#### **Flanders Flood Forecasting**



#### Maarten Deschamps 03/05/2022











ABORATOR UM

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- 1. Introduction
  - 1. Floods in Flanders
  - 2. Watermanagement in Flanders
- 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







- 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









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













#### • June 2016

Local intense rainfall



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### **Floods in Flanders**

- Major types of floods:
  - "Winter" floods : saturated soil + rain event (wide spread + big amount) → <u>Fluvial</u> Flood [big area affected]
  - "Summer" floods : rain event (local + big amount) → <u>Pluvial</u> Flood [local impact]
  - "<u>Tidal</u> 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 :

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- 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)



### **Crisismanagement in Flanders**

#### WATERMANAGEMERS



# **2. Hydrological Information Centre** (HIC)

departement Mobiliteit en Openbare Werken

• Mission:

The HIC is thé partner of the flemish waterwaymanagers, which ensures 24x7 accurate **measurements**, **forecasts** and on-time **reporting** before floodevents and watershortages.

The HIC **supports research** on the watersystem through sedimentanalysis, datamanagement, validation and measurementcampaigns

Staffing: internal 14 + external through projects





#### **Organisation HIC: 6 units**



### **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 (m<sup>3</sup>/s) (50) (40 10)
  - Rainfall (mm) (19)
  - Physical parameters (turbidity/dissolved oxygen/Conductivity (17))
  - Automated sampling (dissolved sediment)









### **Gauging network**











#### **2. Sediment Laboratory**















- Validation of several parameters
  - Rainfall: monthly and yearly
  - Waterlevel: yearly

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- 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





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- Highwaterreporting for floods and storms
  - Highwaterreports

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- 5 8 13 17 23 depending on threshold transgression
- 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 <u>www.waterinfo.be</u>



### 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**

METEOROLOGICAL **HYDROLOGIC HYDRAULIC** OUTPUT POSTPROCESSING MODEL MODELS MODEL RAIN ALARO – ICON - ECMWF meas<u>urements</u> structures FCMWF river Saturated zone . . . Information Measured en (timeseries) about forecasted timeseries: discharges, Rainfall, waterlevels, Floodmaps, evapotranspiration gatelevels,... for Freeboardmaps,... and wind. every location in river and floodareas. Measured waterlevels en discharges.



- 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



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**FEWS FLANDERS** – spatial display







#### **FEWS FLANDERS – data display**





### **FEWS FLANDERS – schematic**

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departement Mobiliteit en





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#### Quality control – performance indicators

Aarschot H

Periode	01012021-3103202				
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
999.0-10.3	-0.01	-0.01	-0.01	-0.02	-0.02

Negative: over estimation Positive: under estimation



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17.27-17.41	-0.12	0.19	0.39	-0.14	-0.0
17.13-17.27	-0.13	0.12	0.33	0.28	-0.0
16.99-17.13	-0.08	0.05	0.19	0.26	0.2
-999.0-16.99	0.03	0.03	0.03	0.04	0.0





#### **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. Artifical 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?