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Key Points:
- Dry and wet inorganic nitrogen deposition fluxes have been estimated for the Nam Theun 2 Reservoir and the vegetated area present before impoundment
- Wet deposition was the major source of the atmospheric nitrogen input to the Nam Theun 2 Reservoir, contributing to 80% of the total deposition
- The total inorganic N deposition over the studied area has been reduced by 26% after impoundment

Supporting Information:
- Supporting Information S1

Correspondence to:
M. Adon and C. Galy-Lacaux,
adonatma@yahoo.fr;
lacc@aero.obs-mip.fr

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First Assessment of Inorganic Nitrogen Deposition Budget Following the Impoundment of a Subtropical Hydroelectric Reservoir (Nam Theun 2, Lao PDR)

Marcellin Adon[1,2], Corinne Galy-Lacaux[2], Dominique Serça[2], Pierre Guedant[3], Axay Vongkhamsao[3], Wanidaporn Rode[3], Yves Meyerfeld[2], and Frédéric Guérin[4,5]

[1]Laboratoire de Physique de l'Atmosphère et de Mécanique des Fluides, Université Félix Houphouët-Boigny, Abidjan, Côte d'Ivoire, [2]Laboratoire d'Aérologie, Université de Toulouse, CNRS, UPS, Toulouse, France, [3]Environment Department, Environment and Social Unit, Nam Theun 2 Power Company Limited, Vientiane, Lao PDR, [4]Université de Toulouse, UPS, GET, Toulouse, France, [5]IRD, UR 234, GET, Toulouse, France

Abstract With around 490 km^2 at full level of operation, the Nam Theun 2 Reservoir (NT2R) is one of the largest hydroreservoir in Southeast Asia. This study presents a first estimation of the atmospheric inorganic nitrogen deposition into the NT2R based on a 2-year monitoring (June 2010 to July 2012) including gas concentrations and precipitation. Dry deposition fluxes are estimated by the inferential method using, on the one hand, surface measurements of gas concentrations (NO_2, HNO_3, NH_3) from passive samplers and, on the other hand, modeled exchange rates. Wet deposition fluxes are calculated from NH_4^+ and NO_3^- concentrations determined in samples of rain from an automatic precipitation collector. The average nitrogen deposition flux is estimated at 1.26 ± 0.14 kgN·ha^{-1}·year^{-1} from dry processes and 5.01 ± 0.92 kgN·ha^{-1}·year^{-1} from wet ones, that is, an average annual total nitrogen flux of 6.27 ± 1.06 kgN·ha^{-1}·year^{-1} deposited at the NT2R with 80% from wet deposition. Before impoundment, the mean N flux has been estimated at 3.42 ± 1.88 kgN·ha^{-1}·year^{-1} for dry deposition and 5.01 ± 2.12 kgN·ha^{-1}·year^{-1} for wet deposition, or a total N deposition flux of 8.43 ± 4.01 kgN·ha^{-1}·year^{-1} over the studied area dominated by forests with little agriculture soil and water surfaces. Thus, the total N deposition over the studied area has been reduced of 26% (or 63% for dry deposition) following the reservoir impoundment based on our working hypothesis.

1. Introduction

Studies of N input to various water surfaces (coastal, lake, river, and ocean) indicate that atmospheric nitrogen deposition represents a significant amount of the total nitrogen input (Canham et al., 2012; Gao et al., 2007; Jung et al., 2009; Qi et al., 2013; Whitall et al., 2003). Recent N deposition-monitoring studies also showed very high N deposition rates at several observation sites including agricultural catchments in different regions of East Asia (Pan et al., 2012; Shen et al., 2013; Sugimoto & Tsuboi, 2017). Although effects are usually the greatest near the sources of pollution (Fenn et al., 2003), atmospheric deposition of N is of particular concern since anthropogenic N deposition can be seen in areas located far from pollution sources (Elser et al., 2009). Therefore, the increase of N deposition is a local, regional, and continental issue. Atmospheric nitrogen deposition can affect the terrestrial ecosystems but also marine systems and inland water, eventually leading to eutrophication and acidification (Goulding et al., 1998; Jones et al., 2014; Liu et al., 2010, St-Laurent et al., 2017). Although extensive work has been done on the effects of N deposition in polluted regions, little is known about N deposition and its impact following the modification of the land use resulting in the conversion of a forested area to a water body. This study is a first attempt to quantify the net perturbation of N deposition following the transfer of a terrestrial landscape into an aquatic system.

Atmospheric N can affect water surfaces directly through wet deposition (precipitation) and dry deposition of both aerosol particles and gases, as in all surfaces. Wet and dry deposition can also indirectly contribute to N budget in water bodies. This is the case when nitrogen collected in the watershed is being delivered to the water body by groundwater and surface runoff. A large fraction of the atmospheric nitrogen input is in the form of inorganic nitrogen, mainly ammonium (NH_4^+) and nitrate (NO_3^-; Ayars & Gao, 2007). Atmospheric