



KOMPETENZ IN SACHEN  
REGENWASSER  
INGENIEURGESELLSCHAFT  
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# Flood prediction in urban and rural drainage based on runoff prediction

HydroPredict' 2010, Praha  
22.09.2010

Dr. Harald Sommer



# Dortmund

- Extreme Rainfall event on July 26th 2008
- Appr. 200 mm in 2 Stunden (Station Universität Dortmund d. meteomedia GmbH : 193,3 mm)



Quelle, Gutachten Prof. Grünewald



# England

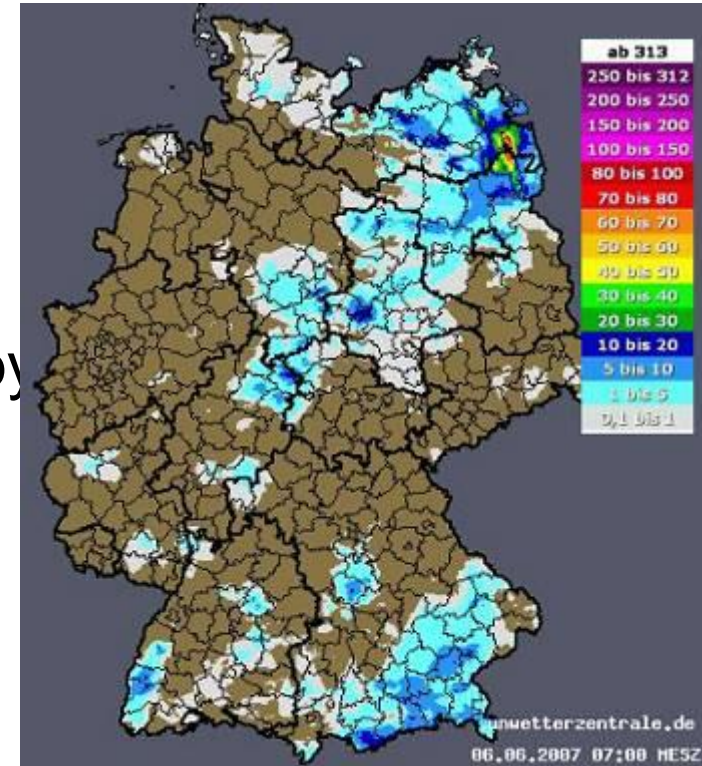
- Storm event Nov 20th 2009 in North-West England
- Amount of rainfall: up to 314 mm in 24 h  
Rain gauge: Seawaite Farm  
500 mm maximum rainfall event





# Prenzlau

- Intense Rainfall event in Prenzlau appr. 130 mm within 2h!!
- Severe damages caused by local flooding

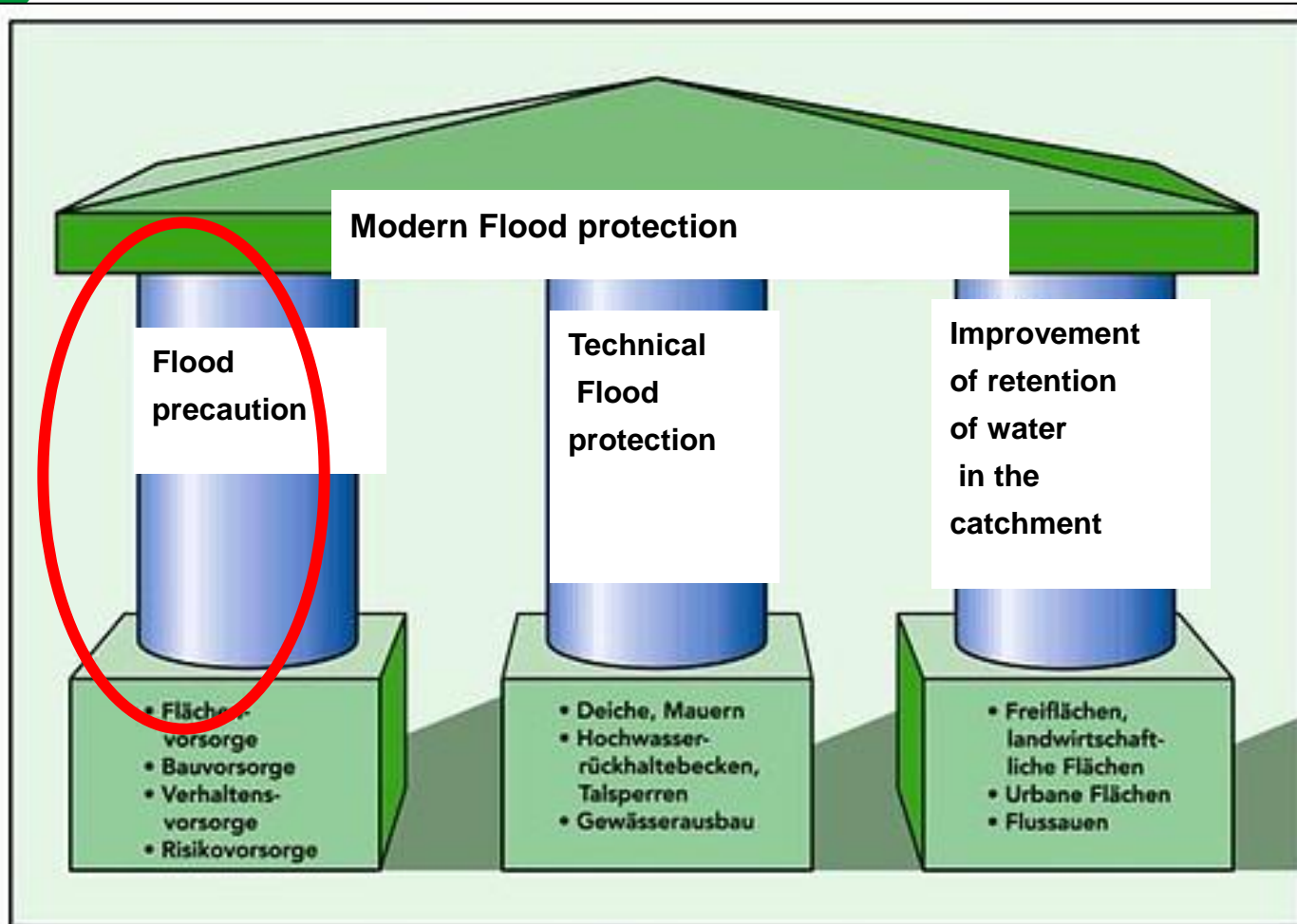


***Wish of Prenzlau Utility:***

***Forecast warning and visualisation  
of system overload***



# Example Baden-Baden



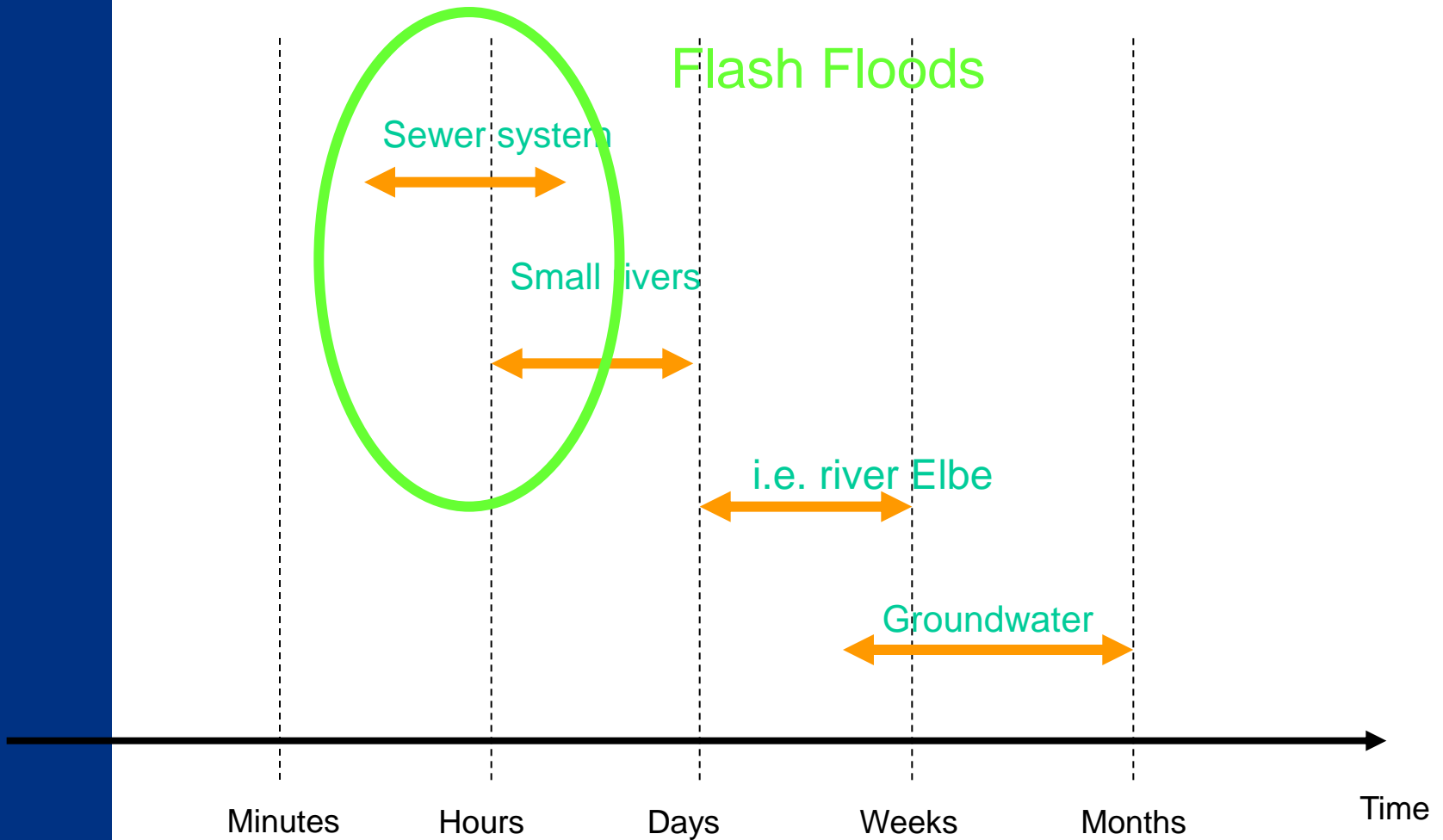
## Grenzen des Hochwasserschutzes

- Hochwasser sind Naturereignisse und vom Menschen nicht zu verhindern
- Es gibt keinen 100 %igen Hochwasserschutz





# Flood waves



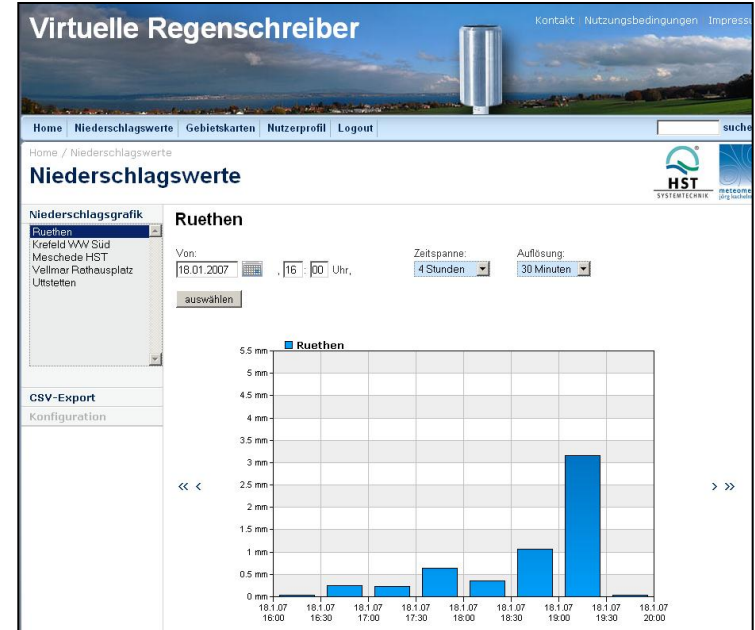
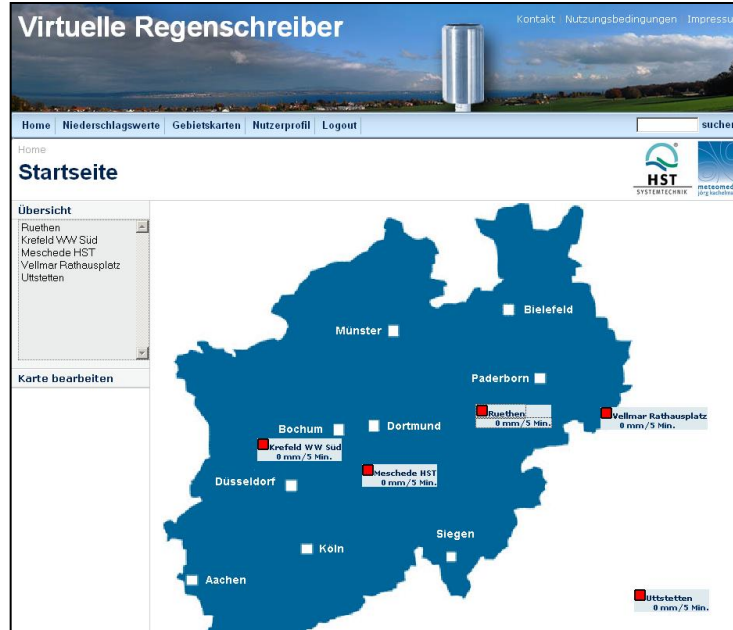


# Solution

- Coupling of precipitation forecast with hydrological / hydraulic models
- Precipitation forecast  
-> Runoff ie. Water level forecast
- Coupling of
  - **Virtual rain gauges (HST) with forecast and measured data**
  - **Baden-Baden:**
    - **Precipitation runoff model STORM (Flood warning)**
    - **Pollution load model STORM (Master Plan)**
  - **Prenzlau:**
    - **Precipitation runoff model STORM for outer waters**
    - **Hydrodynamic Sewer model (i.e. Extran) (Master Plan)**



# Virtual rain gauges

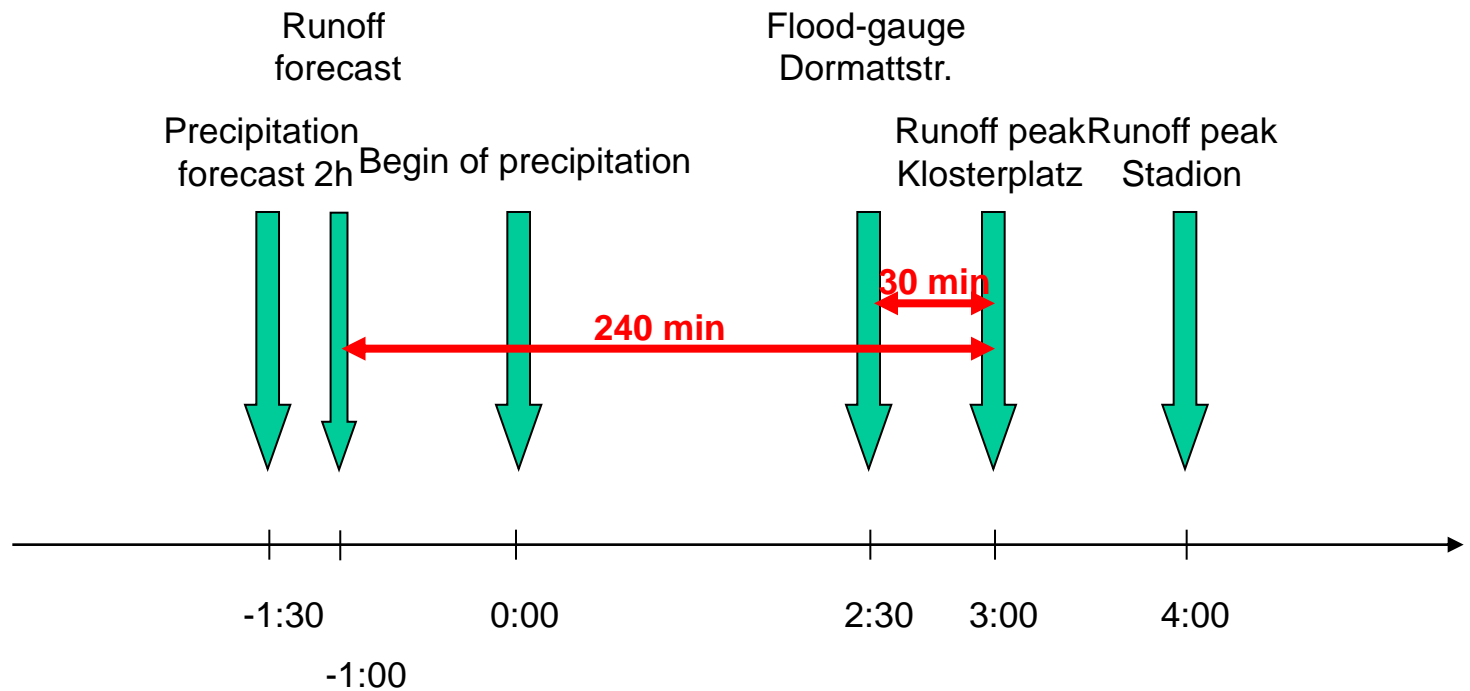


- Service offered by HST in cooperation with Meteomedia
- Based on rainfall radar
- Delivers forecast data for Germany (i.e. 2h with  $\Delta t=5$  min)





# Forecast periods, i.e. Baden-Baden











# Forecast

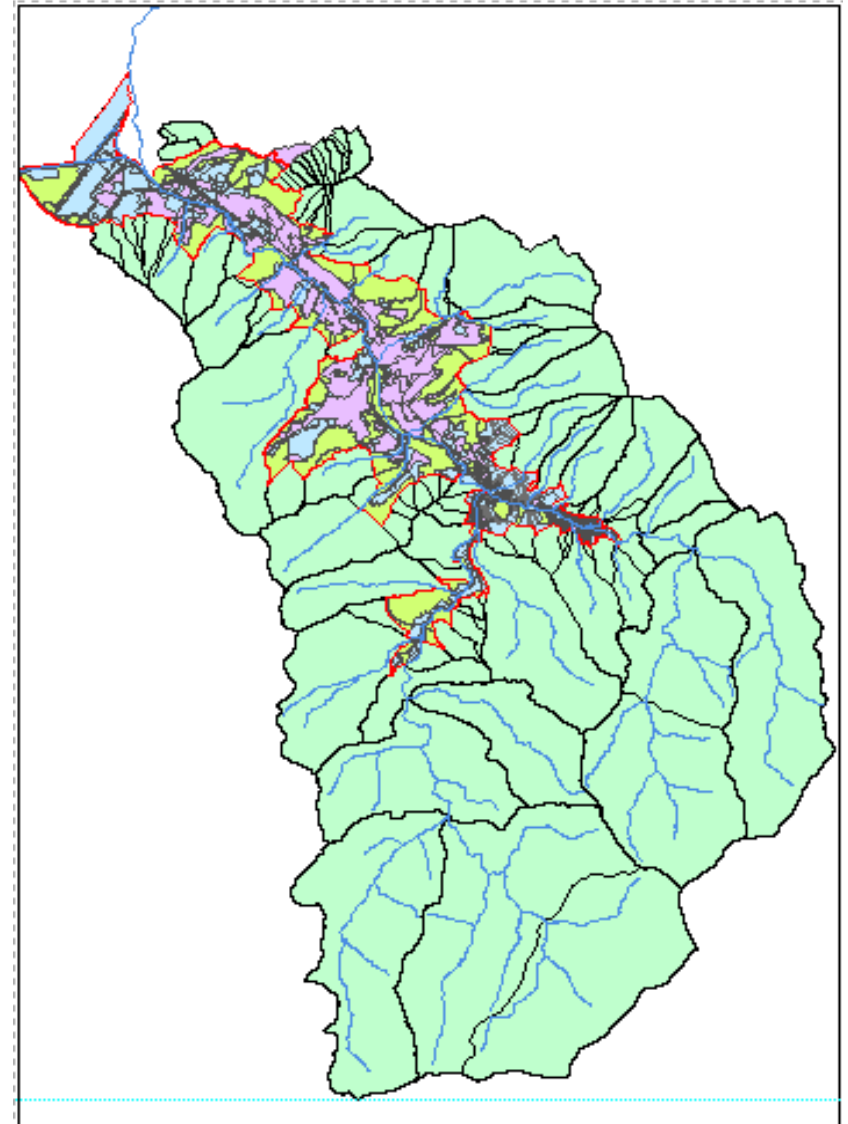
- Existing models
  - **Precipitation-Runoff-Model (STORM)**  
-> **Calculates runoff from rain data**
  - **Hydraulik-Modell (WASP)**  
-> **Calculates water level from runoff**
- Usage
  - **With historical or synthetic rain data (standard rainfall event)**
  - **For runoff and water level forecast in small urban catchments**



# STORM-Model

## Legend

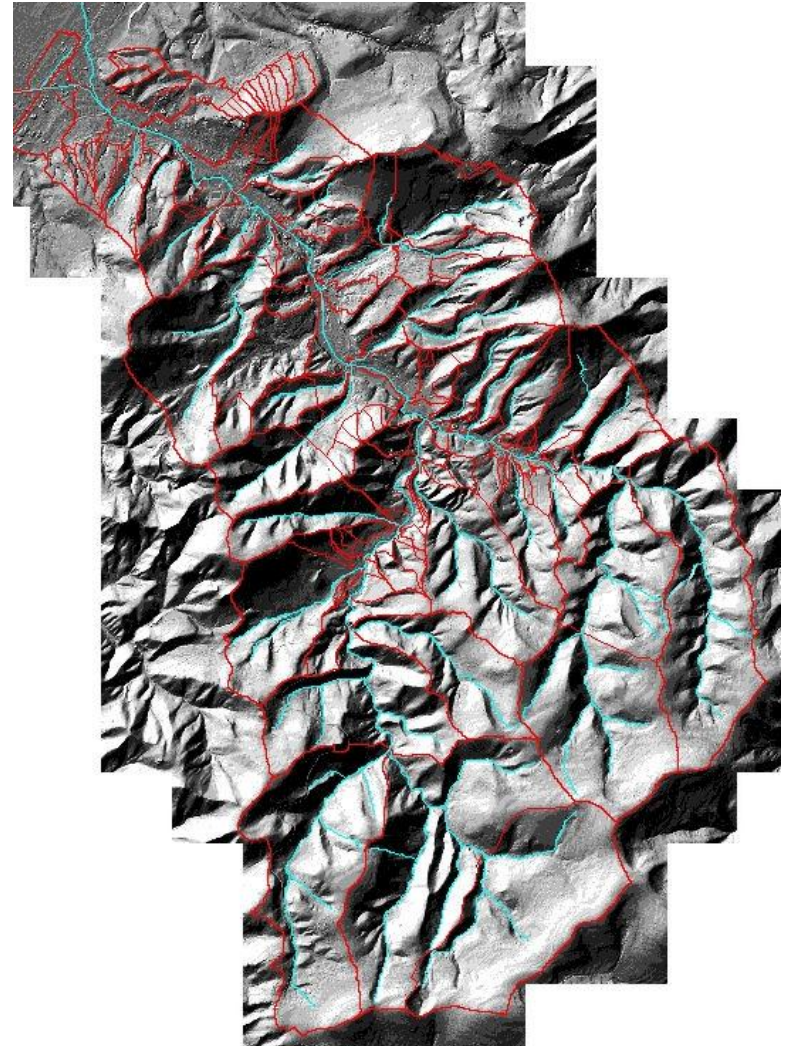
-  River
-  Natural Catchment
-  Border of settlement
- Settlement area**
  -  Unsealed area
  - Sealed area**
    -  Combined sewer system
    -  Separate sewer system





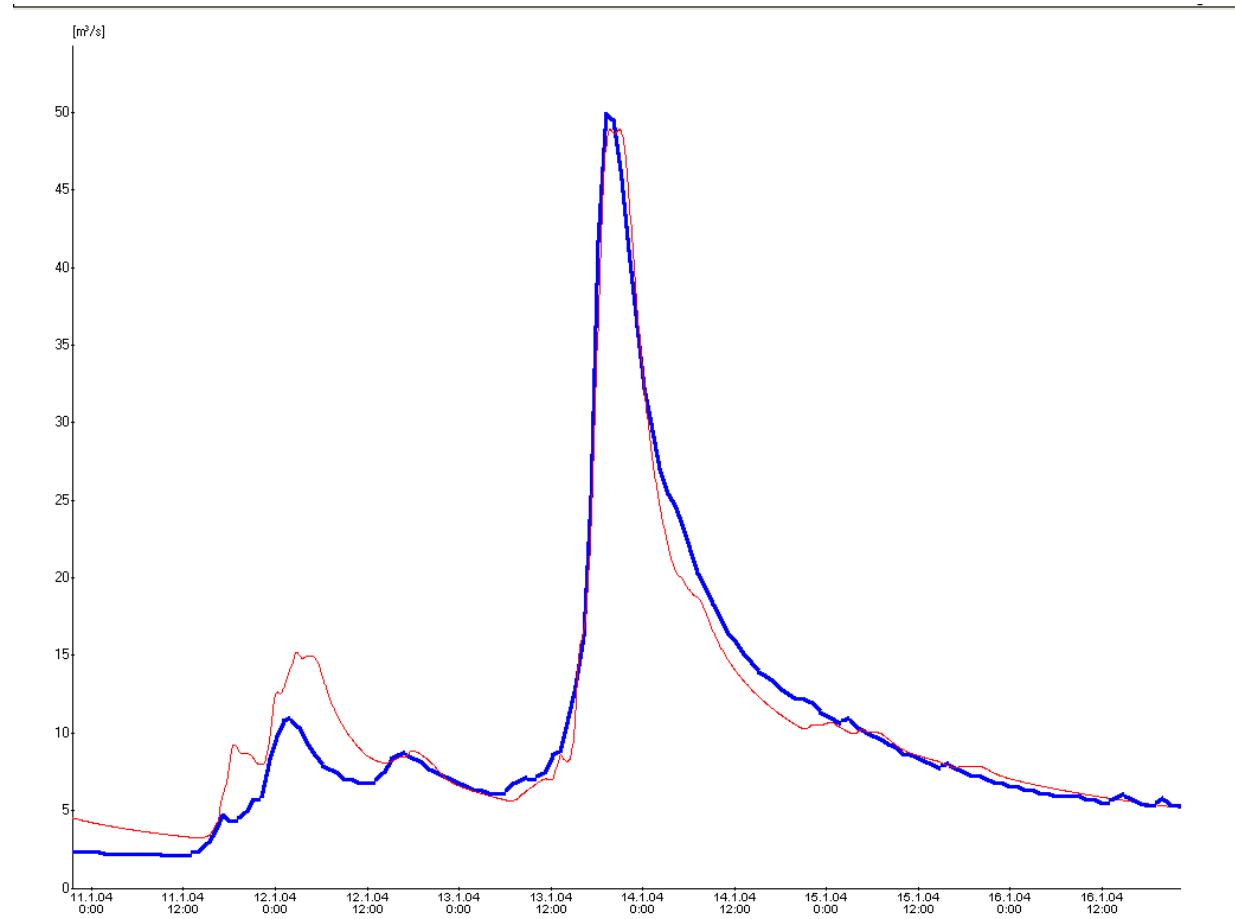
# Precip.-Runoff-Model: Runoff Concentration

Digital Elevation Model





# Precip.-Runoff-Model: Calibration

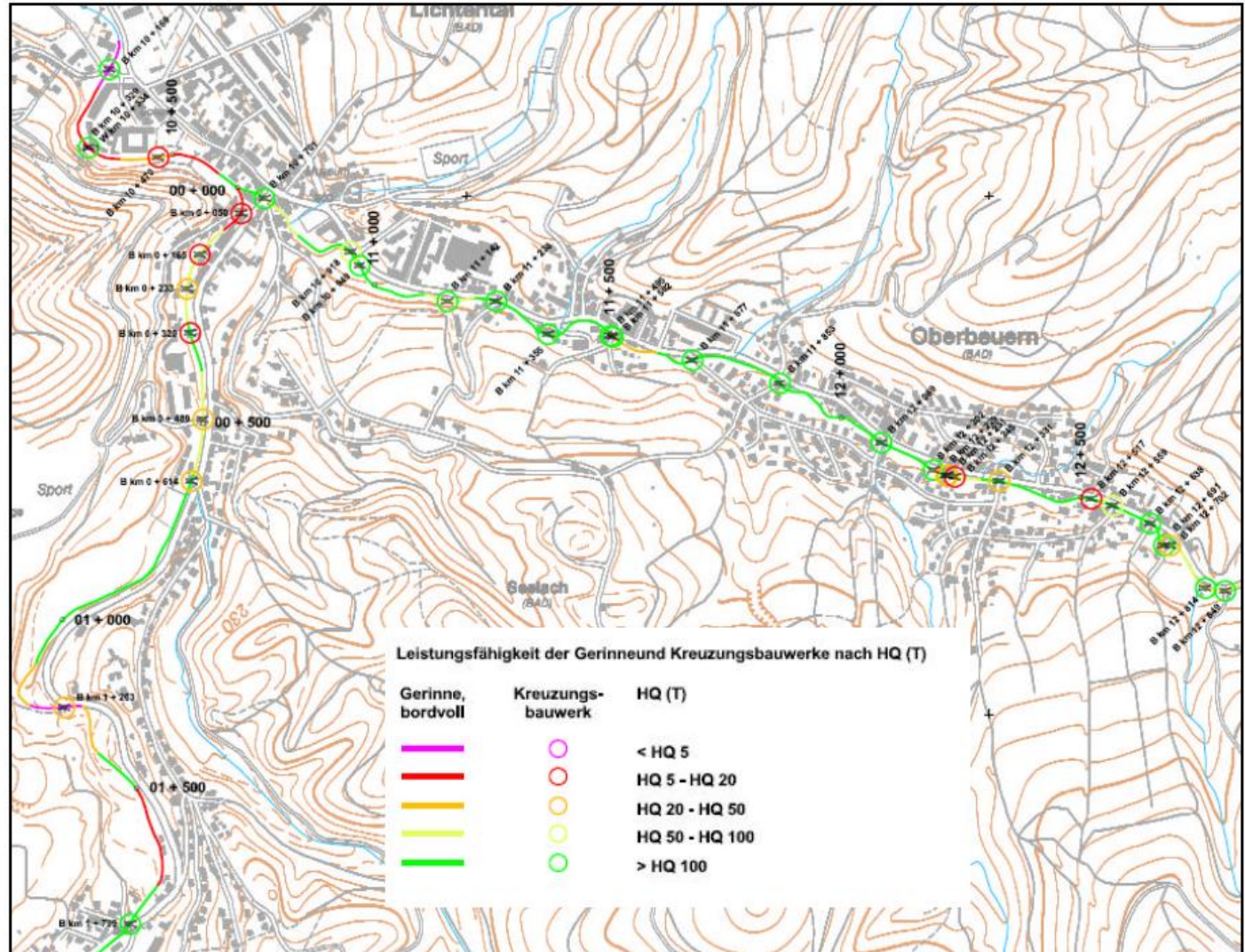


- Flood event Jan 13th 2004
- Meas. Aumattstadion
- Runoff coeff. 53%

— Measurement  
— Result Model

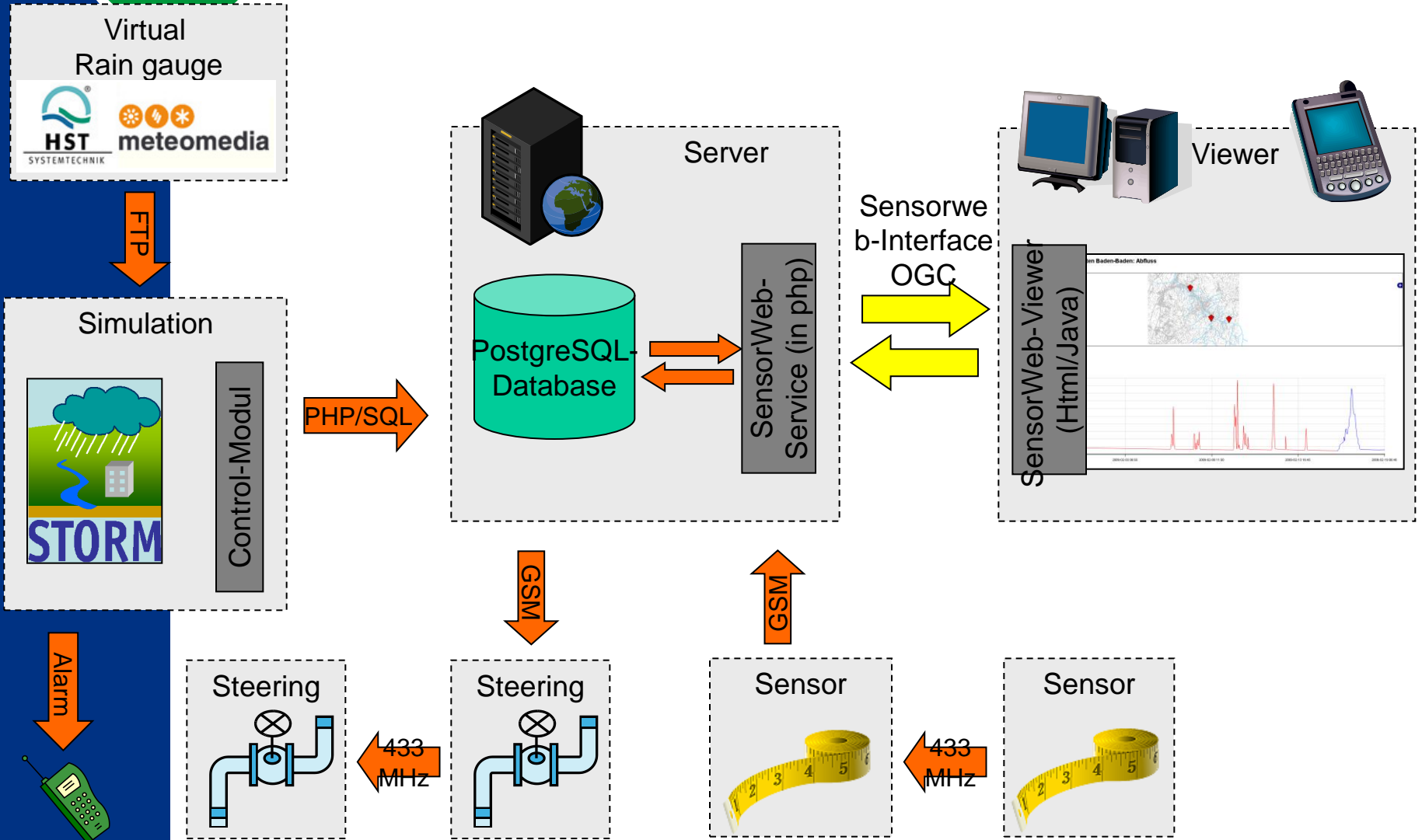


# Hydraulic capacity





# Concept with OGC Standards





# Example Baden-Baden

## Projekt HydroWebView in Baden-Baden

Projektpartner IPS + 3S Berlin

### Zeitreihen-Abfrage

Von Datum: 2010-6-9 Zeit: 15:44

Bis Datum: 2010-6-13 Zeit: 15:44

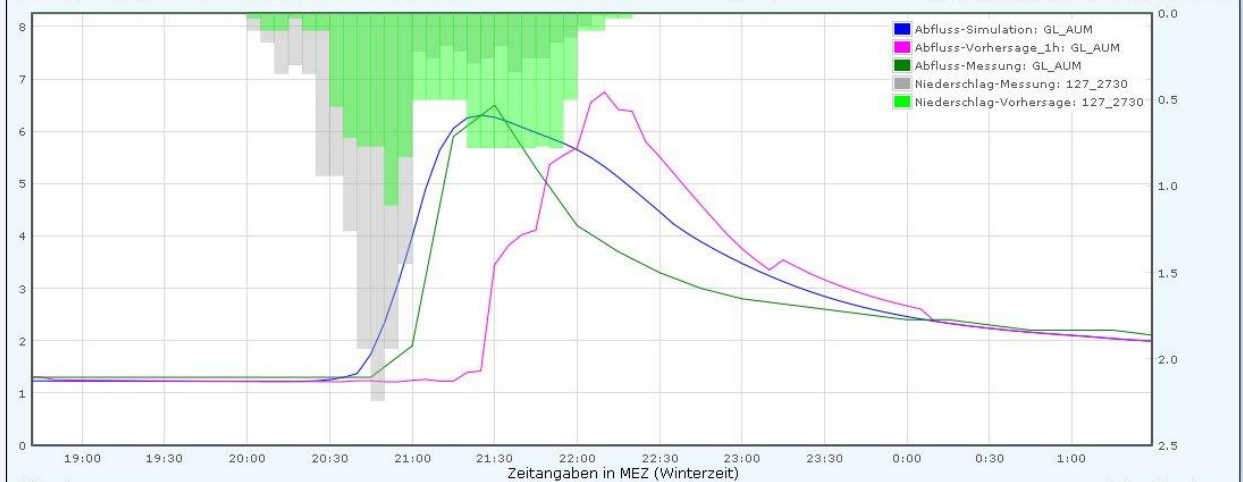
Abfrage starten

Auswahl aufheben

### Karten Kontrolle

- Basis Layer
- Daten Layer
- Operations
- SOS Oosbach
  - Ingenieurgesellschaft Sieker mbH
  - <http://www.sieker.de>
  - Öffne Zeitreihen-Abfrage
- Properties
- Wasserstand
- Abfluss
  - GL\_AUM
    - Simulation
    - Vorhersage\_1h
    - Vorhersage\_24h
    - Messung
  - GL\_AUS
  - GL\_GROBO
  - TE\_OBERW
  - TE\_S\_GEN
- Niederschlag
  - 127\_2725
  - 127\_2726
  - 127\_2727
  - 127\_2728
  - 127\_2729
  - 127\_2730
    - Vorhersage\_1h
    - Vorhersage\_24h
    - Messung
    - Vorhersage
  - 127\_2731

Expertenmodus



Abfluss in m3 per sec

Zeitangaben in MEZ (Winterzeit)

Niederschlag in mm

Zoom:

Ziehen mit gedrückter linker Maustaste





# Example Prenzlau

Projekt HydroWebView in Prenzlau  
Projektpartner IPS + 3S Berlin

Zeitreihen-Abfrage  
Von Datum: 2010-6-9 Zeit: 0:00  
Bis Datum: 2010-6-9 Zeit: 8:00  
Abfrage starten

Abfrage  
Load Base-Layer Load WMS-Layer  
Load SOS-Layer Load SPS-Layer  
Auswahl aufheben

- Karten Kontrolle
  - Basis Layer
  - Daten Layer
  - SPS-Server
  - SOS Prenzlau
  - Ingenieurgesellschaft Sieker mbH
    - http://www.sieker.de
    - Öffne Zeitreihen-Abfrage
  - Properties
    - Niederschlag
      - WRS1
      - WRS2
    - Akku\_Ladezustand\_1
    - Wasserstand
      - 909900
      - 901001
      - 900001
      - Messung
      - R1009\_S
    - Wasserstand\_V
      - 909900
      - 901001
      - 900001
    - Abfluss
      - H1009\_H
      - Simulation
      - Vorhersage\_1h
      - Vorhersage\_24h

Expertenmodus

Kartenansicht Diagrammansicht SPS-Steuerung

Wasserstand-Messung: 900001  
Abfluss-Simulation: H1009\_H

Wasserstand in m  
Zeitangaben in MEZ (Winterzeit)  
Abfluss in m3 per sec

Zoom: Ziehen mit gedrückter linker Maustaste. Zurück mit



# Future Outlook

- **Present situation**
  - Flood prediction model in Baden-Baden runs continuously
  - Coupling STORM with hydrodynamic Hystem-Extran-Model in Prenzlau is done
  - Runoff forecast with measurements is verified, but not good enough
- **Next steps**
  - Coupling of models via SOS/SPS interface standards incl. 2D-hydraulic model and WWTP
  - Steering of on site stormwater management and storage systems
  - Continuous improvement of the prognosis



**Thank you for your  
attention !**

Ingenieurgesellschaft Prof. Dr. Sieker mbH  
[www.sieker.de](http://www.sieker.de)