Influence of climate changes on mangrove ability to fix and store CO2

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Mangroves are forested ecosystems developing in the intertidal zone of tropical and subtropical coastlines. They cover up to 140,000 km² worldwide, and extend from 30° north to 30° south. They are among the most productive ecosystems in the world (2). Furthermore, they have been suggested to be enhancers of heterotrophic secondary production and offshore fisheries. In addition, it is well recognized that mangroves are crucially important ecologically and economically, serving various vital ecosystem services (5). For example, mangroves stabilize the shoreline and serve as barriers against erosion. Mangrove systems also are also threatened by climate changes are not well understood (10). Relative sea-level rise may be the greatest threat to mangroves because most mangrove sediment surface elevations are not keeping pace with sea-level rise (11). Additionally, because most mangrove sediment surface elevations are not keeping pace with sea-level rise (11), mangrove forested shorelines were significantly less affected (6). The annual economic value of mangroves, including products and services has been estimated to be US$ 200,000–900,000 ha⁻¹ (7). Mangrove ecosystems also are also threatened by climate change. Mangrove habitat loss also may reduce coastal water quality, biodiversity, and fish and crustacean breeding and nursery habitats. Such ecological deterioration may have direct and indirect adverse effect on adjacent coastal habitats, and may eliminate a major resource for human communities that rely on mangroves for numerous products and services. Mangrove destruction also has the potential to release large quantities of stored carbon, which can have dramatic global implications (13). A synthesis of the current knowledge will be proposed, and our project of mangrove monitoring in the Indo– Pacific area will be presented.
Mass mortality events in atoll lagoons: present environmental control and increased future vulnerability with climate change

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Several geomorphologically closed atolls of the Pacific Ocean have experienced in recent decades mass benthic and pelagic lagoon fish mortalities, that are due to unusual calm weather conditions lasting for several weeks. These events, although poorly known and characterized, post a risk for species sustainability for islands, and need to be taken into account for long-term resource management. A sample of eleven mortality events on eight atolls from the central South Pacific occurring between 1993 and 2012 were revisited to estimate the environmental thresholds required to trigger such events. We investigated thresholds and spatial patterns of sea surface temperature, significant wave height and wind stress satellite data. Then, using these thresholds, spatial maps of present-day potential risk are produced for the central South Pacific region. The highest risk zone lies north of the Tuamotu Archipelago in French Polynesia. To assess future risks in a climate change era, a regional climate model is used to downscale the projected future climate and to estimate the potential change in risk by the end of the 21st century. This process highlights a relative risk increase of up to 60% for the eastern Tuamotu atolls. However, caution is required given the limited number of case-studies available to train the analysis and identify thresholds. This study suggests that long-term monitoring of the biophysical conditions of the lagoon at risk is needed to precisely identify the physical thresholds and better understand the biological processes involved in these rare, but consequential, mass mortality events.

Mesopelagic heterotrophic N2 fixation related to organic matter composition in the Solomon and Bismarck Seas (Southwest Pacific)

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The oceans play a key role in absorbing carbon dioxide (CO2) emitted by human activities. This absorbing power depends largely on the activity of microalgae, which take up CO2 using nutrients and sunlight. The availability of nutrients is thus essential for maintaining life in the oceans and balancing global carbon cycles. In open ocean areas nitrogen is mainly provided through nitrate fixation, a process performed by specific microorganisms called diazotrophs. Primary production in the ocean is strongly limited by the availability of fixed nitrogen. In open ocean nutrient-impoverished areas, which make up ~50% of the global ocean surface, nitrogen is mainly provided through biological processes nitrogen fixation (N2) fixation. N2 fixation is carried out by the so termed diazotrophs, marine microorganisms that may belong to the cyanobacteria, bacteria or archaea. For marine diazotrophs, carbon fixation is performed by the most abundant diazotrophs in the ocean. Autotrophic diazotrophs need light to fix carbon dioxide via photosynthesis, and are therefore constrained to the sunlit layers of the ocean, which generally less than 100 m deep. Recent investigations have revealed that heterotrophic diazotrophs, which cannot photosynthesize, are present in greater abundance than autotrophic diazotrophs in the world's oceans. Heterotrophic diazotrophs are the only microorganisms that are not constrained by the availability of light and therefore are able to live in the dark ocean, the largest and less studied habitat on Earth. This discovery significantly expands the habitats where N2 fixation can potentially take place, and theoretically increases the inputs of fixed nitrogen to the ocean, which remain unaccounted for. The diazotrophs inhabiting mesopelagic dark waters are heterotrophic and depend on organic matter for their nutrition. In this study, we investigated the relative importance of heterotrophic diazotrophs in the Southern Ocean (SO), the largest and most unexplored ocean on Earth, which makes up ~50% of the global ocean surface. The SO plays a critical role in the control of the Earth's climate. In turn it is very sensitive to climate variability. Given its critical