Global mapping of sea surface nutrients using neural network

Y. NOJIRI[1*], C. WADA[1], S. NAKAOKA[1], S. YASUNAKA[2], AND J. ZENG[1]

[1]National Institute for Environmetal Studies, Tsukuba, Ibaraki 305-8506, Japan (*correspondence: nojiri@nies.go.jp)
[2]Japan Agency for Marine-Earth Science and Technology (yasunaka@jamstec.go.jp)

National Institute for Environmental Studies (NIES) is operating volunteer ship observation in the North (Japan-US West/East coast route) and Western Pacific (Japan-Australia-New Zealand route) for ocean surface pCO_2 survey. Other ocean surface parameters, such as salinity, phosphate, nitrate, silica and chlorophyl-a concentration are also analyzed at on shore laboratory. Samples are taken by on board personnel and frozen on board, typically 3 samples per day. The data set have been combined with similar sampling and analysis by IOS (Institute of Ocean Sciences, Canada) and a hydrographic database (PACIFICA, Pacific Ocean Interior Carbon dataset) to estimate monthly nutrient maps in the North Pacific using a self organizing map type neural network [1]. In this study, we have extended the mapping to global ocean using a feed forward type neural network. The scheme of the neural network has already been described as application to global ocean surface fCO_2 mapping [2].

Relationship between sea surface temperature, sea surface salinity, mixed layer depth and satellite observed chlorophyl-a were analyzed and trained by the nutrient data set. The global archive of nutrient data set (World Ocean Database 2013 by NODC/NOAA) was combined with the NIES and IOS data set from VOS surveys. Monthly maps with 1x1 degree latitude and longitude resolution for phosphate, nitrate and silica were obtained and error of estimation was examined by comparison with training data set. Results for nitrate and phosphate were generally reasonable, however, problem in estimated silica concentrations in North Pacific high latitude and Southern Ocean was recognized with negative and positive biases. It is caused by the large difference of silica concentrations even other ocean parameters are similar. Precise global mapping of macro nutrients are useful for global biogeochemical model and improvement of the accuracy is in progress.

[1] Yasunaka et al (2014) *GRL*, **119**, 7756-7771. [2] Zeng et al (2014) *JAOT*, **31**, 1838-1849.