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Upscaling N2O emissions at the watershed scale: role of land cover and topography

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Agricultural basins are the major source of N2O emissions, with arable land accounting for half of the biogenic emissions worldwide. Moreover, N2O emissions strongly depend on the position of agricultural land in relation with topographical gradients, as footslope soils are often more prone to denitrification.

The estimation of land surface area occupied by agricultural soils depends on the available spatial input information and resolution. Surface areas of grassland, forest and arable lands were estimated for the Orgeval sub-basin using two cover representations: the "Pan-European CORINE Land Cover 2006 database (CLC 2006) and a combination of two databases produced by the Institut d'Aménagement et d'Urbanisme de la Région d'Île-de-France (IAU IDF), the MOS (Mode d'Occupation des Sols) combined with the Ecomos 2000, a land-use classification.

The two main objectives of this study were i) to establish a watershed-scale N2O budget taking into account direct emissions as well as indirect ones (by groundwater and rivers) and ii) to analyze the sensitivity of the input data used for the upscaling.

We therefore analyzed how different land-cover representations influence and introduce errors into the results of regional N2O emissions inventories. A further introduction of the topography concept was used to better identify the critical zones for N2O emissions, a crucial issue to better adapt the strategies of N2O emissions mitigation.

Overall, we observed that a refinement of the land-cover database led to a 5% decrease in the estimation of N2O emissions, while the integration of the topography decreased the estimation of N2O emissions up to 25%.

An other significant result of this study is the small contribution to the total N2O emissions from indirect sources from the hydrological network (streams + groundwater) compared with direct emissions by soils.