How dams and wetlands affect carbon and nutrient fluxes in the Zambezi River

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Dams and wetlands acta as large scale biogeochemical reactors which transform carbon and nutrient species, reduce their fluxes via sedimentation and accumulation of biomass, and emit greenhouse gases to the atmosphere. We specifically addressed the question how large hydropower reservoirs changed the seasonality and overall availability of nutrients to the downstream ecosystems and how the biogeochemistry of large wetlands was affected by upstream reservoirs.

Detailed sedimenta analysis in the Kariba reservoir revealed that 70 and 90% of the total N and P inputs, respectively, were eliminated by sedimentation and denitrification [1,2] with significant effects on the downstream ecosystems, such as the protected wetlands of the Kafue Flats [3]. In order to optimize nitrogen delivery to the downstream ecosystems, a biogeochemical modeling study recommended improved turbine intakes at the Itezhi-Tezhi dam [4]. The carbon footprint of tropical hydropower reservoirs has been a matter of intense debate. Using sonar techiques to track bubble emissions, a study on Lake Kariba confirmed that also old hydropower reservoirs produce significant methane emissions [5].

Large tropical wetlands can act as important organic matter sources to their river system [3] and their functionality changes when flood intensities are reduced by upstream reservoirs [6,7]. Continuously recording sensors revealed distinct hysteresis patterns in the river water which provide integral information of primary production, respiration and nutrient cycling in the floodplain. Detailed analysis of the main biogeochemical reactors in large river systems allows constructing future scenarios of the effects of new hydropower schemes and the transformation of riparian wetlands into disconnected cropland.

[1] Kunz *et al.* (2011) *JGR*, **116**, G03003. [2] Kunz *et al.* (2011) *WRR*, **47,** W12531. [3] Zurbrügg *et al.* (2013), *Biogeosci.* **10** 23-28. [4] Kunz *et al.* (2013) *WRR*, 49, 5570-5584. [5] DelSontro et al. (2011) *ES&T*, **45**, 9866-9873. [6] Zurbrügg *et al.* (2012) *JGR*, **117**, G03008. [7] Zuijdgeest *et al.* (2015) *Biogeosci.* **12**, 7535-7547.