Tree-centric mapping of forest carbon density from airborne laser scanning and hyperspectral data

David Anthony Coomes1, Michele Dalponte1,2, Juheon Lee1,3, Carola Schönlieb3, Xiaohao Cai1,3

1Dept Plant Sciences, University of Cambridge, United Kingdom; 2Fondazione E. Mach, San Michele all'Adige (Trento), Italy; 3Dept Applied Mathematics and Theoretical Physics, University of Cambridge, United Kingdom; dac18@cam.ac.uk

Airborne remote sensing is increasingly recognized as an outstanding data source for high-fidelity mapping of carbon stocks at regional scales. A tree-centric approach to carbon mapping is developed, based on identifying individual tree crowns (ITCs) from the LiDAR point cloud and identifying species from airborne hyperspectral data by machine learning. Using examples from coniferous forest in the Italian Alps, deciduous woodland in Britain, and lowland tropical forest in Borneo, the tree-centric approach is shown to deliver precise estimates of individual tree biomass and forest stocks. ITC delineation approaches based on canopy height models fail to detect subcanopy trees, and a small correction needs to be made to accommodate these in carbon maps. However, new graph cut approaches using the entire point cloud can detect individuals beneath the main canopy, provided the LiDAR point cloud is sufficiently dense. An advantage of the tree-centric approach over existing plot-level methods is that it is founded on the same principles as field-based inventory approaches, making it intuitive and transparent to use.