

EFFEKTER AV KLIMATFÖRÄNDRINGAR PÅ SJÖPRODUKTIVITET

Jan Karlsson

Climate Impacts Research Centre (CIRC)

Dept. Ecology and Environmental Science (EMG), Umeå university



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www.arcticcirc.net



CLIMATE IMPACTS RESEARCH CENTRE



POLARFORSKNINGS
SEKRETARIET

SWEDISH POLAR RESEARCH SECRETARIAT



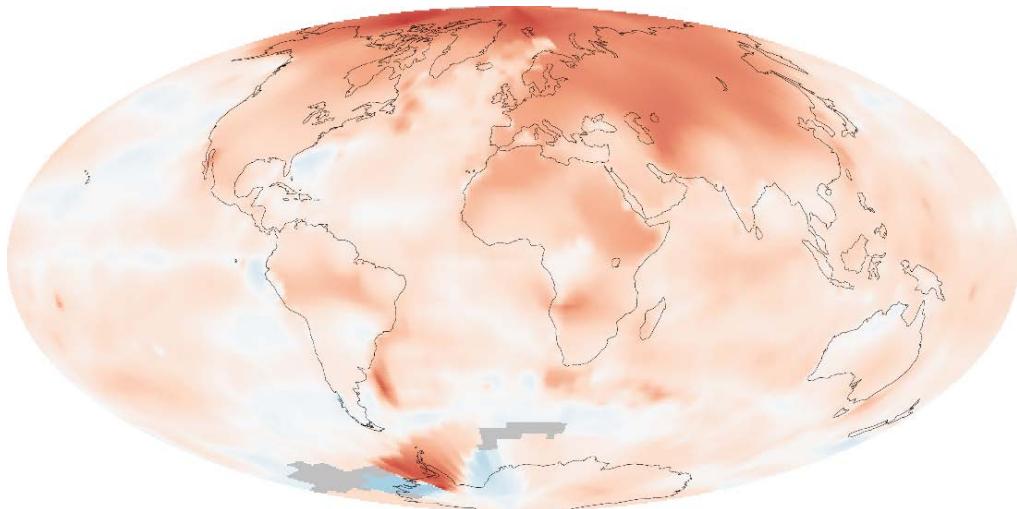
The Climate Impacts Research Centre is based at the
[Department of Ecology and Environmental Sciences](#)



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Kraftig uppvärmning i norr

Hittills

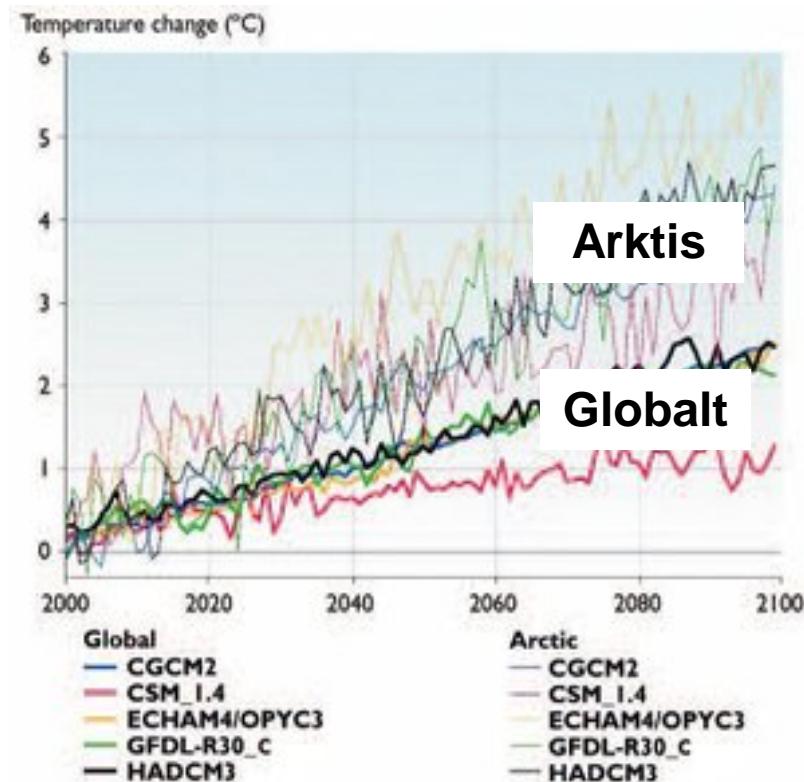


Temperature Anomaly ($^{\circ}\text{C}$)

-2 -1 0 1 2

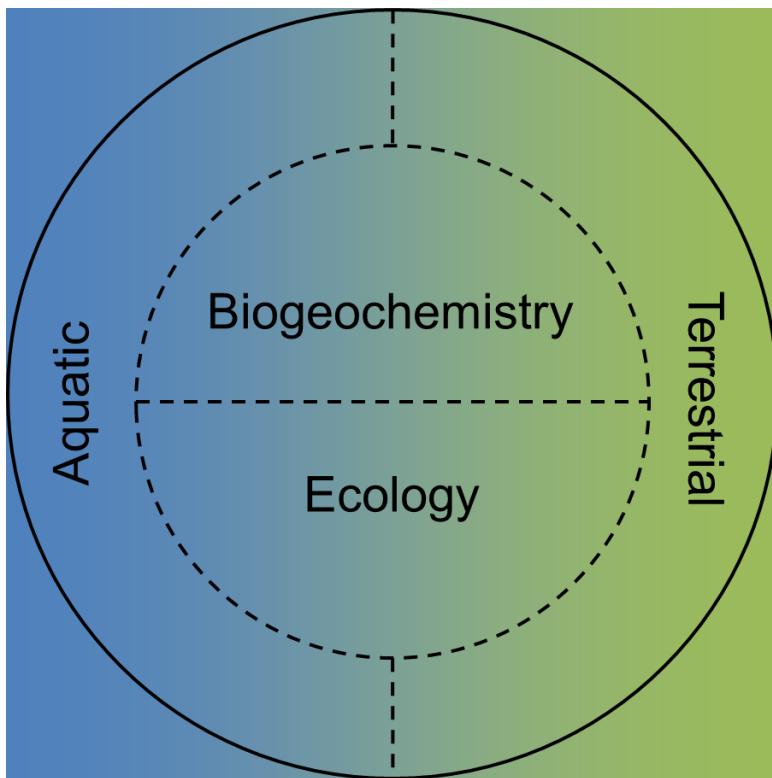
2000-2009 vs 1951-1980

Framtiden

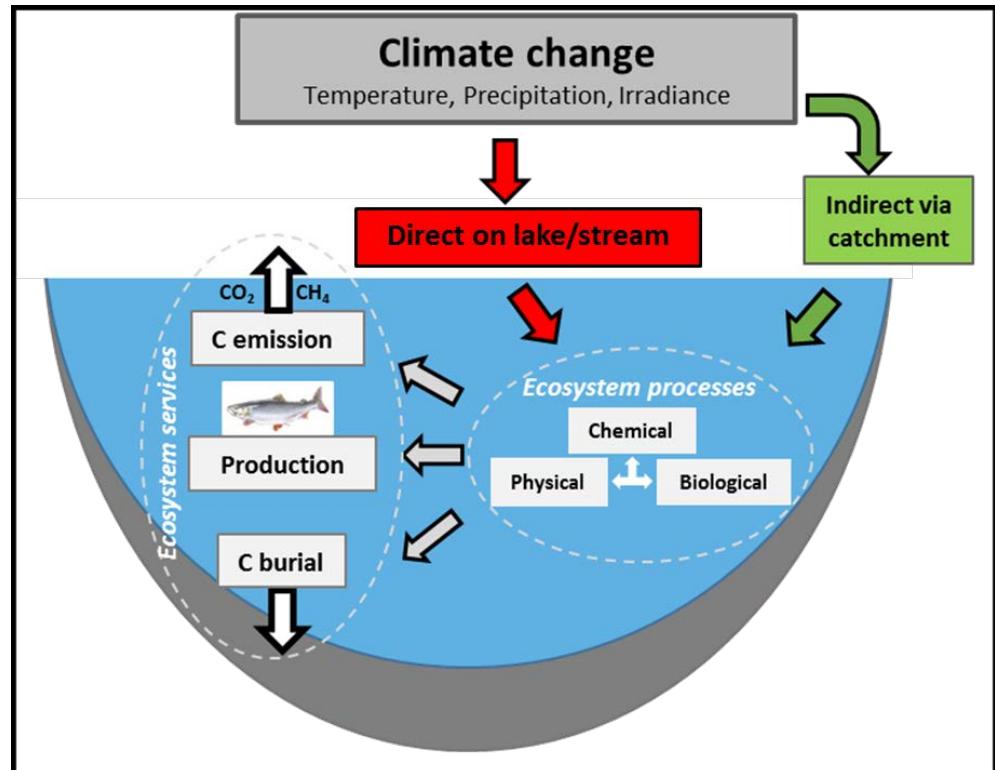


Integrerad forskning över olika vetenskapliga discipliner

-Viktigt för att förstå och prediktera effekter av klimatförändringar-



Klimateffekter på sjöekosystem beror på direkta och indirekta effekter



High latitude lakes numerous and diverse

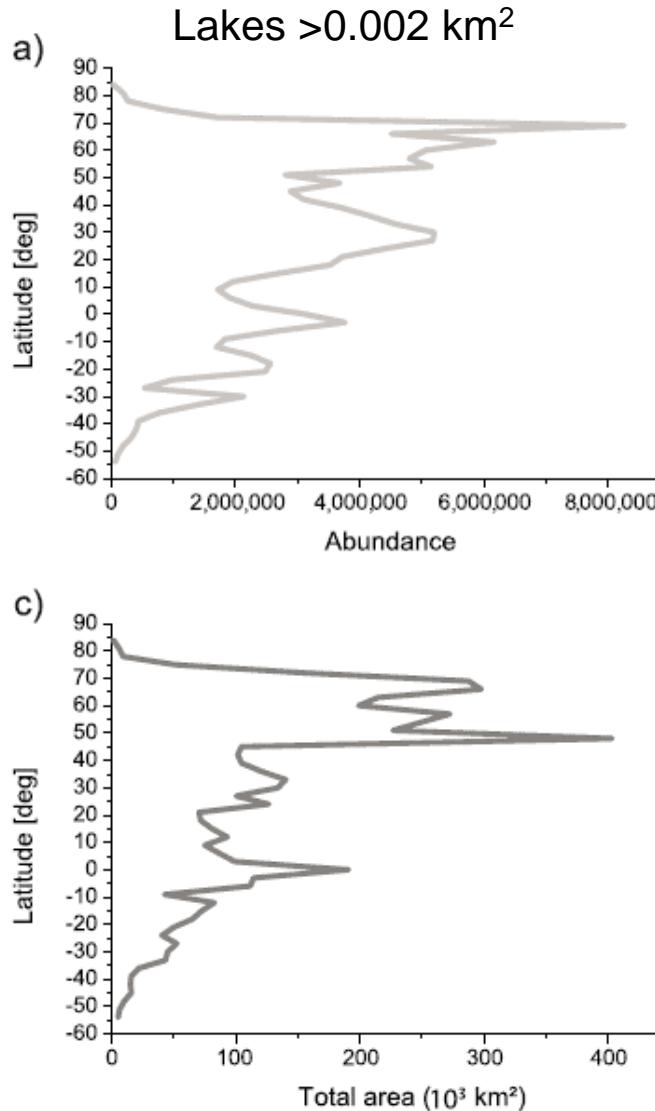


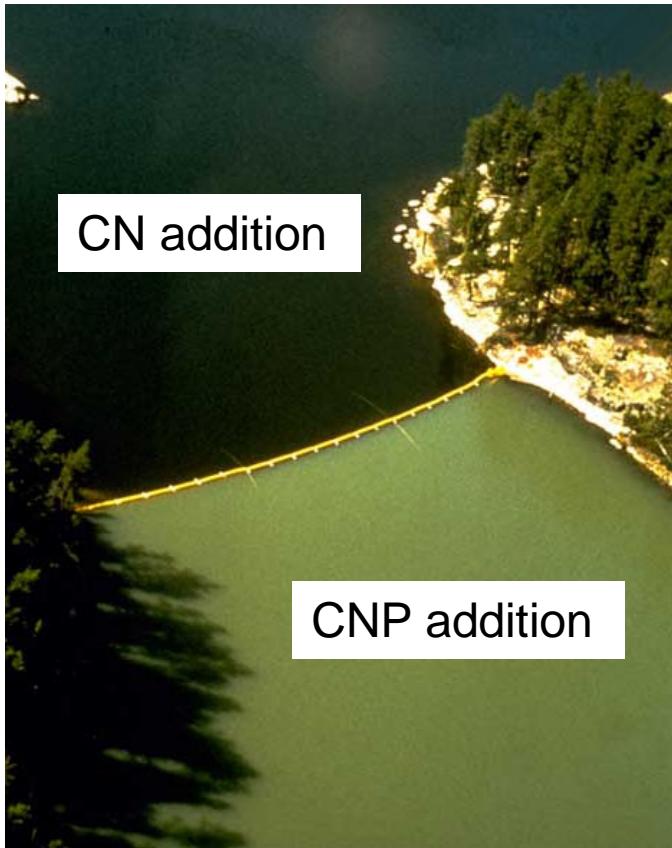
FIGURE 1. Photos of ponds studied. a) Resolute rock ponds, b) Kilpisjärvi tundra ponds, c) Zackenberg tundra pond, d) polar desert pond in the Ward Hunt Island region, e) Mackenzie thaw ponds, and f) BGR site thaw ponds.

Vad kontrollerar sjöproduktivitet?

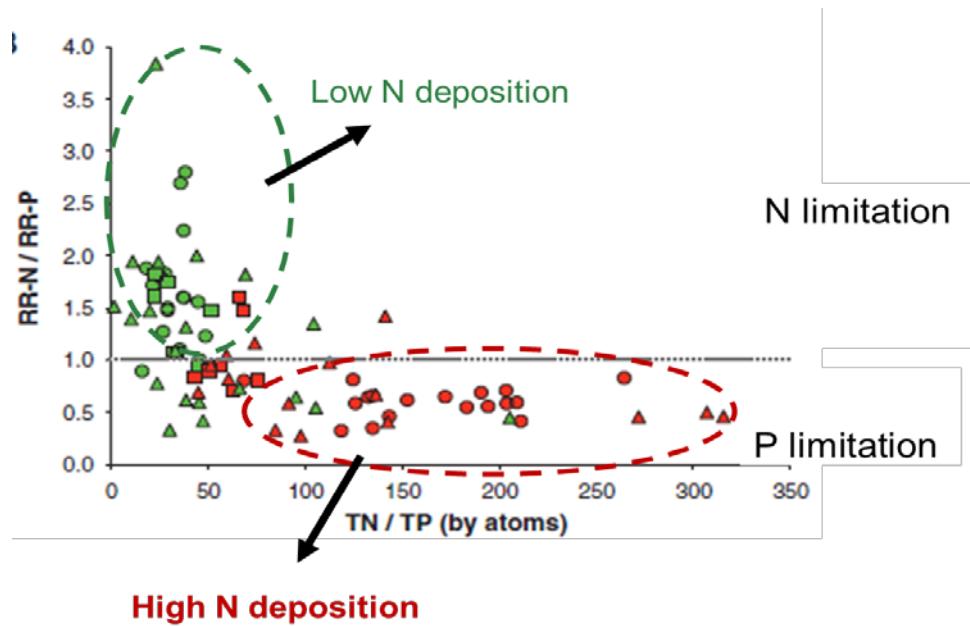
The P limitation paradigm is questioned

- N rather than P limited phytoplankton in many natural lakes
- Phytoplankton does not always dominate whole lake production

P limitation paradigm



N limited phytoplankton in natural lakes

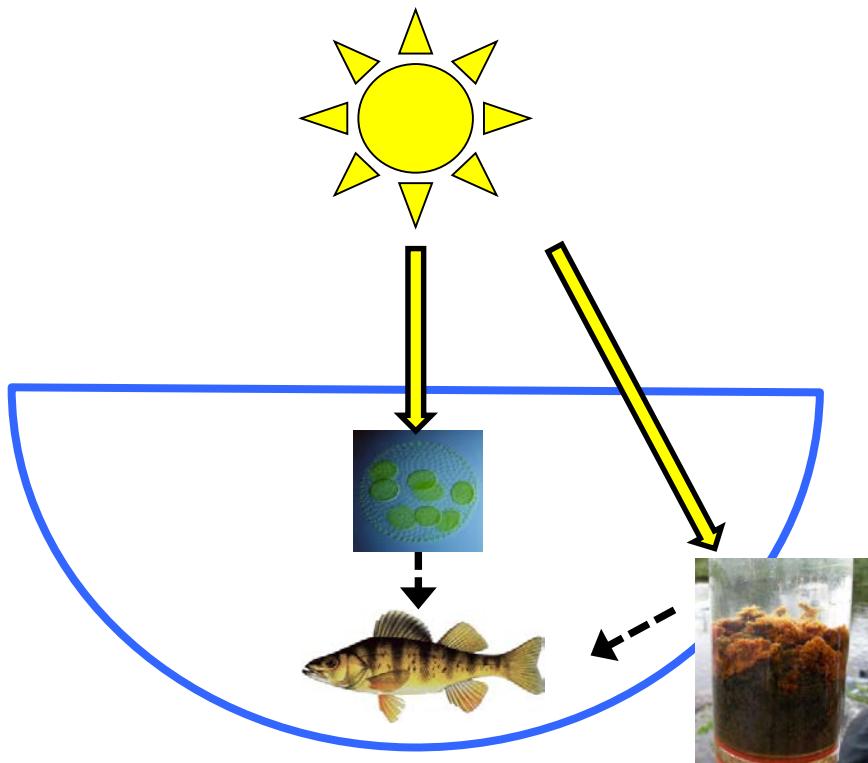


Elser et al. 2009 Science

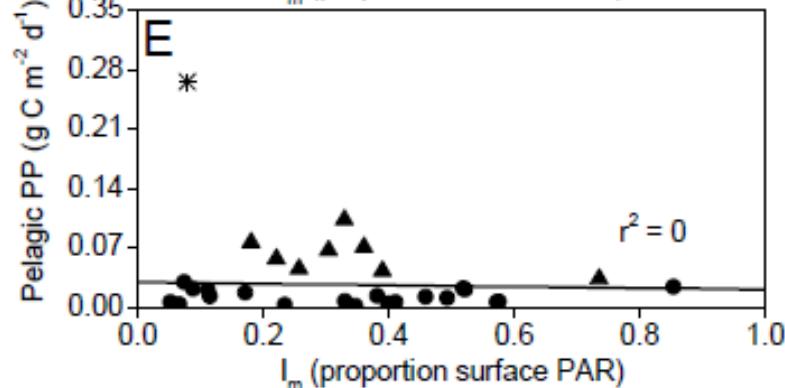
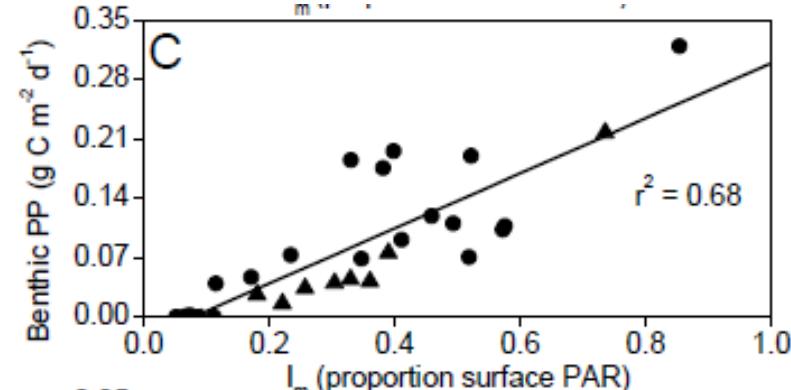
Vad kontrollerar sjöproduktivitet?

The P limitation paradigm is questioned

- N rather than P limited phytoplankton in many natural lakes
- Phytoplankton does not always dominate whole lake production
- Benthic algae mainly limited by light



Boreal-Arctic lakes

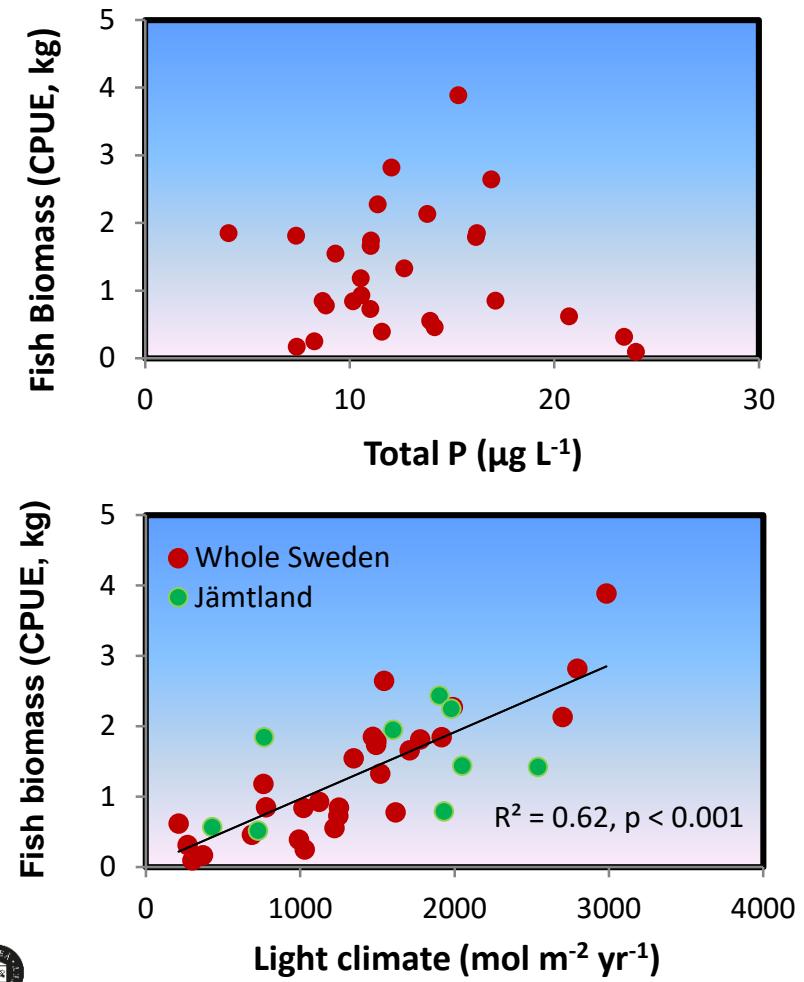


Ljus, inte näring, kontrollerar fisk produktion

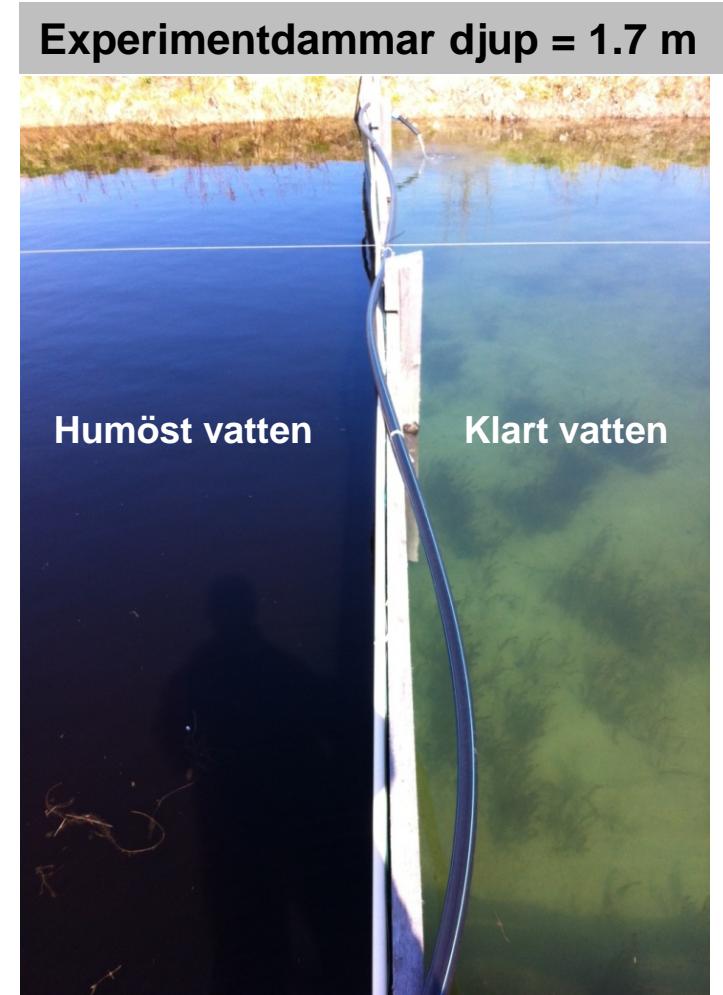
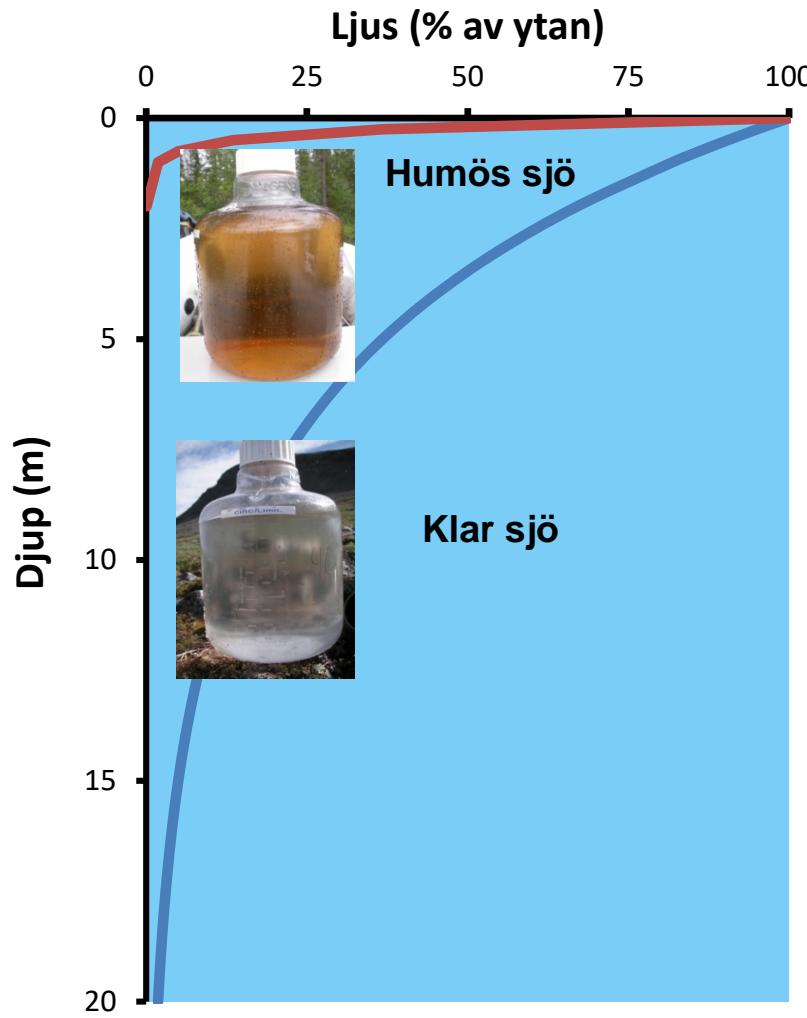
Gradient study



Karlsson et al. 2009 Nature, unpubl.

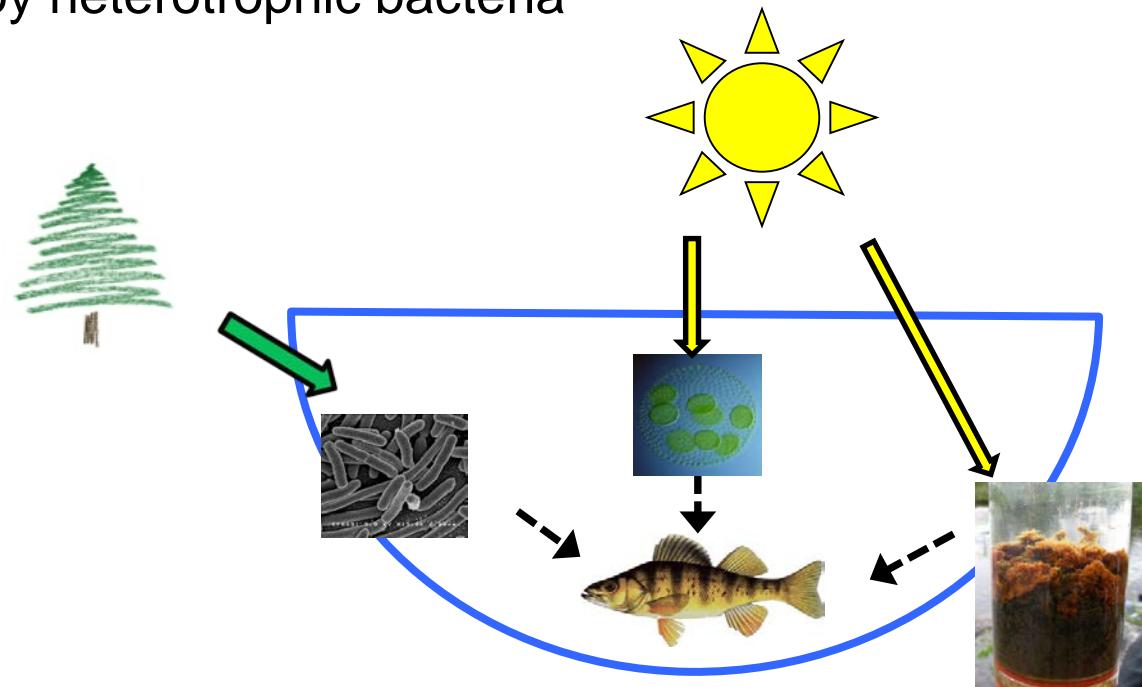


Organiskt material från land påverkar ljuset i sjöar

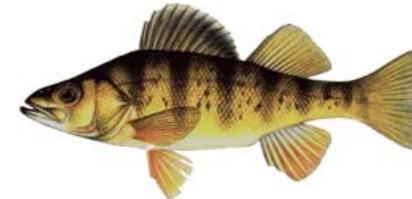
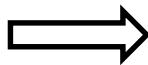


Terrestrial OM affect biomass production in lakes

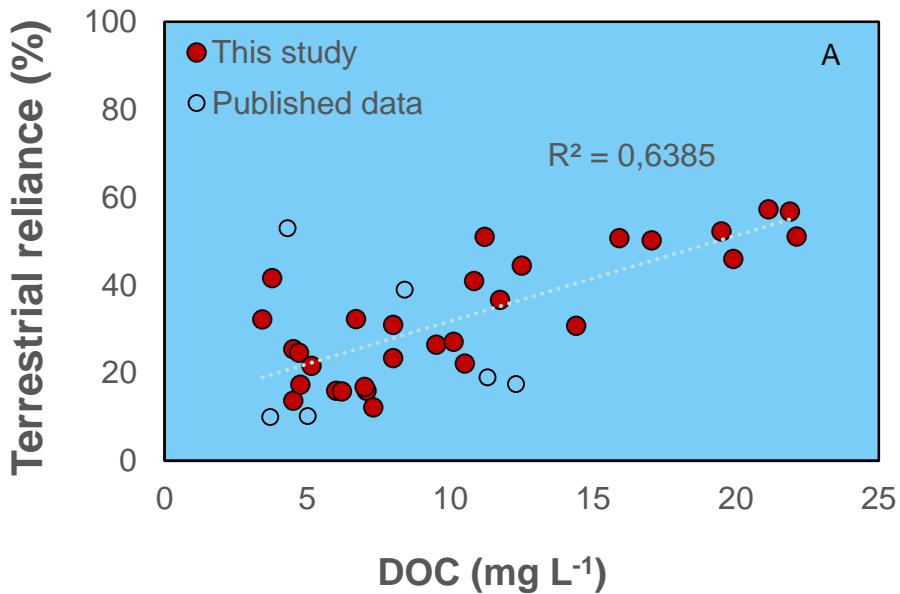
- Positive and negative effects on primary production
 - Decreasing the light climate in lakes (-)
 - Increasing bacterial nutrient uptake and hence competition for nutrients (-)
 - UV protection (+)
 - Increase CO₂ availability in the water (+)
- Used by heterotrophic bacteria



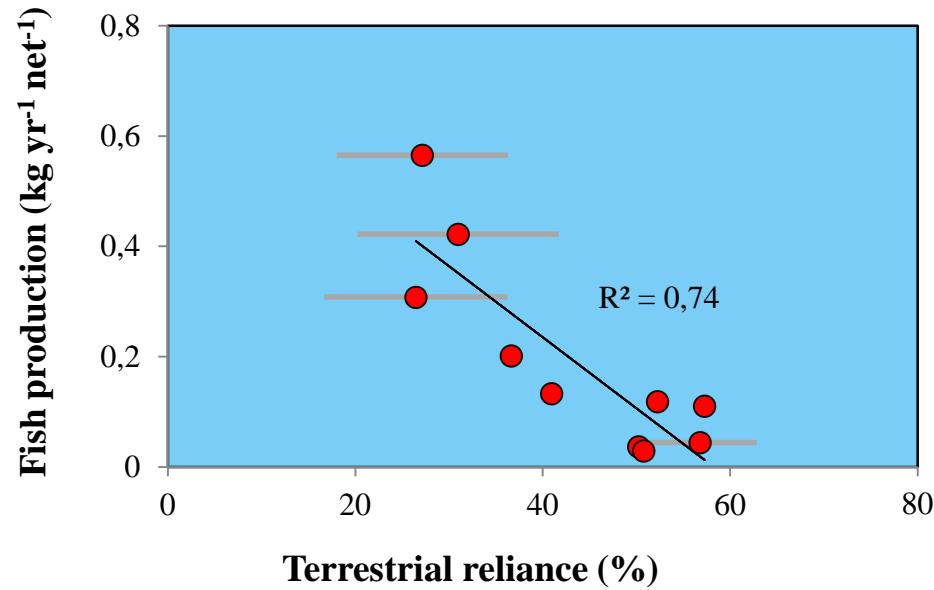
Fish are made of trees



Increase with input of
coloured terrestrial OM



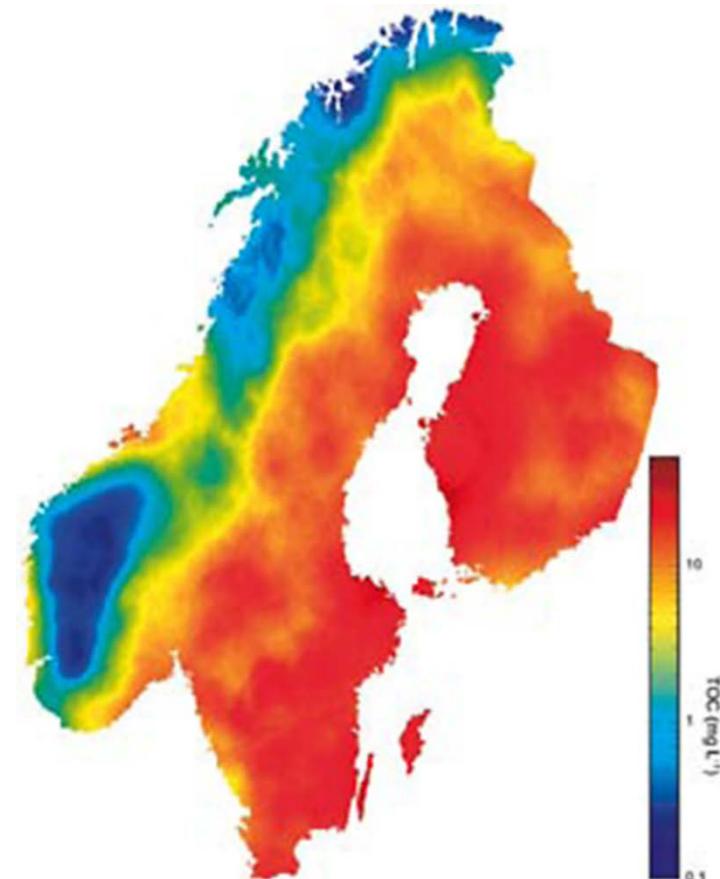
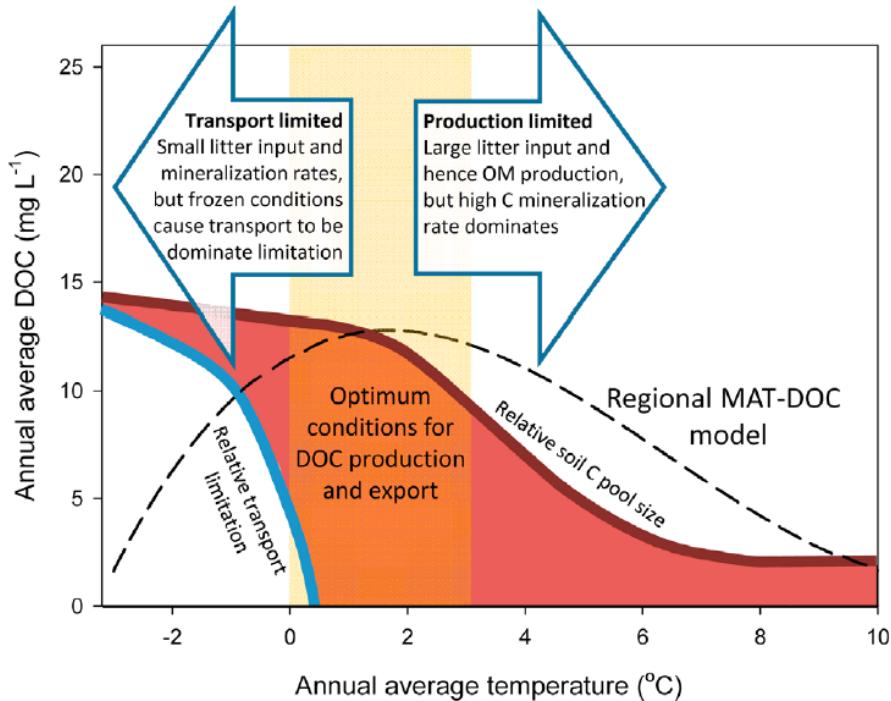
Use of terrestrial OM can not
compensate for negative effects



Terrestrial OM export vary over space and time

Depend on

- Temperature & Runoff
- Permafrost
- Vegetation, land use
- Acid deposition

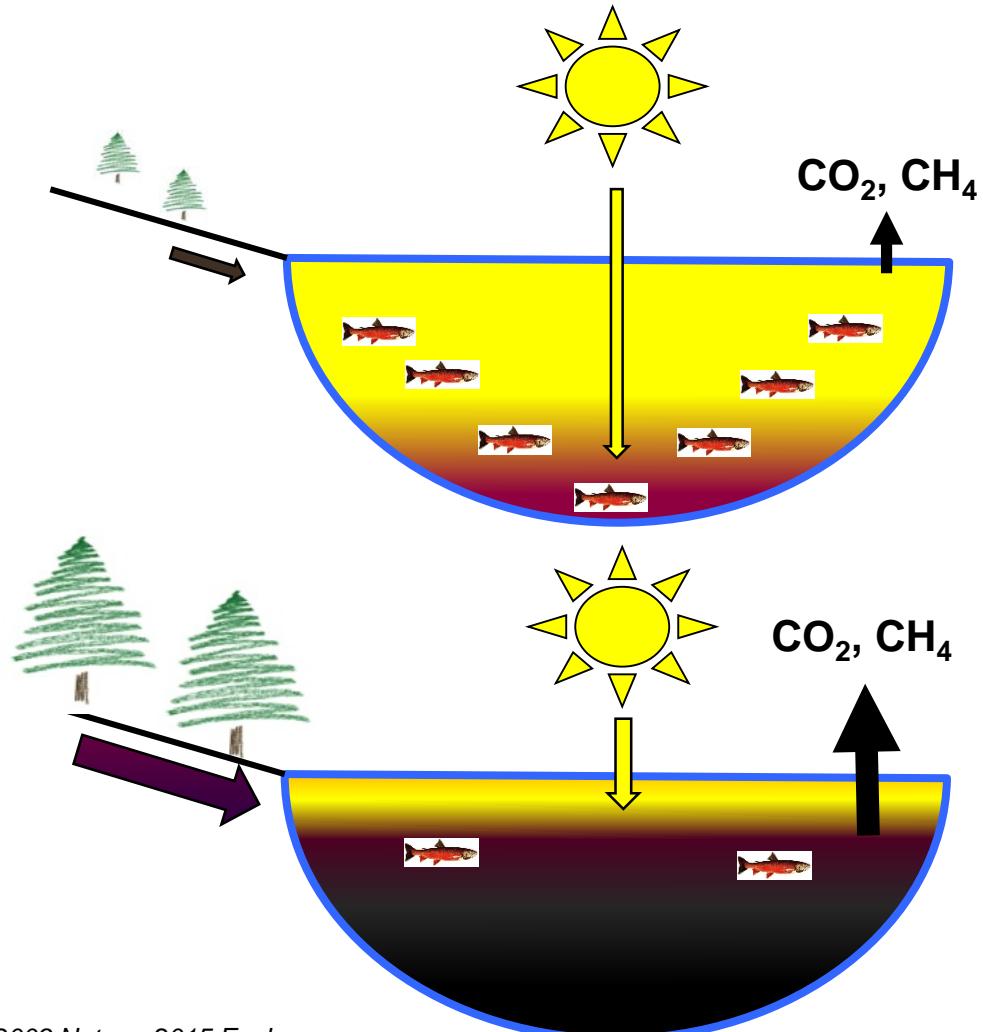


Uppvärmning har stor påverkan på sjöar

- Minskad fiskproduktion
- Ökade utsläpp av växthusgaser



Brunifiering



Karlsson et al. 2009 *Nature*, 2015 *Ecology*,
Lundin et al. 2015 *Scientific reports*, Hotchkiss et al. 2015 *Nature Geoscience*



Management of arctic lakes in a changing climate

Collaboration between Umeå University and county boards

Umeå University

Pär Byström, Anki Bergström, Jan Karlsson, Sven Norman, David Seekell

County boards

Jens Andersson (Jämtland)

Torleif Ericsson (Västerbotten)

David Bell (Norrbotten)



Länstyrelsen
Jämtlands län



Länstyrelsen
Västerbotten



Länstyrelsen
Norrbotten



Forskningsrådet
Formas

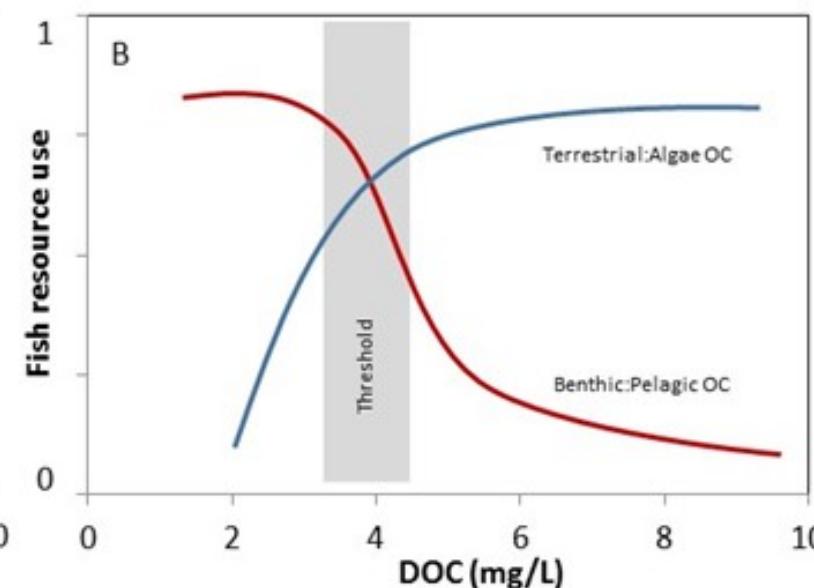
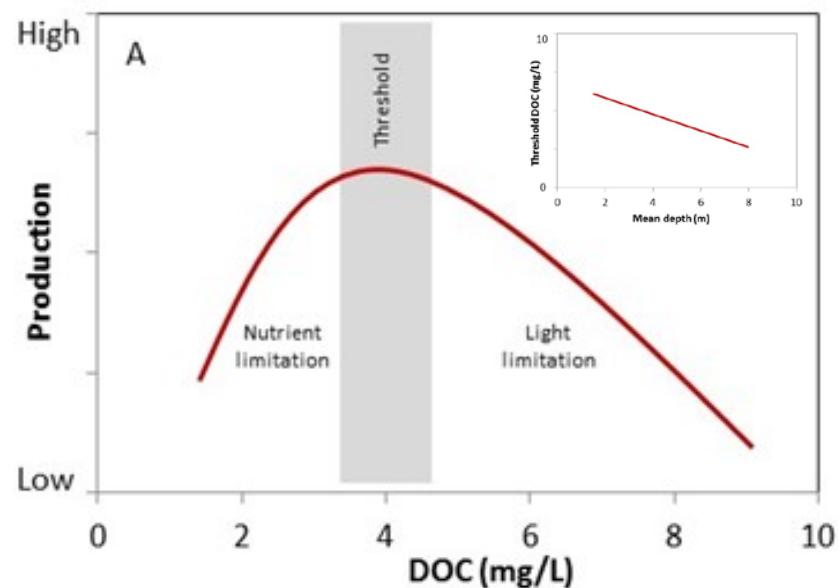


Företagarforskarskolan

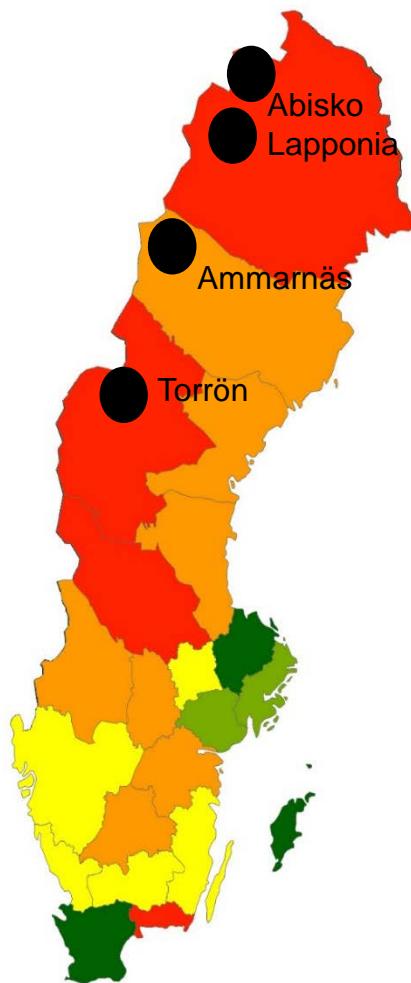
Management of arctic lakes in a changing climate

Purpose: improve knowledge of climate impacts on Subarctic, Arctic and alpine lakes.

Specific aims: to quantify and provide threshold variables for climate change induced regime shifts in fish resource use and production, and to develop tools and guidelines to be used in monitoring programs.



APPROACH



Sampling lakes (10-50 ha) in Jämtland, Västerbotten and Norrbotten varying in **depth (3-8m) and DOC (1-15 mg/l) levels**.
Char, brown trout and char-Brown trout lakes.

18 lakes per year (6 in each region) year 1-2.
6 harvest lakes per year (2 per countyboard) year 2-3.

Chemistry (DOC, N, P), **physics** (temp., oxygen, PAR, bathymetry),
biology (GPP, biomass) from May to September.

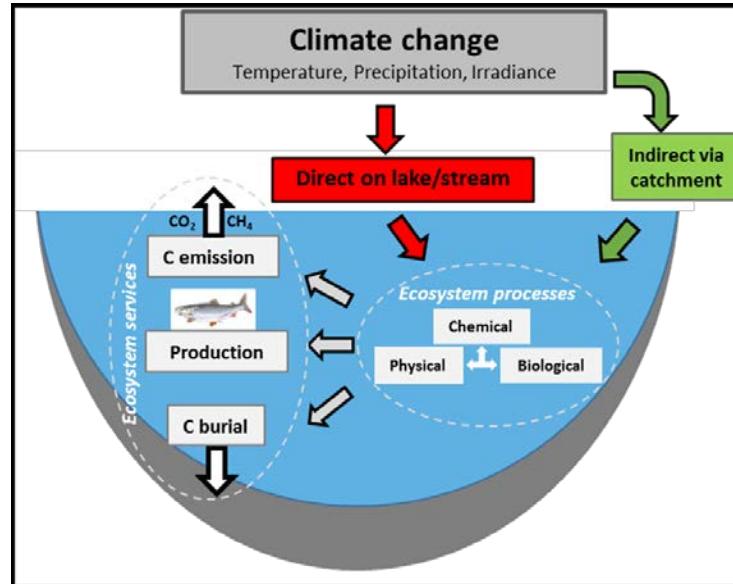
Fish: Multi-mesh survey gillnets will be set in July/August for two nights in each lake in the pelagic, littoral and profundal to collect data on the size structure and growth of fish.

En stor utmaning är att prediktera klimatpåverkan

-Klimateffekter är komplexa med förväntad stor variation i tid och rum-

Stort behov av:

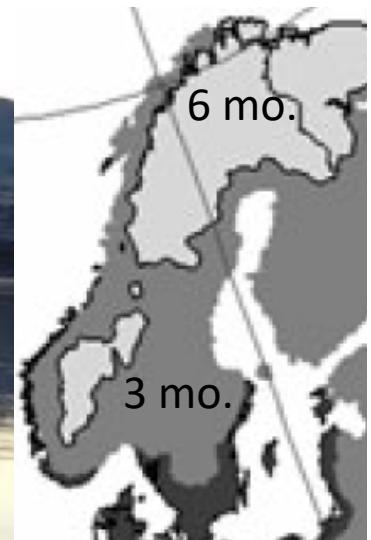
- Integrerad och interdisciplinär forskning
- Storskaliga experimentella studier
- Fältbaserad + Modellering
- Interaktioner med andra påverkansfaktorer, tex markanvändning



För mera information

www.arcticcerc.net

jan.p.karlsson@umu.se



Prowse et al. 2011, AMBIO



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Forskningsrådet Formas

Formas främjar framstående forskning för hållbar utveckling

Kempestiftelserna