Spatiotemporal association patterns of multiple parameters in the northwestern Pacific Ocean and their relationships with ENSO

Abstract

The northwestern Pacific Ocean (NWPO) is a region sensitive to global climate change and regional sea–air interactions. A number of remote-sensing images from the past three decades were used to define sensitive marine regions, which were then applied to determine the spatiotemporal association patterns of abnormal variations in marine environmental parameters using a quantitative association rule-mining method. The NWPO object 1 (NWPO-obj1) region (130°–150° E, 2°–15° N) and NWPO object 2 (NWPO-obj2) region (170°–180° E, 0°–8° N) showed more pronounced changes than elsewhere, and the monthly anomaly of sea-surface temperature (SSTA), monthly anomaly of sea-surface chlorophyll-a (chl-a), monthly anomaly of sea-level anomaly (SLAA), and El Niño Southern Oscillation (ENSO) events were closely related to one another in these two regions. In NWPO-obj1, the relation between SLAA and chl-a yields a correlation coefficient of −0.79 and the abnormal drop in SLAA was the principal factor controlling the chl-a bloom. In NWPO-obj2, the SSTA is anti-correlated with chl-a (correlation coefficient of −0.83), and the abnormal increase in SSTA might be one of the main factors leading to the extinction of chl-a. Comparing the two regions, abnormal increases in chl-a and decreases in SSTA in NWPO-obj2 were indicators of abnormal increases in SLAA in NWPO-obj1 (positive and negative correlation coefficients of 0.60 and −0.61, respectively), and the abnormal decrease of SLAA in NWPO-obj1 is correlated with the abnormal decrease of SSTA in NWPO-obj2 (correlation coefficient of 0.86), although ahead by one year. In addition, the abnormal decrease of SLAA in NWPO-obj1 was the only factor influenced by El Niño, while La Niña events had an impact on the abnormal increase of SLAA in NWPO-obj1 and the abnormal decrease of SSTA in NWPO-obj2, and also dominated their interrelationships.