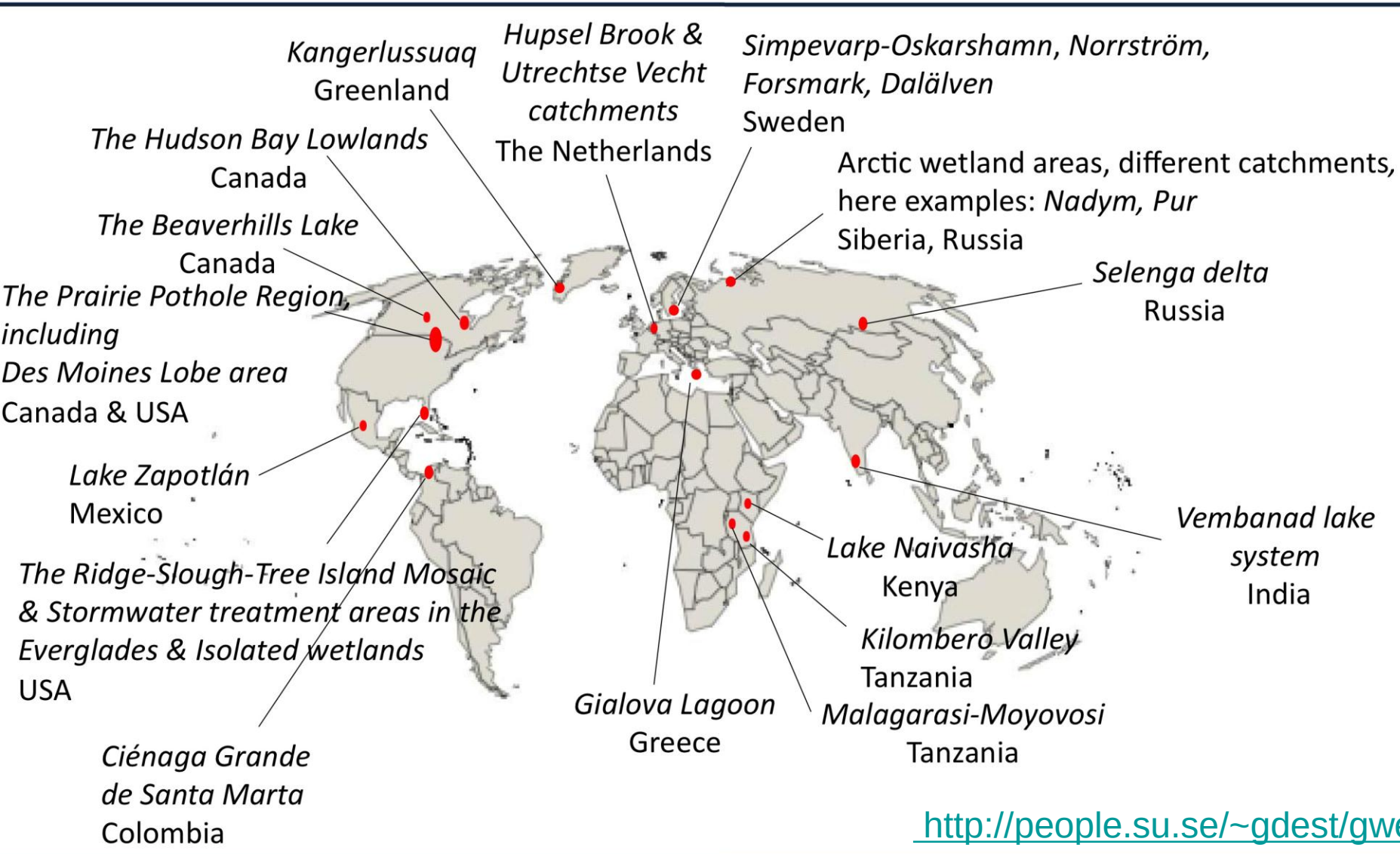
Hydro-Biogeochemical and Environmental-Management Functions of Wetland Networks in Landscapes

Georgia Destouni

Nandita Basu, Matthew J. Cohen, Helen Dahlke, Fernando Jaramillo, Jerker Jarsjö, James W. Jawitz, John Juston, Elin M. Karlsson, Antonis D. Koussis, Steve Lyon, Katerina Mazi, Johanna Mård-Karlsson, Carmen Prieto, Suresh C. Rao, Ype van der Velde, Nikki Vercauteren, **et al.** … **GWEN research network**

GWEN - Global **W**etland **E**cohydrology **N**etwork: An Agora for Scientists and Study Sites



http://people.su.se/~gdest/gwen

Map of GWEN study sites

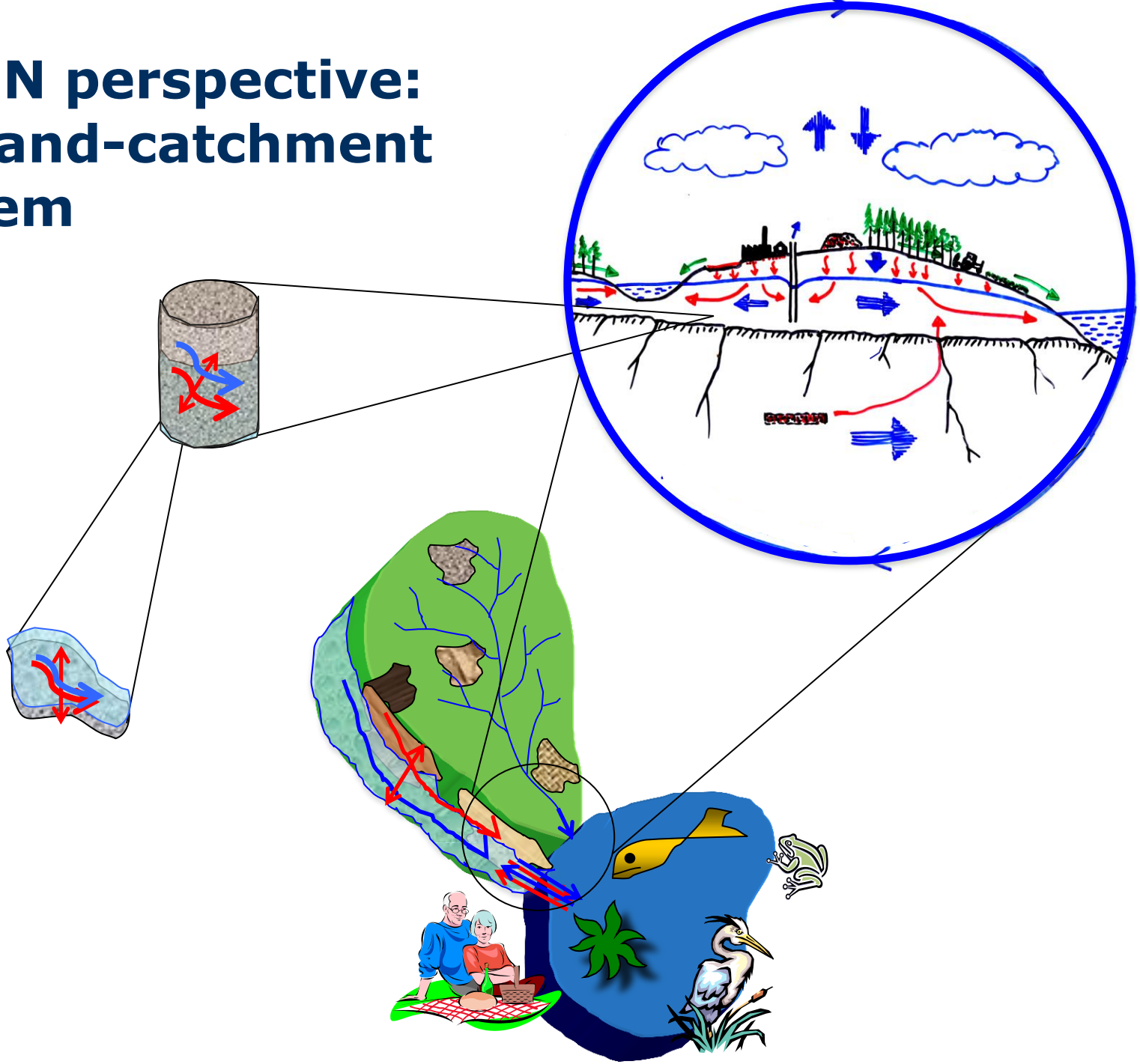
GWEN investigates

Stockholm University

Across different scales-catchments with different wetland and human disturbance conditions:

- Wetland-catchment interactions - water fluxes, spreading, attenuation-retention, loading of tracers, nutrients, pollutants
- Ecosystem services of wetlands and wetland networks
- Influences of hydroclimatic variability and change

GWEN perspective: wetland-catchment system

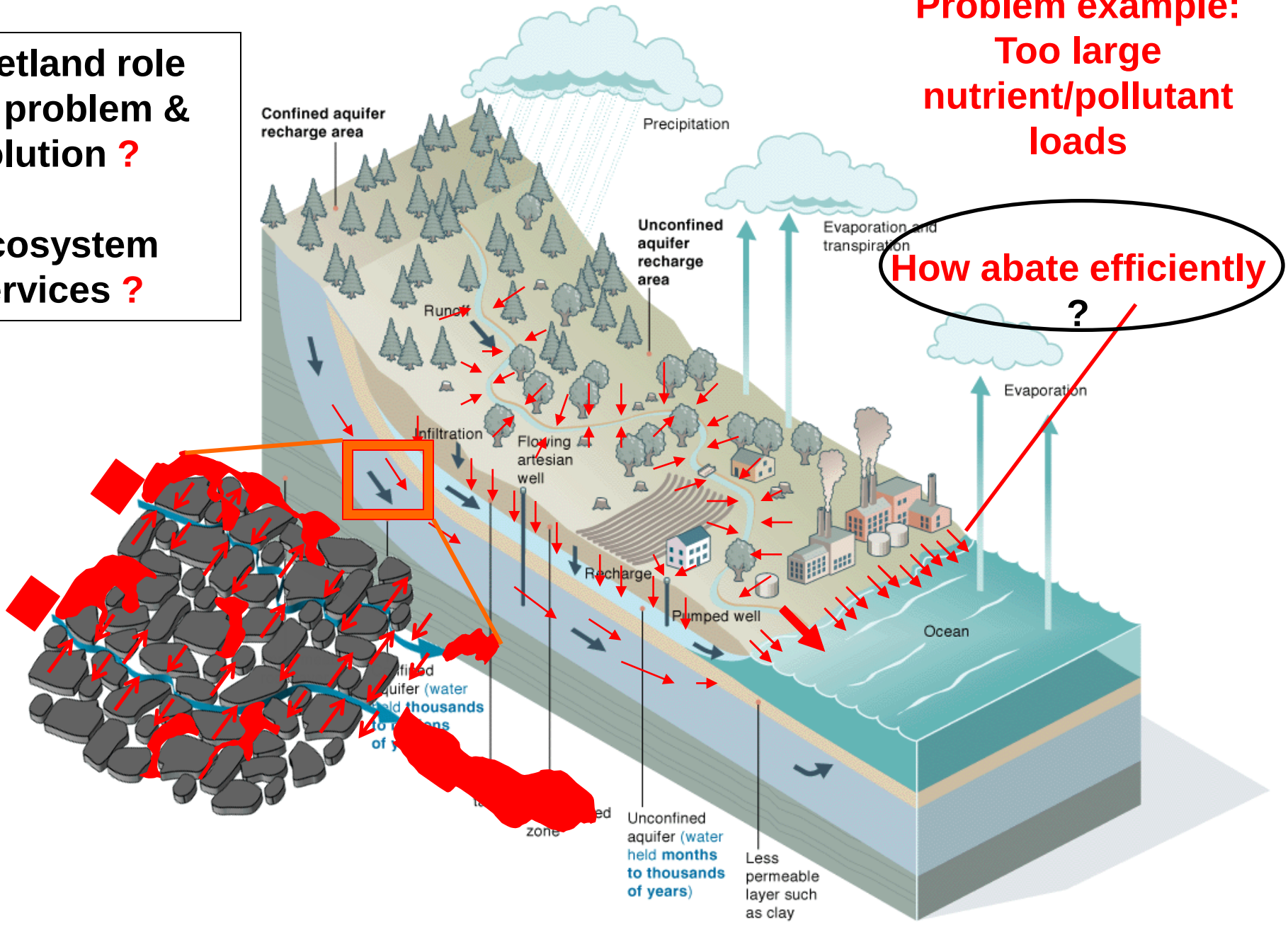


Wetland role in problem & solution ?

Ecosystem services ?

Problem example: Too large nutrient/pollutant loads

How abate efficiently ?



Problem

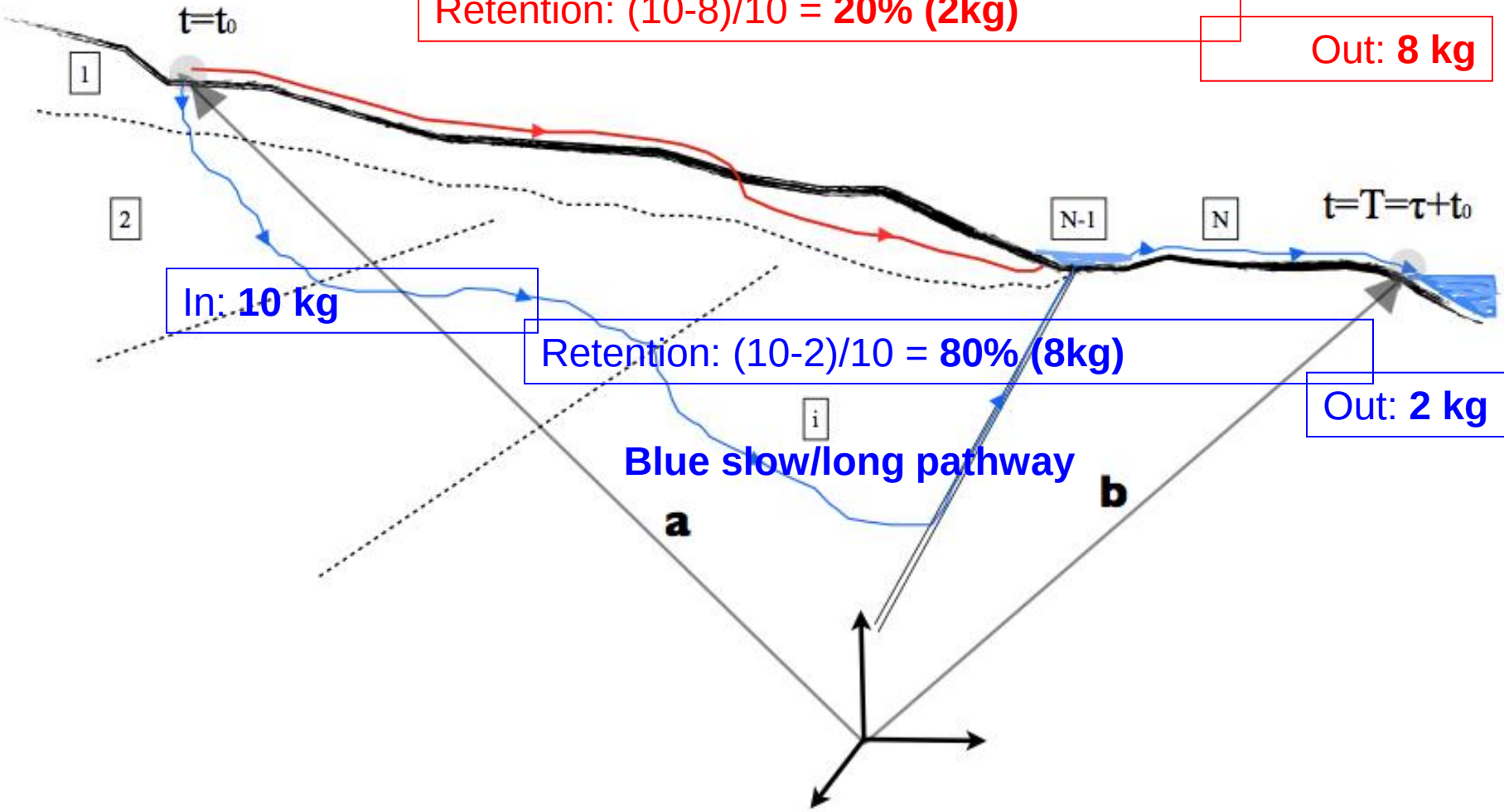
Stockholm University

Red fast/short pathway

In: **10 kg**

Retention: (10-8)/10 = **20% (2kg)**

Out: **8 kg**



In: **10 kg**

Retention: (10-2)/10 = **80% (8kg)**

Out: **2 kg**

Blue slow/long pathway

Source abatement as solution

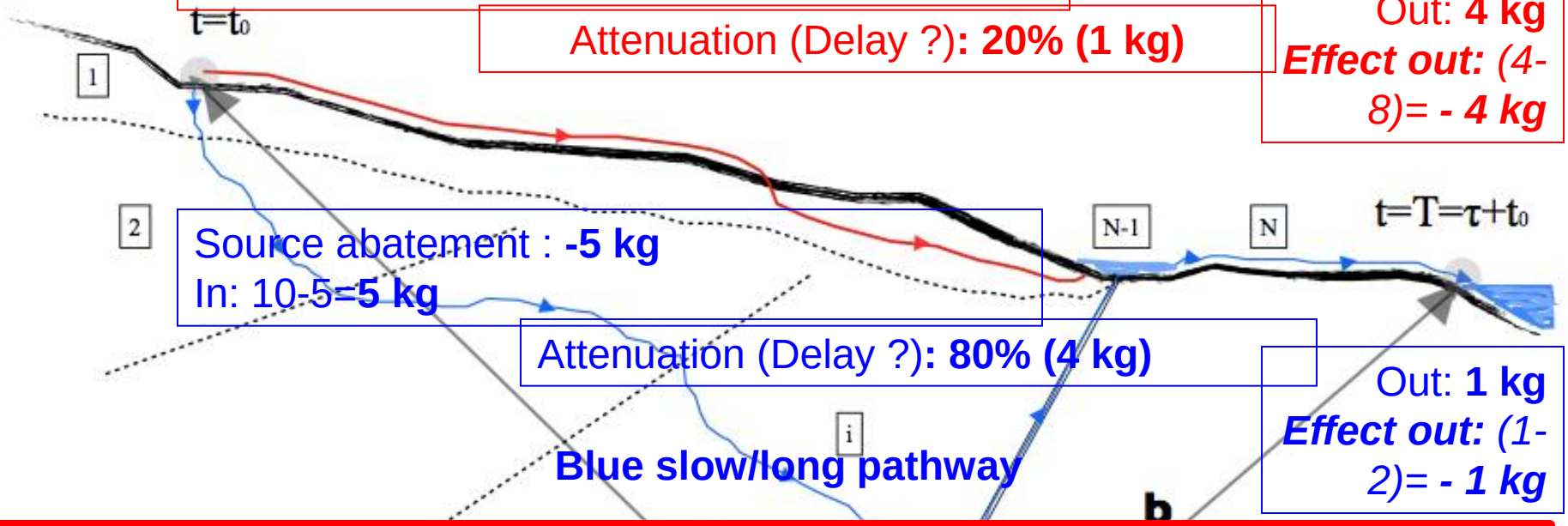
Stockholm University

Red fast/short pathway

Source abatement : **-5 kg**
In: 10-5=**5 kg**

Attenuation (Delay ?)**: 20% (1 kg)**

Out: **4 kg**
Effect out: *(4-8)=* ***- 4 kg***



Source abatement : **-5 kg**
In: 10-5=**5 kg**

Attenuation (Delay ?)**: 80% (4 kg)**

Out: **1 kg**
Effect out: *(1-2)=* ***- 1 kg***

Blue slow/long pathway

Blue pathway:
4 times more - 4 times more expensive
source abatement for same load effect

Existing ecosystem service (ES) ➔ Attenuates also abatement effects

Abatement efficiency – outside current ES

Downstream measure as solution

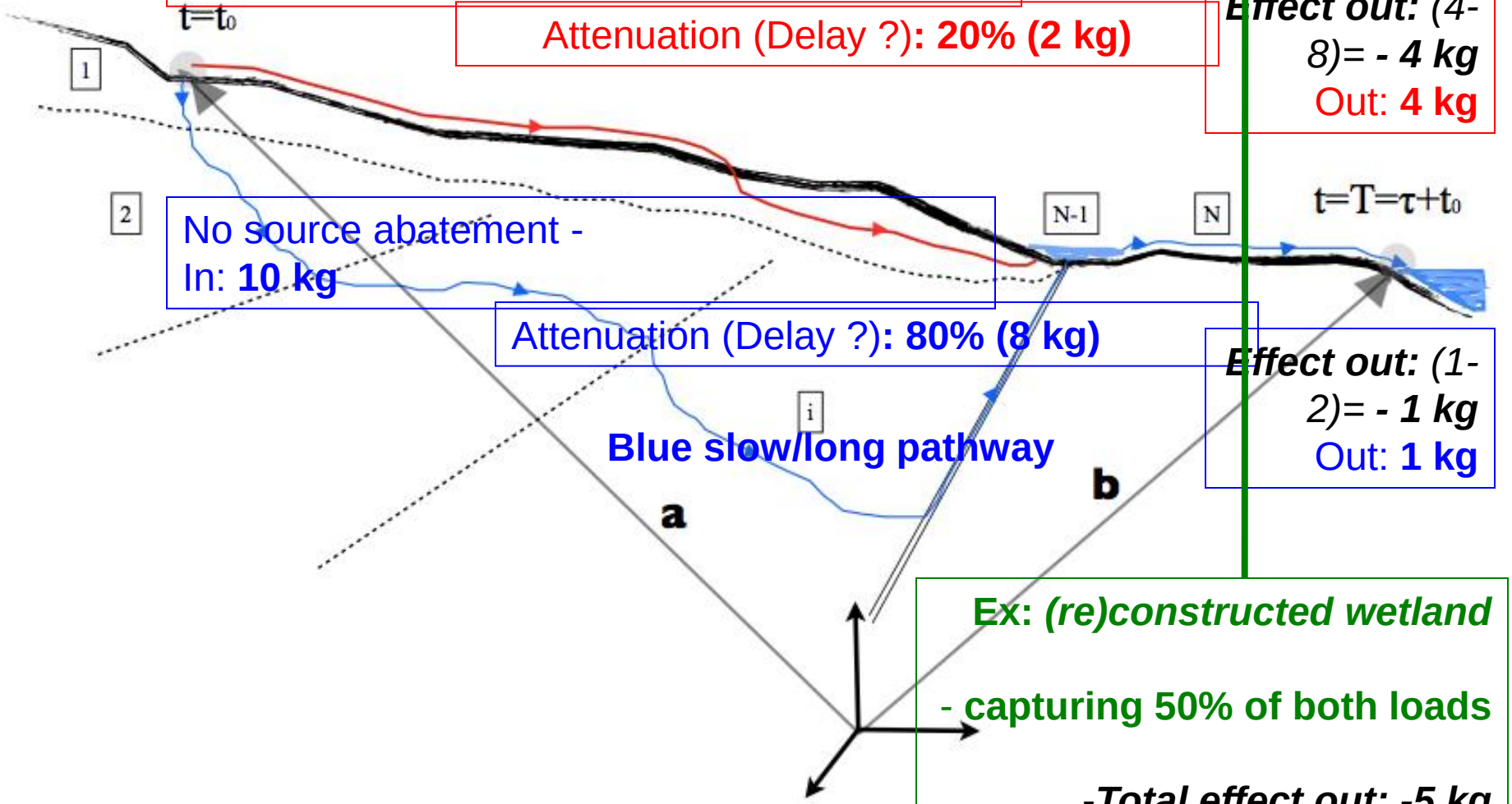
Stockholm University

Red fast/short pathway

No source abatement -
In: **10 kg**

Attenuation (Delay ?)**: 20% (2 kg)**

Effect out: *(4-8)=* ***- 4 kg***
Out: **4 kg**



No source abatement -
In: **10 kg**

Attenuation (Delay ?)**: 80% (8 kg)**

Blue slow/long pathway

Effect out: *(1-2)=* ***- 1 kg***
Out: **1 kg**

Ex: *(re)constructed wetland*

- capturing 50% of both loads

-Total effect out: -5 kg

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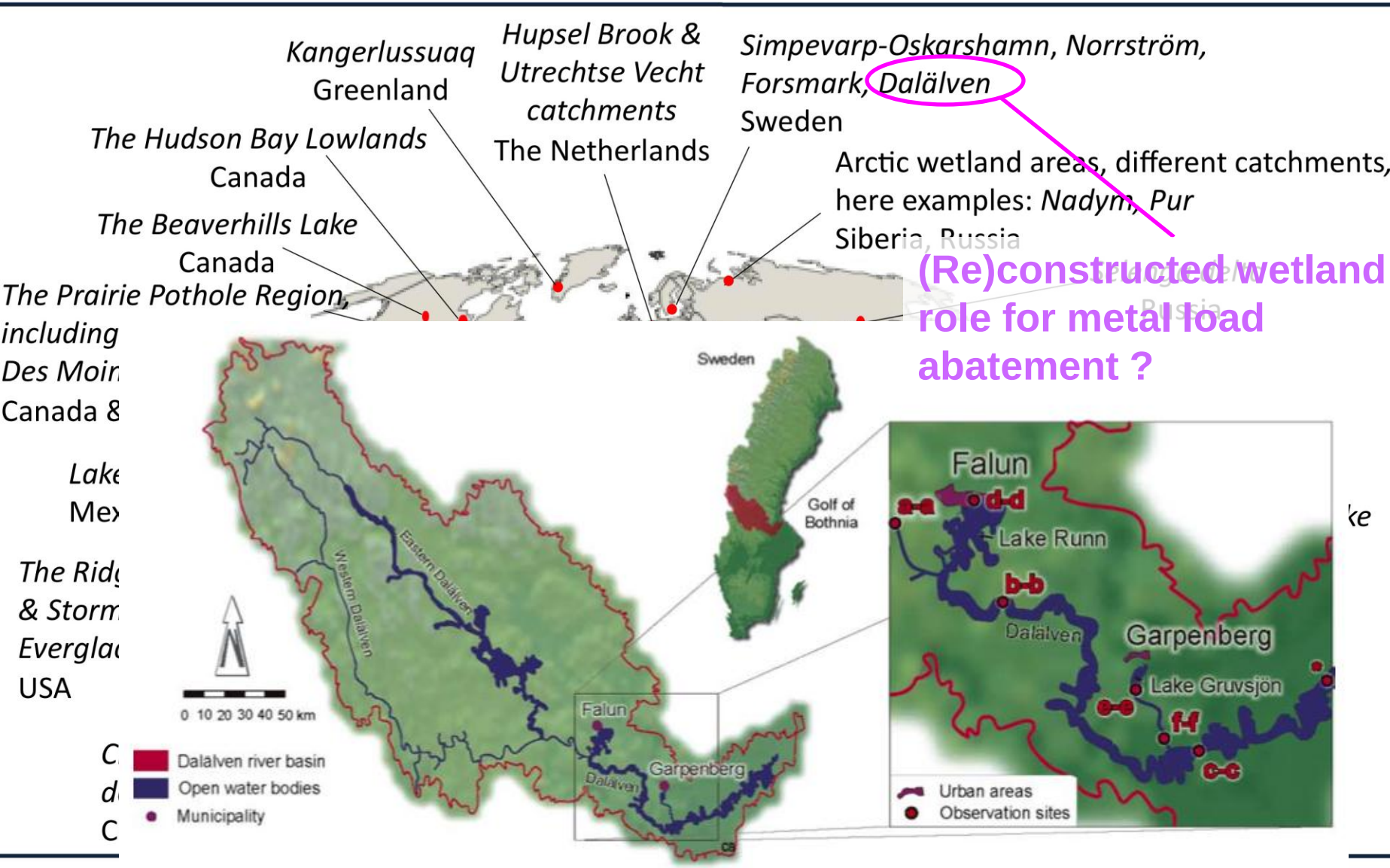
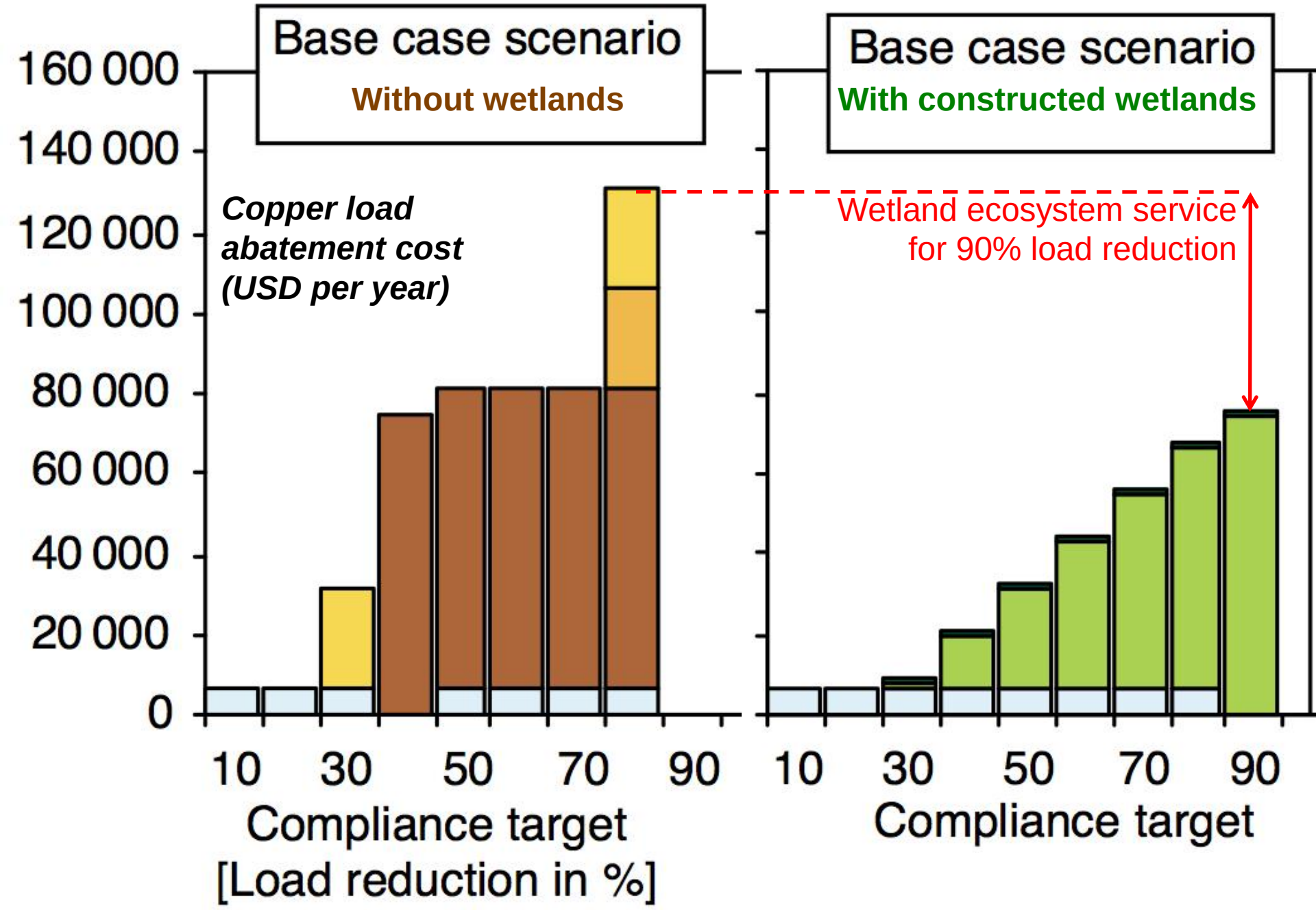
Global **W**etland **E**cohydrology **N**etwork: An Agora for Scientists and Study Sites



Map of GWEN study sites

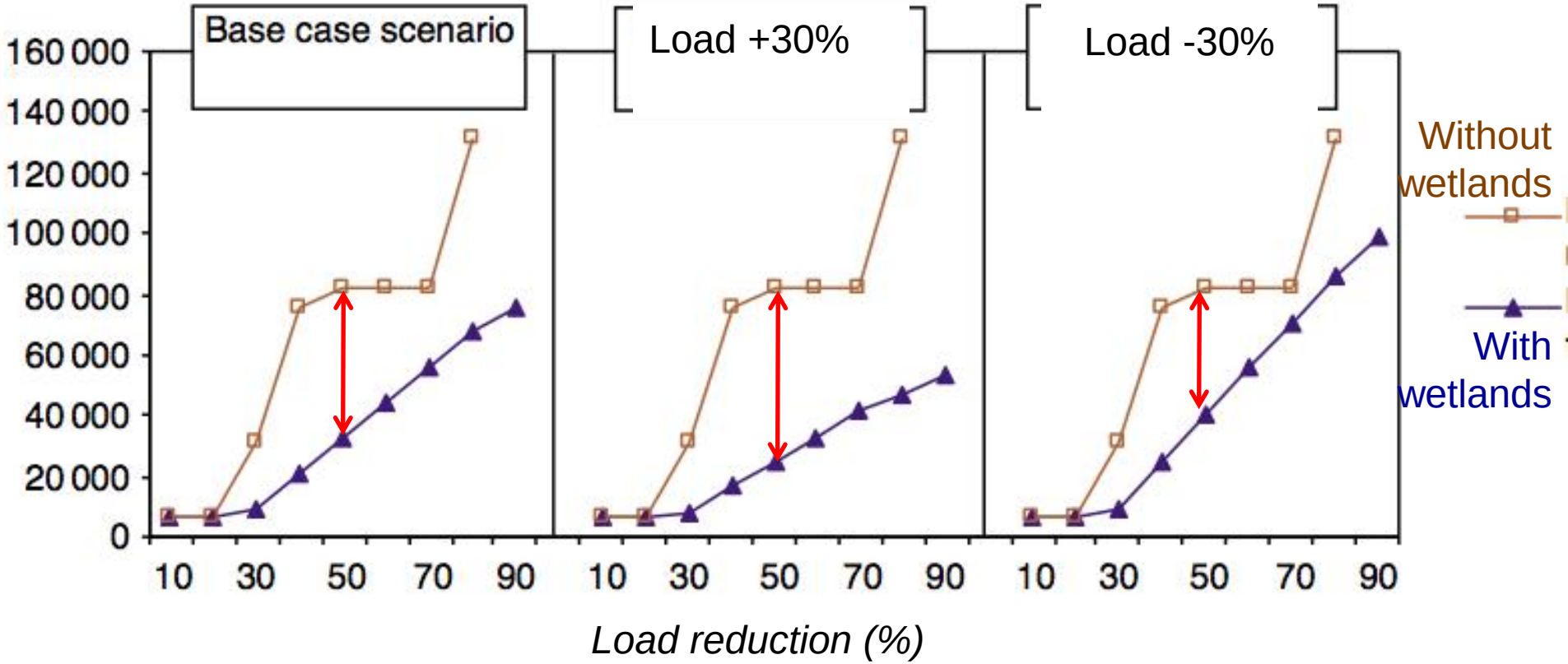


Based on Baresel et al., 2006

Ecosystem service,
for ex. 50% load reduction

Stockholm University

Copper load abatement cost (USD per year)



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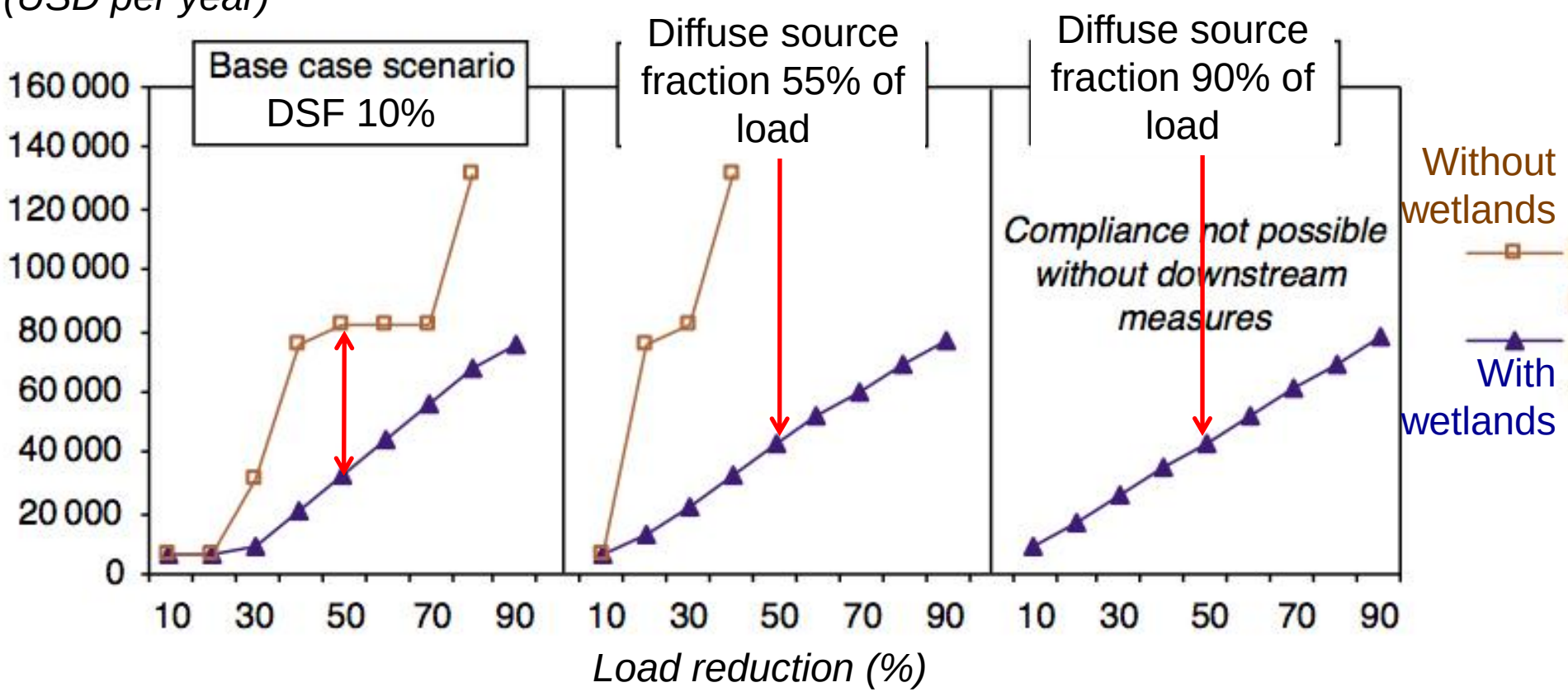

Based on Baresel et al., 2006

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Global **W**etland **E**cohydrology **N**etwork: An Agora for Scientists and Study Sites

Kangerlussuaq
Greenland

Hupsel Brook & Utrechtse Vecht catchments
The Netherlands

Simpevarp-Oskarshamn, Norrström, Forsmark, Dalälven
Sweden

The Hudson Bay Lowlands
Canada

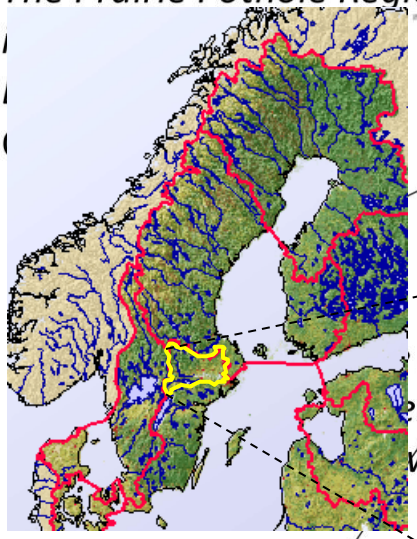
Arctic wetland areas, different catchments, here examples: *Nadym, Pur*
Siberia, Russia

The Beaverhills Lake
Canada

Selenga delta
Russia

The Prairie Pothole Region,

Wetland role in eutrophication problem – solution ?



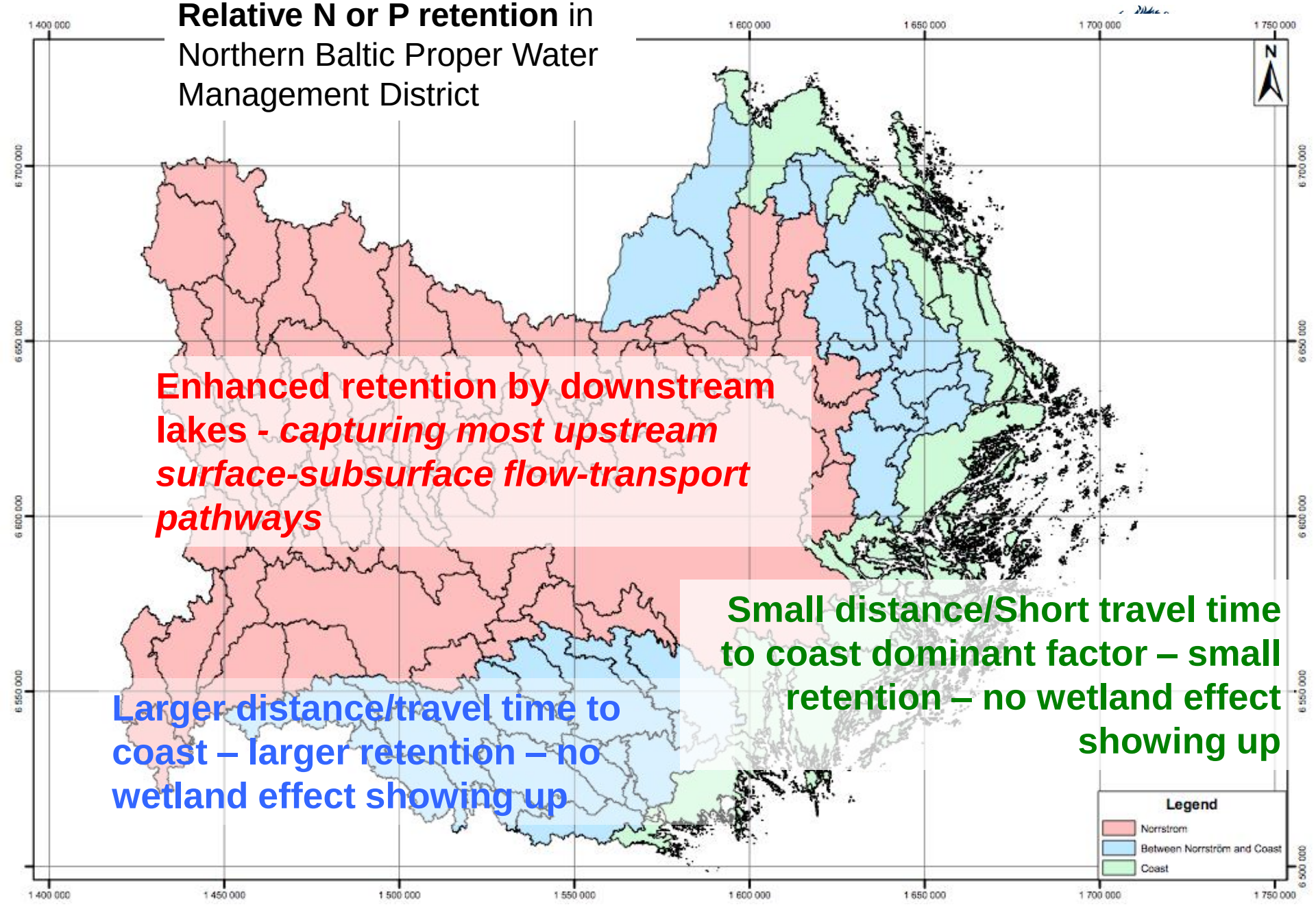
Från Baltic Environmental Atlas (UNEP/GRIP Arendal)

Island Mosaic
nt areas in the
wetlands

Ciénaga Grande de Santa Marta
Colombia

Ma

Relative N or P retention in Northern Baltic Proper Water Management District

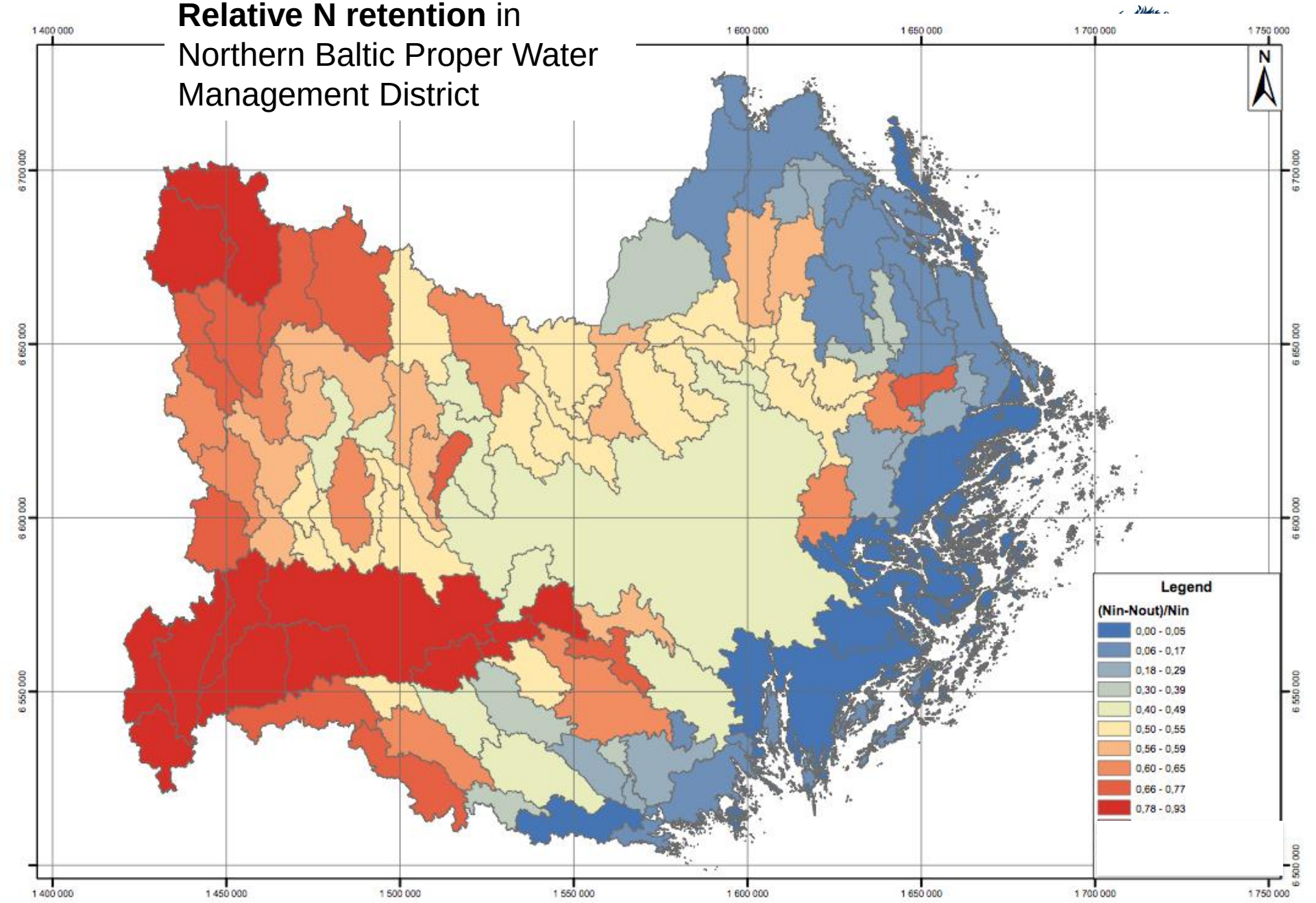


Enhanced retention by downstream lakes - *capturing most upstream surface-subsurface flow-transport pathways*

Small distance/Short travel time to coast dominant factor – small retention – no wetland effect showing up

Larger distance/travel time to coast – larger retention – no wetland effect showing up

Relative N retention in Northern Baltic Proper Water Management District

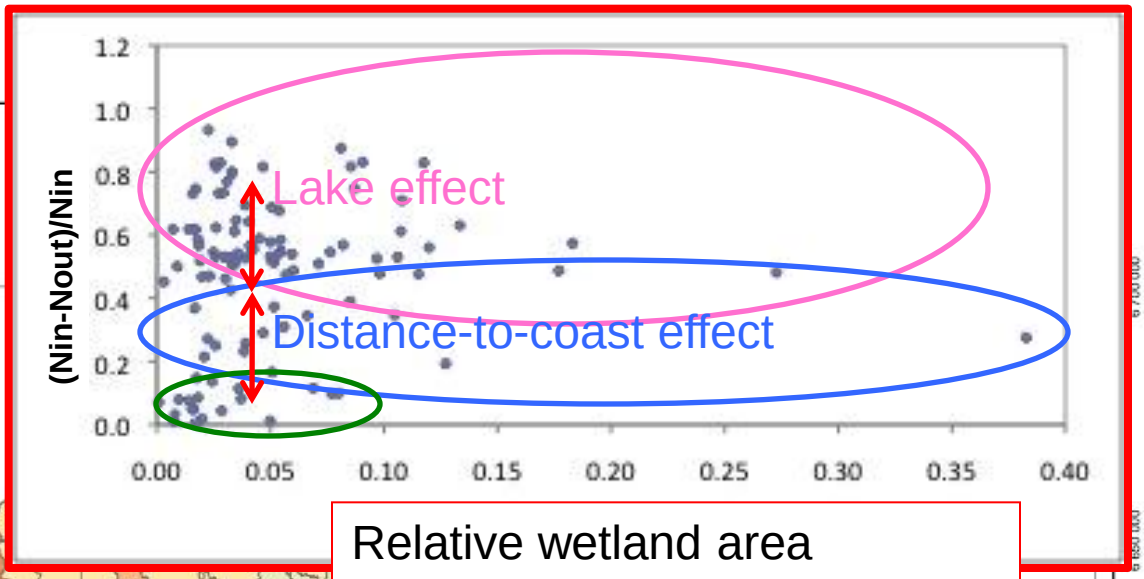


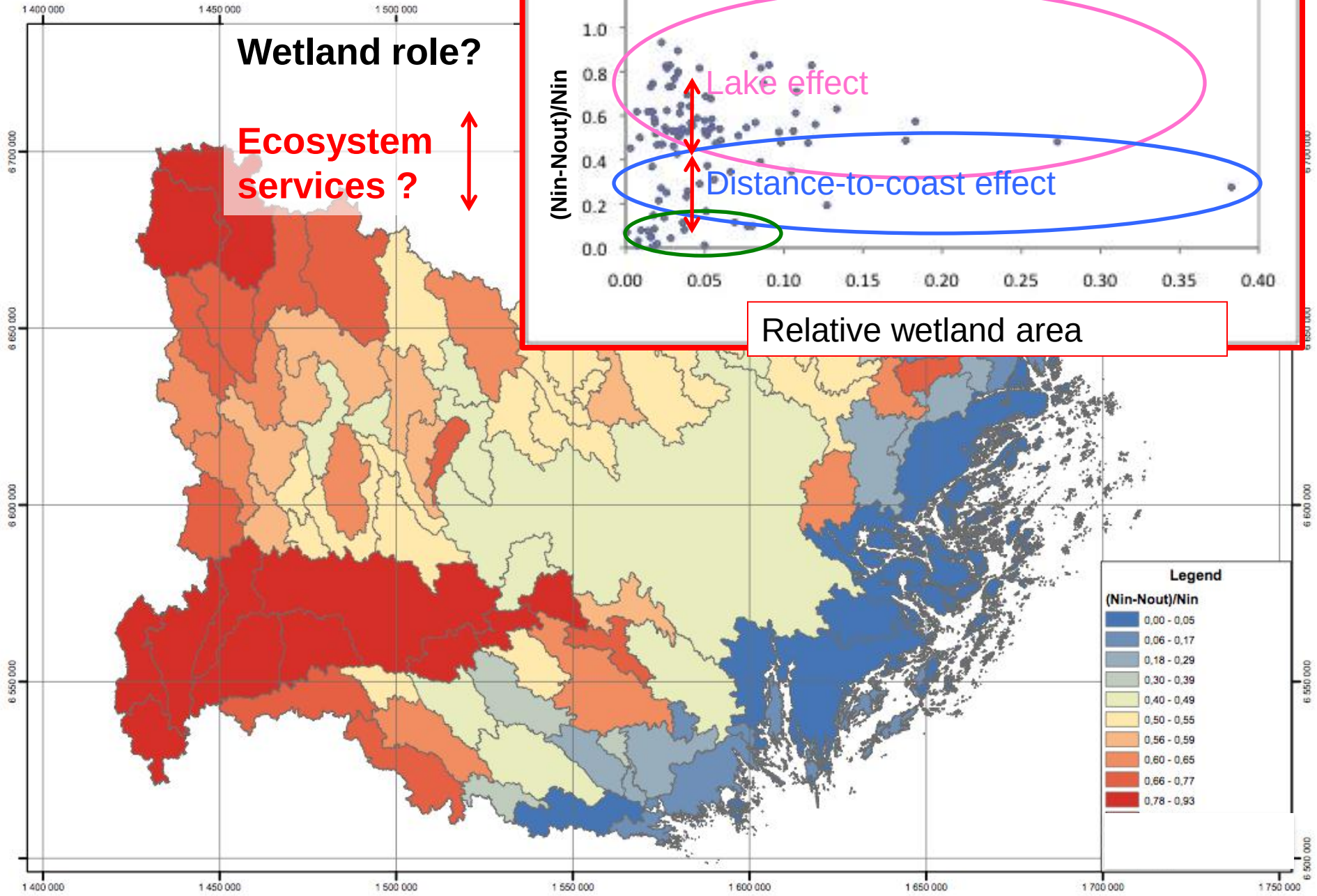
Based on: PLC5 official Swedish data

Relative N retention

Wetland role?

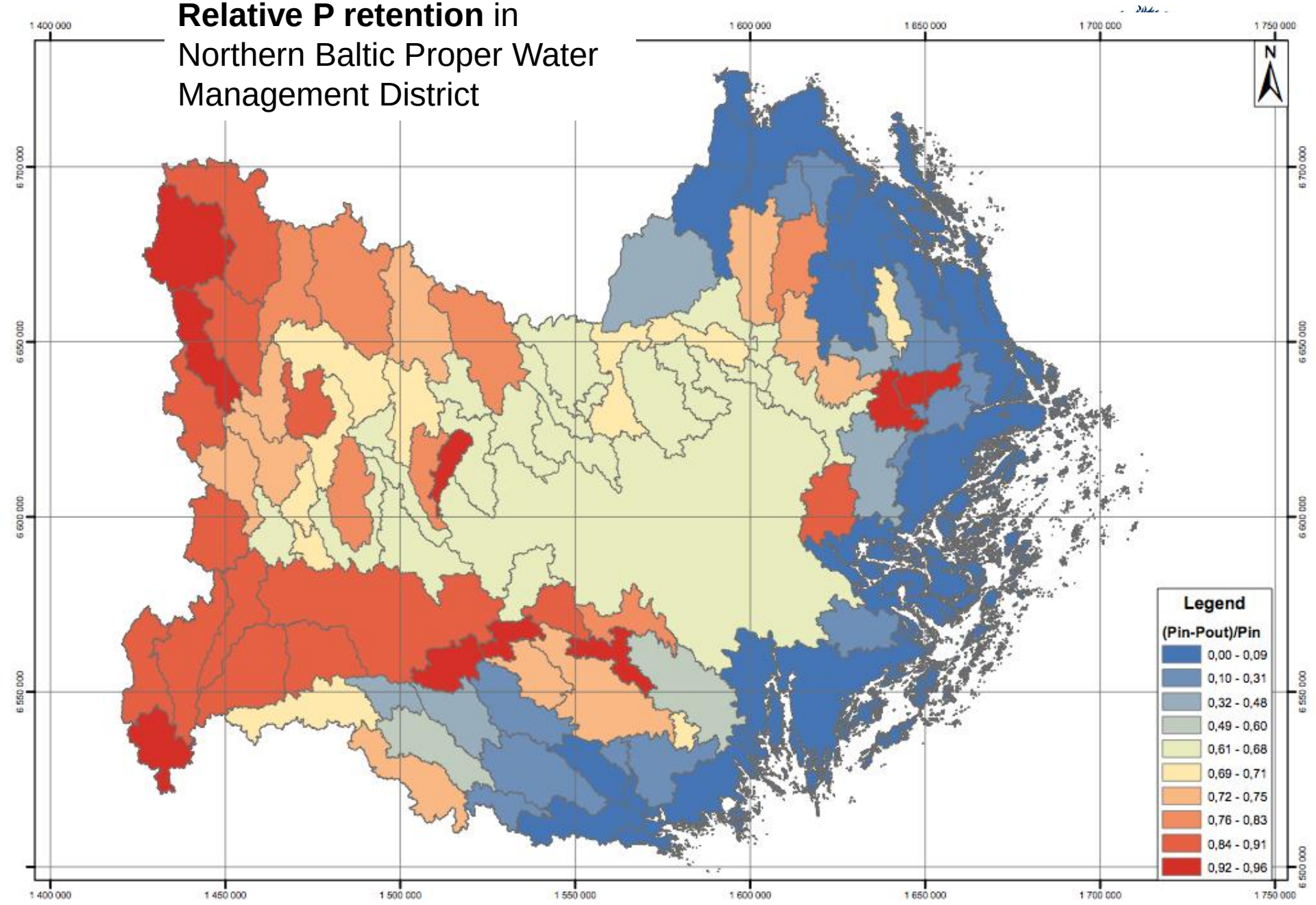
Ecosystem services ?



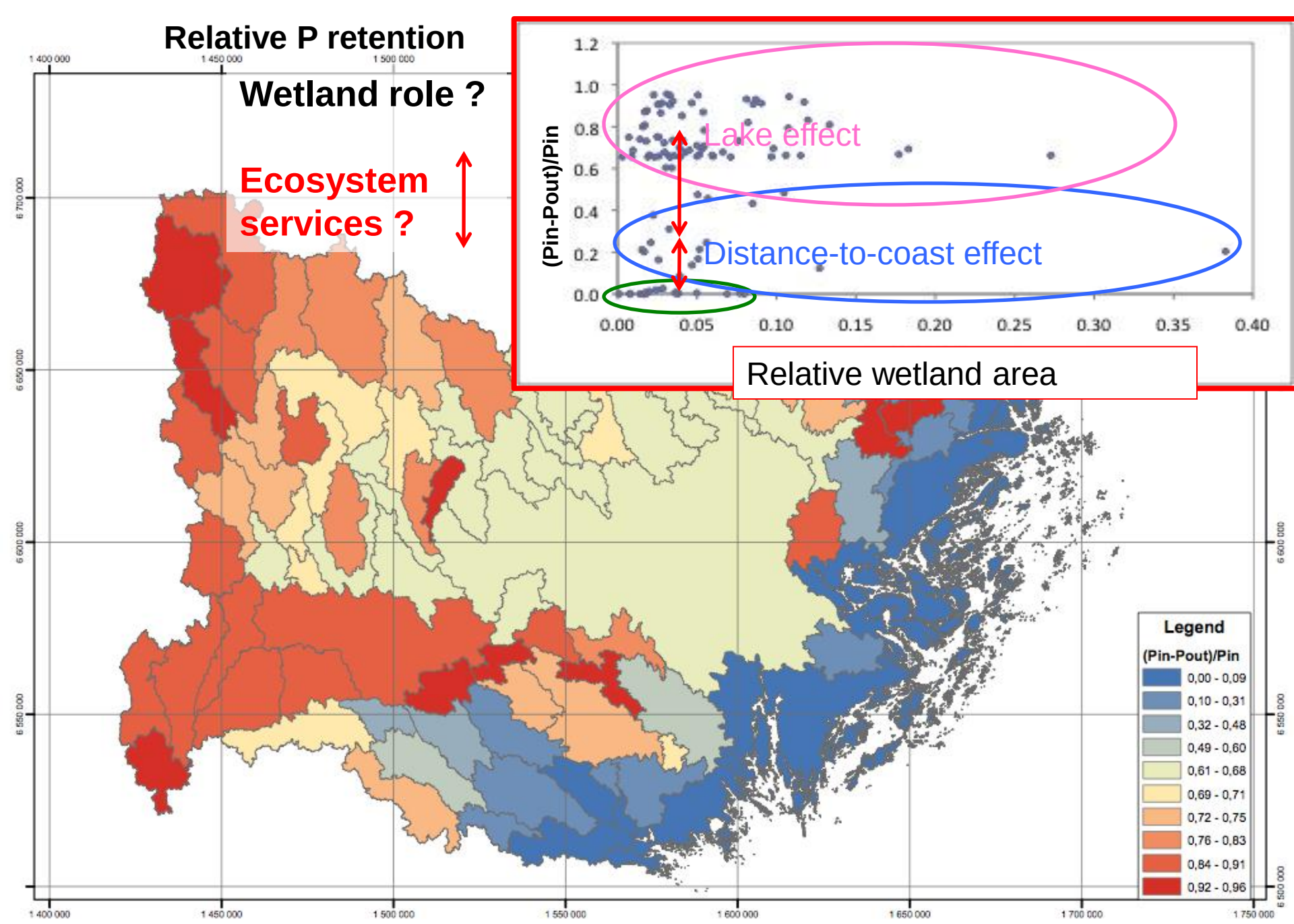


Based on: PLC5 official Swedish data

Relative P retention in Northern Baltic Proper Water Management District



Based on: PLC5 official Swedish data



Based on: PLC5 official Swedish data

Important role of (re)constructed wetlands to mitigate uncertainty by capturing loads downstream ?

Scenario simulations:

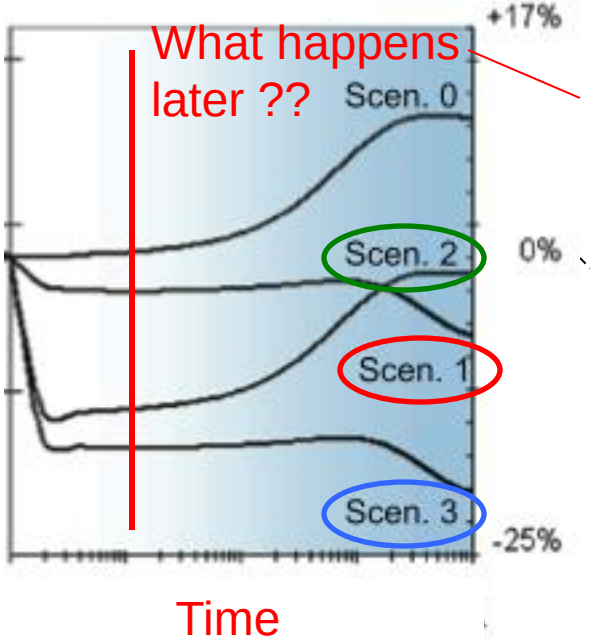
0- Source stabilization after 2005

1- 40% decrease agricultural / diffuse sources

2- 40% decrease point / fast-spread sources

3- 40% decrease all sources

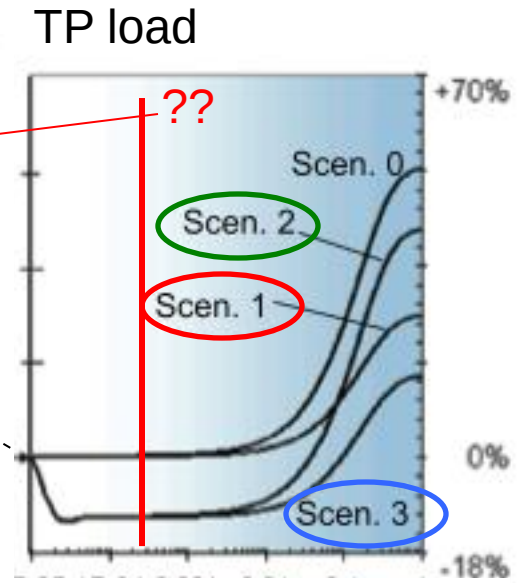
TN load



BUT - what is this retention - irreversible attenuation **??** OR just delay **??**

0%=2005 level

TP load



Darracq et al., GBC, 2008

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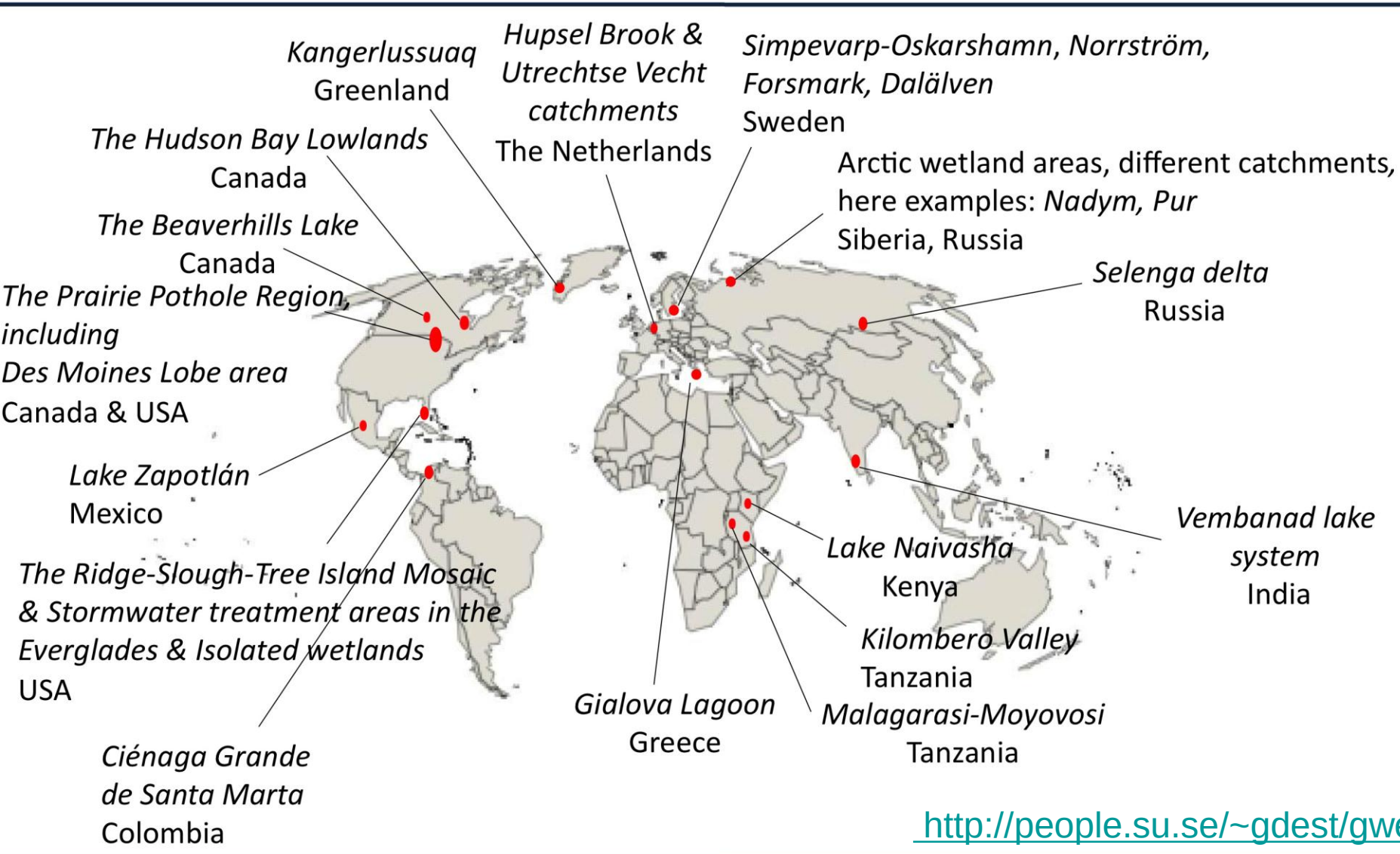

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