

Flood and drought security in Belgium: climate impact and adaptation

Physical and cyber safety in critical water infrastructure
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What is the impact of climate change on droughts and floods?

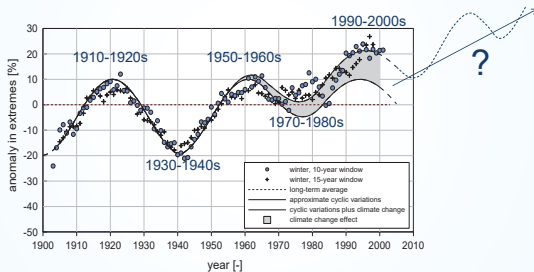
Climate change: temperature rise

Increase of yearly average temperature by +2°C in Belgium since 1900



... but also changing rainfall extremes

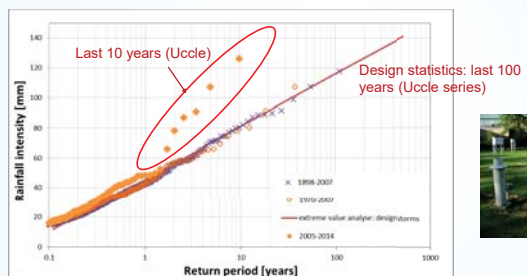
Multi-decadal oscillations in rainfall extremes (winter)



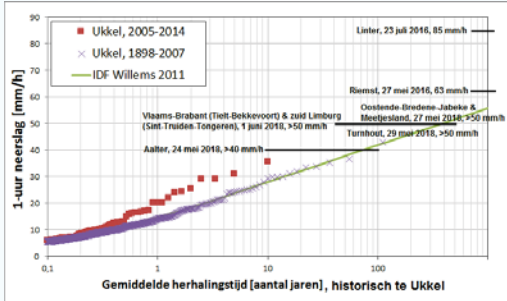
source: Willems, P. (2013), 'Multidecadal oscillatory behaviour of rainfall extremes in Europe', Climatic Change, 120(4), 931-944

Rainfall becomes more extreme

10-minute rainfall extremes in Uccle since 1898:



Rainfall becomes more extreme



... leading to more (urban!) floods

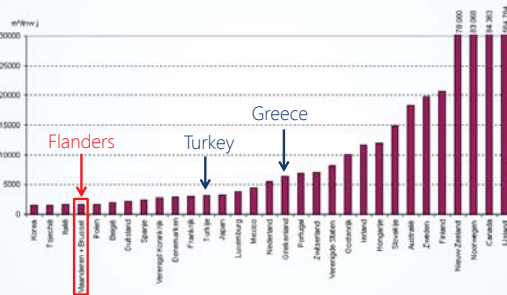
Antwerp (yearly...)



Aalter, 24 May 2018, 85 mm in 90 minutes

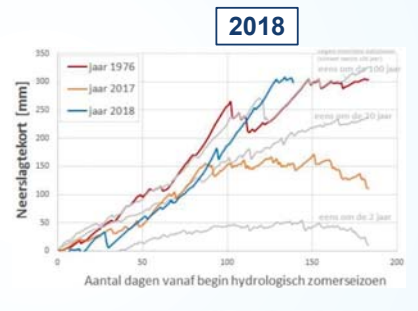


Water shortage: a serious risk in Belgium



Extreme droughts in 2017 and 2018

Waterkwaliteit in West-Vlaanderen levensbedreigend door droogte



Drought actions

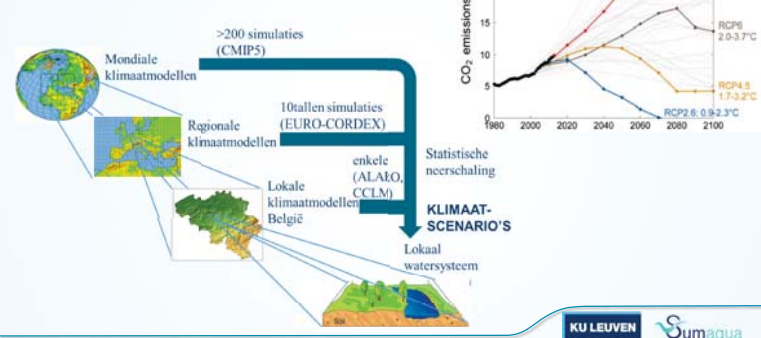
Schauwliege verbiedt waterspilling in heel Vlaanderen



Boeren krijgen Europese hulp na droogte

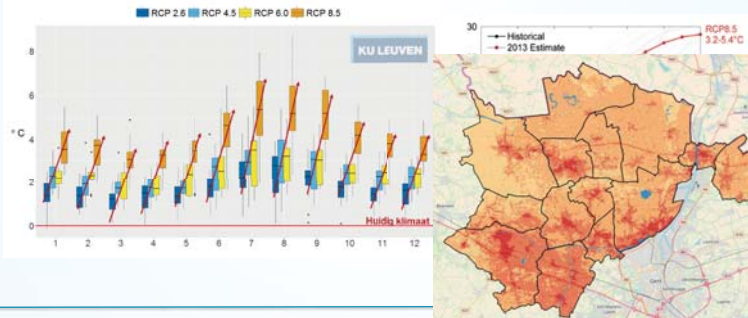


What does the future bring?



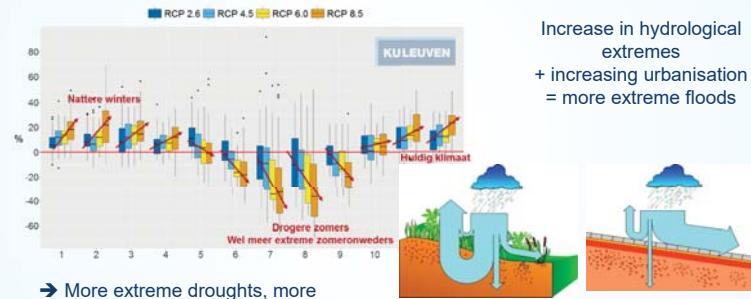
What does the future bring?

Temperature rise by 2100



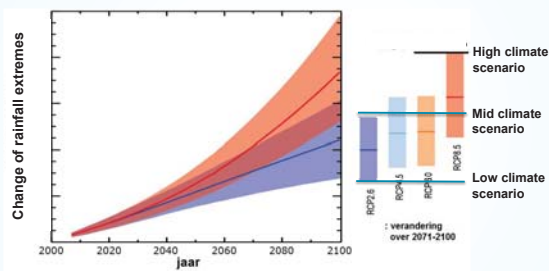
What does the future bring?

Increase in hydrological extremes
+ increasing urbanisation
= more extreme floods



→ More extreme droughts, more extreme (urban) floods

Climate change scenarios for policy making

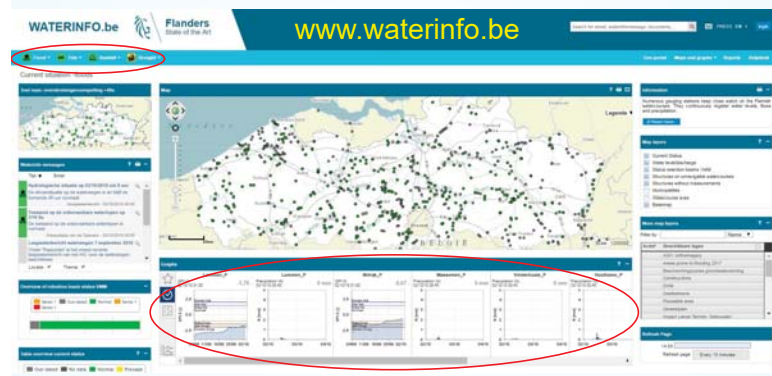
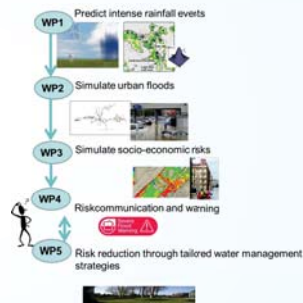


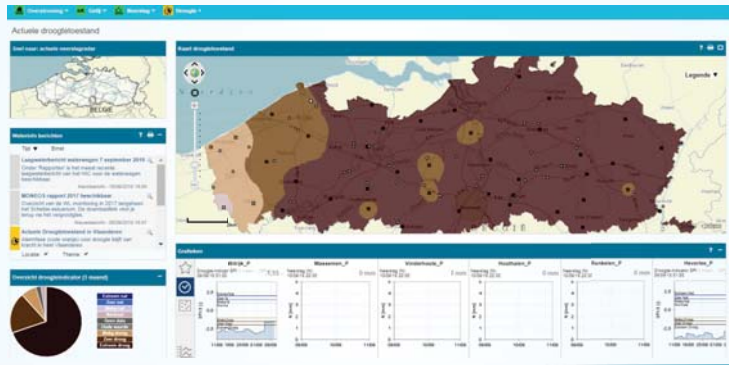
Adaptation actions

Strategy in Flanders

"Multilayer water safety":

- o Preparedness
- o Prevention
 - "Watertoets", spatial planning
 - Build resilient
- o Protection
 - Control basins
 - Dikes
 - Intelligent control
 - New technologies
 - ...





Climate adaptation and policy making

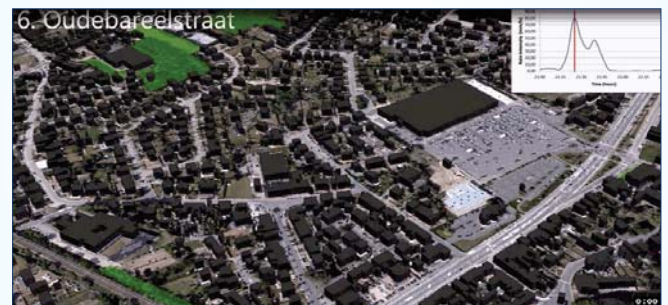
- Policy in Flanders (since 2014):
 - Every new building must have a rainwater tank + reuse its rainwater
 - Every new building must have an infiltration basin
 - "Watertoets": buildings in floodprone areas in prohibited ("give space to rivers")
 - Creation of regional and local climate adaptation plans ("Covenant of Mayors")



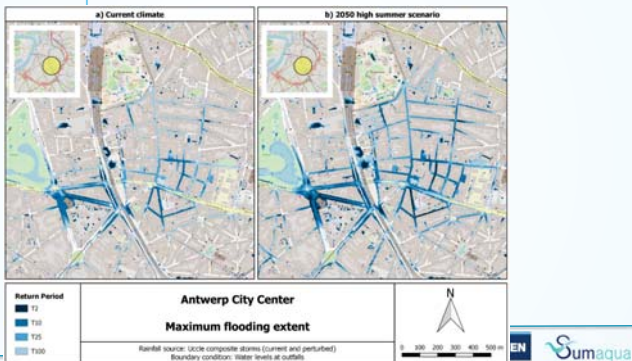
Case Antwerp



Case Antwerp

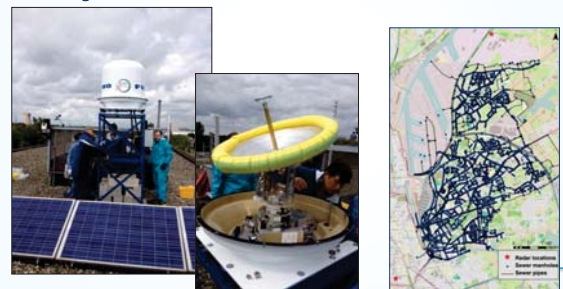


Case Antwerp: current vs. future climate



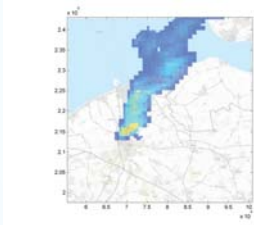
Weather forecasts: early warning and intelligent control

Local urban radars
High resolution (50m - 100m)

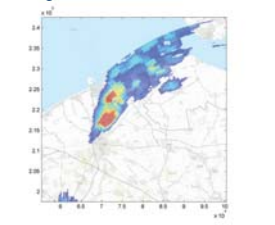


Weather forecasts with radars

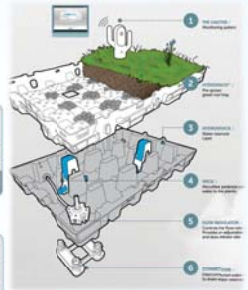
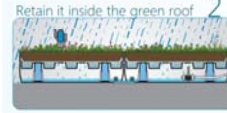
Large scale radars



Local urban radars
High resolution (50m - 100m)

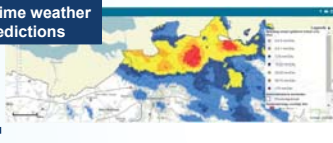


Innovation: intelligent green roof



Innovation: intelligent green roof

Real-time weather predictions



Real-time flood predictions

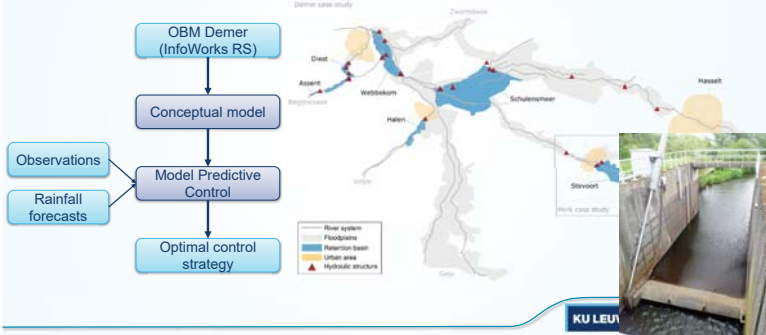


Conceptual models



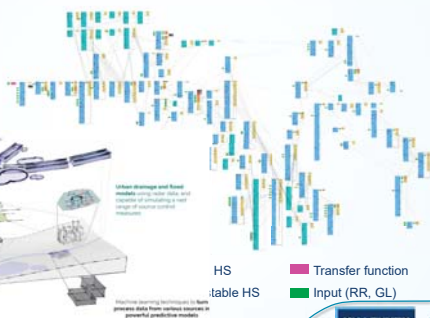
Decision making

Intelligent control of the Demer basin



Intelligent control of the Demer basin

- Conceptual model
- ✓ Fast!!
- ✓ Accurate
- ✓ Flexible



"SCAN" tool

HS
table HS

Transfer function
Input (RR, GL)

Intelligent control of the Demer basin

Event	Economic damage cost [€]		Damage reduction [%]
	PLC	MPC	
Sept1998	3.0M	2.1M	30
Aug2003	0	0	/
Dec1999	0	0	/
Jan1995	0	0	/
Jan2002	0	0	/
Nov2010	300	100	(67)
VMM	4.7M	3.5M	26
T1000	2.0M	1.7M	15
Sept1998x1.3	28.0M	26.8M	4
2xSept1998	28.1M	27.5M	2



Conclusions

- Water managers face new challenges
 - Rapid urbanisation
 - Climate change
 - more extremes x larger consequences = bigger risks!
 - Technicalities: Big Data
- Way forward: sustainable, targeted and tailored solutions
 - Climate change analysis, including uncertainties
 - Establish SUDS: sustainable urban drainage systems
 - If not avoidable: warning systems
 - New technologies emerge: intelligent real time control, Big Data models, ...



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