Sub-basin scale modelling of nutrient export by rivers to coastal waters of China

Maryna Strokal

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Key messages for China:

1. Rivers transport too much nutrients, causing coastal eutrophication
2. Animal production is the main reason of coastal pollution by nutrients
3. High risk for coastal eutrophication in the future
Nutrient pollution of coastal waters in China

Research objective

To quantify nutrient export by large Chinese rivers to coastal waters by source from sub-basins.

Sub-basin scale modelling:
- Dissolved inorganic nitrogen
- Dissolved inorganic phosphorus
- 1970, 2000, 2050
Sub-basin scale modelling: a new approach

UP-STREAM
Agriculture, urbanisation

MIDDLE-STREAM
Agriculture, urbanisation

DOWN-STREAM
Agriculture, urbanisation

Nutrient removal and retention

River export of nutrients

River mouth (Coastal waters)

Sub-basins:
Up-stream → Middle-stream → Down-stream

Yellow River
Yangtze River
Pearl River

Coastal waters
Gridded database (0.5 by 0.5 degree cell)

Bouwman et al., (2009); Van Drecht et al., (2010); Fekete et al., (2010)

Information for China and its provinces

Ma et al., (2012); Moréé et al., (2013)

Global Reservoir and Dam Database

Lehner et al., (2010)
River export of dissolved inorganic nitrogen

kton year\(^{-1}\)

2050: a globalized world with fast economic development
(Alcamo et al., 2010; Seitzinger et al., 2010)

Sub-basins:
- Up-stream
- Middle-stream
- Down-stream

Yellow

Manure discharged to water
Manure used in agriculture
Fertilizer used in agriculture
Deposition and fixation
Human waste used in agriculture
Human waste discharged to water
Human waste from sewage systems
River export of dissolved inorganic nitrogen

kton year^{-1}

2050: a globalized world with fast economic development
(Alcamo et al., 2010; Seitzinger et al., 2010)

Sub-basins:
- Up-stream
- Middle-stream
- Down-stream

2-fold↑

Manure discharged to water
Manure used in agriculture
Fertilizer used in agriculture
Deposition and fixation
Human waste used in agriculture
Human waste discharged to water
Human waste from sewage systems
River export of dissolved inorganic nitrogen

- River export of nitrogen **increases fast over time**
- **Animal manure** is the main reason of this increase
- **Synthetic fertilizers** are the reason for the Yangtze and Pearl rivers

**2050:** a globalized world with fast economic development

*(Alcamo et al., 2010; Seitzinger et al., 2010)*

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**Sub-basins:**
- Up-stream
- Middle-stream
- Down-stream

**Coastal waters**
River export of dissolved inorganic phosphorus

kton year\(^{-1}\)

- **Yellow River**
  - 1970: 0.5 kton
  - 2000: 2.5 kton
  - 2050: 4.0 kton
  - Manure discharged to water
  - Human waste from sewage systems
  - Fertilizer used in agriculture

- **Yangtze River**
  - 1970: 15 kton
  - 2000: 30 kton
  - 2050: 45 kton
  - Manure discharged to water
  - Human waste from sewage systems
  - Fertilizer used in agriculture

- **Pearl River**
  - 1970: 5 kton
  - 2000: 15 kton
  - 2050: 35 kton
  - Manure discharged to water
  - Human waste from sewage systems
  - Fertilizer used in agriculture

Sub-basins:
- **Up-stream**
- **Middle-stream**
- **Down-stream**

Globalized world with fast economic development (Alcamo et al., 2010; Seitzinger et al., 2010)

Human waste from sewage systems

Fertilizer used in agriculture

Coastal waters
Main conclusions

1. Rivers transport too much nutrients, causing coastal eutrophication.

2. Human activates at middle- and down-stream areas:
   - Animal production: responsible for 5-70% of nutrients
   - Synthetic fertilizers: an important contributor for wet basins
   - Urbanisation: an important contributor for deltas

3. In the future:
   - High risks for coastal eutrophication
   - Efficient nutrient management in agriculture is required
Thank you for your attention!

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