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Riverine emissions of nitrous oxide in a cropland region in France

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Agriculture is the major source of nitrous oxide (N₂O) emissions (4.1 Tg-N/year, IPCC) through direct emissions from soils with crops or animals and indirect ones after nitrogen transfer, downstream or downwind croplands. Indirect emissions are estimated to represent 22% of total anthropogenic emissions (UNEP 2013). One component of indirect emissions is riverine emissions but based on a small number of studies reporting very variable emission levels, estimations exhibit a very large uncertainty. Currently, the IPCC Tier I methodology for national inventories calculations proposes an emission factor for fresh water EF₅=0.75% [0.05%-2.5%] of leached nitrogen emitted as N₂O, one third being attributed to rivers (EF_{5r}).

Due to the need for more observations of the riverine contribution in various climatic, land use and hydrogeological situations, the HydroGES project studies the spatial distribution of dissolved N₂O and other nitrogen forms in a 3453 km² watershed (Haut-Loir, Centre region, France) with monthly sampling campaigns from February 2017 to December 2018. This site includes two contrasted hydrological regions: the western part (Perche and Faux-Perche region) with a dense tributary network and dominance of (sub)surface runoff and the eastern part (Beauce region) with a deep groundwater system.

HydroGES wants to provide estimation of riverine N₂O emission with Tier 1 (calculation based on EF_{5r}), Tier 2 (statistical modelling based on measured N₂O emissions) and Tier 3 (Riverstrahler mecanistic modelling) at watershed scale in intensive cropland French regions. First results show a mean dissolved N₂O concentration of 1.25 µg-N L⁻¹. In Beauce region, the ratio N₂O-N/NO₃-N is rather constant between winter and summer (0.023% - 0.027%) while in Faux-Perche, a clear seasonal pattern is visible (0.009% - 0.030%). It suggests thus that EF_{5r} are one order of magnitude below the IPCC proposed factor.

UNEP 2013 : Bouwman, Lex, et al. Drawing down N₂O to protect climate and the ozone layer. A UNEP Synthesis Report. United Nations Environment Programme (UNEP), 2013.