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Nitrogen and carbon interactions in controlling terrestrial greenhouse gas fluxes

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The increased input of N to terrestrial systems may have profound impacts on net greenhouse gas (GHGs) fluxes and, consequently, our future climate; however, fully capturing and quantifying these interactions under field conditions urgently requires new, more efficient, measurement approaches. We have recently developed and deployed a novel system for the automation of terrestrial GHG flux measurements at the chamber and plot scales, using the approach of 'flying' a single measurement chamber to multiple points in an experimental field arena. As an example of the value of this approach, we shall describe the results from a field experiment investigating the interactions between increasing inorganic nitrogen (N) and carbon (C) additions on net ecosystem exchanges of N2O, CH4 and CO_2, enabling the simultaneous application of 25 treatments, replicated five times in a fully replicated block field design. We will describe how the ability to deliver automated GHG flux measurements, highly replicated in space and time, has revealed hitherto unreported findings on N and C interactions in field soil. In our experiments we found insignificant N2O fluxes from bare field soil, even at very high inorganic N addition rates, but the interactive addition of even small amounts of available C resulted in very large and rapid N2O fluxes. The SkyGas experimental system enabled investigation of the underlying interacting response surfaces on the fluxes of the major soil-derived GHGs (CO_2, CH4 and N2O) to increasing N and C inputs, and revealed unexpected interactions. In addition to these results we will also discuss some of the technical problems which have been overcome in developing these 'flying' systems and the potential of the systems for automatically screening the impacts of large numbers of treatments on GHG fluxes, and other ecosystem responses, under field conditions. We describe here technological advances that can facilitate the development of more robust GHG mitigation strategies and can be used to monitor whether land management schemes, such as those now supported under EU CAP, can really deliver the anticipated GHG reductions under real field conditions.