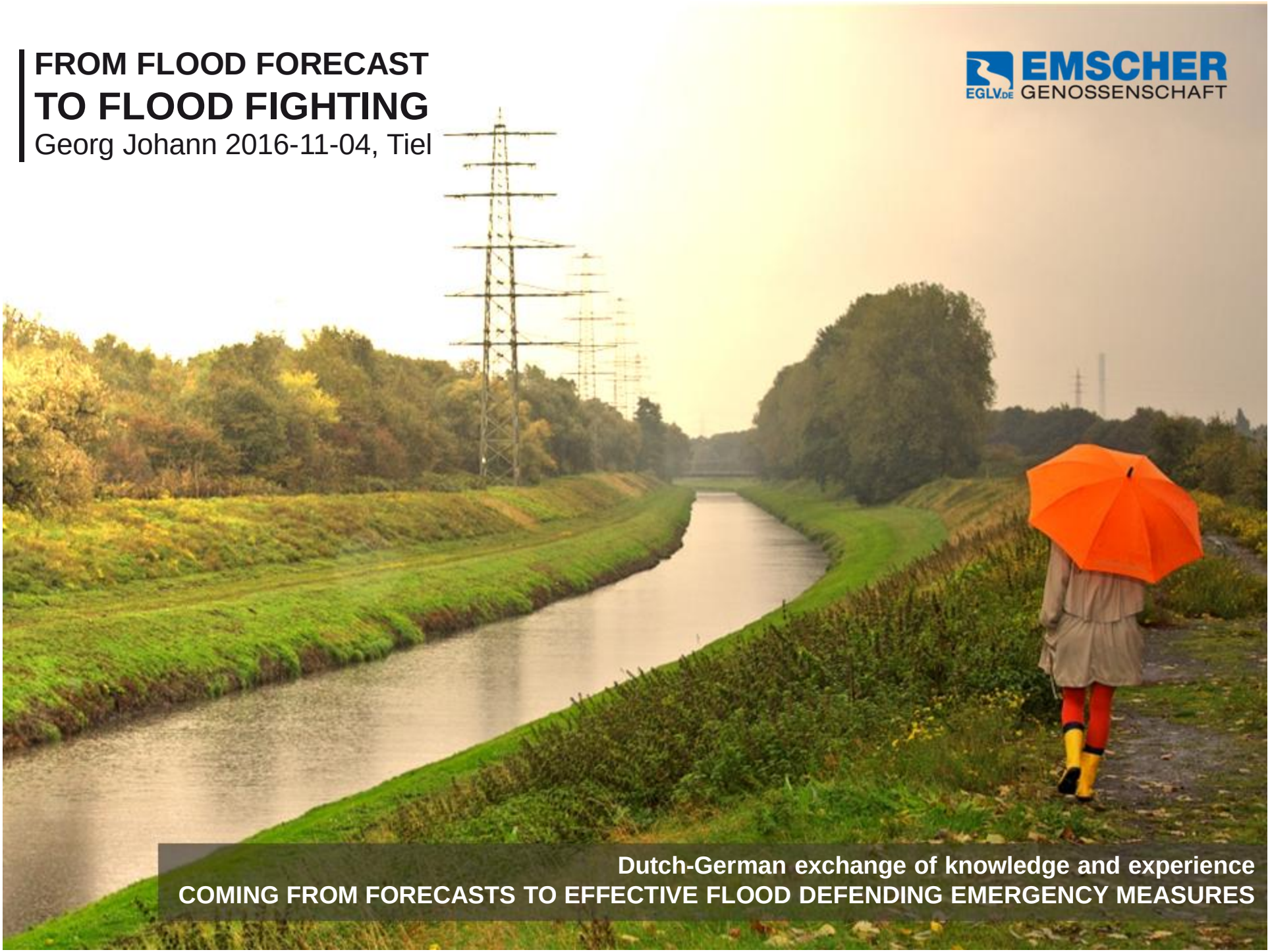
FROM FLOOD FORECAST
TO FLOOD FIGHTING

Georg Johann 2016-11-04, Tiel

EMSCHER GENOSSENSCHAFT



Dutch-German exchange of knowledge and experience

COMING FROM FORECASTS TO EFFECTIVE FLOOD DEFENDING EMERGENCY MEASURES

Flood forecasting – Emscher experiences

1 Introduction

2 Emscher catchment

3 Runoff characteristics

4 Hydrometric data

5 Flood management

6 Flood forecasting system

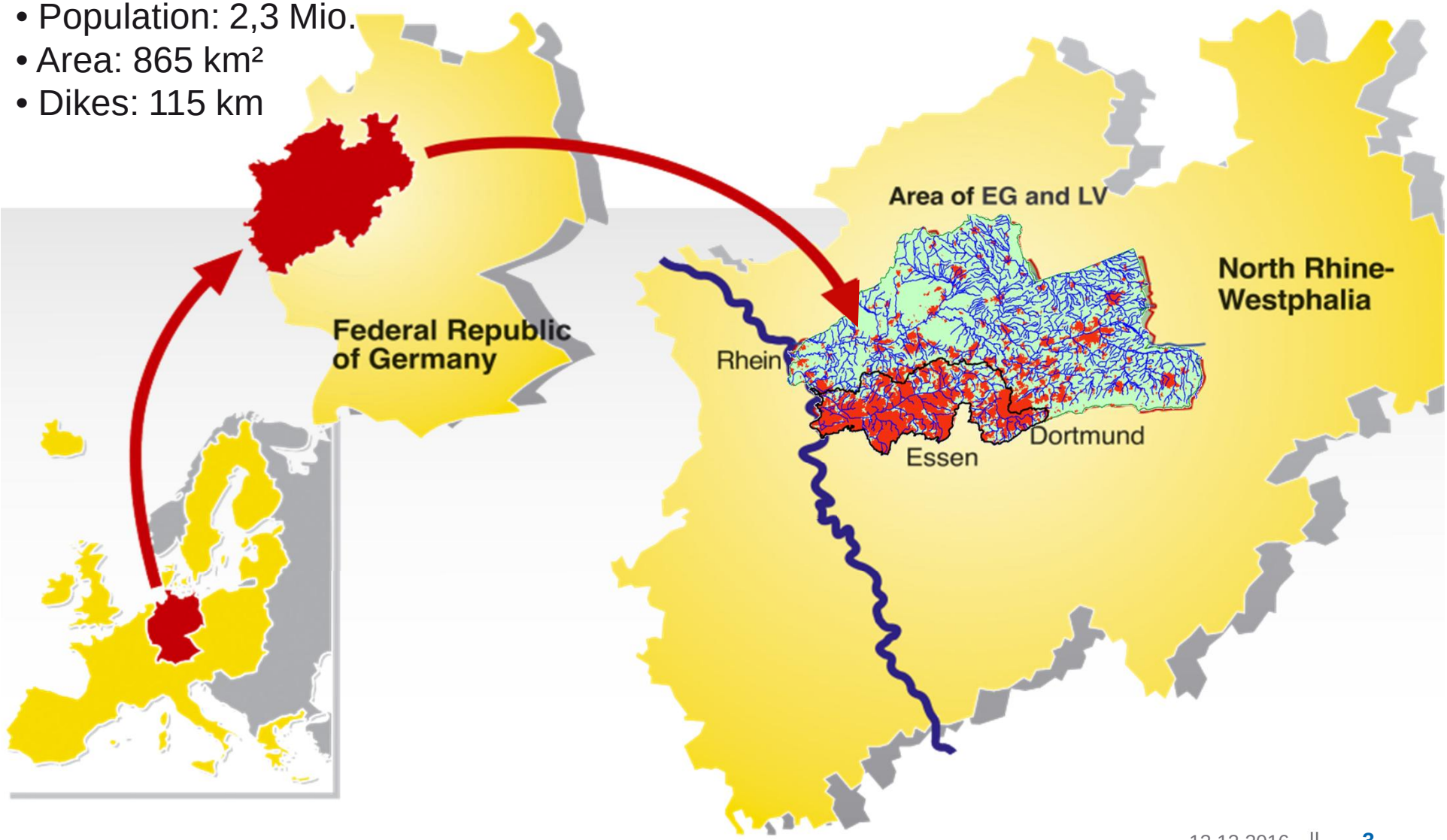
7 Dike data service

8 Conclusions

Flood forecasting – Emscher experiences

Emscher catchment

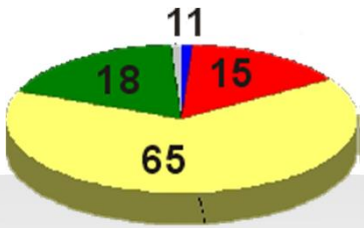
- Population: 2,3 Mio.
- Area: 865 km²
- Dikes: 115 km

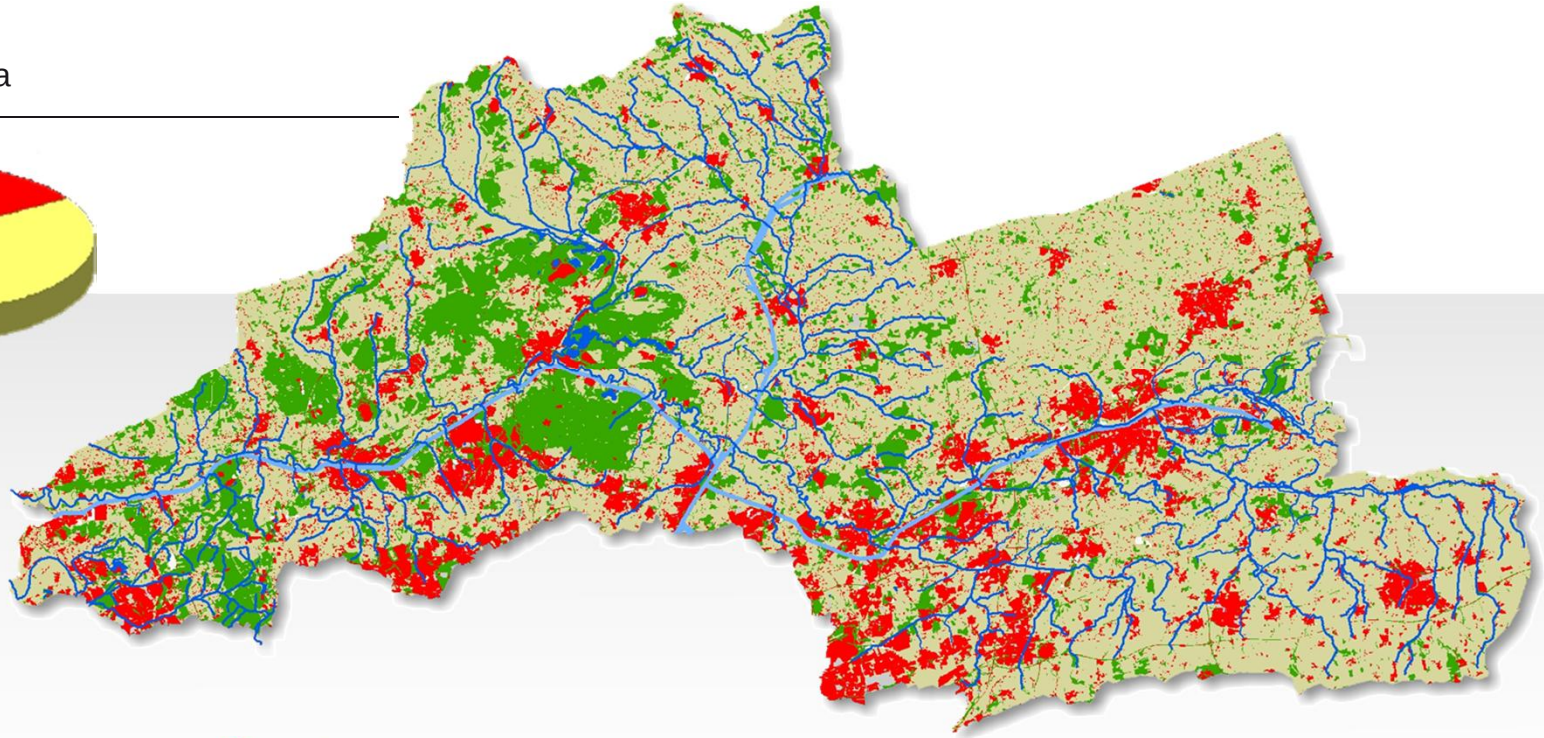


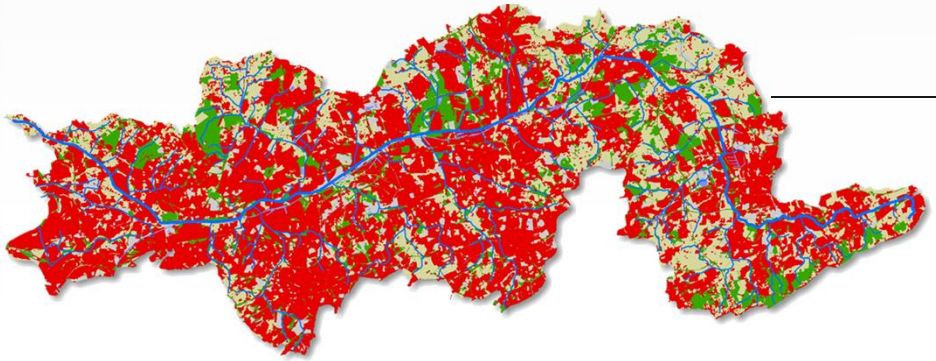
Our catchment area

Emscher– and Lippearea show different catchment characteristics

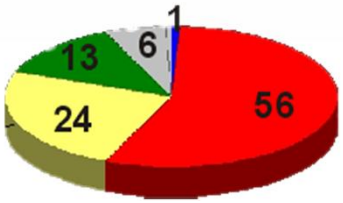
Lippeverband area







Emscher area

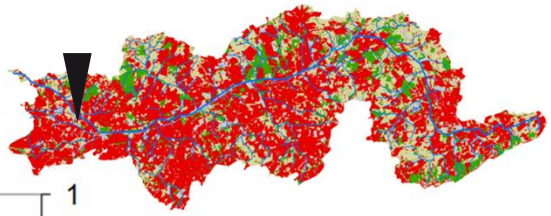


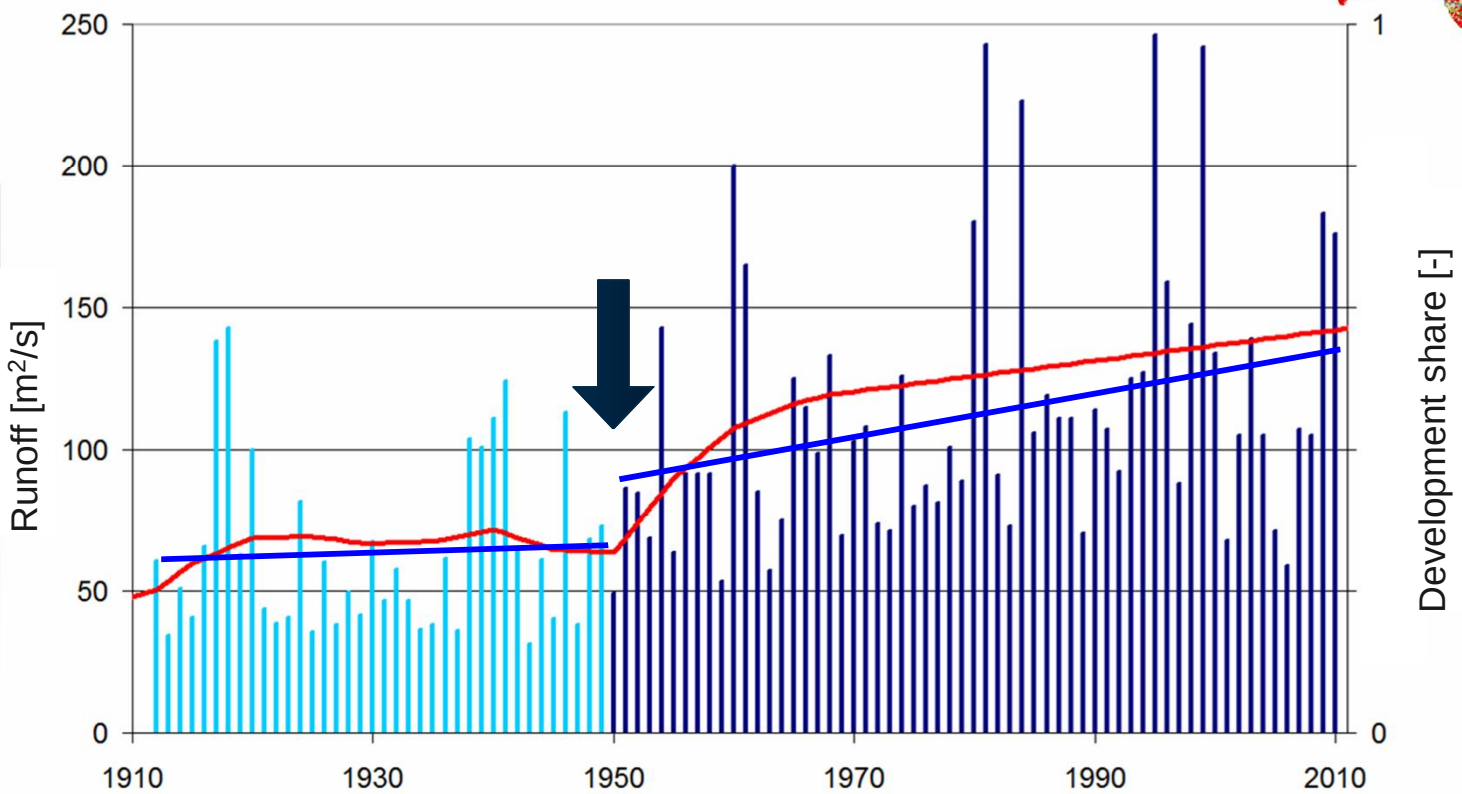
land use

- other
- urban area
- agriculture
- forest
- water

Flood forecasting – Emscher experiences

Emscher catchment





Building development share

Flood events Königstraße level

Trend

Catchment characteristics of the Emscher – Lippe - region

- Concentration time of flood discharges:
  - Lippe: 2 - 4 days

Floods generated by continuous rain and snowmelt

  - Emscher: 6 - 12 hours
  - Lippe-tributaries: 2 - 6 hours
  - Emscher-tributaries: less than 2 hours

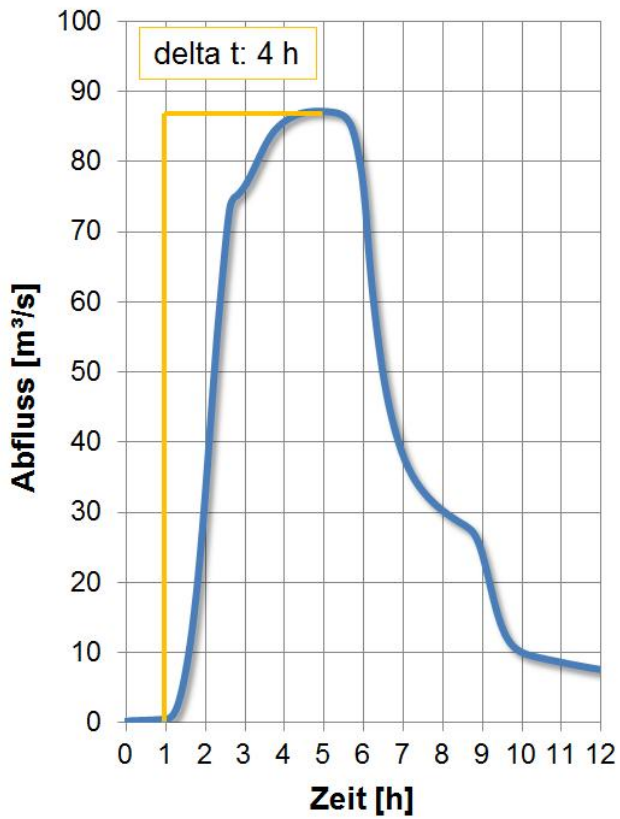
Floods resulting from heavy rain

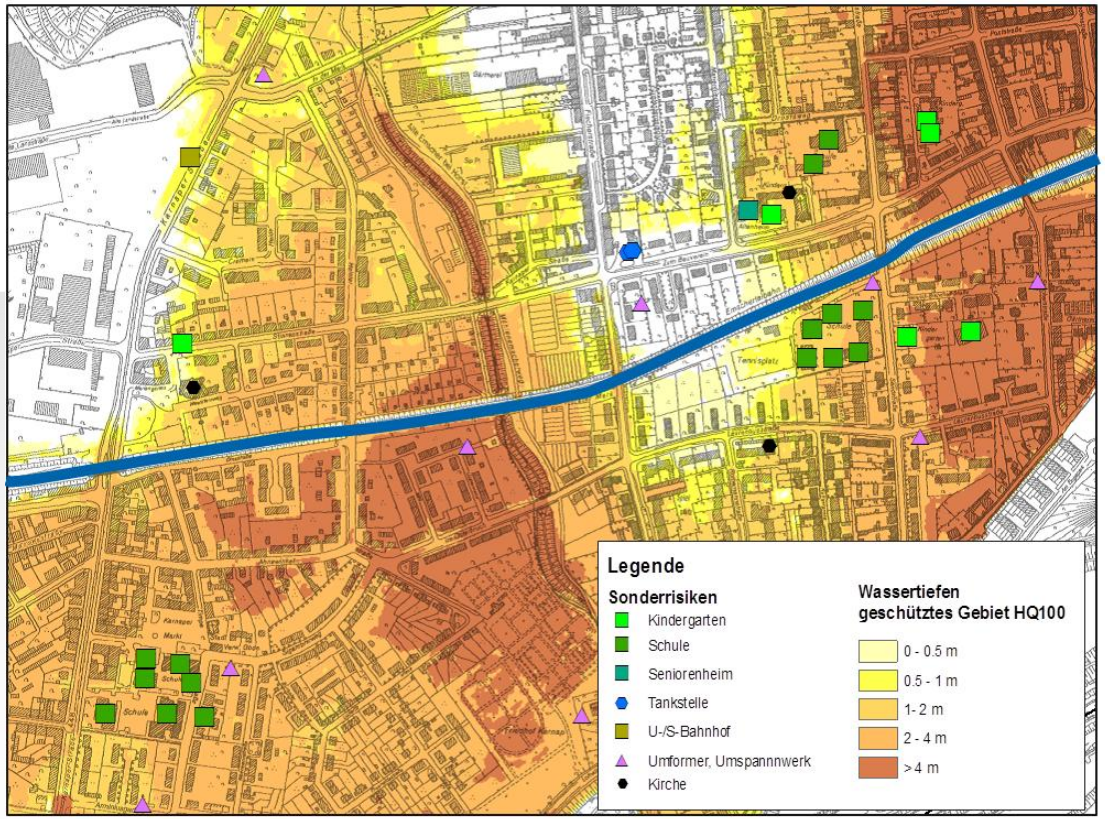


Flood forecasting – Emscher experiences

Flood management

Emscher flood HQ_{100}



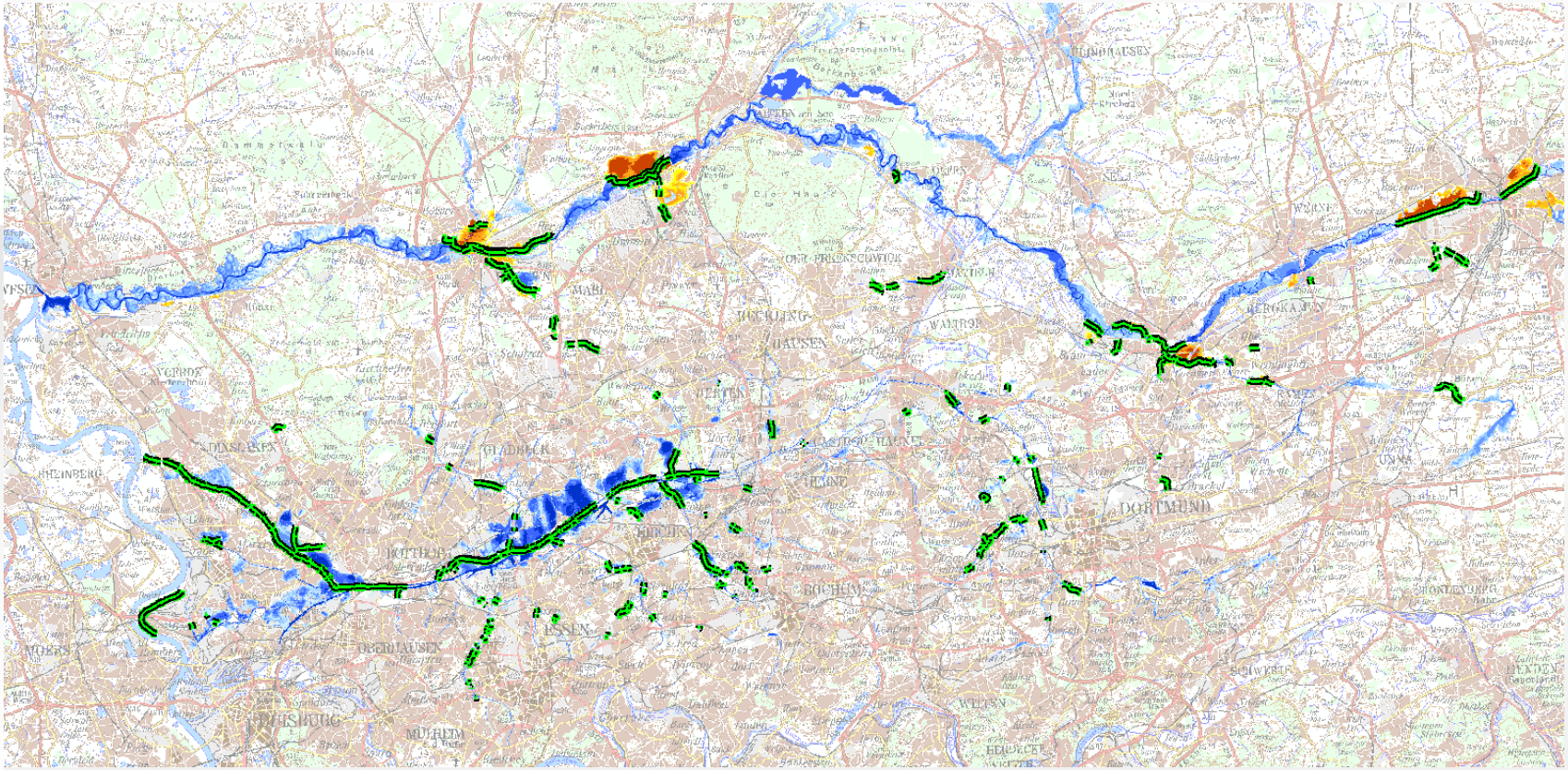


rate of waterlevel rise in the floodplain

- 2,5 m/h with 5,90 m maximum water depth

Emscher and Lippe catchments

With floodplains and 200 km dikes



Flood forecasting – Emscher experiences

Flood management

Department for basic research and services

- Operates all hydrometric measurements
- Provides all hydrometric data
- Operates the hydrologic models and provides the forecast
- Hydrologist on duty (8 persons and 1 per week) gives daily situation report

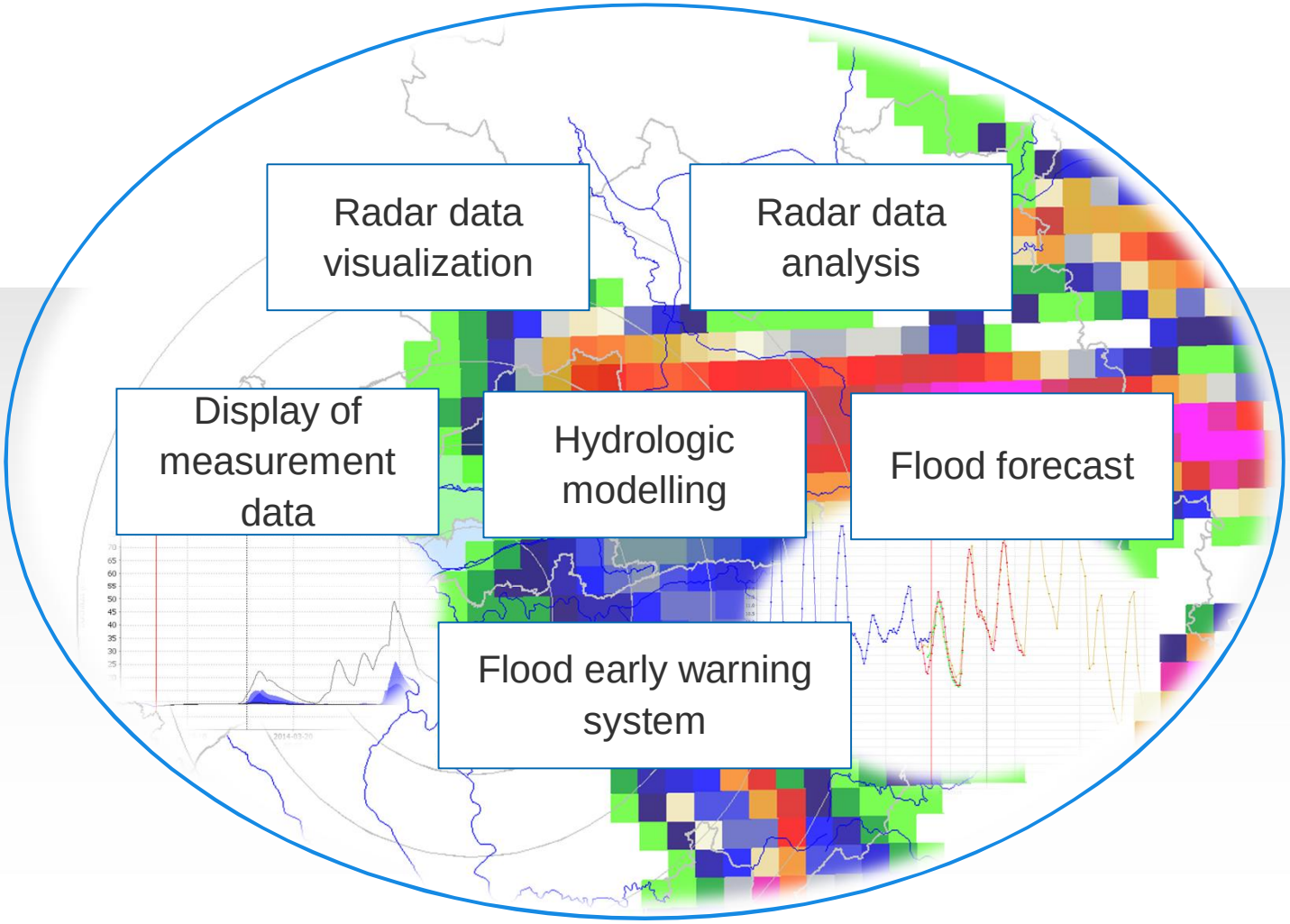
District preparedness teams

Superordinate flood control center

Operative branch of our organisation

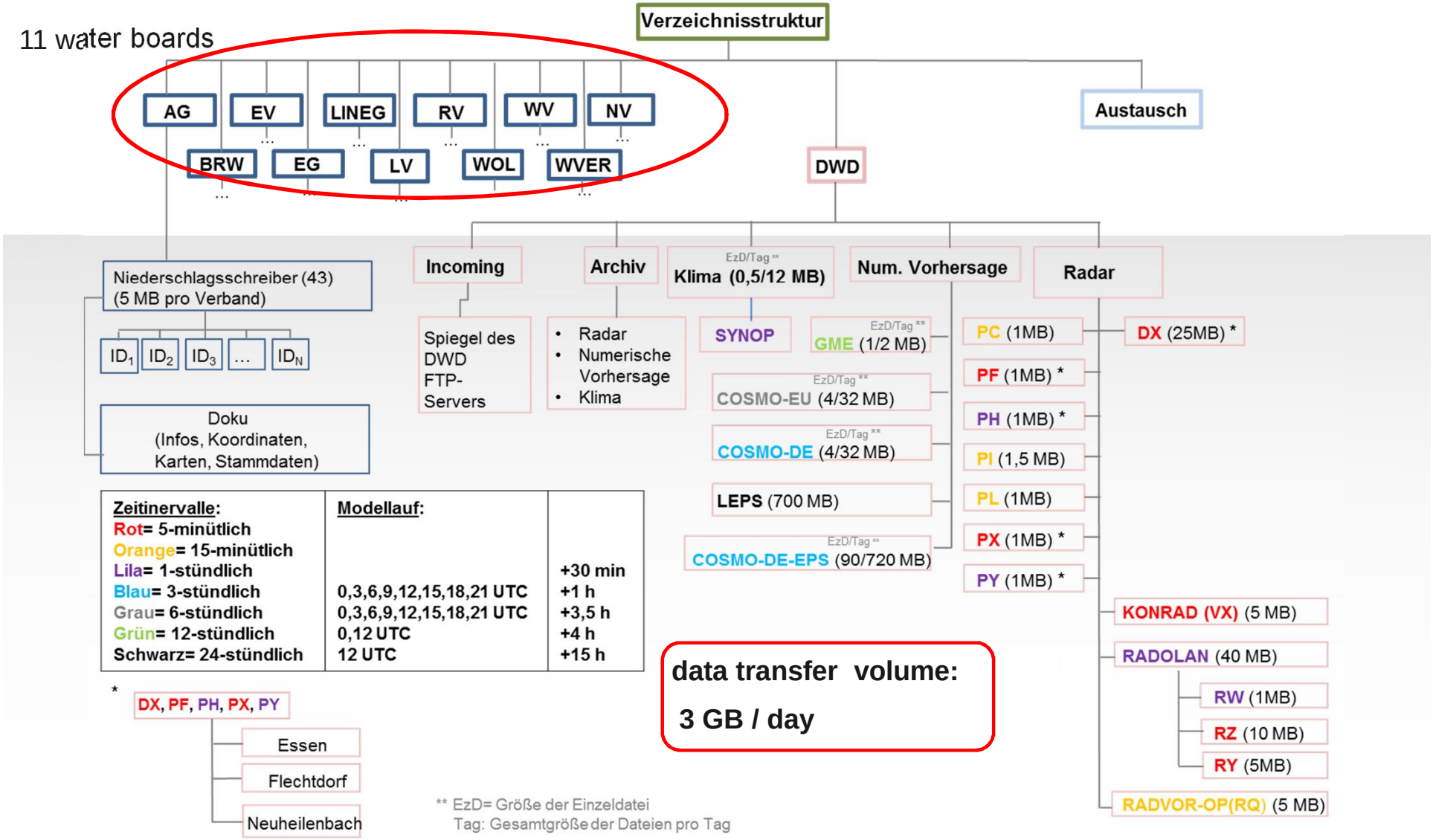
- Operates all pumping stations, treatment plants, retention basins and rivers
- Divided in 5 districts
- Incorporates nearly 850 employees
- Responsible for 342 km streams, 107 pumping stations, 327 km² polder areas and 115 km dikes

Flood early warning system
requirements



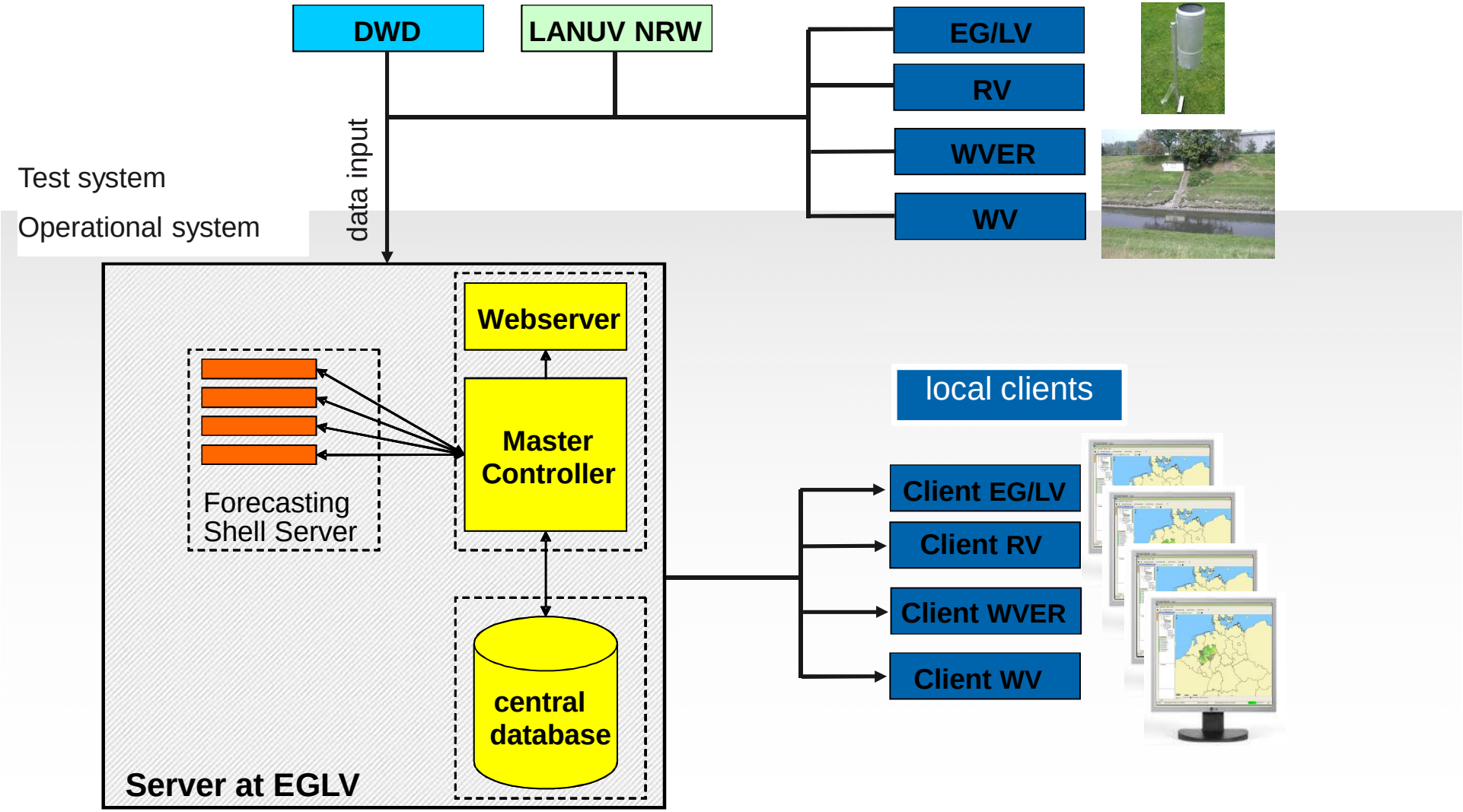
Radar data exchange server

Technical infrastructure

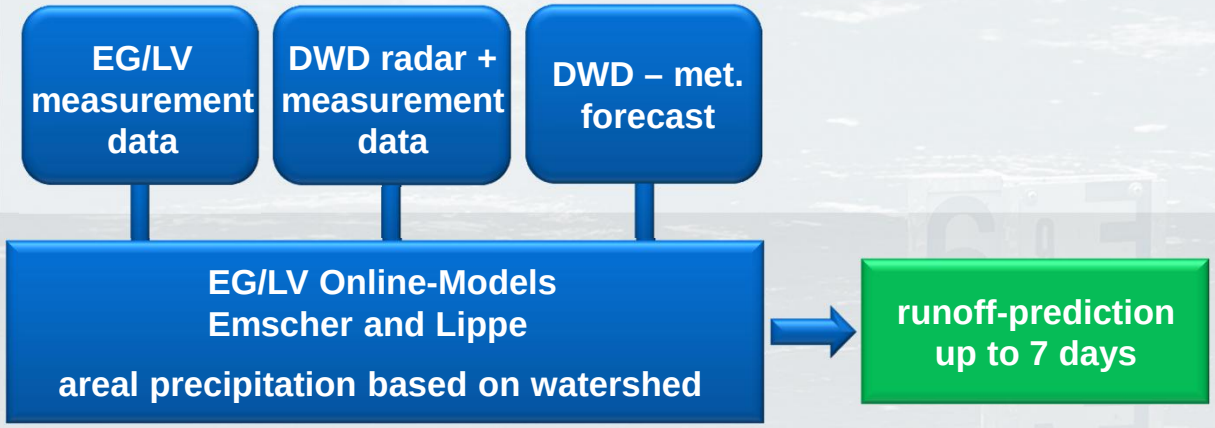


Flood Early Warning system (FEWS)

Server architecture



Flood Early Warning System



Current status report of flood situation

Flood Early Warning System

EMSCHER GENOSSENSCHAFT

EG/LV measurement data

DWD radar + measurement data

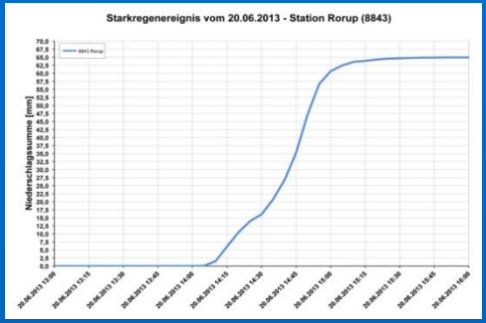
DWD – met. forecast

EG/LV Online-Models
Emscher and Lippe

areal precipitation based on watershed

runoff-prediction up to 7 days

EG/LV measurement data



Current status report of flood situation

EG/LV Hochwasserlagebericht Freitag 25.10.2013 – 15:12 Uhr

Berichtswoche: 43. KW 21.10.2013 bis 27.10.2013

Thursday
0.4 mm precipitation sum 24.10.2013

Friday
0.6 mm measurement (08:30–14:15 25.10.2013)
27.2 mm prediction

Saturday + Sunday
0.7 mm prediction 26.10.2013
7.2 mm prediction 27.10.2013

Emscher

Friday Saturday Sunday

warning

pre warning

Flood Early Warning System

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EGLV.DE

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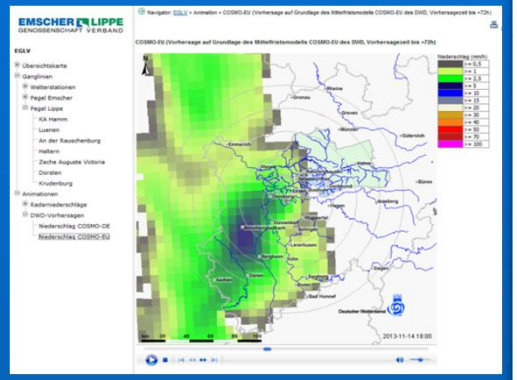

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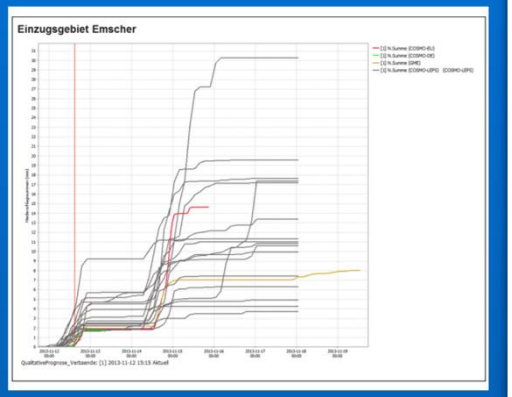

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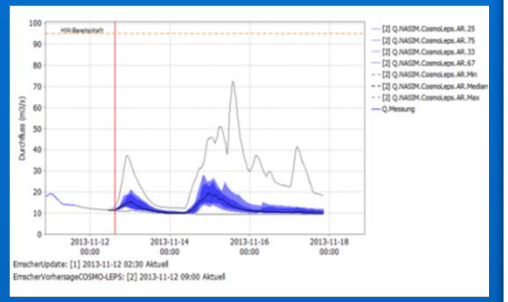

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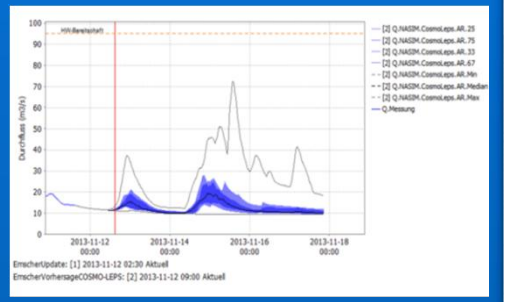

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Emscher

Friday Saturday Sunday

warning

pre warning

Automated SMS- warning and alert system

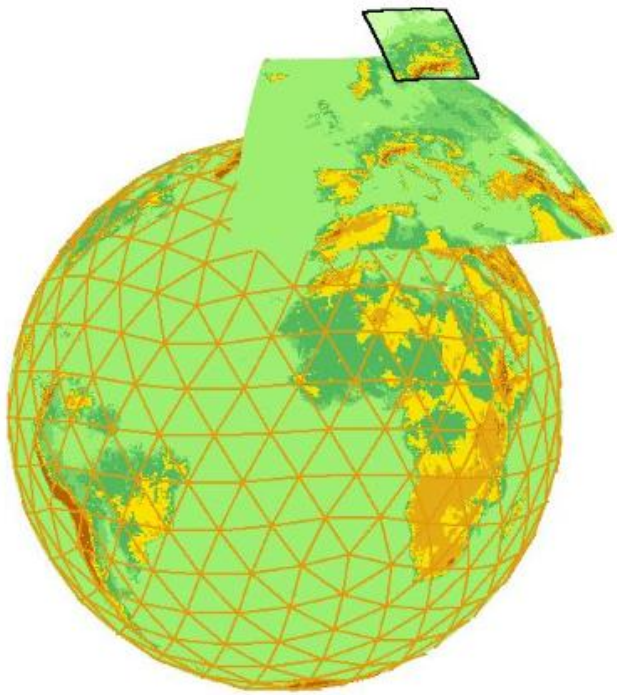
10.08.2015 23:12

HOWIS-Portal Emscher: HOCHWASSERBEREITSCHAFT

HOWIS-Portal Lippe: VORWARNUNG

Numerical Weather predicition

The actual numerical weather prediction model system of the DWD



Local scale: COSMO DE

Regional scale: ICON-EU

Global scale: ICON

Boundary conditions

Chain of models with successively finer resolution

One prediction (model output) every 12 h, 6h, 3 h

Numerical Weather prediction

Numerical weather prediction models (NWP) of the DWD

Global-Modell ICON

Grid scale : 13 km

vertical layers : 90

prediction :

180 h von 00 und 12 UTC

120 h von 06 und 18 UTC

265 mio. grid points

ICON-EU Nestgebiet Europa

Grid scale : 6.5 km

vertical layers : 60

prediction :

120 h von 00, 06, 12 und 18 UTC

17.5 mio. grid points

COSMO-DE (-EPS)

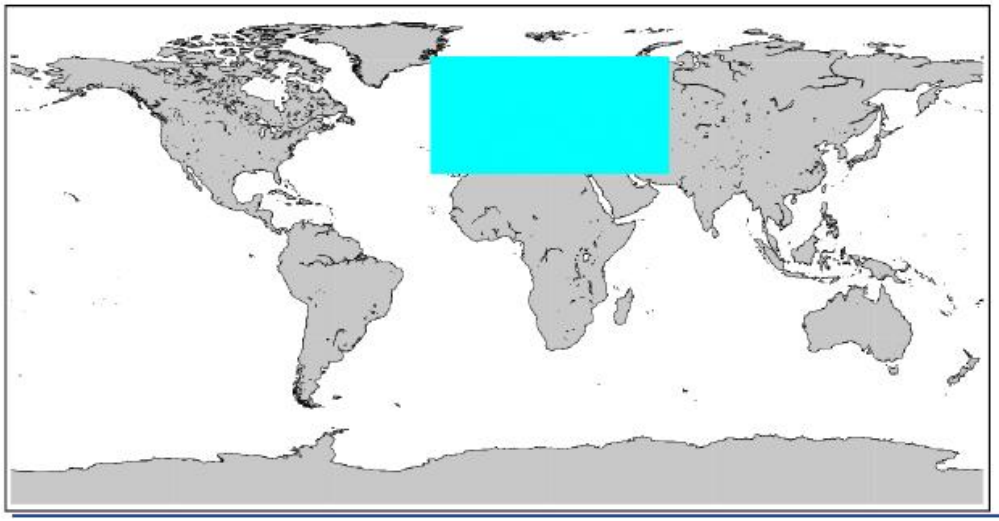
Grid scale : 2.8 (2.2) km

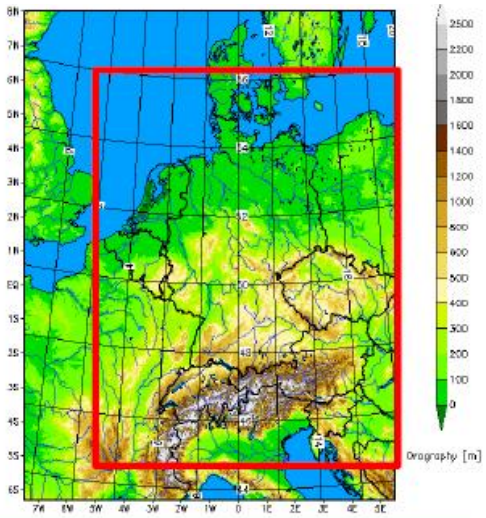
vertical layers : 50 (65)

prediction :

27/45 h von 00, 03, 06, 09, 12, 15, 18, 21 UTC

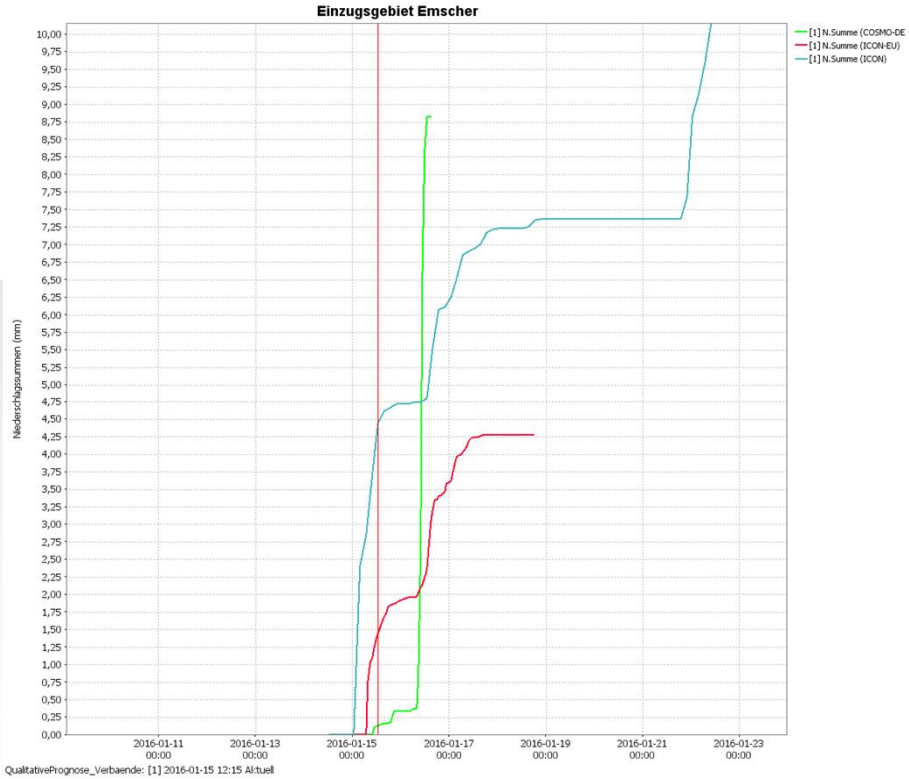
9.5 mio. grid points

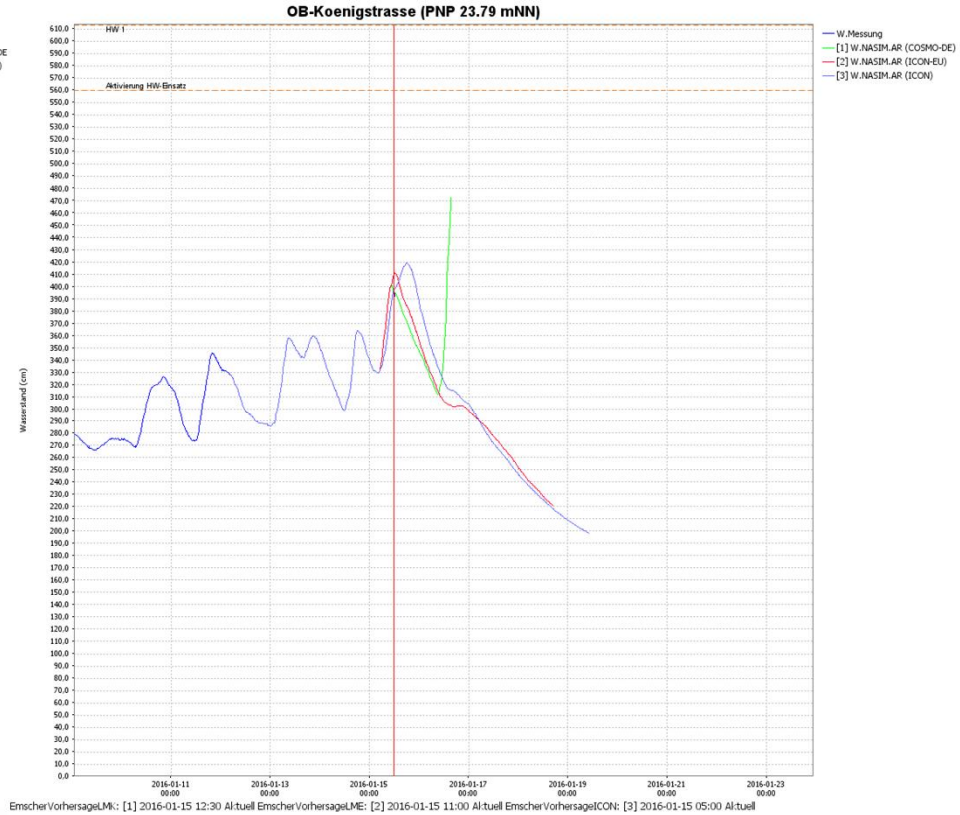




Numerical weater predicition

Rainfall- Runoff predicition in the Emscher catchment



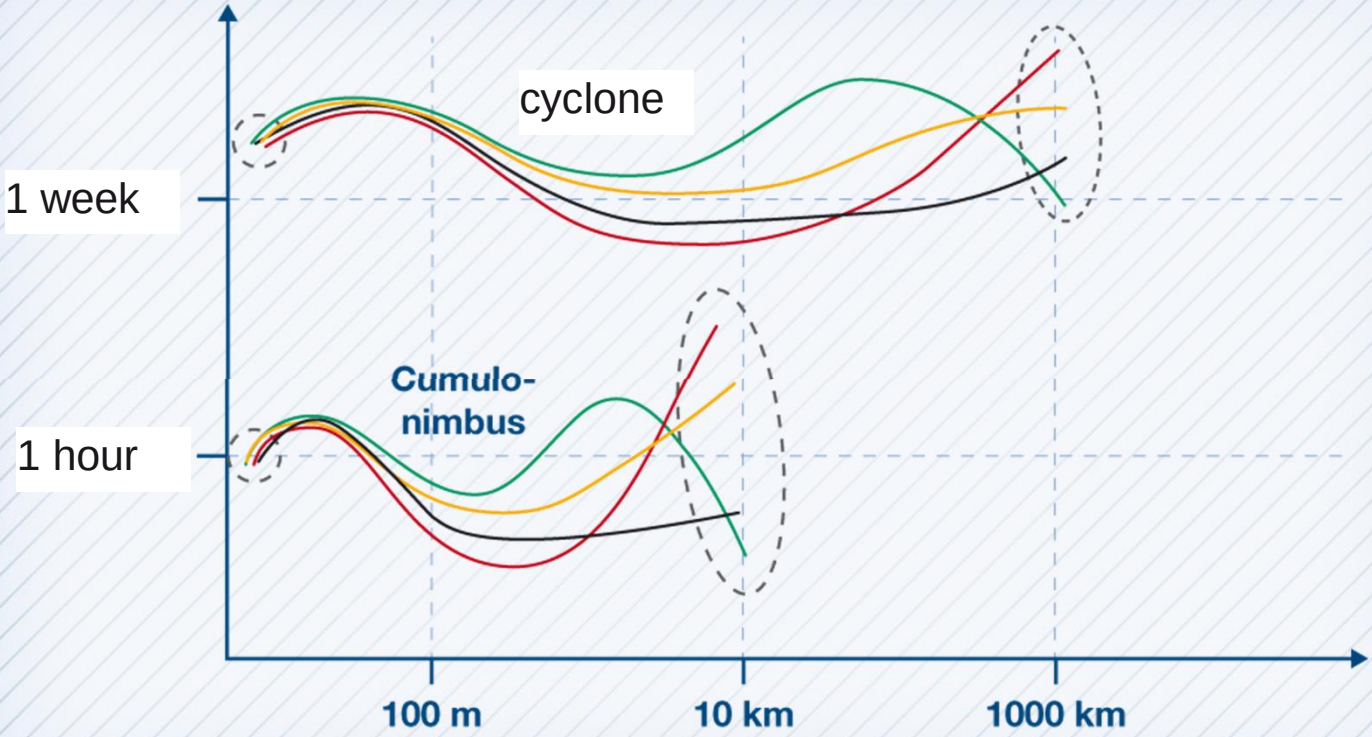


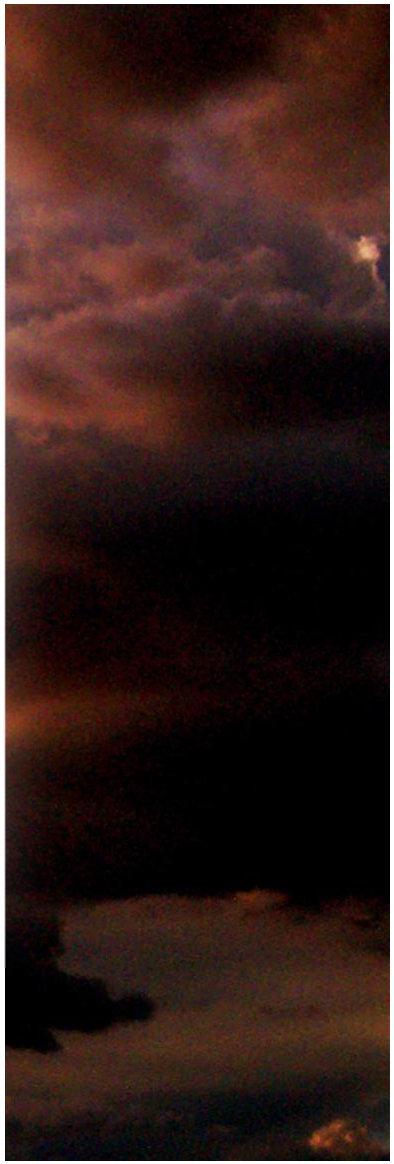
“Good” for the hydrologist on duty, only one predicition to deal with

But remember: atmosphere is a chaotic system, the one true prediction doesn‘t exist

Uncertainties of forecast

Ensemble prediction systems (EPS)





Chaotic systems atmosphere– the one accurate forecast does not exist, but there are weather conditions with a lower uncertainty regarding space and time

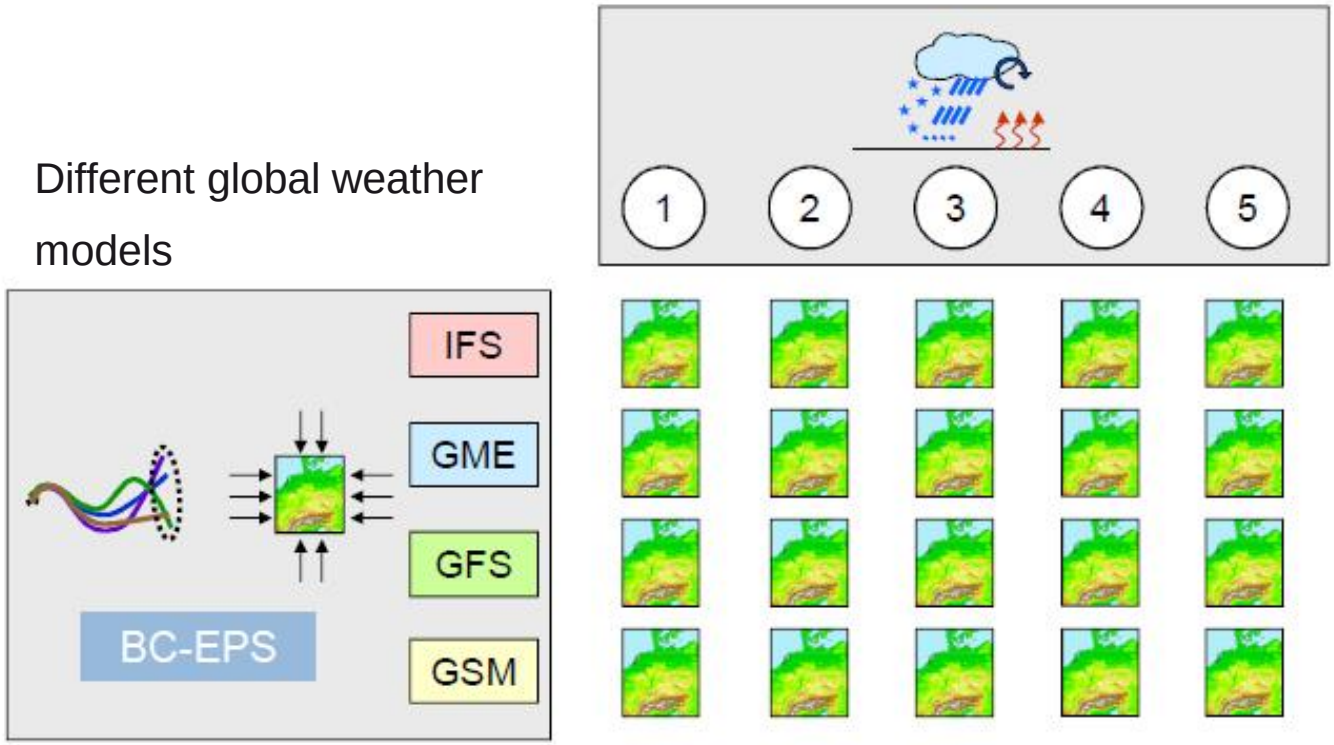
Uncertainties of forecast

Ensemble prediction systems (EPS)

Variation of sensitive variables:

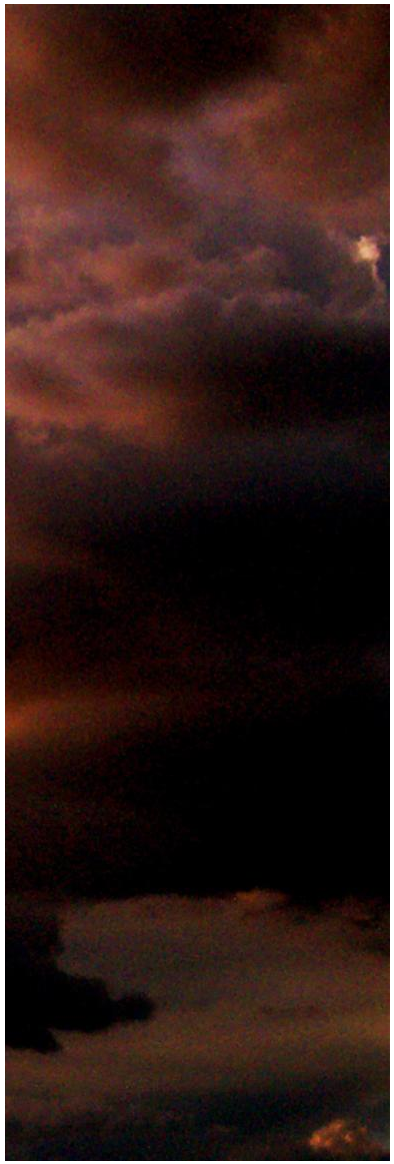
humidity, temperature, …

Different global weather models



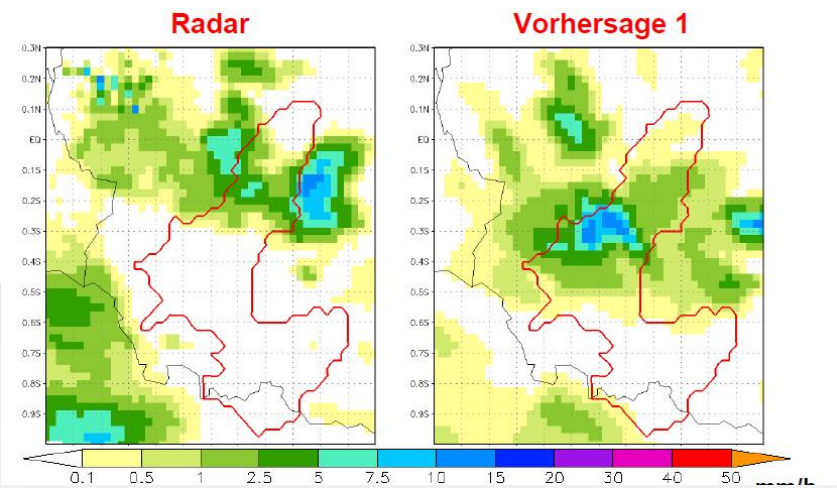
20 model runs with different results, but the same probability ->

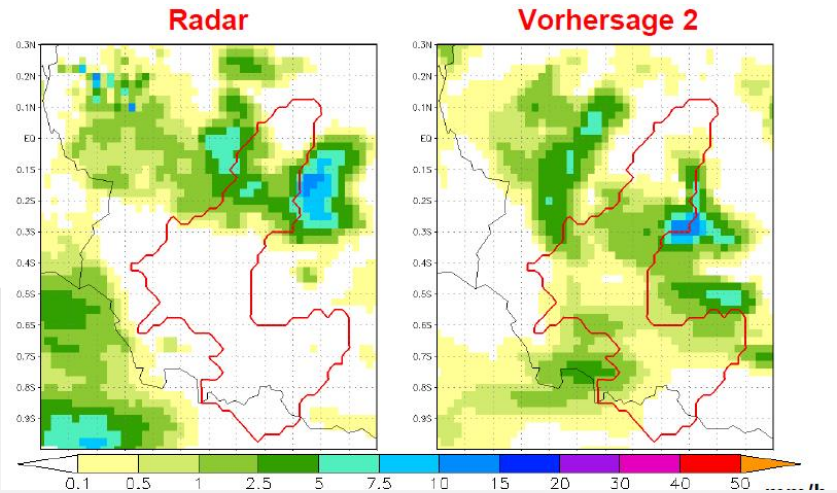
Large variation = index for uncertainty

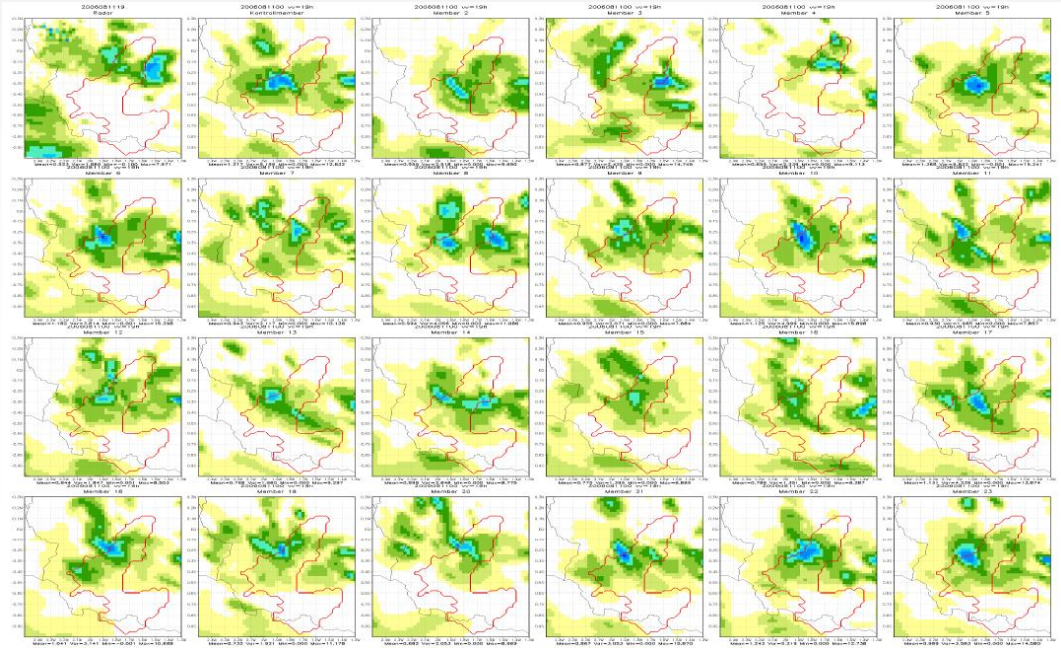


Ensemble Prediction Systems

Challenges for flood prediction in local catchments







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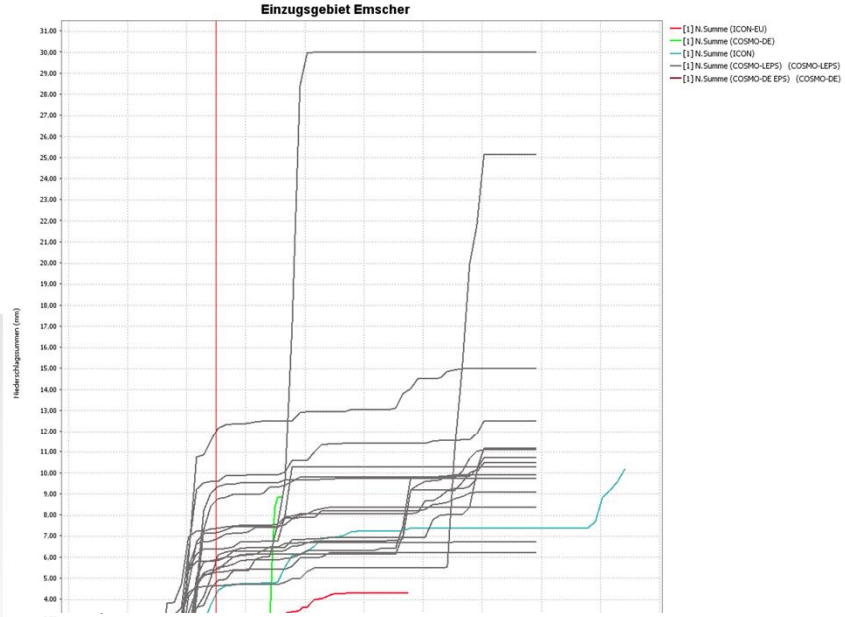
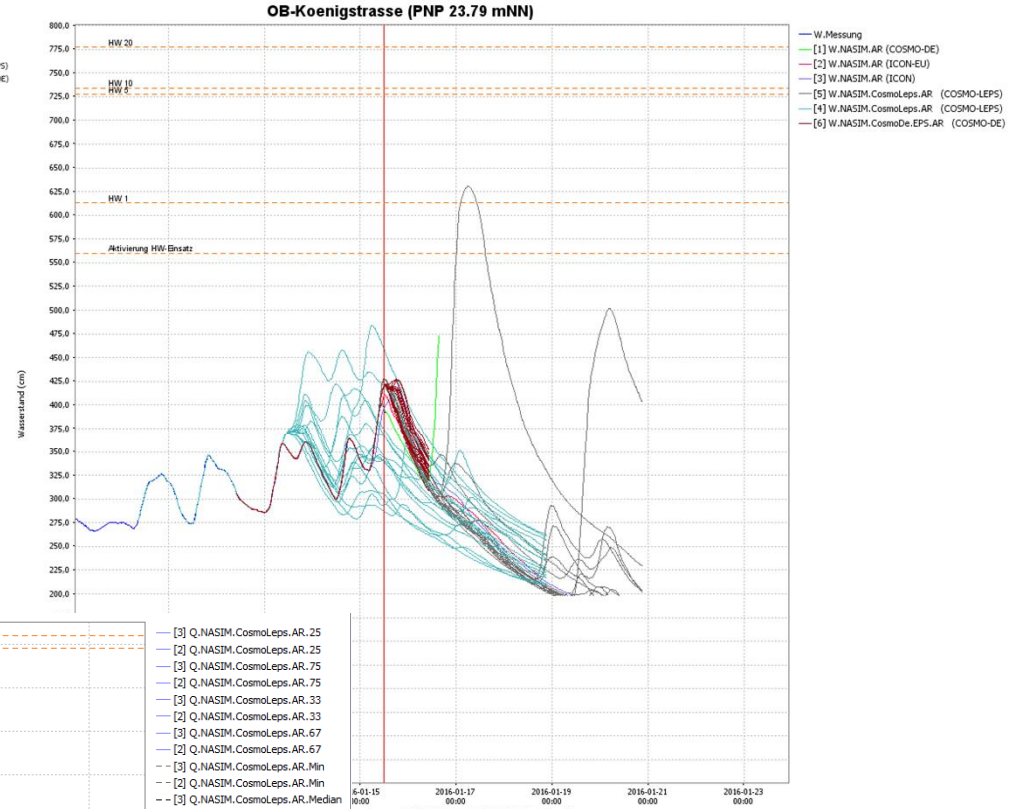
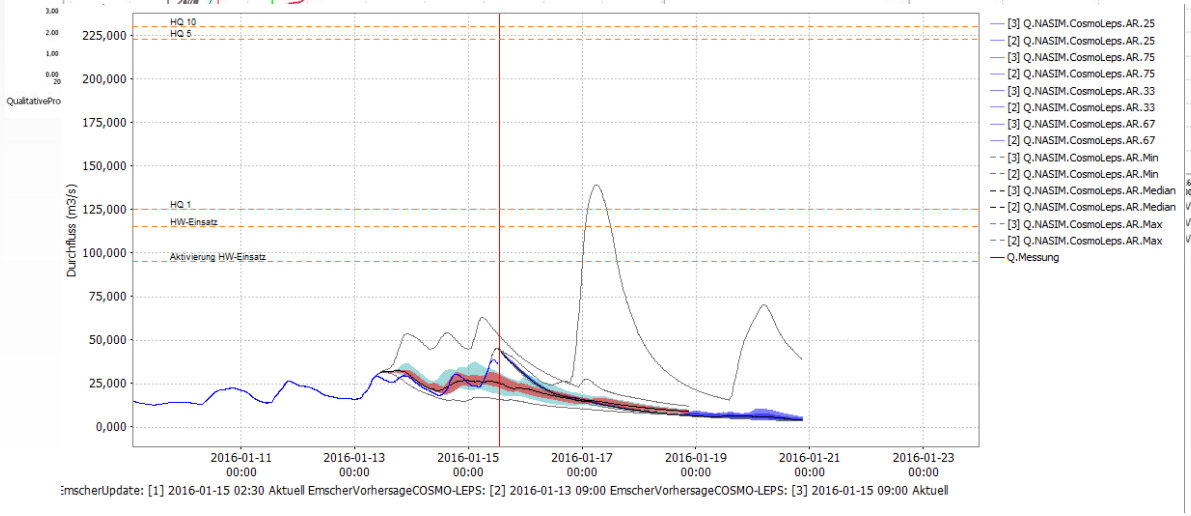




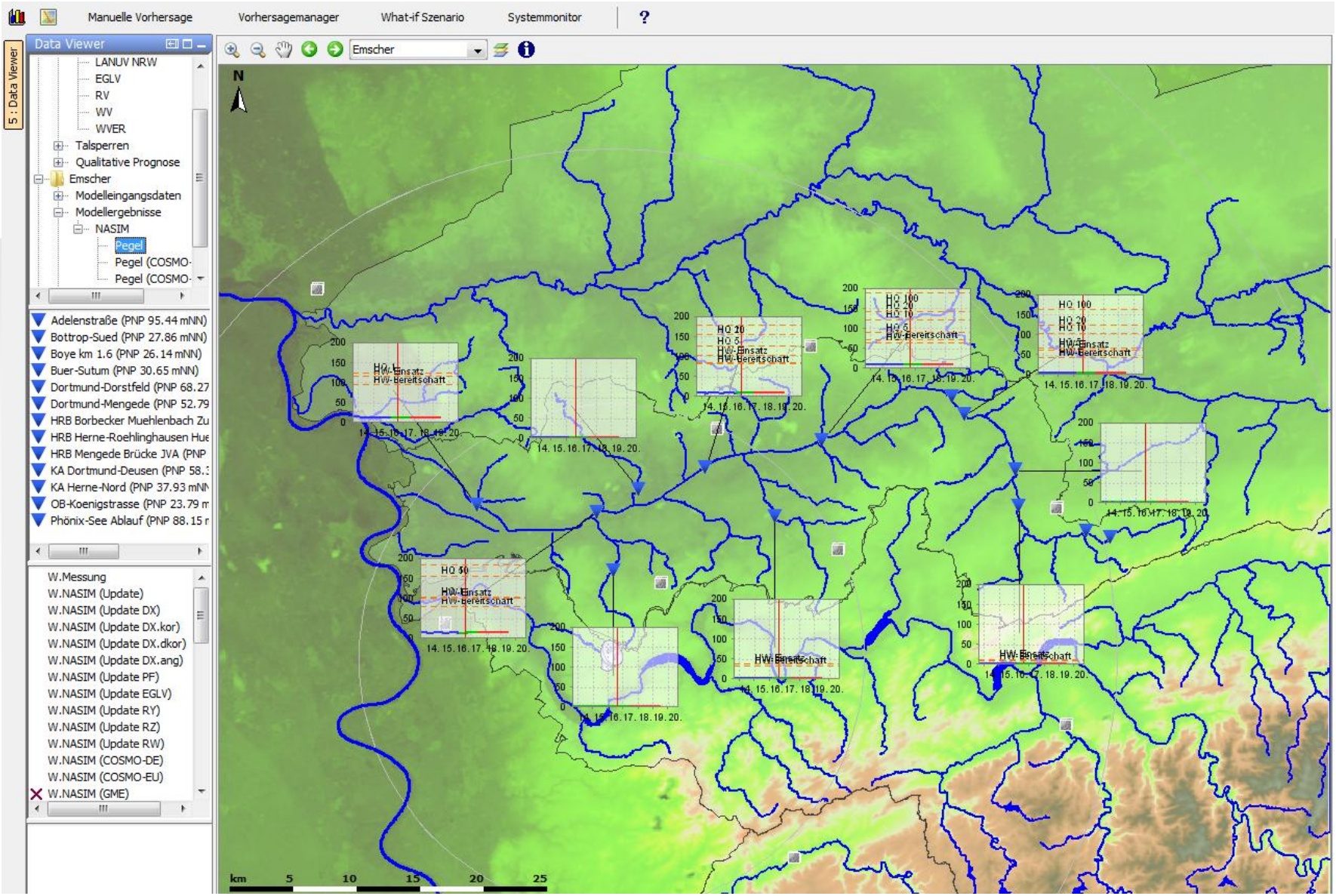


Precipitation warning messages and call of service

Overview discharge year 2015 (1st. Nov. – 30th. Oct.)

		1st. half-year	2nd. half-year	Discharge year 2015
DWD warning messages	**thunder storm / heavy rain**	23	47	70
	continuous rain	6	3	9
	severe weather	0	14	14
	call of service - hydrologist	35	33	68
	exceeding of critical river levels	7	5	12

EMSCHER GENOSSENSCHAFT



http://mapapps.emscher-lippe.eglv.de:8080/mapapps/resources/apps/Hochwassermanage

Emschergenossenschaft Lippe... | Hochwasser-Management

Datei Bearbeiten Ansicht Favoriten Extras ?

Emsc... Emsc... Emsc... Emsc... Emsc... Deut... EGLV...

Startseite | Feeds (J) | E-Mail lesen | Drucken | Seite | Sicherheit | Extras | Hilfe

Hochwasser-Management

Geben Sie Ihre Suche hier ein (Adresse, Projekte...)

Gefundene Treffer

Ebene **Freibord** Objekt **IX 2000**

Attribut	Wert
Route-ID	1013
Von Deichstation	27976.94
Bis Deichstation	28076.94
HWSL-Element	Deich
Freibord [m]	1.59
Jährlichkeit	200
Deichkrone [mNN]	40.18
Geländehöhe landseitig [mNN]	37.13
Horizont	IX 2000
BHW [mNN]	38.59
Deichhöhe [m]	3.05
BHQ [m³/s]	278.12
Pegel-Nummer	10011
Böschung landseitig 1:	2.8
Böschung wasserseitig 1:	1.7
Kronenbreite [m]	3.26
Bei Deichstation	28032.58
Ersterfassung	29.08.08 02:00
Datenherkunft	23-BV-30
Letzte Änderung	16.01.09 01:00
Letzter Bearbeiter	L. Riese

Legende

Freibord

EG/LV Deiche

Freibord

- *Keine Angaben*
- *< 0,0*
- *0,0 - 0,5*
- *0,5 - 1,0*
- *> 1,0*

Verbandsgrenzen

Verbandsgrenzen

- *Emschergenossenschaft*
- *Lippeverband*

Gewässerabschnitte

Gewässerabschnitte

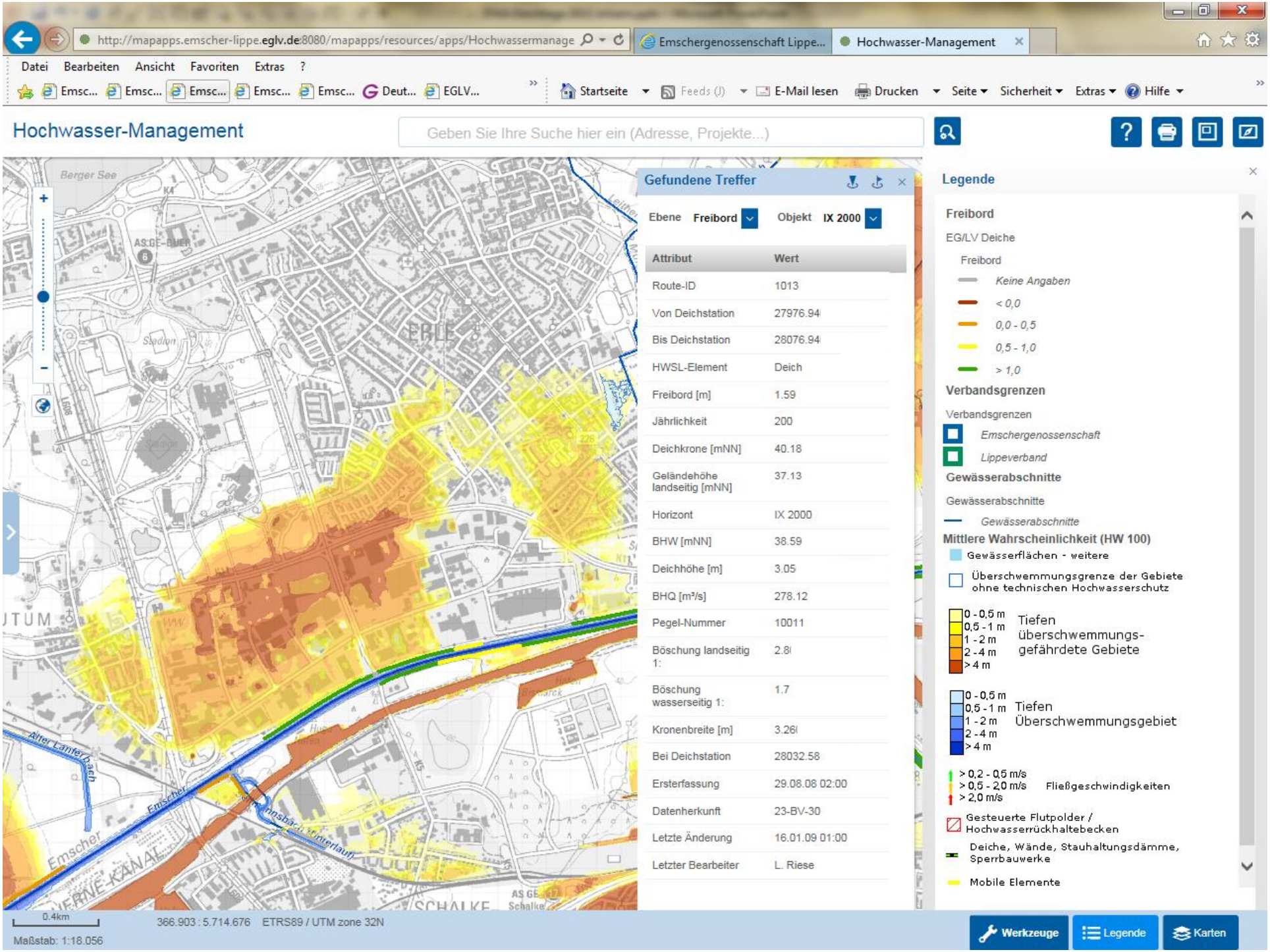
- *Gewässerabschnitte*

0.4km

368.212 : 5.714.576 ETRS89 / UTM zone 32N

Maßstab: 1:18.056

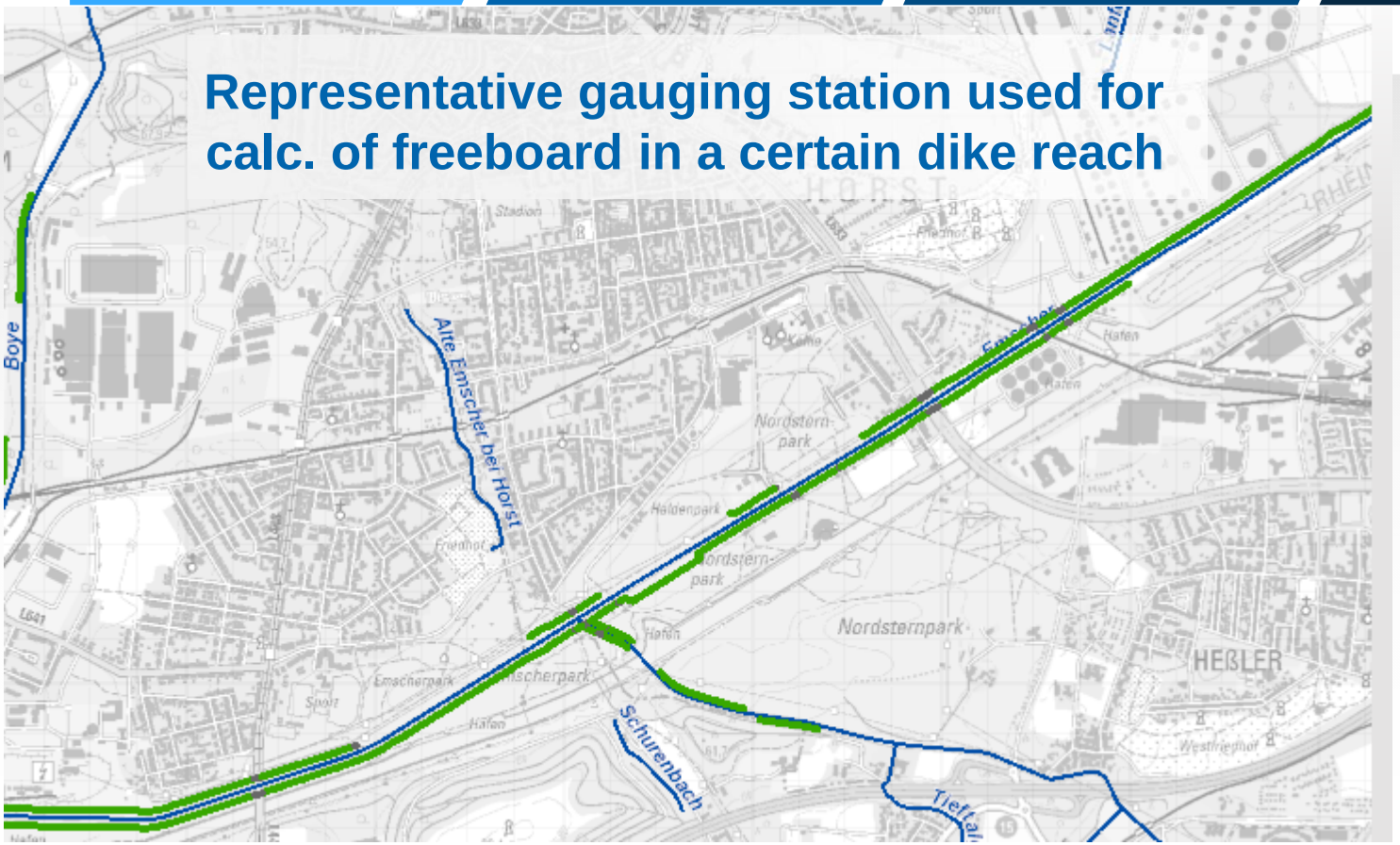
Werkzeuge | Legende | Karten


http://mapapps.emscher-lippe.eglv.de:8080/mapapps/resources/apps/Hochwassermanage
Emschergenossenschaft Lippe...
Hochwasser-Management
Datei Bearbeiten Ansicht Favoriten Extras ?
Startseite Feeds (J) E-Mail lesen Drucken Seite Sicherheit Extras Hilfe
Hochwasser-Management
Geben Sie Ihre Suche hier ein (Adresse, Projekte...)
Gefundene Treffer
Ebene Freibord
Objekt IX 2000
Attribut Wert
Route-ID 1013
Von Deichstation 27976.94
Bis Deichstation 28076.94
HWSL-Element Deich
Freibord [m] 1.59
Jährlichkeit 200
Deichkrone [mNN] 40.18
Geländehöhe landseitig [mNN] 37.13
Horizont IX 2000
BHW [mNN] 38.59
Deichhöhe [m] 3.05
BHQ [m³/s] 278.12
Pegel-Nummer 10011
Böschung landseitig 1: 2.8
Böschung wasserseitig 1: 1.7
Kronenbreite [m] 3.26
Bei Deichstation 28032.58
Ersterfassung 29.08.08 02:00
Datenherkunft 23-BV-30
Letzte Änderung 16.01.09 01:00
Letzter Bearbeiter L. Riese
Legende
Freibord
EG/LV Deiche
Freibord
Keine Angaben
< 0,0
0,0 - 0,5
0,5 - 1,0
> 1,0
Verbandsgrenzen
Verbandsgrenzen
Emschergenossenschaft
Lippeverband
Gewässerabschnitte
Gewässerabschnitte
Gewässerabschnitte
Mittlere Wahrscheinlichkeit (HW 100)
Gewässerflächen - weitere
Überschwemmungsgrenze der Gebiete ohne technischen Hochwasserschutz
0 - 0,5 m
0,5 - 1 m
1 - 2 m
2 - 4 m
> 4 m
Tiefen überschwemmungsgefährdete Gebiete
0 - 0,5 m
0,5 - 1 m
1 - 2 m
2 - 4 m
> 4 m
Tiefen Überschwemmungsgebiet
> 0,2 - 0,5 m/s
> 0,5 - 2,0 m/s
> 2,0 m/s
Fließgeschwindigkeiten
Gesteuerte Flutpolder / Hochwasserrückhaltebecken
Deiche, Wände, Stauhaltungsdämme, Sperrbauwerke
Mobile Elemente
0.4km
Maßstab: 1:18.056
366.903 : 5.714.676 ETRS89 / UTM zone 32N
Werkzeuge
Legende
Karten

Flood forecasting – Emscher experiences

Dike data service

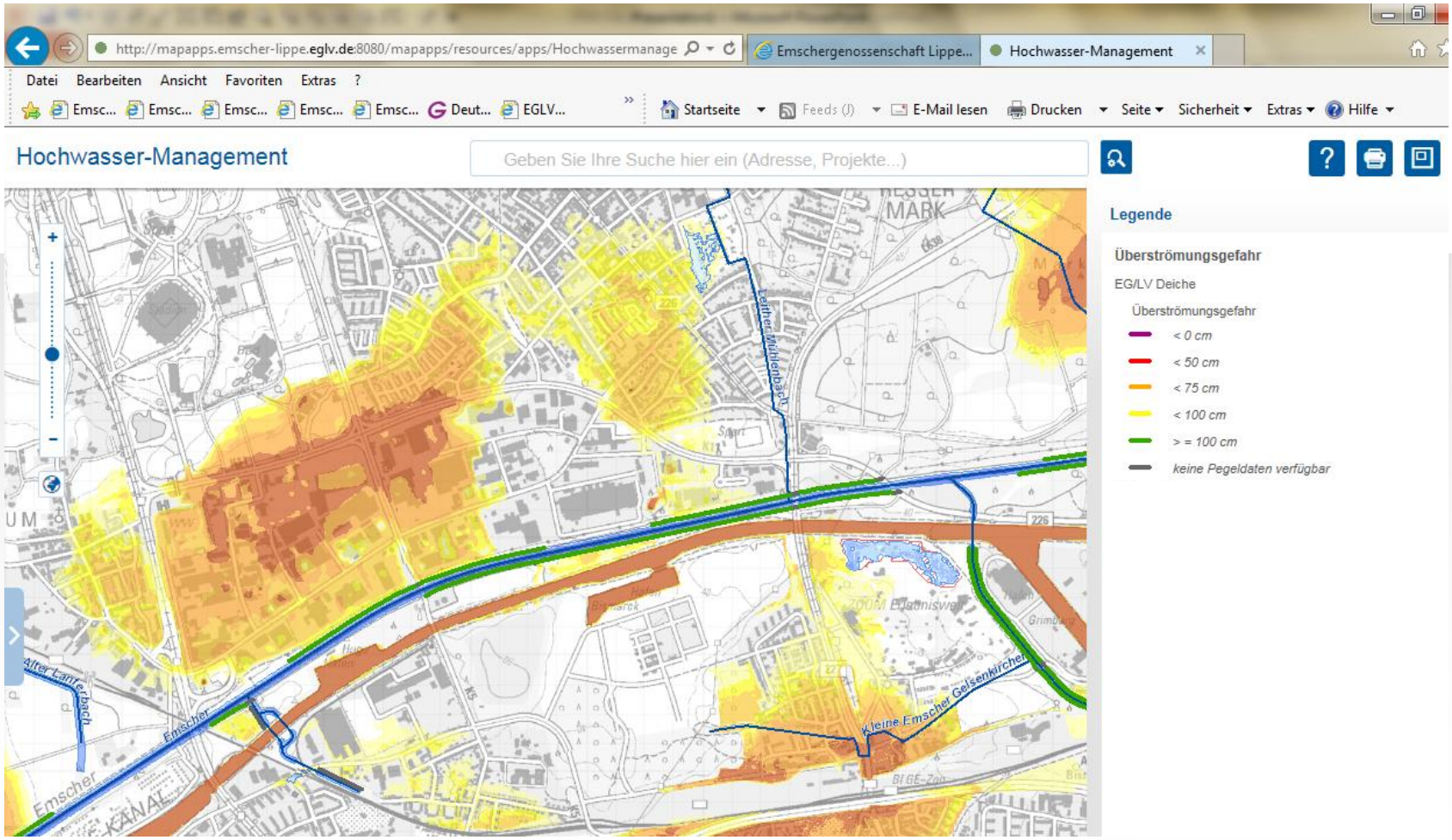
Present situation: Every 15 min map current freeboard → **Next step: use discharge to calc. freeboard** → **Next step: use 6 hour forecast** → **Next step: use 24 hour forecast**



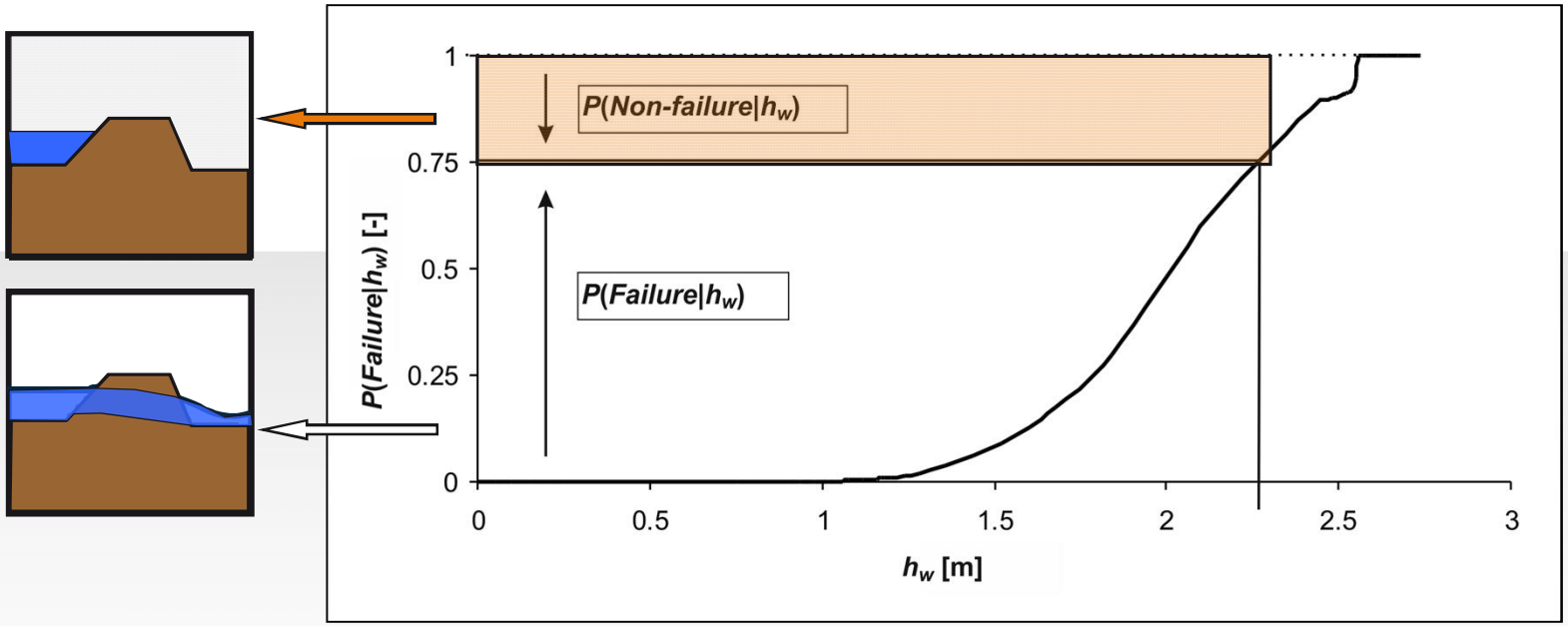
REMAINING FREEBOARD

- < 0 cm
- < 50 cm
- < 75 cm
- < 100 cm
- > = 100 cm

Online dike toping hazard

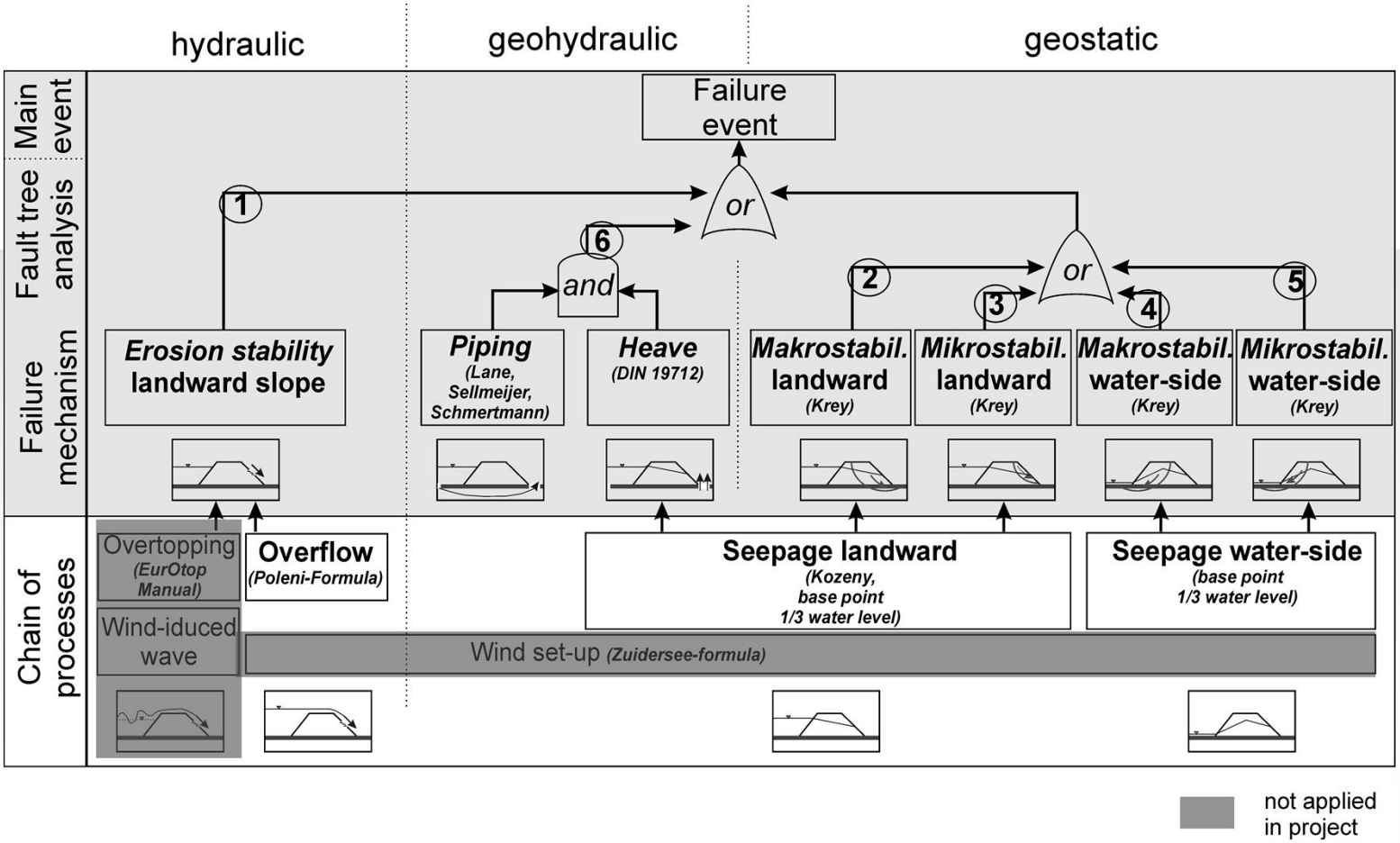


The fragility curve



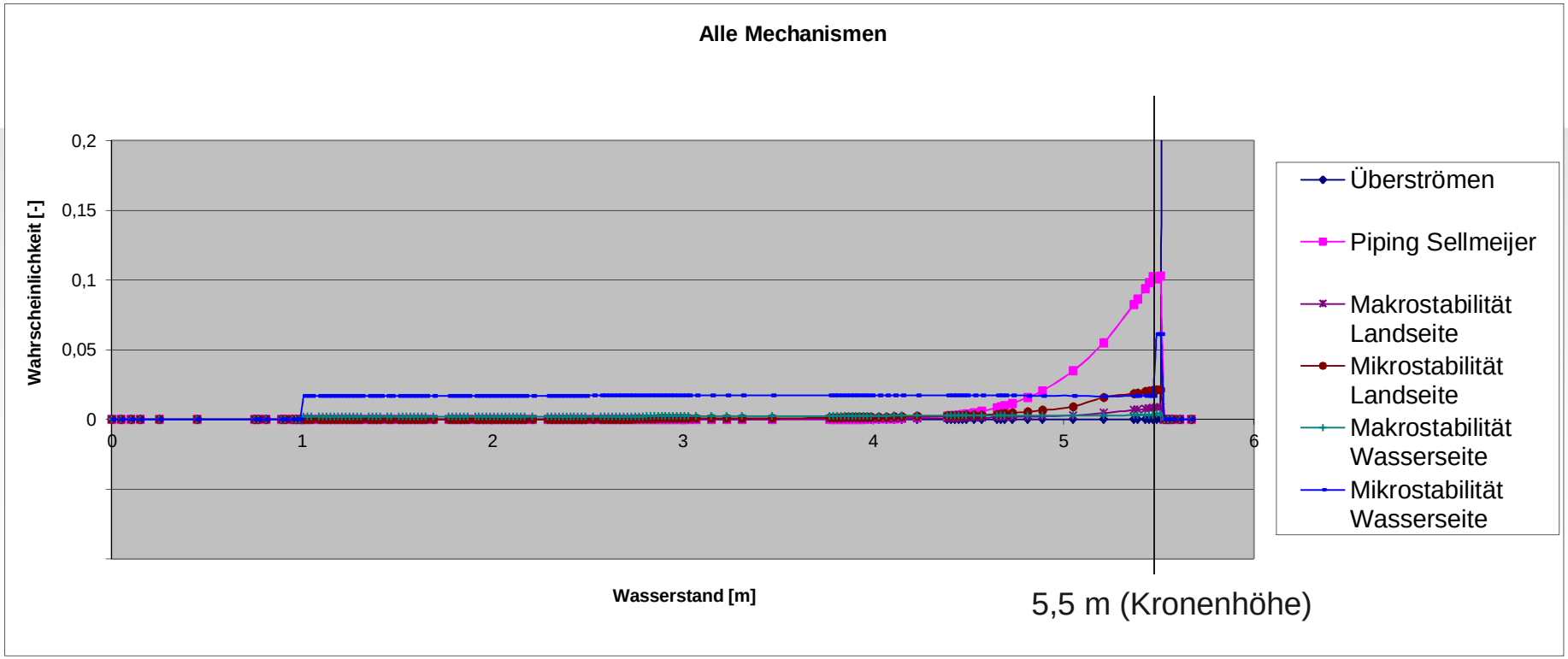
Summary of the reliability / failure probability of a structure depending to the stress (e.g. water level [m])

Model of the structure type *dike*



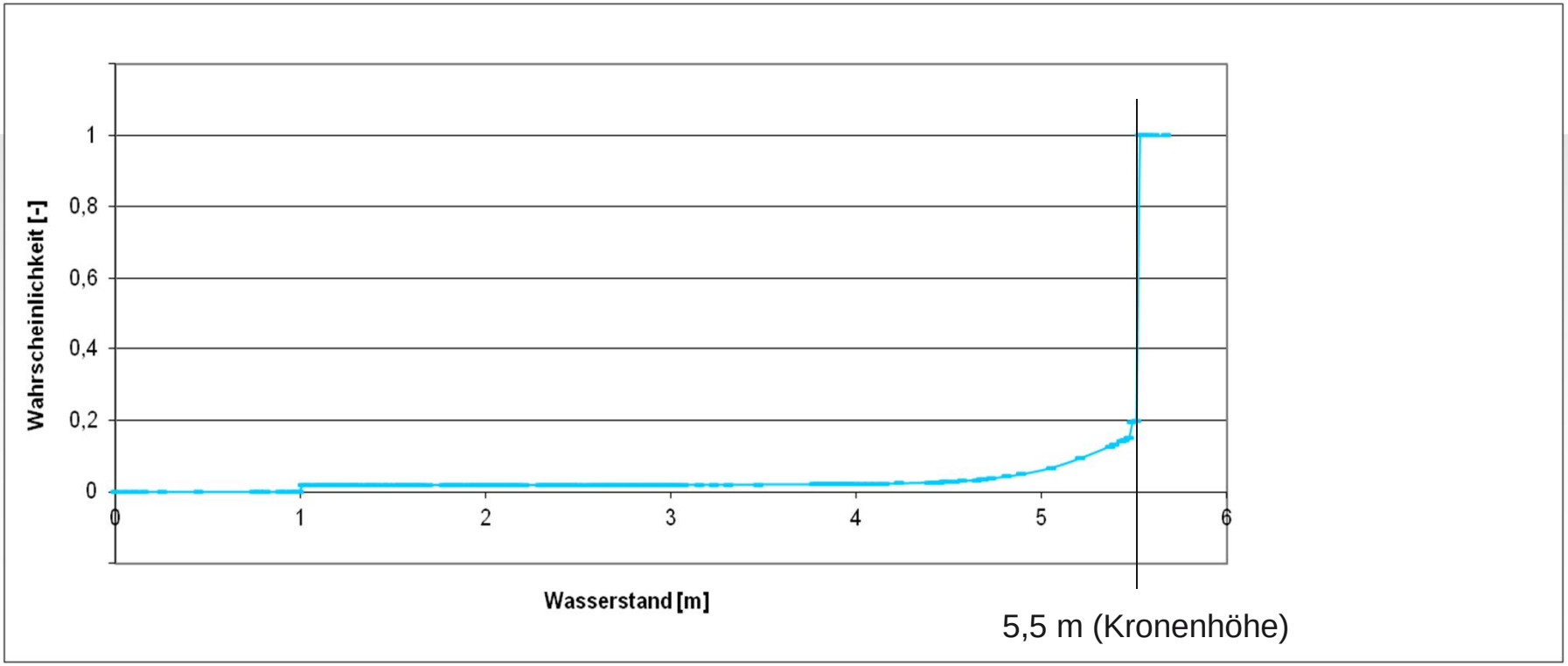
fragility curves

reliability / failure probability

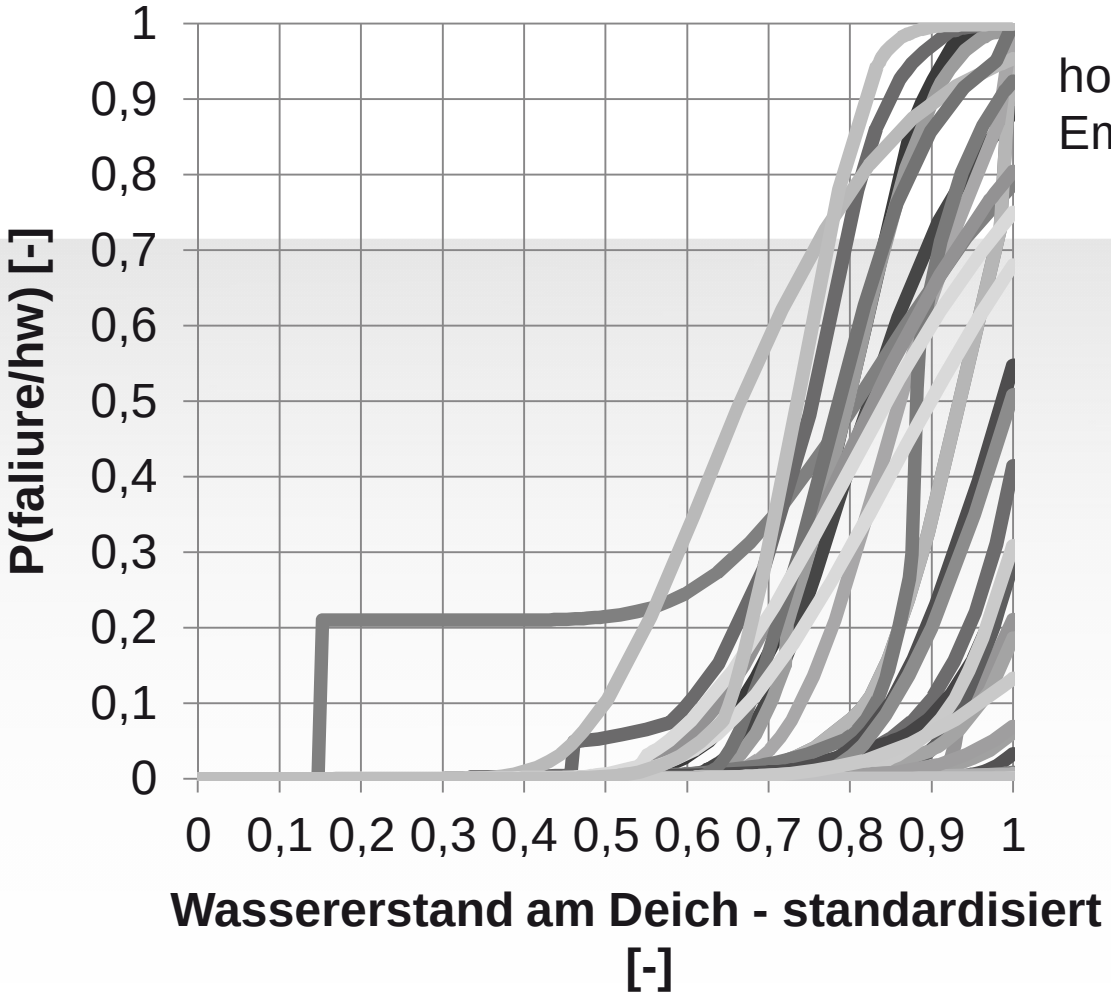


fragility curve

Summary of the reliability / failure probability

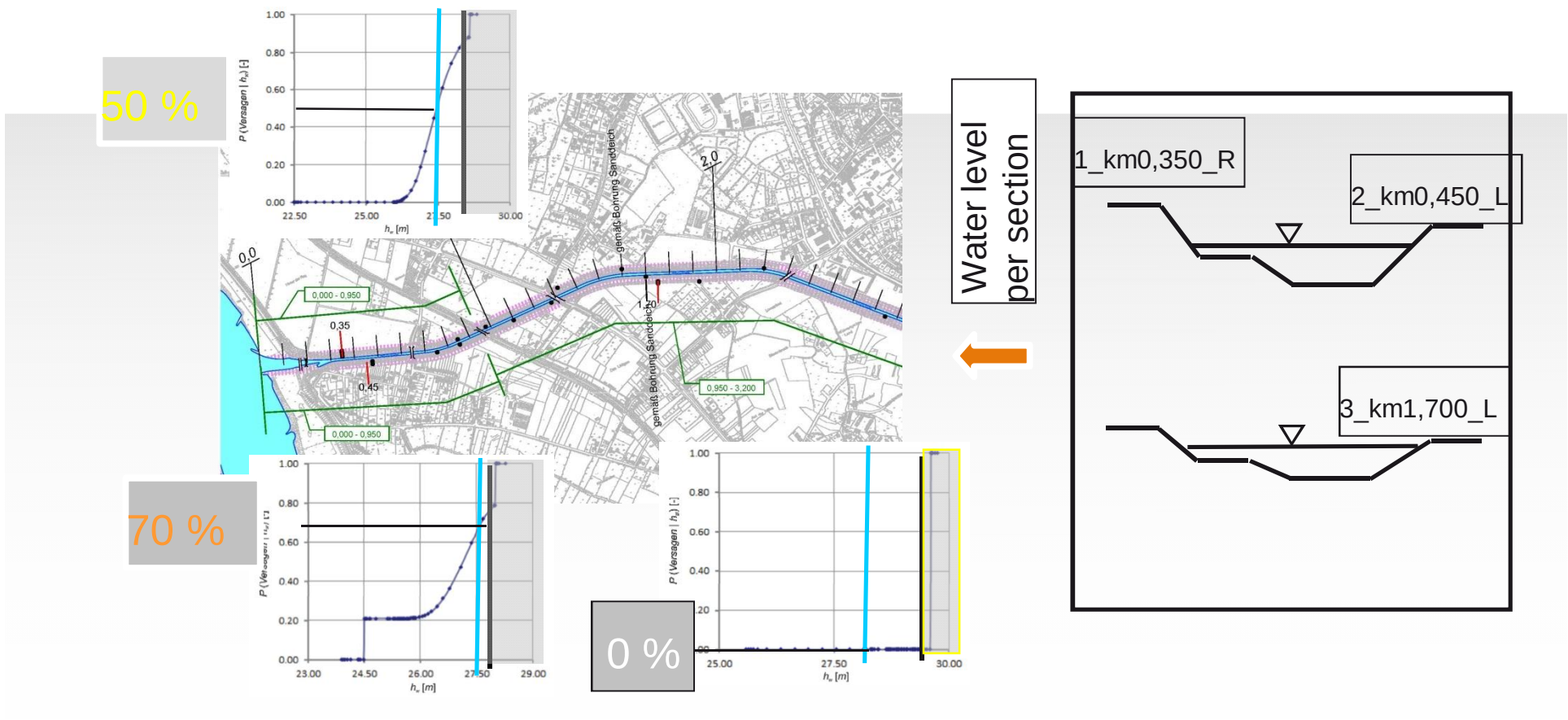


standardised fragility curves



homogene Abschnitte
Emscherdeiche km 0 – km 19

Integration of the fragility curve in the operational flood management system of the EGLV



Flood forecasting – Emscher experiences

Conclusions

- **Flood comes very fast**
- **Fast data transfer and models**
- **Little chance to react**
- **Forecast quality is crucial**

Dank u voor uw aandacht

- Precaution is the best thing we can do