HydroLogic

TKI-V
Pilot boezemmodel Waternet

Eindpresentatie

Inhoud

- SOBEK model omzetten naar D-HYDRO
- RTC sturing
- Uitwisseling RTC – FlowFM
- Koppelen van waterbalansen in FEWS
- D-HYDRO model implementeren in FEWS

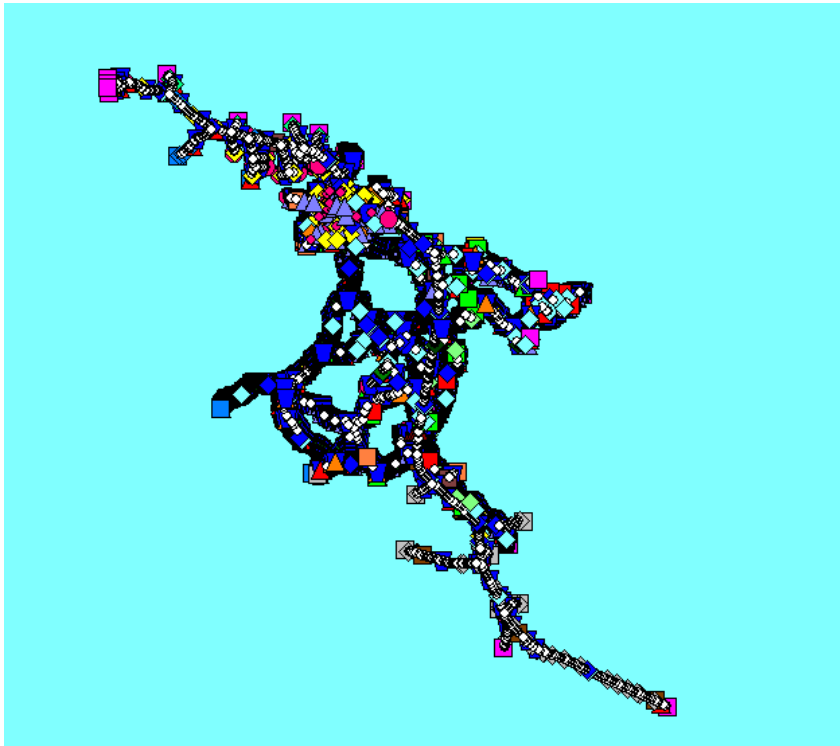
HydroLogic

SOBEK model omzetten naar D-HYDRO

Boezemmodel Waternet (B14)

- SOBEK CF(-RR)

- Boezemwateren + ARK/NZK
- Voornamelijk CF
- Aantal RR-knopen
- Invoer via lateralen met invoer vanaf 2012 (lengte varieert)



SOBEK naar D-HYDRO

1. SOBEK werkt met extrapolatie van tijdreeksen, D-HYDRO (nog) niet.

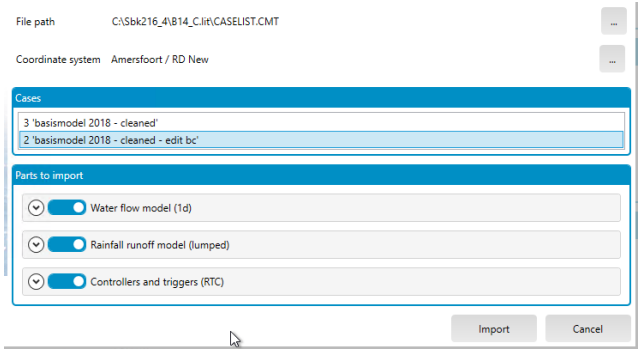
   Verlengen/aanvullen tijdreeksen in SOBEK:

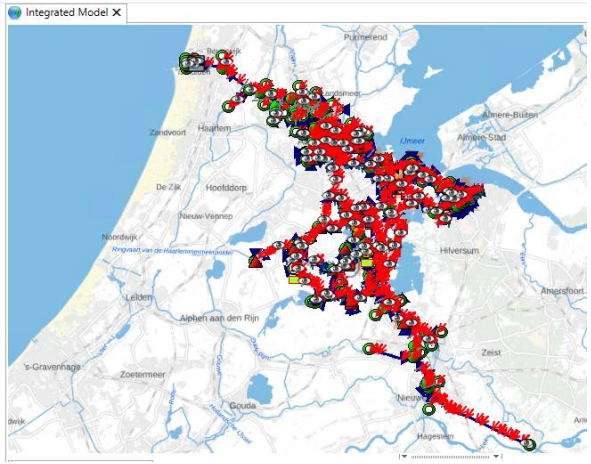
   - Lateral.dat
   - Boundary.dat

   Laatste waarde laten doorlopen tot 01-01-2021 d.m.v. scripting

SOBEK naar D-HYDRO

2. Importeren met de SOBEK 2 import functie
   - door lange tijdreeksen in SOBEK duurt dit ca. 30 min



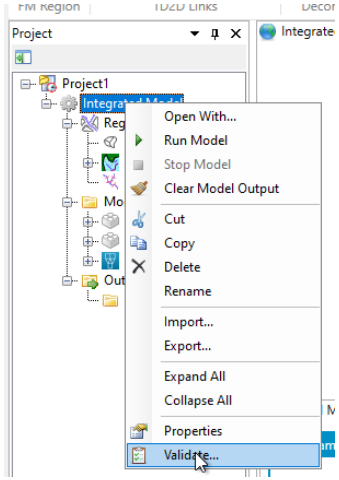


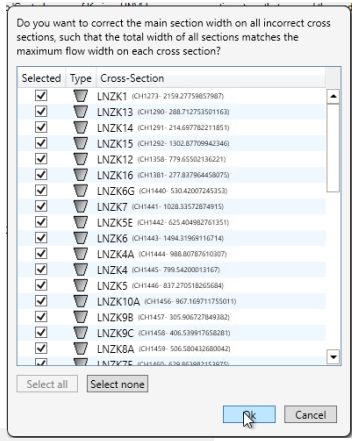
SOBEK naar D-HYDRO

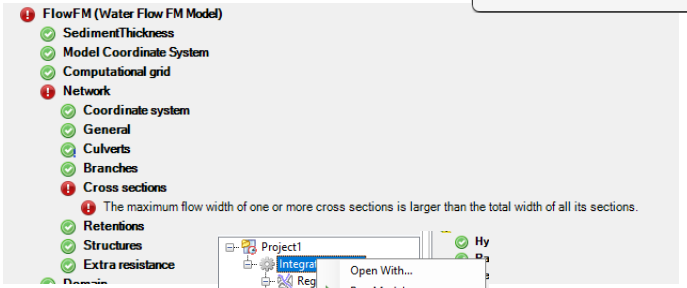
3. Validatie van model
   - incorrecte profielen, eenvoudig te corrigeren in GUI*
   - helaas niet op te slaan*

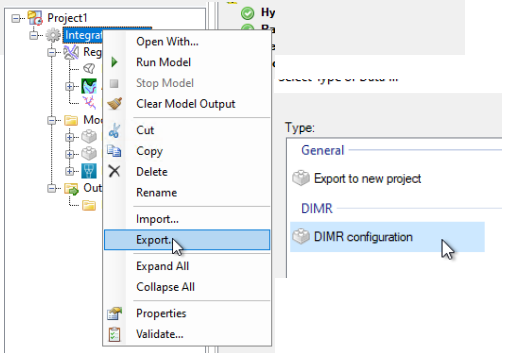
* In versie 2022.04 (en mogelijk eerdere en naar verwachting ook latere versies) worden profielen wel als correct geïmporteerd

4. Model exporteren als DIMR
   - modelconfiguratie aanpassen m.b.v. scripting







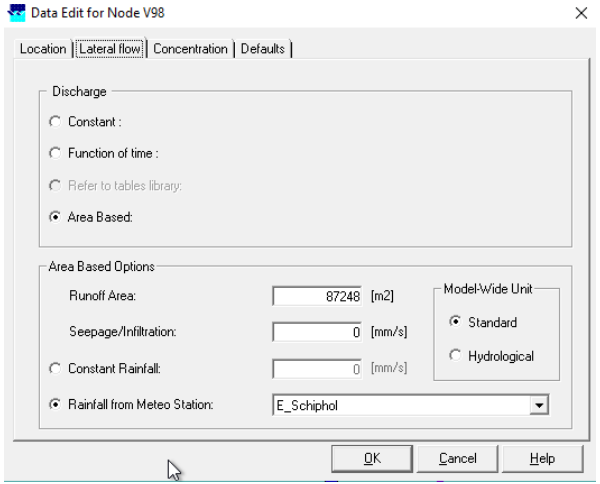


Omzetten SOBEK - D-HYDRO

5. Laterale knopen met ‘rational method’ voor neerslag en verdamping worden in FlowFM (nog) niet ondersteund

   → Workaround:

   Alle laterale oppervlaktes in rr schematiseren als ‘Open Water Basin’ en koppelen aan originele SOBEK laterale knopen

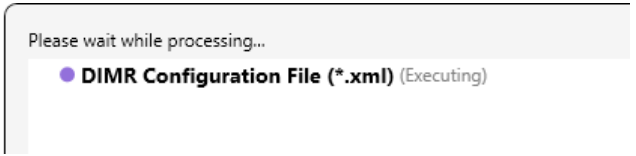


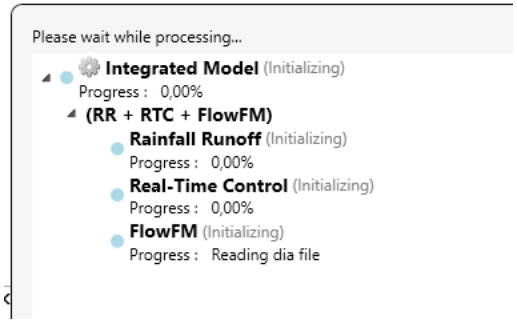
Omzetten SOBEK - D-HYDRO

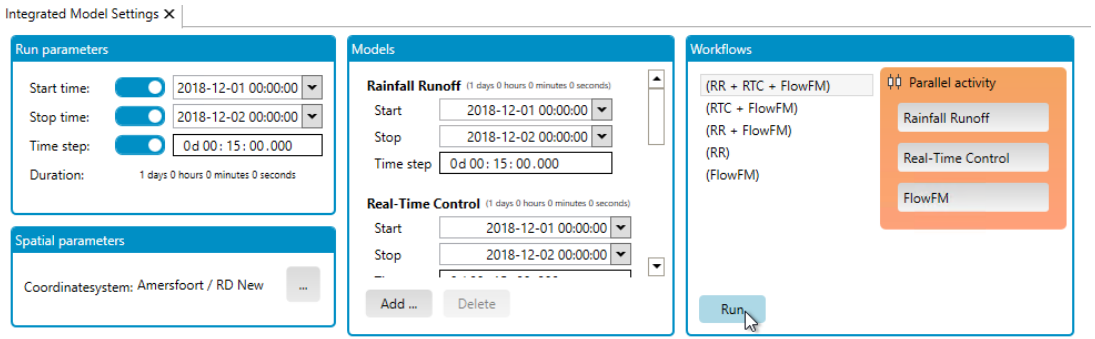
6. Aangepaste DIMR importeren in D-HYDRO GUI
   - valideren van model
     - aantal incorrecte profielen, eenvoudig te corrigeren in GUI*

* In versie 2022.04 (en mogelijk eerdere en naar verwachting ook latere versies) worden profielen wel als correct geïmporteerd

   - doorrekenen van model





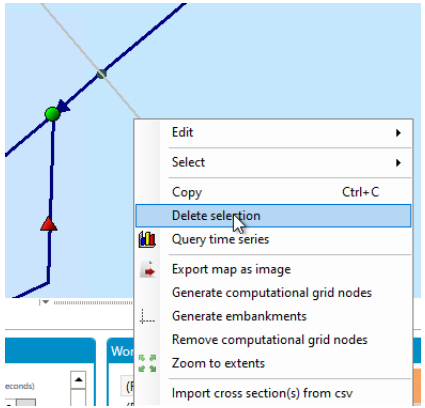


Omzetten SOBEK - D-HYDRO

- Model crasht, via ‘Dimr Run Log’:
  - meerdere profielen op zelfde locatie

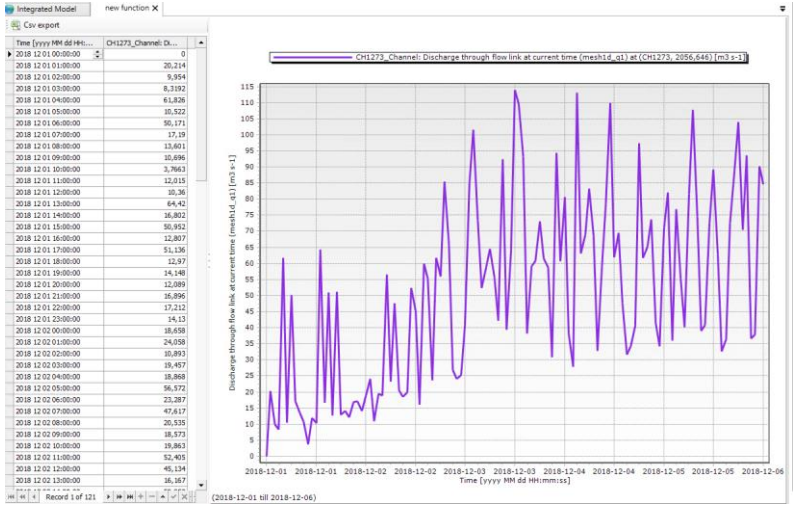
```
Dimr [2022-01-12 11:14:28.456] #0 >> kernel: Cross section 'L14913' and 'L14986' are exactly at the same location.
Dimr [2022-01-12 11:14:28.489] #0 >> kernel: Cross section 'L07_910' and 'L910' are exactly at the same location.
Dimr [2022-01-12 11:14:28.497] #0 >> kernel: Cross section 'L07_13953' and 'L07_4158' are exactly at the same location.
Dimr [2022-01-12 11:14:28.498] #0 >> kernel: Cross section 'L07_4156' and 'L07_13951' are exactly at the same location.
Dimr [2022-01-12 11:14:28.503] #0 >> kernel: Cross section 'L07_14072' and 'L07_14142' are exactly at the same location.
```

  - handmatig verwijderen van dubbele profielen

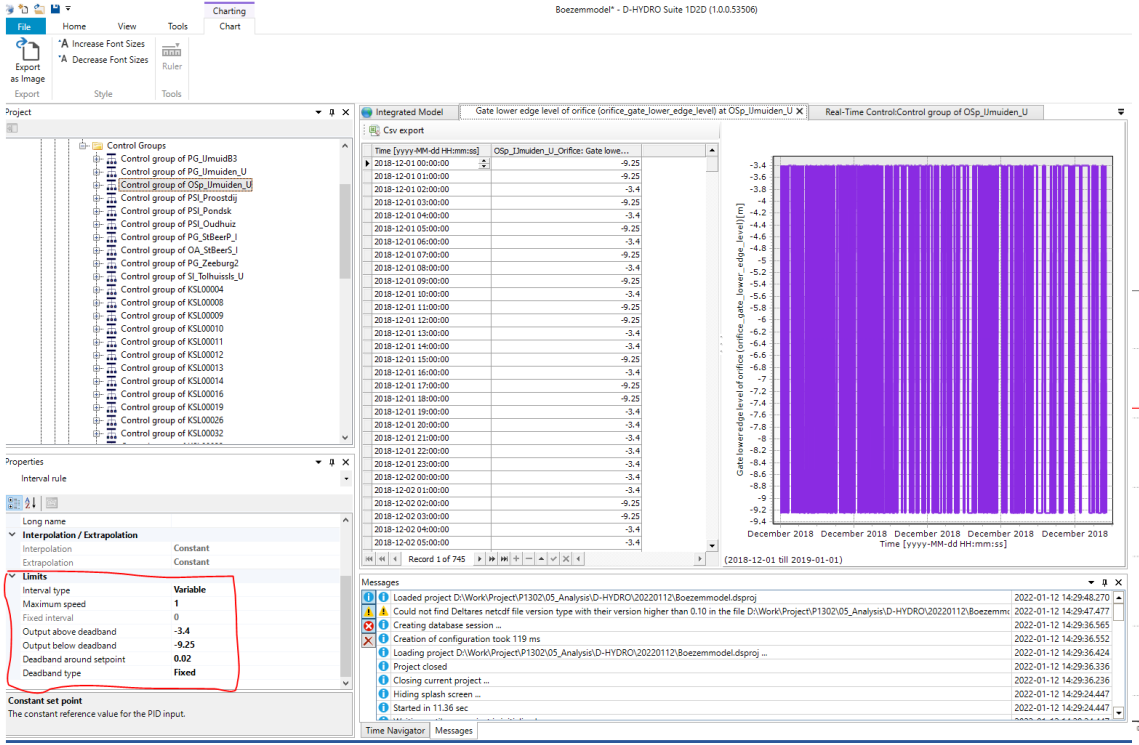


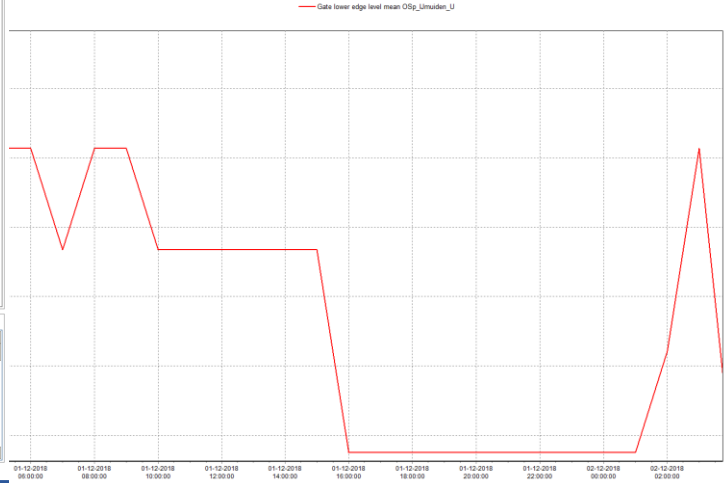
Omzetten SOBEK - D-HYDRO

Model rekent succesvol!



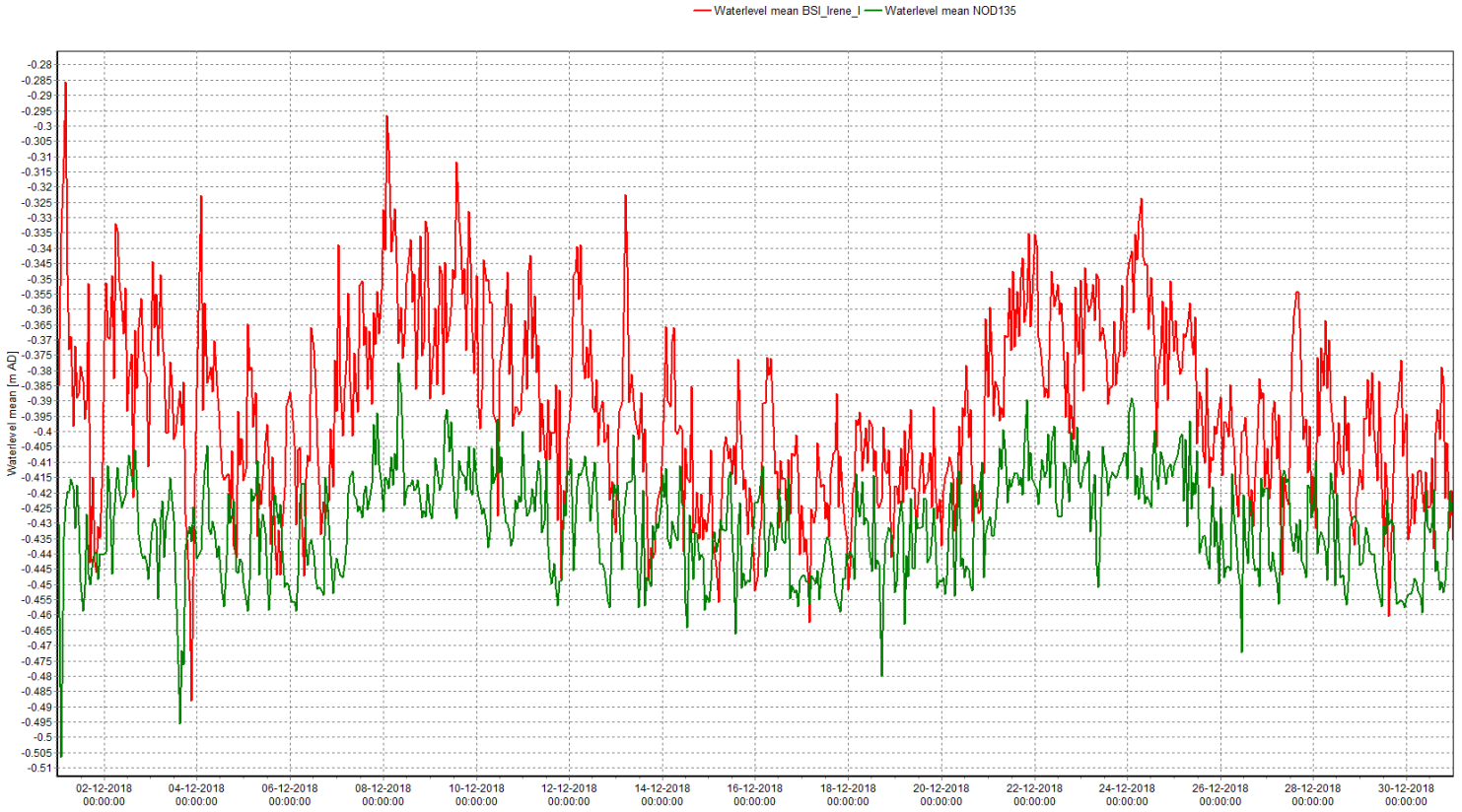
Vergelijking SOBEK en D-HYDRO - control velocity





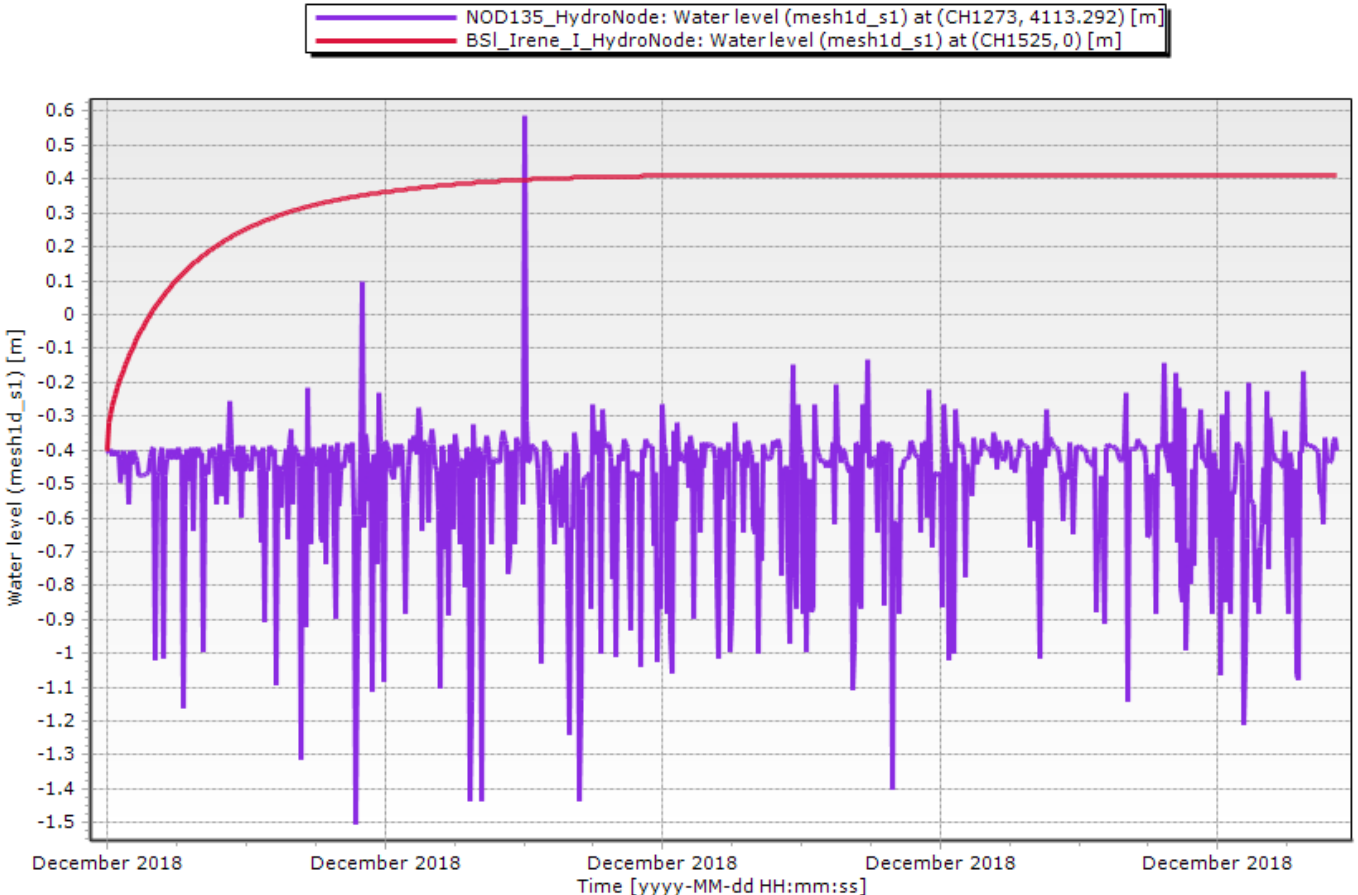

```
CNTL id 'PG_IJmuidB3' nm 'nieuwe pompen IJmuiden' ct 2 ac 1 ca 3 cf 1 ml 'RWS_IJmui_binn' cp 0 ui 0 ua 100 cn 1 du 0 cv 1000 dt 0 d_ 0.04 bl 1 sp tc 0 -
CNTL id 'PG_IJmuiden_U' nm 'IJmuiden oude pompen' ct 2 ac 1 ca 3 cf 1 ml 'RWS_IJmui_binn' cp 0 ui 0 ua 160 cn 1 du 0 cv 100 dt 0 d_ 0.04 bl 1 sp tc 0 -0
CNTL id 'OSp_IJmuiden_U' nm 'spuisluis IJmuiden' ct 2 ac 1 ca 2 cf 1 ml 'RWS_IJmui_binn' cp 0 ui -9.25 ua -3.4 cn 1 du 0 cv 1 dt 0 d_ 0.02 bl 1 sp tc 0 -
```

Vergelijking SOBEK en D-HYDRO - verhang



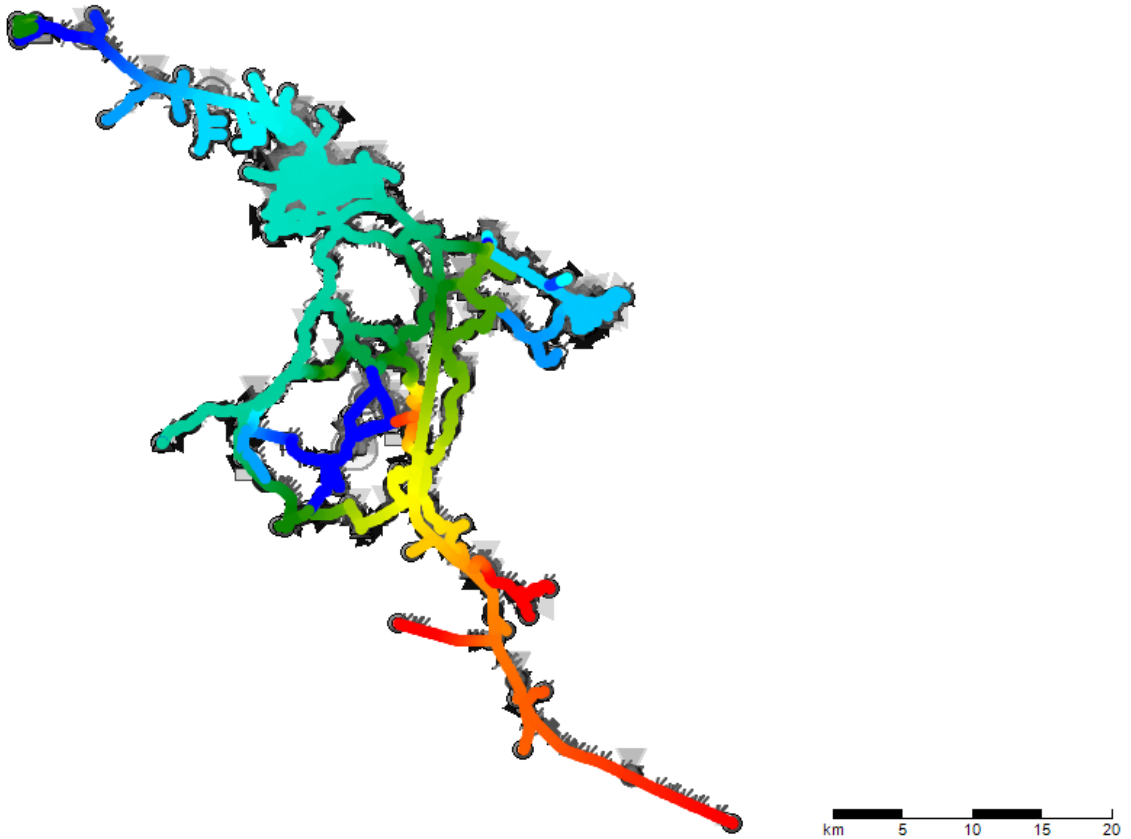
SOBEK

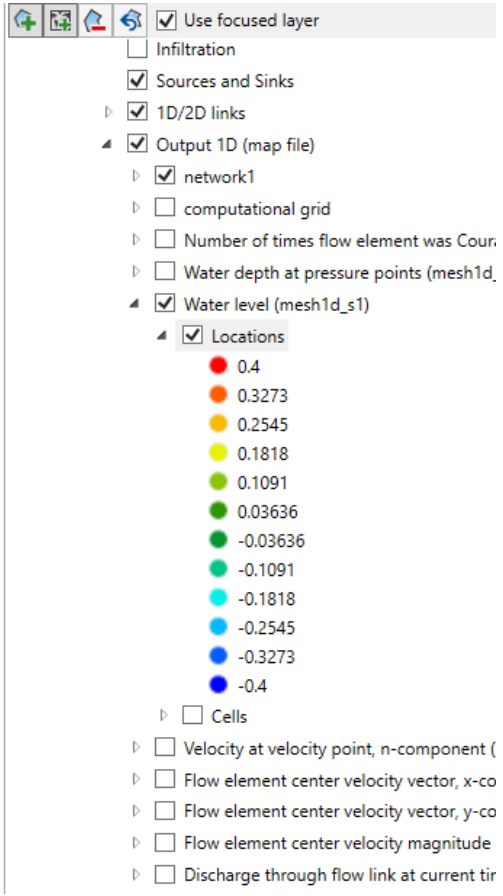
Vergelijking SOBEK en D-HYDRO - verhang



D-HYDRO
Verhang veel groter

Vergelijking SOBEK en D-HYDRO - verhang

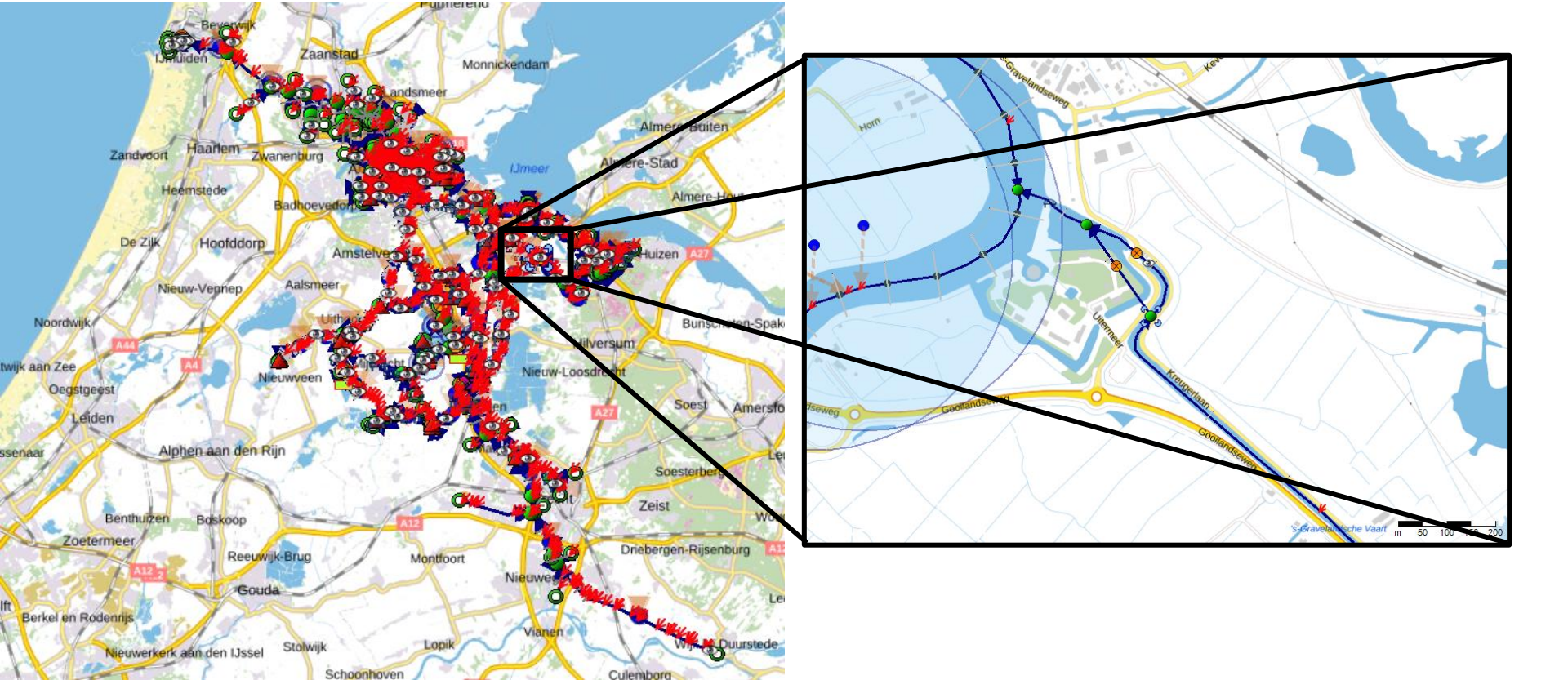




Vergelijking SOBEK en D-HYDRO verhang

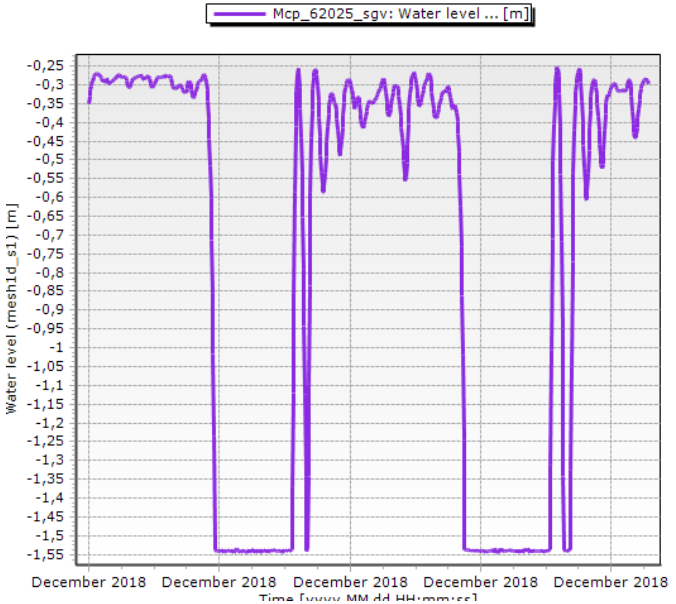
- Verhang veroorzaakt door:
  - klepperen gemalen
  - ruwheid te hoog
- Eerste stap: klepperen gemalen verbeteren
- Tweede stap: ruwheid verbeteren

Droogvallende watergang



Droogvallende watergang

- Droogvallende watergang
- Mogelijke oorzaken
  - ruwheid
  - uitwisseling tussen RTC - FlowFM
    - inzicht gewenst in of de uitwisseling tussen modules (RTC - FlowFM) effect heeft op resultaten



Droogvallende watergang

- Mogelijke oorzaken
  - ruwheid
  - uitwisseling tussen RTC - FlowFM
    - inzicht gewenst in of de uitwisseling tussen modules (RTC - FlowFM) effect heeft op resultaten

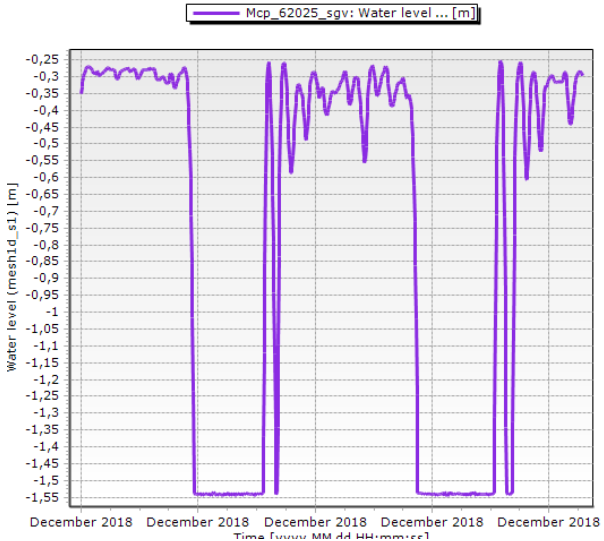
Droogvallende watergang

- Ruwheid
  - overgenomen uit SOBEK model
    - gedefinieerd per cross-section
  - nieuwe modelvariant
    - alle losse definities verwijderd
    - uniforme ruwheid opgegeven

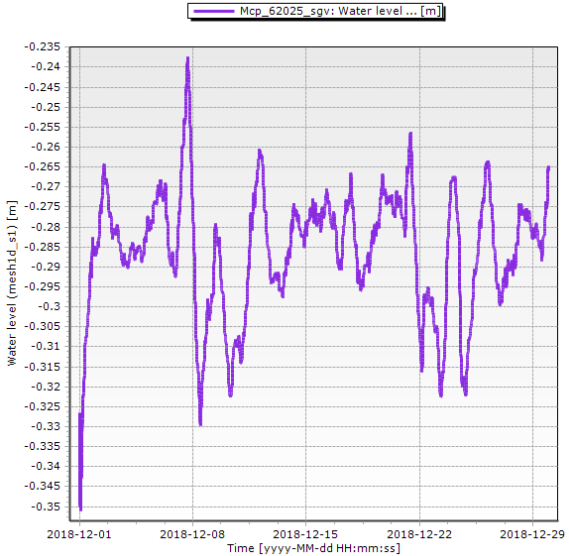
Droogvallende watergang

- Uniforme ruwheid opgegeven
  - snellere rekentijd
  - waterstand nu wel zoals verwacht

Oude ruwheid:



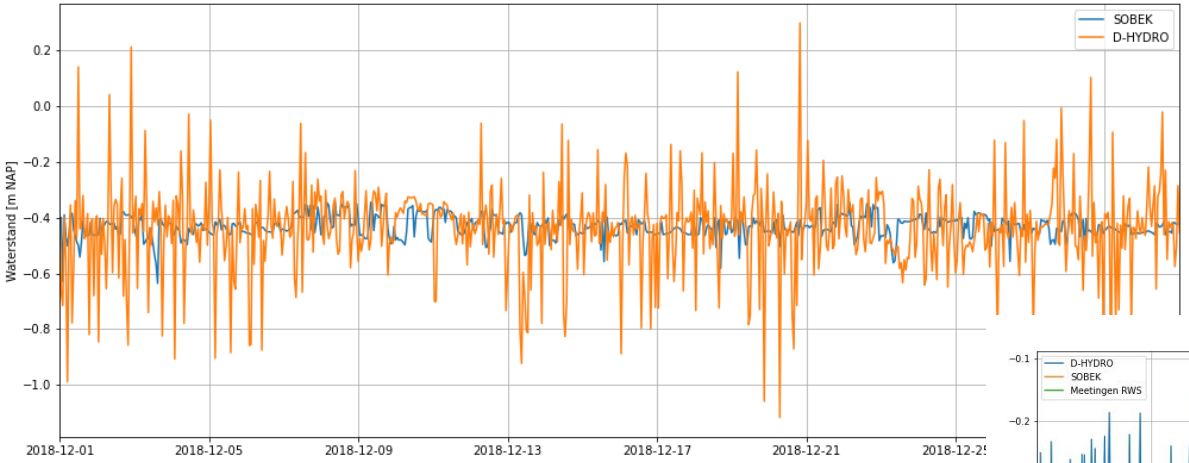
Nieuwe ruwheid:

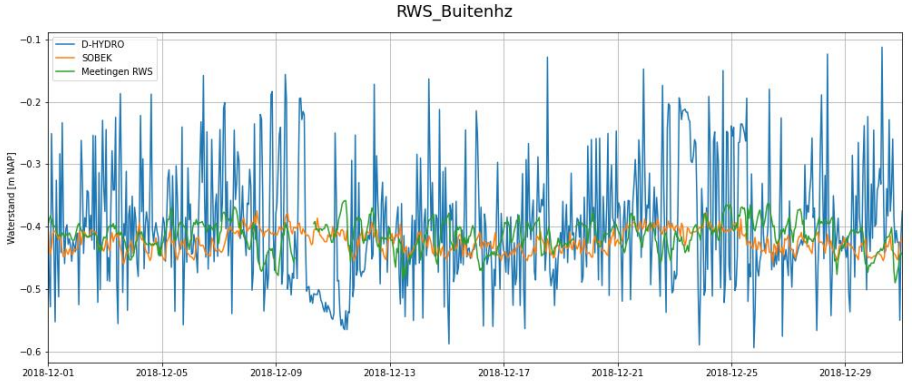



HydroLogic
RTC sturing

Sturing IJmuiden

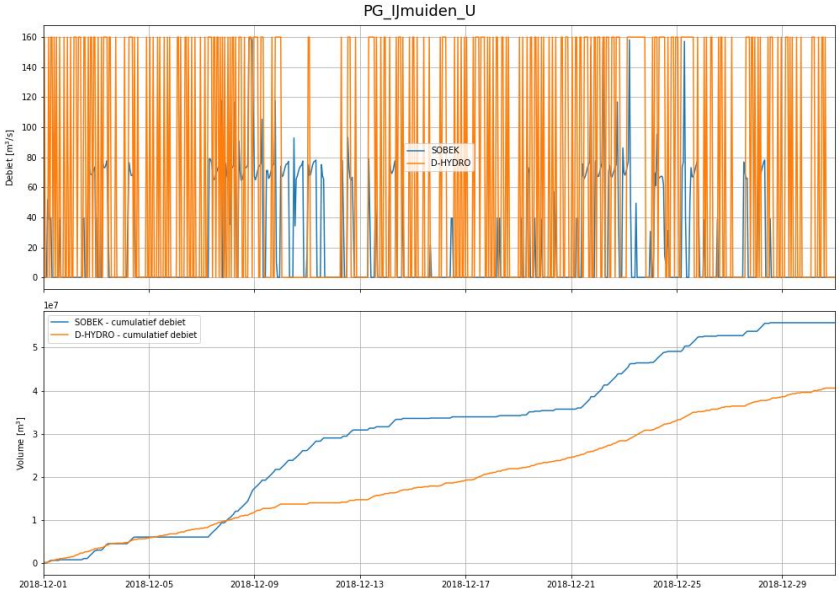
- Startpunt
  - waterstand nabij IJmuiden

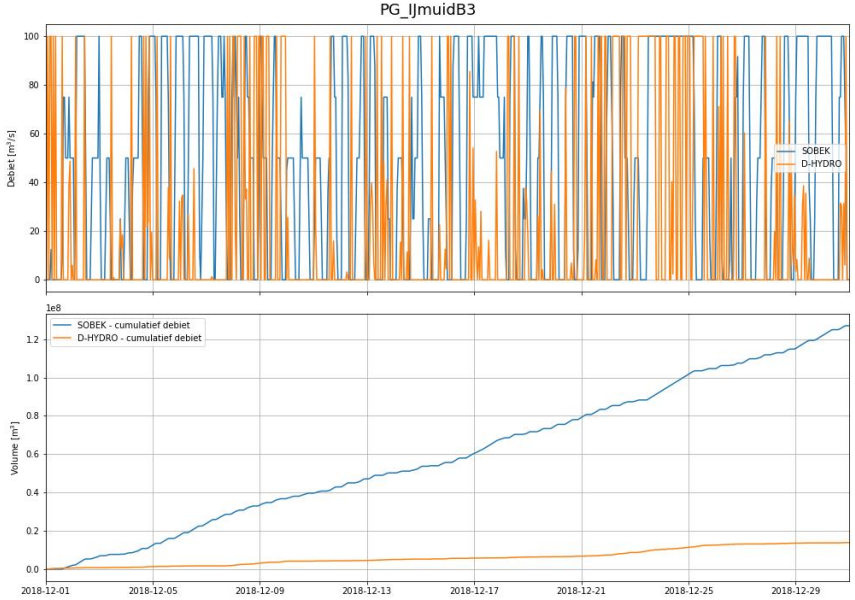




Sturing IJmuiden

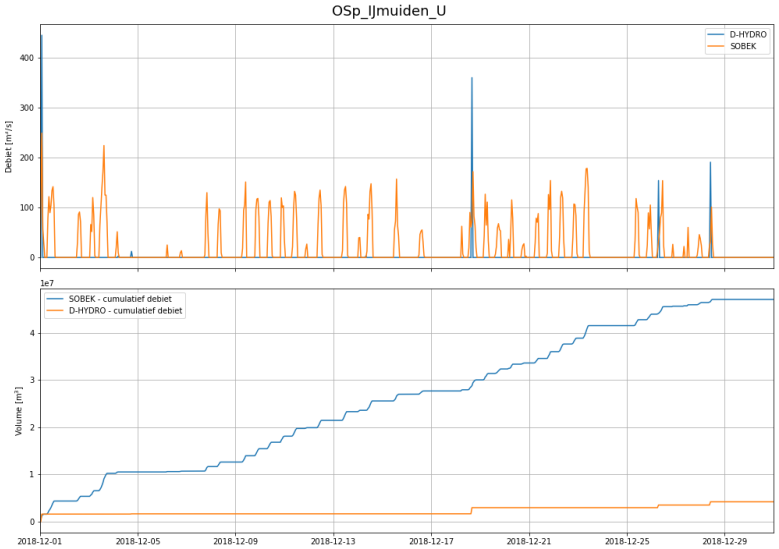
- Startpunt
  - waterstand nabij IJmuiden
  - debiet gemalen





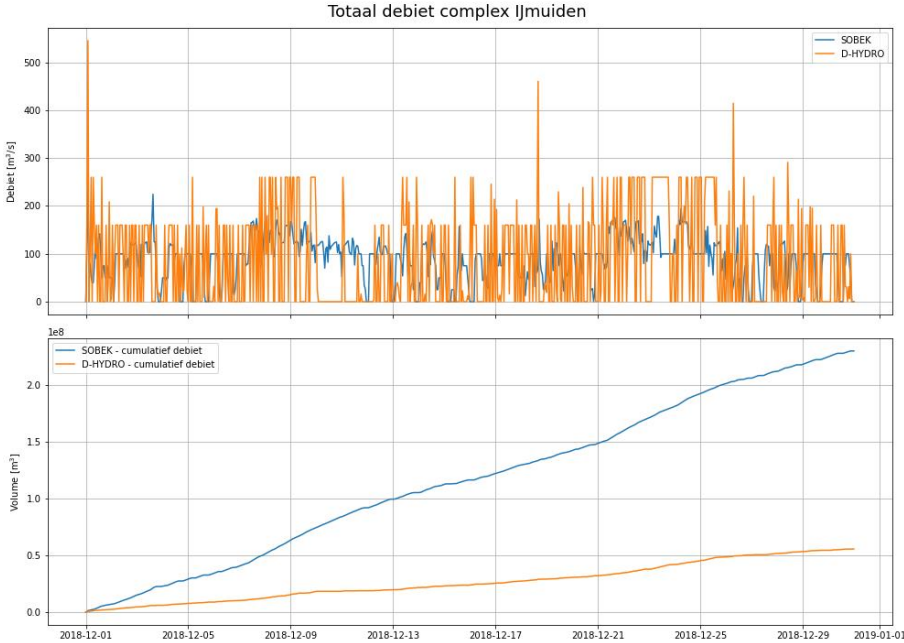
Sturing IJmuiden

- Startpunt
  - waterstand nabij IJmuiden
  - debiet gemalen
  - debiet sluizen



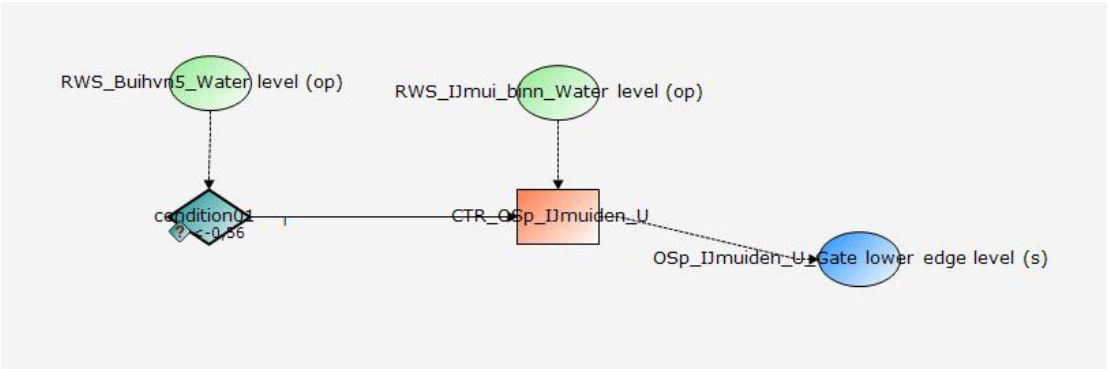
Sturing IJmuiden

- Startpunt
  - waterstand nabij IJmuiden
  - debiet gemalen
  - debiet sluizen
  - Totaal complex IJmuiden



Sturing IJmuiden – stap 1

- Aanpassing Spuisluizen



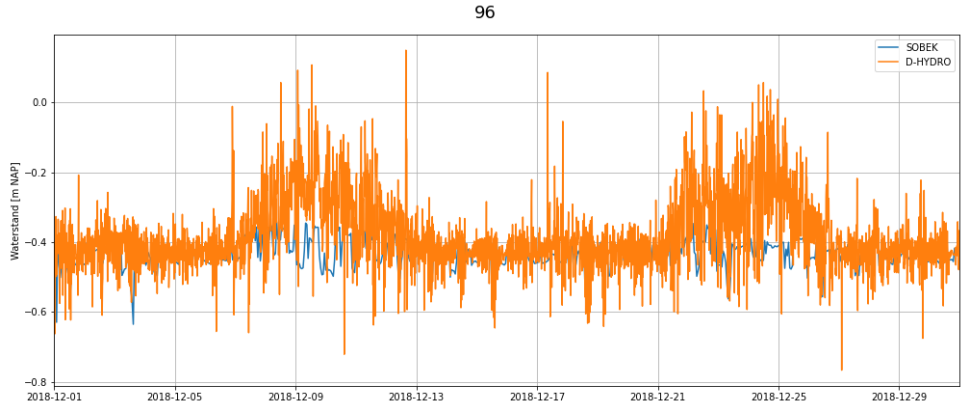
- Gemalen: 'maximum speed' verlaagd

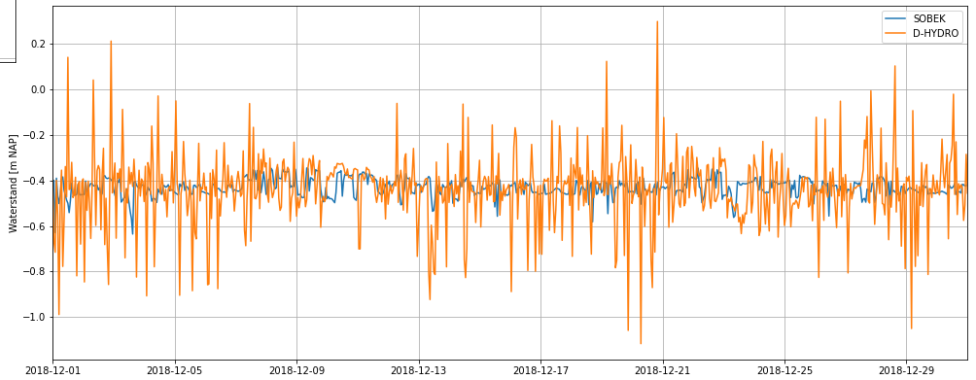
Limits	
Interval type	**Variable**
Maximum speed	**0,0444**
Fixed interval	0
Output above deadband	**160**
Output below deadband	**0**
Deadband around setpoint	**0,04**
Deadband type	**Fixed**

Limits	
Interval type	**Variable**
Maximum speed	**0,02778**
Fixed interval	0
Output above deadband	**100**
Output below deadband	**0**
Deadband around setpoint	**0,04**
Deadband type	**Fixed**

Sturing IJmuiden - stap 1

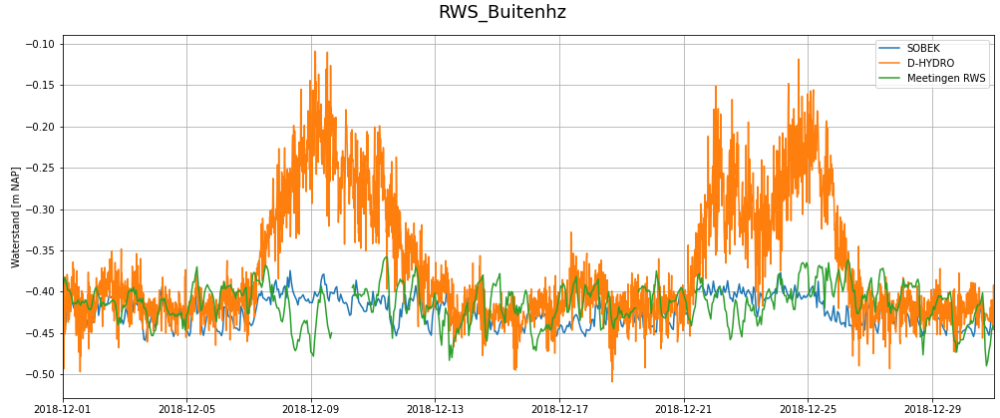
- Resultaten – stap 1
  - waterstand nabij IJmuiden

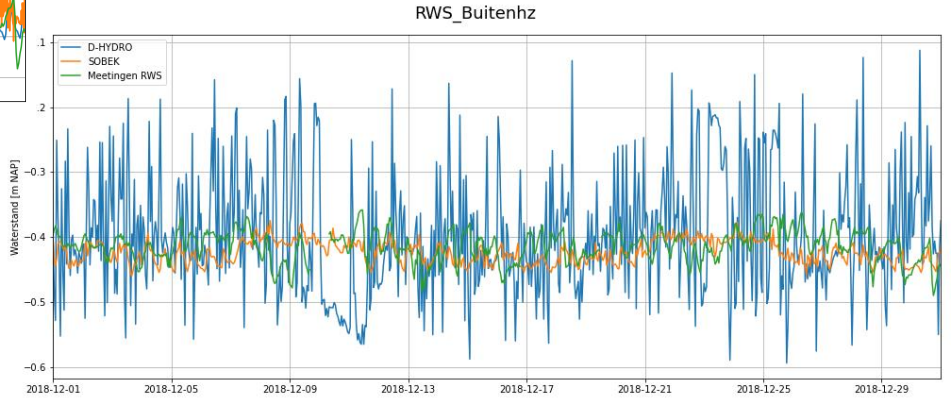




Sturing IJmuiden - stap 1

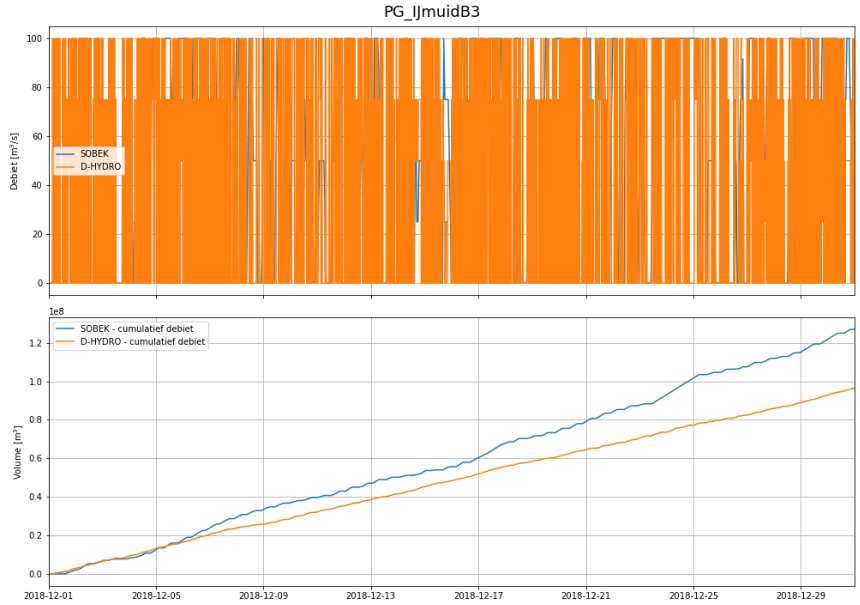
- Resultaten – stap 1
  - waterstand nabij RWS Buitenhuizen

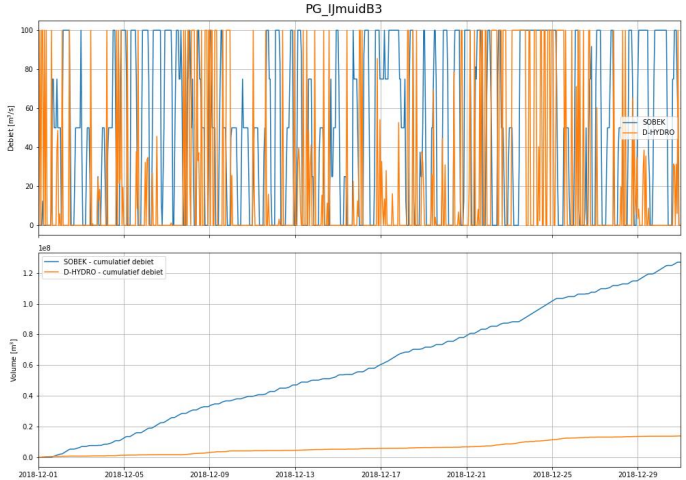




Sturing IJmuiden - stap 1

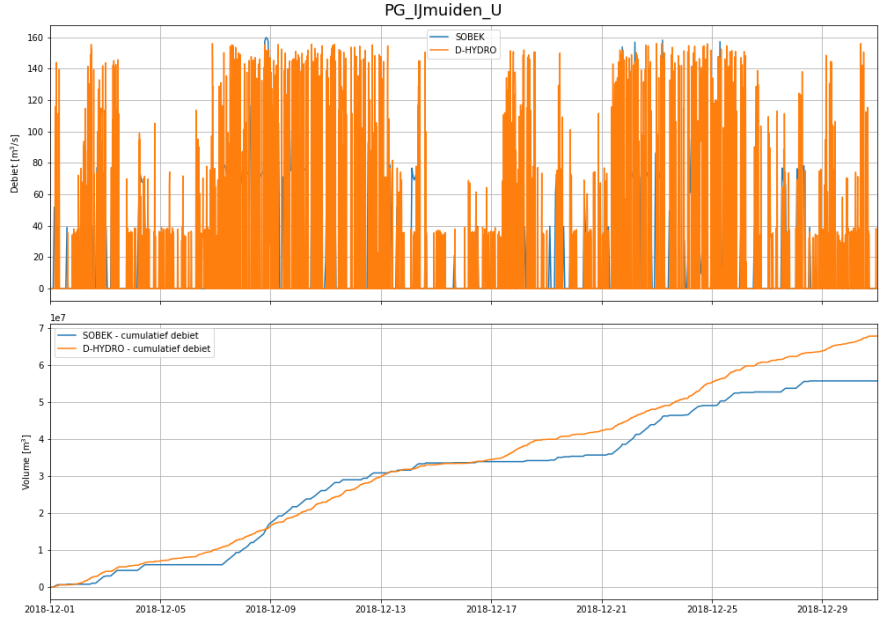
- Resultaten – stap 1
  - waterstand nabij IJmuiden
  - debiet gemalen

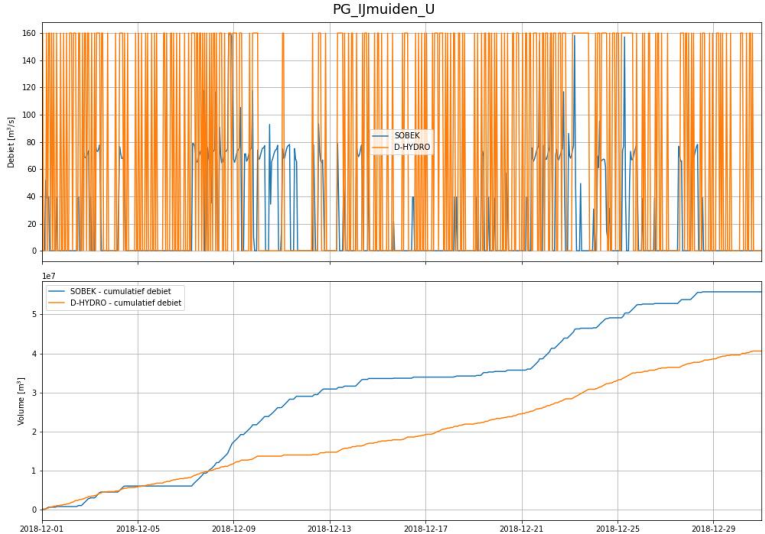




Sturing IJmuiden - stap 1

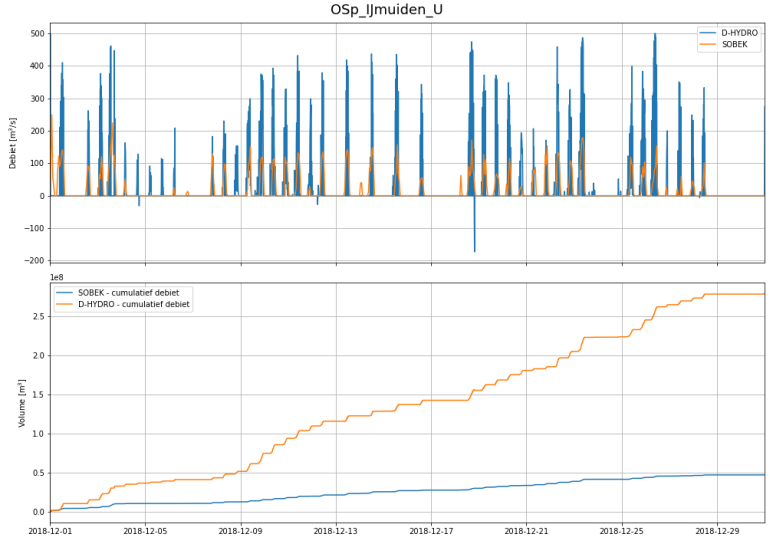
- Resultaten – stap 1
  - waterstand nabij IJmuiden
  - debiet gemalen

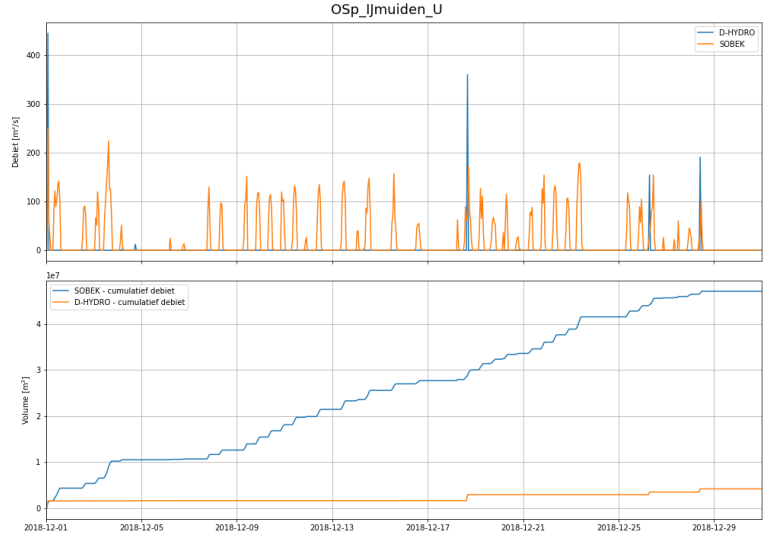




Sturing IJmuiden - stap 1

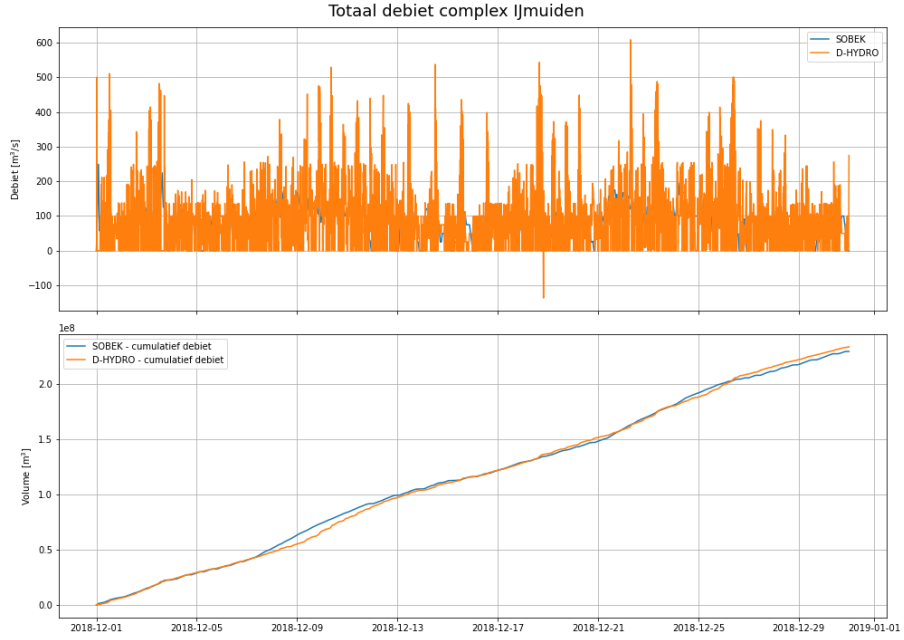
- Resultaten – stap 1
  - waterstand nabij IJmuiden
  - debiet gemalen
  - debiet sluizen

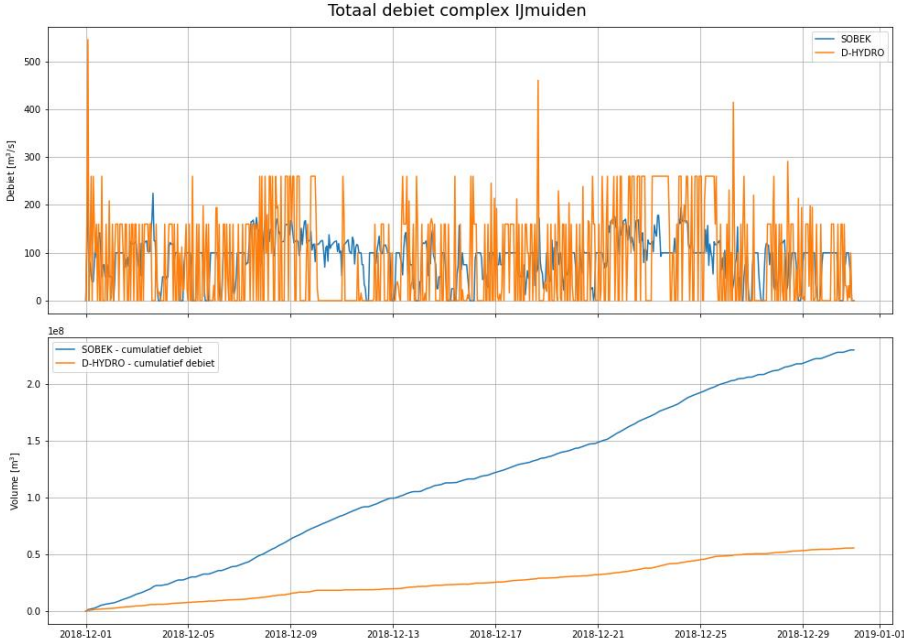




Sturing IJmuiden - stap 1

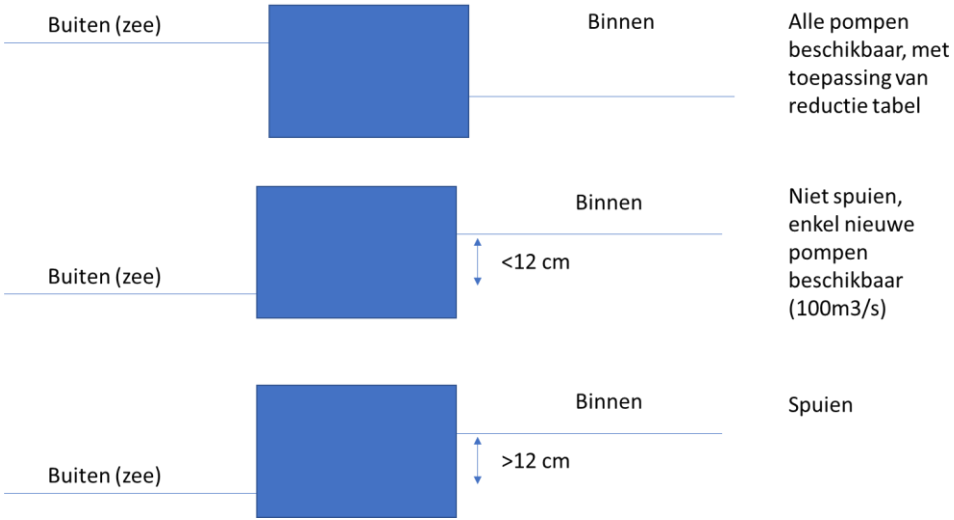
- Resultaten – stap 1
  - waterstand nabij IJmuiden
  - debiet gemalen





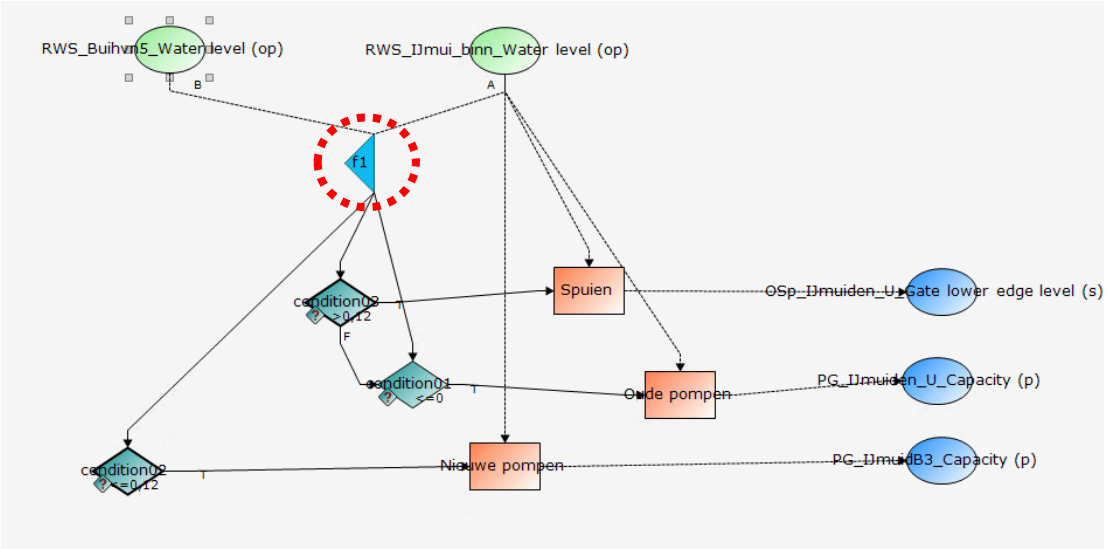
Sturing IJmuiden – stap 2

- Toepassen complexe sturing, opzet:



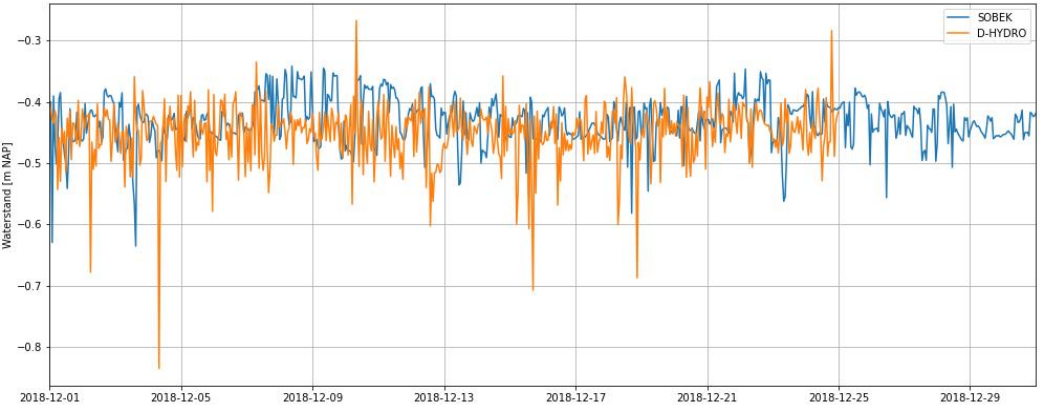
Sturing IJmuiden - stap 2

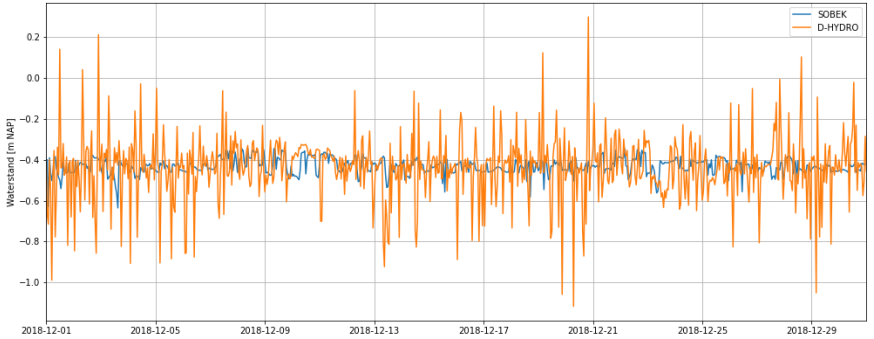
- Toepassen complexe sturing



Sturing IJmuiden – stap 2

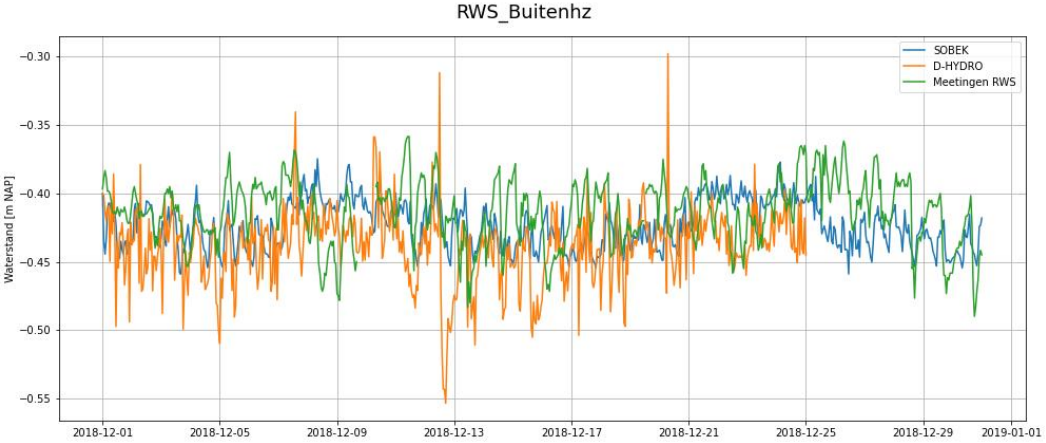
- Resultaten
  - waterstand nabij IJmuiden

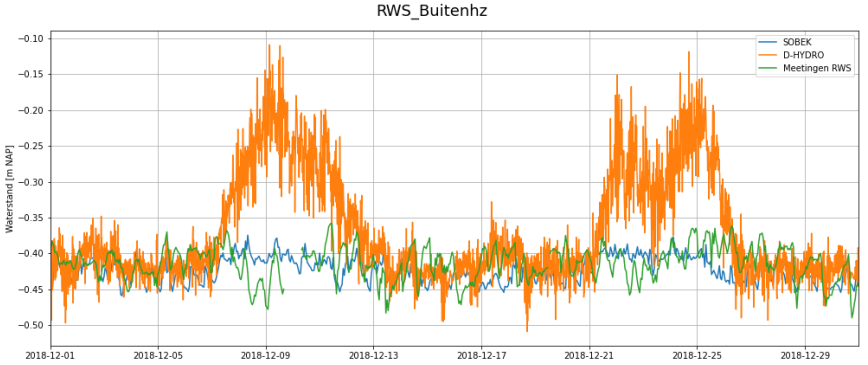




Sturing IJmuiden - stap 2

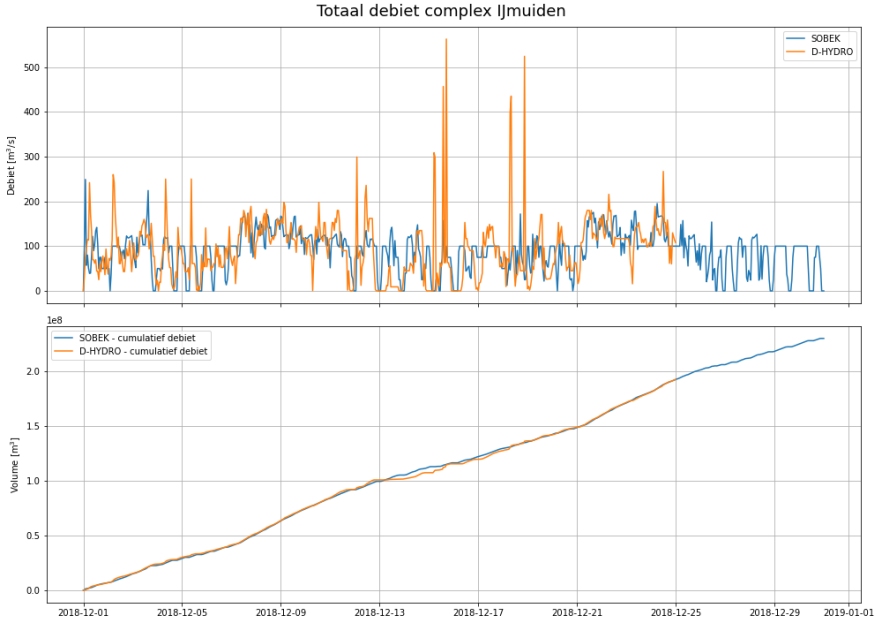
- Resultaten
  - waterstand nabij RWS Buitenhuizen

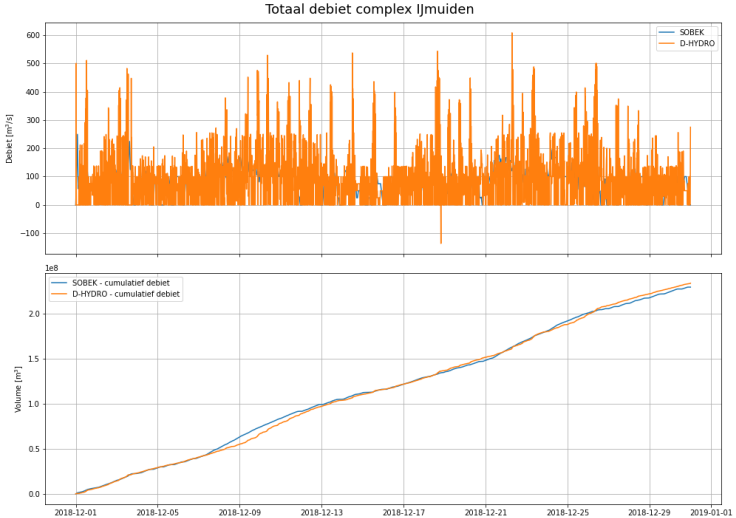




Sturing IJmuiden - stap 2

- Resultaten
  - waterstand nabij IJmuiden
  - totaal debiet complex IJmuiden



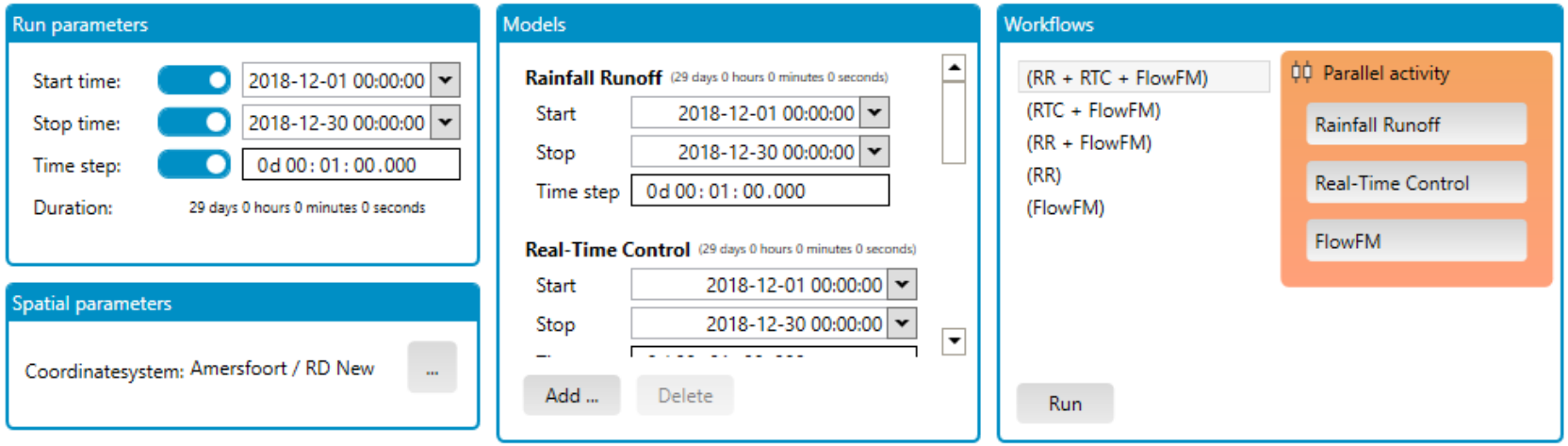


HydroLogic

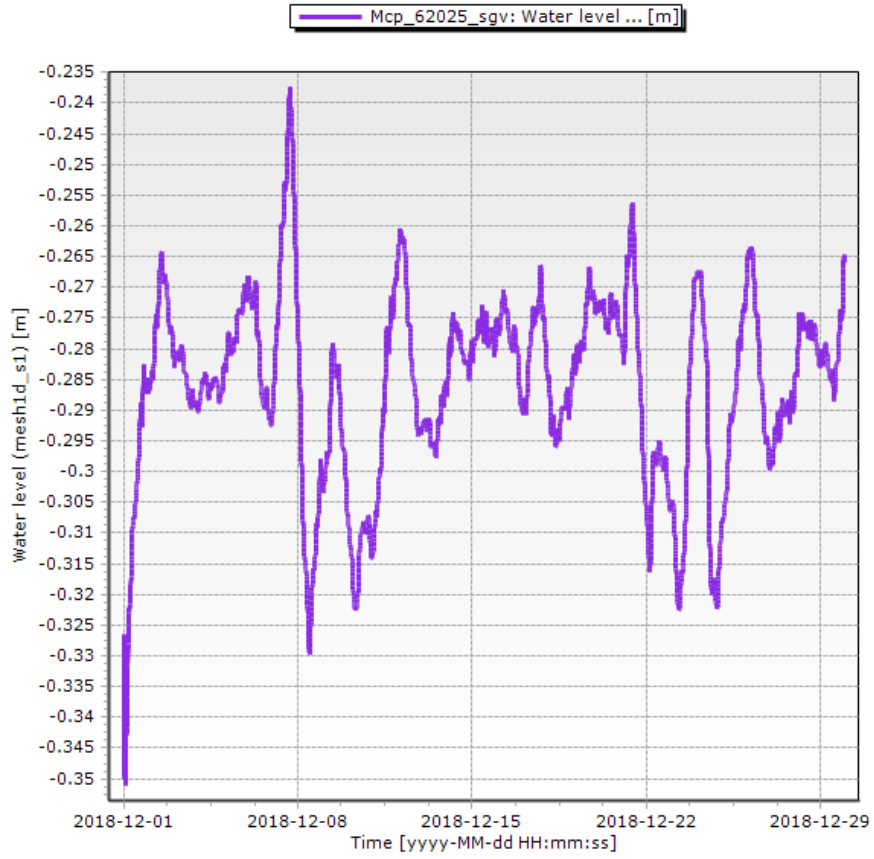
Uitwisseling tussen RTC - FlowFM

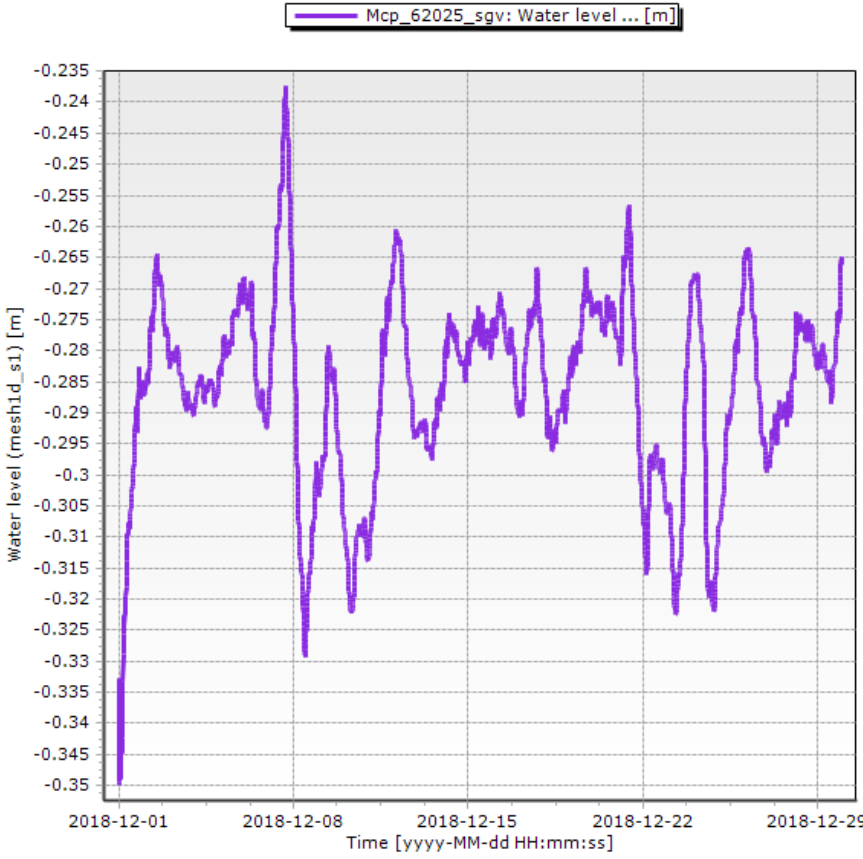
Modelvarianten

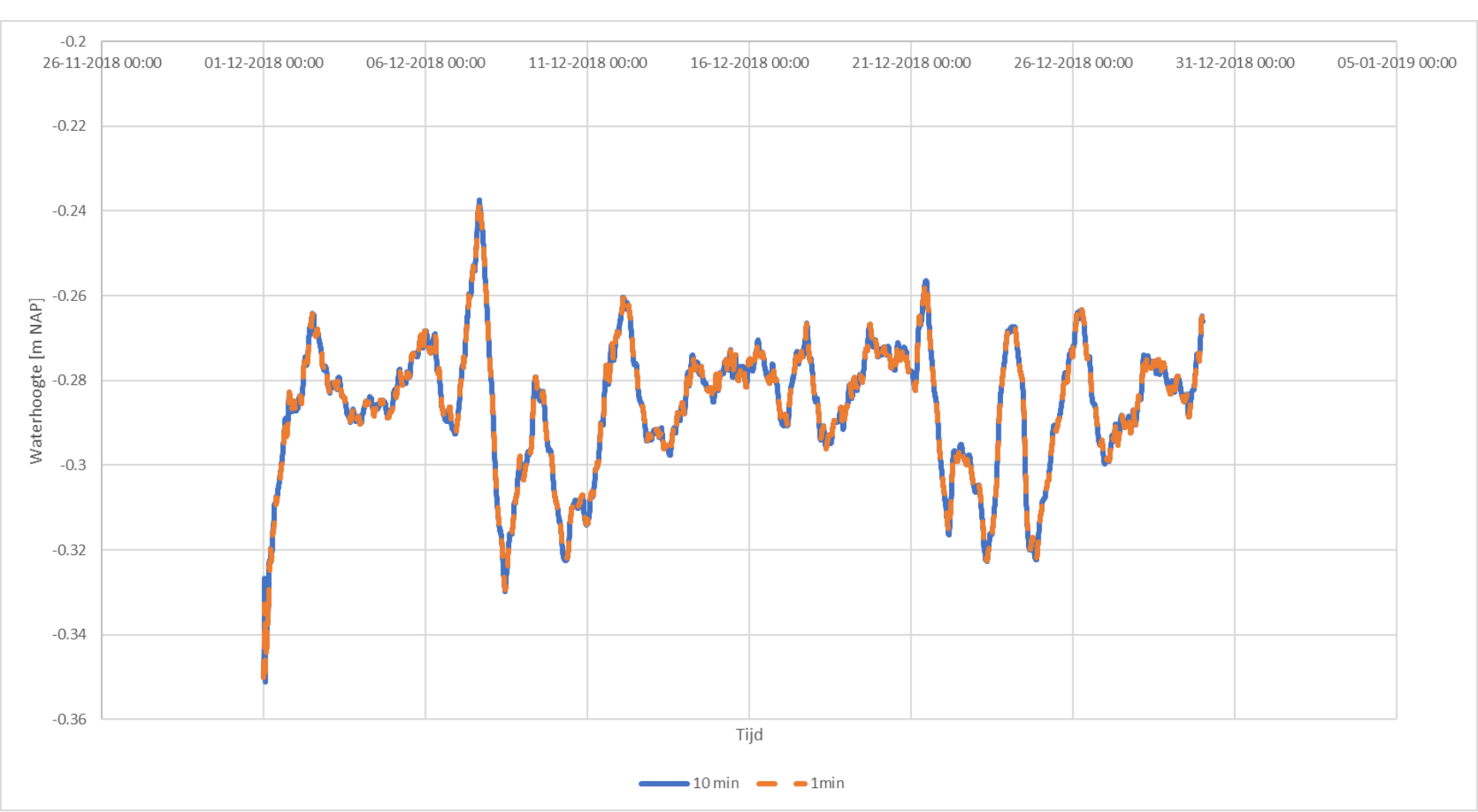
- tijdstap 10 min
- tijdstap 1 min



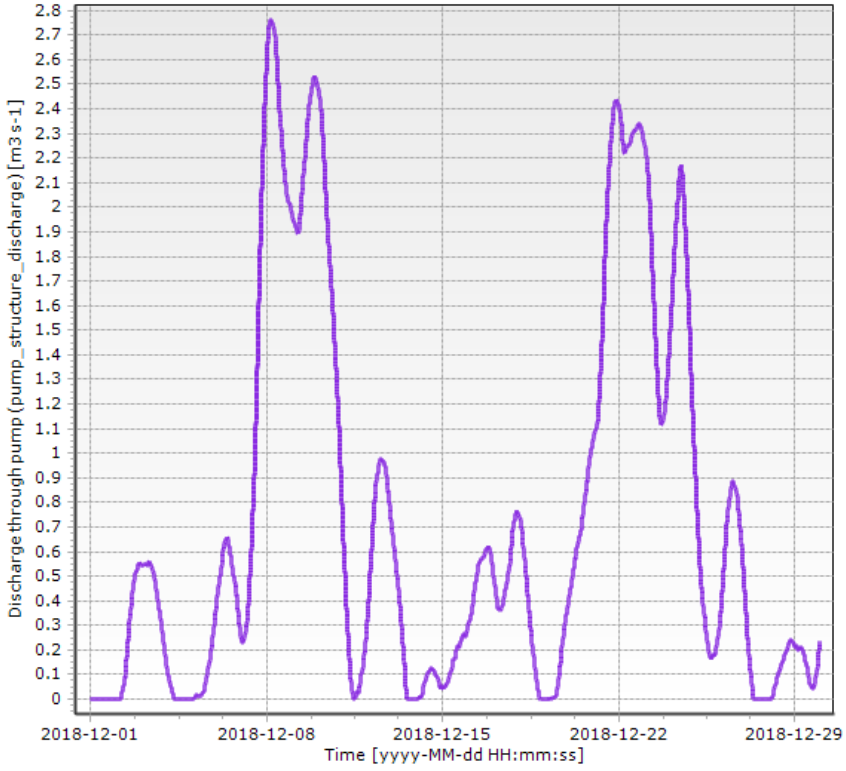
Waterhoogte bovenstrooms

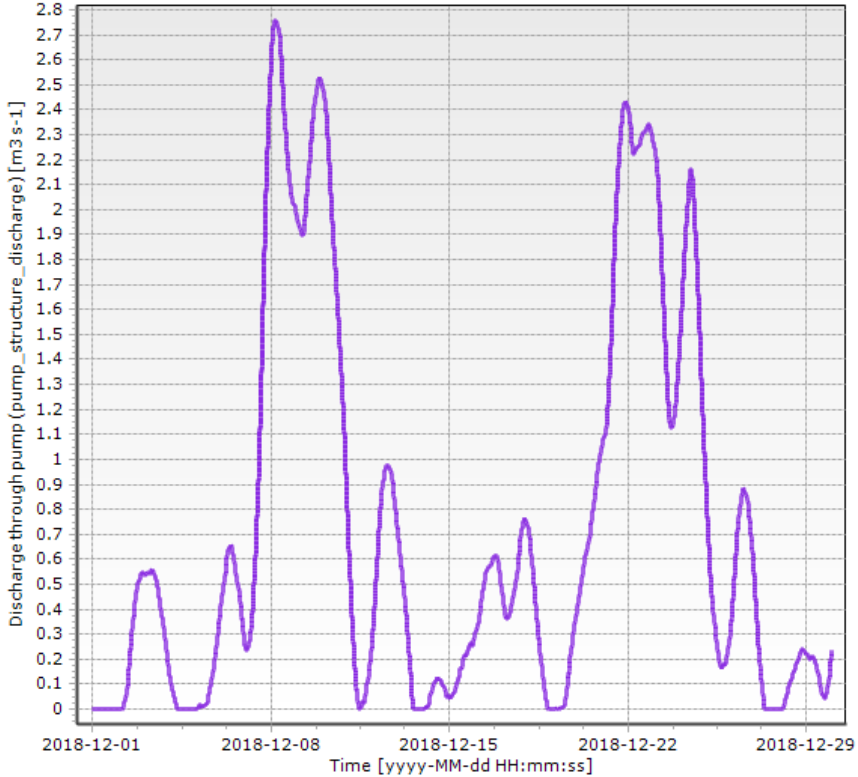


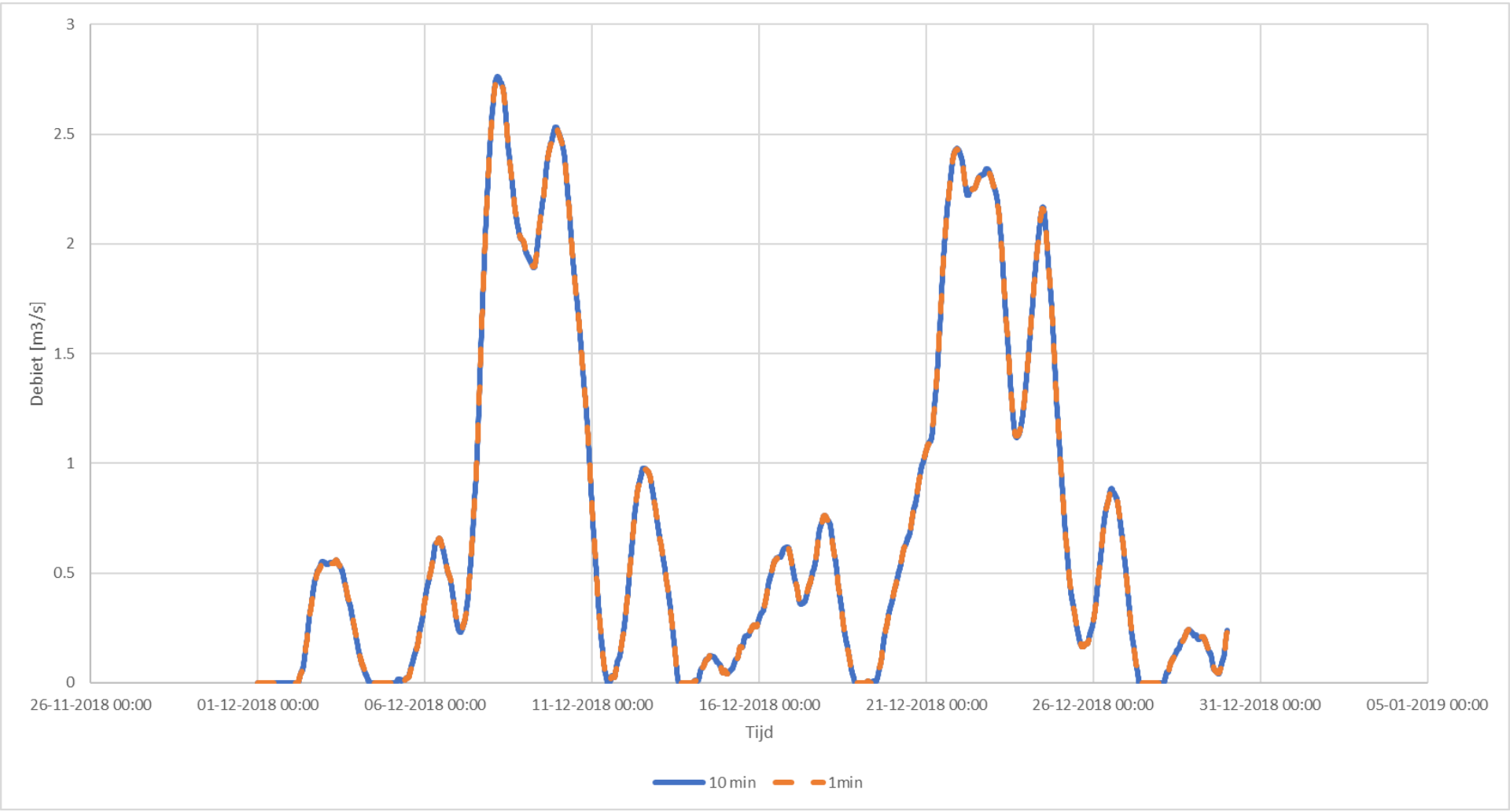



-0.2
-0.22
-0.24
-0.26
-0.28
-0.3
-0.32
-0.34
-0.36
Waterhoogte [m NAP]
26-11-2018 00:00
01-12-2018 00:00
06-12-2018 00:00
11-12-2018 00:00
16-12-2018 00:00
21-12-2018 00:00
26-12-2018 00:00
31-12-2018 00:00
05-01-2019 00:00
Tijd
10 min
1min

Debieten


Discharge through pump (pump_structure_discharge) [m3 s-1]
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2018-12-01
2018-12-08
2018-12-15
2018-12-22
2018-12-29
Time [yyyy-MM-dd HH:mm:ss]


Discharge through pump (pump_structure_discharge) [m3 s-1]
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2018-12-01
2018-12-08
2018-12-15
2018-12-22
2018-12-29
Time [yyyy-MM-dd HH:mm:ss]


3
2.5
2
1.5
1
0.5
0
Debiet [m3/s]
26-11-2018 00:00
01-12-2018 00:00
06-12-2018 00:00
11-12-2018 00:00
16-12-2018 00:00
21-12-2018 00:00
26-12-2018 00:00
31-12-2018 00:00
05-01-2019 00:00
Tijd
10 min
1min

Conclusie tijdstap

- Uitwisseltijdstap maakt niet uit, zolang de tijdstap fijn genoeg is
- Uit resultaten blijkt dat een uitwissel tijdstap van 10 minuten fijn genoeg is

HydroLogic

Koppelen waterbalansen in FEWS

FEWS-data

- Data is onttrokken uit de volgende bestanden uit SOBEK-Boezemmodel versie B14:
  - Lateral.dat
  - Boundary.dat
  - BOUNDLAT.dat
  - M12_19.bui
  - M12_19.evp

FEWS - data

- Metingen
  - neerslag
  - verdamping
  - waterstanden
  - debieten
- Model input
  - randvoorwaarden
  - laterale debieten

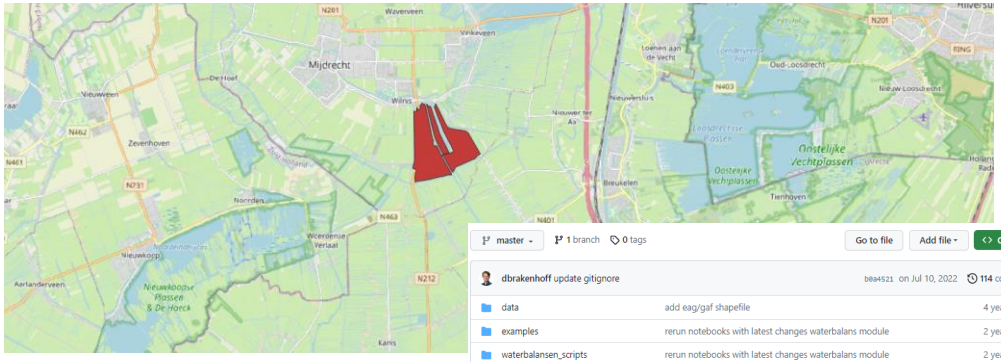
FEWS

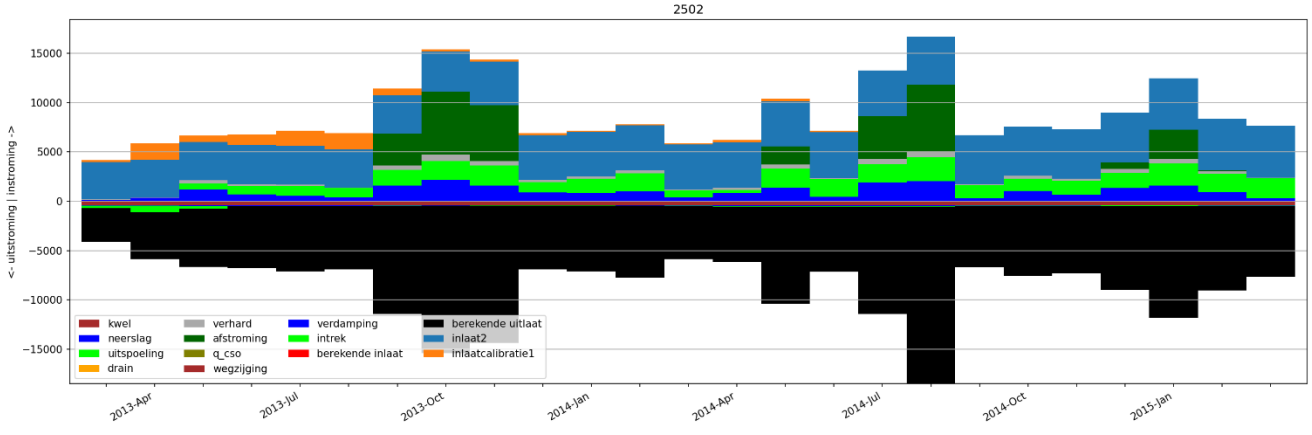
- Neerslag
- Verdamping
- Waterstanden
- Debieten
- Randvoorwaarden
- Laterale debieten
- RTC sturing

Waterbalans

- Pilot gebied
- Python module
- Invoer
  - aangeleverd “template”
- Uitvoer

opp_139_2502-GAF	17-05-2019 10:36	Microsoft Excel Com...	1 KB
param_139_2502-GAF	17-05-2019 10:37	Microsoft Excel Com...	2 KB
reeks_139_2502-GAF	07-06-2022 17:19	Microsoft Excel Com...	4 KB
series_139_2502-GAF-original	17-05-2019 10:44	Microsoft Excel Com...	708 KB
stoffen_chloride_139_2502-GAF	17-05-2019 10:40	Microsoft Excel Com...	2 KB
stoffen_fosfor_139_2502-GAF	17-05-2019 10:42	Microsoft Excel Com...	1 KB





readme.md

Waterbalansen in Python

Deze repository bevat de scripts om de waterbalansen van Waternet te runnen, zoals uitgewerkt door Maarten Ouboter in de Excel Waterbalansen. De waterbalans module zelf is beschikbaar via deze repository.

Auteurs:

- R.A. Collenteur, Artesia Water 2018
- D.A. Brakenhoff, Artesia Water 2018

Waterbalans

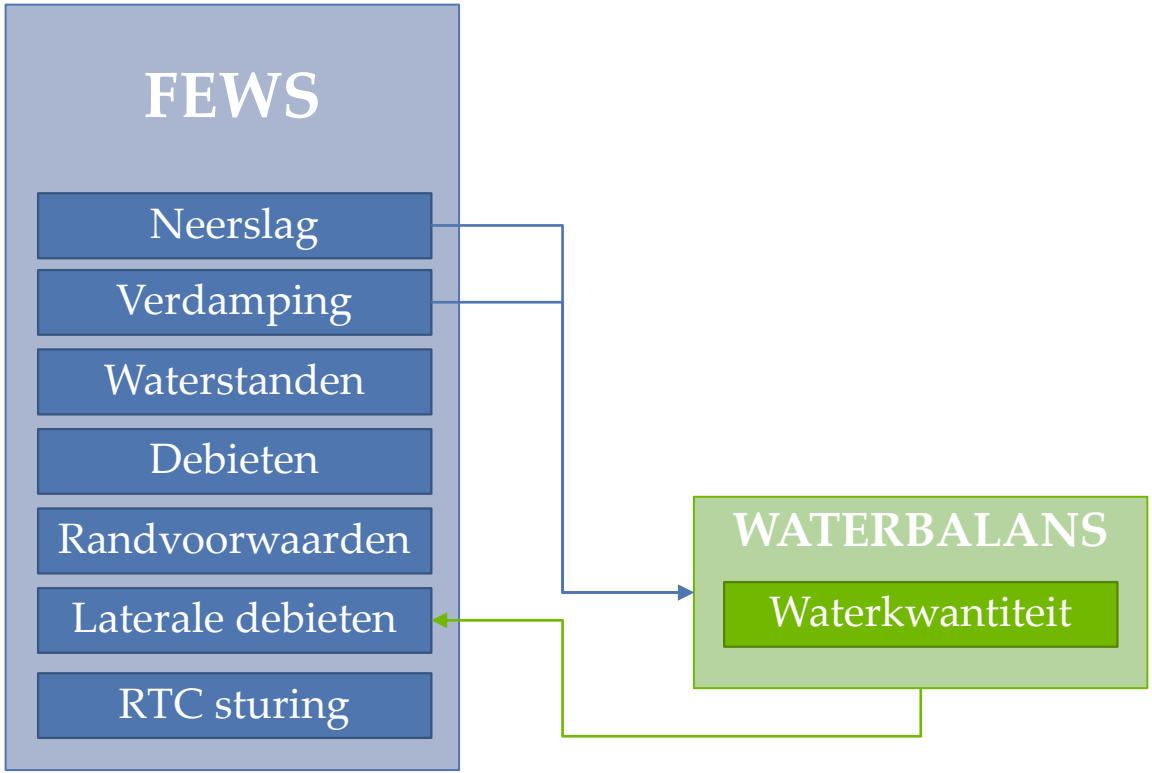
Installatie

- Er is geen installatie nodig voor het runnen van deze scripts. Download de bestanden door de repository te clonen via b.v. GitHub Desktop of via de website zelf.
- Wel moet de waterbalans module geinstalleerd zijn. Zie daarvoor de instructies op de github pagina voor deze module.

Waterbalans vanuit FEWS

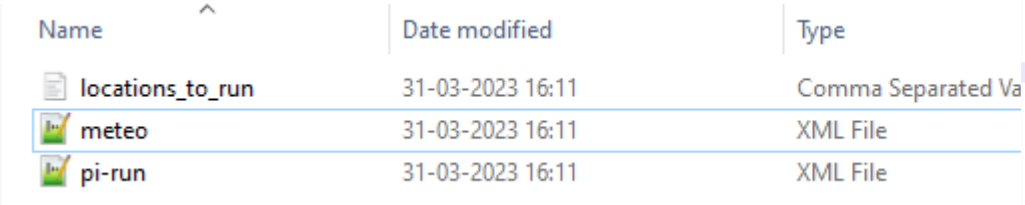
1. Meteo per afvoergebied, per dag berekenen
2. Meteo data exporteren uit FEWS
3. Omzetten tot input Waterbalans
4. Waterbalans module uitvoeren
5. Uitvoer omzetten naar FEWS formaat
6. Uitvoer importeren in FEWS

FEWS schematisatie

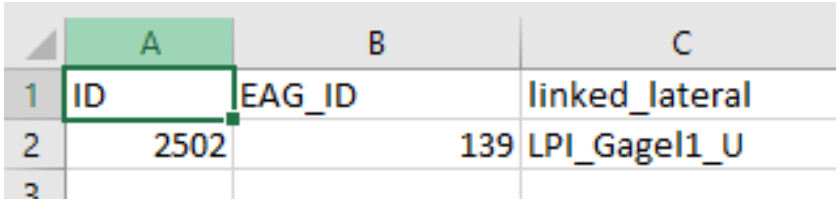


Waterbalans vanuit FEWS

- Uitvoer FEWS
  - locaties
  - meteo



Name	Date modified	Type
locations_to_run	31-03-2023 16:11	Comma Separated Va
meteo	31-03-2023 16:11	XML File
pi-run	31-03-2023 16:11	XML File



	A	B	C
1	ID	EAG_ID	linked_lateral
2	2502	139	LPI_Gagel1_U
3			

```
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        <locationId>2502</locationId>
        <parameterId>P.dag</parameterId>
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        <missVal>-999.0</missVal>
        <stationName>Polder Groot Wilnis-Vinkeveen (midden)</stationName>
        <lat>52.18171225152295</lat>
        <lon>4.916759755235546</lon>
        <x>122824.87627577572</x>
        <y>466057.0226106212</y>
        <z>0.0</z>
        <units>mm</units>
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    <event date="2014-03-19" time="00:00:00" value="3.3" flag="2"/>
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    <event date="2014-03-24" time="00:00:00" value="0.7" flag="2"/>
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    <event date="2014-04-03" time="00:00:00" value="0" flag="2"/>
    <event date="2014-04-04" time="00:00:00" value="0" flag="2"/>
    <event date="2014-04-05" time="00:00:00" value="0" flag="2"/>
    <event date="2014-04-06" time="00:00:00" value="0" flag="2"/>
    <event date="2014-04-07" time="00:00:00" value="1.5" flag="2"/>
    <event date="2014-04-08" time="00:00:00" value="8.2" flag="2"/>
```

Waterbalans vanuit FEWS

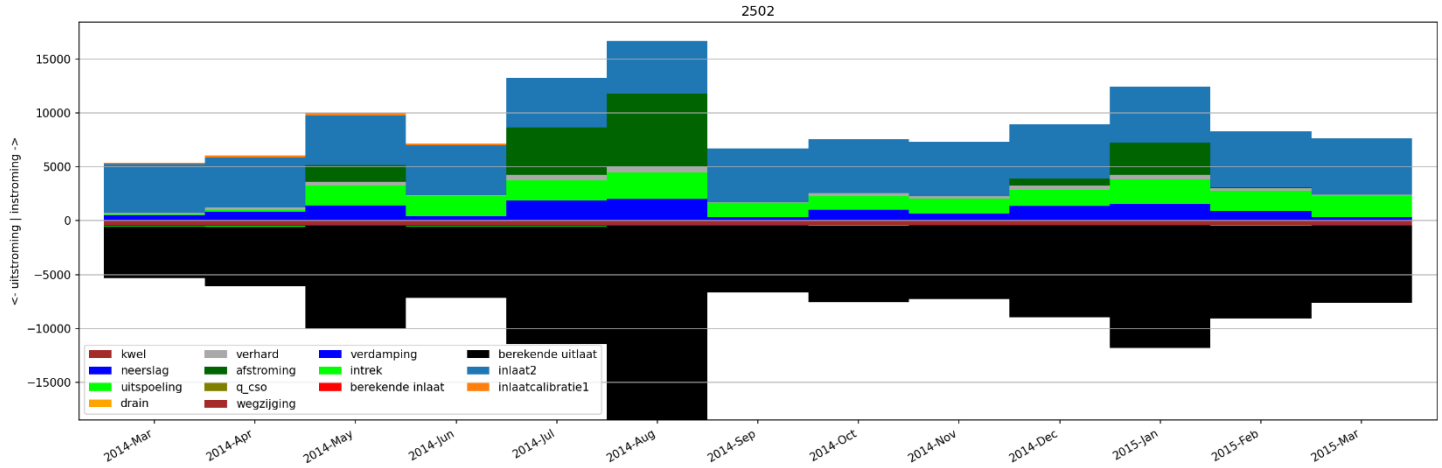
- Waterbalans invoer
- Data overschijven met FEWS data

- opp_139_2502-GAF
- param_139_2502-GAF
- reeks_139_2502-GAF
- series_139_2502-GAF
- series_139_2502-GAF-original
- stoffen_chloride_139_2502-GAF
- stoffen_fosfor_139_2502-GAF

datum	1|Immissie	Gemaal1|Gemaal 1	Inlaat2	Inlaat3	Inlaatcalibratie1	Neerslag1|Neerslag	Peil1|Peil	q_cso1|Gemengd	Verdamping1|Verdamping
01-01-1996		2325				0.1	-2.656	0	0.1
02-01-1996		1230				0	-2.641	0	0.2
03-01-1996		1230				0	-2.644	0	0.3
04-01-1996		1425				0	-2.644	0	0.2
05-01-1996		1350				0	-2.641	0	0.4
06-01-1996		2760				1.9	-2.635	0	0.2
07-01-1996		2520				2.3	-2.654	0	0.2
08-01-1996		3150				0.2	-2.657	0	0.3
09-01-1996		5190				0.6	-2.666	0	0.1
10-01-1996		3915				0.9	-2.648	0	0.1
11-01-1996		645				0.2	-2.645	0	0.2
12-01-1996		8355				0	-2.681	0	0.4
13-01-1996		0				0	-2.651	0	0.4
14-01-1996		0				0	-2.638	0	0.4
15-01-1996		0				0	-2.634	0	0.4
16-01-1996		0				0	-2.629	0	0.4
17-01-1996		0				0	-2.626	0	0.2
18-01-1996		10335				0	-2.698	0	0.1
19-01-1996		0				0	-2.653	0	0.1
20-01-1996		0				0	-2.642	0	0.1
21-01-1996		0				0	-2.634	0	0.3
22-01-1996		0				0	-2.628	0	0.4
23-01-1996		0				0	-2.625	0	0.3
24-01-1996		6270				0	-2.624	0	0.3
25-01-1996		21600				0.2	-2.622	0	0.4
26-01-1996		12840				0.3	-2.629	0	0.1
27-01-1996		0				0	-2.63	0	0.2
28-01-1996		0				0	-2.628	0	0.5
29-01-1996		0				0	-2.629	0	0.5
30-01-1996		0				0	-2.628	0	0.5
31-01-1996		0				0	-2.627	0	0.6

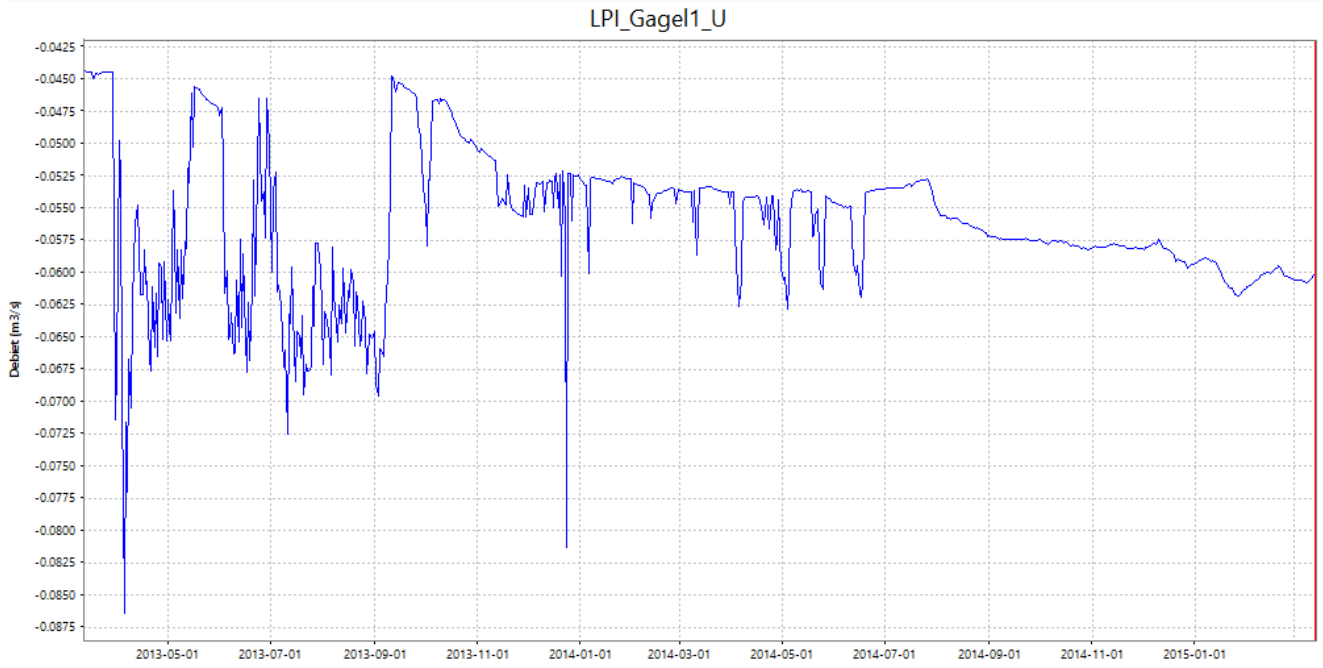
Waterbalans vanuit FEWS

- Waterbalans uitvoeren
- Uitvoer:
  - waterbalans als csv
  - plot waterbalans



Waterbalans vanuit FEWS

- CSV omzetten tot FEWS input
- Data importeren in FEWS



Koppelen D-HYDRO in FEWS

HydroLogic

D-HYDRO vanuit FEWS

FEWS

- Neerslag
- Verdamping
- Waterstanden
- Debieten
- Randvoorwaarden
- Laterale debieten
- RTC sturing

D-HYDRO

- Rainfall Runoff
- 1D
- RTC sturing

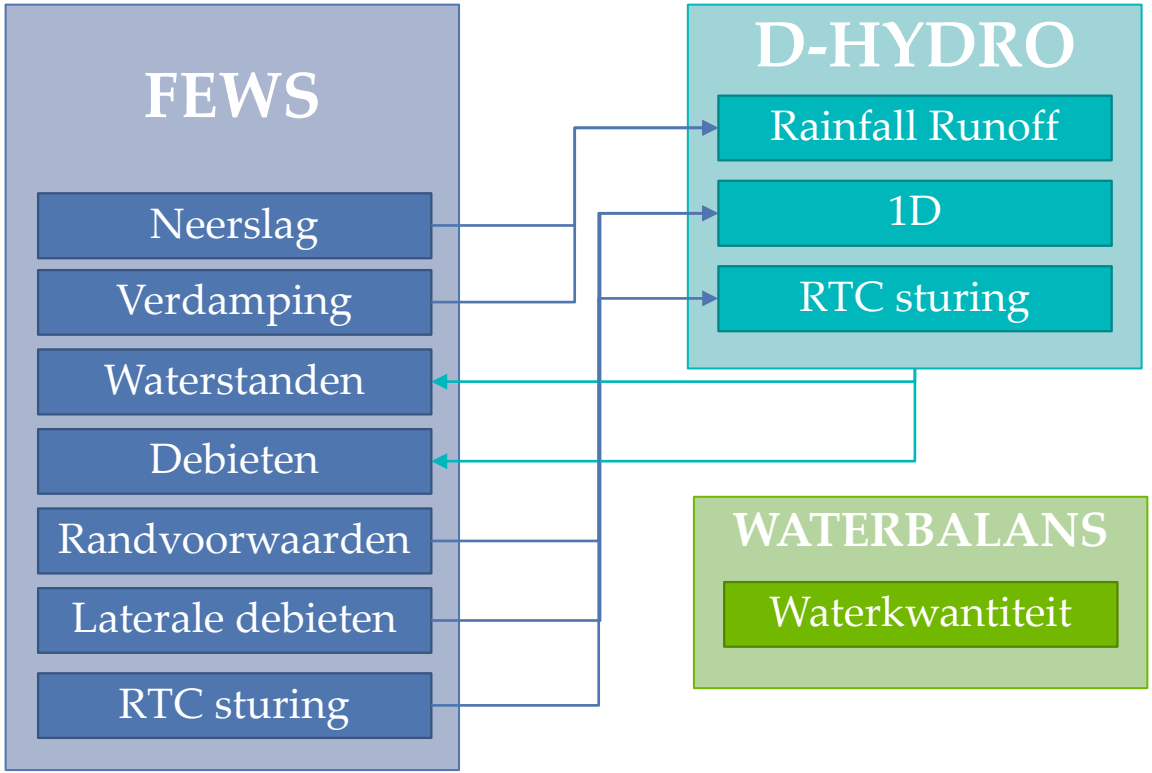
WATERBALANS

- Waterkwantiteit

D-HYDRO vanuit FEWS

1. FEWS data exporteren
2. Omzetten tot D-HYDRO input
3. D-HYDRO uitvoeren
4. Uitvoer D-HYDRO importeren in FEWS

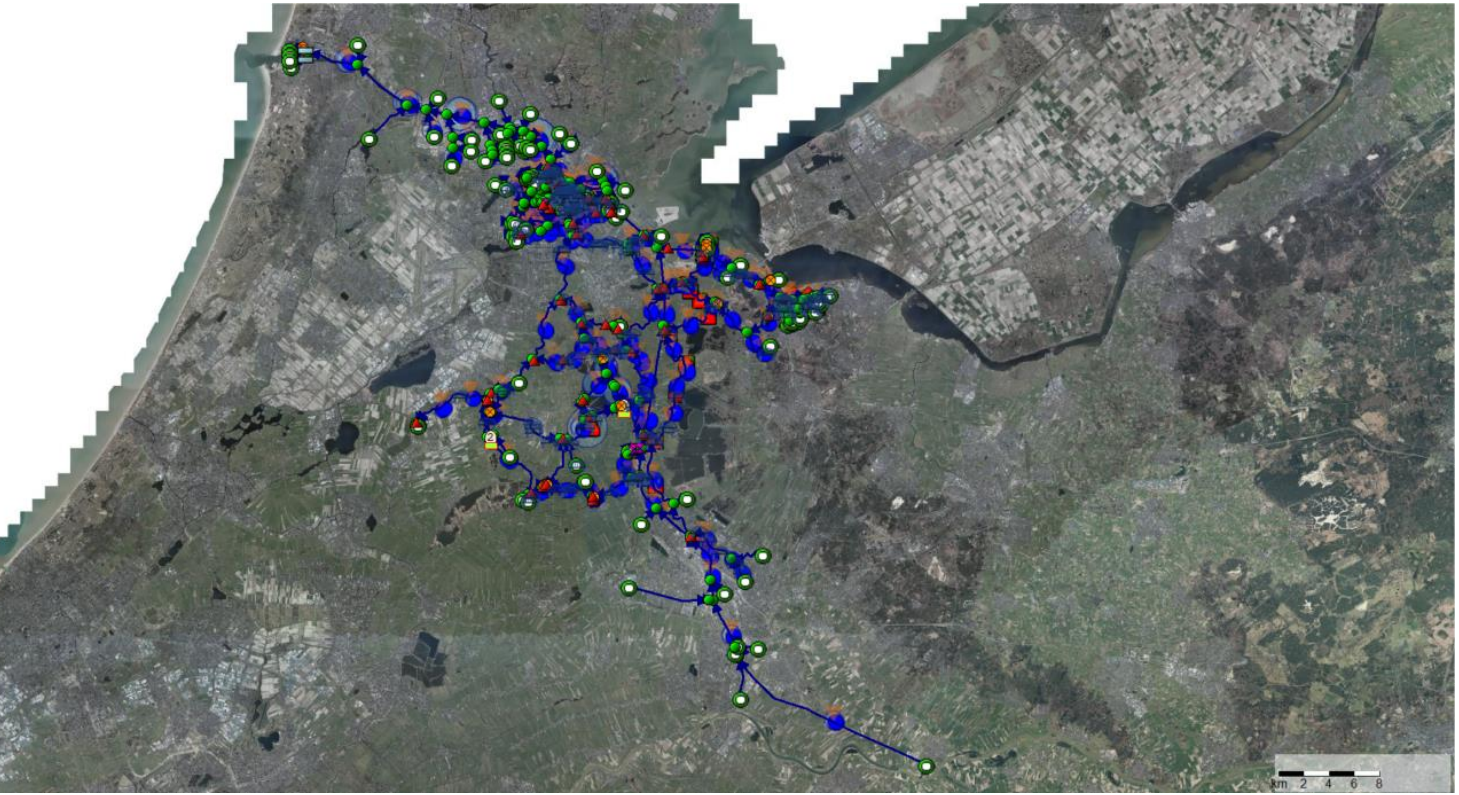
D-HYDRO vanuit FEWS



D-HYDRO vanuit FEWS

- FEWS output → D-HYDRO input
  - Deltares pre adapter
    - RTC
    - laterale debieten
  - Custom pre adapter
    - rainfall runoff
    - neerslag/verdamping op basis van station naam opgegeven, met Deltares pre adapter momenteel alleen mogelijk via netCDF grids
- Restart files

D-HYDRO



D-HYDRO vanuit FEWS

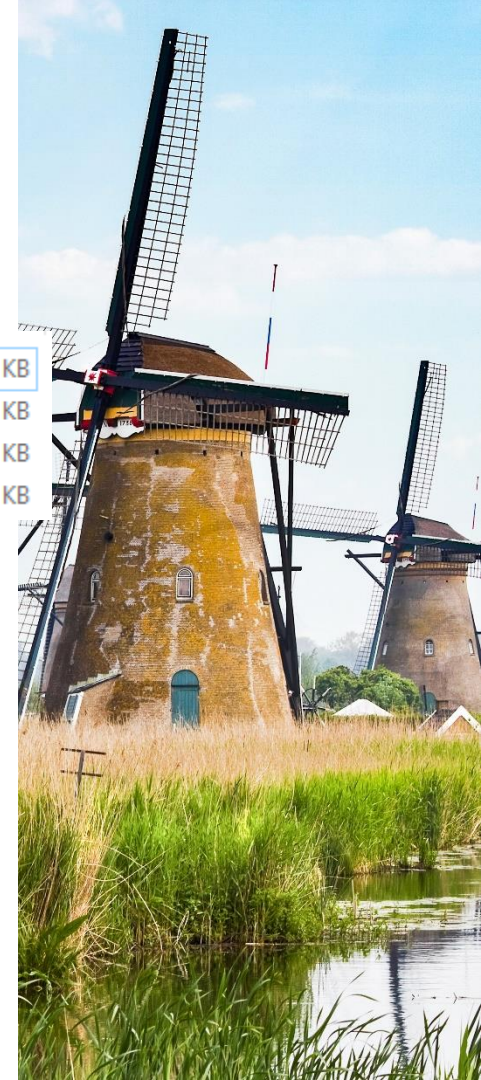
- Uit FEWS:

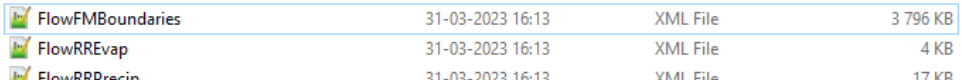
FlowFMBoundaries	31-03-2023 16:13	XML File	3 796 KB
FlowRREvap	31-03-2023 16:13	XML File	4 KB
FlowRRPrecip	31-03-2023 16:13	XML File	17 KB
FlowRTCTimeSeriesImport	31-03-2023 16:13	XML File	1 123 KB

- D-HYDRO model

s PC › Local Disk (C:) › Werk › Projecten › P1302_TKI_V › FEWS › FEWS-Waternet-git › config › ModuleDataSetFiles › RunBoezemmodel

Name	Type	Compressed size	Passwc
dflowfm	File folder		
process	File folder		
rr	File folder		
rr-adapter	File folder		
rtc	File folder		
Boezemmodel	XML File	6 KB	No
RunOutsideFews_template	Windows Batch File	1 KB	No





FlowFMBoundaries	31-03-2023 16:13	XML File	3 796 KB
FlowRREvap	31-03-2023 16:13	XML File	4 KB
FlowRRPrecip	31-03-2023 16:13	XML File	17 KB
FlowRTCTimeSeriesImport	31-03-2023 16:13	XML File	1 123 KB

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        <y>500000.0</y>
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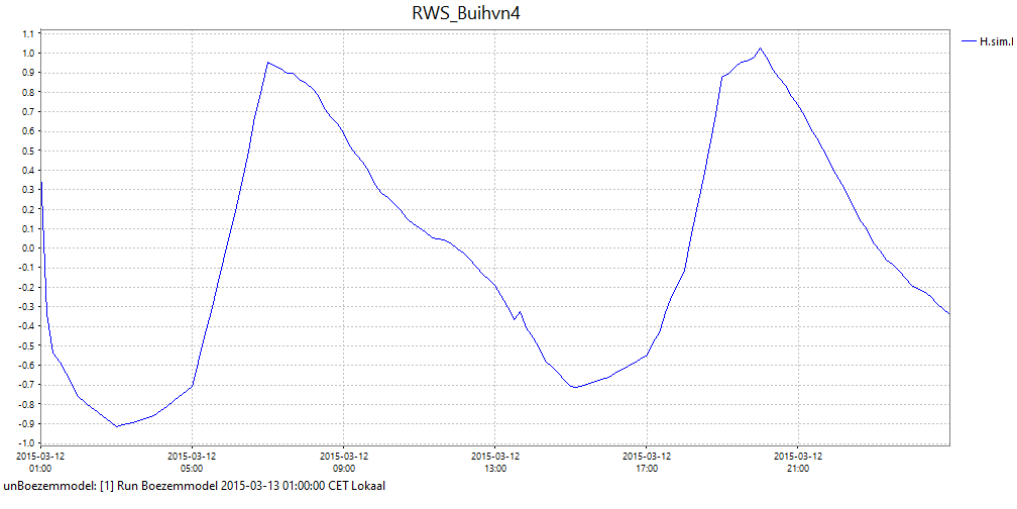
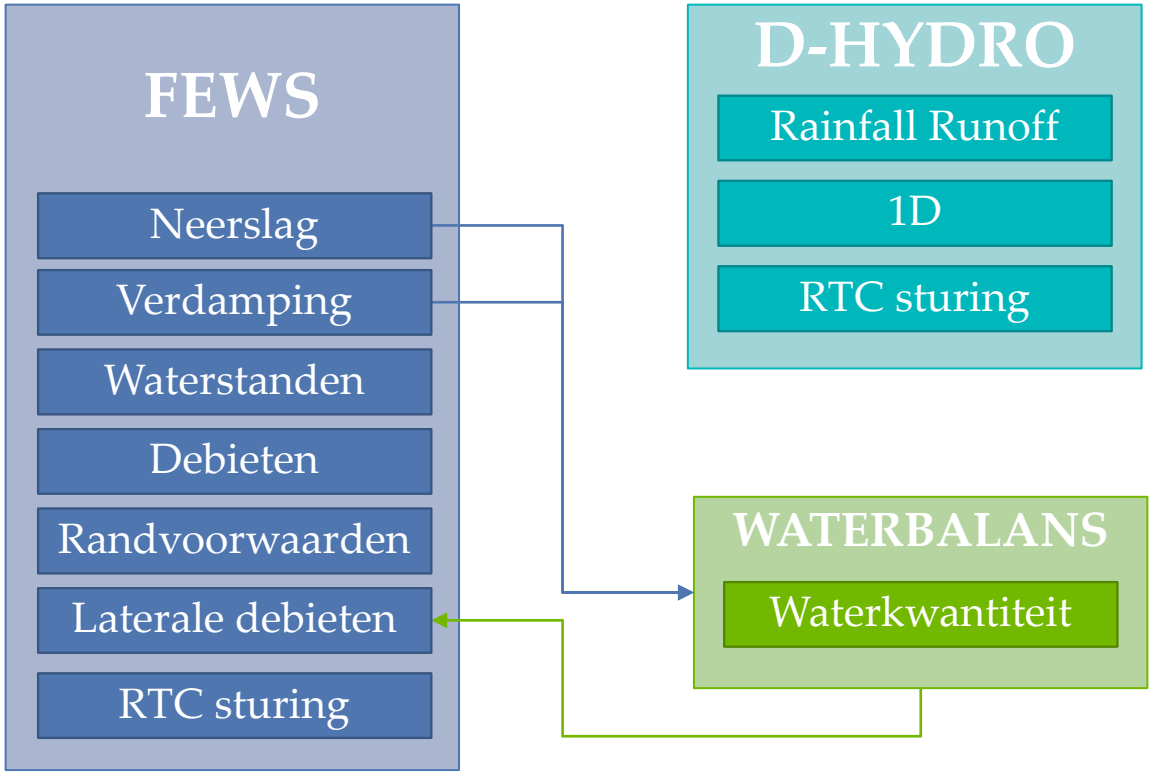
Stap 2 – D-HYDRO vanuit FEWS

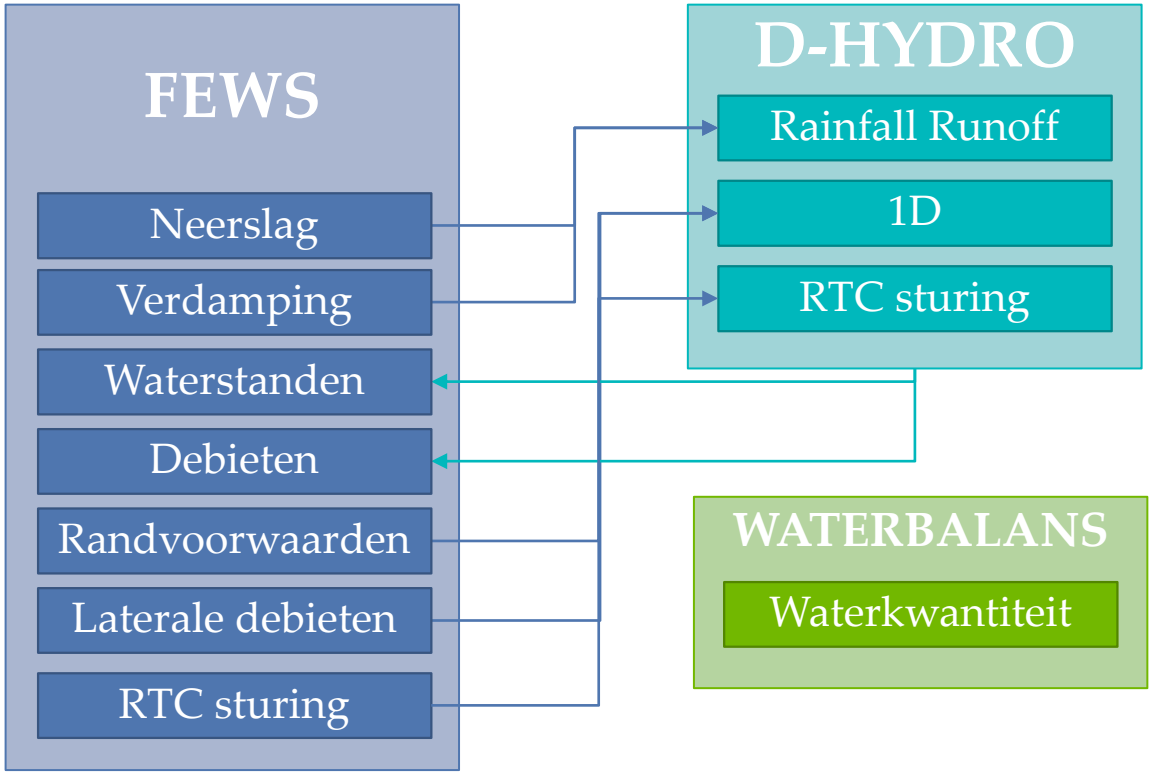
- Model uitvoeren
- Resultaten importeren in FEWS
  - via NetCDF
  - waterstanden
  - debieten



FEWS - schematisatie



FEWS - schematisatie



Conclusies

- Boezemmodel
  - van SOBEK omgezet naar D-HYDRO
  - complexe RTC sturing
  - effect tijdstap geanalyseerd
  - resultaten vergeleken

Conclusies

- Waterbalans gekoppeld in FEWS
  - voor één deelgebied
  - met neerslag en verdamping uit FEWS
- D-HYDRO uitvoeren vanuit FEWS
  - Deltares dimr adapter
- Koppeling waterbalans en D-HYDRO
  - uitvoer waterbalans -> invoer D-HYDRO

HydroLogic

Eindpresentatie

TKI-V

Pilot boezemmodel Waternet