



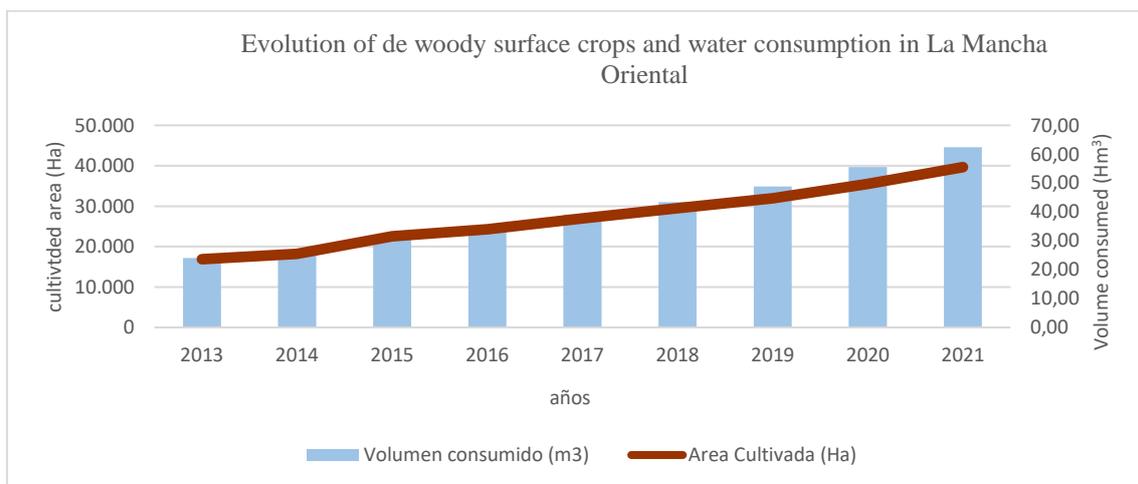
Application of the rules of water use in woody crops with the support of Remote Sensing.

With tools based on remote sensing, groups of water consumption can be differentiated from irrigation plots of woody crops, such as almond, pistachio and olive. This allows the application of practical and effective standards in the control of water use.

Introduction.

Irrigated woody cultivation in La Mancha Oriental (Spain) is expanding.

This is due to the increase in the prices of almonds and the low prices of cereals in the international market.



These woody crops have a great adaptation to water stress. Irrigation can be applied from 1,500 m³ / ha (support irrigation) to 5,000 m³ / ha (intensive production).

How is this water use measured in woody crops?

The standard in La Mancha Oriental allows farmers to choose between 2 systems for measuring their water consumption:

1. Measurement by volumetric counters.



2. Declaration of the cultivation and water consumption, according to the following table:

WOODY CROPS	WATER CONSUMPTION (m³ / ha)
ALMOND, SUPPORT IRRIGATION	1800
OLIVE, PISTACHIO AND VINEYARD, SUPPORT IRRIGATION	1500
ALMOND, PISTACHIO, OLIVE (0,35 <= NDVI < 0,45)	3000
ALMOND, PISTACHIO, OLIVE (0,45 <= NDVI < 0,55)	4000
ALMOND, PISTACHIO, OLIVE (NDVI >= 0,55)	5.000

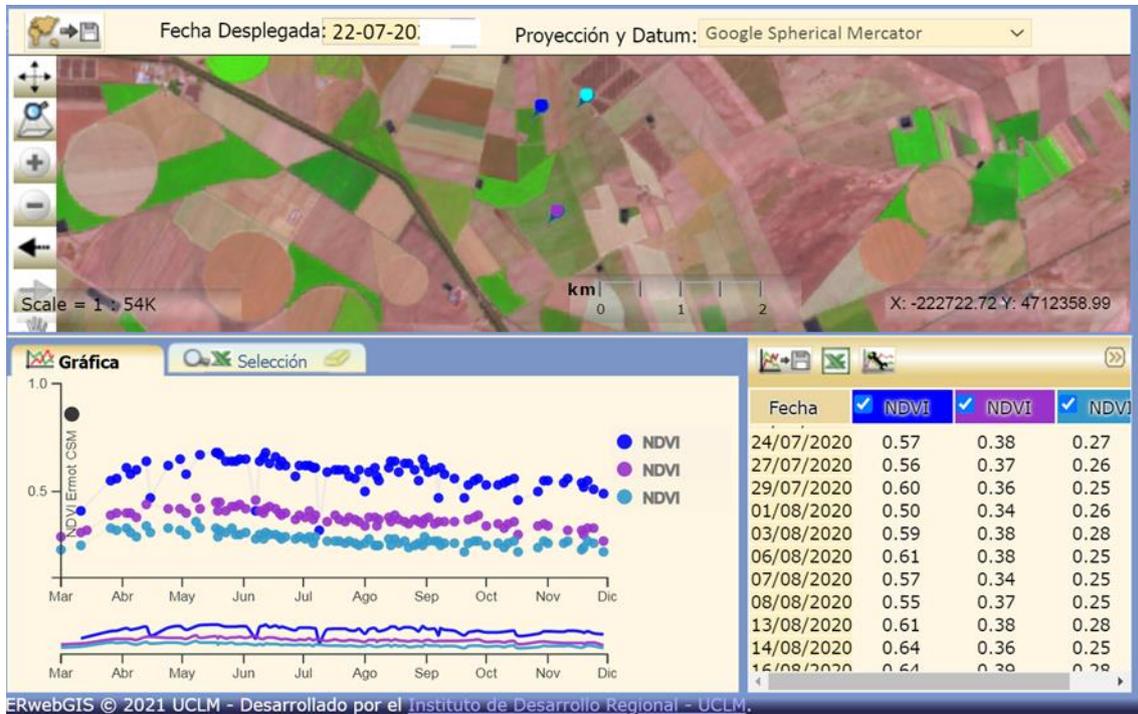
Either of the two modalities needs a surveillance system, to verify the veracity of the farmer's declaration and the correct operation of the volumetric counter.

Methodology applied in this control system.

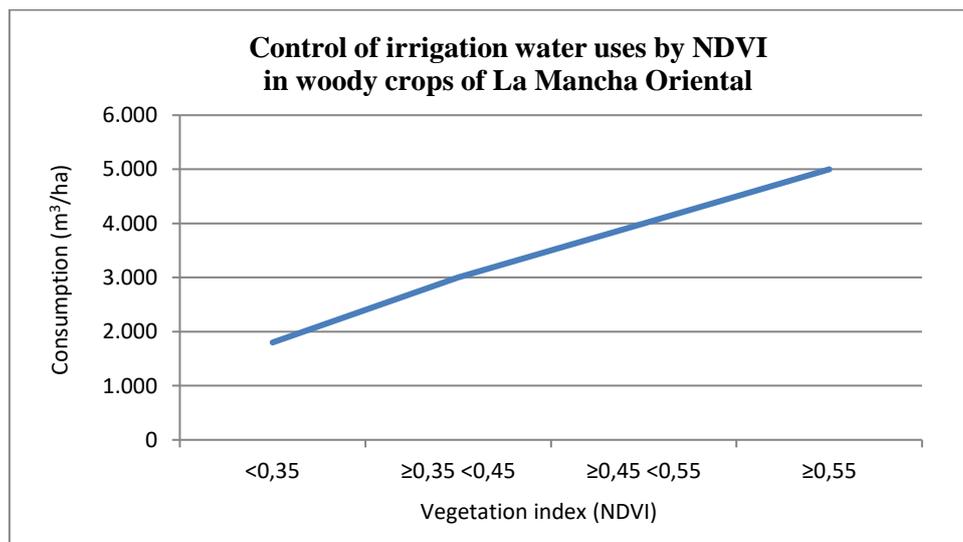
Collaborative studies carried out between users, the state water administration, the university, and the irrigation advisory service have made it possible to determine a relationship between the irrigation water needs of woody crops and the vegetation indices (NDVI) obtained by remote sensing.

This index is directly related to the amount of green leaves in the crop.

The following image is an example of the vegetation indices observed in 3 plots of adult almond trees, with different doses of irrigation water:



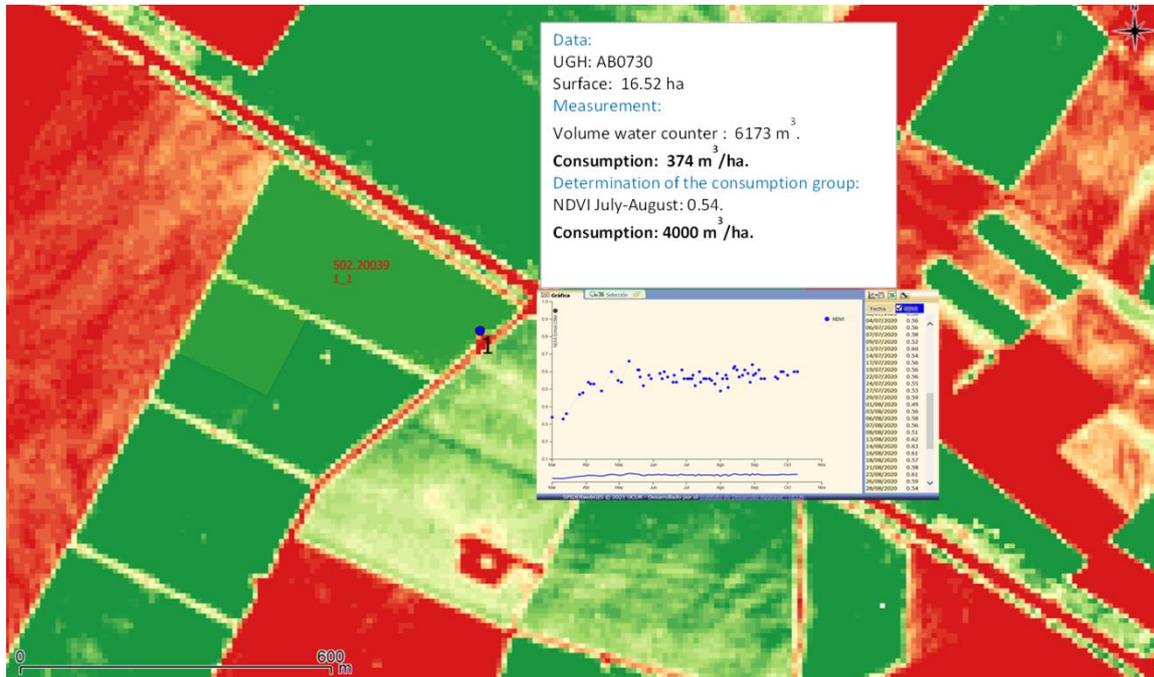
The results obtained have been summarized in groups of crop water consumption, taking as a reference the NDVI of the summer months. This information makes it possible to apply a practical and effective standard in the control of water uses.



Verification of the operation of the water counters by remote sensing.

The volume measured by the volumetric counters can be compared to the estimated irrigation volume by remote sensing. The deviation between the two data makes it possible to locate the equipment that has a malfunction.

A real example is the following:



Verification of the crop declared by the farmers.

Before starting the irrigation campaign, the farmers are informed of the water consumption in the woody crop plots. This information refers to plots where there is a difference between the declaration and remote sensing observation.

The reported water consumption is deducted from the water concession to farmers, who will have to schedule the rest of their crops to avoid exceeding their authorized volume.

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ID	Prov.	Municip.	Polig.	Parcela	Rec. / Subrec.	Sup (ha)	NDVI	observed irrigation	declared irrigation		
27447	2	900	33	12	1	1	0,12	0,50			
27464	2	900	33	12	2	1	10,62	0,50			
27453	2	900	33	42	2	1	0,02	0,48	Intensive irrigation		
27466	2	900	33	99	3	1	25,64	0,48			
27456	2	900	33	99	8	1	0,02	0,47			



Benefits

The use of remote sensing in La Mancha Oriental allows the control of water consumption in some 18400 plots of woody crops and the monitoring of the correct operation of 3700 water meters, distributed in an area of 9968 km².

This information makes it possible to locate the plots and wells where it must be inspected, with an objective selection criterion. This is effective in saving labor time and material resources.

