ROLE OF PINE FORESTS ON SOIL WATER BALANCE IN TWO MEDITERRANEAN AREAS: SEMIARID AND DRY AT SOUTH EASTERN OF SPAIN

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INTRODUCTION

Water is a limited resource in the semiarid areas, which affects both, the population services and the natural ecosystems stability. An accurate knowledge of soil water balance and role of the vegetation cover contribute to improve the management of resources water and forest. For this purpose, we used HYDROBAL, an eco-hydrological modeling approach for assessing water balance with a daily resolution, it has been applied successfully to analize the soil water balance on different vegetation cover types and assess its effects on runoff, evapotranspiration and soil moisture. [2] [3]

Objectives:

(1) Determine the soil water balance on two different climatic conditions, semiarid and dry climate.

(2) Assess the effect of vegetation (structure and cover) on soil water balance.

For this purpose we used HYDROBAL model in two sites in the south-eastern of Spain.

STUDY AREA

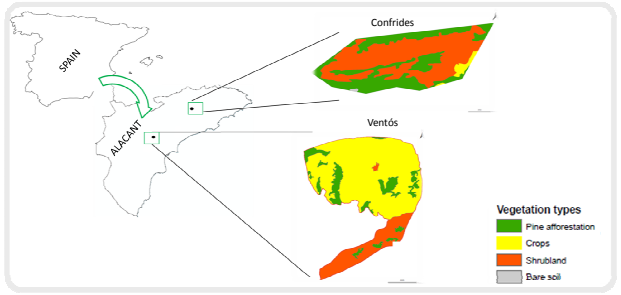
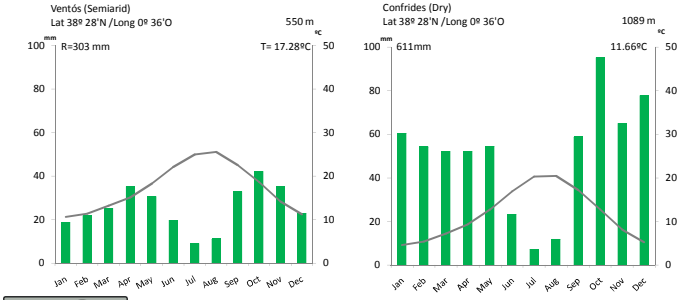


Figure 1. Main characteristics of soil and vegetation cover in both sites.

Vegetation cover (*Pinus halepensis*)	Canopy cover (%)	Density (trees·ha^{-1})	Height (meters)	Basal Area (m^2·ha^{-1})
Ventós	44	800	3.63	14.45
Confrides	77	1366	6.68	29.24

Soil characteristics	Wilting point (%)	Field capacity (%)	Total porosity (%)	Depht (mm)	Organic matter (%)	Texture classes
Ventós	11	21	46.3	300	3.95	Clay loam
Confrides	13	25	46.4	300	1.44	loam

Figure 2. Ombroclimatic diagram of Ventós (semiarid region), and Confrides (dry region). Mean values for the period between 1961 and 2012. R, mean annual rainfall. T, mean annual temperature.



MATERIALS AND METHODS

Soil water balance was determined in each site using HYDROBAL ecohydrological model on one hydrological year (October 2012 and September 2013). We can find a detailed description in [1].

Model inputs

- **Climatic variables** (daily rainfall and temperature)
- **Soil** and **vegetation** characteristics.

VEGETATION COVER TYPE

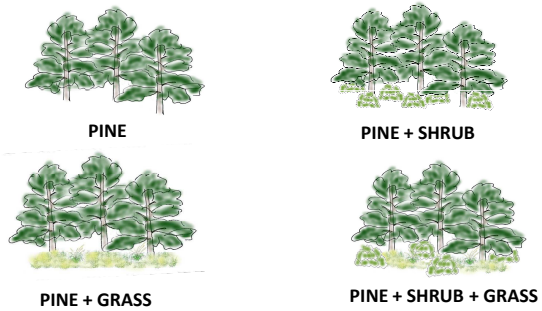
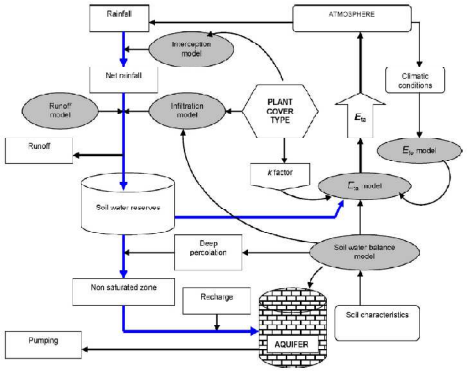


Figure 3. HYDROBAL model operation [1].



One important assumption of **HYDROBAL** consists on determinate the **evaporative coefficients** or *K factor*, used to adjust and calibrate the model to account for differences among the vegetation types.

$$E_{ta\_t} = E_{to\_t} \times (1 - e^{(-k \times SWs_t)})$$

In this case, ***k factor*** corresponds to the transpiration capacity of vegetation

Model outputs:

- Interception
- Net rainfall
- Runoff
- Soil water
- Actual evapotranspiration
- Direct percolation and Deep percolation (aquifer recharge)

To validate the model, it is possible to use runoff, Soil water, Evapotranspration, Direct percolation [2]. In this case, daily soil water content (observed vs. estimated) were used to calibrate the model (figure 4).

RESULTS AND CONCLUSION

The application of Hydrobal model shows different results in both sites, due to the role of vegetation cover and volume of annual rainfall. Confrides site interception and recharge showed higher values than Ventós. Moreover in Ventós site, actual evapotranspiration was higher.

Figure 4. Results of HYDROBAL model validation.

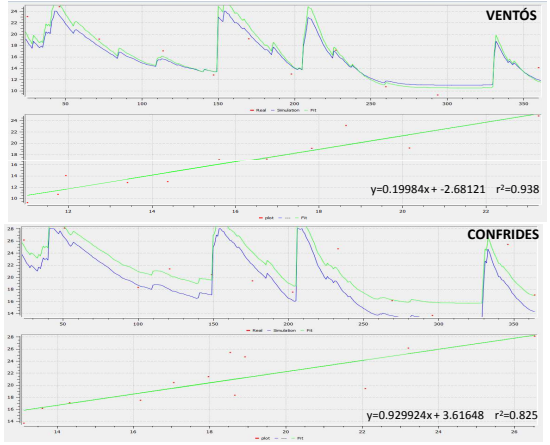
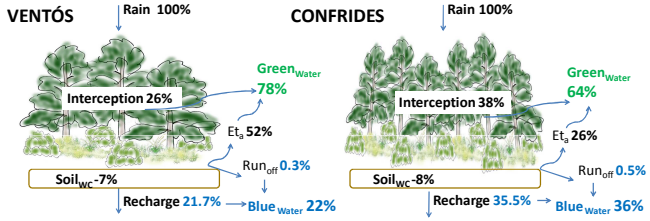


Figure 5. Results of HYDROBAL water balance.

Water Balance	Rainfall (mm)	Eto (mm)	Net_Rain (mm)	Runoff (mm)	SWC (%)	Deep_P (mm)	Slow Inf (mm)	Eta (mm)	Recharge (mm)	k_Plant (mm)
Ventós	406,91	1236,4	293,98	1,43	-7	91,47	3,04	222,9	94,52	0,02
Confrides	894	1118,1	552,52	4,19	-8	259,30	70,19	247,8	329,4	0,02



In areas with **limited water resources**, even with moderate cover, actual evapotranspiration and interceptation values are quite high. High values of interception may be attributed to the to the high number of events < 5 mm, which represent 72.2%.

Considering the **high pine density** in Confrides, practices of **forest management** as thinning can contribute to improve the forest stand and increase of aquifer recharge.

ACKNOWLEDGEMENTS

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REFERENCES

[1] J. Bellot, E. Chirino. Hydrobal: An eco-hydrological modelling approach for assessing water balances in different vegetation types in semi-arid areas. Ecological Modelling 266 (2013) 30-41.

[2] I. Touhami, J. M. Andreu, E. Chirino, J. R. Sánchez, H. Moutahir, A. Pulido-Bosch, P. Martínez-Santos and J. Bellot. Recharge estimation of a small karstic aquifer in a semiarid Mediterranean region (southeastern Spain) using a hydrological model. *Hydrol. Process.* 27, (2013) 165–174.

[3] I. Touhami, J. M. Andreu, E. Chirino, J. R. Sánchez, A. Pulido-Bosch, P. Martínez-Santos, H. Moutahir and J. Bellot. Comparative performance of soil water balance models in computing semi-arid aquifer recharge. Hydrological Sciences Journal, 59 (2013) (1), 1–11.

[*] The HYDROBAL model can be provide to interested persons for free.