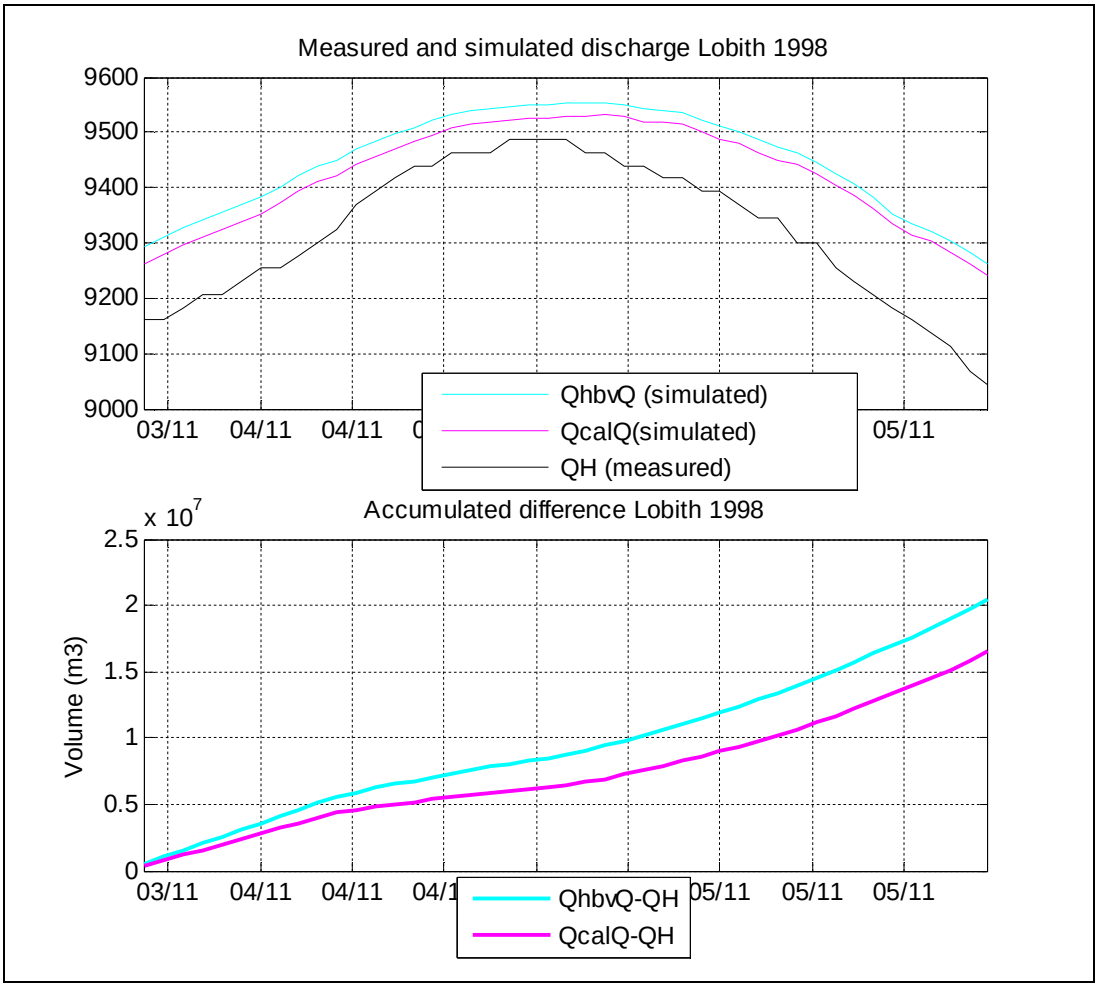

Figure B.46. (a) Measured discharge (black line, QH) versus simulated discharge (QcalQ) using the calibration set (magenta line) and (QhbvQ) the HBV set (cyan line) at Lobith, (b) accumulated difference at Lobith for both the calibration set and the HBV set.

Table B.46. Overview waterbalance section 14: Emmerich-Lobith for the flood period of 1998 (in B$m^3=10^9\ m^3$) based on measurements (QH) and two SOBEK simulations (QcalQ, laterals from calibration set) and (QhbvQ, laterals from HBV set). Δ indicates the difference between results obtained using the calibration set and the HBV set (HBV-cal). QcalL and QhbvL (in M$m^3=10^6\ m^3$) are the laterals from the calibration set and the HBV set, respectively.

Section 14: Emmerich - Lobith Flood period: 03/11/1998 18:00 – 05/11/1998 14:00						
Water balance from derived discharges						
	Average volume (Bm^3)			**Average volume relative to QH Lobith (%)**		
Emmerich	1.53			101.26		
Lobith	1.51			100.00		
Sum of Laterals	0			0		
I+SoL-O[1]	0.02			1.26		
Water balance from SOBEK calculations						
	Average volume (Bm^3)			**Average volume relative to QH Lobtih (%)**		
	QcalQ	**QhbvQ**	**Δ**	**QcalQ**	**QhbvQ**	**Δ**
Emmerich	1.53	1.53	0	101.26	101.26	0
Lobith	1.53	1.53	0.00	101.09	101.36	0.26
Sum of Laterals	0	0.00	0.00	0.00	0.31	0.31
I+SoL-O[1]	0.00	0.00	0.00	0.16	0.20	0.04
Overview laterals						
	Average volume (Mm^3)			**Average volume relative to sum of laterals QcalL (%)**		
	QcalL	**QhbvL**	**Δ**	**QcalL**	**QhbvL**	**Δ**
LowRhine4	0	4.62		-	-	
Sum of Laterals	0	4.62		-	-	

[1]I =inflow upstream, O=outflow downstream, SoL=Sum of Laterals.

C Laterals

C.1 Section1: Maxau-Speyer

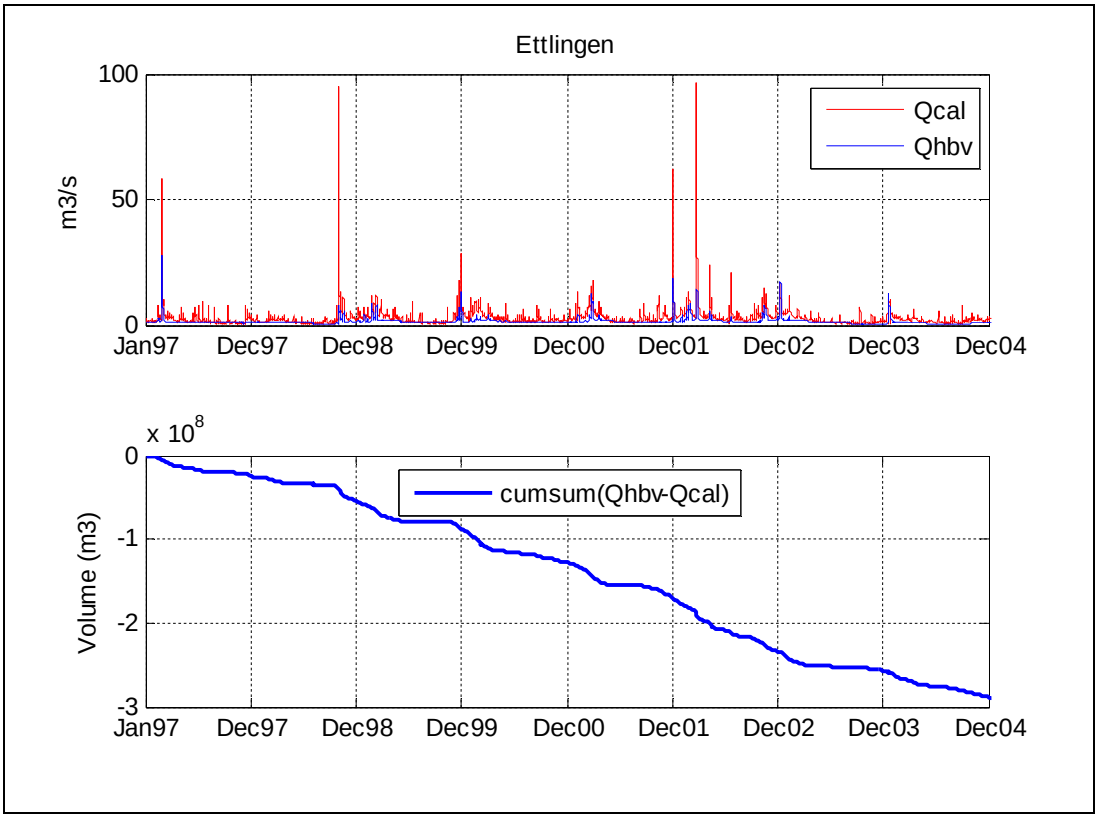

Figure C.1. (a) Calibration set lateral versus HBV set lateral for Ettlingen, (b) accumulated difference between simulation and measurement.

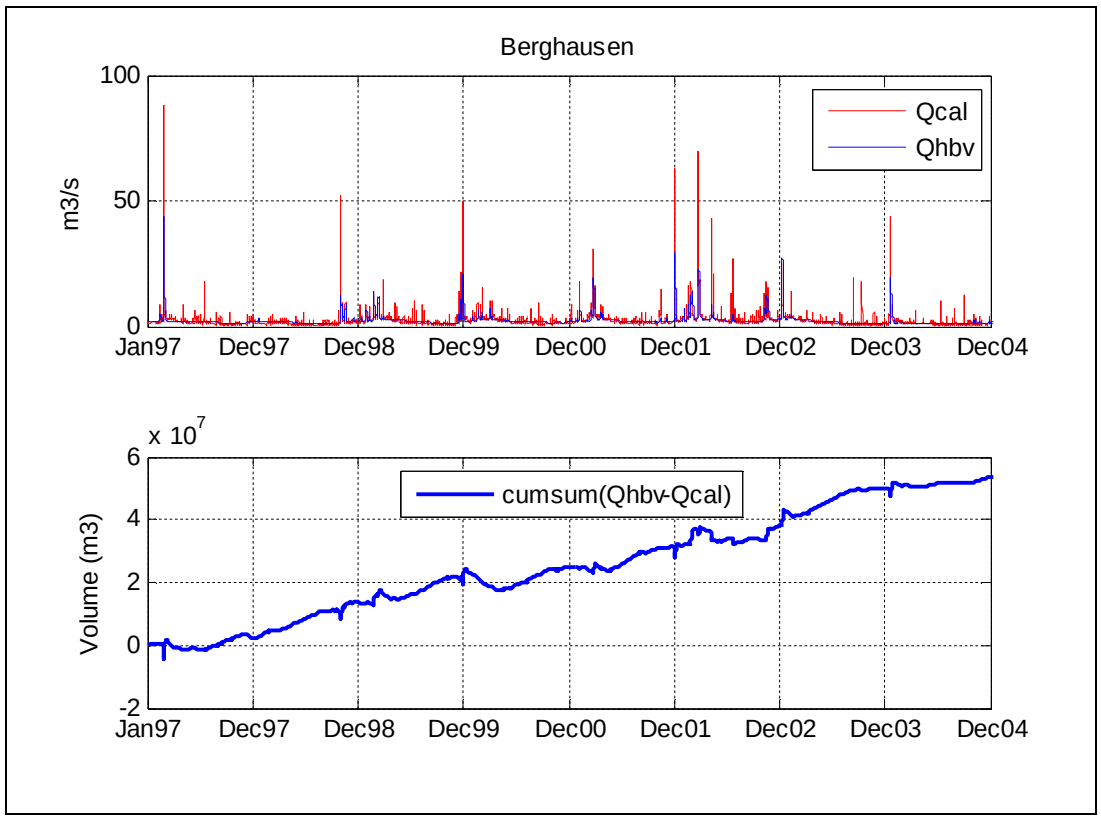

Figure C.2. (a) Calibration set lateral versus hbv set lateral for Berghausen(b) accumulated difference between simulation and measurement.

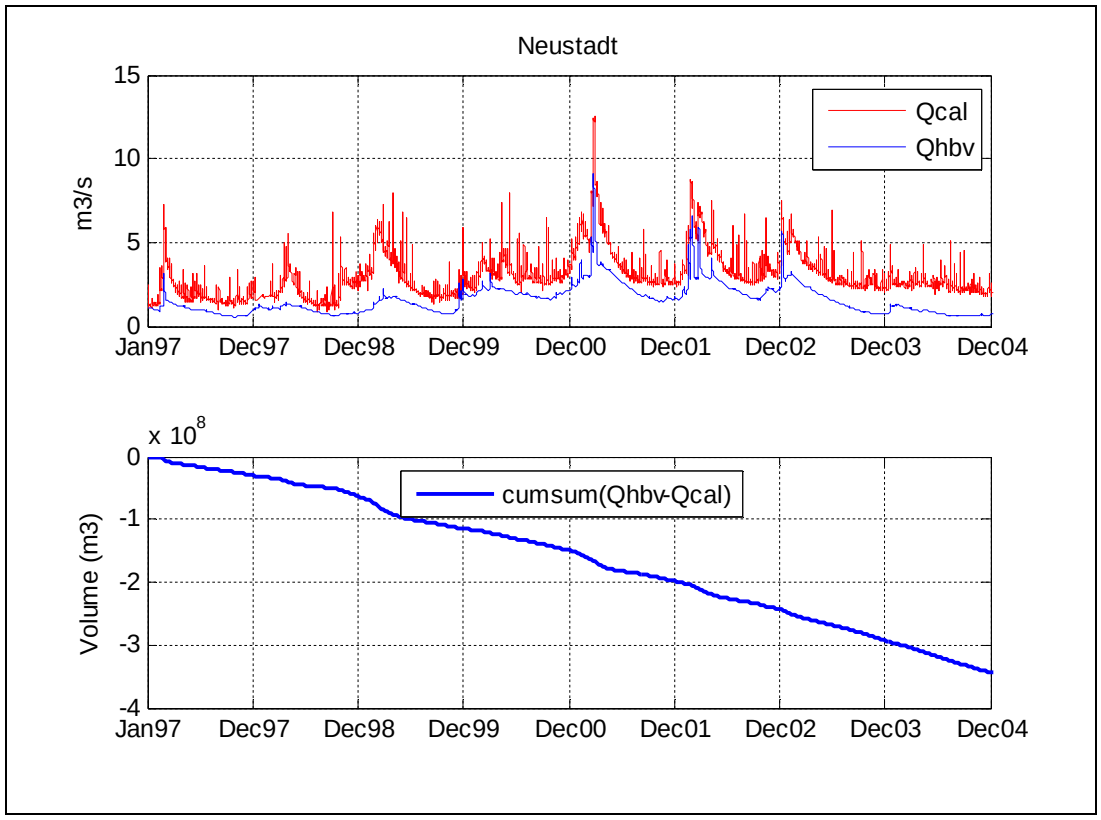

Figure C.3. (a) Calibration set lateral versus HBV set lateral for Neustadt, (b) accumulated difference between simulation and measurement.

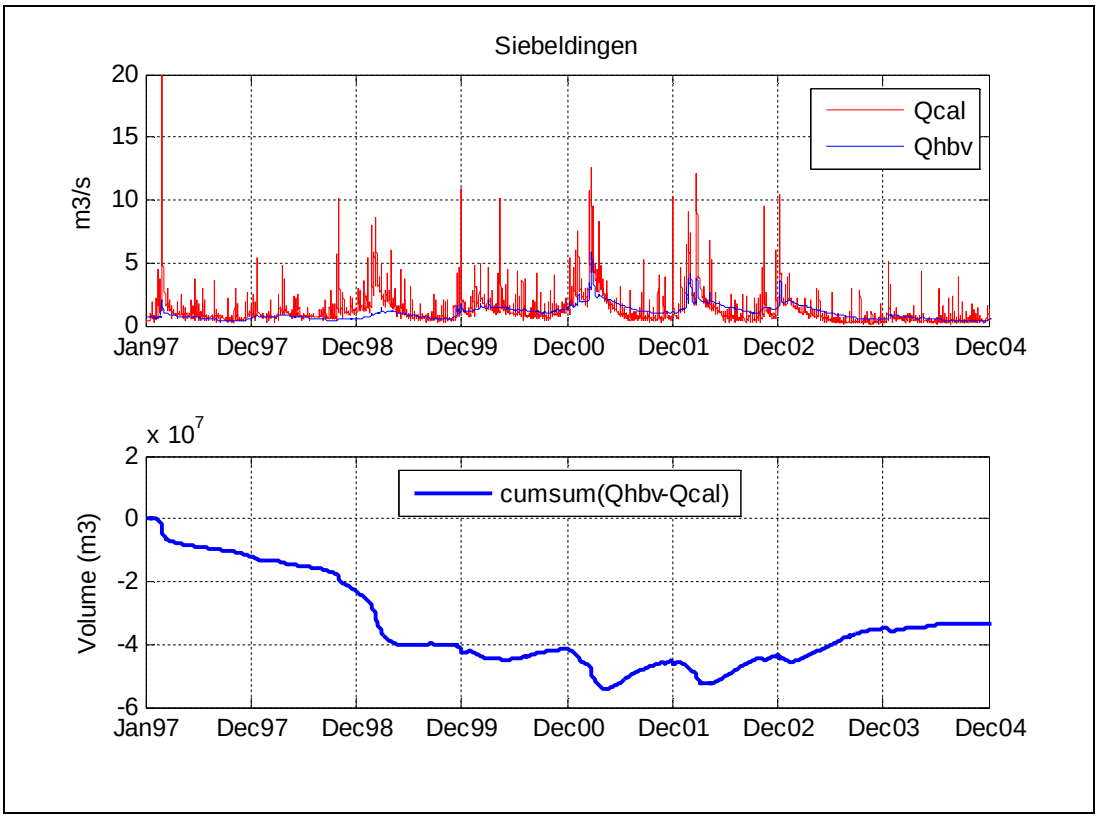

Figure C.4. (a) Calibration set lateral versus HBV set lateral for Siebeldingen, (b) accumulated difference between simulation and measurement.

C.2 Section 2: Speyer-Worms

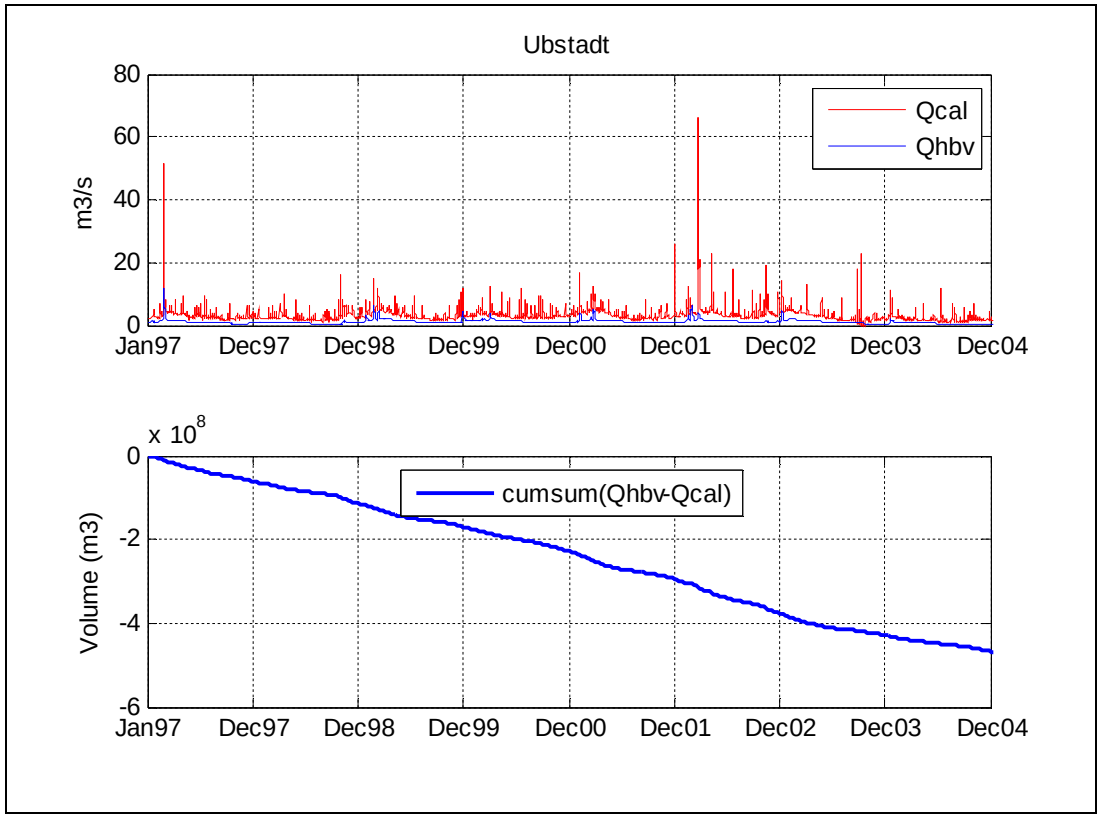

Figure C.5. (a) Calibration set lateral versus HBV set lateral for Ubstadt, (b) accumulated difference between simulation and measurement.

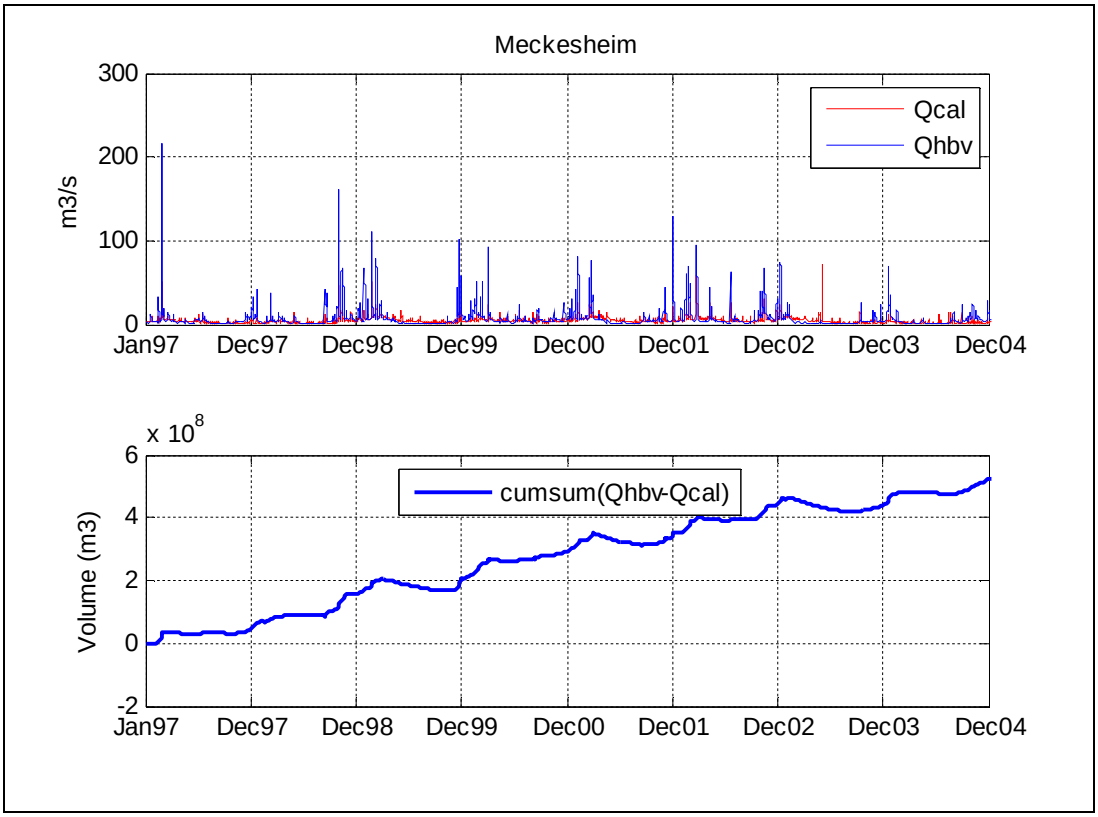

Figure C.6. (a) Calibration set lateral versus HBV set lateral for Meckesheim, (b) accumulated difference between simulation and measurement.

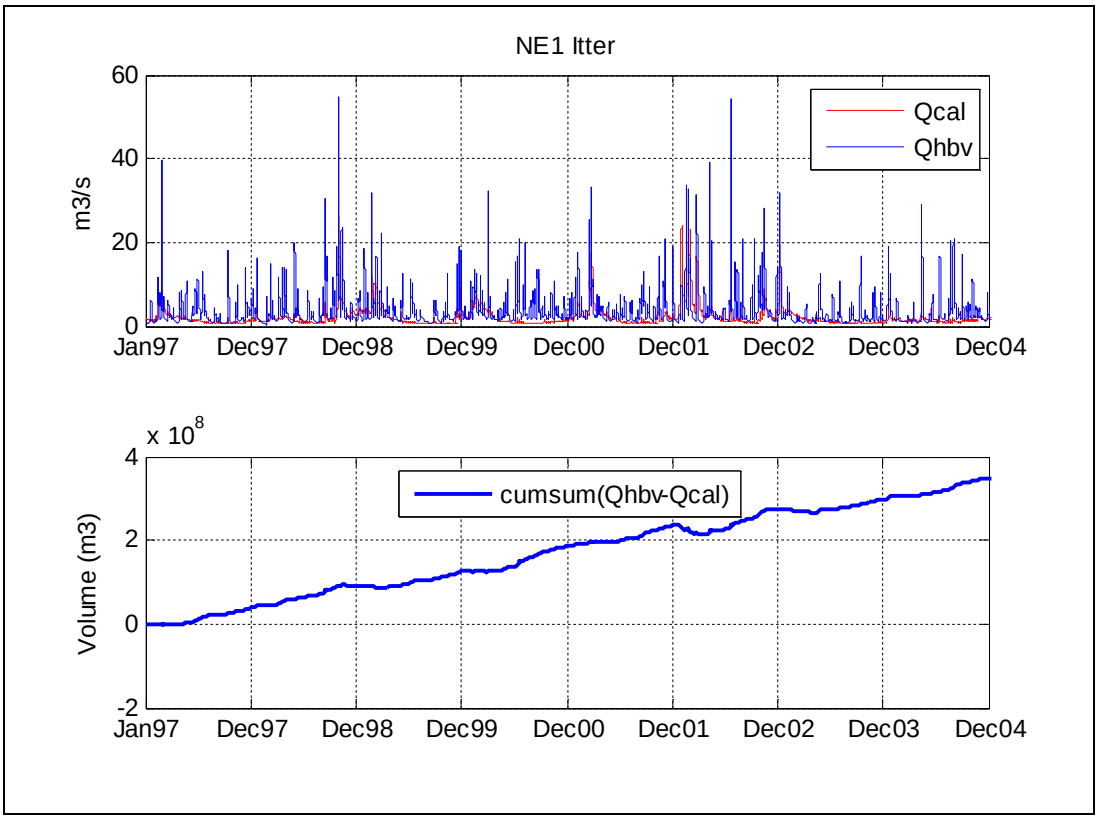

Figure C.7. (a) Calibration set lateral versus HBV set lateral for NE1_Itter, (b) accumulated difference between simulation and measurement.

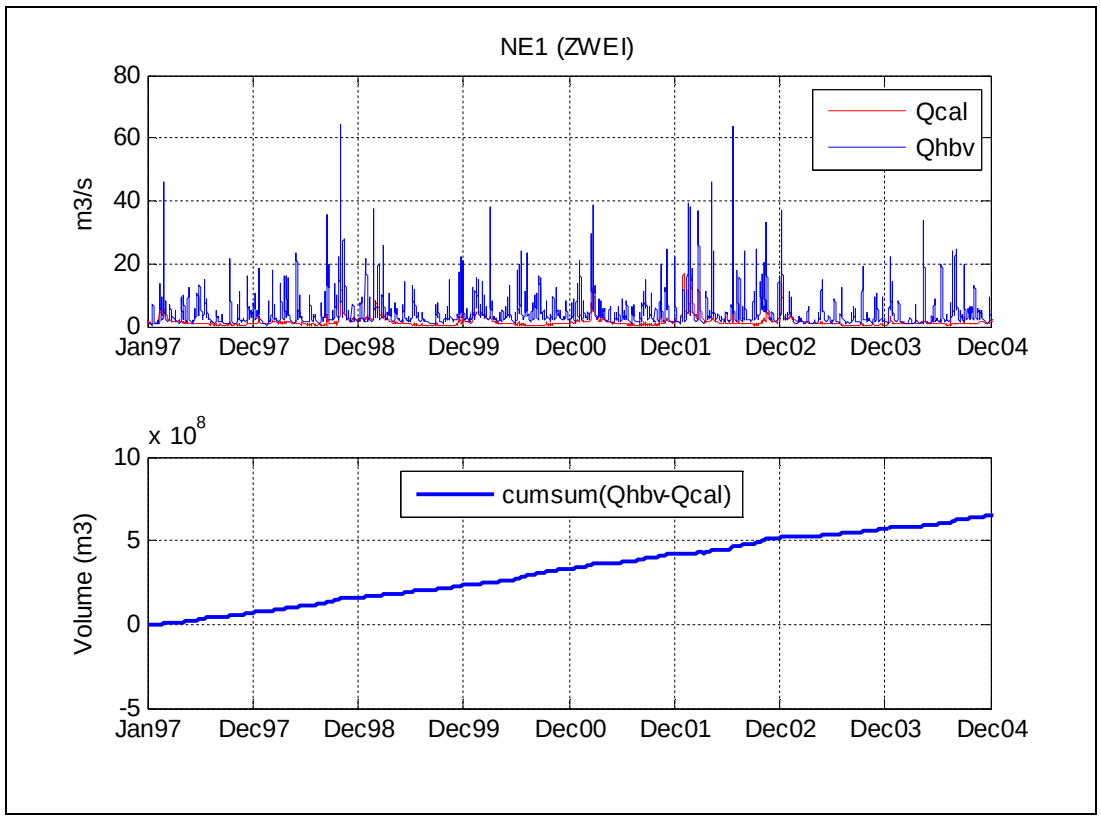

Figure C.8. (a) Calibration set lateral versus HBV set lateral for NE1_ZWE5/I, (b) accumulated difference between simulation and measurement.

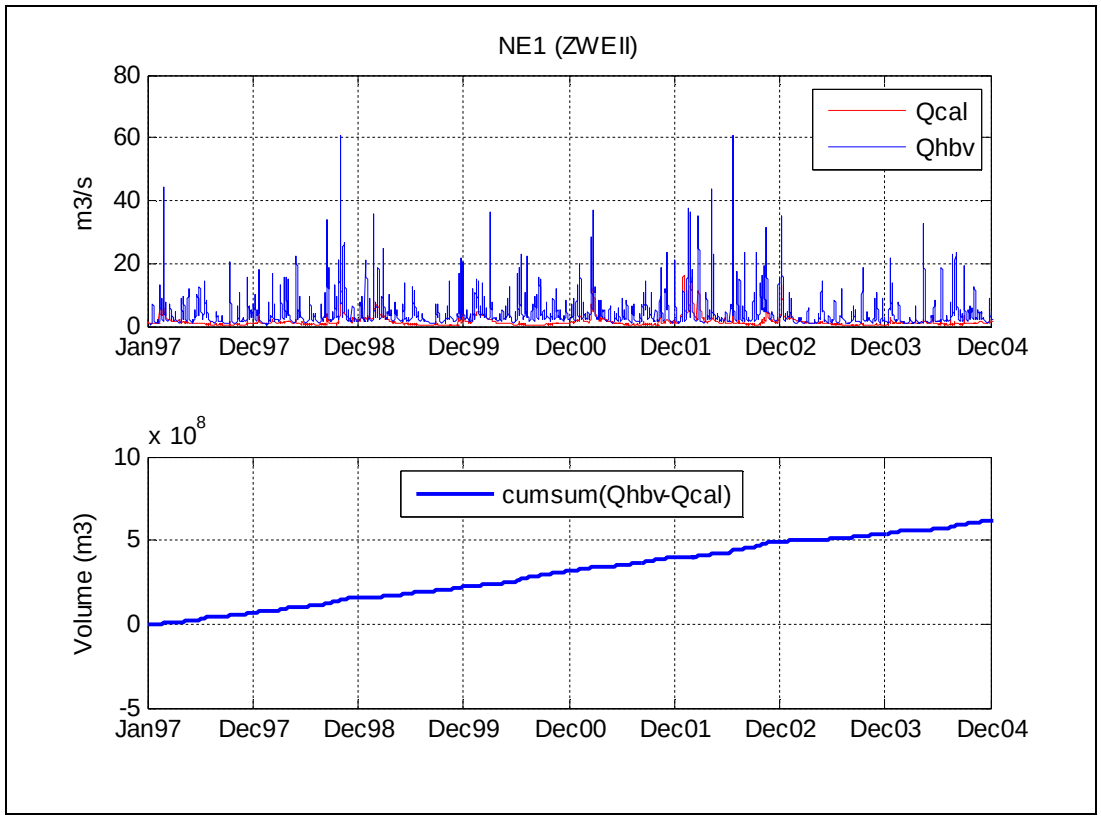

Figure C.9. (a) Calibration set lateral versus HBV set lateral for NE1_ZWE5/II, (b) accumulated difference between simulation and measurement.

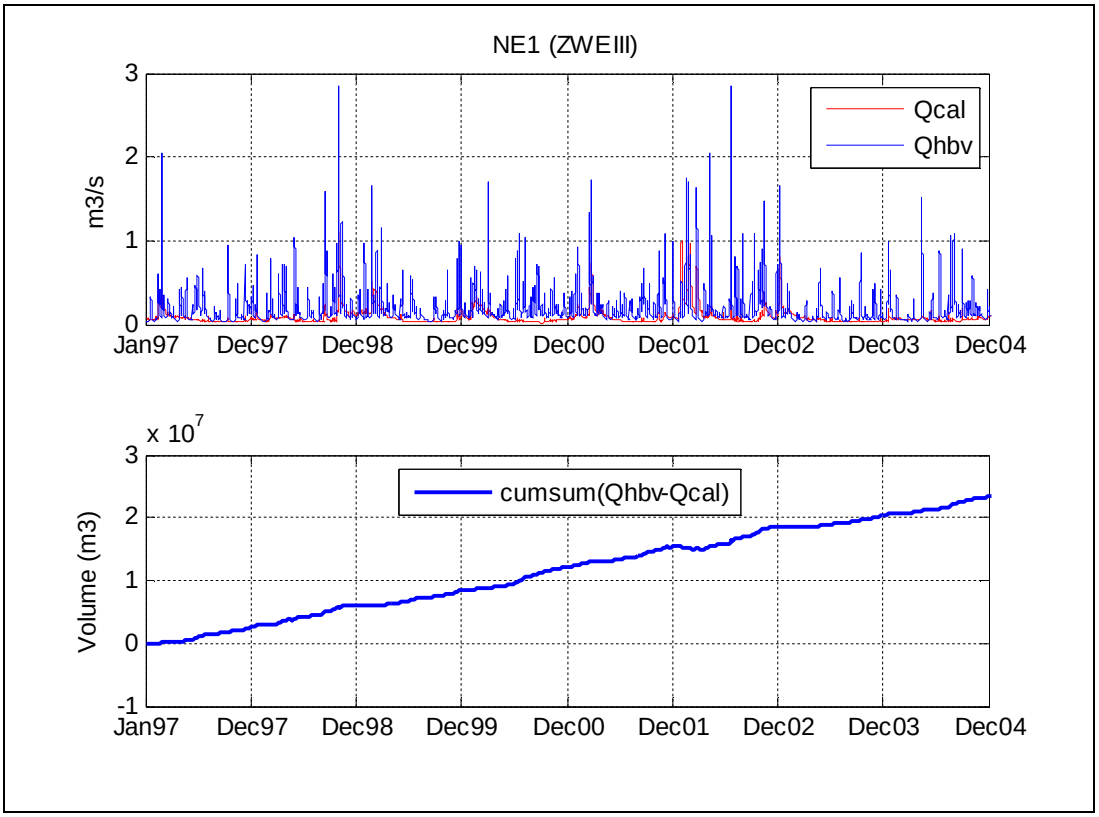

Figure C.10. (a) Calibration set lateral versus HBV set lateral for NE1_ZWE5/III, (b) accumulated difference between simulation and measurement.

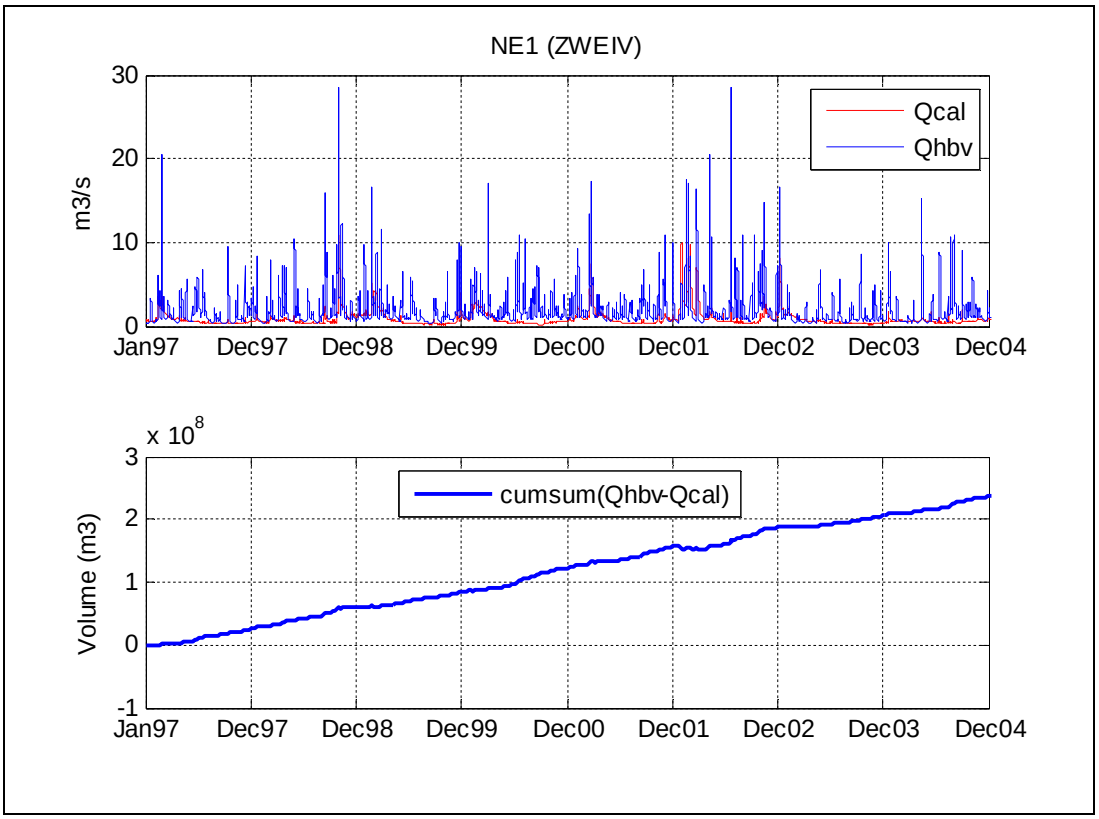

Figure C.11. (a) Calibration set lateral versus HBV set lateral for NE1_ZWE5/IV, (b) accumulated difference between simulation and measurement.

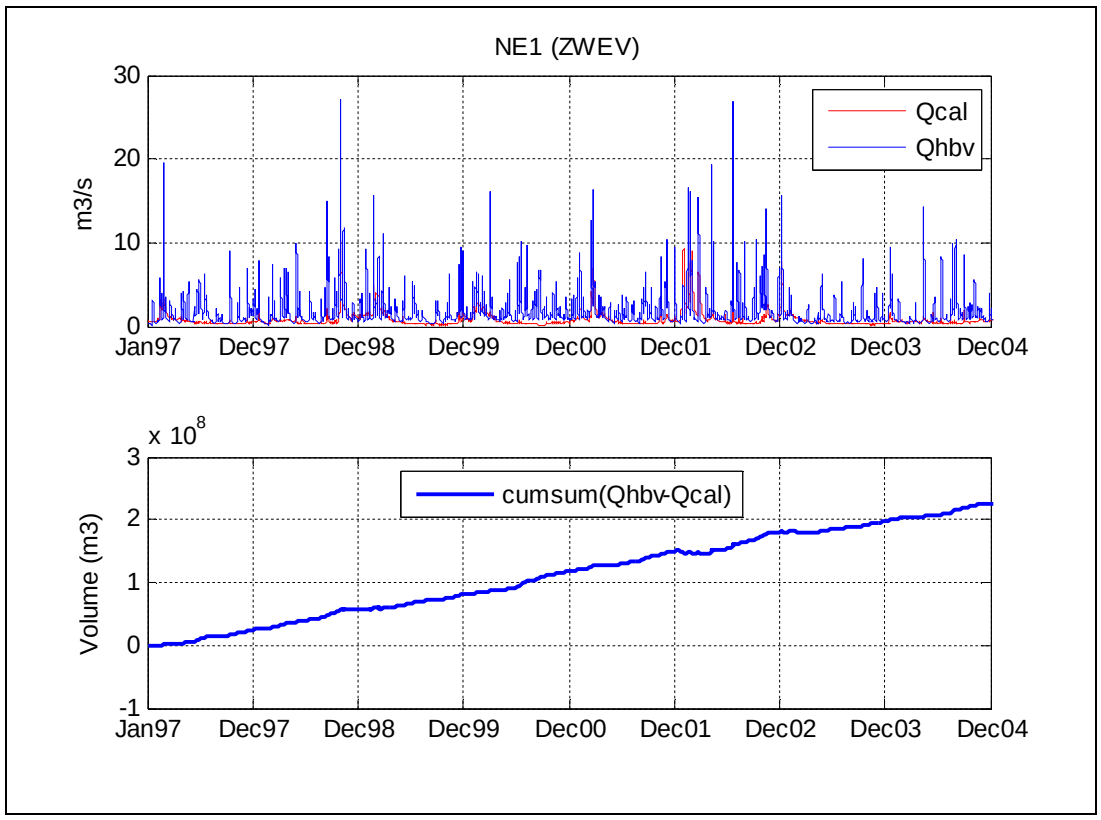

Figure C.12. (a) Calibration set lateral versus HBV set lateral for NE1_ZWE5/V, (b) accumulated difference between simulation and measurement.

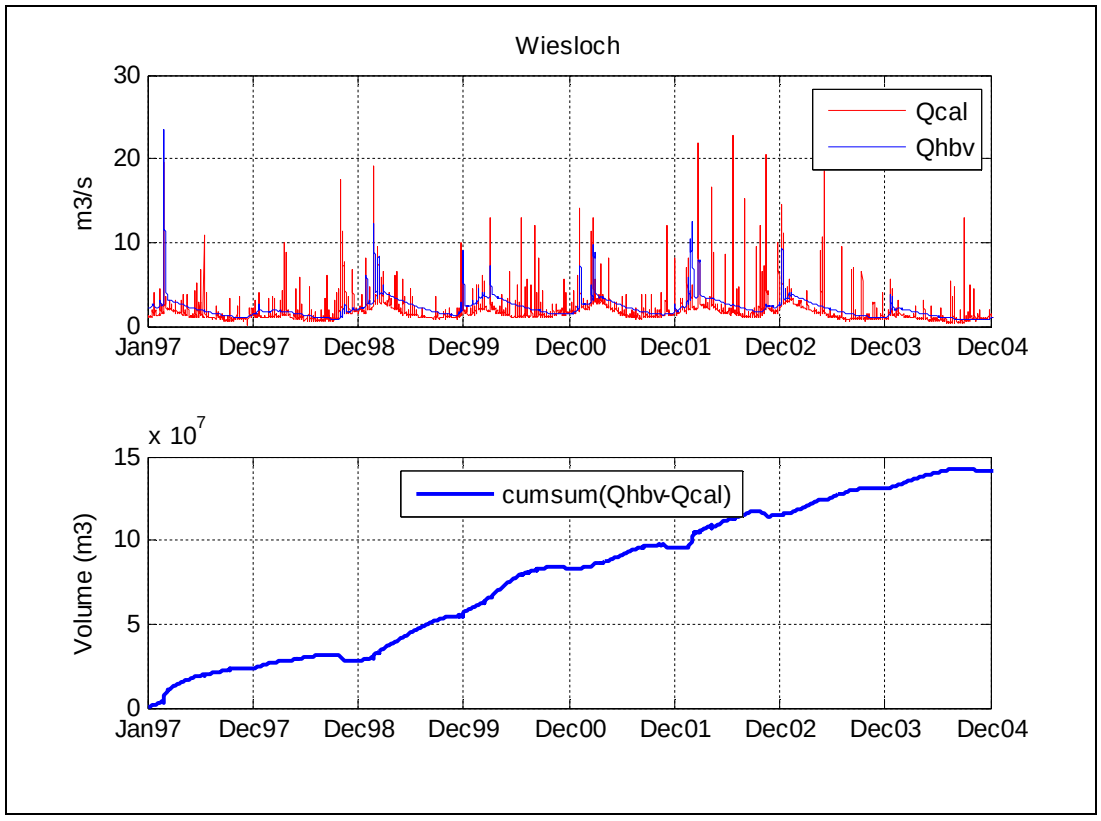

Figure C.13. (a) Calibration set lateral versus HBV set lateral for Wiesloch, (b) accumulated difference between simulation and measurement.

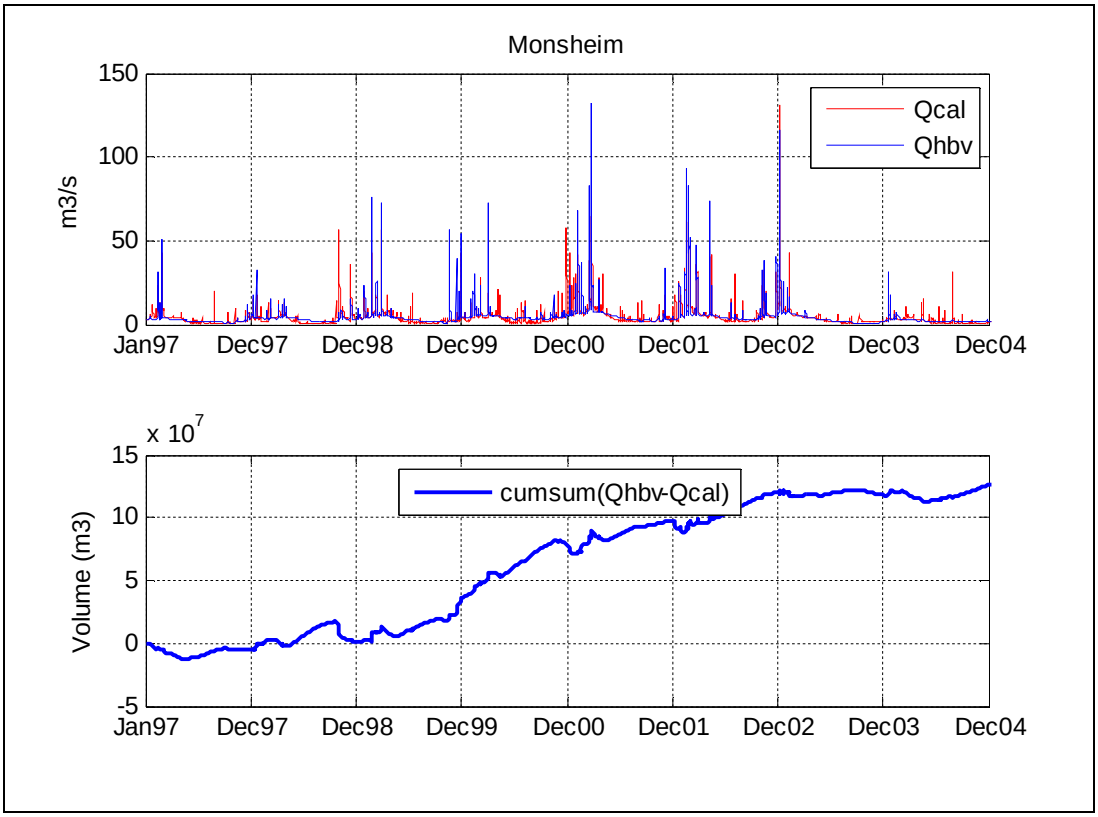

Figure C.14. (a) Calibration set lateral versus HBV set lateral for Monsheim, (b) accumulated difference between simulation and measurement.

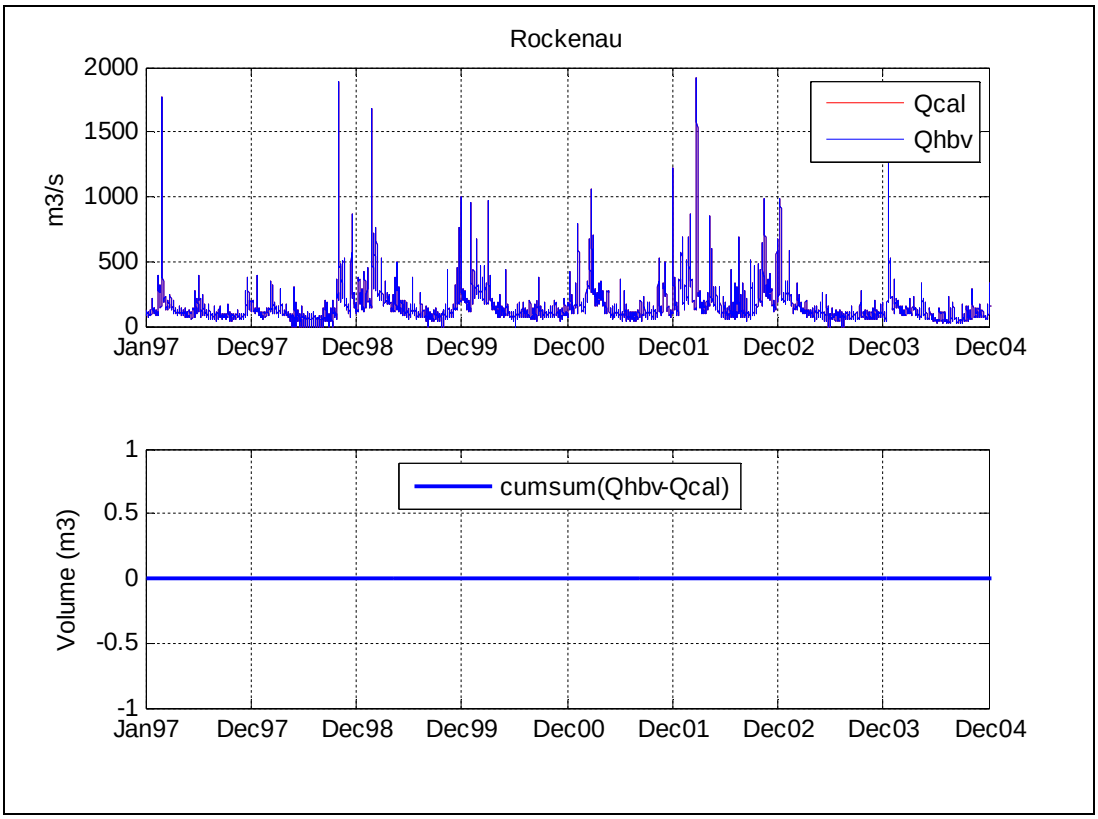

Figure C.15. (a) Calibration set lateral versus HBV set lateral for Rockenau, (b) accumulated difference between simulation and measurement.

C.3 Section 3: Worms-Mainz

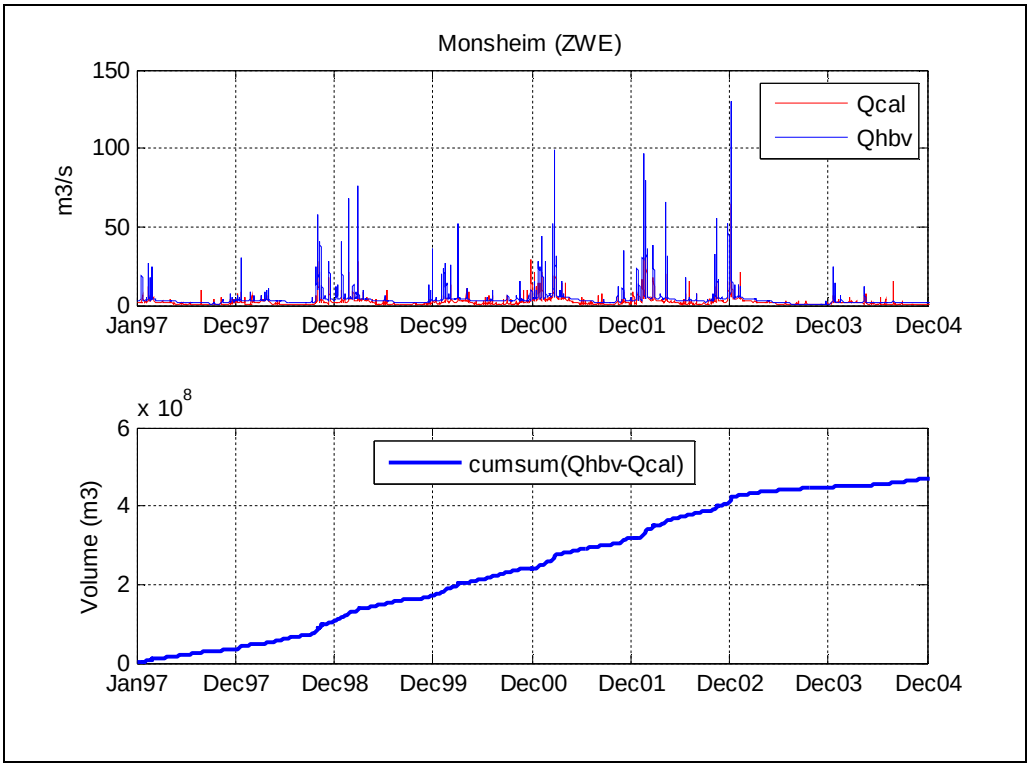

Figure C.16. (a) Calibration set lateral versus HBV set lateral for Monsheim, (b) accumulated difference between simulation and measurement.

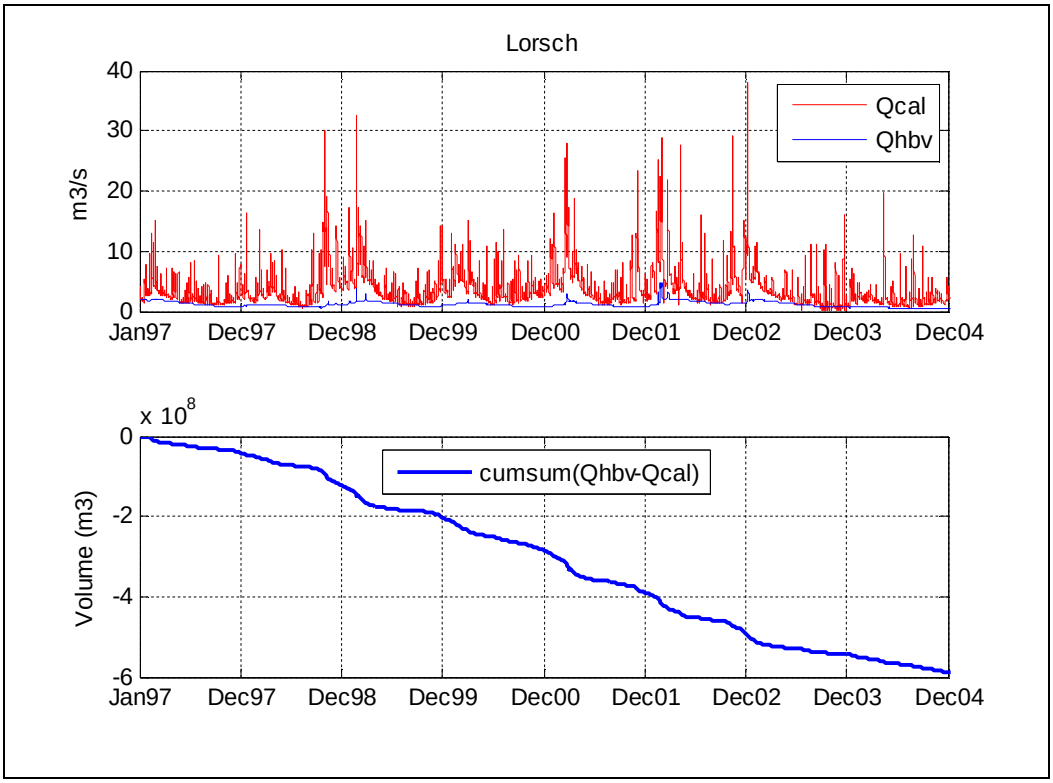

Figure C.17. (a) Calibration set lateral versus HBV set lateral for Lorsch, (b) accumulated difference between simulation and measurement.

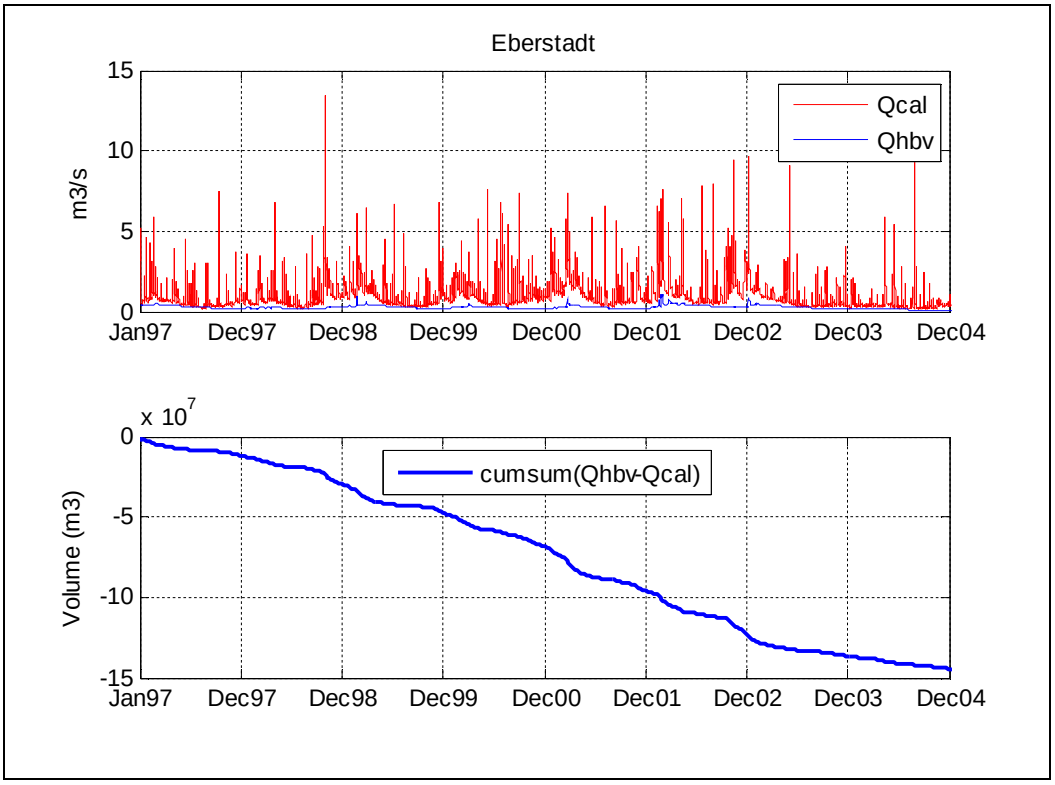

Figure C.18. (a) Calibration set lateral versus HBV set lateral for Eberstadt, (b) accumulated difference between simulation and measurement.

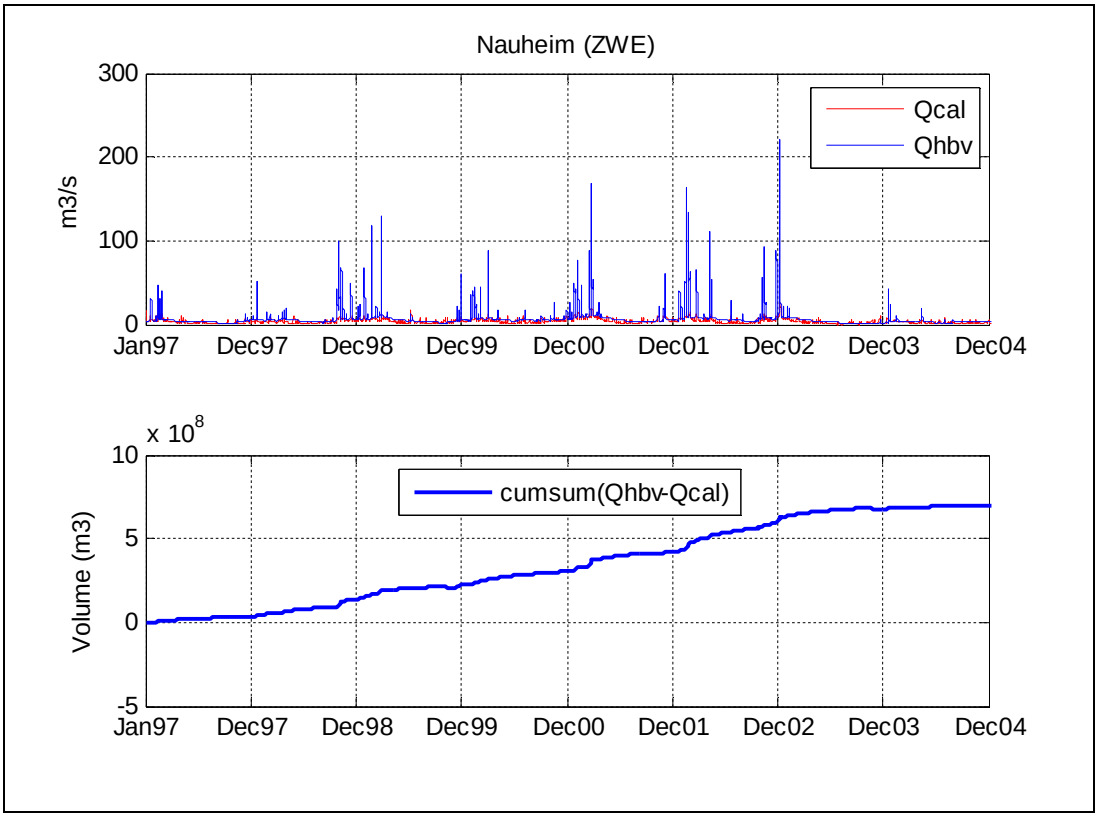

Figure C.19. (a) Calibration set lateral versus HBV set lateral for Naunheim, (b) accumulated difference between simulation and measurement.

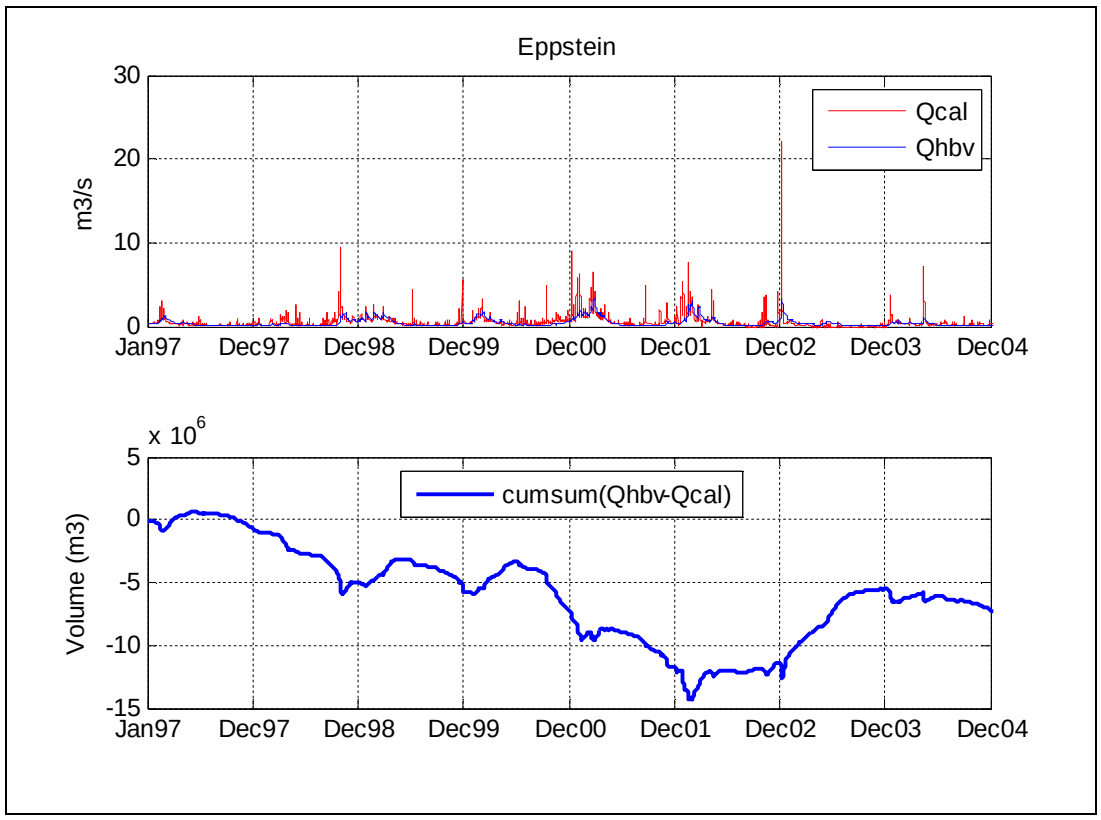

Figure C.20. (a) Calibration set lateral versus HBV set lateral for Eppstein, (b) accumulated difference between simulation and measurement.

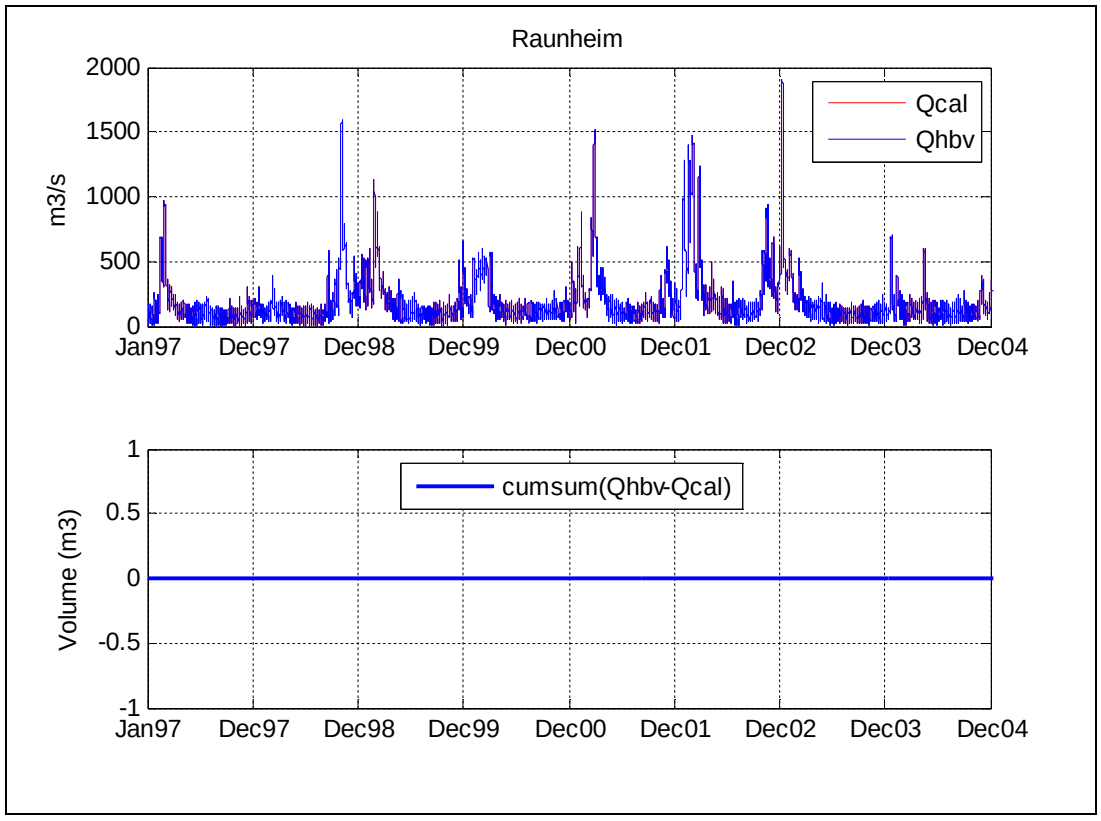

Figure C.21. (a) Calibration set lateral versus HBV set lateral for Raunheim, (b) accumulated difference between simulation and measurement.

C.4 Section 4: Mainz-Kaub

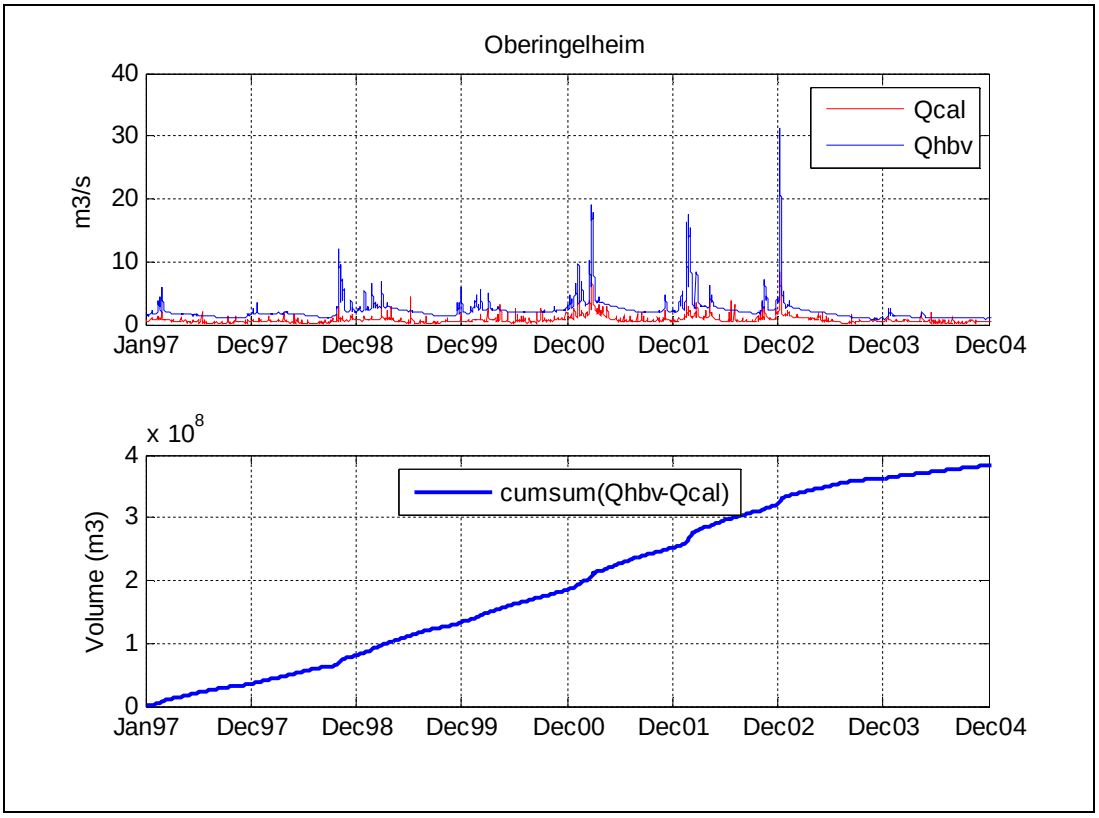

Figure C.22. (a) Calibration set lateral versus HBV set lateral for Oberingelheim, (b) accumulated difference between simulation and measurement.

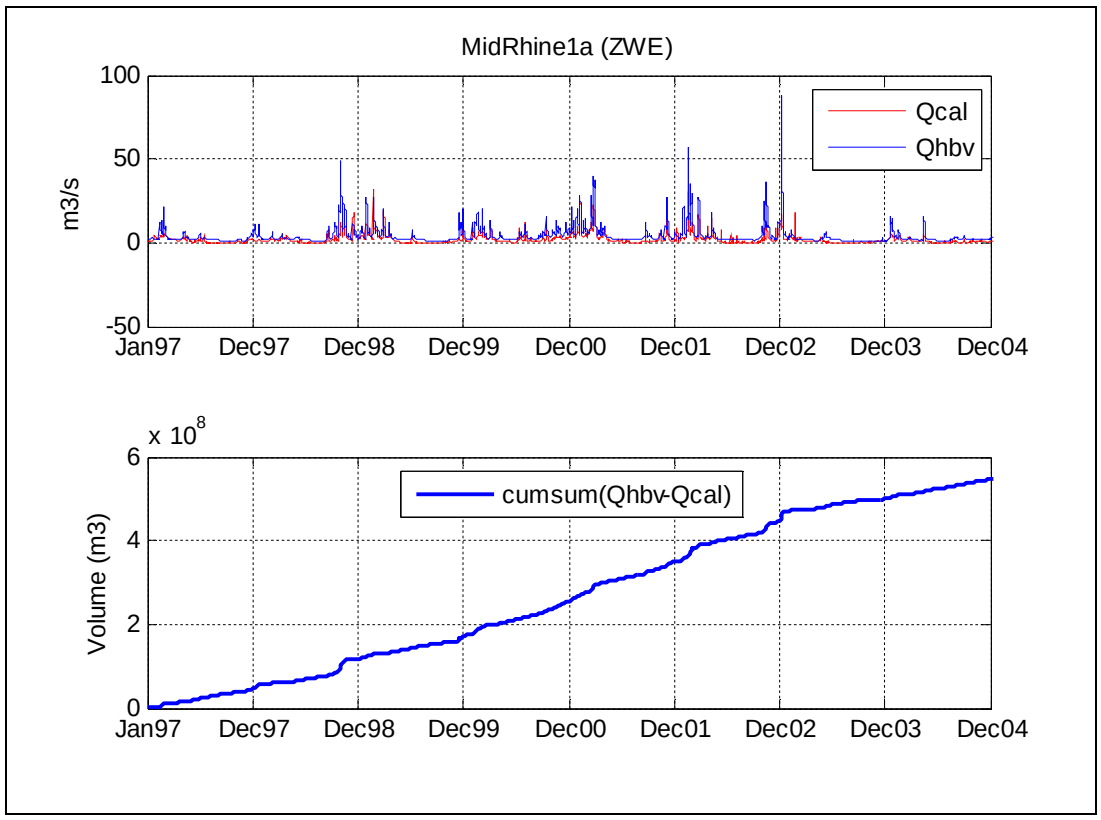

Figure C.23. (a) Calibration set lateral versus HBV set lateral for MidRhine 1a, (b) accumulated difference between simulation and measurement.

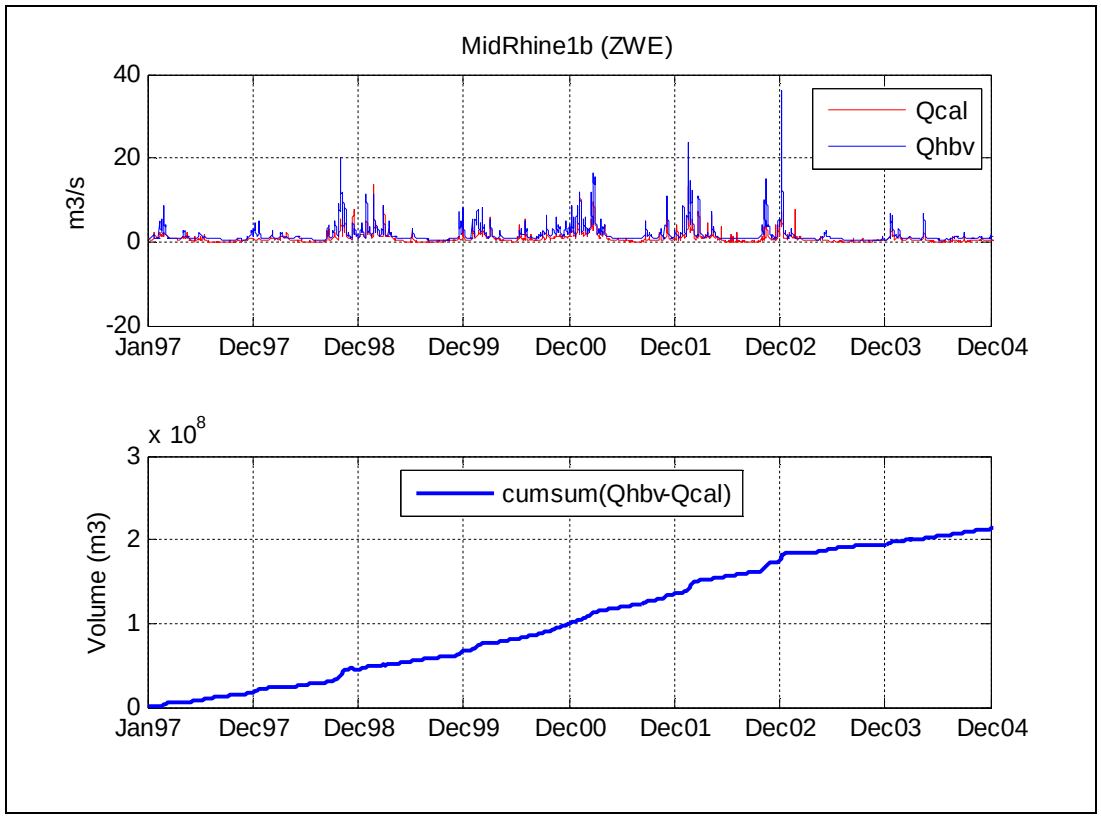

Figure C.24. (a) Calibration set lateral versus HBV set lateral for MidRhine 1b, (b) accumulated difference between simulation and measurement.

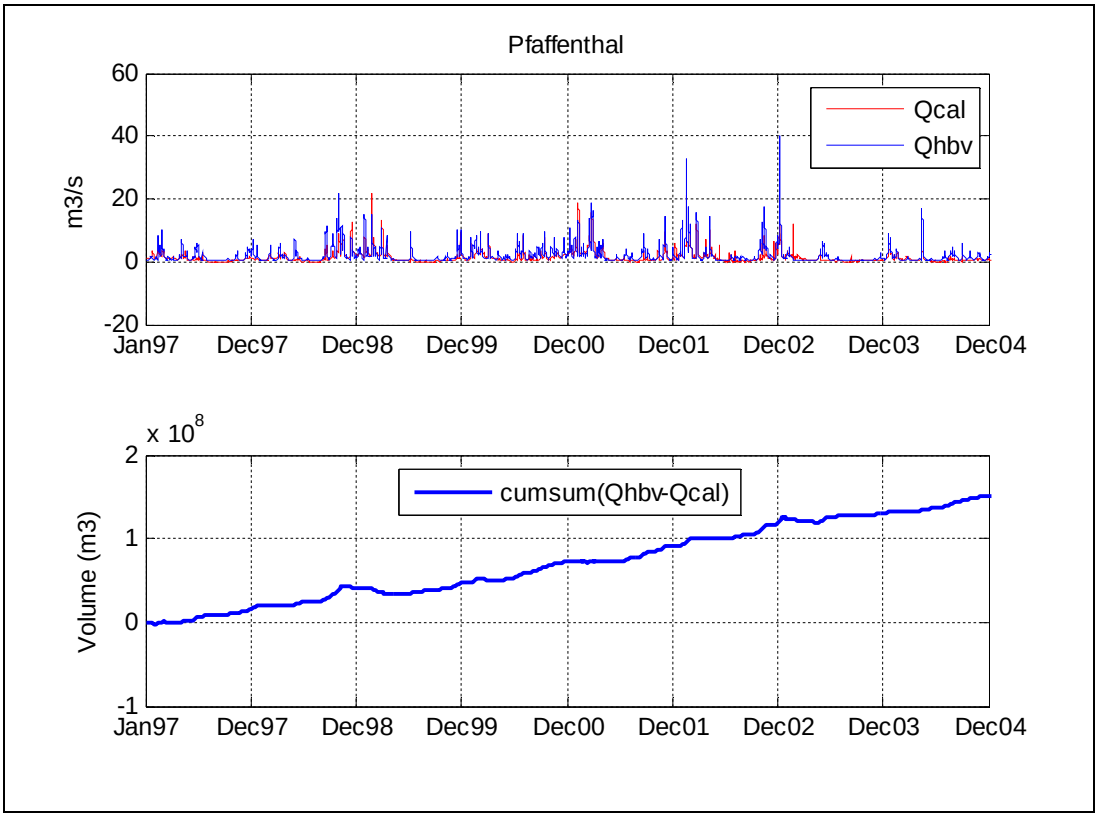

Figure C.25. (a) Calibration set lateral versus HBV set lateral for Pfaffenthal, (b) accumulated difference between simulation and measurement.

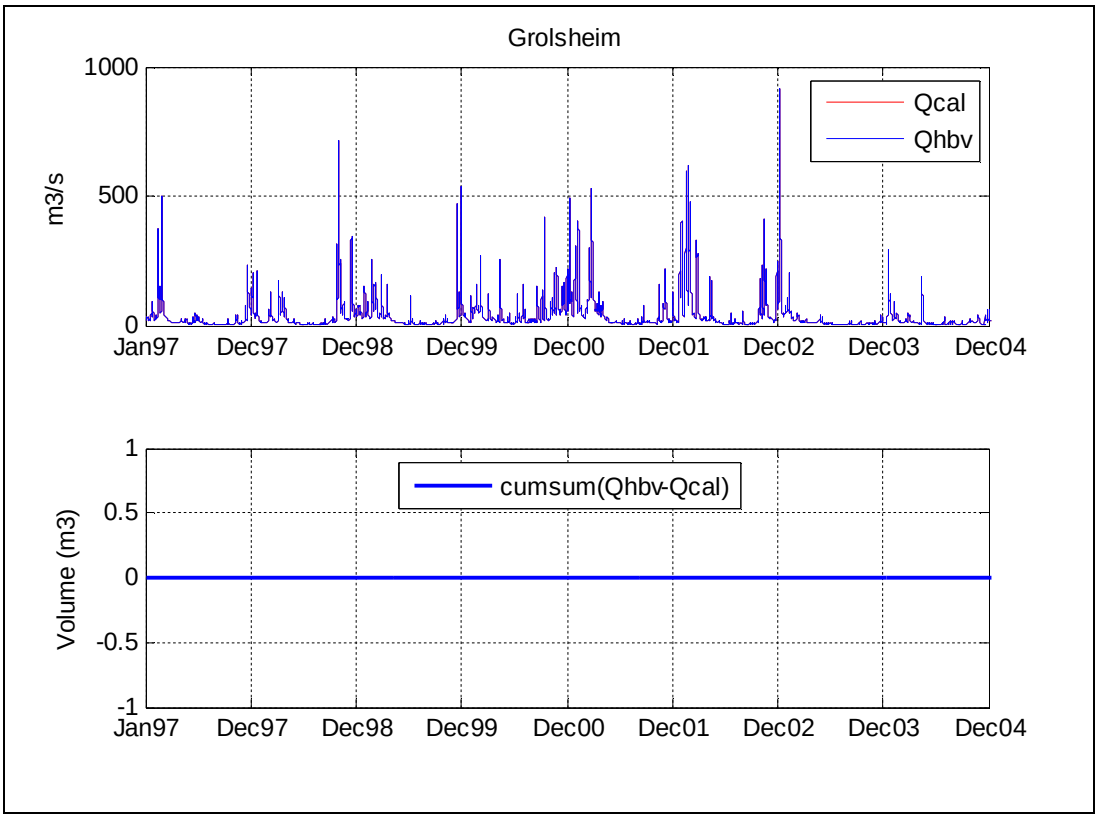

Figure C.26. (a) Calibration set lateral versus HBV set lateral for Grolsheim, (b) accumulated difference between simulation and measurement.

C.5 Section 5/6: Kaub-Andernach

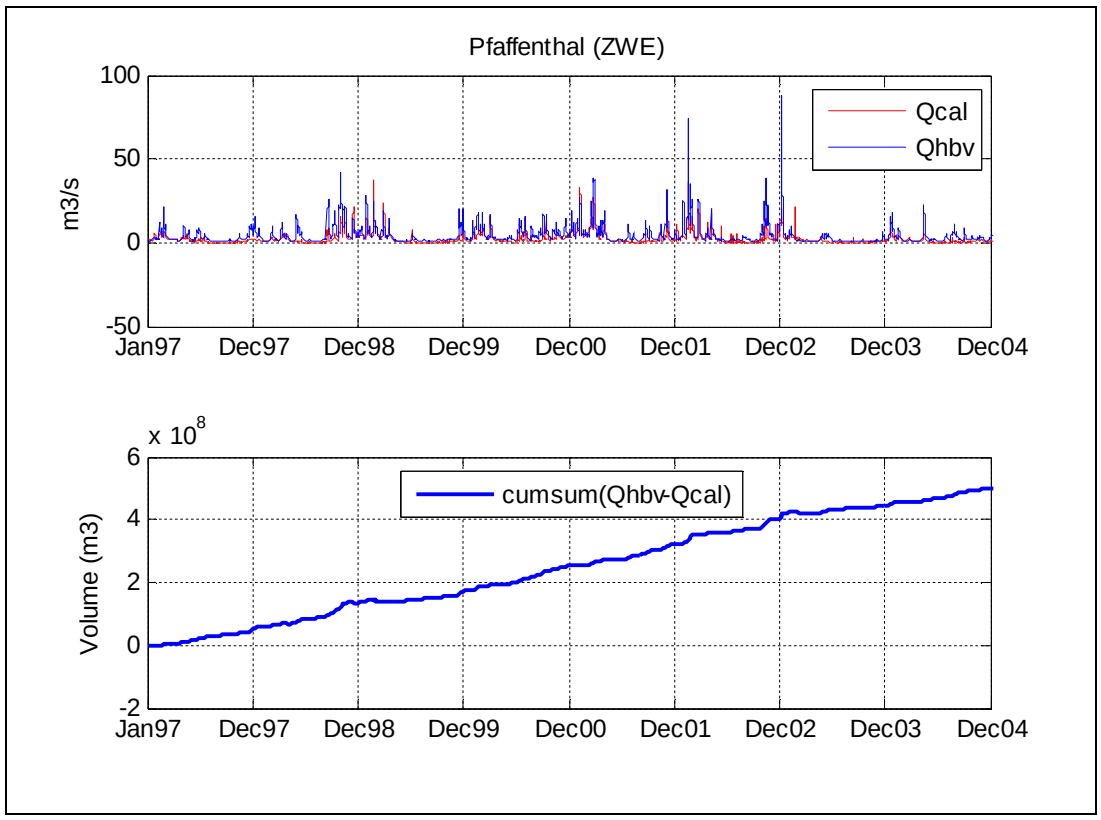

Figure C.27. (a) Calibration set lateral versus HBV set lateral for Pfaffenthal_ZWE, (b) accumulated difference between simulation and measurement.

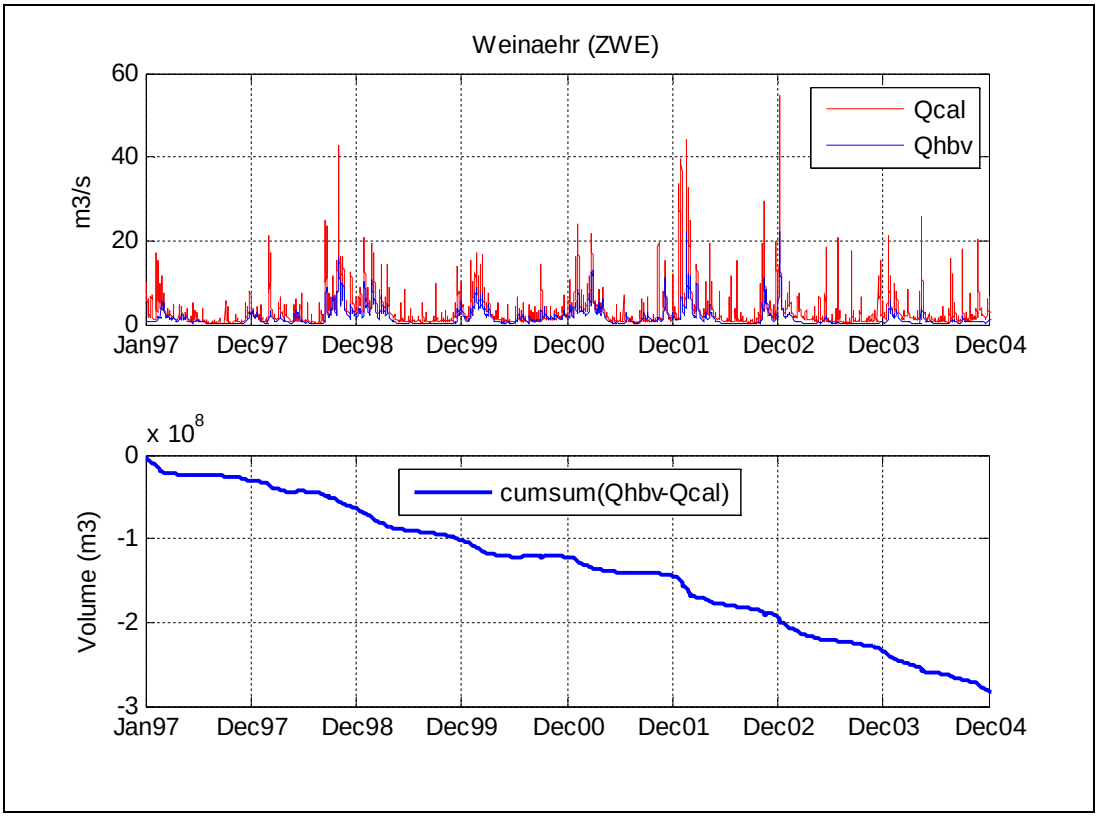

Figure C.28. (a) Calibration set lateral versus HBV set lateral for Wheinähr_ZWE, (b) accumulated difference between simulation and measurement.

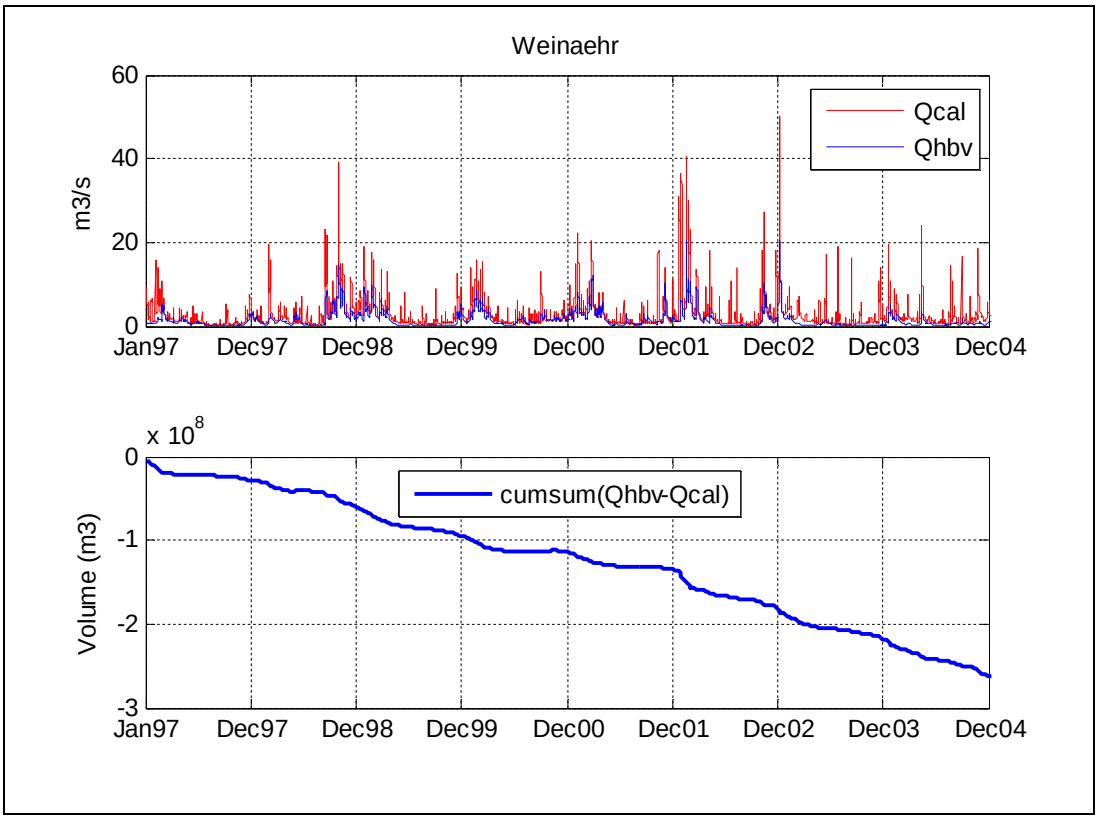

Figure C.29. (a) Calibration set lateral versus HBV set lateral for Wheinähr, (b) accumulated difference between simulation and measurement.

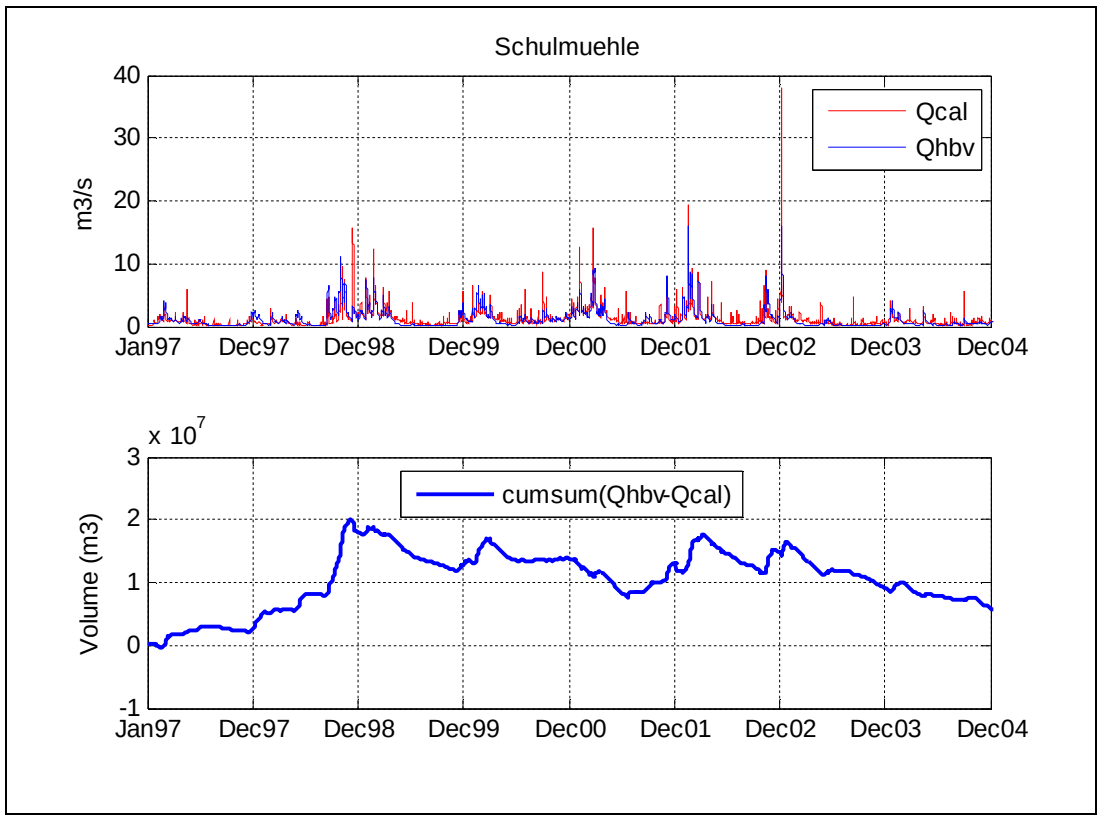

Figure C.30. (a) Calibration set lateral versus HBV set lateral for Schulmühle, (b) accumulated difference between simulation and measurement.

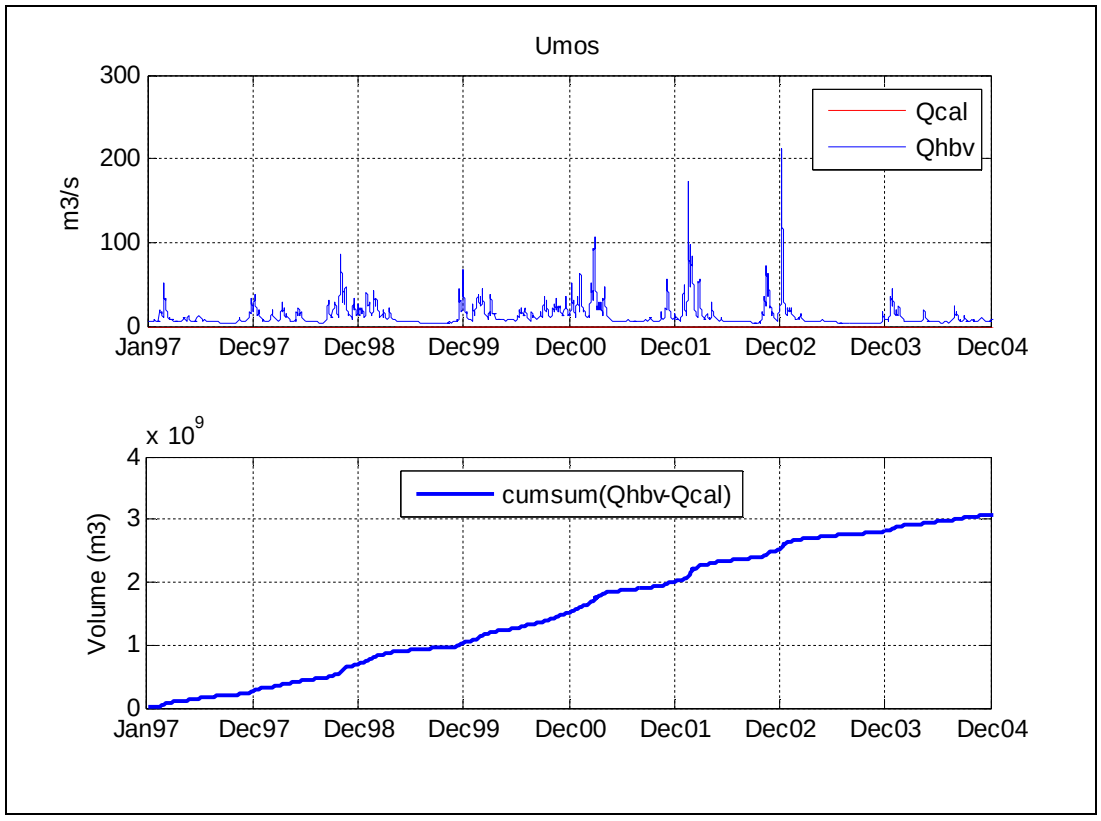

Figure C.31. (a) Calibration set lateral versus HBV set lateral for Umos4, (b) accumulated difference between simulation and measurement.

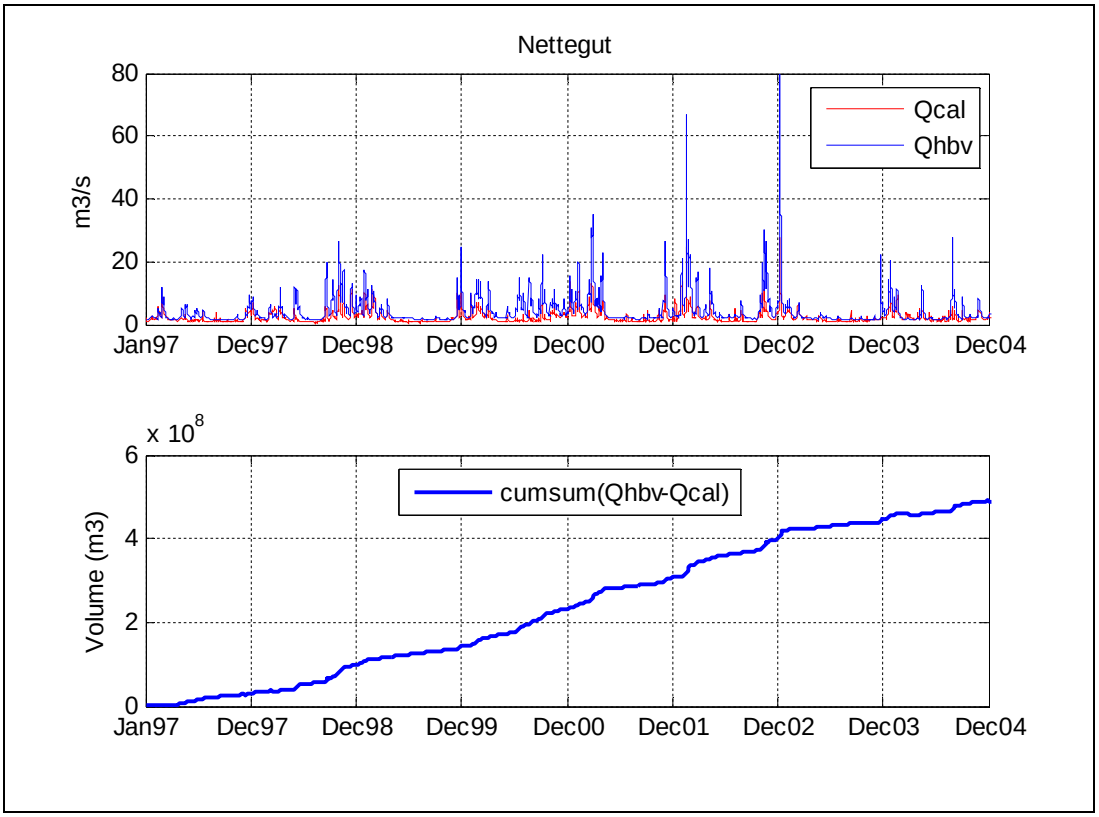

Figure C.32. (a) Calibration set lateral versus HBV set lateral for Nettegut, (b) accumulated difference between simulation and measurement.

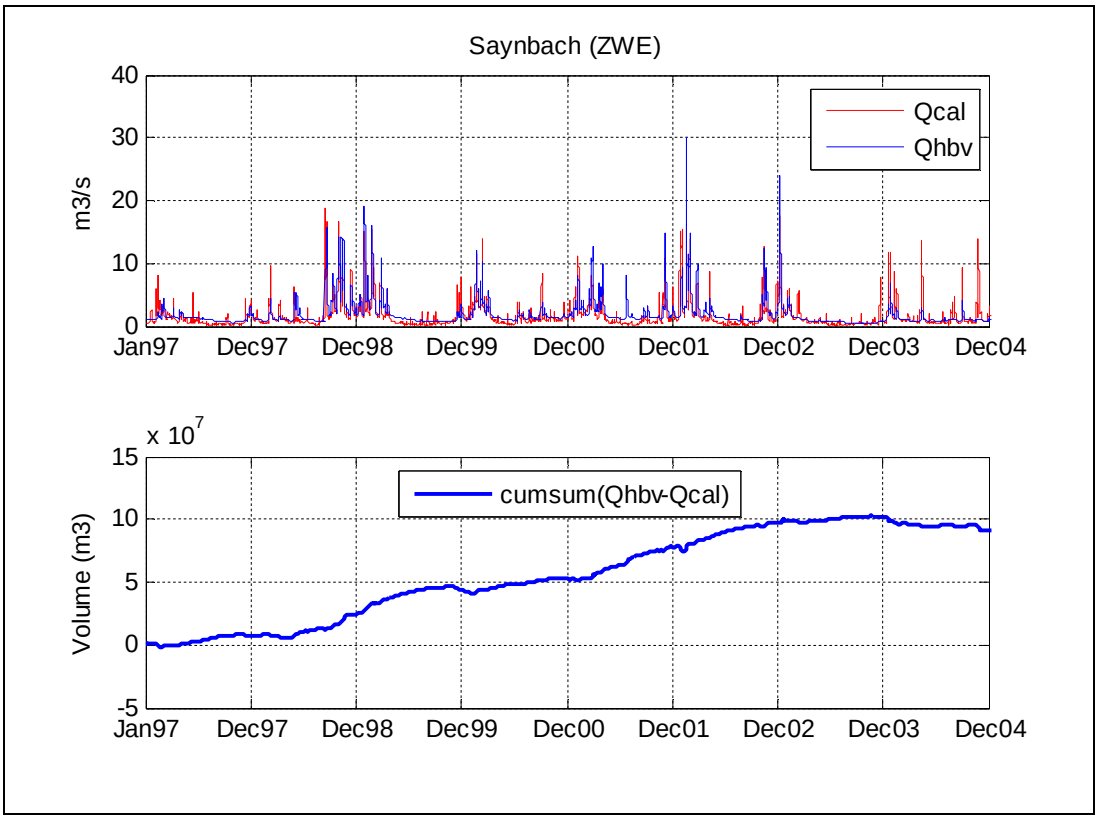

Figure C.33. (a) Calibration set lateral versus HBV set lateral for Saynbach_ZWE, (b) accumulated difference between simulation and measurement.

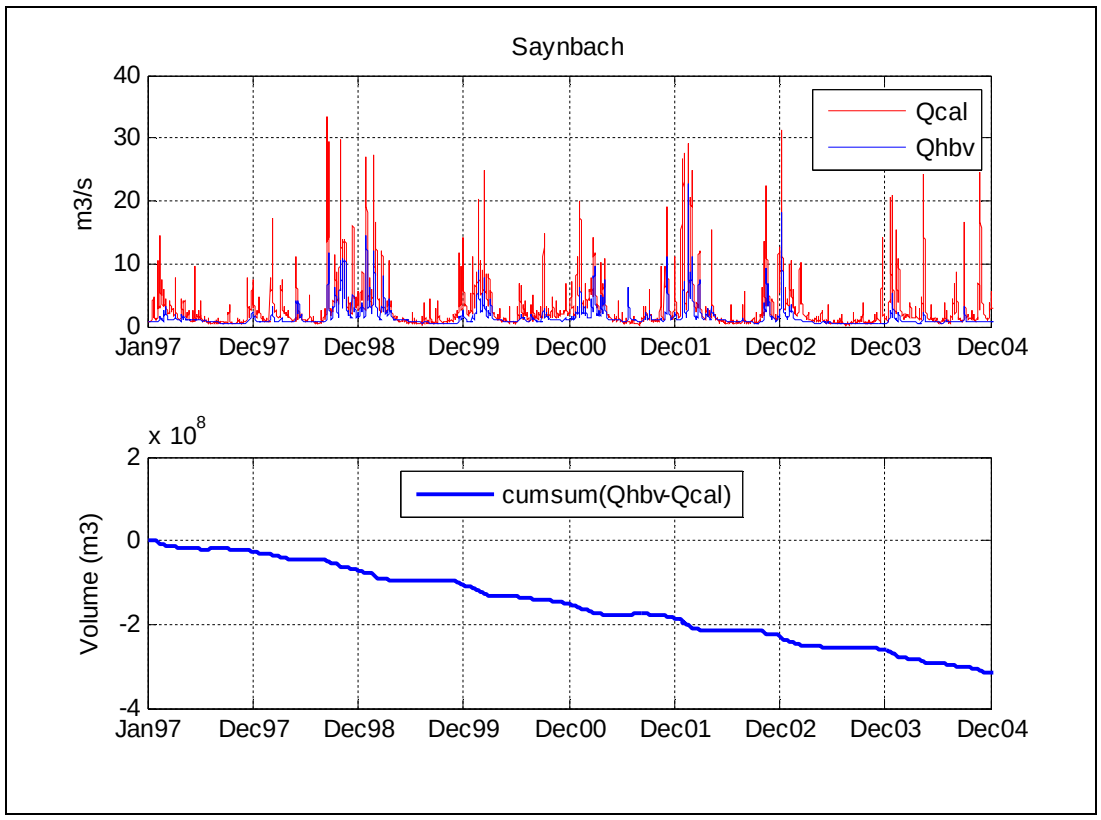

Figure C.34. (a) Calibration set lateral versus HBV set lateral for Saynbach, (b) accumulated difference between simulation and measurement.

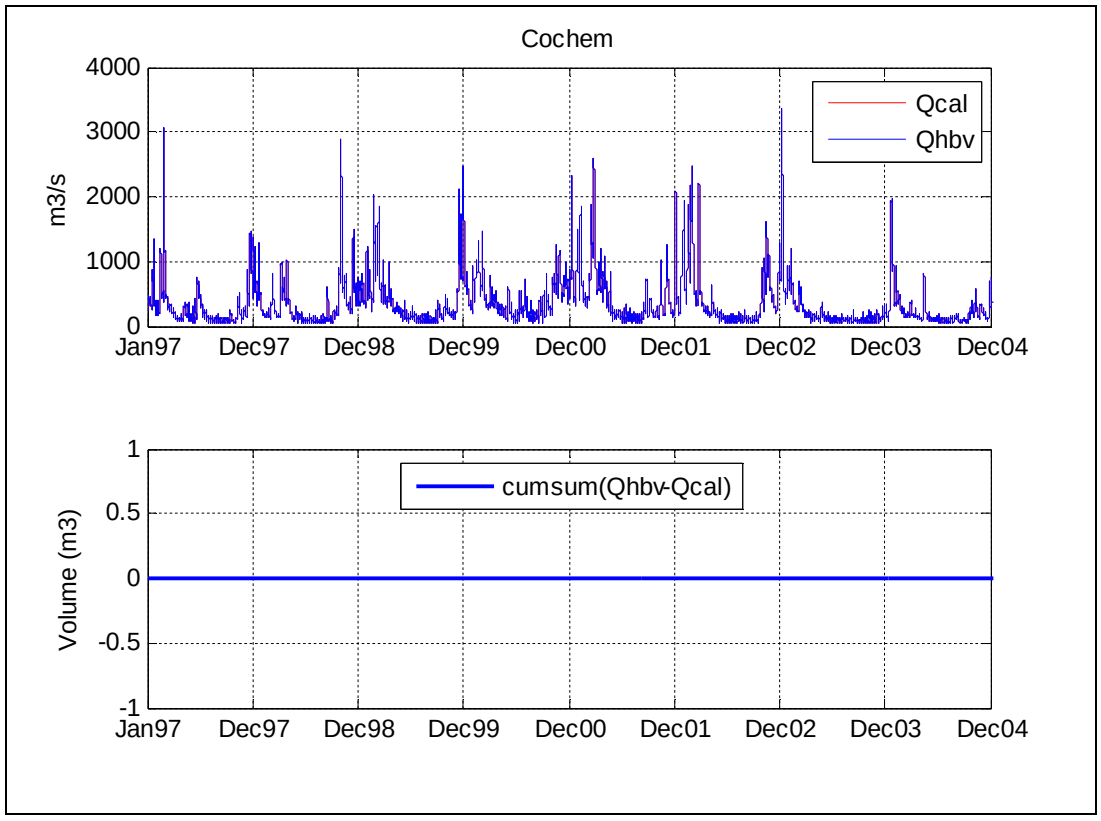

Figure C.35. (a) Calibration set lateral versus HBV set lateral for Cochem, (b) accumulated difference between simulation and measurement.

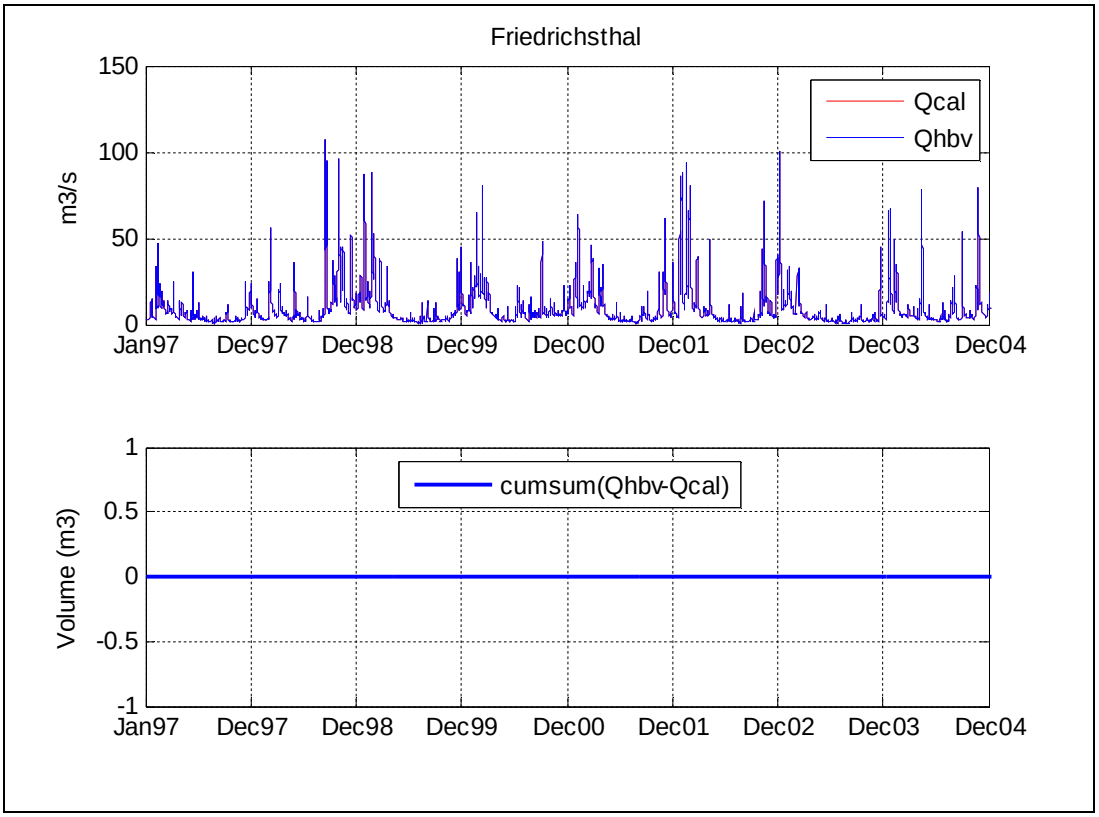

Figure C.36. (a) Calibration set lateral versus HBV set lateral for Friedrichsthal, (b) accumulated difference between simulation and measurement.

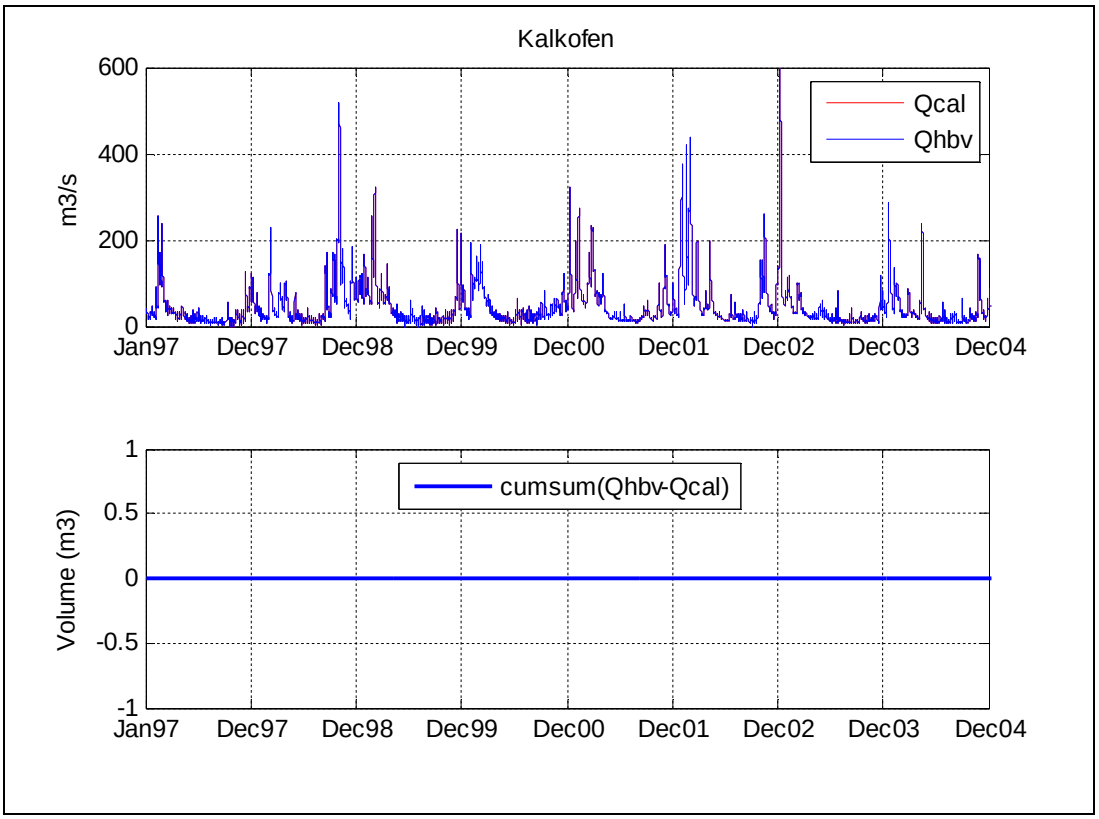

Figure C.37. (a) Calibration set lateral versus HBV set lateral for Kalkofen, (b) accumulated difference between simulation and measurement.

C.6 Section 7: Andernach-Bonn

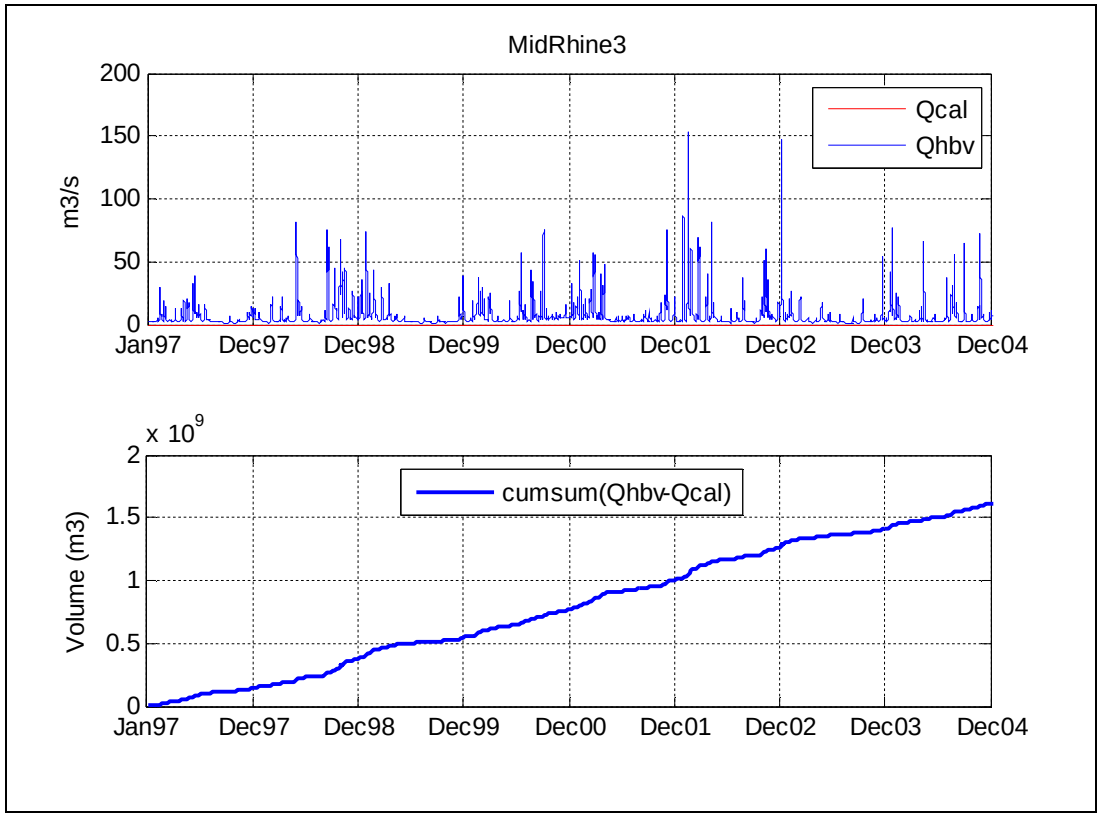

Figure C.38. (a) Calibration set lateral versus HBV set lateral for MidRhine3, (b) accumulated difference between simulation and measurement.

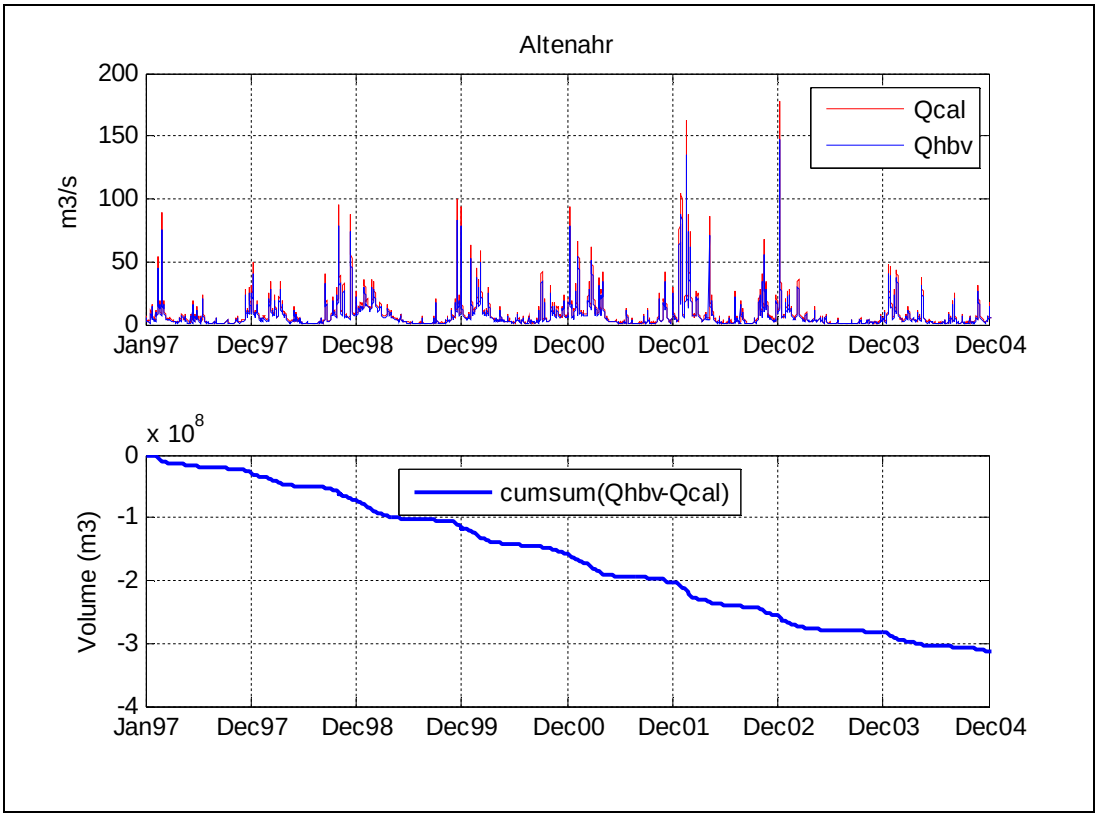

Figure C.39. (a) Calibration set lateral versus HBV set lateral for Altenahr, (b) accumulated difference between simulation and measurement.

C.7 Section 8: Bonn-Köln

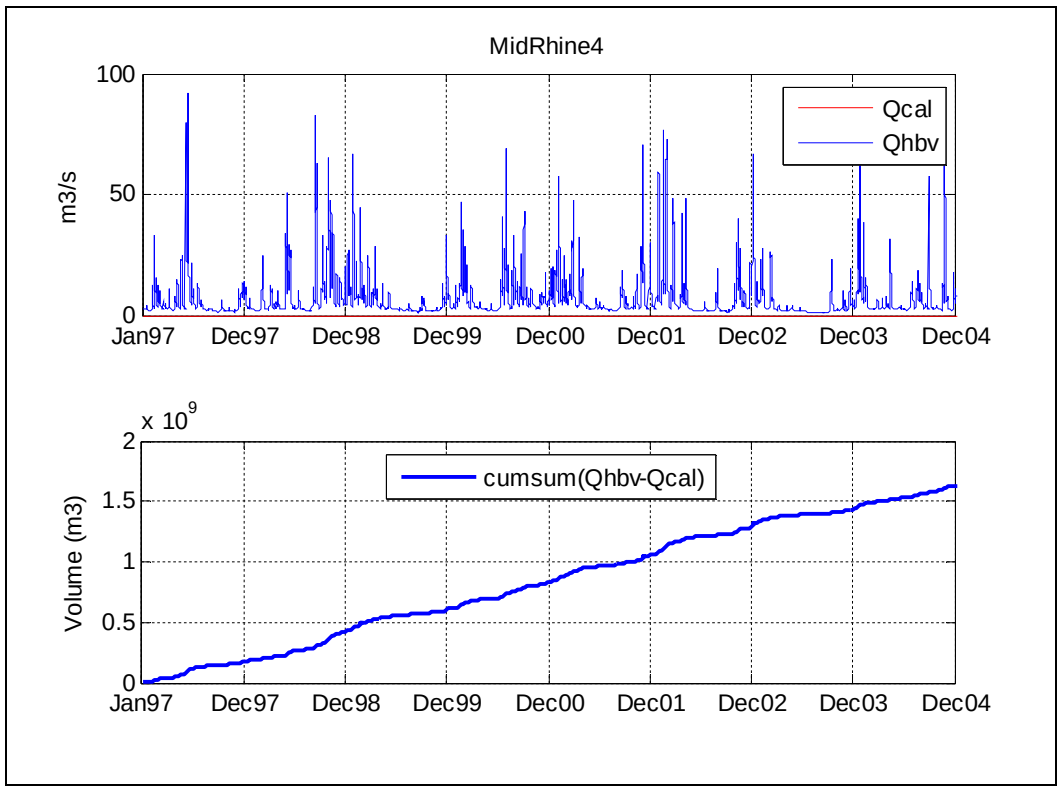

Figure C.40. (a) Calibration set lateral versus HBV set lateral for MidRhine4, (b) accumulated difference between simulation and measurement.

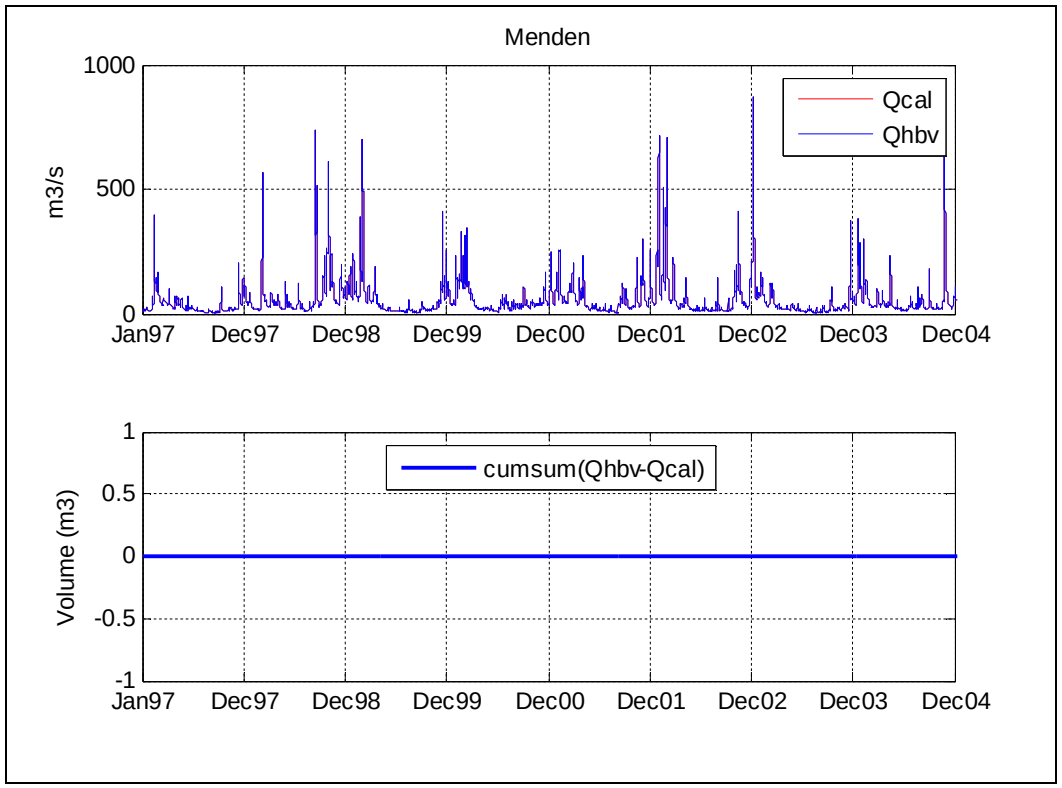

Figure C.41. (a) Calibration set lateral versus HBV set lateral for Menden, (b) accumulated difference between simulation and measurement.

C.8 Section 9: Köln-Düsseldorf

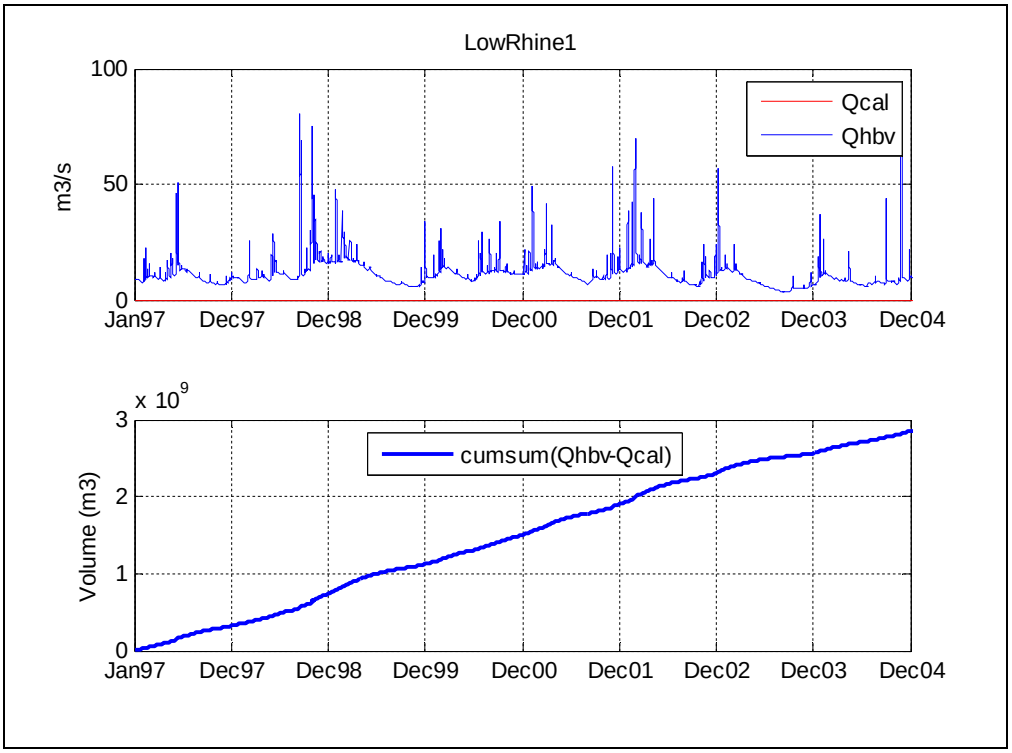

Figure C.42. (a) Calibration set lateral versus HBV set lateral for LowRhine1, (b) accumulated difference between simulation and measurement.

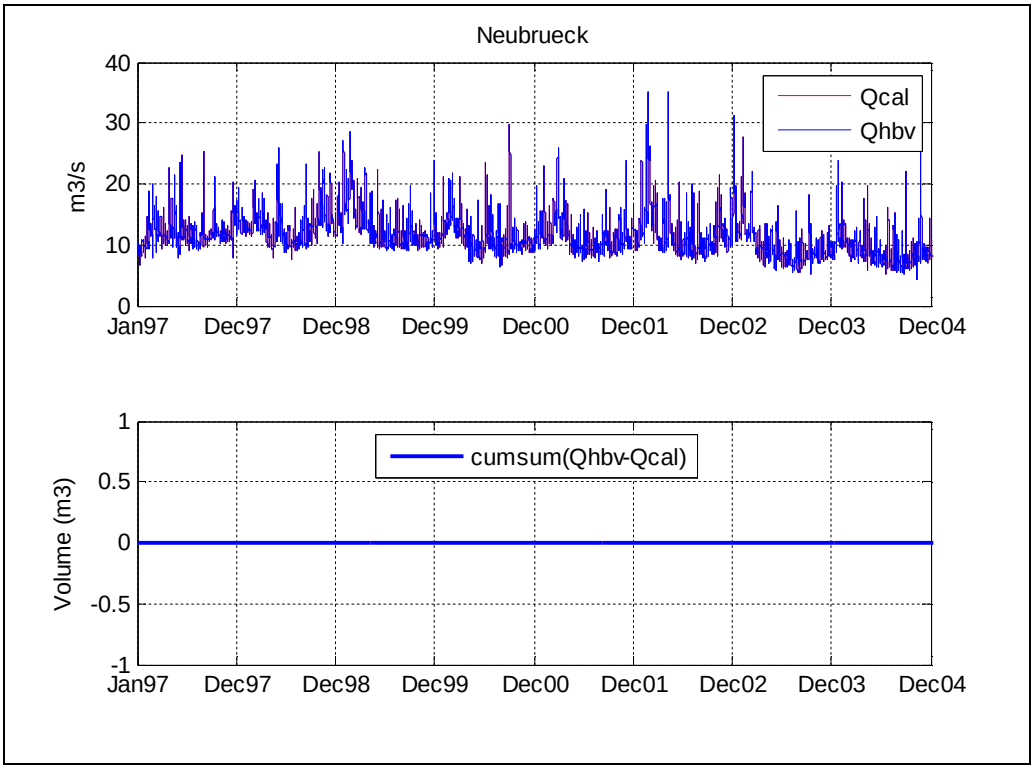

Figure C.43. (a) Calibration set lateral versus HBV set lateral for Neubrück, (b) accumulated difference between simulation and measurement.

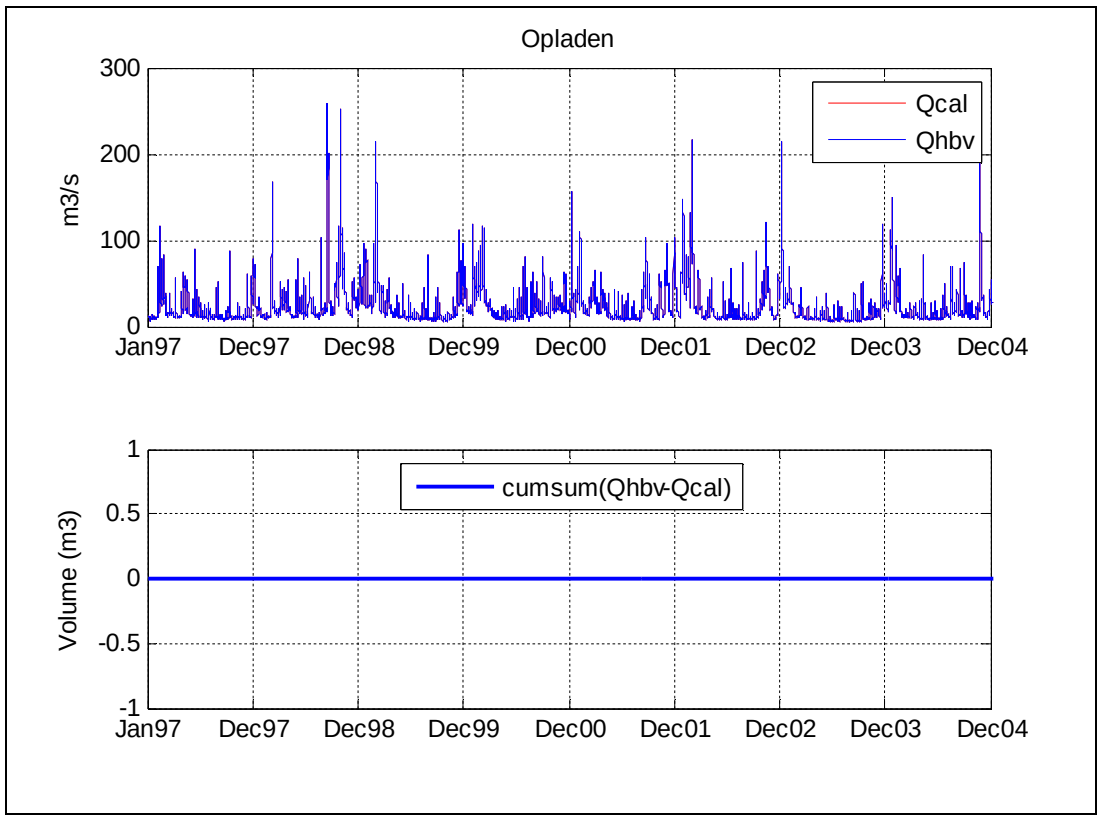

Figure C.44. (a) Calibration set lateral versus HBV set lateral for Neubrück, (b) accumulated difference between simulation and measurement.

C.9 Section 10: Düsseldorf-Ruhrort

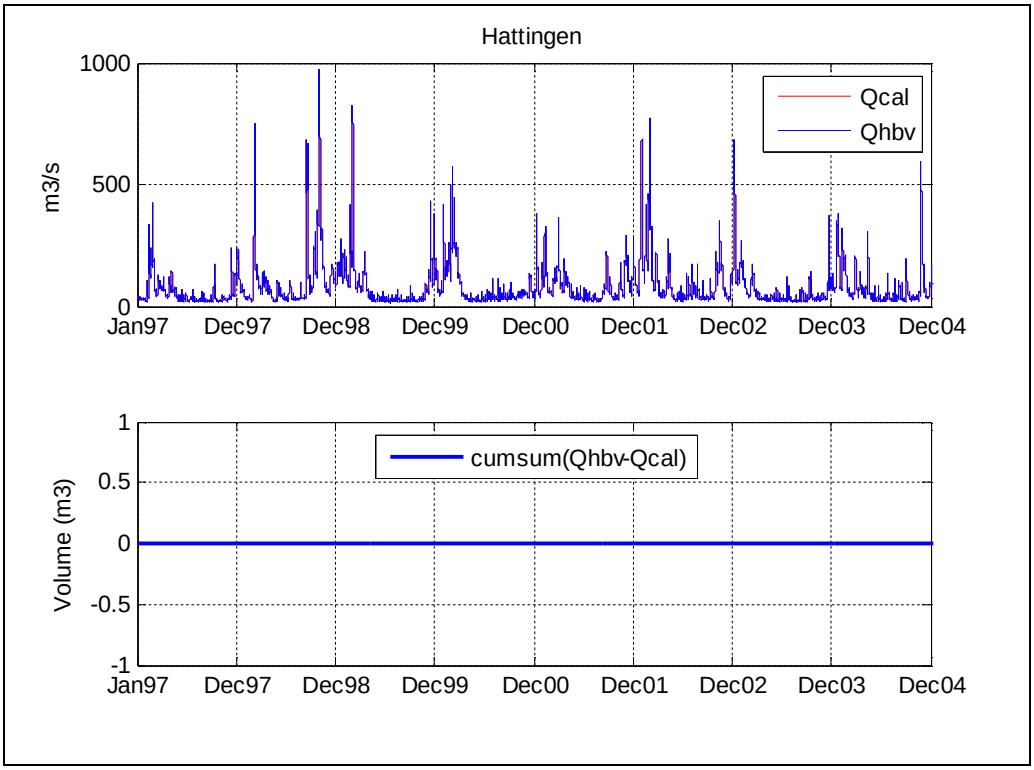

Figure C.45. (a) Calibration set lateral versus HBV set lateral for Hattingen, (b) accumulated difference between simulation and measurement.

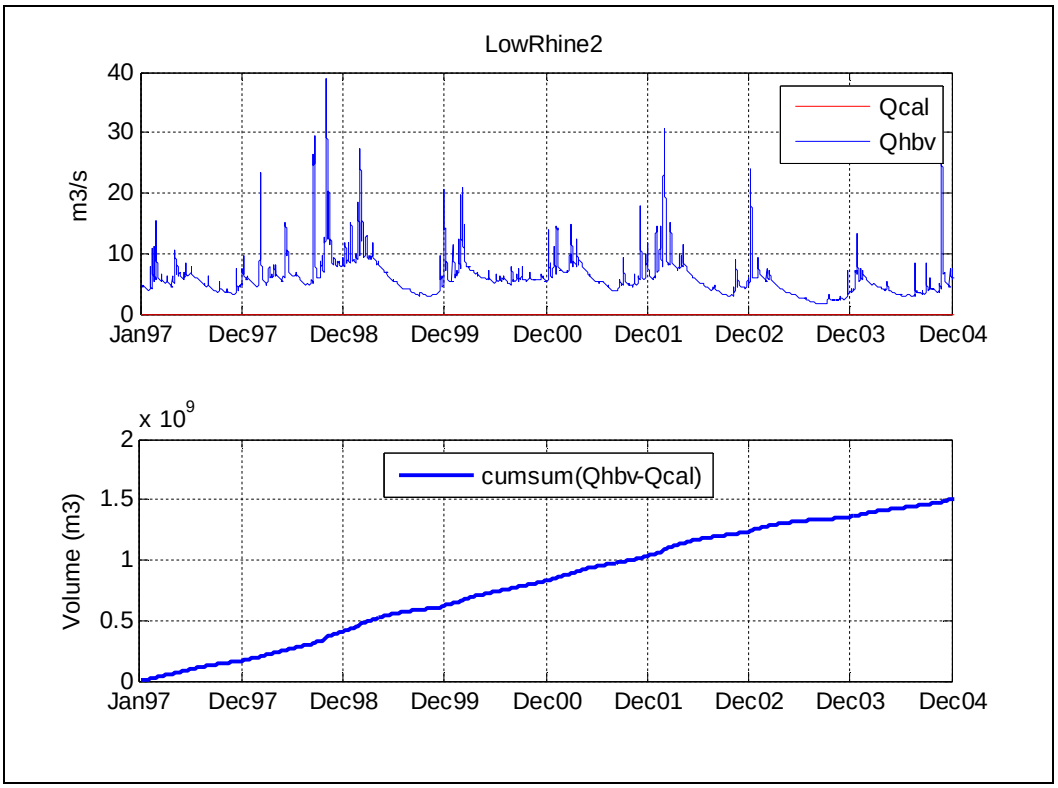

Figure C.46. (a) Calibration set lateral versus HBV set lateral for LowRhine2, (b) accumulated difference between simulation and measurement.

C.10 Section 11: Ruhrort-Wesel

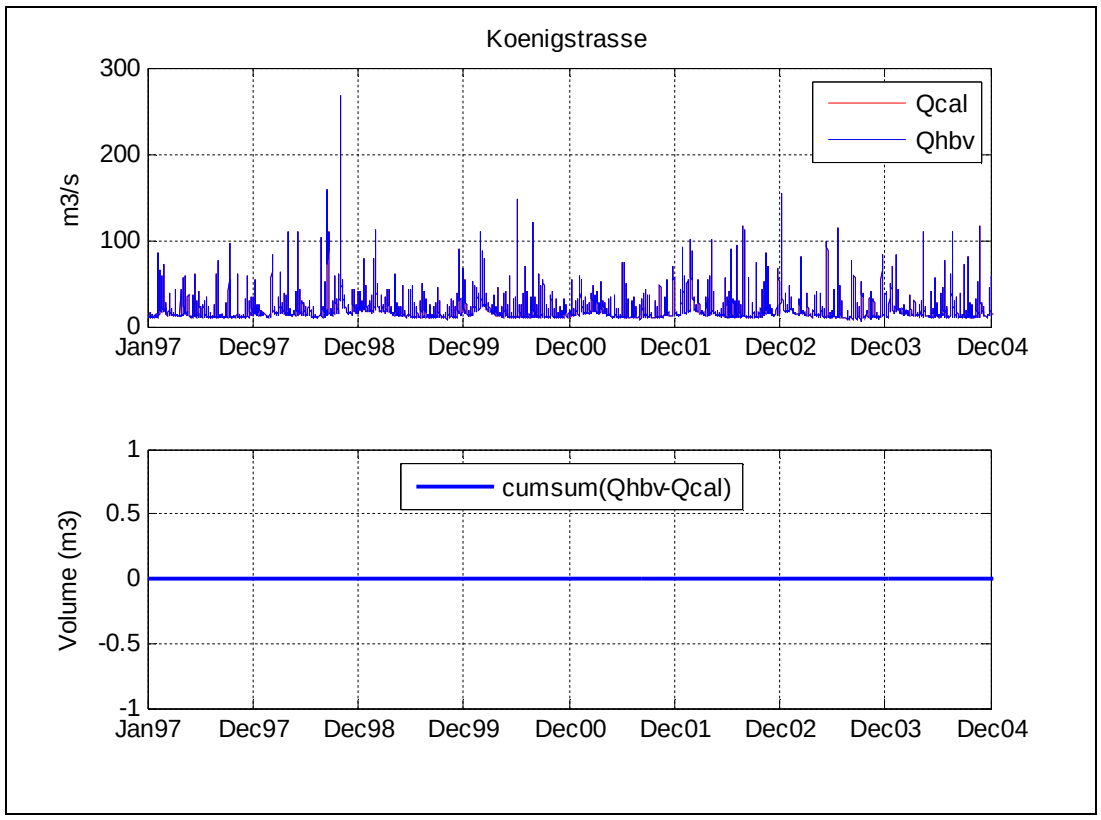

Figure C.47. (a) Calibration set lateral versus HBV set lateral for Köningstrasse, (b) accumulated difference between simulation and measurement.

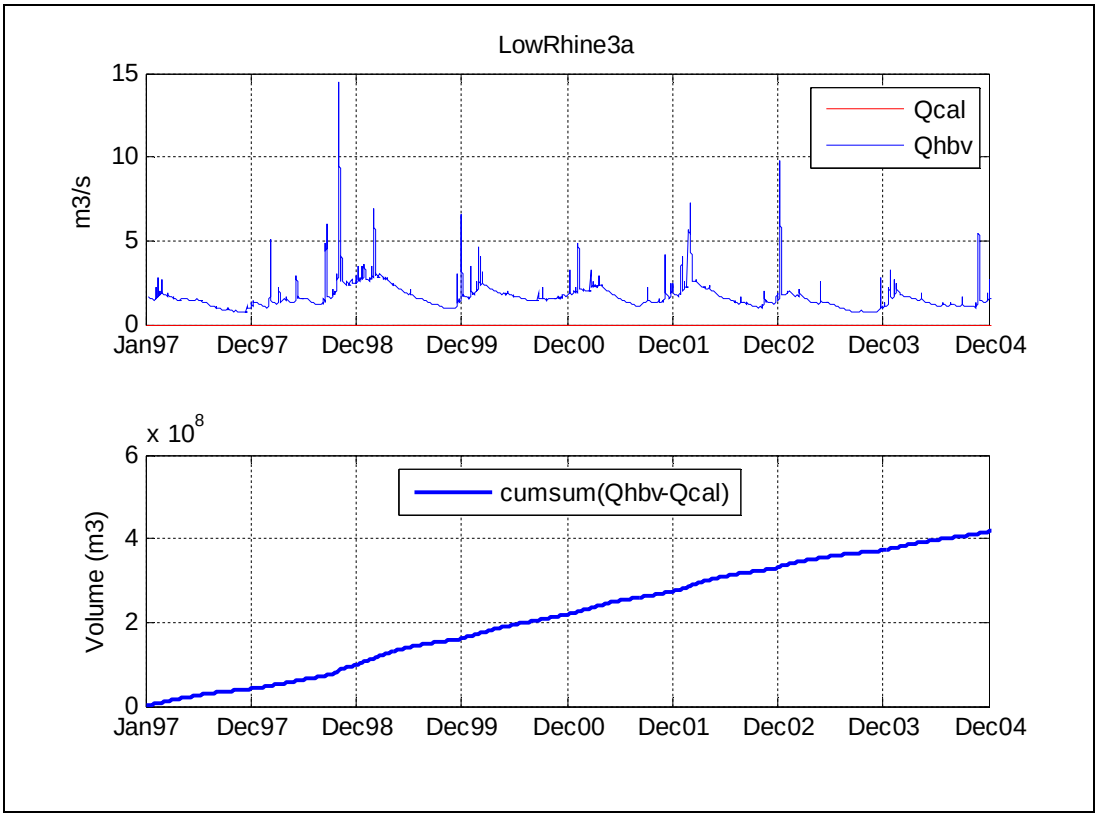

Figure C.48. (a) Calibration set lateral versus HBV set lateral for LowRhine3a, (b) accumulated difference between simulation and measurement.

C.11 Section 12: Wesel-Rees

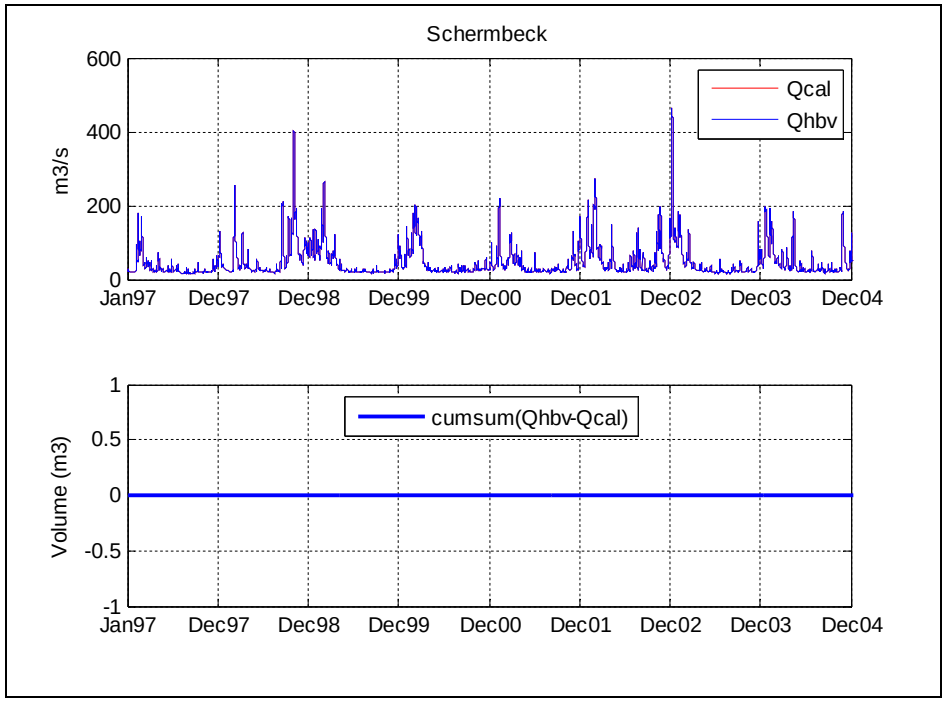

Figure C.49. (a) Calibration set lateral versus HBV set lateral for Schermbeck, (b) accumulated difference between simulation and measurement.

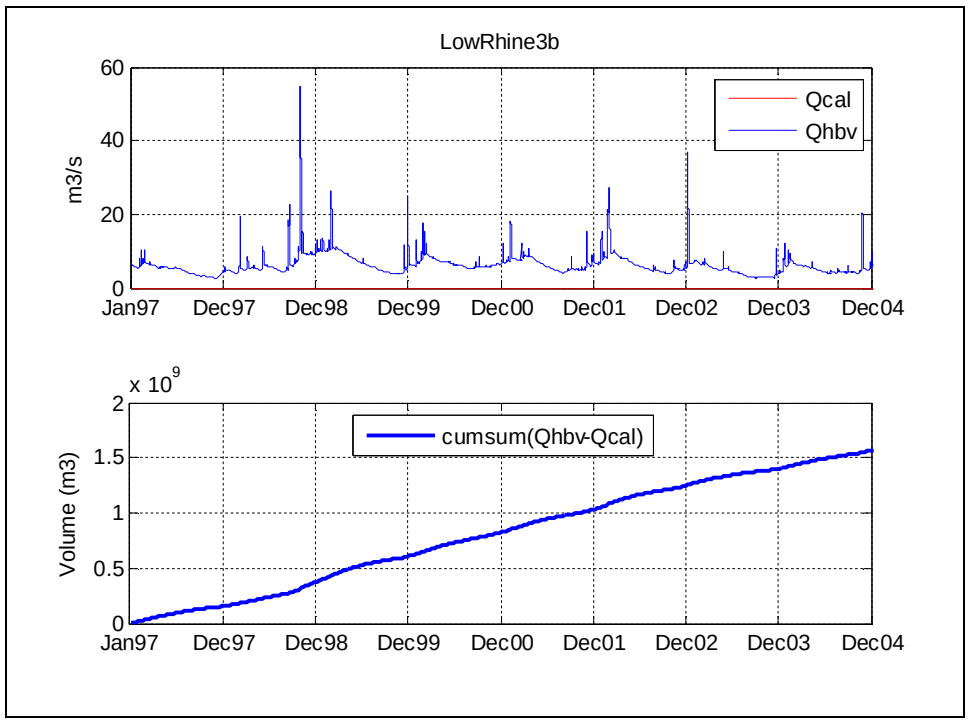

Figure C.50. (a) Calibration set lateral versus HBV set lateral for LowRhine3b, (b) accumulated difference between simulation and measurement.

C.12 Section 13: Rees-Emmerich

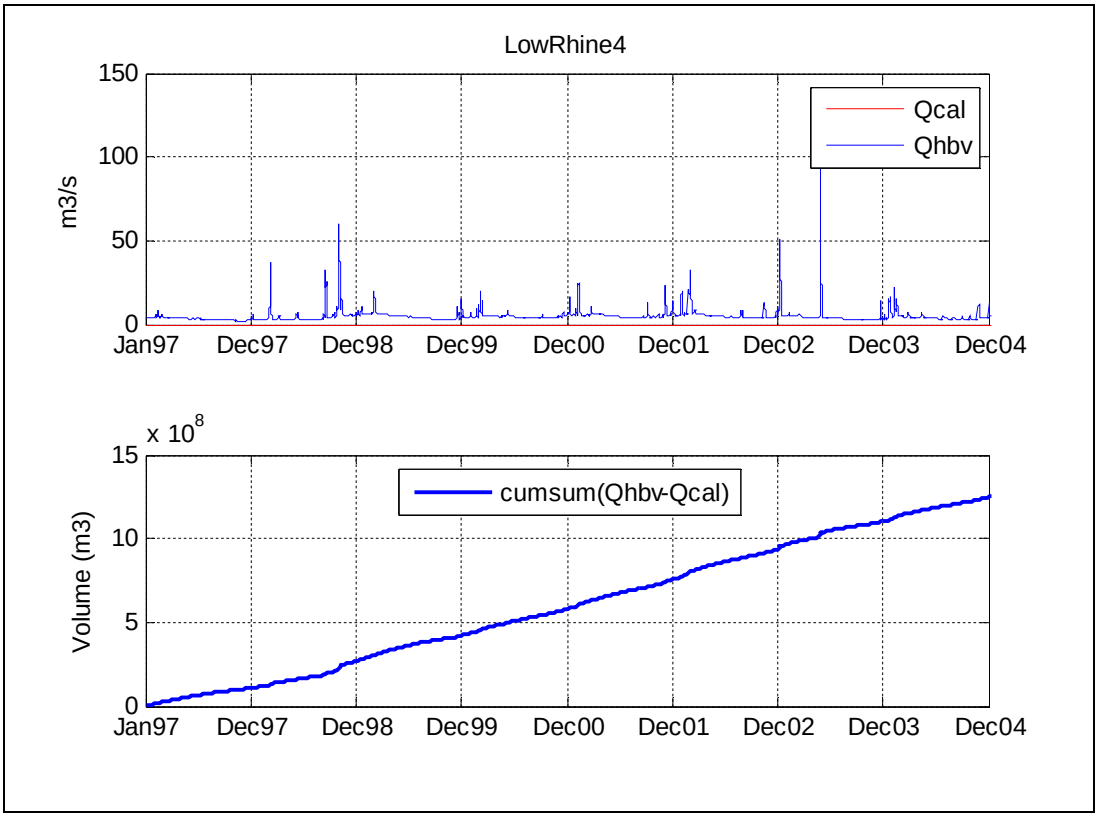

Figure C.51. (a) Calibration set lateral versus HBV set lateral for LowRhine4a, (b) accumulated difference between simulation and measurement.

C.13 Section 14: Emmerich-Lobith

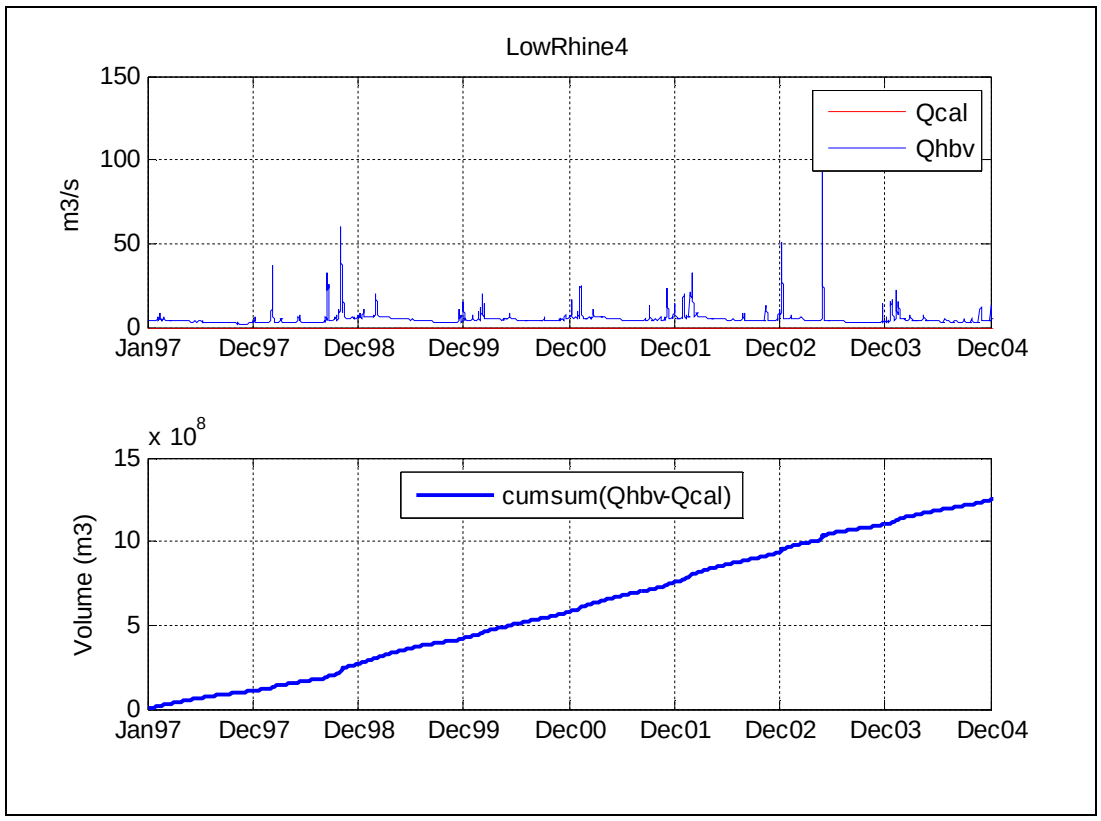

Figure C.52. (a) Calibration set lateral versus HBV set lateral for LowRhine4b, (b) accumulated difference between simulation and measurement.

D Overview of Water Balances

D.1 Section 1: Maxau- Speyer

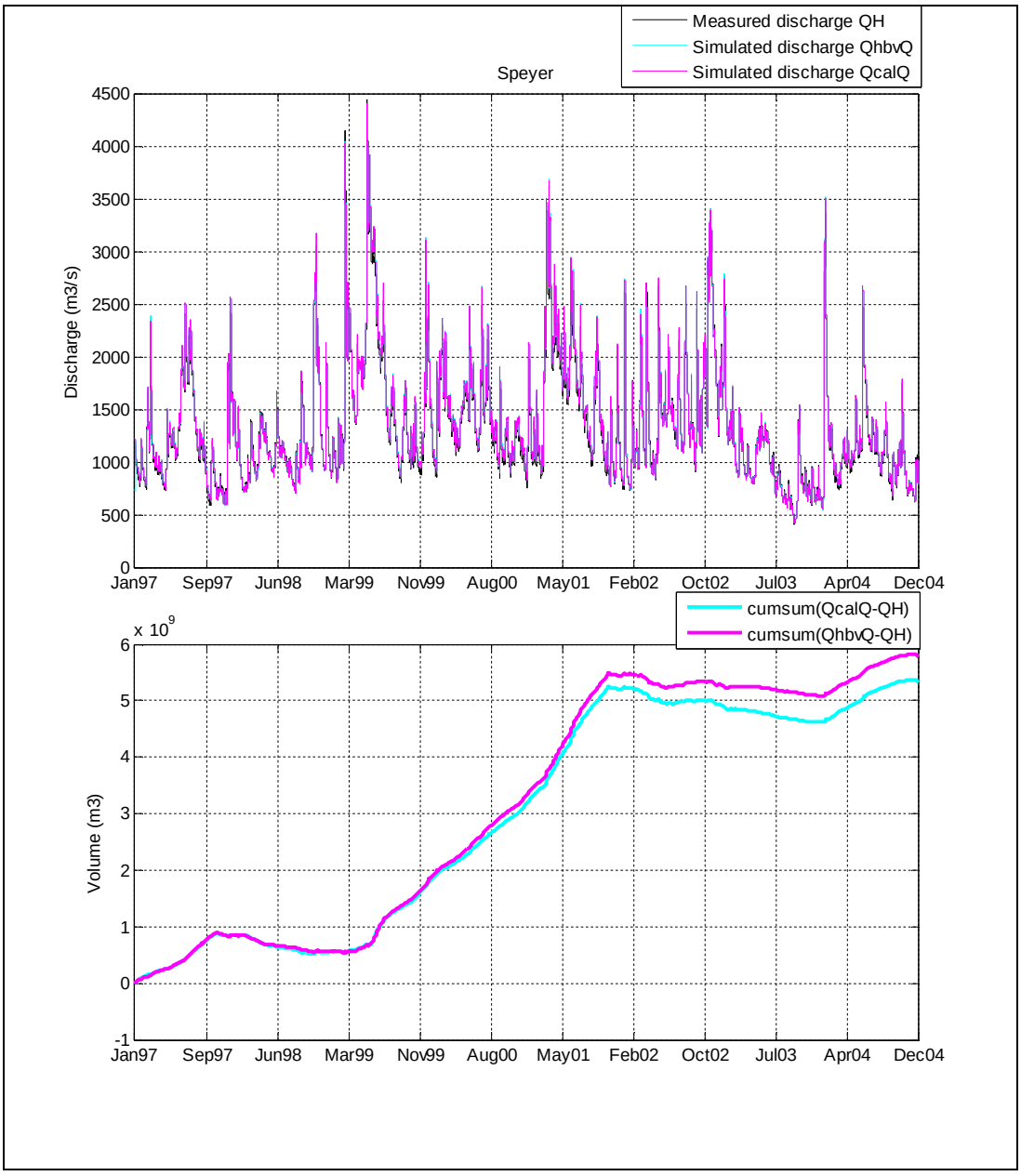

Figure D.1. (a) SOBEK simulated discharge using the calibration and HBV set vs measured discharge at Speyer (b) cumulative difference between the measurements and the SOBEK simulations.

D.2 Section 2: Speyer – Worms

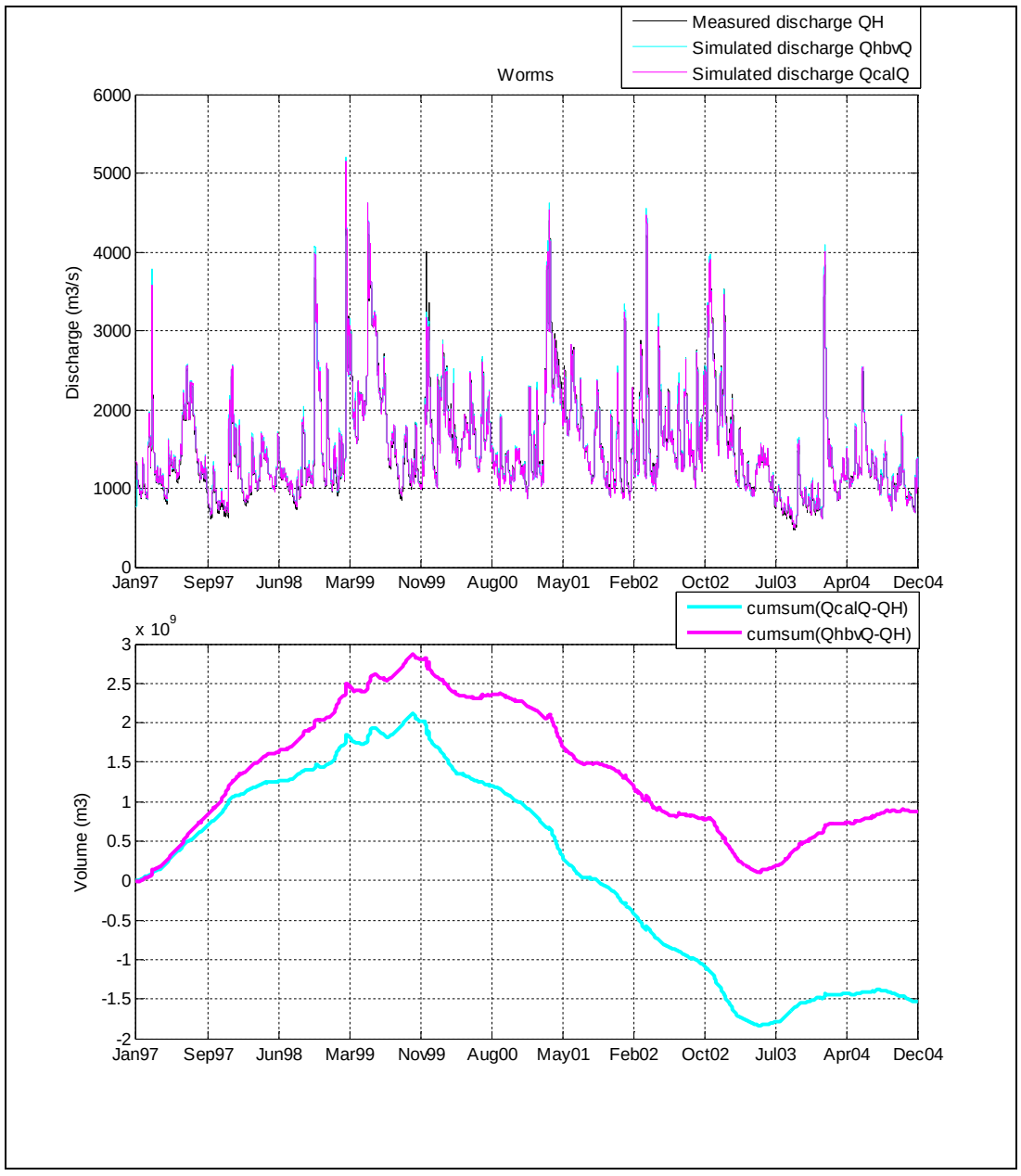

Figure D.2. (a) SOBEK simulated discharge using the calibration and HBV set vs measured discharge at Worms (b) cumulative difference between the measurements and the SOBEK simulations.

D.3 Section 3: Worms – Mainz

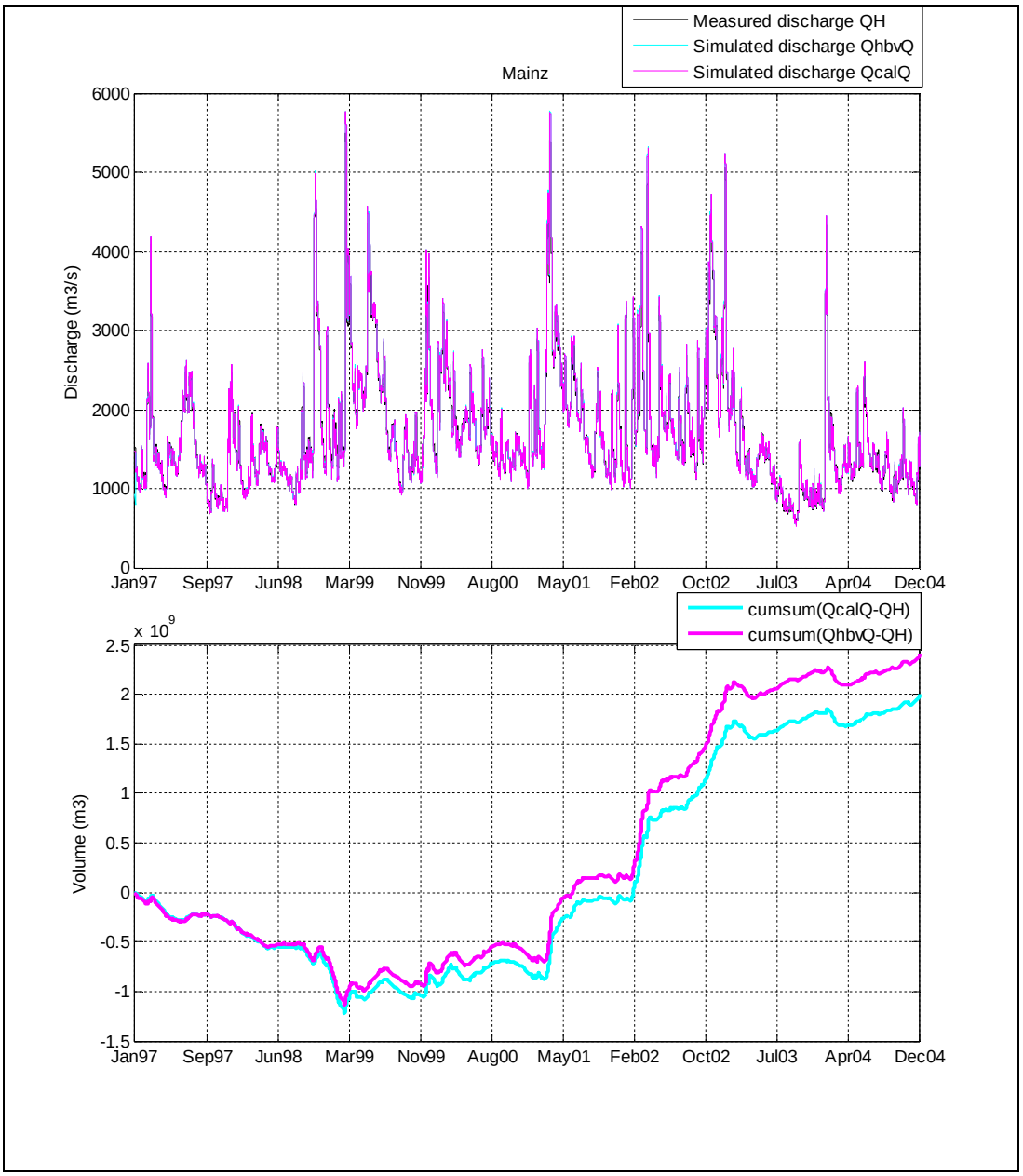

Figure D.3. (a) SOBEK simulated discharge using the calibration and HBV set vs measured discharge at Mainz (b) cumulative difference between the measurements and the SOBEK simulations.

D.4 Section 4: Mainz - Kaub

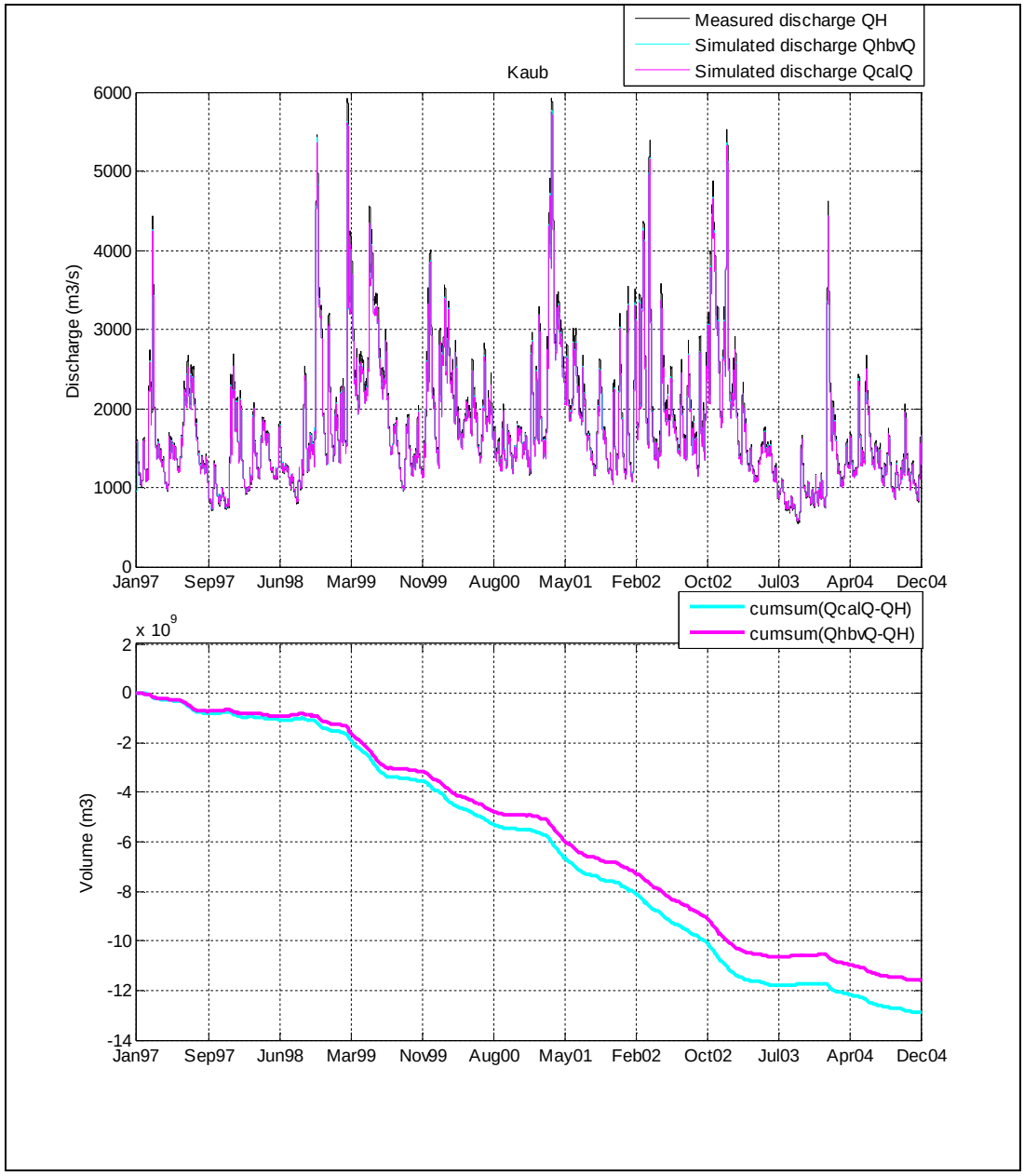

Figure D.4. (a) SOBEK simulated discharge using the calibration and HBV set vs measured discharge at Kaub (b) cumulative difference between the measurements and the SOBEK simulations.

D.5 Section 5/6 Kaub – Andernach

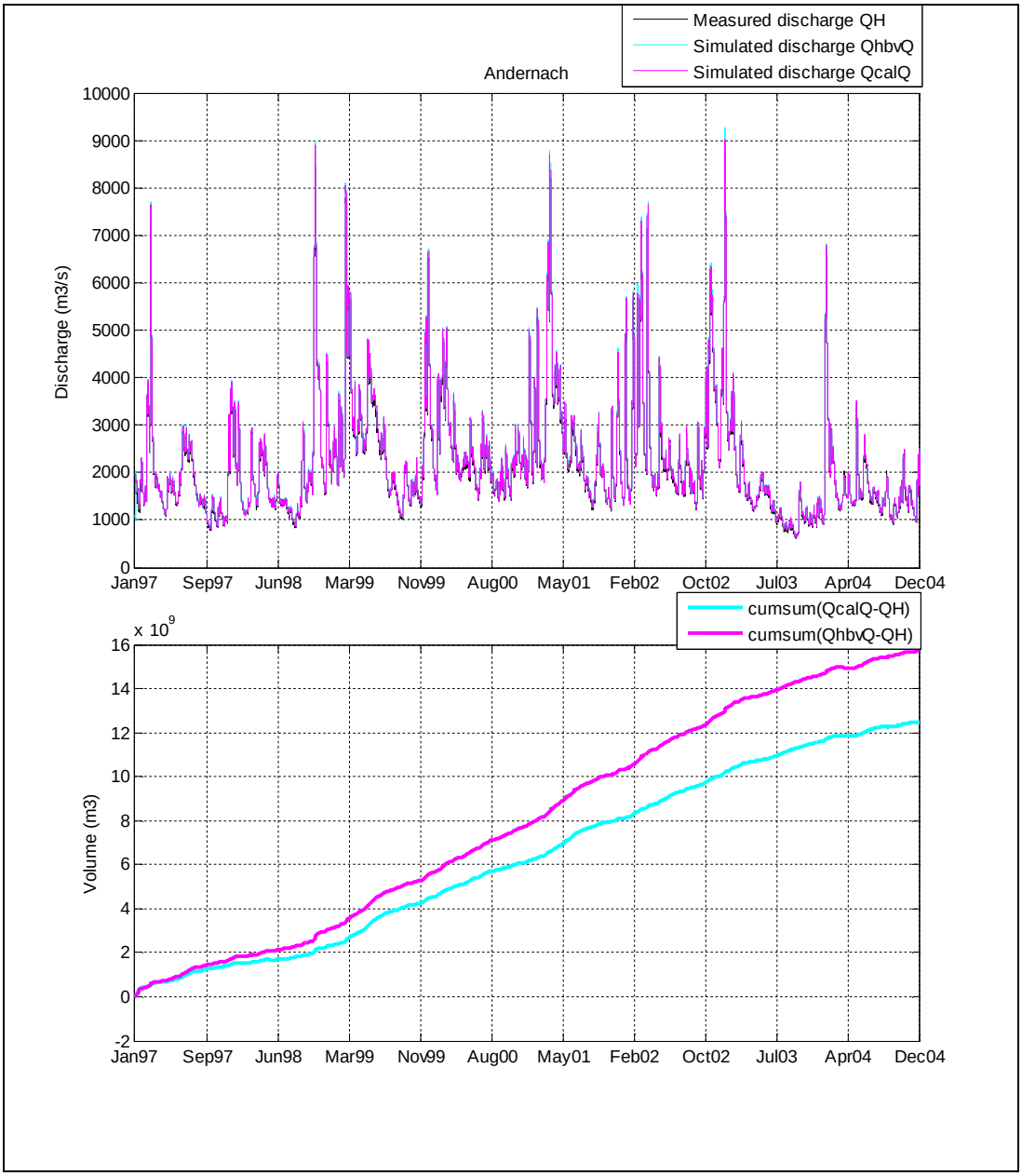

Figure D.5. (a) SOBEK simulated discharge using the calibration and HBV set vs measured discharge at Andernach (b) cumulative difference between the measurements and the SOBEK simulations.

D.6 Section 7: Andernach – Bonn

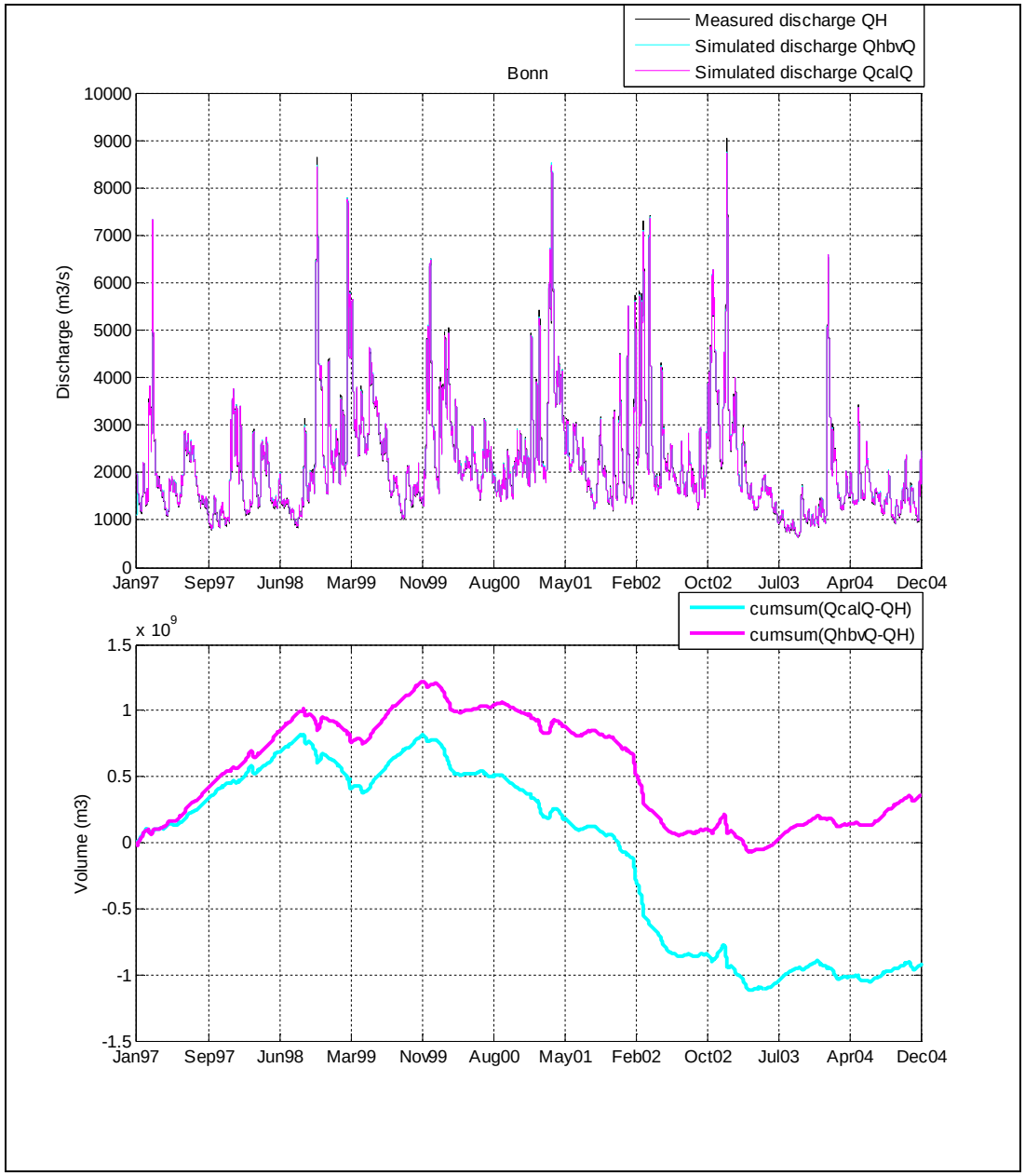

Figure D.6. (a) SOBEK simulated discharge using the calibration and HBV set vs measured discharge at Bonn (b) cumulative difference between the measurements and the SOBEK simulations.

D.7 Section 8: Bonn – Köln

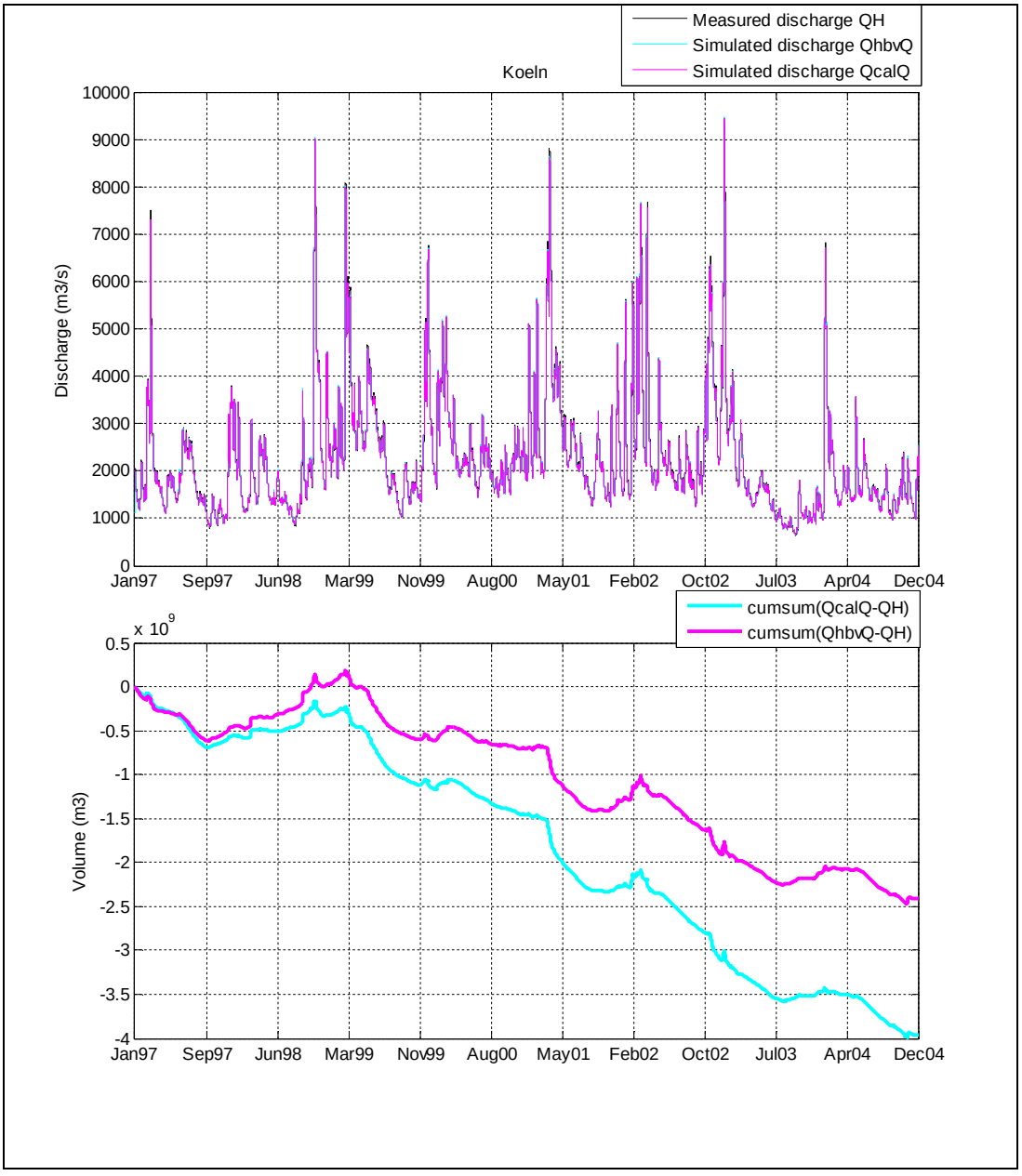

Figure D.7. (a) SOBEK simulated discharge using the calibration and HBV set vs measured discharge at Köln (b) cumulative difference between the measurements and the SOBEK simulations.

D.8 Section 9: Köln – Düsseldorf

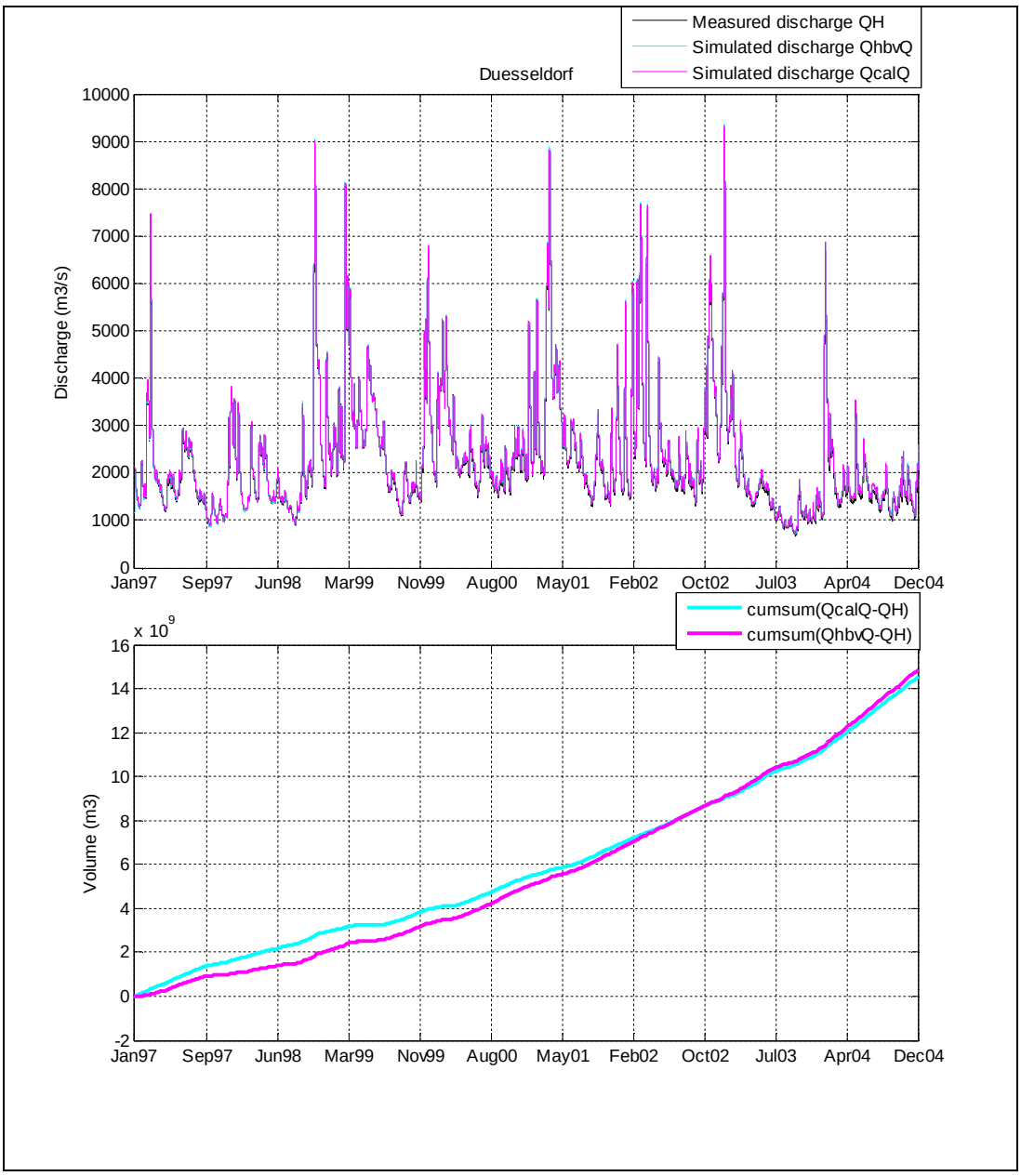

Figure D.8. (a) SOBEK simulated discharge using the calibration and HBV set vs measured discharge at Düsseldorf (b) cumulative difference between the measurements and the SOBEK simulations.

D.9 Section 10: Düsseldorf – Ruhrort

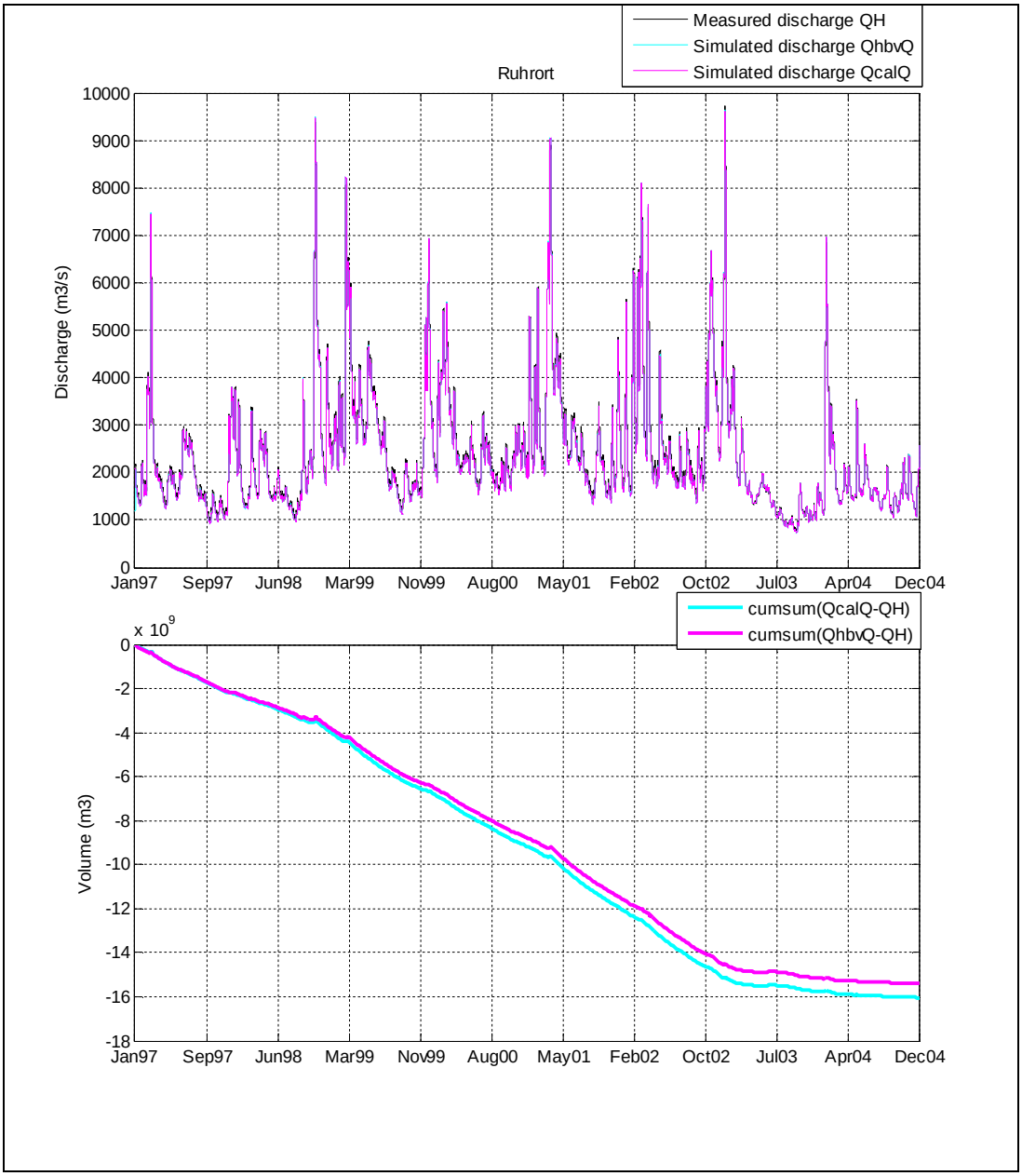

Figure D.9. (a) SOBEK simulated discharge using the calibration and HBV set vs measured discharge at Ruhrort (b) cumulative difference between the measurements and the SOBEK simulations.

D.10 Section 11: Ruhrort – Wesel

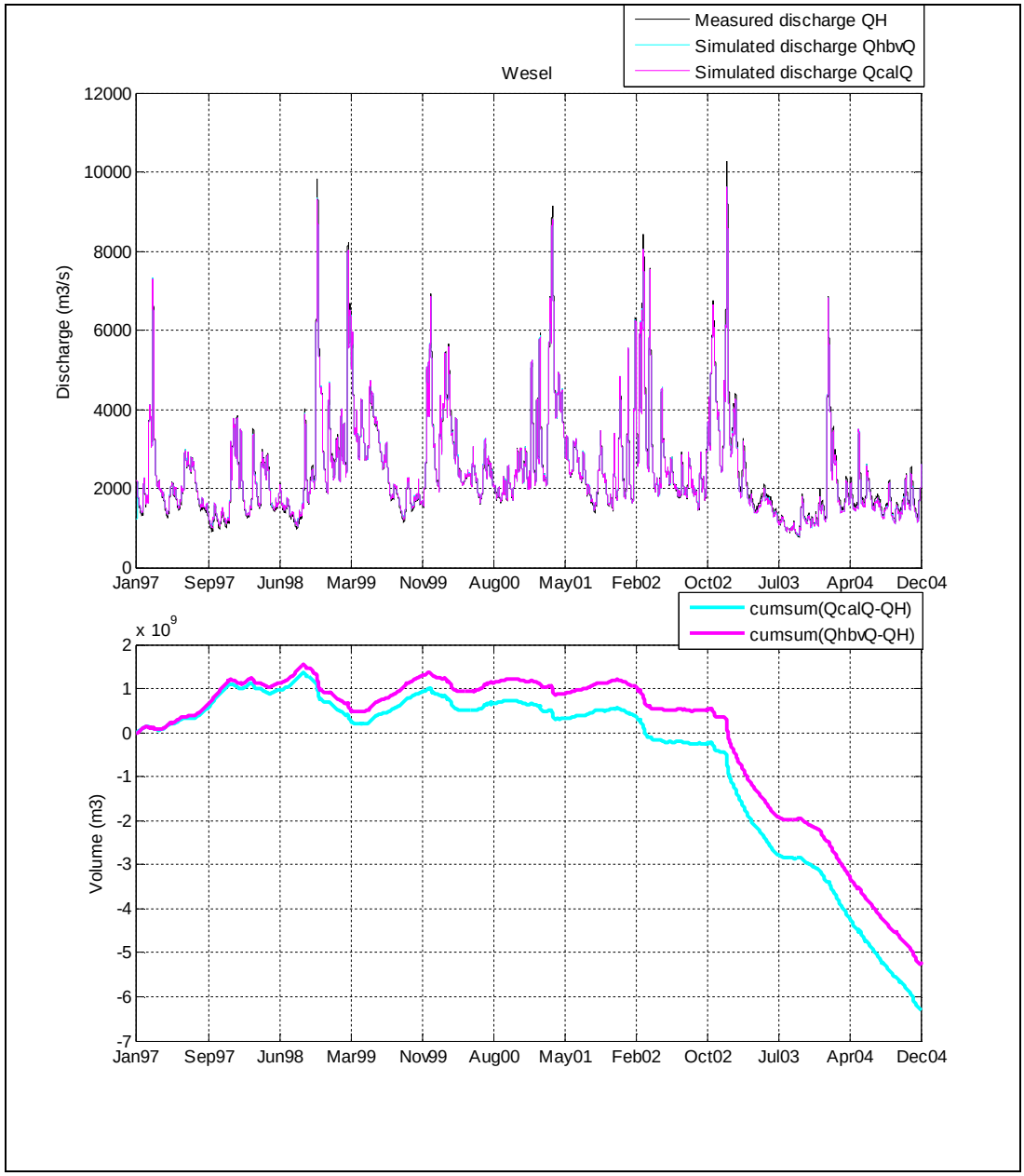

Figure D.10. (a) SOBEK simulated discharge using the calibration and HBV set vs measured discharge at Wesel (b) cumulative difference between the measurements and the SOBEK simulations.

D.11 Section 12: Wesel – Rees

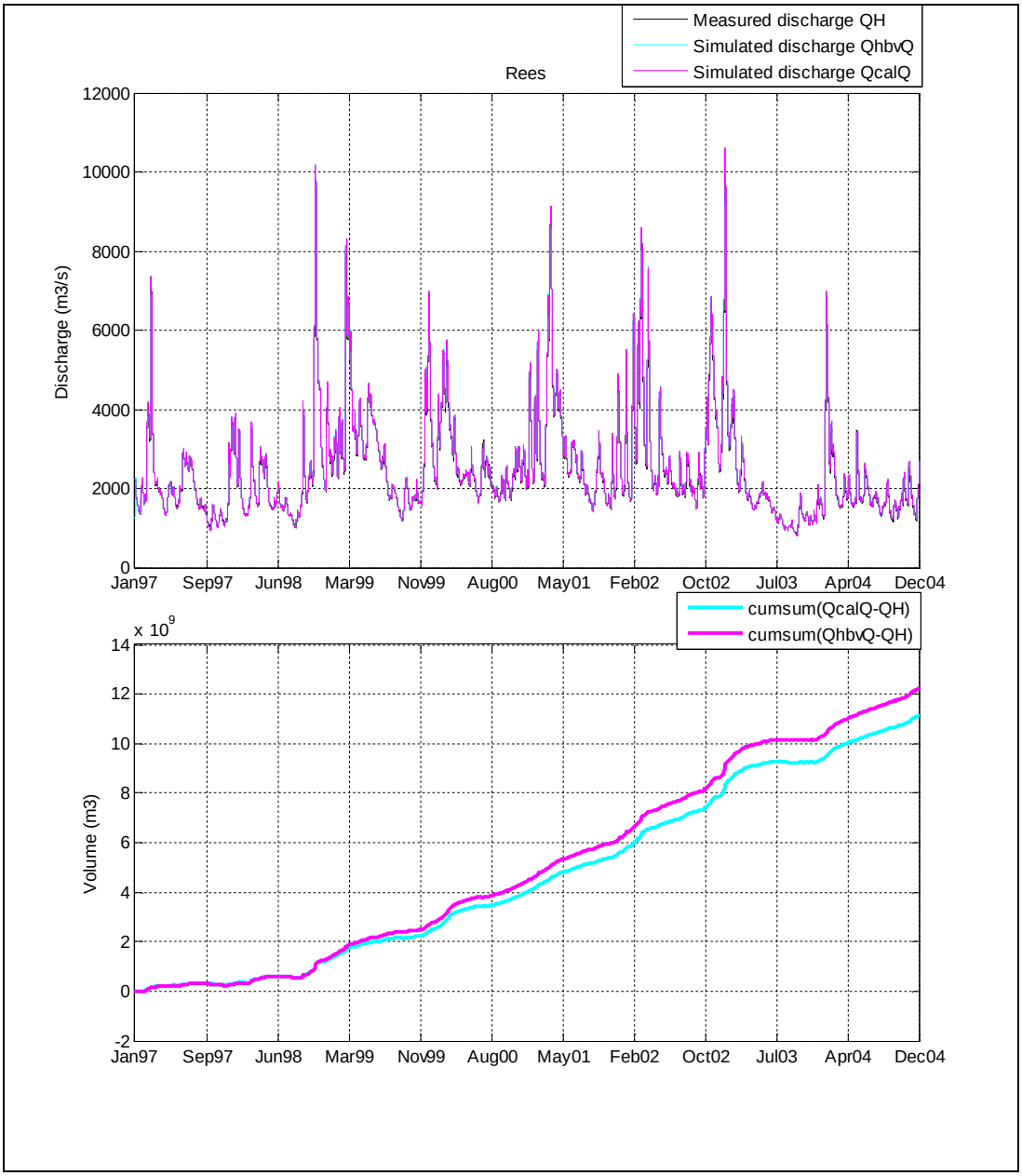

Figure D.11. (a) SOBEK simulated discharge using the calibration and HBV set vs measured discharge at Rees (b) cumulative difference between the measurements and the SOBEK simulations.

D.12 Section 13: Rees - Emmerich

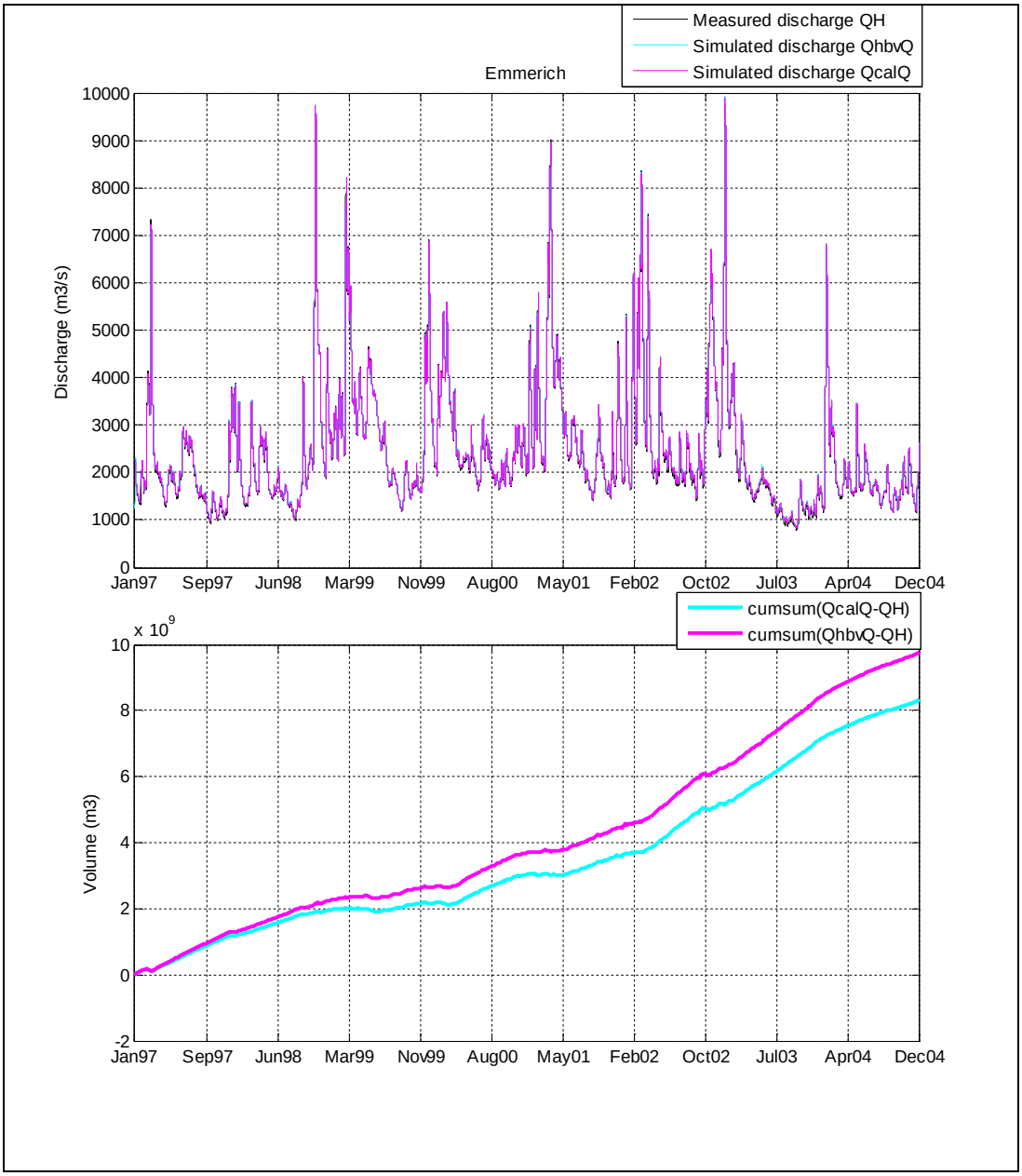

Figure D.12. (a) SOBEK simulated discharge using the calibration and HBV set vs measured discharge at Emmerich (b) cumulative difference between the measurements and the SOBEK simulations.

D.13 Section 14: Emmerich - Lobith

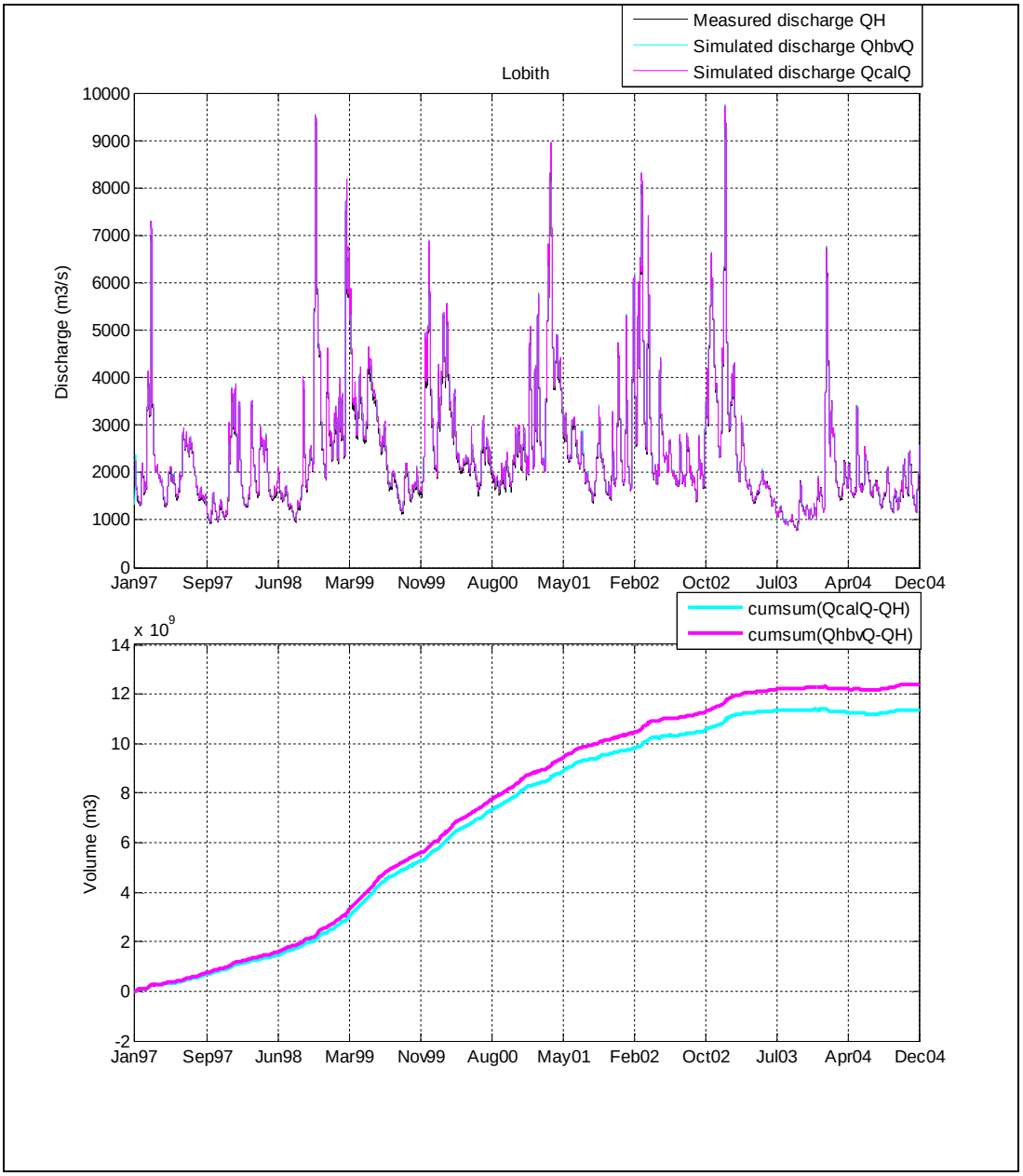

Figure D.13. (a) SOBEK simulated discharge using the calibration and HBV set vs measured discharge at Lobith (b) cumulative difference between the measurements and the SOBEK simulations.

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