



Integrated modelling in Denmark: Current applications and research projects

Vezzaro, Luca; Mikkelsen, Peter Steen

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Integrated modelling in Denmark: Current applications and research projects

L. Vezzaro^{1,2)}, P.S. Mikkelsen¹⁾

1) Department of Environmental Engineering (DTU Environment),
Technical University of Denmark, Kgs. Lyngby, Denmark

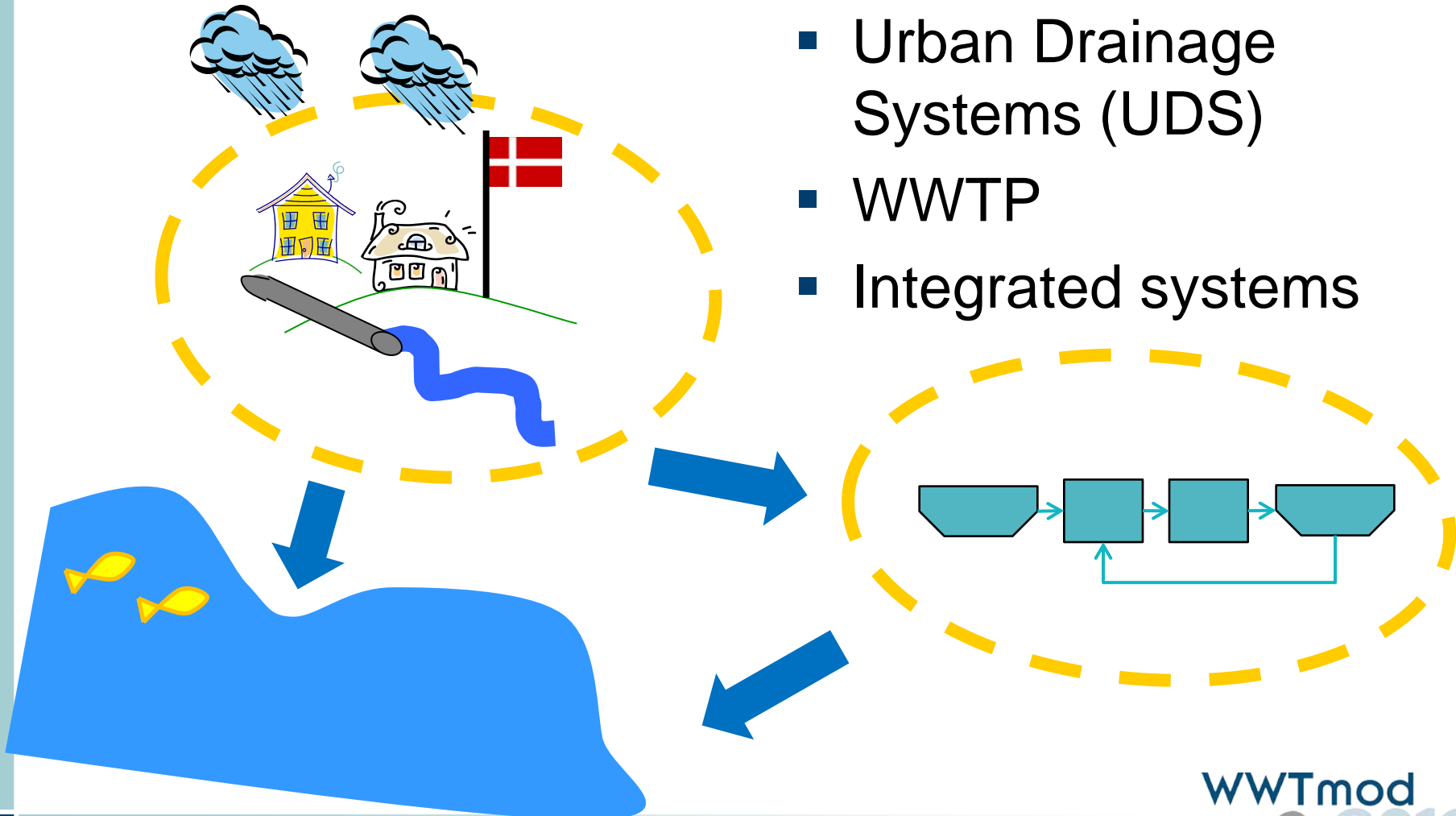
2) Krüger A/S, Søborg, Denmark



International
Water Association

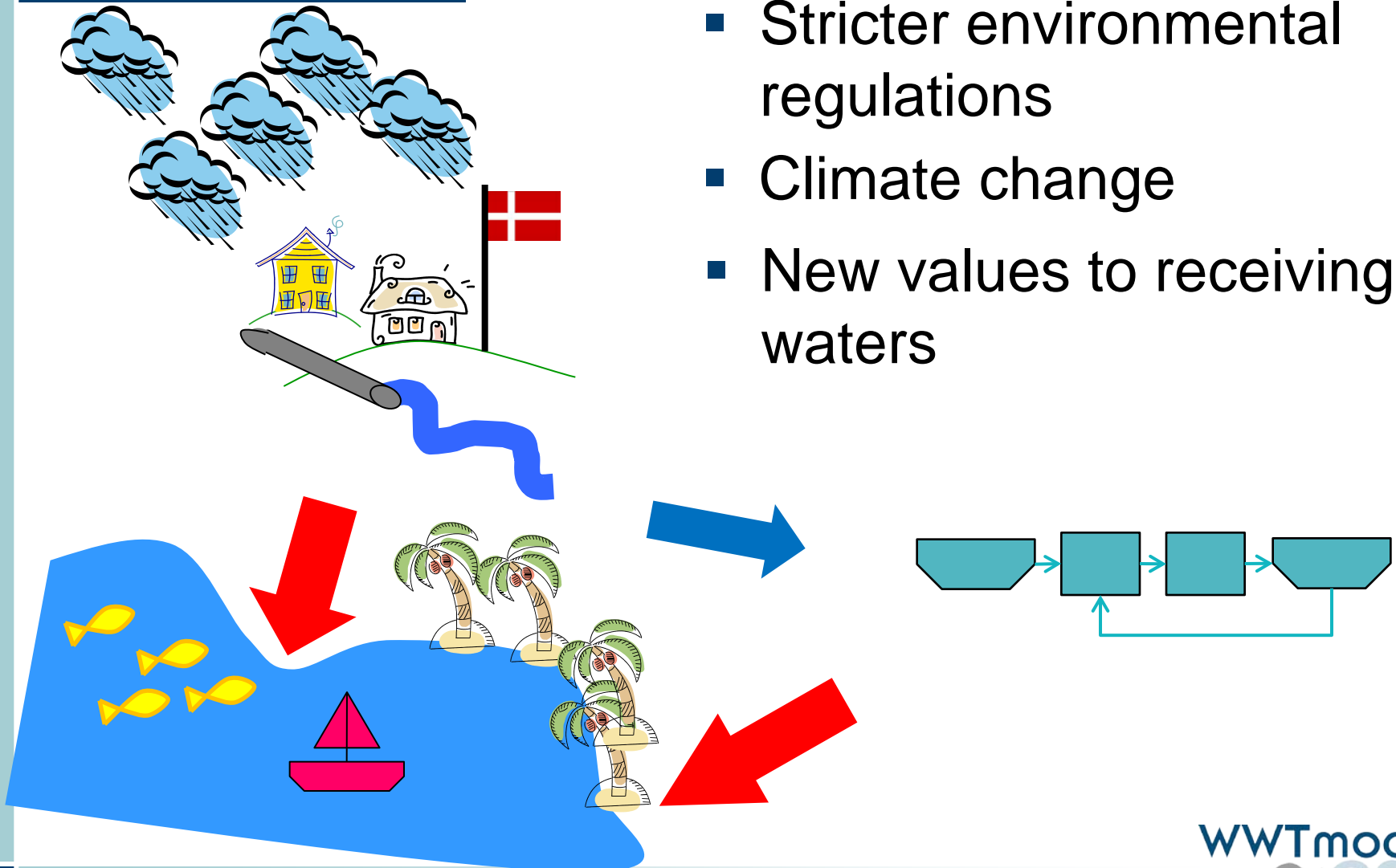
Modelling and control in the past

- Long experience in
 - Urban Drainage Systems (UDS)
 - WWTP
 - Integrated systems

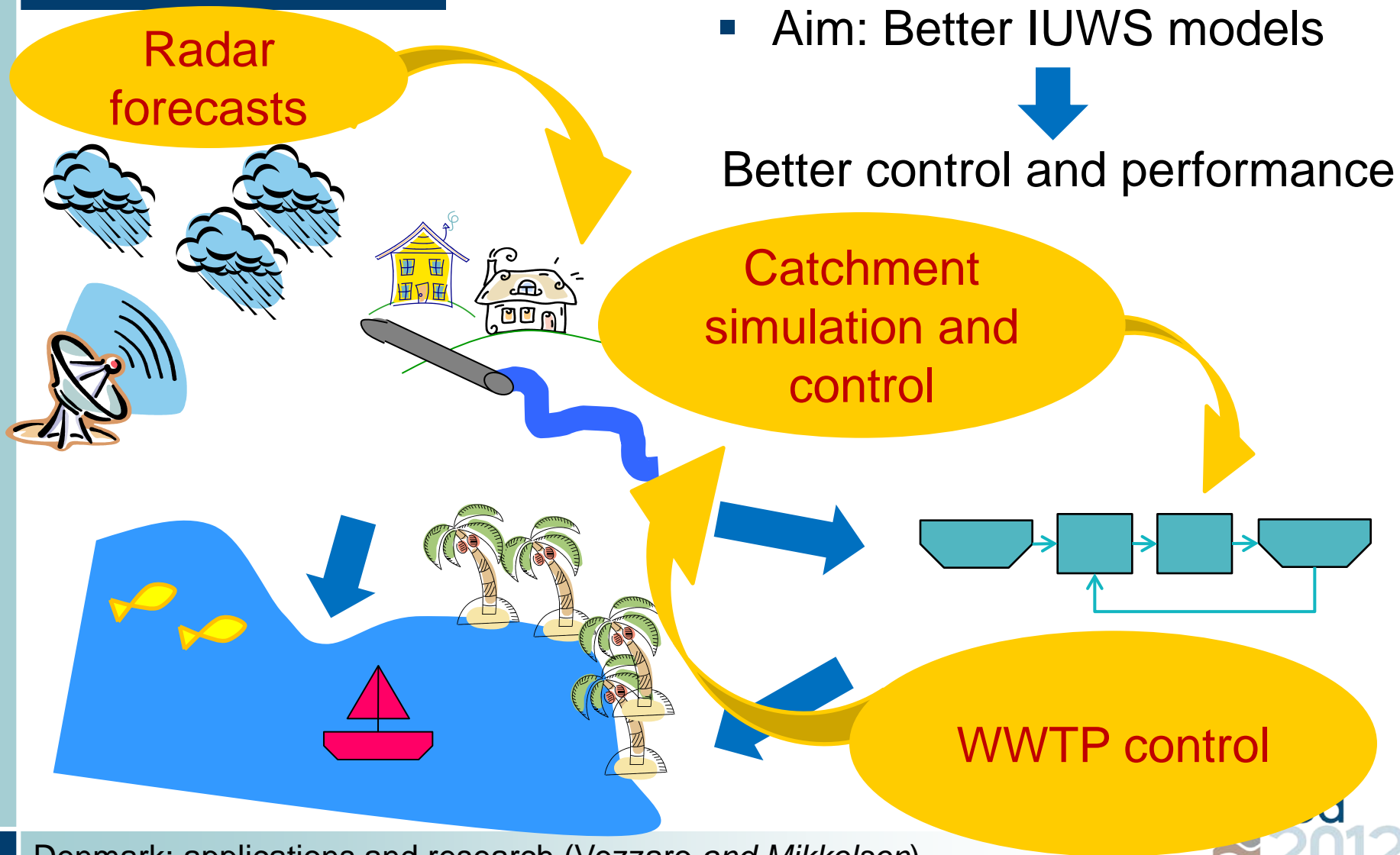


New drivers for IUWS control

- Stricter environmental regulations
- Climate change
- New values to receiving waters



Storm- and Wastewater Informatics (SWI)



SWI study areas

Radar based forecasts

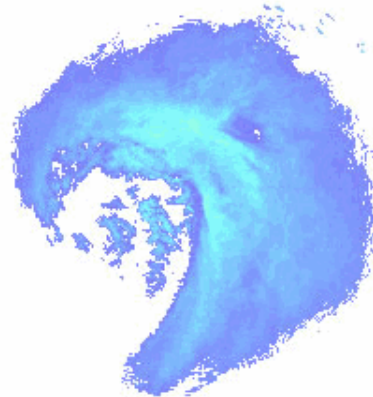
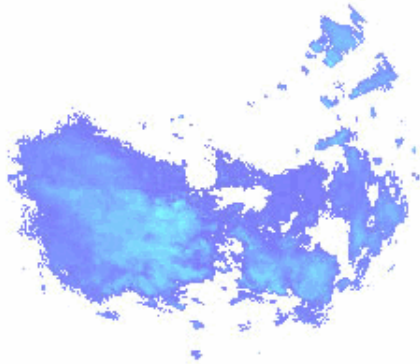


- Coupling of X-band and C-band radar for forecast prediction (*Jesper Ellerbæk Nielsen*)

Stratiform event

Cyclonic event

Convective event



Problems for IUWS performance

Low

Uncertainty in model predictions

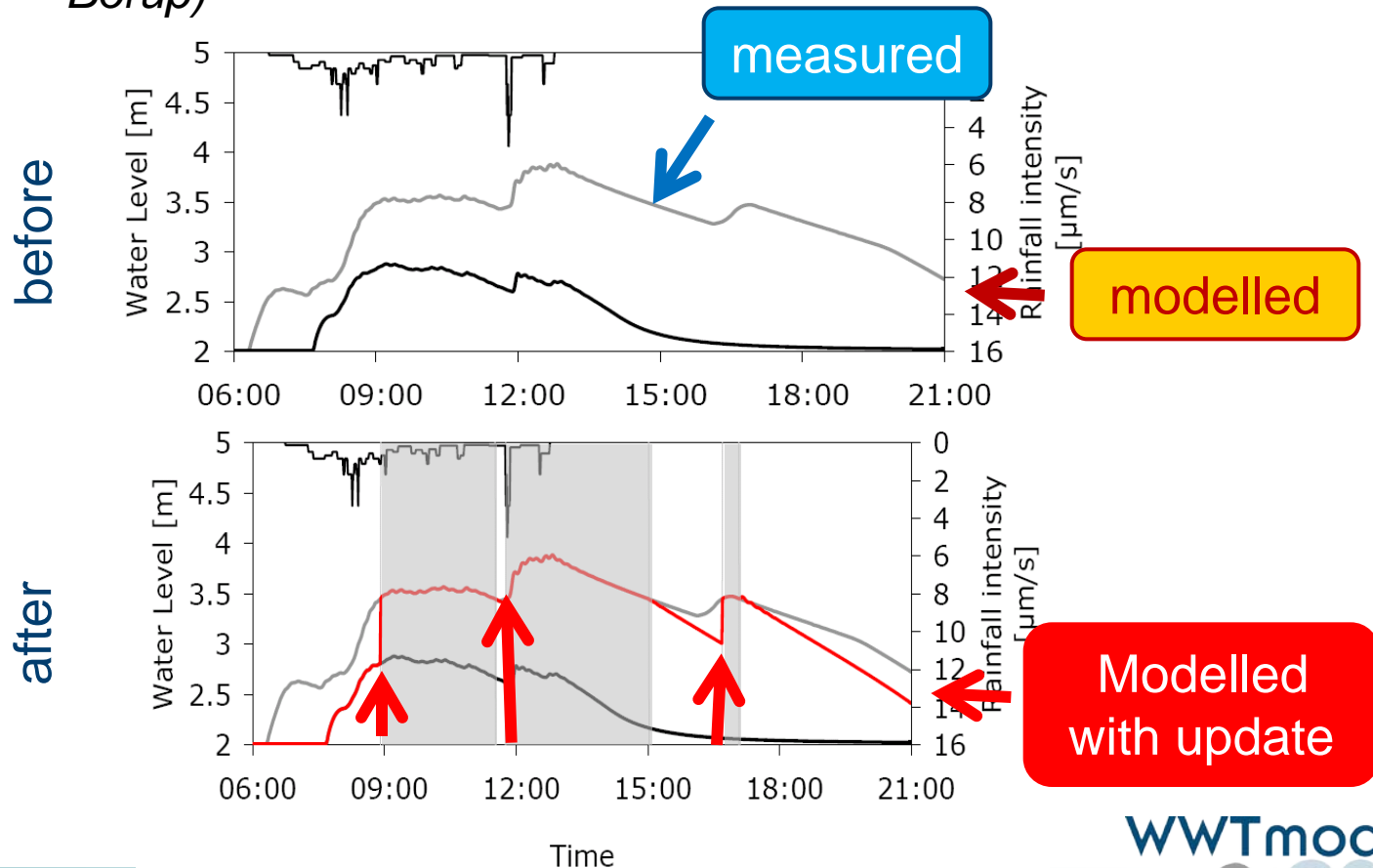
High

SWI study areas

Urban drainage models



- Data assimilation in urban drainage models (*Morten Borup*)



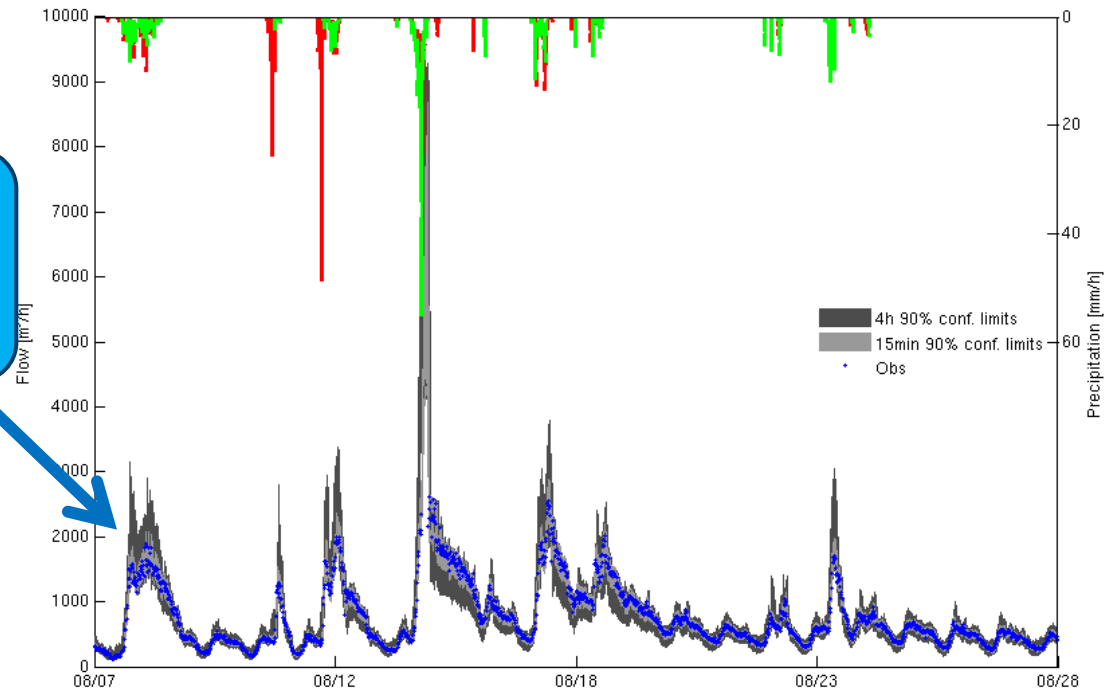
SWI study areas

Urban drainage models



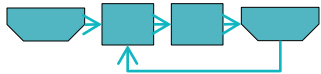
- Grey-box models for flow forecasts (*Roland Löwe*)

Probabilistic estimation of uncertainty bounds

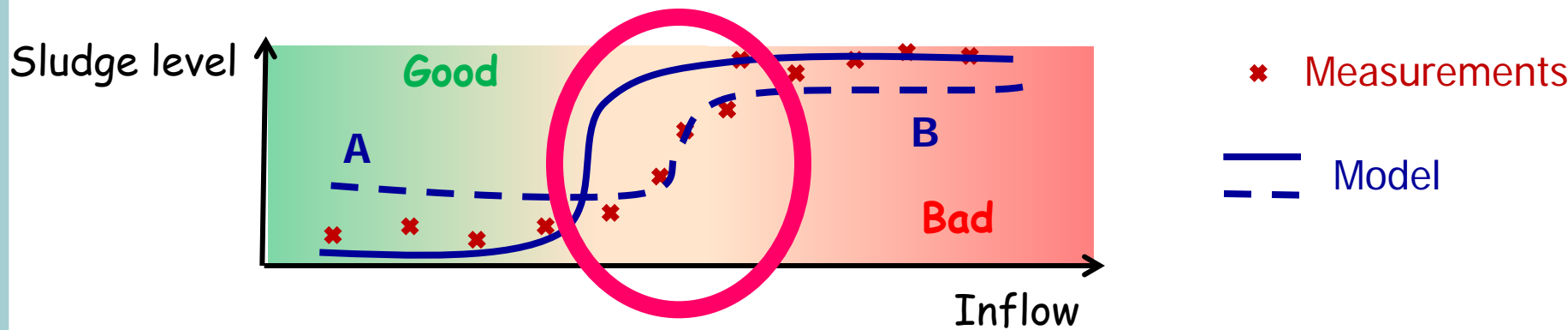


SWI study areas

Clarifier models



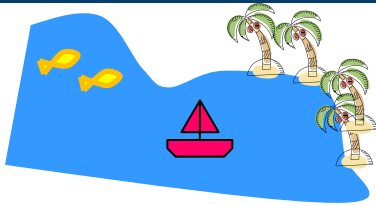
- Better models for sludge blanket (*Elham Ramin*)



Which model is better? A or B?

SWI study areas

Risk analysis



- Quantitative microbial risk assessment (*Signe Tanja Andersen*)

Photo: Bente Schou

How sick will this man become?

What is the quality during rain events?



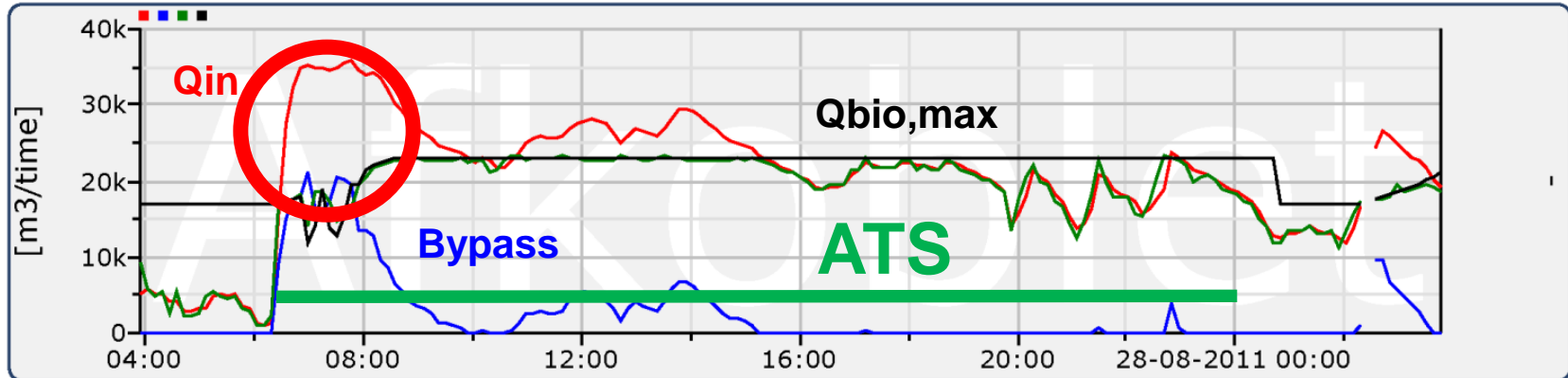
Benefit of IUWS integrated modelling

example from Lynetten in Cph, with Aeration Tank Settling

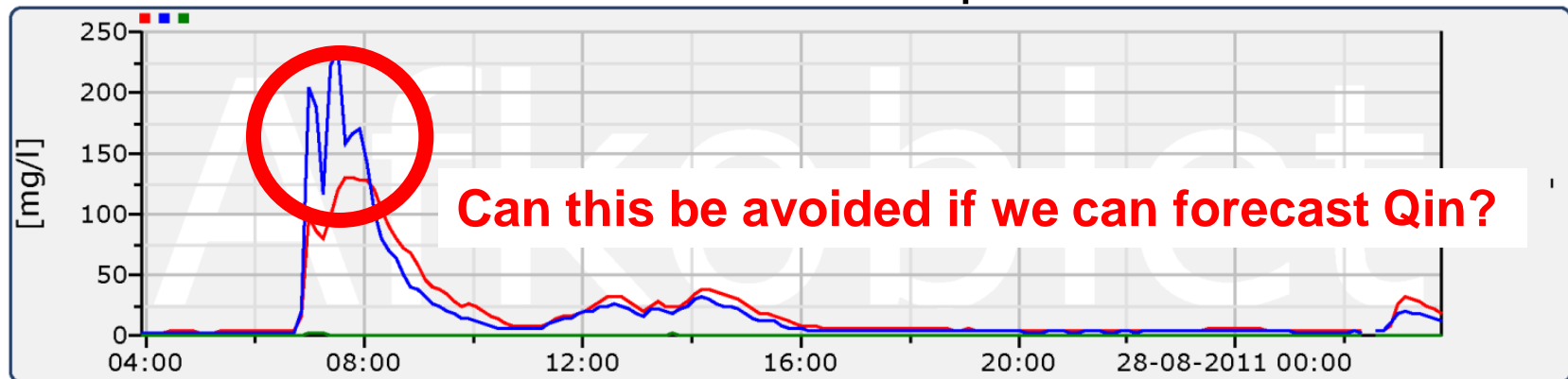
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Inflow to WWTP



SS in settler output



Benefit of IUWS integrated modelling

Model Predictive Control of Marselisborg catchment (Aarhus)



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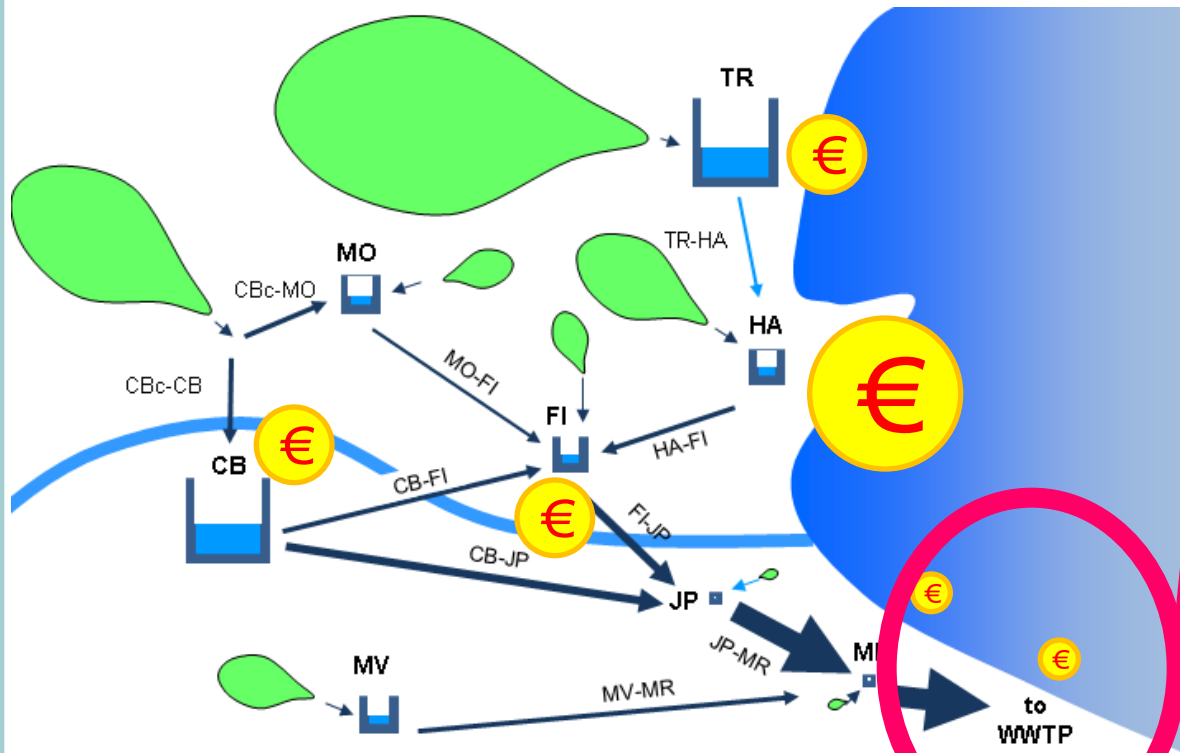
Runoff forecast



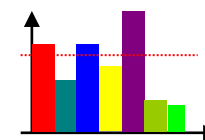
Uncertainty



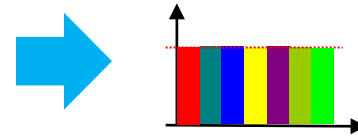
Less overflows in sensitive points



State



Wanted state



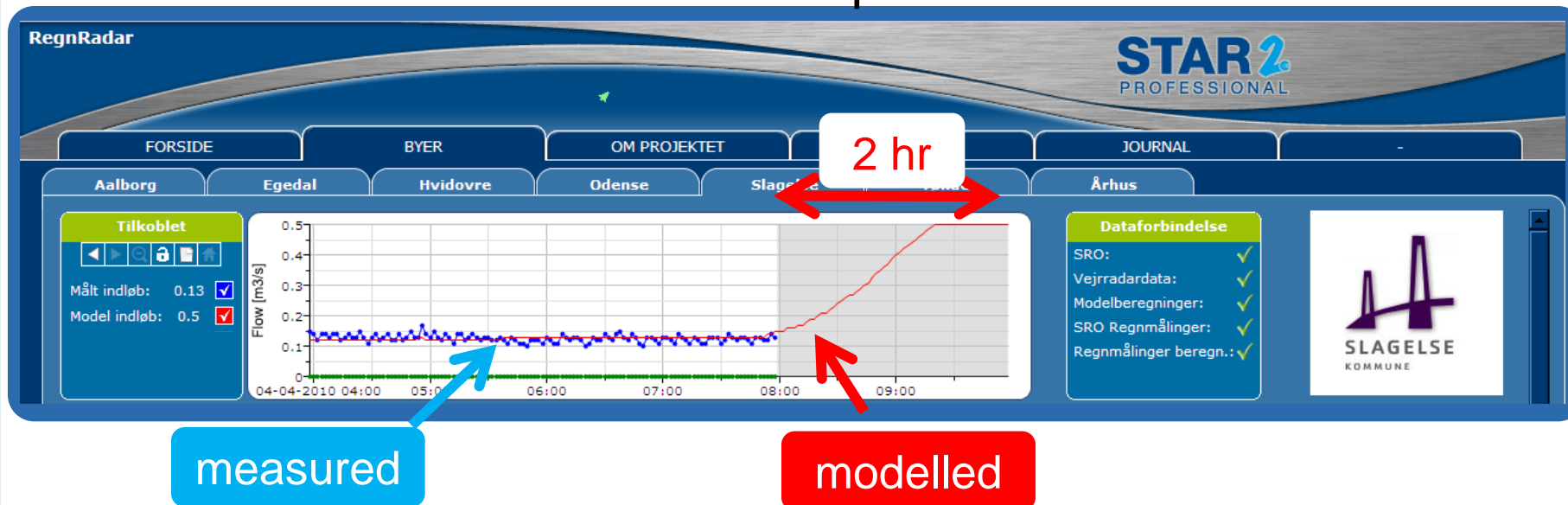
How much water can I send downstream to the WWTP?

How good are we?

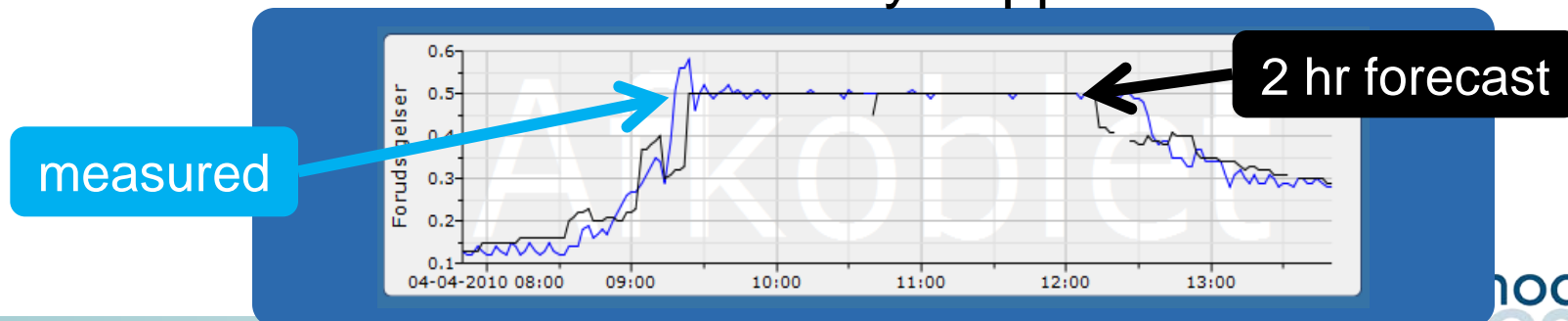
Radar-based runoff forecast as input to WWTP

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What the model predicts



What actually happened



How good are we?

Not always things go well...

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Inflow to Hvidovre WWTP (15-06-2010)

Fast periode

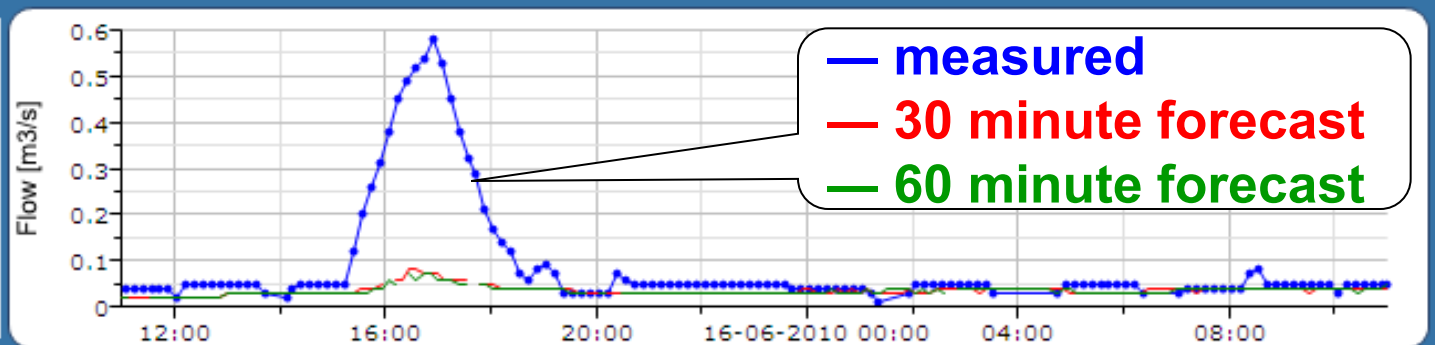
Navigation icons: back, forward, search, lock, print, home

Målt flow: 0.05

Forud 30min: 0.04

Forud 60min: 0.05

Y-akse min.: 0



Fast periode

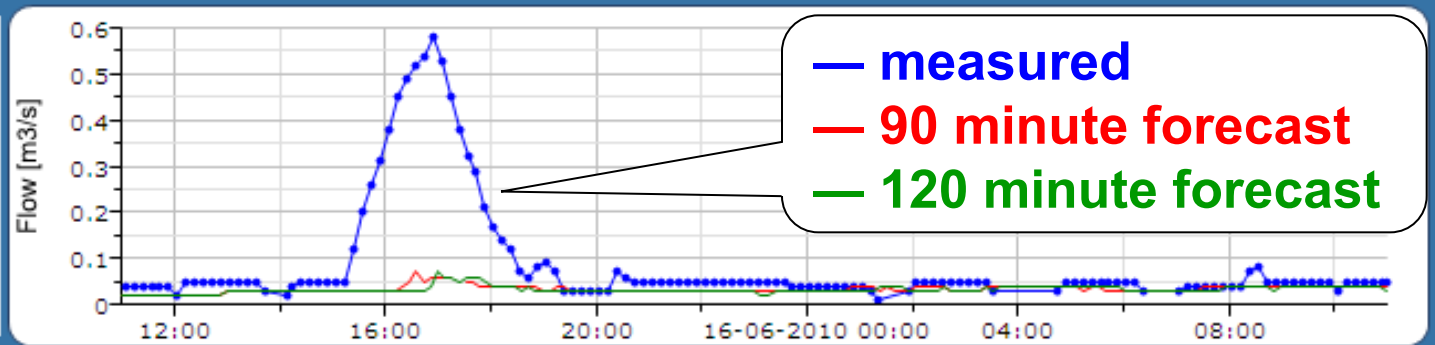
Navigation icons: back, forward, search, lock, print, home

Målt flow: 0.05

Forud 90min: 0.04

Forud 120min: 0.03

Y-akse min.: 0



Uncertainty in radar-based forecasts

TV2



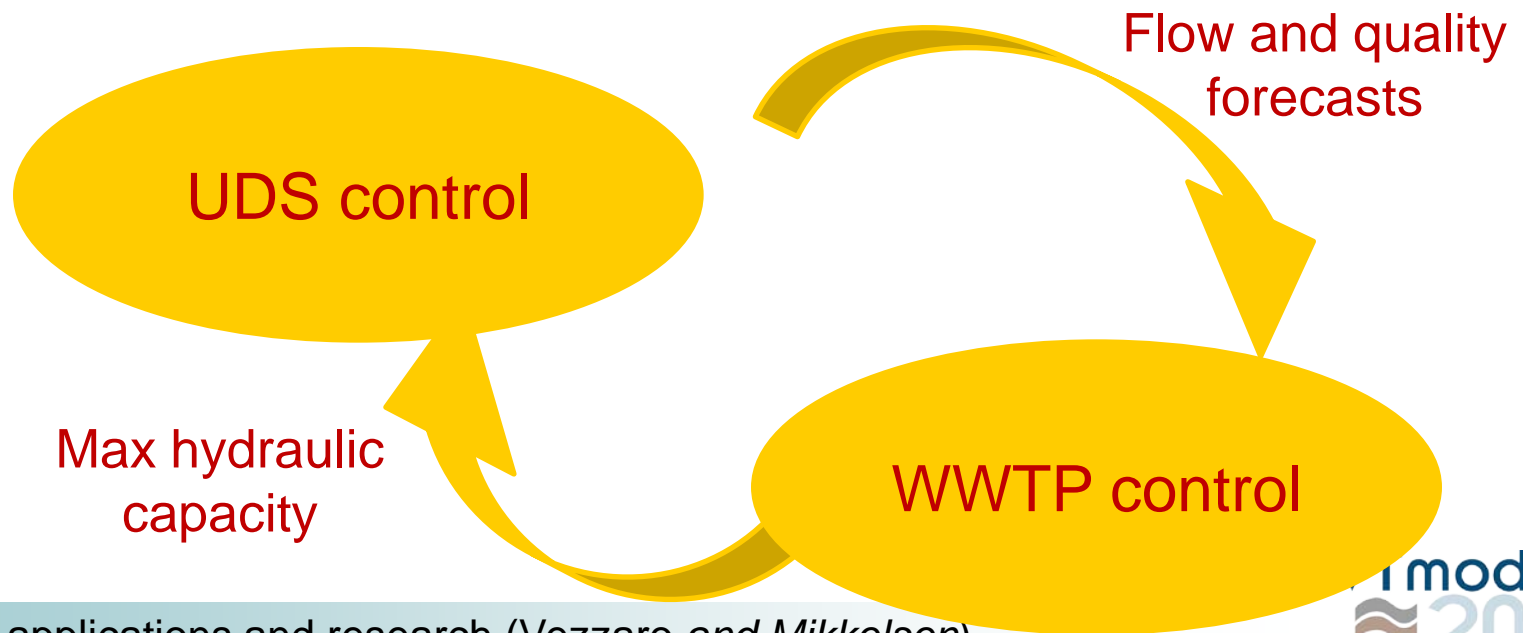
Foto: Oliver Winther
Hagl i Dragør på Amager den 15/6 2010.



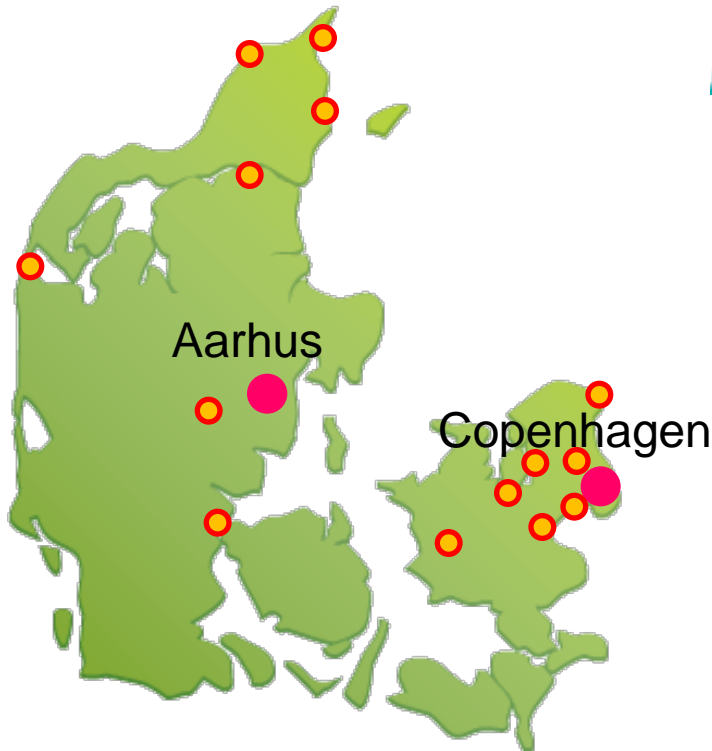
Foto: willy jensen
Haglvejr på Amager den 15/6 2010.

Integrated real time control of UDS and WWTP

- Potential of reducing environmental impacts through integrated control of SS and WWTP
- Great potential for developments



Several implementation in Denmark



- Several WWTP are equipped with advanced RTC



Methods and knowledge (research)



- Intelligent Wastewater handling (implementation)
 - Radar (3) + catchment (28 km² - MOUSE) + WWTP (700.000 PE – WEST)
- METSAM (demonstration)
 - Global RTC based on uncertainty
- Integrated control of drainage and WWTP/ PREPARED (implementation)
 - Radar + catchment + WWTP + receiving water (river and sea)

Conclusions

- A lot of theory, but few applications (so far)
- New knowledge from SWI project
- Several demonstration projects are on their way
- A lot of new tools and examples from Denmark!

SWI partners



Spildevandscenter Avedøre



PH-CONSULT



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Lynettefællesskabet I/S

www.swi.env.dtu.dk