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Effects of Temperature on the Threshold of Phosphorus for Algal Blooms

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Abstract
Algal blooms, worsening marine ecosystems and causing great economic loss, have been paid much attention to for a long time. Such environmental factors as light penetration, water temperature, and nutrient concentration are crucial in blooms processes. Among them, only nutrients can be controlled. Therefore, the threshold of nutrients for algal blooms is of great concern.
To begin with, a dynamic eutrophication model has been constructed to simulate the algal growth and phosphorus cycling. The model encapsulates the essential biological processes of algal growth and decay, and phosphorus regeneration due to algal decay. The nutrient limitation is based upon commonly used Monod's kinetics. The effects of temperature and phosphorus limitation are particularly addressed. Then, we have endeavored to elucidate the threshold of phosphorus at different temperature for algal blooms.
Based on the numerical simulation, the isoquant contours of change rate of alga as shown in the figure are obtained, which obviously demonstrate the threshold of nutrient at an arbitrary reasonable temperature. The larger the change rate is, the more rapidly the alga grows. If the phosphorus concentration at a given temperature remains larger than the threshold, the algal biomass may increase monotonically, leading to the algal blooming. With the rising of temperature, the threshold is apparently reduced, which may explain why likely red tide disasters occur in a fine summer day. So, high temperature and sufficient phosphorus supply are the major factors which result in algal growth and blowout of red tide.

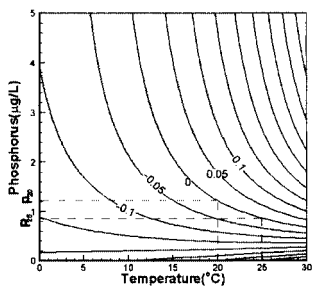

Figure: The isoquant contours of change rate of alga

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