NVE

FLOOD FORECASTING EVERYWHERE - PUTTING PUB TO WORK

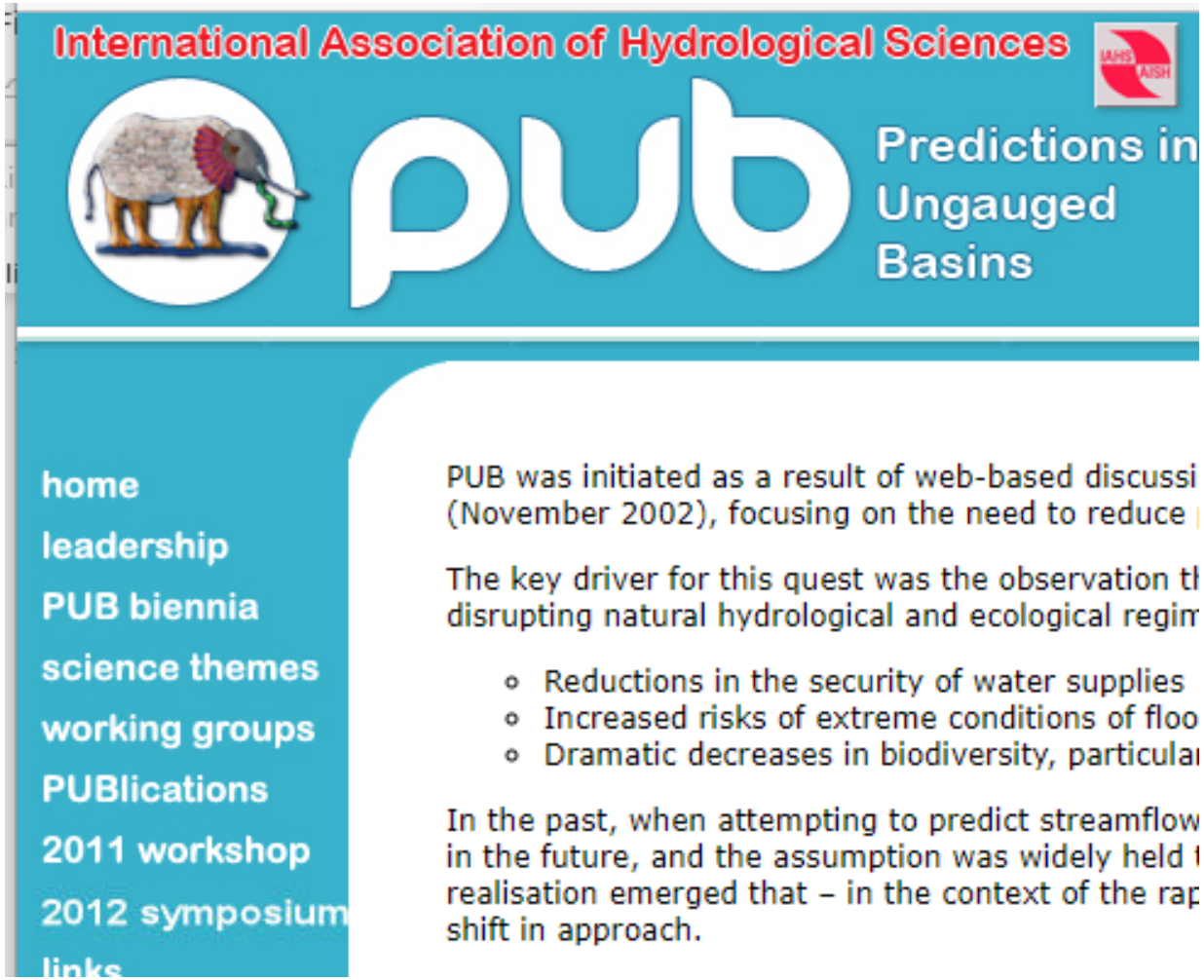
A PROJECT UNDER THE FLOMRISK UMBRELLA

Thomas Skaugen, Zelalem Mengistu, Ivar Peereboom, W.K. Wong and J. Andersen

HM, IKTI, HV

Back in the day - 2003

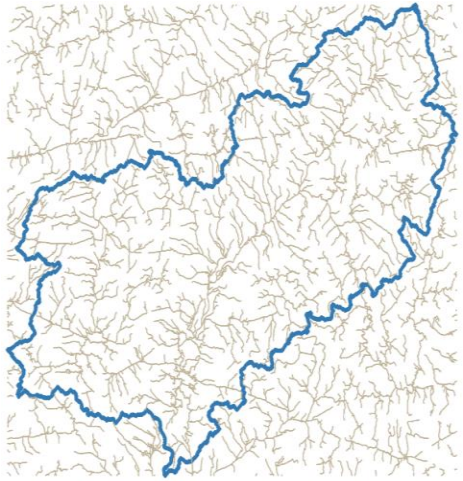
- The IAHS' PUB decade 2003-2013
- A very inspiring and challenging theme: useful and with a clear objective
- There is an increasing need for hydrological information, historical and forecasts, everywhere: runoff (floods, droughts), snow (when, how much), groundwater (high-, low levels), etc.
- The potential for the use of PUB has no limits…



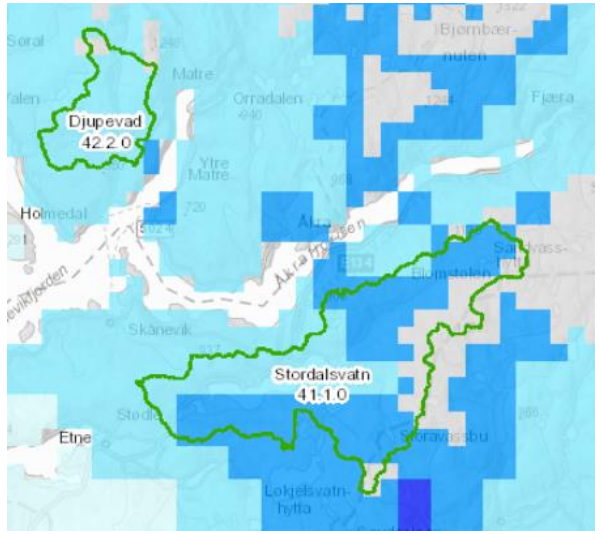
PUB is possible because:

- Everywhere (in Norway) we have the information needed for setting up a rainfall-runoff model and simulate long time series of hydrological information -historical and forecasts

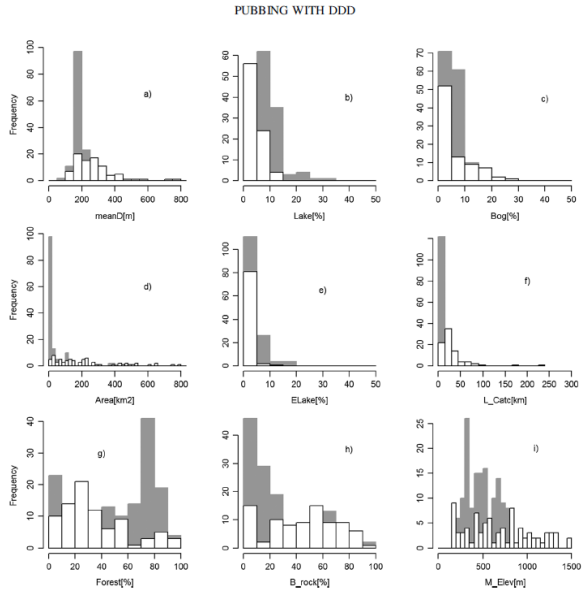
DTM- catchments- rivernetworks



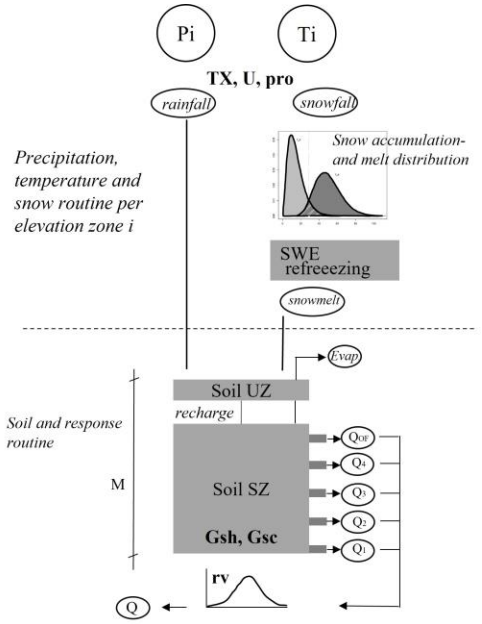
Meteorology- precip and temperature



Catchment characteristics



Rainfall-runoff model (DDD)



The DDD model has previously been used to estimate hydrology in ungauged basins - at nesting sites of Norway's national bird, Fossekallen

HYDROLOGICAL PROCESSES
Hydrol. Process. **29**, 1999–2013 (2015)
Published online 22 September 2014 in Wiley Online Library
(wileyonlinelibrary.com) DOI: 10.1002/hyp.10315

Use of a parsimonious rainfall–run-off model for predicting hydrological response in ungauged basins

Thomas Skaugen,[1]* Ivar Olaf Peerebom[1] and Anna Nilsson[2]

Received: 3 November 2017 | Revised: 26 January 2018 | Accepted: 9 February 2018
DOI: 10.1002/ece3.3958

ORIGINAL RESEARCH

WILEY Ecology and Evolution

The potential influence of Atlantic salmon *Salmo salar* and brown trout *Salmo trutta* on density and breeding of the white-throated dipper *Cinclus cinclus*

Anna L. K. Nilsson[1] | Jan Henning L'Abée-Lund[2] | L. Asbjørn Vøllestad[1] | Kurt Jerstad[3] | Bjørn Mejdell Larsen[4] | Ole Wi… | Thomas Skaugen[2] | Nils C. Stenseth[1] | Bjørn W…

frontiers in Ecology and Evolution

ORIGINAL RESEARCH
published: 14 October 2020
doi: 10.3389/fevo.2020.542846

Location Is Everything, but Climate Gets a Share: Analyzing Small-Scale Environmental Influences on Breeding Success in the White-Throated Dipper

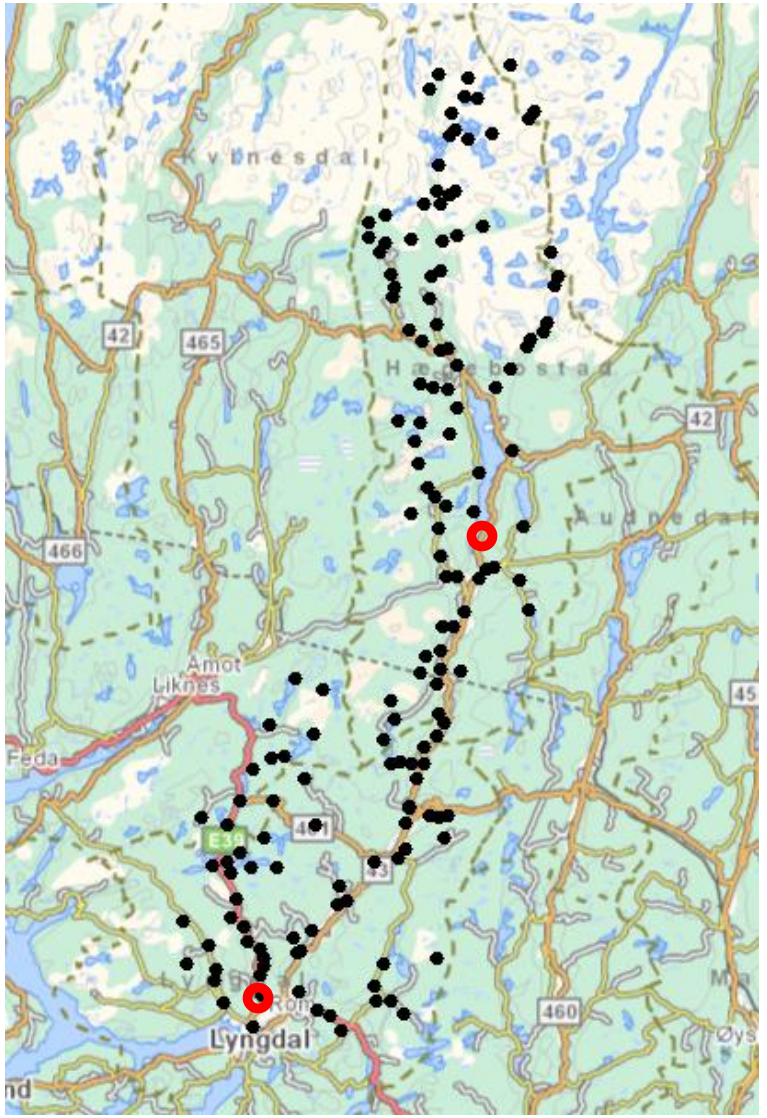
OPEN ACCESS

Anna L. K. Nilsson[1,2], Trond Reitan[1,3], Thomas Skaugen[3], Jan Henning L'Abée-Lund[2], Marlène Gamelon[4], Kurt Jerstad[5], Ole Wiggo Røstad[5], Tore Slagsvold[1], Nils C. Stenseth[1], L. Asbjørn Vøllestad[1] and Bjørn Walseng[7]*

Edited by:

Red circle, measured sites
24.8 Møska (south)
24.9 Tingvatn (north)

Black dots are known nesting sites for Fossekallen and define catchments with simulated hydrology



The idea behind the dvelopment of the DDD model was:

- as few as possible parameters to calibrate

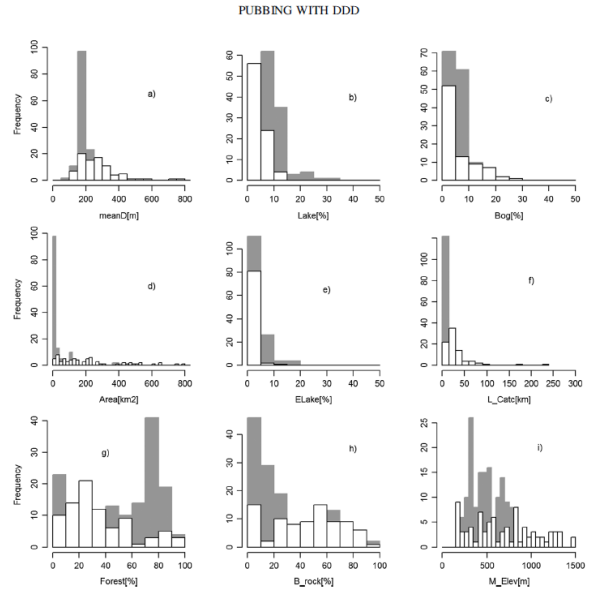
- physically based model parameters –a real possibility to estimate them from CCs.

— Procedure:

1) Calibrate the DDD model against measured runoff for many catchments (111).

2) Establish regression equations for model parameters. Calibrated model parameters are explained and a function of catchment characteristics (CC) such as % of Lakes, Wetlands, Forest, Elevation, mean daily runoff etc.

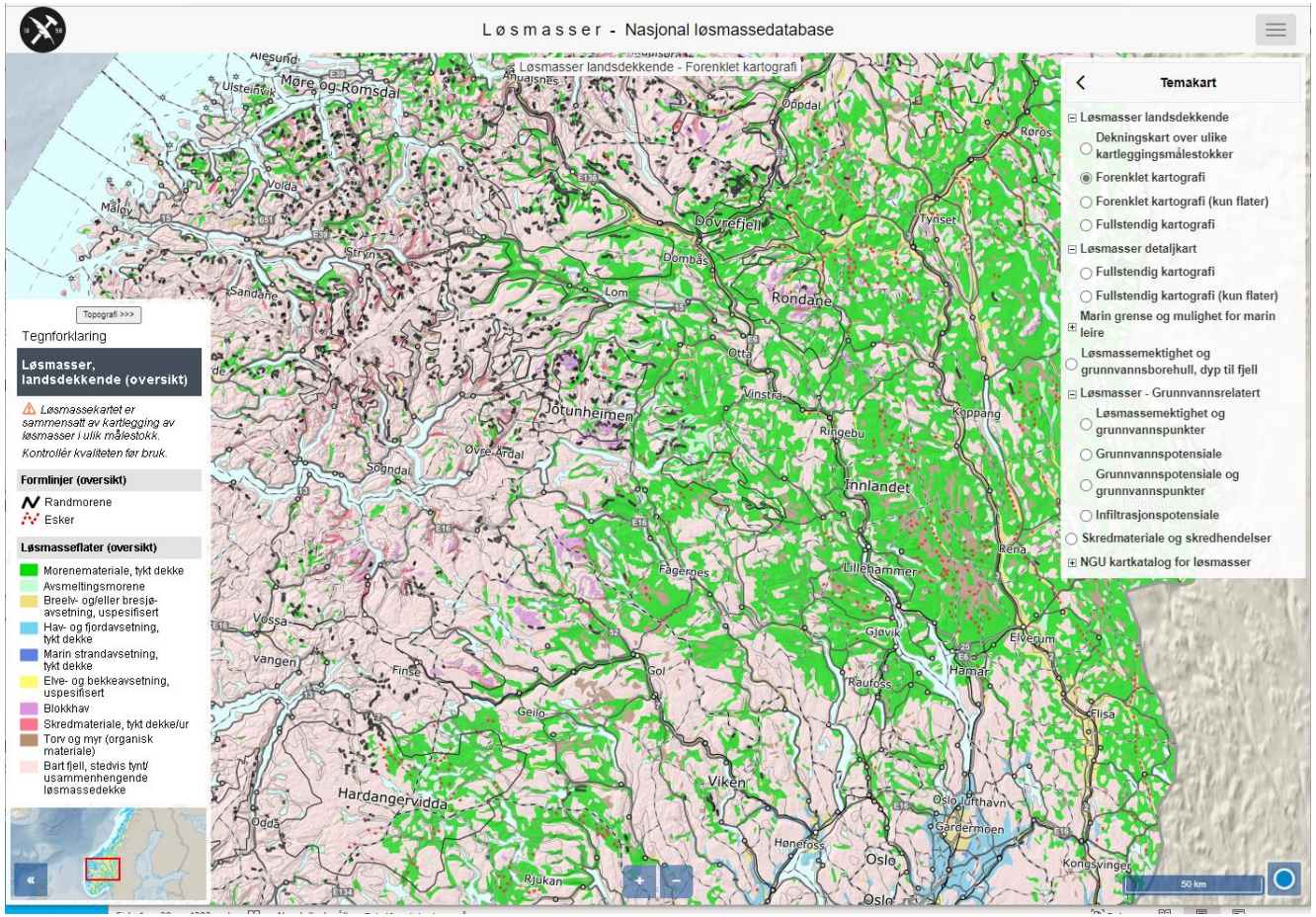
Catchment characteristics CC



A new model parameter for describing runoff dynamics in DDD: Mean Response Time (MRT) is estimated from CCs (R2 = 0.8)

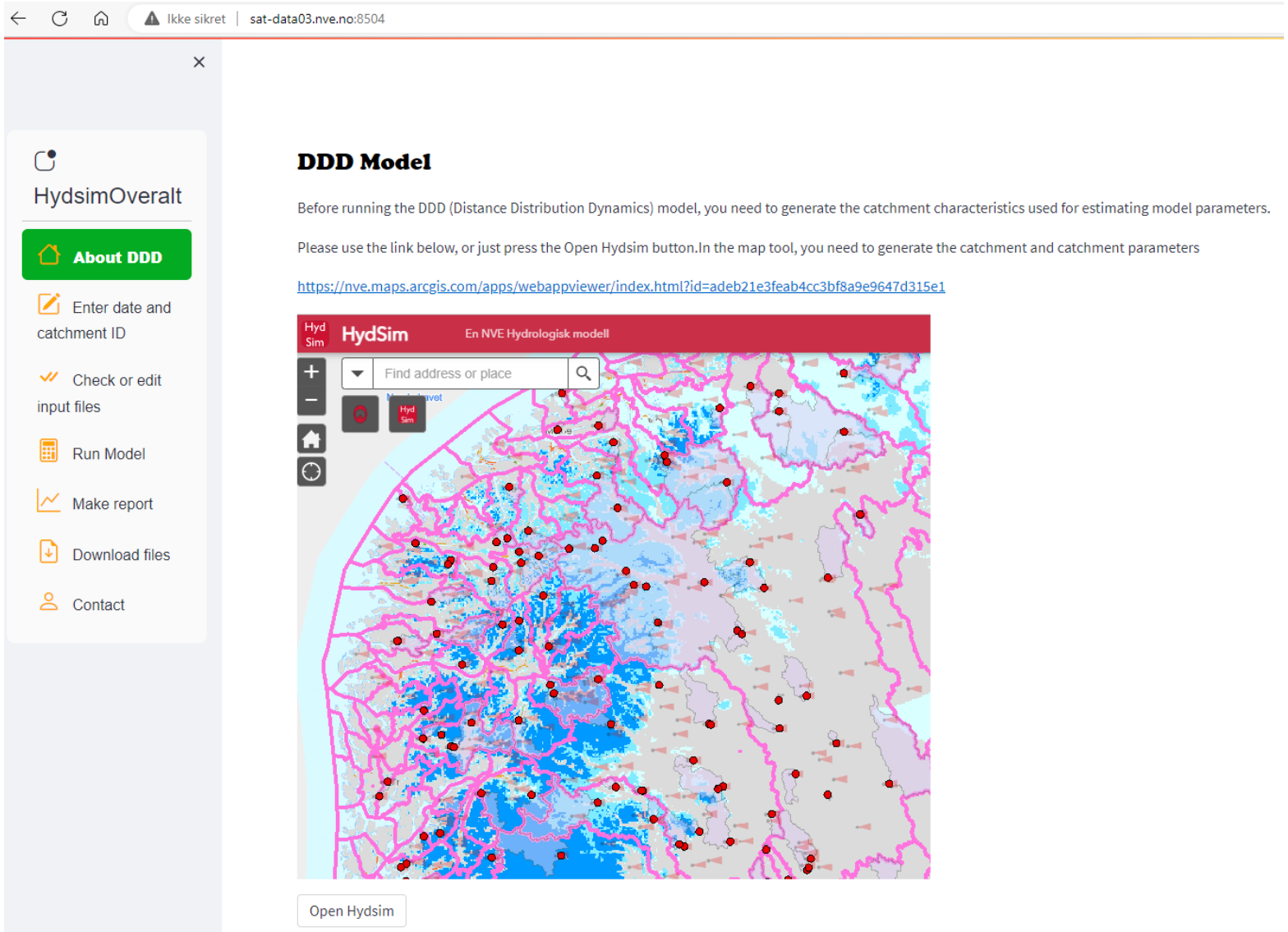
Personal best!

- NGU's map of infiltration capacity significantly explains some of the variability of MRT



Skaugen, T., Stavang, A.E., Lawrence, D., Møen, K.M. 2023. Catchment response times – understanding runoff dynamics from catchment distances and celerities. *Hydrological Sciences Journal 68/8: 1127-1138 https://doi.org/10.1080/02626667.2023.2201449*

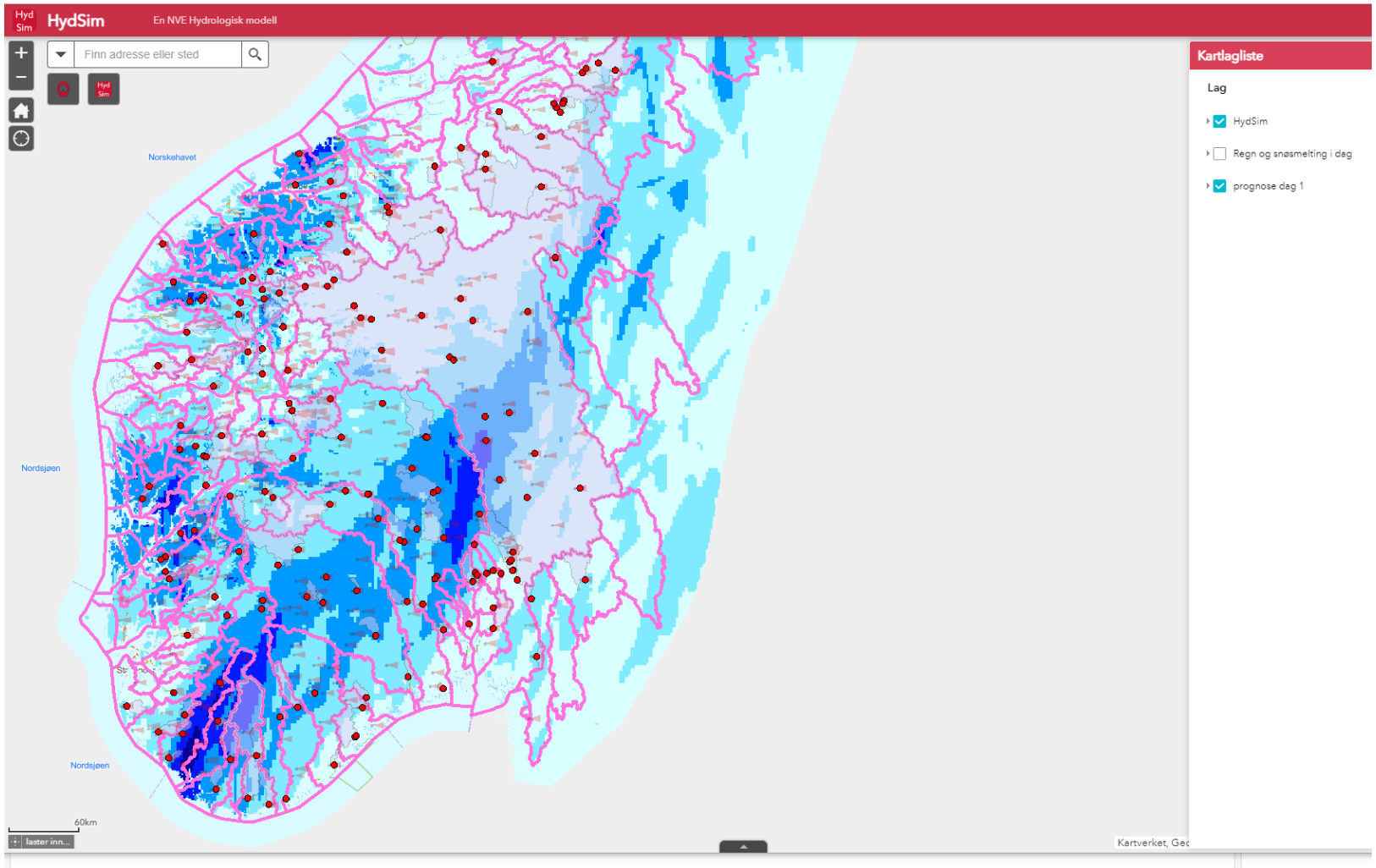
The service HydSimOveralt



The service HydSimOveralt

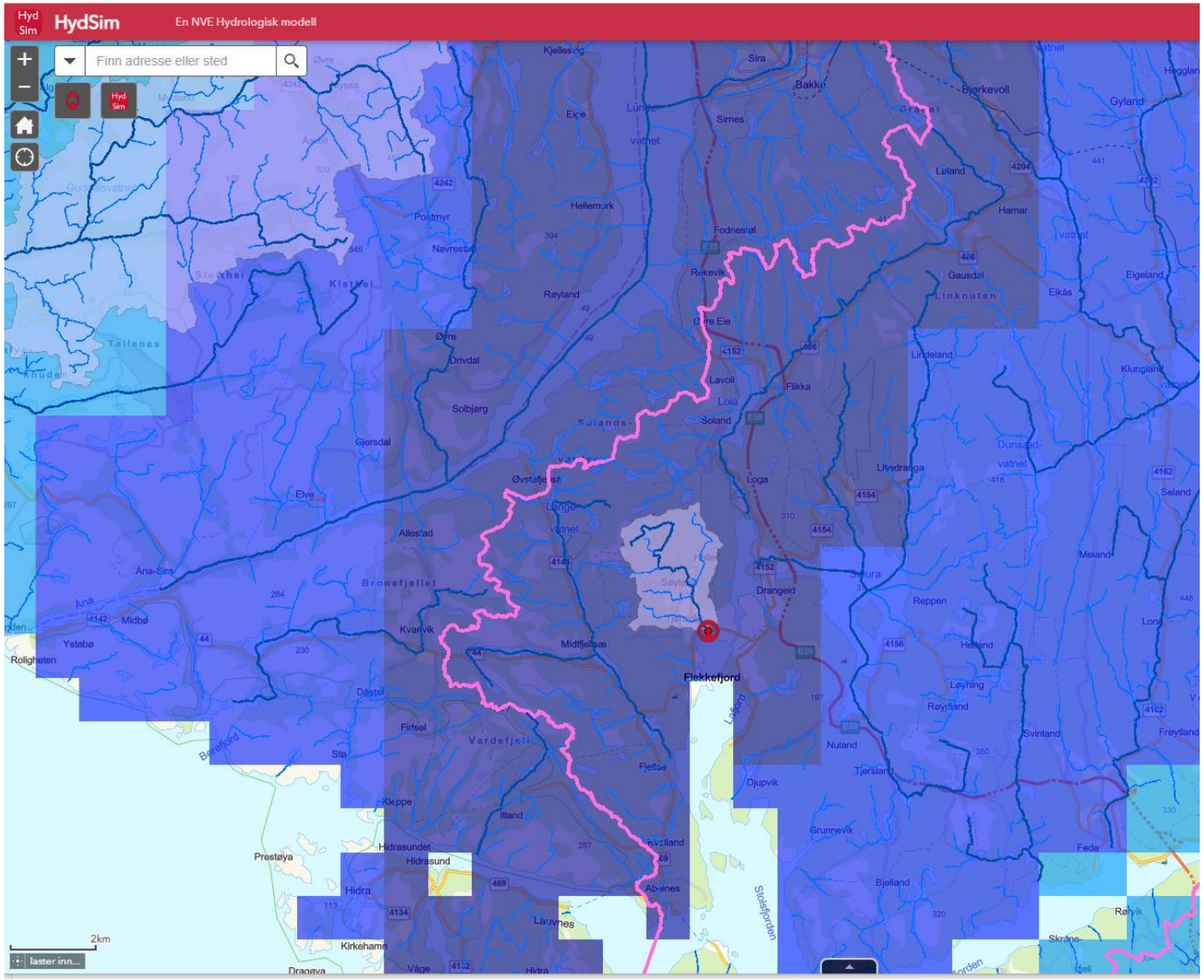
- In the map tool, which includes gridded meteorological forecasts, you can choose to simulate for an area where you think the action will be

(15.08.2023)



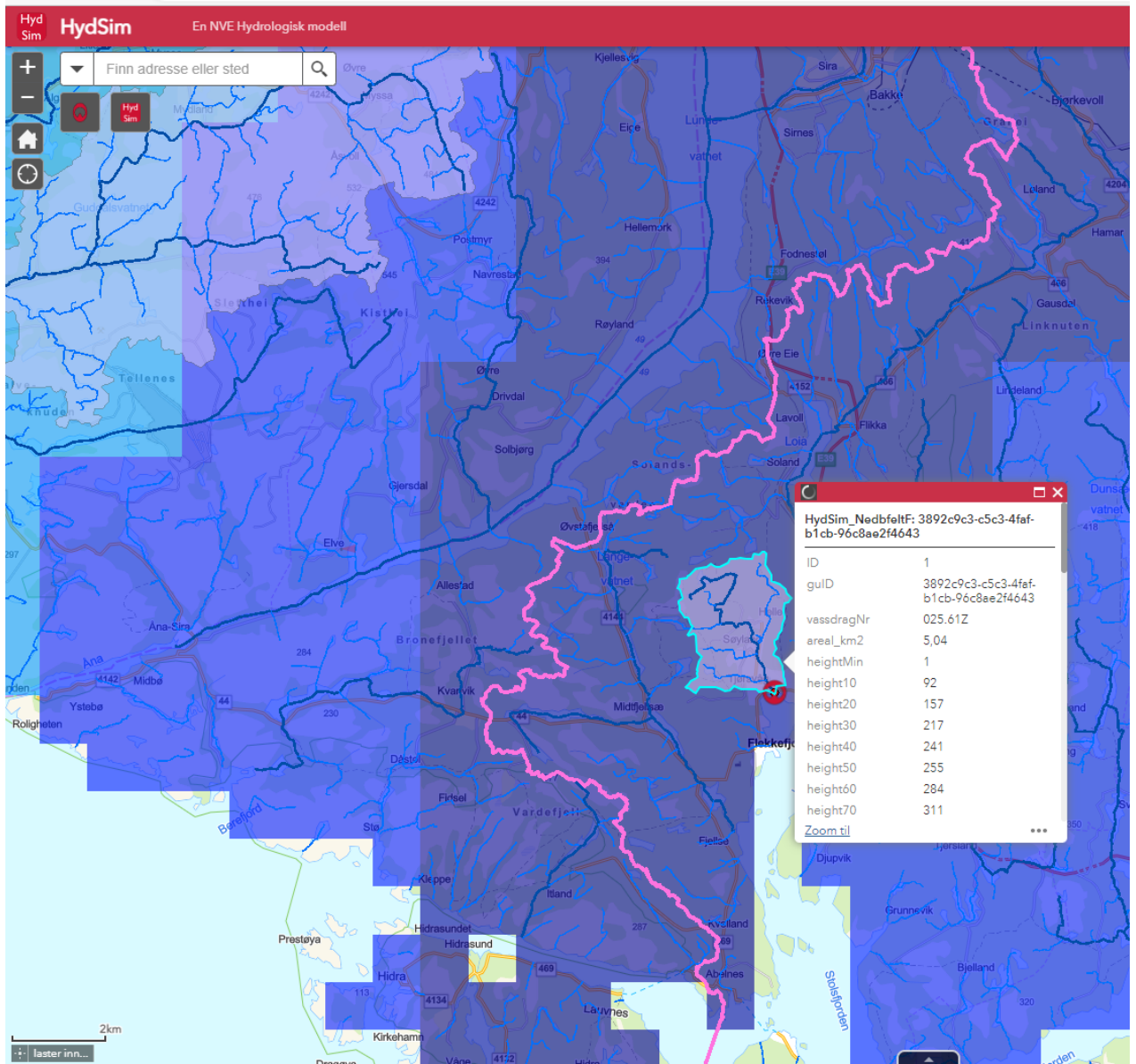
The service HydSimOveralt

- In the map tool, which includes gridded meteorological forecasts, you can choose to simulate for an area where the action is
- Select your catchment

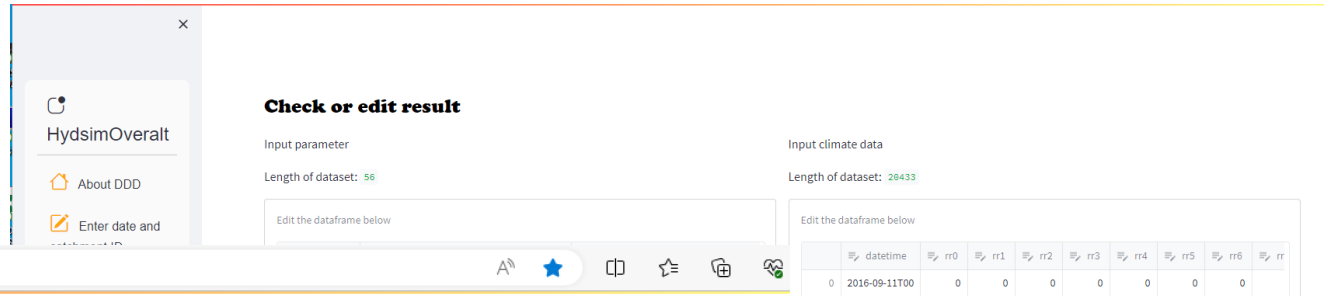


The service HydSimOveralt

- In the map tool, which includes gridded meteorological forecasts, you can choose to simulate for an area where the action is
- Select your catchment
- The tool calculates the necessary information for estimating model parameters and provides a unique ID



The service HydSimOveralt



Ikke sikret | sat-data03.nve.no:8504

HydsimOveralt

- About DDD
- **Enter date and catchment ID**
- Check or edit input files
- Run Model
- Make report
- Download files
- Contact

Enter date and catchment GUID,then by pressing submit, param file and PT file is generated...

GUID	Time step	Start date	Start time	End date	End time
3892c9c3-c5c3-4faf-b1cb-96c8ae2f4643	3H	2016/09/11	00	2023/09/09	00

3H
24H

Submit

3892c9c3-c5c3-4faf-b1cb-96c8ae2f4643

Input parameter

	OBJECTID	3031
0	ID	1
1	3892c9c3-c	1
2	025.61Z	1
3	heightMin	1
4	height10	92
5	height20	157
6	height30	217
7	height40	241
8	height50	255
9	height60	284

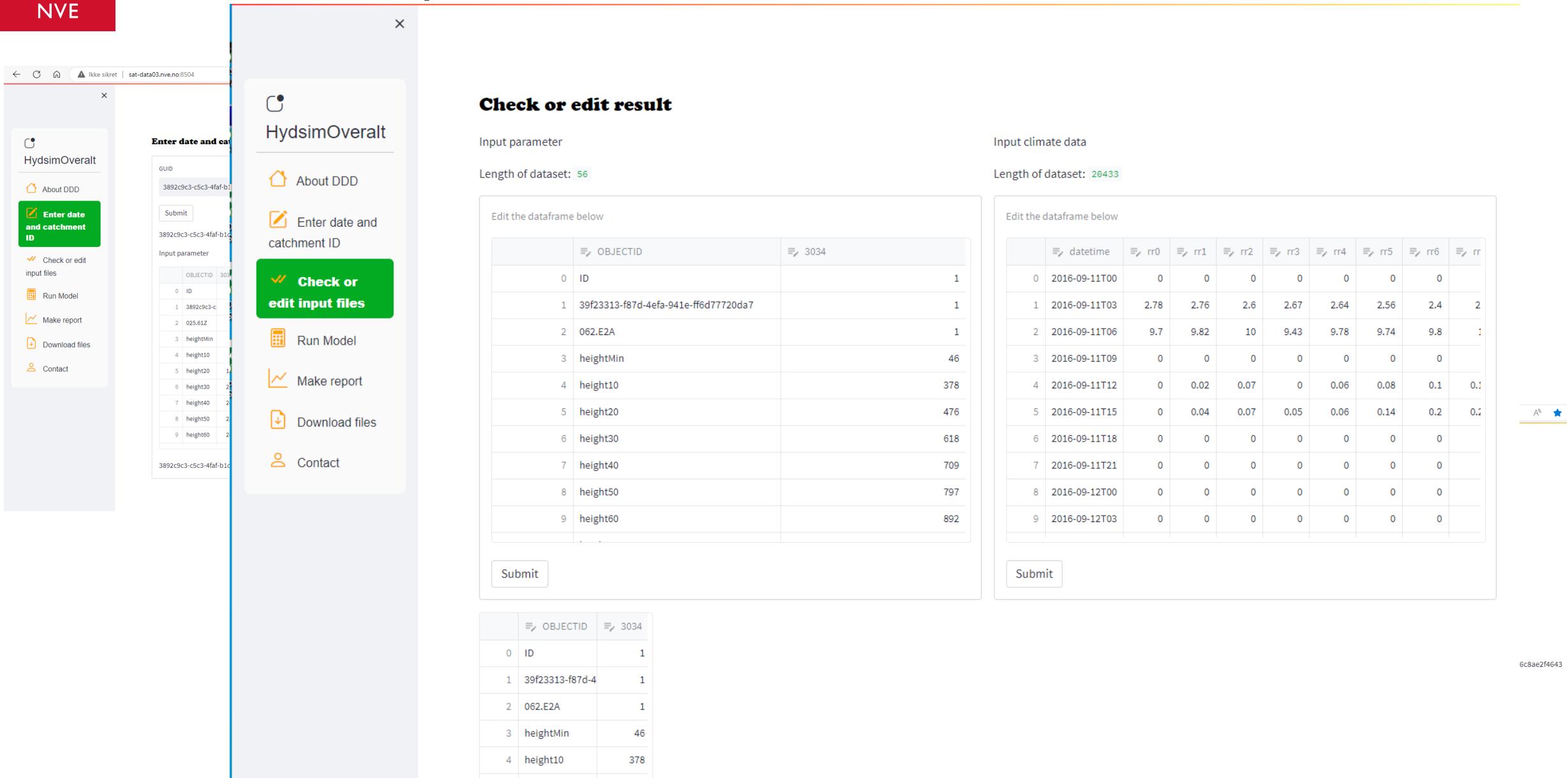
Input climate data

	datetime	rr0	rr1	rr2	rr3	rr4	rr5	rr6	rr7	rr8	rr9
0	2016-09-11T00	6.2	7	6.8	6.8	6.8	6.2	6.2	6.7	6.2	6.
1	2016-09-11T03	9.7	10.3	10.25	10.25	10.25	9.7	9.7	11.2	9.7	9.
2	2016-09-11T06	12.3	10.7	11.9	11.9	11.9	12.3	12.3	11.2	12.3	12.
3	2016-09-11T09	0	0	0	0	0	0	0	0	0	
4	2016-09-11T12	0	0	0	0	0	0	0	0	0	
5	2016-09-11T15	0	0	0	0	0	0	0	0	0	
6	2016-09-11T18	0	0	0	0	0	0	0	0	0	
7	2016-09-11T21	0	0	0	0	0	0	0	0	0	
8	2016-09-12T00	0	0	0	0	0	0	0	0	0	
9	2016-09-12T03	0	0	0	0	0	0	0	0	0	

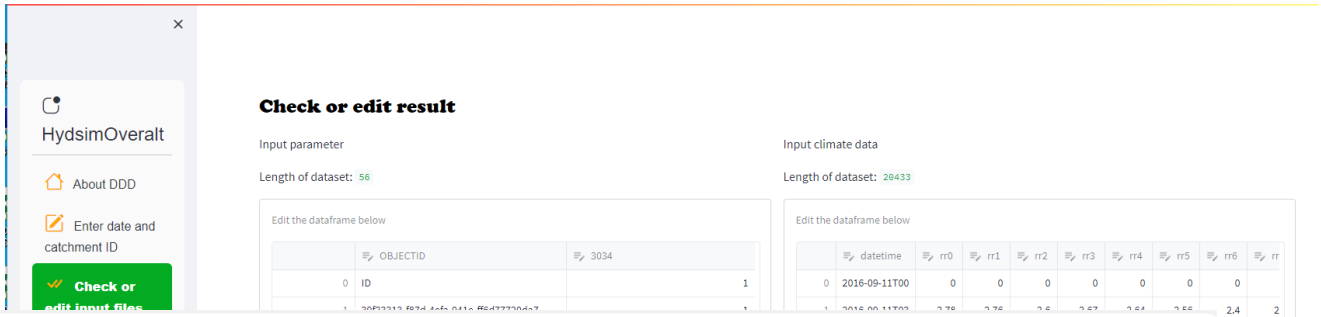
3892c9c3-c5c3-4faf-b1cb-96c8ae2f4643 3H

ıs=1.049 Time elapsed[s]= 56.312573895 3892c9c3-c5c3-4faf-b1cb-96c8ae2f4643

The service HydSimOveralt



The service HydSimOveralt



Ikke sikret | sat-data03.nve.no:8504

HydsimOveralt

- About DDD
- Enter date and catchment ID
- Check or edit input files
- **Run Model**
- Make report
- Download files
- Contact

Run Model

Before running the model, make sure the input files are fine

for the catchment and time resolution shown below

3892c9c3-c5c3-4faf-b1cb-96c8ae2f4643

3H

Run DDDOveralt

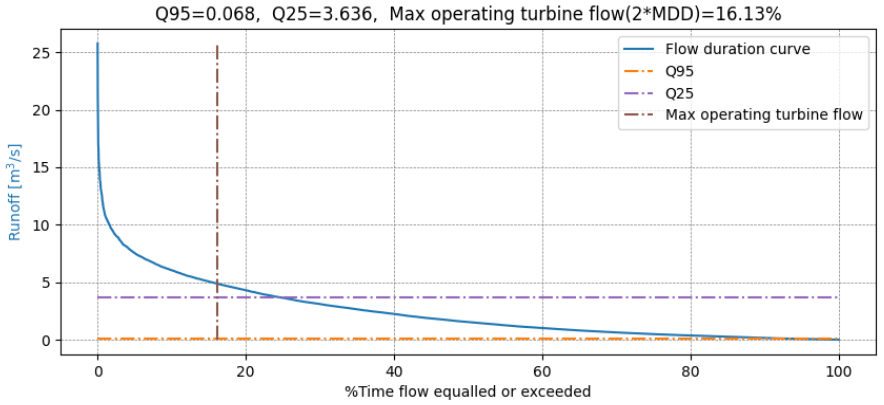
starter modell for the following GUID 3892c9c3-c5c3-4faf-b1cb-96c8ae2f4643 and Time 3H

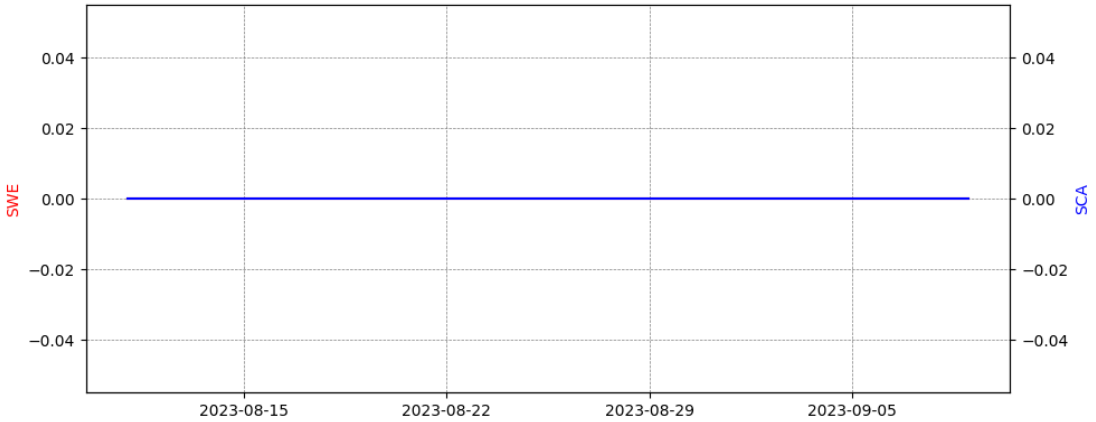
julia .\DDD\RunDDDHSOClassicPT_rev.jl 3892c9c3-c5c3-4faf-b1cb-96c8ae2f4643 3H

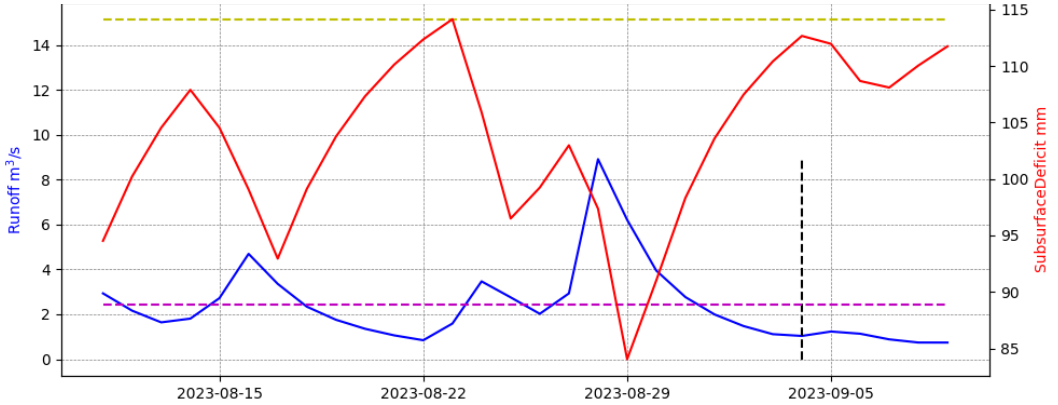
C:\Users\flomtana\hydsim2\DDD\inndata\3892c9c3-c5c3-4faf-b1cb-96c8ae2f4643_3H_pt.csv 0 bias=1.049 Time elapsed[s]= 56.312573895 3892c9c3-c5c3-4faf-b1cb-96c8ae2f4643

The model run is finished

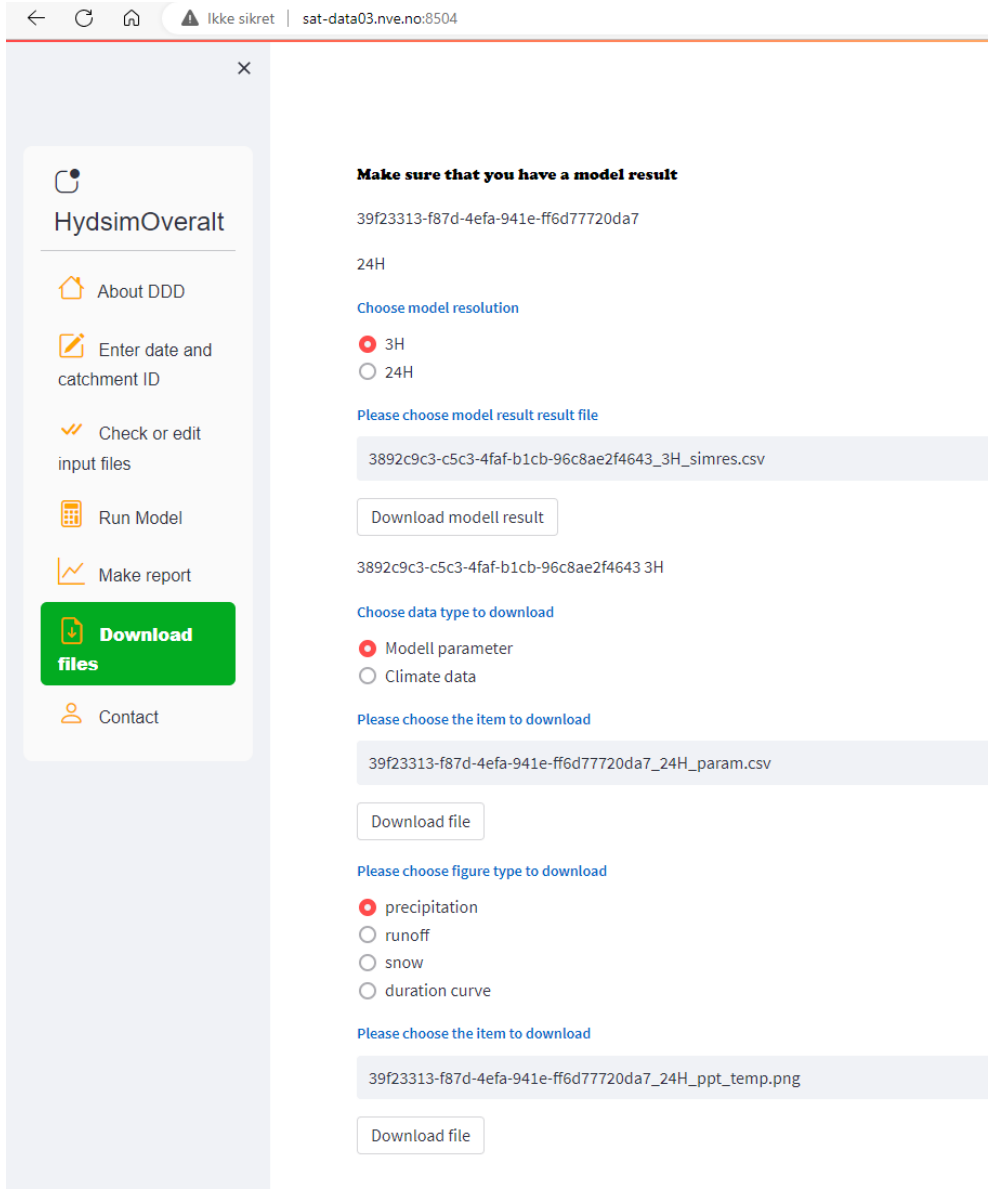
The service HydSimOveralt- the entire operation takes about 10 minutes



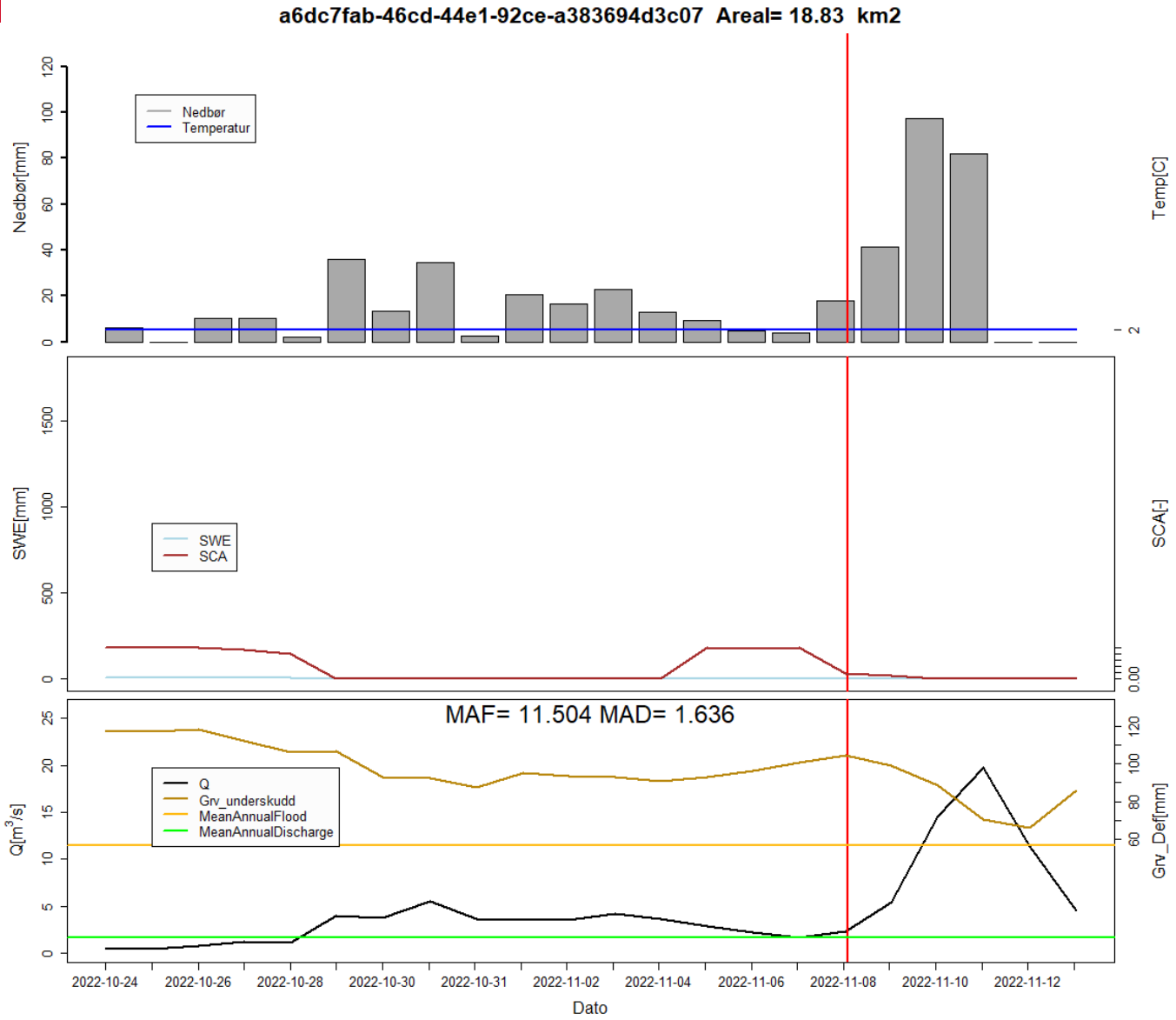




The service HydSimOveralt- downloading the results



«On the fly» flood forecasts. Vestlandet, November 2022



Mean annual flood calculated from simulated 30 years timeseries (time lengths can be chosen)

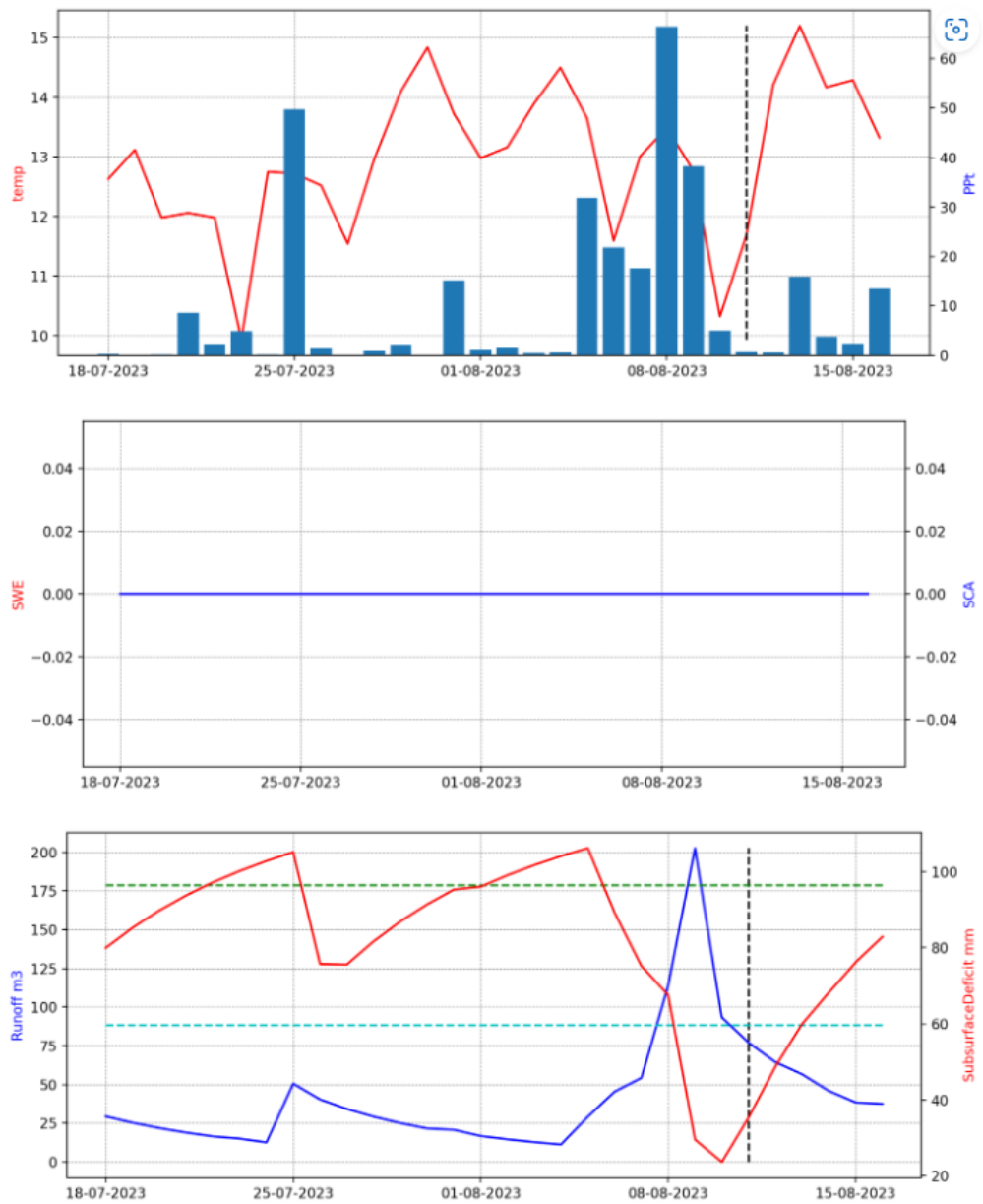
The model compares simulated forecasts against simulated mean annual flood

Each catchment has its unique ID calculated once and for all. With new meteorological data, running the model again is very speedy and simple.

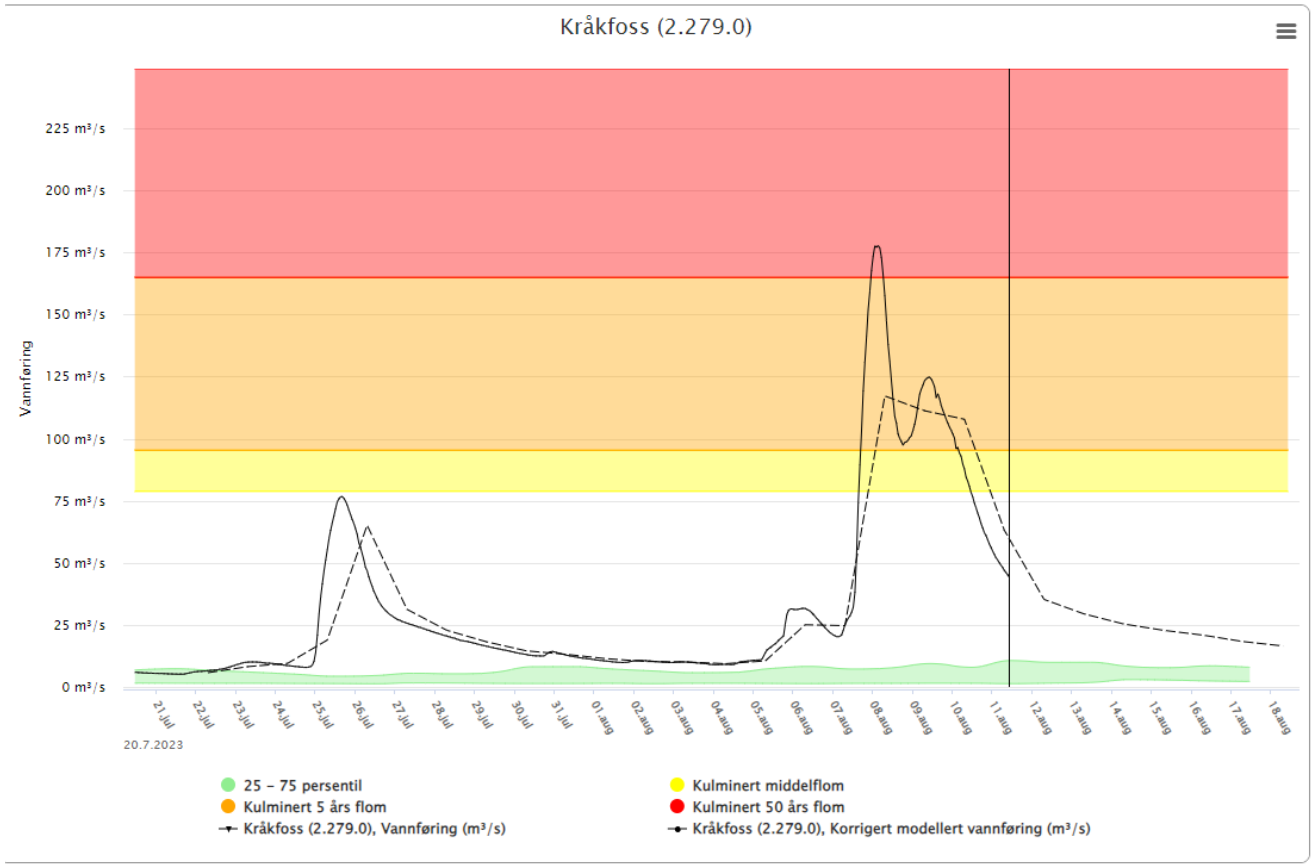
.\DDD\inndata\simres_e5f3a0eb-f4a8-45f6-b2e6-38a3470867ea.csv

M_200 = 283.455 M_50 = 178.617 M_5 = 88.327 MAF = 77.144 MAD = 10.746

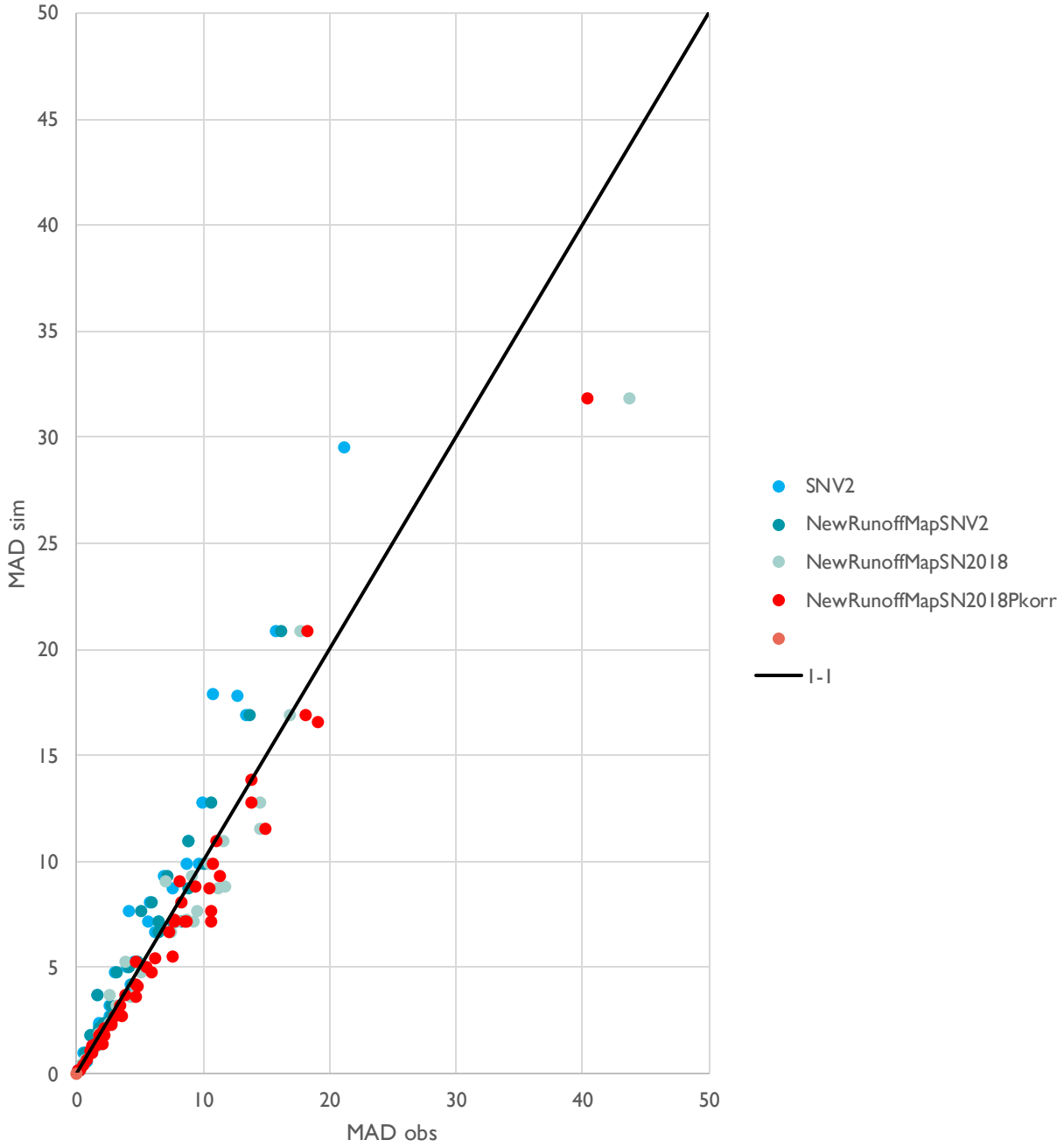
Show M_200 Show M_50 Show M_5 Show MAF Show MAD



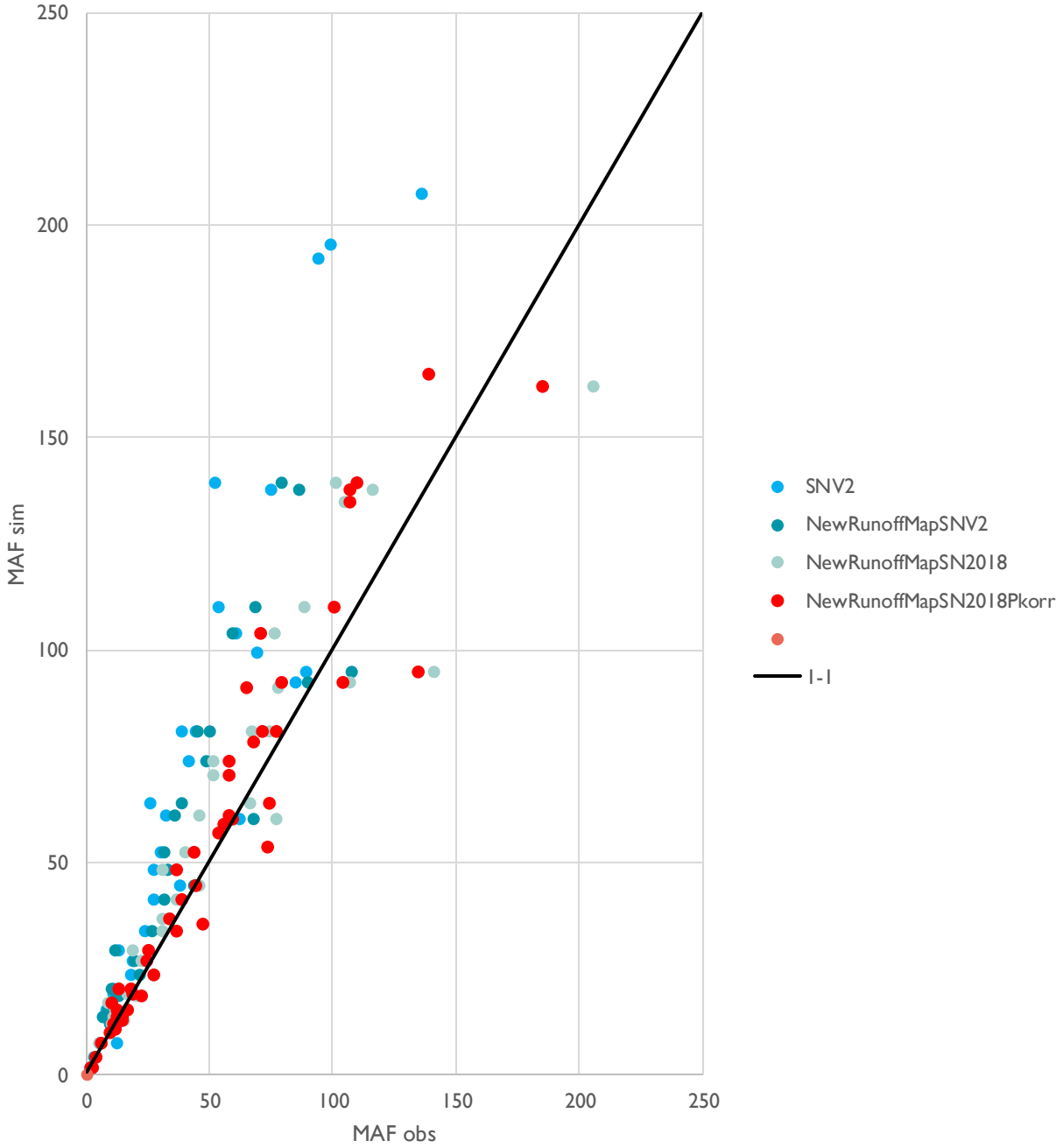
HANS @runoff station Kråkfoss



HSO Mean Annual Discharge

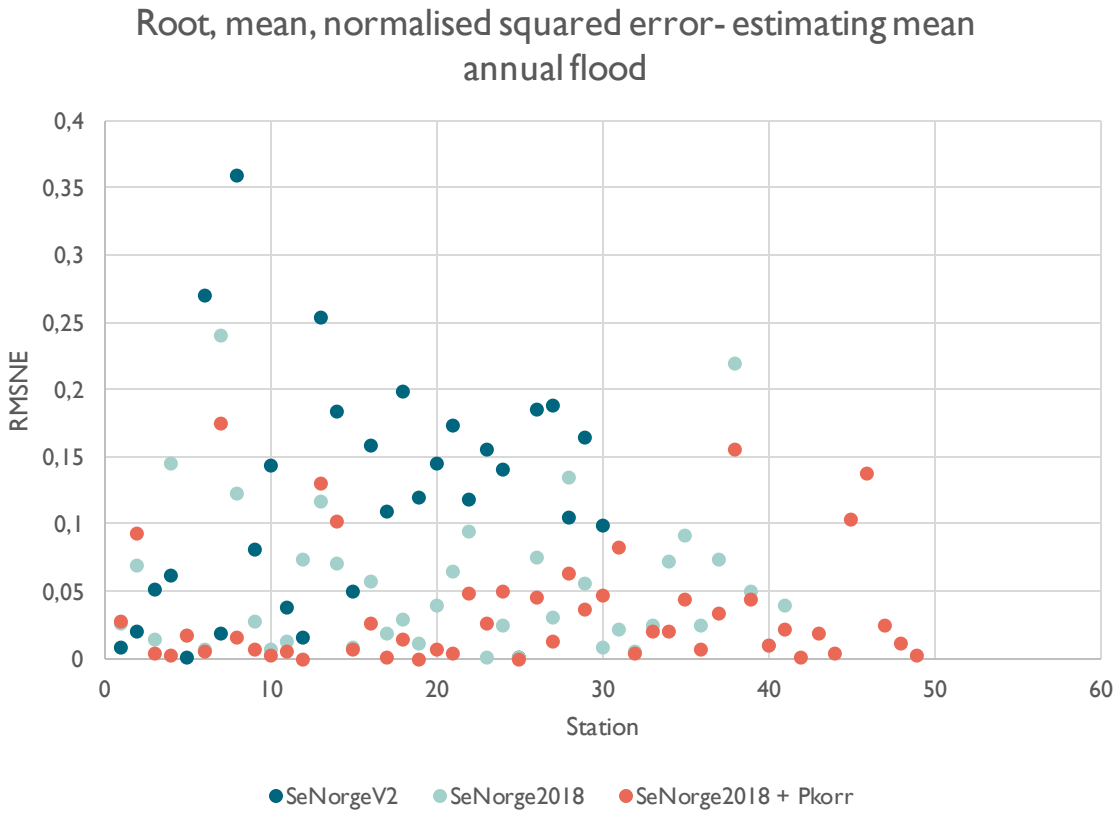


HSO Mean Annual Flood



Application: Estimate the mean annual flood,

RMSNE = 0.35 (SeNorgeV2)
RMSNE = 0.23 (SeNorge2018)
RMSNE= 0.19 (SeNorge2018 + Pkorr)



RMSNE for HSO is 0.19,
RMSNE for RFFA2018 is 0.23.

More, and better information further improves the system!

Conclusions- HydSimOveralt

- The parts of the system are in place and works well - how to develop the ideal system (or systems) for users remains to be decided.
- Runoff forecasts can be run for everywhere in Norway
- Relevant hydrological statistics can be calculated for everywhere in Norway
- The model has no preferred temporal resolution. Current version runs for 24h som 3h. Higher resolution on temporal and spatial data will give high resolution hydrological simulations.
- Extracting meteorological data, calculating model parameters and running the model is carried out on a time scale suitable for operational flood forecating (5-10 minutes)
- We want to make a (n even) better GUI, and make the system accessible for users outside of NVE