Geophysical Research Abstracts
Vol. 19, EGU2017-12308, 2017
EGU General Assembly 2017

Nitrogen fertilizer fate after introducing maize into a continuous paddy rice cropping system

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After introducing upland crops into permanent flooded cropping systems, soil conditions temporally change from anaerobic to aerobic, which profoundly impacts nitrogen (N) dynamics. In the framework of the DFG research unit 1701 ICON we applied a single 15N-urea pulse in a field experiment in the Philippines with three different crop rotations: continuous paddy rice, paddy rice–dry rice, and paddy rice-maize. Subsequently, we traced the fate of the labelled urea in bulk soil, rhizosphere, roots, biomass and microbial residues (amino sugars) within the following two years. 15N recovery in the first 5 cm of bulk soil was highest in the first dry season of continuous paddy rice cropping (37.8 % of applied 15N) and lowest in the paddy rice–maize rotation (19.2 %). While an accumulation over time could be observed in bulk soil in 5-20 cm depth of the continuous paddy rice system, the recoveries decreased over time within the following two years in the other cropping systems. Highest 15N-recovery in shoots and roots were found in the continuous paddy rice system in the first dry season (27.3 % in shoots, 3.2 % in roots) as well as in the following wet season (4.2 % in shoots, 0.3 % in roots). Lowest recoveries in biomass were found for the paddy rice–dry rice rotation. Long-term fixation of 15N in microbial biomass residues was observed in all cropping systems (2-3 % in the 3rd dry season). The results indicate that the introduction of maize into a continuous paddy rice cropping system can reduce the fertilizer N use efficiency especially in the first year, most likely due to nitrate leaching and gaseous losses to the atmosphere.