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On the use of climate scenarios for water management in Flanders

Kris Cauwenberghs

CORDEX.be meeting KMI - 25/9/2017

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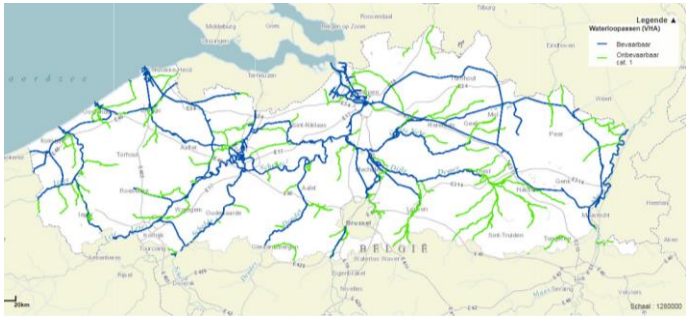
2. Flood Risk Management/Mapping
3. Climate Impact on Watersystems
4. Use of climate projections in watermanagement
5. Conclusions

1. Introduction

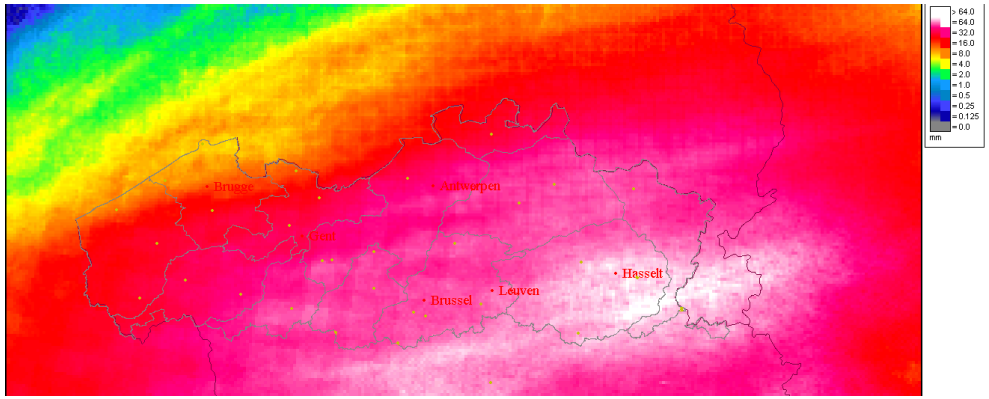
- **VMM = Flemish Environment Agency competent for**
  - → Waterquality (monitoring, reporting, economic & ecologic supervision on waste water treatment infrastructure, …)
  - → Air quality
  - → Environmental reporting (MiRa)
  - → Ground Water (quantity & quality) + Drinking Water regulation
  - → Waterquantity
- **Division Operational Watermanagement (AOW)**
  - → Operate 1400 km of non-navigable watercourses of 1° category
  - → Maintenance, investments & renovations
- **Unit Floodmanagement**
  - → Operate hydrologic measurement networks (+400 sites)
  - → Off-line + real-time hydraulic models (4200 km)
  - → R&D unit with about 30 engineers & scientists



1. Recent weather extremes

- **River flooding: 13-16 november 2010**

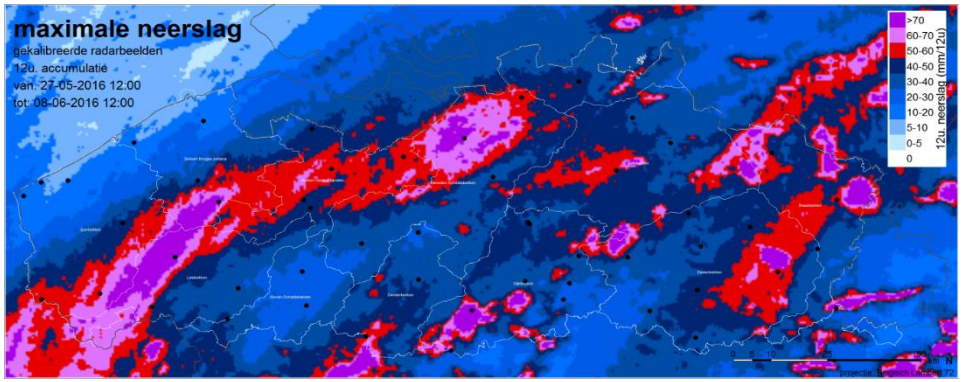
  → 3 months of high rainfall (335-500mm, saturated soils)
  + up to 105 mm 9/11 -16/11
  → T25-50 flows
  → Historic maxima: surpassed till 10 cm
  → Impact:
  × +21.000 houses affected
  × over 104 million euros damage



1. Recent weather extremes

- **Pluvial flooding: 27 May - 8 June 2016**

  → 12 days of heavy summer rainfall events
  → Maximum intensities
    × Kanne 62 mm/h (T>200)
    × Cfr. Ukkel-record = 43 mm/h & Kortenaken 23/7 = 83mm/h
  → T25-50 flows
  → Impact:
    × 305 mio EUR Insured Damage + 248 mio EUR Agricultural damage
    × 85.000 damage claims + 26.000 claims



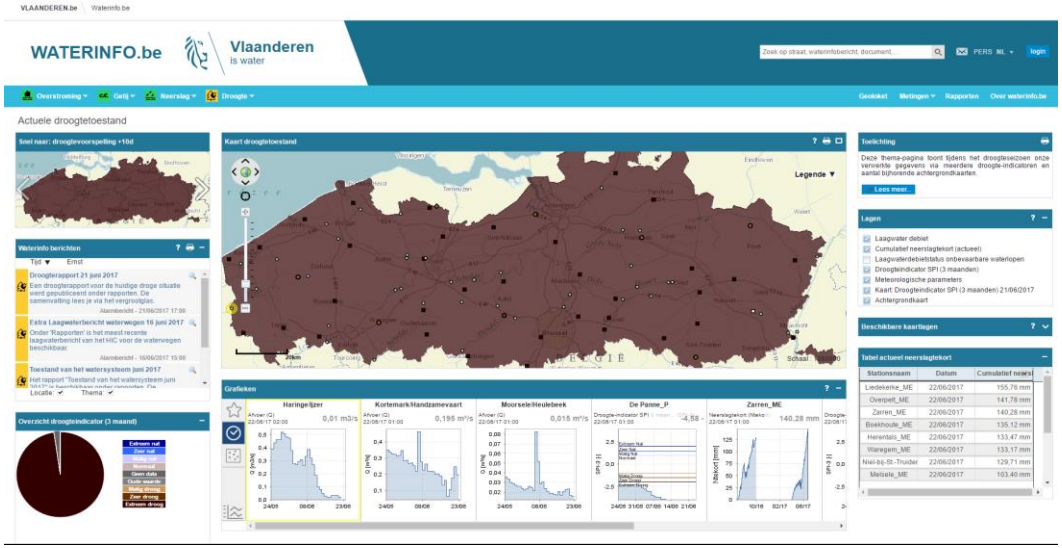
1. Recent weather extremes

- **Drought – June 2017**

  → March 2017 – may 2017:
  - × 99,7 mm ↔ longterm average 187,8 mm

  → June 2017:
  - × 19,7 mm ↔ longterm average 71,8 mm
  - × min 2,8 mm Poperinge

  → Top 3 drought in 50 years (P10 - P5)




FLANDERS NEWS.BE

"Drought is costing farmers 187 million already"

Mon 19/06/2017 - 11:47 Michaël Torfs

The continuing dry spell is a disaster for Belgian farmers. The situation is worst in West Flanders, which had even less rain than other provinces over the past months. Farming expert Luc Busschaert calculated for Het Nieuwsblad that almost 200 million euros have been lost already/will be lost looking at the situation now.


FLANDERS NEWS.BE

Anti-drought measures extended to the whole of Flanders

Wed 21/06/2017 - 14:37 Michaël Torfs

The Flemish Environment Minister Joke Schauvliege has extended measures to stop the wasting of tap water as the drought continues. A number of things will be prohibited, like washing your car, sprinkling your lawn, or filling a (small) outdoor pool using tap water as from Thursday. Schauvliege

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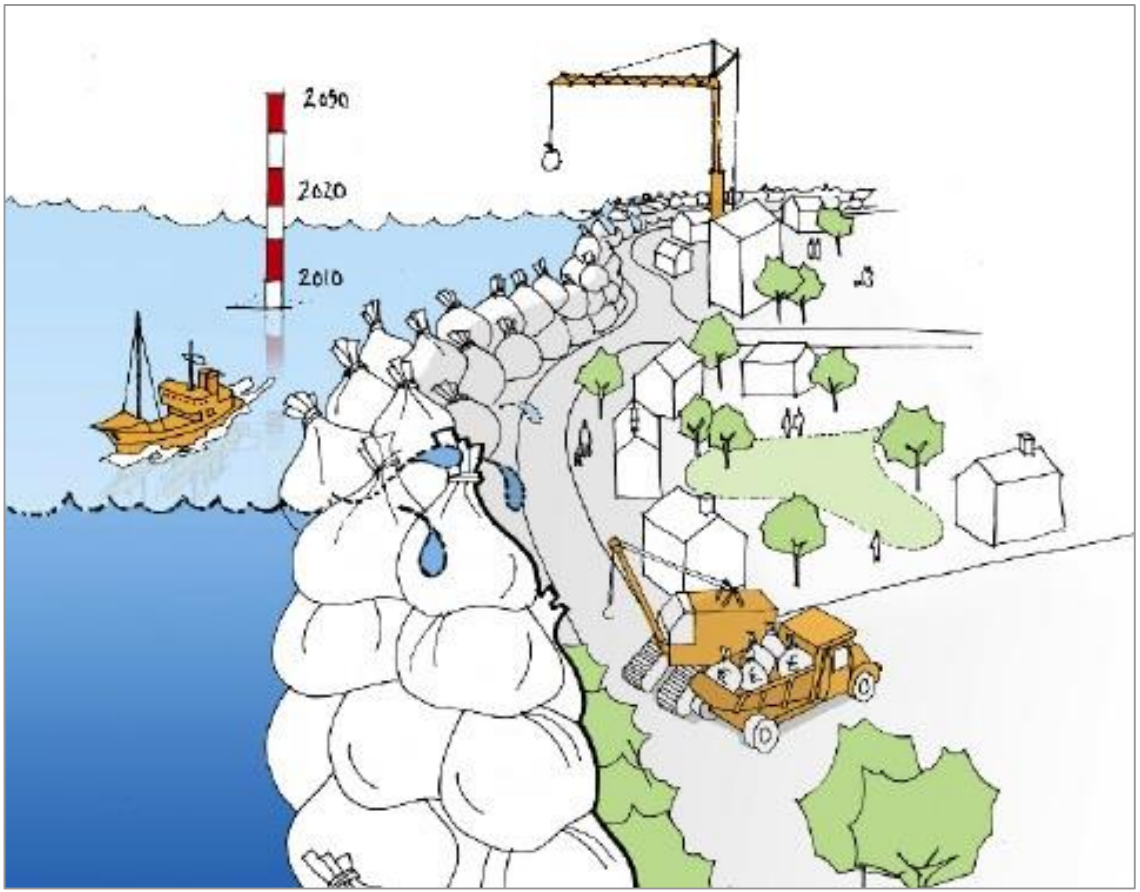
How to deal with these changing weather extremes ?



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2. Flood Risk Management

- **EU Floods Directive 2007**

  → EU-memberstates need to submit (each 6 years) a FRM-**Plan** including measures causing a "*reduction of the potential negative consequences of flooding for human health, the environment, the cultural heritage and economic activities*"
  (integrated in RBMP-II, *http://www.integraalwaterbeleid.be/nl/stroomgebiedbeheerplannen*)

  → Produce Flood hazard **maps**
  → Define Floodrisk **objectives** (planhorizon 2050)

  × Floods Directive defines risk = probability * consequences
  × Floods Directive Taken requires to include in the FRM-plan: cost-benefits, autonomous developments and climate change.
  × Measures have to focuss on **P**rotection, **P**revention and **P**repardness

2. Flood Risk Management

- **Flood Risk Management Goals**

  → Cit. "… **Sustainable** reduction of flood risk in Flanders, with sufficient protection for humans, economic activities, the ecosystem and cultural heritage"

  → Cit. " *… reducing the flood riks by lowering the flood probabilities and the flood damages. An optimal mix of protective, preventive and prepardness measures is needed so the residual risk is reduced to a socially acceptable level.*

  *At least the **autonomous developments due to climate change and changing landuse are nullified** with measures based upon positive cost-benefit efficiencies and resulting in maximum benefits for humans, economic activities, ecosystem and cultural heritage".*

2. Flood Risk Management

- **Flood Risk Management Plan:** main conclusions

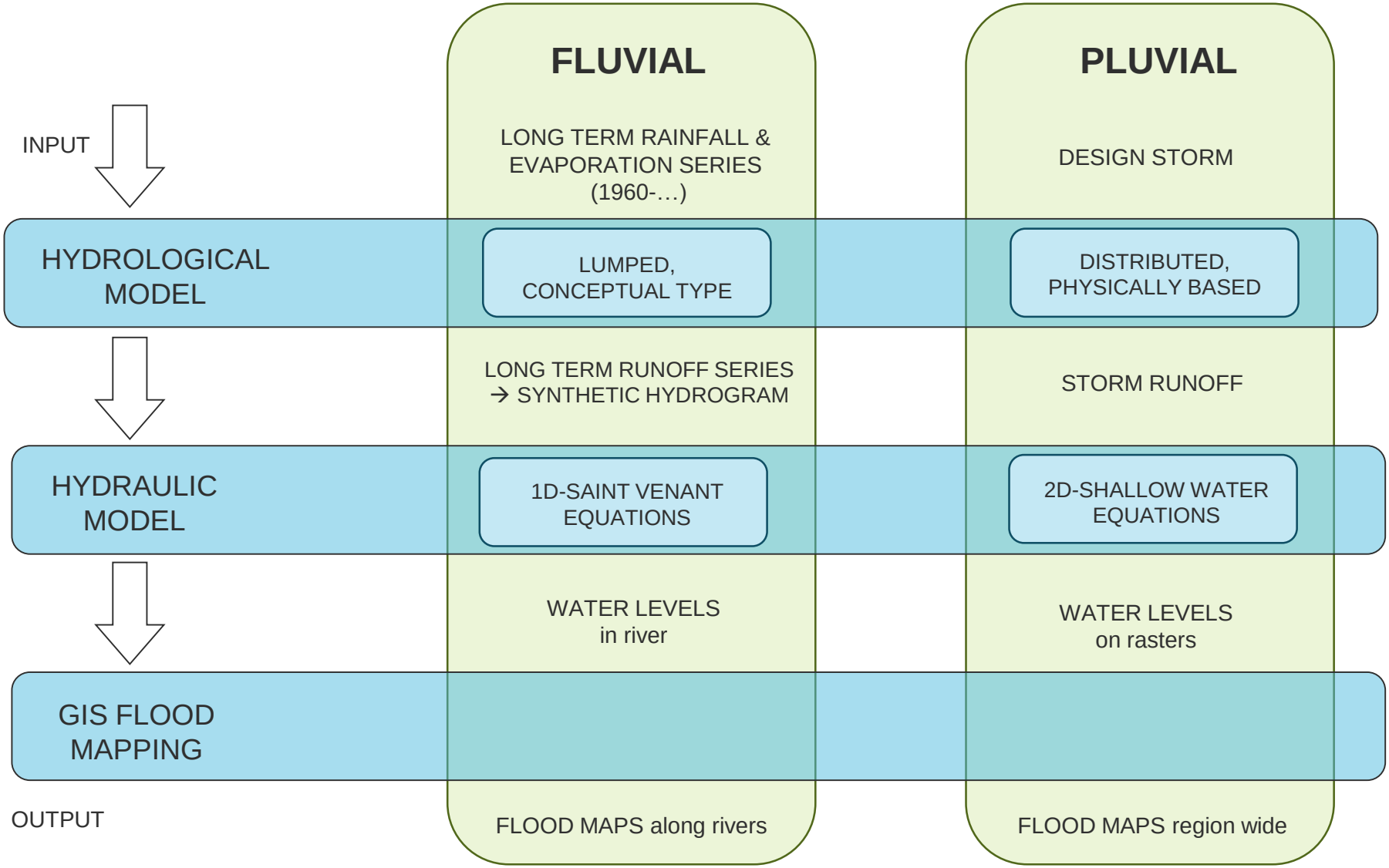
  → No-action policy = (autonomous developments due to climate change [**mean** variant] and landuse changes till **2050**) =>

  × Economisch risk (mio €/year): + **42%** on average
  × Social risk (People@Risk): **+ 54%** on average

  → With only no-regret protective measures (= 30 extra dikes + 37 reservoirs) => risk in 2050 is 10-22% **higher** compared to 2010.

  → Need for a transition towards « *Multi-Layered Water Safety policy* »
  = **extra** measures on prevention and prepardness needed !
  = **combination** of measures + shared responsabilities
  = Risc 2050 < Risc 2010

2. Flood Risk Mapping



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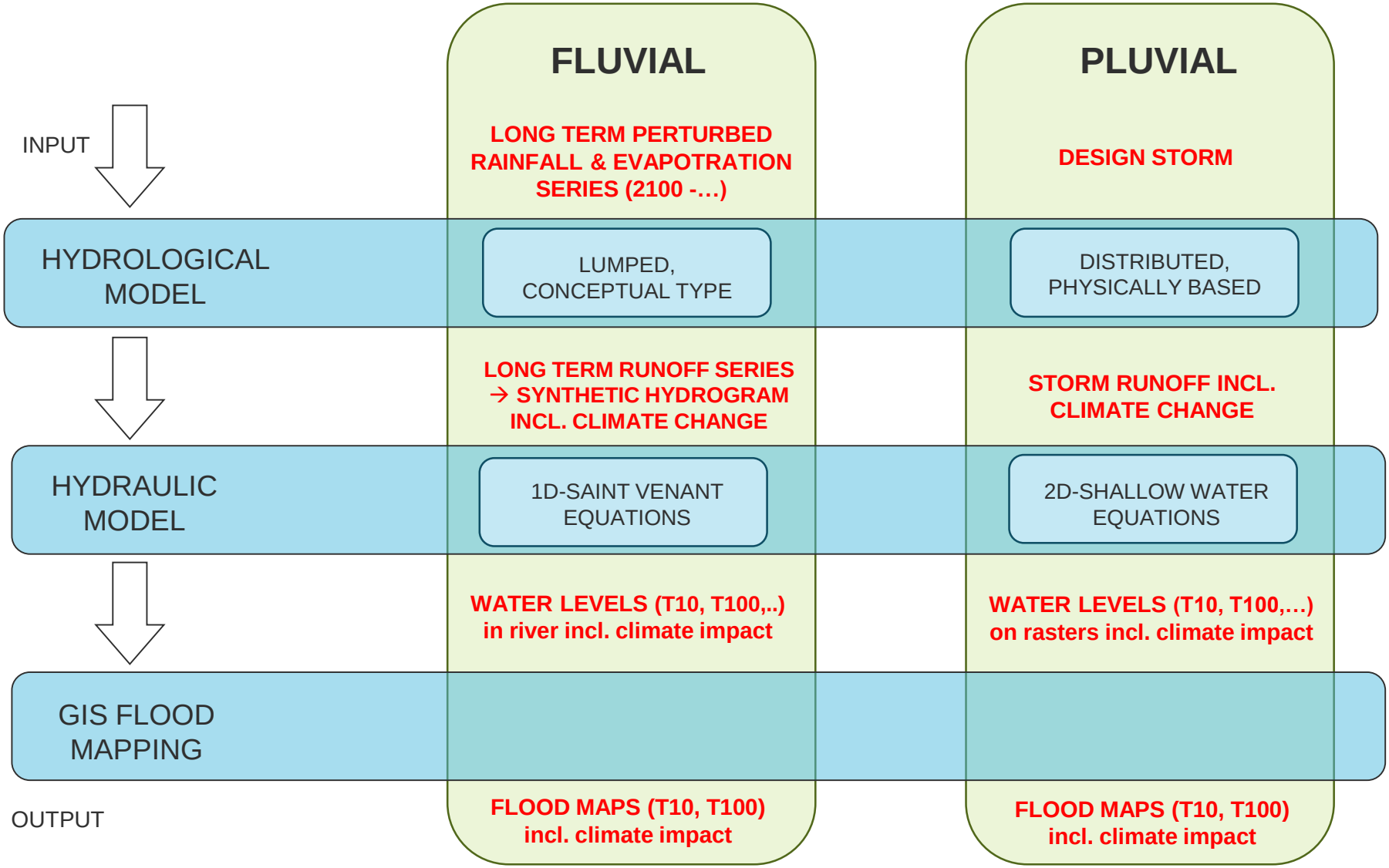

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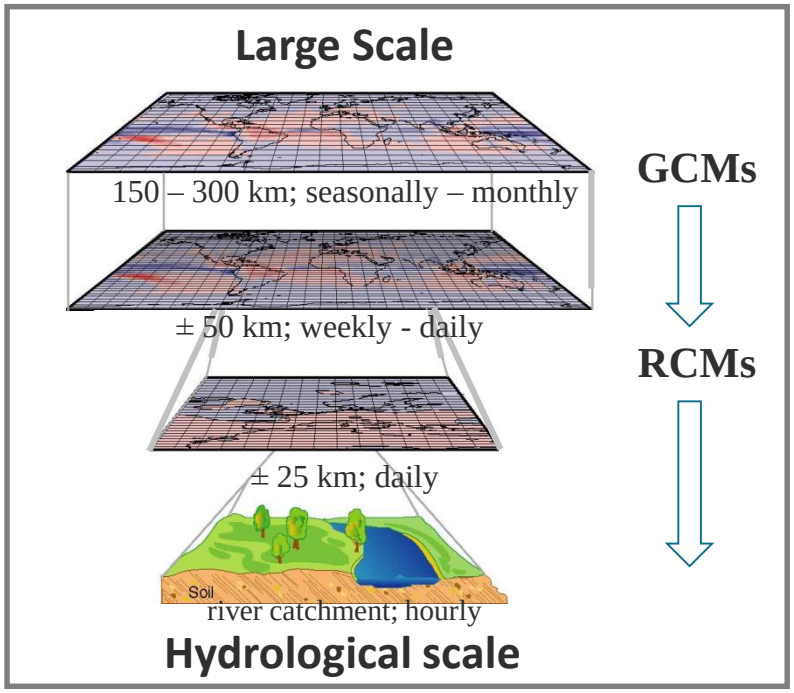
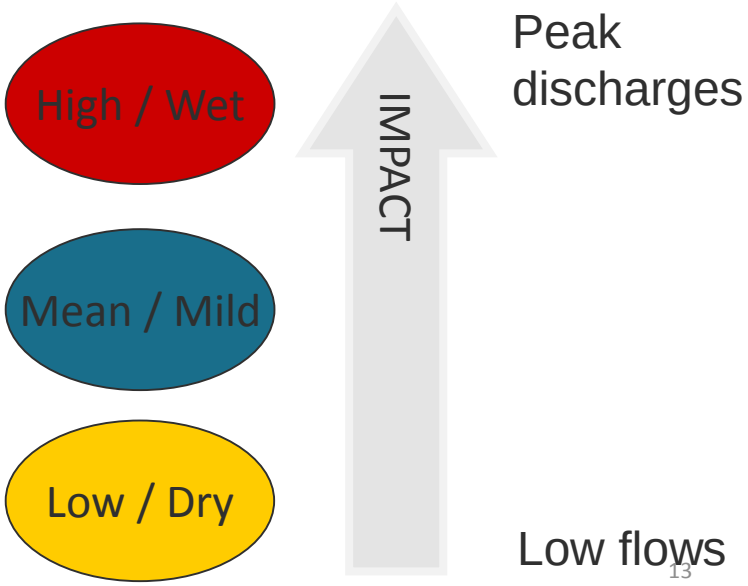


136 RCP runs for rainfall, 33 for evaporation are summarized in a high, mean and low climate change impact scenario for Flanders

For water management the high impact scenario after hydrological analysis is considered as worst case

Perturbation Tool:

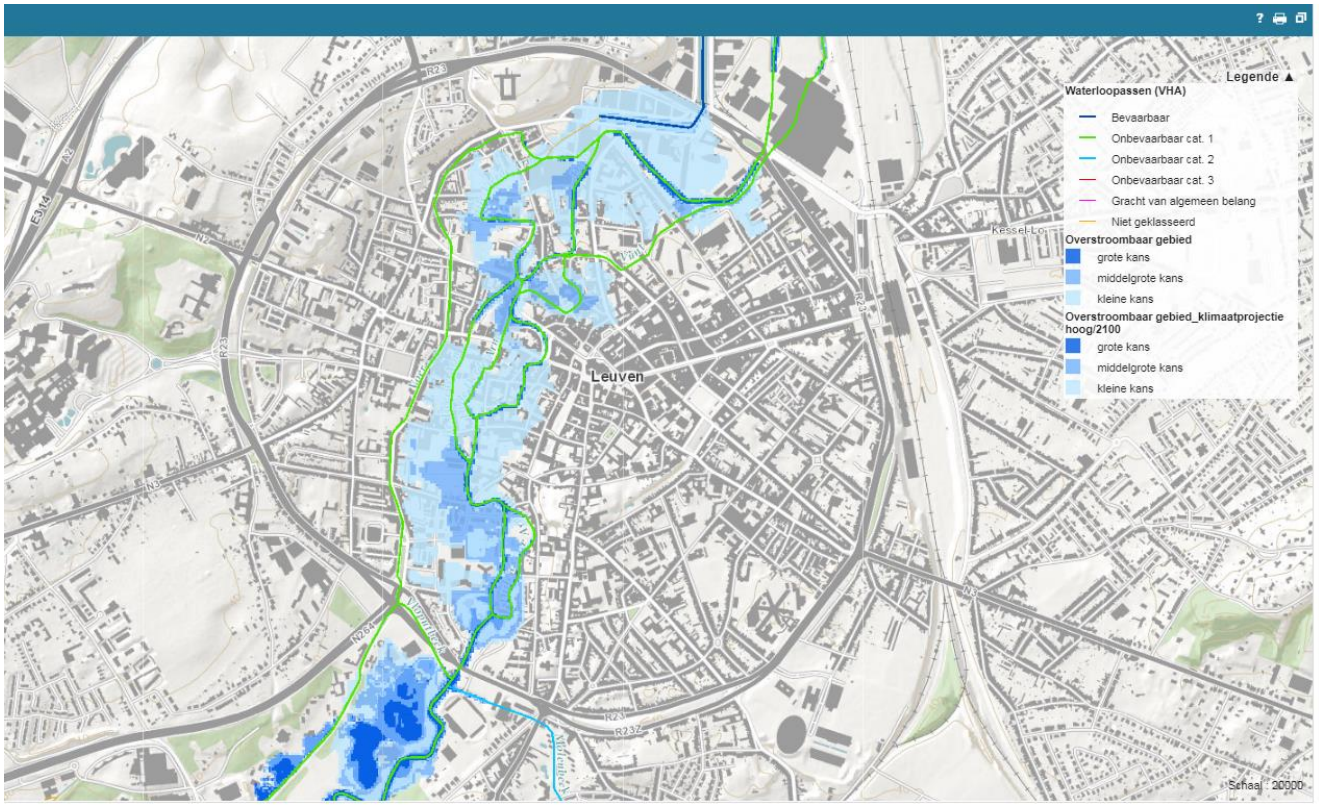


2. Flood Risk Mapping

- **Generation of fluvial flood maps (Leuven)**

  → 4000 km of maps (main rivers) => flooddepth for T10/100/1000

  → Notion of new threatened locations under climate change



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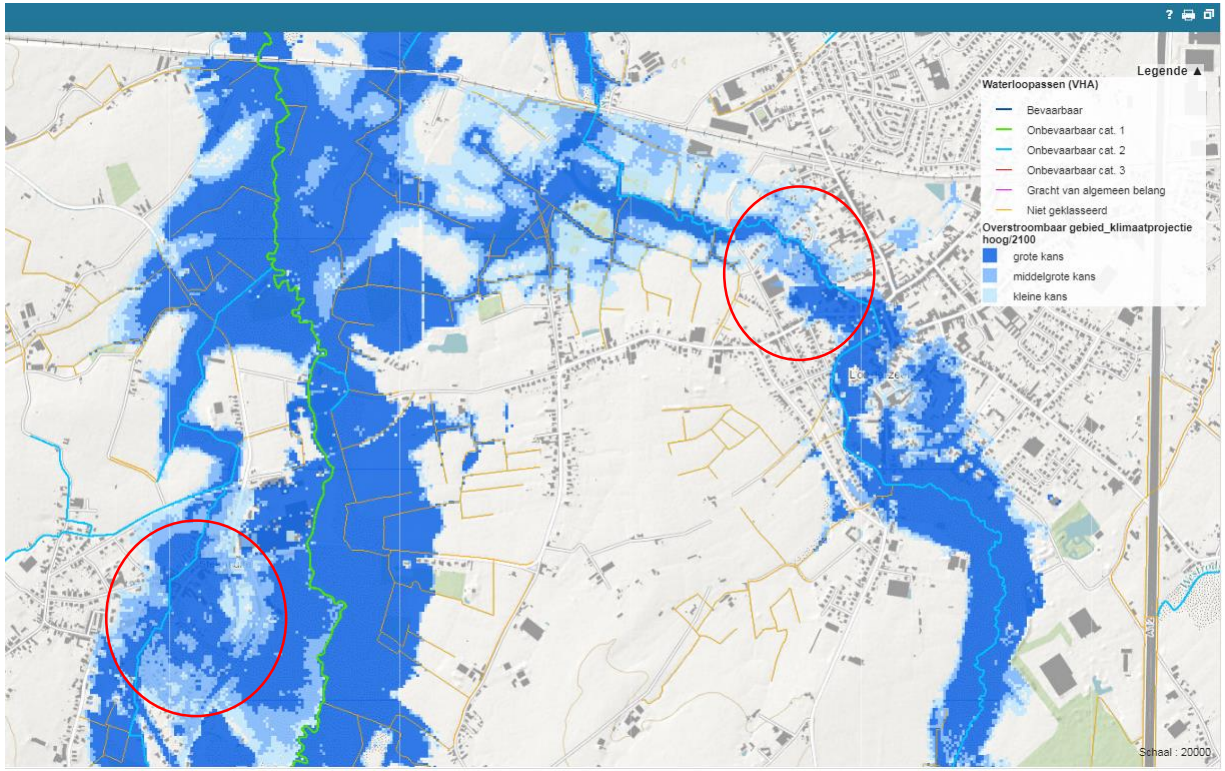
2. Flood Risk Mapping

- **Generation of fluvial flood maps (Londerzeel) 2100**

  → 4000 km of maps (main rivers) => flooddepth for T10/100/1000

  → Notion of new threatened locations under climate change



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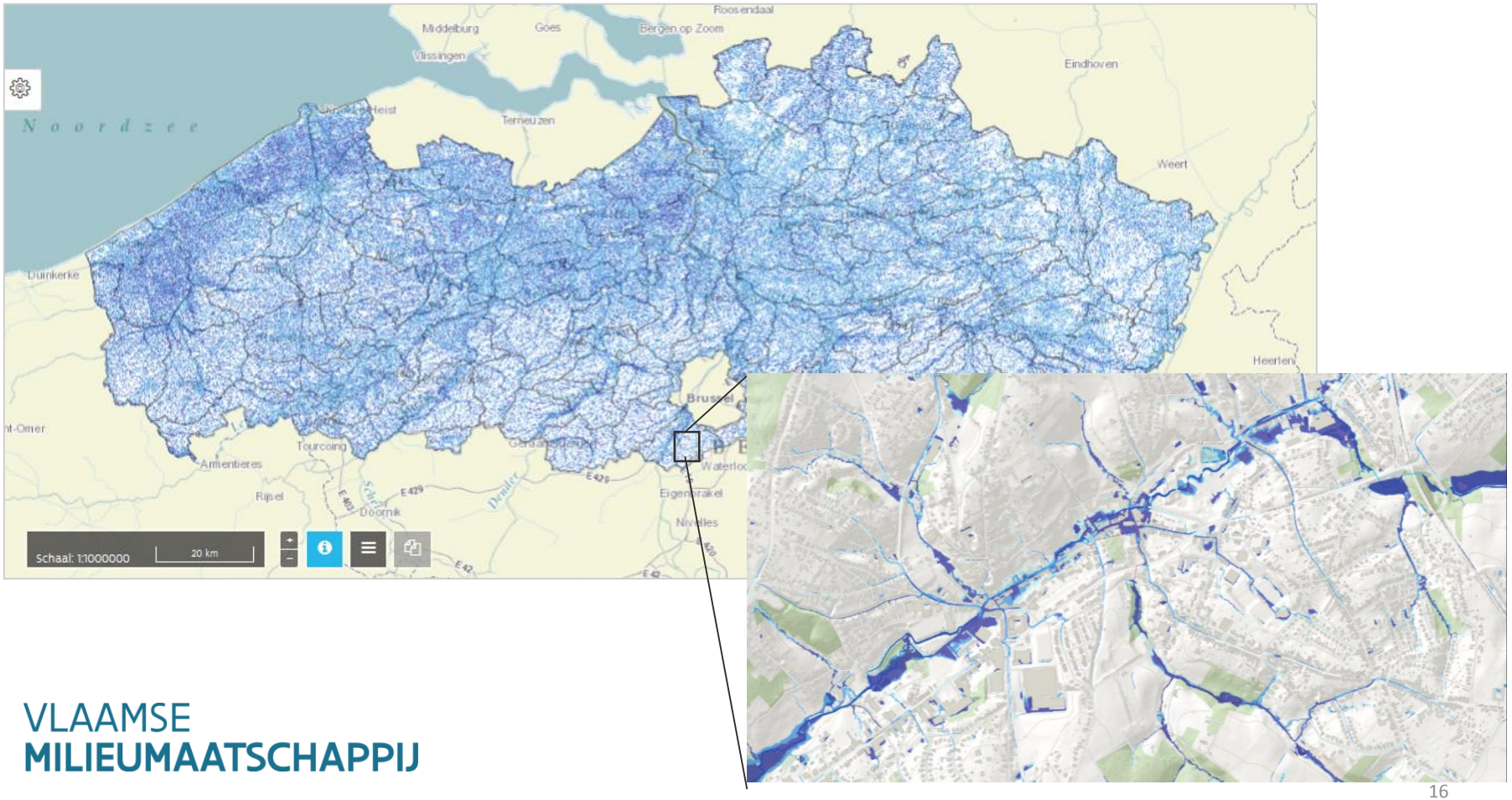
2. Flood Risk Mapping

- **Generation of pluvial flood maps**

  → Flanders wide map, high-resolution (2m grid) information

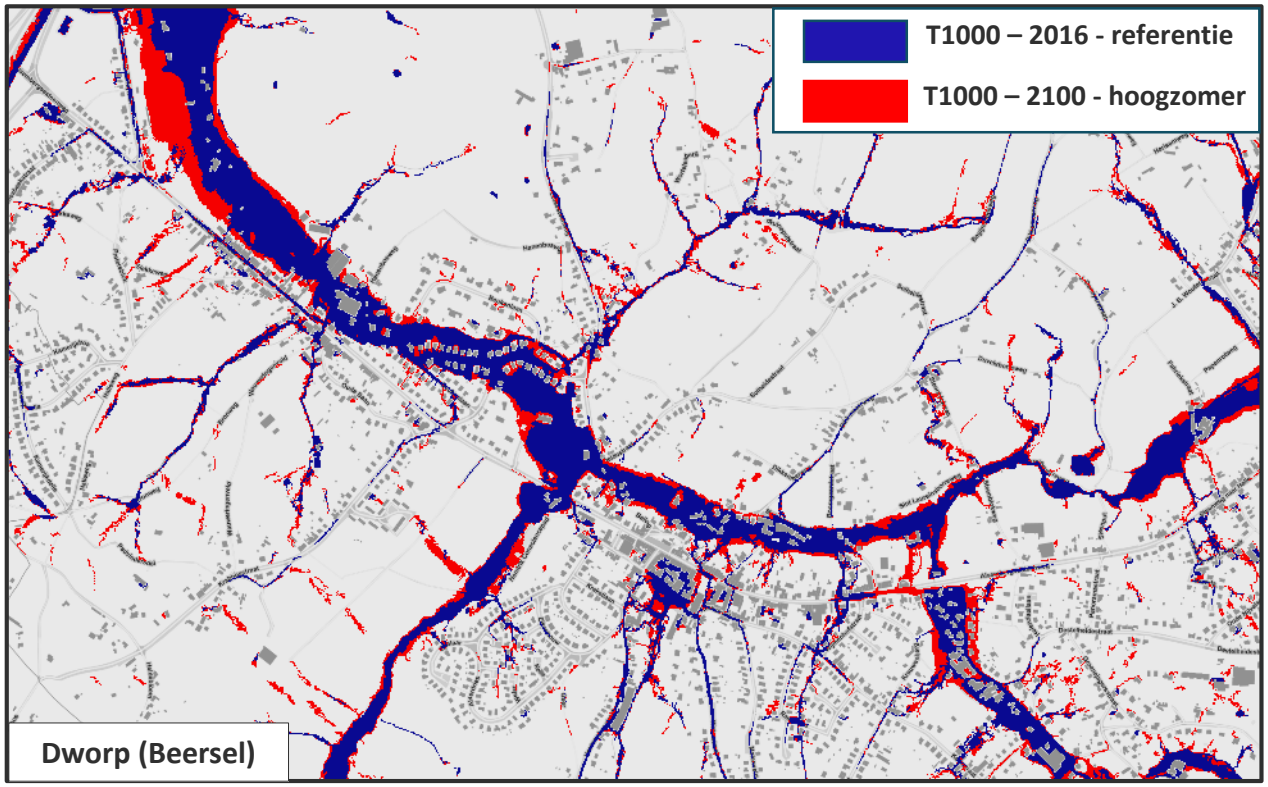


2. Flood Risk Mapping

- **Generation of pluvial flood maps 2100**

  → T10, T100 and T1000 maps,

  → Also for high impact CC-scenario @ 2100



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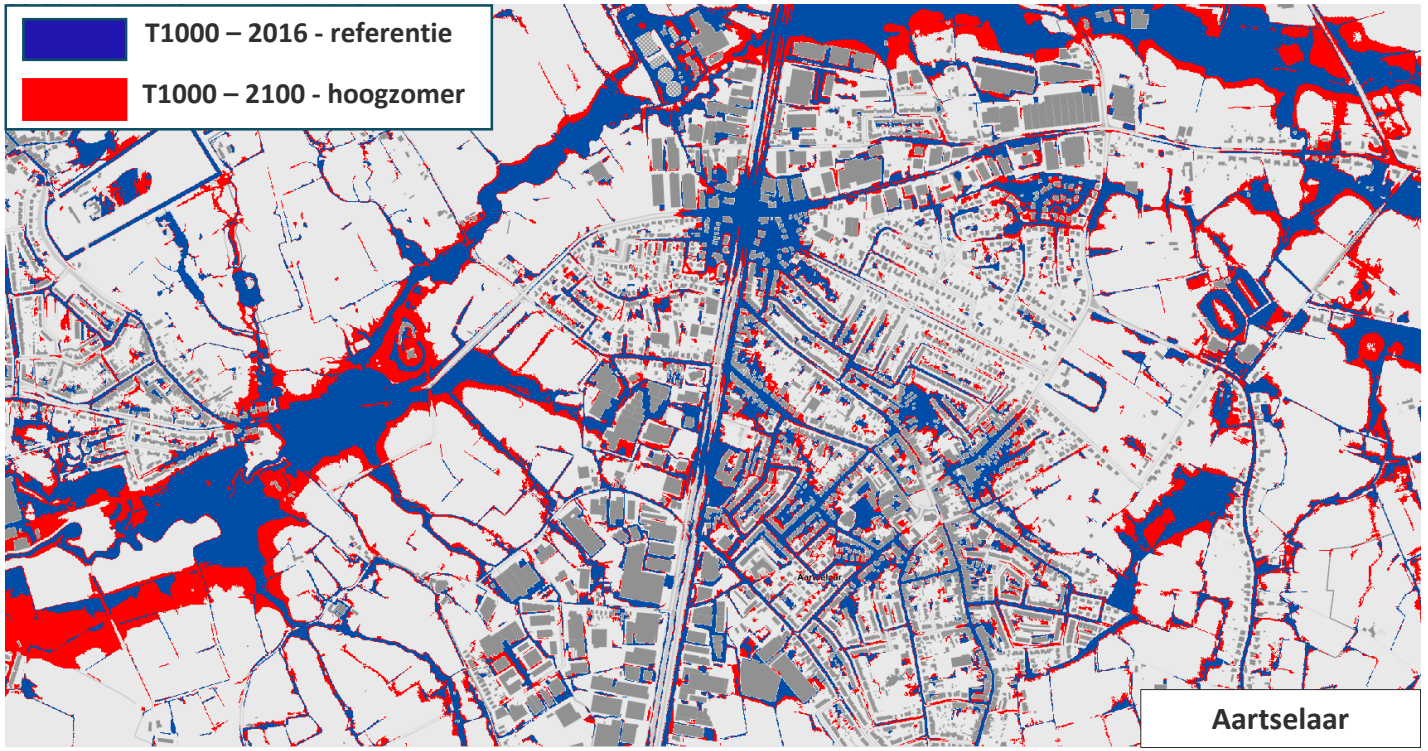
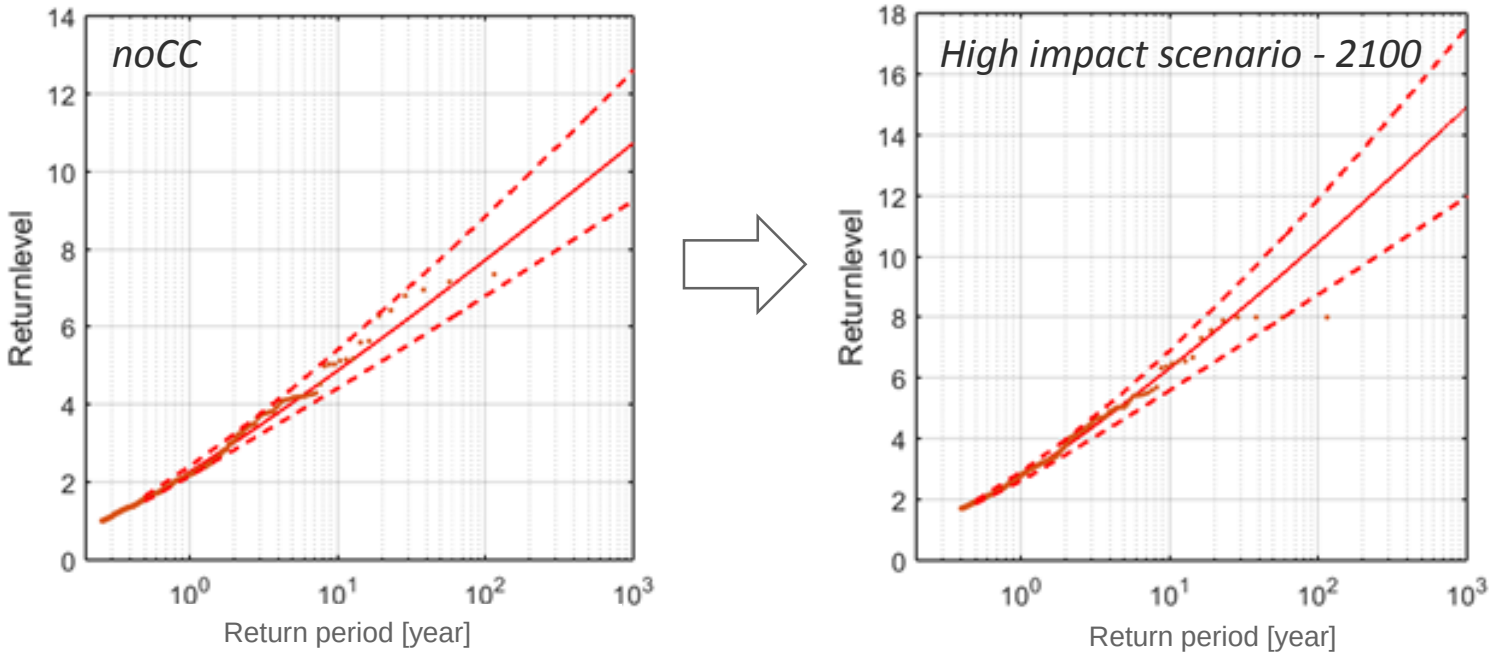


3. Climate impact on water systems

- **Change of peak discharges:** *+30% increase avg*.

Subcatchment Kleine Nete



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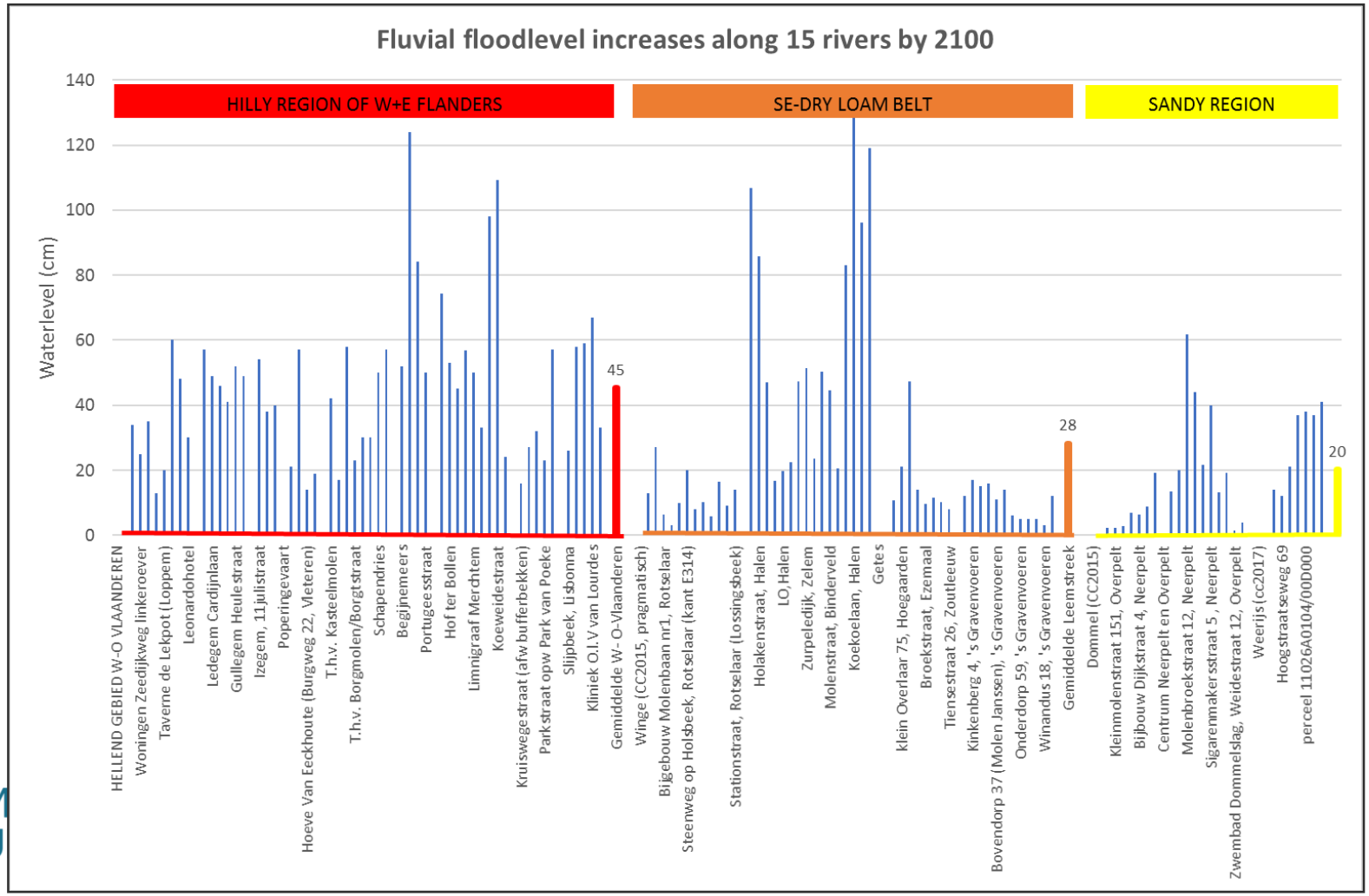
3. Climate impact on water systems

- **Change of maximum water levels:** *+20-45 cm avg. +**120cm** max. !*



3. Climate impact on water systems

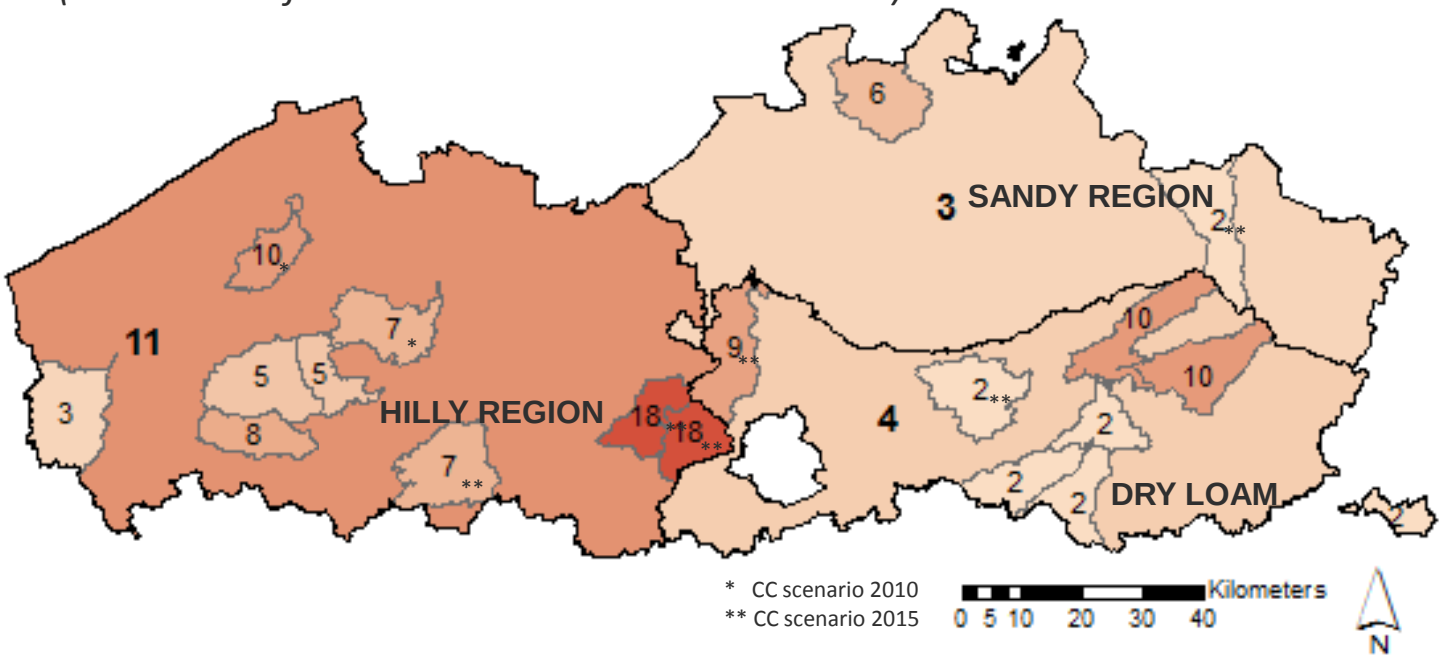
- **Change of flood frequency**: *factor 2-10 increase !*

Watercourse	Floodprone locations	Return period of critical event (current)	Return period of critical event (high scenario, 2100)	Factor change
Hilly loamy region				
Heulebeek	Dadizele,	50	5	**10**
Mandel	Ingelmunster	10	2	**5**
Poperingevaart	Poperinge	25	10	**3**
Maarkbebeek	Maarke-Kerkem	20	2	**10**
Viet-Molenbeek	Sneppelaar	50	5	**10**
Poekebeek	Ruislede	50	5	**10**
Loamy region				
Winge	Rotselaar	100	75	**1**
Gete	Helen-Bos	10	5	**2**
Sandy region				
Dommel	Neerpelt	30	15	**2**
Weerijs	Brecht	30	5	**6**

3. Climate impact on water systems

Change of flood frequency (factor)

Regional differences in CC-change factors – scenarios 2017
(means out of 47 catchments studied 2013-2017)



Lower climat-effect in Eastern catchments as peakflows are limited due to very low projected saturations. Higher storage capacity in sandy and loamy catchments takes longer to reach again significant saturations.

3. Climate impact on water systems

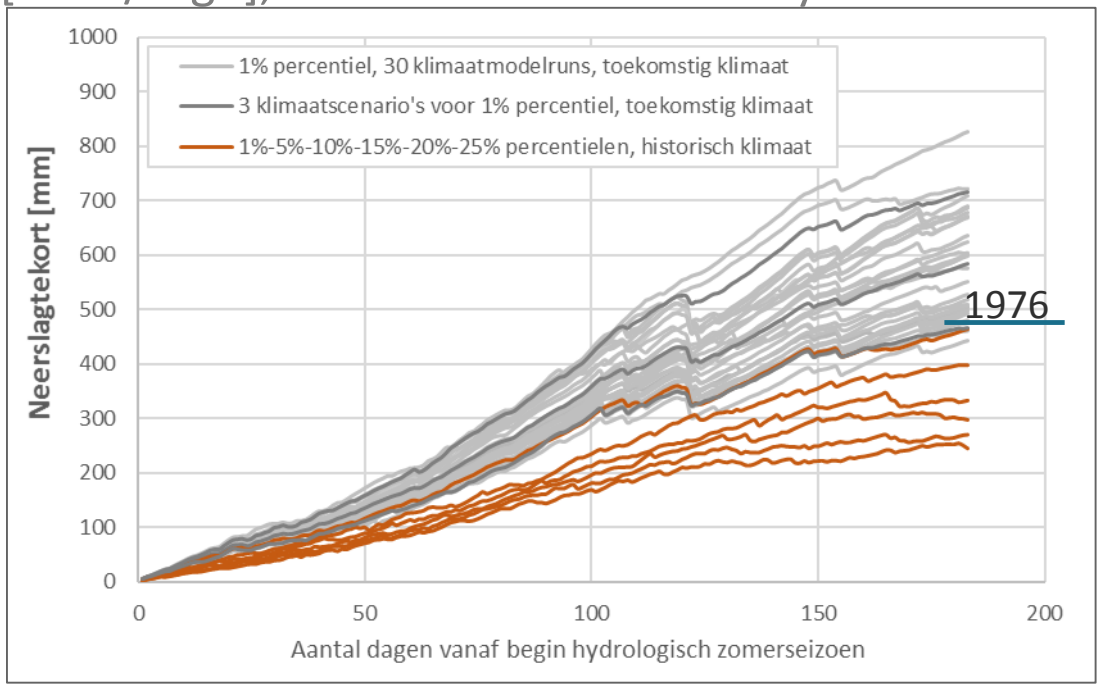
- **Change of low flows and droughts**

  → Low flows: 10 to 70% decrease [2100 - High]

  → Cumulative rainfall deficit between April 1th and September 30th:

  + factor 6.5 [2100/Mean]

  + factor 20 [2100/High], summer 1976 each 2-5 years



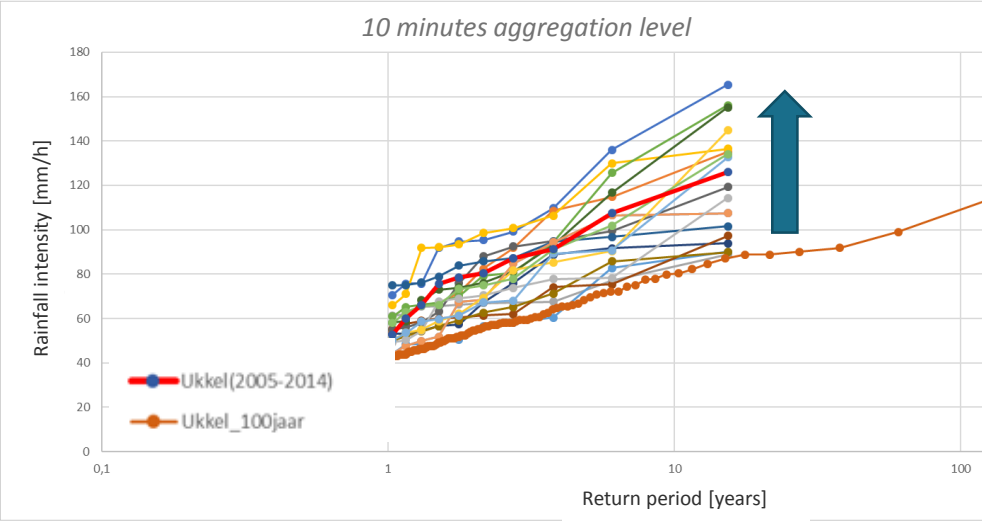
3. Climate impact on water systems

Observed Change in extreme rainfall

→ In 2011: 7,5% increase for 10 minute aggregation IDF's.

→ Observed increase of rainfall intensities the last decade for 10-minutes and daily aggregation levels

→ T5 storms: observed 10-15 times on same spot last 12 years



rang	locatie	stationsnummer	datum	neerslag (mm/u)	T-waarde (jaar)
1.	St-Pieters-Leeuw	P08_009	29/07/2005	67.34	>200
2.	Kanne	P11_024	27/05/2016	62.48	>200
3.	Kanne	P11_024	20/05/2012	56.18	>200
4.	Roeselare	P05_039	28/07/2014	53.81	>200
5.	Tessenderlo	P09_034	2/06/2008	51.54	>200
6.	Oostkamp	P02_004	4/07/2005	51.41	>200
7.	Wingene	P_ALMC_WN01	28/07/2014	49.4	>200
8.	Stekene	P03_036	14/05/2009	46.71	>200
9.	Bonheiden	P_ALMC_BO01	28/06/2011	46.1	>200
10.	Overpelt	P11_002	29/07/2014	45.13	>200
11.	Lummen	P09_016	10/09/2005	43.32	>200
12.	Loenhout	P11_007	6/06/2011	42.45	173.4
13.	Zarren	P01_003	31/07/2008	42.13	164.4
14.	Bonheiden	P_ALMC_BO01	21/06/2013	41.7	153.2
15.	Rotselaar	P08_028	23/08/2011	41.68	152.7
16.	Runkelen	P09_026	14/07/2010	40.12	118.0
17.	St-Pieters-Leeuw	P08_009	14/06/2007	39.94	114.5
18.	Bonheiden	P_ALMC_BO01	5/07/2012	39.9	113.8
19.	Boekhoute	P03_017	3/08/2006	39.87	113.2
20.	Neeroeteren	P11_043	7/06/2016	39.67	109.5
21.	Oostkamp	P02_004	30/08/2015	39.31	103.2
22.	Bonheiden	P08_018	28/06/2011	39.18	101.0
23.	Tielt-Winge	P_ALMC_TE01	29/07/2014	38.9	96.4
24.	Overpelt	P11_002	29/07/2005	38.8	94.9
25.	Wingene	P_ALMC_WN01	30/08/2015	37.7	79.1
26.	Lummen	P09_016	29/07/2014	37.54	77.0
27.	Liedekerke	P07_006	15/05/2008	36.92	69.5
28.	Zarren	P01_003	4/07/2005	36.87	69.0
29.	Korbeek-Dijle	P08_013	18/08/2011	36.58	65.7
30.	Bonheiden	P08_018	18/08/2011	36.45	64.3

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4. Use climate projections in waterpolicy

- **Water-test** *(www.watertoets.be)*
- **Signal-areas** *(www.signaalgbieden.be)*
- **Adaptive design**
- **Climate Communication**

4. Use climate projections in waterpolicy

- **Water-test** *(www.watertoets.be)*

  = « For all new developments in floodplains compulsary advice has to be asked at the watermanagers »

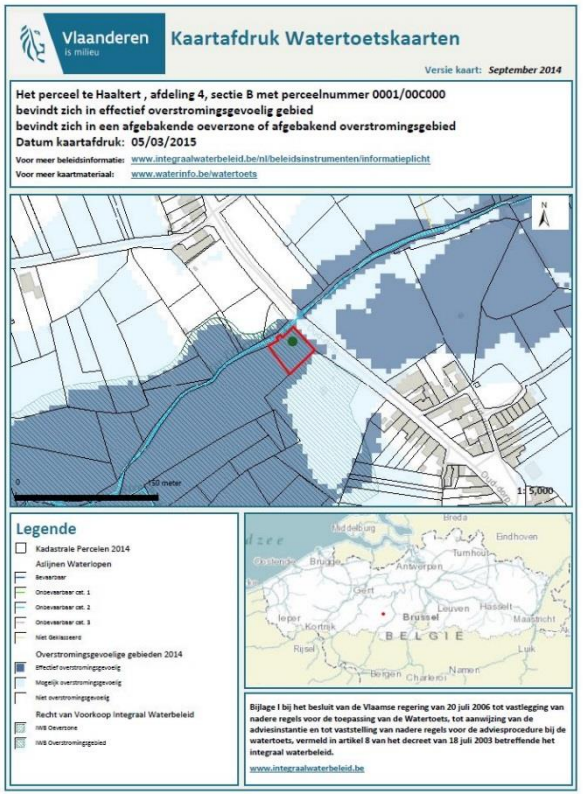
  → Adviced «Watersafe floorlevels » =

  T-100 year waterlevel

  + climate change increase (high-scenario)

  → + 2000 advices /year by VMM

  → Before each property transaction, information on the flood status has to be provided (= information duty)



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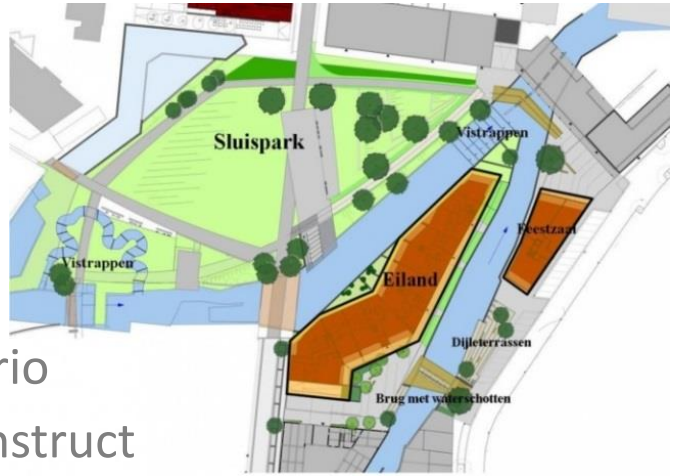
4. Use climate projections in waterpolicy

- **Water-test:** *example 'Dijledelta – Leuven'*



→ Urban development project (60.000m², 140 mio €)

→ Floor level 19,20 mTAW (+ 70cm ground level)

= **T 200-500** level – High impactscenario

→ Opening of Dijle river, install park, construct dijle terraces, fish ladder, sluices, walls on riverbanks

4. Use climate projections in waterpolicy

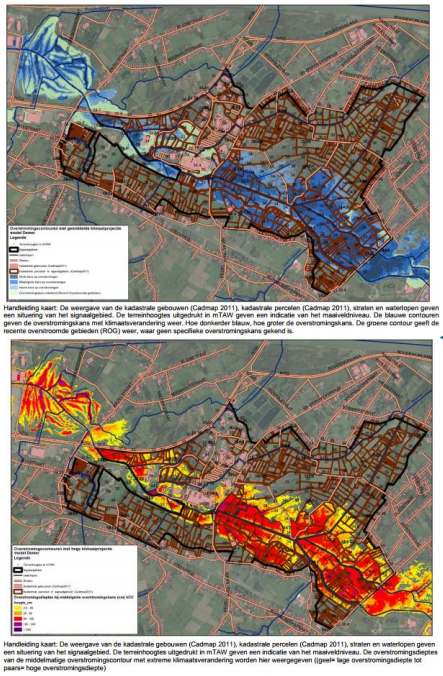
- **Signal areas** *(www.signaalgebieden.be)*

  = " open and non-built areas with a contrast between its planning destination and the concerns of the watersystems"

  - 235 signal areas in Flanders
  - the Flemish Government decides about their future development by a general framework. Based upon flood probabilities, the area is divided in the following zones:

    1. ***No buiding zone*** *in T10 flood => change of destination*
    2. *Zone with* ***conservation of destination*** *+ flood-proof building conditions*
    3. *Zones with building restrictions (infiltration, rainfall storage,..)*

  - « Climate-test » included in files on Starting Decission



4. Use climate projections in waterpolicy

- **Signal areas:** *Example of 'Campus Diepenbeek'*

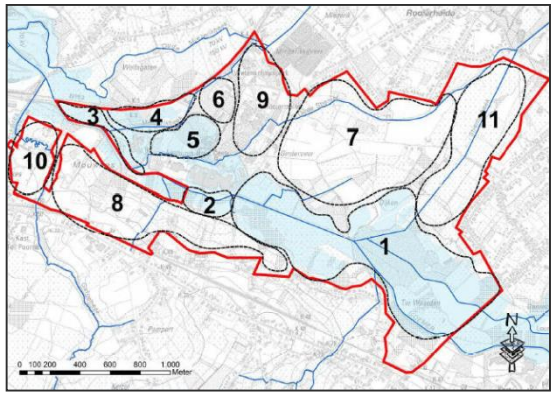
  → largest in Flanders (ca 375 ha)

  → near river Demer and Stiemerbeek, which **frequently floods**

  → divided in different zones with other perspectives according the flooding frequency:

  × zones with high flood frequency are **reserved** for nature

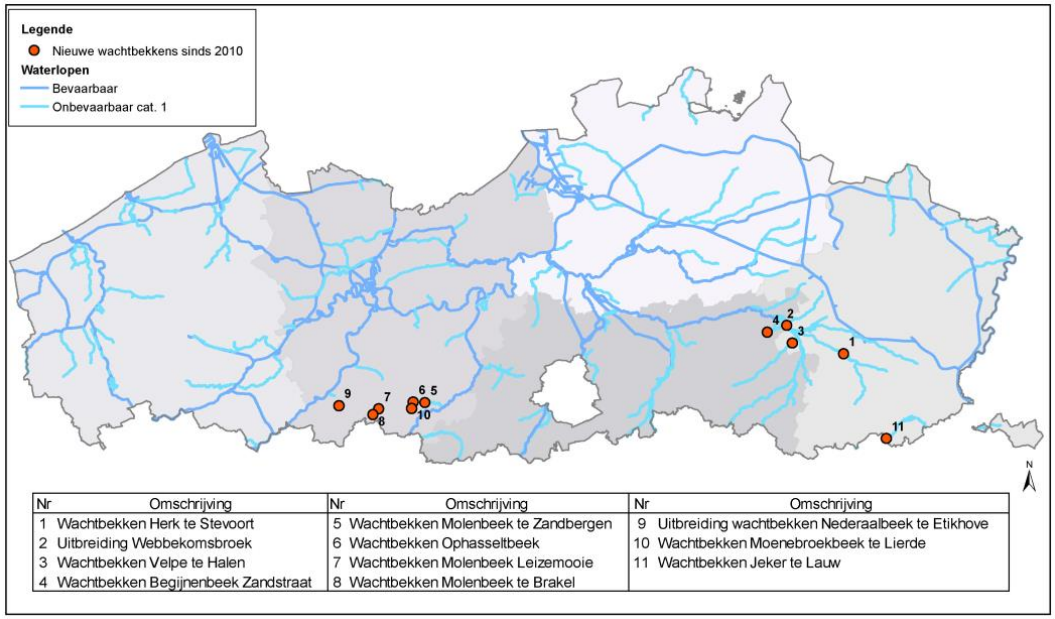
  × for other zones conditions are imposed (a.o. **floodproof building**) in the planning regulations



4. Use climate projections in waterpolicy

- **Adaptive design**
  - → Construction of new retention climate-proof basins
    - × Stevoort, Halen, Zandbergen, Ophasselt, Brakel, Lierde, Lauw, Liezemooie,
  - → Extension of existing retension basin (second step)
    - × Webbekomsbroek, Etikhove


Stevoort



Nr	Omschrijving	Nr	Omschrijving	Nr	Omschrijving
1	Wachtbekken Herk te Stevoort	5	Wachtbekken Molenbeek te Zandbergen	9	Uitbreiding wachtbekken Nederaalbeek te Etikhove
2	Uitbreiding Webbekomsbroek	6	Wachtbekken Ophasseltbeek	10	Wachtbekken Moenebroekbeek te Lierde
3	Wachtbekken Velpe te Halen	7	Wachtbekken Molenbeek Leizemooie	11	Wachtbekken Jeker te Lauw
4	Wachtbekken Begijnenbeek Zandstraat	8	Wachtbekken Molenbeek te Brakel		

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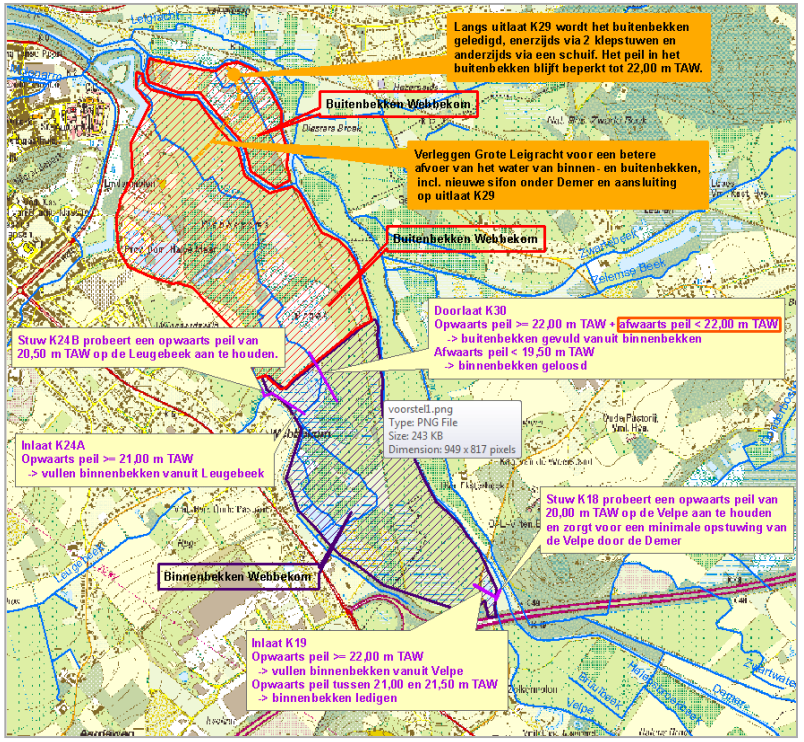
4. Use climate projections in waterpolicy

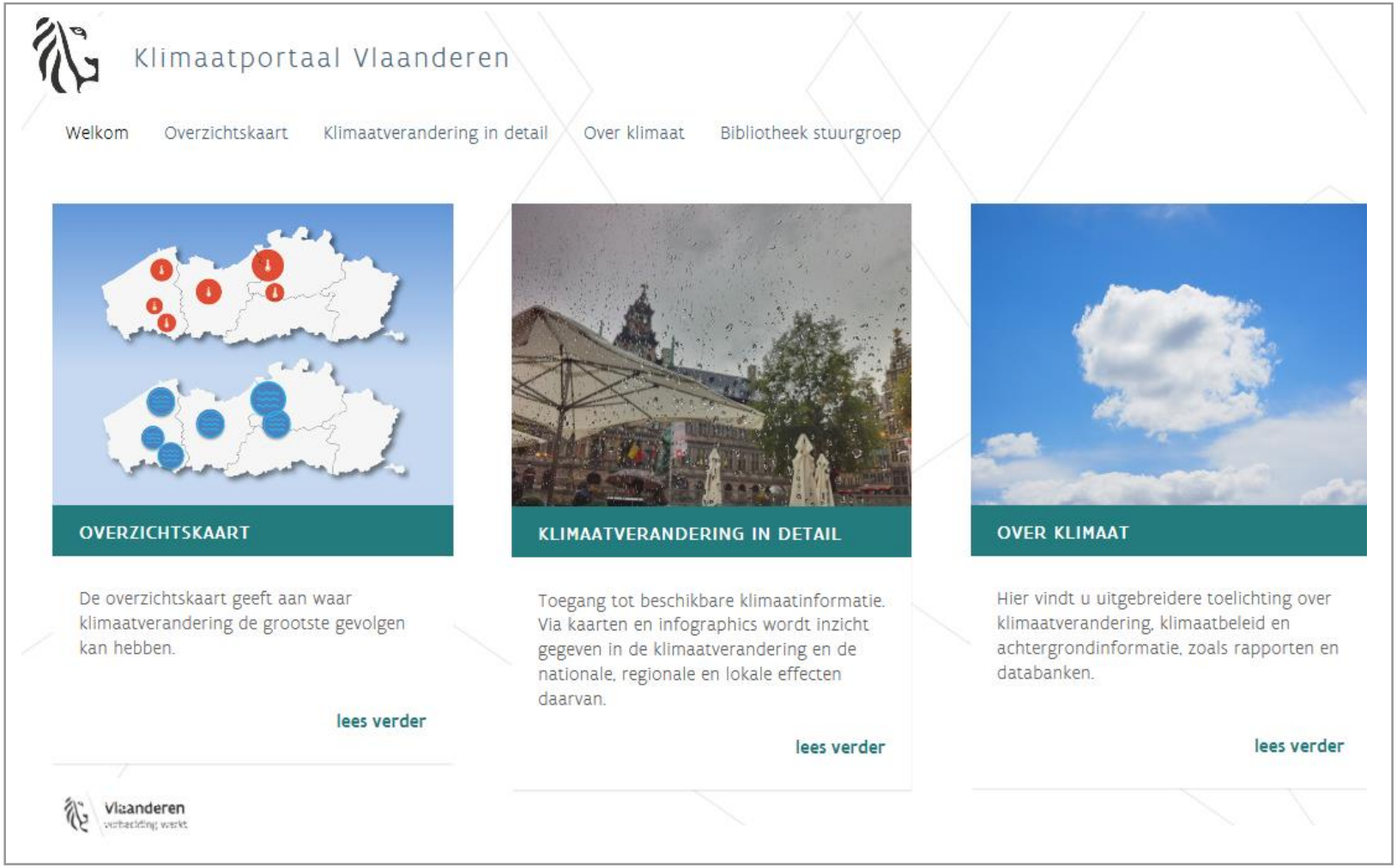
- **Adaptive design:** *Example 'Webbekomsbroek' basin*

  → extension of retention basin (2014)
  → to protect city of Diest
  → dike level **+0,5m**
  → storage capacity: + 700.000 m³
  → safety level increased with 10-15 years



4. Use climate projections in waterpolicy

- *Climate Communication*



4. Use climate projections in waterpolicy

- **Klimaatportaal.vmm.be will (in 2018) bring together all climate information in Flanders:**

  - → Climate state (temp., precip, evap., …)
  - → Climate effects (floods, drought, heat, …)
  - → Climate impact (people, sectors, municipalities, …)
  - → Broad target audience:
    - × mainly for cities and municipalities
      - → ‘Mayors Adapt’ - Climate change adaptation at city level
    - × research institutes, eductional and teaching purposes , media, etc.

5. Summary

- Recent (frequent) extreme weathers cause significant damage, +100 mio EUR/event.
- Climate change has potential to increase frequency of floods and droughts drastically (factor 2-10, 6-20).
- Climate projections are widely used in watermanagement (water-test, signal-areas, adaptive design).
- More Climate Communication/Action in Flanders will be needed to reduce flood- and drought risks

  => a new Flemmish Climate Portal is in development.