Continuous water potential monitoring for soil-plant continuum hydraulic parameterisation and simulation

Huade Guan

National Centre for Groundwater Research and Training, College of Science and Engineering, Flinders University, Australia.

Abstract: Terrestrial vegetation is a core element of the land phase of the hydrological cycle. It transfers soil moisture to the atmosphere through root water uptake, sap flow, and transpiration. This dynamic system, referred to as the soil-plant-atmosphere continuum (SPAC), forms the core of the critical zone which provides habitat and food for almost all terrestrial living forms. It controls hydrological partitioning of precipitation to support plant growth, survival and production; mediates runoff generation to form catchment water yield and mitigate flooding; shapes land-atmosphere interactions to influence climate; and is sensitive to global and local environmental changes. SPAC monitoring and modelling is important but challenging. Due to the vegetation's distributed nature and the root zone's hidden characteristics, it is a lot more difficult to monitor SPAC states and fluxes than other land-surface variables, such as stream discharge, precipitation, and temperature. Plant water potential reflects dynamic water condition in vegetation, which is determined by moisture supply in the root zone, atmospheric demand, and plant physiological control. Thus, dynamic water potential can provide a "periscope" to observe root zone hydraulic conditions. Based on this hydraulic connection in SPAC, plant individuals work very likely as "observation wells" to the whole root zone at predawn, and as "pumping-test wells" in daytime. On behalf of a team of former and present students and collaborators, I will present plant water potential monitoring over a decade on eight tree species in two climate zones, covering both urban and rural settings. we will show how this plant water potential data, together with sap flow measurement, have been successfully applied in SPAC model development, root water uptake model improvement, transpiration model parameterization, plant hydraulic characterization, and plant water stress diagnosis.

Keywords: *Root zone, Water potential, SPAC modelling, Sap flow, Transpiration, Root water uptake*