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Understanding the Ecoydrology of Mangroves: A Simple SPAC Model for Avicennia Marina

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Mangroves represent one of the most carbon-rich ecosystems in the Tropics, noticeably impacting ecosystem services and the economy of these regions. Whether the ability of mangroves to exclude and tolerate salt has been extensively investigated in the literature – both from the structural and functional point of view – their eco-hydrological characteristics remains largely understudied, despite the crucial link with productivity, efficient carbon storage and fluxes.

In this contribution we develop a "first-order" Soil Plant Atmosphere Continuum model for Avicennia Marina, a mangrove able to adapt to hyper-arid intertidal zones and characterized by complex morphological and eco-physiological traits. Among mangroves, Avicennia marina is one of the most tolerant to salinity and arid climatic conditions.

Our model, based on a simple macroscopic approach, takes into account the specific characteristics of the mangrove ecosystem and in particular, the salinity of the water in the soil and the levels of salt stress to which the plant may be subjected. Mangrove transpiration is hence obtained by solving the plant and leaf water balance and the leaf energy balance, taking explicitly into account the role of osmotic water potential and salinity in governing plant resistance to water fluxes.

The SPAC model of Avicennia is hence tested against experimental data obtained from the literature, showing the reliability and effectiveness of this minimalist model in reproducing observed transpiration fluxes. Finally, sensitivity analysis is used to assess whether uncertainty on the adopted parameters could lead to significant errors in the transpiration assessment.