Evapotranspiration variability depending on the type of surface in a semi-arid area with irrigation

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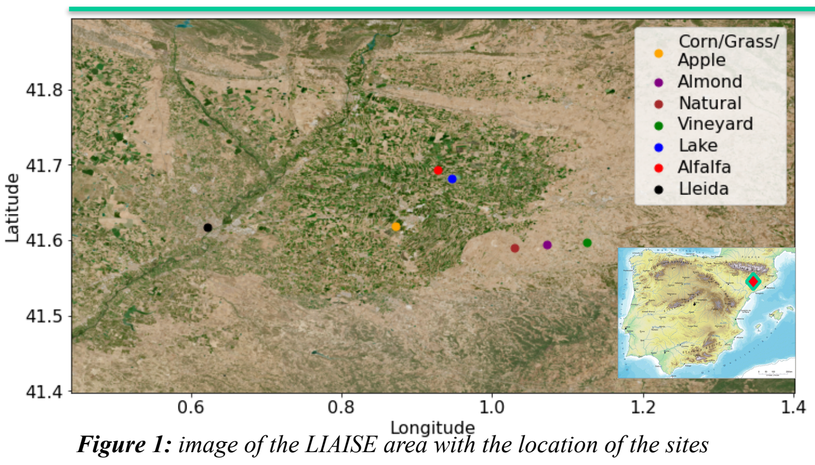

Figure 1: *image of the LIAISE area with the location of the sites*

Site	surface cover	size (m^2)	Watering	Operator	Lat (N), Lon (E)
La Cendrosa	Alfalfa field	300 x 200	flood	MF	41.6934, 0.9284
Mollerussa	Corn field	250 x 120	flood	OWL/UIB	41.6191, 0.8753
Mollerussa	Grass plot	25 x 15	sprinkle	SMC/UIB	41.6182, 0.8719
Mollerussa	Apple orc.	120 x 50	drip	UIB/MF	41.6176, 0.8720
Lake Ivars	Open water	1200 x 400	canal	MF	41.6821, 0.9470
Verdú	Vineyard	400 x 600	drip	CESBIO	41.5969, 1.1254
Preixana	Almond orc.	150 x 200	rainfed	MF	41.5937, 1.0725
Els Plans	Natural veg.	150 x 60	rainfed	UKMO	41.5901, 1.0294

Table I: *Characteristics of the sites, including watering method*

Figure 2*: sampling fields of alfalfa (A), apple orchard (B), almonds (C), vineyard (D)*

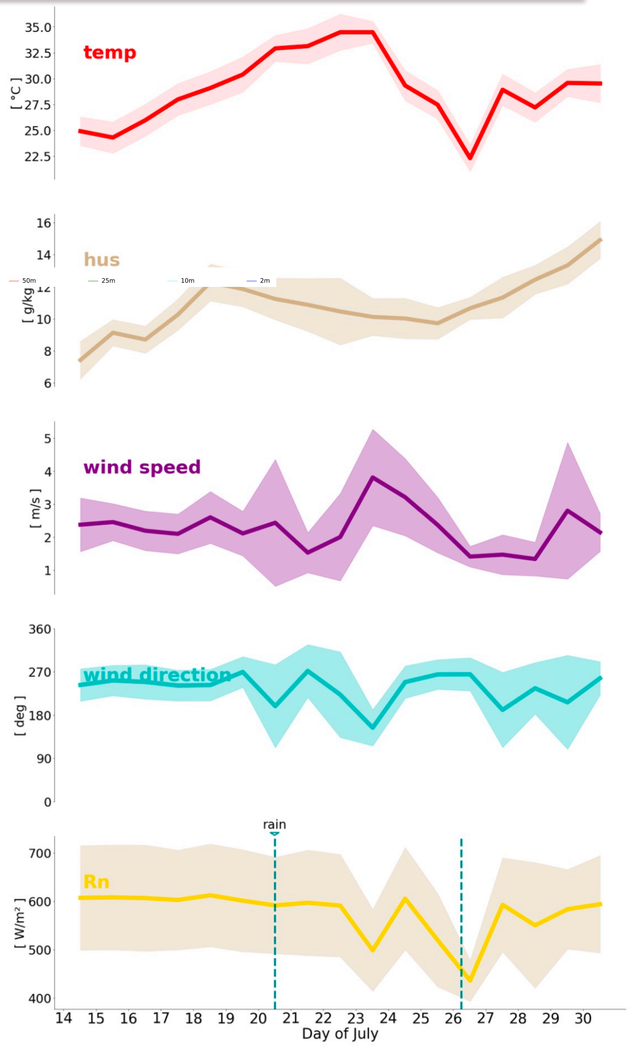

Figure 3*: evolution of some meteorological parameters at local noon during the SOP: Line: averages for all sites, Shadowed areas standard deviations*

The initiative ***Land surface Interactions with the Atmosphere over the Iberian Semi-arid Environment (LIAISE***, *Boone et al 2019)* aims to improve our understanding of the impact of anthropization on the water cycle in terms of land-atmosphere-hydrology interactions, and the limitations of models to represent all aspects of the terrestrial water cycle in a semi-arid environment on the Iberian peninsula.

An experimental effort took place between June and September 2021 near the town of Mollerussa (Catalonia) with a Special Observing Period during the second half of July, which included in-situ and remote sensing observations both surface-based and on board aircraft. The area of study is divided by the Canal of Urgell in an extensively irrigaated area to the West and a rainfed area with some drip irrigated cultures to the East.

Here we inspect summarily the variability of the latent heat flux and the other terms of the surface energy budget over eight different surfaces. The locations and characteristics of the plots are given in Fig. 1 and Table I, some images of the sites in Fig. 2 and the meteorological evolution in Fig. 3, showing the values at 12 UTC. The latter indicates that the temperature rose continuously during the first week, the humidity was high as the sea breeze reached the area regularly, weak westerlies prevailed and the net radiation was high, with two nocturnal rain events.

Latent, sensible, ground fluxes and Net Radiation during the LIAISE SOP (14-30 July 2021)

Daytime (averages 11-14 UTC)

Table II: *T, speed and terms of the surface energy budget (11-14 UTC)*

Site (irr)	T (°C)	v ($m\ s^{-1}$)	LE ($W\ m^{-2}$)	H ($W\ m^{-2}$)	Rn ($W\ m^{-2}$)	G ($W\ m^{-2}$)	Imb ($W\ m^{-2}$)
Alfalfa (f)	28.3	1.7	389 ± 87	71 ± 68	572 ± 55	111 ± 40	1 ± 42
Corn (f)	28.3	1.5	346 ± 78	53 ± 60	649 ± 61	39 ± 12	162 ± 46
Grass (s)	29.9	1.8	257 ± 30	91 ± 27	565 ± 59	9 ± 14	169 ± 28
Apple (d)	29.8	1.3	183 ± 40	252 ± 50	642 ± 59	45 ± 8	210 ± 29
Lake (n)	26.0	2.6	152 ± 32	2 ± 10	733 ± 73	533 ± 210	26 ± 171
Vineyard (d)	29.3	2.4	124 ± 25	207 ± 41	522 ± 41	93 ± 23	98 ± 19
Almonds (n)	30.1	3.1	107 ± 26	288 ± 52	425 ± 33	145 ± 30	-116 ± 52
Natural (n)	29.9	3.5	35 ± 16	288 ± 43	501 ± 39	142 ± 21	58 ± 26

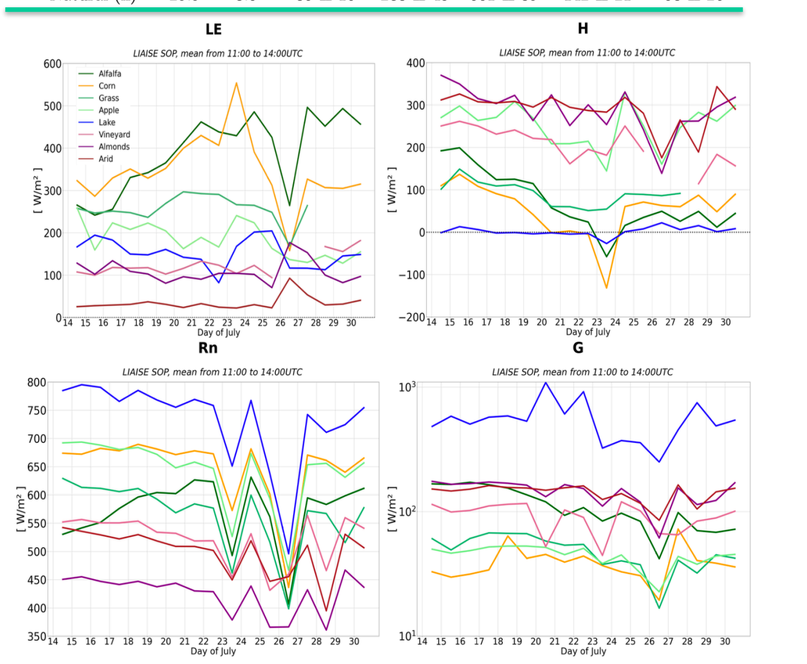

Figure 4: *evolution of the 11-14 UTC average values of the heat fluxes: latent (LE), sensible (H), ground (G), net radiation (Rn)*

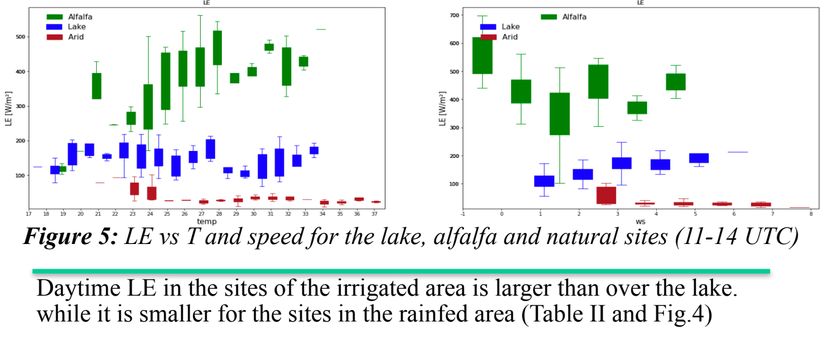

Figure 5: *LE vs T and speed for the lake, alfalfa and natural sites (11-14 UTC)*

Daytime LE in the sites of the irrigated area is larger than over the lake. while it is smaller for the sites in the rainfed area (Table II and Fig.4)

LE is relatively insensitive to temperature, except over irrigated corn and alfalfa. LE over the lake shows some dependency on wind speed.(Fig.5)

Rn varies largely with the surface type and the sensible heat flux (H) becomes small where LE is high, specially at the lake (Fig, 4)

Nighttime (averages 00-03 UTC)

Table III: *T, speed and terms of the surface energy budget (00-03 UTC)*

Site (irr)	T (°C)	v ($m\ s^{-1}$)	LE ($W\ m^{-2}$)	H ($W\ m^{-2}$)	Rn ($W\ m^{-2}$)	G ($W\ m^{-2}$)	Imb ($W\ m^{-2}$)
Alfalfa (f)	18.7	1.7	15± 17	-18 ± 13	-52 ± 10	-34 ± 8	-15 ± 10
Corn (f)	17.8	0.8	13± 12	-21 ± 14	-50 ± 9	-22 ± 4	-20 ± 4
Grass (s)	20.0	0.7	8 ± 15	-8 ± 10	-39 ± 8	-20 ± 7	-18 ± 9
Apple (d)	18.7	0.6	-3 ± 13	-13 ± 11	-59 ± 9	-3 ± 3	-40 ± 18
Lake (n)	18.9	2.1	120 ± 35	21 ± 7	-84 ± 15	-243 ± 67	-46 ± 12
Vineyard (d)	20.2	1.5	7 ± 10	-21 ± 11	-76 ± 12	-50 ± 12	-12 ± 7
Almonds (n)	20.5	2.2	1 ± 13	-18 ± 9	-65 ± 8	-48 ± 7	2 ± 8
Natural (n)	20.2	1.9	-1 ± 4	-12 ± 8	-63 ± 8	-51 ± 8	0 ± 7

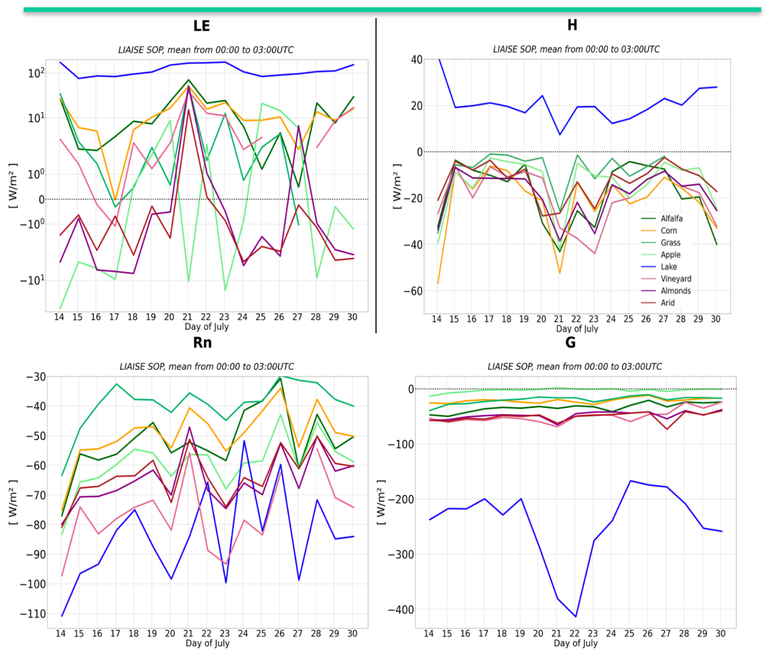

Figure 6: *evolution of the 00-03 UTC average values of the heat fluxes: latent (LE), sensible (H), ground (G), net radiation (Rn)*

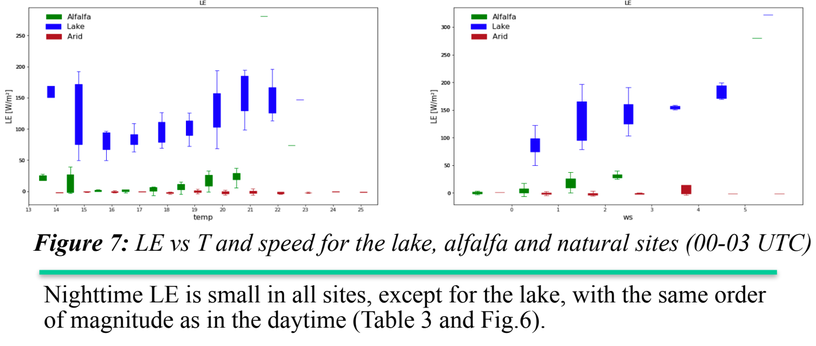

Figure 7: *LE vs T and speed for the lake, alfalfa and natural sites (00-03 UTC)*

Nighttime LE is small in all sites, except for the lake, with the same order of magnitude as in the daytime (Table 3 and Fig.6).

Rn and G dominate the surface energy budget, and H is significant in windy nights. (Fig. 6).

LE is small, except for the lake where warm water evaporates into cool air, and increases with the wind speed in the lake, as over alfalfa (Fig. 7).

Meso-NH and UM model values compared to observations

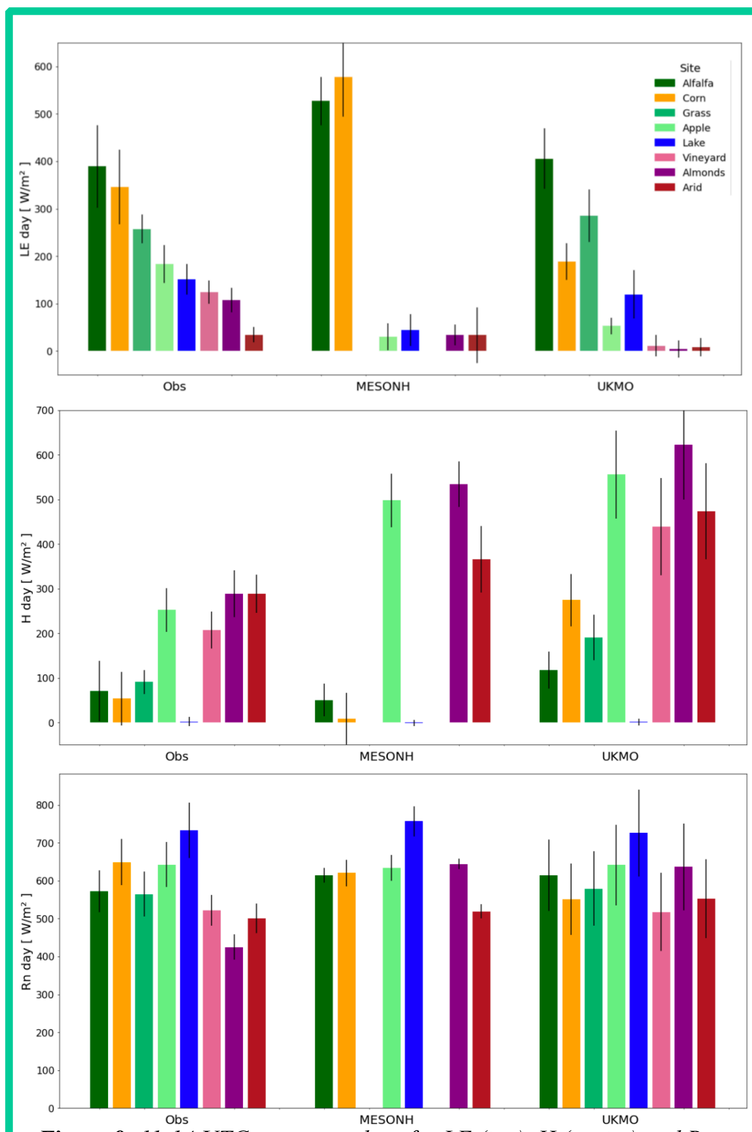

Figure 8: *11-14 UTC average values for LE (top), H (centre) and Rn (bottom), for observations (left), Meso-NH (centre) and UM (right).*

Models compare values obtained using the temperature and moisture values for the tile closest to the real terrain of each site within the corresponding grid box, when it exists. Irrigation is applied.

They are able to reproduce qualitatively the observed behaviour of the irrigated and rainfed sites for LE and Rn, with larger differences for H.

The comparison is difficult for the sites in the very heterogeneous area of Mollerussa, where lateral transport between different surfaces takes place.

Also the fields with cultures in rows (such as almond, apple and vineyard) are a challenge both for the observations and for models.

This poster is an extract of material from the manuscript of the same title recently submitted to Journal of Geophysical Research-Atmospheres

Ref: *Land Surface Interactions with the Atmosphere over the Iberian Semi-Arid Environment*, A.A. Boone, M.J. Best, J. Cuxart, J. Polcher, P. Quintana, J. Bellvert, J. Brooke, G. Canut, J.D. Price, Gewex News, 2019 (4)

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