Isotope constraints on dynamic nitrogen transformations in a nitrogen-replete coastal bay in southern China

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Nitrogen is essential for organisms and regulates marine productivity. Growing input of anthropogenic nitrogen from land significantly altered the original N cycle in coastal seas and consequently, the community structure and ecosystem function. However, it is a difficult task to resolve all nitrogen transformation processes at the same time due to the complexity and dynamic feature of nitrogen reaction web (five major N components, particulate/dissolved organic nitrogen, ammonium, nitrite and nitrate, interact rapidly). By adding one single ^{15}N-labelled tracer (e.g., NH_4^+) and measuring the concentration and isotopic composition changes simultaneously for PON, NH_4^+, NO_2^- and NO_3^-, we created matrix equation to derive rates of well-known transformation processes in the reaction web under the assumption of mass conservation. A 24-hr incubation experiment was conducted in January 2014 in Wuyuanwan, a nutrient-replete bay in southern China. Two water depths with distinctive light intensity (2% and 80% PAR) were chosen. The solutions of matrix equation provided us rates for NH_4^+, NO_2^- and NO_3^--uptake, ammonia oxidation, nitrite oxidation, nitrite excretion. Results showed that phytoplankton uptake dominates ammonium consumption, with rates of（691-1155）and（465-931）nmol/L/h under 80% and 2% PAR, respectively, which are orders of magnitude higher than ammonium oxidation rates at corresponding depth. Allochthonous NH_4^+ input passing through phytoplankton assimilation instead of nitrification means an enhancement of oxygen producing rather than consuming. The high ammonium (~25 uM) likely inhibit NO_3^- uptake (175 and 96 nmol/L/h) though nitrate concentration (~30 uM) is also high. In addition, NO_2^- uptake is undetectable while NO_2^- excretion from phytoplankton is light sensitive. This is the first attempt to untangle the specific rate of individual N processes at once in costal water where characterized by serious anthropogenic influence.