

# Flanders Flood Forecasting



departement  
Mobiliteit en  
Openbare Werken

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**03/05/2022**



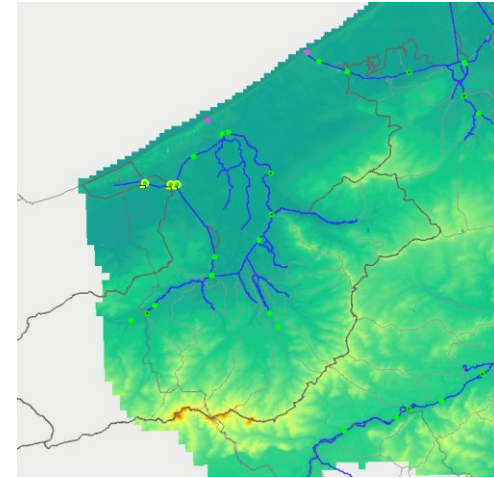
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2. Hydrological Information Centre / Forecasting

# 1. Introduction

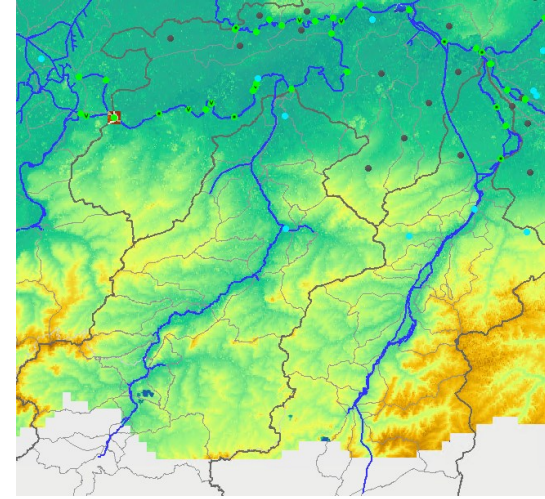
## "Recent" floods in Flanders

- 10/2009 + 11/2021: river IJzer
  - 2009: 35mm/12u (70/3d) / 2021: 80mm/2d
  - Return period Q IJzer (main river): > 100year (+100m<sup>3</sup>/s)
  - Flooded area > 30km<sup>2</sup> - Damage limited



## Recent floods in Flanders

- 11/2010: river Dender / river Zenne
  - Antecedent rainfalls (60mm) + 100mm/2d
  - Return period Q Dender > 100 year
  - Return period Q Zenne > 250 year
- Damage > 150 000 000 euros



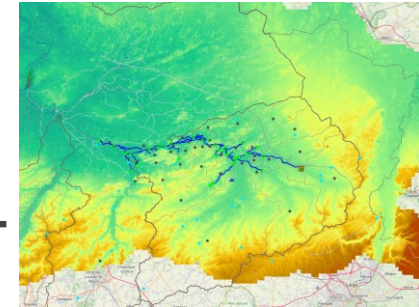
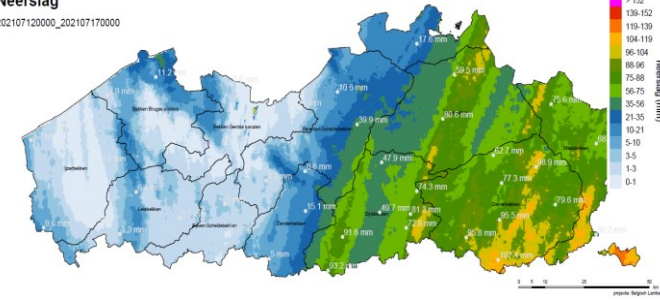


# Recent floods in Flanders

- 07/2021: river Demer
  - +100mm/4d
  - Return period Q Demer > 30 year
- Damage limited (infrastructure) – ecology...

Neerslag

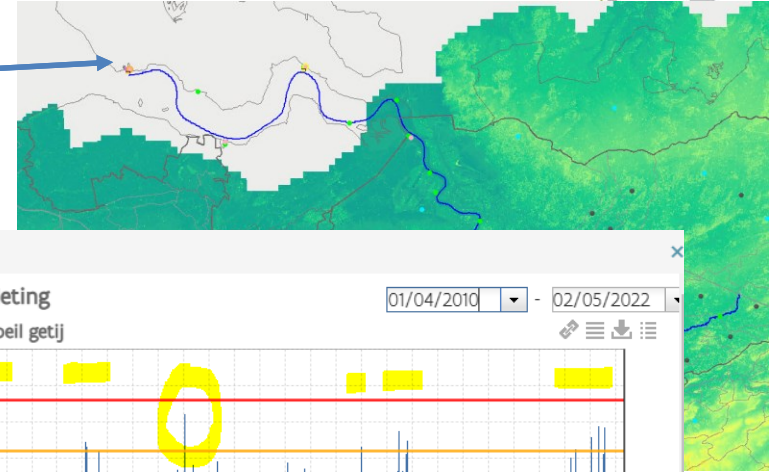
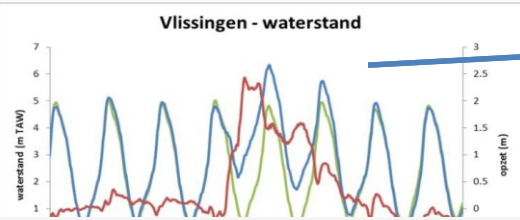
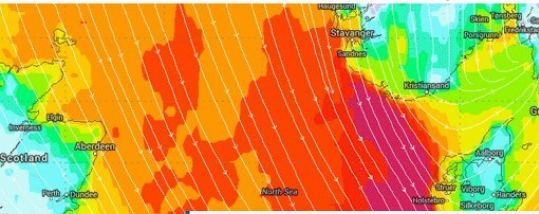
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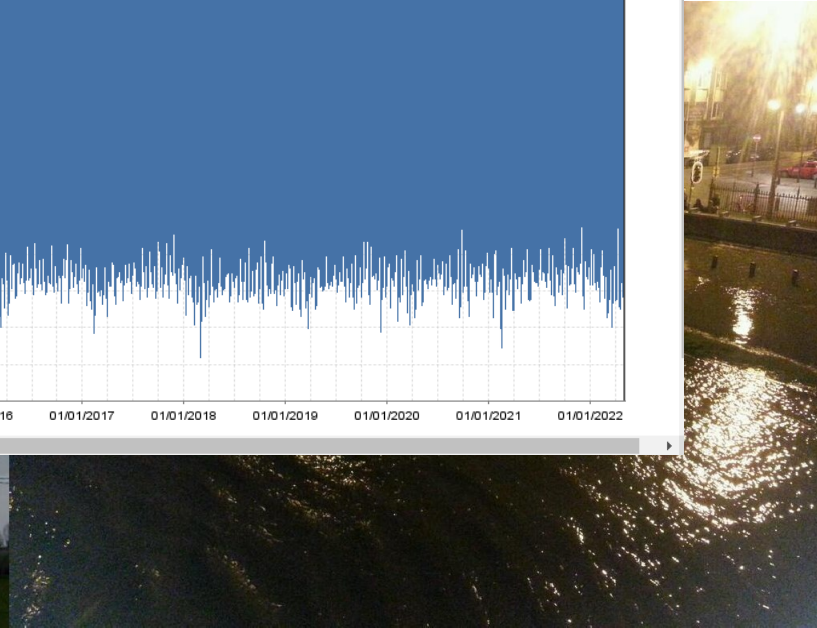
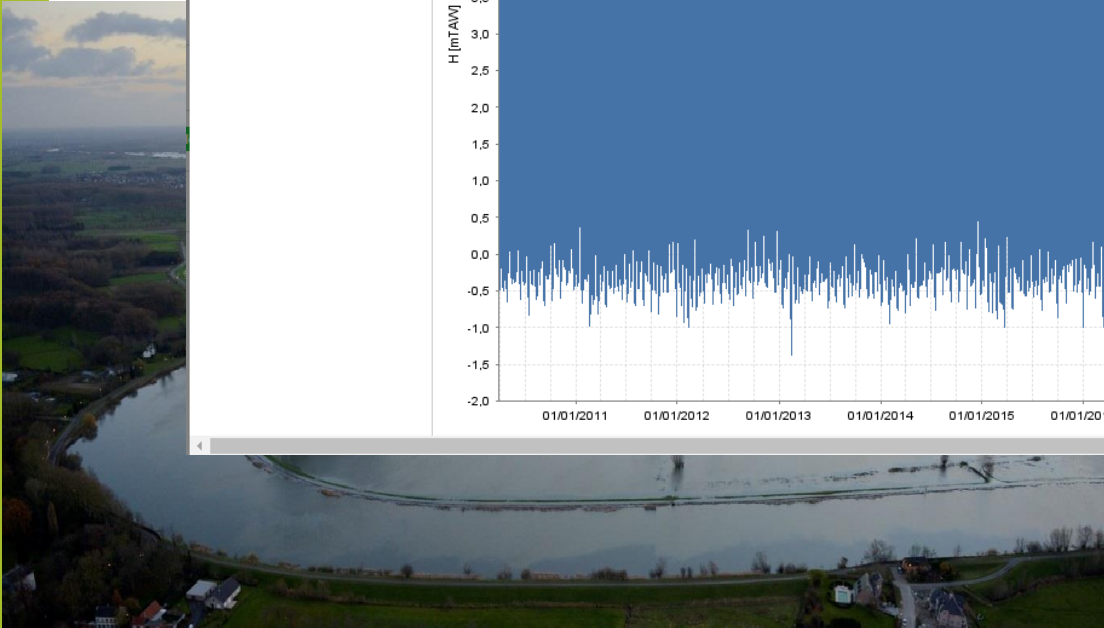
# Recent floods in Flanders

ECMWF Wind Forecast Valid 18 UTC Thursday December



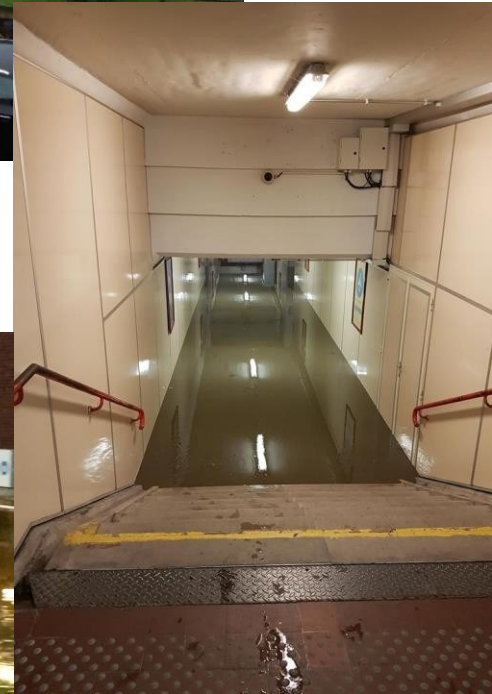
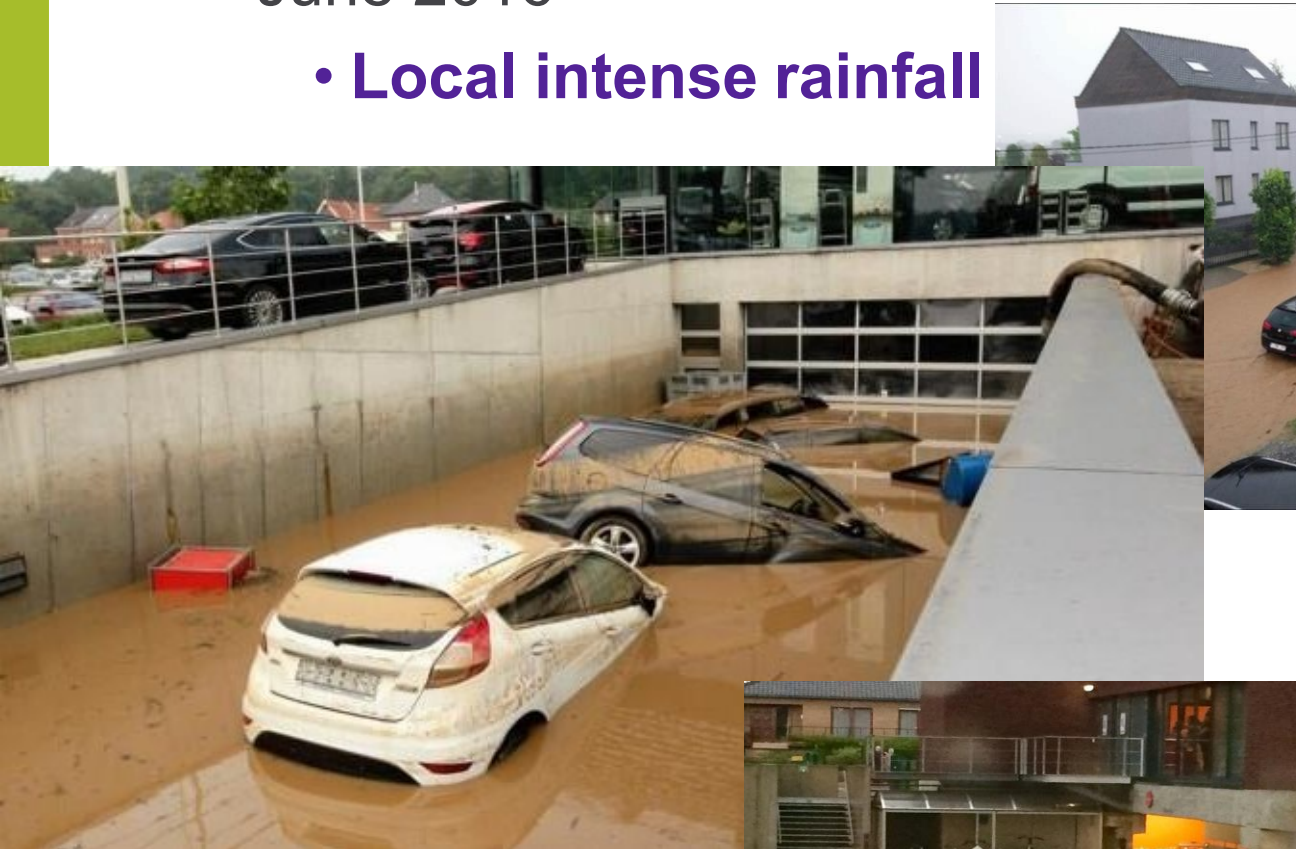
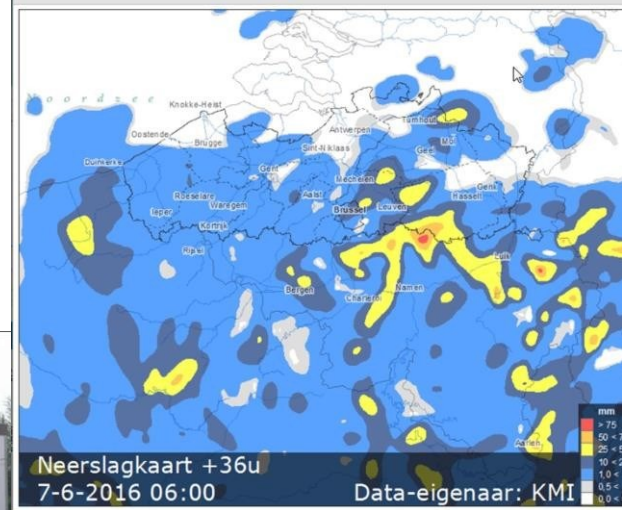
Antwerpen tij/Zeeschelde (zes21a-1066)

- Waterpeil/afvoer
- Meting
- Korte-termijn voorspelling
- Lange-termijn voorspelling
- Andere parameters
- Info Station
- Meer info...
- Extreme waarden analyses
- Gemiddeld tij
- Springtij
- DoodTij



# Recent floods in Flanders

- June 2016
- Local intense rainfall



## Floods in Flanders

- Major types of floods:
  - "Winter" floods : saturated soil + rain event (wide spread + big amount) → Fluvial Flood [big area affected]
  - "Summer" floods : rain event (local + big amount) → Pluvial Flood [local impact]
  - "Tidal floods" : storm (= wind) on northern sea [whole scheldt estuary at risk] – (1) no breaches – limited impact (2) Breaches – severe impact



# Flanders sensitive to flooding

- Due to :
  1. **History: Tradition of watercontrol (straighten and deepen rivers, complex (old) system (weirs), buiding of high levees,...) versus watermanagement [Room for water “Sigma Plan” ]**
  2. **Lots of hardening (roads, driveway, parking lots, industry...) → Less infiltration → Fast(er) runoff to the rivers → prone to flooding**
  3. **Dense populated area / poor spatial planning → high risks (= impact)**

# Introduction: Watermanagement in Flanders



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Mobiliteit en  
Openbare Werken



NAVIGABLE

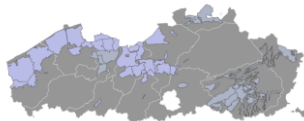
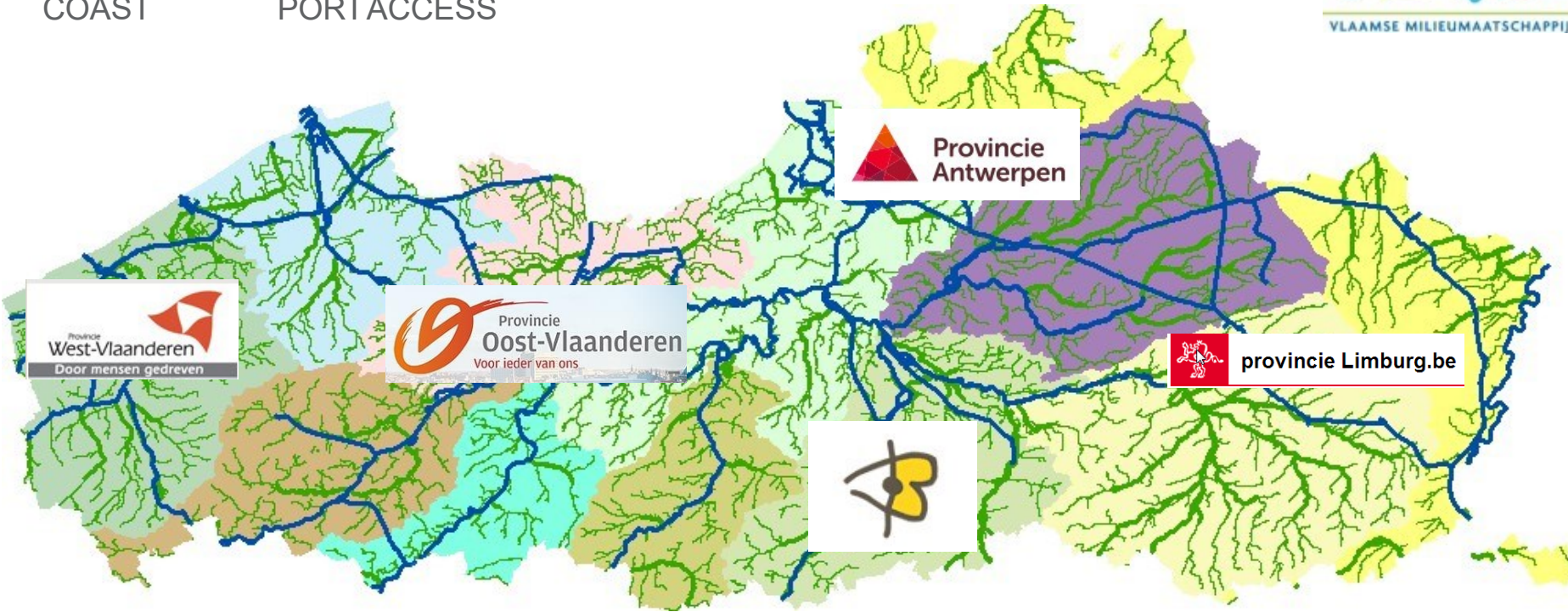
NON NAVIG



COAST



PORT ACCESS



LOT's OFF  
WATERMANAGERS !!

# Crisismanagement in Flanders

## WARNING

OMS  
Info over OMS  
AFDELING KUST

COAST

Vmm  
VLAAMSE MILIEUMAATSCHAPPIJ

NON NAVIGABLE

waterbouwkundig  
LABORATORIUM  
HYDROLOGISCH  
INFORMATIECENTRUM

NAVIGABLE

KMI

## CIVIL SERVICES

## ORGANISATION/LEAD

Local: mair (300)

Several communities:  
Governor(5)

ibz Federale Overheidsdienst  
Binnenlandse Zaken

## WATERMANAGEMERS

Several provinces: Federal

- Gewesten :
- Vlaams Gewest
  - Vlaams Gewest
  - Brussels Hoofdstedelijk Gewest
- Gemeenschappen :
- Vlaamse Gemeenschap
  - Franse Gemeenschap
  - Duitstalige Gemeenschap

## 2. Hydrological Information Centre (HIC)

- Mission:

The HIC is the partner of the Flemish waterway managers, which ensures 24x7 accurate **measurements**, **forecasts** and on-time **reporting** before flood events and water shortages.

The HIC **supports research** on the watersystem through sediment analysis, data management, validation and measurement campaigns

Staffing: internal 14 + external through projects



## Organisation HIC: 6 units

1. Gauging Network and measurement campaigns
2. Sedimentological Laboratory

**Data  
generation**



3. Datamanagement
4. Datavalidation

**Data  
Storage/Control**



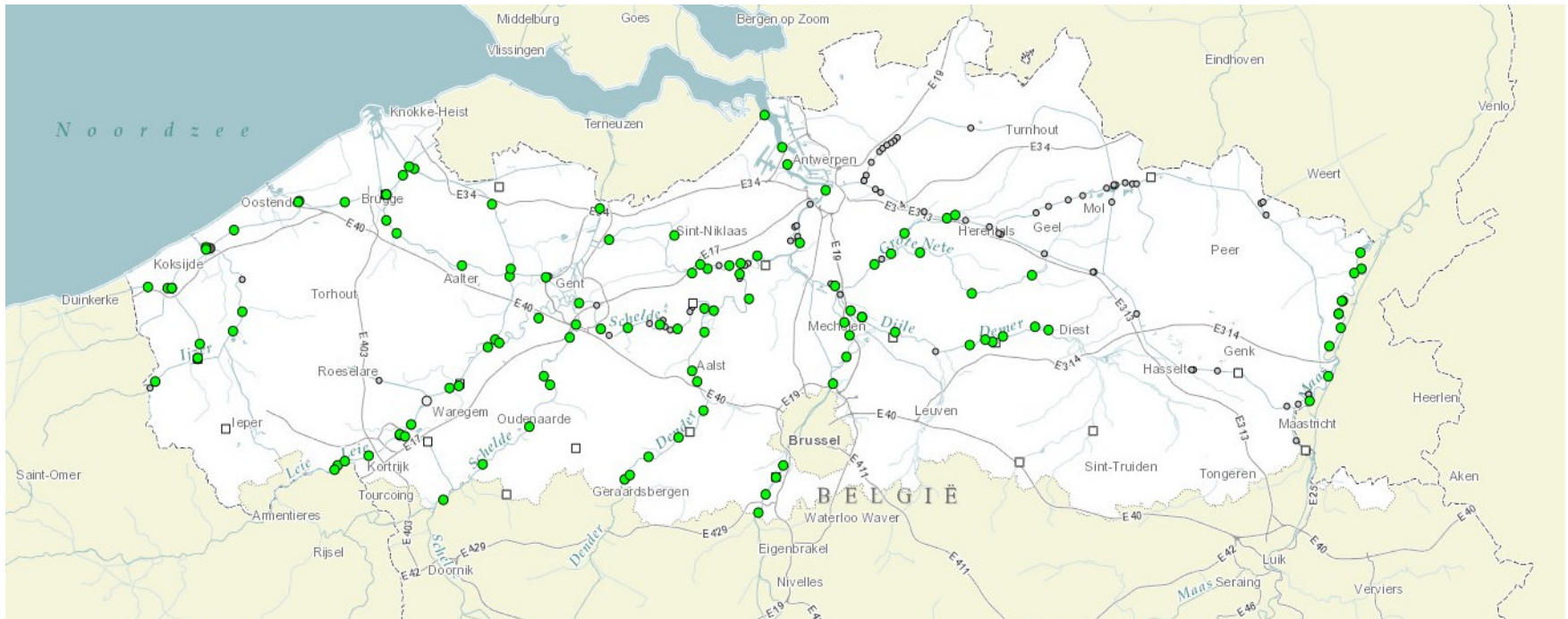
5. Surveillance service
6. Forecasting systems

**Data use**

# 1. Gauging network

## • HIC-gauging network

- Fully automatic measuring + telemetry (GPRS/3G/4G)
- 220V → solar panels
- Continuous operational control
- Team for gauging, maintenance and monitoring (+ external support)



# Gauging network

- Water-related parameters:
  - Stage (m TAW) – (+150 (29 Tidal))
  - Discharge ( $\text{m}^3/\text{s}$ ) – (50) (40 – 10)
  - Rainfall (mm) – (19)
  - Physical parameters (turbidity/dissolved oxygen/Conductivity (17))
  - Automated sampling (dissolved sediment)



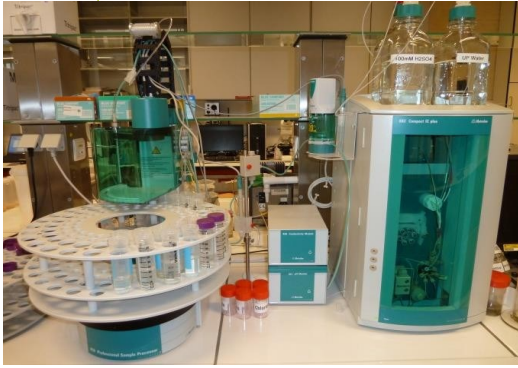


# Gauging network



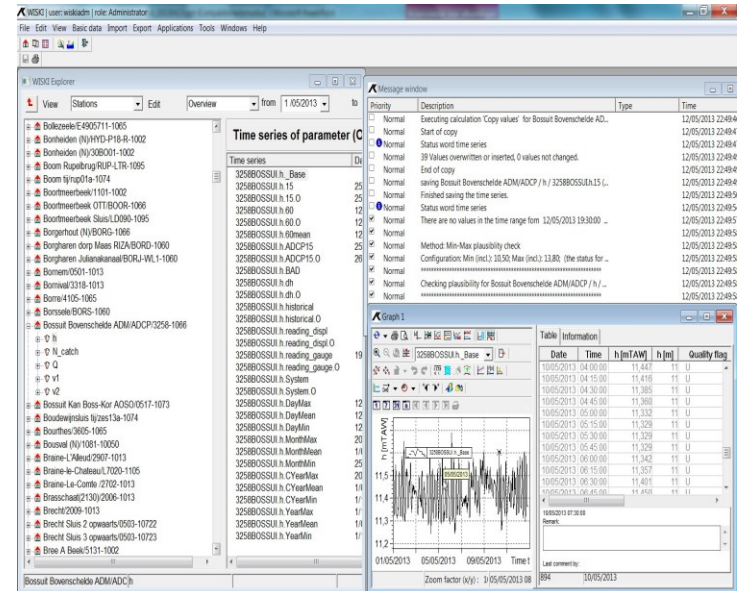
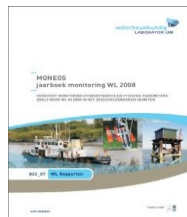


## 2. Sediment Laboratory



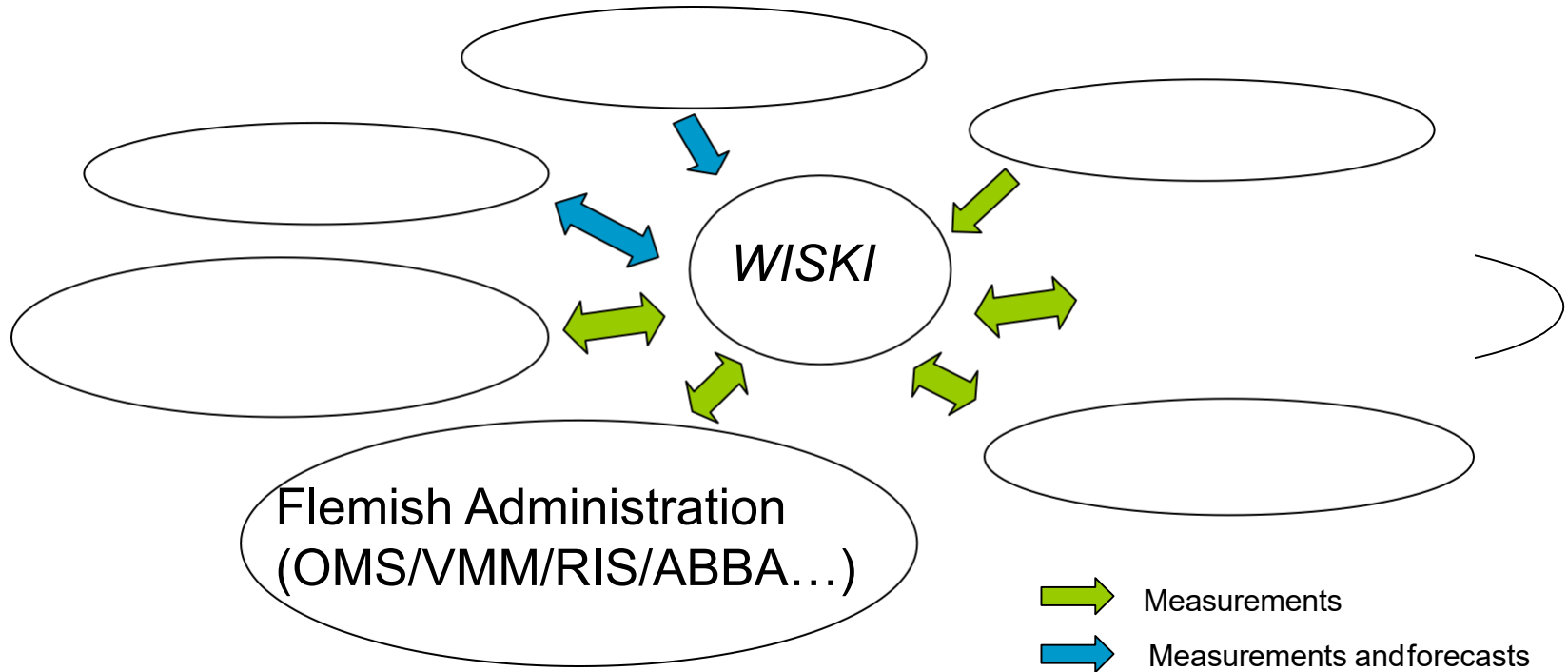
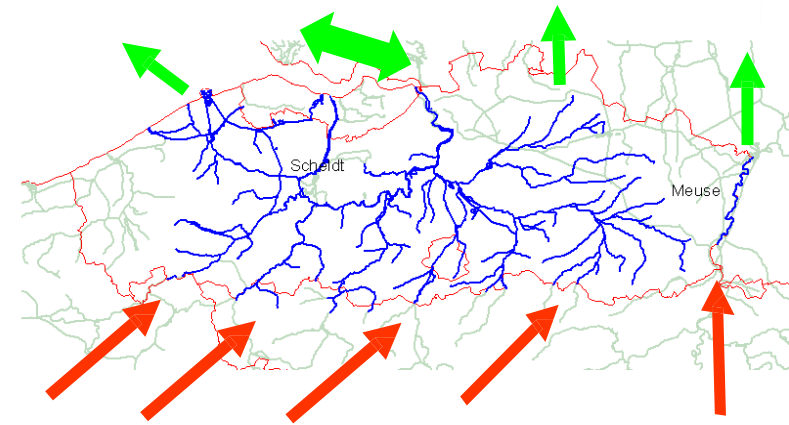
# 3. Datavalidation

- Validation of several parameters
  - Rainfall: monthly and yearly
  - Waterlevel: yearly
  - Discharges: yearly
  - Waterlevel Tides: yearly
  - Physical/Sedimentological parameters : yearly
- Data validation through scripting (Python, R) & Wiski
- Data available through hic@vlaanderen.be
- Data available through www.waterinfo.be [DL section]
- Data available through webservices (hicws.vlaanderen.be)
- Reports



# 4. Data management

## Data-exchange



## 5. Surveillance service

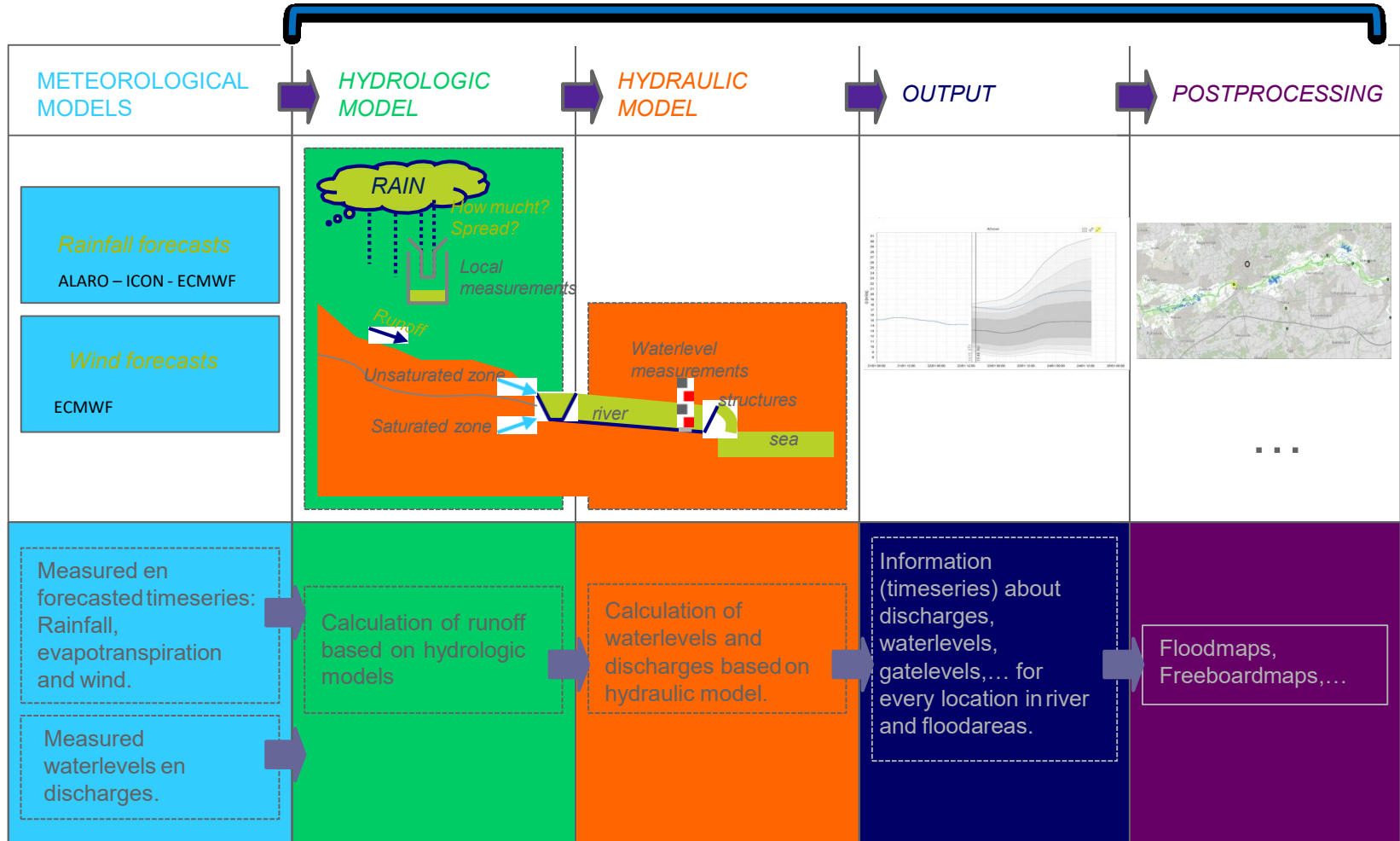
- Highwaterreporting for floods and storms
  - Highwaterreports
    - 5 – 8 -13 -17 – 23 depending on thresholdtransgression
    - On website + distribution through mail
  - 24/24h available for watermanagers
  - Sending highwaterreport to River Information Services
- Lowwaterreporting → importance grows every dry year...
- Tidal warnings for river Scheldt
- Lower the impact/damage of floods
  - **Pro-active warnings**
  - **Informing the public through [www.waterinfo.be](http://www.waterinfo.be)**



## 6. Forecasting systems HIC

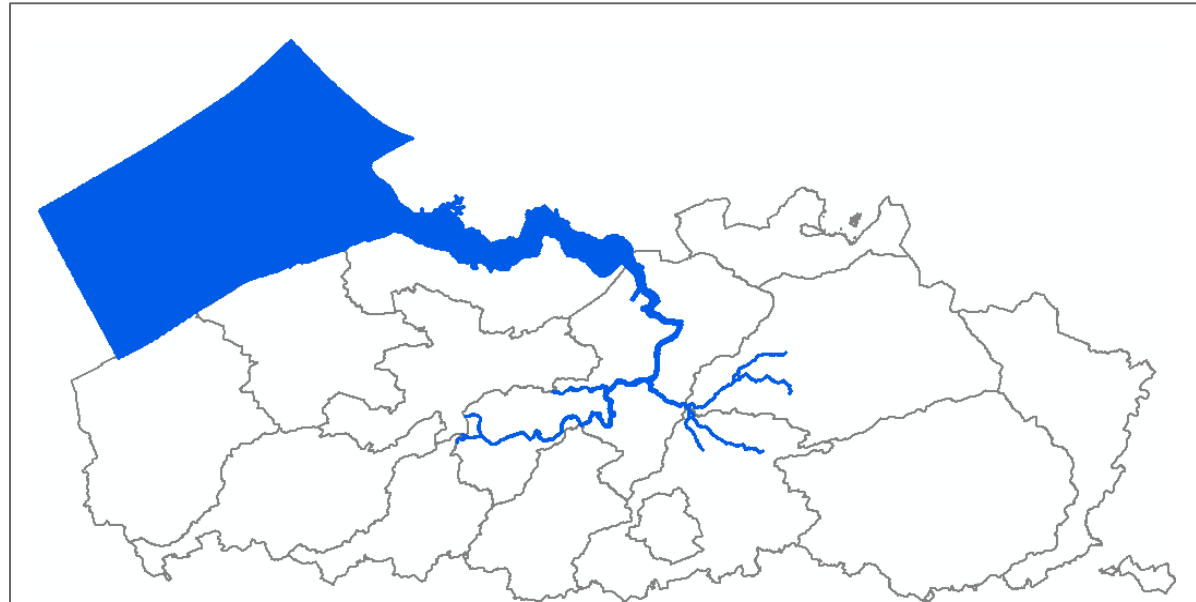
- 2 systems (navigable waterways)
  - **FS 1D – system : rainfall driven (= “Fluvial Flood”) + tidal**
  - **FS 2D – system : wind and tidal driven (= “Storm”)**

# Forecasting system – 1D

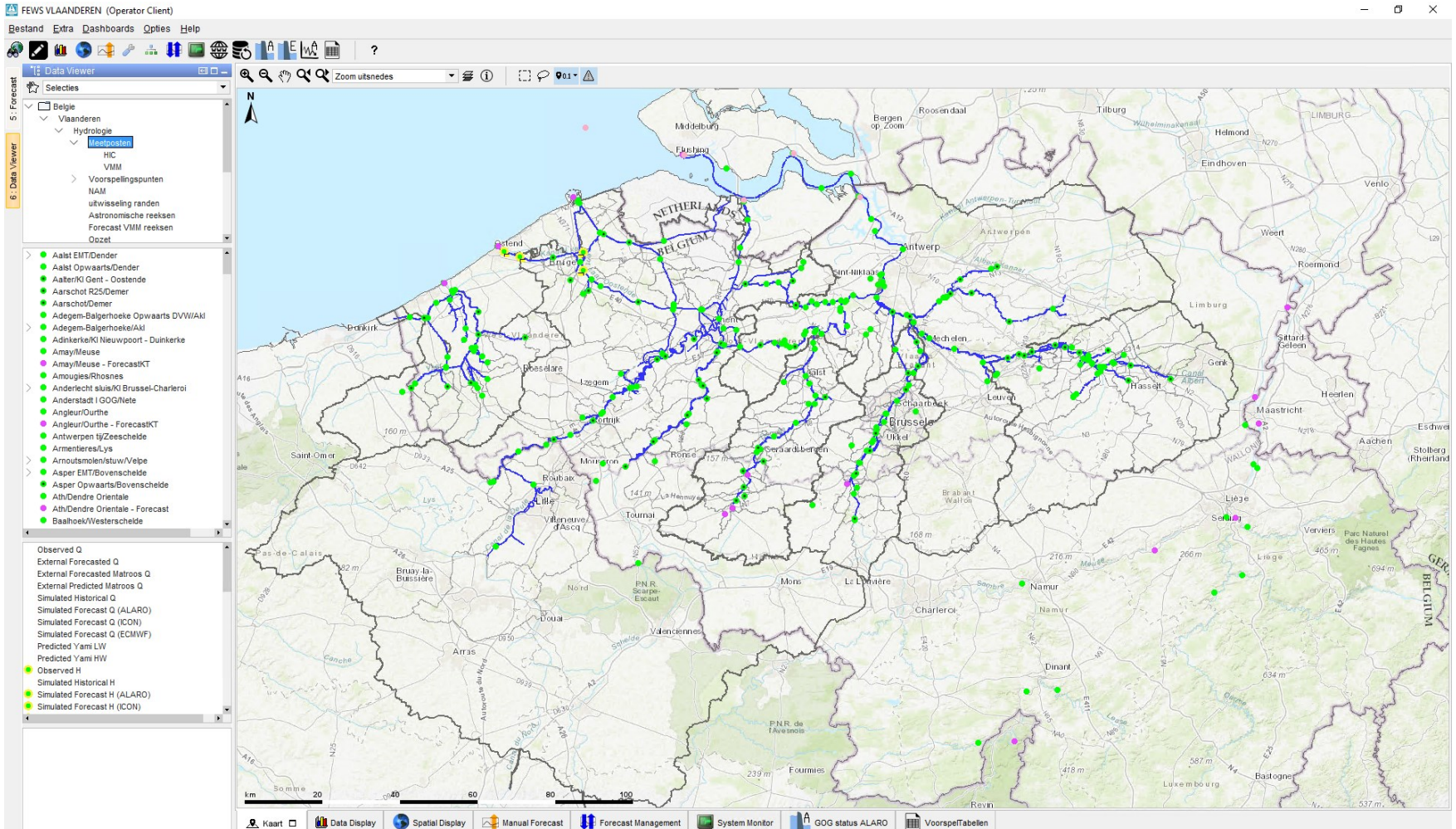


# Forecasting system 2D – tidal/wind [STORM]

- Model-train – 2 operational systems
  - **Train 1 (copy NL)**
    - DCSM – ZUNO – KUSTZUID/KUSTGROF
  - **Train 2**
    - DCSM – ZUNO – NEVLA G (scheldt area)
- New system : FEWS Flanders + 2D models [through the cloud] – W.I.P.

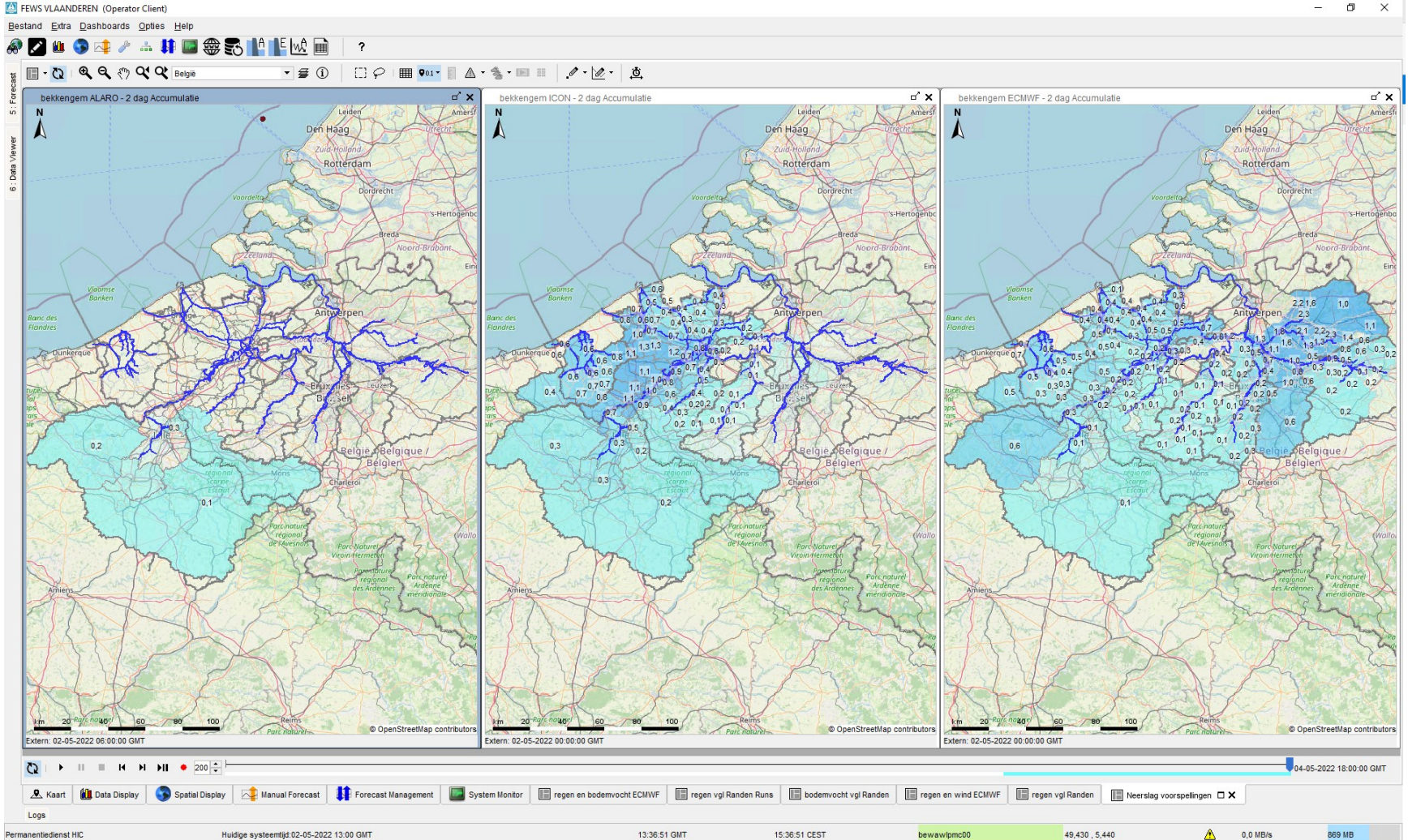


# FEWS FLANDERS [1D] – map view

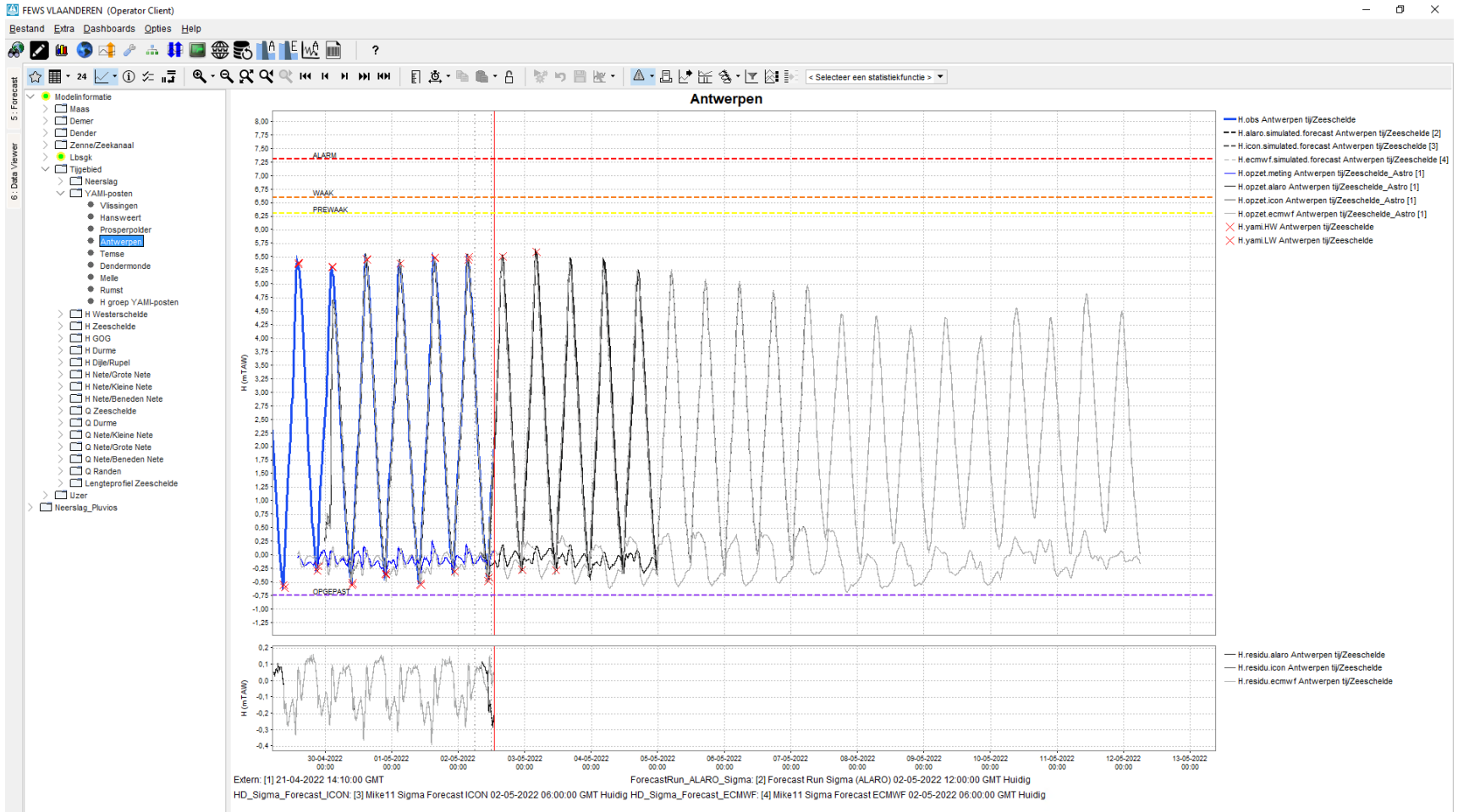




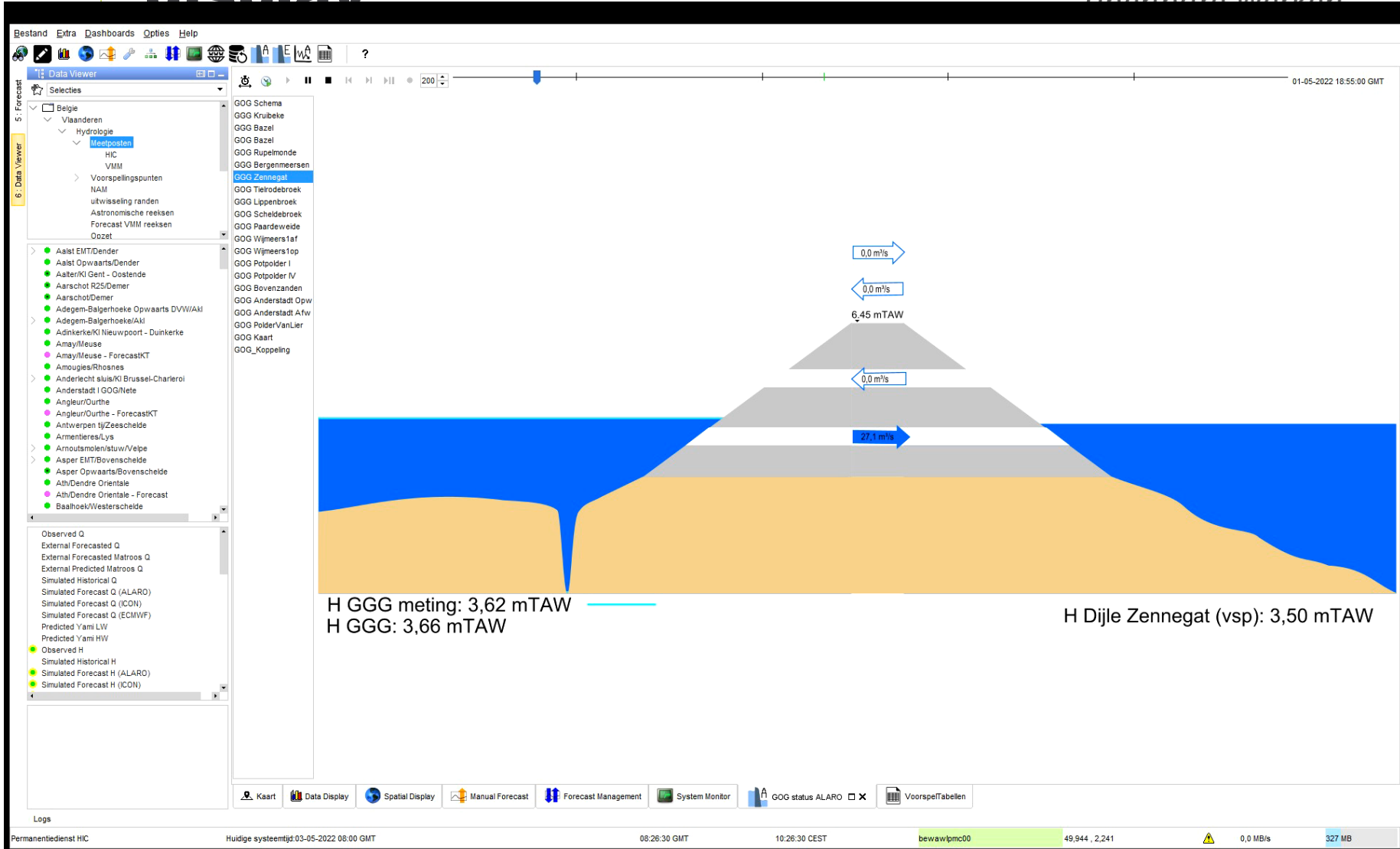
# FEWS FLANDERS – spatial display



# FEWS FLANDERS – data display

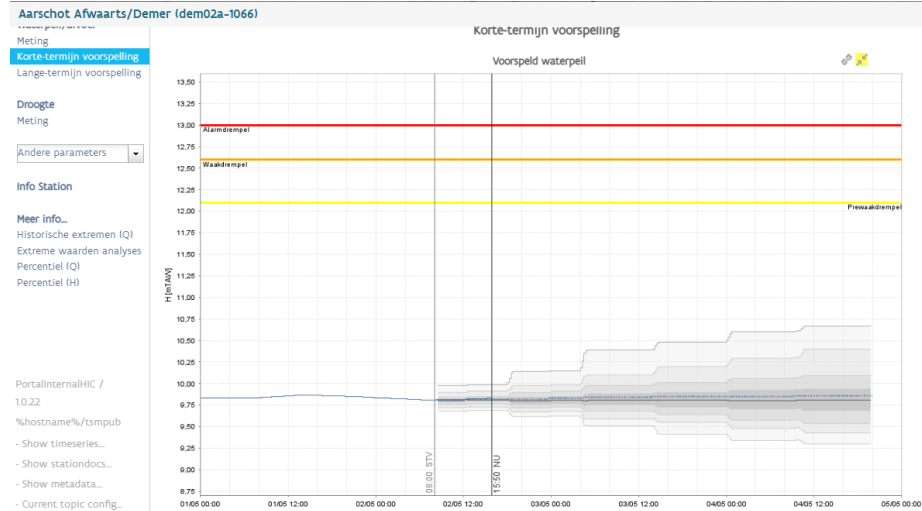
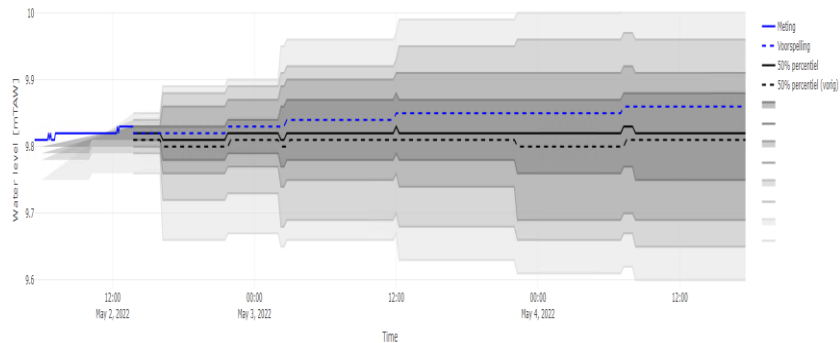
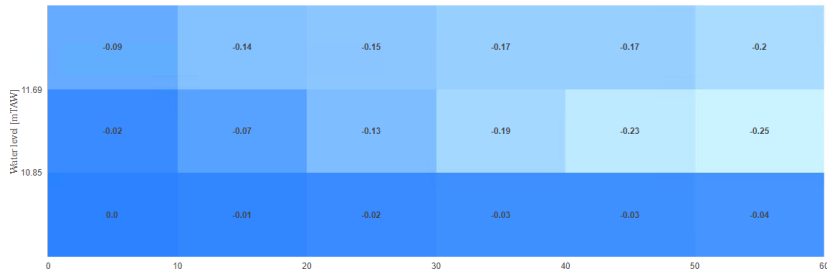
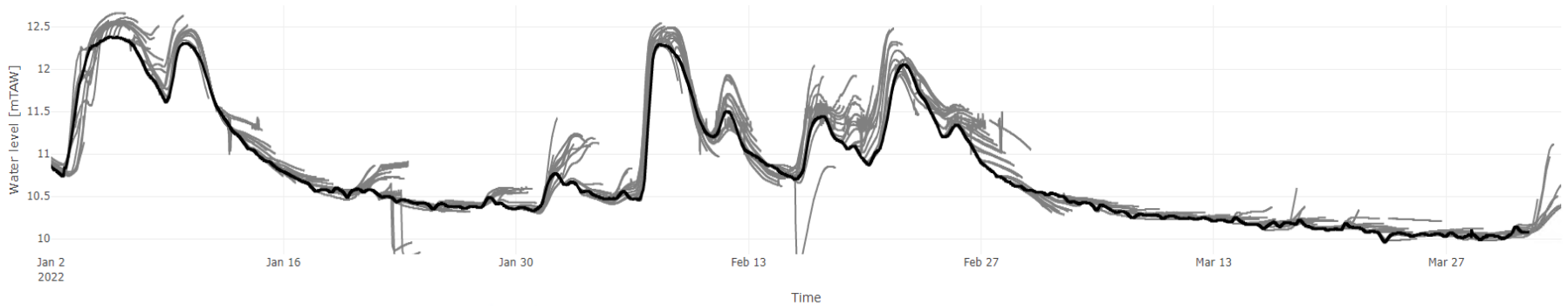


# FEWS FLANDERS – schematic display





# Uncertainty

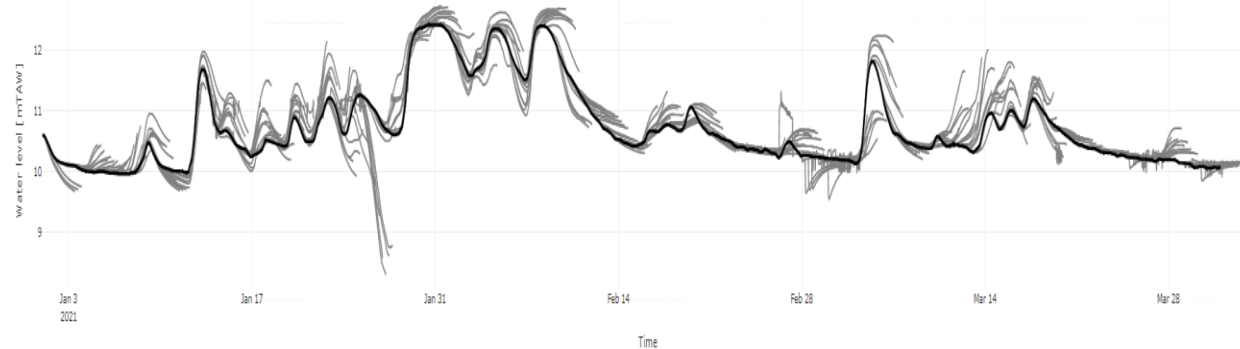




# Quality control – performance indicators

## Aarschot H

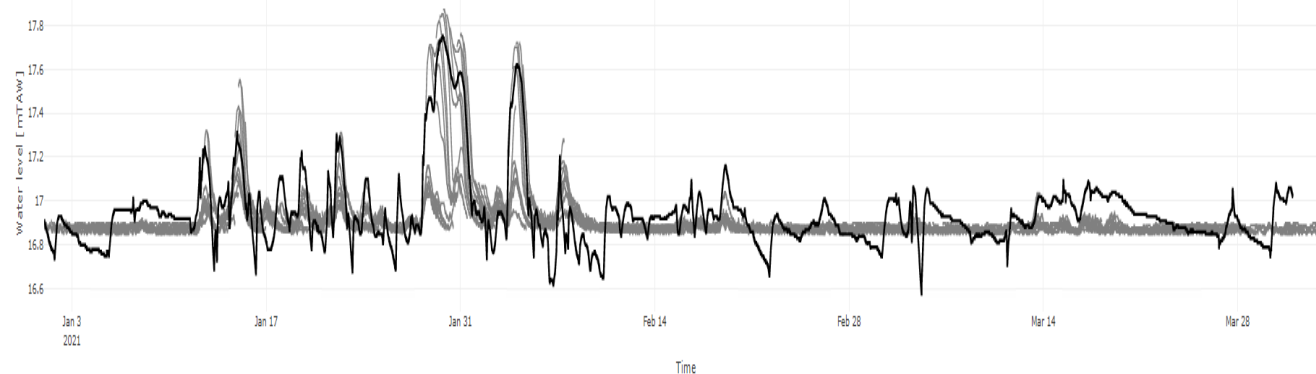
Periode	01012021-31032021				
HW	-0.1	0.1		-0.2	0.2
	0.0-12.0	12.0-24.0	24.0-36.0	36.0-48.0	48.0-60.0
12.06-999.0	-0.02	-0.11	-0.17	-0.19	-0.24
11.48-12.06	0.02	0.02	-0.21	-0.23	-0.36
10.91-11.48	-0.01	-0.07	-0.19	-0.29	-0.34
10.33-10.91	-0.01	-0.03	-0.03	-0.05	-0.07
999.0-10.33	-0.01	-0.01	-0.01	-0.02	-0.02



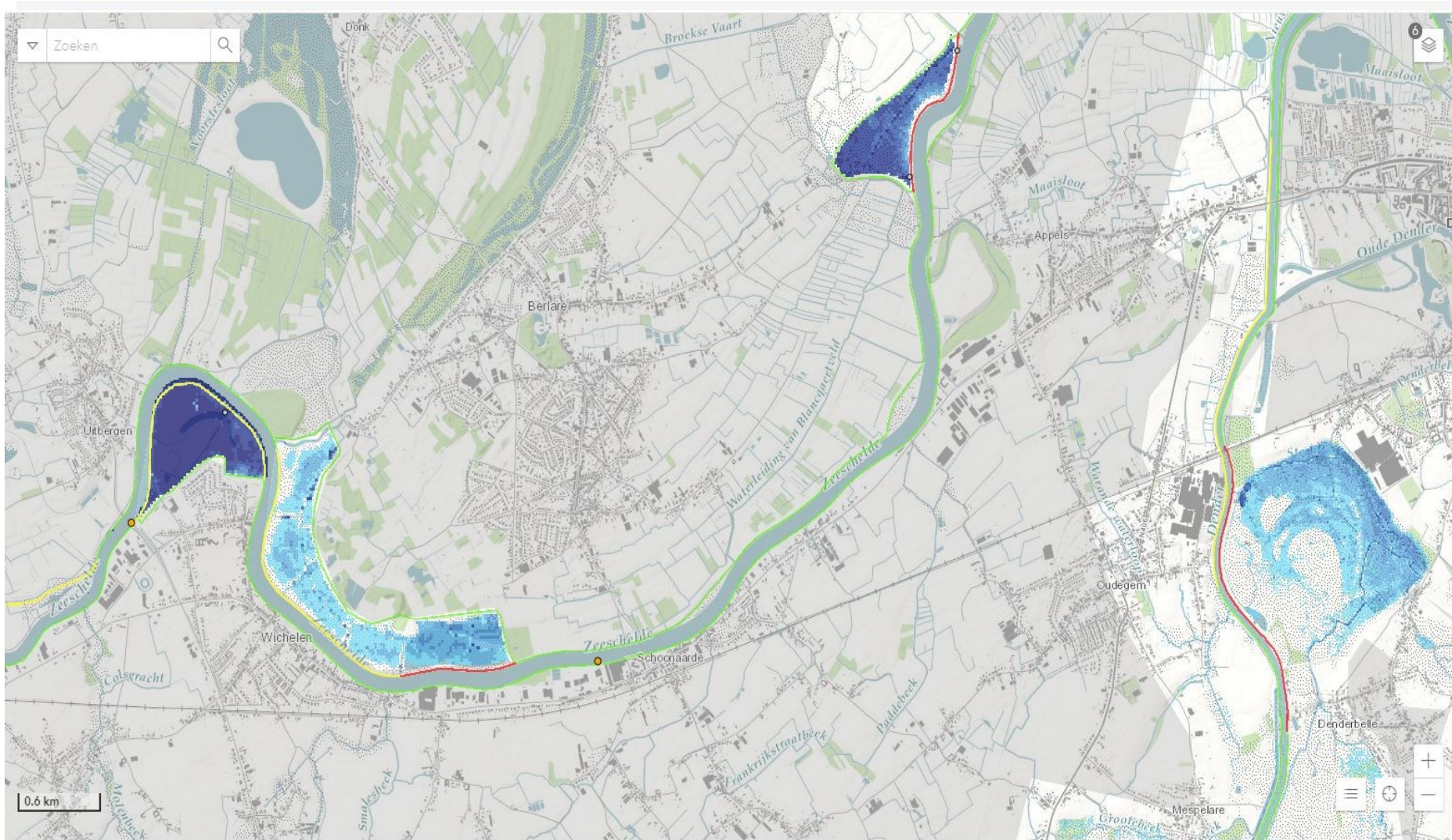
Negative: over estimation  
Positive: under estimation

## Overboelare H

Periode	01012021-31032021				
HW	-0.1	0.1		-0.2	0.2
	0.0-12.0	12.0-24.0	24.0-36.0	36.0-48.0	48.0-60.0
17.41-999.0	-0.18	0.09	0.1	0.05	0.17
17.27-17.41	-0.12	0.19	0.39	-0.14	-0.04
17.13-17.27	-0.13	0.12	0.33	0.28	-0.08
16.99-17.13	-0.08	0.05	0.19	0.26	0.25
999.0-16.99	0.03	0.03	0.03	0.04	0.04

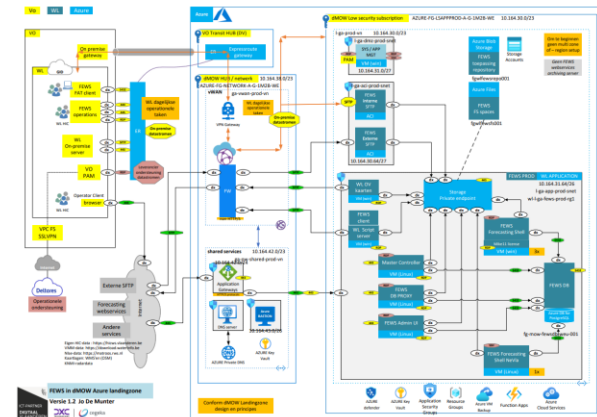


# Operational Floodmaps and Freeboardmaps



# Future in forecasting: ongoing work/challenges

- Keeping models up 2 date / update IT system / Integration 1D – 2D models
- Shift in types of models used
  1. Hydrological and hydrodynamic (1D/2D) models
  2. Evolution towards new types of models:
    1. Artificial Intelligence / Neural networks → hAldro
    2. Conceptual models (based on / derived from complex models)
- Decision support systems – Watermanagers ask advice
  - Use of measured data of infrastructure (gates/locks/pumps)
  - Running scenario's (what if...)
  - Multimodel approach → impact on decision tree
- Systems moving from on premise towards cloud



**Thank you for your attention**

- Questions?