Sources of Water Pollution: A Multi-pollutant Perspective

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Messages

- A need for multi-pollutant approaches
- Agriculture and sewage are common sources of pollutants
- At least 50% of global population experience multi-pollutant issues
Eutrophication

Nitrogen

Phosphorus
A need for multi-pollutant approaches

- Multiple impacts
- Diverse interactions
- **Common sources**
- Effective solutions
Common sources of water pollution
Common sources for > 10,000 rivers
MARINA models: Model to Assess River Inputs of pollutants to sea

- Integration of processes
- Food-water-climate interaction
- Animal-crop interaction
- Spatially explicit
- Past, present and future

https://www.wur.nl/en/Research-Results/Chair-groups/Environmental-Sciences/Water-Systems-and-Global-Change-Group/MARINA-2.htm
MARINA Family

In short, MARINA is a Model to Assess River Inputs of pollution to seas.

We develop the MARINA family consisting of interdisciplinary, sub-basin scale models. Our MARINA models focus on multi-pollutant issues under global change. The models aim to quantify the levels of multiple pollutants in water, their sources, and trends in relation to interactions between climate and socio-economic systems at different scales in time (annual, seasonal) and space (past, present and future). The models are used to explore effective solutions under global change.

MARINA sub-themes

Our MARINA models are developed along the four pollution sub-themes: Nutrients, Plasctics, Antibiotics and Multiple Pollutants. These sub-themes consist of specific versions of the models. We invite you to visit the sub-themes that illustrate the model descriptions and examples of the modelling outcomes.

MARINA video’s

Curious to learn more about water pollution in general and on how to use the MARINA models? We invite you to take a look at our MARINA video channel.

https://www.wur.nl/en/Research-Results/Chair-groups/Environmental-Sciences/Water-Systems-and-Global-Change-Group/MARINA-2.htm
Model evaluation – “building trust” approach

Option 1: Comparing modelled nutrient fluxes with empirical studies

Option 2: Comparing modelled nutrient trends with empirical studies

Option 3: Sensitivity analyses

Option 4: Comparing model inputs with other independent datasets

Option 5: Expert knowledge

Option 6: Comparing model results with other modeling studies

Scientific trust in model performance

Strokal et al. (2016), (2021)
Common sources of water pollution
Agriculture: a source of nutrients, pathogens, and antibiotics
Agriculture: a source of **nutrients**, pathogens, and antibiotics

Preliminary results

Nitrogen in rivers per sub-basin area (kg/km²/year)

- 0 - 500
- 501 - 1000
- 1001 - 2500
- 2501 - 5000
- 5001 - 21443

Natural diffuse

Point (e.g., sewage systems)

Anthropogenic diffuse (e.g., chemical fertilizers)

Wang et al (in prep)
Agriculture: a source of **nutrients**, pathogens, and antibiotics

Preliminary results
Agriculture: a source of nutrients, pathogens, and antibiotics

Inputs of nitrogen, phosphorus and pathogen to rivers from livestock in 2010

Li et al (2022) Water Resources
https://doi.org/10.1016/j.watres.2021.117906
Agriculture: a source of nutrients, pathogens, and antibiotics

Inputs of nitrogen, phosphorus and pathogen to rivers from livestock in 2010

Li et al. (2022) Water Resources
https://doi.org/10.1016/j.watres.2021.117906
Agriculture: a source of **nutrients, pathogens, and antibiotics**

**Preliminary results**

**Shares of 5 classes** of antibiotics in Tetracyclines group (%)
- Chlortetracycline
- Tetracycline
- Methacycline
- Dcyccycline
- Oxytetracycline

**Excretion of tetracyclines** in pig manure in sub-basin (kg/year)
- Low
- High

Qi Zhang et al (unpublished)
Common sources of water pollution

- Pathogens
- Chemicals
- Nutrients
- Plastic
Sewage systems: sources of multiple pollutants in rivers

Nitrogen (kgN/km²/year)

Phosphorus (kgP/km²/year)

Strokal et al (2019)
Sewage systems: sources of multiple pollutants in rivers

- **Nitrogen** (kgN/km²/year)
- **Phosphorus** (kgP/km²/year)
- **Microplastic** (kgMP/km²/year)
- **Triclosan** (gTCS/km²/year)
- **Cryptosporidium** (pathogen) \( (10^{17} \text{ oocysts/km}^2/\text{year}) \)

![Maps showing distribution of pollutants](image)

Strokal et al (2019)
Sewage systems: sources of multiple pollutants in rivers

Nitrogen (kgN/km²/year)
Phosphorus (kgP/km²/year)
Microplastic (kgMP/km²/year)

Triclosan (gTCS/km²/year)
Cryptosporidium (pathogen) ($10^{17}$ oocysts/km²/year)

Strokal et al (2019)
Messages

- A need for multi-pollutant approaches
- Agriculture and sewage are common sources of pollutants
- At least 50% of global population experience multi-pollutant issues today
“A multi-pollutant perspective matters for water quality and its pollution sources”
Webinar 2

Water quality drivers

Perspectives on climate and pollution sources

Dr. Michelle van Vliet
Associate professor
Geosciences
Hydrology and quality
Pollution drivers

Dr. Maryna Strokal
Assistant professor
Multi-pollutant modelling
Water pollution
Sources and trends
Webinar 2: discussion

- Which **tools** (approaches) can we use to analyze **drivers of water quality and water scarcity**?

- [www.menti.com](http://www.menti.com)
- **41 95 59 8**
Highlights

Webinar series

Water quality in a changing world: status, drivers, impacts and optimistic futures

1. Water quality status | June 28
   Perspectives on lakes and surface waters

2. Water quality drivers | July 5
   Perspectives on climate change and pollution sources

3. Water quality impacts | September 14
   Perspectives on food and health

4. Water quality impacts | October 4
   Perspectives on optimistic futures with effective solutions
To explain **nutrient pollution** in water we need to better understand what is happening on the land.

Both **rivers and lakes** are important elements of the landscape system.

What are sources of water pollution in your own home country?

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**Webinars 1 (status)**

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**Dr. Arthur Beusen**
Researcher
Geosciences
Earth Sciences
Geochemistry

**Dr. ABG (Annette) Janssen**
Researcher
Lakes, algae
Nutrient pollution
Critical loadings

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Go to www.menti.com and use the code 6106 4885

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What great research ideas would we able to work out?
Webinars 2 (drivers & sources)

Dr. Michelle van Vliet
Associate professor
Geosciences
Hydrology and quality
Pollution drivers

Dr. Maryna Strokal
Assistant professor
Multi-pollutant modelling
Water pollution
Sources and trends

“Quality matters for water scarcity and its drivers”

“A multi-pollutant perspective matters for water quality and its pollution sources”

Which tools (approaches) can we use to analyze drivers of water quality and water scarcity?
Webinar 3 on impacts - 14 September

Water quality impacts | September 14
Perspectives on food and health