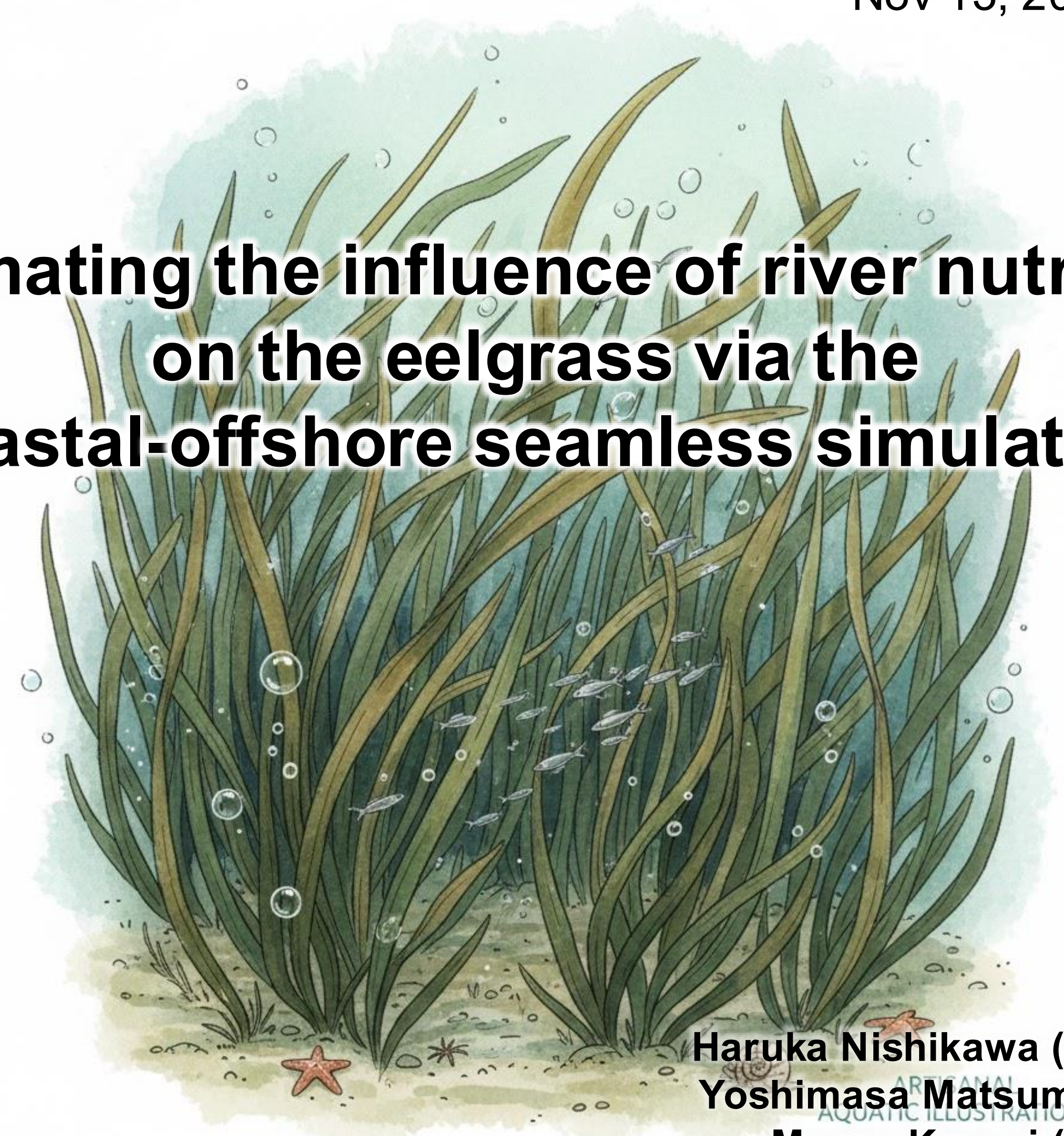
Nov 13, 2025, 11:40–11:55

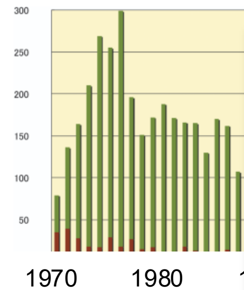


Estimating the influence of river nutrients on the eelgrass via the coastal-offshore seamless simulation

Haruka Nishikawa (JAMSTEC)
Yoshimasa Matsumura (NIES)
Masao Kurogi (JAMSTEC)
Dai Yamazaki (IIS, Univ. Tokyo)
Hiroyasu Hasumi (AORI, Univ. Tokyo)

Urbanization and Coastal environment

In Japanese coastal area



Occurrence of red tide

However, for seagrasses such as eelgrass, which absorb nutrients not only from the water but also through their roots, research has not progressed (Yoshida et al., 2011).

1960s

With urbanization, domestic wastewater flowing into rivers increased, leading to rapid coastal eutrophication and a rise in red tides.

1990s

Red tides decreased.
Decline in fishery catches began to be reported.

Research has progressed from the perspective that a moderate input of nutrients is necessary for coastal fisheries.

Red tide
https://www.rd.ntt/se/media/article/0053.html

1970s

Peak of red tide occurrences.
Legislations to regulate wastewater discharge was established.

2000s

It has become clear that **cultural oligotrophication** is occurring. (Yamamoto et al., 2003)

It is reported that Inland sea is clearer than coral reef sea.

Why eelgrass?

Eelgrass is cosmopolitan species in the northern hemisphere.

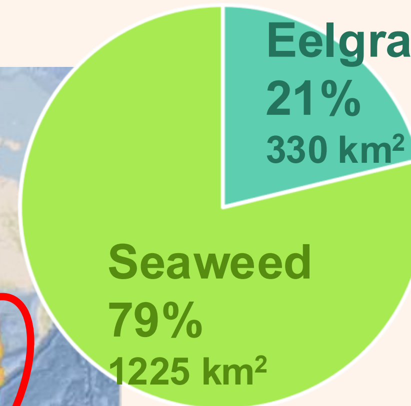
Distribution of the eelgrass (*Zostera marina*)
Gundersen et al. (2017)

Essential habitat of many fish.

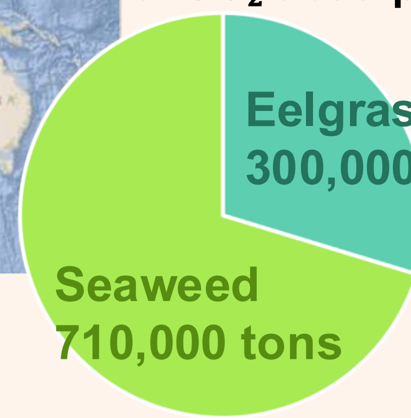
TOKYO ZOO NET
https://www.tokyo-zoo.net/topic/topics_detail?link_...m=21718

In Japan

Proportion of eelgrass in seaweed beds



Annual CO_2 absorption



Important resource of the blue carbon.

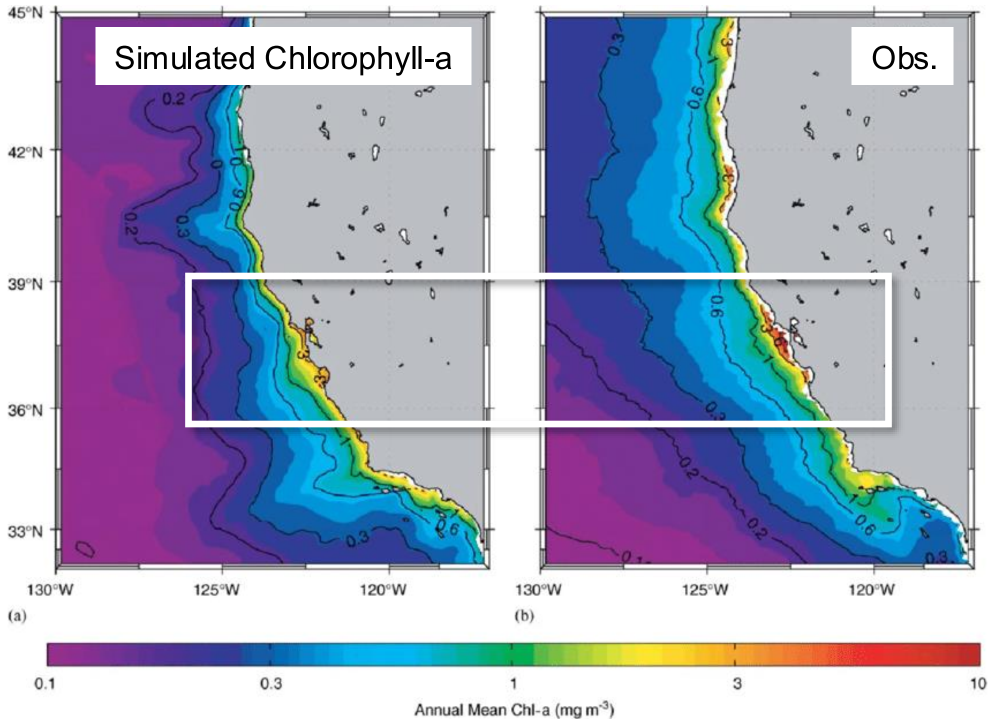
Question

While the importance of riverine nutrient inputs to coastal ecosystems has been highlighted, eelgrass can absorb nutrients through grounds by roots and therefore it is thought to be less affected by nutrient concentrations in the water column.

However, there are few research on **how resilient eelgrass is to changes in nutrient concentrations in the water column**.

Because it is difficult to determine observationally whether eelgrass use the nutrients originated from river, we approach this issue using a lower-trophic ecosystem model.

Data and method: NPZD model



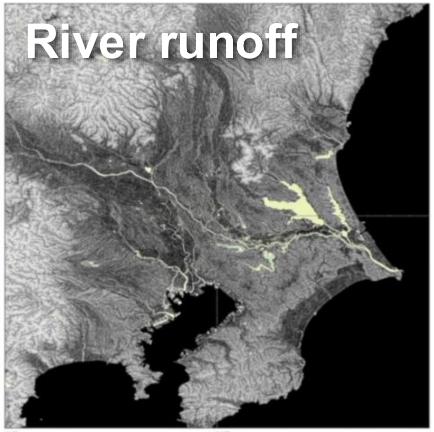
Example of Chl-a reproducibility
Spatial resolution: 15km
Gruber et al. (2006)

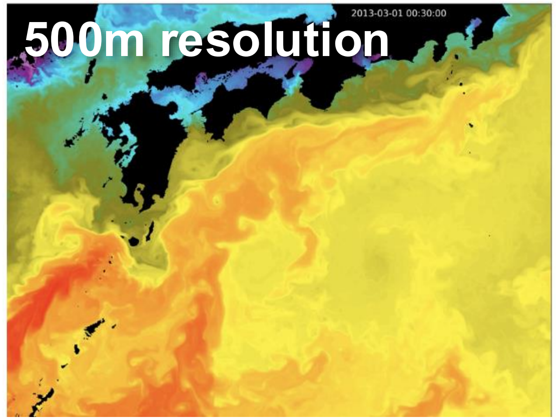
Obviously, the coastal ecosystem depends on **riverine nutrients**. But the coastal ecosystem also use the **nutrients transported from the offshore** which is supplied through the water exchange between coastal and offshore.

Reproduce the riverine nutrients: **river resolving model**
Reproduce the offshore nutrients: offshore nutrients supplied by the basin scale phenomena (e.g. seasonal monsoon), **so it needs basin scale model**.

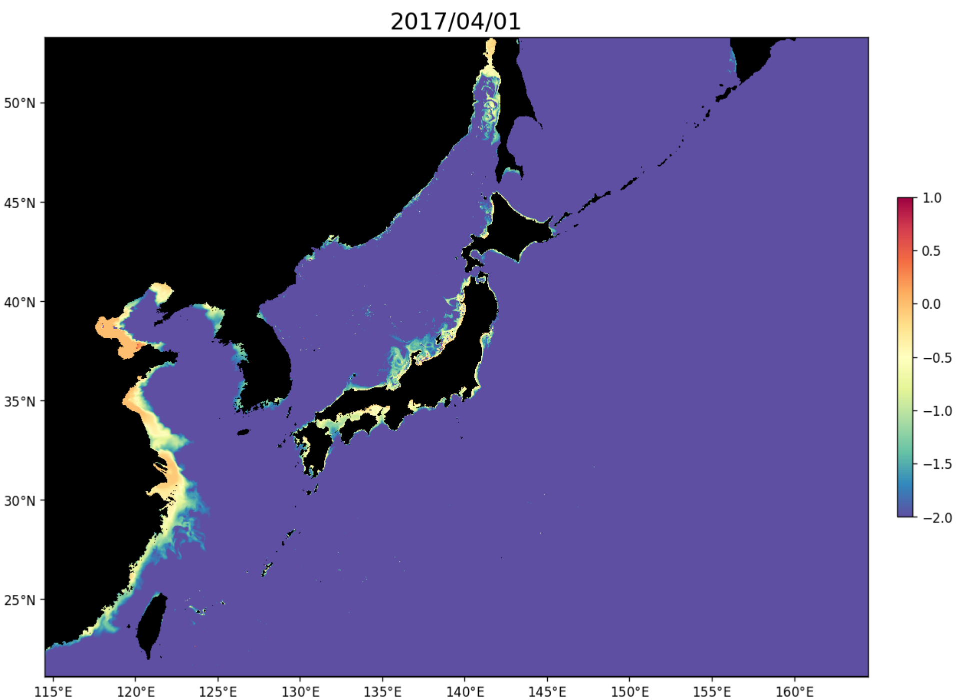
We develop a model with river resolving and wide area, which can link the offshore and coastal areas seamlessly.

Data and method: NPZD model





Our model
500 m hydrodynamics model covers the Northwestern Pacific coupled with NPZD model with/without a **2 mg/L nutrient input from rivers**.
Matsumura et al. (in prep.)



An example of the model

Distribution of the $\dfrac{NPP_{input} - NPP_{no\text{-}input}}{NPP_{input}}$

This comparative experiment revealed that riverine nutrients account for 11% of NPP on the continental shelf.

Data and method: Eelgrass model

の開発と現地検証

金澤 剛[1]・鯉渕幸生[2]・磯部雅彦[3]

Kanazawa et al. (2006)

は光が十分に届き，海底の地

Input:
Nutrients, temperature and light

Output:

- **Shoots biomass**
- **Roots biomass**
- **Nutrient concentration in the shoots and roots**

We focused on the shoots biomass.

dS/dt = growth rate – N transportation from shoots to roots – respiration - mortality

Growth rate depends NO_3 in the water, NH_4 in the water and NO_3 in the ground.

Our experiment

NO_3 in the water: Input the N value of the NPZD model with/without riverine nutrients.

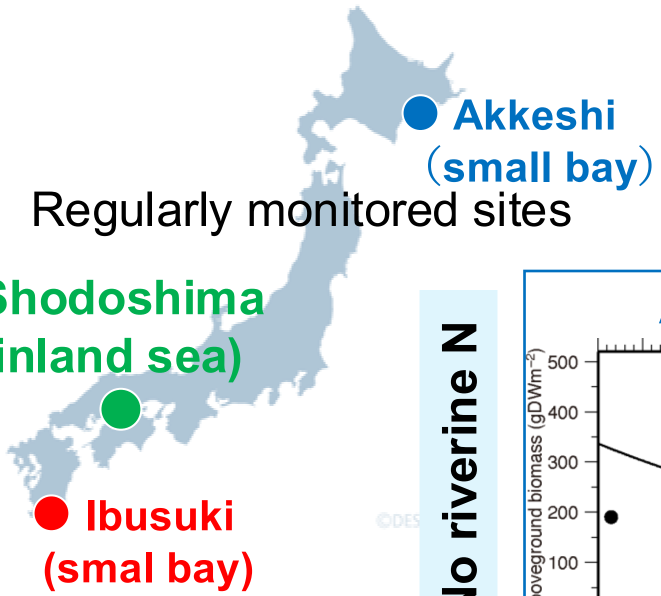
NH_4 in the water: Fix at the half saturation constant.

NO_3 in the ground: Fix at the half saturation constant.

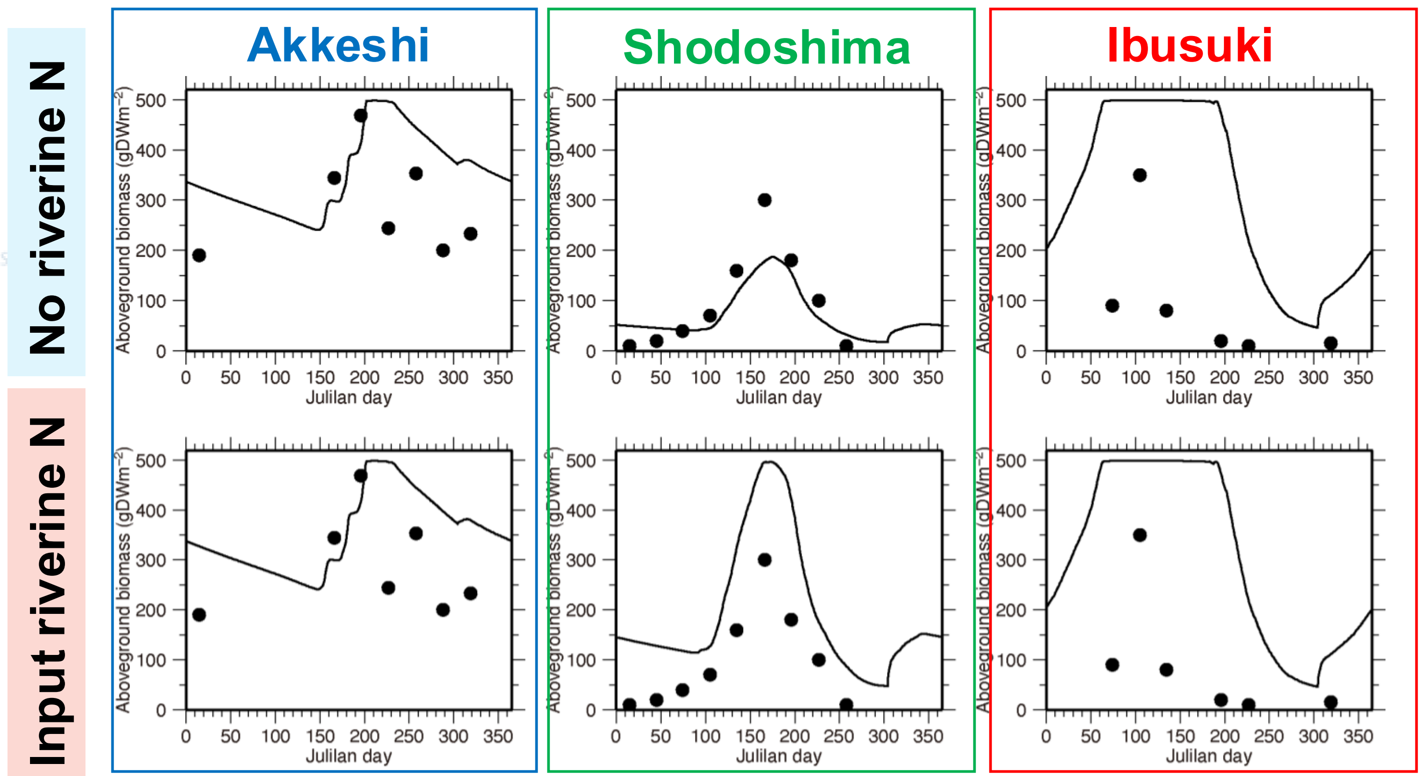
Simulation period: Jan. 1 to Dec. 31, 2018

Results: Reproducibility

Regularly monitored sites



Comparison of eelgrass shoots biomass between simulation (—) and observation (●) in the three sites.



Seasonality is roughly reproduced.

No differences between models are observed in Bay area (Akkeshi and Ibusuki).

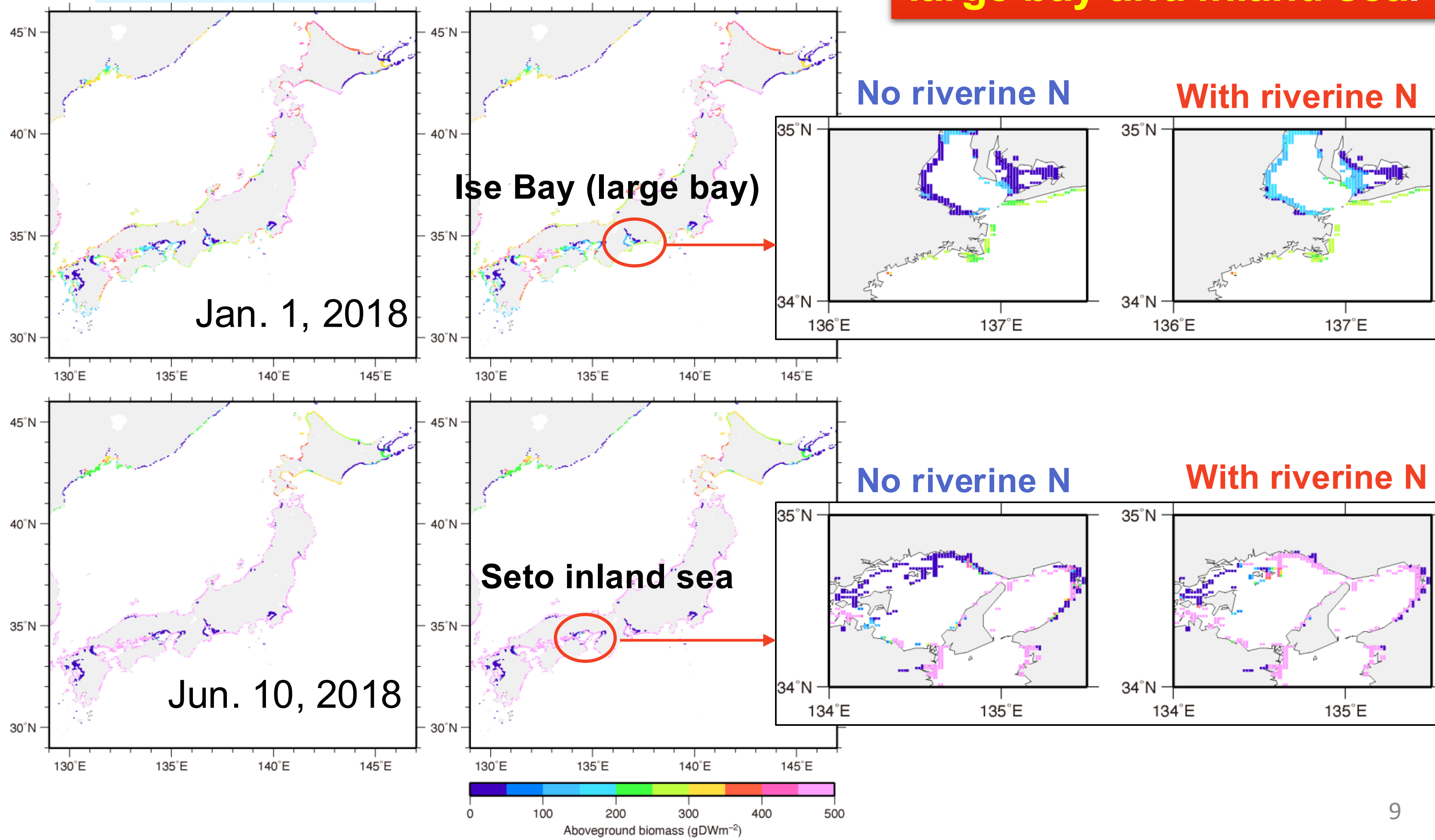
Riverine nutrients affects the shoots biomass in the inland sea (Shodoshima).

Results: Where is the influence of the riverine N strong?

Remarkable differences observed in the large bay and inland sea.

Distribution of the shoots biomass

No riverine N | **Input riverine N**



Summary and Discussion

Summary

- We developed the first NPZD model for Japanese coastal waters that seamlessly links the offshore and coastal areas, while explicitly incorporating riverine nutrients.
- We demonstrated that the riverine nutrients can affect the eelgrass biomass in large bays and inland seas.

Since some areas with poor eelgrass growth were undergoing oligotrophication (Morita, 2013)**, the excessive regulation of urban wastewater discharge may lead to a decline in seagrass bed**.

Future works

- Evaluating the validity of assumptions used in this study, such as a fixed value for underground nutrients.
- Considering negative effects of eutrophic river runoff on eelgrass. For example, turbidity increase would inhibit photosynthesis.