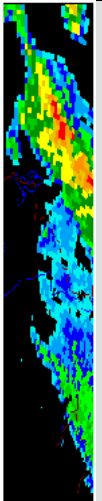
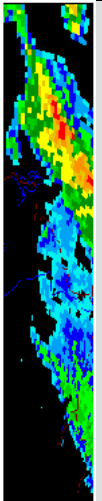


Weather radar and heavy rainfall - how to estimate the real amount of precipitation?

Thomas Einfalt

hydro & meteo GmbH & Co. KG, Lübeck

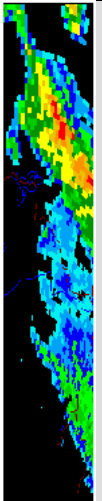
hydro & meteo GmbH & Co. KG
Wetter + Wasser



Overview

- Motivation
- „Cooking“ good quality data
  - Radar data quality control
  - Rain gauge data quality control
  - Transformation reflectivity ➔ intensity
- Further analyses: statistics
- Discussion and outlook

hydro & meteo GmbH & Co. KG
Wetter + Wasser



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hydro & meteo GmbH & Co. KG
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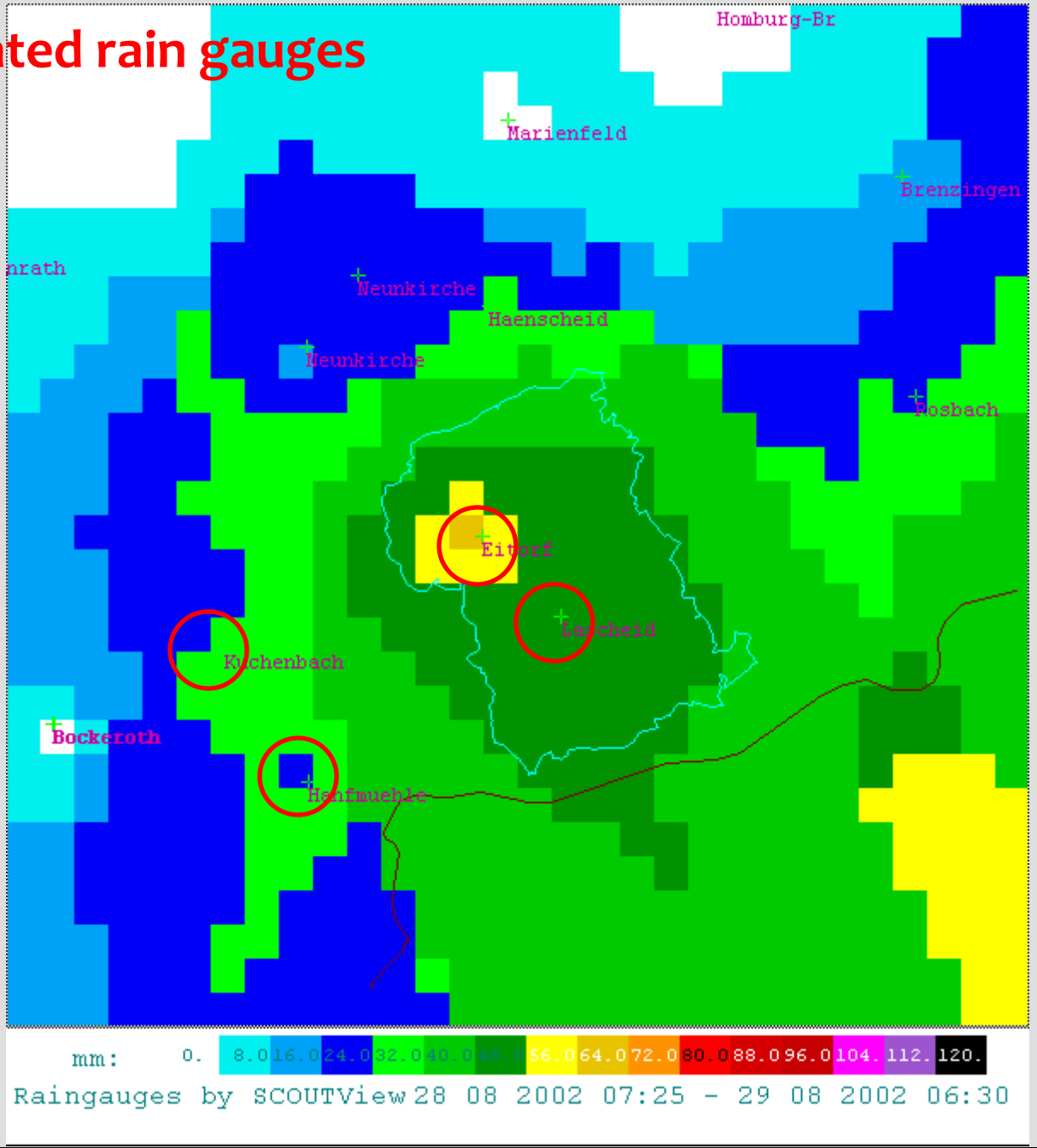
Motivation: extreme event

Interpolated rain gauges



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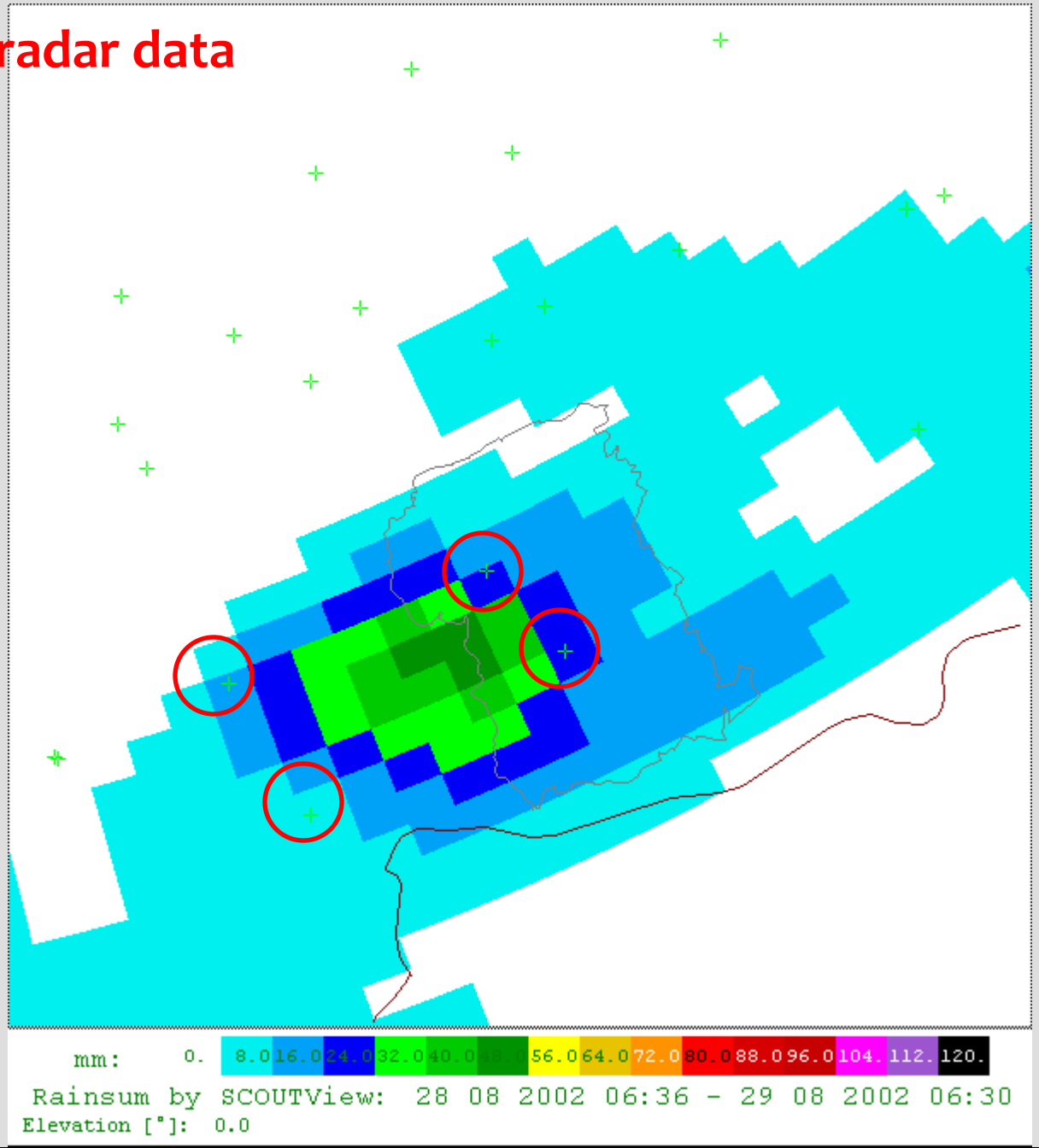
Original radar data



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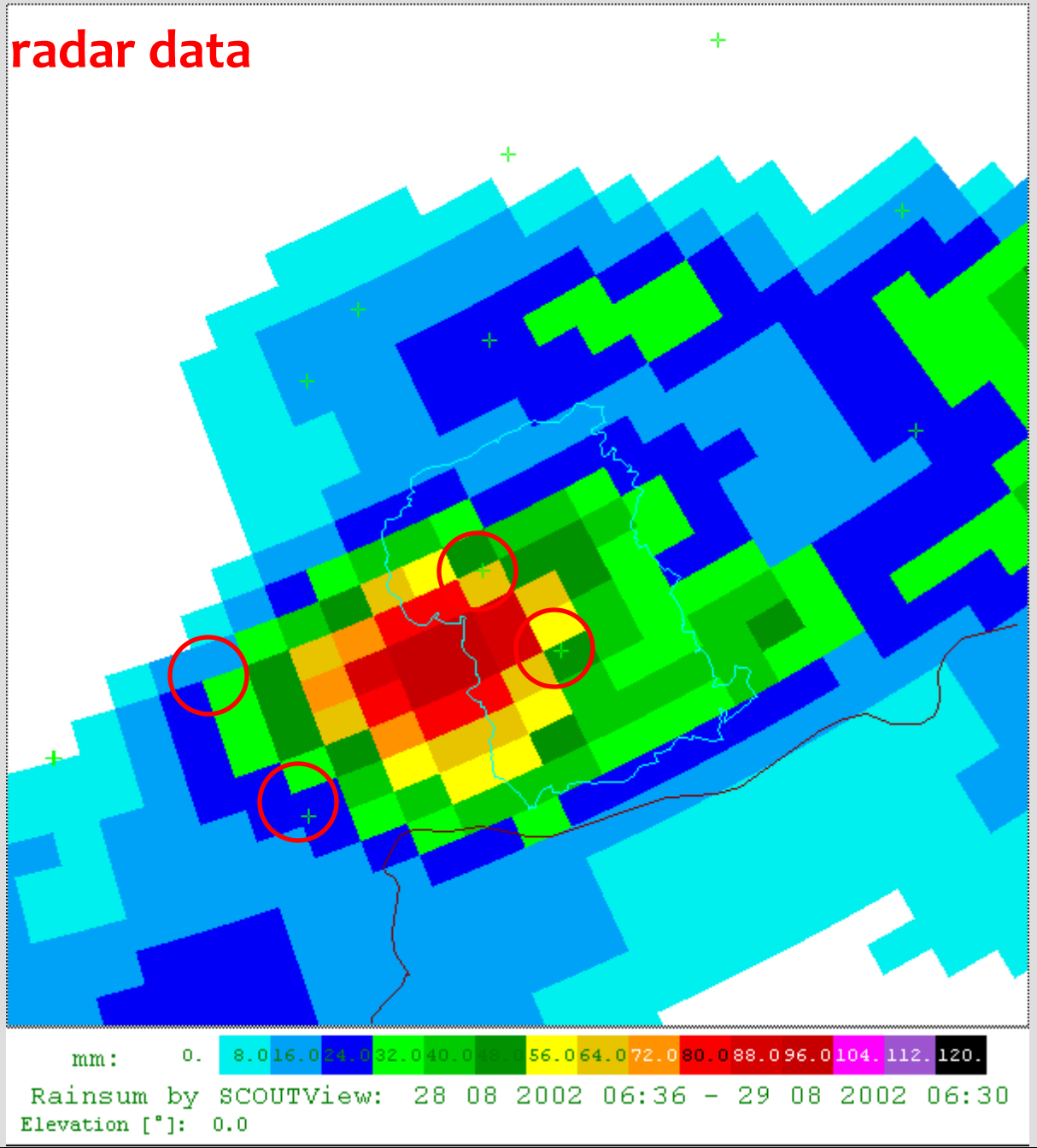
Adjusted radar data



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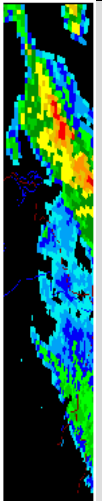

Motivation

- Rain gauges: peak missed
- Radar: too low

- We need:
  - correct level of values
  - At the right location

- How to get there?

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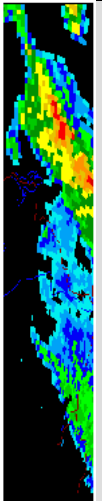

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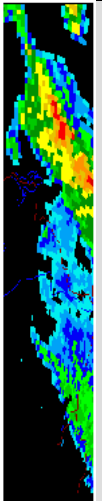

„cooking" good precipitation data

- Radar data quality
  - Clutter
  - Beam blockage
  - Bright band
  - Attenuation
  - Many correction algorithms, many recipes!
- Rain gauge quality
  - Wrong zero values
  - Wrong timing
  - Mainly manual
  - Taking 50% of work time to produce high quality data!

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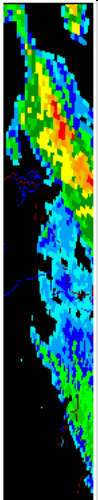

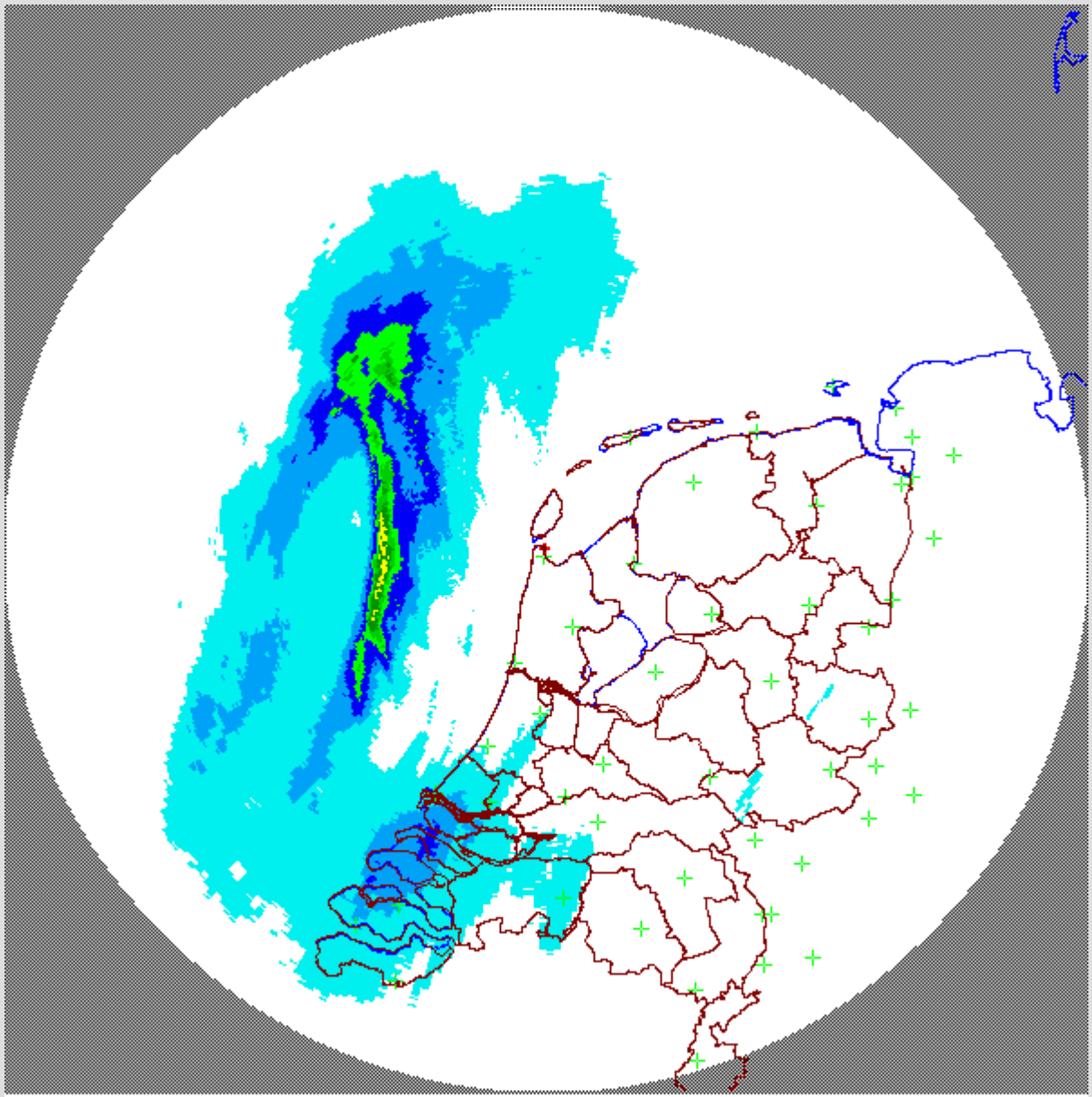

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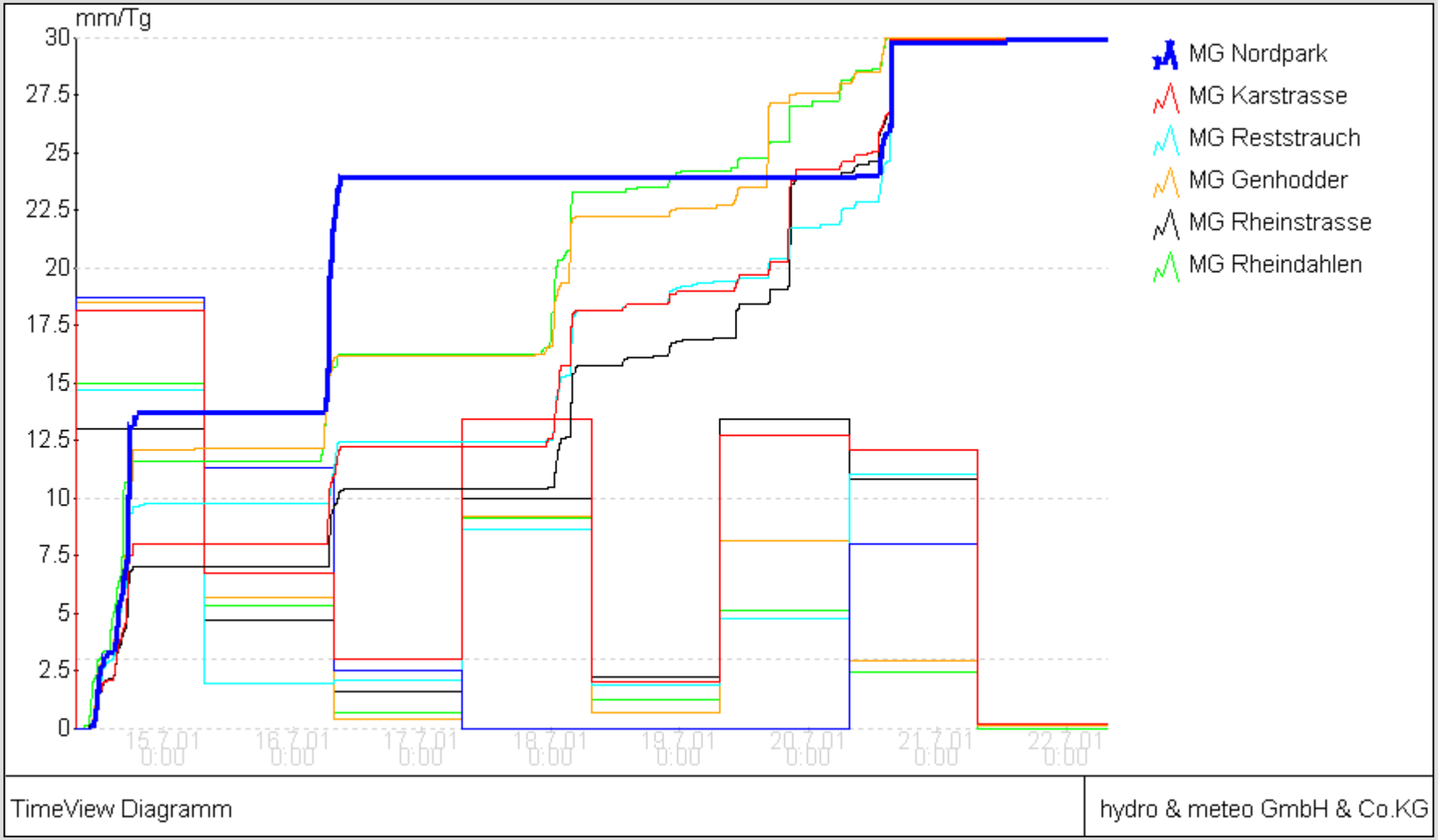
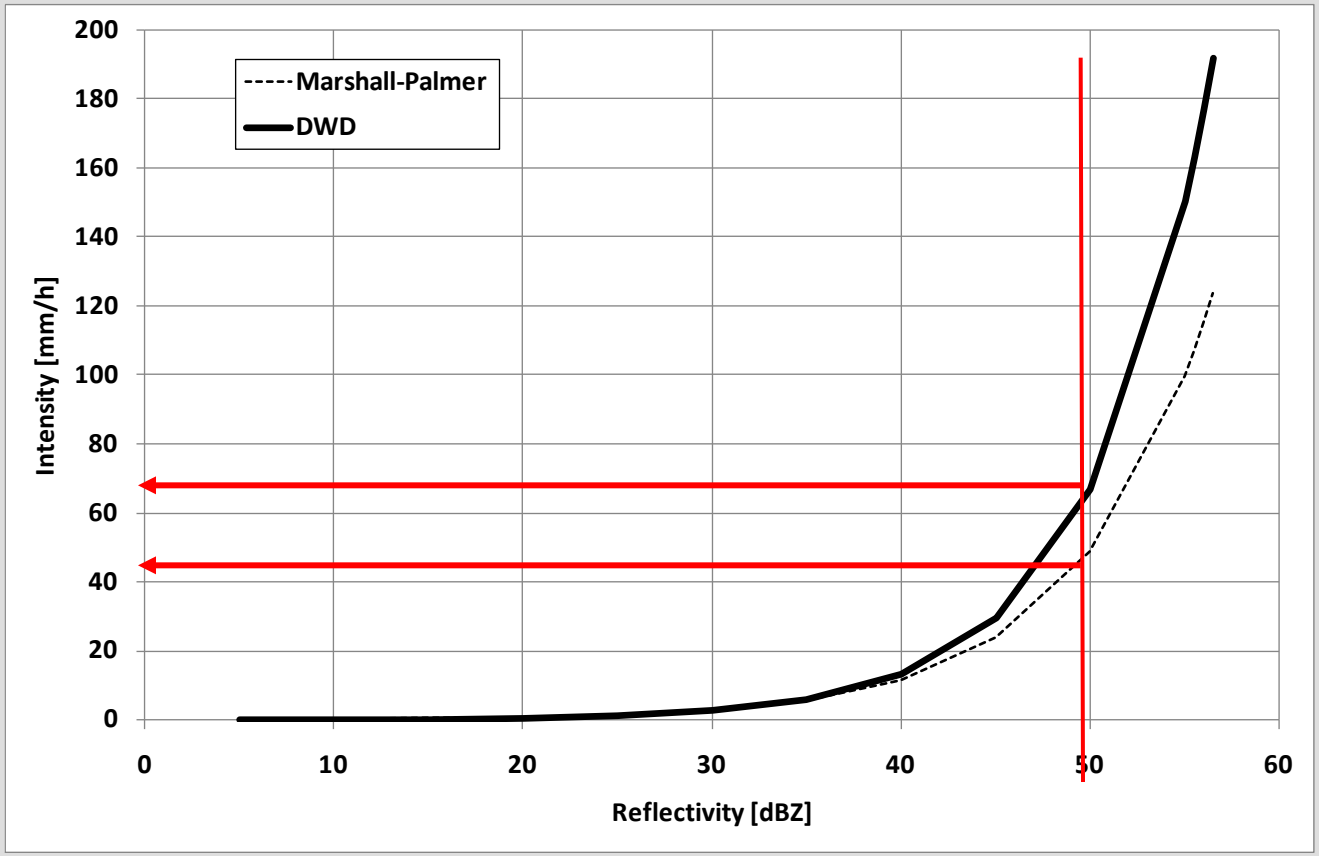
Data quality control of gauge data

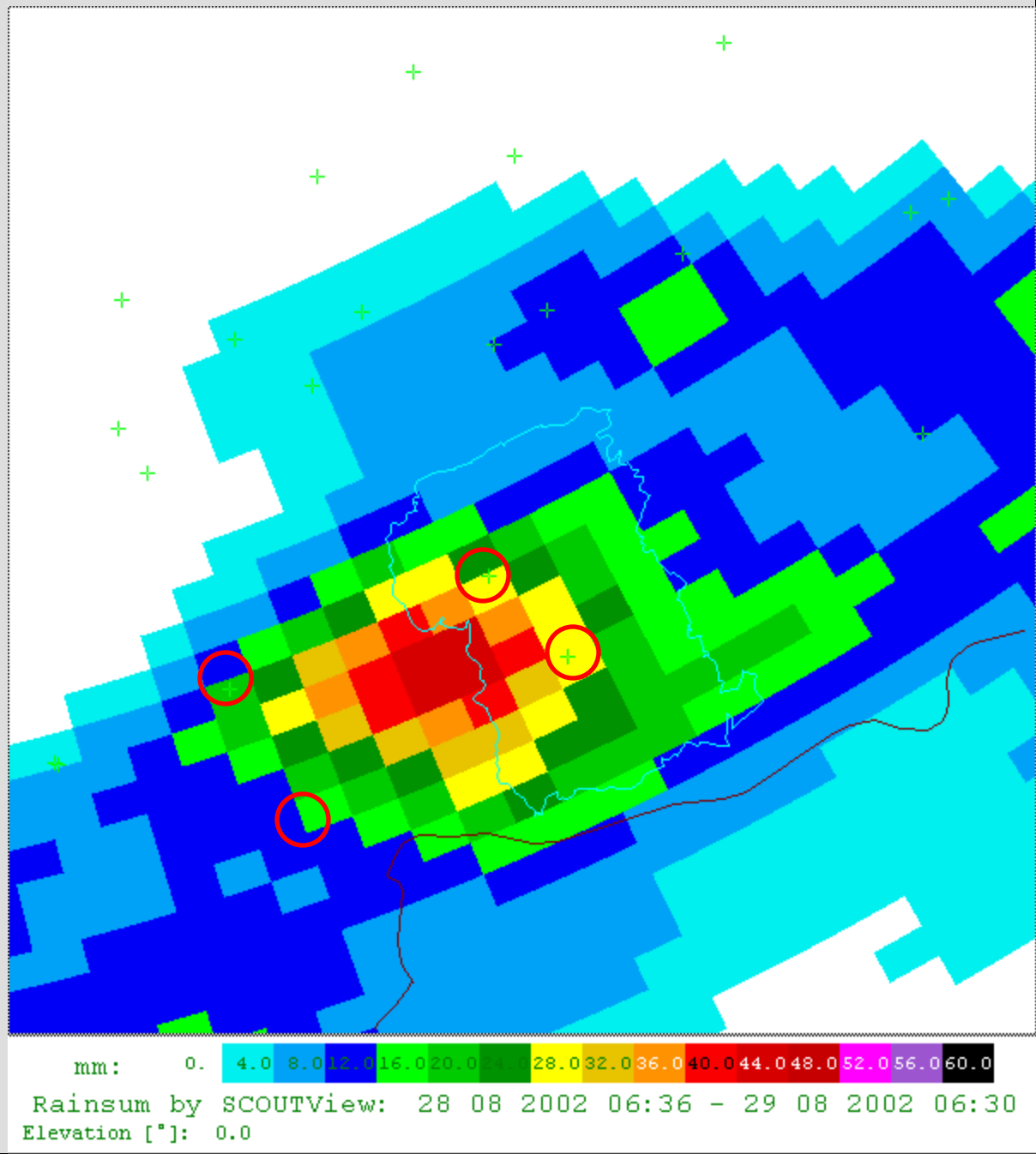


Transformation reflectivity to intensity

- ZR



- Radar original
- standard ZR



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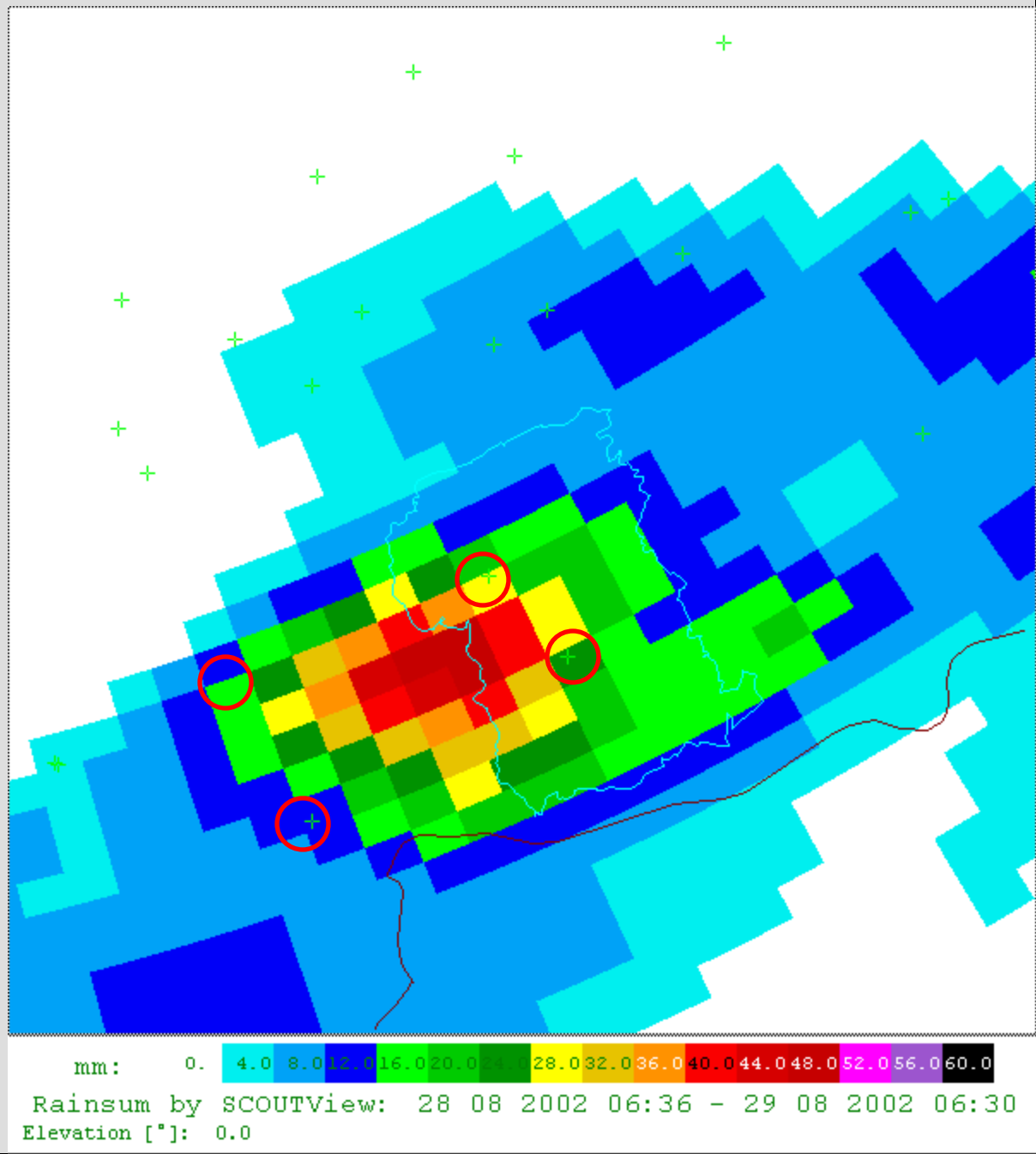
- Radar original
- ZR = $256R^{1.42}$



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Z-R relationship

- Here the results show

Gauge	Rain at gauge [mm]	Radar mod. [mm]	Radar conv. [mm]	absolute difference mod.	absolute difference conv.	mean percentage difference mod.	mean percentage difference conv.	absolute percentage difference mod.	absolute percentage difference conv.
Eitorf	70.3	57.42	61.99	12.88	8.31	-18.32	-11.82	18.32	11.82
Lascheid	50.4	54.65	56.74	4.25	6.34	8.43	12.57	8.43	12.57
Hanfmühle	31.3	31.77	30.21	0.47	1.09	1.52	-3.50	1.52	3.50
Kuchenbach	36.5	41.23	38.42	4.73	1.92	12.96	5.27	12.96	5.27
Parameter Sum				22.33	17.66	4.58	2.53	41.22	33.16

Z-R relationship

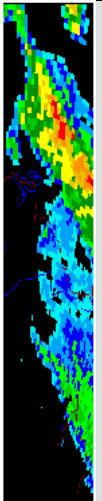
- Here the results show

Gauge	Rain at gauge [mm]	Radar mod. [mm]	Radar conv. [mm]	absolute difference mod.	absolute difference conv.	mean percentage difference mod.	mean percentage difference conv.	absolute percentage difference mod.	absolute percentage difference conv.
Eitorf	70.3	57.42	61.99	12.88	8.31	-18.32	-11.82	18.32	11.82
Lascheid	50.4	54.65	56.74	4.25	6.34	8.43	12.57	8.43	12.57
Hanfmühle	31.3	31.77	30.21	0.47	1.09	1.52	-3.50	1.52	3.50
Kuchenbach	36.5	41.23	38.42	4.73	1.92	12.96	5.27	12.96	5.27
Parameter Sum				22.33	17.66	4.58	2.53	41.22	33.16

- The second Z-R relationship is better: event sum 103 mm instead of 95 mm

➔ Automated procedure for test ?

➔ Good rain gauge values are more important …



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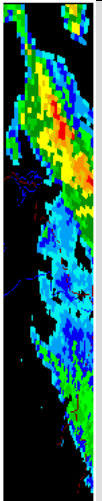

Further Analyses

- Comparison of highest pixels to areal rainfall: measure of homogeneity
- Extreme Value Statistics

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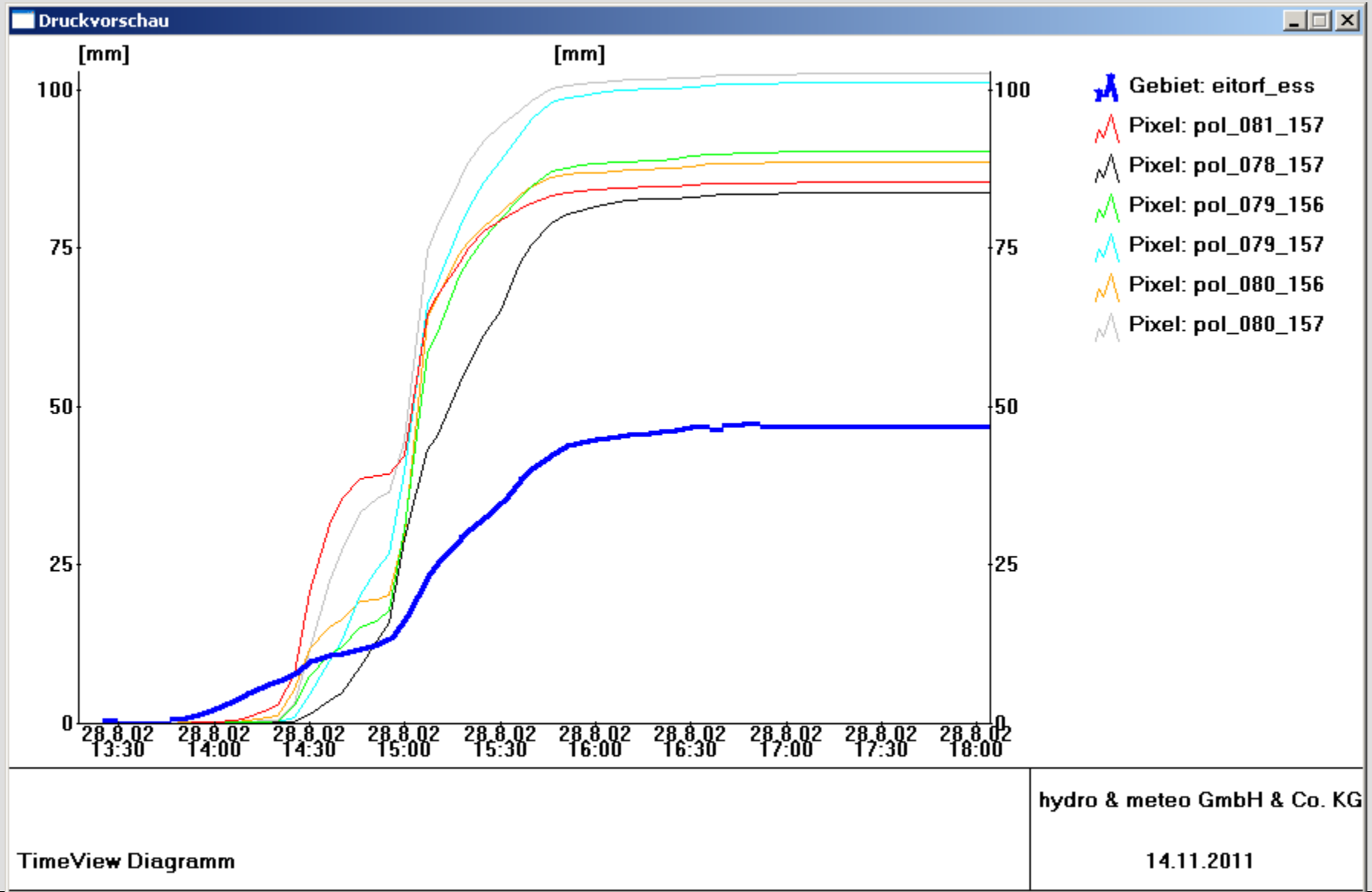
Areal rainfall vs. peak values



Statistics for precipitation
function of duration and return period

KOSTRA-DWD 2000

Deutscher Wetterdienst - Hydrometeorologie -

Niederschlagshöhen und -spenden nach KOSTRA-DWD 2000

Niederschlagshöhen und -spenden für Eitorf

Zeitspanne : Januar - Dezember

Rasterfeld : Spalte: 14 Zeile: 58

T	0,5		1,0		2,0		5,0		10,0		20,0		50,0		100,0	
D	hN	rN	hN	rN	hN	rN	hN	rN	hN	rN	hN	rN	hN	rN	hN	rN
5,0 min	3,4	113,3	5,1	170,0	6,8	226,7	9,1	301,7	10,8	358,4	12,5	415,1	14,7	490,1	16,4	546,8
10,0 min	5,8	97,4	8,2	136,4	10,5	175,4	13,6	227,0	16,0	266,0	18,3	305,1	21,4	356,7	23,7	395,7
15,0 min	7,4	82,5	10,3	113,9	13,1	145,2	16,8	186,7	19,6	218,1	22,4	249,4	26,2	290,9	29,0	322,2
20,0 min	8,5	70,9	11,7	97,8	15,0	124,6	19,2	160,1	22,4	187,0	25,7	213,8	29,9	249,3	33,1	276,1
30,0 min	9,8	54,6	13,7	76,2	17,6	97,8	22,7	126,3	26,6	147,9	30,5	169,4	35,6	197,9	39,5	219,5
45,0 min	10,8	39,9	15,5	57,2	20,1	74,6	26,3	97,5	31,0	114,8	35,7	132,2	41,9	155,1	46,5	172,4
60,0 min	11,2	31,0	16,5	45,8	21,8	60,7	28,9	80,3	34,3	95,1	39,6	110,0	46,7	129,6	52,0	144,4
90,0 min	13,1	24,3	18,4	34,0	23,7	43,8	30,6	56,7	35,9	66,5	41,2	76,3	48,2	89,2	53,5	99,0
2,0 h	14,6	20,3	19,8	27,6	25,1	34,9	32,0	44,5	37,2	51,7	42,5	59,0	49,4	68,6	54,6	75,9
3,0 h	16,9	15,7	22,1	20,5	27,3	25,3	34,1	31,6	39,3	36,4	44,5	41,2	51,3	47,5	56,5	52,3
4,0 h	18,7	13,0	23,9	16,6	29,0	20,1	35,8	24,9	40,9	28,4	46,0	32,0	52,8	36,7	58,0	40,3
6,0 h	21,5	10,0	26,6	12,3	31,7	14,7	38,4	17,8	43,4	20,1	48,5	22,5	55,2	25,6	60,3	27,9
9,0 h	24,6	7,6	29,6	9,1	34,6	10,7	41,3	12,7	46,3	14,3	51,3	15,8	57,9	17,9	62,9	19,4
12,0 h	27,0	6,3	32,0	7,4	37,0	8,6	43,5	10,1	48,5	11,2	53,5	12,4	60,0	13,9	65,0	15,0
18,0 h	28,3	4,4	34,8	5,4	41,2	6,4	49,7	7,7	56,1	8,7	62,6	9,7	71,1	11,0	77,5	12,0
24,0 h	29,6	3,4	37,5	4,3	45,4	5,3	55,8	6,5	63,8	7,4	71,7	8,3	82,1	9,5	90,0	10,4
48,0 h	36,7	2,1	45,0	2,6	53,3	3,1	64,2	3,7	72,5	4,2	80,8	4,7	91,7	5,3	100,0	5,8
72,0 h	46,7	1,8	55,0	2,1	63,3	2,4	74,2	2,9	82,5	3,2	90,8	3,5	101,7	3,9	110,0	4,2

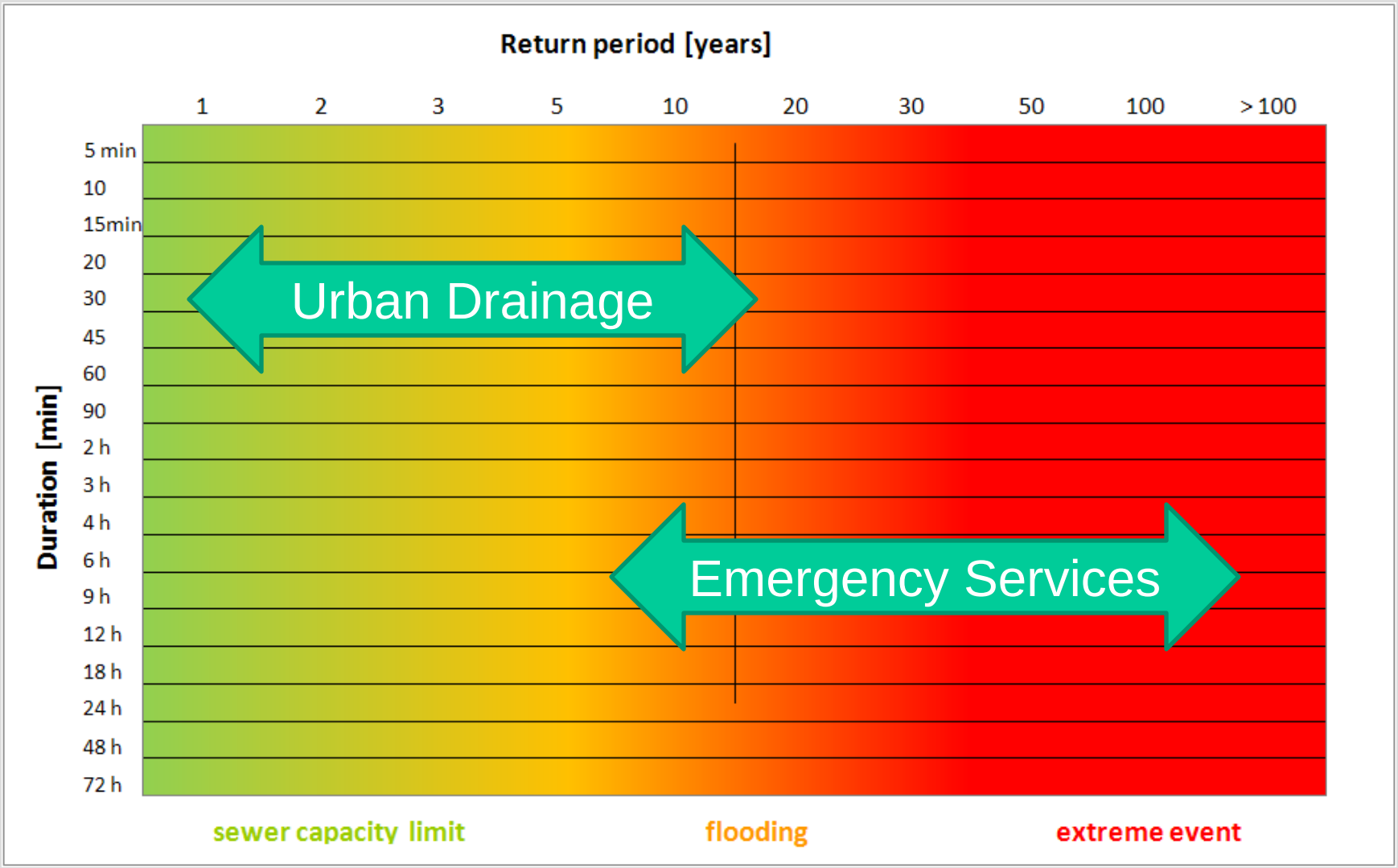
T - Wiederkehrzeit (in [a]): mittlere Zeitspanne, in der ein Ereignis einen Wert einmal erreicht oder überschreitet

D - Niederschlagsdauer einschließlich Unterbrechungen (in [min, h])

hN - Niederschlagshoehe (in [mm])

rN - Niederschlagsspende (in [l/(s*ha)])

Statistics – why ?



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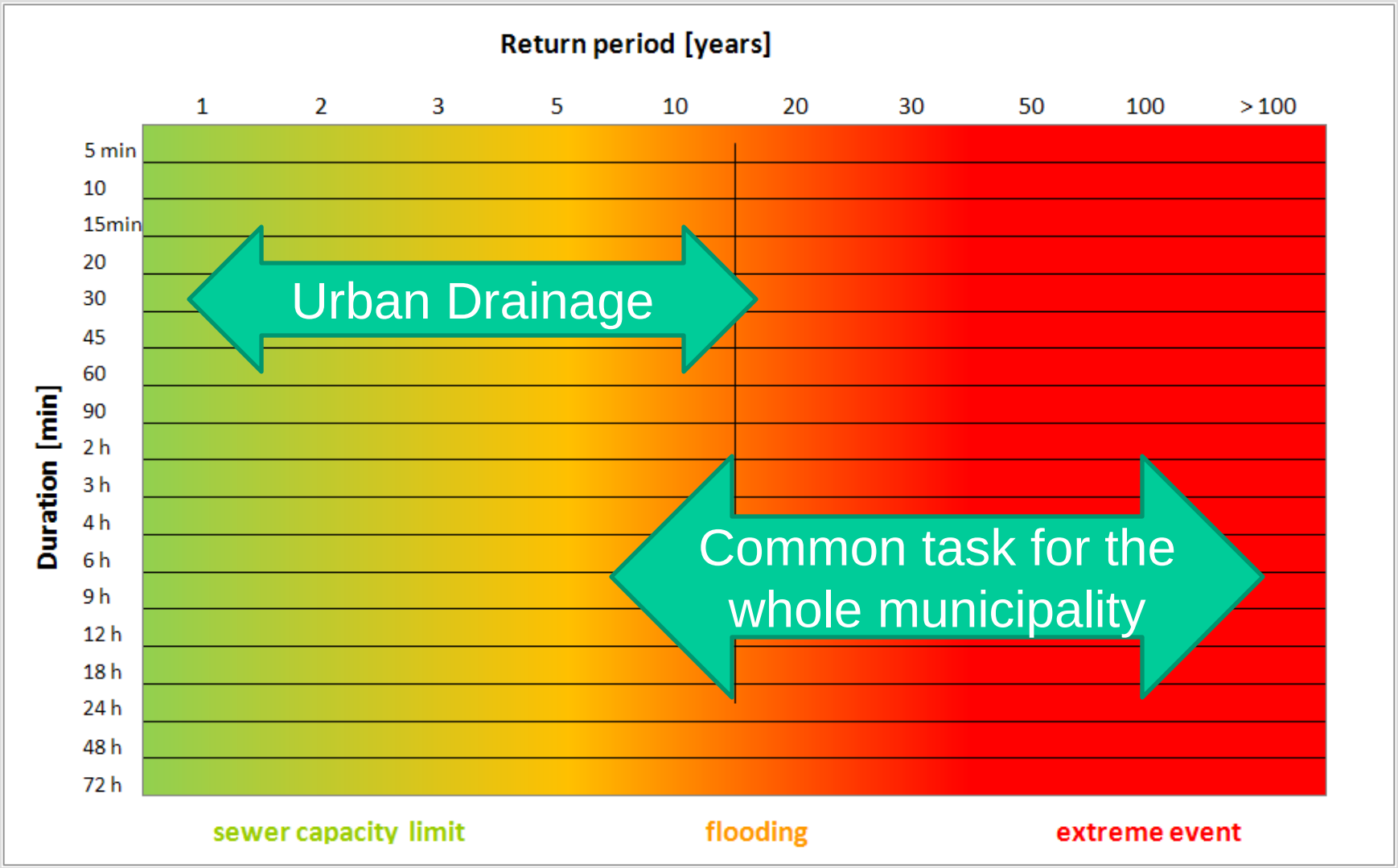
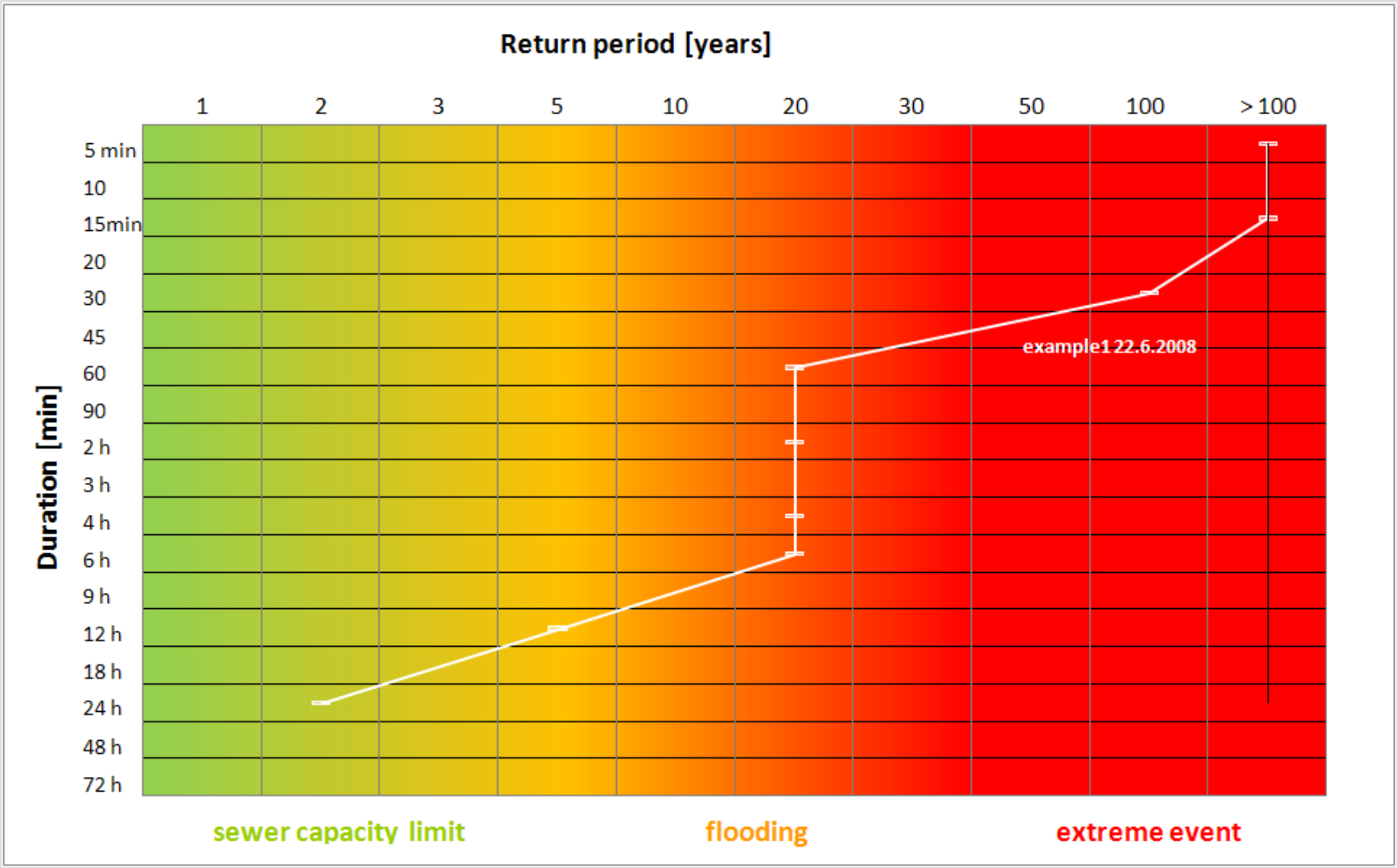


Statistics – how ?
Event characteristics



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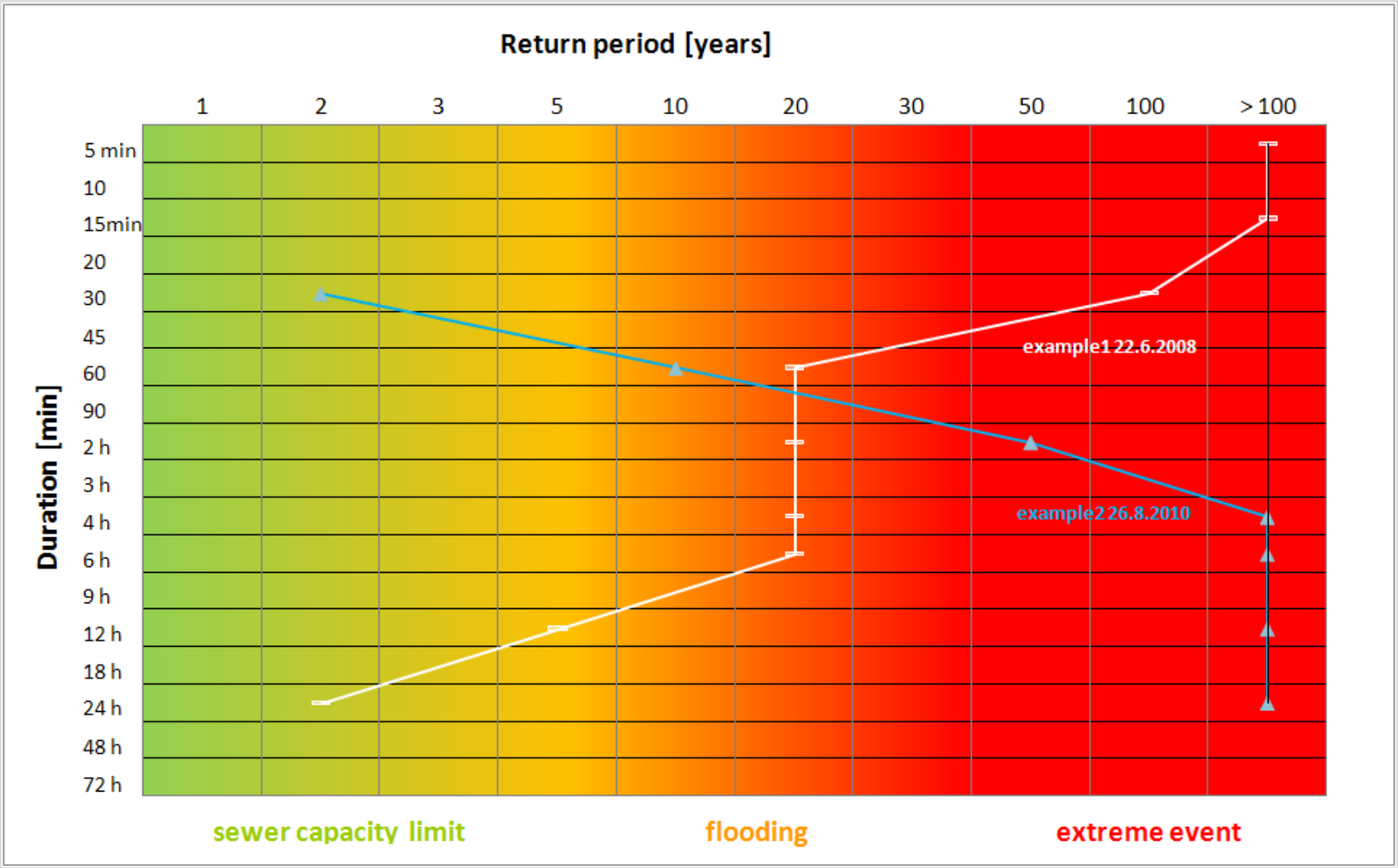
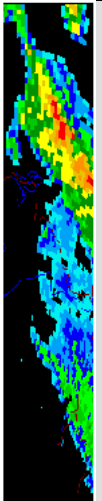
Event characteristics





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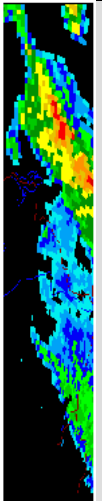
Wetter + Wasser



Discussion and Outlook (1)

- Extreme events are difficult to analyse
- All available data should be used
- Rain gauge data are not sufficient
- Radar data alone are not sufficient either
- Only a combination of both, with a thorough data quality control permits analyses
- Methods to verify radar data quality and Z-R-assumptions have to be employed

Discussion and Outlook (2)

- A detailed image is produced on the precipitation distribution in time and space
- Statistics can be obtained
- data can be cross-compared to damage data

- The future are
  - ➔ these informations on the web in near real-time:
  - ➔ www.hydrocity.com

HydroCity.com

HydroCity – online platform as a bridge to a climate adaptive city

HydroLogic

NEO

sBIR

Call: climate adaptation and Water

hydro & meteo GmbH & Co. KG
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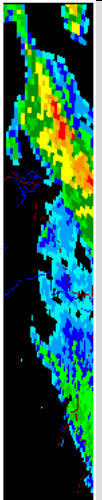

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http://portal.hydronet.nl/

HydroWeb - HydroNE...

- Neerslagradar
- Weerstations
- Verwachting
- Cumulatief neerslagtekort
- Actuele verdamping
- Help

Radar

Open radarbeeld | Sommeren radarbeeld | 22-06-2011 16:00 | Info | Help | Disclaimer

HydroNET

[mm/dag]

0.1
10
20
30
40
60
100

Cumulatief | 1 uur interval | 1 dag interval

Neerslag
HydroNET

mm: 0, 10, 20

04-05 06-05

Regionaal gecorrigeerd met automatische stations

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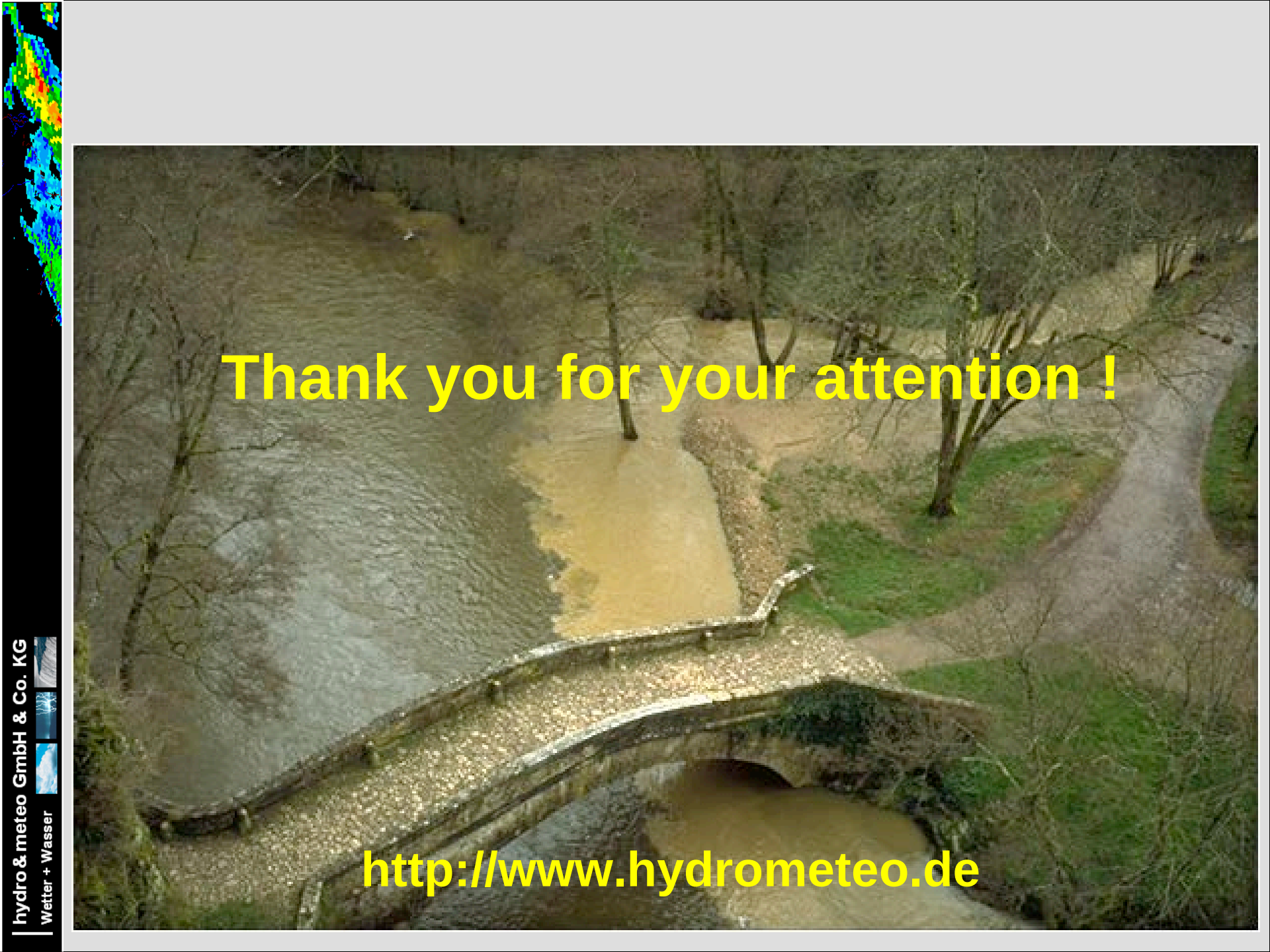

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