## ESA2019 – Abstract 400 words

Title: **Individual-based modeling to discover the ecological importance of tree networks**

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Abstract – Text

Background/Question/Methods

Two of the oldest living trees known on earth, the Pando and the Old Tjikko, are clonal plants. Their longevity has been attributed to the mutual benefit of resource sharing and the accumulation of beneficial somatic mutations. Similar effects are known for mycorrhizal networks and trees connected by grafted roots. Could it be that networking is generally advantageous increasing forest integrity under resource limitation or harsh conditions? This would revolutionize our understanding of forest dynamics, which so far is believed to be driven by the inference of competition and facilitation among single trees, and not among single trees and tree networks. Natural root grafting could play a pivotal role in forest resilience, since grafting can be a facilitative interaction potentially increasing individual fitness. To find this out, it is necessary to systematically investigate under which conditions the sharing of resources (e.g. water under drought stress) is beneficial for a group of trees compared to individual trees. Logistical problems hinder such investigations. Individual-based models, however, allow to synthesize the few existing empirical results and to develop new concepts on the functioning of tree networks, the fitness of groups and its impact on forest dynamics.

Results/Conclusions

We provide an individual-based model serving as a virtual laboratory to investigate the formation of networks in plant populations depending on spatio-temporal patterns of resource availability. As an example, we designed simulation experiments mimicking black mangroves exposed to water stress, and compared the results with field data from Mexico. As expected, root grafting depends on trees constellation, tree density and water scarcity. The probability of root grafting is a sigmoid function increasing with trees size, but its shape is influenced by the dynamics of water limitation. Under more stressful conditions, the reflection point of the function is earlier (smaller trees graft) and steeper (the maximum number of grafted trees is earlier achieved). Impressively, the tree networks are small with 4 - 5 connected trees in average and have a predominant linear structure. The latter is in agreement with evolutionary game theory, which predicts that cooperation flourishes most if organisms are strongly pairwise tied since the costs (for grafting) are quickly pay-offed by reciprocated benefits (share of water, nutrients etc.). Our findings thus challenge the recent hypothesis that root networking is an evolutionary beneficial, adaptive behavior, which improves resource acquisition of trees favoring its survival under stressful environmental conditions.