**Experimental and modeling studies of simultaneous partial nitrification, Anammox and denitrification processes**

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The simultaneous partial nitrification, Anammox and denitrification (SNAD) plays an important role in cycling of the Nitrogen in the ecosystem and seems pivotal for marine nitrogen budget, especially at Oceanic Oxygen deficient zones (Casciotti et al., 2013; Ward et al., 2009). SNAD is also one of the common biological methods of removing nitrates from wastewater. The method has several advantages such as low requirement of oxygen and external carbon sources over conventional nitrogen removal processes (Ahn, 2006; Chen et al., 2009).

There is a large uncertainty associated with the mechanisms, dynamics, interaction, and intervention of the above processes (nitrification, Anammox and denitrification) in natural and man-made ecosystems and the extent of their contribution on nitrogen cycling is still unresolved. The isotope analysis of nitrogen species was shown to be a powerful tool of nitrification and denitrification detection (e.g., Nestler, 2011). For the Anammox process identification, however, only isotope labeling method has been so far applied (Holtappels, 2011; Trimmer, 2006). The aim of this study is, therefore, to develop an Anammox detection method using natural isotope signatures. The fractionation factors for Anammox have been described only in pure cultures or for the nitrogen isotopes (Brunner, 2013). In contrast, the apparent fractionation factors of Anammox in mixed cultures for both nitrogen and Oxygen isotopes have not yet been investigated. To this end, SNAD batch experiments are performed to detect isotope changes in all the involved nitrogen species such as nitrate, nitrite, ammonium and dinitrogen gas. To better understand the relative impact of Anammox, denitrification and nitrification on overall Nitrogen cycling, numerical models are developed and employed to estimate the effective kinetic rate constants and isotope fractionation factors of these processes from the concentration changes of the N-species.