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MET Nordic Reanalysis data improves the performance of catchment-level hydrological models

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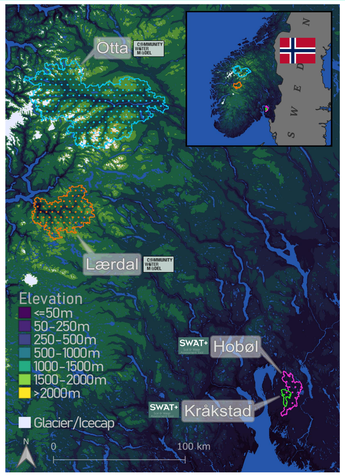
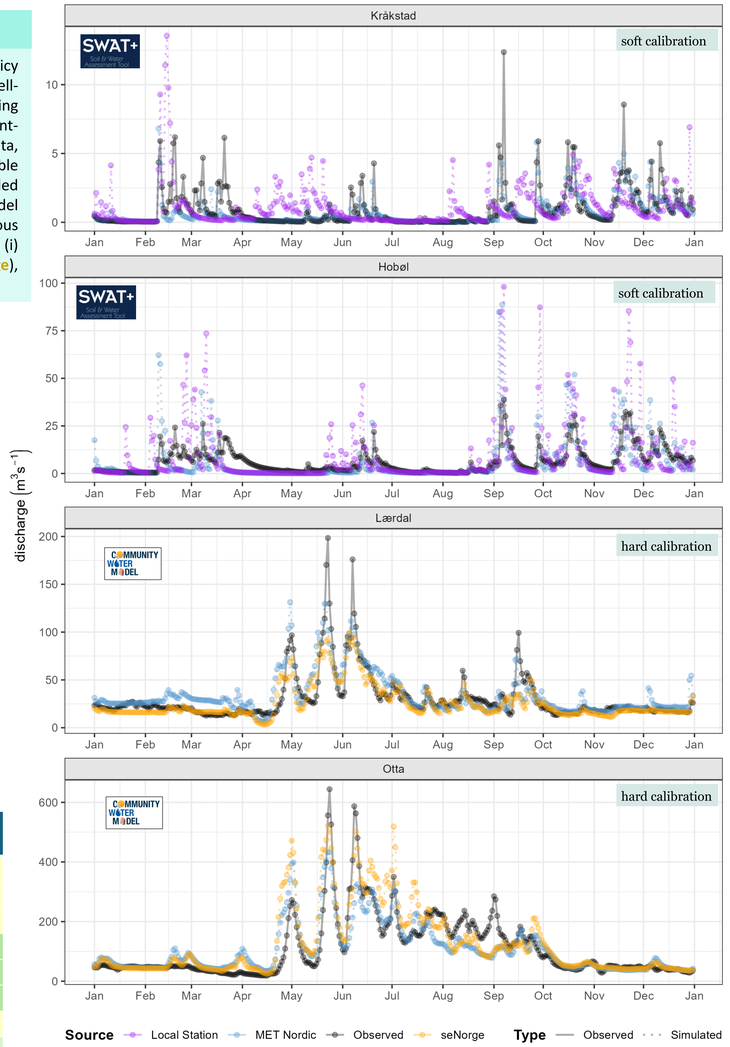
Introduction

Catchment-level hydrological models are important tools in guiding policy and management decisions on agriculture, water resources, etc. Well-performing models can provide insight on various scenarios, including land use change, climate change, and management scenarios. Catchment-level model performance is strongly dependent on driving input data, specifically meteorology, therefore the use of the best possible representation of the meteorological conditions within the modelled domain is of key interest. Here we test the differences in model performance from four catchment-level hydrological models of various scales and model designs in Norway using meteorological data from (i) direct observation (**local**) , (ii) interpolated grid of observations (**seNorge**), and (iii) model output from a reanalysis product (**MET Nordic**) .

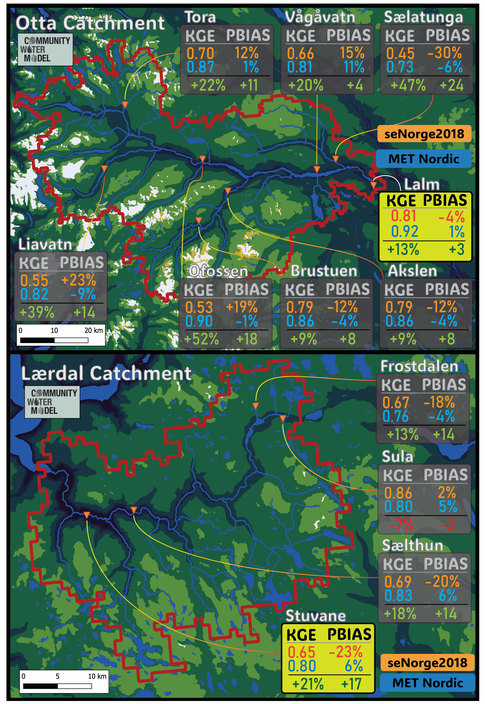




Model's performance statistics (daily data)

Model	Catchment	Weather input	NSE	KGE	PBIAS (%)
SWAT+ soft calib.	Kråkstad	local station	-0.61	0.15	14.6
	Kråkstad	MetNordic	0.45	0.59	-16.3
	Hobølelva	local stations	0.38	0.67	15.4
	Hobølelva	MetNordic	0.62	0.81	3.6
CWatM hard calib.	Otta	SeNorge	0.71	0.81	-4.0
	Otta	MetNordic	0.84	0.92	1.0
	Lærdal	SeNorge	0.66	0.65	-23
	Lærdal	MetNordic	0.62	0.80	6

Evaluation (Pandit et al., 2025)	
poor	good
limited	very good
satisfactory	not applicable



Methodology

Model setup

- Simulation of reservoir management, crop growth, irrigation and domestic water use.
- Paired model setups using meteorological data as driving variables from:
  - **seNorge_2018, a collection of observational gridded datasets over Norway, 1 km x 1 km** (precipitation, temperature, humidity, surface pressure, radiation, windspeed)
  - **MET Nordic, a reanalysis product from the Norwegian Meteorological Institute, 1 km x 1 km** (precipitation and air temperature were used)

Model calibration

- The **CWatM** model was calibrated with **NSGA-II** (Deb et al., 2002) for single-objective optimisation using **DEAP** (Fortin et al., 2012*). [Population size: 256, combination pool of 32, and 20 generations]*. Model performance was evaluated using **KGE**.
- Snow parameters were calibrated against observations (seven monitoring sites) for the Otta catchment. Both catchments were calibrated at their main outlet (highlighted in yellow, **left of textbox**).

Methodology

Model setup

- Model setup includes simulation of agricultural management, land use, and nature-based measure implementation. Catchment "Kråkstad" implements the COCOA approach (Schürz et al, 2022), allowing for model connectivity on the [agricultural] field-scale. Catchment "Hobøl" was set up following the traditional "QSWAT+" approach.
- Paired model setups using meteorological data as driving variables from:
  - a **local weather station** *(precipitation, temperature, humidity, radiation, windspeed)*
  - **seNorge_2018, a collection of observational gridded datasets over Norway, 1 km x 1 km** (precipitation, temperature, humidity, surface pressure, radiation, windspeed) – **Hobøl only**
  - **MET Nordic, a reanalysis product from the Norwegian Meteorological Institute, 1 km x 1 km** (precipitation and air temperature were used)

Model Calibration

- Model paired setups passed through a model verification (SWATdoctR, Plunge et al. 2024), soft and hard calibration (SWATtunR). Calibration period was 2014-2017 (1 year warmup). The model was validated from 2018-2020. Model performance was evaluated with **NSE, KGE, PBIAS**.

seNorge2018 Gridded weather data interpolated from a network of weather stations (Lussana et al. 2019)

MET Nordic Gridded weather data from MetCoOp (MEPS) model combined with weather observations [Re-analysis]

Local Station Weather data sourced directly from a local weather station

Next Steps

- Fully integrate **MET Nordic** into COMMUNITY WATER MODEL catchments and test the added performance
- Implement **seNorge2018** into SWAT+ catchments and compare to **MET Nordic**
- Incorporate SWAT+ catchments in Denmark and Latvia to test **MET Nordic** outside of Norway
- Test relationship between **MET Nordic** grid resolution and model performance
- Compare global reanalysis **ERA5** to regional reanalysis **MET Nordic** in all models.

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