Quantification of new production during a winter *Noctiluca scintillans* bloom in the Arabian Sea

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[1] We present new data on the nitrate (new production), ammonium, urea uptake rates and f-ratios for the eastern Arabian Sea (10° to 22°N) during the late winter (northeast) monsoon, 2004, including regions of green *Noctiluca scintillans* bloom. A comparison of N-uptake rates of the *Noctiluca* dominated northern zone to the southern non-bloom zone indicates the presence of two biogeochemical regimes during the late winter monsoon: highly productive north and less productive south. The conservative estimates of photic zone-integrated total N-uptake and f-ratio are high in the north (≈19 mmolNm⁻²d⁻¹ and 0.82, respectively) during the bloom and low (≈5.5 mmolNm⁻²d⁻¹ and 0.38 respectively) in the south. The present and earlier data imply persistence of high N-uptake and f-ratio during blooms year after year. This quantification of the enhanced seasonal sequestration of carbon is an important input to global biogeochemical models. Citation: Prakash, S., R. Ramesh, M. S. Sheshshayee, R. M. Dwivedi, and M. Raman (2008), Quantification of new production during a winter *Noctiluca scintillans* bloom in the Arabian Sea, Geophys. Res. Lett., 35, L08604, doi:10.1029/2008GL033819.

1. Introduction

[2] The Arabian Sea, one of the most biologically productive regions of the world ocean [Madhupratap et al., 1996; Smith, 2001], is characterized by a range of biogeochemical provinces, based on atmospheric forcing due to the seasonally reversing southwest (summer) and northeast (winter) monsoons [Bange et al., 2000; Wiggert et al., 2000: Prasanna Kumar et al., 2001a]. Both trigger high biological production through different mechanisms. During the winter monsoon, cool dry air from the Himalaya enhances evaporation in the northern Arabian Sea causing convective mixing. This deepens the upper mixed layer causing entrainment of nutrients from the deeper to the upper layers and triggers high primary production [Prasanna Kumar et al., 2001b], often leading to the initiation of phytoplankton blooms. The total production during this period can reach up to 3gCm⁻²d⁻¹ (S. Kumar et al., Effect of winter cooling on nitrogen uptake in the northeastern Arabian Sea, submitted to Journal of Geophysical Research, 2008). The bloom during the late winter monsoon is dominated by *Noctiluca scintillans*, a large and conspicuous dinoflagellate, commonly found in coastal areas worldwide. Its most wide-spread red form is heterotrophic and survives on a wide range of prey such as phytoplankton and micro-zooplankton [Hansen et al., 2004]. Heterotrophic *Noctiluca scintillans* has been reported from the eastern Arabian in the month of September, i.e., during the late summer monsoon [Satyayak et al., 2005]. In the tropical and subtropical areas of the Southeast Asia, particularly in the northeastern Arabian Sea during late winter monsoon, a green form of *Noctiluca scintillans*, which survives by autotrophy under light for at least a month [cf. Sweeney, 1971], is found. The appearance of *Noctiluca* bloom in the northeast Arabian Sea is well documented in the literature [Dwivedi et al., 2006; Parab et al., 2006] but data available on the nitrogen uptake and f-ratios is limited (e.g., S. Kumar et al., submitted manuscript, 2008). Primary production can be subdivided into new and regenerated production [Dugdale and Goering, 1967]; the former is the fraction supported by the newly borne nitrate into the euphotic zone and the latter, supported by the recycled nutrients such as ammonium and urea. The ratio of new to total production is known as f-ratio; integrated over an annual time scale, new production serves as a measure of the fraction of the photosynthetically fixed carbon that can be exported to the deeper ocean [Eppley and Peterson, 1979]. This study was aimed at measuring the N-uptake and f-ratio characteristics of the eastern Arabian Sea during the late winter monsoon, in particular during a *Noctiluca scintillans* bloom, and to compare N-uptake rates between bloom and non-bloom areas. Here, we present the nitrate, ammonium and urea uptake rates, measured using the 15N tracer technique, and f-ratios for the eastern Arabian Sea during the late winter monsoon.

2. Materials and Methods

[3] Nitrogen uptake rates were measured at 11 different stations on board FORV Sagar Sampada (Cruise # SS 222) during the winter monsoon (20 February to 11 March 2004, station locations given in Table 1). The depth at which light falls to 1% of the surface level (photic zone), was estimated using an underwater multispectral radiometer (Satlantic Inc.). Based on light measurements six different depths were chosen for collecting water samples for 15N and chlorophyll measurements. In all, six depths, corresponding to light levels 100, 80, 64, 20, 5 and 1% of the surface value, were chosen to cover the entire photic zone (except at two stations: PP 5 and PP 6). Water samples were collected using clean Go-Flo bottles (General Oceanic, Miami, Florida, USA) attached to a CTD rosette. 100 ml of each sample was separately collected for nutrient measurement using a SKALAR autoanalyzer. 1 L of water sample from each depth was also collected for chlorophyll measurement...