

## Report for the year 2020 and future activities

### SOLAS 'Korea'

compiled by: *'Kitack Lee (Pohang University of Science and Technology)*

*and Eunil Lee (Korea Hydrographic and Oceanographic Agency)'*

**First things first...Please tell us what the IPO may do to help you in your current and future SOLAS activities. ?**

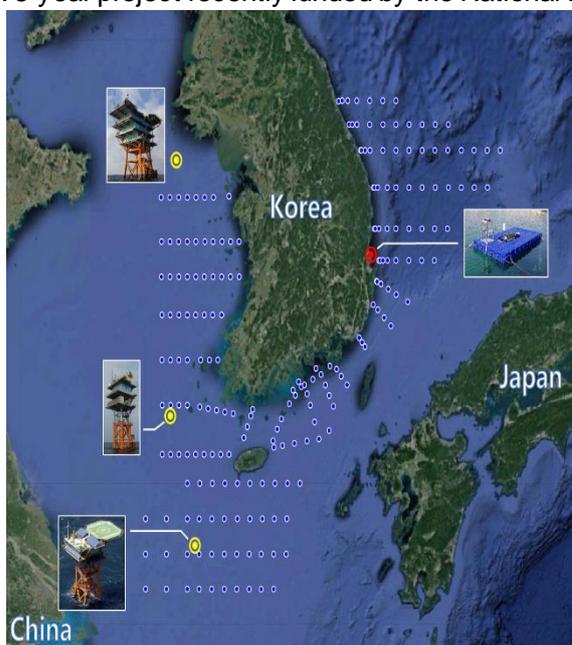
### PART 1 - Activities from January 2020 to Jan/Feb 2021

#### 1. Scientific highlight

Studies on carbon dynamics in the Yellow, East China, and East Seas (marginal seas of the northwestern Pacific Ocean) funded for 2020-2025 by Korea National Research Foundation :

Input of anthropogenic nitrogen may increase the phytoplankton biomass in Asian marginal seas that have been N deficient relative to P and Si. This increase in the production of planktonic organic matter could exacerbate hypoxia by increased oxidation of the resulting organic matter. Moreover, the disproportionate increase in N relative to both P and Si may trigger a change in the phytoplankton community structure. The immediate and long-term consequences of anthropogenic nitrogen input are becoming evident, but their magnitude and direction remain largely unknown.

A 5-year project recently funded by the National Research foundation of Korea aims to assess



whether the East China Sea, the Yellow Sea, the East Sea, and coastal waters around Korea are shifting from N deficiency towards P deficiency as a result of anthropogenic nitrogen input. This project will also address whether this anthropogenic perturbation has increased primary production and export production, which is another longstanding issue in this region of the Pacific Ocean.

Two critical goals will be perused through concerted efforts of both direct observations and analysis of historical data. The field observations have two components:

seasonally-resolved discrete measurements and continuous measurements at selected locations. In these field observations, two carbon parameters (total alkalinity and total dissolved inorganic carbon) will be measured for coastal samples ( $n > 240$ ) (three times per year) across the extensive areas of the Yellow,

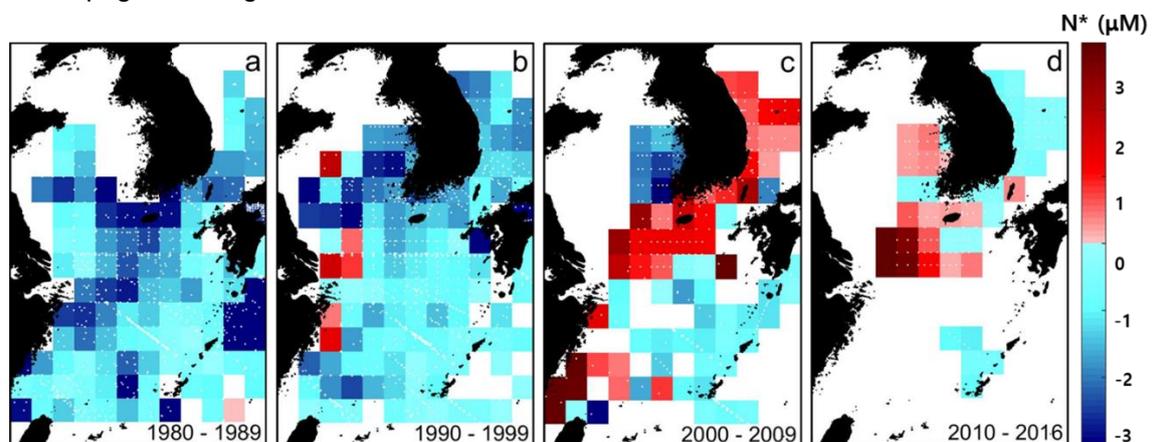
and East China, and East seas (sampling locations shown as open circles in Figure). In addition, to more fully resolve temporal variations in carbon parameters continuous pH or  $pCO_2$  measurements at 1-hr intervals are to be measured at four selected locations (four measurement facilities shown).

In parallel with this measurement effort, historical datasets (> 100,000 sets of nitrate; N, phosphate; P, and silicate; Si) that cover much of the East China Sea, the Yellow Sea and the coastal waters of Korea collected over a period of four decades will be analysed to evaluate how biological export production has evolved over time in this region of the Pacific Ocean.

## 2. Activities/main accomplishments in 2020 (e.g., projects; field campaigns; workshops and conferences; model and data intercomparisons; capacity building; international collaborations; contributions to int. assessments such as IPCC; collaborations with social sciences, humanities, medicine, economics and/or arts; interactions with policy makers, companies, and/or journalists and media).

Anthropogenic nitrogen is changing the East China and Yellow seas from being N deficient to being P deficient (multi-institutional collaboration)

A research team comprised of researchers from Pohang University of Science and Technology, Korea (Ji-Young Moon, Ja-Myung Kim and Kitack Lee) and other institutions (Weol-Ae Lim, Eunil Lee, Minhan Dai, Yang-Ho Choi, and In-Seong Han, Kyoungsoo Shin, and Jinho Cjae) assessed the nutrient regime shift using historical datasets. Addition of the increased anthropogenic nitrogen emitted from northeast Asian countries to the Yellow and East China seas and coastal waters around Korea has resulted in an unparalleled increase in the nitrate (N) concentration relative to the phosphate (P) and silicate (Si) concentrations in the upper ocean. The disproportionate and persistent input of nutrients to the marine waters of this region over the past four decades has transformed extensive areas from being N deficient (indicated by blue boxes) to being P deficient (indicated by red boxes), and has concurrently decreased the concentration of Si relative to N. In coastal waters around Korea in particular, these shifts in the nutrient regime have been accompanied by a change from diatom-dominated to dinoflagellate-dominated blooms. Given the complexity of coastal ecosystems, the associations between changes in nutrient regimes and biological changes need to be investigated in other coastal areas receiving increasing loads of anthropogenic nitrogen.



## 3. Top 5 publications in 2020 (only PUBLISHED articles) and if any, weblinks to models, datasets, products, etc.

Kim, J.-M., K. Lee, Han, I.-S., Lee, J.-S., Choi, Y.-H., Lee, J.H., Moon, J.-Y., "Anthropogenic Nitrogen-Induced Changes in Seasonal Carbonate Dynamics in a Productive Coastal Environment", 2020, *Geophysical Research Letters*, doi: 10.1029/2020GL088232.

Moon, J.-Y., Lee, K., Lim, W.-A., Lee, E., Dai, M., Choi, Y.-H., Han, I.-S., Shin, K., Kim, J.-M., Chae, J., "Anthropogenic nitrogen is changing the East China and Yellow seas from being N deficient to being P deficient", 2020, *Limnology and Oceanography*, DOI: 10.1002/lno.11651.

Yang, J.-Y.T., Lee, K., Zhang, J.-Z., †Moon, J.-Y., J.-S., Han, I.-S., Lee, E., "Contrasting decadal trends of subsurface excess nitrate in the western and eastern North Atlantic Ocean", 2020, *Biogeosciences*, 17(13), 3631-3642, DOI: 10.5194/bg-17-3631-2020.

## 4. Did you engage any stakeholders/societal partners/external research users in order to co-produce knowledge in 2020? If yes, who? How did you engage?

--

<b>PART 2 - Planned activities for 2021 and 2022</b>
--

<b>1. Planned major national and international field studies and collaborative laboratory and modelling studies (incl. all information possible, dates, locations, teams, work, etc.).</b>
--

Study on atmospheric DMS dynamics in Iceland:

<b>2. Events like conferences, workshops, meetings, summer schools, capacity building etc. (incl. all information possible).</b>
--

<b>3. Funded national and international projects/activities underway.</b>
---

<b>4. Plans/ ideas for future national or international projects, programmes, proposals, etc. (please indicate the funding agencies and potential submission dates).</b>
--

<b>5. Engagements with other international projects, organisations, programmes, etc.</b>
--

<b>Comments</b>
-----------------