Coastal, environmental and ecosystem modelling

Responses Of The Hiroshima Bay Ecosystem To Inputs

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The Japanese Government is seeking an appropriate level of nutrient loads from land which satisfy the two aspects at the same time, one is to maintain estuarine fishery production and another is the water transparency as high as possible. To give a scientific basis to the governmental inquiry, we conducted sensitivity analyses using an ecosystem model. The ecosystem modeling of Hiroshima Bay has been implemented in order to assess the ecosystem's responses to increasing or decreasing phosphorus and nitrogen inputs in the bay. The model developed in this study comprised three categories of living organisms (phytoplankton, zooplankton, and oysters); three variables for different forms of phosphorus (detritus, dissolved organic phosphorus, and dissolved inorganic phosphorus); and four variables for nitrogen (detritus, dissolved organic nitrogen, ammonia, and nitrate). Different loading levels (±25, ±50, and ±75%) of phosphorus (Case P), nitrogen (Case N) and both phosphorus and nitrogen (Case NP) from the average loading recorded during 1991-2000 were applied to assess how the Hiroshima Bay ecosystem would react. The results have clearly shown that phosphorus had a significantly greater impact on the phytoplankton biomass than nitrogen. Case P+25 increased the primary production of the bay but led to N-limitation. On the other hand, it was implied that Case NP at levels over +25% could bring the Hiroshima Bay ecosystem back to its eutrophic state of 30 years ago. In conclusion, we suggest that 25% increase in phosphorus with additional increase of nitrogen loads to the level of 1991-2000, meeting to the Redfield ratio, is appropriate to recover the fishery production to the level before the recent oligotrophic state and simultaneously to maintain high transparency without harmful algal blooms as we had in 1970s and 1980s.