Investigations to determine the effects of preventive measures within the framework of the German National Flood Protection Programme (NHWSP)

Part 1: Marcus Hatz, German Federal Institute of Hydrology (BfG)

&

Exemplary application of flood forecasting under consideration of NHWSP measures

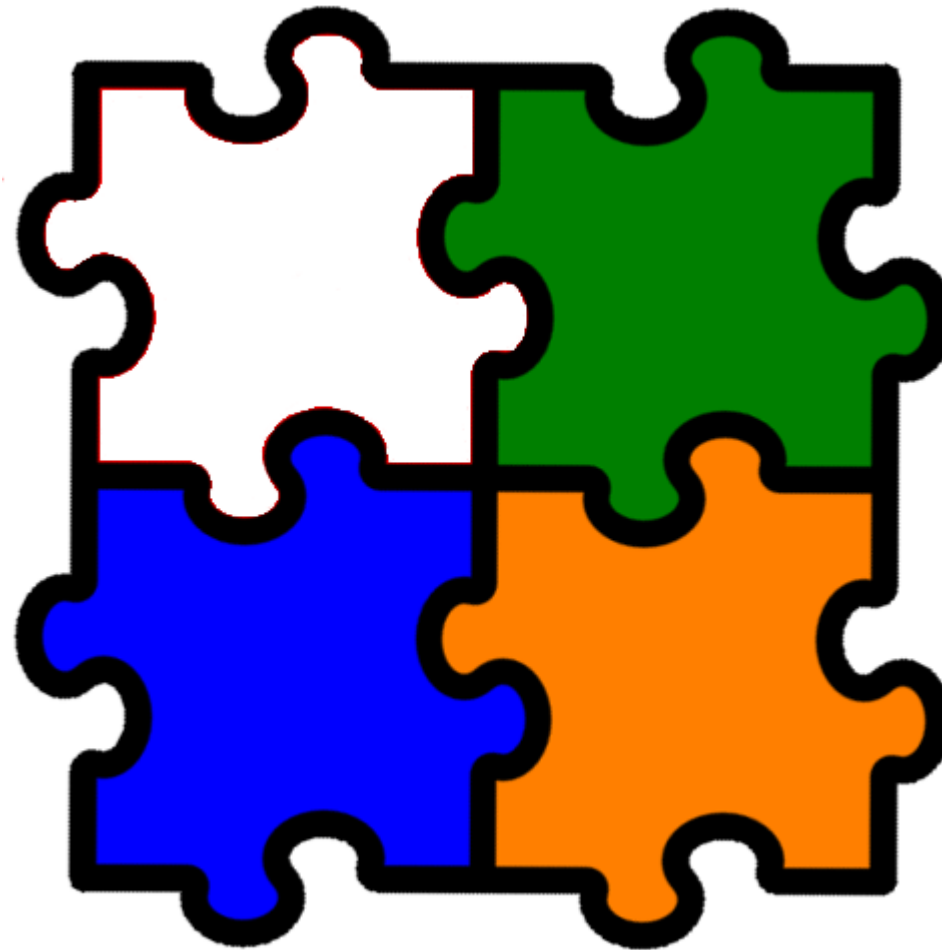Part 2: Finn Hartwig, German River Basin Community Elbe (FGG Elbe)

International Elbe River Conference
14th of April, 2021
Simultaneously interpreted video conference

„Flood Protection Measure" during the Elbe river flood in 2013
(photo: BfG, Elbe river nearby the gauging station Neu Darchau)

Challenges for transregional deployment of retention measures **with reference to forecasting**

Criteria for use

Robust & coordinated for all relevant measures along the Elbe / in the Elbe region

Presentation, **Part 1 & 2**

Documentation

of all relevant actions & management steps during a flood (in real-time, software assisted)
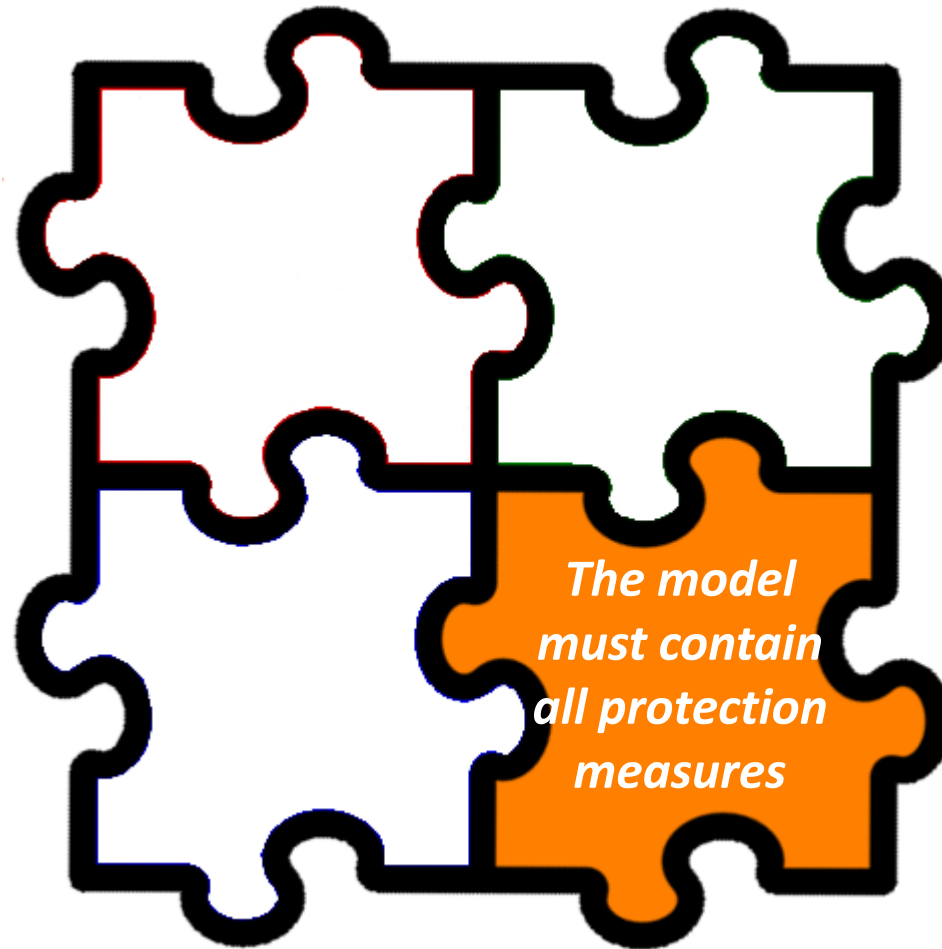
Presentation, **Part 2**

Flood forecasting

Proper integration and consideration of flood protection measures in flood forecasting

Presentation, **Part 2**

Criteria for use

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Presentation, **Part 2**

The model must contain all protection measures

Flood forecasting

Proper integration and consideration of flood protection measures in flood forecasting

Presentation, **Part 2**

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The forecast model must contain all protection measures
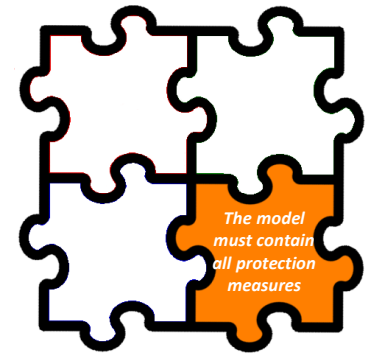
Already part of the forecast model:

- 13 controlled measures (HWR)

- 11 uncontrolled measures (DRV)
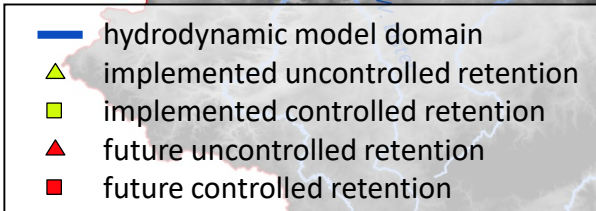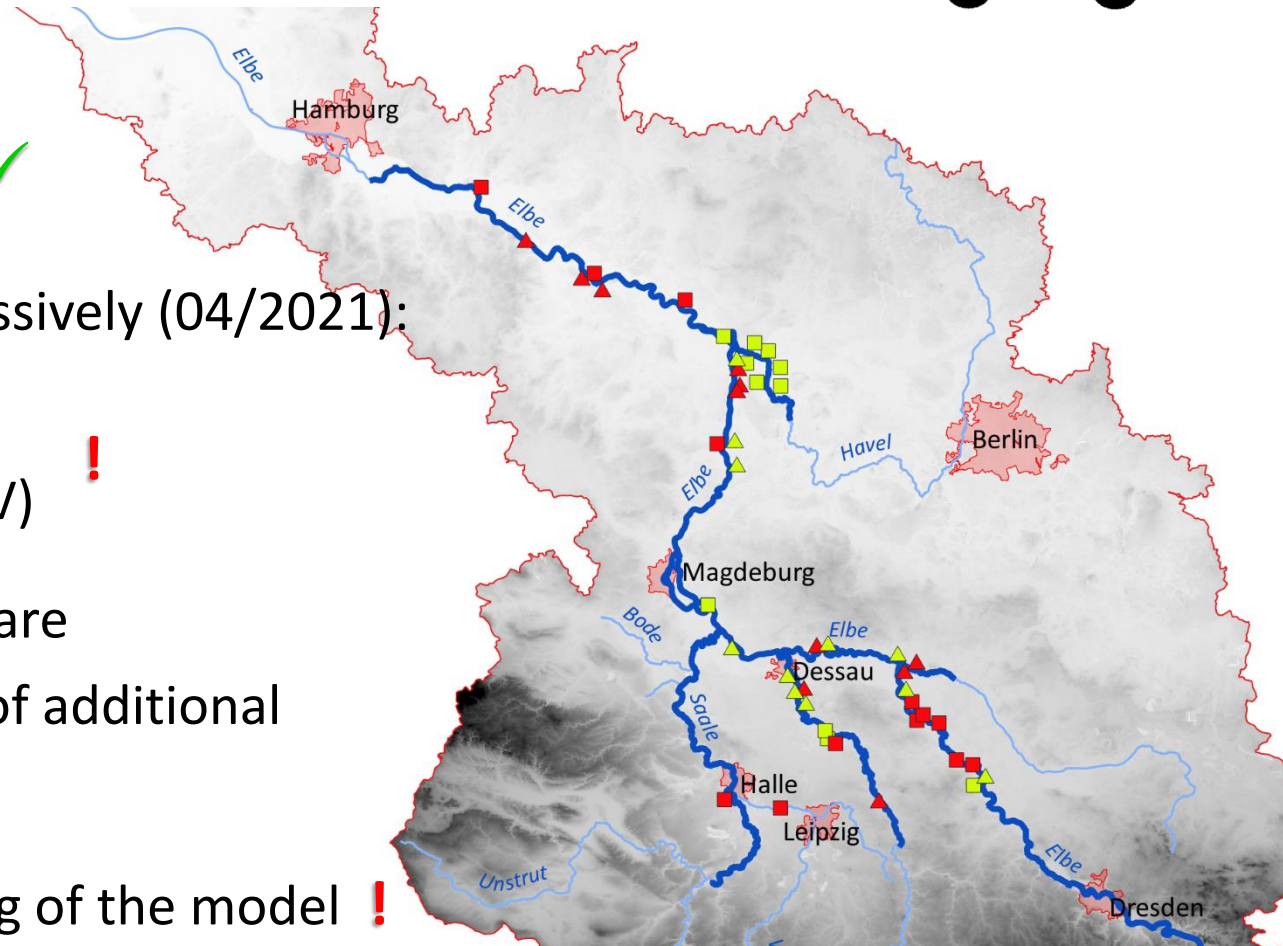
= all current effective measures ✓

Yet to integrate into the model successively (04/2021):

- 12 controlled measures (HWR)

- 12 uncontrolled measures (DRV) **!**
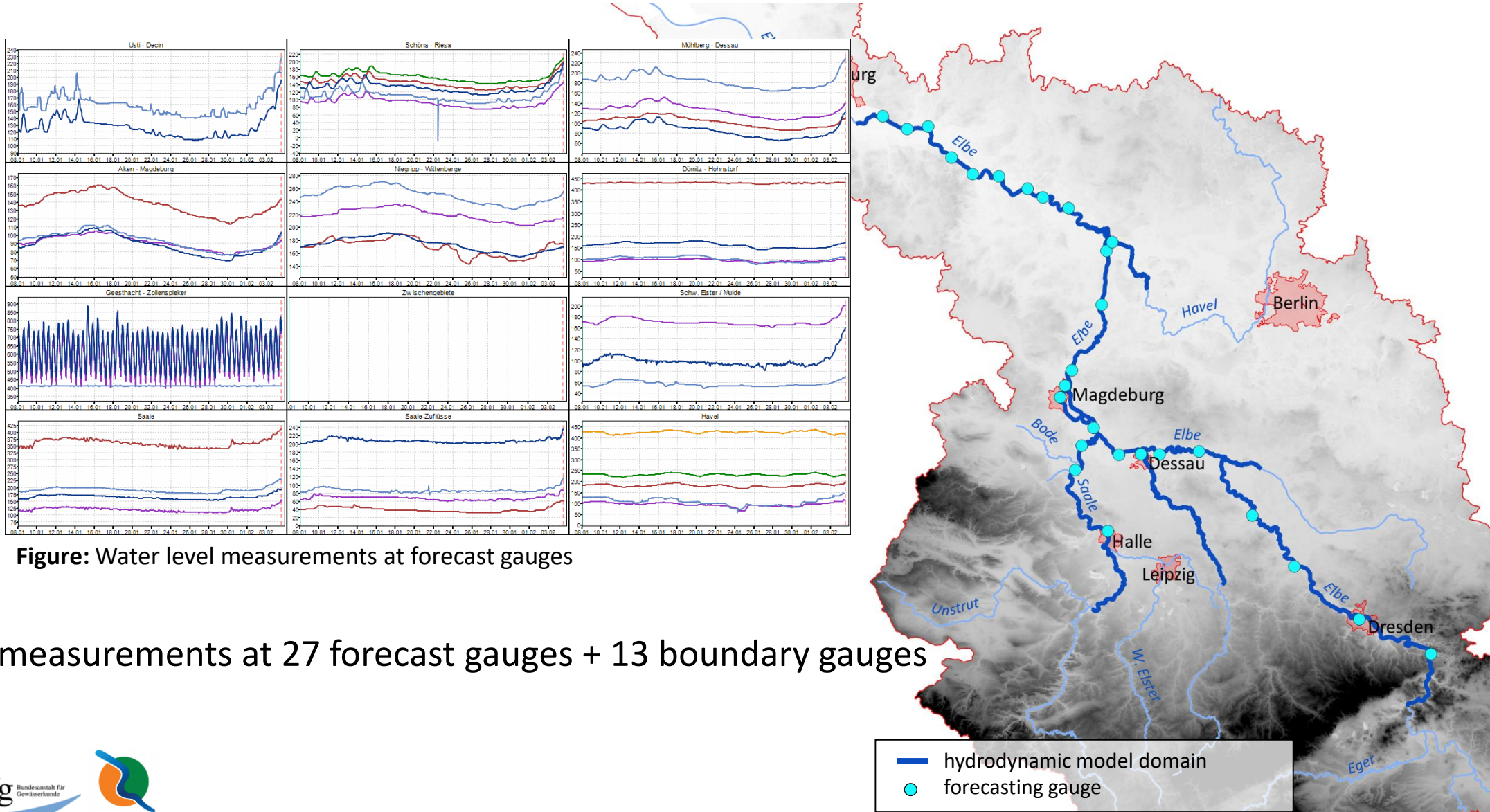
→ additional demand on model care

→ ensured by recruitment of additional employees ✓

→ additional demand on handling of the model **!**

Legend:
— hydrodynamic model domain
△ implemented uncontrolled retention
□ implemented controlled retention
▲ future uncontrolled retention
■ future controlled retention

1st step of performing a flood forecast

Verification of measurements

Figure: Water level measurements at forecast gauges

measurements at 27 forecast gauges + 13 boundary gauges

hydrodynamic model domain
forecasting gauge

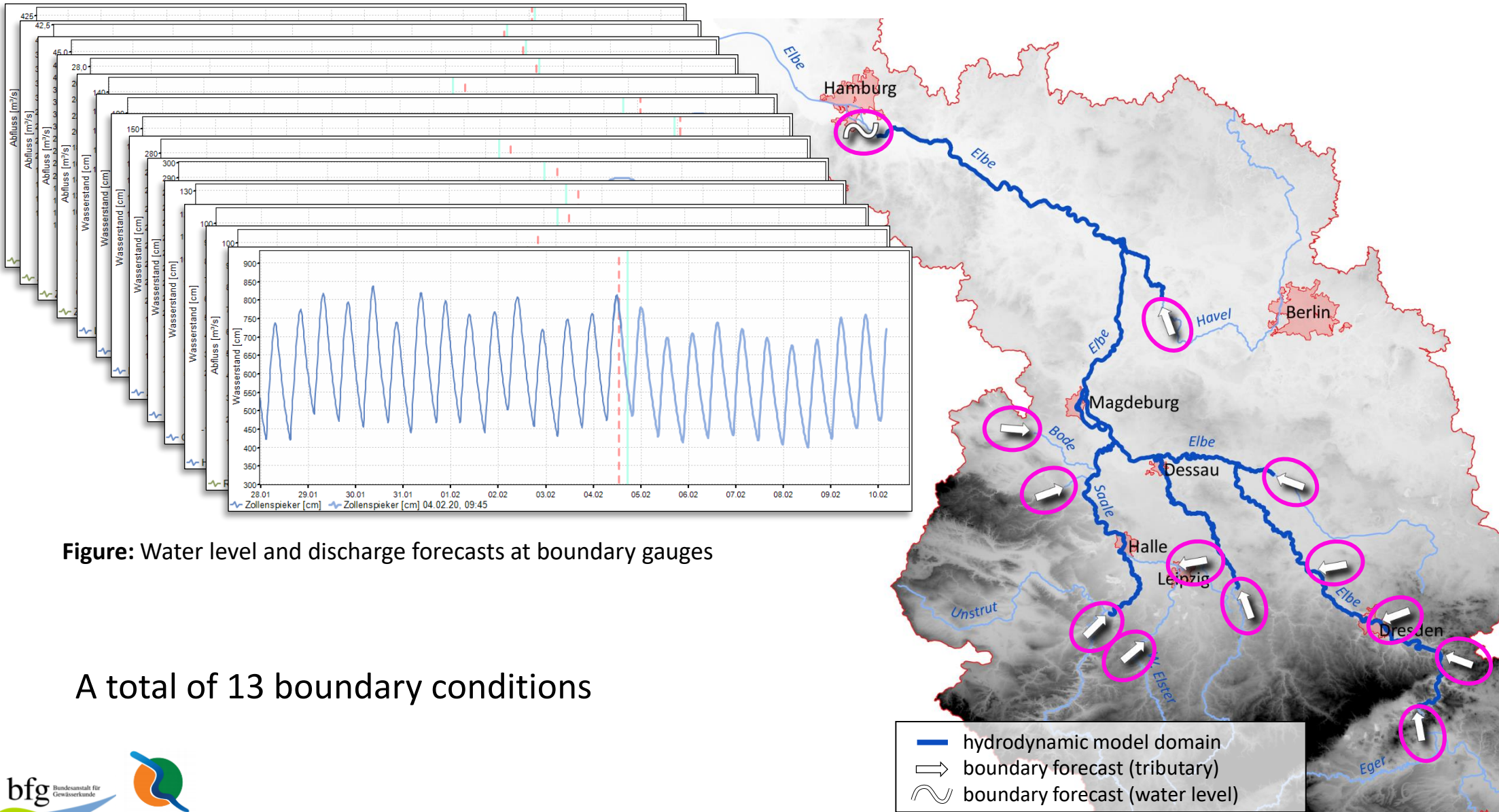# 2nd step of performing a flood forecast

Checking the boundary forecasts

Figure: Water level and discharge forecasts at boundary gauges

A total of 13 boundary conditions

2nd step of performing a flood forecast

Checking the boundary forecasts
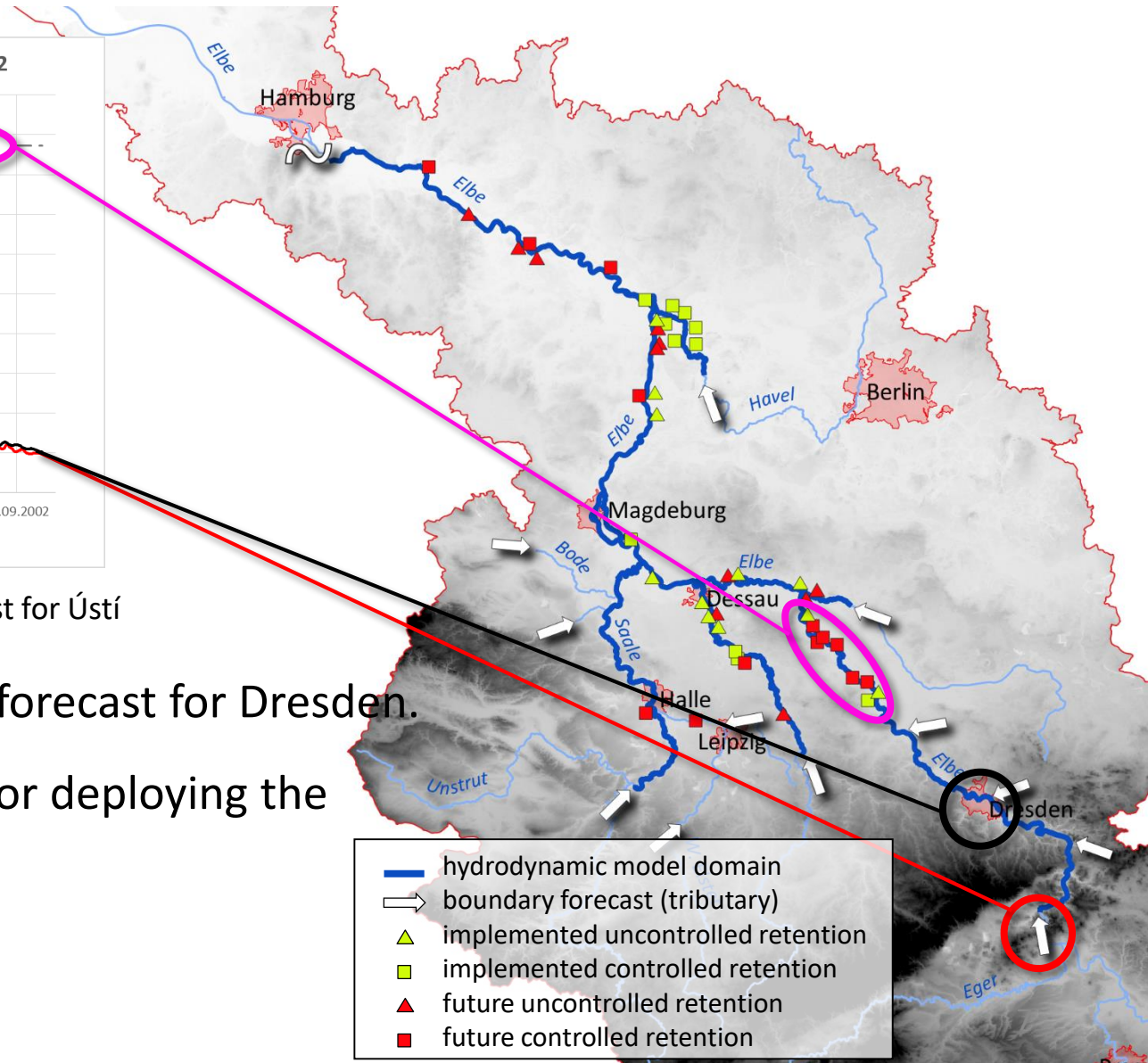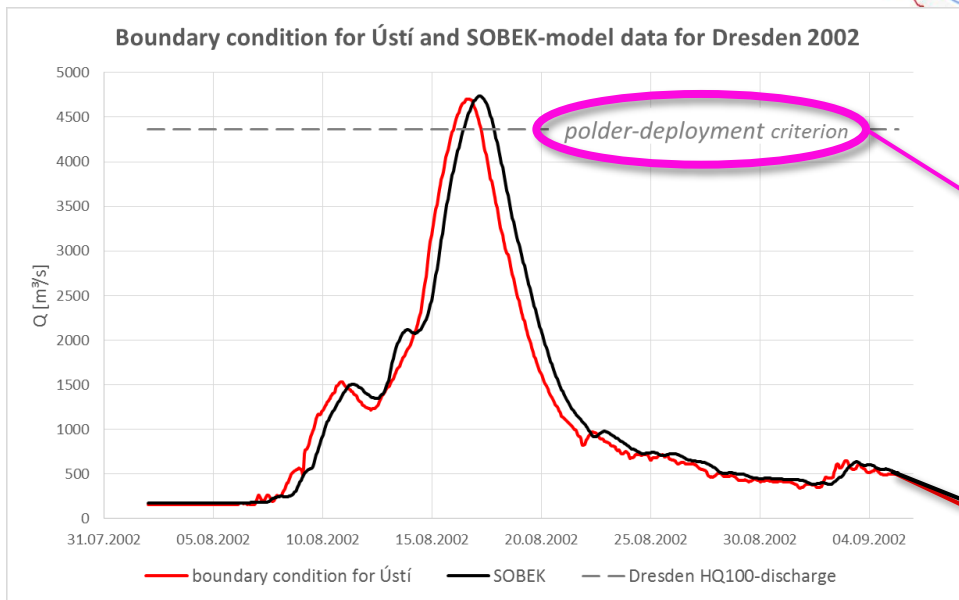
Ústí is the most important boundary forecast:

Figure: Discharge measurement at Dresden and forecast for Ústí

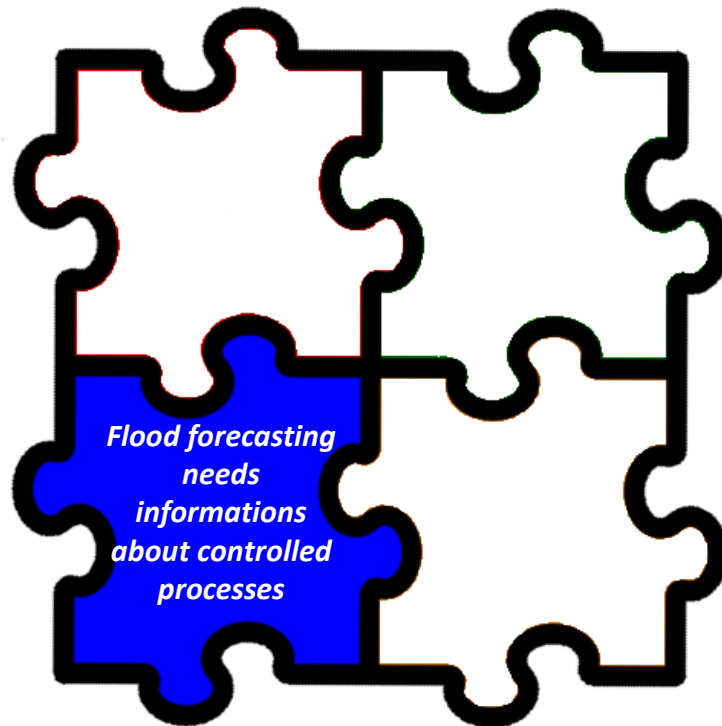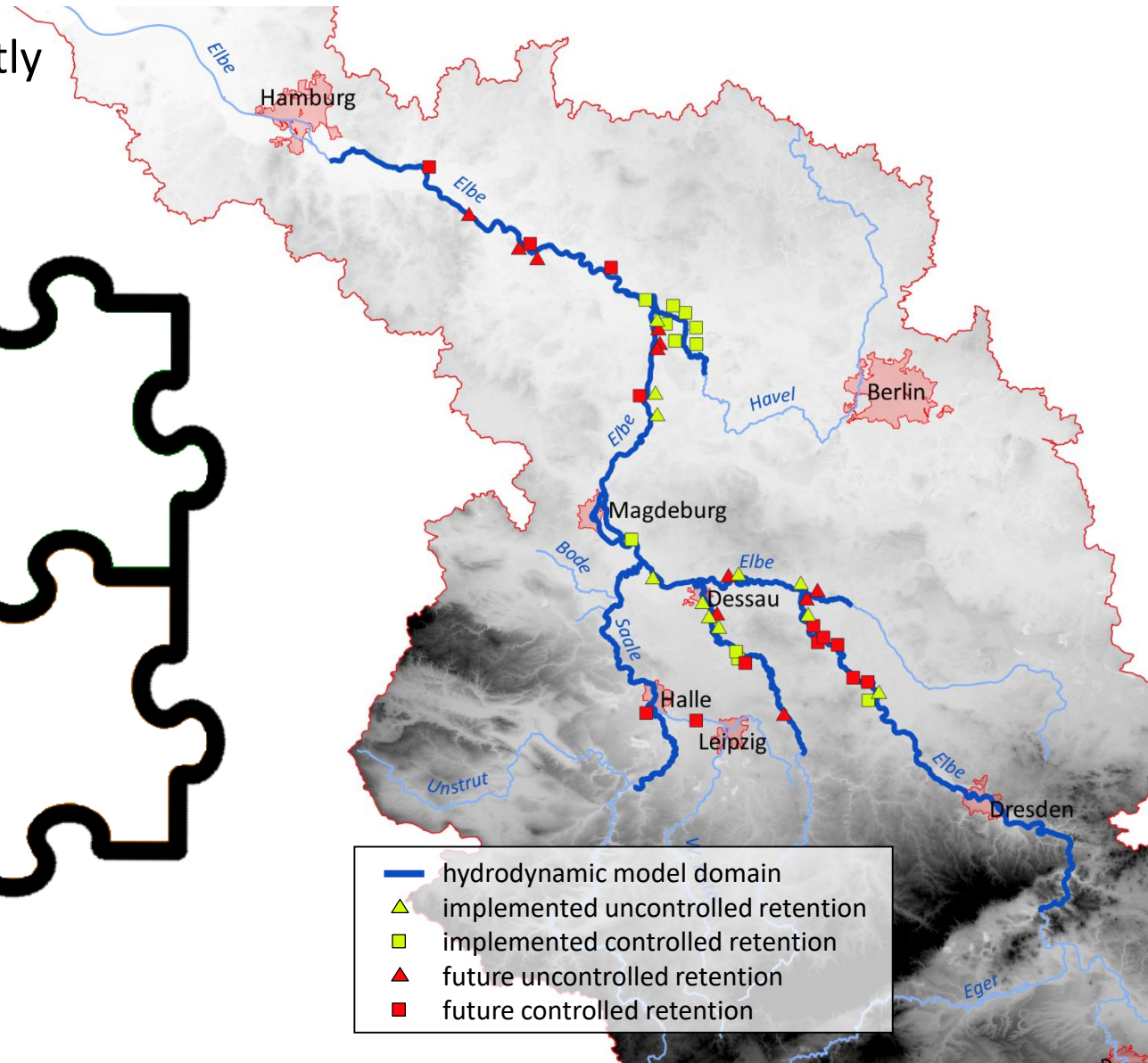→ The forecast for Ústí dominates the forecast for Dresden.

→ The Czech inflow forecast is crucial for deploying the saxony polder-series.

3rd step of performing a flood forecast

Processing of structure control

→All relevant actions must be
   documented and provided immediatly

Documentation

of all relevant actions &
management steps during
a flood (in real-time,
software assisted)

Presentation, **Part 2**

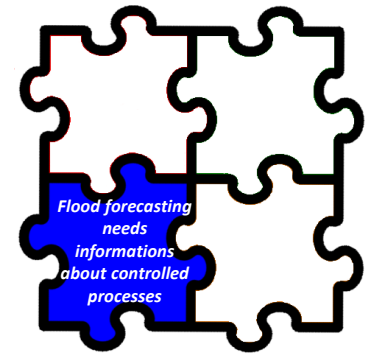*Flood forecasting
needs
informations
about controlled
processes*

— hydrodynamic model domain
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3rd step of performing a flood forecast

Processing of structure control

→ All relevant actions must be documented and provided immediatly

a. <u>At this point:</u> Engagement by revised administrative agreement ✓

Figure: Form sheet for transmitting relevant informations for forecasts
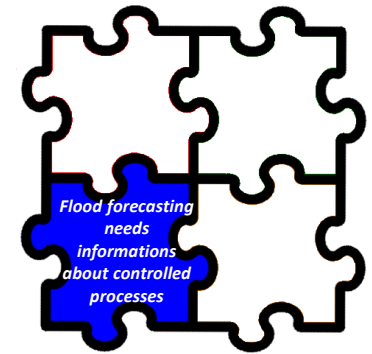
Legend:
- hydrodynamic model domain
- ▲ implemented uncontrolled retention
- ▪ implemented controlled retention
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- ▪ future controlled retention

Map labels: Hamburg, Elbe, Havel, Berlin, Magdeburg, Bode, Saale, Dessau, Elbe, Halle, Leipzig, Unstrut, Dresden, Eger

Processing of structure control

→All relevant actions must be
documented and provided immediatly

a. <u>At this point:</u> Engagement by new
administrative agreement ✓

b. <u>Future:</u> Internet-based communication- and
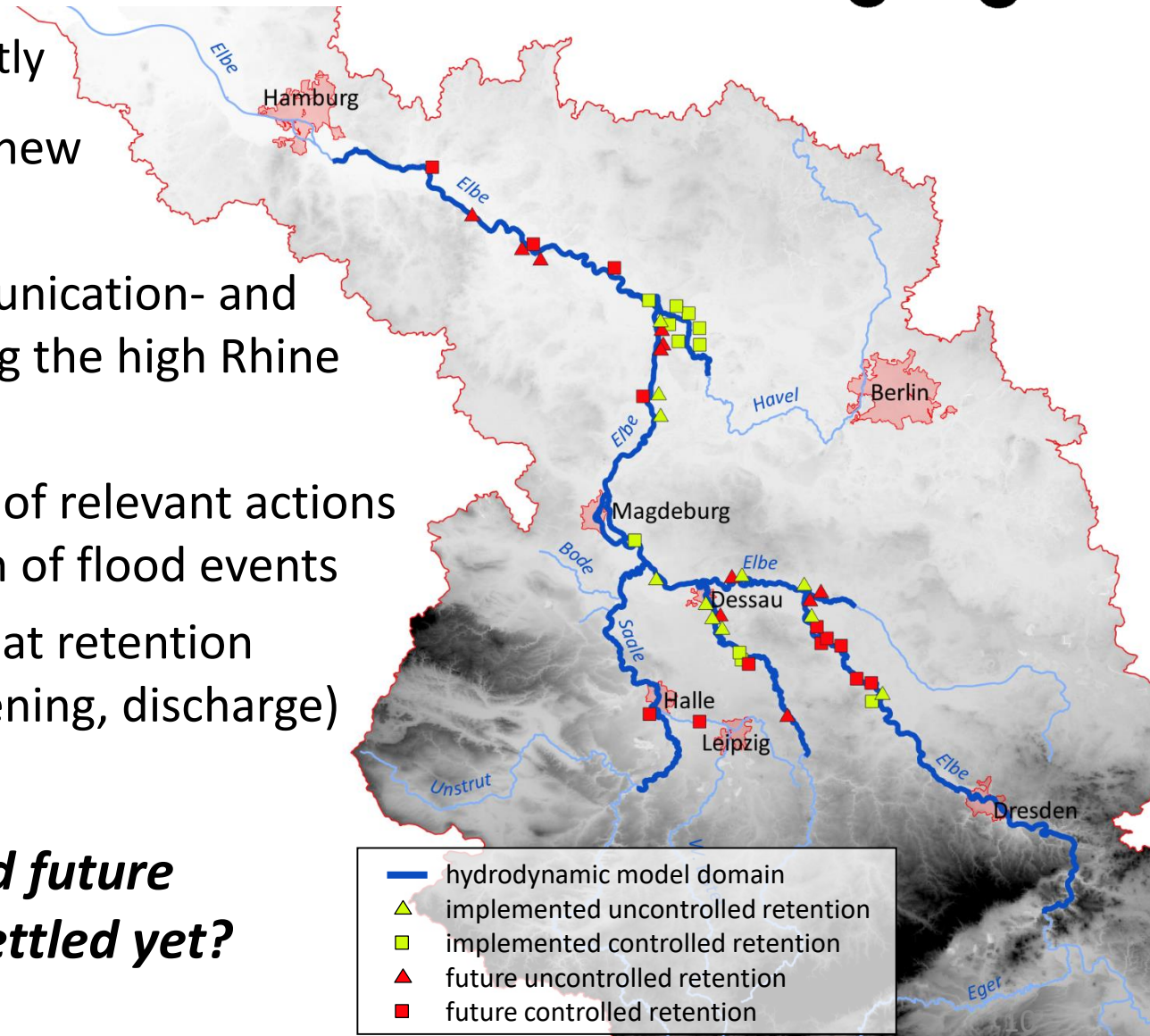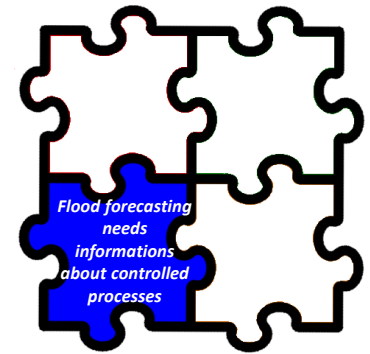information platform following the high Rhine
(under construction) !

- Non-public documentation of relevant actions
during and in the aftermath of flood events

- Tabular listing of processes at retention
measures (e.g. structur opening, discharge)

- Automatic email

***What about controlled future
processes that are not settled yet?***

Flood forecasting needs informations about controlled processes

- hydrodynamic model domain
- implemented uncontrolled retention
- implemented controlled retention
- future uncontrolled retention
- future controlled retention

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Future processes that are controllable but not settled yet

There are too many potential control variants to compute the whole ensemble.

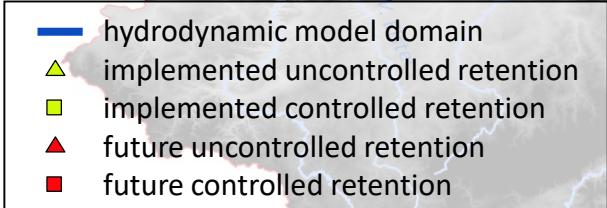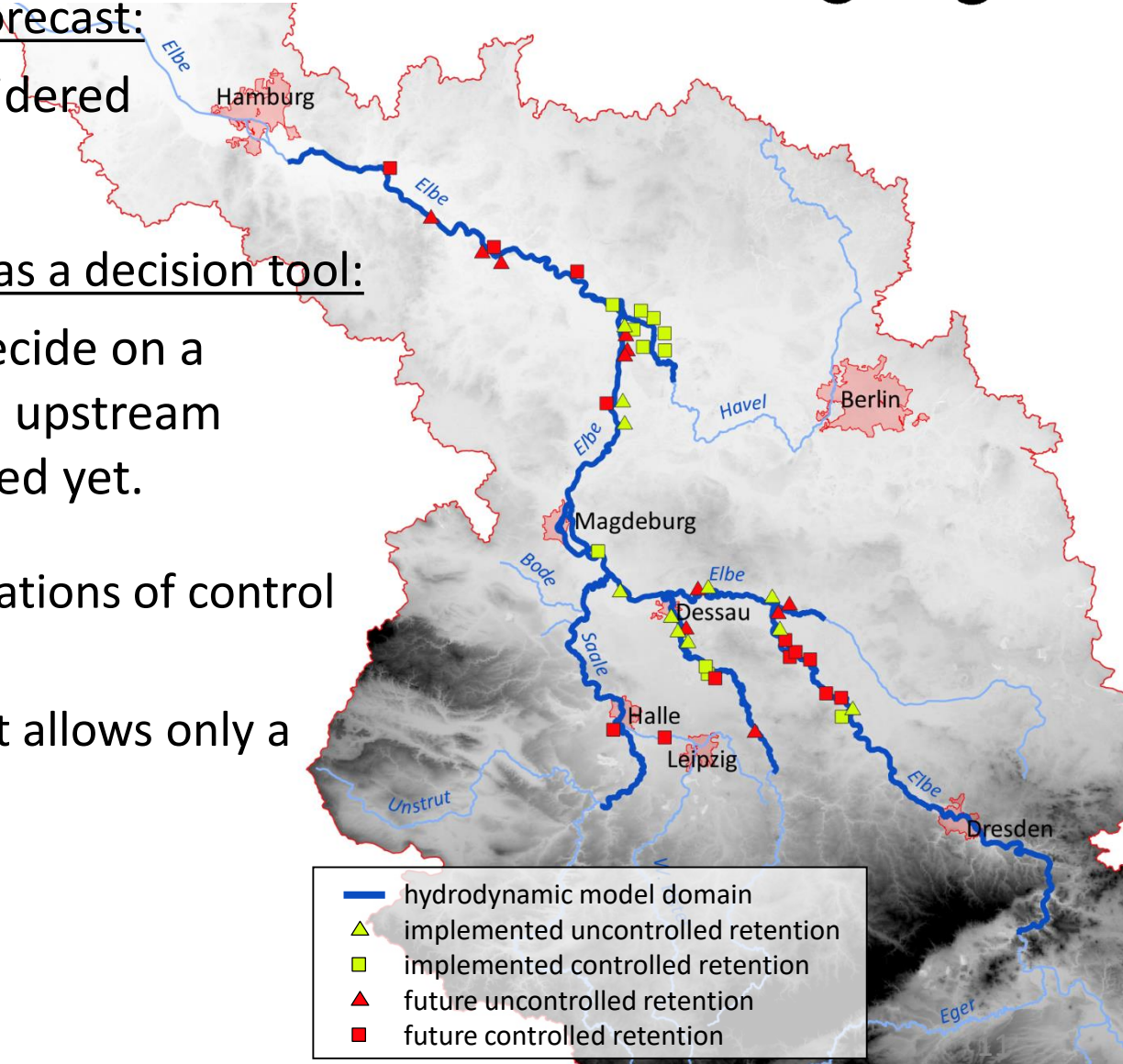a. Consequence for the official flood forecast:

   Control processes can only be considered if they are settled.

b. Consequence for the flood forecast as a decision tool:

   Sometimes forecasts are used to decide on a measure deployment, although the upstream measure deployments are not settled yet.

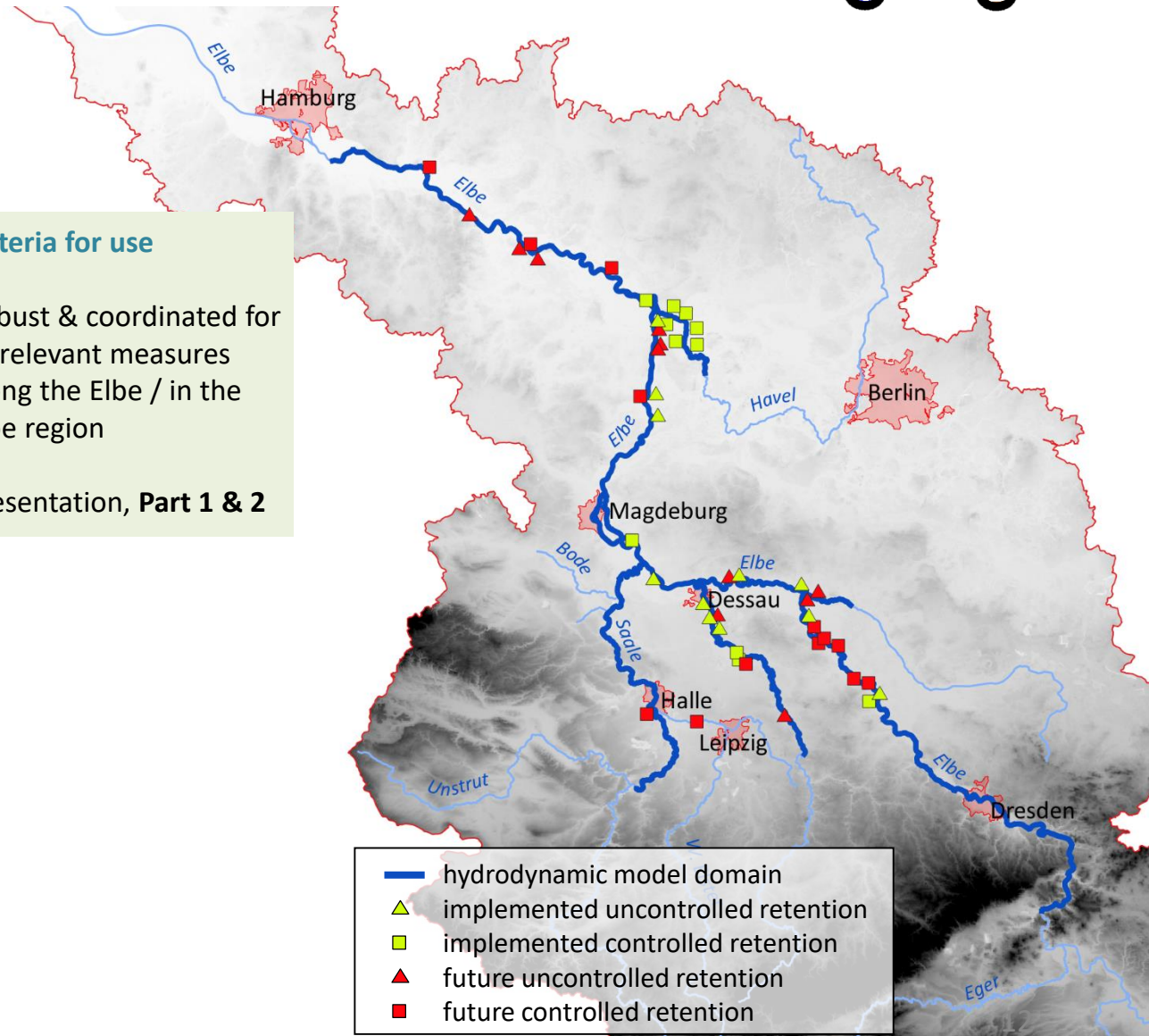   →Need of additional intern computations of control variants

   →Need of an explicit reglement that allows only a limited number of control variants
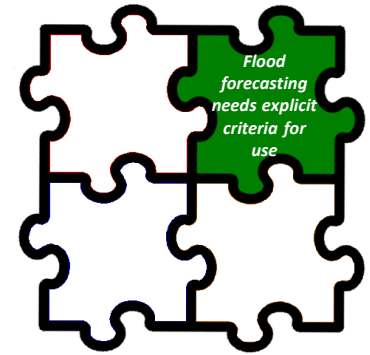

Flood forecasting needs informations about controlled processes

Legend:
- — hydrodynamic model domain
- △ implemented uncontrolled retention
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Need of an explicit control reglement

We have to define deployment criteria for all controllable measures successively:

Criteria for use

Robust & coordinated for all relevant measures along the Elbe / in the Elbe region

Presentation, **Part 1 & 2**

Flood forecasting needs explicit criteria for use

Map legend:
- hydrodynamic model domain
- implemented uncontrolled retention
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Need of an explicit control reglement

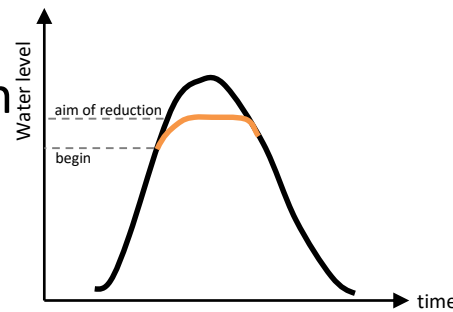*Flood forecasting needs explicit criteria for use*

We have to define deployment criteria for all controllable measures successively:
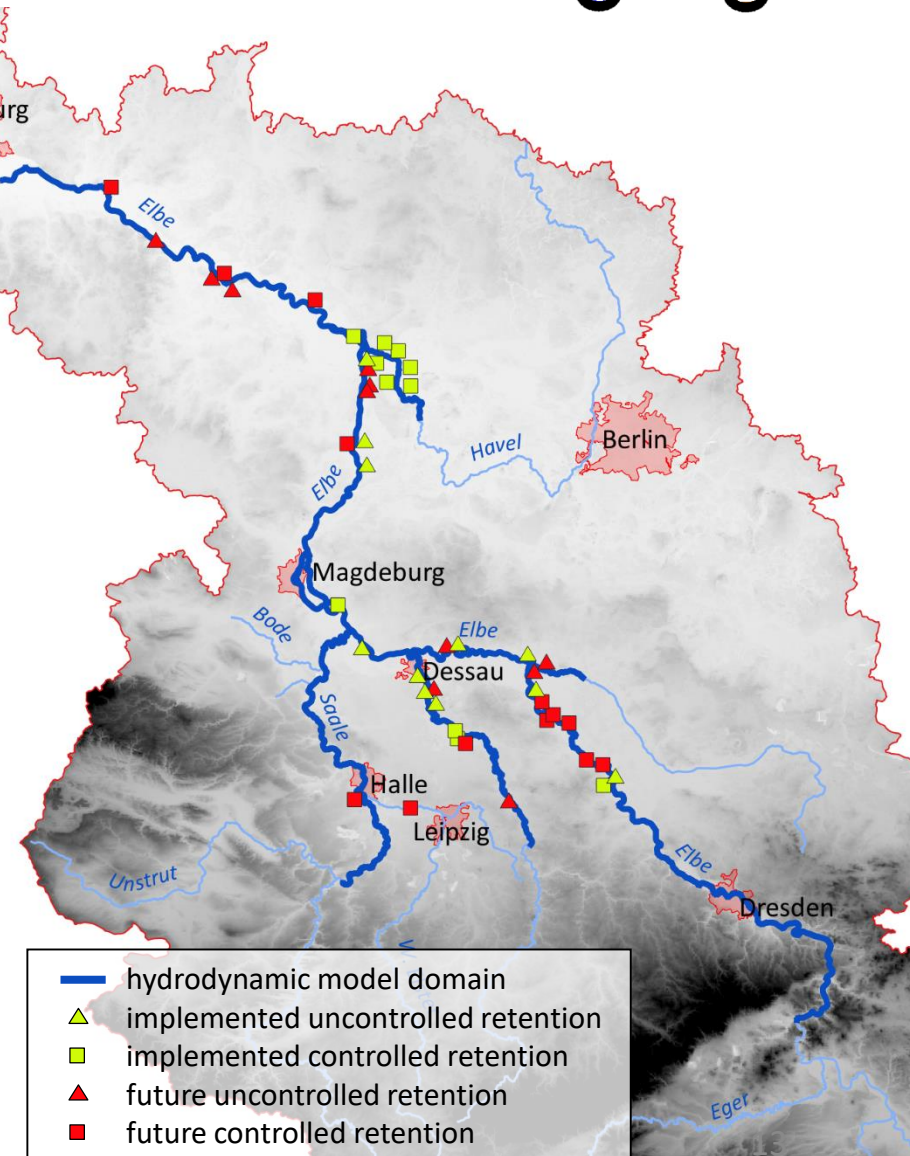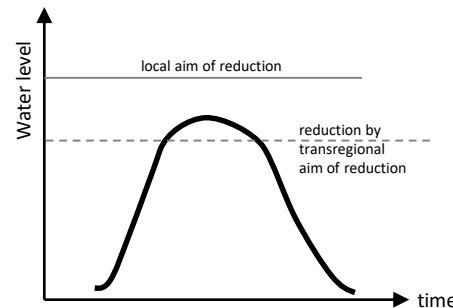
a. Fixed local criterion for flood peak reduction
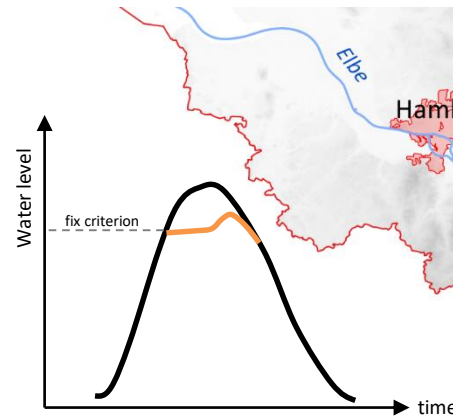
b. Event-depending reduction on a forecast-basis

c. Transregional criterion for flood peak reduction

Legend (map):
- hydrodynamic model domain
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- implemented controlled retention
- future uncontrolled retention
- future controlled retention

2 examples for explicit deployment criteria

a. <u>Weir Pretzien: Fixed local criterion</u>

- opened if $W=5.92$m oTGZ at gauge Barby

b. <u>Havel: Event-depending reduction</u>

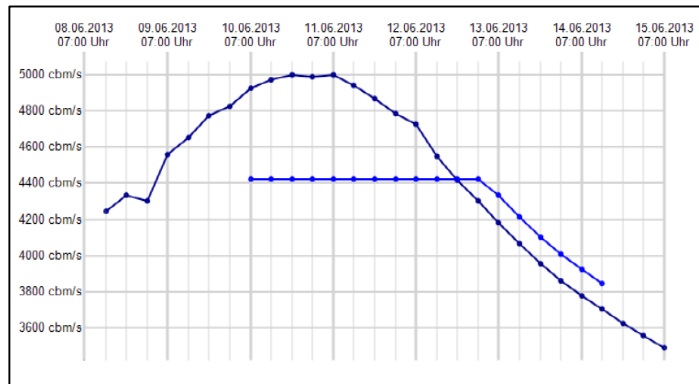- A seperate model computes controlling-devices on a basis of the actual flood forecast.

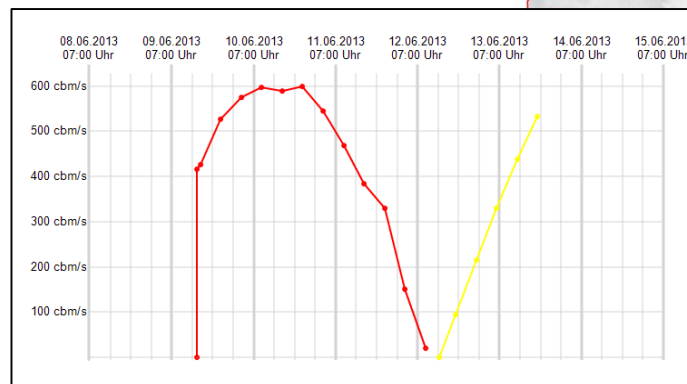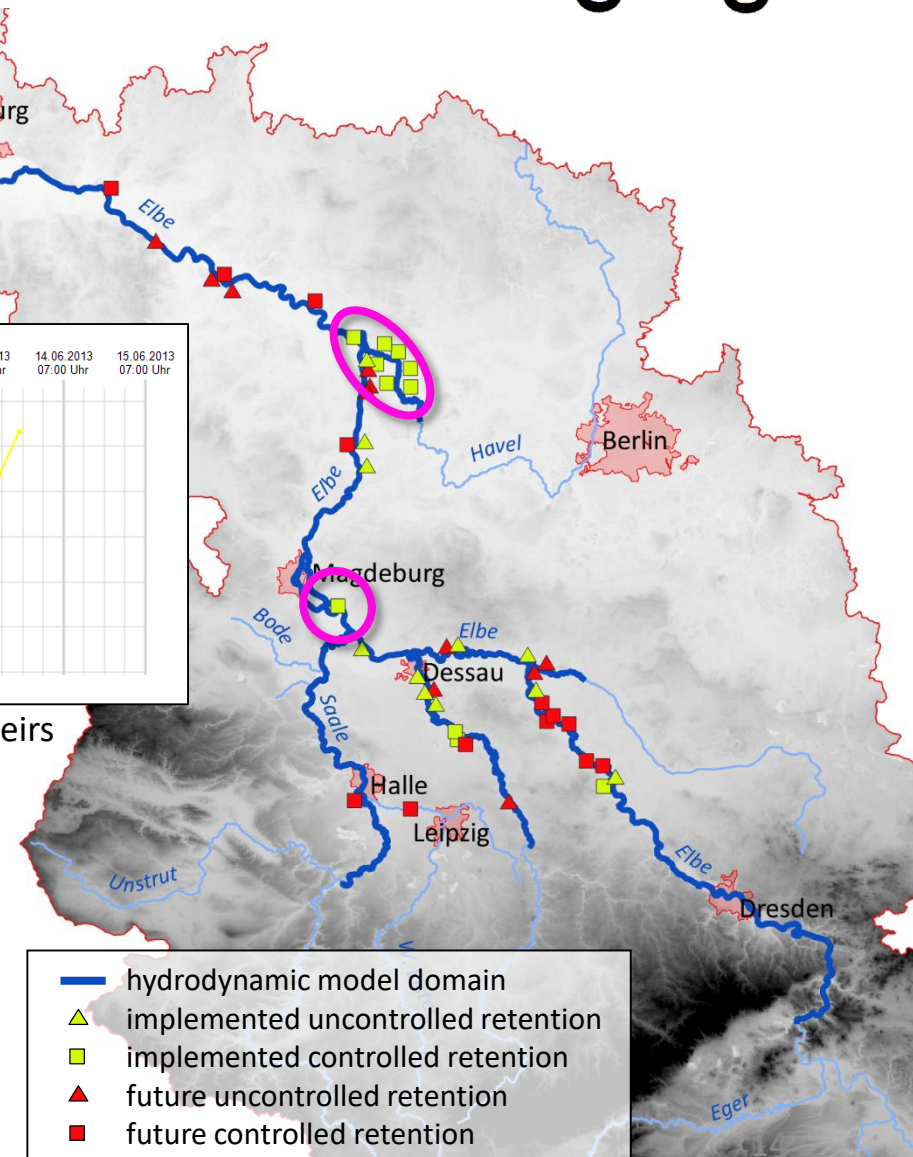**Figure:** Forecast with and without flood peak reduction

Figure: Control parameters for weirs at mouth of Havel

- These control parameters are processed for the following flood forecast.

Legend:
- hydrodynamic model domain
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Flood forecasting needs explicit criteria for use

Computation and checking of the flood forecast
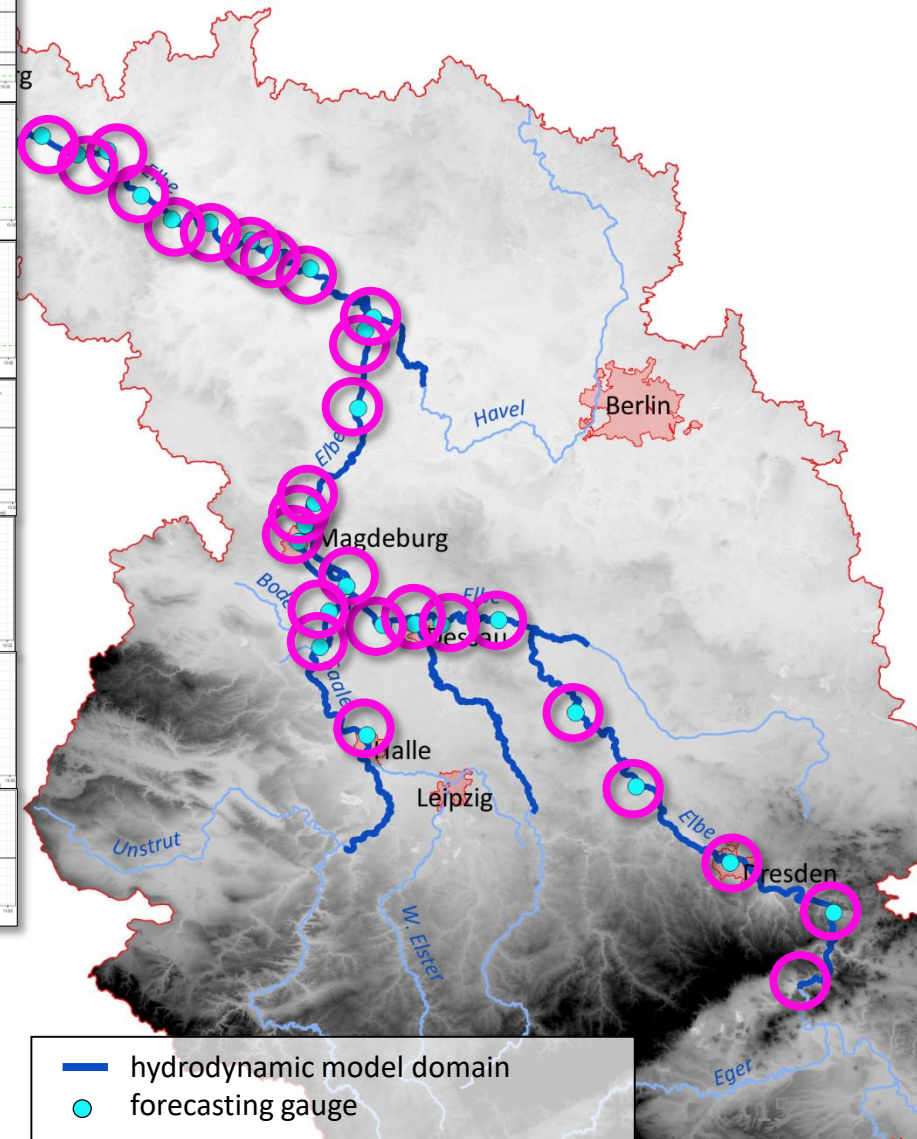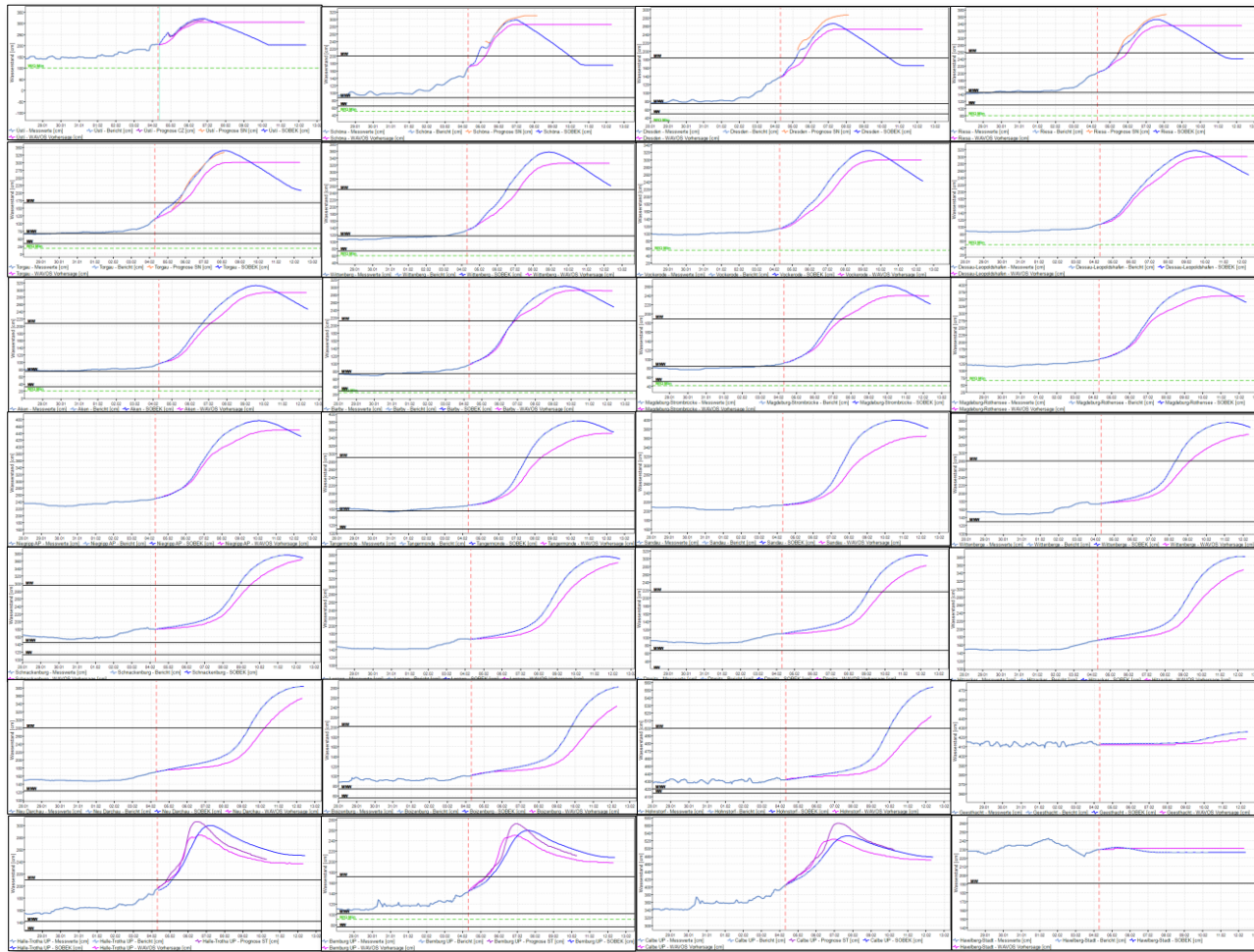
Figure: Water level forecasts

A total of 28 gauges.

hydrodynamic model domain
forecasting gauge
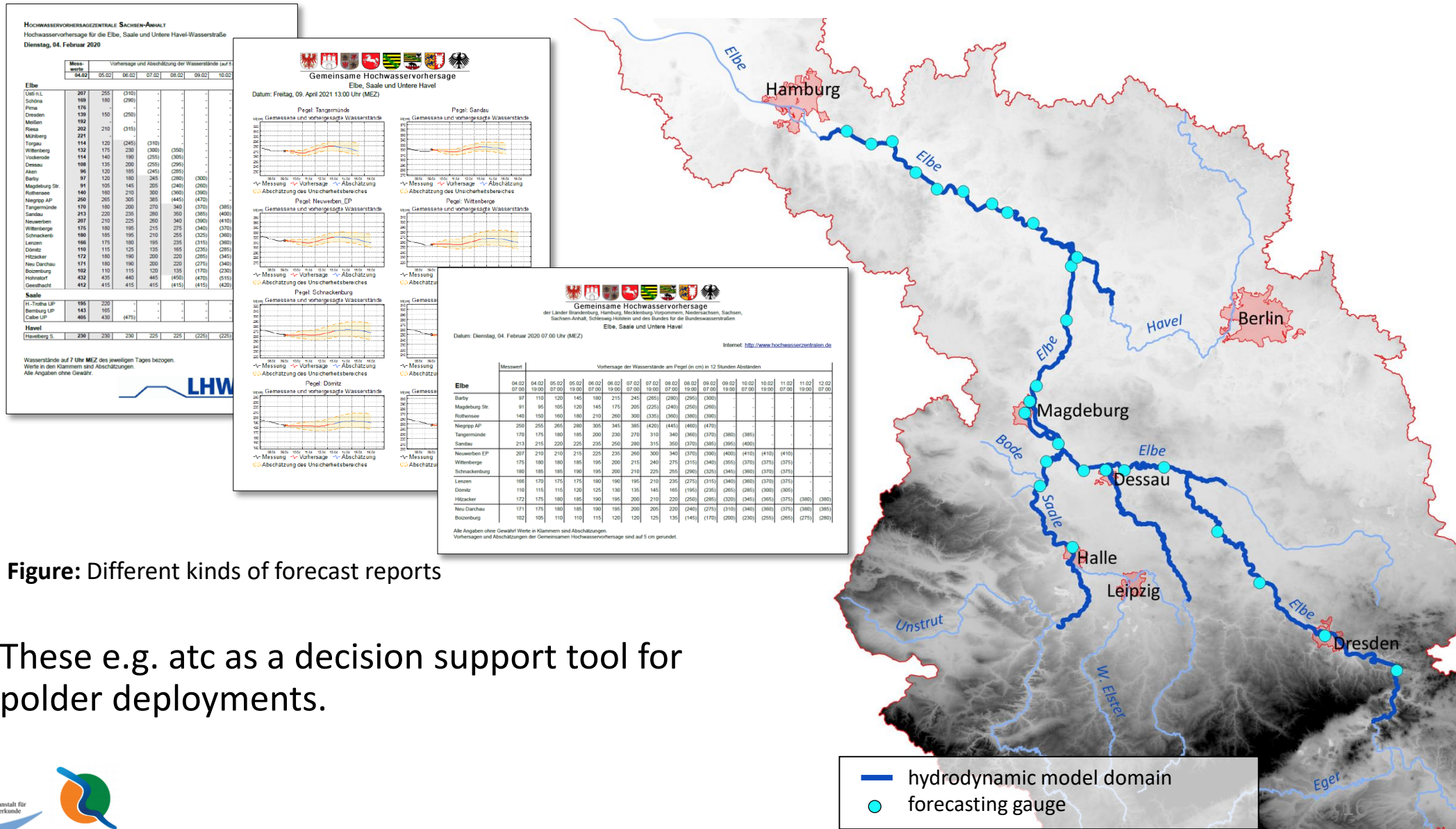
Generate and transmit documents

Figure: Different kinds of forecast reports

These e.g. atc as a decision support tool for polder deployments.

The forecast's meaning for measure deployment

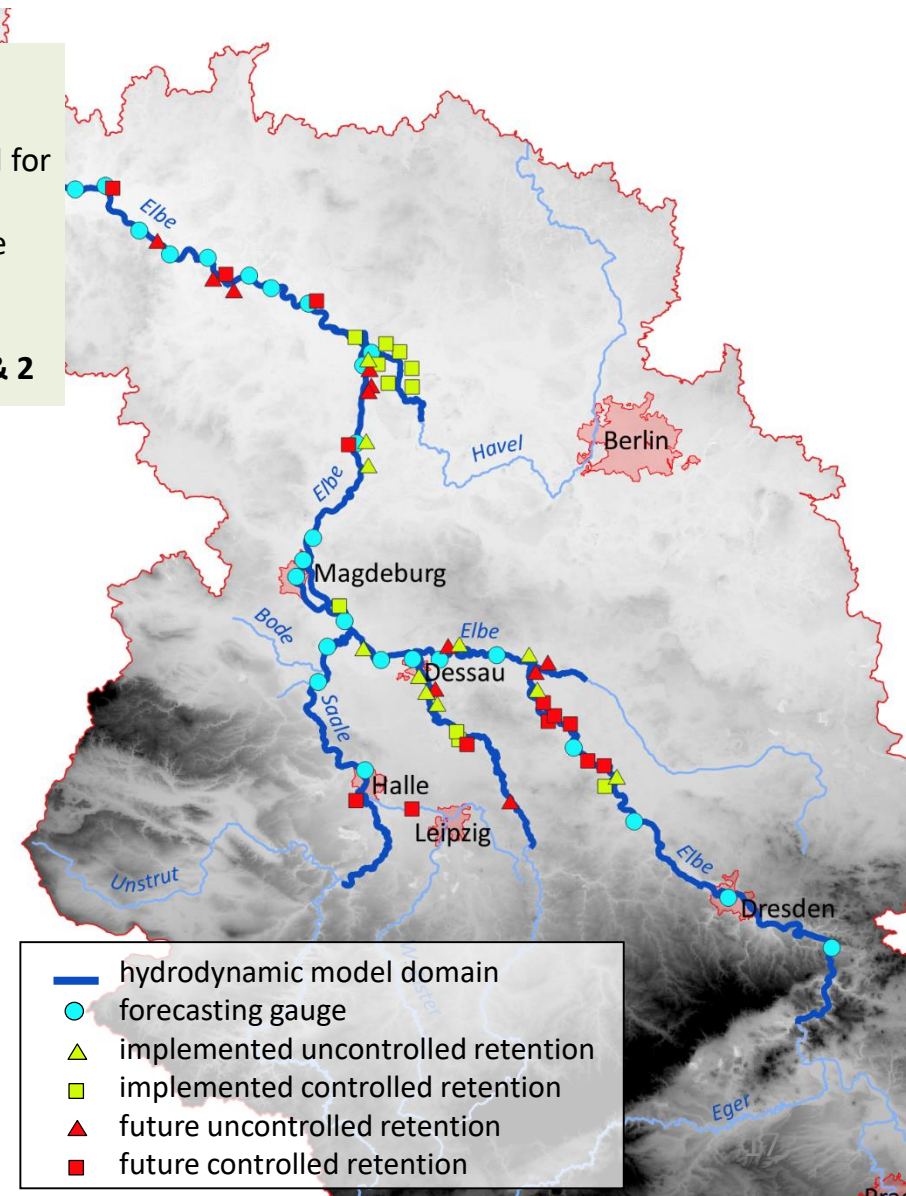Flood forecasting acts as a decision support tool

Flood forecasting acts as decision support tool

Criteria for use

Robust & coordinated for all relevant measures along the Elbe / in the Elbe region

Presentation, **Part 1 & 2**

→ additional demand on (a) quality and
(b) frequency of flood forecasting

Legend:
- ▬ hydrodynamic model domain
- ○ forecasting gauge
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The forecast's meaning for measure deployment

Flood forecasting acts as a decision support tool

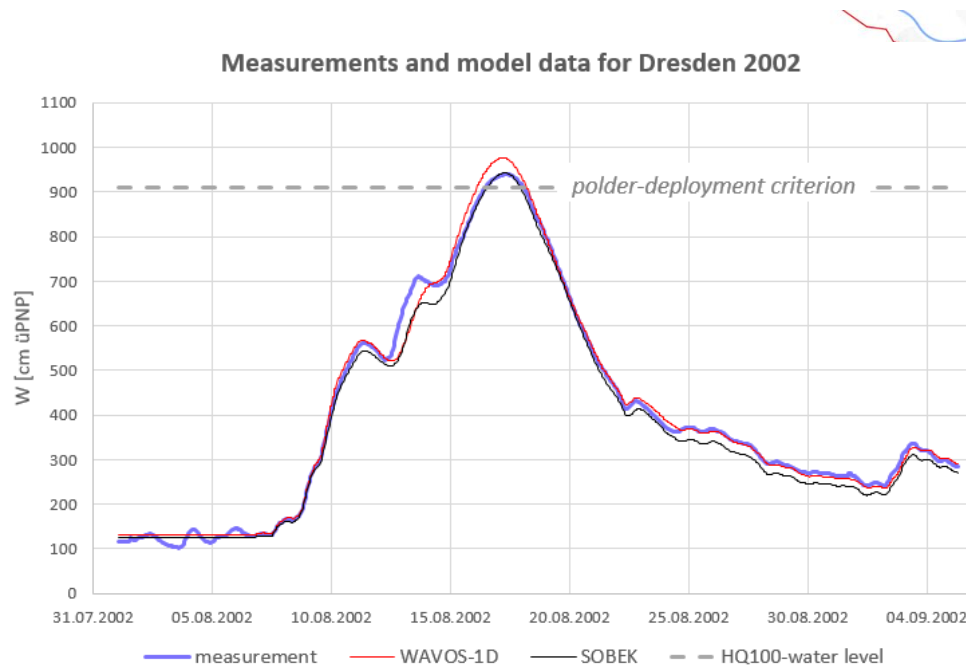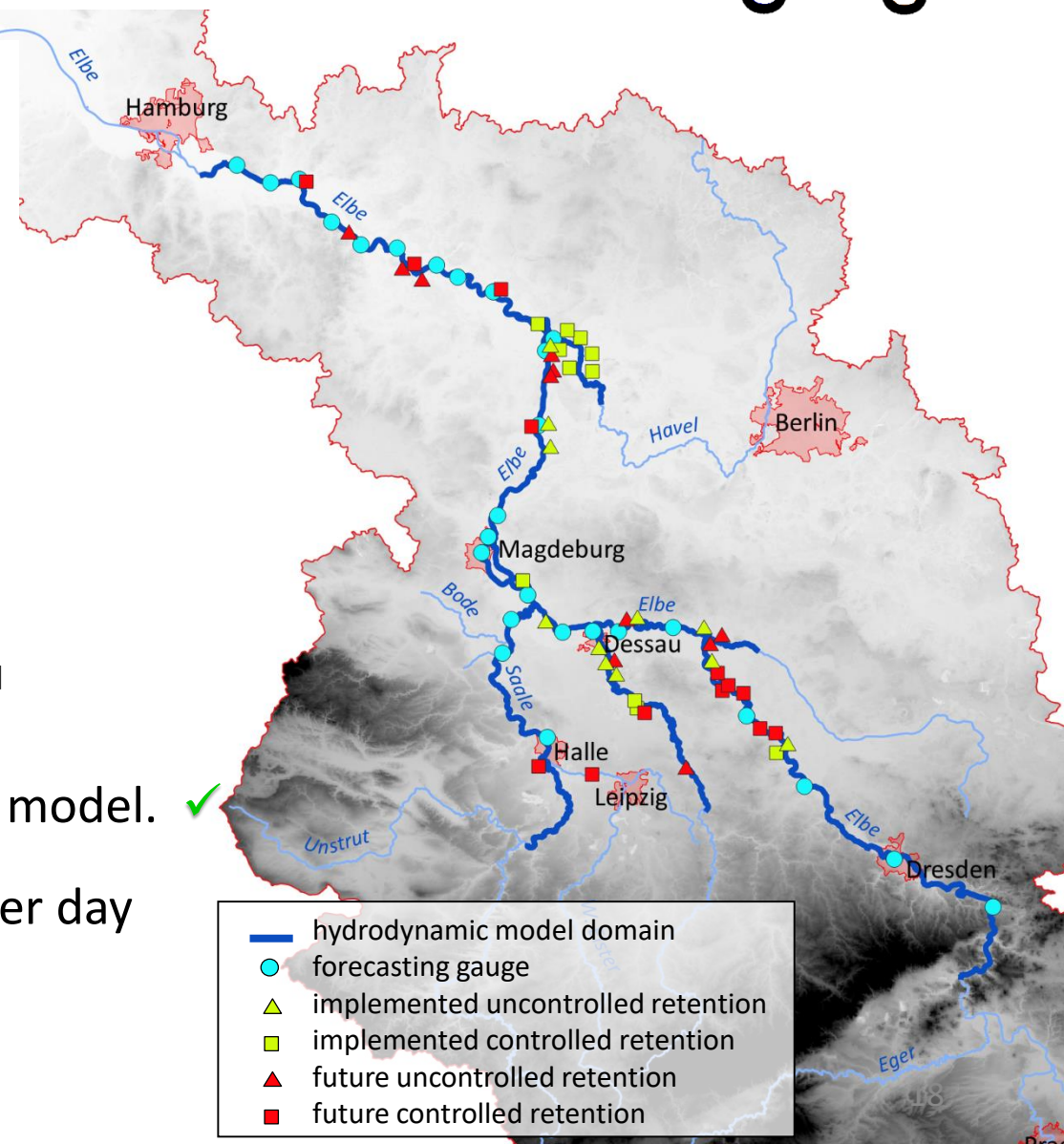a.   demand on quality of forecasts:

Figure: Water level measurements and model results of the old WAVOS- and the new SOBEK-model at gauge Dresden

→ Quality has been improved by new SOBEK model. ✓

b.   Frequency of forecasts is limited to 2 per day by the Czech boundary forecasts.

Thanks for your interest.

hydrodynamic model domain
○ forecasting gauge
△ implemented uncontrolled retention
▢ implemented controlled retention
▲ future uncontrolled retention
■ future controlled retention