# ICP Waters

## International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Rivers and Lakes

# Activities and results 2012

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# ICP Waters: Programme aims

- Assess the degree and geographic extent of the impact of atmospheric pollution, in particular acidification, on surface waters
- Collect information to evaluate dose/response relationships
- Describe and evaluate long-term trends and variation in aquatic chemistry and biota attributable to atmospheric pollution

# The 27th meeting of the Programme TF, Sochi, Russia, 19-21 October 2011

- Attended by 22 experts from 14 Parties
- Reports from Programme activities 2010/2011 on major topics

# 1. New scientific findings and reports that are of particular interest for the policy part of the Convention as expressed in the LTS and elsewhere

- Results that include monetization of effects
  - Economic evaluation of damage to freshwater ecosystems and their services by long-range transported air pollution
- New findings on long term trends in relation to protocols
  - Trend results S, N, biology
  - Impact assessment – modelling the effects on surface waters

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# Ecosystem services of *oligotrophic* lakes and rivers

- Provisioning services:
  - Drinking water
  - Food supply
- Regulating services:
  - Climate regulations through sequestering and releasing a major proportion of fixed carbon in the biosphere
- Cultural services:
  - Recreation
- Supporting services (feeding into the three other types of services):
  - Biodiversity
  - Habitat

An **oligotrophic lake** is a lake with low nutrient content, low primary productivity, low algal production,, often clear waters, with high drinking-water quality – **and they are very sensitive to air pollution**

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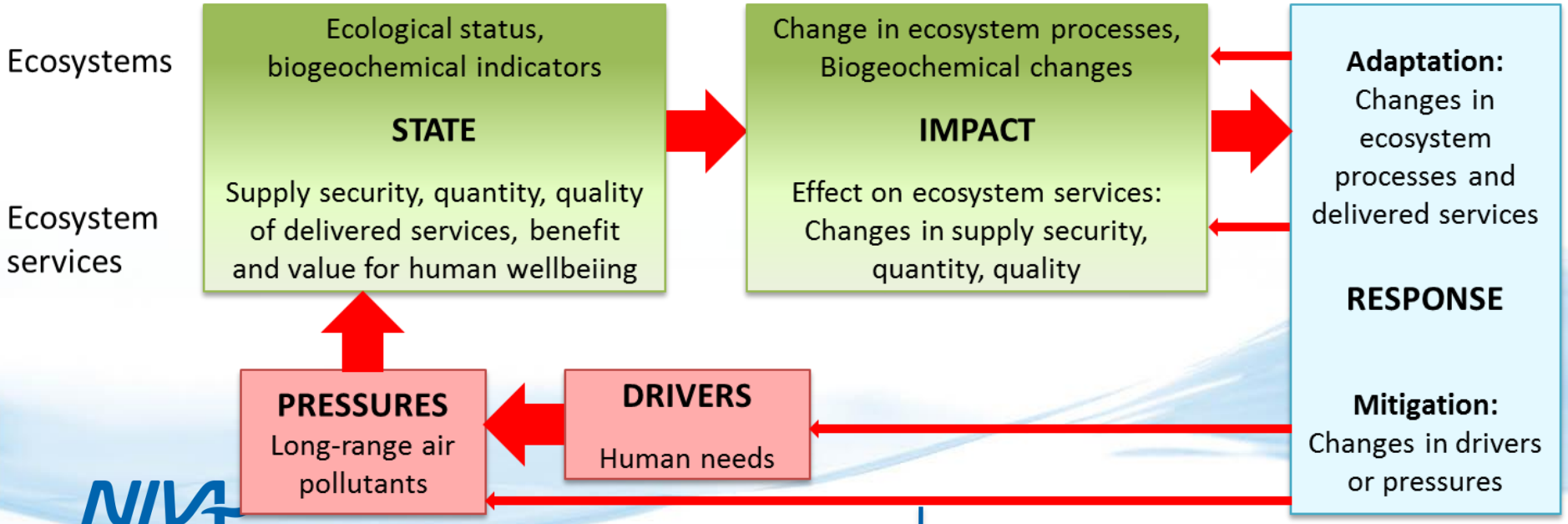
# Economic evaluation of damage to freshwater ecosystems and their services, by long-range transported air pollution

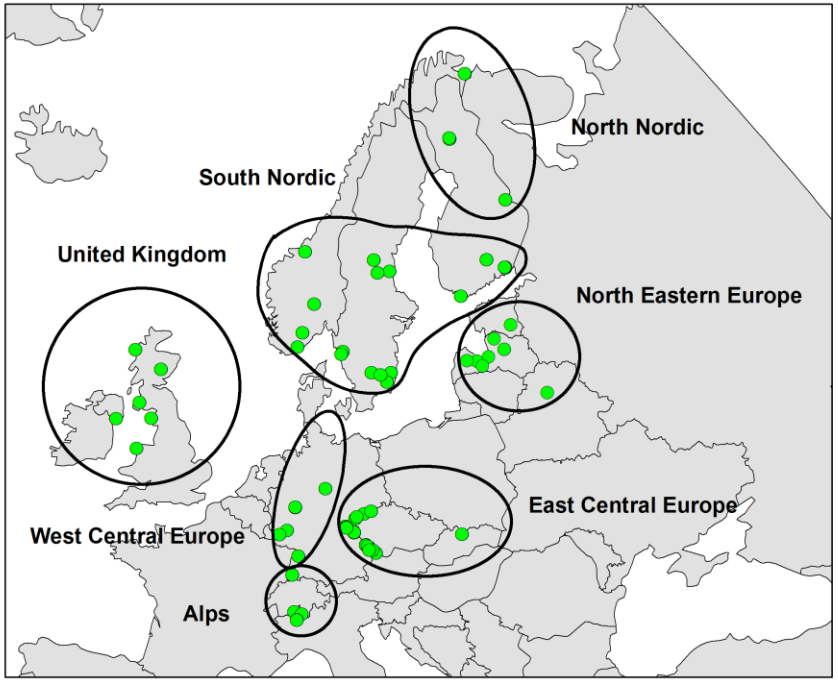
- Focus on changes in ecosystem services caused by air pollution
- A DPSIR-framework in combination with an ecosystem services approach.
- 1-2 case studies to illustrate economic impact on ecosystem services from air pollution.
- Literature review.

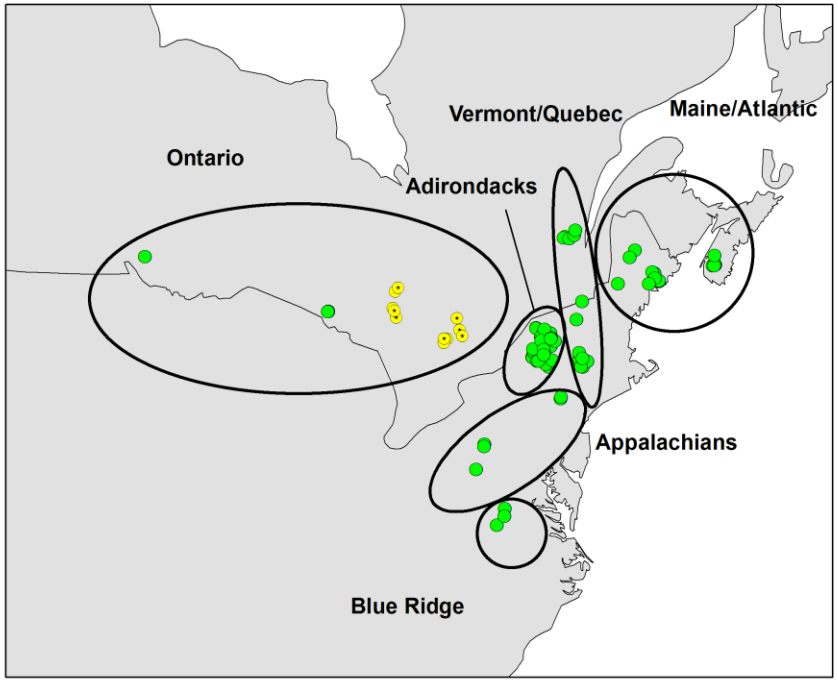


# Trends in surface water chemistry and biology

# Trends in surface wate chemistry and biota

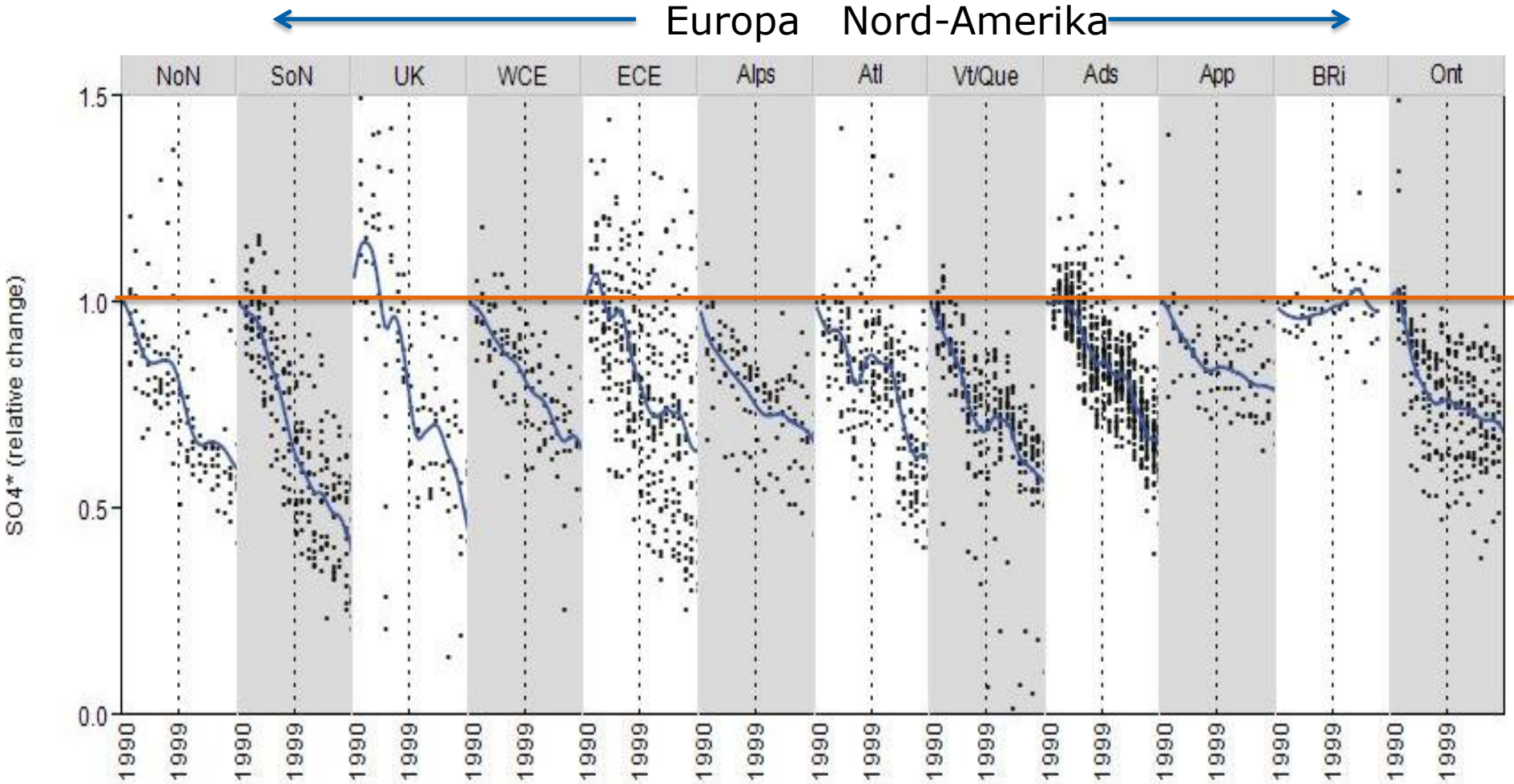
Approx 200 sites in 15 countries in Europe and North America with long-term data for trend analysis



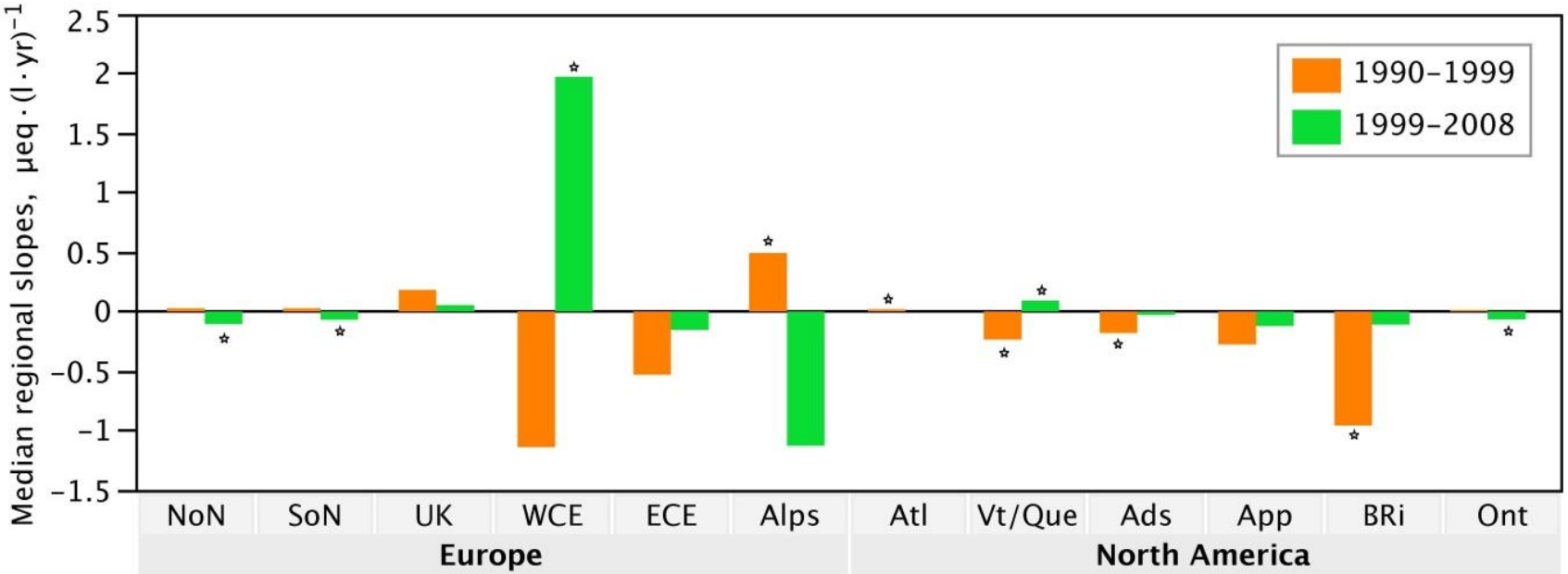



# Decrease in sulphate in all areas in Europe and North America 1990-2008

- Decrease larger in 1990-1999, than 200-2008



# Nitrate show no regional pattern. Most areas show no change



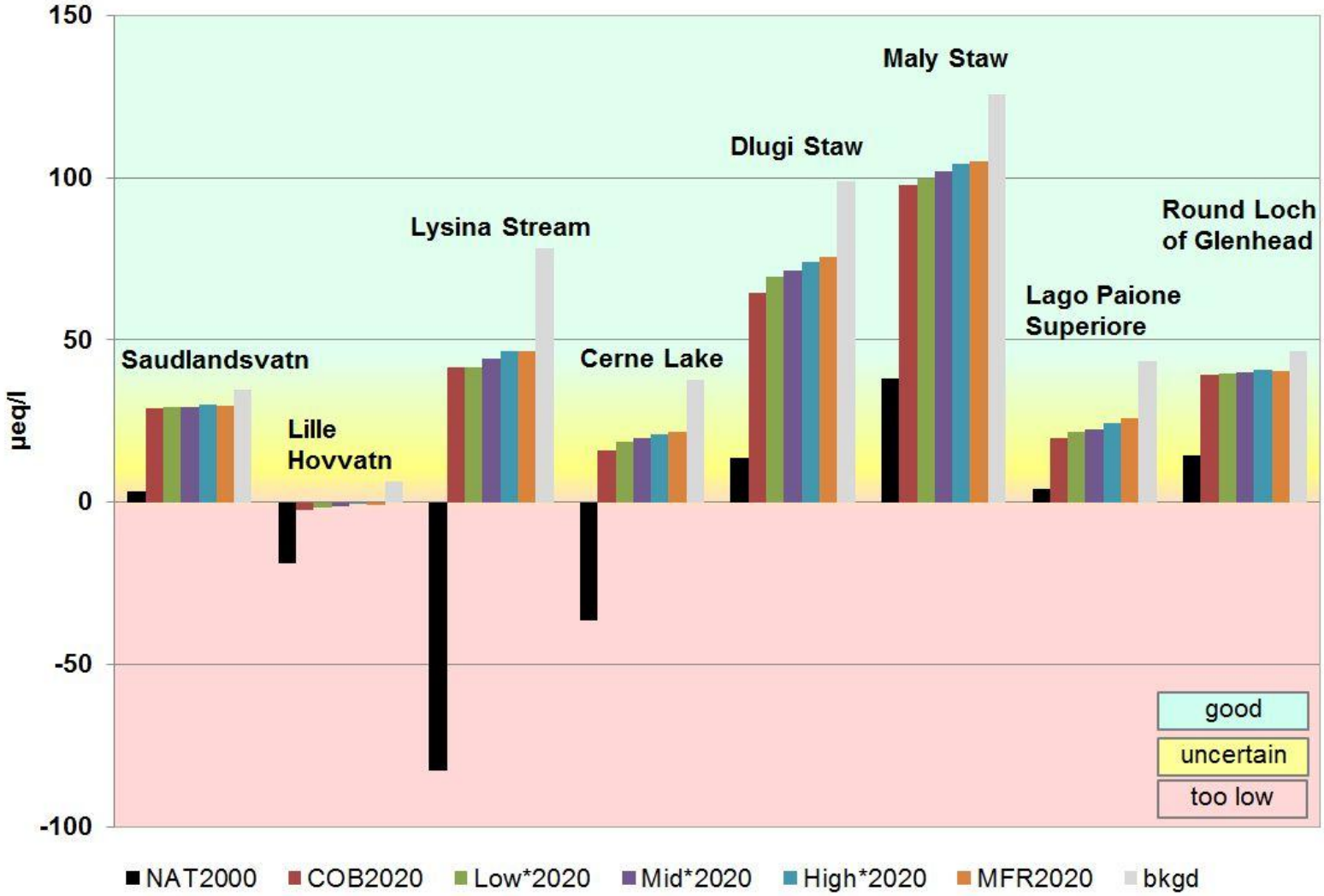

| | $NO_3$ | |
|---|---|---|
| | 90-99 | 99-08 |
| % increasing | 8 | 8 |
| % insignificant | 78 | 77 |
| % decreasing | 14 | 16 |

# Main results from the trend analysis on chemistry and biology

- Improvements in acidification of surface waters are related to lower acid deposition
- Reductions in precipitation are larger and quicker than the observed improvements in water chemistry
- Increase in pH, alkalinity and ANC indicate that biological recovery can be expected
- Biological recovery is documented in many regions in Europe
  - Full recovery is not documented anywhere.
  - A return to pre-industrial biodiversity is unlikely
- Future reductions of both S and N deposition would be necessary to achieve biological recovery not influenced by acidification.

# Impact analysis on 8 ICP Waters sites

At all but the most acid sensitive, ANC will increase to levels above the critical level for biological damage under the different secnarios

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# 3. Interactive effects with other problems (nitrogen/biodiversity, climate change etc.)

- Combined effects of climate change and air pollution on aquatic biodiversity
- Effects on biota (biodiversity) of direct N-load on lakes

# Effects of air pollution (and climate change) on aquatic biodiversity

## Trends in biodiversity of freshwater **benthic animals** through time

- Biodiversity is in general decreasing in the world
- In order to stop the loss, it essential to understand how human influence is affecting biodiversity
- We ask:
- *Are there common trends in diversity through time?*
- *What are the chemical/ environmental cues responsible for the observed patterns?*

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- **Ongoing work – preliminary results**

Sampling in Stryn 2007. Photo: A.

# Databasis for analysis

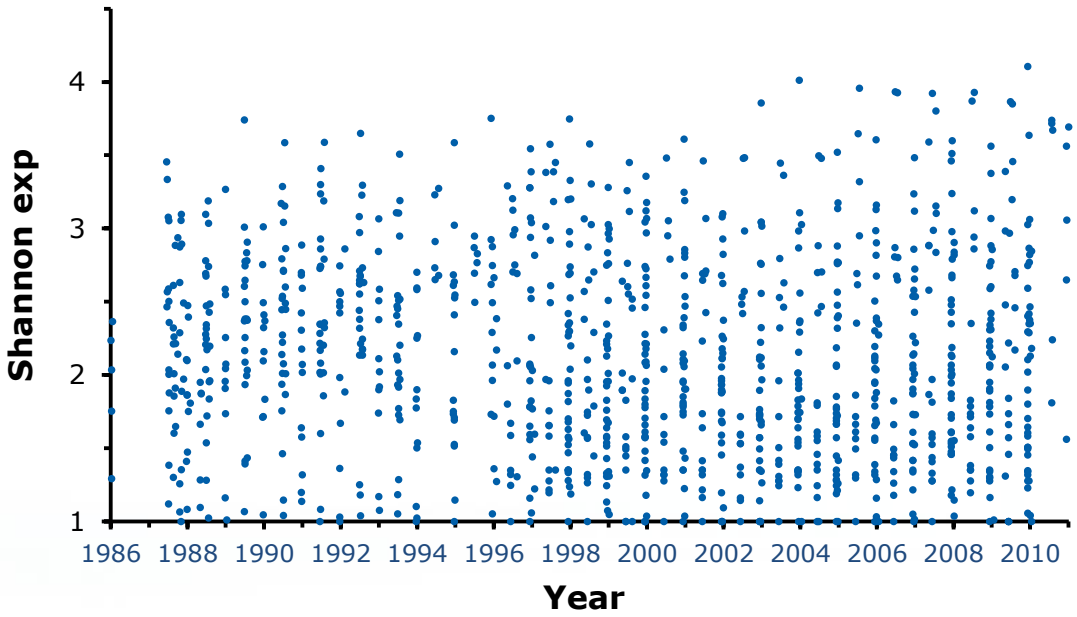
- Benthic invertebrates from five countries sampled in streams and lakes between 1981 and 2011
- Approx 1,5 million animals in 4450 samples
- Chemical data of the water are measured for the same sites and periode

| | Rivers | Lakes | Number of samples |
|---|---|---|---|
| **Germany** | 29 | 0 | 929 |
| **Latvia** | 5 | 1 | 67 |
| **Norway** | 3 | 20 | 2674 |
| **Sweden** | 6 | 21 | 637 |
| **UK** | 0 | 7 | 142 |

# Lakes

**Preliminary results**

No significant change in biodiversity from 1986 to the present



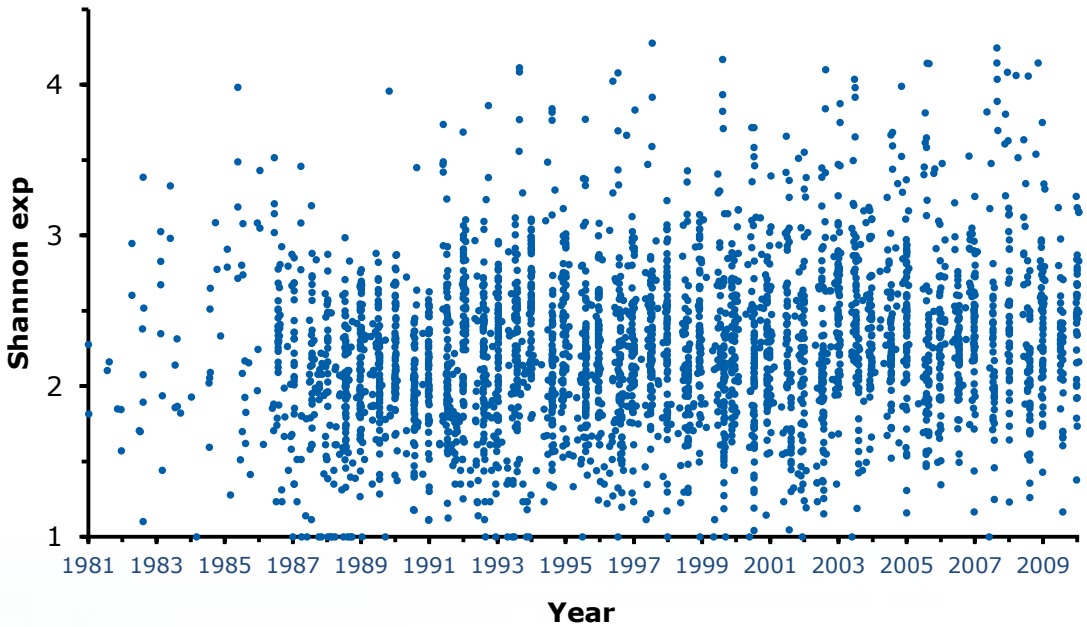


Biodiversity is measured as the effective number of species present (Shannon$^{exp}$)

# Streams and rivers

**Preliminary results**

Maybe a slight increase in biodiversity from 1981 to 2010




**Preliminary results**

# Drivers of biodiversity in lakes

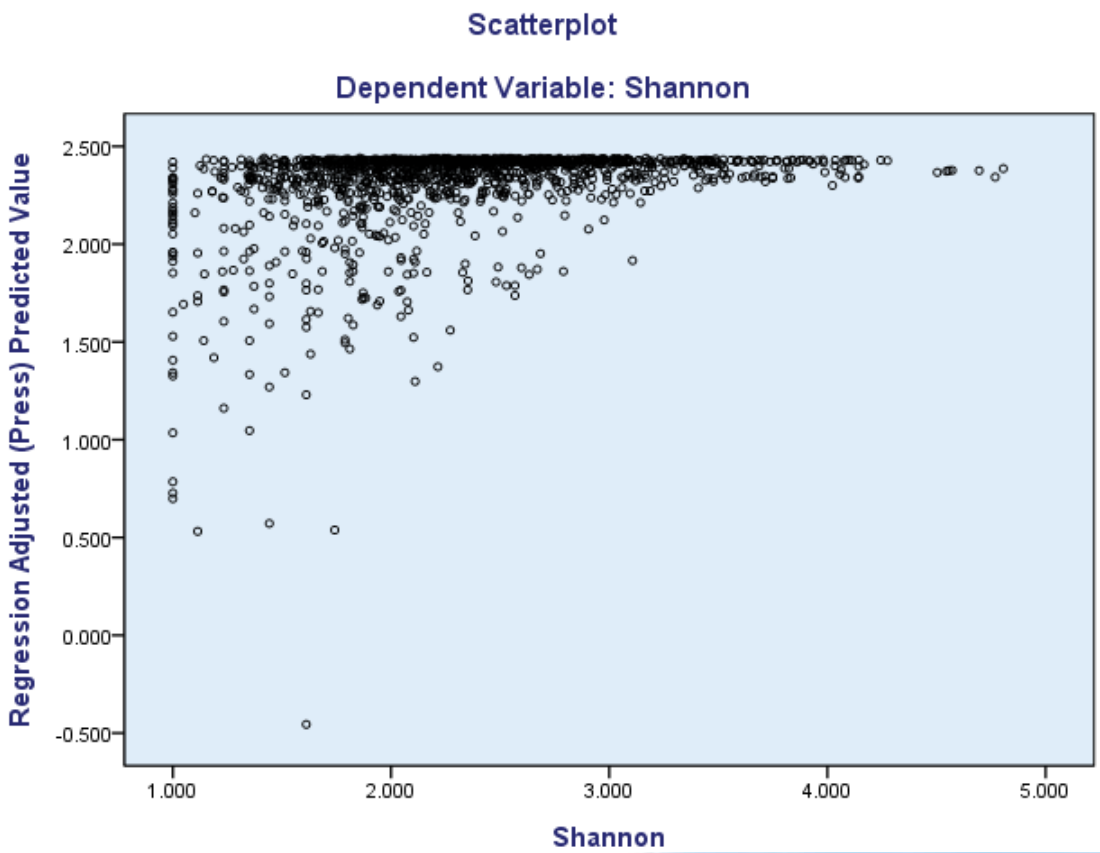
- **Total nitrogen** is a weak, but significant variable explaining biodiversity of lakes.
- Many previous studies suggest that **temperature** and **nutrient status** (including nitrogen) are important.


**Preliminary results**

# Drivers of biodiversity in rivers

- In streams and rivers, **sulphate** is a highly important variable for driving changes in diversity

- 9% of the changes in diversity is attributed to changes sulphate concentration ($p<0.000$)




*High diversity only occur in low sulphate streams*

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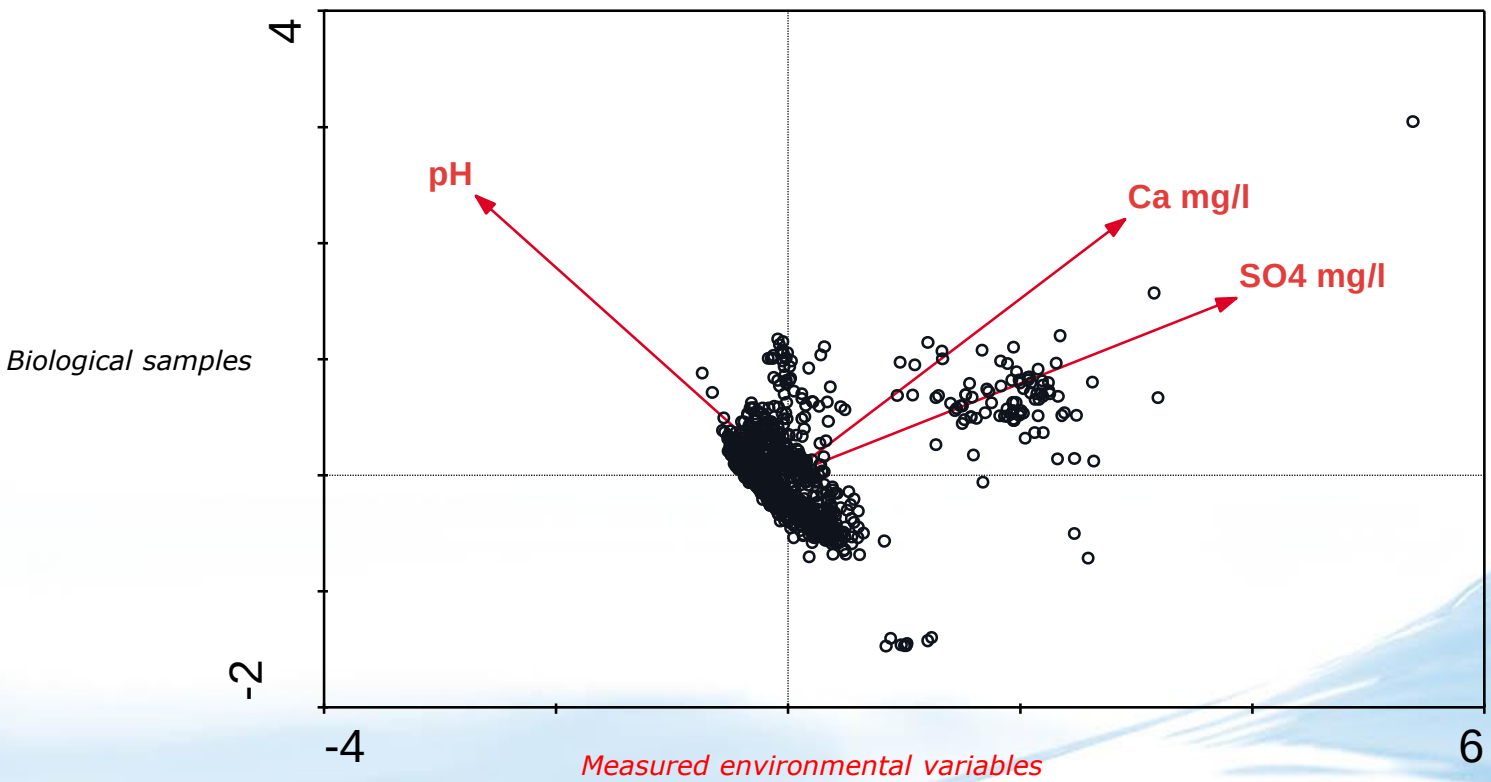
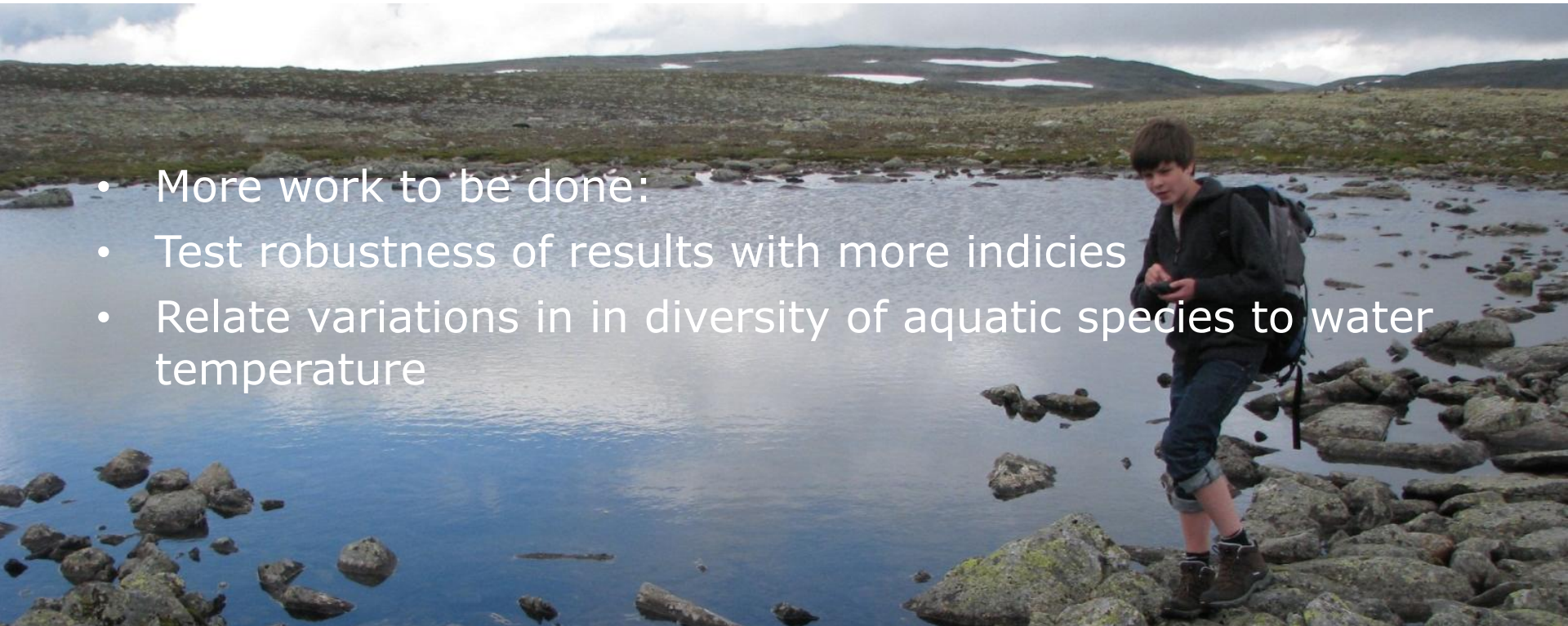
**Preliminary results**

# Example:
# 40% of the species distribution in German streams can be explained by pH, Ca and $SO_4$



# Biodiversity work is ongoing!
# **Preliminary results!!**

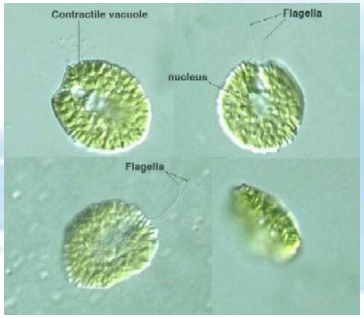
- Preliminary results show that the biodiversity of inland waters has remained stable during the last 30 years – Good news ☺
- Maybe a slight increase in biodiversity in running waters
- Variability in biodiversity can best be explained by changes in sulphate, pH and Ca, and to some extent nitrogen



- More work to be done:
- Test robustness of results with more indicies
- Relate variations in in diversity of aquatic species to water temperature

# N-deposition on nutrient poor lakes has an effect on biota

- Atmospheric N deposition leads to N-enrichment of oligotrophic lakes in arctic, alpine and boreal regions
- Evidence from paleolimnology, whole-lake and smaller scale experiments, regional surveys of biological effects
  - Increased productivity
  - Shifts in algal communities
  - Loss of rare macrophyte species, increase of other (nuisance) species
  - Data scarcity on effects on benthic algae and effects at higher trophic levels

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# 3. Engagement of parties, in particular the EECCA countries

- Armenia
  - Good contact, but struggel to fund work
- Russia
  - Close cooperation.
  - Project on water chemistry in Russia


Water chemistry in small lakes along a transect from boreal to arid ecoregions in European Russia; effects of air pollution and climate change
*Moiseenko T.I., Skjelkvåle B.L., Cashkina N.A., Shalabodov A.D., Khoroshavin V. Yu.*

# 4. Collaboration with other organizations within and outside the Convention

- LTER Europe (Long-term Ecological Research Sites)

- EU Water Framework Directive
  - is a EU Directive which commits EU member states to achieve good qualitative and quantitative status of all water bodies by 2015

- EU-projects
  - :(

# Next ICP Waters Task Force meeting

Pallanza, Italy

8-10 October 2012

Welcome!