

Carbon dynamics in mangrove ecosystems: interactions between intertidal and adjacent aquatic habitats

Bouillon, S, Koedam, N, Borges, AV, Frankignoulle, M, Dehairs, F

The role of mangrove primary production in the carbon cycle of mangrove ecosystems and in the coastal zone continues to be an issue of debate. Although it was long hypothesized that a direct trophic link exists between mangroves and faunal communities in adjacent aquatic habitats, all recent studies find little or no evidence for the existence of such a link, and many of the earlier work which fed the persistence of the "outwelling hypothesis" may need to be re-interpreted. Mangrove ecosystems are highly variable, however, and a data compilation from widely differing mangrove ecosystems shows that although organic carbon stocks in intertidal mangrove forests can be very high and almost entirely of mangrove origin, there are also systems in which deposited estuarine or marine suspended matter is the dominant source of organic carbon and nitrogen in these sediments. Such variations are expected to have a major impact on the carbon dynamics in mangrove ecosystems. In particular, we find that the carbon substrate for microbial populations varies strongly between mangrove ecosystems with different sedimentary carbon inputs, and that for "flow-through" systems with important external carbon inputs to the intertidal zone, surprisingly few species of macro-invertebrates make significant use of mangrove carbon as a food source. Preliminary results suggest that as more mangrove litter is retained within the system, its trophic importance also becomes higher. Large uncertainties remain concerning the ecological fate of exported mangrove carbon. As little evidence can be found for its assimilation by subtidal faunal communities, and as the sedimentary organic carbon pool in some systems suggest that its contribution is minor, mineralization might represent a quantitatively important fate of mangrove production, although very few direct measurements exist. For an extensive mangrove ecosystem in the Gautami Godavari delta (east-India), we demonstrate that very abrupt local changes can occur in the aquatic biogeochemistry, whereby mangrove creeks act as localized sites of mineralization of organic matter, and for subsequent efflux of CO₂ towards the atmosphere.