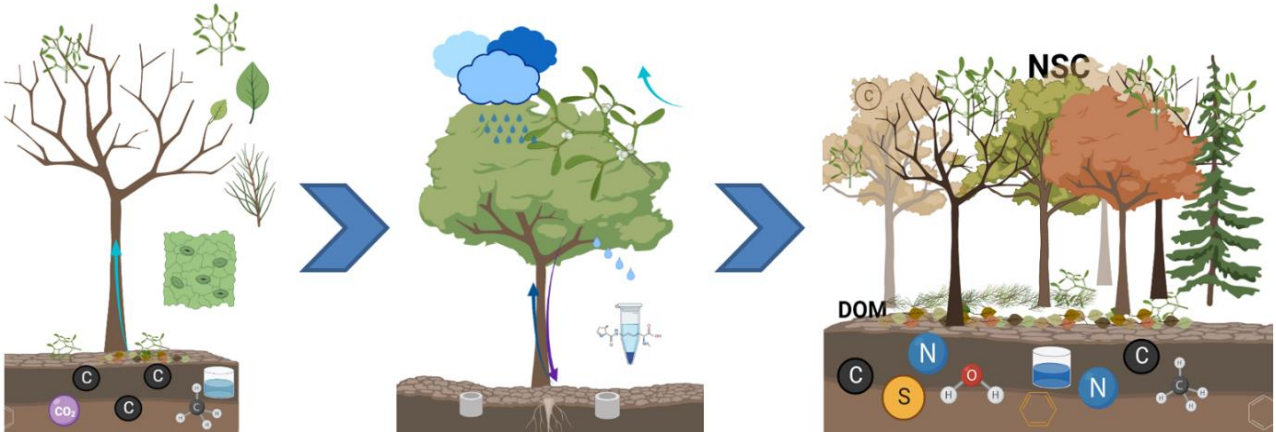
Are mistletoes more than a leaky faucet in a drying world? The hydrological and biogeochemical impacts of mistletoes on trees and their environment

Climate extremes are adversely affecting trees and forests worldwide. Drought lowers forest vitality and alters the water cycle in catchments. Hemiparasitic plants such as European mistletoe (*Viscum album L.*) can exacerbate these negative effects by uncontrolled water consumption, disturbing precisely balanced ecosystem water relations. Despite the importance of increased transpiration on vitality of infested trees and on ecosystem water cycle, there is still a lack of information on how mistletoe affects hydraulics and hydrology at organ, tree and canopy levels. Furthermore, no complex study on host-to-mistletoe interactions integrating the cellular level with the whole-tree and ecosystem levels has been done. Mistletoe is increasingly contributing to large-scale loss of tree vitality, changes in water and nutrient cycle, affecting carbon sequestration and last, but not least, causing significant economical losses. Due to increasing extent of the mistletoe distribution and with increased frequency and severity of drought and heat waves, the role of the mistletoe in a water and carbon cycle becomes more and more important. Since mistletoe barely regulates its transpiration and since it reduces throughfall, it has the potential to increase evapotranspiration while decreasing soil water availability and imposing drought on trees and the whole ecosystem.



To gain better insight on how mistletoe affects the fate of water in a soil-plant-atmosphere continuum and to identify biogeochemical changes that alter their mutual relationships we propose a complex study on trees and their mistletoes. Matching expertise of Czech and Polish team will allow us to study on the scales from tree hydraulic anatomy, physiology and whole-tree transpiration to the whole stand water balance, including water quantity and quality. The research will be conducted on coniferous and broadleaved trees at the multiple sites in Poland and Czechia.

We will measure how mistletoe affects transpiration from trees and from the forest canopy in the summer and in winter, under various levels of water availability. How does the mistletoe change tree growth and functioning of its xylem. How does the mistletoe affect throughfall (amount of water that precipitates on the soil) and soil moisture. How do nutrients and secondary metabolites leached from the mistletoe change soil hydraulic properties and decomposition of litter. Last, but not least, we will develop a machine learning algorithm which will help people to automatically recognize mistletoe plants in the entire stand based on the remote survey. This will allow us to develop patterns that transfer the obtained hydrological and biogeochemical data on a larger scale. Such a procedure will be a real milestone in determining how much mistletoe is a "running faucet" for both water and other nutrients on the tree and forest level.

Our findings will significantly advance our understanding of the effect of mistletoe on the functioning of a single tree and forests. The results of such comprehensive studies will become the basis for the development of strategies to mitigate the effects of mistletoe, drought and global change on trees and forests.