Greenhouse gas emissions from a Mediterranean floodplain forest: the role of tree emissions under a changing flooding regime.

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The increase of greenhouse gas (GHG) emissions into the atmosphere is promoting and accelerating climate warming. Among GHG sources, soils are an important natural source of GHG to the atmosphere through aerobic soil respiration that release carbon dioxide (CO₂). However, in riparian areas, soils can also release relevant amounts of methane (CH₄) and nitrous oxide (N₂O) through anaerobic processes promoted by high groundwater levels or flooded conditions. Recent studies have highlighted the role of trees in CH₄ emissions, but little is still known about the origin of these emissions, the processes involved, and their contribution to the global carbon and nitrogen cycles. To shed light on this issue, we measured GHG emissions (i.e. CO₂, CH₄, and N₂O) from the stems of two riparian tree species (Fraxinus agustifolia and Quercus robur) located along a gradient of soil moisture conditions (i.e. from wet to completely flooded soils) in a Mediterranean floodplain forest. Moreover, we also analyzed the isotopic carbon signature of the GHG emitted and the microbial communities inhabiting within tree stems by 16S rRNA gene analysis. Our results showed that CH₄ emitted by riparian tree stems was 100-fold higher at the flooded than at wet soil locations, while CO₂ and N₂O emissions did not vary across moisture conditions. When considering together emissions form soil surface and tree stems under flooded conditions, riparian trees contributed up to 20%, 40% and 60% of the total CH₄, CO₂, and N₂O emissions, respectively. Keeling plots suggested that CO₂ emitted through tree stems was produced within the soil compartment and thus transported to the atmosphere through the tree stems, whereas CH₄ emissions may have a different origin. However, methanogens were almost absent on the wood microbiome. The substantially higher presence of methanotrophs on the wood than on the soil compartment suggested that, despite CH₄ emitted by stems could come from soil microbial activity, the microbial consumption of that CH₄ within the tree stem could have changed its isotopic signature. Overall, our findings suggest that the riparian trees growing in this Mediterranean floodplain forest may mainly act as passive transporters of GHG produced in soils...
instead of being active GHG producers.