

Recent studies on the diazotrophic cyanobacteria *Trichodesmium* showed a pronounced CO<sub>2</sub> dependency in N<sub>2</sub>- and C-fixation. However, significant uncertainties remain as to the degree of sensitivity to CO<sub>2</sub>, modification of these responses by other environmental factors, and the underlying processes. To this end, we investigated carbon acquisition and nitrogen fixation in *Trichodesmium* IMS101 under different CO<sub>2</sub> and light levels. In these acclimations, growth rates, cellular C and N content, and respective isotopic values were measured. *In vivo* activities of photosynthetic O<sub>2</sub> evolution, O<sub>2</sub> uptake, CO<sub>2</sub> and HCO<sub>3</sub><sup>-</sup> fluxes were obtained using membrane inlet mass spectrometry methods (MIMS). Nitrogen fixation rates were determined using the acetylene reduction assay, and chlorophyll a fluorescence was measured via fluorescence induction and relaxation method (FIRE). Photosynthesis and N<sub>2</sub>-fixation increased with CO<sub>2</sub> and this effect was even more pronounced under high light. Moreover, our data suggest a shift in the distribution of metabolic energy between photosynthesis, carbon acquisition and N<sub>2</sub>-fixation in *Trichodesmium*. The observed stimulation in photosynthesis and N<sub>2</sub>-fixation may enhance the productivity in N-limited oligotrophic regions.

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#### SINKING AND REMINERALISATION OF PARTICULATE ORGANIC MATTER IN LARGE-SCALE MODELS OF MARINE BIOGEOCHEMISTRY

Sinking and remineralisation of particulate organic matter (POM) in large-scale models of marine biogeochemistry is usually parameterised by a prescribed function of an idealised particle's settling velocity and decay rate. Here we investigate two common representations of sinking (remineralisation) with respect to their intrinsic assumptions and their effect on POM mass and sedimentation profiles. Using a model of an idealised water column, we additionally investigate the effect of an assumed surface particle size spectrum on deep sedimentation. Conversely, the effect of sinking on deep particle size spectra is examined. A constant, uniform sinking speed does not appear appropriate for long-term simulations. A size spectrum of particles causes the average sinking speed of POM to increase with depth, although the increase is not strictly linear. Its particular form depends on the size spectrum at the surface; thus, regional variations of the surface POM size spectrum might cause regional variations of remineralisation length scales. In the deep ocean, the combined effects of sinking and remineralisation can lead to unimodal particle size distributions.

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#### BENTHIC METABOLISM AND CARBON GAS (CO<sub>2</sub> AND CH<sub>4</sub>) BALANCE IN TWO TANZANIAN MANGROVE FORESTS UNDER DIFFERENT ANTHROPOGENIC INFLUENCE

Sediment metabolism and carbon gas balance was measured in the anthropogenically impacted Mtoni and the pristine Ras Dege mangrove forest, Tanzania. In situ CO<sub>2</sub> and CH<sub>4</sub> emission from sediments and open creek water were determined at high and low tides. Sulfate reduction (SRR) and iron reduction (FeR) was quantified from sediment incubations. CO<sub>2</sub> emission from sediments was lowest at the freshwater influenced inner part of Mtoni. Benthic metabolism was primarily driven by FeR (54-78%) and to lesser extent SRR (9-12%), except for organic-rich inner sites at Ras Dege (FeR: 38% and SRR: 46%). Other processes (aerobic respiration and methanogenesis) accounted for 10-15%, except for 37% of the inner part of Mtoni. CH<sub>4</sub> emission was 3 orders of magnitude lower than for CO<sub>2</sub>; highest at the inner part of Mtoni. Pneumatophores and crab burrows increased emissions considerably. Highest emissions from open creek waters occurred during low tide due to porewater seepage. Primary production estimates and measured emissions reveal that the densely vegetated Ras Dege is an efficient sink of greenhouse carbon gases, while clear-cutting has reduced the capacity considerably at Mtoni.

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#### POTENTIAL REESTABLISHMENT OF ZOSTERA MARINA IN A SHALLOW DANISH FJORD WAS EVALUATED BY FIELD, LABORATORY AND MODEL ACTIVITIES.

The sediment erosion thresholds were measured at 13 stations in Odense Fjord. Basic sediment parameters such as water content, organic matter, grain size distribution, total N and P were measured on these and 79 other stations. The basic sediment parameters and the erosion thresholds were correlated. The thresholds correlated linearly to the top layer sediment organic content ranging from 0 to 2% of the dry weight. Here the erosion thresholds declined from 0.40 to 0.25 ms<sup>-1</sup>. Organic matter content between 2 and 7% showed stable erosion thresholds of about 0.25 ms<sup>-1</sup>. Our hypothesis: that reestablishment of eelgrass only appears in areas with infrequently resuspension events were tested in a newly developed dynamic model. All site specific data including current and wave action was implemented in the dynamic mathematical model to describe the potential distribution of *Zostera marina*. In the model the reestablishment of eelgrass is described by growth that is dependent on light and nutrient availability, while biomass losses are described by erosion thresholds dynamics. A suite of simulations indicated that the reestablishment of eelgrass belongs to a distant future.

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#### CHANGES IN BACTERIAL CARBON METABOLISM IN RESPONSE TO INCREASING TEMPERATURE

Marine dissolved organic matter holds as much carbon as there is carbon dioxide in the atmosphere. This carbon pool is largely regulated by bacterioplankton that, to the extent that it is available, convert DOC into bacterial biomass or remineralize it into carbon dioxide. If bacterial processing of the DOC pool is limited by temperature, global warming can reduce the amount of carbon stored in DOM. Bacteria in permanently cold waters have been argued to be more sensitive to temperature, but this is not independent of substrate and nutrient availability. This study provides experimental data on the regulation of bacterial production, respiration and growth efficiency in the Fram Strait. We investigate how bacterial processes are regulated by temperature and nutrients within a temperature range that is likely to be realized before the turn of the century.

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WHY IS THE EASTERN MEDITERRANEAN SEA PHOSPHORUS LIMITED AND WHY DOES THE EXPLANATION MATTER TO IDEAS OF GLOBAL NUTRIENT CYCLING

Two very different explanations proposed to explain the observed high Nitrate: phosphate (28:1) ratios in the EMS. Bethoux and others suggested this high ratio is caused by regionally high rates of N<sub>2</sub> fixation. At the time no measurements of N<sub>2</sub> fixation had been made in the EMS. A limited number of isotopically light 15N-NO<sub>3</sub><sup>-</sup> and PON measurements supported this explanation. However the EMS is a P starved ecosystem. If N<sub>2</sub> fixation is causing the N:P ratio to stabilise at well above 16:1, then this explanation is incompatible with the generally accepted mechanism resulting in the Redfield ratio elsewhere in the global ocean. Recently we have suggested, based on a basin-wide nutrient budget, that all the nutrient inputs to the basin have an N:P ratio greater than 16:1 and that there is very little denitrification in the basin, due to its extreme ultra-oligotrophic nature, to reduce the N:P ratio towards 16:1. Here relevant new results are summarised. Several new measurements of N<sub>2</sub> fixation have been made all of which show low values. The 15N results for atmospheric input (light), for PON (light) and for DON (heavy) are interpreted as being the result of microbial cycling in a P limited system without requiring any significant N<sub>2</sub> fixation. Existing reviews which conclude major N<sub>2</sub> fixation in the EMS are shown to have misquoted previously published data. All of the new data supports or is compatible with there being low N<sub>2</sub> fixation rates in the basin.

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#### CHANGES IN PHYTOPLANKTON BIOMASS IN THE WESTERN SCHELDT ESTUARY DURING THE PERIOD 1978-2006

Changes in annual mean chl a concentrations were studied the eutrophic and turbid macrotidal Western Scheldt estuary. Three stations were investigated: WS1 (30 PSU at the mouth of the estuary, station WS6 (17 PSU) and station WS11 (10 PSU). No significant long term changes in yearly averaged chlorophyll a (chl a) concentrations were observed in WS1 and WS6, but in WS11 a large decrease. Spectral analyses revealed a possible periodicity of 7 years in mean chl a which we could not relate to abiotic factors. Strong phenological responses in the timing of the spring/summer bloom were observed: the center of gravity or the day at which 50% of the cumulative chl a was reached during the year advanced with 1-2 days per year. All stations showed an earlier initiation of the bloom, whereas the day at which the phytoplankton bloom terminated also moved forward in time, WS11 excepted. As a result the bloom length decreased in station WS1, remained the same in station WS6 and increased in WS11. This complicated pattern in bloom phenology demonstrates the complex nature of ecosystem functioning in estuaries.

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#### MORPHOLOGICAL TRAITS AS DESCRIPTORS OF PHYTOPLANKTON FUNCTIONAL VARIETY

The most objective approach to construct functional groups of phytoplankton is to cluster species according to their functional traits. We use information on more than