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Numerical study on the origins and the forcing mechanism of the phosphate in upwelling areas off the coast of Zhejiang province, China in summer

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Off the coast of Zhejiang province, China, algal blooms are frequently observed where the phosphate seems to be an essential ingredient to dominate the growth of the phytoplankton in summer. Therefore, the observed high phosphate distributions off the coast of Zhejiang are closely examined to find out the dominant phosphate origin as well as the underlying forcing mechanism in summer. The observed phosphate distribution has been faithfully reproduced by our numerical model based on the Regional Ocean model System (ROMS). Then, on the basis of the numerical experiments as well as the observations, we propose that the phosphate off the coast of Zhejiang mainly originates from deep sea water in a special area (122.1oE–122.5oE, 130 m–300 m deep) along 24.9oN northeast of Taiwan. Also, the forcing mechanism is clearly illustrated. In the bottom water of southern East China Sea, huge phosphate is continuously transported to the area off the coast of Zhejiang by a nearshore Kuroshio branch current (NKBC) which links the high phosphate deep sea water to the bottom water off the coast of Zhejiang. Then, off the coast of Zhejiang the transported phosphate-rich water is further upwelled to the surface water due to an upwelling just off the coast of Zhejiang. Then, the upwelled phosphate-rich water is transported offshore in the surface water by northeastward flowing Taiwan Warm Current, forming a high phosphate tongue which can be easily utilized by the phytoplankton and then immediately explains the observed high chlorophyll tongue off the coast of Zhejiang.