Science for Environment Policy
DG Environment News Alert Service
European Commission

09 March, 2006

Importance of Mangrove Plants for Global Carbon Cycle

An analysis of the impact of mangrove plants on marine carbon inventories suggests that the mangroves account for more than 10% of the terrestrially derived dissolved organic carbon transported to the ocean, while they cover only 0.1% of the continents' surface. The worldwide rapid decline of mangroves could have potential consequences on the atmospheric composition and the climate.

The global carbon cycle is currently the topic of great interest because of its importance in the global climate system and also because human activities are altering the carbon cycle to a significant degree. This crucial biogeochemical cycle involves the exchange of carbon between the Earth's atmosphere, the oceans, the vegetation, and the soils of the Earth's terrestrial ecosystems.

Since the oceans stand for the largest pool of carbon near the surface of the Earth, their role is of particular importance in the global carbon cycle. Indeed, the organic matter dissolved in the oceans contains a similar amount of carbon as is stored in the skies as atmospheric carbon dioxide. Consequently, in order to understand global carbon cycle, and its effects on climate, it is crucial to quantify the sources of marine dissolved organic carbon (DOC).

In this regard, German researchers have investigated the impact of mangroves, the dominant intertidal vegetation of the tropics and a source of terrestrial DOC, on marine DOC inventories. The study was performed on the scale of an entire mangrove-shelf system that integrates information of about 10,000 km² of north Brazilian mangroves. A combined approach of stable carbon isotopes and nuclear magnetic resonance was used to quantify mangrove-derived DOC on the North Brazilian shelf.

Their results have shown that mangroves are the main source of terrestrial DOC in the open ocean off northern Brazil. Even at the outermost stations, where intrusion of Amazon River water could not be excluded, the mangrove-derived DOC concentration were almost two-fold more important than the estimated riverine DOC concentration.

The authors calculated that about 12 mol of DOC was exported per m² of mangrove per year. Next, they have calculated the global DOC flux from mangroves to the ocean by multiplying the obtained results with the estimates of global surface area covered by mangroves.

It results that DOC export from mangroves is more than 2 trillion moles of carbon per year which is similar to the annual Amazon River discharge and nearly triples the amount estimated from previous smaller scale estimates of the carbon released to the oceans. According to these estimates, mangroves probably account for more than 10% of the DOC globally transported from the continents to the ocean while covering less than 0.1% of the continents.

Since mangroves play a major role for the dissolved organic matter (DOM) exchange between continents and oceans, their rapid decline over the recent decades may already have reduced the flux of terrestrial DOM to the ocean, impacting one of the largest organic carbon pools on Earth. Mangrove foliage, however, has declined by nearly half over the past several decades because of increasing coastal development and damage to its habitat. As the habitat has changed, ever-smaller quantities of mangrove-derived detritus are available for formation and export of dissolved organic matter to the ocean. The researchers speculate that the rapid decline in mangrove extent threatens the delicate balance and may eventually shut off the important link between the land and ocean, with potential consequences for atmospheric composition and climate.

Source: Dittmar, T, et al., (2006), "Mangroves, a major source of dissolved organic carbon to the oceans", Global Biogeochem. Cycles, 20(1).

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Theme(s): Marine ecosystems, Biodiversity, Climate change and energy