Groundwater dependent vegetation identified by remote sensing in the Iberian Peninsula

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1.Motivation

Groundwater Dependant Vegetation (GDV) is defined as vegetation that depends on the water supplies from groundwater aquifers. Within GDV, phreatophytes are terrestrial plants relying on groundwater through deep rooting. They can be found worldwide but are mostly adapted to environments facing scarce water availability or recurrent drought periods mainly in semi-arid to arid climate geographical areas, such as some areas in the Iberian Peninsula (IP).

The severity of droughts in the IP has increased in the last decades [1], making it particularly important to understand the vulnerability of GDV to groundwater availability. In this context, we propose to map the GDV distribution on the IP, using remote sensing only.

2. Data

- NDVI SPOT VGT, 1km resolution, covering the period April 1998 to May 2014
- CORINE Land Cover, for the year 2006
- Precipitation and temperature, 1km resolution for the calculation of the Aridity Index
- CRU TS3.21 for the calculation of SPEI
- Distribution of phreatophytic species in the IP

3. Methods

Humid areas were eliminated, based on the Aridity Index [2]. CORINE Land Cover map was used to eliminate areas that were least likely to have phreatophytic species (Fig.1).

Potential GDV were identified based on three criteria [3] shown on Fig.3

SPEI (12 months) timeseries was used to assess a dry year, used in the Crit. 1 and 2 (Fig.2).

The potential GDV map was compared with the distribution of phreatophytic species in the IP [4].

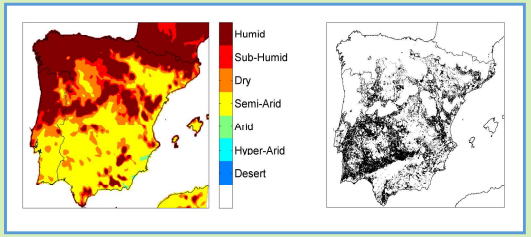

Fig. 1 - Aridity classification of the IP (left pannel) and pixels used to map potential GDV (right pannel).

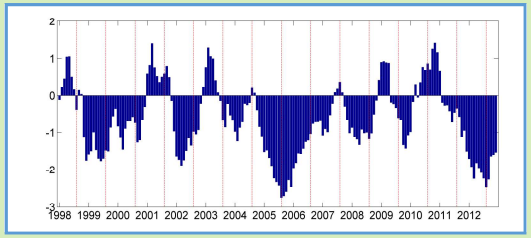

Fig. 2 - SPEI computed for the IP from 1998 to 2012. Red dashed lines mark the month of September.

4. Results

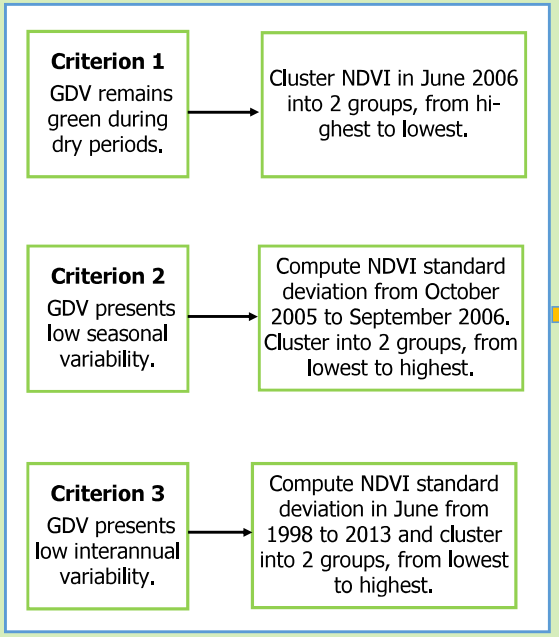

Fig. 3 - Criteria used to identify potential GDV (left pannel) and computations used to implement each criterion (right pannel).

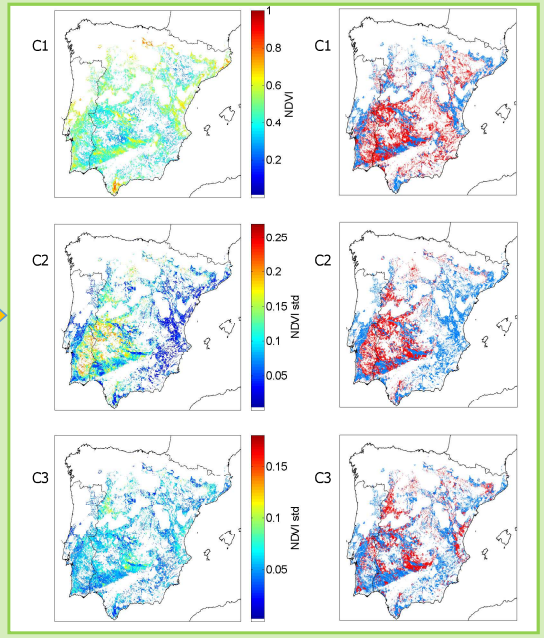

Fig. 4 - Computations described in Fig. 3 (left pannel) and results of cluster analysis for each criterion (right pannel).

Table 1 - Centroids of the clusters obtained for each criterion

Criterion	Cluster 1	Cluster 2
C1	0.56	0.39
C2	0.06	0.15
C3	0.05	0.07

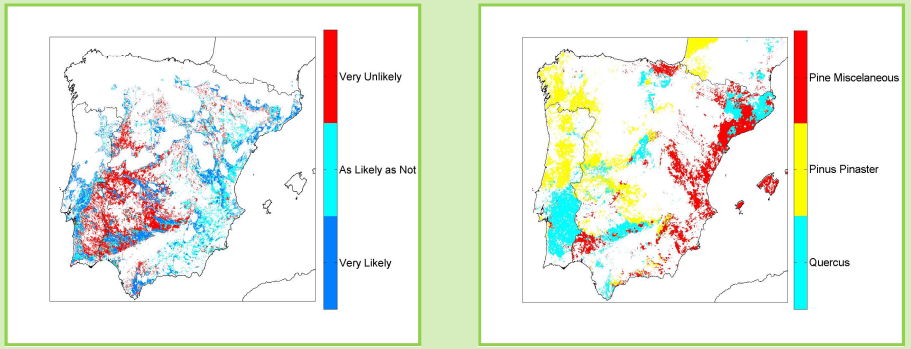

Fig. 5 - Likelihood of being groundwater dependent vegetation (left pannel) and distribution of phreatophytic vegetation in the IP (right pannel).

5. Final Remarks

Most of the IP is classified as semi-arid. In this territory, phreatophytes are adapted to water scarcity and severe drougths, such as the 2005-06 drought.

NDVI identified areas where the vegetation meet the criteria to be GDV, which correspond to areas where phratophytes also occur.

References

[1] Vicente-Serrano SM *et al.* (2014) Evidence of increasing drought severity caused by temperature rise in Southern Europe. Environ Res Lett 9
[2] Spinoni *et al.* (2015). Towards identifying areas at climatological risk of desertification using the Köppen-Geiger classification and FAO aridity índex. Int J Climatol, 35, 2210-2222
[3] Gou S, *et al.* (2015). Mapping Potential Groundwater-Dependent Ecosystems for Sustainable Management. Groundwater 53, 99–110
[4] Brus, DJ, *et al.* (2012) Statistical Mapping of tree species over Europe. Eropean Journal of Forest Research, 131-1, 145-157

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