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Ocean Thermal Energy Conversion: the potential impact on microphytoplankton of bottom water discharge at subsurface in the Caribbean Sea

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Part of the solar energy can be harvested and used in different processes. Taking advantage of the natural temperature gradient between the surface and deep ocean, the Ocean Thermal Energy Conversion (OTEC) process fulfills this goal. The IMPALA project (Impacts of artificial upwelling on microplankton) aims to study the potential environmental impacts of releasing, below the surface, deep seawater flowing out of a scheduled OTEC pilot plant offshore the Martinique Island in the Caribbean Sea.
Biogeochemical processes involved in the artificial upwelling generated by the use of an Ocean Thermal Energy Conversion (OTEC) plant were studied in this poor nutrient environment. The biogeochemical and physical ecosystem structure and functioning on the OTEC site were described and deep seawater discharge using in situ microcosm experiments was carried out off Martinique. Surface seawater was collected in ultra-clean conditions at two depths (corresponding to the maximum of chlorophyll a concentration and bottom of nutricline) and mixed in different proportions with deep seawater (2% and 10%). Pigments determination, picophytoplankton abundance, macro-nutrients (silicates, nitrates, and phosphates), particular organic carbon and nitrogen concentrations and primary production were documented to assess the variability between the natural environment and within the microcosms. The latter were immersed for 6 days on a 250 meters mooring. Variations observed in microcosms experiments and in the surrounding waters were compared in order to evaluate the natural variability of the phytoplankton assemblage and the potential shifts induced by deep water supply.
Results obtained during two fields campaigns conducted off Martinique at the onset of the dry (November-December 2013) and wet seasons (June 2014), respectively, will be presented and discussed. Incubating mixtures of subsurface and deep waters at two ratios and at two depths, allows evaluating the potential impact of a deep water discharge on the microphytoplankton. The release of deep seawater rich in nutrients (Si, P and N) induced an enrichment of the subsurface waters. The microcosm enrichment by 10% of deep seawater induced a significant shift in the phytoplankton assemblage supporting diatoms development whereas the enrichment by 2% of deep seawater only showed a small variation in phytoplankton population.