Land surface Interactions with the Atmosphere over the Iberian Semi-arid Environment (LIAISE)
Overview of the Field Campaign Intense Phase

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4 Observatori de l'Ebre, Roquetes, Spain
5 UIB, Balearic Islands, Spain
6 UKMO, Exeter, UK
7 U. Wageningen, Netherlands
8 SMC, Barcelona
9 CESBIO, Toulouse, France

Contexte:

- les régions semi-arides sont des points chauds pour les biais des modèles

- le couplage entre l'humidité du sol et les précipitations est le plus important dans les régions semi-arides.

- L'irrigation peut avoir un impact sur la croissance de la couche limite atmosphérique locale, la météorologie à l'échelle méso, les conditions atmosphériques de bas niveau, éventuellement la convection des nuages

- Les activités humaines doivent être prises en compte dans les projections climatiques → couverture des terres/irrigation.

Science Questions

1) What are the key natural and anthropogenic semi-arid surface processes that modulate or control infiltration and runoff and govern turbulent fluxes and their spatial heterogeneity?

2. How does the highly heterogeneous (natural and anthropized) surface impact boundary layer development, mesoscale circulations and potentially precipitation recycling over this region via feedbacks with the atmosphere?

3. What is the sustainability of ground water and reservoirs in the face of expanding agricultural and farming activities, especially in light of projected future warming and drying over this region?

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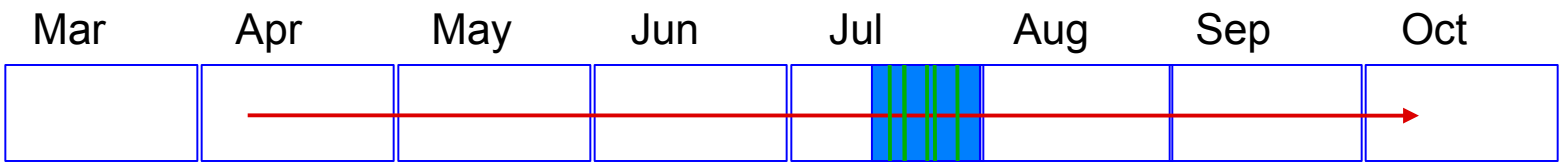
Field Campaign

Strategy → Intense observations of surface and ABL when contrasts between anthropized (irrigated) and natural surfaces are a MAXIMUM and water needs LARGEST

LOP : **April-October, 2021**→ surface flux stations, sfc satellite products, lysemeters, soil moisture & T…

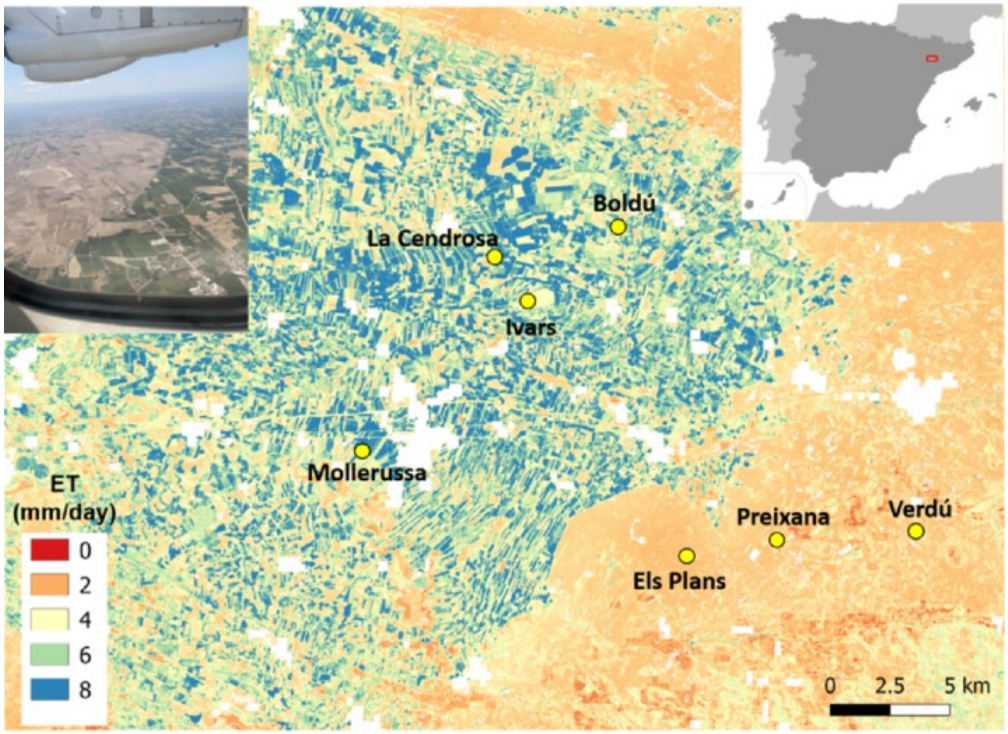
SOP **Summer/**July 15-29 → Lower atmosphere & SEB, lidar
→ 11 **IOP**s (planes, drones/UAVs, balloons, soundings..)



Heterogeneity of land cover

- 2 contrasting areas owing to irrigation

- 7 Sites (SEB, soil moisture, T…), irrigated and rain-fed areas



The LIAISE study zone in Catalonia (NE Spain) with surface site locations plotted over a map of crop evapotranspiration (17th July 2021) using a Two-Source Energy Balance (TSEB) model using images from Sentinel-2 and Sentinel-3. Prepared by IRTA.

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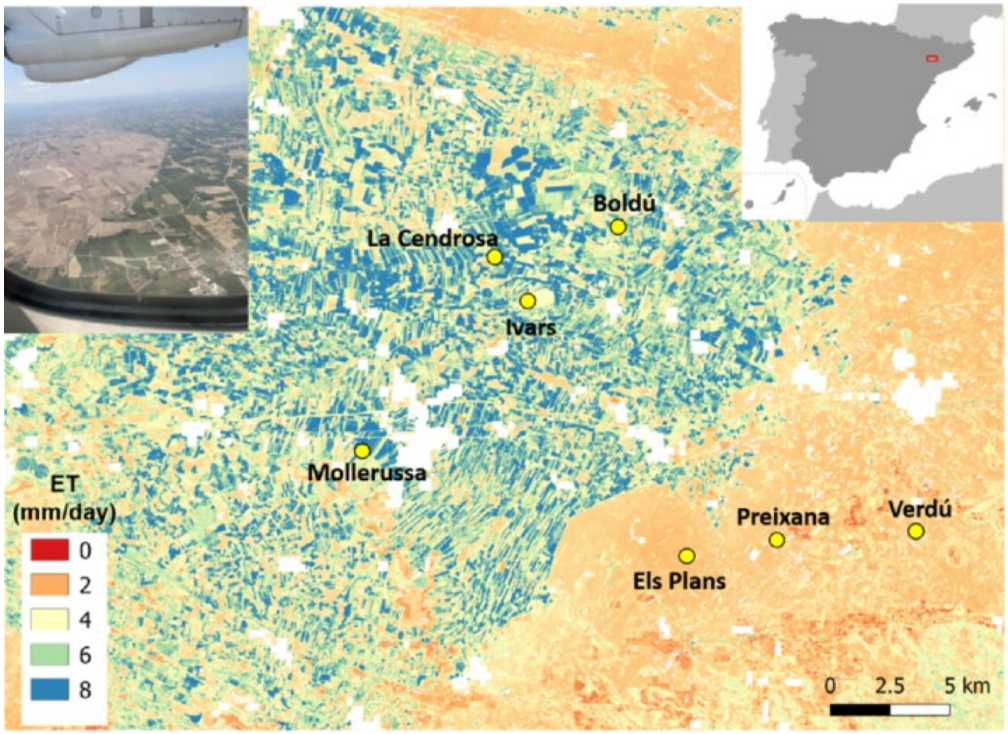

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Common Observations:

- 50m mast: fluxes
- LAI, soil moisture, T
- UHF wind profiler
- radiosoundings (each hour of IOP days)
- airplane-based sfc & atmos measures

Other atmos observations

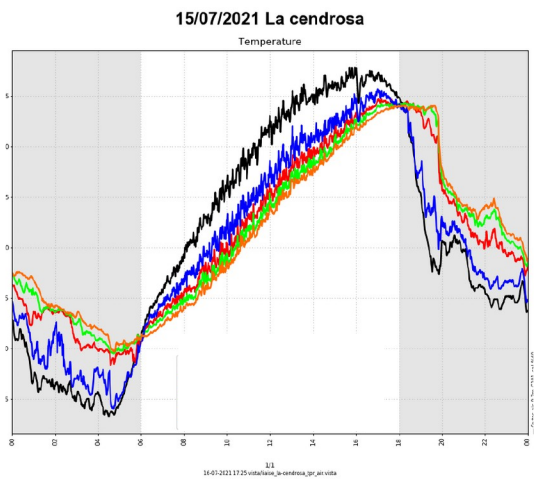
- lidar: q, T
- fluxes from tethered balloon
- temperature (vertical & horizontal-sfc) By DTS (distributed temperature sensing)
- Scintollometers (H, LE)

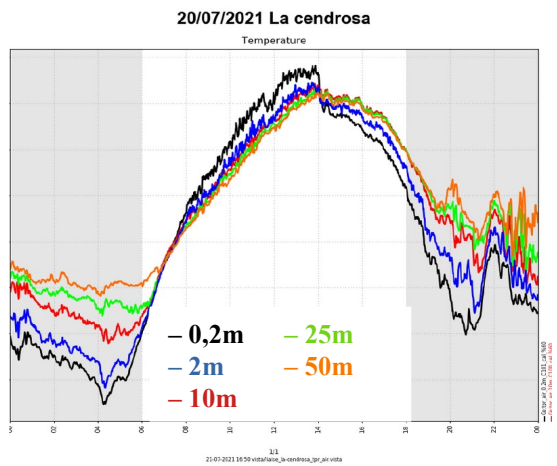
Biogeophysical

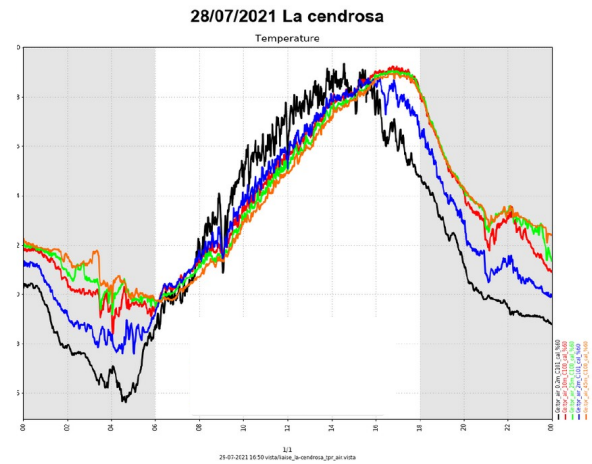
- vegetation fluorescence (passive and active fluorescence and gas exchange)
- CO2 assimilation (A-PAR)
- stomatal conductance
- photochemical yield
- Fluorescence
- chlorophyll content
- vegetation height
- leaf reflectance,
- LAI
- water and carbon isotopes

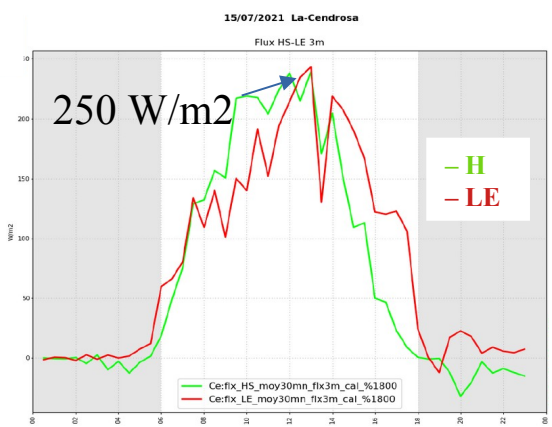
...

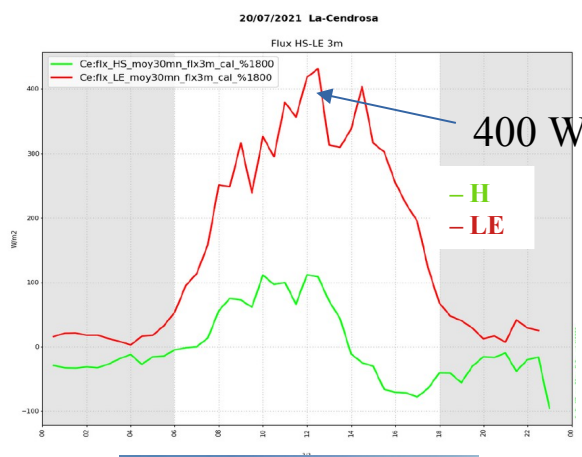
Diurnal cycle for 3 days at La Cendrosa

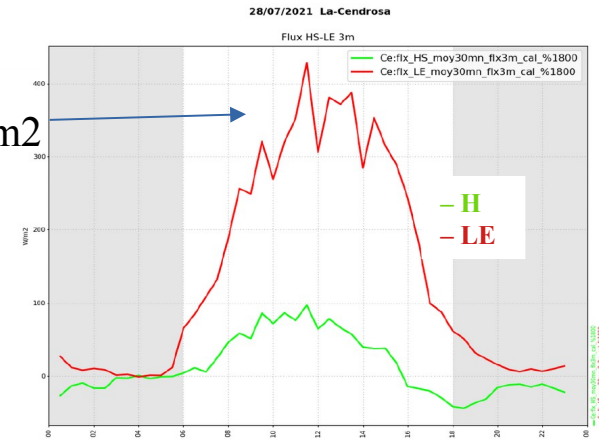




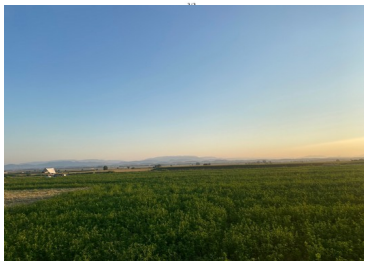




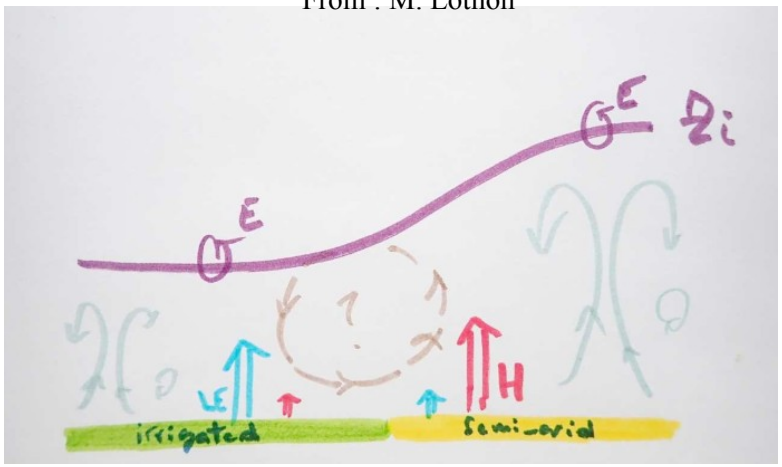


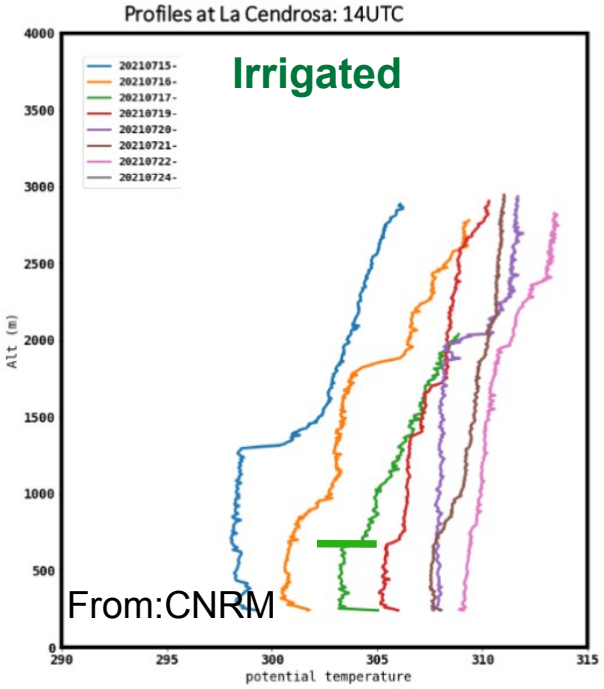


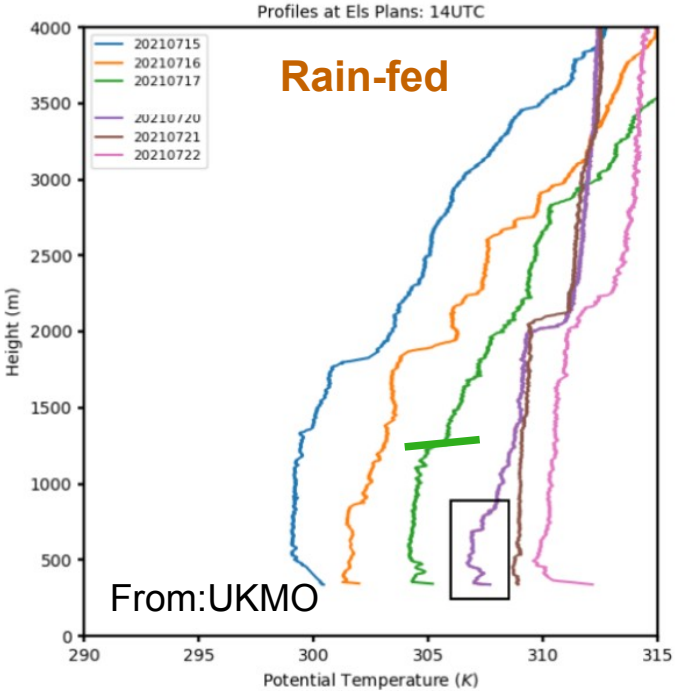
Growth →
4 cm/day



From : M. Lothon







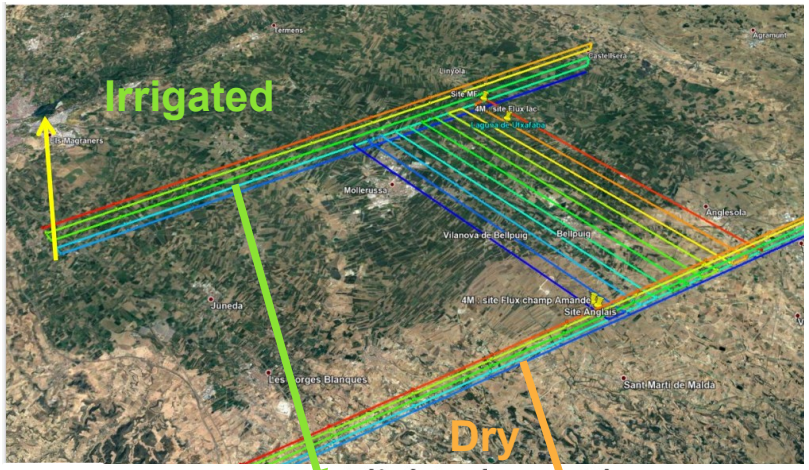
Frequent Radiosounding releases during the 15-day SOP

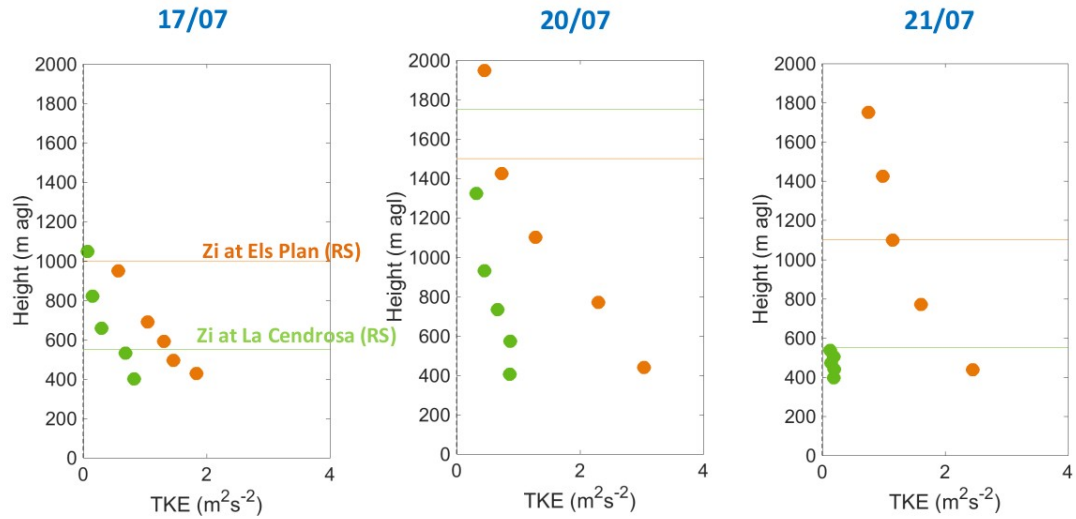
- **Wet/Irrigated** (La Cendrosa)
- 152 hourly RS
- Up to ~ 3km z
- 11 of 11 IOPS

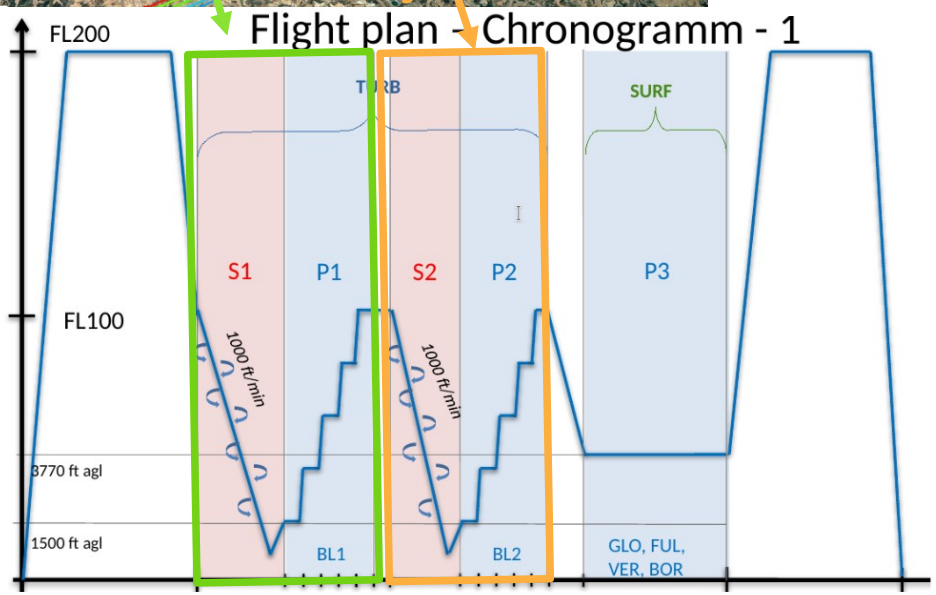
- **Dry/Rain-fed** (Els Plans)
- 116 RS releases
- Up to ~ 8km
- 7 IOPs

In-situ atmospheric measurements

Vertical profiles of TKE over irrigated area (La Cendrosa), and over dry area (Els Plan)







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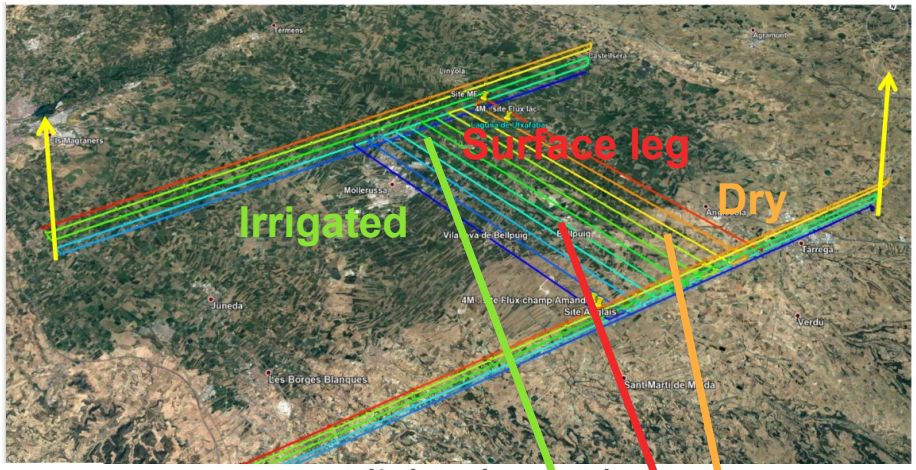
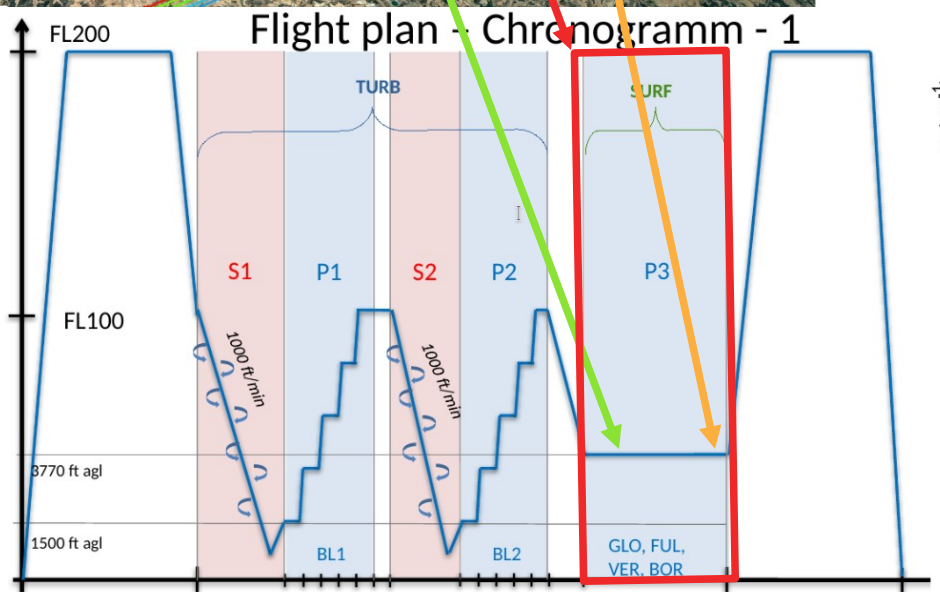
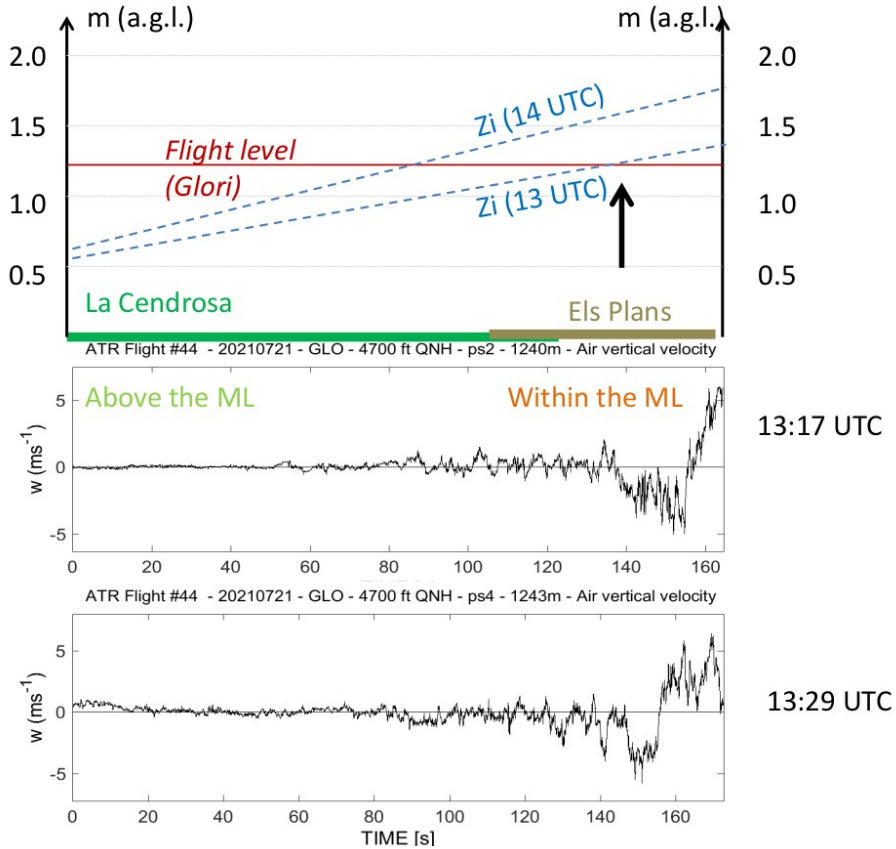
M. Lothon & F. Lohou

In-situ atmospheric measurements







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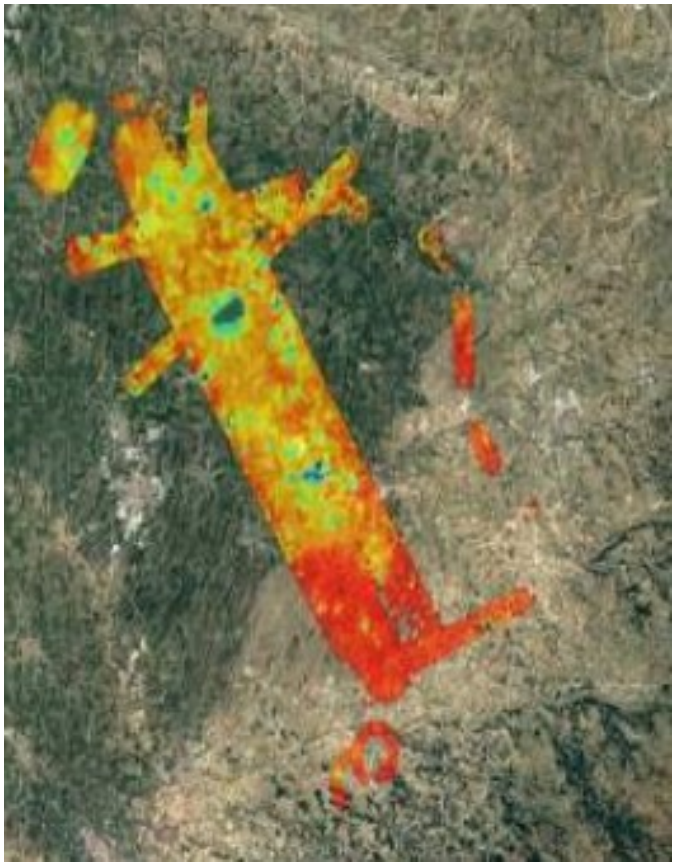
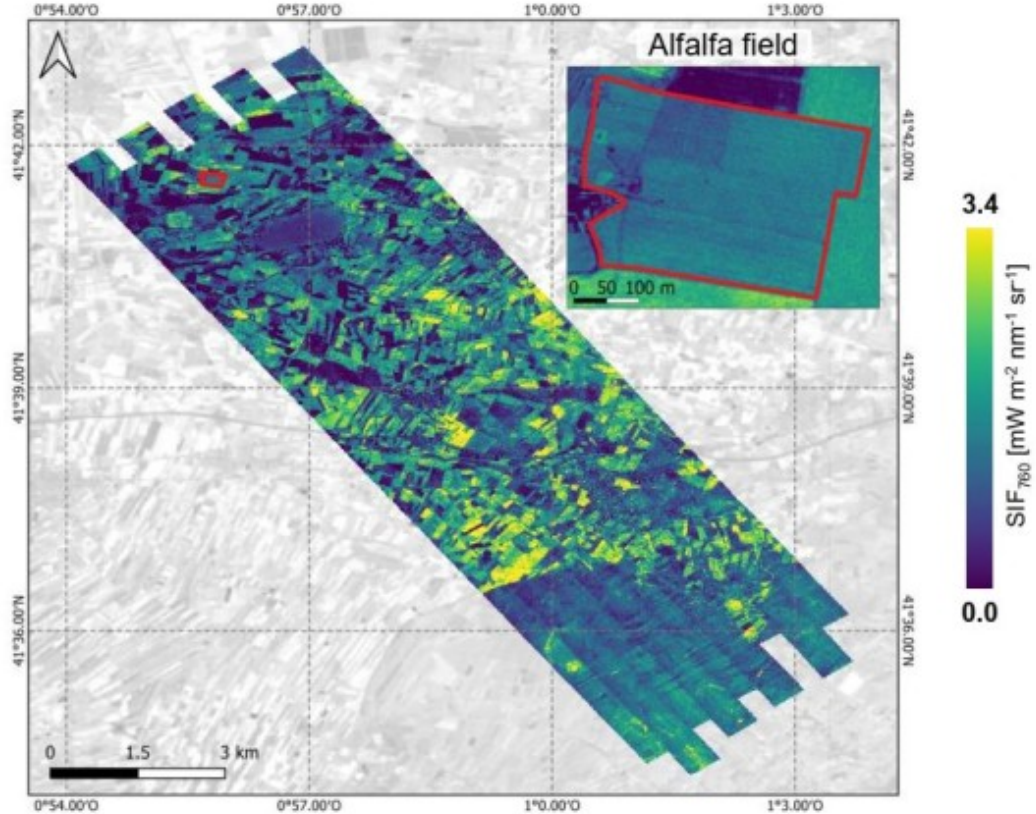
Surface Monitoring from Aircraft: July 17

SLAP (NASA) → soil moisture
(Langley King Air UC-12)



- SMAP simulator
- 1.4 GHz passive, 1.2GHz active microwave
- 100x200m pixel res (at ~1 km height)
- 9 flights, swath widths up to 8km

HyPlant (Julich - JFZ) → SIF
(SAFIRE ATR42)



- SIF and surface reflectance (4-5m pixel res.)
- 8 flight days = 200 flight lines = 400 datasets
- + Ground-based and UAV measures of SIF
- high res or lower res (10m, for spatially dist. Modeling)

ALSO ATR42 : GNSS-R dual polarization → GLORI soil moisture
CzechGlobe: NIR and longwave IR hyperspectral imaging sensors

Results/Outcome :

- A **comprehensive database** : surface-based and aircraft measurements of surface and hydrological fluxes and states, and properties of the PBL :

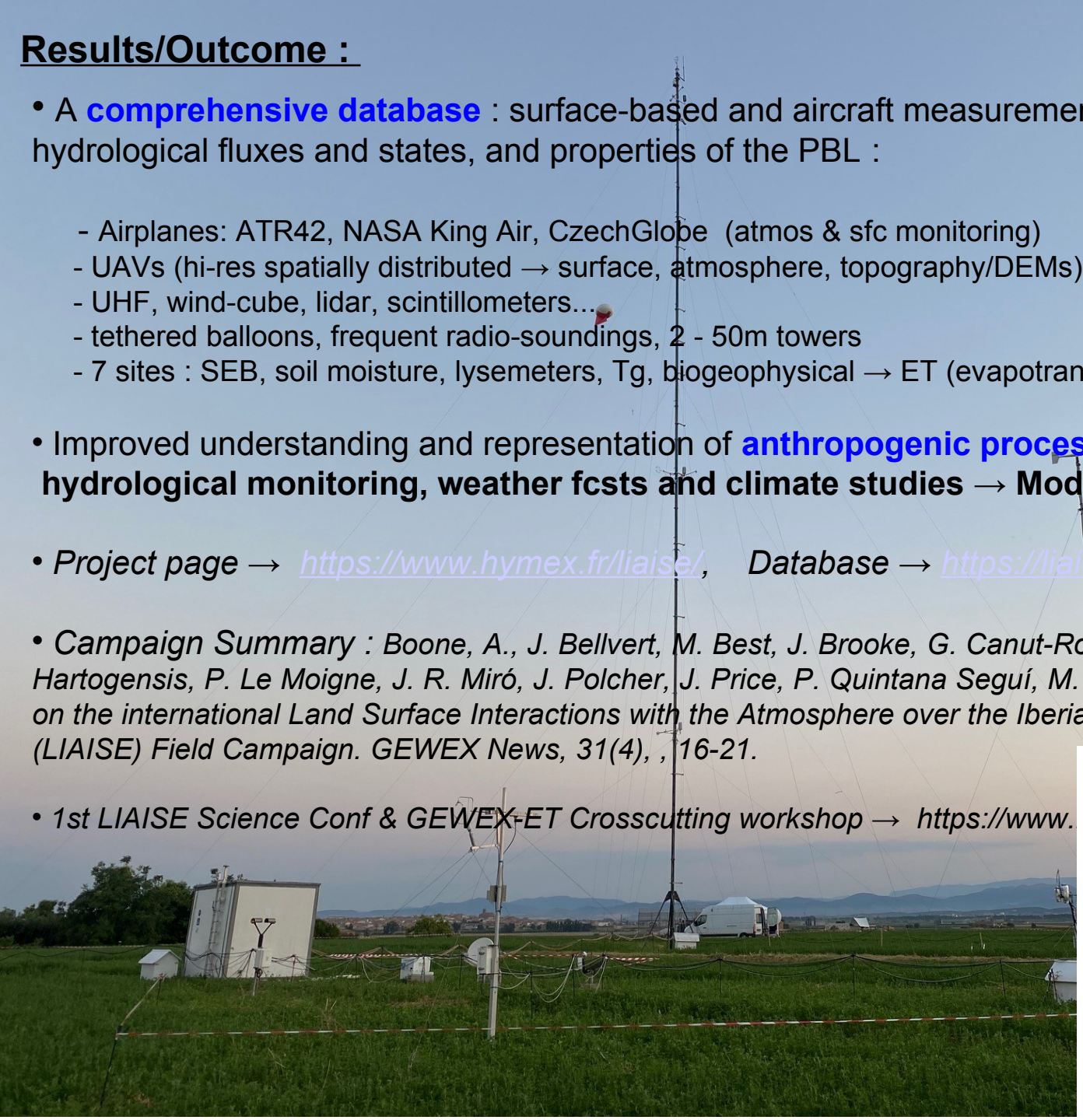
  - Airplanes: ATR42, NASA King Air, CzechGlobe (atmos & sfc monitoring)
  - UAVs (hi-res spatially distributed → surface, atmosphere, topography/DEMs)
  - UHF, wind-cube, lidar, scintillometers...
  - tethered balloons, frequent radio-soundings, 2 - 50m towers
  - 7 sites : SEB, soil moisture, lysemeters, Tg, biogeophysical → ET (evapotranspiration)

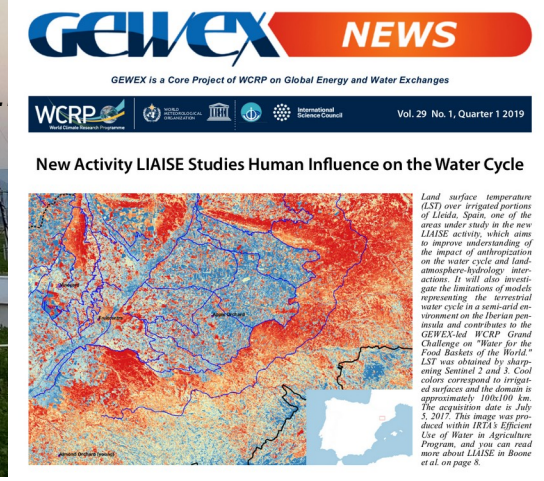
- Improved understanding and representation of **anthropogenic processes** in LSMs used for **hydrological monitoring, weather fcsts and climate studies → Modeling Studies begun!**

- *Project page →* https://www.hymex.fr/liaise/, *Database →* https://liaise.aeris-data.fr/

- *Campaign Summary : Boone, A., J. Bellvert, M. Best, J. Brooke, G. Canut-Rocafort, J. Cuxart, O. Hartogensis, P. Le Moigne, J. R. Miró, J. Polcher, J. Price, P. Quintana Seguí, M. Wooster, 2021: Updates on the international Land Surface Interactions with the Atmosphere over the Iberian Semi-Arid Environment (LIAISE) Field Campaign. GEWEX News, 31(4), , 16-21.*

- *1st LIAISE Science Conf & GEWEX-ET Crosscutting workshop → https://www.*





GEWEX NEWS

GEWEX is a Core Project of WCRP on Global Energy and Water Exchanges

WCRP World Climate Research Programme · World Meteorological Organization · International Science Council

Vol. 29 No. 1, Quarter 1 2019

New Activity LIAISE Studies Human Influence on the Water Cycle

Land surface temperature (LST) over irrigated portions of Lleida, Spain, one of the areas under study in the new LIAISE activity, which aims to improve understanding of the impact of anthropization on the water cycle and land-atmosphere-hydrology interactions. It will also investigate the limitations of models representing the terrestrial water cycle in a semi-arid environment on the Iberian peninsula and contributes to the GEWEX-led WCRP Grand Challenge on "Water for the Food Baskets of the World." LST was obtained by sharpening Sentinel 2 and 3. Cool colors correspond to irrigated surfaces and the domain is approximately 100x100 km. The acquisition date is July 5, 2017. This image was produced within IRTA's Efficient Use of Water in Agriculture Program, and you can read more about LIAISE in Boone et al. on page 8.

LIAISE GEWEX

PIs : A. Boone & M. Best et al.

HILIAISE 'ANR,
A. Boone

HUMID
(Espagne)

WISE-ET
(Espagne)

LIAISE-NLDE
(Pays Bas)

LIAISE-UKMO
(Royaume-Uni)

HyFlex **CNES**
(France)

ESA IRRIGATION+

SLAP
(NASA/Etats-Unis)

MISTRALS (HyMeX) : A. Boone
Météo-France, local support→ IRTA, SMC
EU-PRIMA IDEWA (France), SICMED

TRISHNA (franco-indienne), LST (ESA)