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Editorial

The Ecology of Fine Roots across Forest Biomes

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Fine root-soil interactions fundamentally affect the terrestrial carbon (C) cycle and thereby ecosystem feedbacks to climate change [1]. Fine roots act as conduits of carbon transfer, from plants to soils, and as agents of nutrient acquisition and transport. In parallel, they are the source of secondary metabolites, i.e., the drivers of rhizosphere development and of the root-facilitated C cycling in forest soils.

Beyond that, growth, death, and decomposition of fine roots are key processes that occur continuously and simultaneously throughout the whole year, and stocks of living (biomass) and dead fine roots (necromass) represent the end-products of these processes. Furthermore, along different natural climatic zones, trees have evolved contrasting growth and survival strategies for their fine roots to adapt to the tremendous variations in seasonal climates [2,3]. It was found that standing root biomass varied by over an order of magnitude across plant biomes, and the highest root biomass in terrestrial plant biomes was observed in tropical forests [4]. Thus, modeling responses of different forest ecosystems to global changes can benefit greatly from a better characterization of the fine rootstock patterns and dynamics [5] and, consequently, of the carbon transfer into the soil in different forest biomes across the world.

This necessarily implies novel insights on a broad range of topics on fine roots, including (a) fine root dynamics and seasonal pattern, with a particular focus on the role of starch reserve, (b) methods that help improve the estimation of carbon input into the soil from exudation [6] and decomposition processes, and (c) plant-plant and plant-microbe interactions, microbial community assemblage and functioning processes, as well as the responses to the environmental stresses with a particular focus on the climate change drivers.

All the challenges to understand root functioning in different forest biomes with all its physical, chemical, and biological complexity are welcomed in the current Special Issue entitled "The Ecology of Fine Roots across Forest Biomes" to better depict the fine root derived carbon contribution into C-cycling.

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References

1. Ostonen, I.; Helmisaari, H.S.; Borken, W.; Tedersoo, L.; Kukumägi, M.; Bahram, M.; Lindroos, A.; Nöjd, P.; Uri, V.; Merilä, P.; et al. Fine root foraging strategies in Norway spruce forests across a European climate gradient. *Glob. Chang. Biol.* **2011**, *17*, 3620–3632. [CrossRef]
2. Malhi, Y.; Baldocchi, D.; Jarvis, P. The carbon balance of tropical, temperate and boreal forests. *Plant Cell Environ.* **1999**, *22*, 715–740. [CrossRef]
3. Ma, Z.; Guo, D.; Xu, X.; Lu, M.; Bardgett, R.D.; Eissenstat, D.M.; McCormack, M.L.; Hedin, L.O. Evolutionary history resolves global organization of root functional traits. *Nature* **2018**, *555*, 94–97. [CrossRef] [PubMed]
4. Jackson, R.B.; Canadell, J.; Ehleringer, J.R.; Mooney, H.A.; Sala, O.E.; Schulze, E.D. A global analysis of root distributions for terrestrial biomes. *Oecologia* **1996**, *108*, 389–411. [CrossRef] [PubMed]
5. Wang, C.; Brunner, I.; Zong, S.; Li, M.H. The Dynamics of Living and Dead Fine Roots of Forest Biomes across the Northern Hemisphere. *Forests* **2019**, *10*, 953. [CrossRef]
6. Phillips, R.P.; Erlitz, Y.; Bier, R.; Bernhardt, E.S. New approach for capturing soluble root exudates in forest soils. *Funct. Ecol.* **2008**, *22*, 990–999. [CrossRef]