Indirect effects of wildfires on carbon budgets and fluxes

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Many Mediterranean regions have seen an intensification of wildfire regimes over the past decades, to a large extend reflecting human activities. In Portugal, the long-term annual burnt area is around 100.000 ha but burnt areas over 300.000 ha are not exceptional, having occurred most recently in 2017.

An important societal concern regarding wildfires is their impacts on forest ecosystem services and, in particular, carbon sequestration. Forest policy and management have increasingly targeted the carbon sink potential of forest to offset greenhouse gas emissions. Wildfires affect forest carbon pools both directly, through combustion/heating processes, and indirectly, by changing abiotic and biotic conditions. These indirect impacts appear to be important, as model results have suggested that post-fire carbon losses are roughly equivalent to emissions during the fire. Furthermore, forest stands haven been found to act as carbon sink for 10 and more years after wildfire. However, wildfire impacts on forest carbon dynamics have mainly been studied through biometric surveys of (annual changes in) carbon stocks. Studies measuring soil respiration effluxes have been less frequent and studies measuring eddy covariance fluxes even less. This is especially true for the immediate post-fire conditions.

To address this existing knowledge gap, the FIRE-C-BUDs project has been combining the three above-mentioned methodologies in a 2017 burnt area in the Vila de Rei municipality, central Portugal. Within the burnt area, a study site on a relatively flat plateau dominated by young pine stands was selected as most adequate for installing the eddy covariance system. Within the system's (presumed) foot print area, a transect of five points at roughly 50m distances was laid out in the direction of the (presumed) prevalent wind direction. Subsequently, fire severity indicators were described, ash layer and topsoil were sampled, and soil respiration collars were installed. At each transect point, this was done separately for a pine, a shrub and an inter-patch. The same set-up was implemented at a comparable pine stand immediately outside the burnt area. Also, five additional soil respiration collars were installed in two subareas of the burnt site where pine trees had suffered partial rather than complete crown consumption.

The poster will present preliminary results obtained during the first post-fire year, focusing on the 1- to 2-weekly measurements of soil carbon effluxes at the point scale but trying to link them to ecosystem carbon fluxes at the field scale, even if analysis of the eddy covariance data is hardly straightforward.