Mapping of sea surface nutrients for global ocean using a feed forward neural network

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Feed forward neural network (FNN) is one of neural network families and a software applicable for oceanographic mapping has been developed by Zeng et al. [1]. The method has already been applied for sea surface fCO2 mapping with SOCAT data products [2] and reasonable performance was obtained [1]. Since seasurface nutrients, such as phosphate, nitrate and silicate, are important parameters for ocean biogeochemical cycles, we tried application of FNN to global mapping of these nutrients combining several observational datasets. The dataset, having global coverage, is World Ocean Database 2013 by NODC/NOAA. In Pacific region, we have more detailed surface ocean datasets from ship-of-opportunity programs by NIES (National Institute for Environmental Studies, Japan) and IOS (Institute of Ocean Science, Canada). In this study we combined these data sets and some were added from Pacific hydrographic data set, PACIFICA (Pacific Ocean Interior Carbon dataset). Relationship between sea surface temperature, sea surface salinity, mixed layer depth and satellite observed chlorophyl-a were put into a coordinated format and the FNN was trained with the nutrient data sets. Monthly climatological maps with 1x1 degree latitude and longitude resolution for phosphate, nitrate and silica were obtained and error of estimation was examined by comparison with the training datasets. The evaluation was feasible for oceanic regions of relatively high nutrient concentrations such as North Pacific, Southern Ocean, North Atlantic, and East Pacific Equatrial upwelling regions. The nitrate biases were –0.24±0.62, –0.27±0.72, –0.57±0.81, and –1.21±0.88 μM, respectively for these oceanic regions. The performance was comparable for another mapping study using different neural network scheme by Yasunaka et al. for North Pacific [3], even this study was the global mapping.

[1] Zeng et al. (2014) JAOT **31**, 1838-1849. [2] Pfeil et al. (2013) ESSD **5**, 125-143. [3] Yasunaka et al. (2014) JGR **119**, 7756-7771.