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A soil's perspective on sustainable agriculture (Philippe Duchaufour Medal Lecture)

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One of the greatest challenges facing humanity is to provide food security across the world and in the long term. One of the prerequisites to tackle this great challenge is to understand how sustainable agroecosystems function and provide ecosystem services. I will discuss how we have and hope to continue to elucidate the feedbacks between agroecosystem management options (e.g., tillage, organic practices, integrated soil fertility management, etc.), global change (e.g., elevated CO_2, elevated O_3, and climate change), soil properties (e.g. soil structure and soil biota) and carbon and nutrient cycling. I will make the argument, based on some case studies, of how we need to conduct experimental soil work from the micro- to landscape scale over day to decadal times scales and subsequently integrate the experimental results within simulation models to interpolate and extrapolate them to the regional and global scale over decadal to century-long time scales. These modeling results can then be linked to socioeconomic models in order to holistically assess the sustainability of agriculture. Finally, I will show some case studies on how to bring our improved understanding into practice to effectively ensure a better food security.