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Multiscale Image Based Modelling of Plants and Soil

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We rely on soil to support the crops on which we depend. Less obviously we also rely on soil for a host of ‘free services’ from which we benefit. For example, soil buffers the hydrological system greatly reducing the risk of flooding after heavy rain; soil contains very large quantities of carbon, which would otherwise be released into the atmosphere where it would contribute to climate change. Given its importance it is not surprising that soil, especially its interaction with plant roots, has been a focus of many researchers. However the complex and opaque nature of soil has always made it a difficult medium to study.

In this talk I will show how we can build a state of the art image based model of the physical and chemical properties of soil and soil-root interactions, i.e., a quantitative, model of the rhizosphere based on fundamental scientific laws. This will be realised by a combination of innovative, data rich fusion of structural and chemical imaging methods, integration of experimental efforts to both support and challenge modelling capabilities at the scale of underpinning bio-physical processes, and application of mathematically sound homogenisation/scale-up techniques to translate knowledge from rhizosphere to field scale. I will also describe how imaging and image based modelling can help understand devastating plant bacterial diseases like *Xylella fastidiosa* in olives.

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