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Green-house gas emissions from rice fields under different water management

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During 2012 season, two rice fields have been selected in Italy (Cantaglia farm, Bologna province) and subjected to different water management: one under continuous flooding (WET) and the other under alternate wetting and drying (AWD). In AWD, re-flushing occurred in order to maintain water field capacity over 60 %. Two rice varieties (one commonly cultivated in Italy and one variety from the S.I.S. germoplasm collection) have been considered under WET treatment (Gladio and Zhen Long 13 – abbreviated as ZL13), while only Gladio under AWD. Green house gases (GHGs) sampling have been performed weekly or bi-weekly throughout the growing season. Soluble organic carbon (C), soluble nitrogen (N) and nitrates have been collected through piezometers. Soil sampling have been performed at the beginning and at the end of the growing season and total organic C (TOC), total N (TN), C/N ratio of soil organic matter (SOM), bulk density and water holding capacity were measured. At the end of the growing season rice above- and below-ground biomass have been sampled and C and N content of stem, grain and roots were measured.
Methane (CH4) emissions showed a clear trend, following water availability in soils. An initial peak after the first flooding was observed in all soils, while after the second flooding CH4 was emitted only in the WET treatment. Further flooding events in AWD soil did not determine CH4 emissions during the vegetative season. Overall, in 2012 growing season a 98 % reduction of CH4 emissions in AWD soil was observed. In the WET treatment, no significant variations were observed between the two varieties, although on average ZL13 showed lower rates of CH4 emissions.
Two peaks of nitrous oxide (N2O) emissions were observed: the first after the initial flooding in all soils; the second one, much greater, 14 days after the fertilization only in AWD soils. These two peaks accounted for 92 % of total N2O emissions in 2012 rice season. Overall, in 2012 growing season N2O emissions were five-fold greater in AWD with respect to WET soils. No significant differences were observed between the two varieties, although ZL13 showed on average lower emission rates.
The large difference between the two water management systems indicates that more work is needed to optimize the AWD cultivation method (variety, N management, water management) under Italian conditions before it can be introduced as an instrument to reduce climate impact of the Italian rice crop.