Regional assessment of the current extent of acidification of surface waters in Europe and North America

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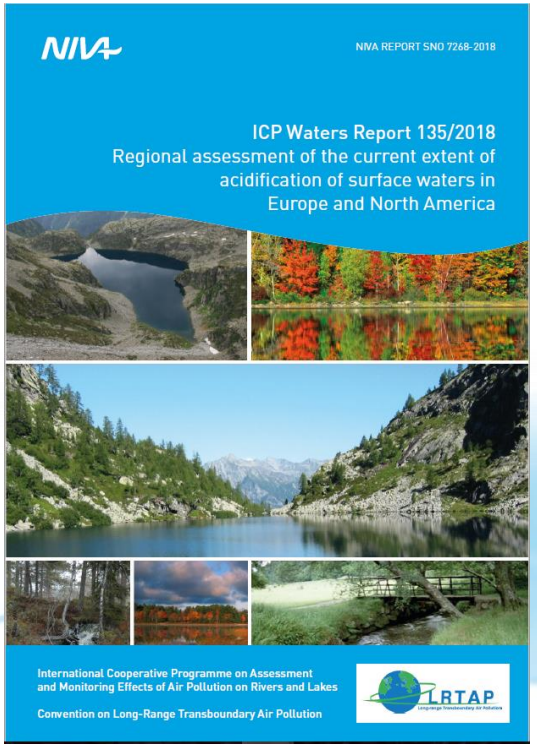
35th ICP M&M Task Force meeting

Madrid 2-4 April 2019



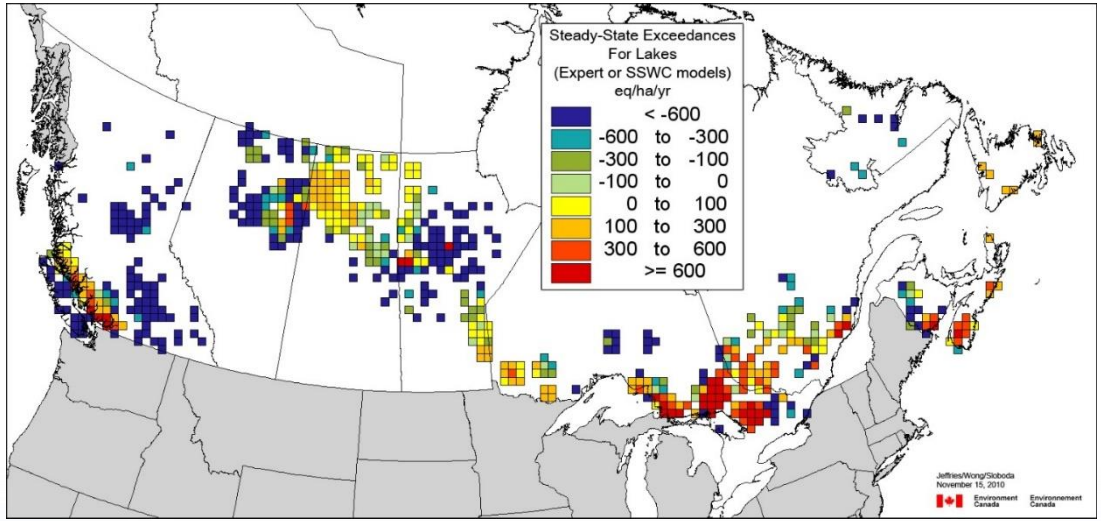
Background

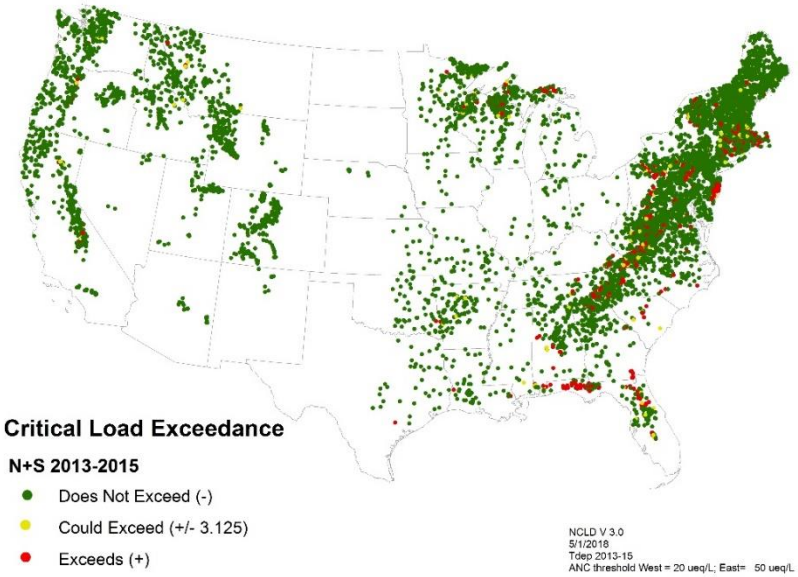
- Deposition has declined and the extent and severity of surface water acidification is reduced
  - What is the current situation on a broad regional scale?
  - Is the information sufficient for all relevant areas?
- Exceedance of critical loads for surface water acidification is reduced
  - Acidification may still prevail due to lag effects
  - Is the current legislation sufficient to reach non-exceedance?

Approach

- Potentially acidified surface waters
  - Exceedance of critical loads
  - Acid-sensitivity and deposition maps
- Acidification status
  - Data from national monitoring programmes
  - Data reported under the Water Framework Directive
- Country reports
- Literature review

CL exceedance North America

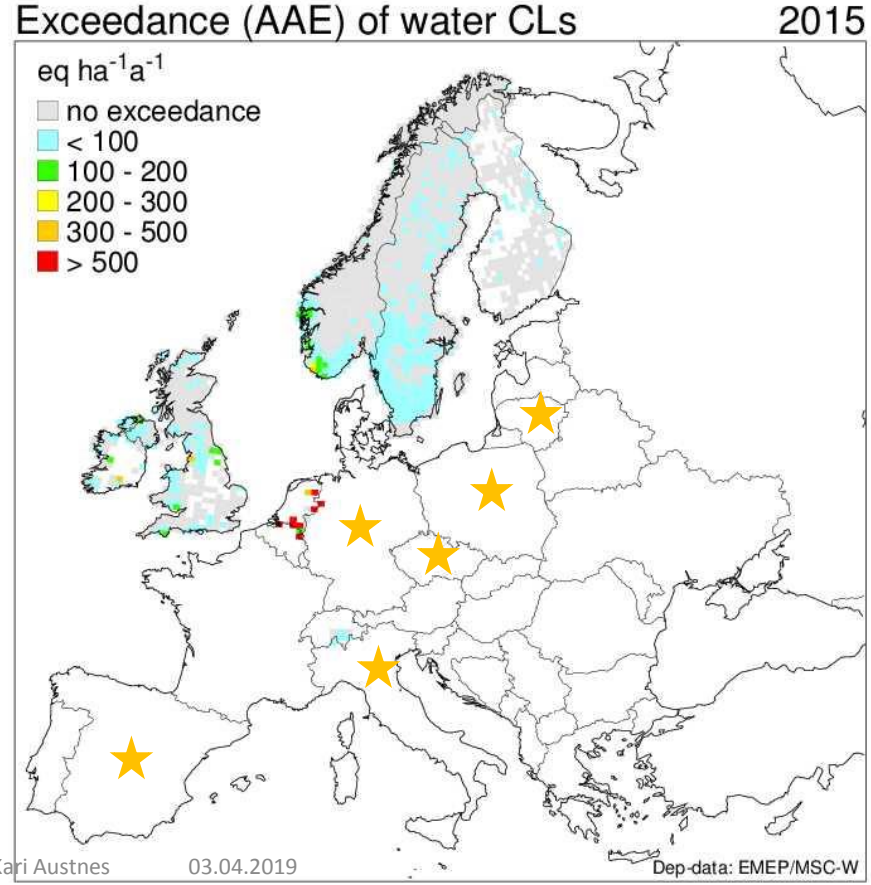




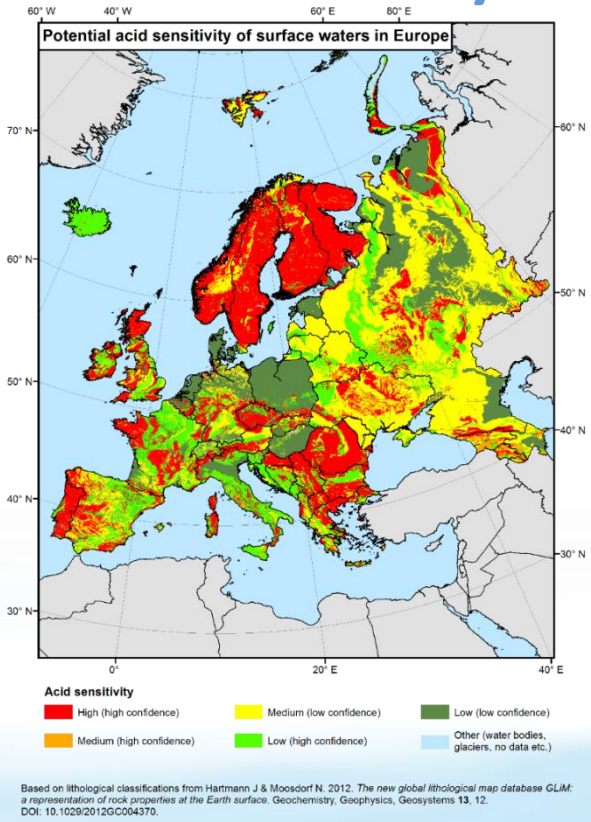
- Exceedance limited to certain regions, but large areas
- Used as background information only – good data on current status

Potentially acidified areas in Europe

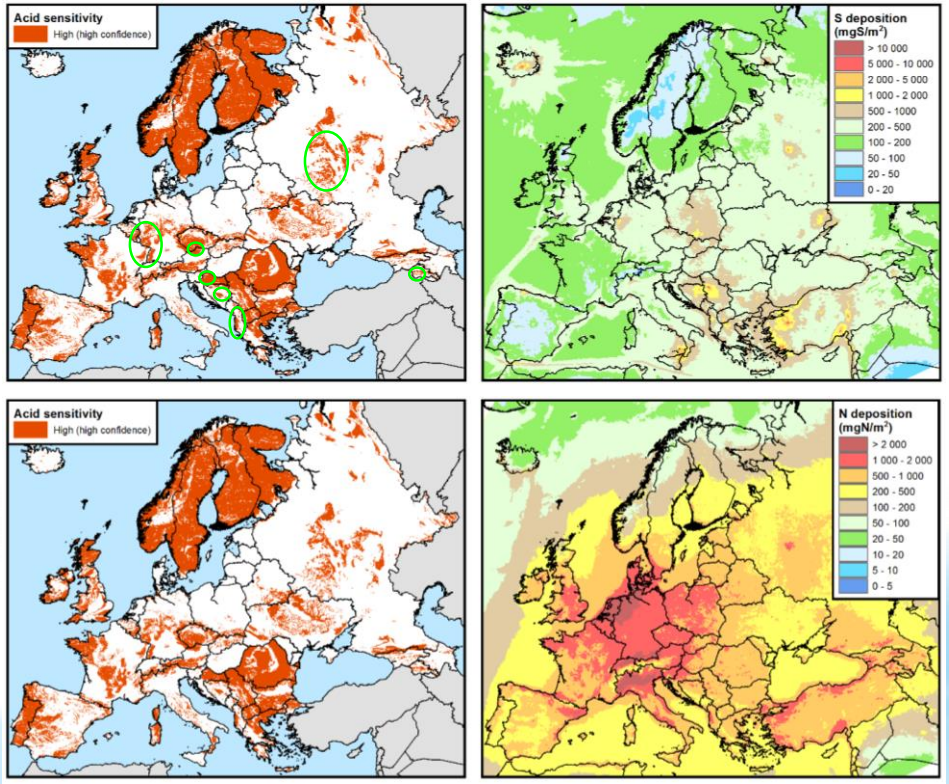
- CLs for water available from 7 countries only
- Country reports from an additional 6 countries



Potentially acidified areas in Europe

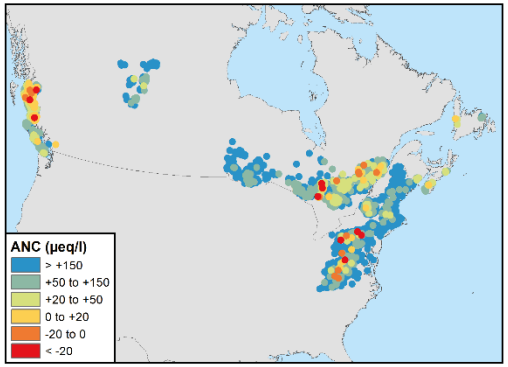


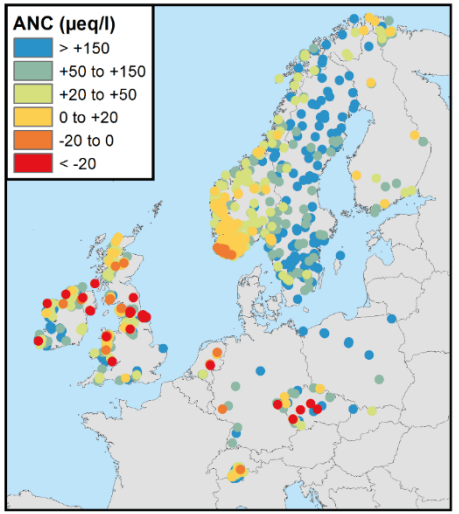
Based on lithological classifications from Hartmann J & Moosdorf N. 2012. *The new global lithological map database GLiM: a representation of rock properties at the Earth surface*. Geochemistry, Geophysics, Geosystems **13**, 12. DOI: 10.1029/2012GC004370.

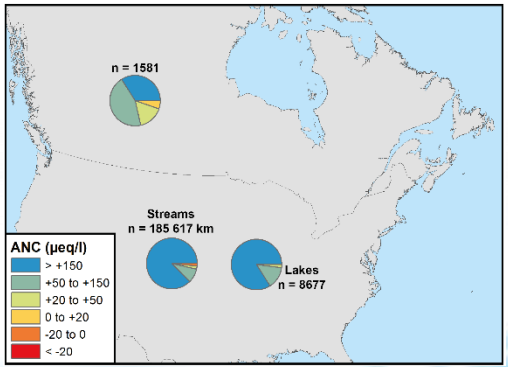


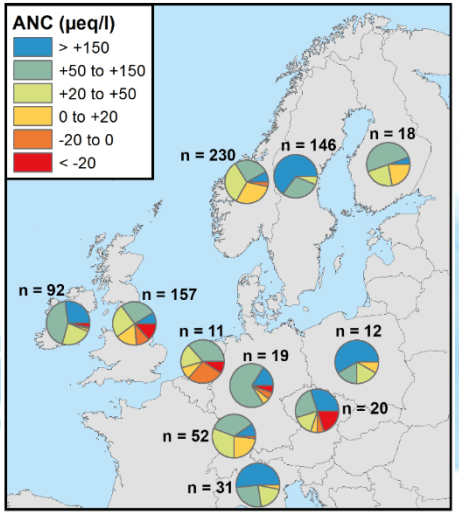
National monitoring data

- From acid-sensitive regions only
- Critical limit depends on lake/stream type
  - Usually 0-50 µeq/l
- Not directly comparable: Range from representative to targeted monitoring
- Extent vs severity
  - Regional issue and/or local hot-spots
- Acidification still widespread



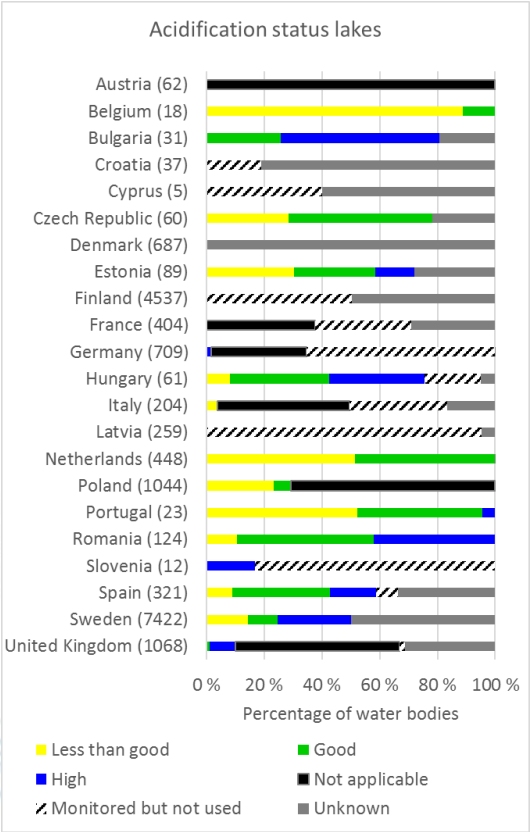






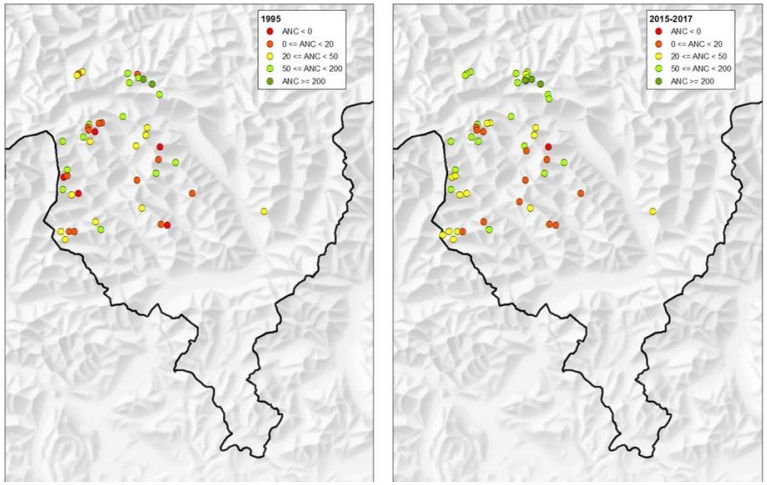
Water Framework Directive

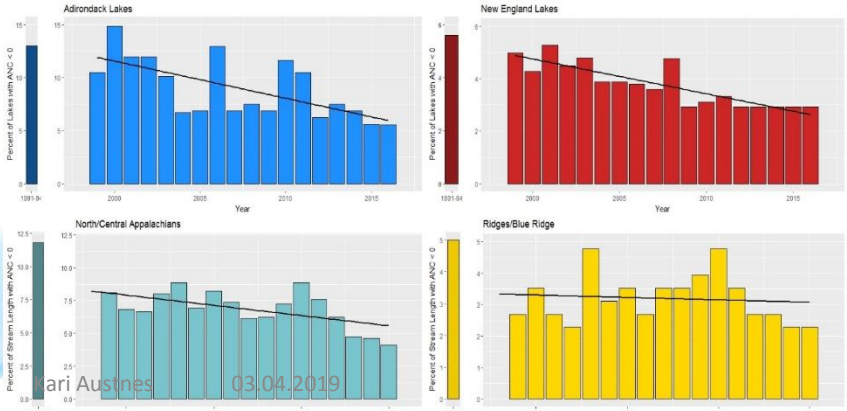
- Adresses larger water bodies
- Ambiguous and uncertain source of information on acidification status
  - Lack of reporting
  - Criteria unclear and variable
  - Mismatch information on ecological status, acidification status, acidification impact and atmospheric deposition pressure
- Limited value in assessing current extent of acidification, despite good coverage

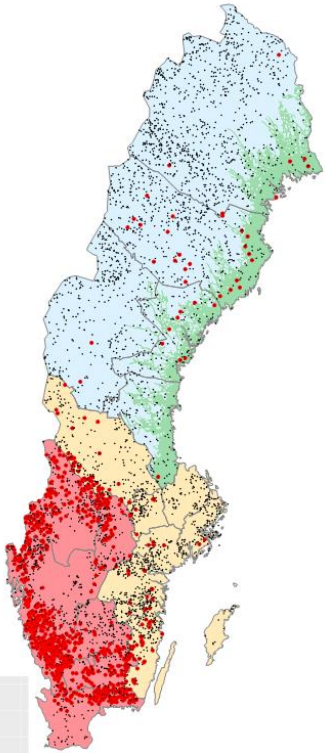


Country reports

- More detailed information on acid sensitivity
- Current status in different regions
- Case studies, trends, modelling, outlook

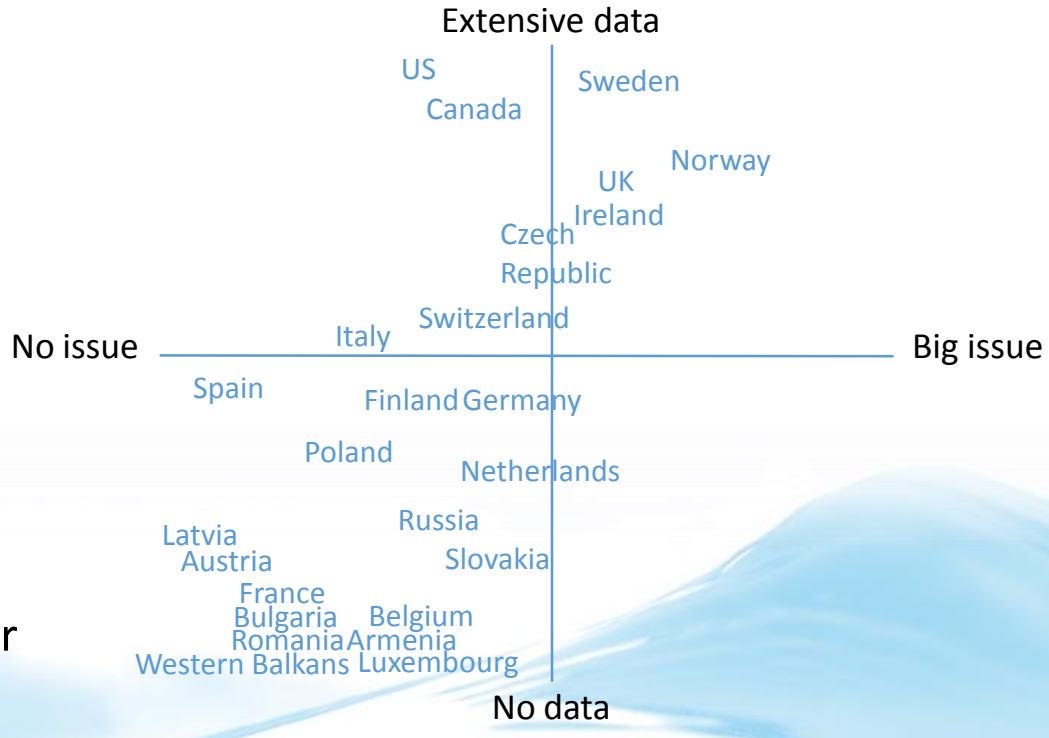






Current extent of acidification

- Rough summary across all information sources
- Potential issues in some of the countries not submitting data/reports, but limited information
  - No recent studies
  - Single studies, but no regular monitoring (?)

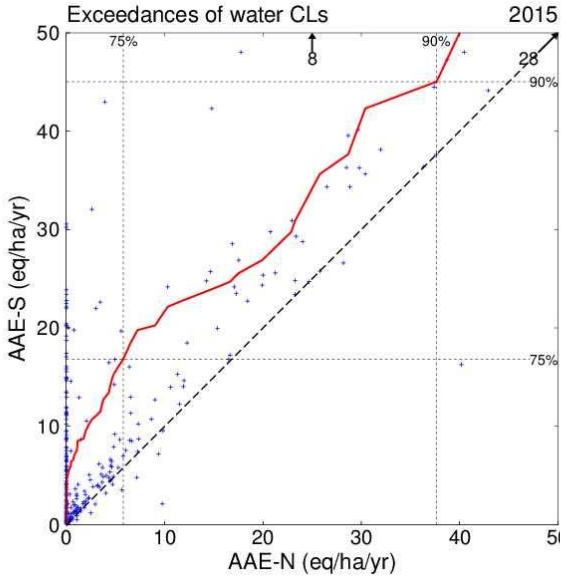


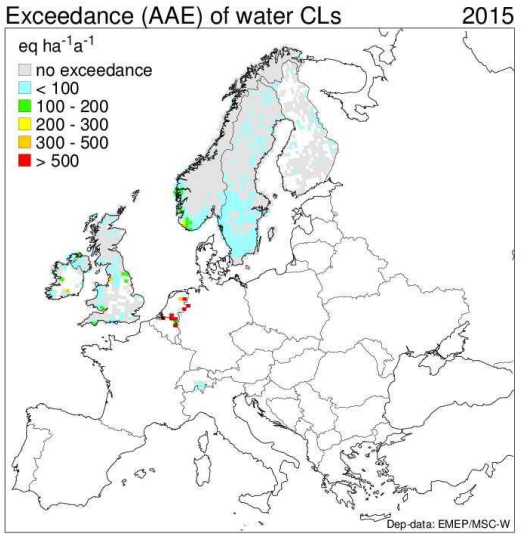
Do we have sufficient information?

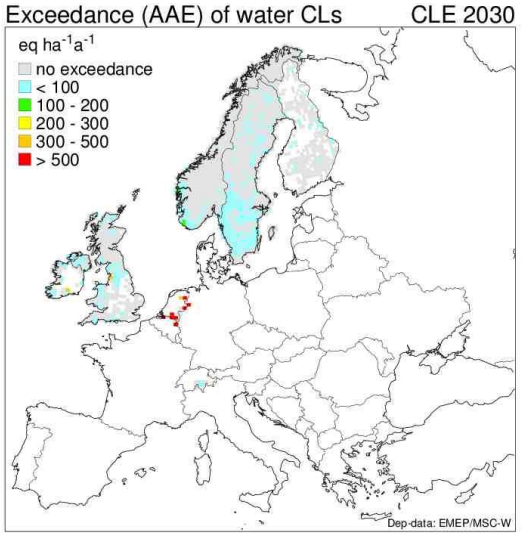
- Low/reduced monitoring in some countries
  - Large-scale surveys rare
- More information needed from identified potentially acidified regions
- WFD monitoring not sufficient
- NEC Directive monitoring essential
  - Targeted at potentially sensitive water bodies
  - Can reverse decline in monitoring

Outlook – critical loads

- CLs for water still exceeded
  - In most cases not very large exceedance
  - S dep constitutes the largest part of the exceedance
- Critical loads still exceeded in 2030
- Water CLs for more countries would be beneficial







Outlook – surface water acidification

- Recovery is observed, but is far for complete
  - Lag time in chemical recovery due to slow base cation replenishment
  - Biological recovery requires
    - Stable chemistry above critical limits
    - Species dispersal
  - Climate change and intensified forestry may counteract recovery
- Deposition below CLs will increase the *rate* of recovery
- Posch et al. 2019 ES&T (just out!): Target loads for 2050
  - Target loads lower than critical loads at 15% of the sites (n=848)
  - 5% of the sites still acidified in 2050 even if deposition reduced to zero in 2020
- Further emission reductions needed!