Modelling nitrogen and carbon cycles in Hooghly estuary along with adjacent mangrove ecosystem

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Hooghly estuary of India is very rich in natural resources and receives large amountof nutrients through litterfall from adjacent mangrove forest. Nitrogen and carbon as important nutrients occur in various forms and plays a crucial role in the regulation of productivity in this estuarine system. Modelling of nitrogen and carbon dynamics from mangrove litterfall and particularly the release of dissolved inorganic nitrogen and carbon in this estuarine system is important because of their roles in augmenting growth of phytoplankton and other higher plants and all other biological components of grazing food chain. Considering the importance of nitrogen and cabron, two dynamic models both with seven compartmentsare proposed. In these models, nitrogen and carbon of the mangrove litterfall are considered as source and its conversion into different organic and inorganic forms are considered as state variables. Some physical and chemical factors and also rate parameters such as nitrogen fraction of litter biomass, litter biomass, redox potential, soil temperature, conversion rates of nitrogen of one form to another form, phytoplankton uptake rate of dissolved inorganic nitrogen and carbon, dissolved oxygen, water temperature and water pH are considered as graph-time functions in this model. These data are collected over two years from field works and experiments. Other rate parameters are calibrated following standard procedure. Sensitivity analysis is performed before calibration. Model simulation results are properly validated with observed data. Sensitivity analysis reveals that the leaching rate of soil organic nitrogen to total organic nitrogen of water and loss rate of soil organic nitrogen as humic acid and fulvic acids are very sensitive parameters in this system. Redox potential plays an important role in the conversion of soil total nitrogen to soil inorganic nitrogen whereas soil temperature is considered to be key factor regulating the microbial activity for the conversion of soil organic nitrogen to soil inorganic nitrogen. Similarly inwater, total organic nitrogen of water including dissolved organic nitrogen and particulate organic nitrogen is dependent on soil organic nitrogen. The dissolved organic nitrogen, particulate organic nitrogen and soil inorganic nitrogen ultimately get converted into dissolved inorganic nitrogen and accumulated in water which is taken by phytoplankton and microflora as minerals.For carbon cycle model results show seasonal variations of litterfall and which is the main source of SOC pool and ultimately transportedto the estuary. Other than litterfall, the death of organisms in soil and water enriches the SOC and POC respectively. pH of water is governing factor and depending on this factor, DIC is converted to DCO_2 and DBC, which are taken up by phytoplankton during photosynthesis. Mineralization rate of SOC to SIC and uptake rate of DCO_2 and DBC are the sensitive parameters.

Keywords: Dynamic models, litterfall, inorganic, organic, tropical estuary

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Abstract
Hooghly estuary of India is very rich in natural resources and receives large amountof nutrients through litterfall from adjacent mangrove forest. Nitrogen and carbon as important nutrients occur in various forms and plays a crucial role in the regulation of productivity in this estuarine system. Modelling of nitrogen and carbon dynamics from mangrove litterfall and particularly the release of dissolved inorganic nitrogen and carbon in this estuarine system is important because of their roles in augmenting growth of phytoplankton and other higher plants and all other biological components of grazing food chain. Considering the importance of nitrogen and cabron, two dynamic models both with seven compartmentsare proposed. In these models, nitrogen and carbon of the mangrove litterfall are considered as source and its conversion into different organic and inorganic forms are considered as state variables. Some physical and chemical factors and also rate parameters such as nitrogen fraction of litter biomass, litter biomass, redox potential, soil temperature, conversion rates of nitrogen of one form to another form, phytoplankton uptake rate of dissolved inorganic nitrogen and carbon, dissolved oxygen, water temperature and water pH are considered as graph-time functions in this model. These data are collected over two years from field works and experiments. Other rate parameters are calibrated following standard procedure. Sensitivity analysis is performed before calibration. Model simulation results are properly validated with observed data. Sensitivity analysis reveals that the leaching rate of soil organic nitrogen to total organic nitrogen of water and loss rate of soil organic nitrogen as humic acid and fulvic acids are very sensitive parameters in this system. Redox potential plays an important role in the conversion of soil total nitrogen to soil inorganic nitrogen whereas soil temperature is considered to be key factor regulating the microbial activity for the conversion of soil organic nitrogen to soil inorganic nitrogen. Similarly inwater, total organic nitrogen of water including dissolved organic nitrogen and particulate organic nitrogen is dependent on soil organic nitrogen. The dissolved organic nitrogen, particulate organic nitrogen and soil inorganic nitrogen ultimately get converted into dissolved inorganic nitrogen and accumulated in water which is taken by phytoplankton and microflora as minerals.For carbon cycle model results show seasonal variations of litterfall and which is the main source of SOC pool and ultimately transportedto the estuary. Other than litterfall, the death of organisms in soil and water enriches the SOC and POC respectively. pH of water is governing factor and depending on this factor, DIC is converted to DCO_2 and DBC, which are taken up by phytoplankton during photosynthesis. Mineralization rate of SOC to SIC and uptake rate of DCO_2 and DBC are the sensitive parameters
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