Land use change from an annual maize cropping systems to a perennial Silphium perfoliatum crop has unused potential to reduce GHG emission in biomass production

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In the last two decades, acreage for biomass production has strongly increased in Germany due to the Renewable Energy Act. Recently, discussion about soil, climate, and biodiversity protection is receiving more and more public attention throughout broad parts of the society. The project BESTLAND focuses on the effect of land use change from the common annual maize cropping system to a perennial cropping system, as a measure against increasing environmental constraints in biomass production. A suitable perennial biomass crop as an alternative for maize is S. perfoliatum (cup plant). On one hand, the yellow flowering plant produces high biomass yields and on the other hand it provides a variety of ecosystems services. Field experiments were carried out in the Saar-Nahe mountain range in the state of Saarland on a fine textured planosol. The experimental sites are characterized by temporal waterlogging and slopes and therefore these sites are prone for soil compaction and soil erosion. Under these conditions perennial crops are assumed to have soil preserving benefits. Maize was compared to cup plant by establishing four paired sites, where each pair consisted of a maize and a cup plant field in close vicinity (< 500 meters) to each other. All sites are grower fields and were managed by the farmers according best management practices. Nitrous oxide and methane fluxes were measured weekly using the static chamber technique all year round. Besides greenhouse gas measurement, soil samples for determination of soil mineral nitrogen were taken at each gas sampling date. Furthermore, soil temperature and water content were continuously monitored using sensors. Biomass yields at each site were determined at harvest. In the first year average nitrous oxide emissions from cup plant fields were lower than from maize fields by more than 70 % on area and dry matter yield basis. These results indicate that perennial bioenergy crops not only offer a wider range of ecosystem services but can also decrease GHG emissions from bioenergy production.