Historical N load from land to East-China sea and riverine N_2O emission in East-Asia

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Conclusion

- The TIN load from land to sea in East-Asia was increasing during 1961 to 2010, however, the increasing trend of TIN loads from major rivers in East Asia has subsided and is becoming steady.
- The estimated riverine N_2O emission in East-Asia was 35 ~ 63 Gg-N Yr^{-1} during the period using VISITorN, which was less than the EF based estimate and the rate of increase was also lower than EF's trend.

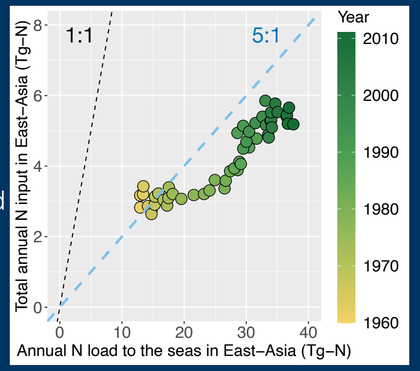


Fig.1 Total N input vs N load to seas in East-Asia during 1961-2010

Introduction

East-Asia is known to be a hotspot of reactive N (Nr) pollution and hence to be a biggest source of atmospheric N_2O among the global regions. In the last half century, the use of N fertilizer in this region was rapidly growing up. Not only N fertilizer, various non-point source of N (N deposition, manure) have also increased with land-use change (i.e., cropland expansion). Furthermore, East Asia is fast urbanizing in this period, which contributed increase of reactive N as a point source to a river via wastewater release.

In this study, we focused on the Total Inorganic N (TIN) load and in-stream N denitrification in rivers in East-Asia (and partially South-East Asia). It is essential to quantitively comprehend each Nr source and their historical trends for the effective Nr management in the watersheds and seas. In order to evaluate a historical N load of the rivers and riverine N_2O emission, we developed a simple off-line riverine N scheme for global ecosystem models, which simulate N cycling. This study aimed to evaluate historical N load to seas by the rivers and the contribution of major non-point sources and point sources to the N load to seas in East-Asia.

Fig.2 Simulated domain in this study

TIN load to seas in major East-Asian rivers

Fig.3 River mouths

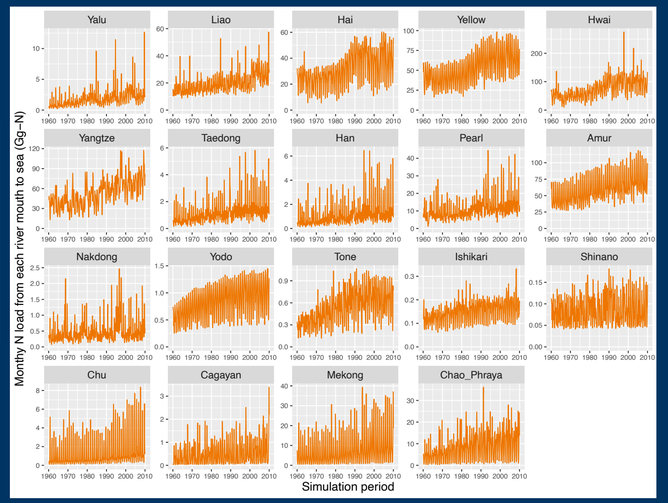


Fig.4 Long-term monthly riverine TIN load in 19 rivers in East-Asia

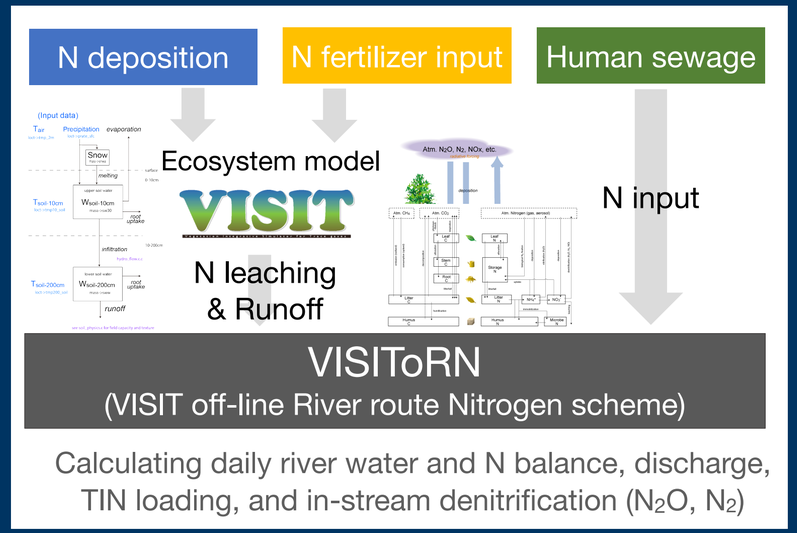
Material & methods

We used a process-based terrestrial ecosystem model "Vegetation Integrative SImulator for Trace gases (VISIT)" (Ito et al., 2018). Spatial resolution is 0.5° × 0.5° in latitude and longitude. Simulation period was 1961-2010. Simulated domain is shown in Fig 2. Climate was used in CRU TS3.25 dataset. In this study, we used the simulation results of ecosystem model "VISIT" (Ito et al., 2018) for runoff and N leaching values from natural and cropland ecosystems which are major non-point sources of reactive nitrogen. The list of major N input as follow;

- Land-use: Hurrt et al. (2011)
- N fertilizer: Wang et al. (2020), Nishina et al. (2017)
- N manure: Wang et al. (2020),
- N deposition: Dentener et al. (2006)
- Human sewage: Bouwman et al. (2005)

In river denitrification process, we assumed Michaelis–Menten-type kinetics in "VISIToRN" (VISIT Off-line River Nitrogen scheme). Right figure summarize the simulation setup in this study.

Simulation scheme



N load map

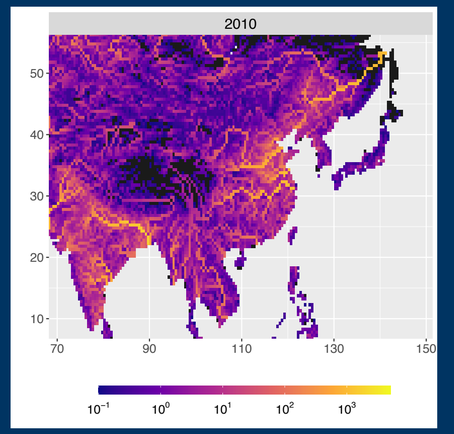


Fig.5 Spatial annual gridded N load in 2010

Riverine N_2O emit.

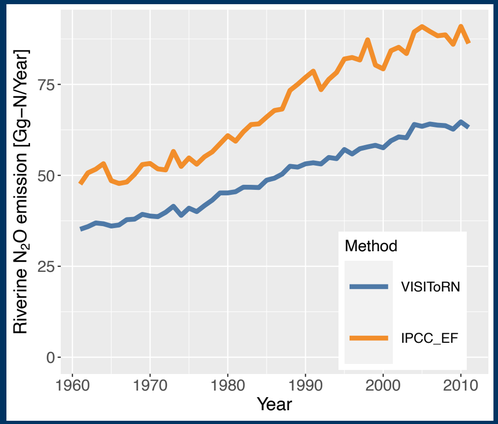


Fig.6 Riverine N_2O emission from East-Asia rivers