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Effects of mixing-induced irradiance fluctuations on nitrogen uptake by phytoplankton

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The kinetics of nitrogen (ammonium and nitrate) uptake by phytoplankton as a function of irradiance were determined with the ^{15}N-tracer technique in the well-mixed waters of the western English Channel (France). Samples were collected at two depths (1% and 50% of incident light (I_0)) between March and August 2005, during neap and spring tides in order to cover all the mixing-induced irradiance fluctuations. The results of the kinetics experiments were well described by the 3-parameter P versus E relationship (photosynthesis vs irradiance) of Platt & Gallegos (1980) which was modified to take into account the dark-uptake of nitrogenous compounds. All the parameters derived from this model indicated a higher light dependency of nitrate uptake than of ammonium uptake, according to previously published studies. During spring tides, the kinetic parameters for both ammonium and nitrate were similar for the two light depths. On the contrary, they were different during neap tides: the maximum nitrogen uptake rates (ρmax) was higher for 50% I_0 than for 1% I_0 (24 and 27% for ammonium and nitrate, respectively); the Index of light adaptation (E_K) was lower for 50% I_0 than for 1% I_0 (22 and 14 % for ammonium and nitrate, respectively). The dark nitrogen uptake rate (ρdark) and the photoinhibition parameter (β) were also lower for 50% I_0, with values of 54 and 90% for ammonium and 20 and 75% for nitrate. These results highlight that during vertical mixing relaxation periods (contrary to spring tide) phytoplankton have different physiological properties in the water column which could reflect a photoadaptation of the cells. This study suggests that the variations of the vertical mixing, which result from the succession of neap and spring tides could have important consequences on the phytoplankton growth in the

well-mixed waters of the western English Channel.