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# Evapotranspiration of an Abandoned Grassland in the Italian Alps: Modeling the impact of shrub encroachment

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Shrub encroachment of grasslands in the Alps is still a poorly studied phenomenon. Therefore, this study analyses the possible effect of shrub encroachment on actual evapotranspiration (ETa) at an abandoned grassland in the Northwestern Italian Alps, colonised by Elaeagnus Rhamnoides shrubs. This is done by means of micrometeorological and eddy covariance data collected during four growing seasons. Additionally, the Hydrus 1D hydrological model modified to account for a soil column with two vegetation types is used. This modified model is run with a variable percentage of shrubs on evapotranspiration, ranging from 0 to 80% and it is validated by using the measured eddy covariance-derived ETa. The Hydrus 1D model is also applied in its usual set-up, having only one vegetation type, to estimate the ETa from both grassland and shrubs separately.

The performance of the modified model with two vegetation types is acceptable, although it is very variable between different growing seasons and in dry condition it could be further improved (R between 0.50 in 2016 and 0.73 in 2014 considering the probable actual percentage of ETa affected by shrubs. The percentage varies between 20% in 2016 and 60% in 2014). Besides, the model captures the inter-annual variability of ETa. The agreement of cumulative simulated and observed ETa is good, since the deviation between observed and modelled cumulative ETa is always lower, in the four analysed growing seasons, than 50 mm.

The simulated ETa approximates the eddy covariance-derived ETa, however the modelled soil water content is very sensitive to precipitation events, more than the measured soil water content. Both models, with the modified and the usual setup, tend to overestimate the vegetation stress during dry periods. Nevertheless, the single vegetation model results allow us to conclude that the shrubs likely are responsible for an enhancement of ETa and an alteration of the hydrological cycle accordingly. Finally, we explore how some micro-meteorological drivers of ETa (vapour pressure deficit – VPD, net radiation, wind speed, air temperature and ground heat flux - $G_0$) affect the difference between modelled and simulated ETa, and between simulated ETa from shrubs and from grass. Frequently, higher deviations from zero are found especially with high VPD and $G_0$.