Title

Annual Cycle and Budgets of Nutrients in the Yellow Sea : a model study

1. **Members' names and affiliations**

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2. **Aim**

This study aims to study the budgets and transformations of both DIN and PON in the Yellow Sea and quantify the spatial differences in the sources and sinks of nutrients in the area with an employment of three-dimensional coupled biophysical model (ECSECOM). What's more, it promotes cooperation and student exchange between Tianjin University of Science and Technology and the Center for Marine Environmental Studies (CEMS) of Ehime University.

3. **Procedure**

A three-dimensional coupled biophysical model (ECSECOM) was established to study the annual cycles and budgets of both dissolved inorganic nitrogen (DIN) and particulate organic nitrogen (PON) in the Yellow Sea,. We simulated the DIN and PON cycles in the Yellow Sea, calculated the annual budgets of nitrogen and analyzed the spatial distributions and seasonal variations of each sources and sinks of DIN and PON.

4. **Results**

Figure 1, and Figure 2 show horizontal distribution of simulated DIN and PON at the surface (2m depth) and bottom layer, where January represents winter, April represents spring, July represents summer, and November represents Autumn; water depth of 2 m represents the surface layer, and the vertical 20th layer of the model (the last layer of water column) represents the bottom layer. Figure 1 and Figure 2 indicate that: The DIN concentration decreases through spring and summer due to the spring blooms and reaches the lowest value in July, then increases greatly in autumn. The concentration of PON is low in winter and spring, and increases in summer and autumn following the growth of chlorophyll-a and peaks in November.

Figure 3 shows annual budgets of the nutrient in the Yellow Sea, while Atmos represents atmospheric deposition, Rege represents regeneration from benthic remineralization, Net prod represents net primary productivity, Dere represents remineralization of the detritus, Mort represents mortality of phytoplankton, Remi represents remineralization, Rsus and Sedi represents resuspend and sedimentation of PON. JJC means Jeju channel. ECS means East China Sea. BS means Bohai Sea. Regarding the budgets of DIN, primary production and respiration of phytoplankton are the most important sink and source of DIN. The remineralization of the detritus pool compensates 29.20% of the consumption of DIN by the primary production process, while external input of DIN accounts for

17.72%. There are 48.08% of PON converting to DIN, the most of the rest PON deposit to the sediment. The transformation rate from DIN to PON is 29.20%.

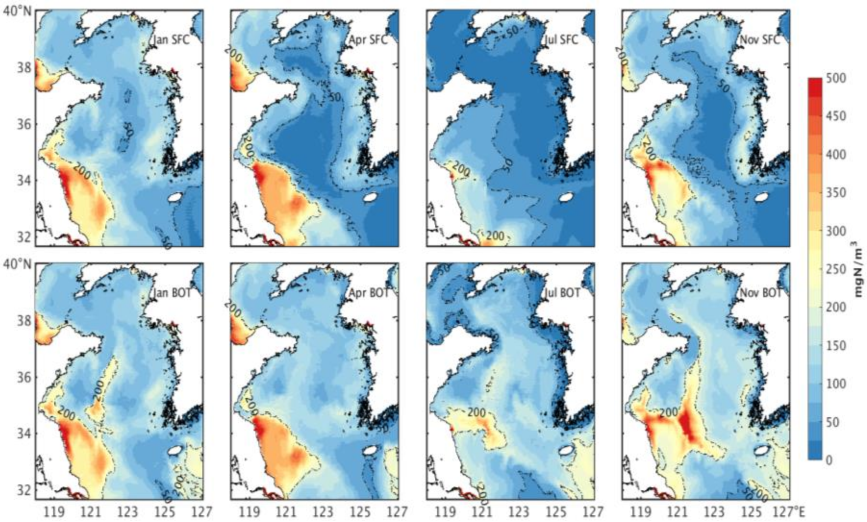

Fig.1 Horizontal distribution of simulated DIN at the surface (2m depth) and bottom layer

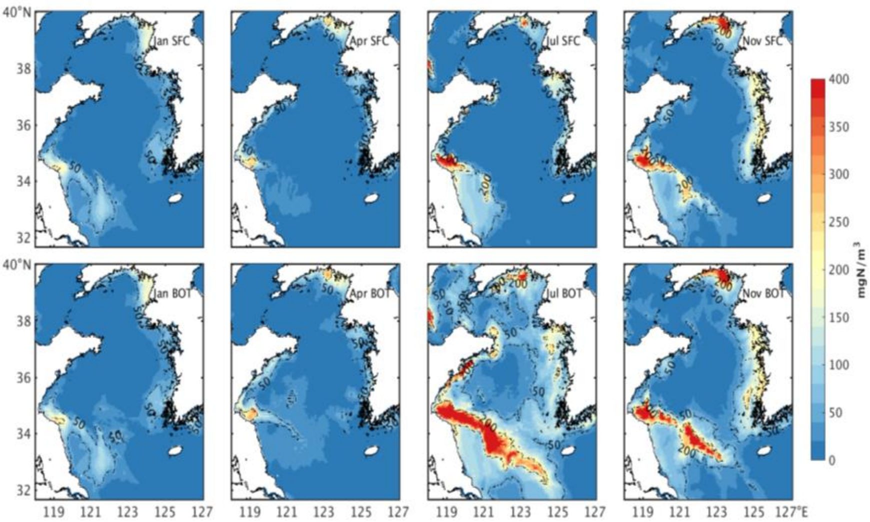

Fig.2 Horizontal distribution of simulated PON at the surface (2m depth) and bottom layer

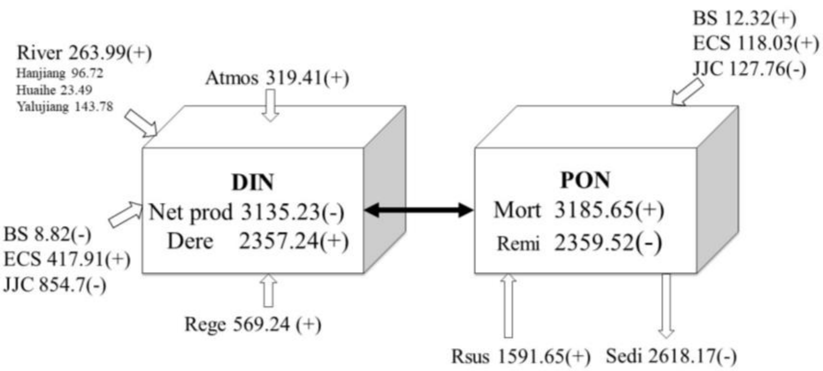

Fig.3 Annual budgets of the nutrients in the Yellow Sea (10^9gN/a)

Figure 4-6 show the spatial distribution of internal processes of N nutrients, which means net primary productivity, DIN from remineralization of the detritus, and PON from mortality of phytoplankton, respectively, indicating that: Two high-value areas of net production in the South Yellow Sea move to the nearshore from spring to summer. The remineralization of the detritus remained high values around the coast of the Korean peninsula. A wide range of low value areas along Shandong peninsula in winter and autumn. Mortality of phytoplankton occurs along the most areas of Yellow Sea except Subei shoal in spring and summer.

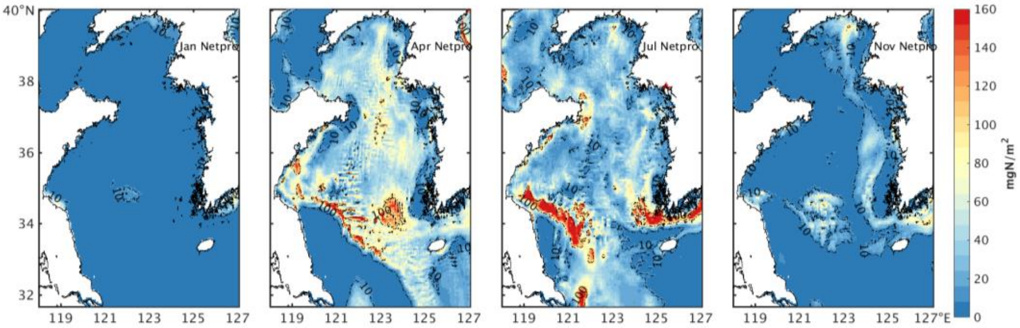

Fig. 4. Net primary productivity in the Yellow Sea

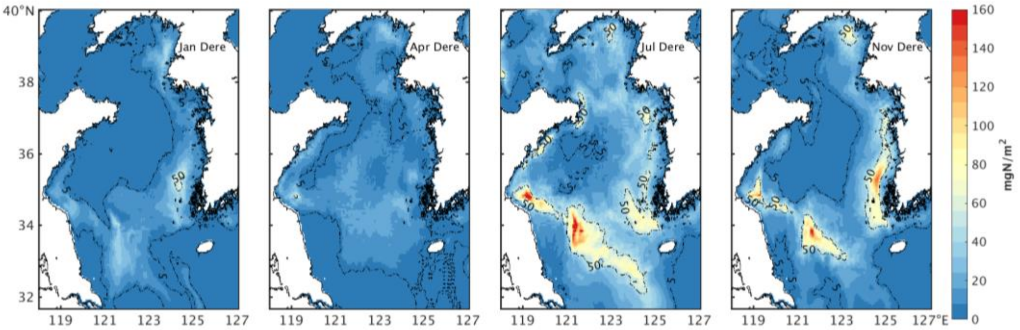

Fig. 5. DIN from remineralization of the detritus in the Yellow Sea

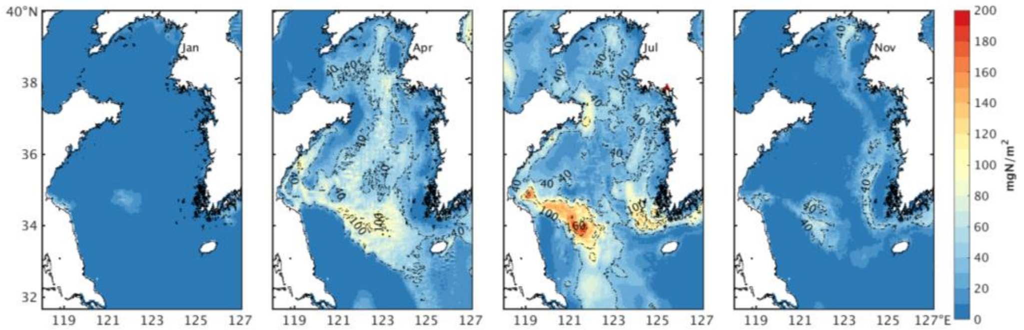

Fig. 6. PON from mortality of phytoplankton in the Yellow Sea

Figure 7-9 show the spatial distribution of external N nutrients, which means DIN from atmospheric deposition, DIN regeneration from benthic remineralization, and Net sedimentation of PON through the sediment-water interface. The figures indicate that:

(1) Atmospheric deposition: Gradient from the coast to the open sea in the south Yellow Sea- mainly wet deposition. Homogeneous in the north yellow sea- mainly dry

deposition.

(2) Regeneration from benthic remineralization: High values in the central muddy area of the south Yellow Sea and the northern part of Shandong peninsula and the central part of the northern yellow sea.

(3) Net exchange of PON through the sediment-water interface: Sedimentation of PON is bigger than resuspend in the Yellow Sea.

Figure 10 is the distribution of dominant external DIN input, as it shows: River input DIN is concentrated in the estuary area, the controlled areas expand to the open sea in summer. The muddy are dominated by regeneration from benthic remineralization. Atmospheric deposition dominates the rest areas of the region.

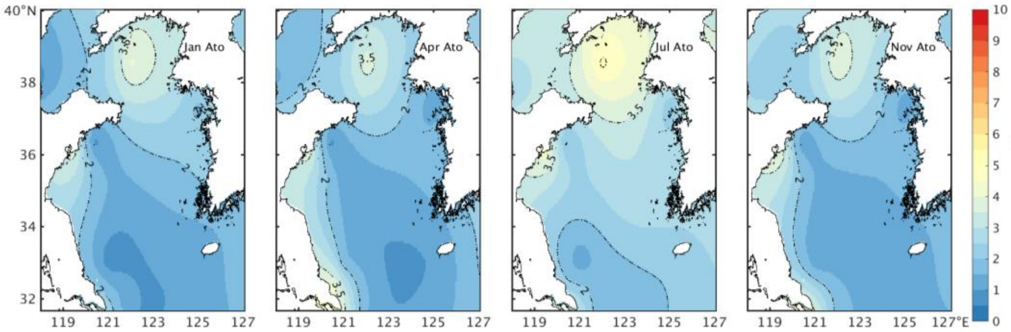

Fig.7 DIN from atmospheric deposition in the Yellow Sea

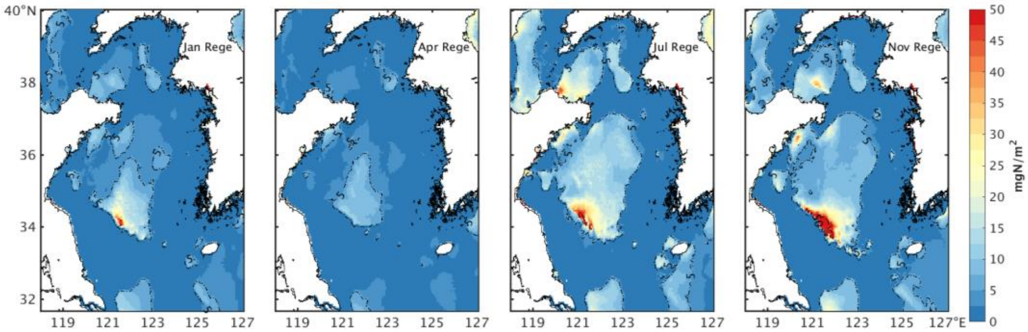

Fig. 8 DIN regeneration from benthic remineralization in the Yellow Sea

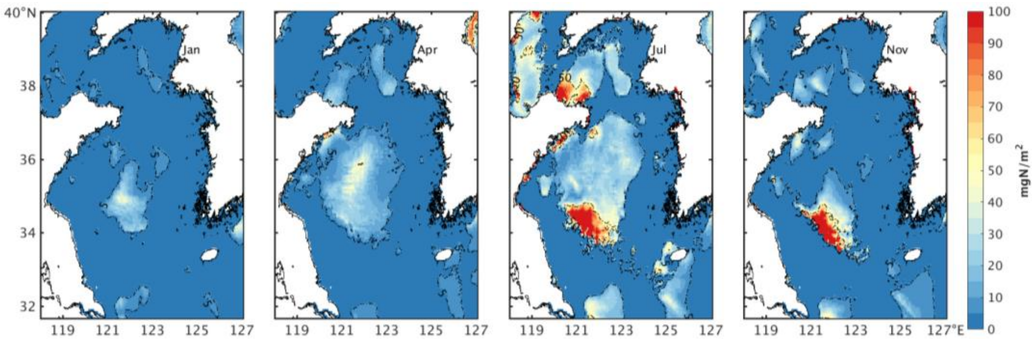

Fig. 9 Net sedimentation of PON through the sediment-water interface in the Yellow Sea

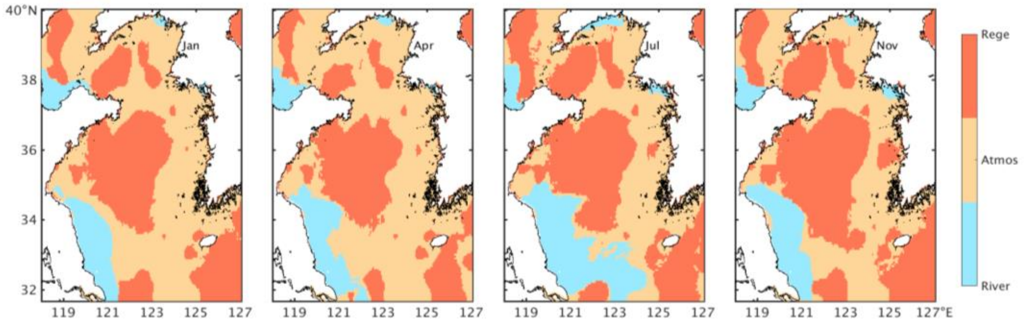

Fig. 10 Distribution of dominant external DIN input

5. Publication/Conference presentation

Conference presentation (poster presentation)

Title: Annual Cycles and Budgets of Nutrients in the Yellow Sea: a model study

Lecturer: Jiang Hao

Time: 14~15 November 2019.

Location: Ehime University.

6. Perspectives in Future

To analyze the cycle and budgets of phosphorus nutrients and silicate nutrients, including particulate organic phosphorus, dissolved inorganic phosphorus, biogenic silicate and dissolved silicate.

To find out and discuss the difference between three types of nutrients.