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Joint Research Centre

Status Report

JRC studies for the
IKSE Elbe Flood Action Plan

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JRC IKSE studies

- Saale reservoir scenario study
- Elbe polder scenario study
- Elbe-EFAS: early flood warning



JRC IKSE studies

- **Saale reservoir scenario study**
- Elbe polder scenario study
- Elbe-EFAS: early flood warning

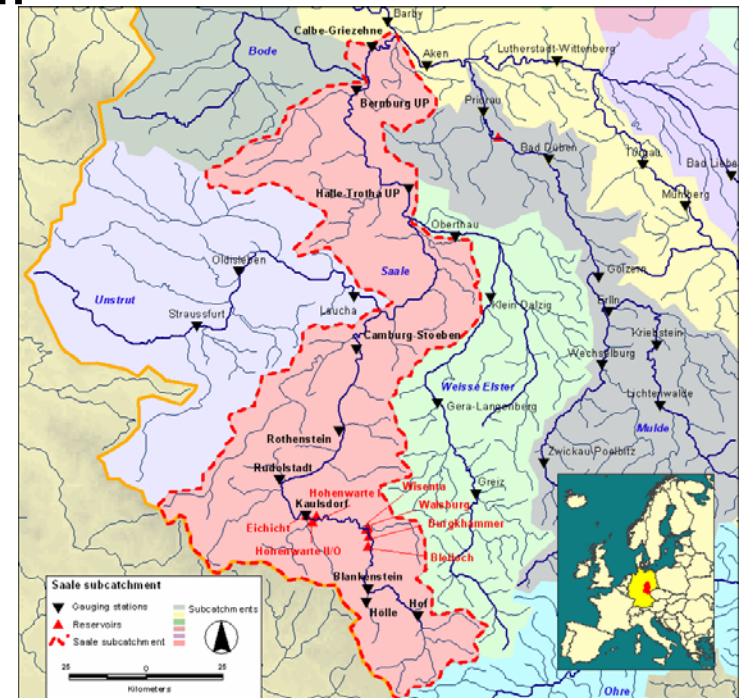


SAALE Study

Impact of the reservoir cascade of the SAALE on discharge behaviour in the ELBE

Agreed within the “Working Group Flood” of the ICPER to take three flood events into consideration:

- flood in April 1994
- flood in August 2002
- flood in January 2003





SAALE Study

- **Reference (Status - current steering):**

- The flood storage for the reservoirs Bleiloch and Hohenwarte together amounts to
 - 25 million m³ in summer and
 - 40 million m³ in winter.
- The minimum discharge (Q_{min}) amounts to 5 m³/s downstream of the Loquitzmündung.

- **Scenario (Plan – optimised steering):**

- The flood storage for the reservoirs Bleiloch and Hohenwarte together amounts to
 - 35 million m³ in summer and
 - 55 million m³ in winter.
- The minimum discharge (Q_{min}) amounts to 6 m³/s as reservoir outflow of the reservoir Eichicht.



SAALE Study

1. Events for reporting:

April 1994
August 2002
January 2003

2. Stations for reporting:

Rudolstadt
Camburg-Stöben
Naumburg-Grochlitz
Halle-Trotha
Calbe-Grieزهne

3. Reporting at each station:

Table with maximum
discharge in m³/s
Hydrograph including all
stream gauging stations of 2.



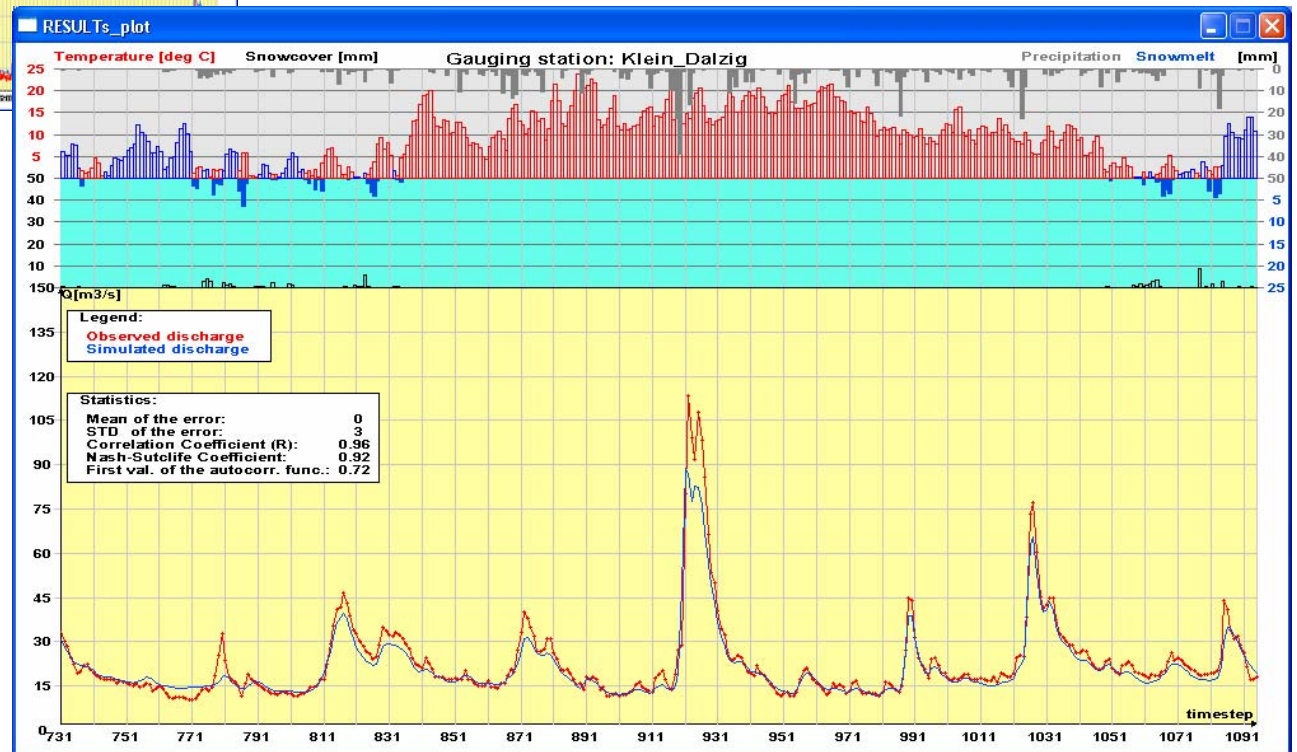
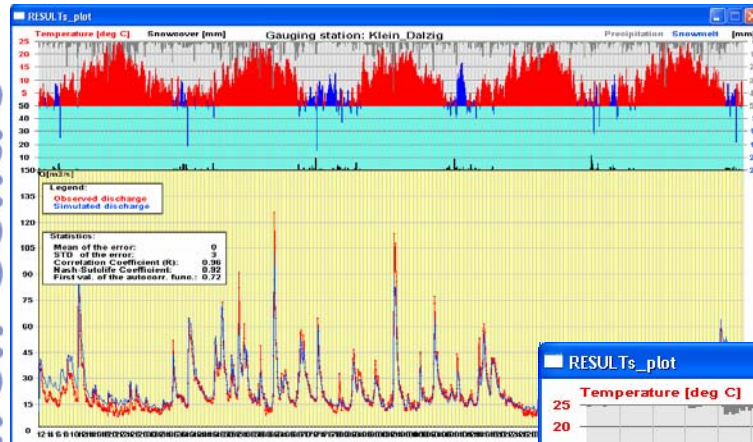
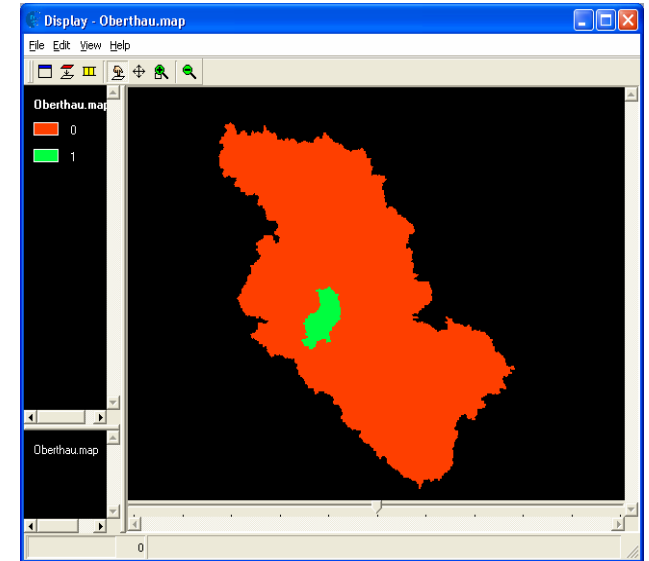
SAALE Study

- Model calibration for German SAALE river basin has been finished
 - ➔ predominantly good results could be achieved
 - ➔ problems appeared within the river section between Halle and Calbe-Grieznehne
 - Measurements wrong at two stations, or water is disappearing
 - Bode inflow unknown but significant -> needed to be estimated



SAALE Study

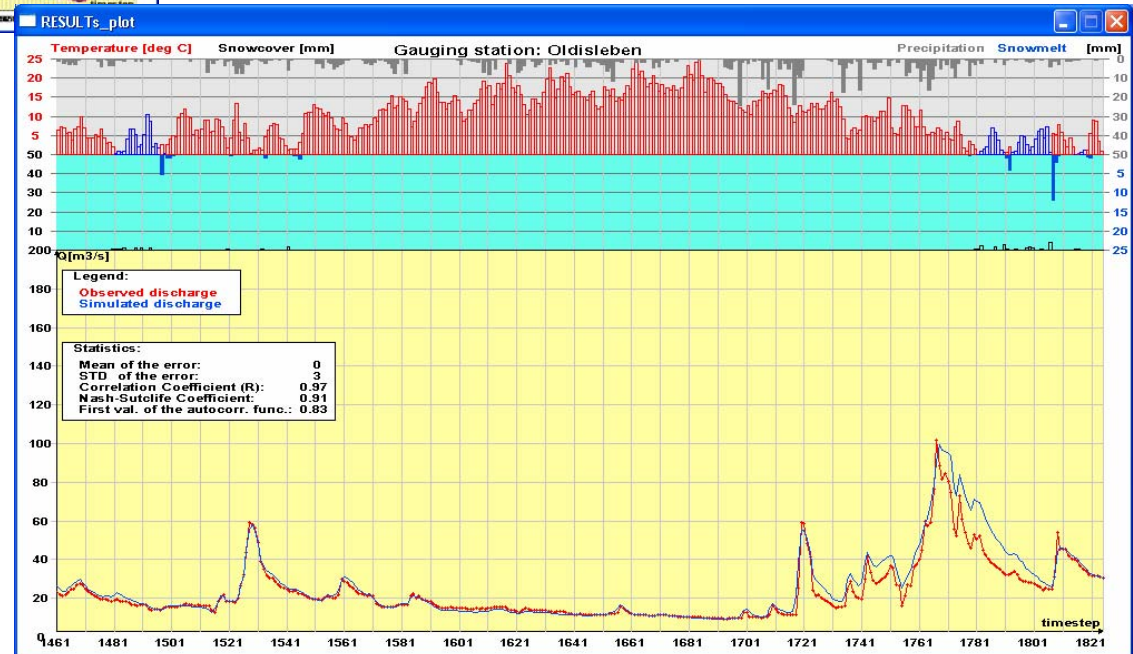
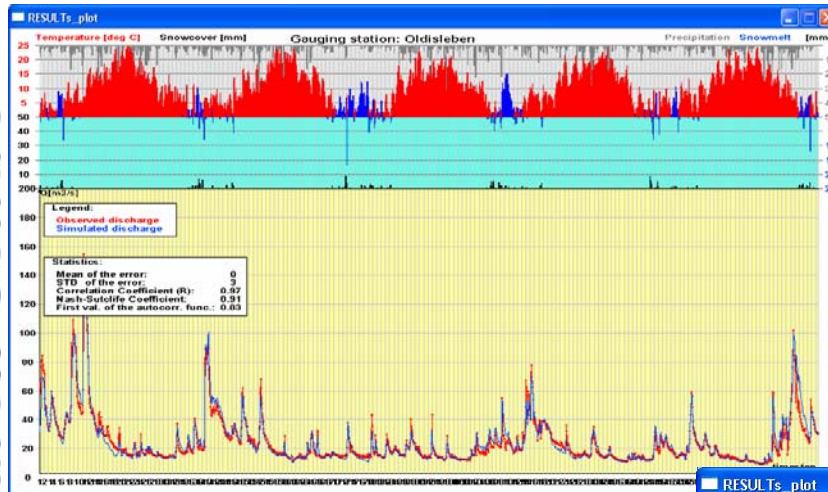
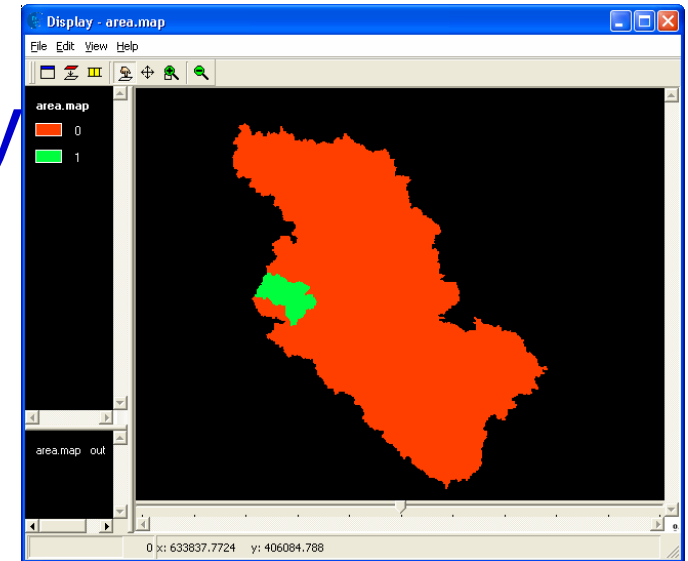
Calibration for Weisse Elster (1994-1998)
Gauge Klein Dalzig





SAALE Study

Calibration for Unstrut (1994-1998)
Gauge Oldisleben

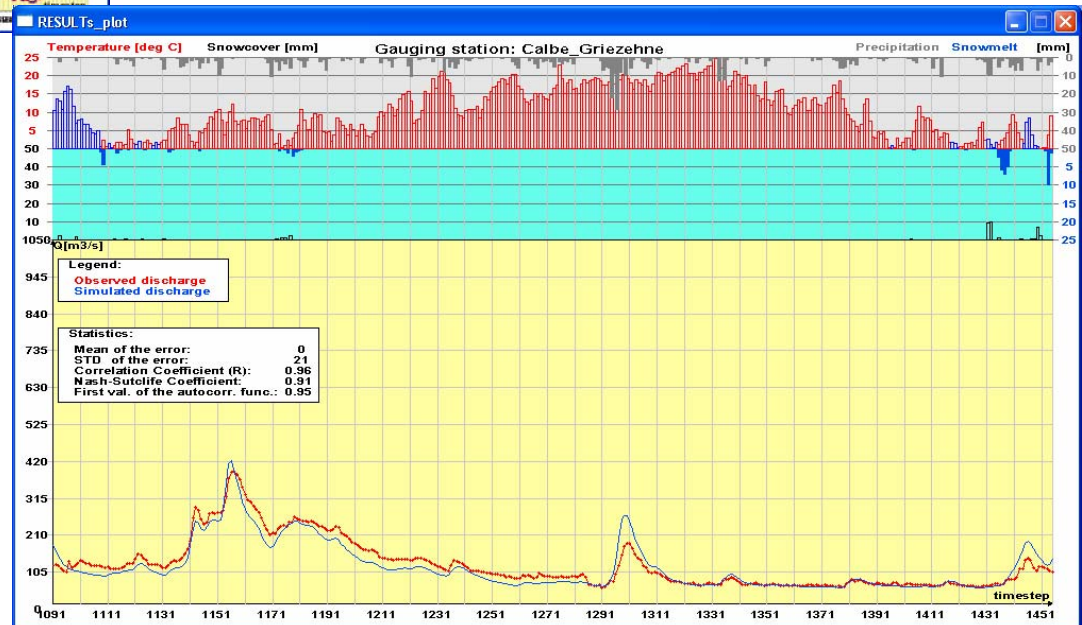
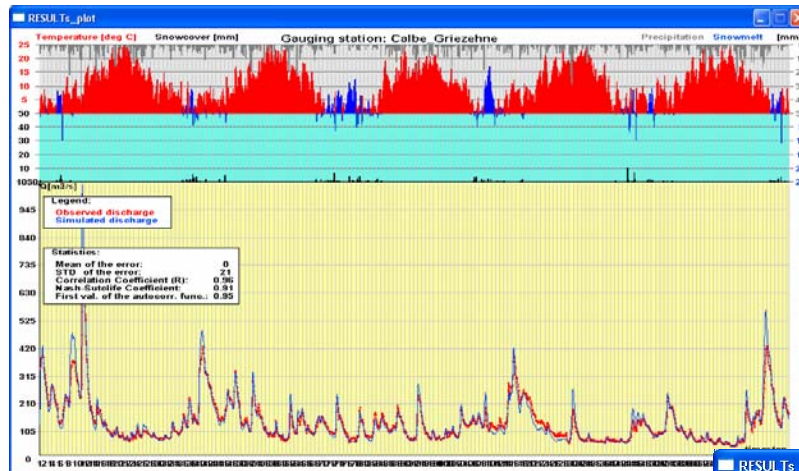
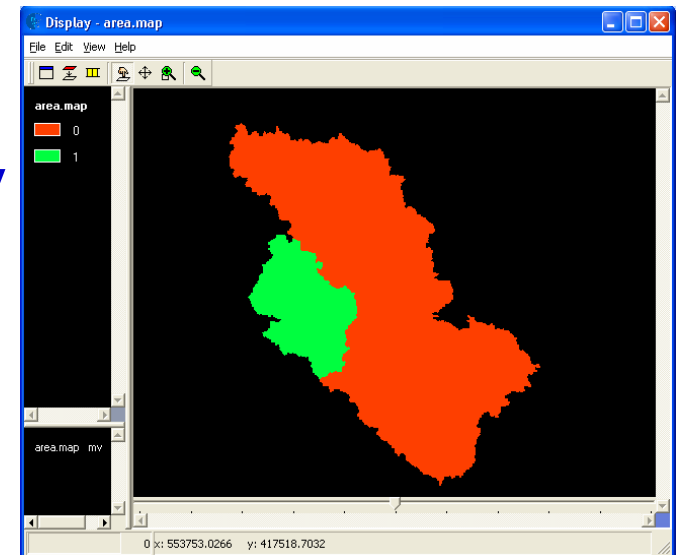




SAALE Study

Calibration SAALE (1994-1998)

Gauge Calbe Griezehne

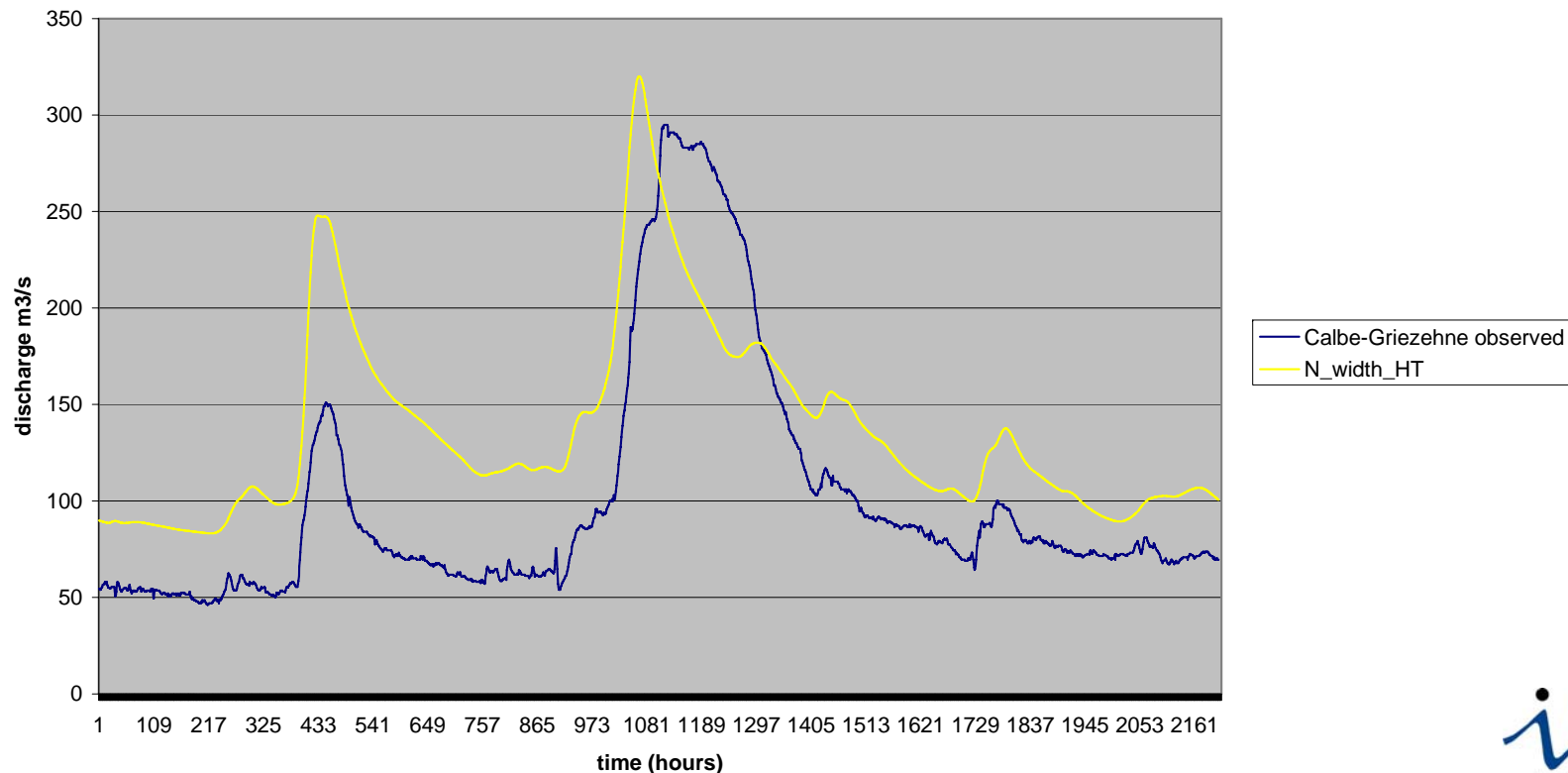




SAALE Study

- Applying the “best” parameter set from the simulated hydrograph at the final stream gauge Calbe-Griezhehne **does not represent a reasonable shape** in particular for discharge peaks in 1994, 2002 and 2002/2003. A simulation example of 2002 calculation is shown here:

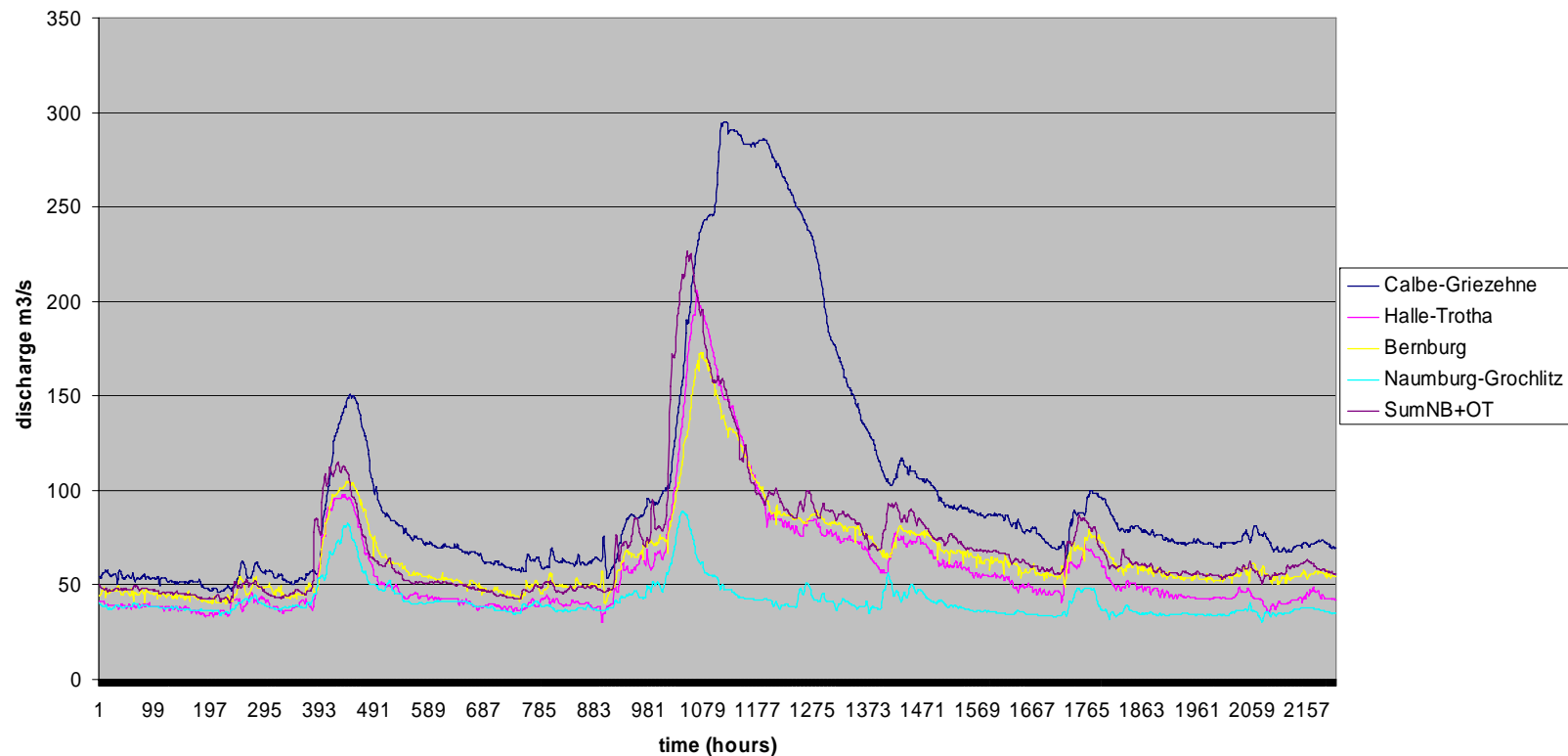
Comparison of hydrographs at the stream gauge Calbe-Griezhehne
for the time series 01/07-30/09/2002 (hourly run)





Saale Problem 1: measured discharge Naumburg + Oberthau (Weisse Elster) > discharge measured at Halle and Bernburg (?!)

Comparison of hourly discharge time series for the time period 01/07/-30/09/2002
Gauging stations of Saale: Calbe-Griesehne, Bernburg, Halle-Trotha, Naumburg-Grochlitz and
"discharge sum" of Naumburg-Grochlitz and Oberthau (Weisse Elster)



-> Assumption: Measurements at one or more of these three stations not reliable and thus ignored for calibration.



Saale Problem 2: Bode tributary inflow is uncertain and needed to be estimated

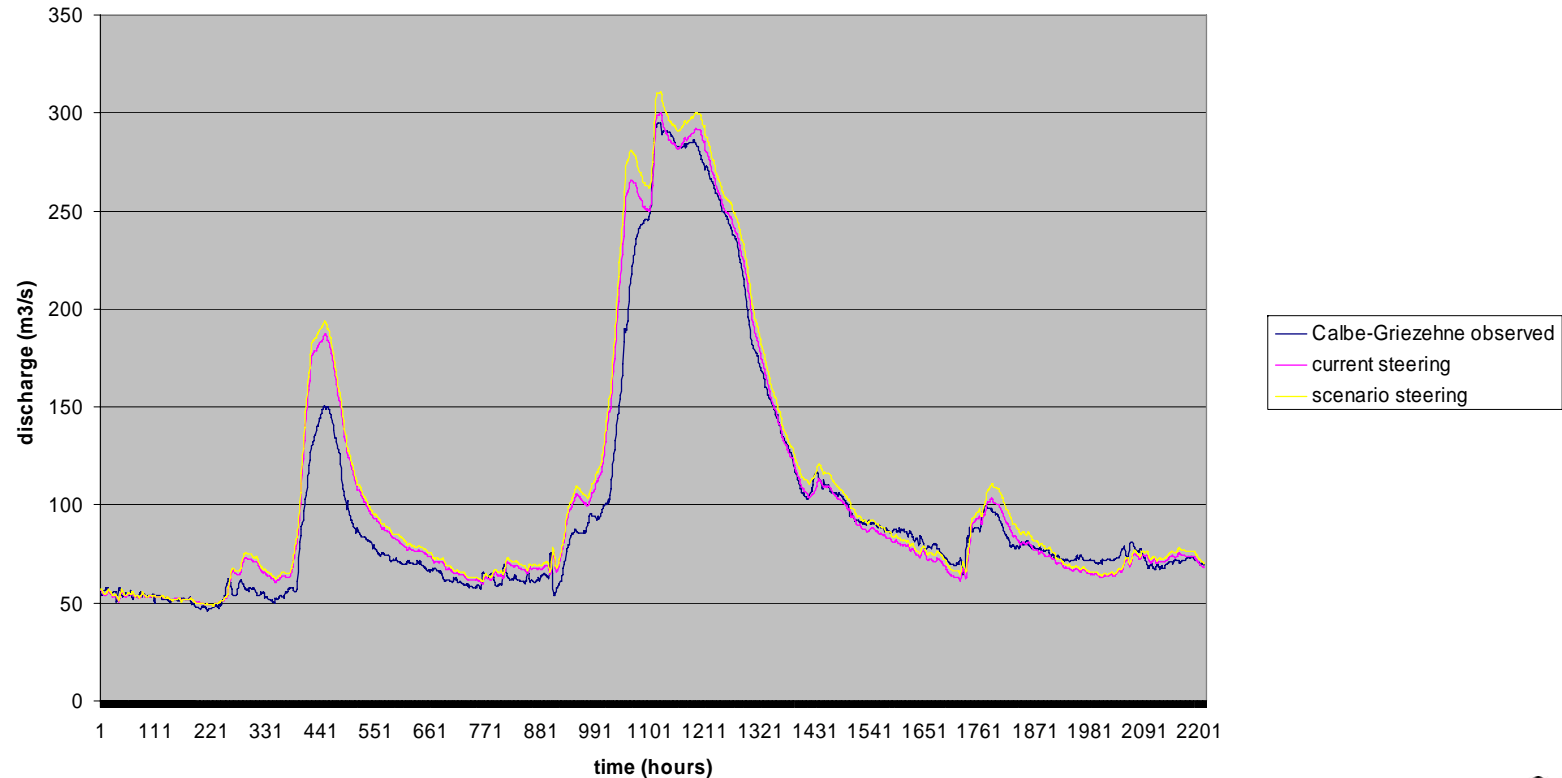
- River Bode simulated hydrograph caused a strange shape of the downstream Saale hydrograph.
 - Assumption: inflow of Bode estimated via subtraction of measured (provided) discharge values of the gauges *Calbe-Griezehne and Bernburg*.
 - The calibration has been entirely repeated for this sub-catchment.



SAALE Study

Result of the assumptions: shape of the hydrograph fits good (example 2002)

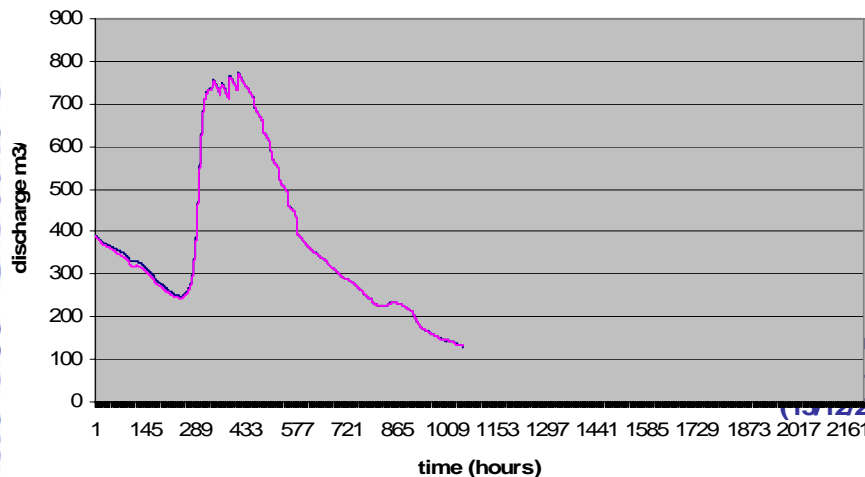
Comparison of discharge simulation for current and scenario steering at gauge Calbe-Grieznehne for the time period 01/07/-30/09/2002
- using "artificial Inflow of Bode" -



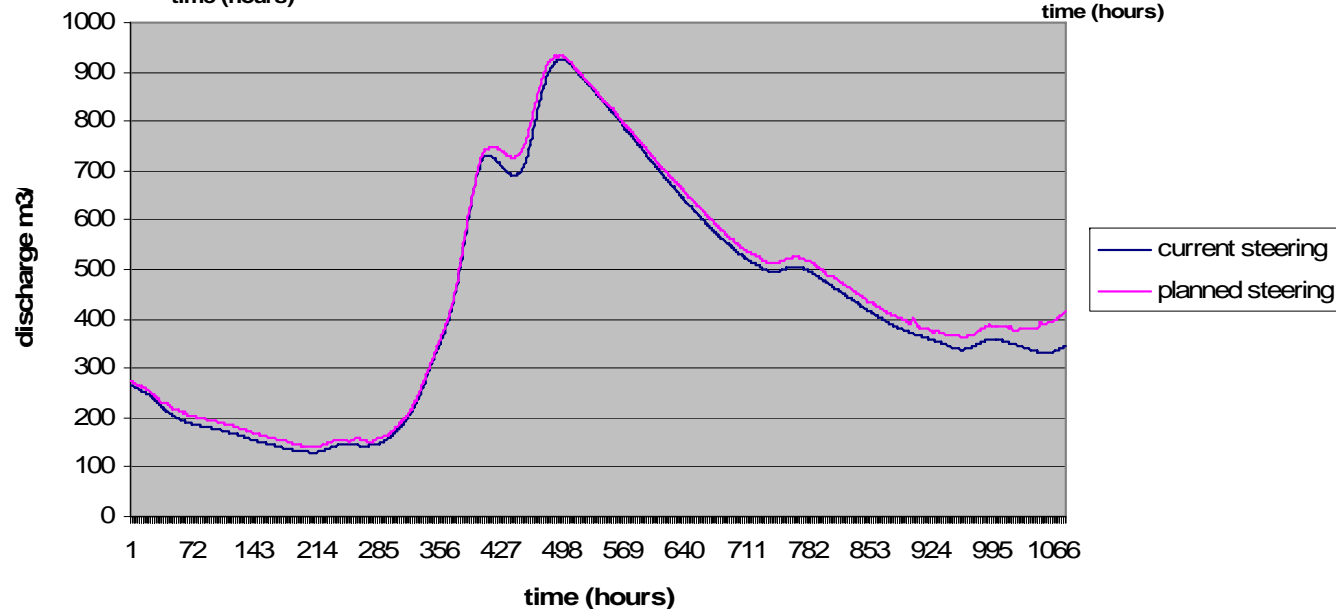
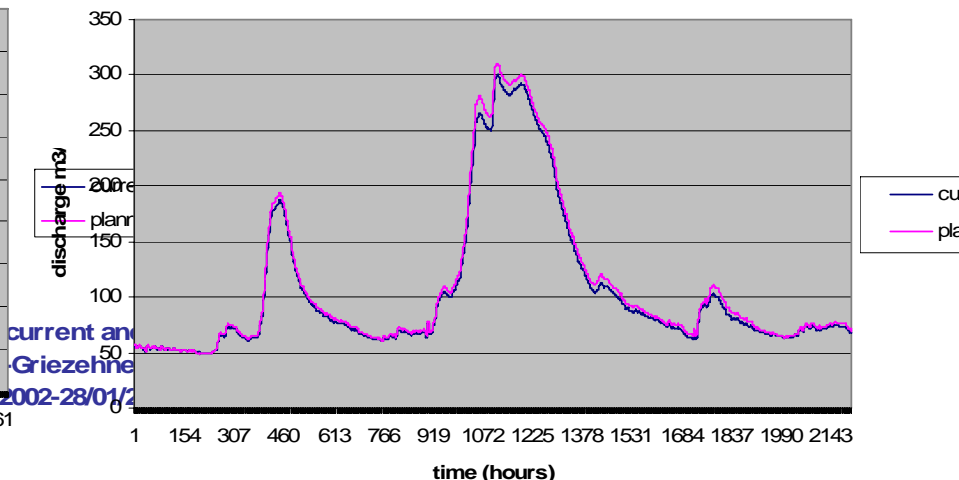


Comparison between current and planned reservoir steering for all three flood events

Comparison of simulations between current and planned steering of the reservoir cascade at Saale stream gauge Calbe-Grieznehne for the flood event in April 1994 (01/04-15/04/1994)



Comparison of simulations between current and planned steering of the reservoir cascade at Saale stream gauge Calbe-Grieznehne for the flood event in August 2002 (01/07/2002-30/09/2002)





SAALE Study - Conclusion

- The simulation results at the last SAALE stream gauge *Calbe-Griezehne* – the last gauge before the confluence with the main ELBE - show no significant differences in discharge between current and planned steering rules of the SAALE reservoir cascade.
- As the results have shown the planned scenario for reservoir steering does not have any significant influence on the discharge of the ELBE.



JRC IKSE studies

- Saale reservoir scenario study
- **Elbe polder scenario study**
- Elbe-EFAS: early flood warning



ELBE Study

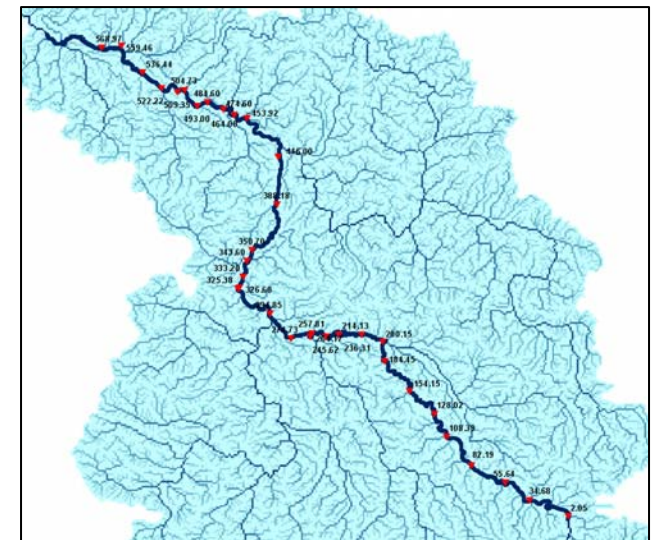
Study on reactivation of former flood plains
and creation of additional retention polder
areas along the German ELBE

Agreed within the “Working Group Flood” of the
ICPER to take
three flood events into consideration:

flood in April 1994

flood in August 2002

flood in January 2003





ELBE Study

ID	Measure	Reservoirs	1994 ELBE	2002 ELBE	2003 ELBE	0210 ELBE	0220 ELBE	0230 ELBE
			April	August	January	2002-10%	2002-20%	2002-30%
0B	2002 Dyke breaches	Current steering		2002_DB_B				
1B	Reference	Current steering	1994_RF_1B	2002_RF_1B	2003_RF_1B	0210_RF_1B	0220_RF_1B	0230_RF_1B
1R		Optimized Moldau/Saale	1994_RF_1R	2002_RF_1R	2003_RF_1R	0210_RF_1R	0220_RF_1R	0230_RF_1R
1A		affected (cz study)	1994_A_1	2002_A_1				
1UA		unaffected (cz study)	1994_UA_1	2002_UA_1				
2B	Dyke overtopping	Current steering	1994_DO_2B	2002_DO_2B	2003_DO_2B	0210_DO_2B	0220_DO_2B	0230_DO_2B
2R		Optimized Moldau/Saale	1994_DO_2R	2002_DO_2R	2003_DO_2R	0210_DO_2R	0220_DO_2R	0230_DO_2R
2A		affected (cz study)	1994_A_2	2002_A_2				
2UA		unaffected (cz study)	1994_UA_2	2002_UA_2				
3B	Dyke Enlargement (Lenzen)	Current steering	1994_DR_3B	2002_DR_3B	2003_DR_3B	0210_DR_3B	0220_DR_3B	0230_DR_3B
3R		Optimized Moldau/Saale	1994_DR_3R	2002_DR_3R	2003_DR_3R	0210_DR_3R	0220_DR_3R	0230_DR_3R
3A		affected (cz study)	1994_A_3	2002_A_3				
3UA		unaffected (cz study)	1994_UA_3	2002_UA_3				
4B	Additional measures Saxony	Current steering	1994_ZM_4B	2002_ZM_4B	2003_ZM_4B	0210_ZM_4B	0220_ZM_4B	0230_ZM_4B
4R		Optimized Moldau/Saale	1994_ZM_4R	2002_ZM_4R	2003_ZM_4R	0210_ZM_4R	0220_ZM_4R	0230_ZM_4R
4A		affected (cz study)	1994_A_4	2002_A_4				
4UA		unaffected (cz study)	1994_UA_4	2002_UA_4				
5B	Polders/optimum steering	Current steering	1994_PO_5B	2002_PO_5B	2003_PO_5B	0210_PO_5B	0220_PO_5B	0230_PO_5B
5R		Optimized Moldau/Saale	1994_PO_5R	2002_PO_5R	2003_PO_5R	0210_PO_5R	0220_PO_5R	0230_PO_5R
5A		affected (cz study)	1994_A_5	2002_A_5				
5UA		unaffected (cz study)	1994_UA_5	2002_UA_5				
6B	Polders/threshold steering	Current steering	1994_PT_6B	2002_PT_6B	2003_PT_6B	0210_PT_6B	0220_PT_6B	0230_PT_6B
6R		Optimized Moldau/Saale	1994_PT_6R	2002_PT_6R	2003_PT_6R	0210_PT_6R	0220_PT_6R	0230_PT_6R
6A		affected (cz study)	1994_A_6	2002_A_6				
6UA		unaffected (cz study)	1994_UA_6	2002_UA_6				
7B	Polders/always open	Current steering	1994_PN_7B	2002_PN_7B	2003_PN_7B	0210_PN_7B	0220_PN_7B	0230_PN_7B
7R		Optimized Moldau/Saale	1994_PN_7R	2002_PN_7R	2003_PN_7R	0210_PN_7R	0220_PN_7R	0230_PN_7R
7A		affected (cz study)	1994_A_7	2002_A_7				
7UA		unaffected (cz study)	1994_UA_7	2002_UA_7				
8B	3B+4B+5B	Current steering	1994_PD_8B	2002_PD_8B	2003_PD_8B	0210_PD_8B	0220_PD_8B	0230_PD_8B
8R		Optimized Moldau/Saale	1994_PD_8R	2002_PD_8R	2003_PD_8R	0210_PD_8R	0220_PD_8R	0230_PD_8R
8A		affected (cz study)	1994_A_8	2002_A_8				
8UA		unaffected (cz study)	1994_UA_8	2002_UA_8				



ELBE Study

1. Events for reporting:

April 1994
August 2002
January 2003

2.1 Stations for reporting:

Schöna
Dresden
Torgau
Lutherstadt-Wittenberg
Aken
Barby

2.2 Stations for reporting:

Magdeburg
Wittenberge
Neu Darchau
Dömitz
Hohnstorf

3. Reporting at each station:

Table with maximum discharge in m³/s
Hydrograph including stream gauging stations of 2.1 in one
Hydrograph including stream gauging stations of 2.2 in one



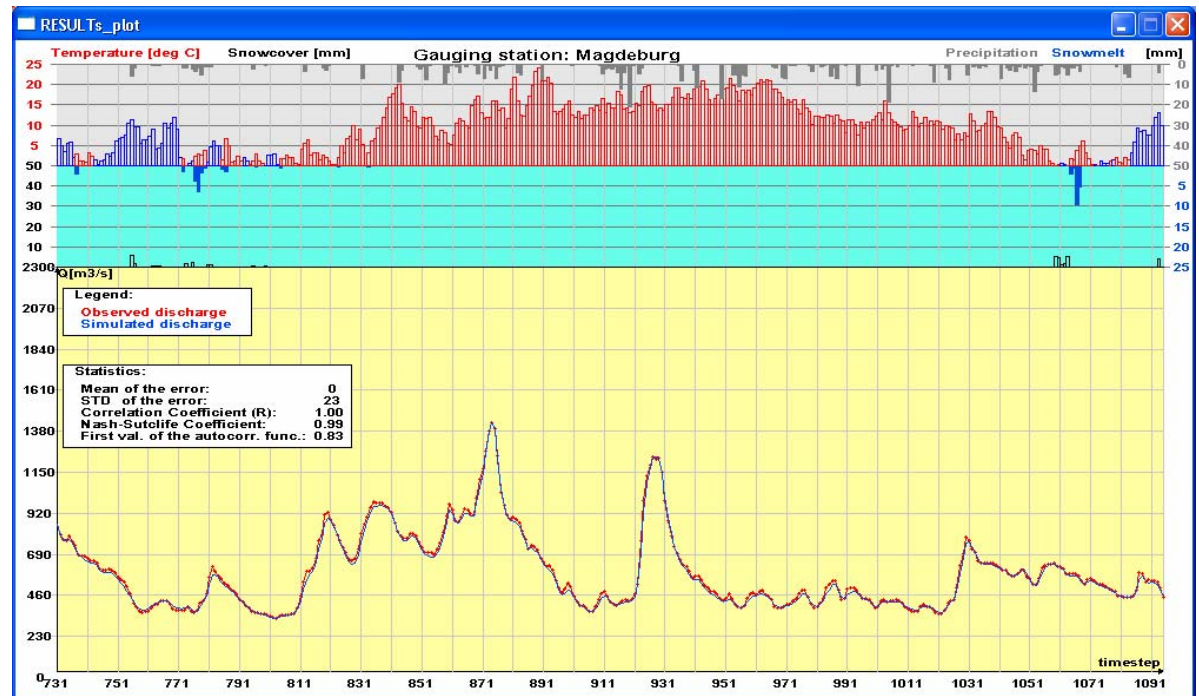
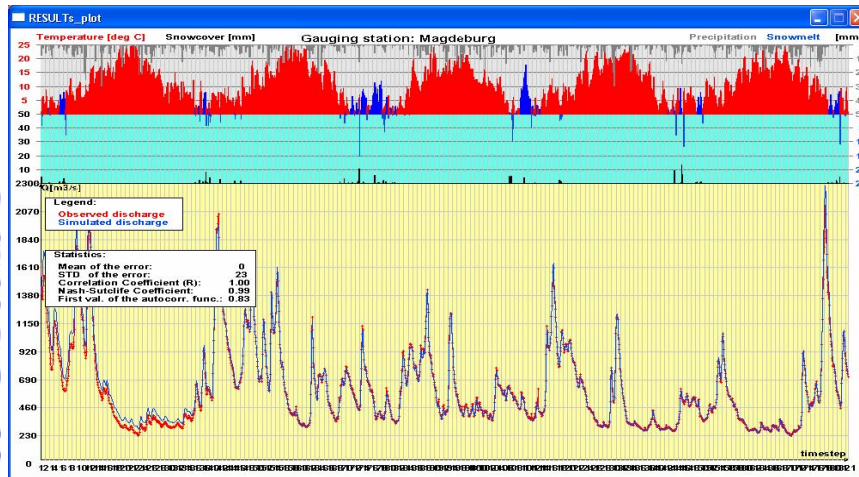
ELBE Study

- Model calibration for German SAALE river basin has been finished
 - predominantly good results could be achieved for discharge
 - problems appeared for calibrating water levels



ELBE Study – calibration results

Gauge Magdeburg
(1994-1998)

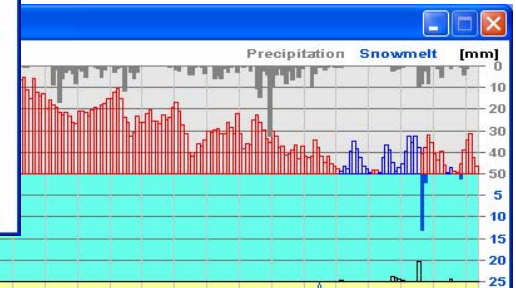
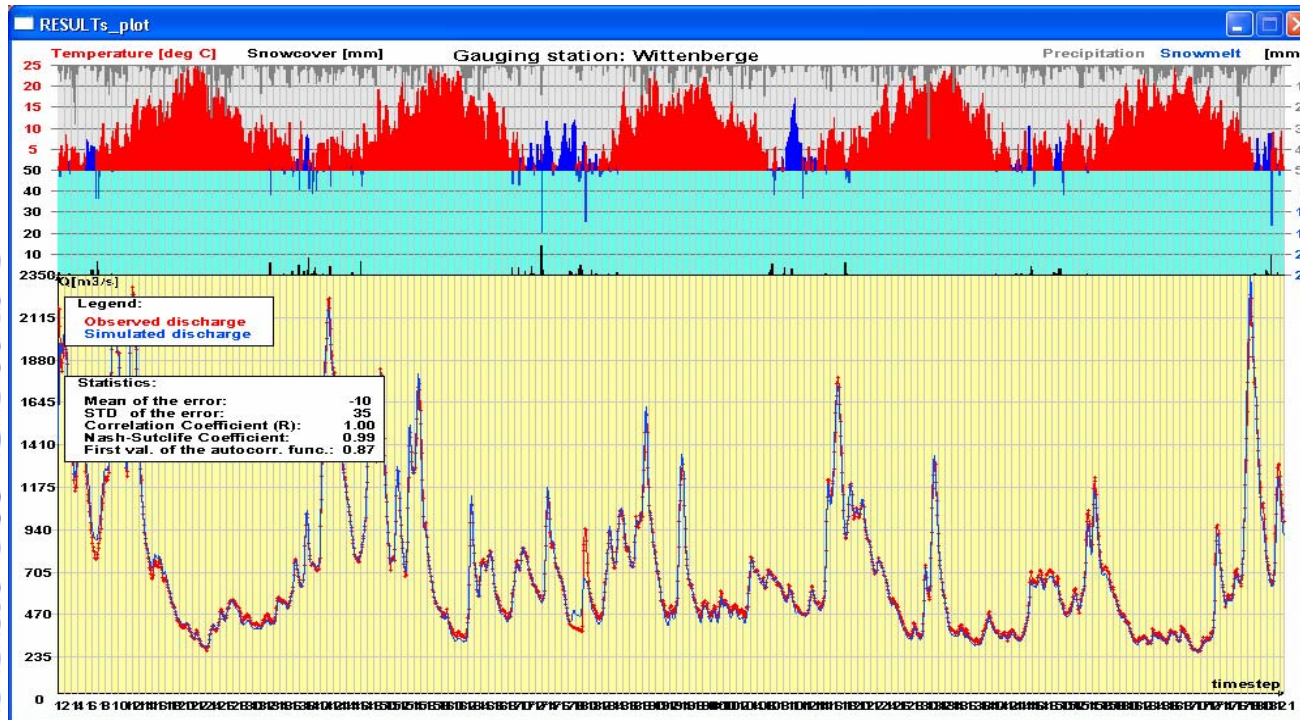




ELBE Study – calibration results

Gauge
Wittenberge
(1994-1998)

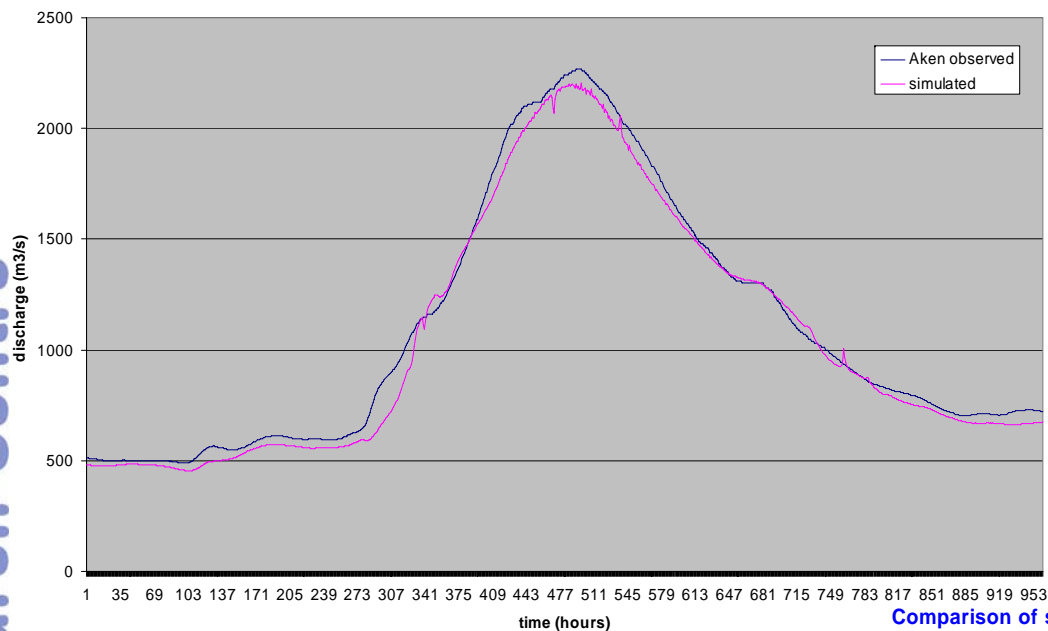
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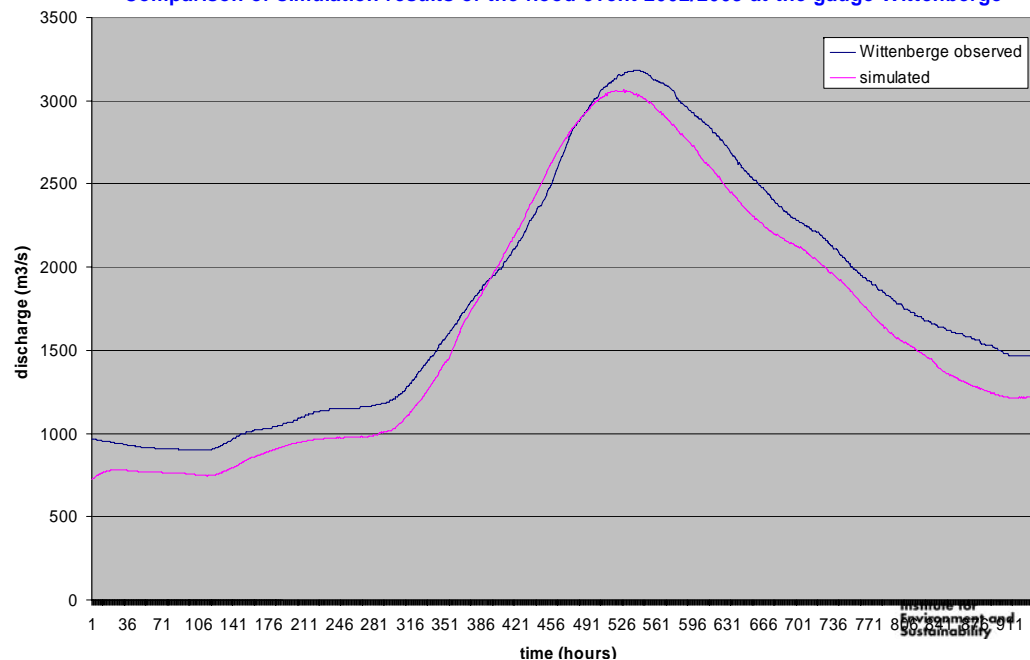


ELBE Study – first study results event 2002/2003

Comparison of simulation results of the flood event 2002/2003 at the gauge Aken



Comparison of simulation results of the flood event 2002/2003 at the gauge Wittenberge

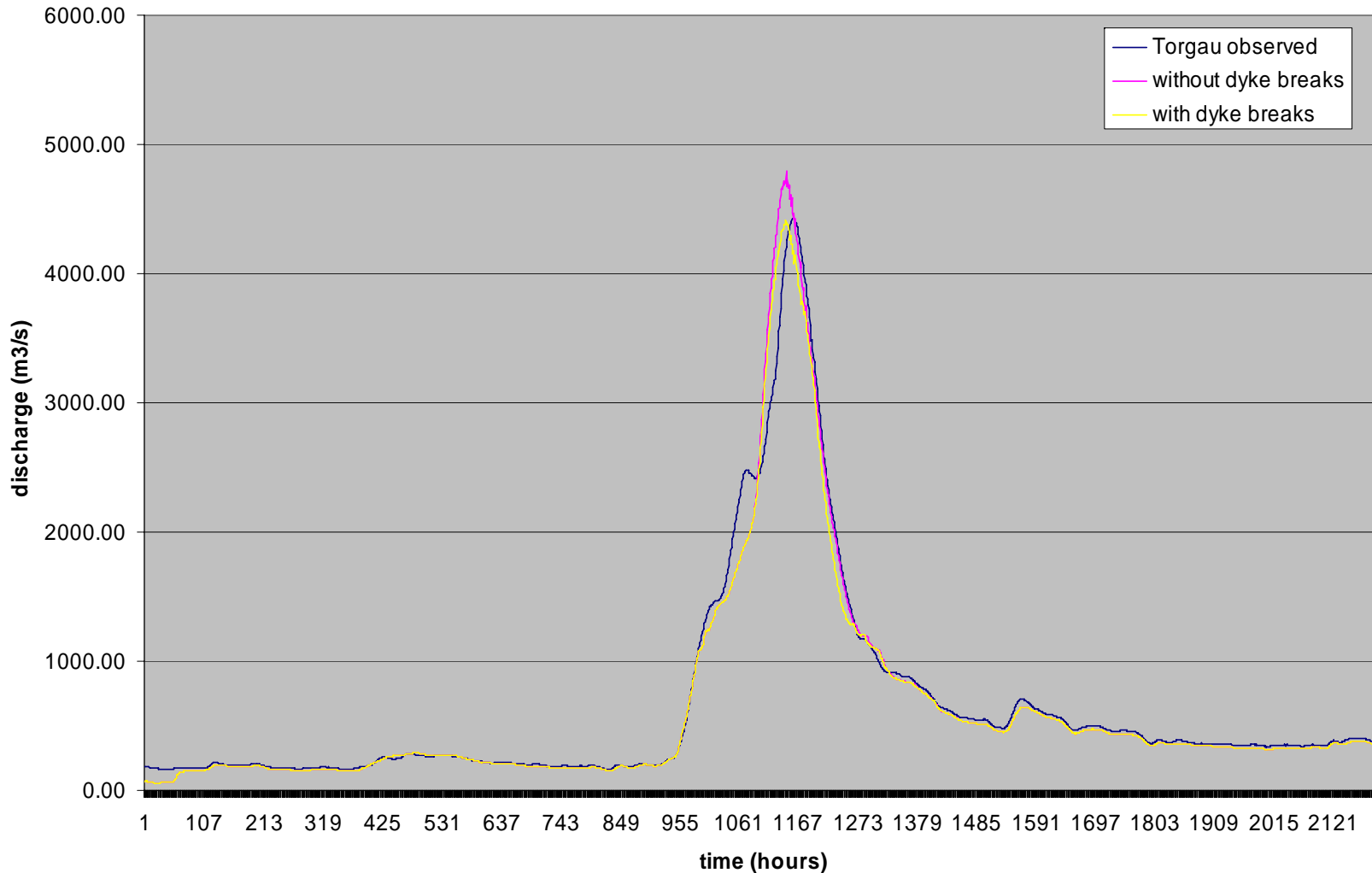




ELBE Study – first study results

Event 2002 with and without Dyke Breaks

Comparison of simulation results of the flood event in summer 2002 at the gauge Torgau
- with and without dyke breaks -



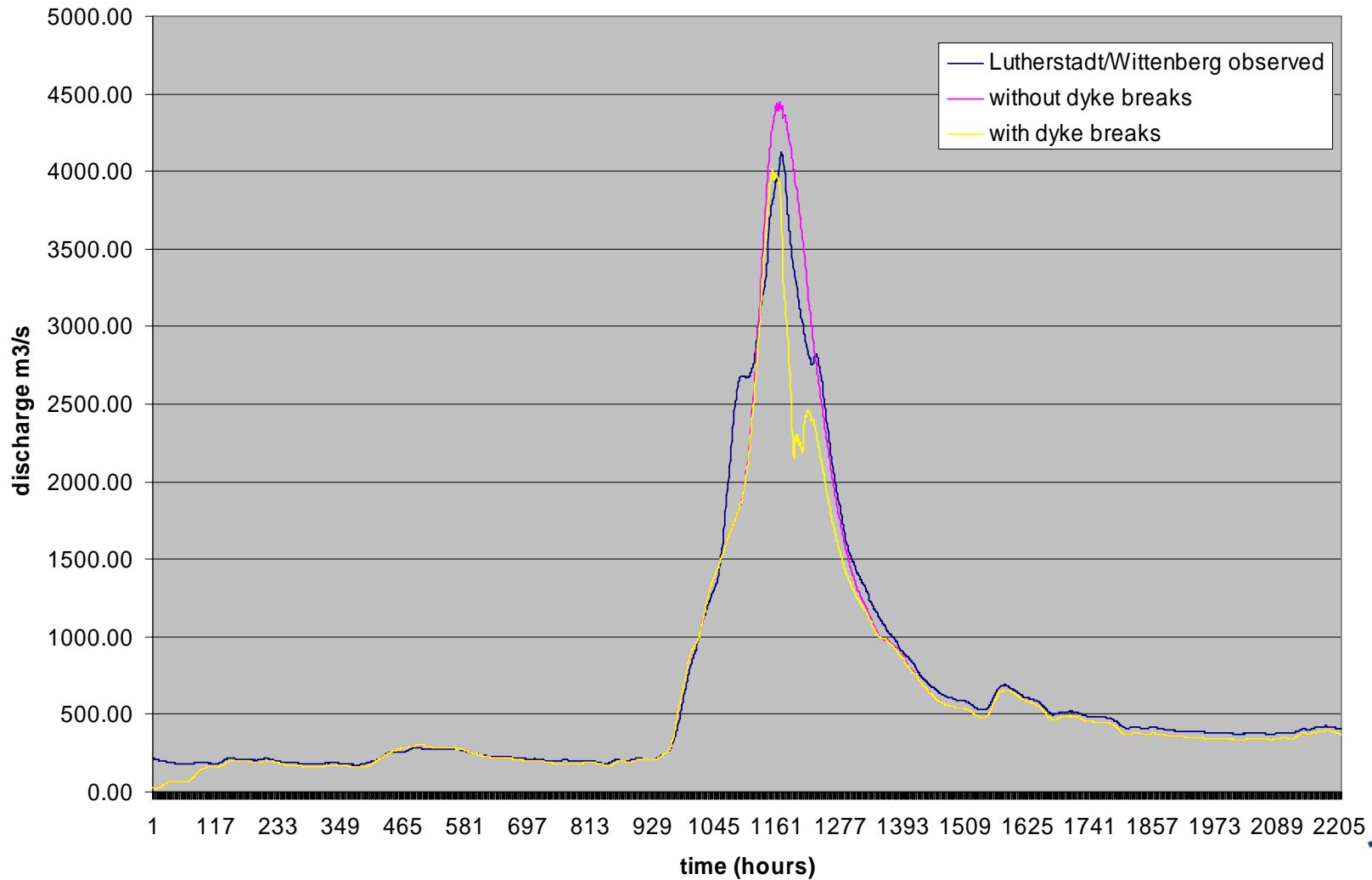


ELBE Study – first study results

Event 2002 with and without Dyke Breaks

Comparison of simulation results of the flood event in summer 2002 at the gauge
Lutherstadt/Wittenberg
- with and without dyke breaks -

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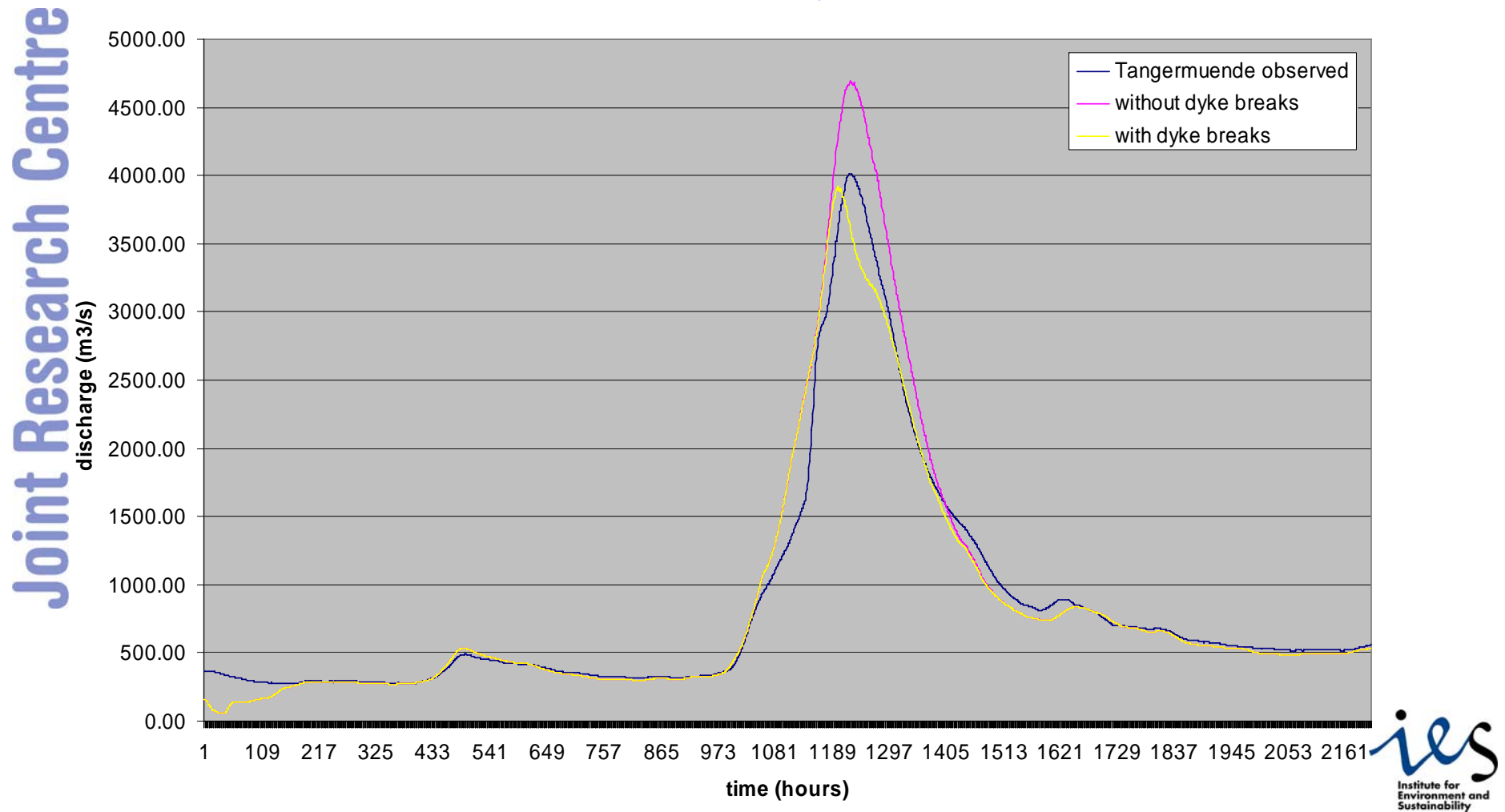




ELBE Study – first study results

Event 2002 with and without Dyke Breaks

Comparison of simulation results of the flood event in summer 2002 at the gauge
Tangermuende
- with and without dyke breaks -





ELBE Study - Preliminary Conclusion

- calibration results for discharge are good
- Waterlevels more difficult to fit correctly
 - Accuracy of some cross sections doubtful
- First scenarios (2002 without dykebreaks) indicate 15% higher peak discharges than observed in 2002



JRC IKSE studies

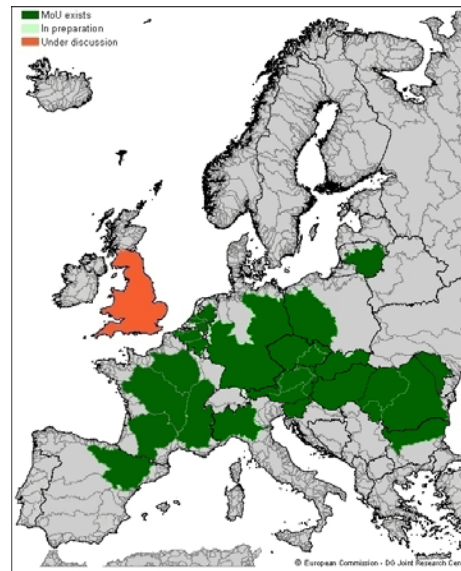
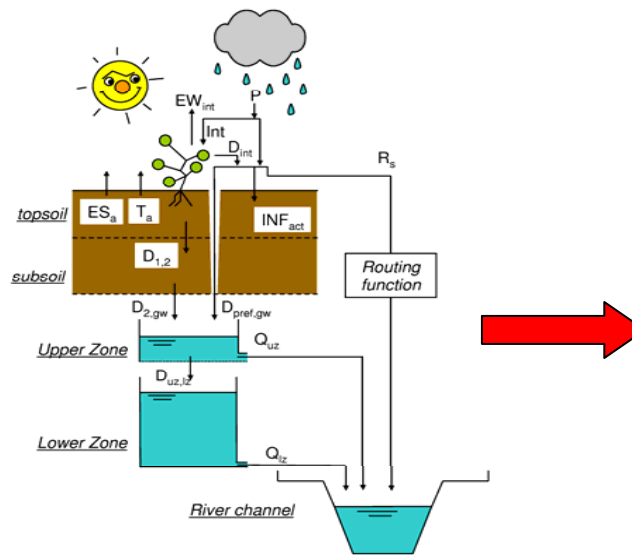
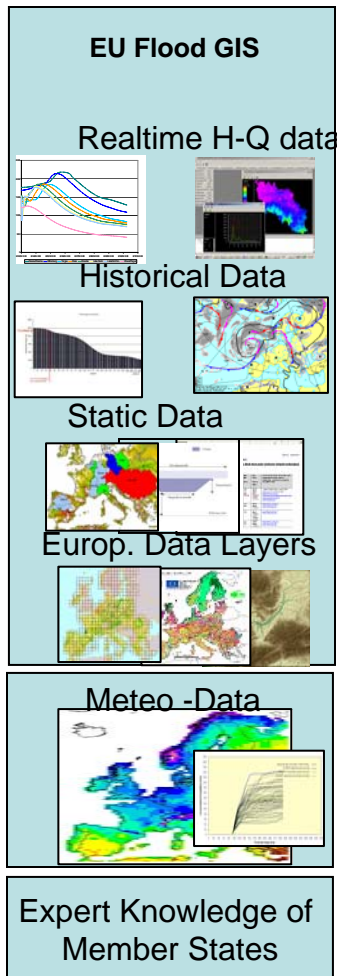
- Saale reservoir scenario study
- Elbe polder scenario study
- **Elbe-EFAS: early flood warning**



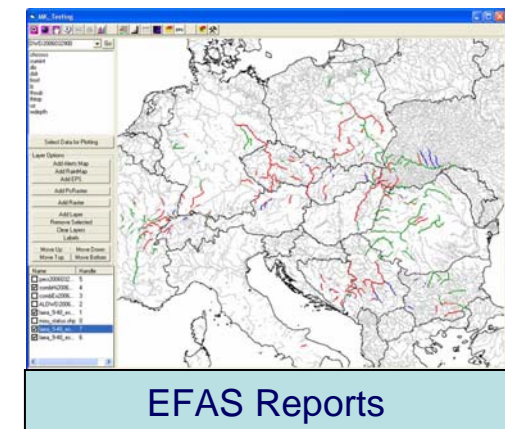
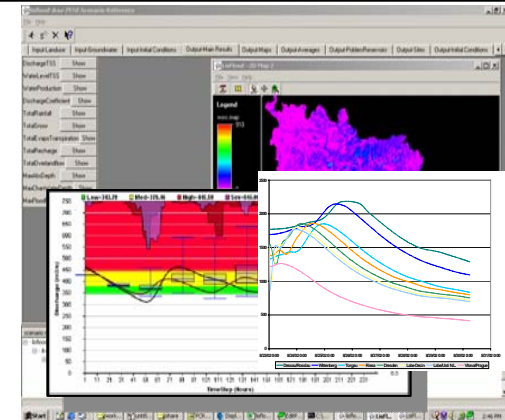
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Development of a European Flood Alert System (EFAS)

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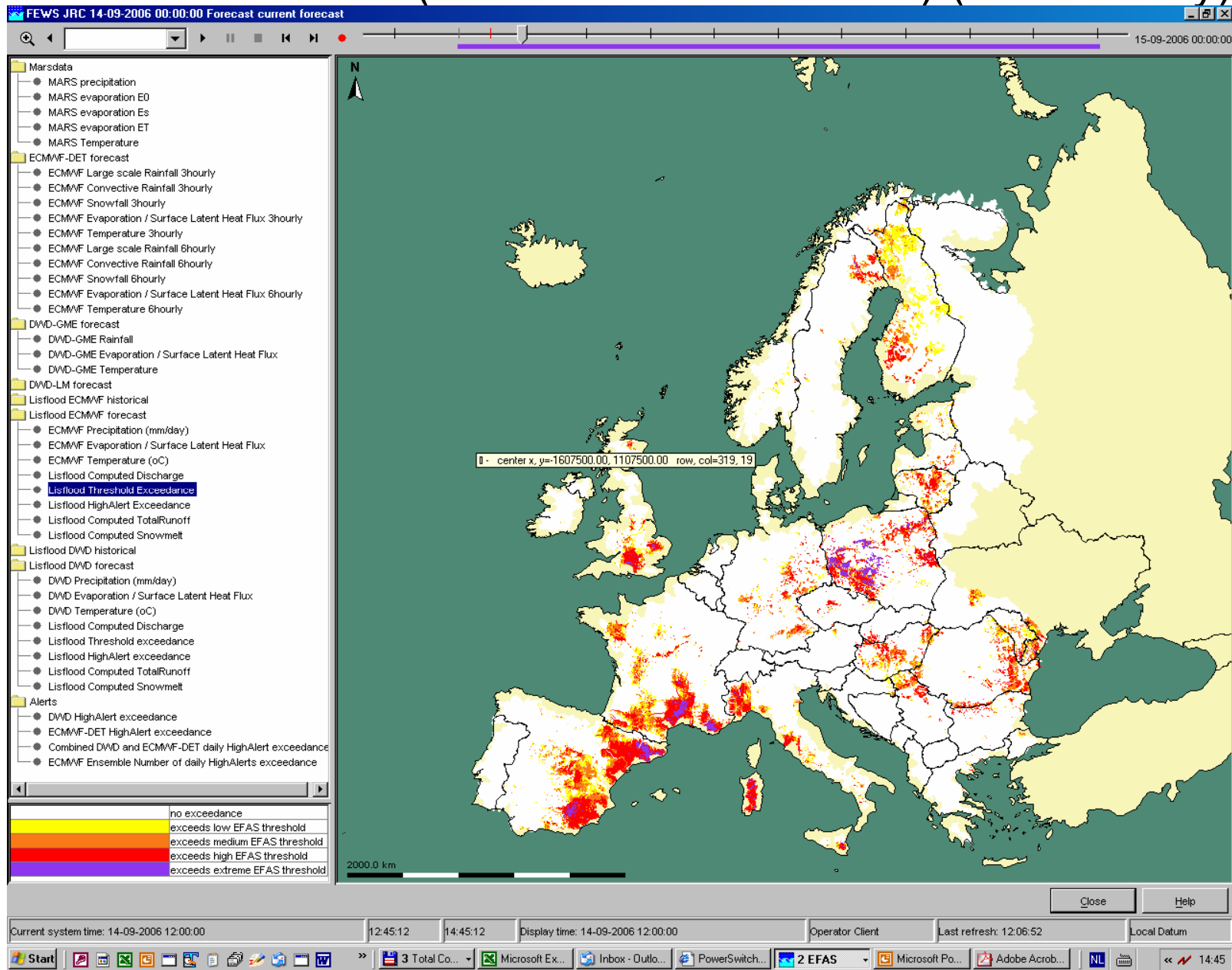


EFAS solely provides early flood alerts to the National Services. These National Services are and keep the responsibility to alert the public and trigger civil protection mechanisms





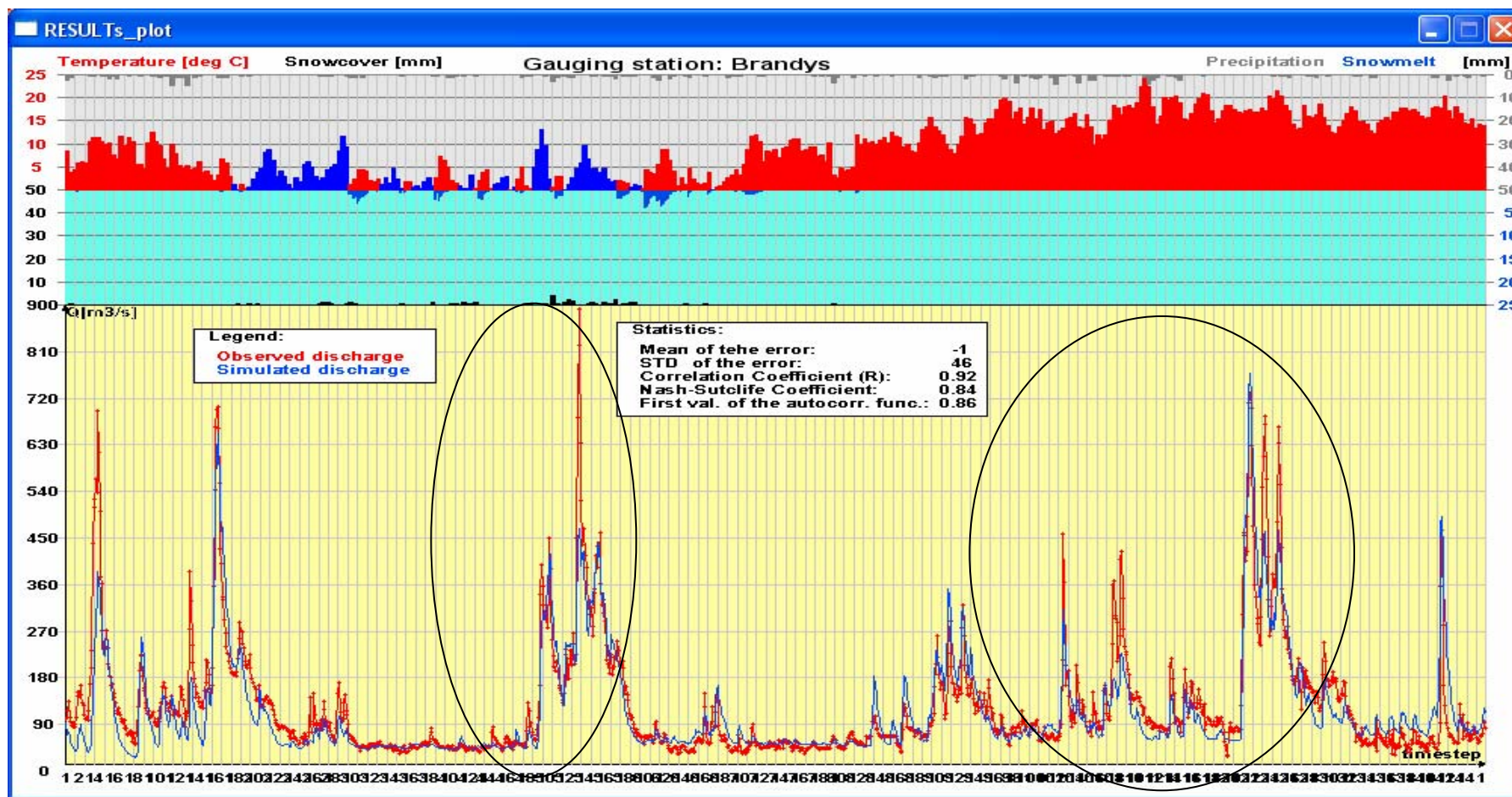
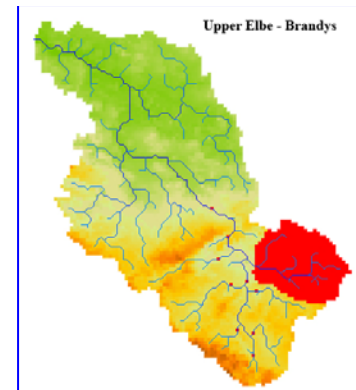
EFAS exceedance of critical flood threshold (deterministic forecasts) (run 2x daily)





Use of high resolution data
leads to an improvement in
model performance

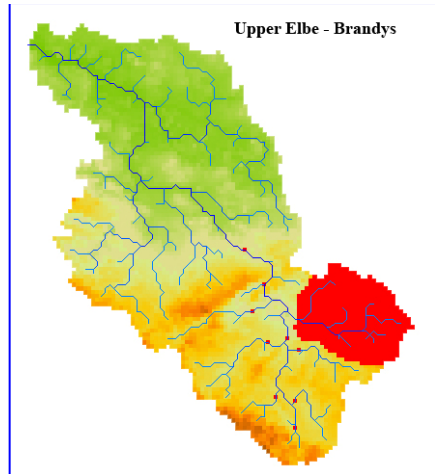
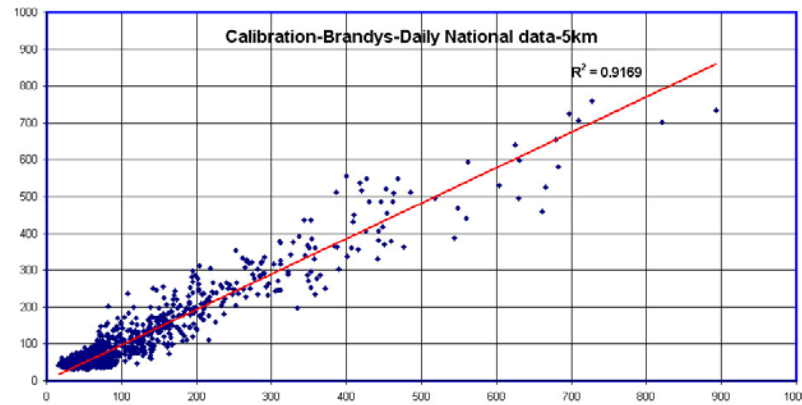
Using Grid Mars Data





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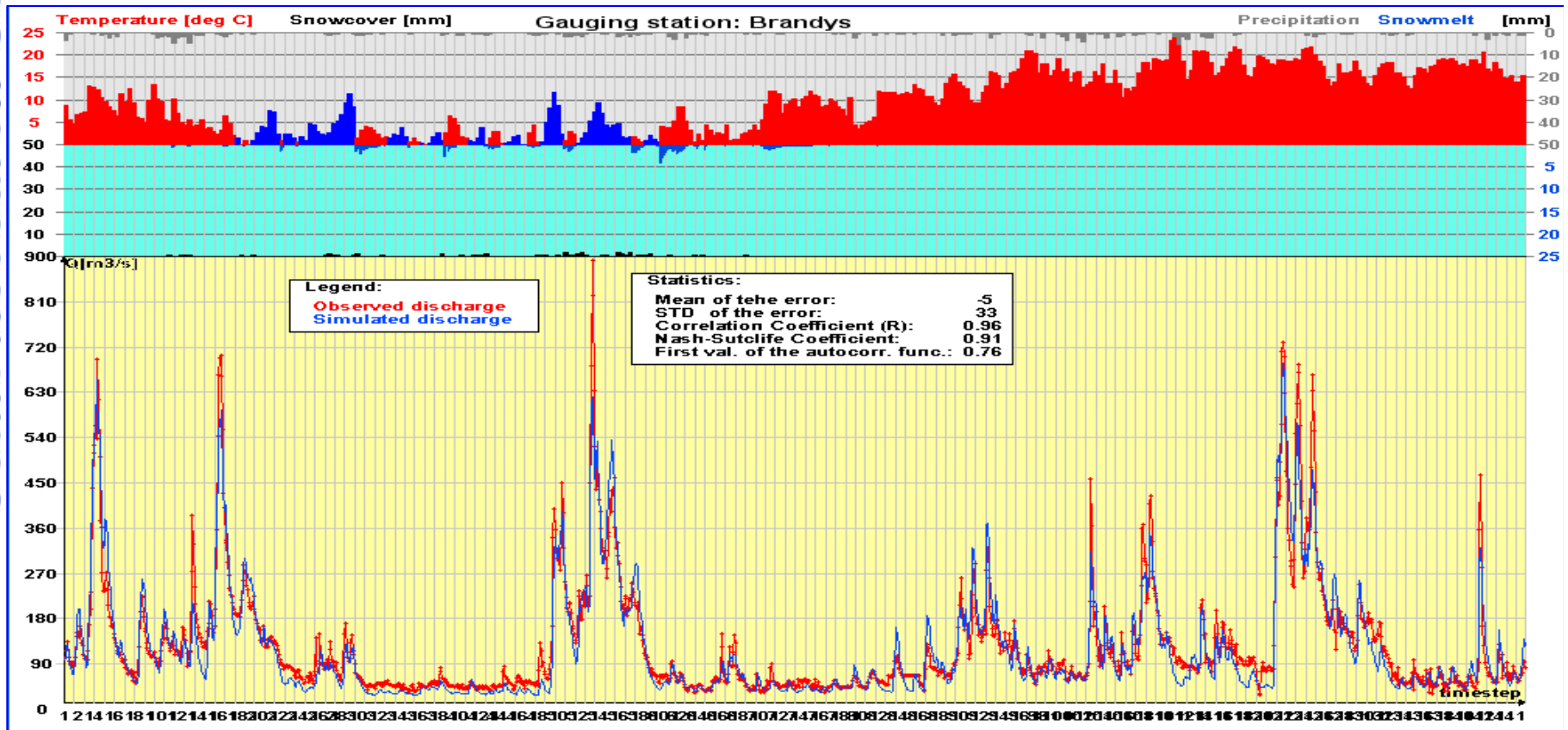
Calibration
1998-2002



Using National Temp. and Rainfall Data

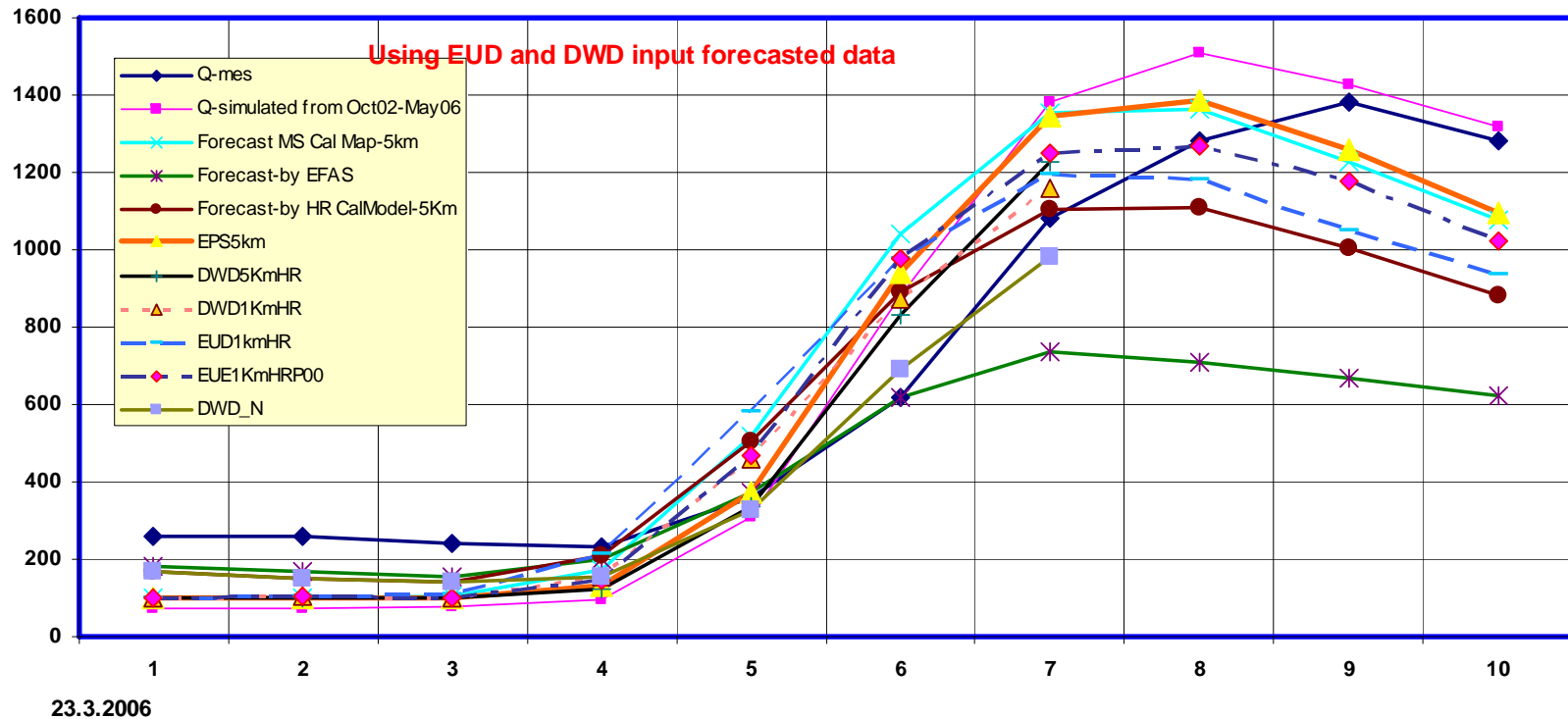
Area= 13111 km²

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EFAS-Elbe forecasts March 2006: old EFAS 5km forecasts vs new 1 & 5km forecasts

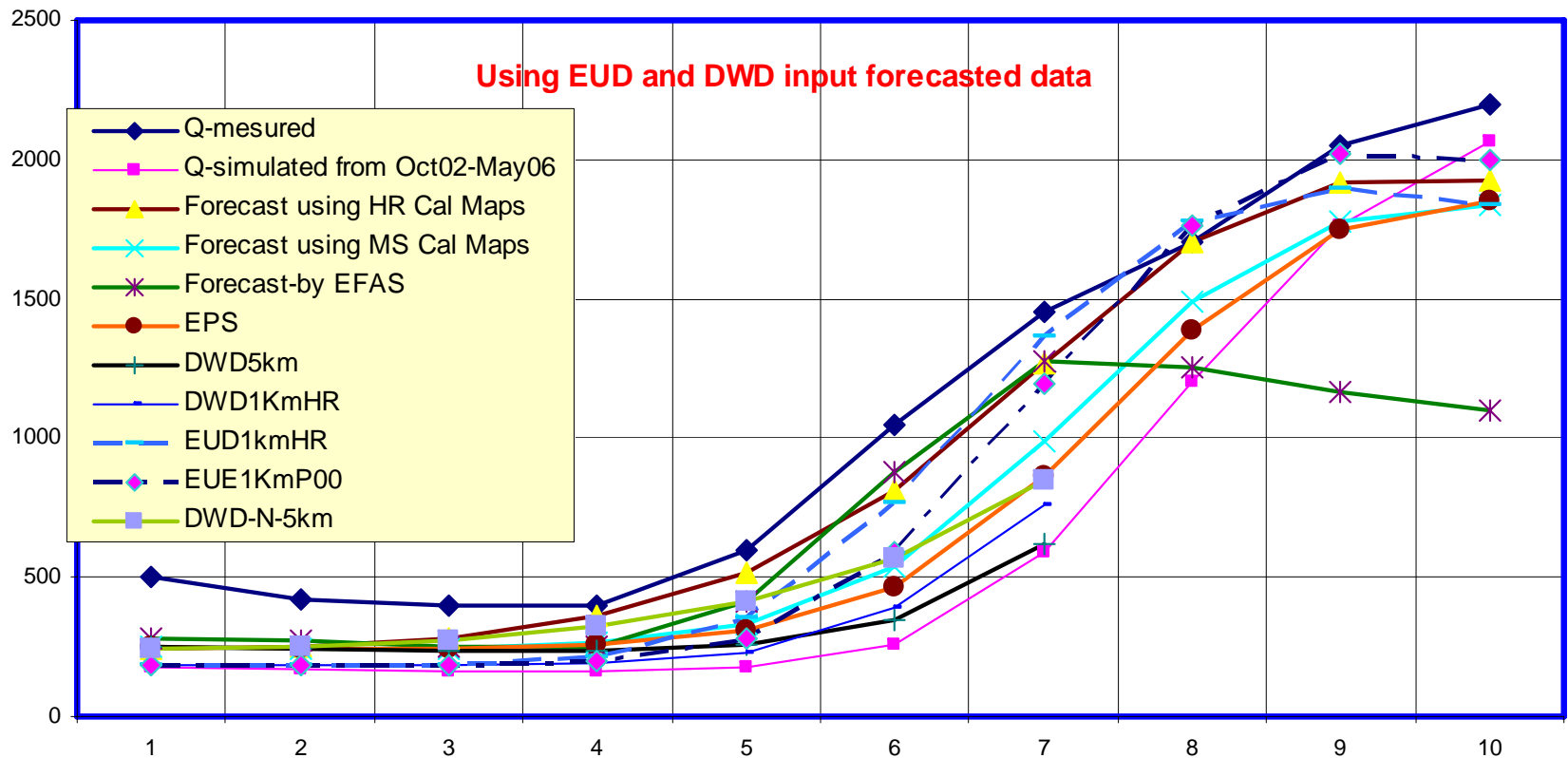
Prague: new 5km forecasts significantly better, both using DWD and ECMWF (EPS)





EFAS-Elbe forecasts

**Usti: new 5km forecasts significantly better,
both using DWD and ECMWF (EPS)**



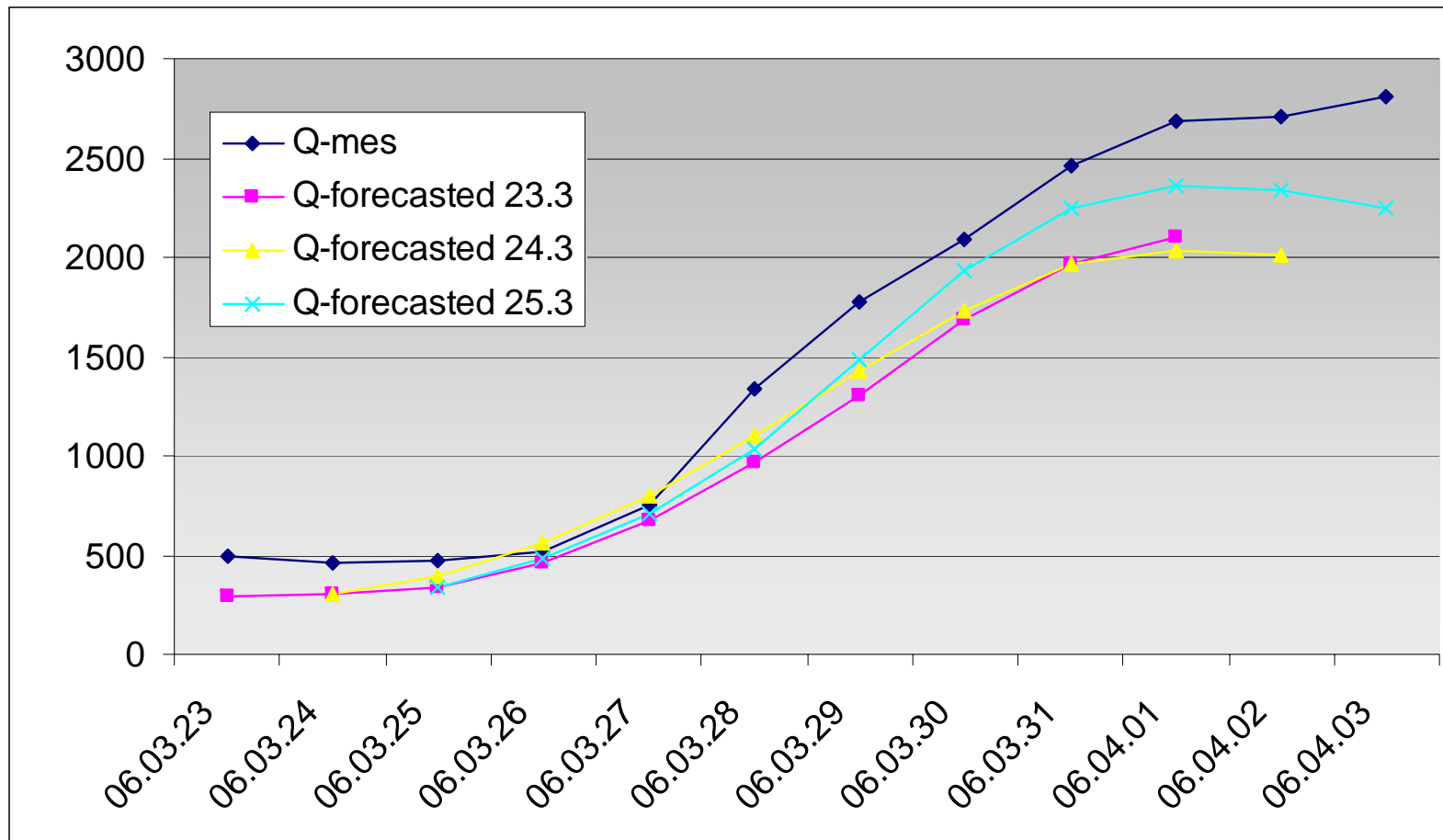
23.3.2006

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Forecasts Dresden March-April 2006

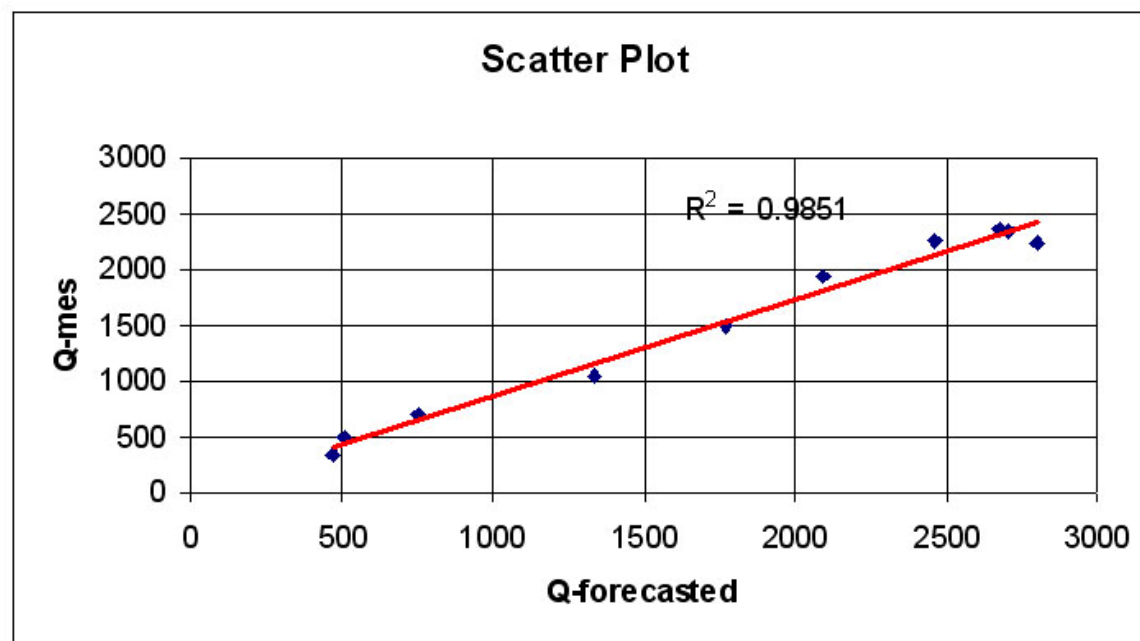
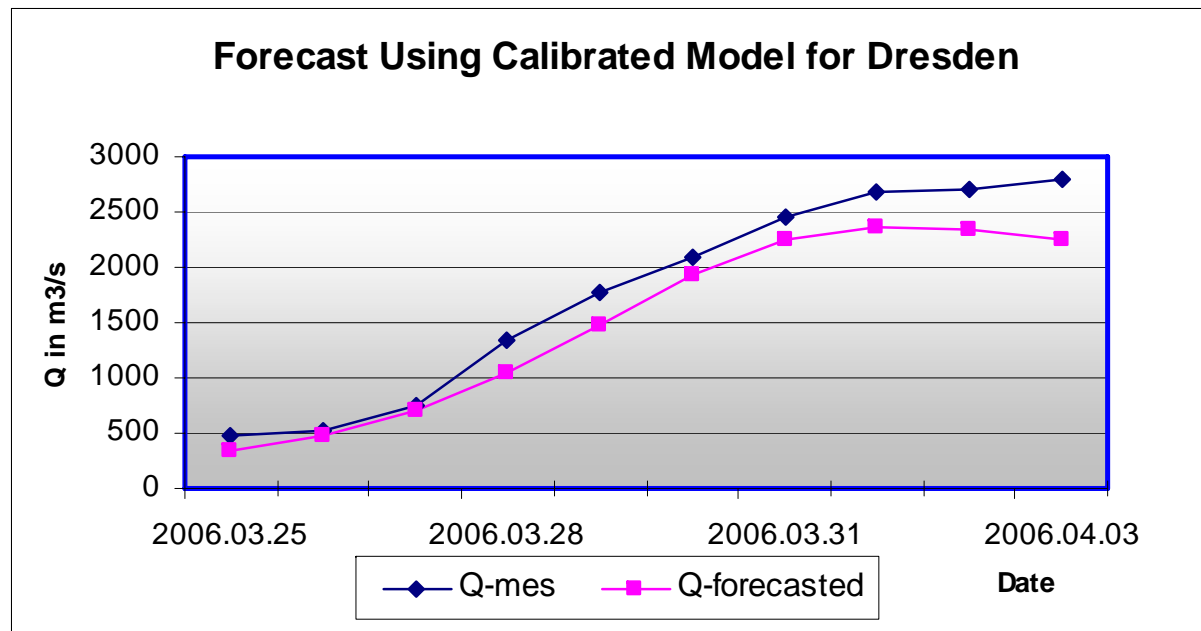
10-day ECMWF based EFAS forecasts 23-25 March 2006

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Forecasting Dresden April 2006





EFAS EPS forecasts: CZ/Vltava (A=2550 km²)

EPS > HAL

March 2006

/ April 2006

Forecast Day	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
2006032000								1	20	31								
2006032012								5	19	31								
2006032100									12	35	42							
2006032112								4	28	41	43							
2006032200									21	46	48	49						
2006032212								4	35	43	44	44						
2006032300								1	13	44	47	49	44					
2006032312								2	35	49	49	50	50					
2006032400									12	45	49	49	51	49				
2006032412									27	50	49	51	49	47				
2006032500									4	51	51	51	51	51	51			
2006032512									47	51	51	51	51	51	51			
2006032600									3	51	51	51	51	51	51	51		
2006032612									38	51	51	51	51	51	51	51		
2006032700										51	51	51	51	51	51	51	51	
2006032712									3	4	7	7	40	41	40	26	37	
2006032800										51	51	51	51	51	51	51	51	51
2006032812									MV	MV	MV	MV	MV	MV	MV	MV	MV	MV

Area too small to currently send out alert reports: early warning could have been send out on 20-21 March already (6-8 days before)

- -> high alert level consistently exceeded



Conclusions EFAS-Elbe

- Use of high resolution national data versus Synop stations significantly improves simulation and forecasting results
- New 1&5km EFAS versions significantly better than 'old' EFAS 5km forecasts
- EFAS has proven to give early flood warnings 6-8 days in advance (snowmelt 2006 floods) to 2-5 days in advance (rainfall driven floods)



Way forward

- IKSE Saale study & polder study (3.1 & 3.2)
 - Report envisaged: Feb 2007
- Elbe-EFAS:
 - Realtime testing during several months
 - Test the added value of 1km vs 5km model
 - Q updating via GRDC ETN-R project