UiO : Department of Chemistry
University of Oslo

SinoTropia

Watershed Eutrophication management in China through system oriented process modelling of Pressures, Impacts and Abatement actions

C.W. Mohr[(1)], R.D. Vogt[(1)], B. Zhou[(1)] and Ping Y[(2)]

[1]Department of Chemistry, University of Oslo

[2]Tianjin Academy of Sciences

X. Lu
X. Deng

M. Yang
W. An
B. Tian

P. Jiahua
L. Meng
P. Qimin

T. Andersen, K. Tominanga
G. Wibetoe, C.W. Mohr
R. Vogt, B. Zhou

O. Røyseth

G. Orderud
J. Naustdalslid

Working across borders

- Bilateral project between China and Norway (2011 – 2014)

- Funding supported by the Chinese Academy of Sciences (CAS) and the Research Council of Norway (RCN)

- Participating research institutes from China:
  - Tianjin Academy of Sciences (TAES)
  - Research Center for Eco-Environmental Sciences (RCEES)
  - Institute for Urban and Environmental Studies Chinese Academy of Social Science

- Participating research institutes from Norway:
  - University of Oslo (UiO)
  - Norwegian Institutt for Water Research (NIVA)
  - Norwegian Institute for Urban and Regional Research (NIBR)

The main issue

- *60 - 70% of the surface water resources in China have too poor quality*
- *Eutrophication is the main cause for poor ecological quality*

Yuqiao water reservoir

- Water source for Tianjins 6 – 10 mill. population
- Declining water quality due to eutrophication
- Eutrophication is the result of excessive nutrient loading to water bodies, with phosphorus being the main problem.

What is the solution..?

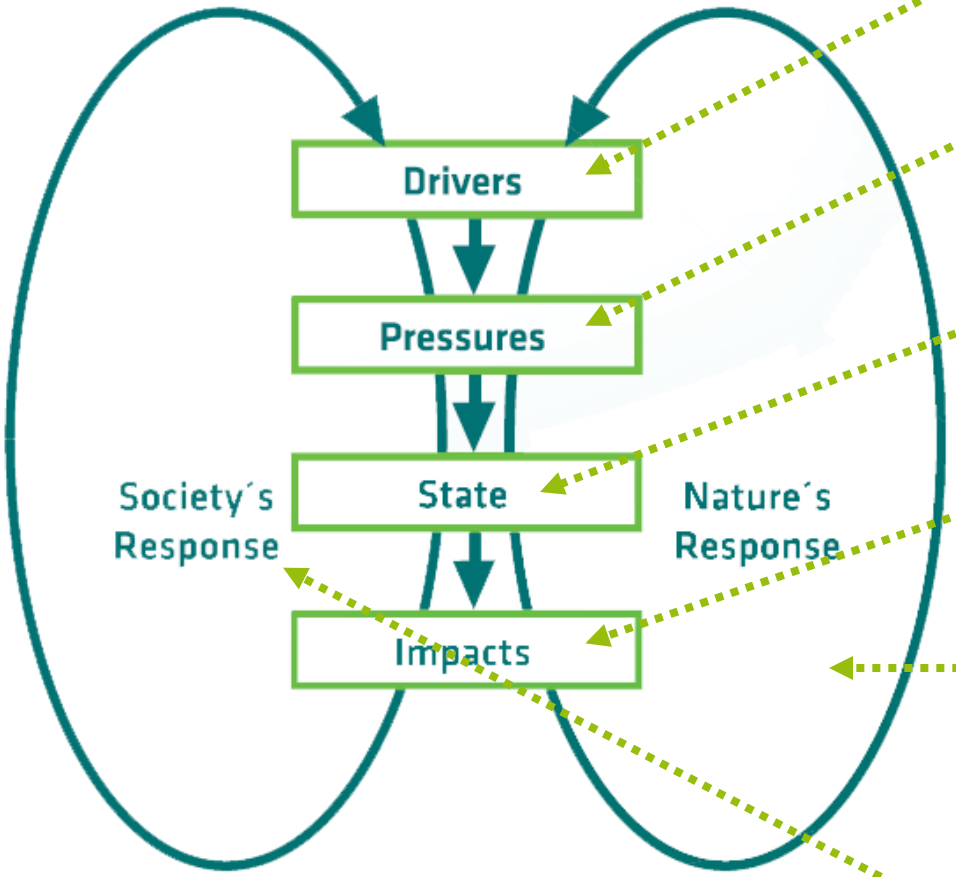
- Can we deal with eutrophication?
  - Are the abatement actions appropriate?
    - Are we targeting the right sources of nutrients and form of nutrients?
    - Are the effects of our abatement actions disguised by changes in other environmental pressures?
  - Are the abatement actions politically and/or socially feasible?
    - What barriers or thresholds in society hinder the implementation of abatement actions?
    - Is there sufficient knowledge of stakeholder interests?
    - What motivates collective action?
  - What can we do next, together?
    - We have already used the obvious abatement actions
    - What do we do next? How do we decide the best next step?

The approach forward

- We need coherent research where hydro-biogeochemical processes governing eutrophication are linked to societal response

Outline

DPSIR - Conceptual framework



Drivers: Population increase, climate change

Pressures: P leaching to water

State: High nutrient levels

Impacts: Eutrophication

Nature's Response: Change in eco-system services, feedback mechanisms

Society's Response: Abatement actions, adaptation, environmental technology, policy, legislations, taxes

Hypothesis – Analytical methods

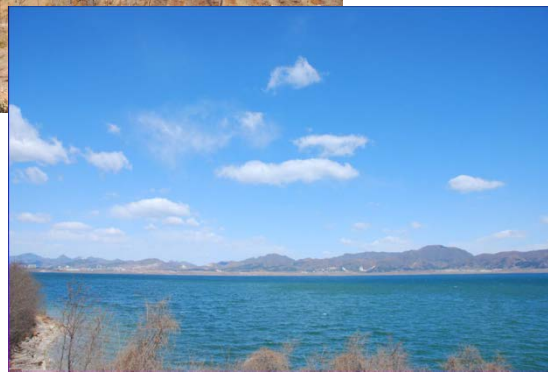
- P-fractionation will enhance our ability to identify :
  - source of Phosphorous
  - processes governing fluxes
  - fate of the Phosphorous
    - effect of bioactive P-fractions and thereby algal growth

Hypothesis - Processes

- More frequent and intensive **rain episodes** enhance eutrophication due to increased erosion and leaching of nutrients

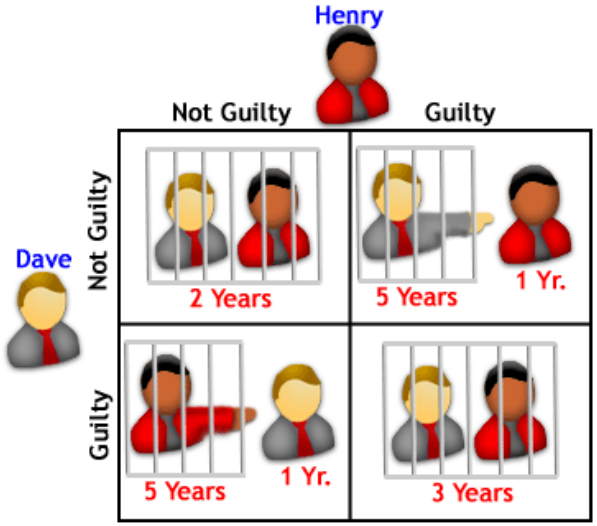
Hypothesis - Models

- Models need to be **adopted** to Chinese environments
  - The main governing processes may not be the same



Hypothesis – Societal response

- Knowledge -
  - Of stakeholder **interests** and learning processes are essential for the success of the public policies abating eutrophication
  - Constitute a necessary basis for sound environmental management through facilitating **collective** action and public policies



SinoTropia Research Strategy

- The hypotheses are tested through integrated works packages

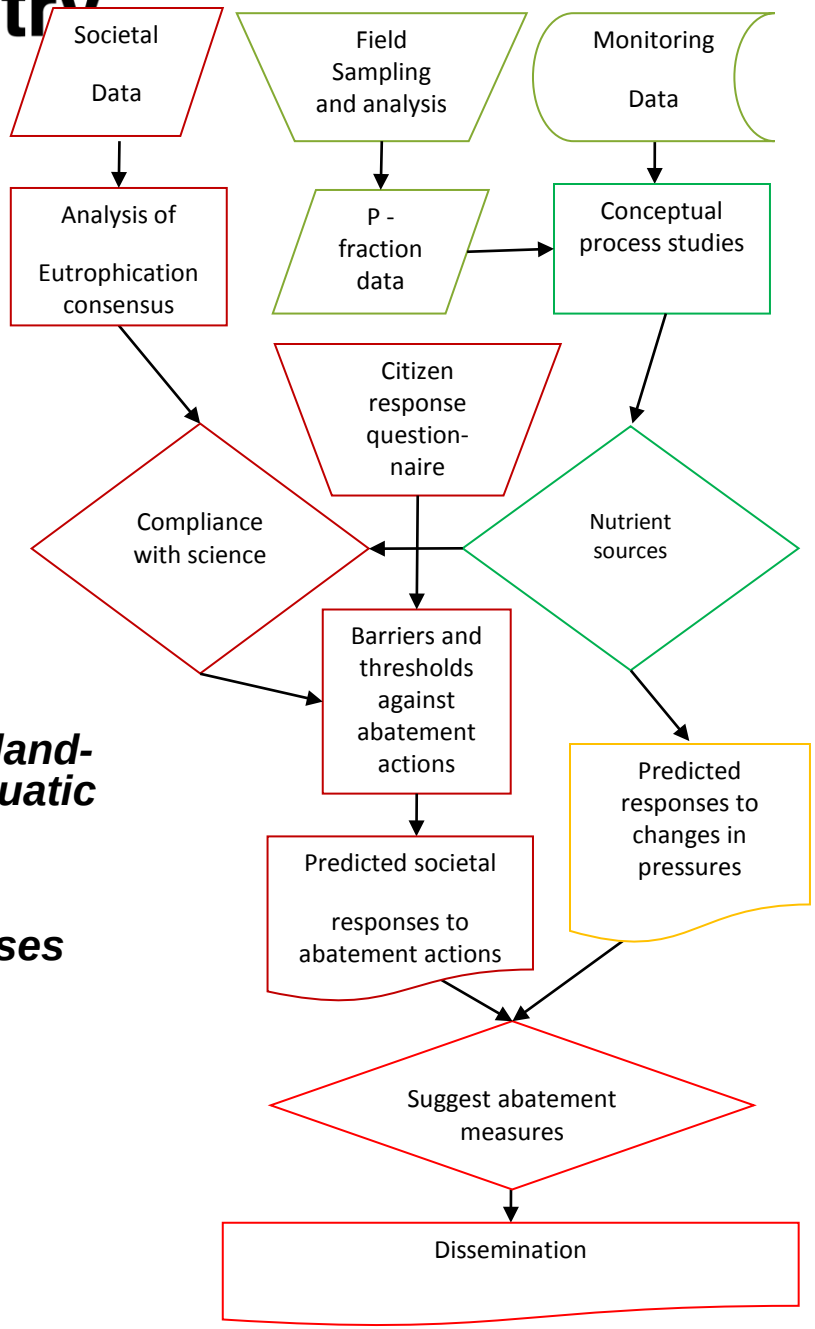
WP1 ***Field sampling and chemical analysis***

WP2 ***Catchment processes - the influence of land-use and climate on nutrient fluxes into aquatic systems.***

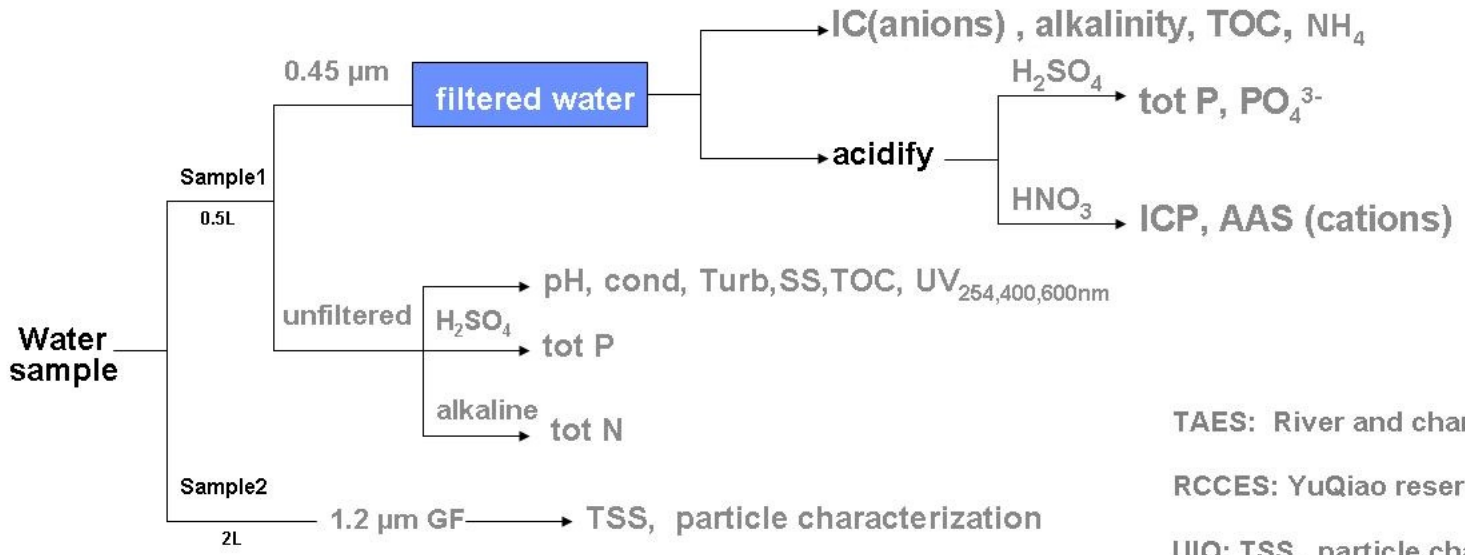
WP3 ***Modelling of catchment and lake processes***

WP4 ***Societal processes and management procedures***

WP5 ***Nutrient management plan for Yuqiao reservoir***



Laboratory sample analysis



TAES: River and channel, lysimeter

RCCES: YuQiao reservoir

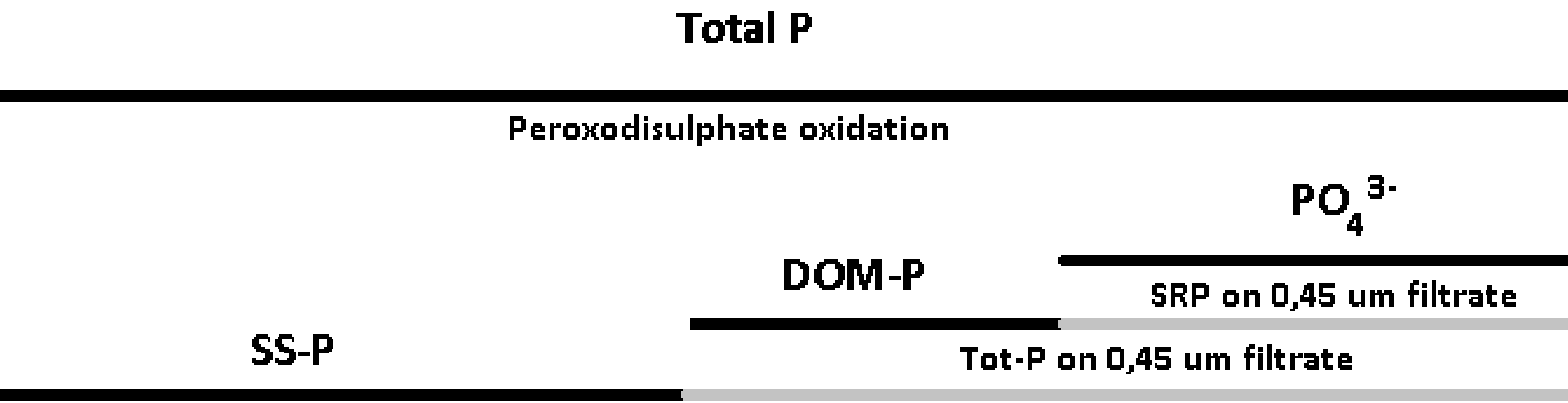
UIO: TSS, particle characterization

TAES: pH, water content, bulk density, CEC, base saturation, organic content

RCCES: PSD

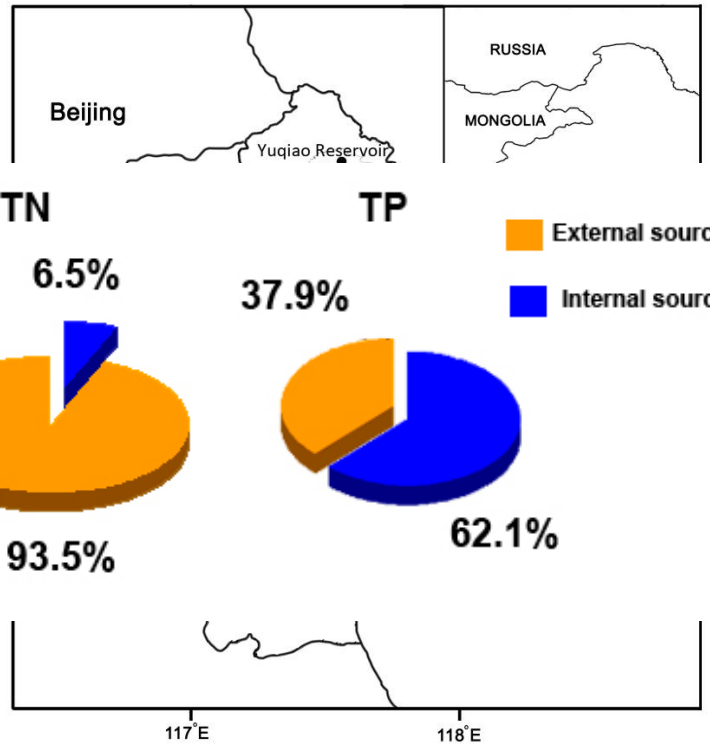
UIO: Other indexes

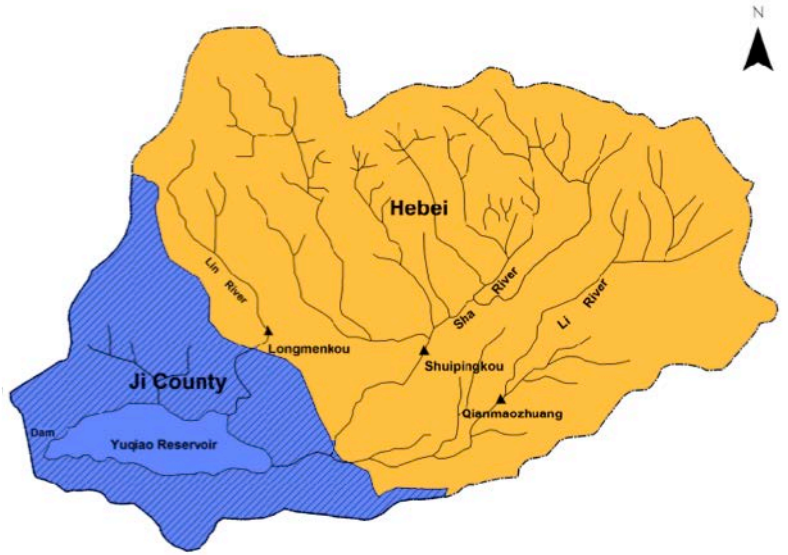
P fractionation



Yuqiao reservoir

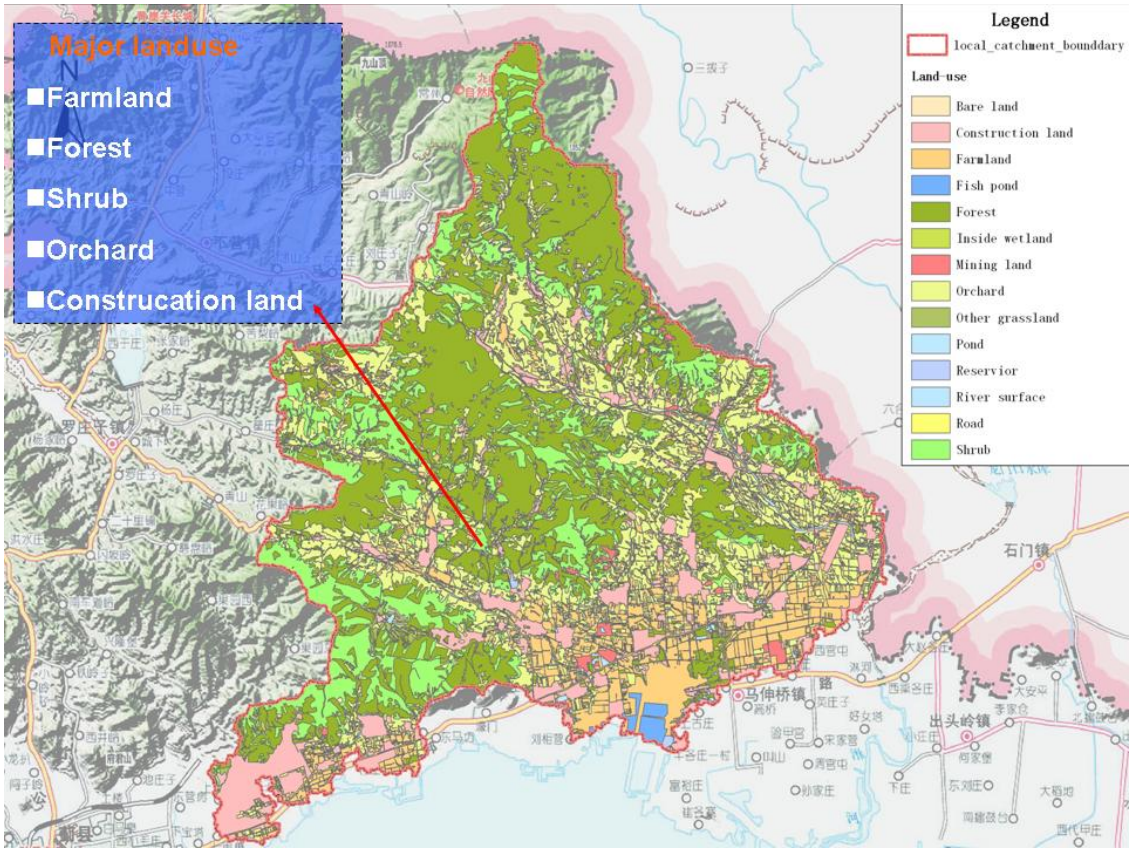
- Main water supply for 6 - 10 mill people in Tianjin
- Attracts considerable attention due to its eutrophication problems
- Recieves water from the diverted Luan river watershed in Hebei
- Main P flux is from local watershed



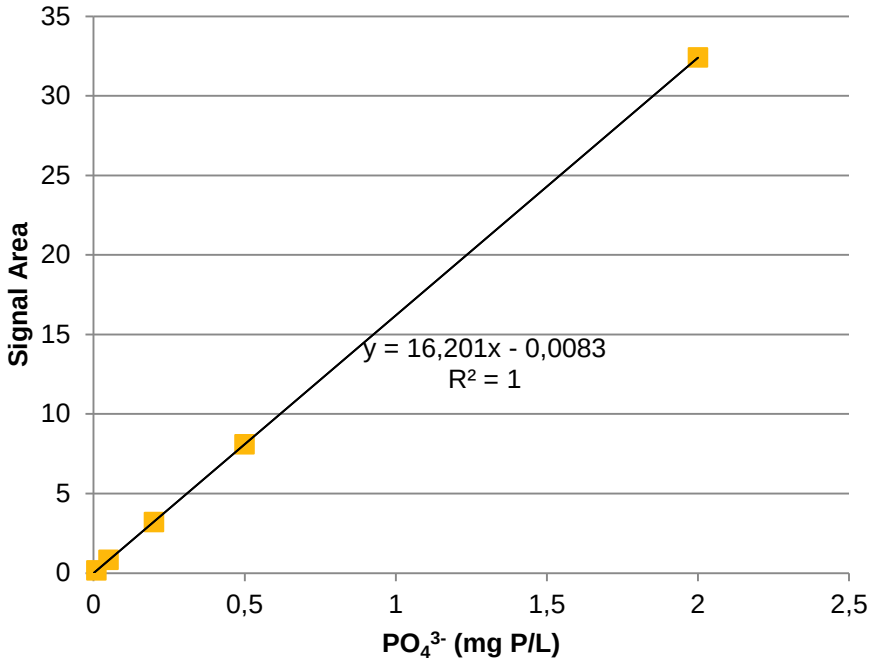


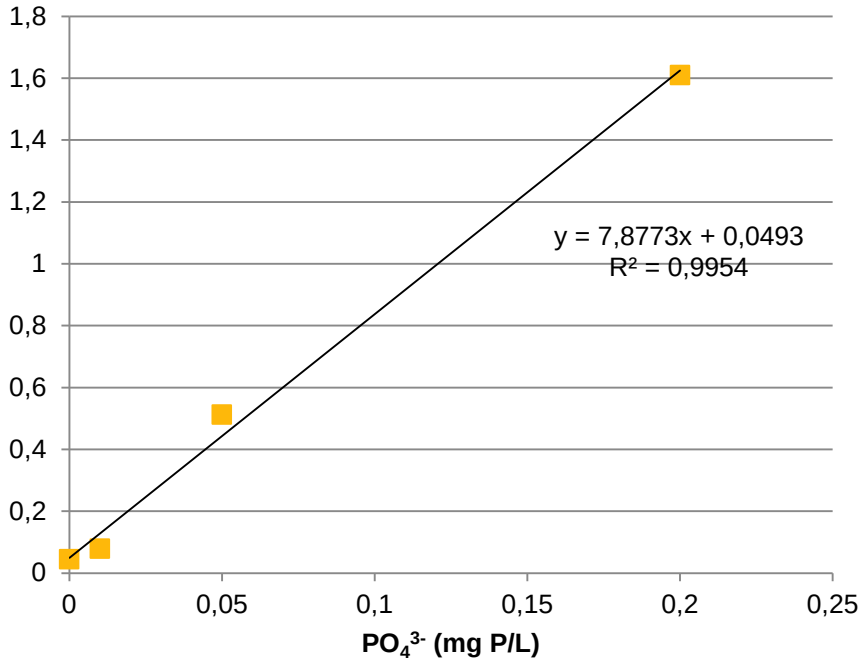
Land-use in local watershed

- 130 000 residens in the local catchment
- Omnipresent agriculture with abundent use of fertilizers
- Clay soils with poor water infiltration in the flats
- Sandier soils in the mountain region



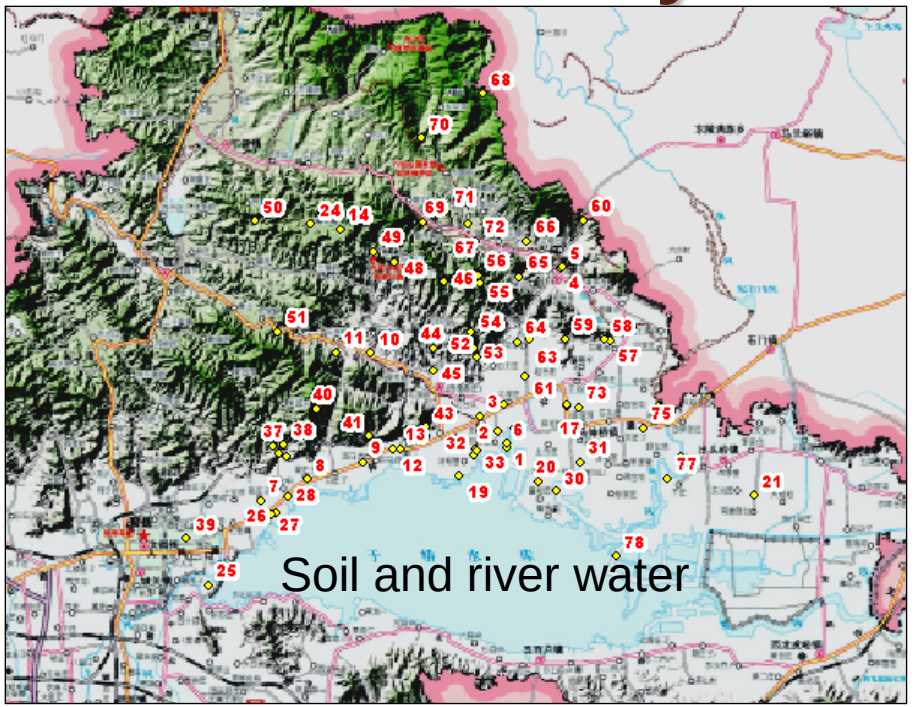
NIVA intercalibration, with TAES and RCEES

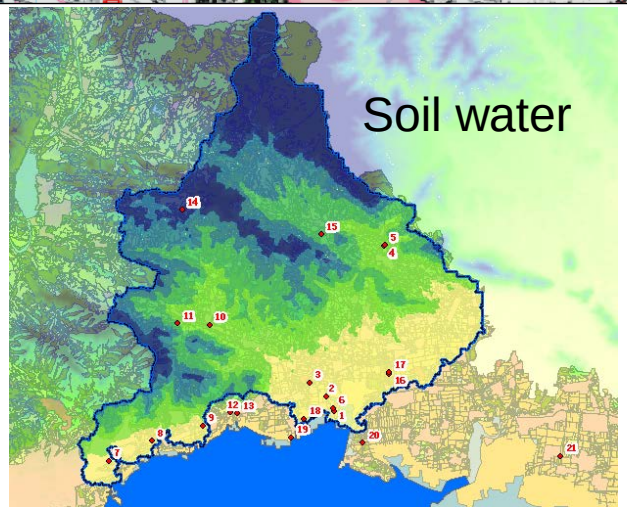




Water samples collected and analyzed

- 154 water samples
  - River:112
  - Soil water: 25
  - Rain: 11
  - Ground water： 2
  - Reservoir: 1





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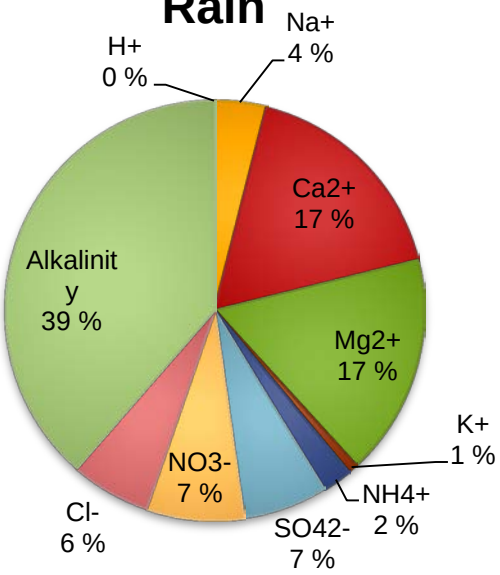
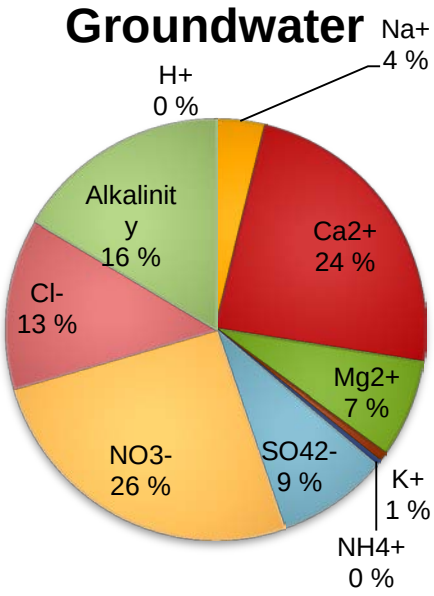
Water Chemistry

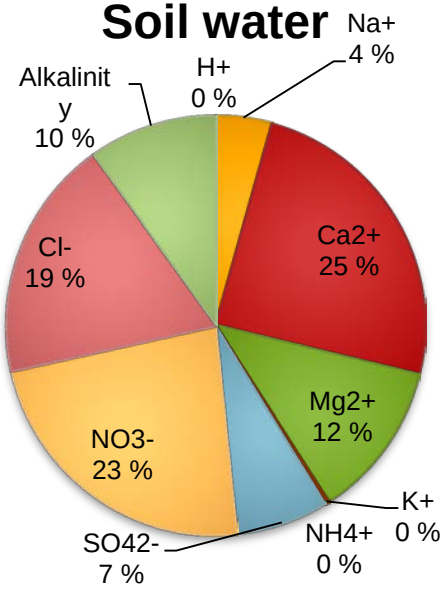
Rain



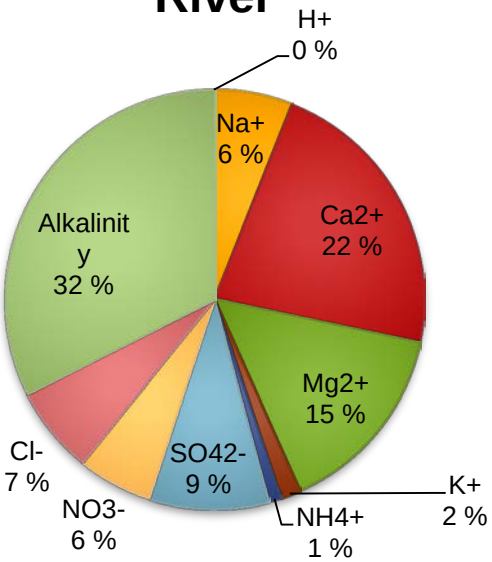
Groundwater



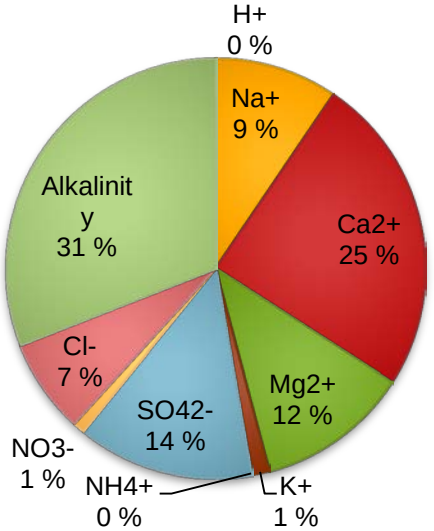
Soil water



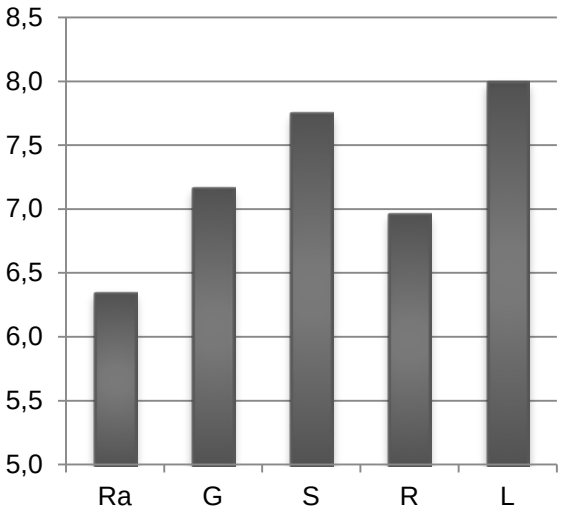
River



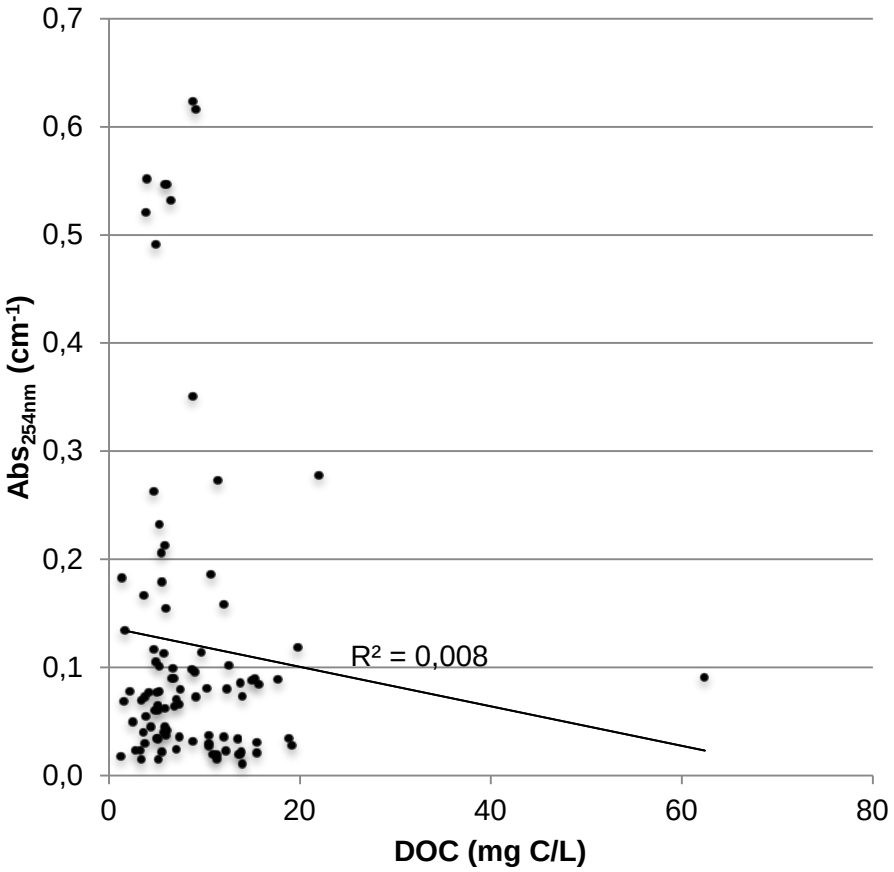
Lake

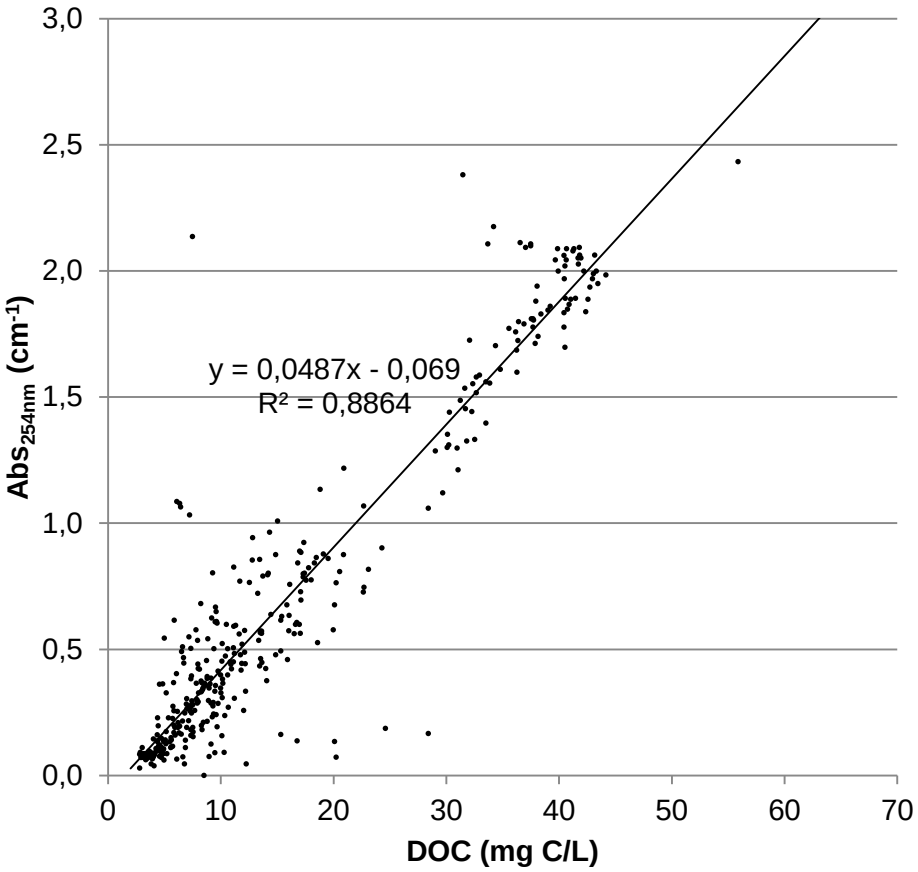


pH



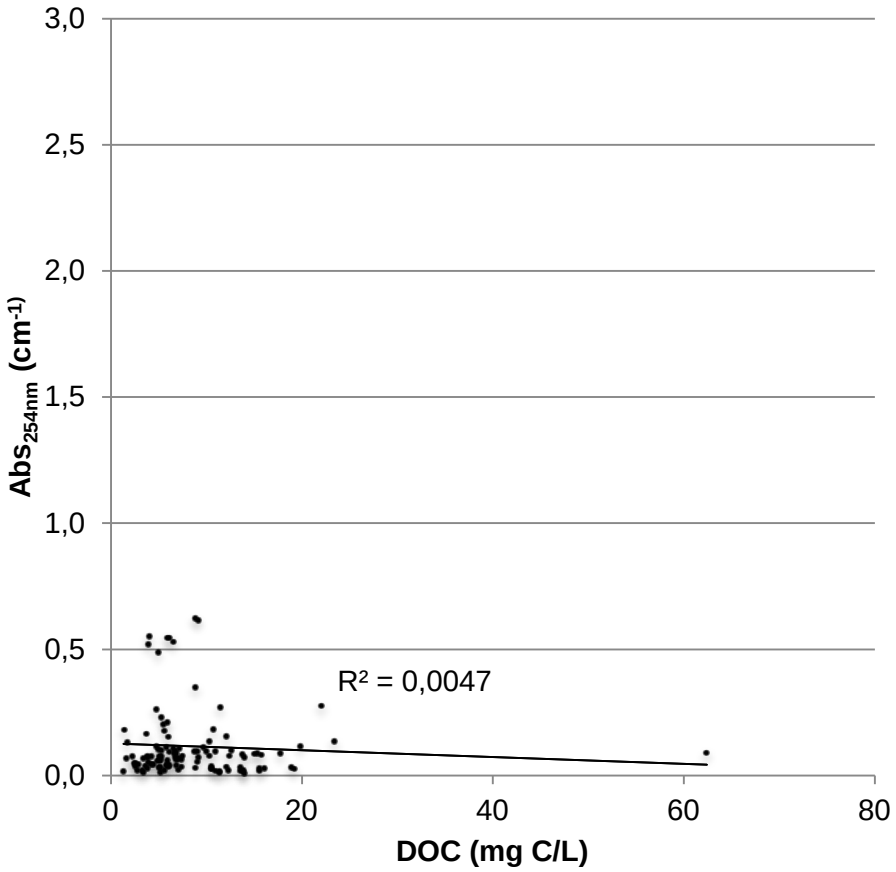
Water Chemistry: Organic Matter

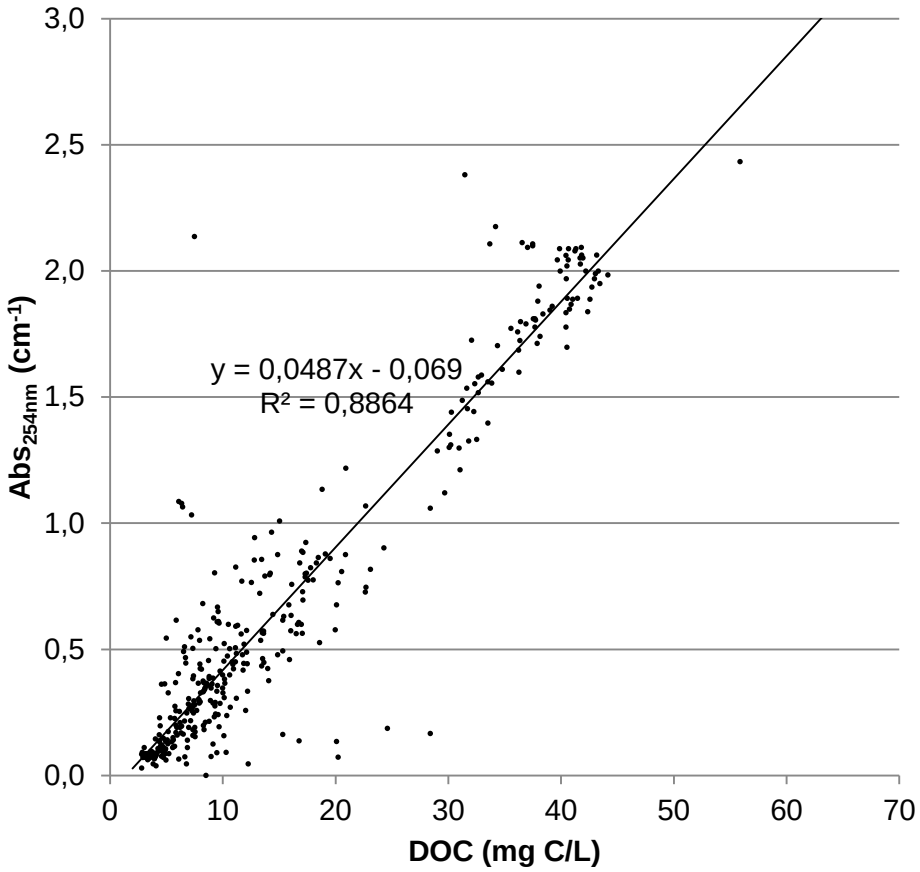




EUTROPIA water chem. data

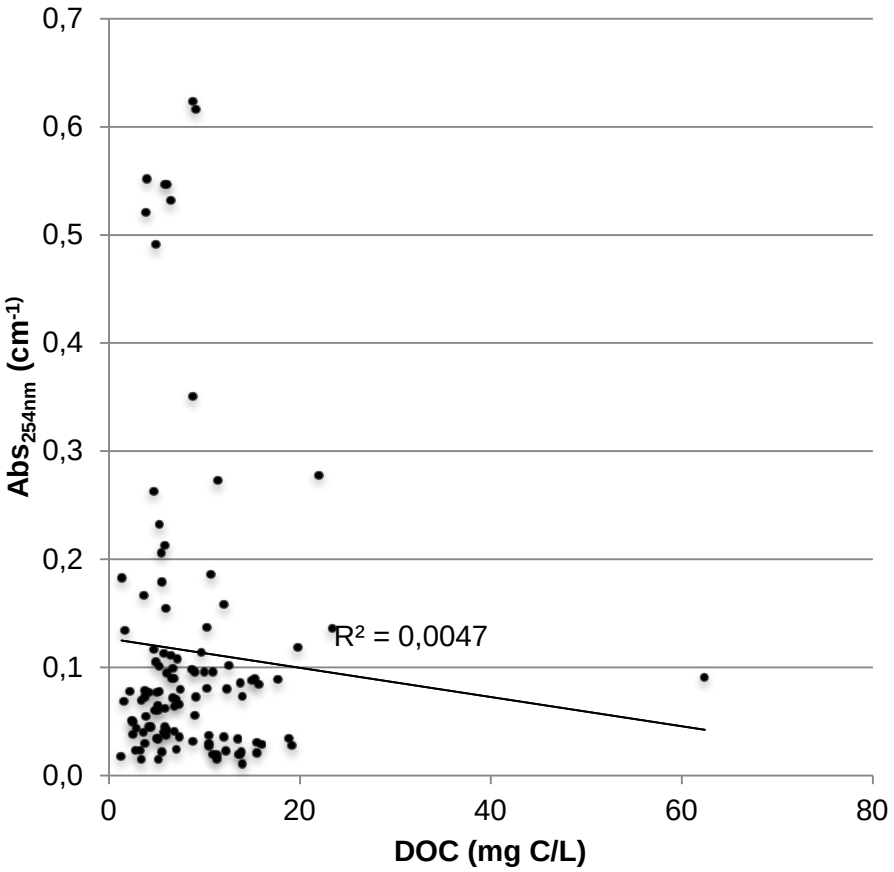
Water Chemistry: Organic Matter





EUTROPIA water chem. data

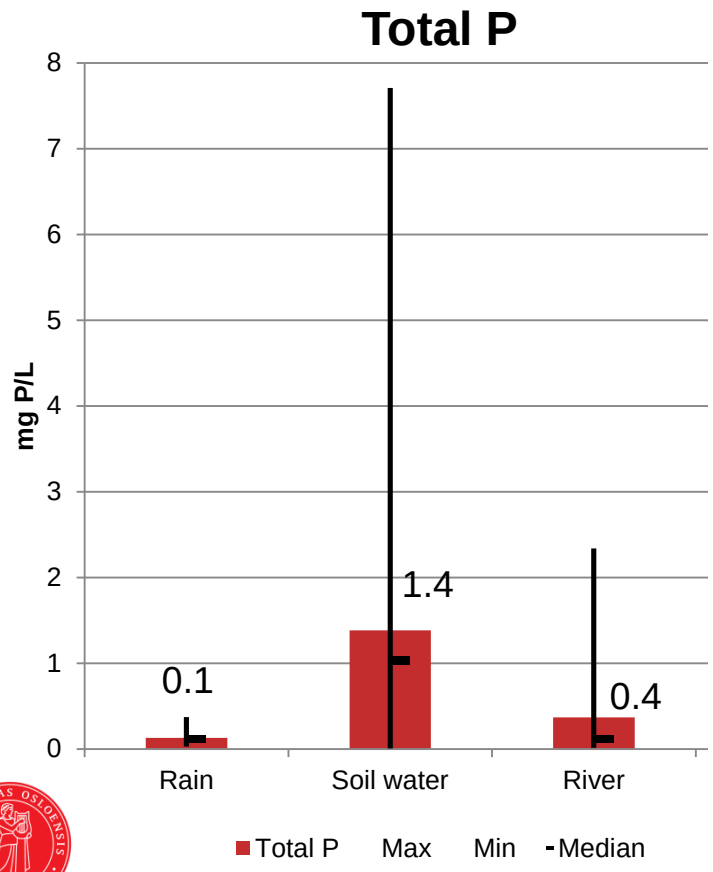
Water Chemistry: Organic Matter

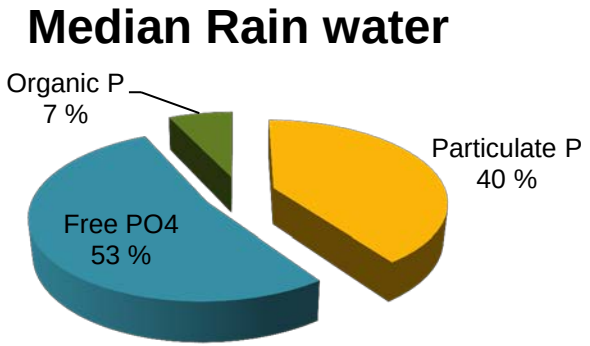


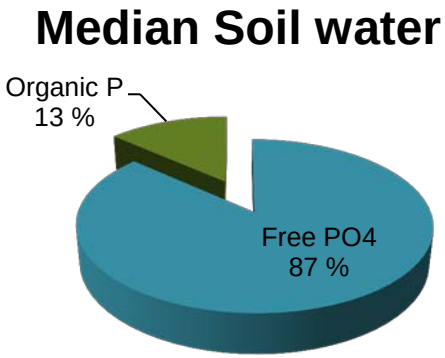
- No correlation between Abs at 254nm and Total Organic Carbon
- Organic matter has a low degree of aromaticity
- Manure and sewage water possibly makes up much of the organic matter

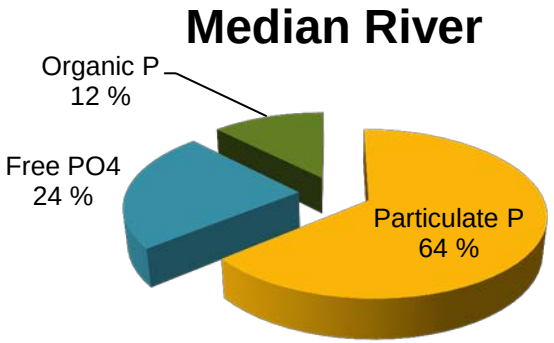
P fractions

- Large variation in soil water
- Suprisingly high values in rainwater
  - Pure rainwater ~50 ng P/L



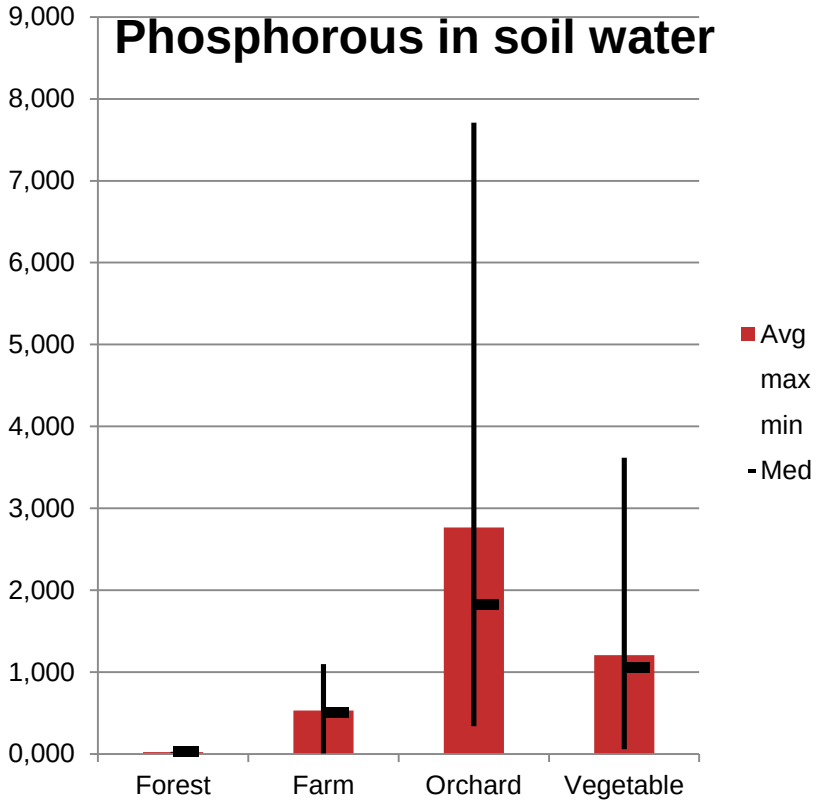




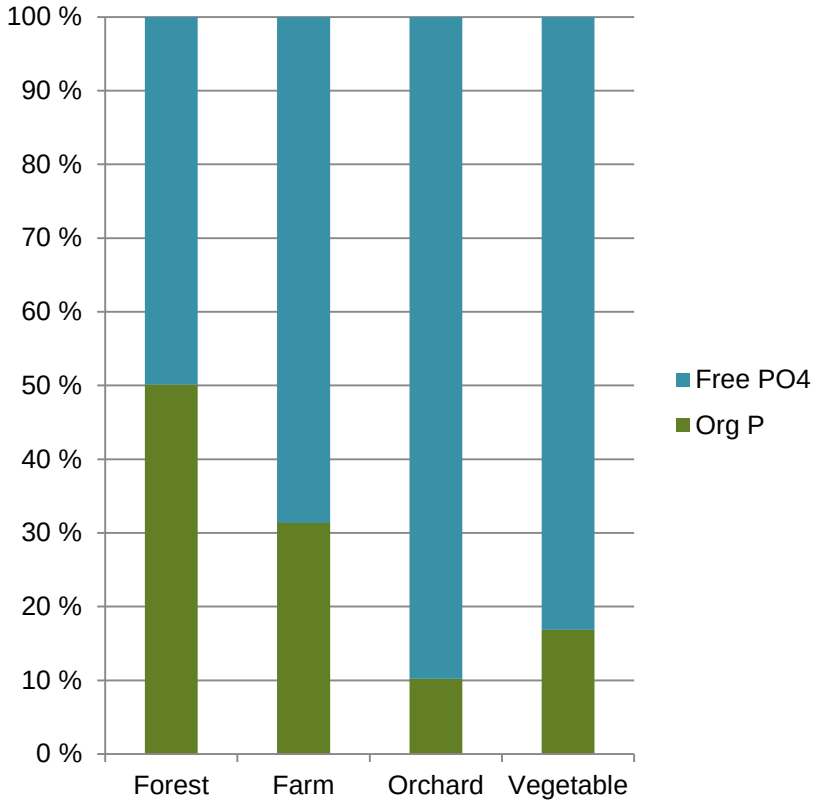


P in soil water

Surprisingly high values in orchards

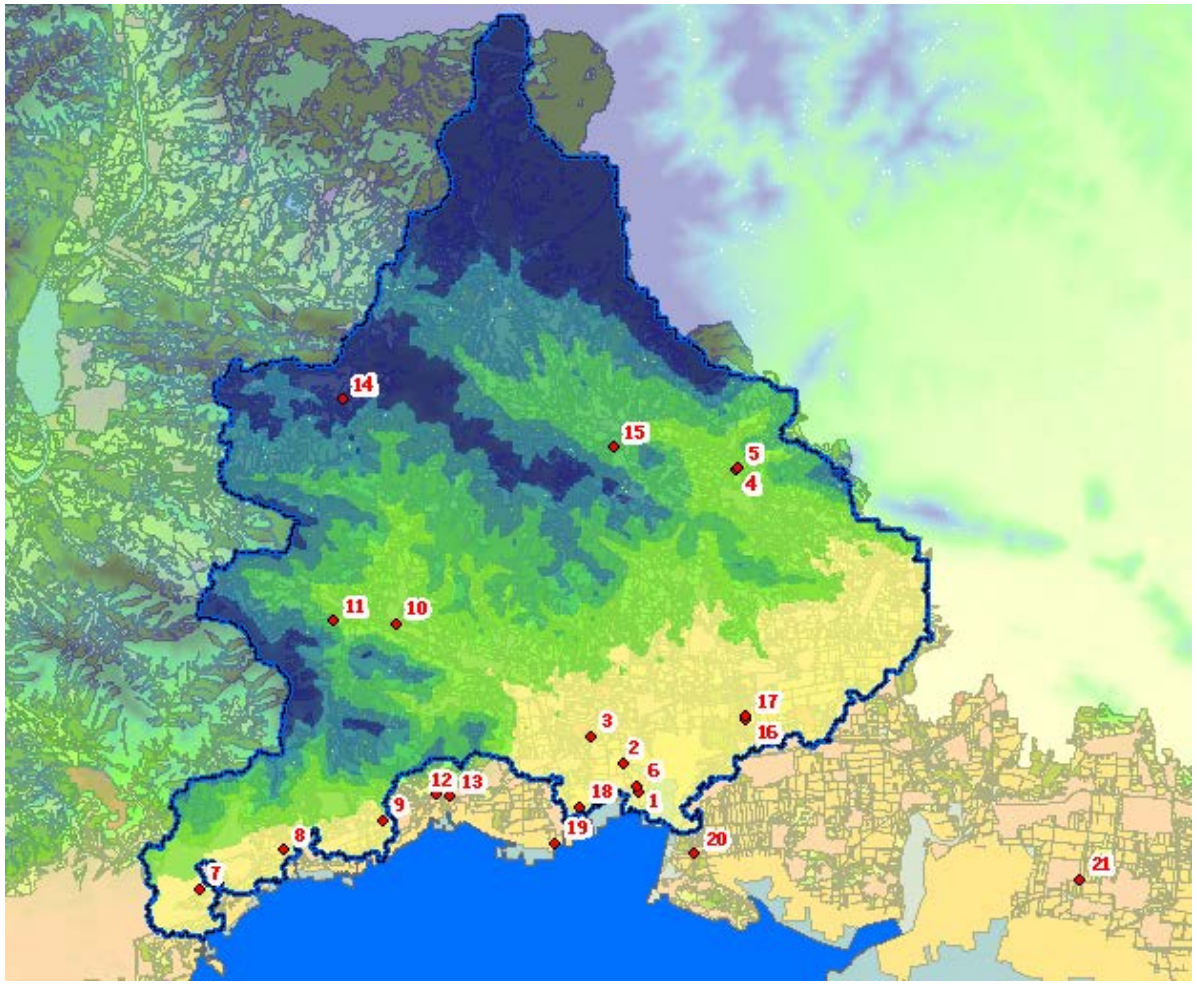


High Free PO_4 in Orchards



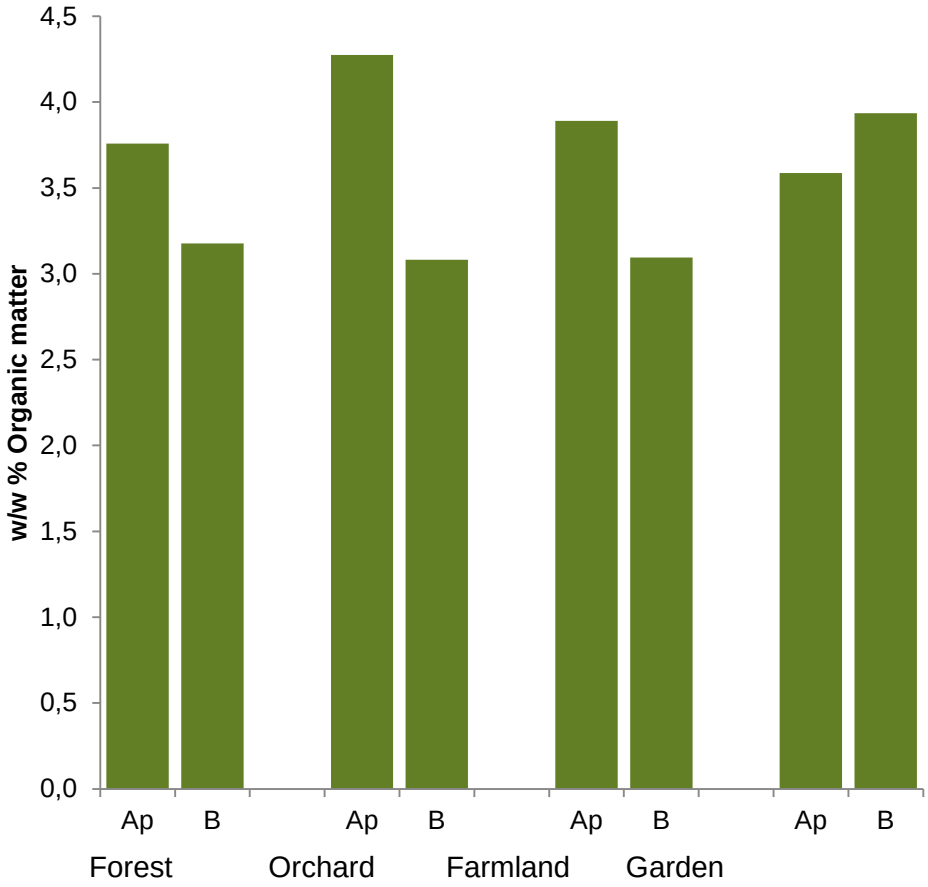
Soil samples

- 44 soil samples from sites where lysimeters are installed



Soil chemistry

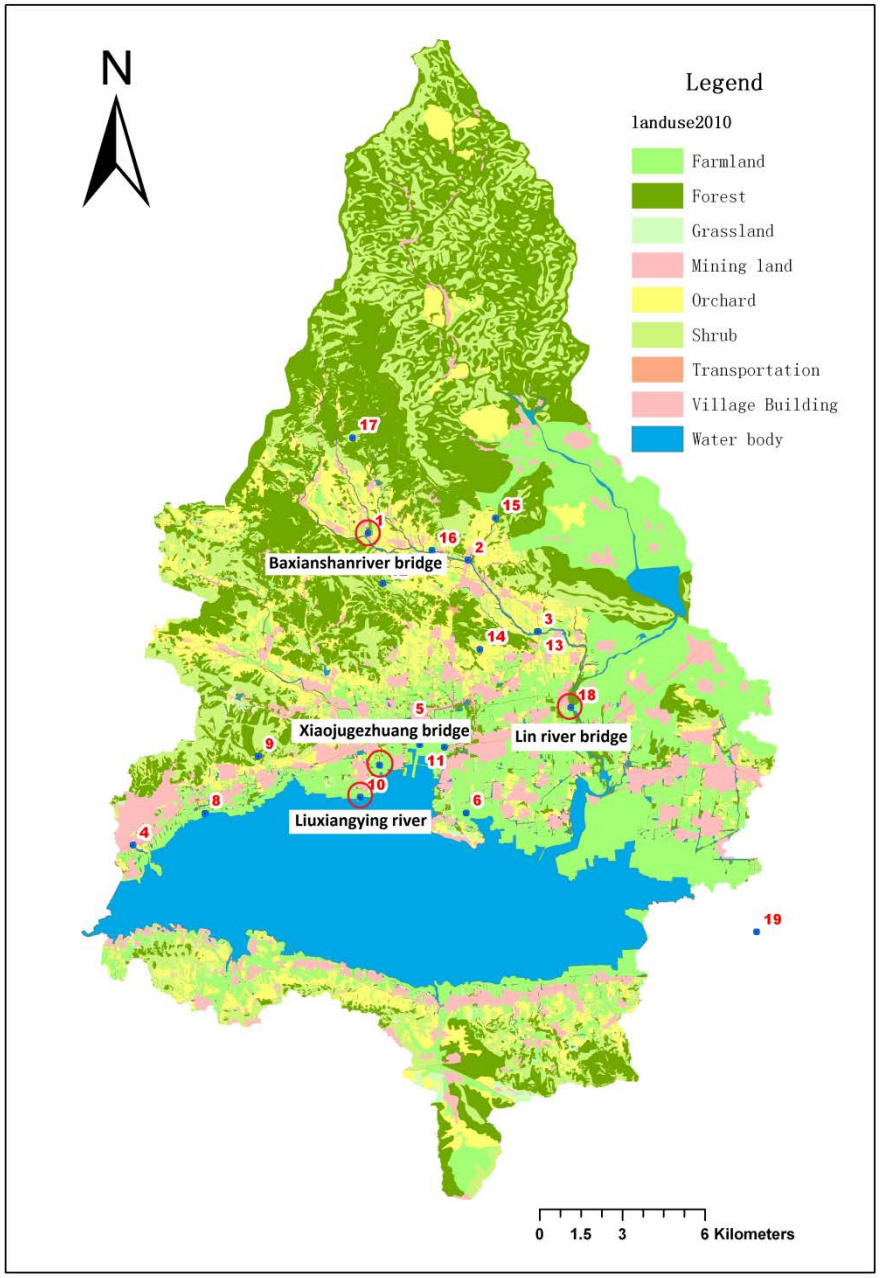
Low organic content
Typically it is usually higehst in the Ap

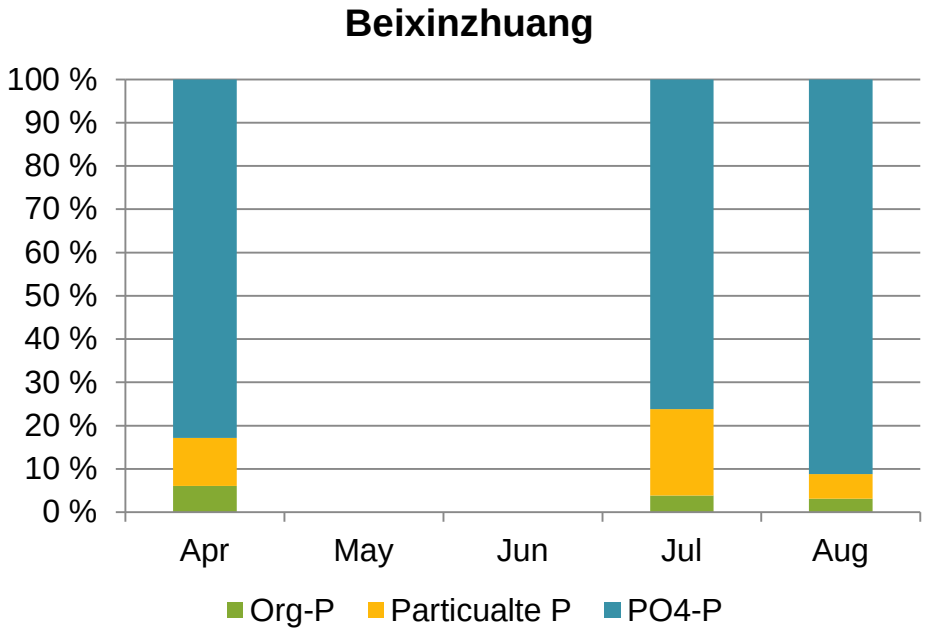


Episode studies

4 streams:

- Baxianshan river bridge
  - Mountain stream
- Lin river bridge
  - Major river
- Liuxiangying
  - Small stream
- Xiaojugezhuang bridge
  - Typical stream

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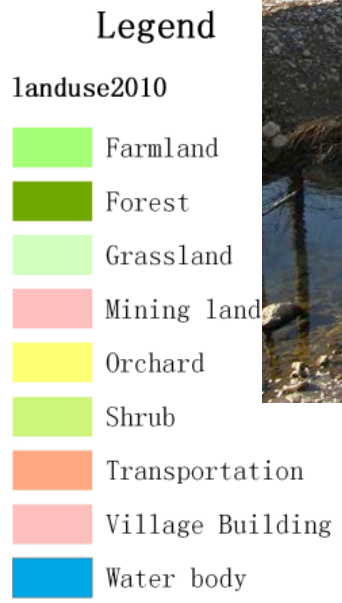
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landuse2010
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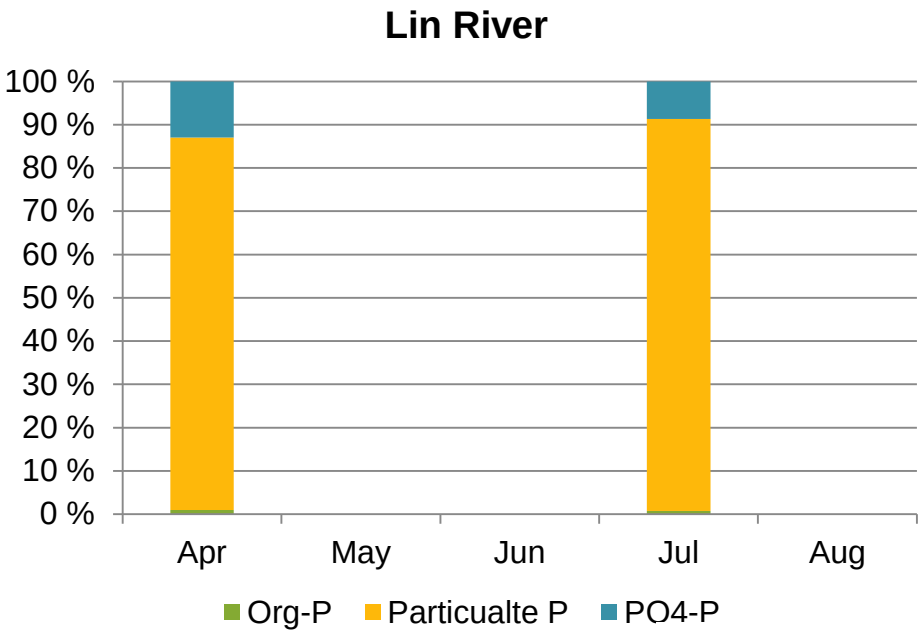
Forest
Grassland
Mining land
Orchard
Shrub
Transportation
Village Building
Water body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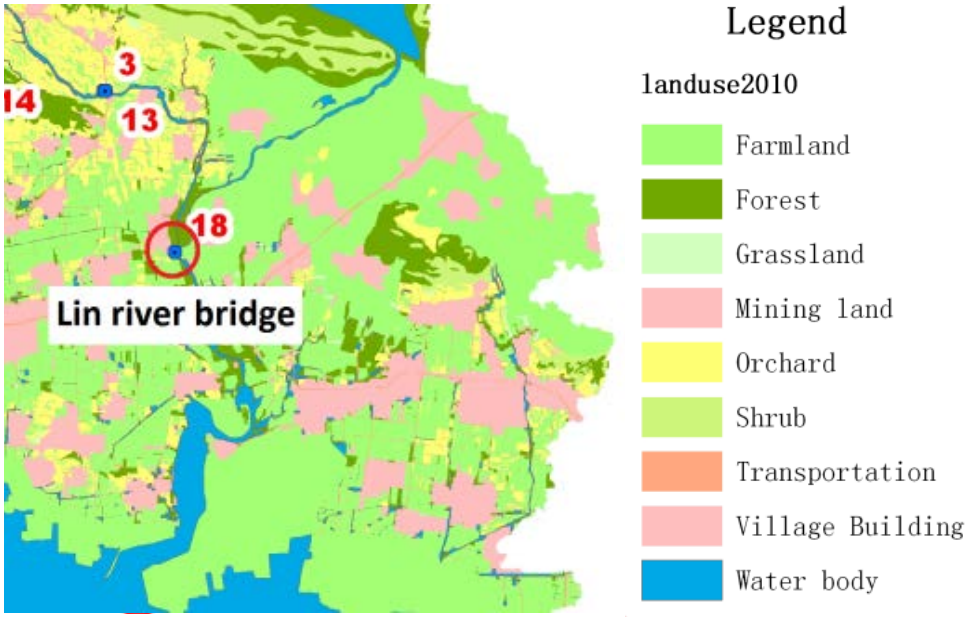
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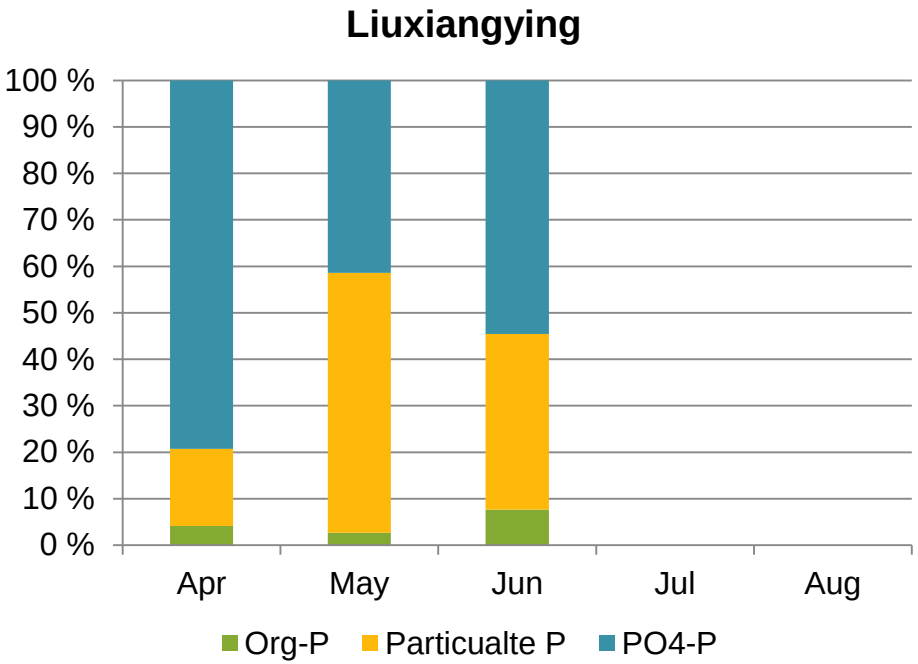
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Xiaojugezhuang bridge
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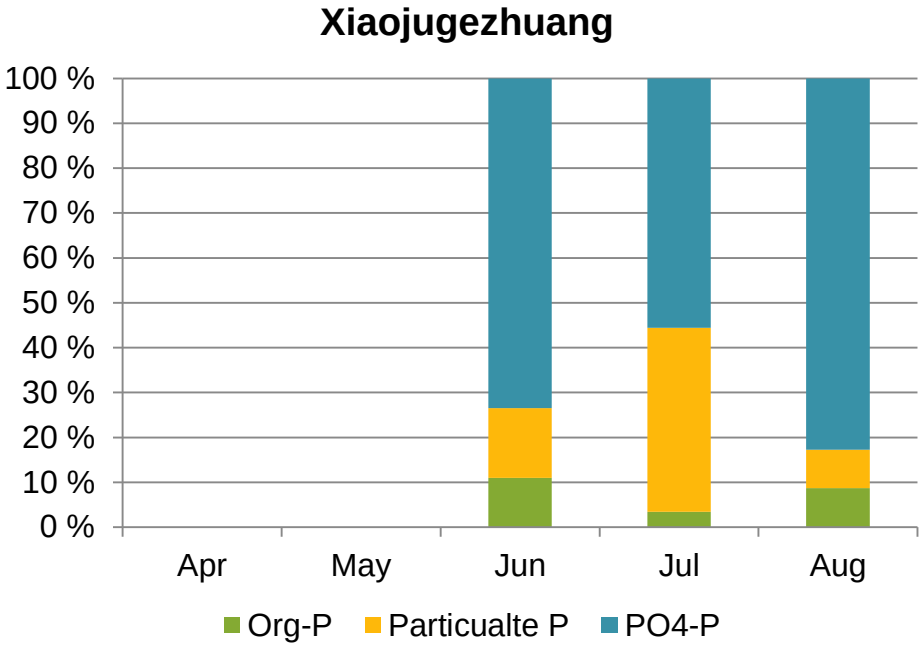
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Xiaojugezhuang bridge
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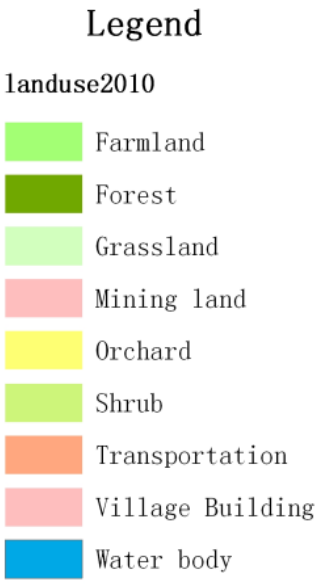
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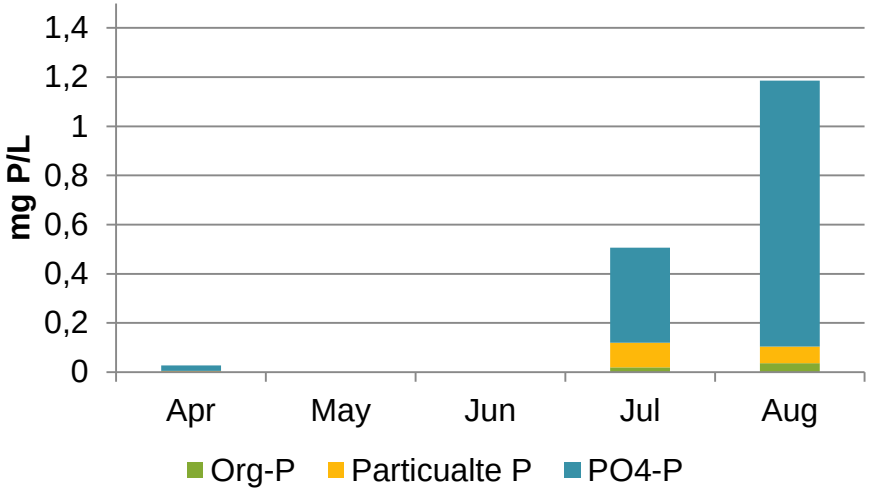
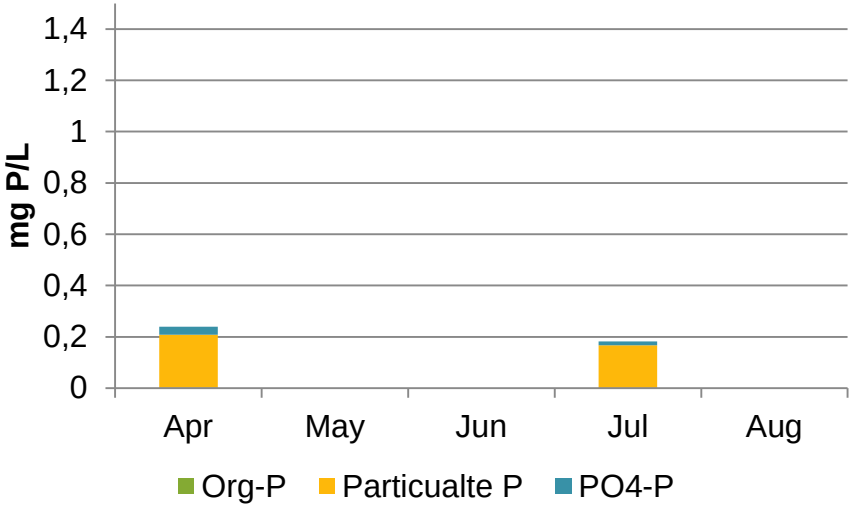
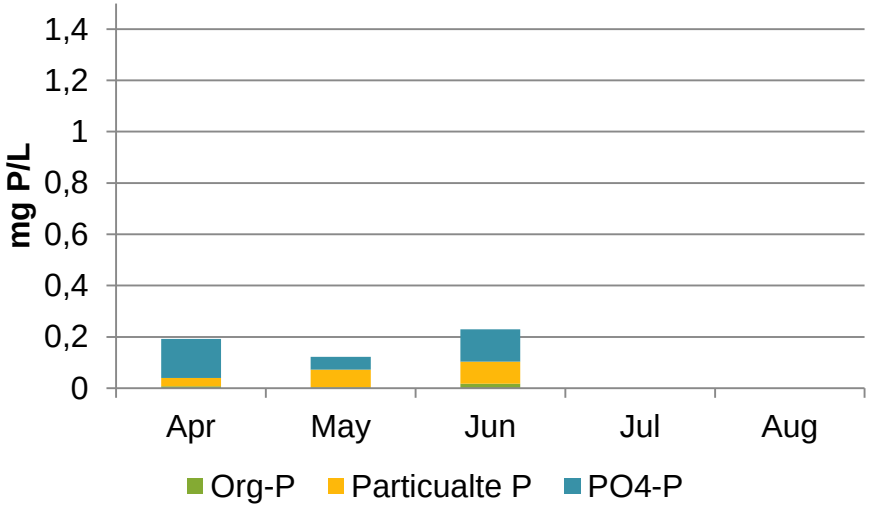


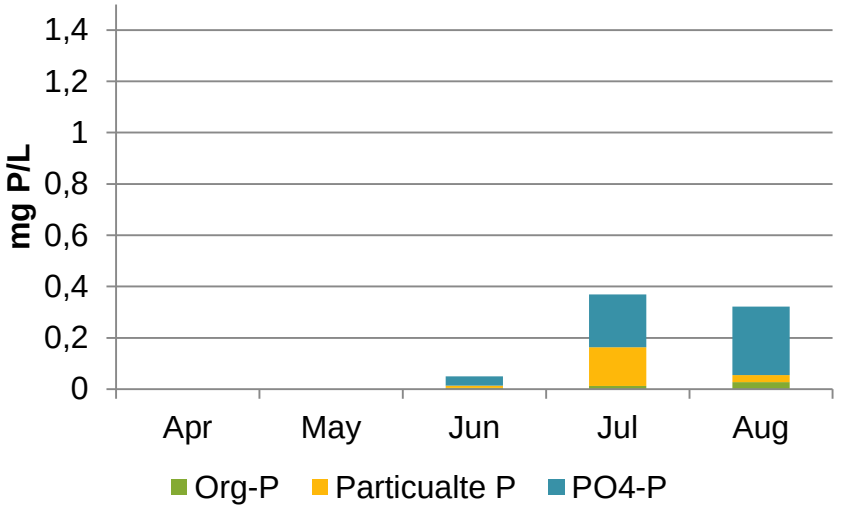
Lin River



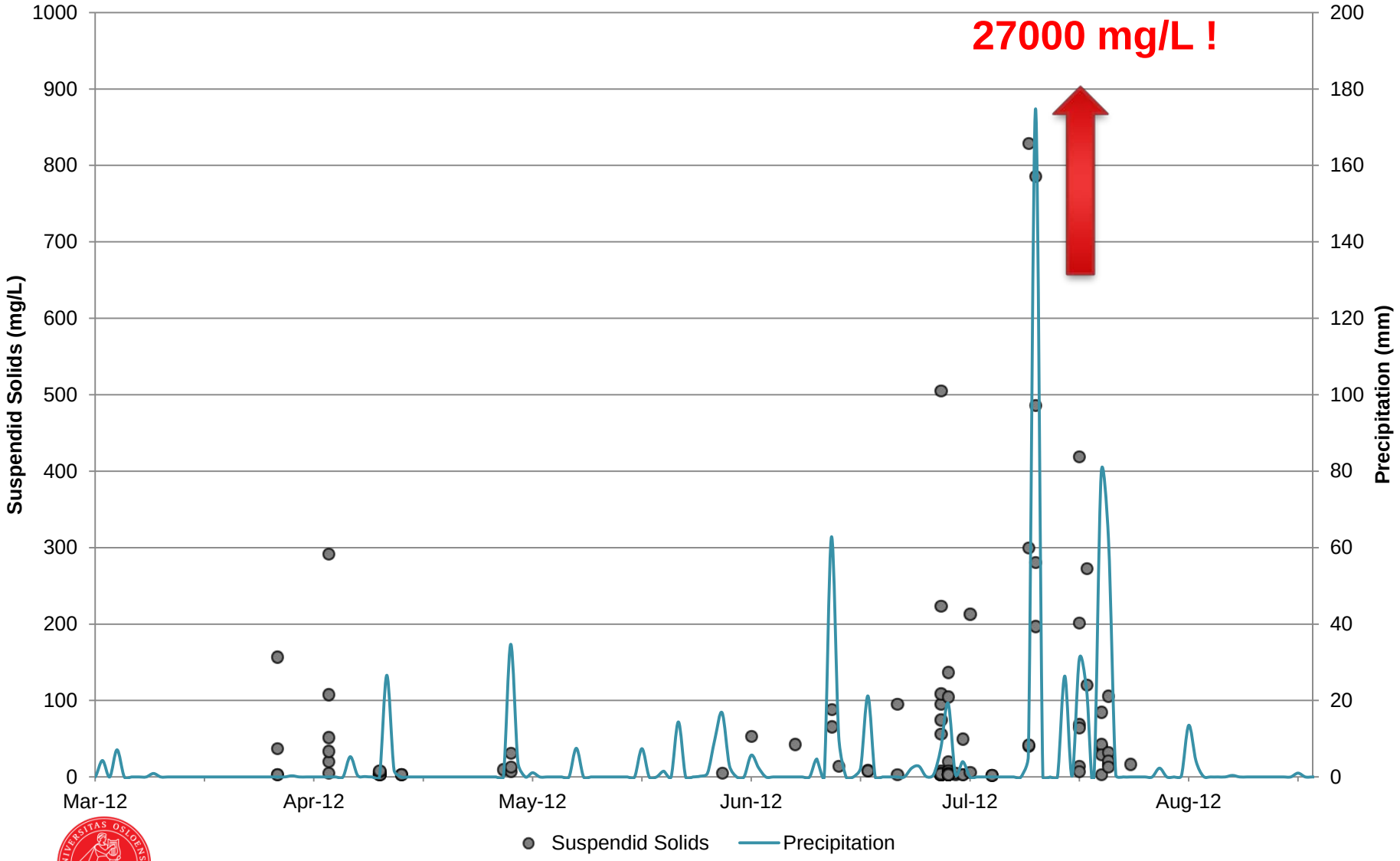
Liuxiangying



Xiaojugezhuang



Precipitation and Suspended solids



UiO : Department of Chemistry

Thank you for your attention