

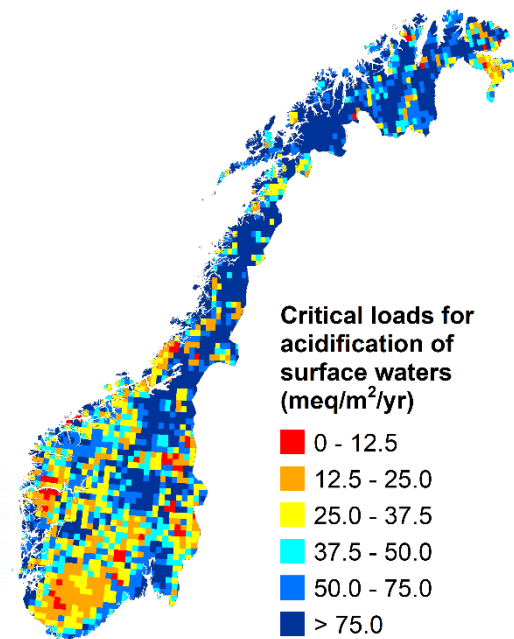
Evaluating the critical loads using data from the national lake survey 2019

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ICP Modelling & Mapping TF meeting 2021

Critical loads for acidification of surface waters in Norway

- SSWC and FAB models
- Calculated for grid cells, not individual water bodies
 - Each grid cell assigned a water chemistry from monitoring data
- Original base cation concentration (BC^*_0) indirectly from MAGIC modelling
 - Regression of BC^*_0 vs «present» BC^* using MAGIC model output for a set of acid-sensitive lakes
- Variable ANC_{limit}
 - Depending on BC^*_0 and TOC



2019 national lake survey

- 1000 statistically selected lakes across the country
- Re-survey of lakes sampled in 1995

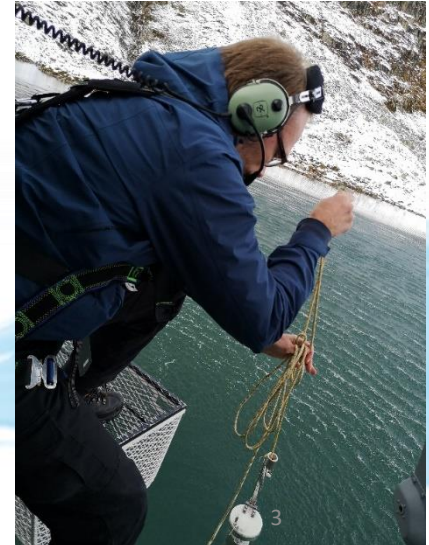


Pictures from Frida Eklund (Helitrans) ®



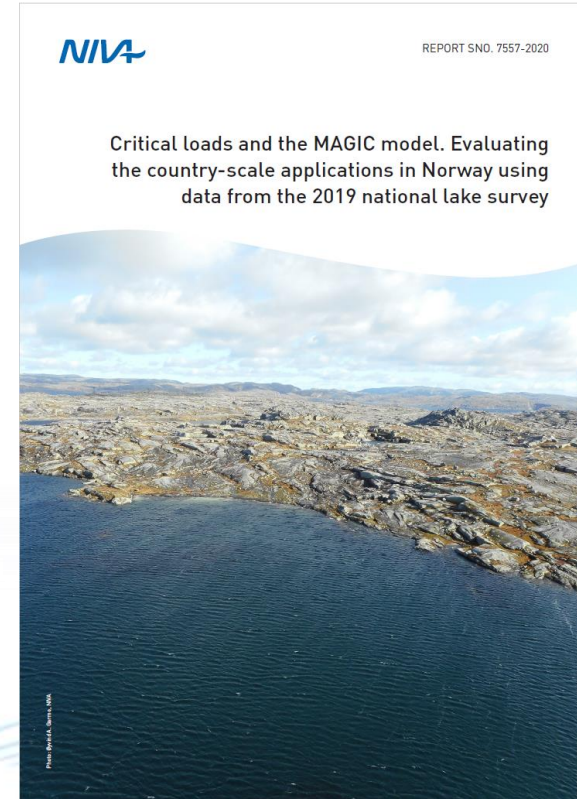
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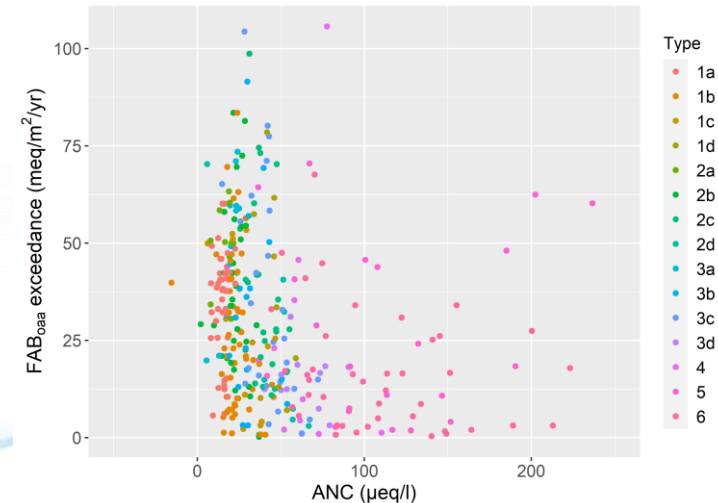
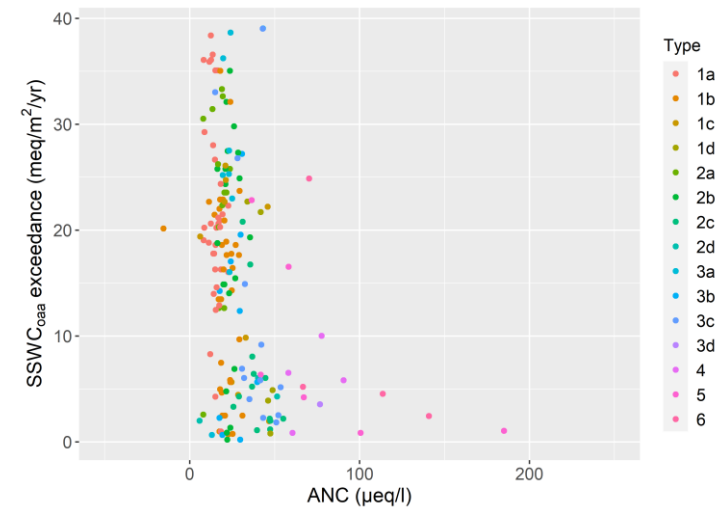
2020 evaluation

- MAGIC model performance
 - Comparing MAGIC projections for 2019 with measured concentrations
 - Aim: What could/should be changed in a re-calibration
 - Very brief conclusion: MAGIC generally performs well, but some steps for further improvement suggested
- The CL methodology
 - Comparing CL exceedance with measured concentrations
 - Sensitivity analysis CL parameters
 - Aim: How could the CLs be improved



CL exceedance vs ANC

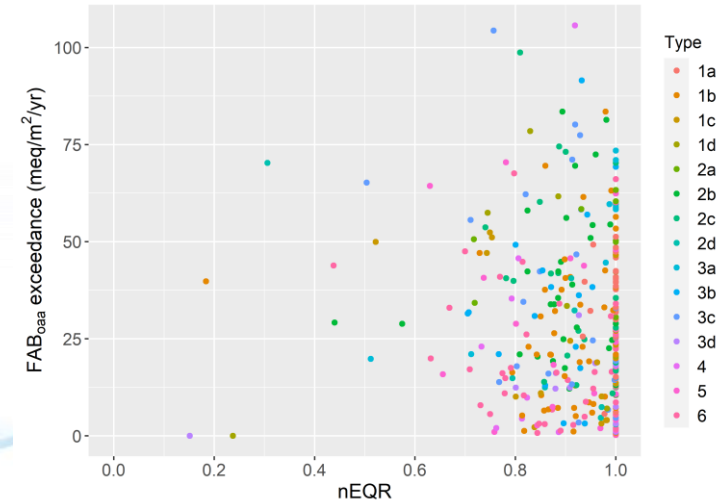
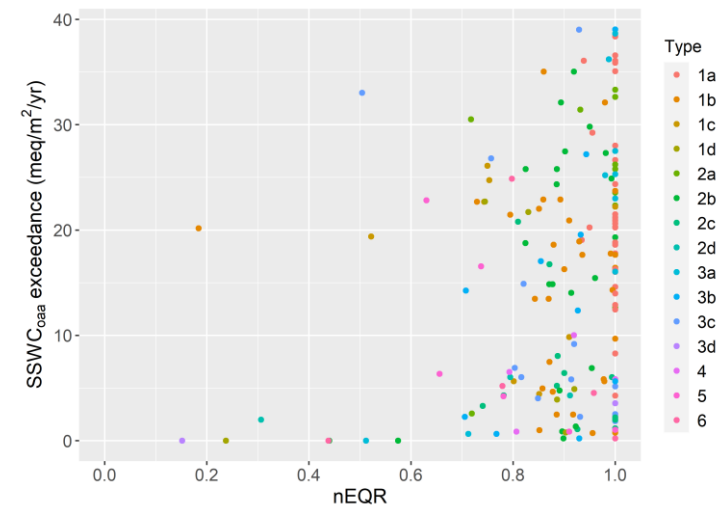
- Most lakes are not in an area with CL exceedance
 - SSWC 922, FAB 653
- With SSWC lakes in areas with CL exceedance mainly had $\text{ANC} < 50 \mu\text{eq/l}$
 - Exceptions often have high TOC
- With FAB several lakes in areas with CL exceedance had $\text{ANC} > 50 \mu\text{eq/l}$



Only lakes with CL exceedance

CL exceedance vs nEQR

- nEQR = normalised ecological quality ratio (WFD)
- Only 10 lakes acidified
 - Some were not in areas with CL exceedance, but this is expected – delayed recovery
- 174 (SSWC) or 339 (FAB) lakes were in areas with CL exceedance, but were not acidified



Non-acidified (nEQR > 0.6) lakes
with no exceedance omitted 6

Mismatch CL exceedance and acidification status

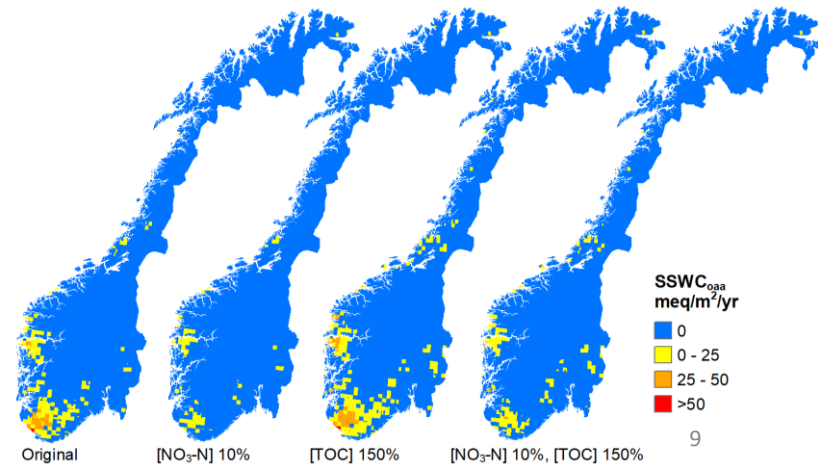
- Data of very different nature – are they really comparable?
- CLs set to protect the most sensitive lakes, while the 1000 lakes are randomly selected
- The Ca concentration was unusually high in 2019
- 2019 deposition was lower in some of the sensitive areas than the deposition used in the exceedance calculations (2012-2016 average)
- The Norwegian WFD classification is not sufficiently strict..?
 - Or the ANC ranges for the different classes are simply very narrow
- Could the CL exceedance be overestimated?
 - FAB certainly, in this type of comparison - does not assume current N immobilisation

Testing/evaluating various elements

- Some data not up to date – rough «sensitivity analysis»
- Evaluating some alternative approaches
- ANC_{limit} : Not evaluated at this stage
 - Previously shown to be fairly in line with WFD good/moderate boundary and any changes should be dealt with in parallel
- BC^*_0 : Evaluated, but a longer story
- Discharge
 - Realistic increase (3-5%) hardly any effect on exceedance
 - Will nonetheless update to the new normal (1991-2020) when available

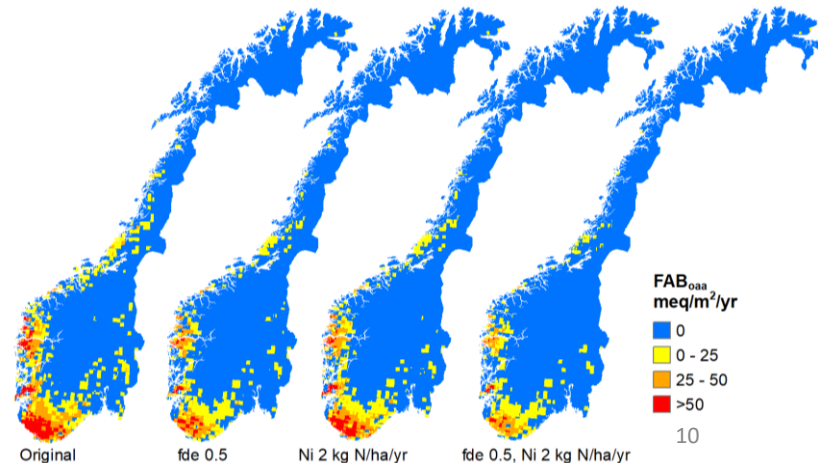
Testing/evaluating - SSWC specific

- TOC conc has increased and NO_3 conc has declined compared to the data applied in the CL calculations
- The combined effect depends on the actual size of the changes – if similar they cancel out
 - May have marked effects locally, but the national exceeded area may be similar
 - More up to date values should be applied



Testing/evaluating – FAB specific

- Increasing nitrogen retention in FAB gives exceedance more similar to SSWC
 - Partly counteracted by increasing TOC concentration
 - But adjusting and/or differentiating constants could be considered
- Do we need FAB?
 - I.e. do we need to apply the long-term N immobilisation as a precautionary principle – in case of nitrogen saturation?
 - Or is most of the N immobilised at any deposition level, i.e. SSWC CLs provide sufficient protection?
 - Probably still yes..



Recommendation

- 1) Using the 1000-lake survey as basis for the CLs
 - Calculating CLs for the lakes and extrapolating using spatial modelling (could also add more lakes/rivers)
 - BC^*_0 from MAGIC after re-calibration
- Or 2) Keep existing BC^*_0 , but update TOC and NO_3
- In any case
 - Keep both SSWC and FAB (FAB as worst-case scenario)
 - Revisit some of the FAB parameters
 - Update land cover distribution and discharge

Way forward

- Re-calibration of MAGIC to the 1000 lakes using the new Mobius platform
 - Useful also for other purposes
 - Building on recommendations from the evaluation
 - Starting in 2021, continued in 2022
- Updating CLs 2022-2023??
 - If and how not decided
- Hence – no new data in response to the Call for data
 - But maybe some news on progress in the 2022 CCE Status report – national chapter?