



# ACCOUNTING FOR CARBON EXCHANGES IN A SEMIARID OAK SAVANNA (DEHESA).

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**IFAPA**

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Investigación y  
Formación Agraria  
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# ET MEDITERRANEAN VEGETATION



**Heterogeneous  
Complex mosaics**

# ET MEDITERRANEAN VEGETATION

Different  
phenology and  
physiology



# ET MEDITERRANEAN VEGETATION

**Variable  
climate**



# ET MEDITERRANEAN VEGETATION

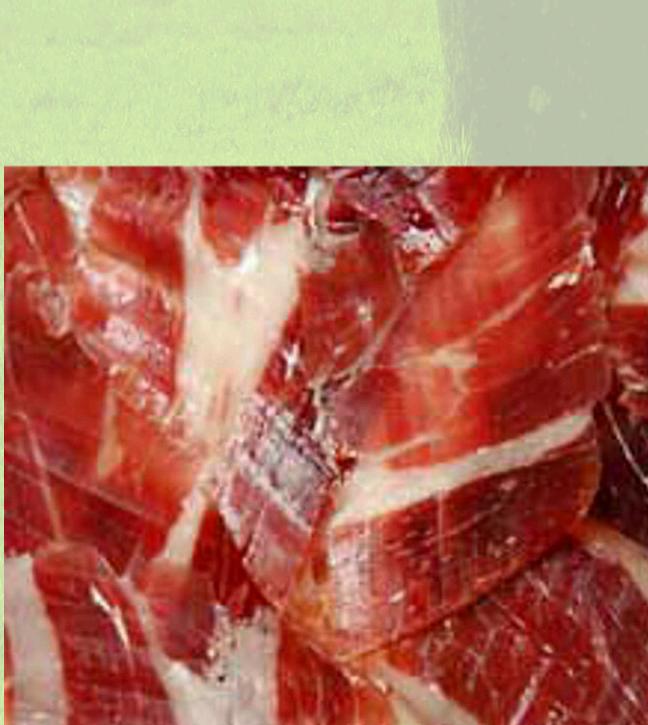
**Control mechanisms to  
face stress**



# DEHESA



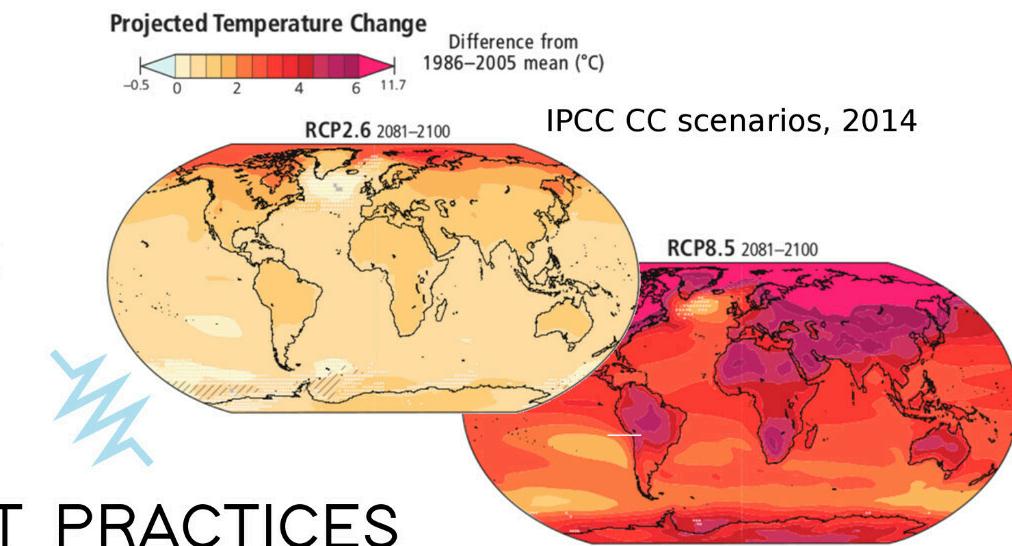
# DEHESA



SUPPORT MANAGEMENT  
(FARM AND BASIN)

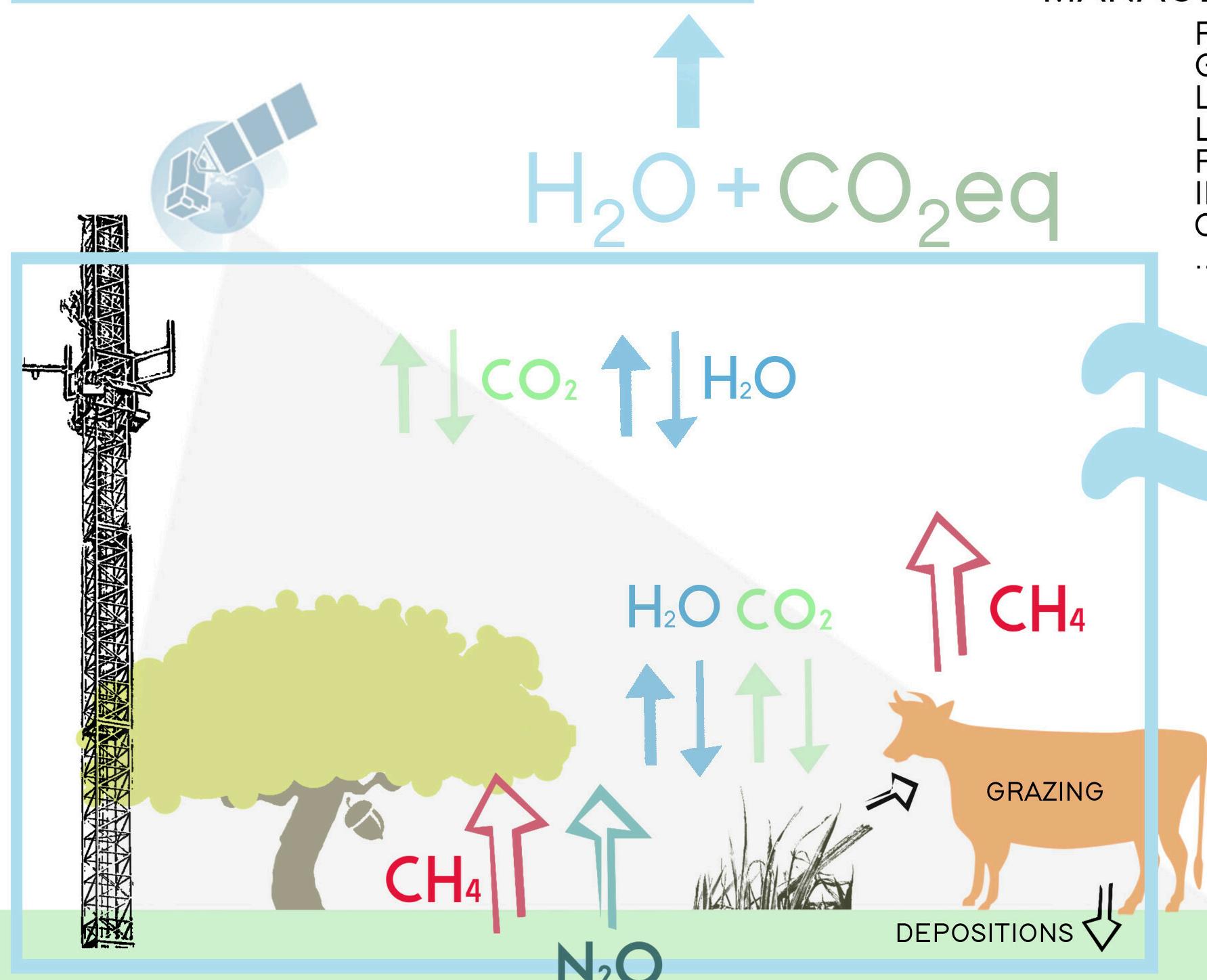
## CLIMATIC CHANGE

- ↑ AIR TEMPERATURE
- ↑ EXTREME EVENTS
- ↓ PRECIPITATION



## MANAGEMENT PRACTICES

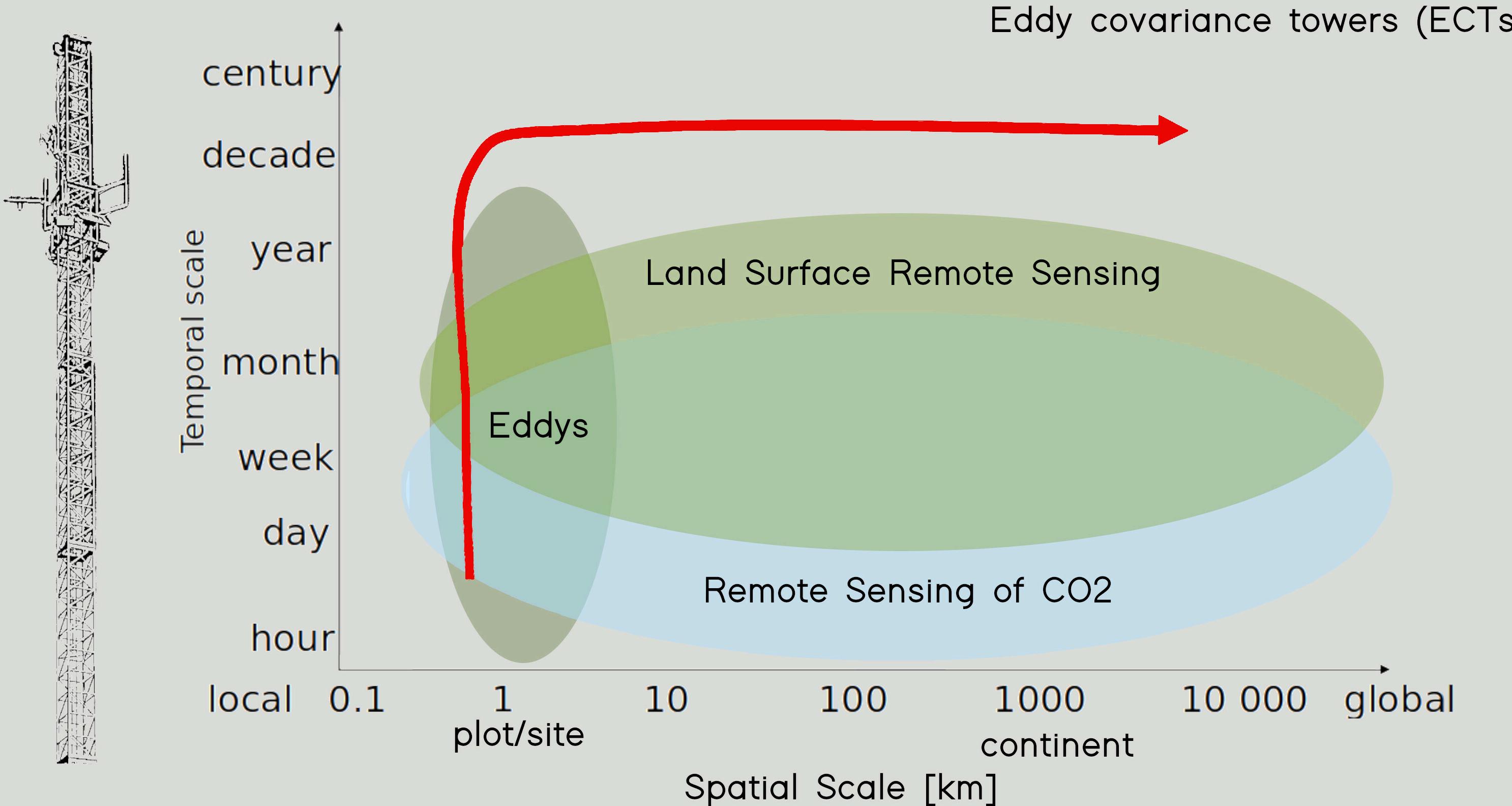
- REGENERATION
- GRASS COMMUNITY
- LIVESTOCK DENSITY
- LIVESTOCK MOBILITY
- FERTILIZATION
- INTENSIFICATION
- CLEARING
- ...



Due to the high human intervention of dehesa, fluxes dynamics are closely linked to the management practices.

To understand responses to environmental and anthropic factors, and to provide validation data sets for surface models used to improve and support management, it is necessary to perform direct measurements on land of water and carbon fluxes, in continuous, high-frequency, and long-term





Adapted Markus Reichstein, MPI

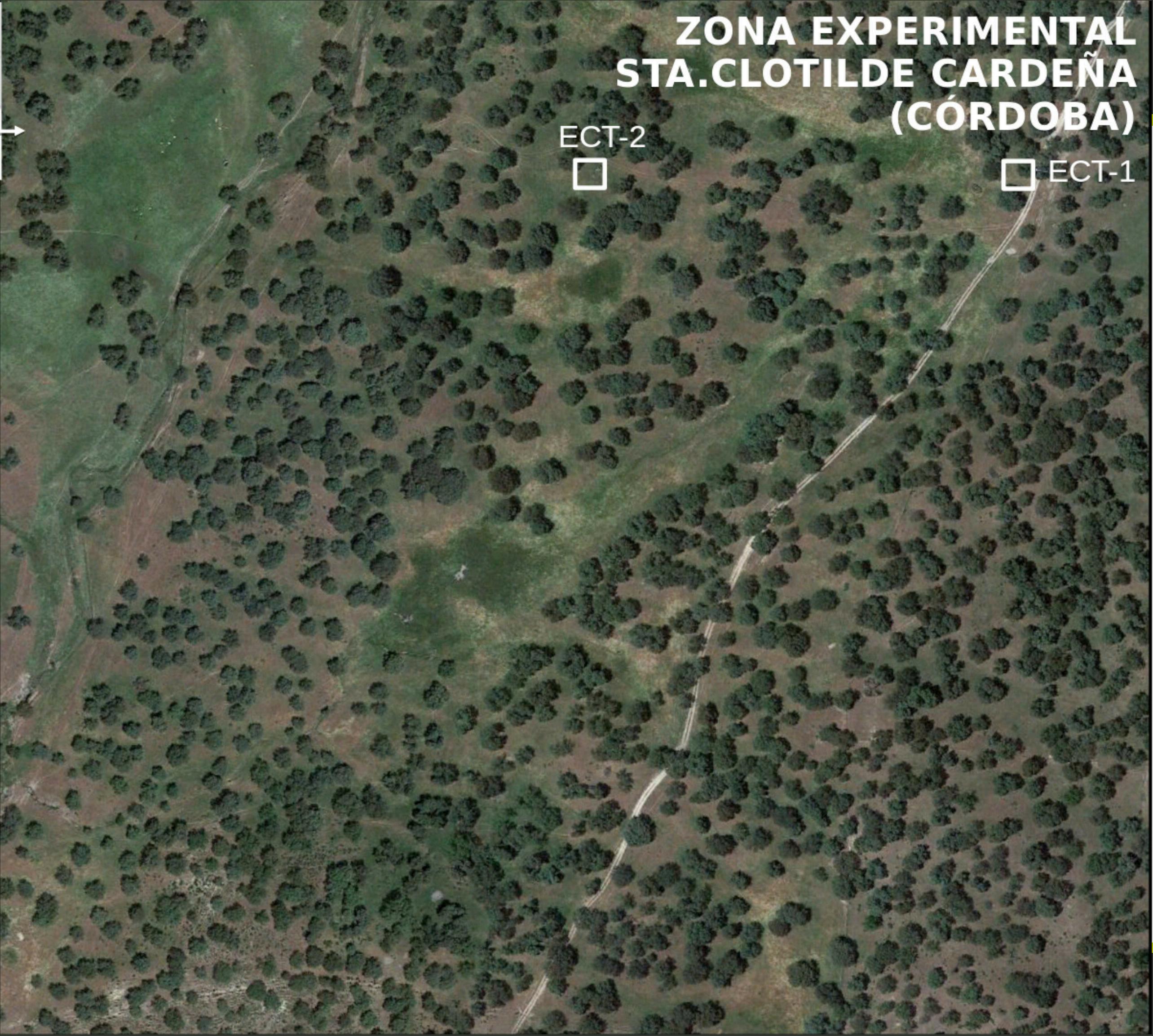


**ZONA EXPERIMENTAL  
STA.CLOTILDE CARDEÑA  
(CÓRDOBA)**

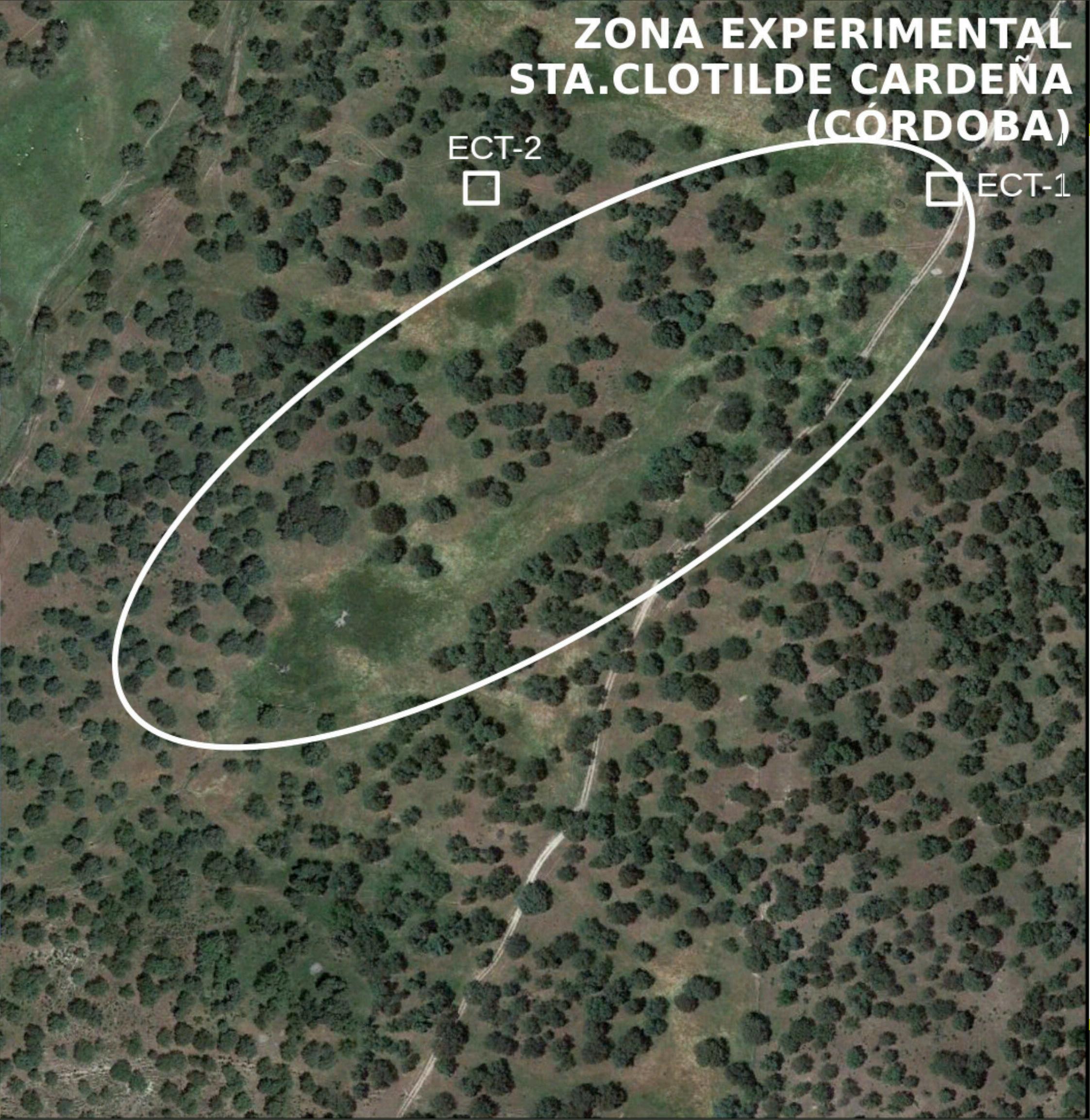
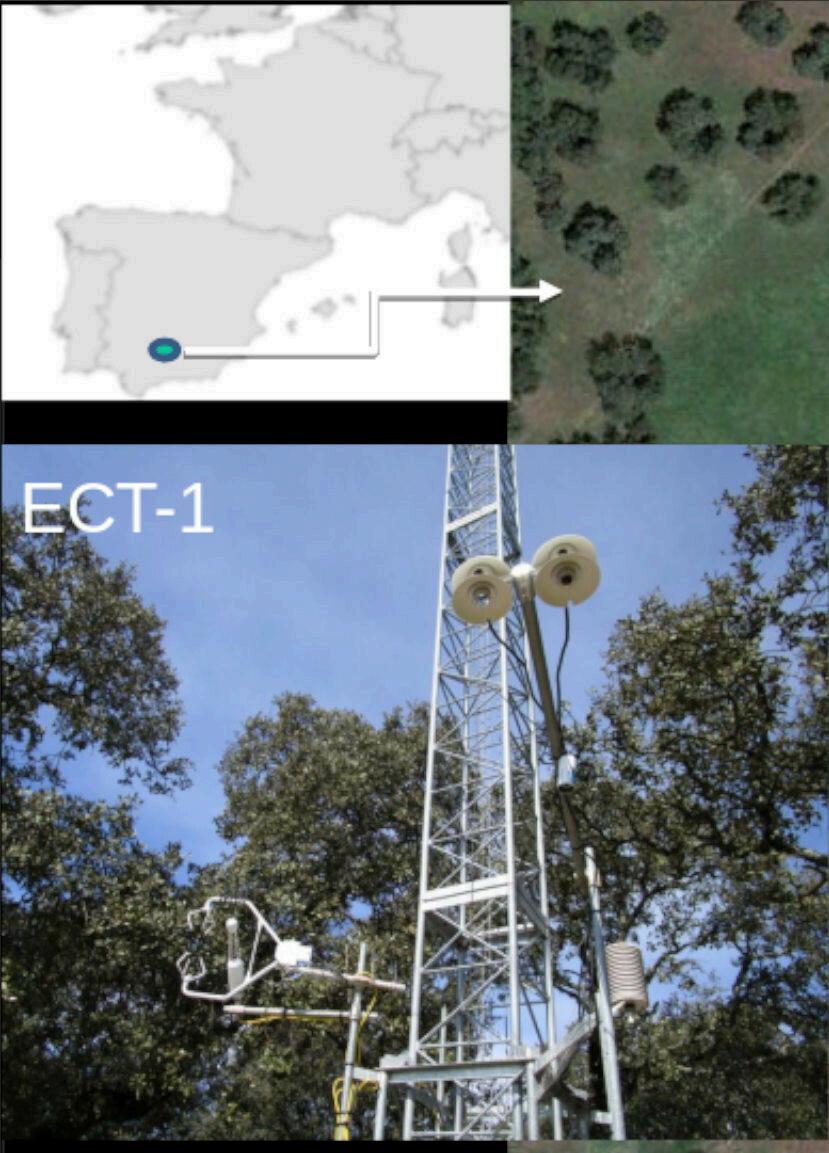
ECT-2



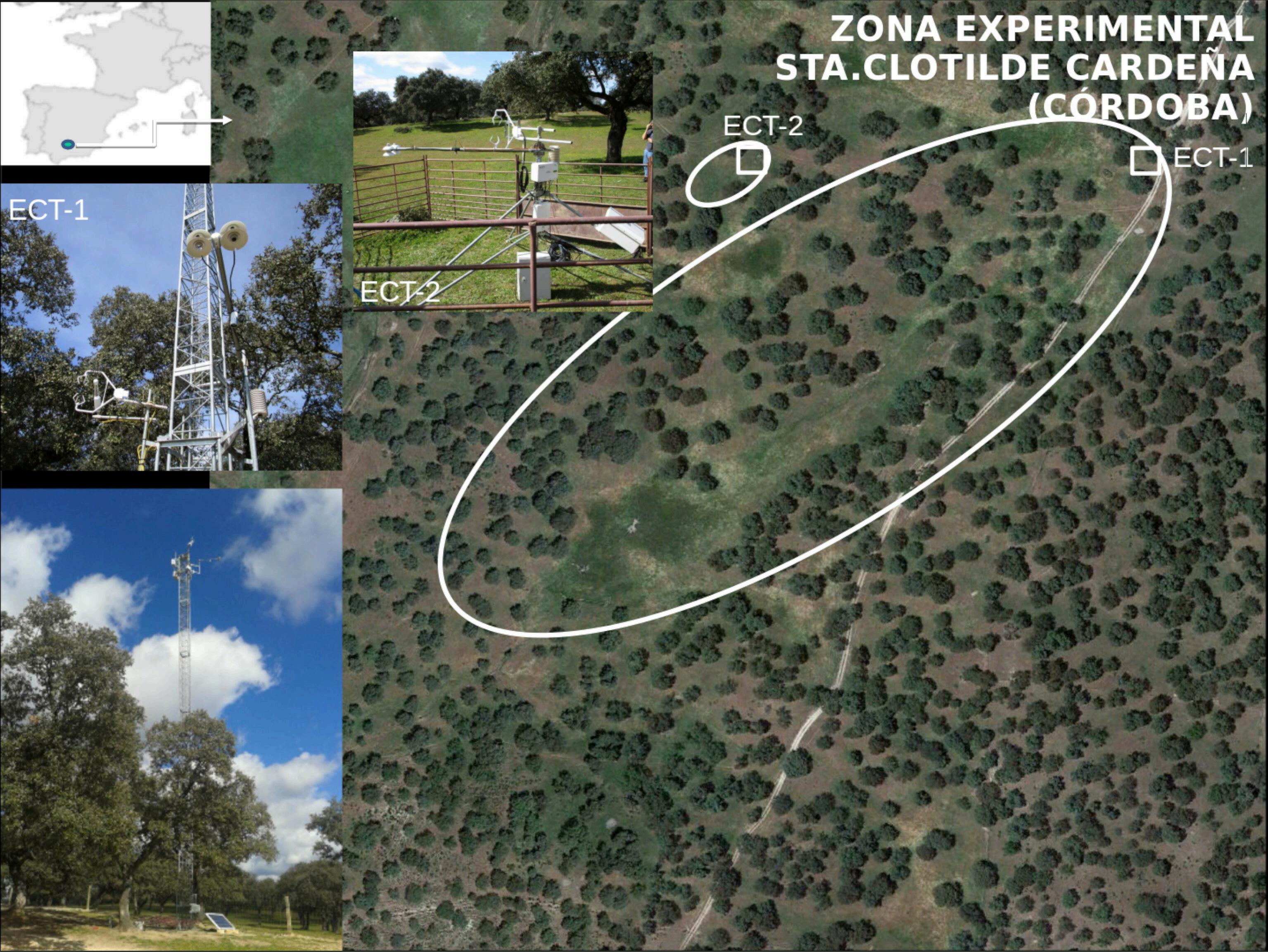
ECT-1



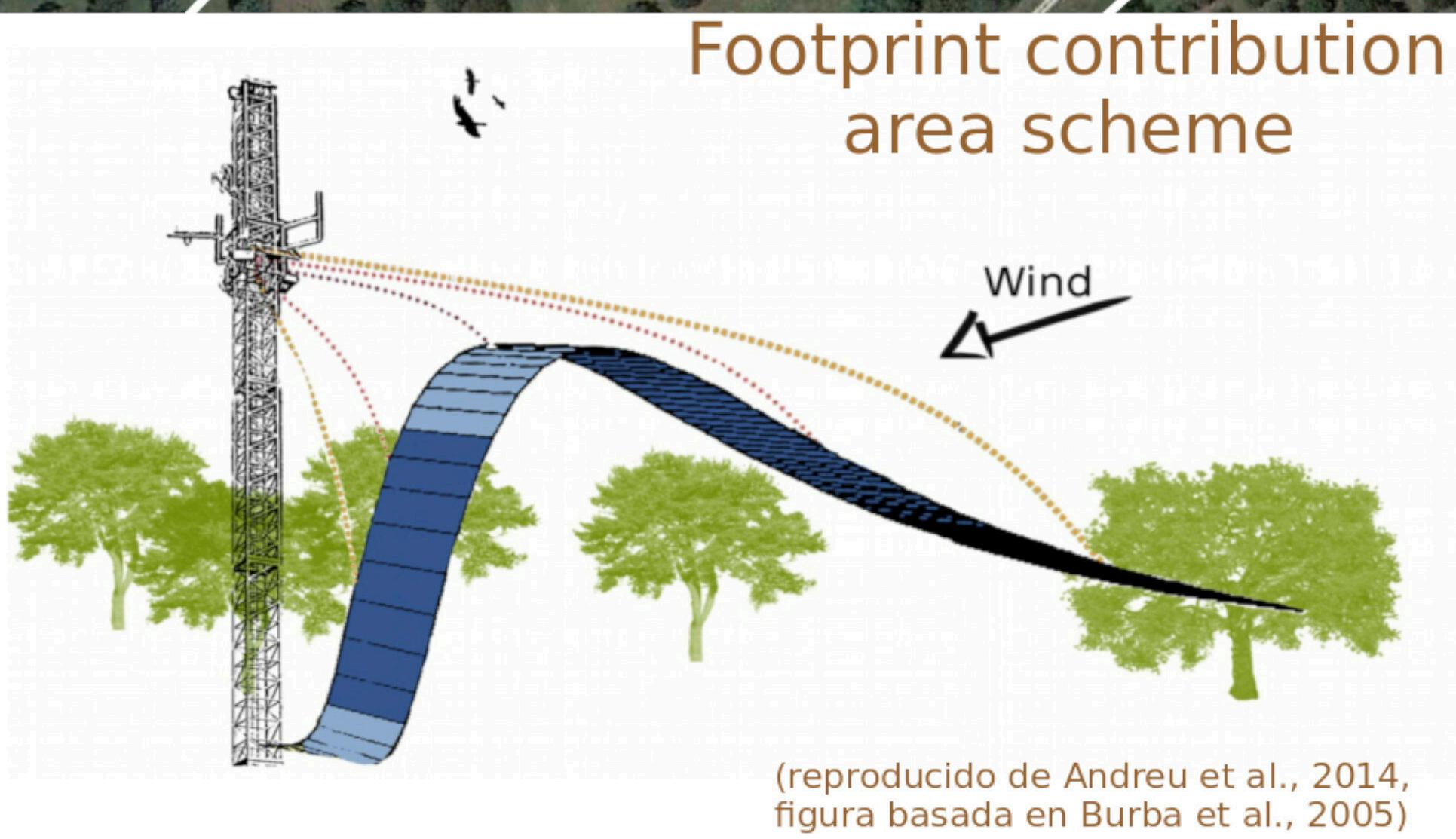
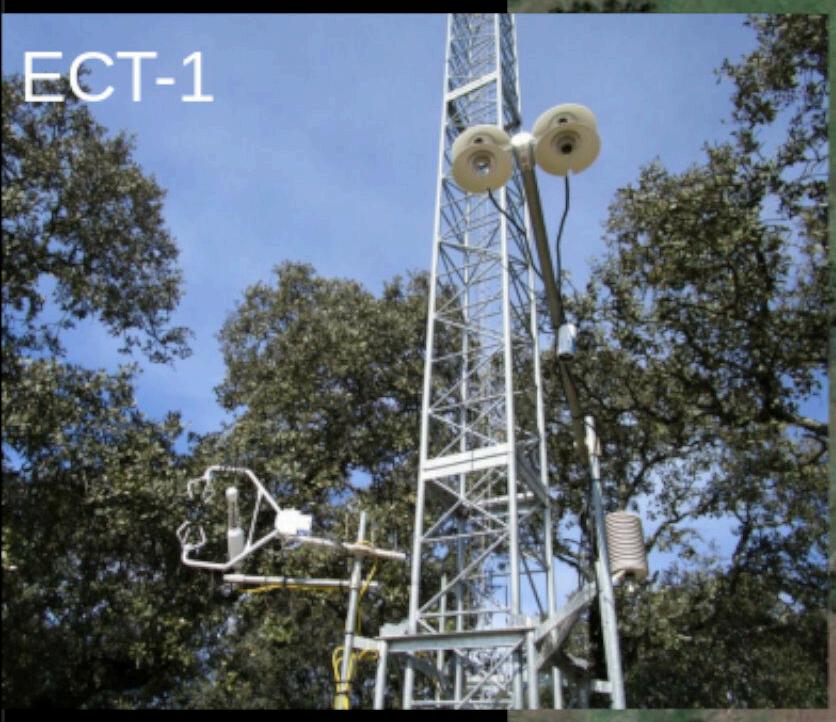
# ZONA EXPERIMENTAL STA.CLOTILDE CARDEÑA (CÓRDOBA)



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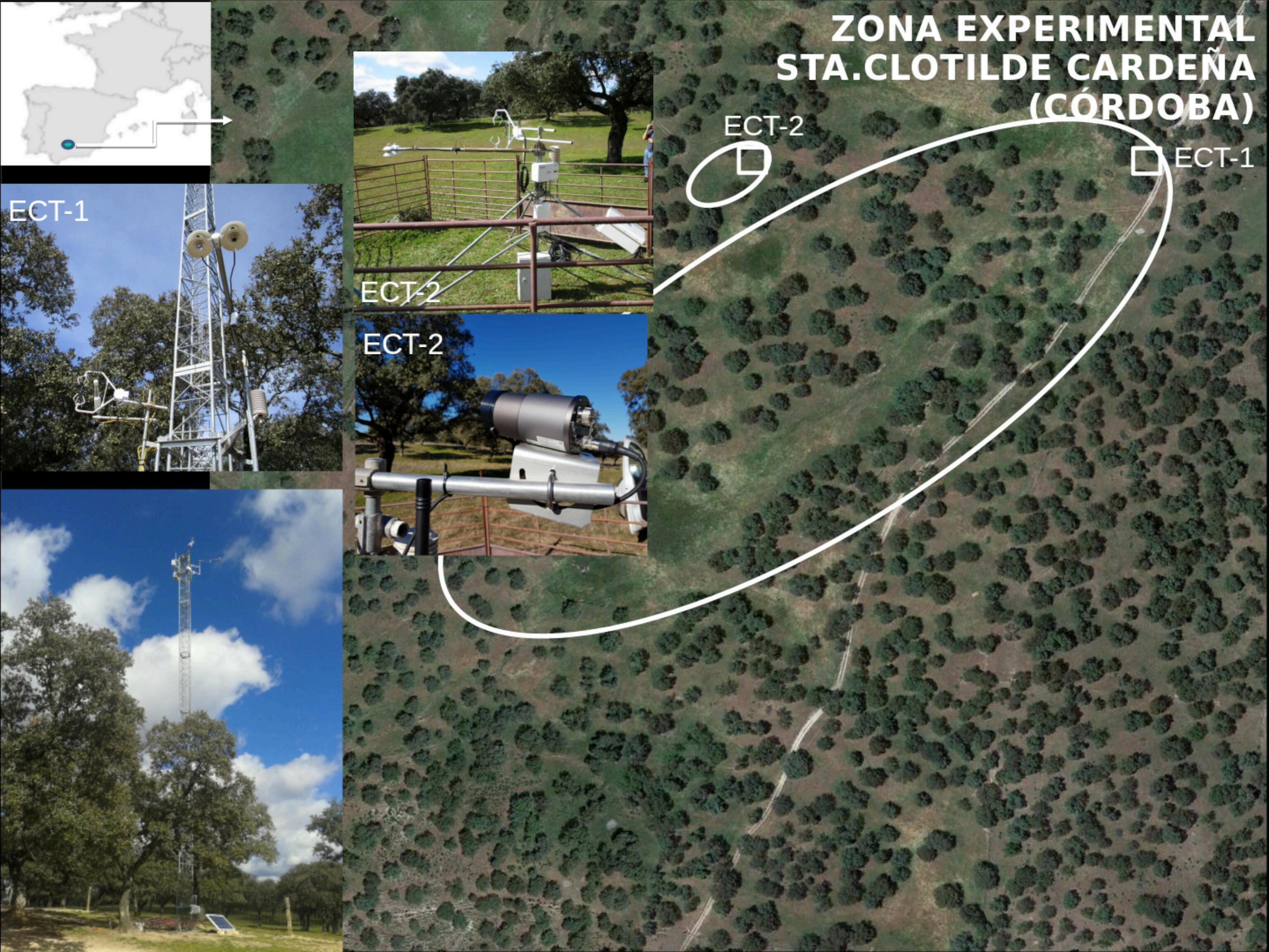


# ZONA EXPERIMENTAL STA.CLOTILDE CARDEÑA (CÓRDOBA)

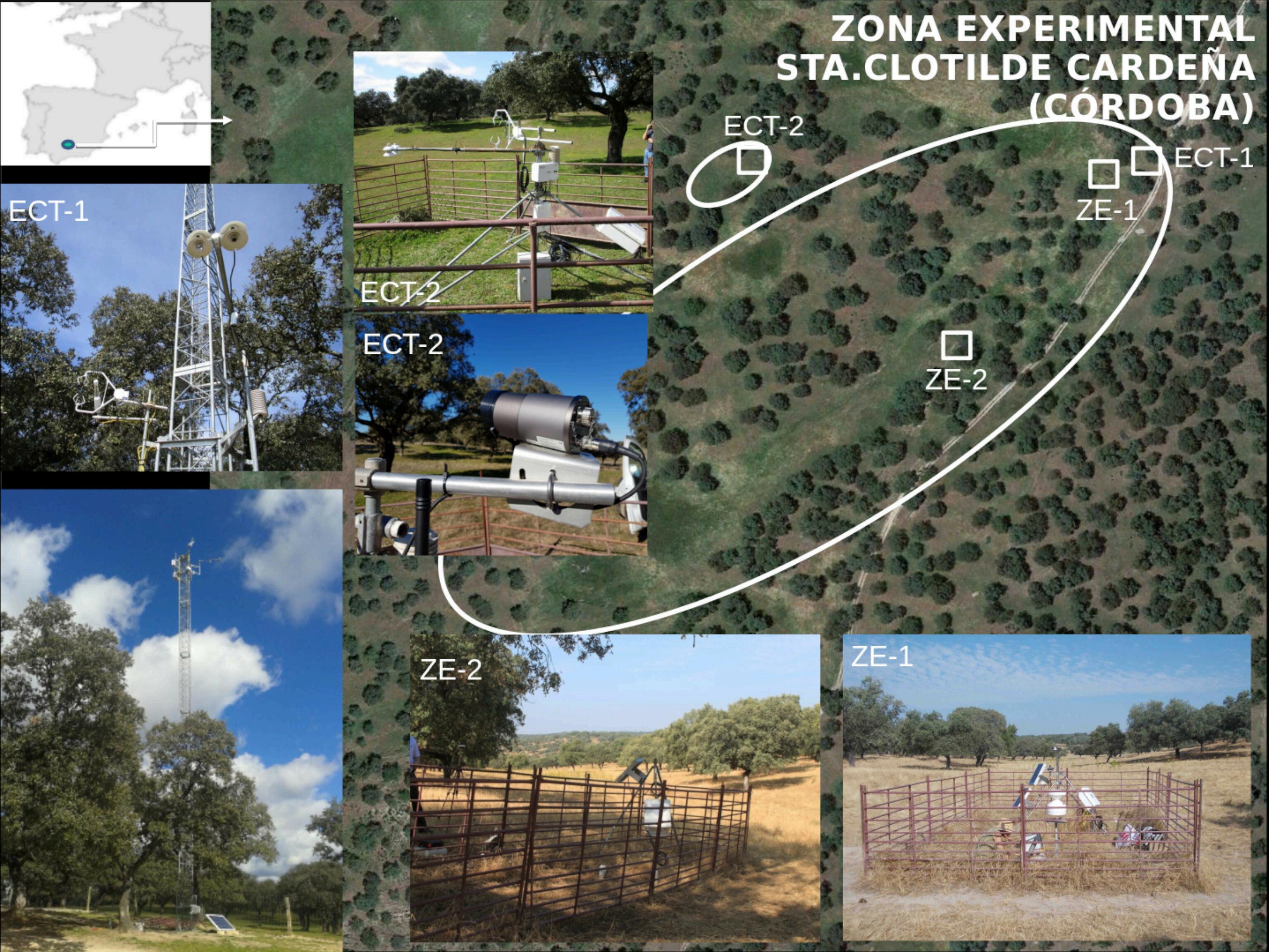


(reproducido de Andreu et al., 2014,  
figura basada en Burba et al., 2005)

# ZONA EXPERIMENTAL STA.CLOTILDE CARDEÑA (CÓRDOBA)



# ZONA EXPERIMENTAL STA.CLOTILDE CARDEÑA (CÓRDOBA)



Better understand the system functioning, in particular in relation to water use, and the vegetation state and production

Estimate the main productions: grass and acorn

Use of remote sensors, mainly on board of satellites

TRANSFER of knowledge  
and provide useful information for DEHESA management and conservation

Base	Surface EB	Soil WB	Light use efficiency
Model	Two-Source EB (TSEB) <sup>23</sup>	WiMMed <sup>26</sup>	LUE model <sup>27</sup>
ED data	Surface thermal data (TIR)	Spectral reflectance (VIS/NIR)	Spectral reflectance (VIS/NIR)
Other	Meteorological data, vegetation characteristics (VIS/NIR)	Meteorological data, soil/vegetation characteristics, precipitation, etc.	Light use efficiency
Why?	-Best accounts for partial canopy cover <sup>24, 25</sup> -Strong physical base <sup>8</sup>	-Distributed hydrological model for Mediterranean watersheds. -Strong physical base	-Evaluated and validated in mostly of the world <sup>11</sup> -Strong relation between VI & fraction of radiation absorbed by green canopies

Table 1: Modelling framework

WATER

CARBON



- 1) Improve the knowledge of the biophysical processes that govern the exchanges of H<sub>2</sub>O and CO<sub>2</sub> between savanna and the atmosphere
- 2) Evaluate the use of mechanistic/semi-empirical models of fluxes in dehesa, through the integration of remote sensing and low-cost sensors. Long term and different scales.
- 3) Implementation in a pilot area in Spain.

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WATER

CARBON





### Savanna WATer and Carbon fluxes modeling integrating eartH observation data

González-Dugo, M. P., Chen, X., Andreu, A., Carpintero, E., Gómez-Giraldez, P. J., Carrara, A., and Su, Z.: Long-term water stress and drought assessment of Mediterranean oak savanna vegetation using thermal remote sensing, *Hydrol. Earth Syst. Sci.*, 25, 755–768, <https://doi.org/10.5194/hess-25-755-2021>, 2021.

Carpintero E, Andreu A, Gómez-Giráldez PJ, Blázquez Á, González-Dugo MP. Remote-Sensing-Based Water Balance for Monitoring of Evapotranspiration and Water Stress of a Mediterranean Oak-Grass Savanna. *Water*. 2020; 12(5):1418. <https://doi.org/10.3390/w12051418>

Carpintero, L. Mateos, A. Andreu, M.P.González-Dugo. 2020. Effect of the differences in spectral response of Mediterranean tree canopies on the estimation of evapotranspiration using vegetation index-based crop coefficients 2020. *Agricultural Water Management*. Vol 238, 2020, 106201. <https://doi.org/10.1016/j.agwat.2020.106201>

Román-Cascón C, Lothon M, Lohou F, Ojha N, Merlin O, Aragónés D, González-Dugo MP, Andreu A, Pellarin T, Brut A, Sorriquer RC, Díaz-Delgado R, Hartogensis O, Yagüe C. Can We Use Satellite-Based Soil-Moisture Products at High Resolution to Investigate Land-Use Differences and Land-Atmosphere Interactions? A Case Study in the Savanna. *Remote Sensing*. 2020; 12(11):1701. <https://doi.org/10.3390/rs12111701>

Andreu A., William P. Kustas, Maria Jose Polo, Arnaud Carrara and Maria P. González-Dugo. Modeling Surface Energy Fluxes over a Dehesa (Oak Savanna) Ecosystem Using a Thermal Based Two-Source Energy Balance Model (TSEB) I. *Remote Sens.* 2018, 10(4), 567; doi:10.3390/rs10040567

Andreu A. William P. Kustas, Maria Jose Polo, Arnaud Carrara and Maria P. González-Dugo. Modeling Surface Energy Fluxes over a Dehesa (Oak Savanna) Ecosystem Using a Thermal Based Two Source Energy Balance Model (TSEB) II—Integration of Remote Sensing Medium and Low Spatial Resolution Satellite Images. *Remote Sens.* 2018, 10(4), 558; doi:10.3390/rs10040558

Andreu A., Andreu A., Dube T., Nieto H., Mudau A.E., Gonzalez-Dugo M.P., Guzinski R., Huelsmann S. 2019. Remote sensing of water use and water stress in the African savanna ecosystem at local scale - Development and validation of a monitoring tool. *Physics and Chemistry of the Earth*, Vol 112, 154-164. 18th WaterNET Symposium on Integrated Water Resources Development and Management. Dube T., Nieto H., Mudau A.E., Gonzalez-Dugo M.P., Guzinski R., Huelsmann S. 2019. Remote sensing of water use and water stress in the African savanna ecosystem at local scale - Development and validation of a monitoring tool. *Physics and Chemistry of the Earth*, Vol 112, 154-164. 18th WaterNET Symposium on Integrated Water Resources Development and Management.

Gómez-Giráldez, Pedro J. & Pérez-Palazón, María José & Polo, María J. & González-Dugo, María. (2020). Monitoring Grass Phenology and Hydrological Dynamics of an Oak-Grass Savanna Ecosystem Using Sentinel-2 and Terrestrial Photography. *Remote Sensing*. 12. 600. 10.3390/rs12040600.

Gómez-Giráldez P. J., Aguilar C, Caño A. B., García-Moreno A., González-Dugo M. P., Remote sensing estimation of net primary production as monitoring indicator of holm oak savanna management, *Ecological Indicators*, Volume 106, 2019, 105526, ISSN 1470-160X, <https://doi.org/10.1016/j.ecolind.2019.105526>.



2-minute presentation on Thursday, 29  
April 2021, 11:19 CEST.

Text chat from 11:42-12:30 CEST 9 April

