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with a great deal of thanks to Daniel Martín (AEMET) for the CAMS implementation and Ulf Andrae (SMHI) for technical support.

## Background

Precipitation bias from coast (too dry) to mountains (too wet).

Contributing factors:

- Artificial sea-land border in CCNs. Default: 100/cm<sup>3</sup> (sea), 300/cm<sup>3</sup> (land).
- Undercatch of wind-blown snow in high-mountain area.
- Spatio-temporal distribution of CCNs not represented.

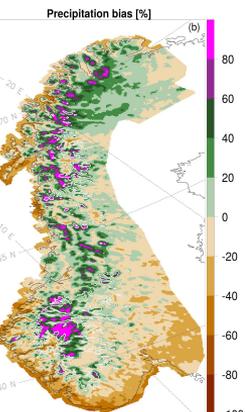
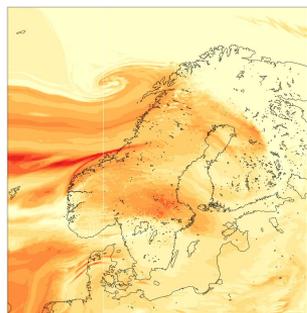


Fig. 1: Precipitation bias from 13-year HCLIM38 simulation relative to seNorge gridded precipitation dataset.

Fig. 2 (left): More realistic CCN concentrations (/cm<sup>3</sup>) from CAMS from 2020-01-01 18h. Evolving in both space and time.

## Experiments

Sensitivity experiments with different CCN concentrations:

- CTR: 100/cm<sup>3</sup> (sea), 300/cm<sup>3</sup> (land)
- Exp2: 100/cm<sup>3</sup> (sea), 100/cm<sup>3</sup> (land)
- Exp3: 300/cm<sup>3</sup> (sea), 300/cm<sup>3</sup> (land)
- CAMS: Using interactive aerosols from CAMS near real-time (NRT) forecasts. HARMONIE implementation developed by Daniel Martín (AEMET).

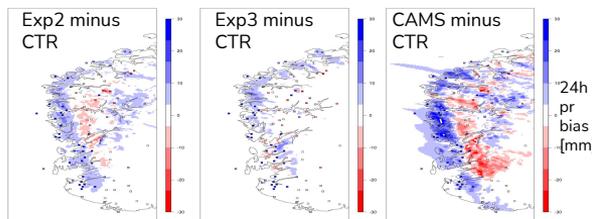


Fig. 3: A high-precipitation case (2017-12-23). Exp2 and CAMS show better spatial agreement with observations (squares).

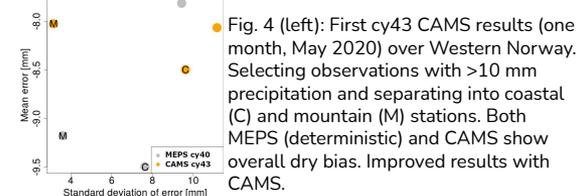


Fig. 4 (left): First cy43 CAMS results (one month, May 2020) over Western Norway. Selecting observations with >10 mm precipitation and separating into coastal (C) and mountain (M) stations. Both MEPS (deterministic) and CAMS show overall dry bias. Improved results with CAMS.

Variable	All stations		Mountain stations (>700 m)		Coastal stations		Corr.
	Abs mean error	SD of error	Abs mean error	SD of error	Abs mean error	SD of error	
Precipitation [mm/day]	-0.21 (-53%)	-0.15 (-2.2%)	+0.00050 (+0.023%)	-0.27 (-4.0%)	-1.1 (-51%)	-0.082 (-1.0%)	+0.017
T2m [K]	+0.29 (+9.3%)	+0.048 (+3.0%)	+0.35 (+5.4%)	+0.047 (+3.2%)	-0.037 (-4.6%)	+0.051 (+5.7%)	-0.002
RH2m [0-1]	+0.0033 (+8.0%)	+0.00048 (+0.61%)	-0.0016 (-2.5%)	0.000085 (+0.11%)	+0.0042 (+1.2%)	-0.00033 (-0.51%)	-0.009
Wind 10m [m/s]	-0.13 (-17%)	-0.037 (-1.8%)	-0.27 (-25%)	+0.06 (+2.0%)	+0.0087 (+1.1%)	-0.024 (-1.1%)	+0.006
SLP [m]	-5.4 (-38%)	+2.6 (+3.2%)	+1.2 (+4.7%)	+2.6 (+2.4%)	-3.3 (-24%)	+5.5 (+7.1%)	±0

Table 1: One-month (Jan 2020, cy40h11) changes between CAMS and CTR for error measures for a few key variables. Green background means CAMS results are better than CTR, and pink means worse.

- Improved precipitation errors on the coast.
- Small improvement in precipitation correlation.
- Overall improvements also in wind and SLP.
- Worse results for temperature.

## Ongoing and future work

- Evaluation of cy43 METCOOP forecasts (with land/sea CCN identical).
- More experiments with cy43 CAMS-NRT aerosols.
- More verification (especially as function of forecast length).