

Hydraulic Redistribution Decreases with Precipitation Magnitude and Frequency in a Dryland Ecosystem: A Data-Model Fusion Approach

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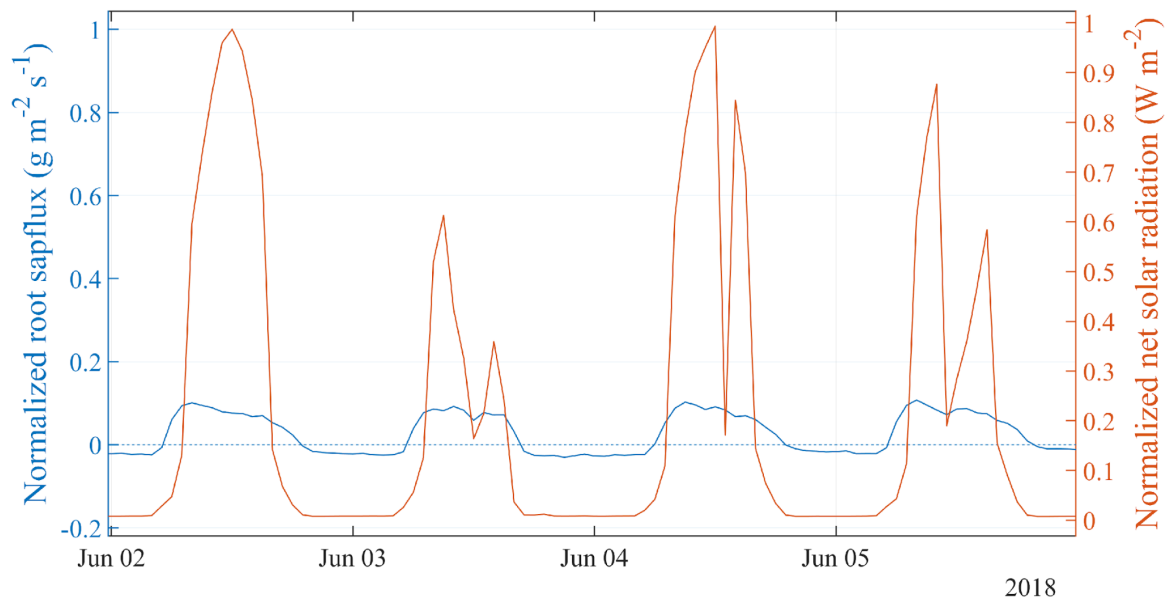


Figure S1: Diurnal patterns of normalized Juniper root sapflux ($\text{g m}^{-2} \text{s}^{-1}$) and normalized solar radiation ($\text{W m}^{-2} \text{s}^{-1}$). The graph illustrates that as solar radiation reaches close to zero, negative sapflux (HR) is observed in Juniper roots.

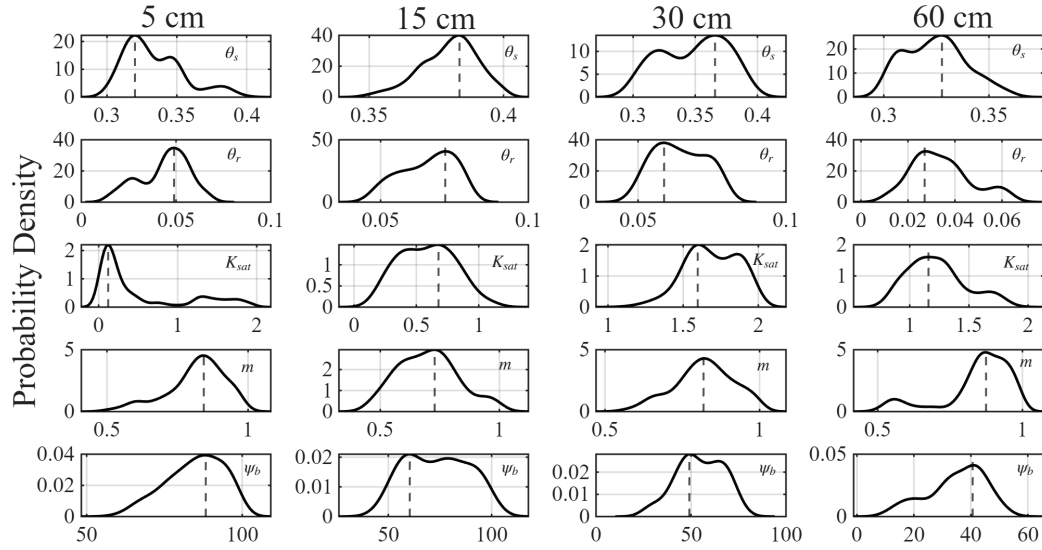


Figure S2: Posterior distributions of calibrated soil hydraulic parameters prior to incorporating the HR process. Shown are saturated and residual soil water content (θ_s and θ_r , respectively), saturated hydraulic conductivity (K_{sat}), pore size distribution parameter (m), and air entry water potential (ψ_b). Posterior distributions with sharp peaks and narrow spread suggest that parameters are well constrained.

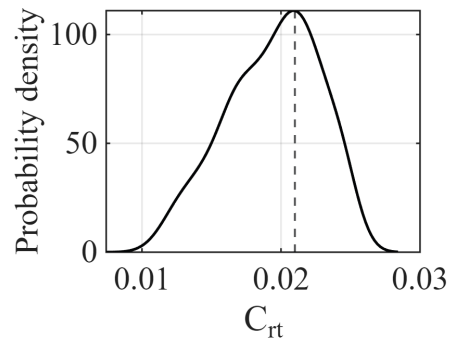


Figure S3: Posterior distribution of calibrated maximum radial soil-root conductance, C_{RT} .

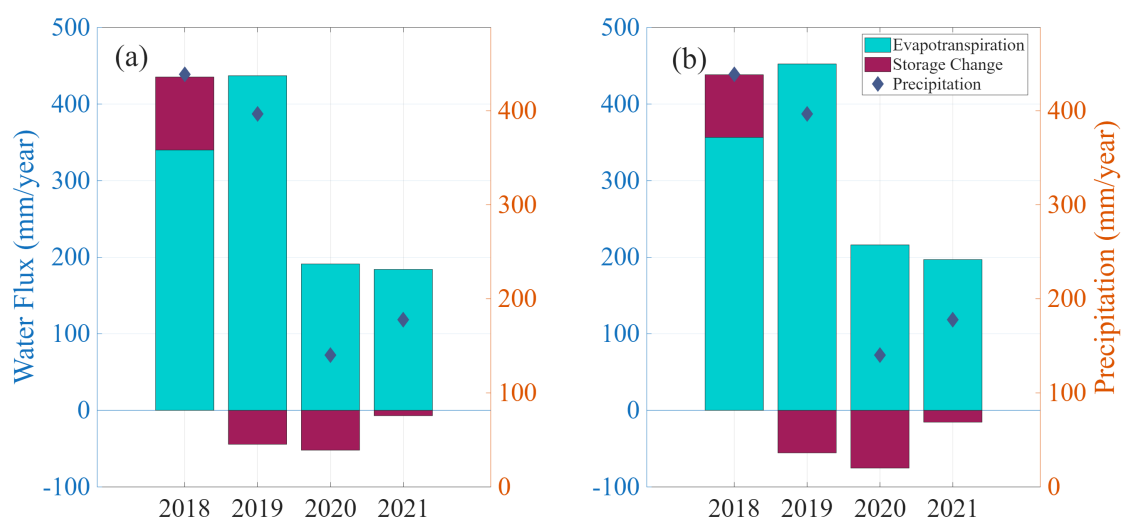


Figure S4. Annual water mass balance components (evapotranspiration and storage change) and precipitation for (a) the default TECO model and (b) the TECO+HR model.

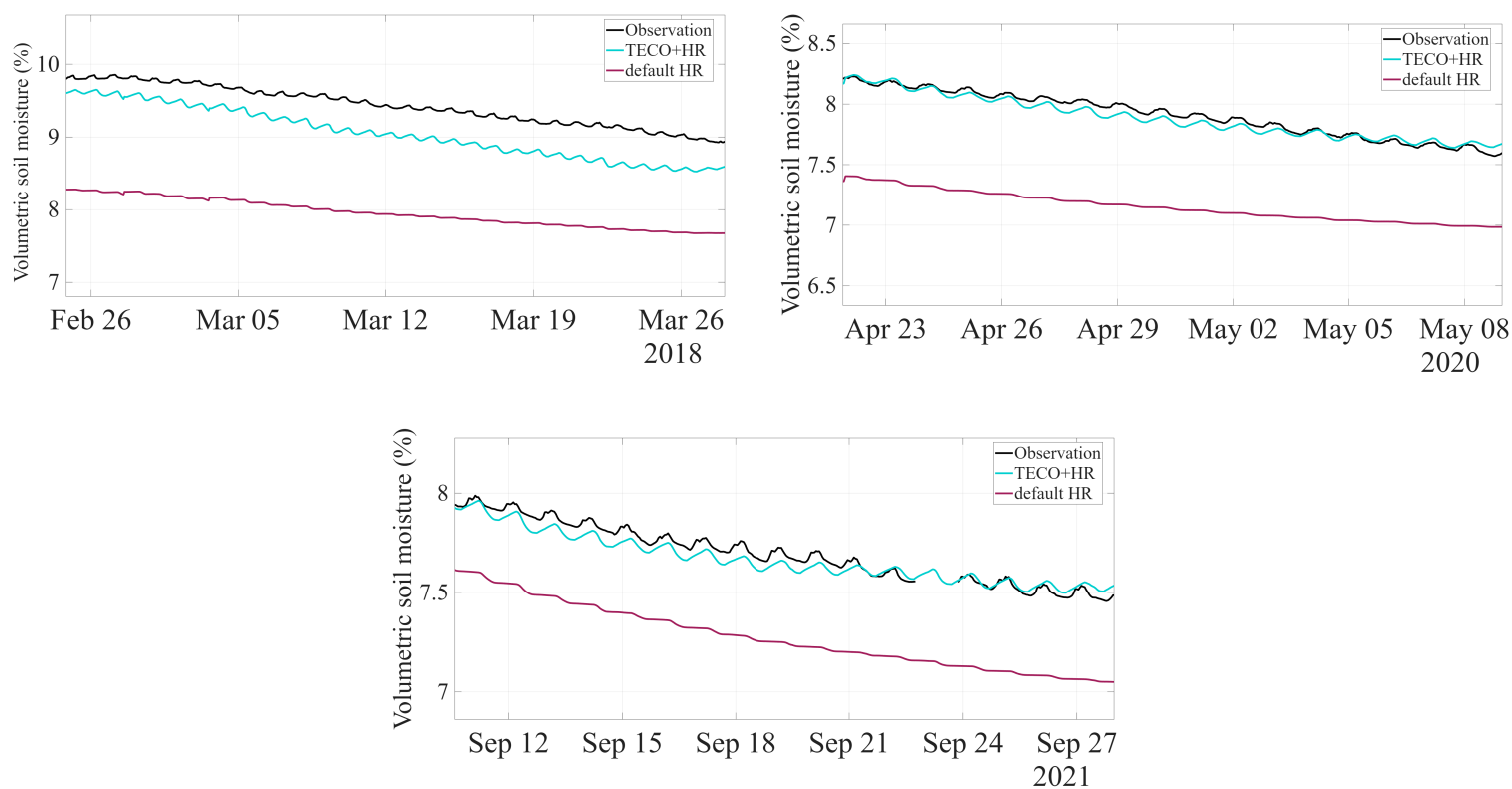


Figure S5: Observed and simulated soil moisture integrated over the top 60 cm of soil.

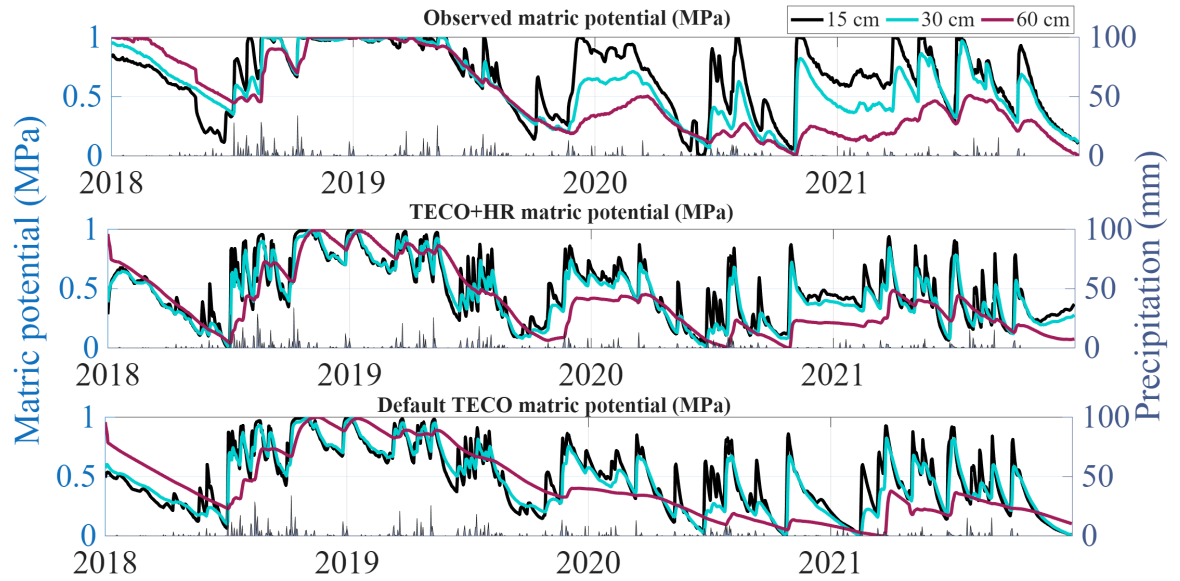


Figure S6: Time series of min-max normalized observed and simulated soil matric potential at 15, 30 and 60 cm soil depths. Panels compare (Top) observed data, (Middle) the TECO+HR model, and (Bottom) the default TECO model. Blue bars indicate daily precipitation.

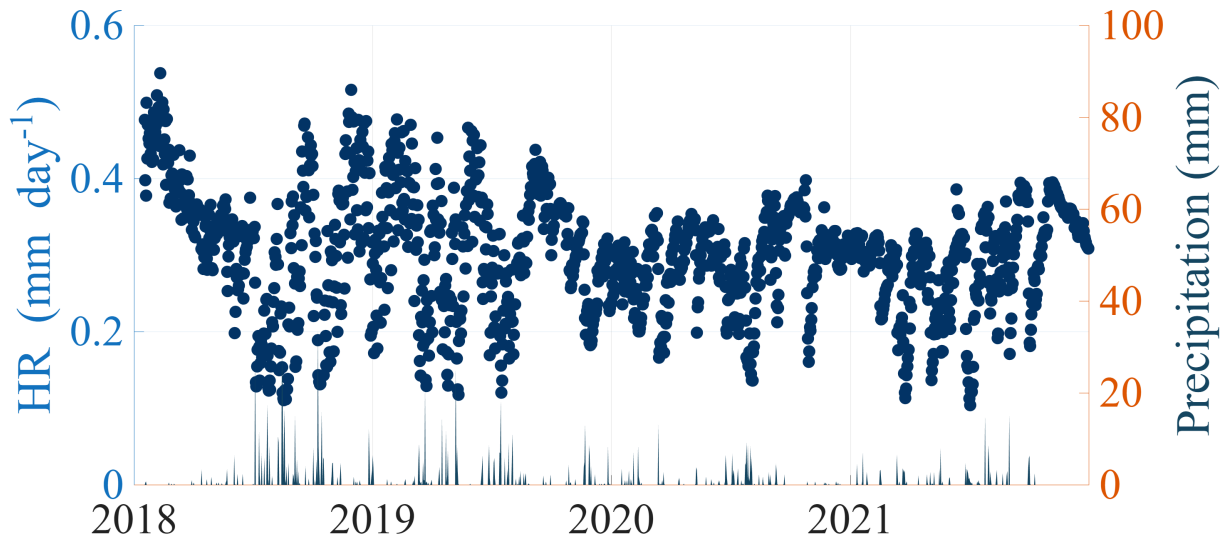


Figure S7: Long-term daily net HR trend (upto 60 cm soil depth) from January 2018 to December 2021. The blue shaded area represents precipitation (right y-axis).

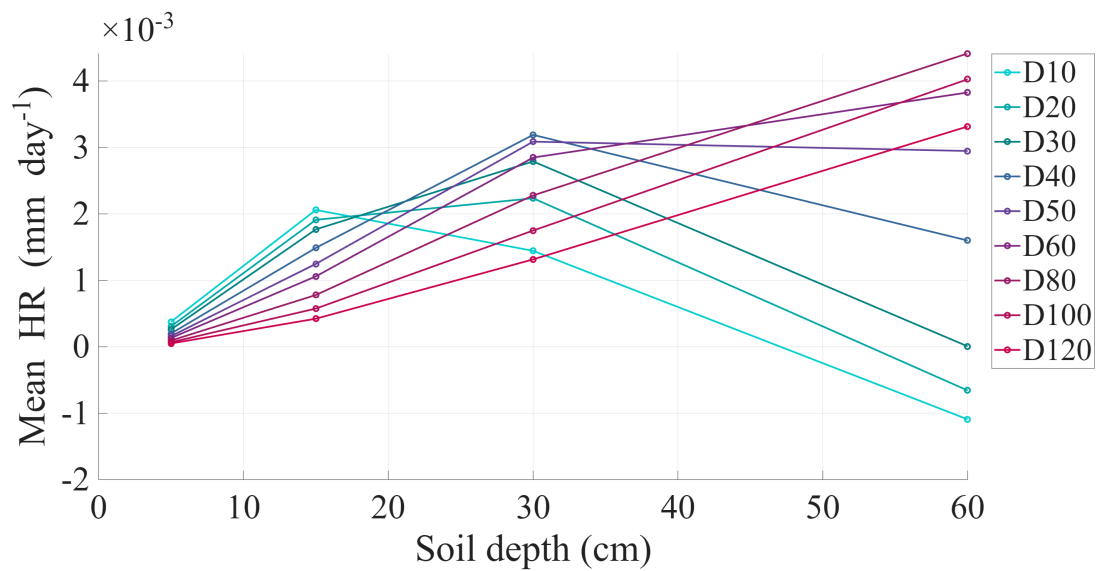


Figure S8: Mean Hydraulic Redistribution (HR) across soil depths for different rooting depths. Mean HR (mm day^{-1}) as a function of soil depth (cm), calculated by averaging daily HR values over a four-year period from 2018 to 2021. Each line represents different rooting depths (D10 to D120), indicating the influence of rooting depth on HR dynamics.