



**TU/e**

Technische Universiteit  
**Eindhoven**  
University of Technology

**Deltares**

Enabling Delta Life

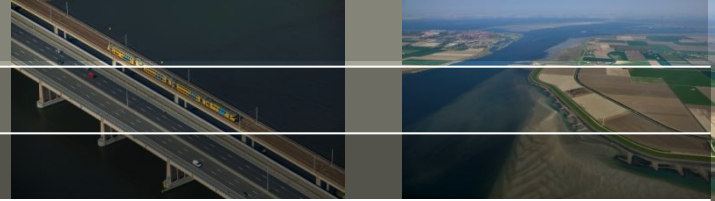


# Gebruikers meeting: JIP Slim malen RTC-Tools developments

Klaudia Horváth

25, April2018

# Outline



- scientific achievements
- full Linge model
- comparison of optimization methods
- closed-loop operation
- pilot results

# Scientific production: conferences



## European Geosciences Union, General Assembly 2017

A water management decision support system contributing to sustainability

Klaudia Horváth, Bart van Esch, Jorn Baayen, Ivo Pothof, Jan Talsma, Klaas-Jan van Heeringen

## SimHydro Conference

Categorization of trapezoidal open channels based on flow conditions for the choice of simple models

Klaudia Horváth, Bart P.M., van Esch, Jorn Baayen

## Hydroinformatics Conference

Model predictive control of a river reach with weirs

Klaudia Horváth, Bart van Esch, Jorn Baayen, Ivo Pothof, Jan Talsma, Tjerk Vreeken

# Scientific production: journals

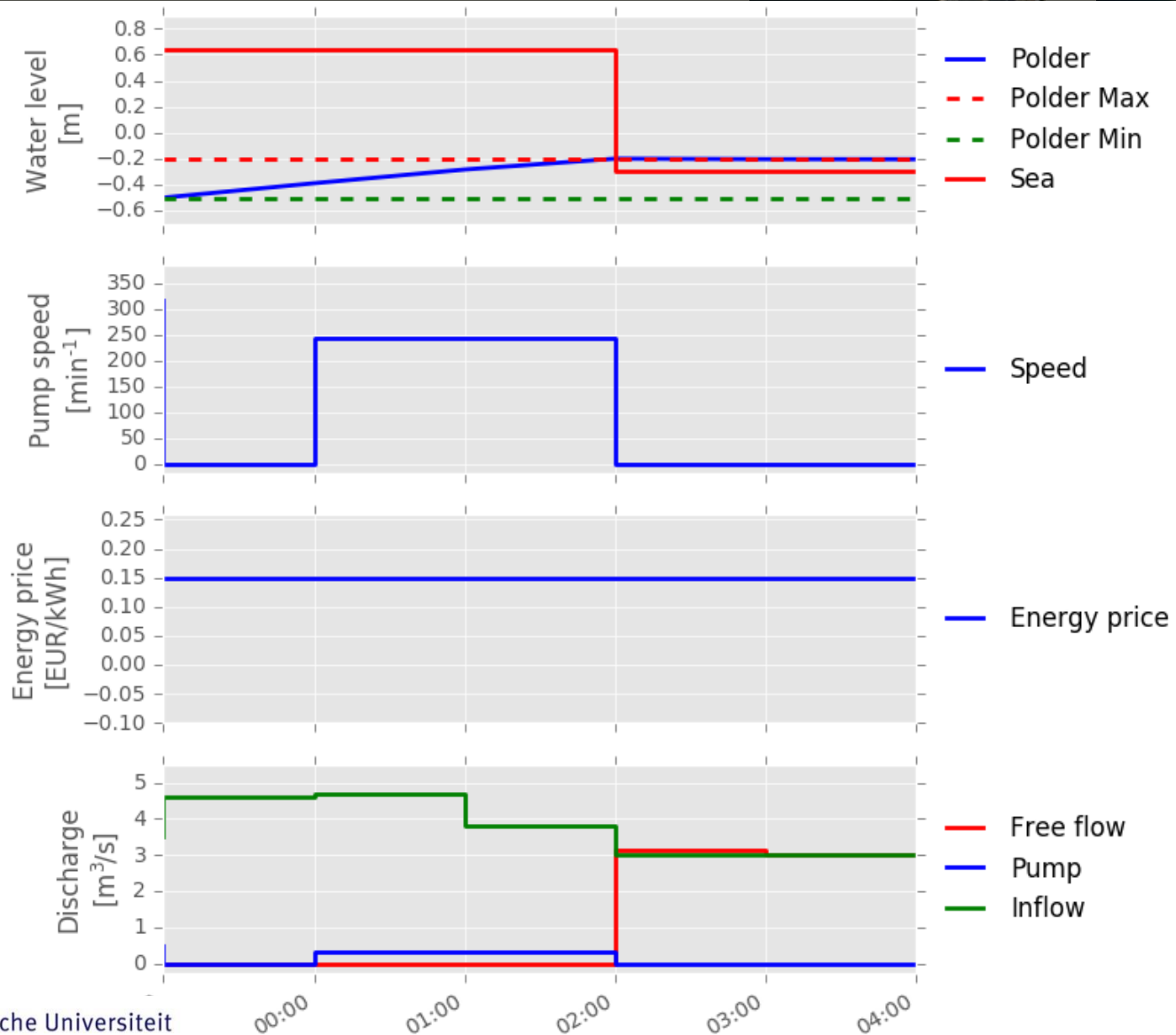
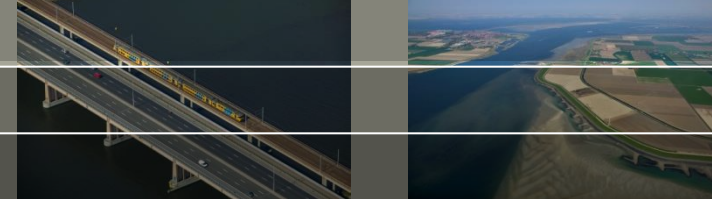


**La Houille Blanche**, International Water Journal: Categorization of trapezoidal open channels based on flow conditions for the choice of simple models

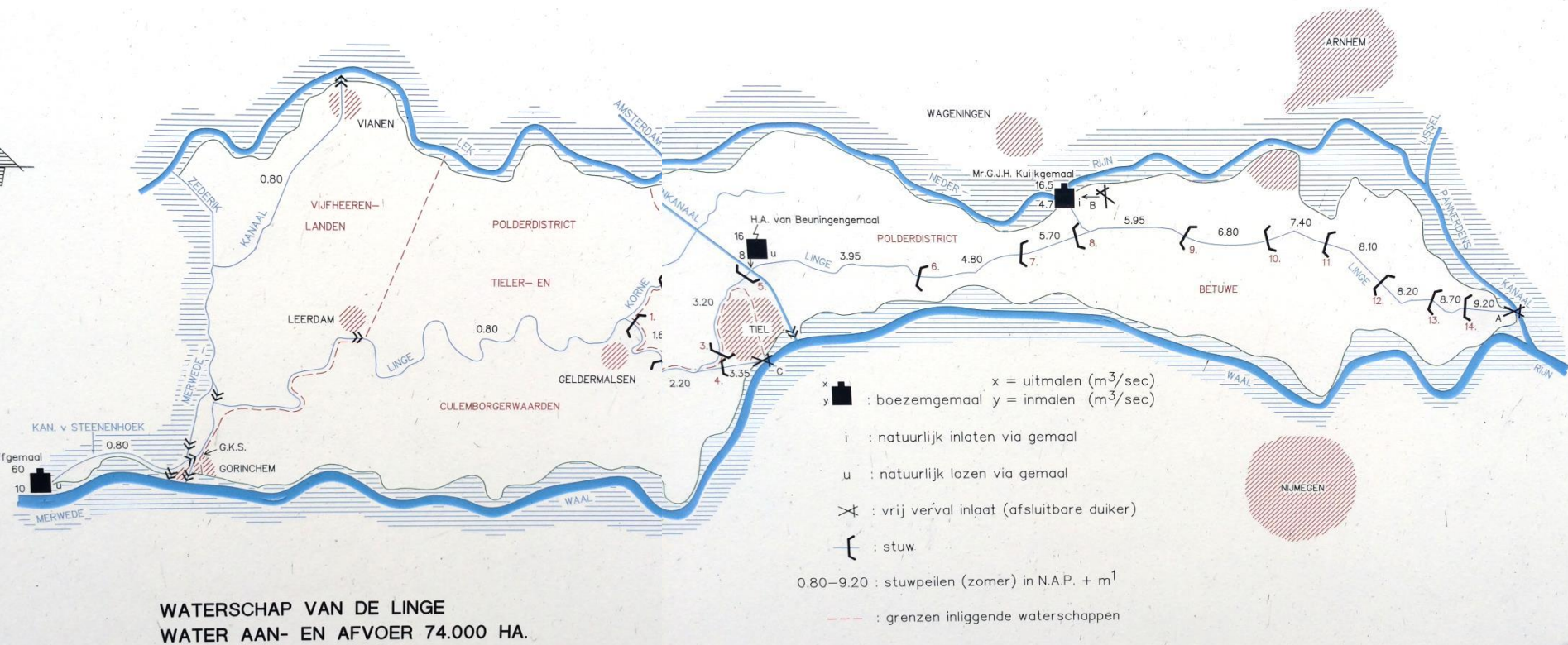
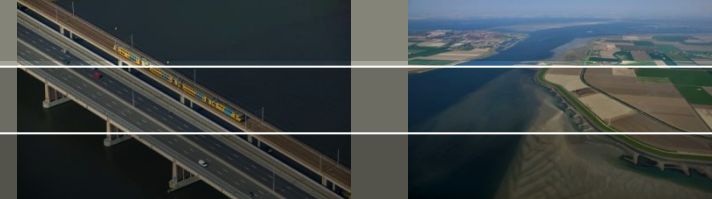
In preparation:

**Transactions on Control Systems Technology:**  
Convex modelling of pumps

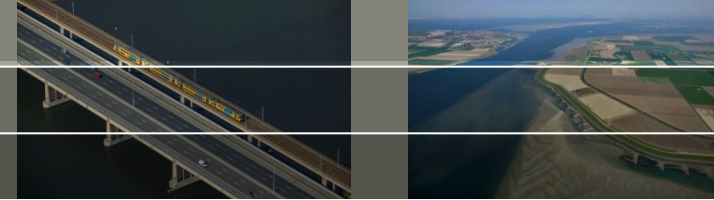
# Pumping or free flow



# Linge

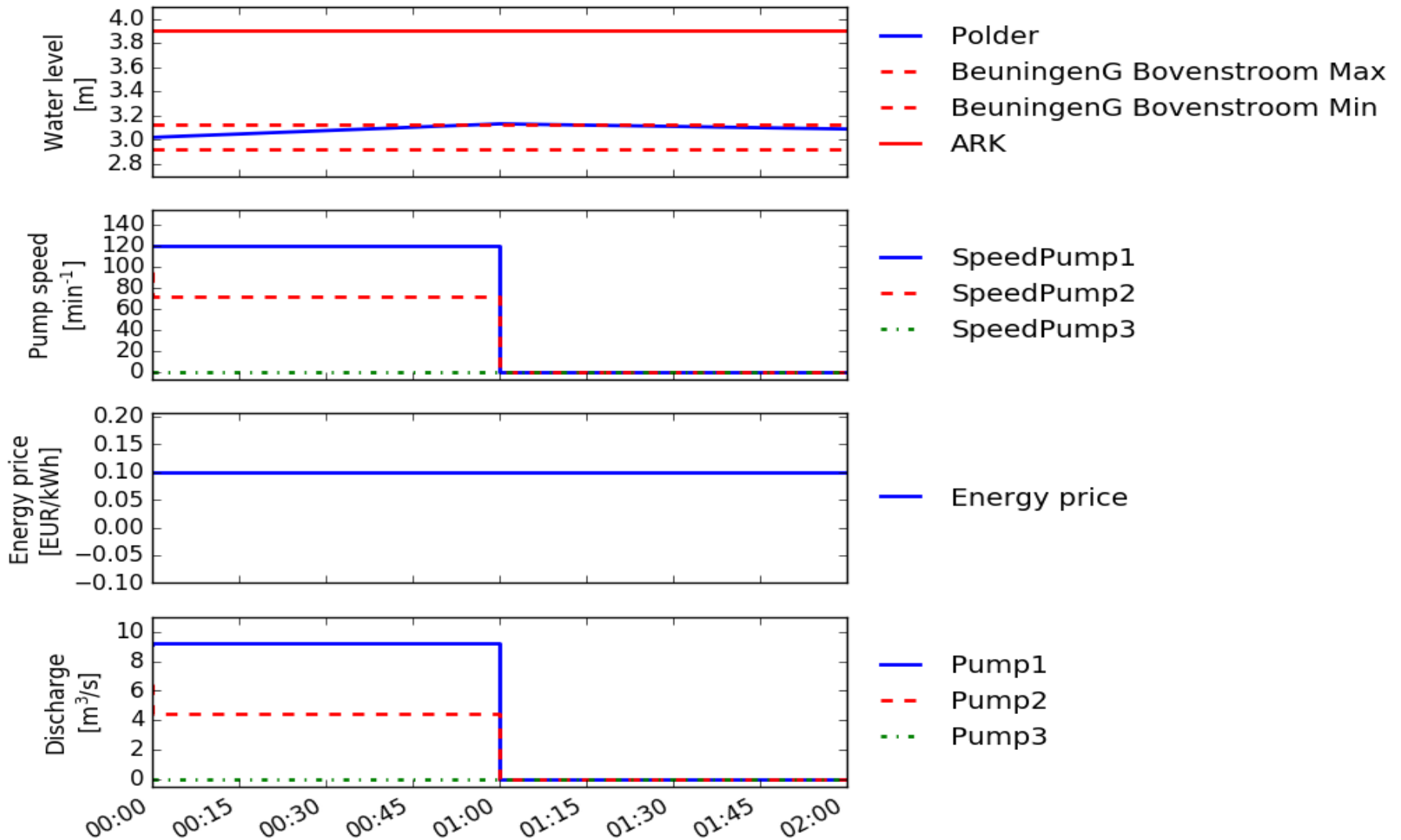
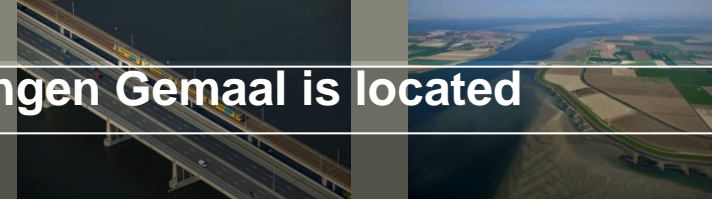


# Complete model



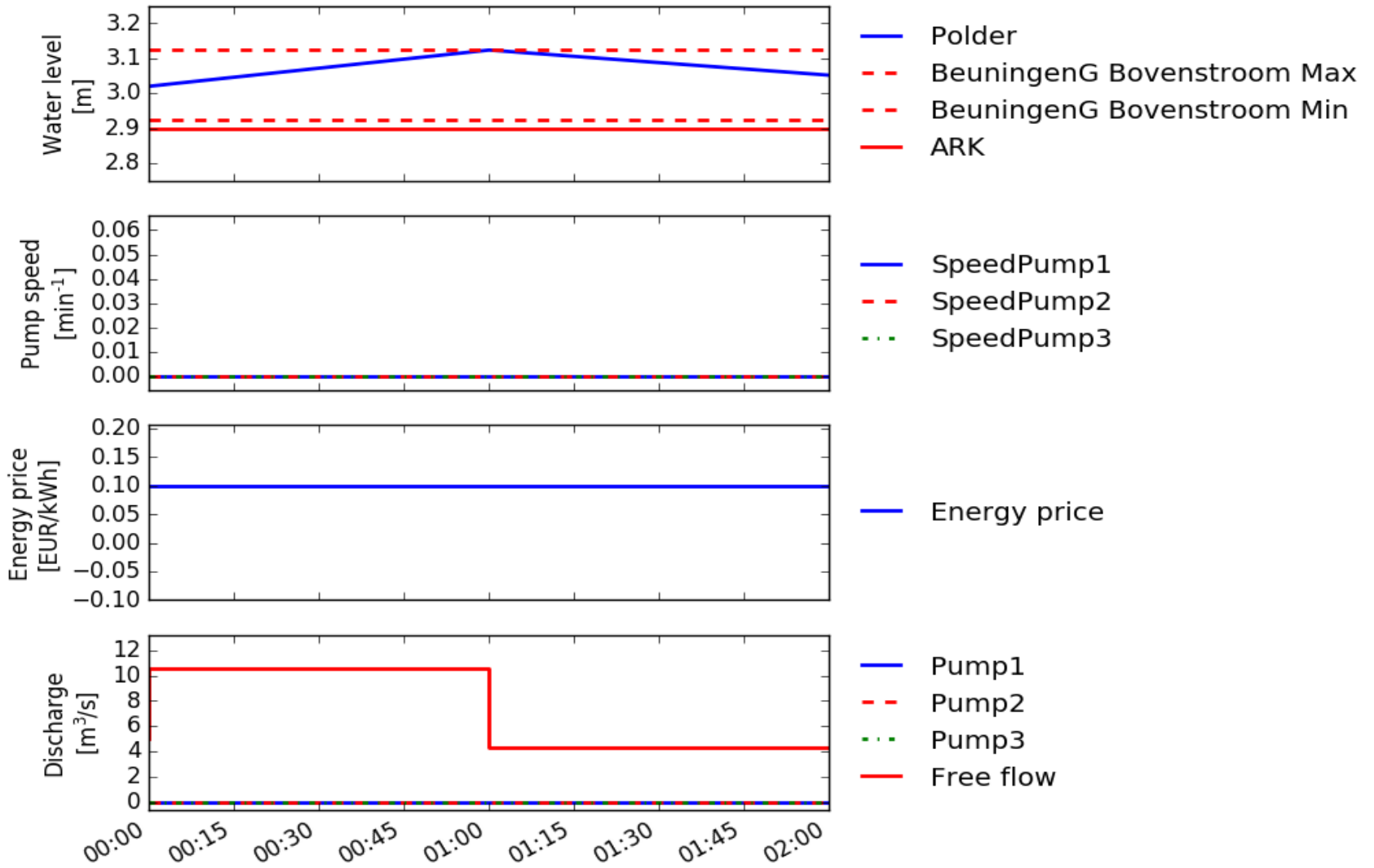
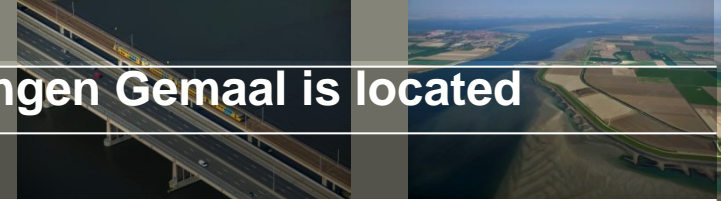
Name	Location (branch)	Number of pumps and directions	Direction of free flow
Pannerling	1	1 in	In
Kuijk Gemaal	7	4 (3 in 1 out)	In
van Beuningen Gemaal	10	3 out	out
Kolffgemaal	13	3 out	out

# 35 m<sup>3</sup>/s inflow to branch 10, where van Beuningen Gemaa! is located

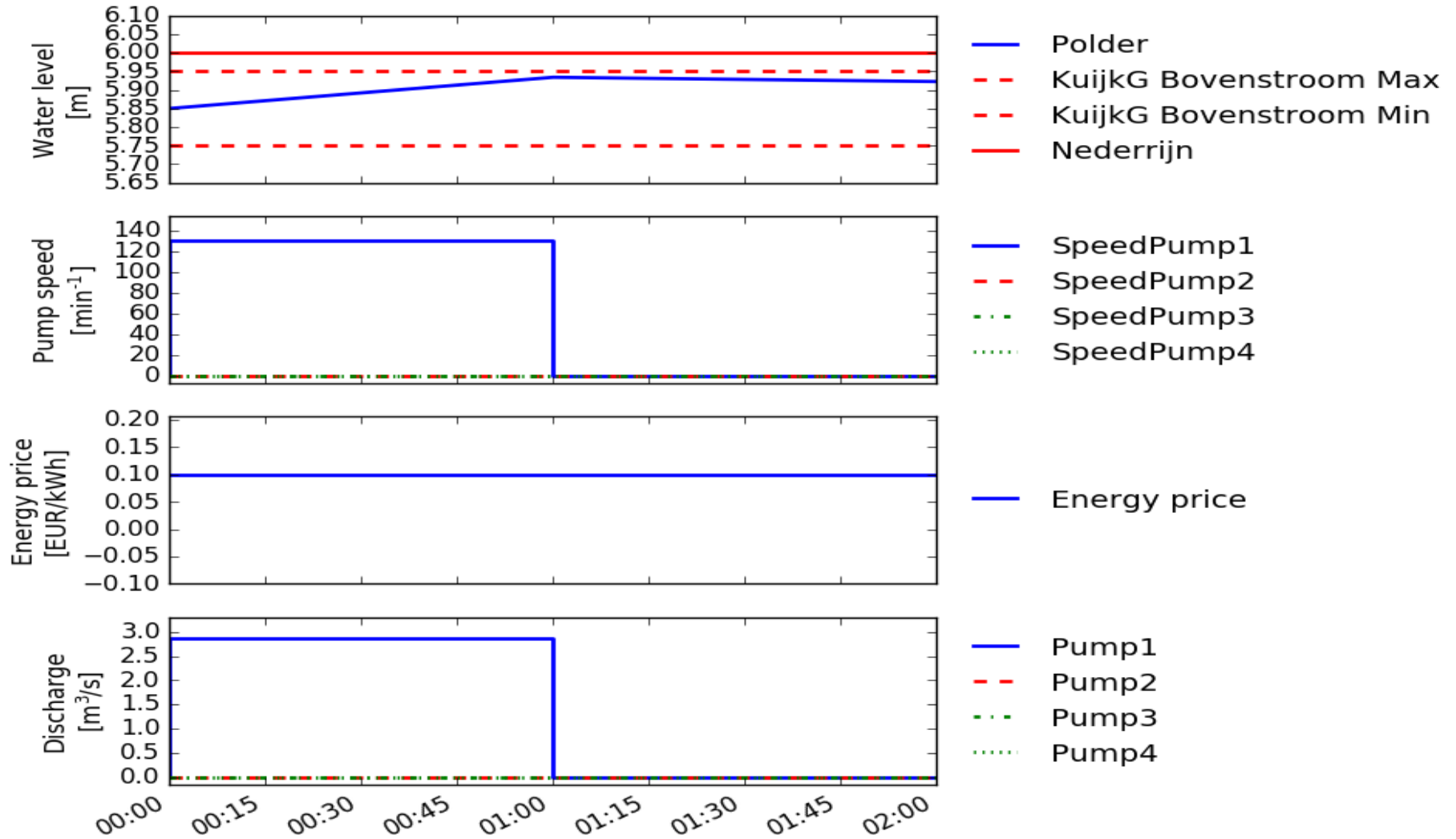




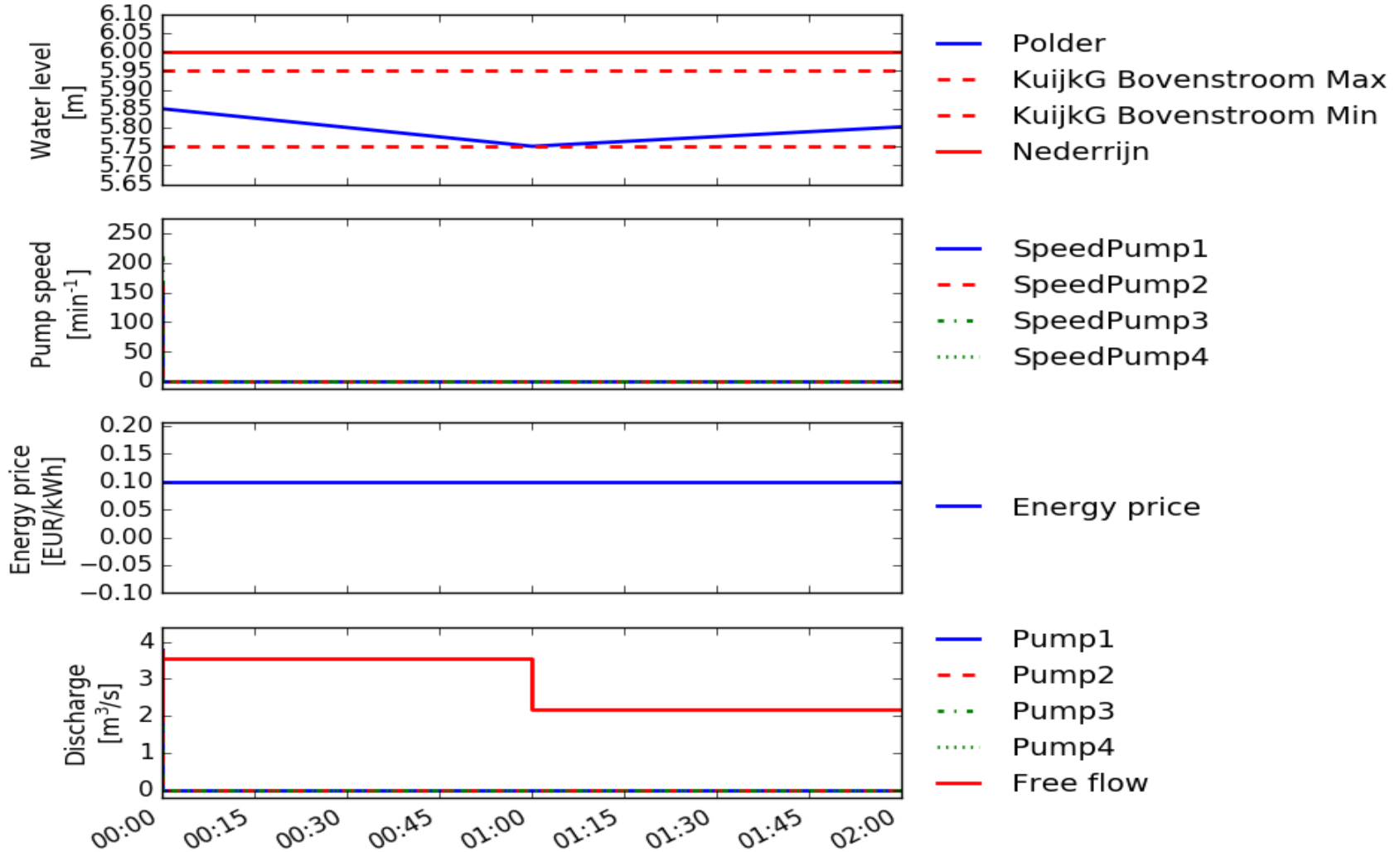
# 35 m<sup>3</sup>/s inflow to branch 10, where van Beuningen Gemaa! is located



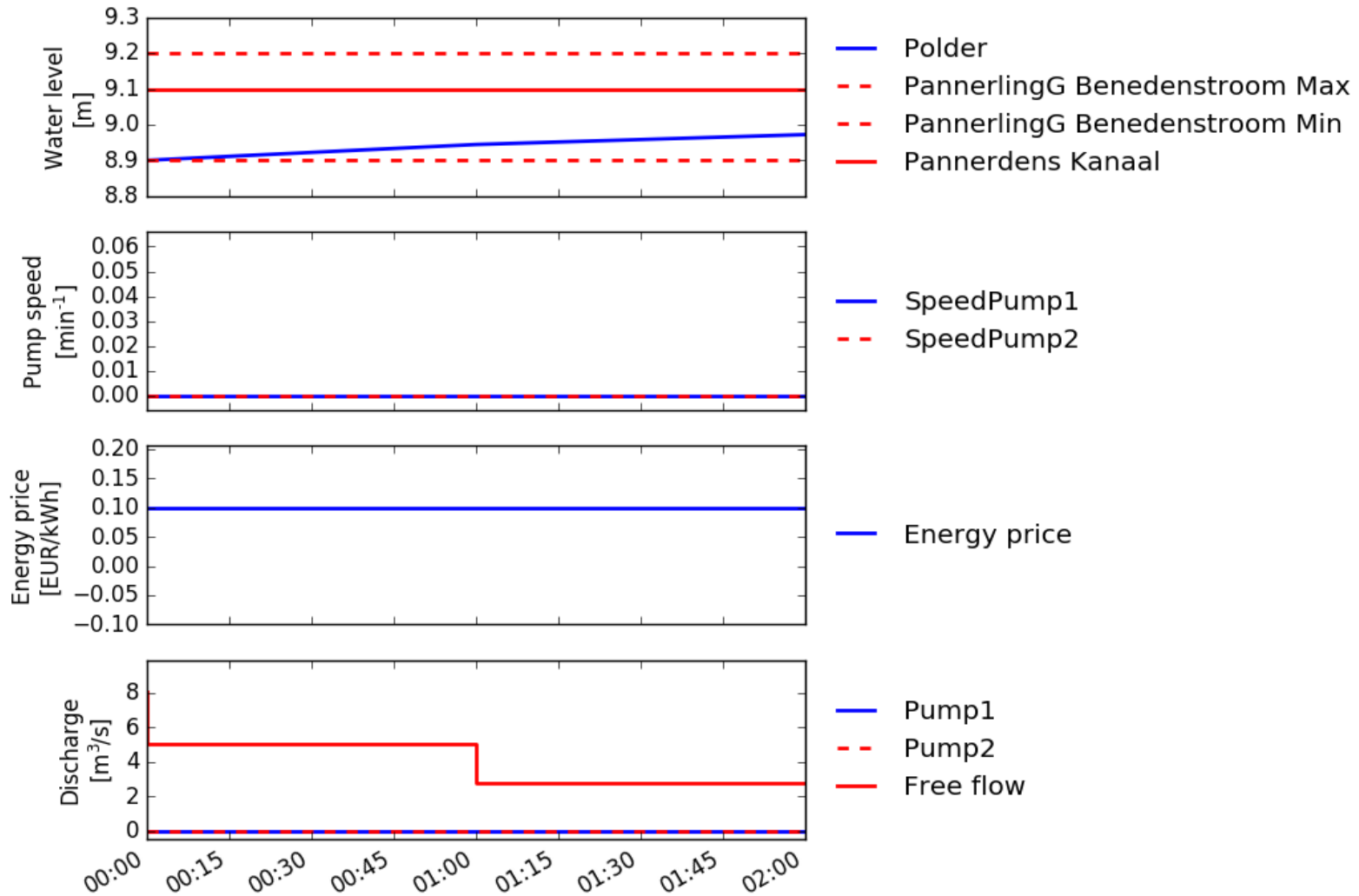
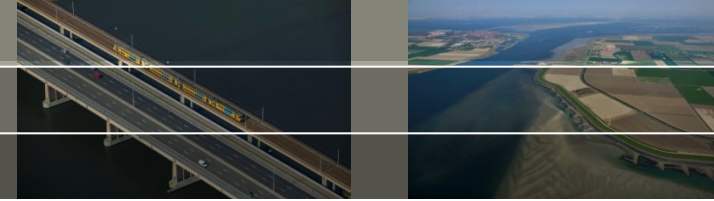
# 11 m<sup>3</sup>/s inflow to branch 7, where van Kuijkemaal is located



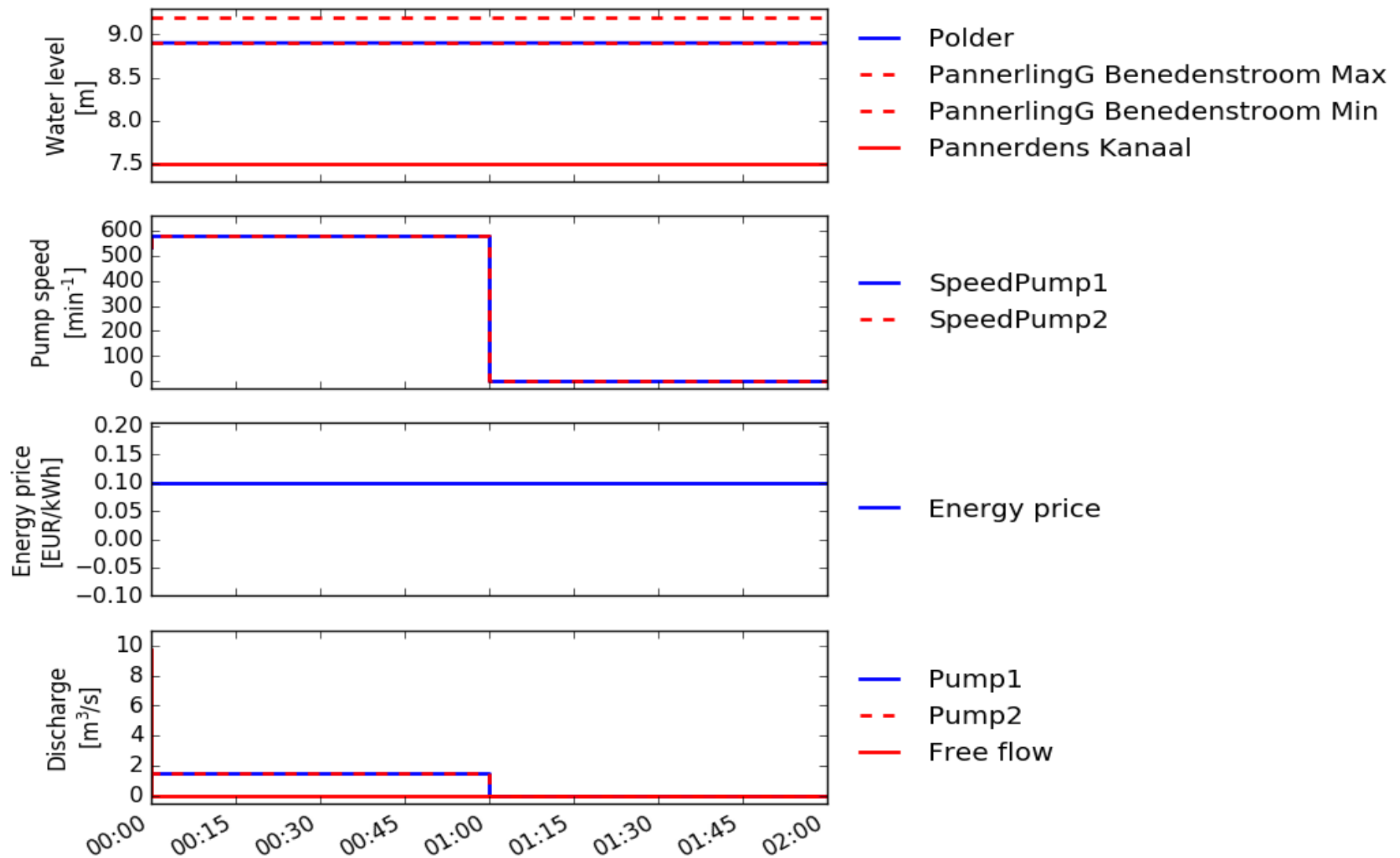
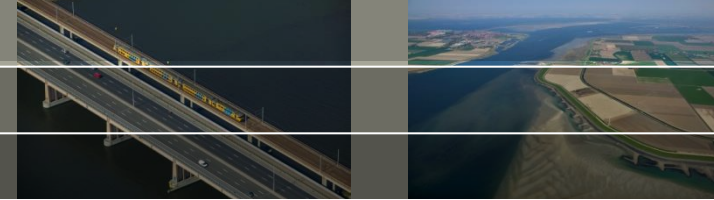
# 11 m<sup>3</sup>/s outflow to branch 7, where van Kuijkemaal is located



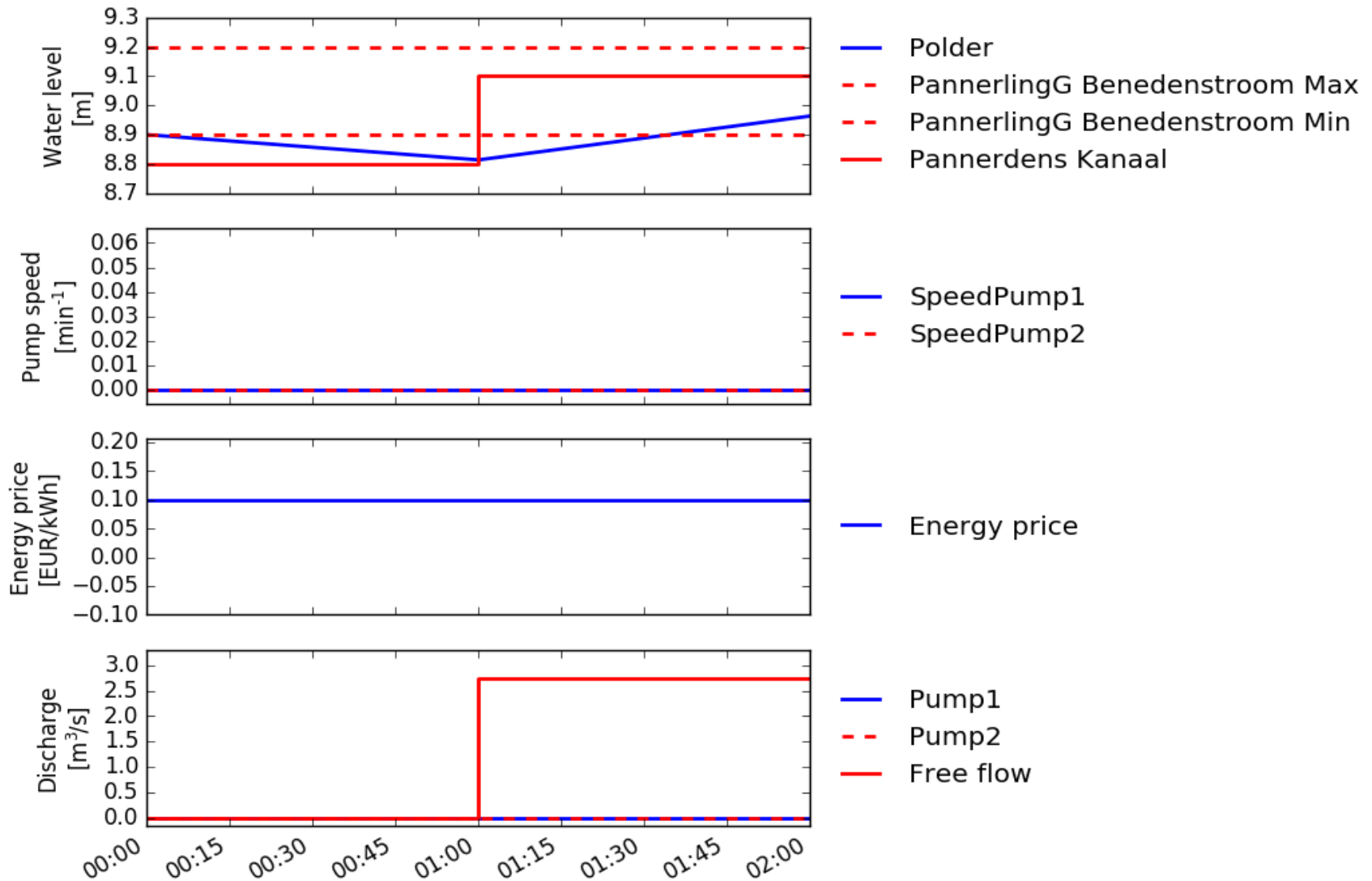
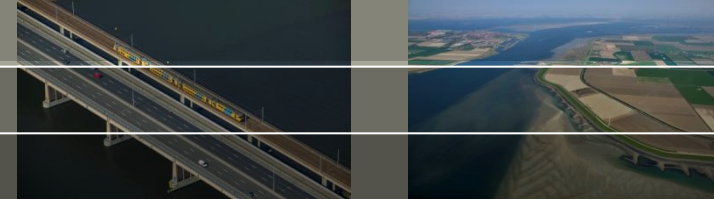
# 3 m<sup>3</sup>/s outflow from Branch 1



# 1 m<sup>3</sup>/s outflow from Branch 1



# 1 m<sup>3</sup>/s outflow from Branch 1



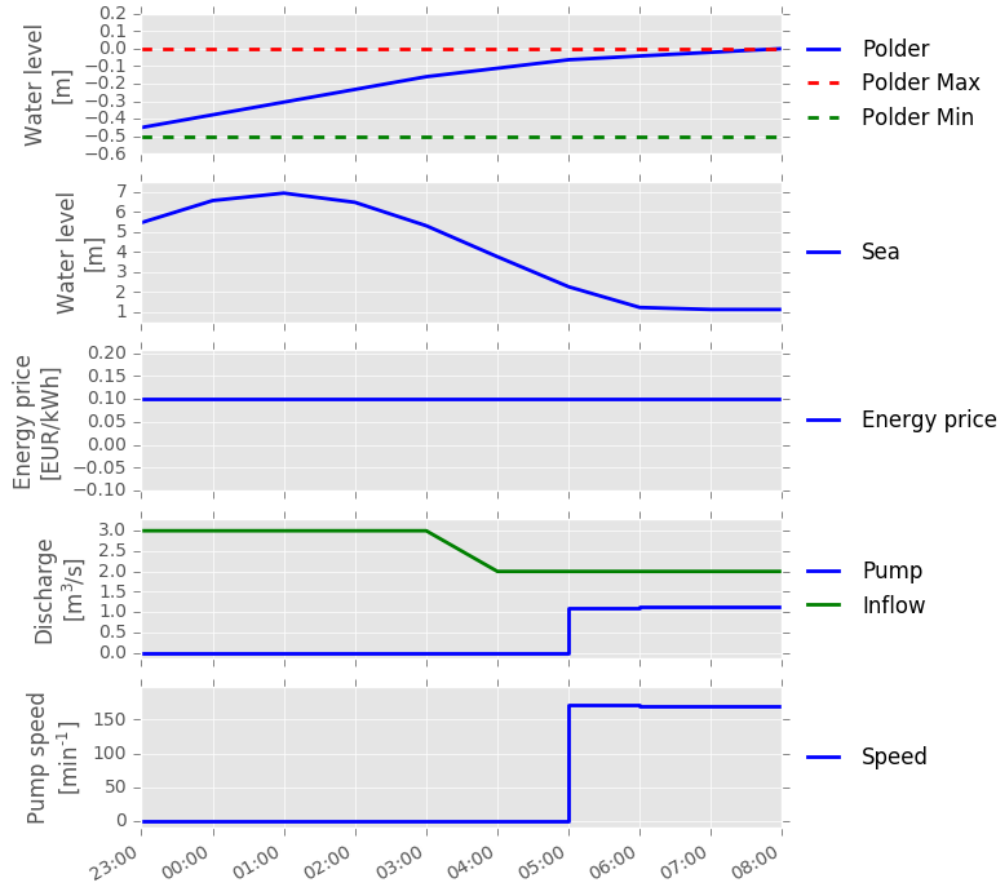
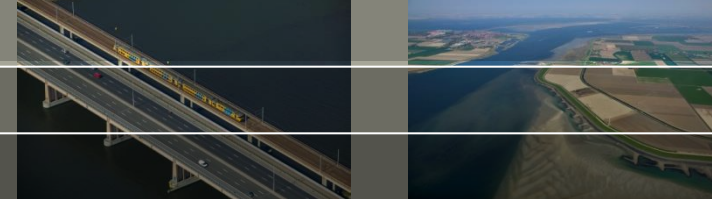
# Why do we need mixed-integer optimization?



3 methods

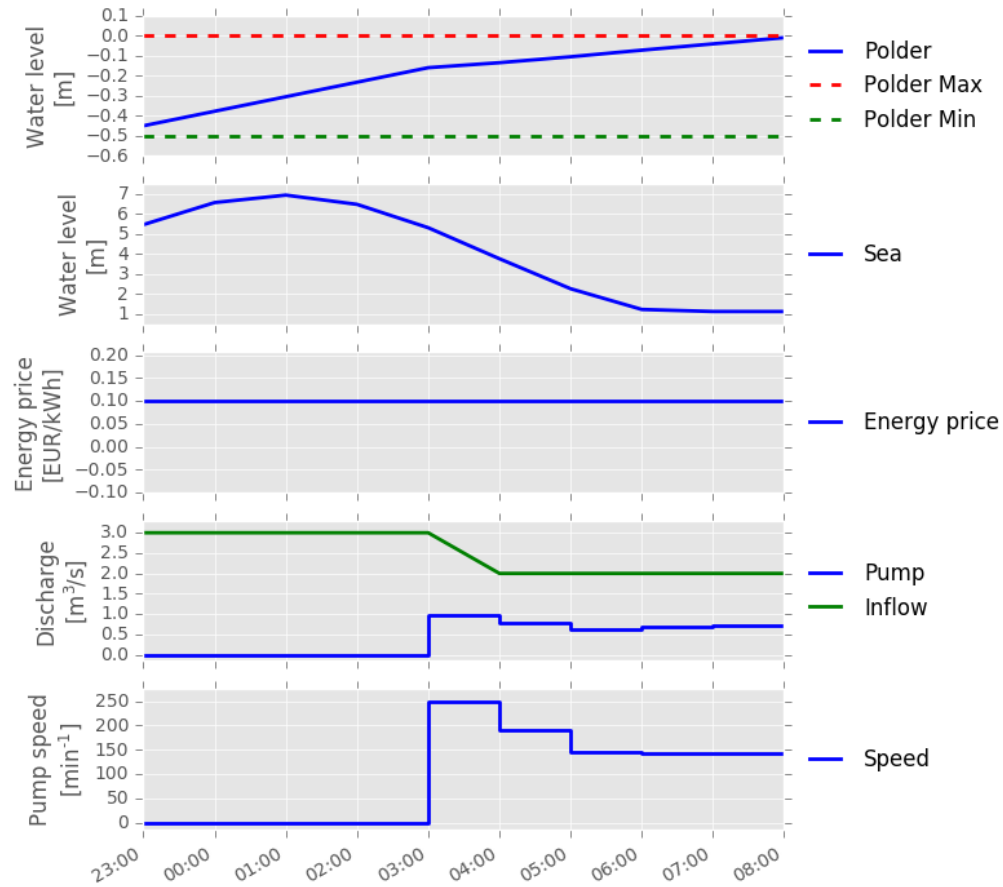
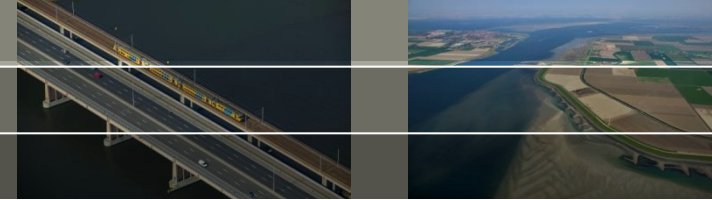
- Our method: Mixed integer
- Simplified mixed integer
- Continuous

# Our method

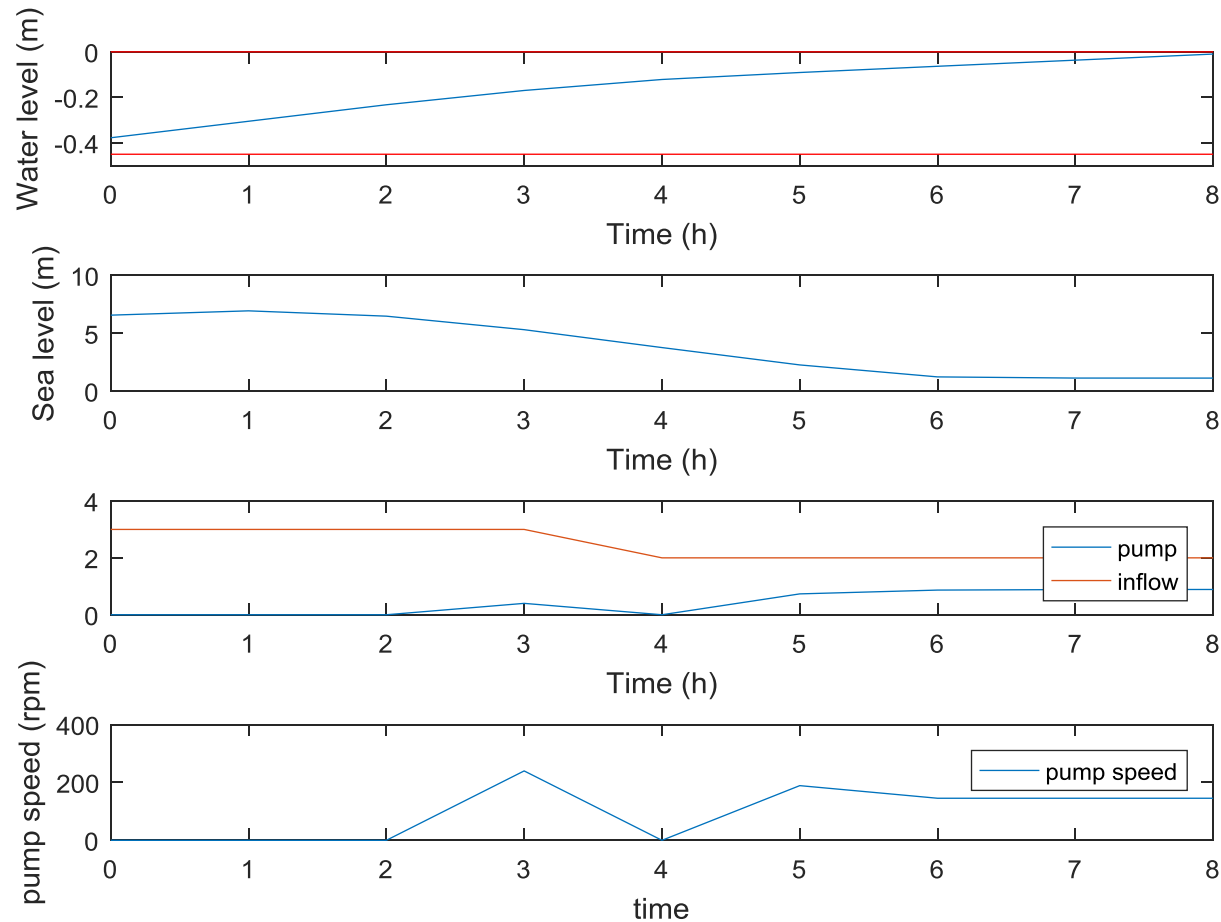
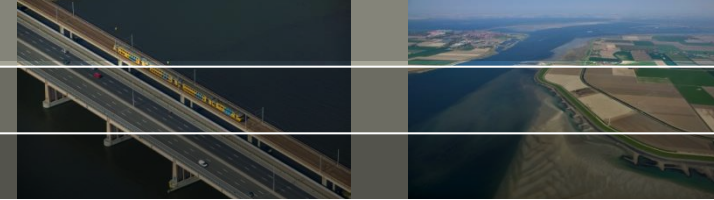




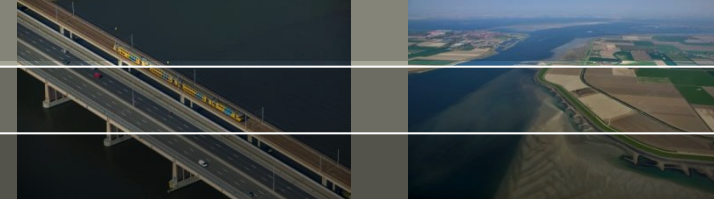
# Head independent power



# Continuous optimization



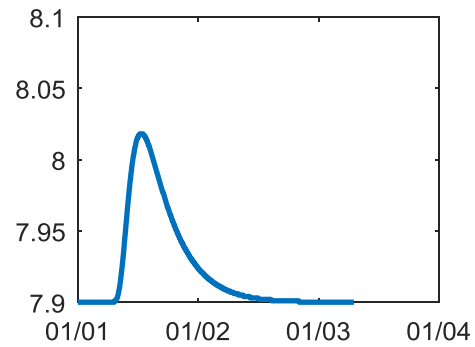
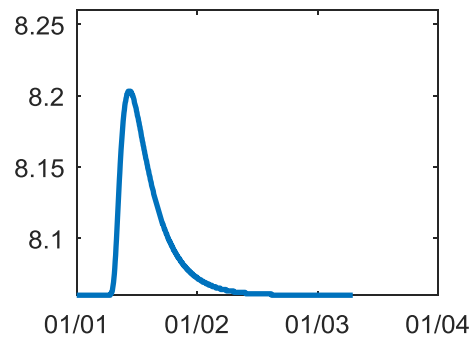
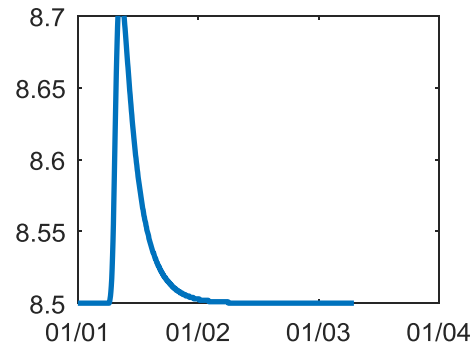
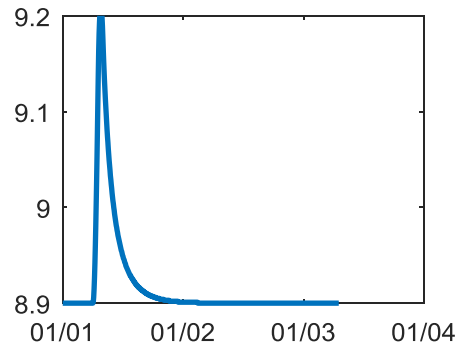
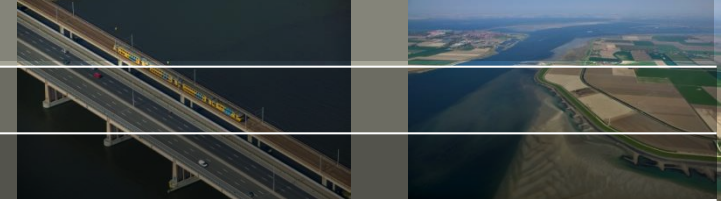
# Runtimes and energy



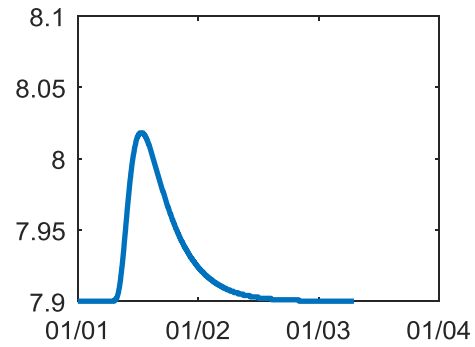
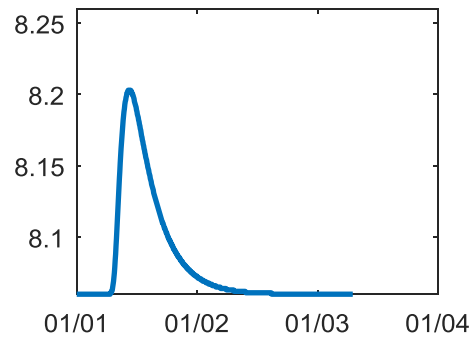
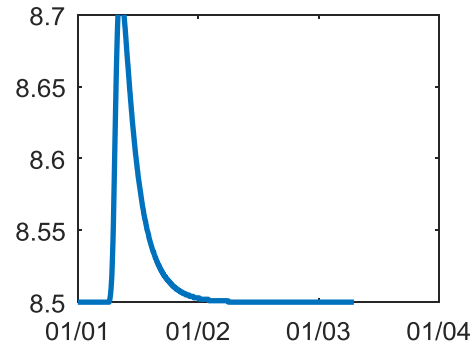
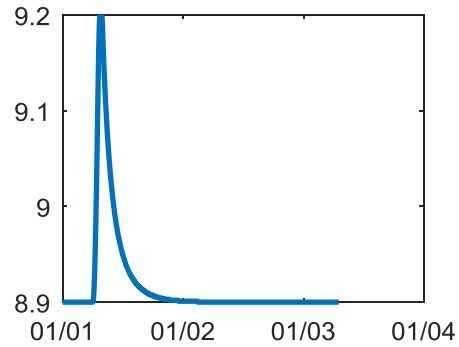
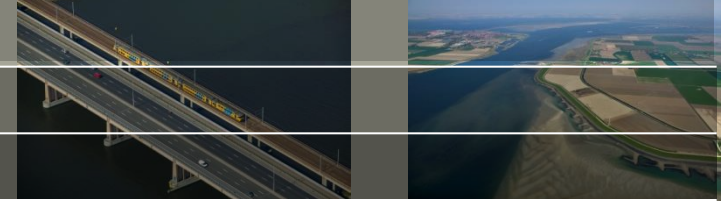
	Proposed method	No head dependence	Continuous
Energy (kWh)	63	146	96
Time (s)	23	29	9

Table 1: Energy consumption of the different methods

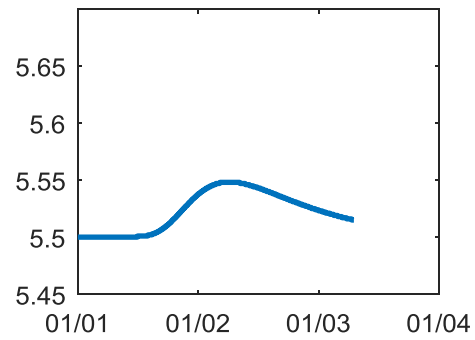
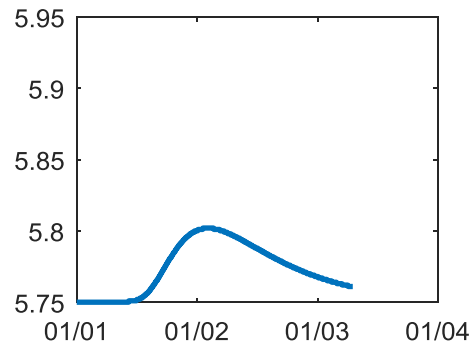
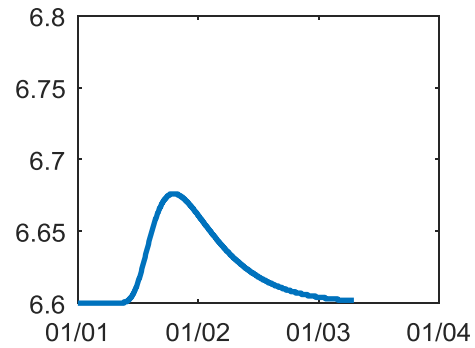
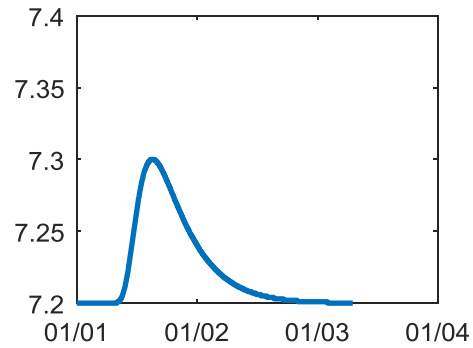
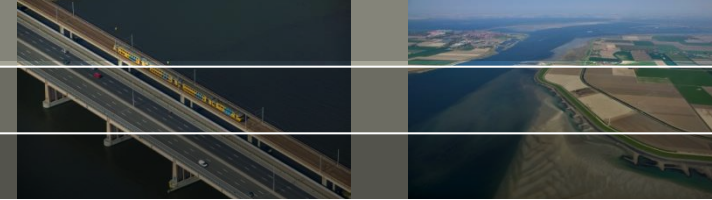
# Boven-Linge closed-loop



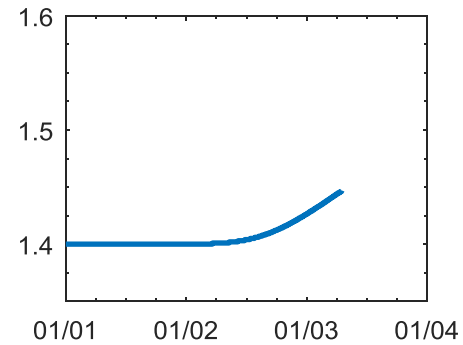
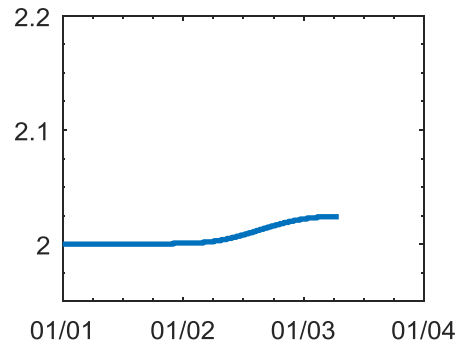
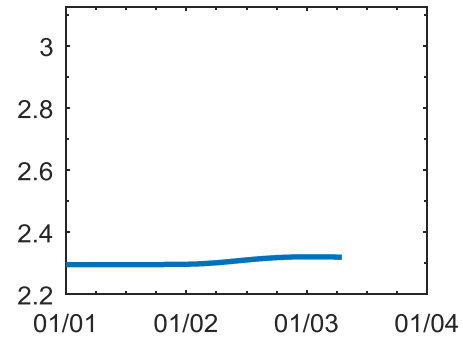
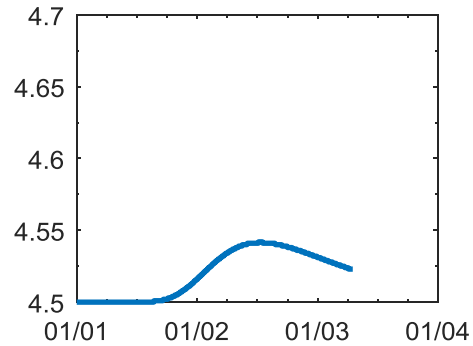
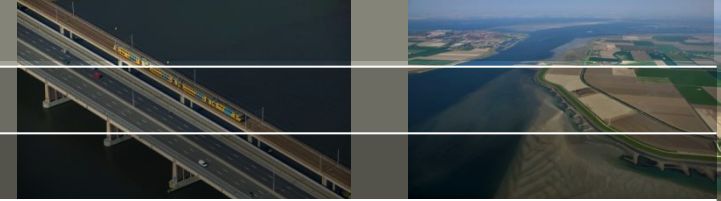
# Boven-Linge closed-loop



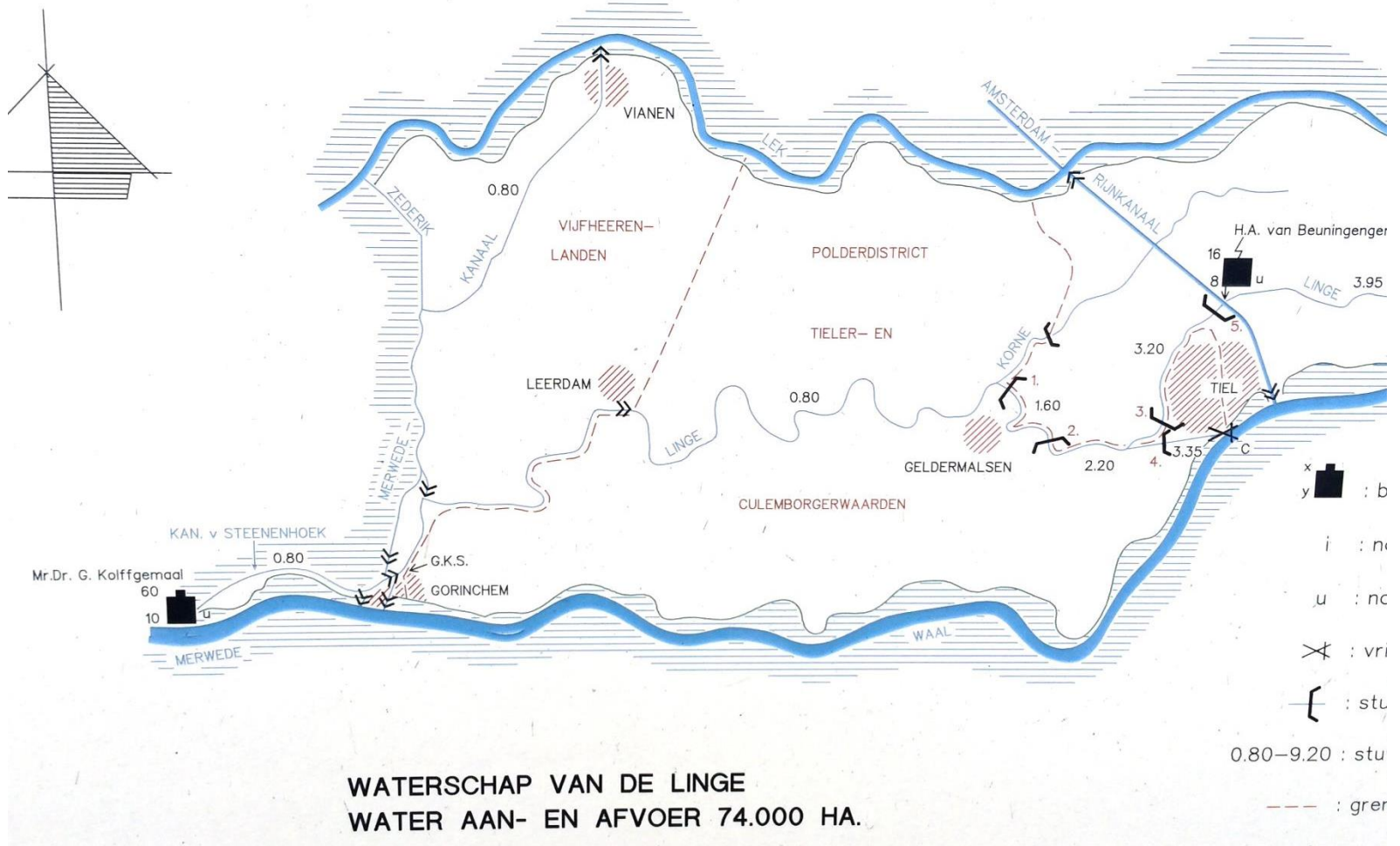
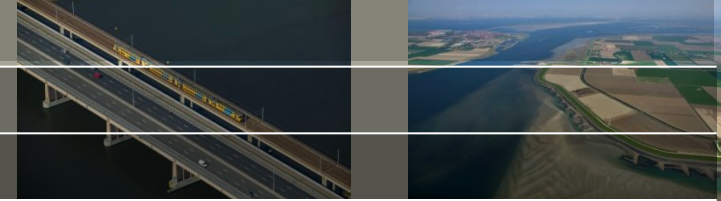
# Boven-Linge closed-loop



# Boven-Linge closed-loop

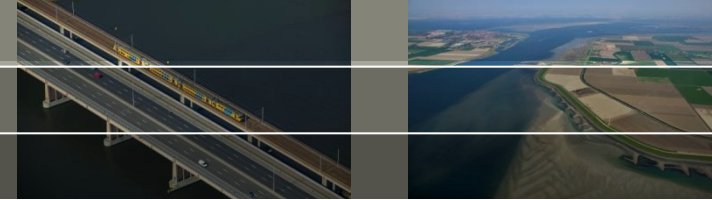


# Beneden-Linge

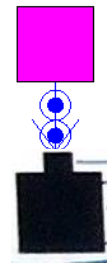




# Beneden-Linge



Amsterdam-Rijnkanaal  
van Beuningengemaal



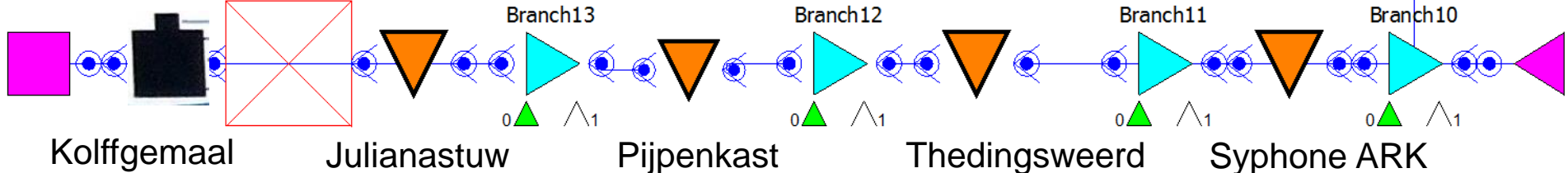
Branch14

Branch13

Branch12

Branch11

Branch10



Kolffgemaal

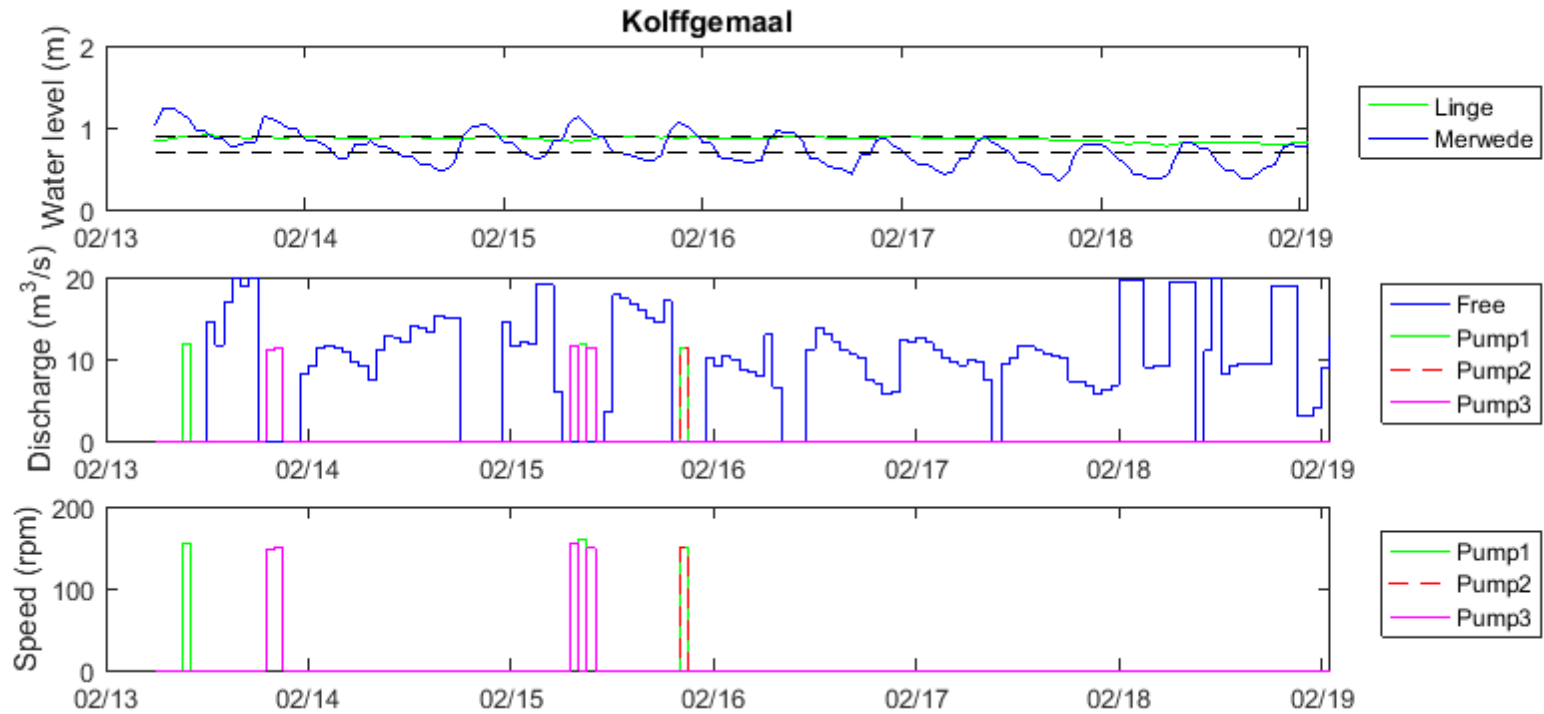
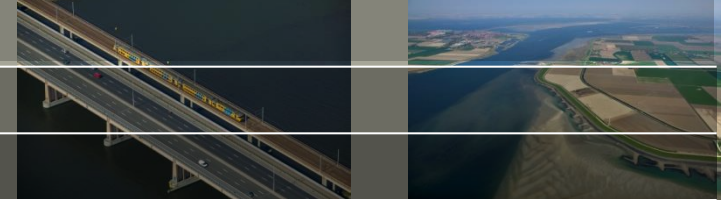
Julianastuw

Pijpenkast

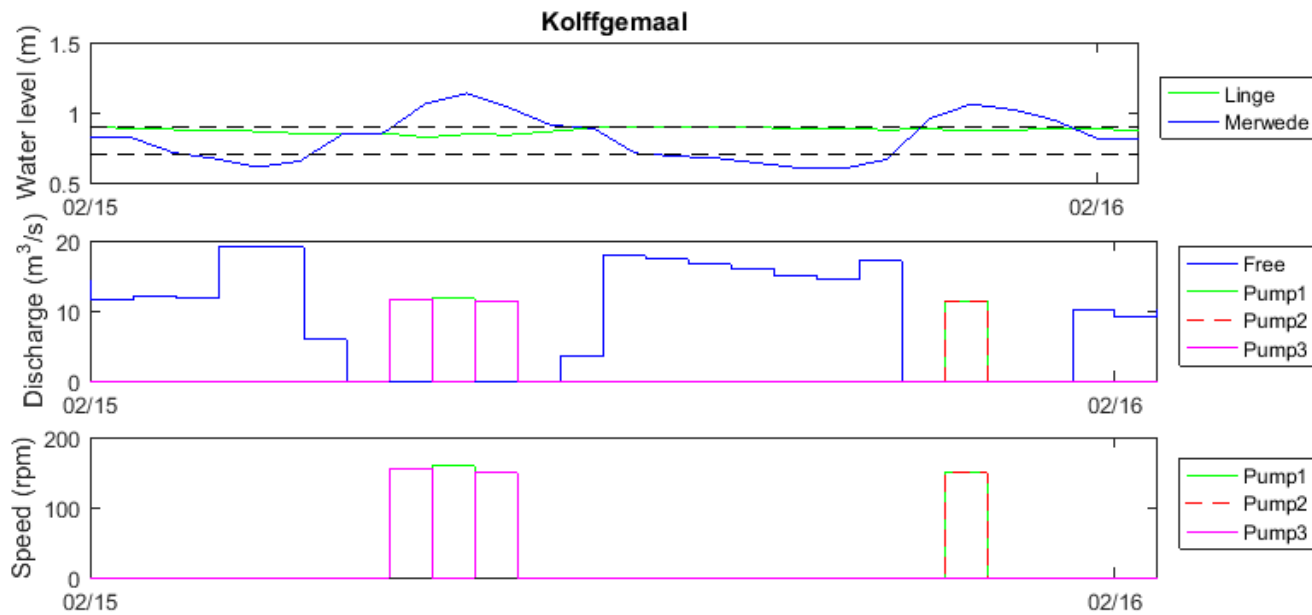
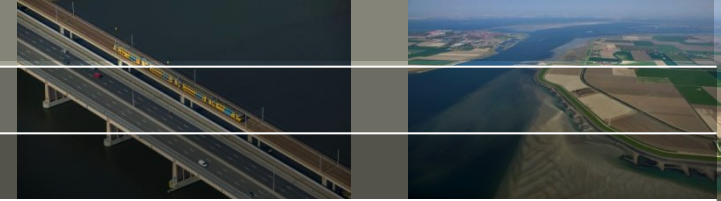
Thedingsweerd

Syphone ARK

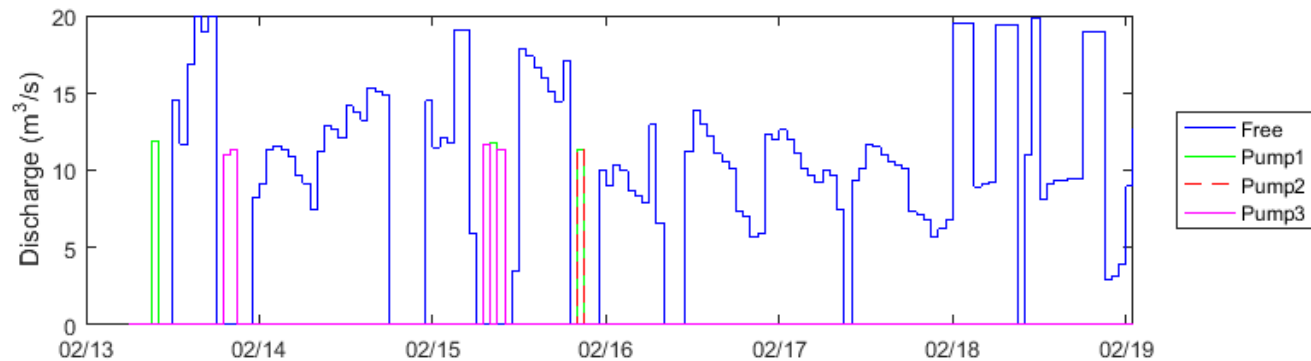
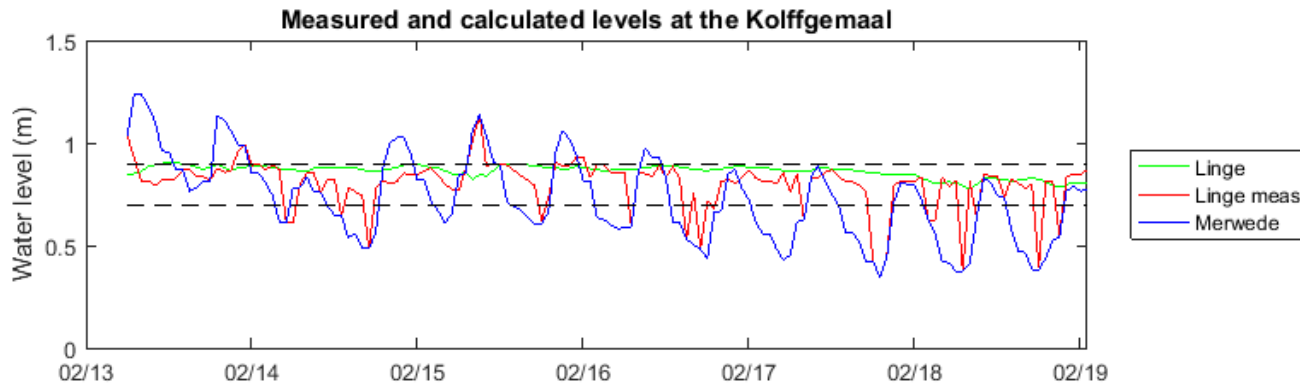
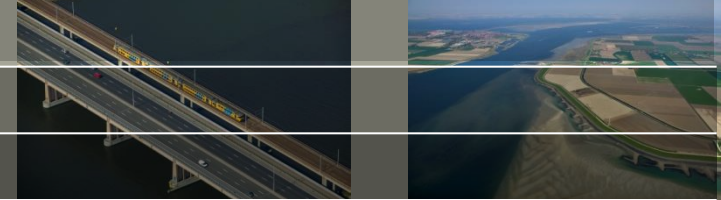
# Period: 2013.02.13-2013.02.19



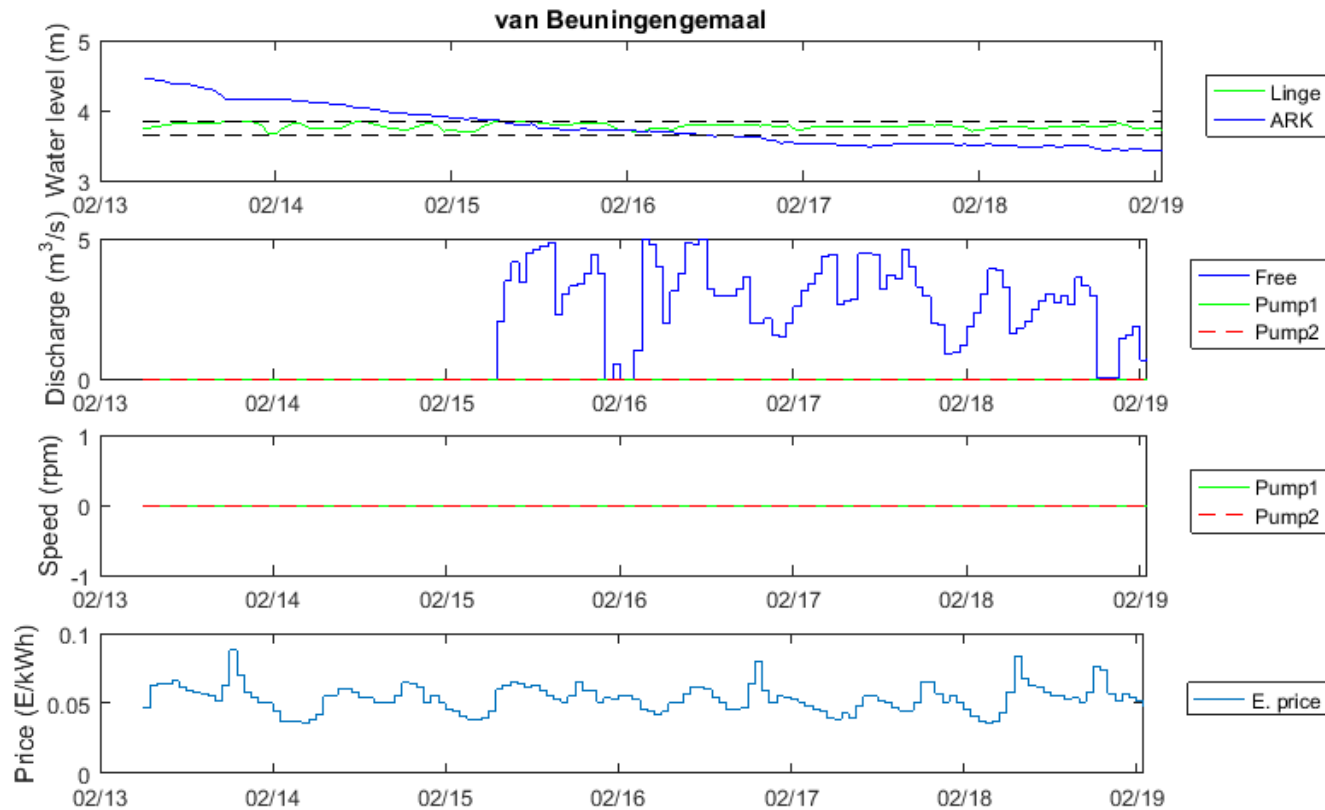
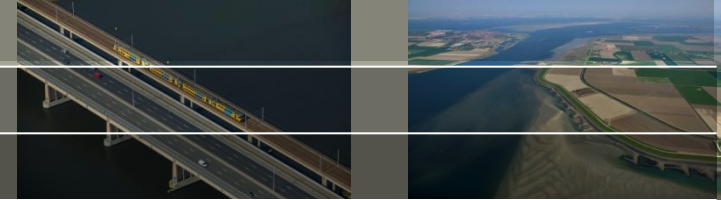
# Period: 2013.02.13-2013.02.19



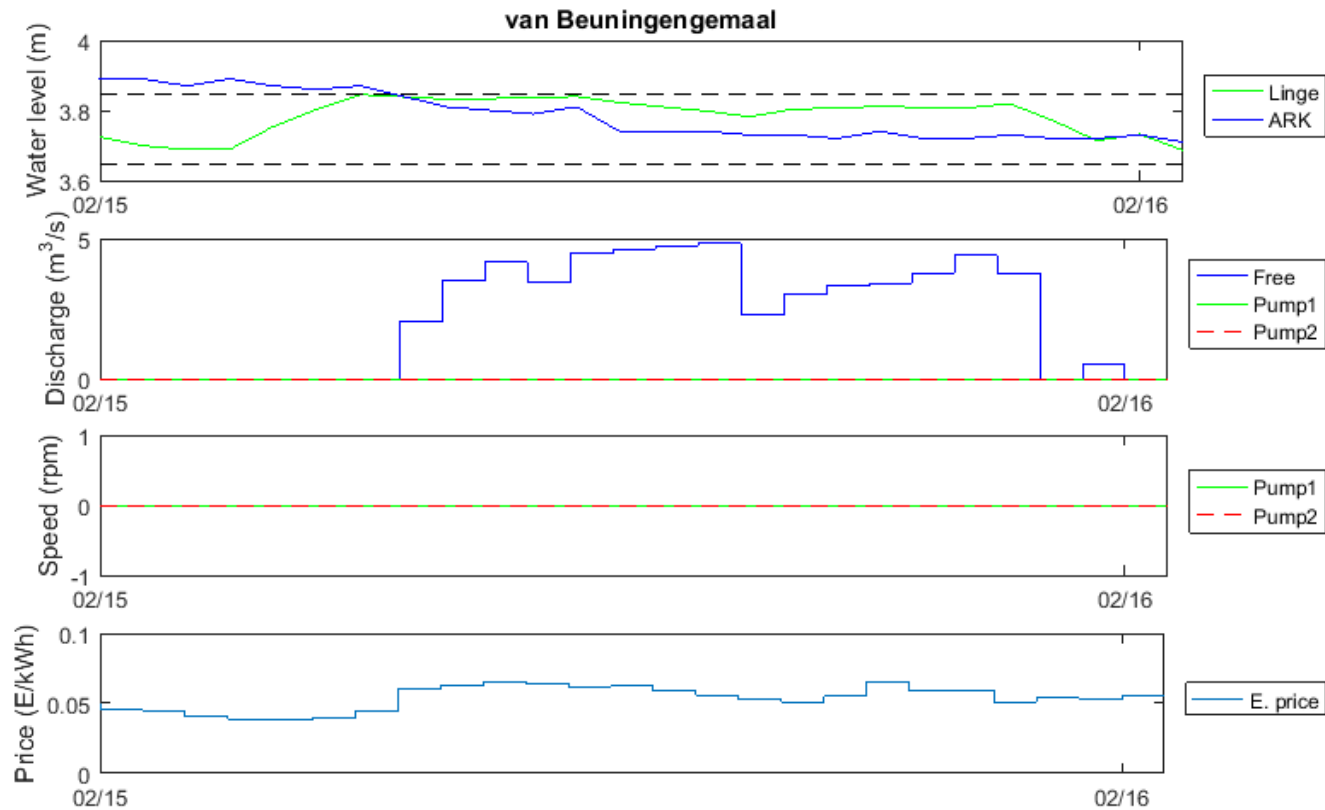
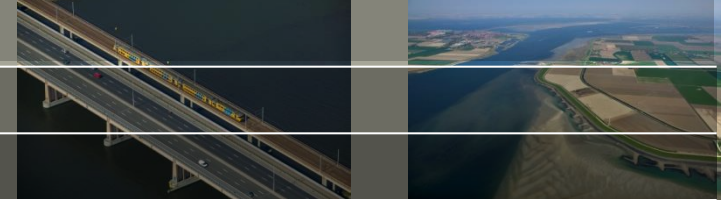
# Period: 2013.02.13-2013.02.19



# Period: 2013.02.13-2013.02.19



# Period: 2013.02.13-2013.02.19



# Period: 2013.02.13-2013.02.19

