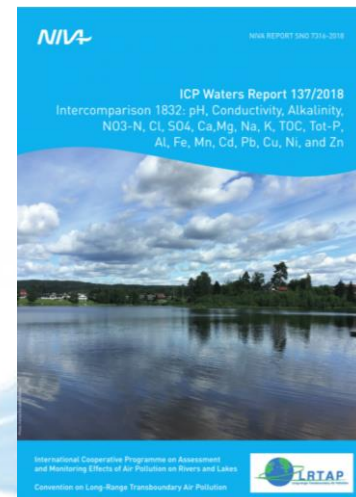




ICP Waters Chemical Intercomparison 1832

pH, Conductivity, Alkalinity, $\text{NO}_3\text{-N}$,
Cl, SO_4 , Ca, Mg, Na, K, TOC, Tot-P,
Al, Fe, Mn, Cd, Pb, Cu, Ni, and Zn

Carlos Escudero and Cathrine Brecke Gundersen
Contact: cathrine.gundersen@niva.no



International Harmonization of Monitoring Practices

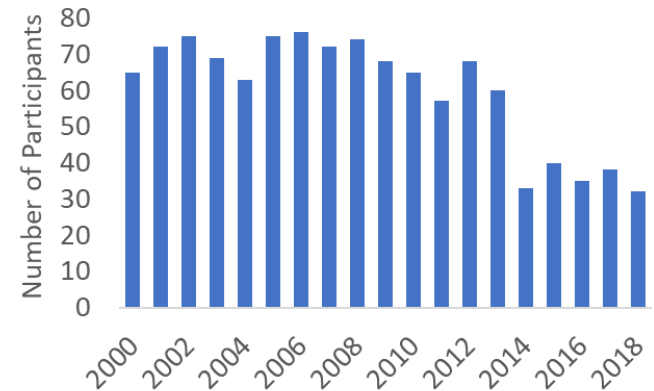
Sources of deviation:

- Different methods
- Errors in e.g. calibration, etc.

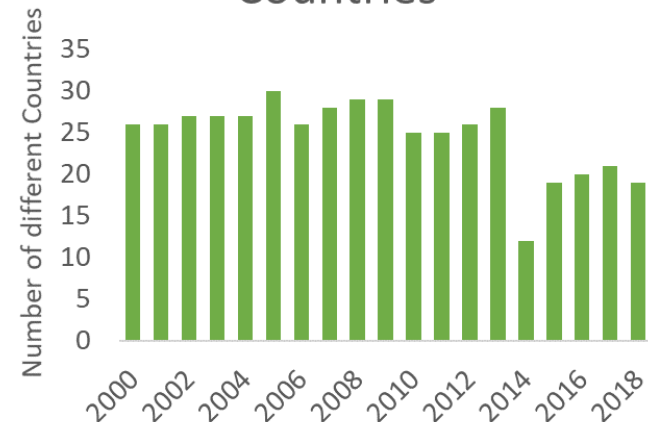
Chemical Intercomparison

- 32 years
- Up to 70 different laboratories
- Up to 30 different countries

Laboratories



Countries



How is it done?

- Natural Lake water adjusted
- Two sample sets:
 - A+B: Major ions
 - C+D: Heavy metals



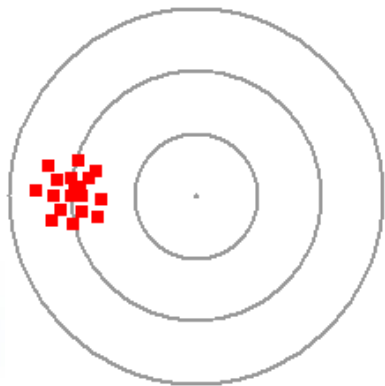
A+B: pH, conductivity, alkalinity,
NO₃/NO₂-N, Cl, SO₄, Ca, Mg, Na, K, TOC, and Tot-P

C+D: Al, Fe, Mn, Cd, Pb, Cu, Ni, and Zn

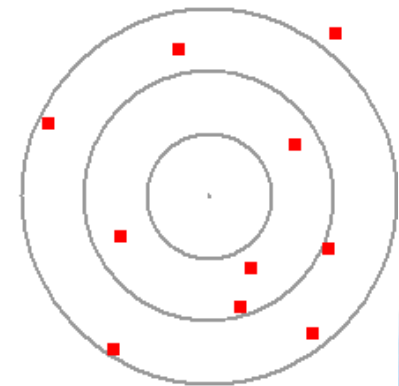
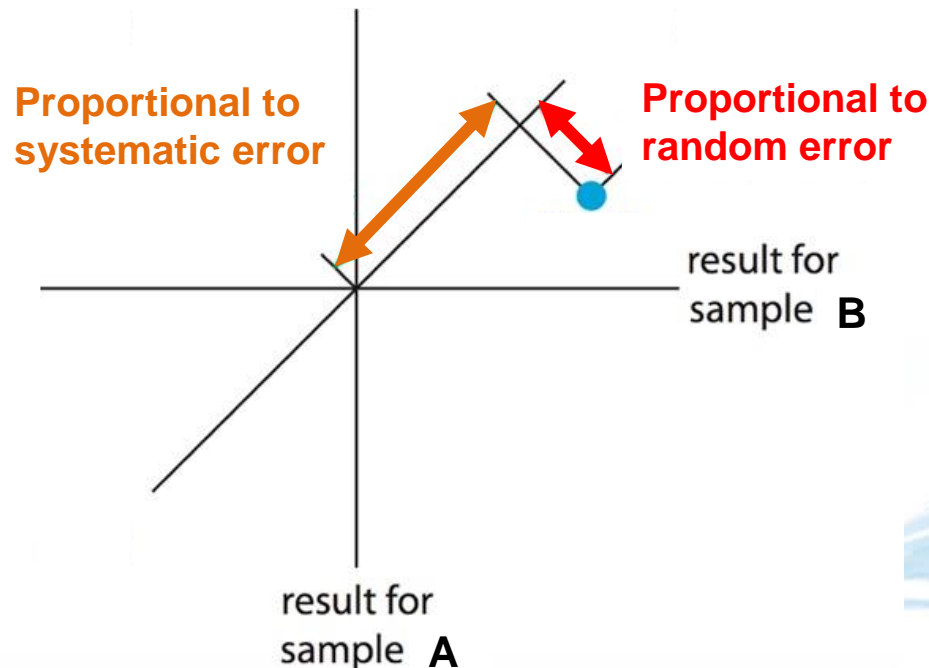
Photo: Kjetil Ree, Wikipedia

Statistics: Youden

- «True value» = median of results
- Acceptance limit = $\pm 20\%$ of «true value»
 - Conductivity $\pm 10\%$ and pH ± 0.2 units



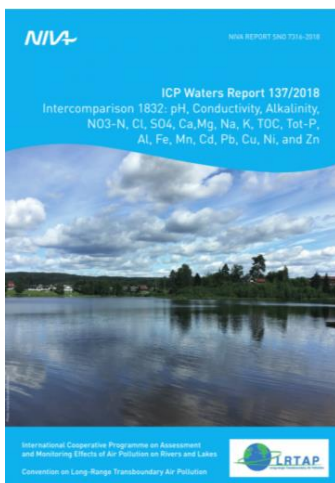
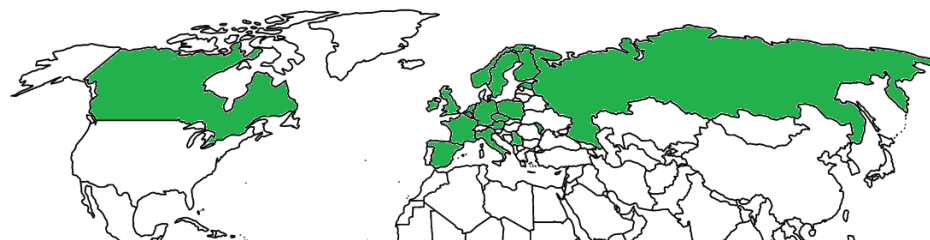
Systematic Error



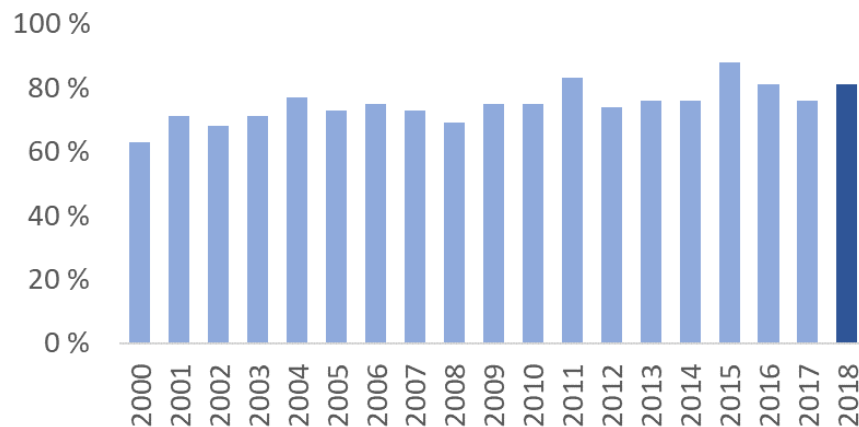
Random Error

2018 Summary

- 32 laboratories
- 19 countries
- 81% of results accepted



Overall Acceptance (%)

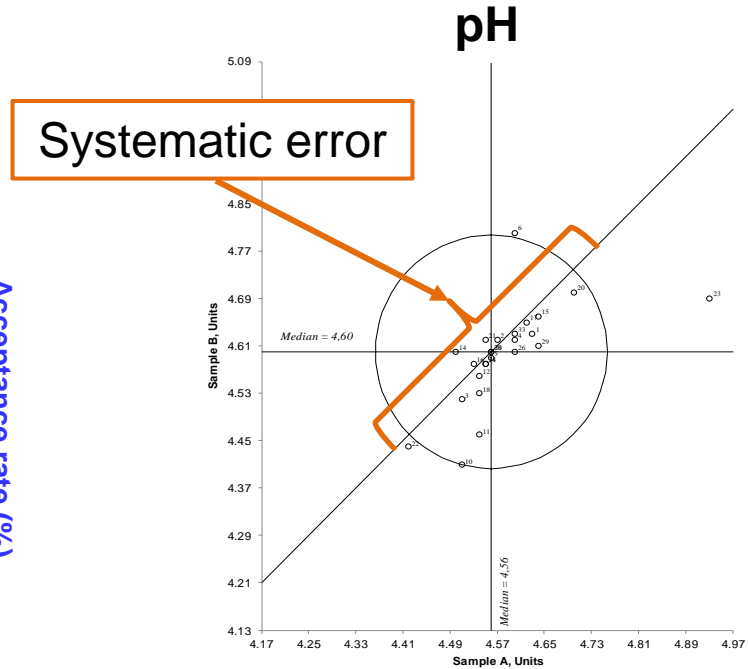
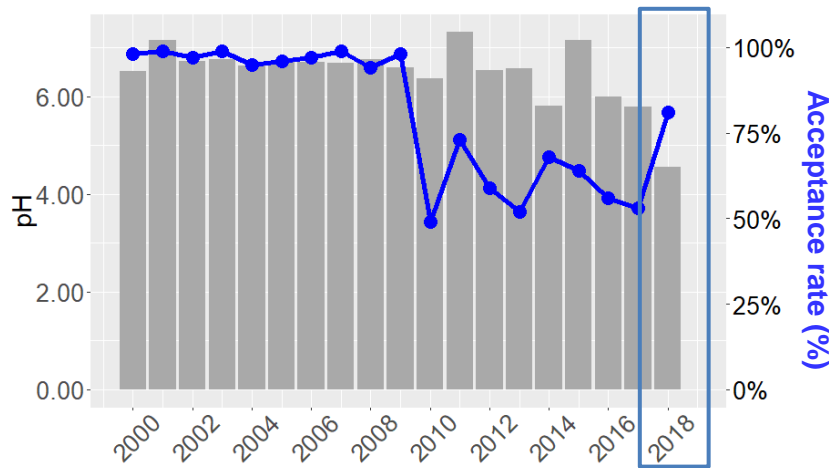


Available at: www.icp-waters.no/2018/12/18/2018-chemical-intercomparison-report

2018: pH, Conductivity and Alkalinity

pH (27): 81% acceptance

- Stirring/non-stirring

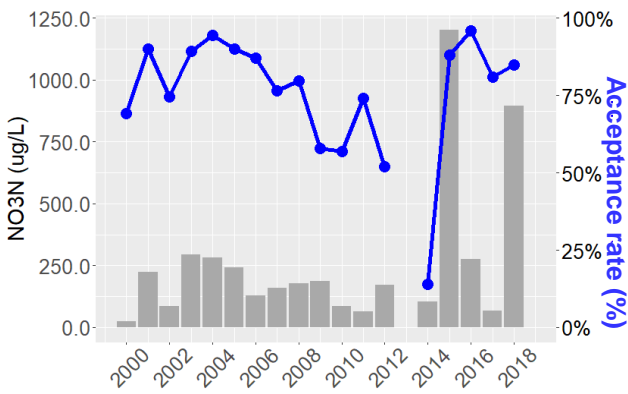


Conductivity (27) always good, 85% accepted ($\pm 10\%$)

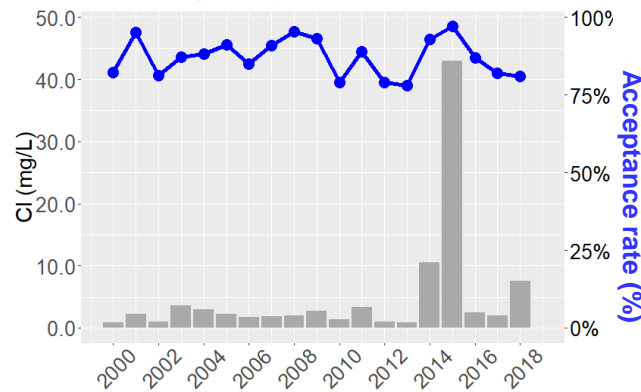
Alkalinity not present due to low pH

2018: Major Anions

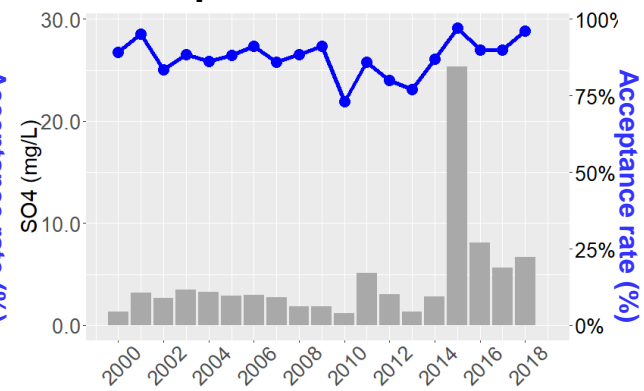
NO₃/NO₂-N (27): 85%



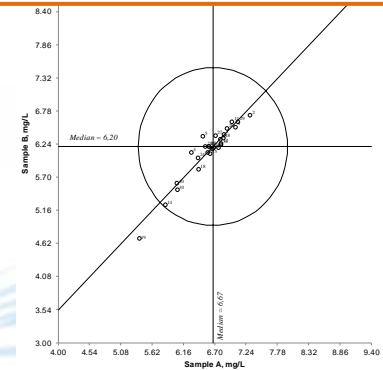
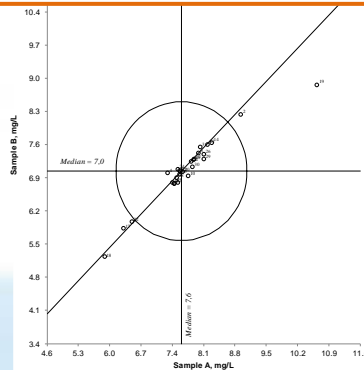
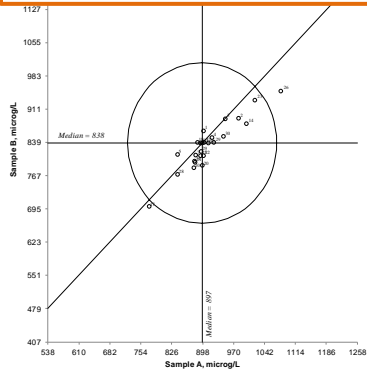
Cl (27): 81%



SO₄ (27): 96%

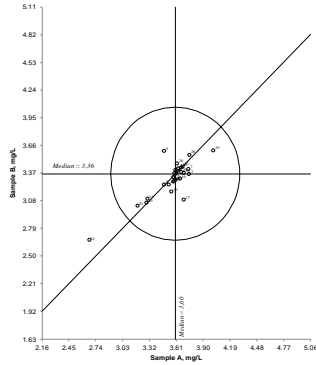
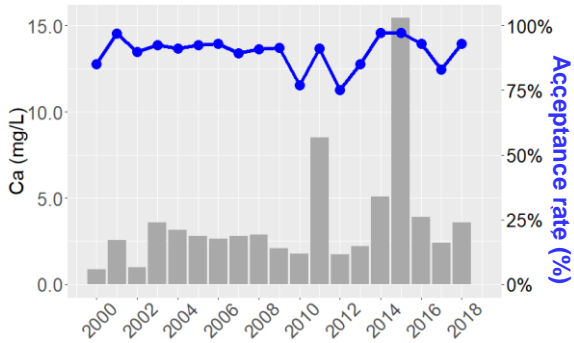


Some systematic error

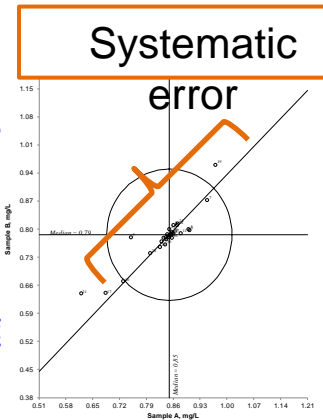
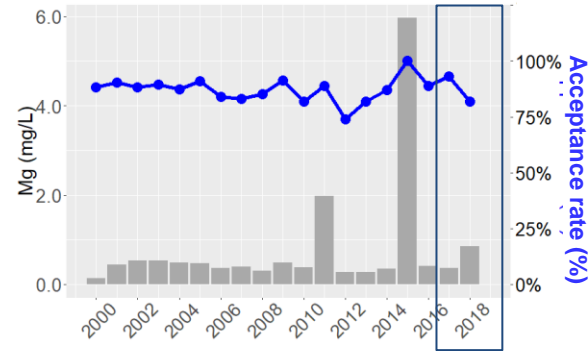


2018: Major Cations

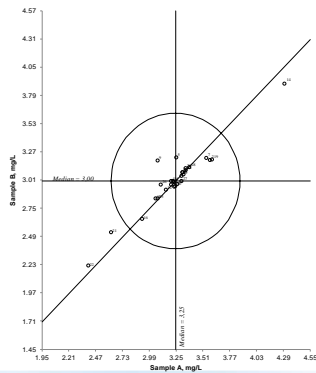
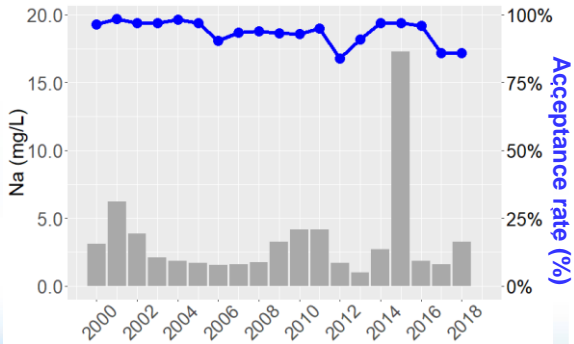
Ca (28): 93%



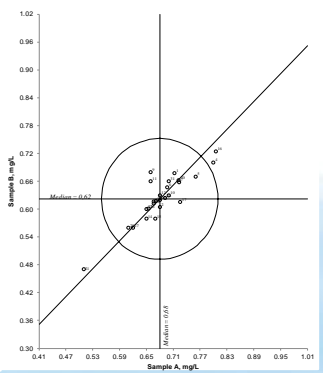
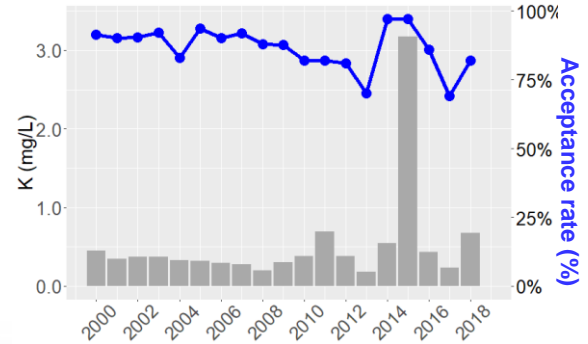
Mg (27): 82%



Na (28): 86%

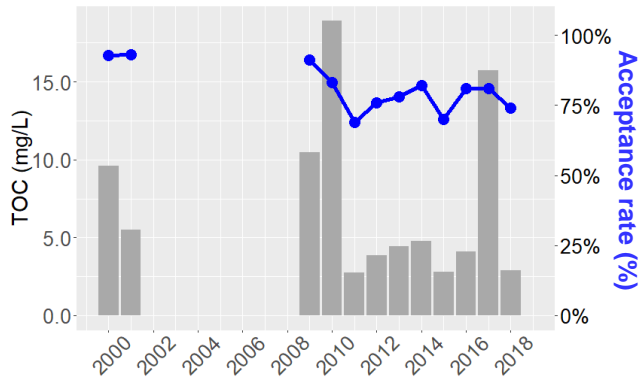


K (27): 82%

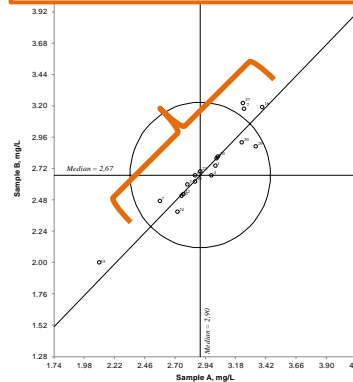


2018: TOC and Tot-P

TOC (19): 74%

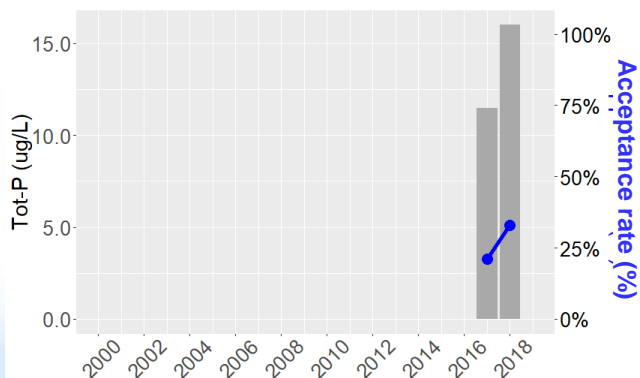


Systematic error

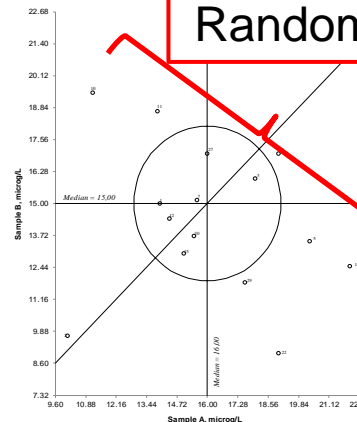


- Low TOC
- Some systematic error at low level?

Tot-P (21): 33%



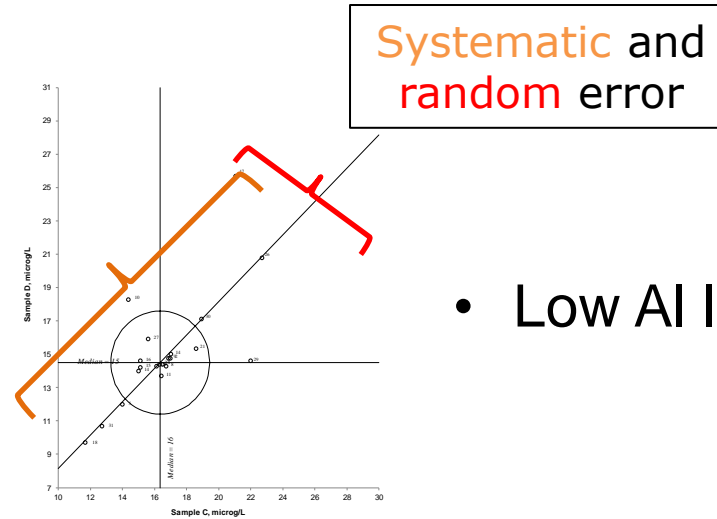
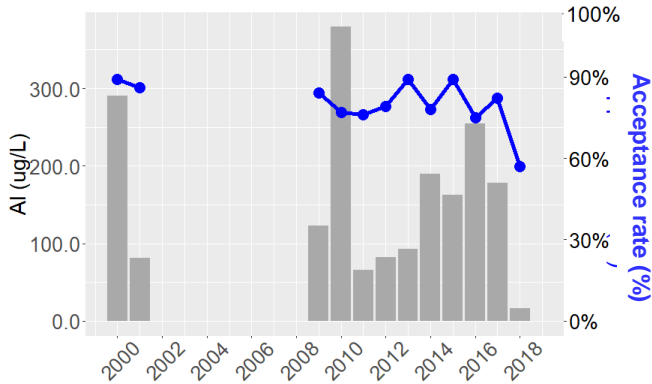
Random error



- Newly included Tot-P
- Low level?

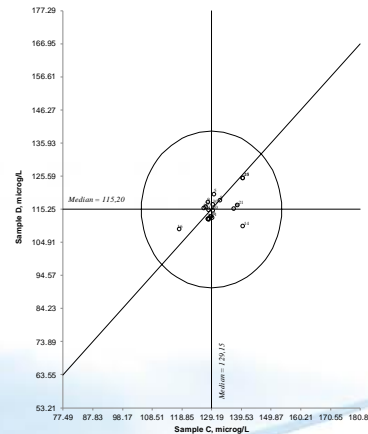
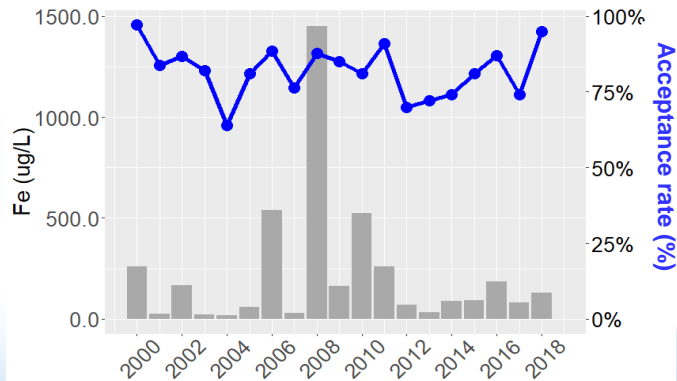
2018: Metals Pt 1

Al (20): 57%



- Low Al level

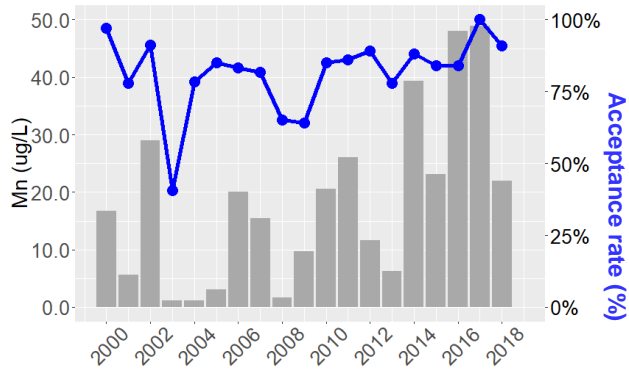
Fe (20): 95%



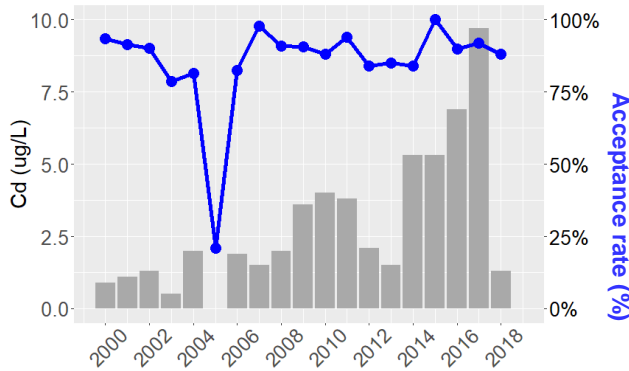
- Improved Fe results!

2018: Metals Pt 2

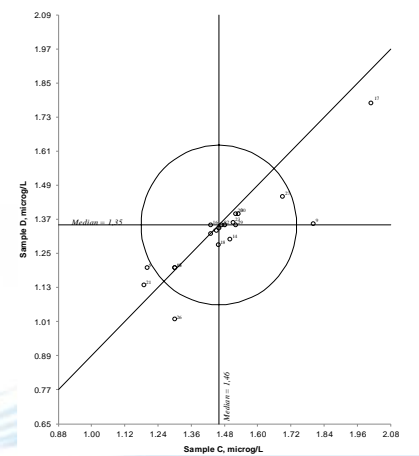
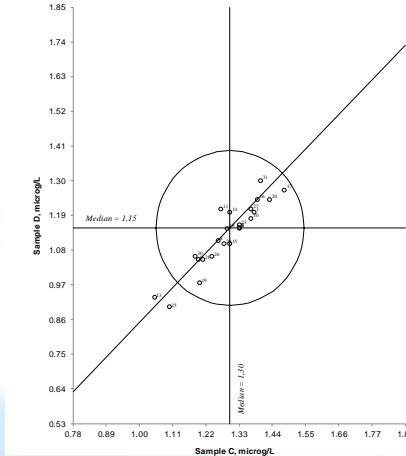
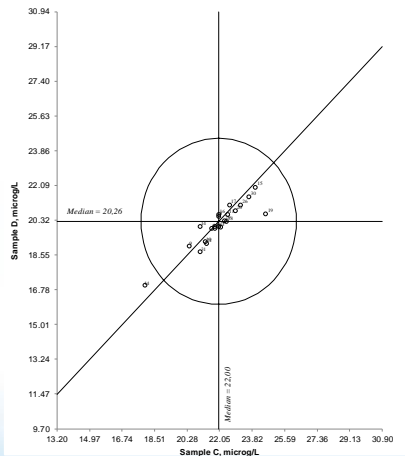
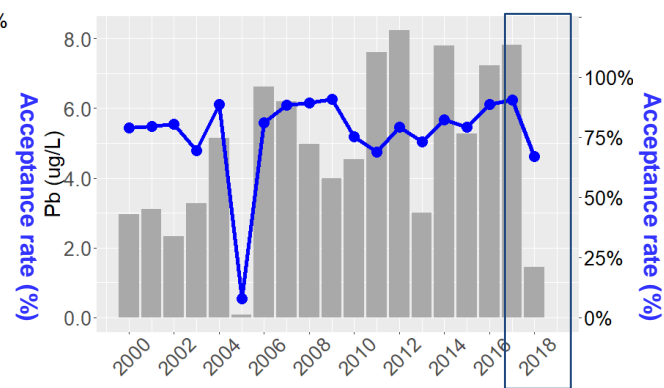
Mn (21): 91%



Cd (24): 92%

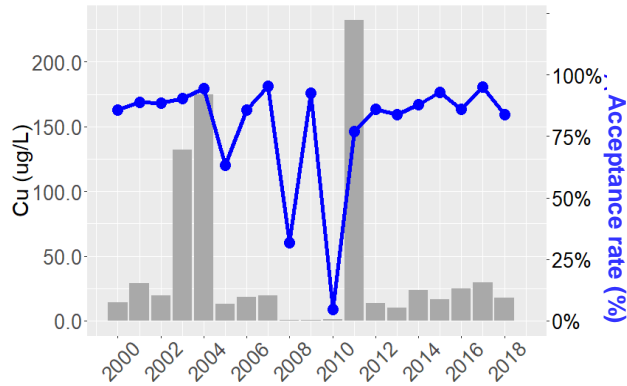


Pb (22): 65%

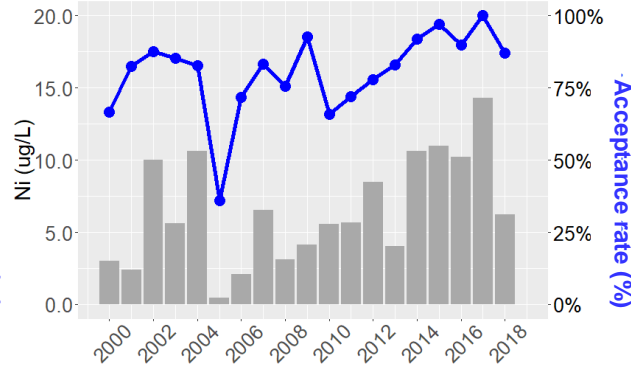


2018: Metals Pt 3

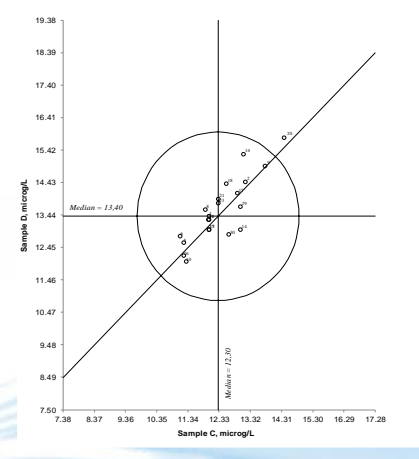
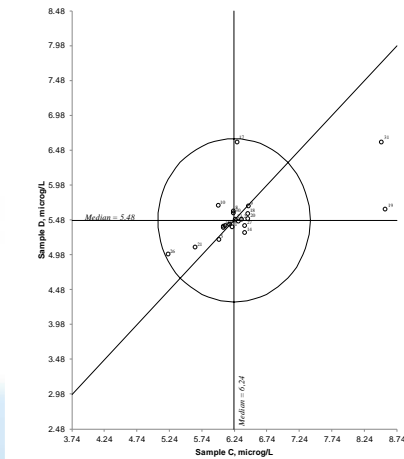
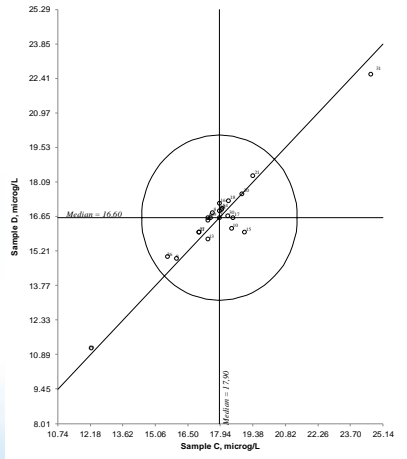
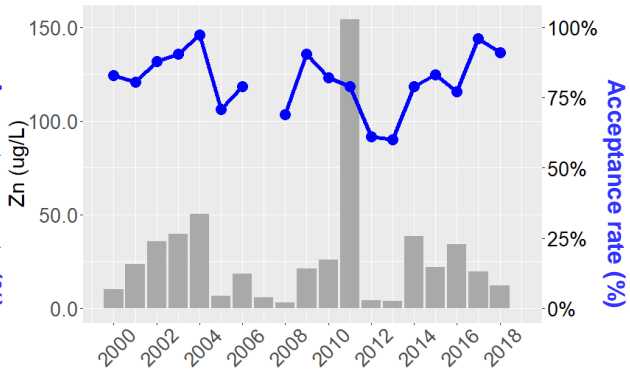
Cu (24): 91%



Ni (22): 87%



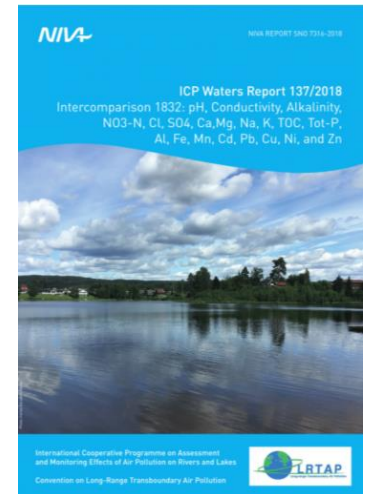
Zn (21): 91%



2018: Summary

- Overall good results!
 - 81% acceptance
- Best at $\geq 90\%$ for SO_4 , Ca, **Fe**, Mn, and Zn
- Worst at 33% for Tot-P

- Possible systematic error from method, e.g. pH
- Metals
 - Levels approaching environmental
 - Shift towards more sensitive plasma techniques
 - (ICP-OES/MS)



Future Outlook

- Levels of variables close to natural
 - Absolute rather than relative acceptance limit?
- Systematic error from methods
 - Eg. pH: stirring or non-stirring
- Looking for new database system

2019:

- 34 participants
- Samples distributed in week 24





Thank you!

Available at:

www.icp-waters.no/2018/12/18/2018-chemical-intercomparison-report

Contact: cathrine.gundersen@niva.no



NIVA

