

Land surface Interactions with the Atmosphere over the Iberian Semi-arid Environment



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J. Brooke⁶, G. Canut-Rocafort¹, J. Price⁶, O. Hartogensis⁷, J. R. Miro⁸, P. LeMoigne¹ **et al.**

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2 LMD, IPSL, Paris, France

3 IRTA, Lleida, Spain

4 Observatori de l'Ebre, Roquetes, Spain

5 UIB, Balearic Islands, Spain

6 UKMO, Exeter, UK

7 U. Wageningen, Netherlands

8 SMC, Barcelona





LIAISE Workshop 2

- Science Questions...how are we doing ?
- Field Campaign...mission accomplished
- Database...still growing
- Working Groups... interactions & exchanges
- Next steps → Future Projects, a follow-on ?

Science Questions



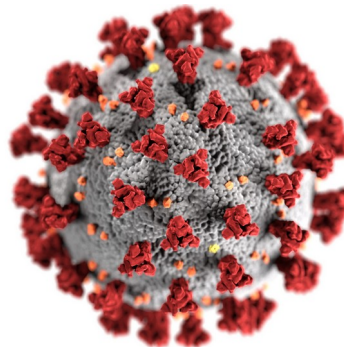
- 1) What are the key **natural and anthropogenic semi-arid surface processes** that modulate or control infiltration and runoff and govern turbulent fluxes and their spatial heterogeneity?
2. How does the highly heterogeneous (natural and anthropized) **surface** impact boundary layer development, mesoscale 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?

→ Data to address these questions are limited , motivation for the field campaign in Summer 2020

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→ Initiated & Contributed to the **GEWEX dET CC**
(**d**etermining **E**vapo**T**ranspiration **C**ross-**C**ut activity)

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



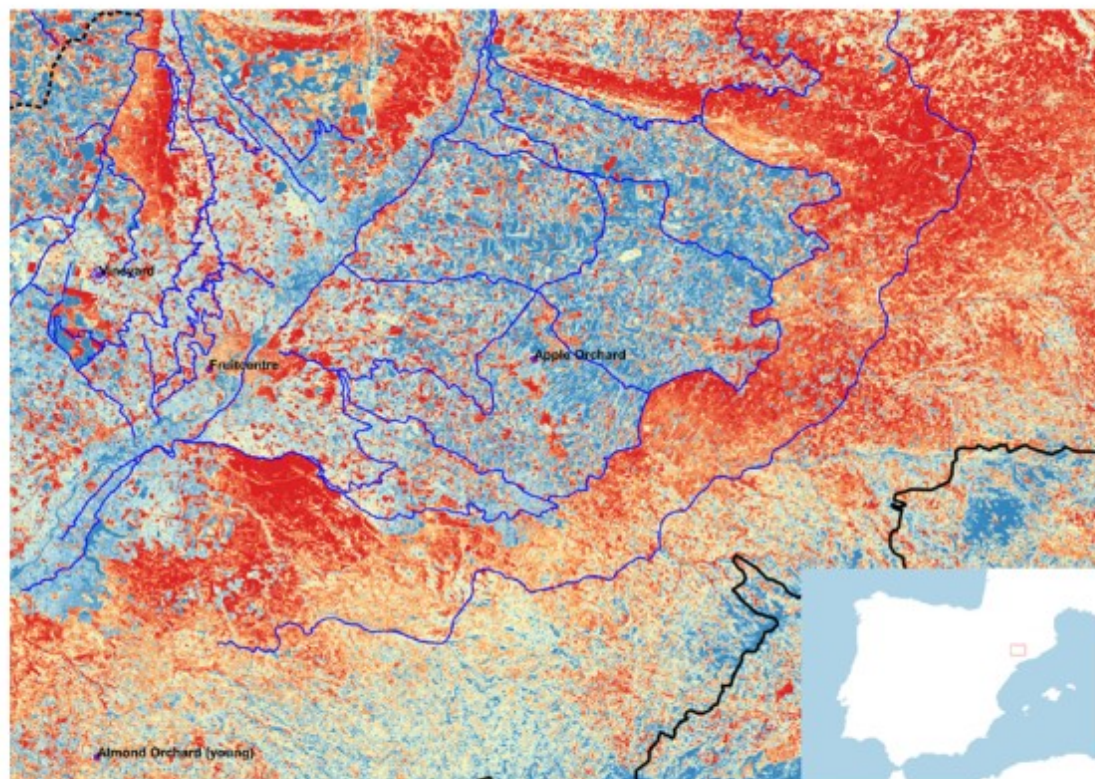
WORLD
METEOROLOGICAL
ORGANIZATION



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.

The
kickoff !



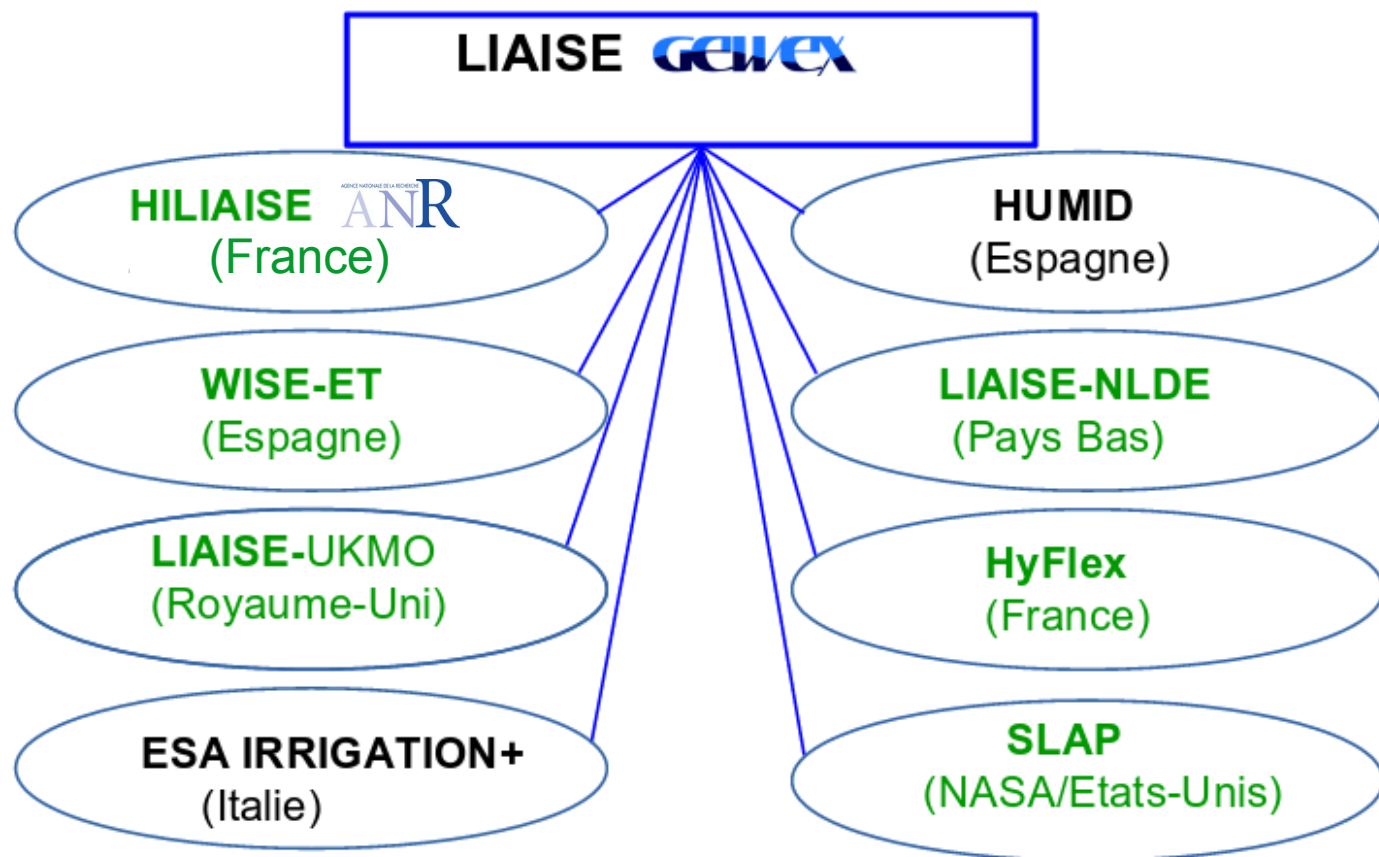
Funded projects contributing to LIAISE campaign:



A. Boone, G. Canut-Rocafort, P. Le Moigne, S. Munier, J.-C. Calvet, C. Albergel, S. Donier, M. Minvielle, O. Garrouste, W. Maurel, A. Dabas et al., J. Polcher, S. Bastin, F. Gibert, Y. Goulas, M. Haeffelin, L. Jarlan, M. Zribi, M. Le Page, V. Le Dantec, O. Merlin, P. Fanise, Y. Tramblay, J. Demarty, M. Lothon, F. Lohou, Y. Bezombes,

J. Cuxart⁷, O. Hartogensis¹⁰, J. Bellevert⁴, M.-A. Jiménez-Cortéz⁷, P. Quintana-Seguí⁶

M. Best⁸, J. Price⁸, J. Brooke⁸



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

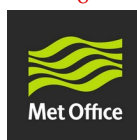
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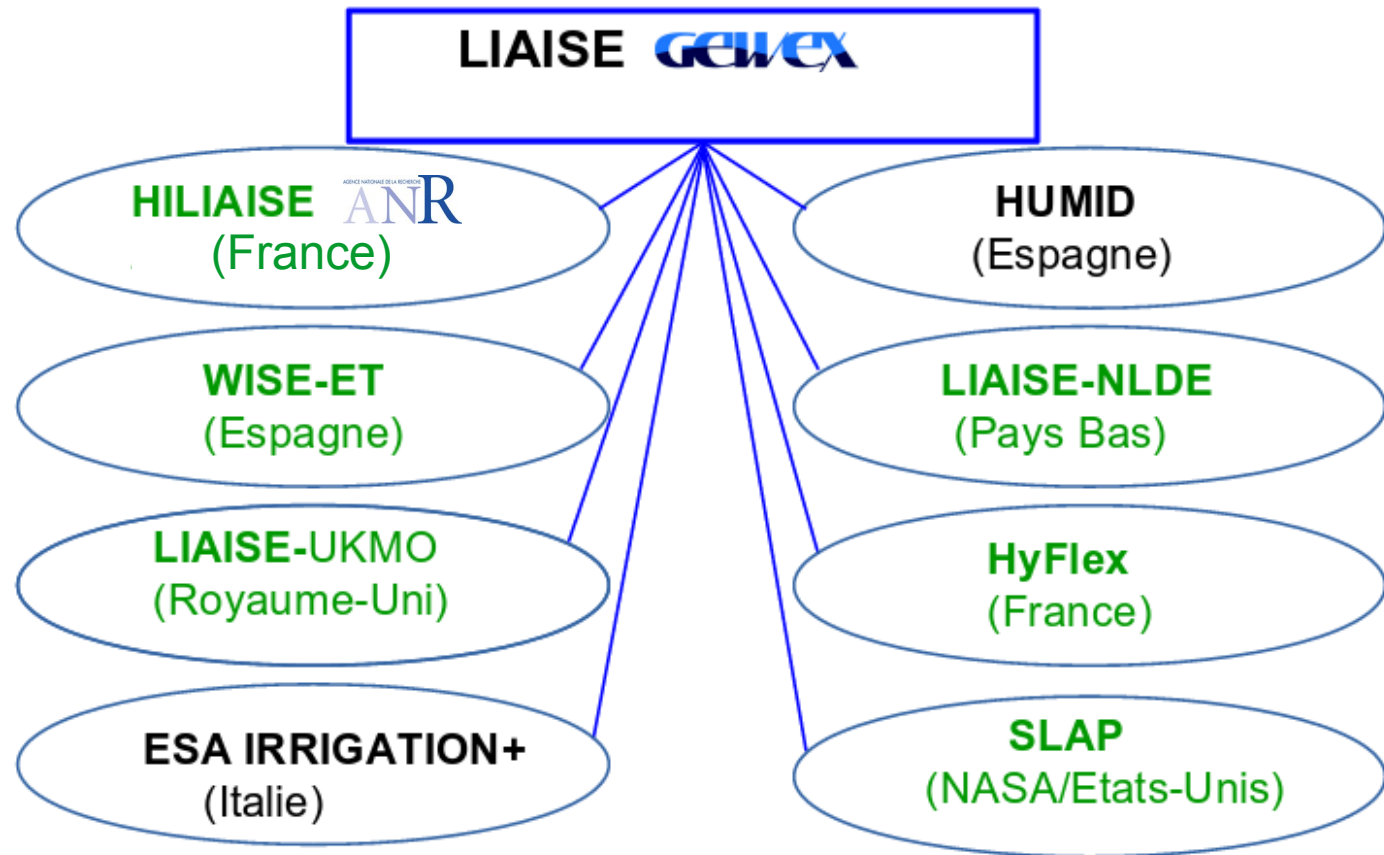
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9



Projects with links to LIAISE :

HUMID
PIRAGUA
IRRIGATION+
ALTOS
ACCWA



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

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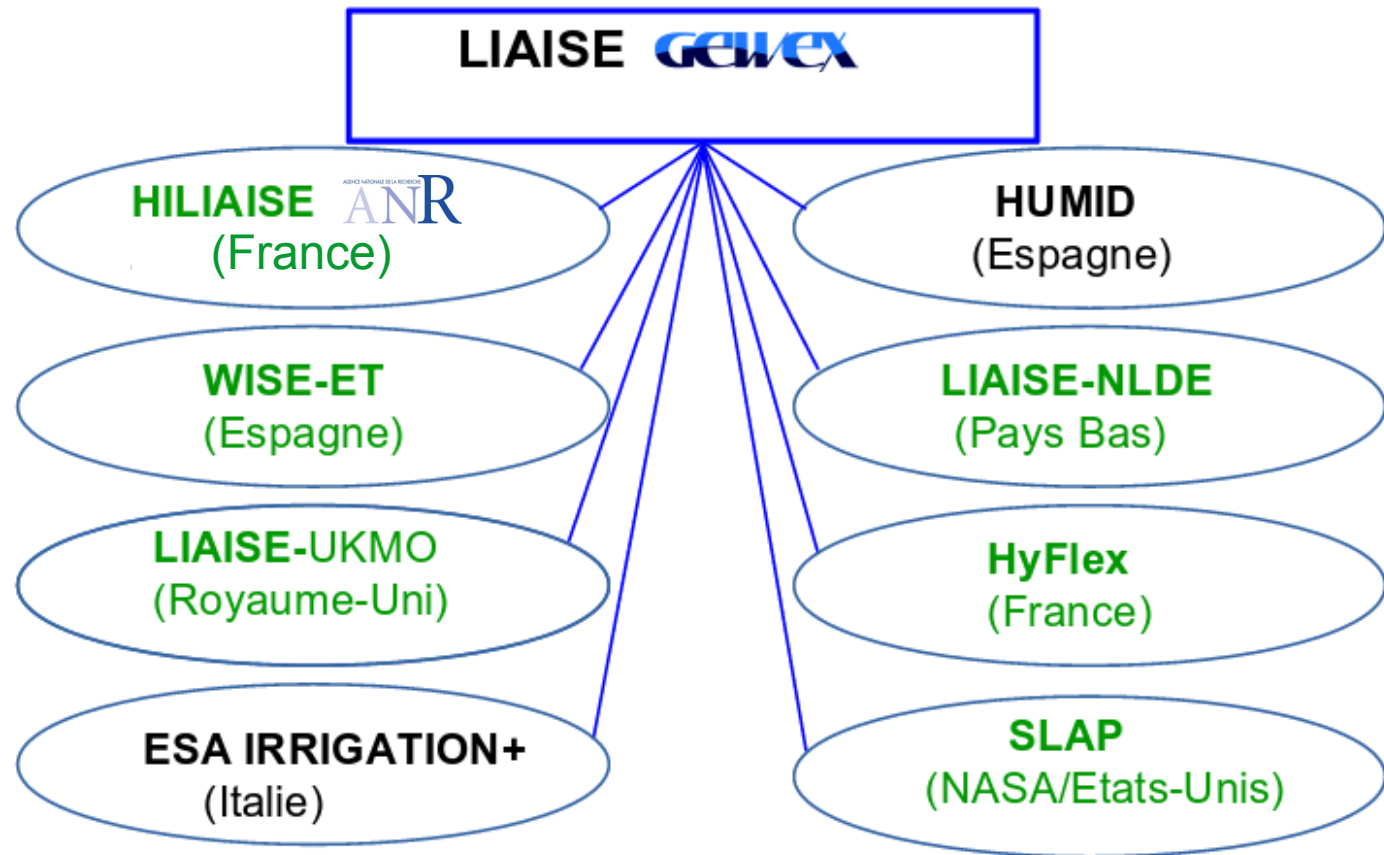
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Joined many research groups/laboratories/centers to study what is viewed as a critical issue !



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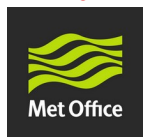
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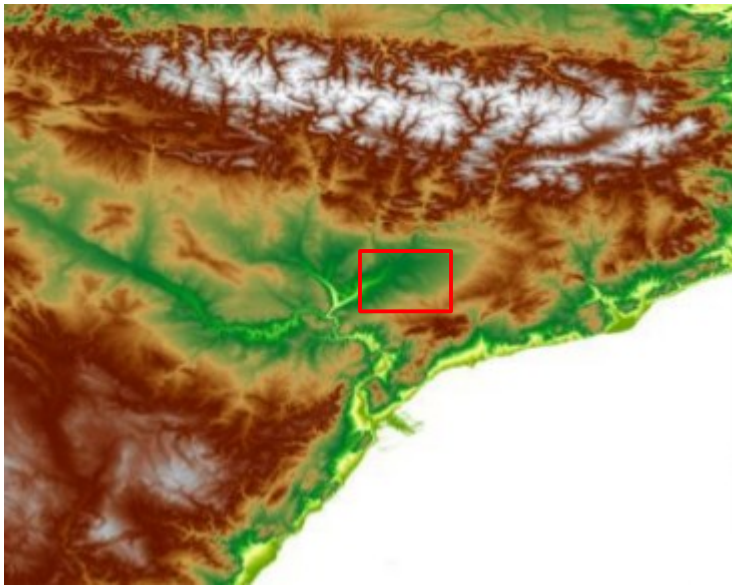
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The Pla Urgell within the Ebro basin:

- major EU *Bread Basket* region (WCRP)
- limited water resources
- area likely to be subjected to significant future drying & warming (IPCC)

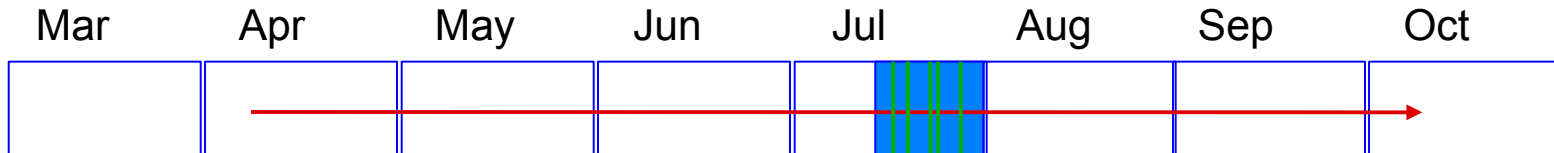
Land surface Interactions with the Atmosphere over the Iberian Semi-arid Environment

Strategy → Intense observations of surface and ABL →
irrigated and natural surface contrasts are a MAXIMUM and water needs LARGEST

LOP : April-October, 2021 → surface flux stations, sfc satellite products, lysimeters, soil moisture & T...

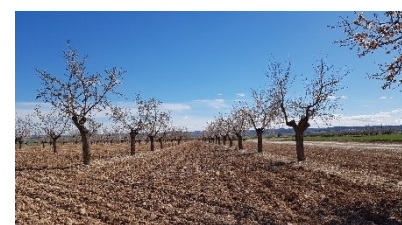
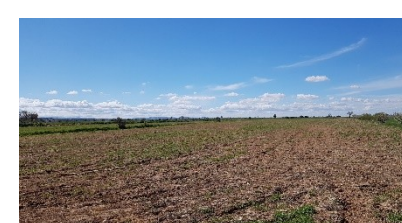
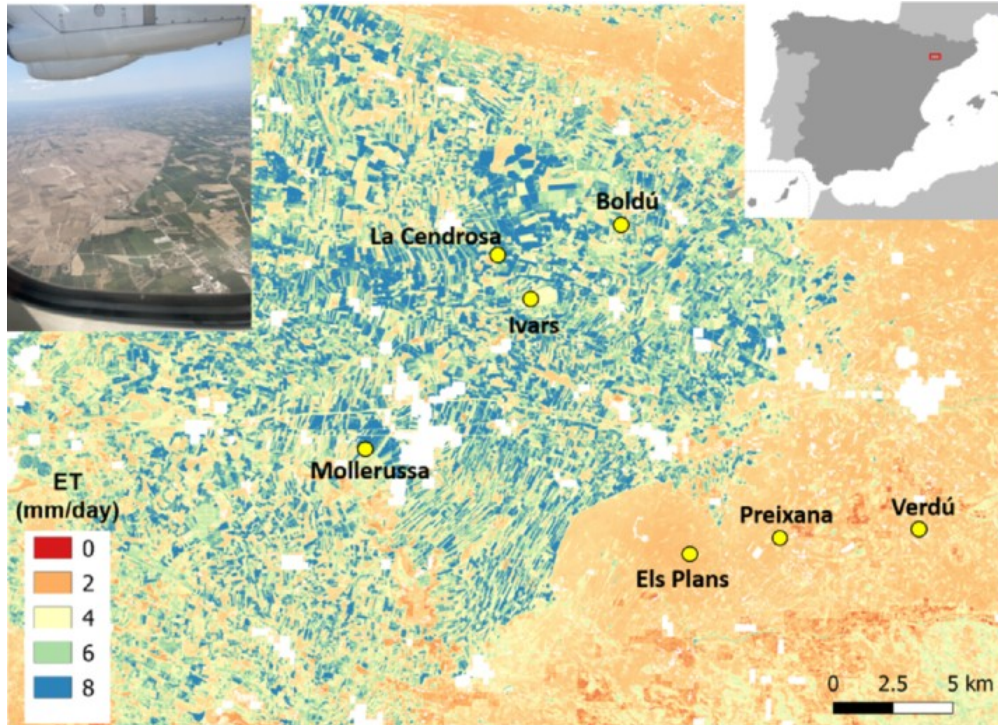
SOP : Summer/July 15-29 → Lower atmosphere & SEB, lidar, UHF...

→ 11 **IOP(s)** : (planes, drones/UAVs, balloons, soundings..)



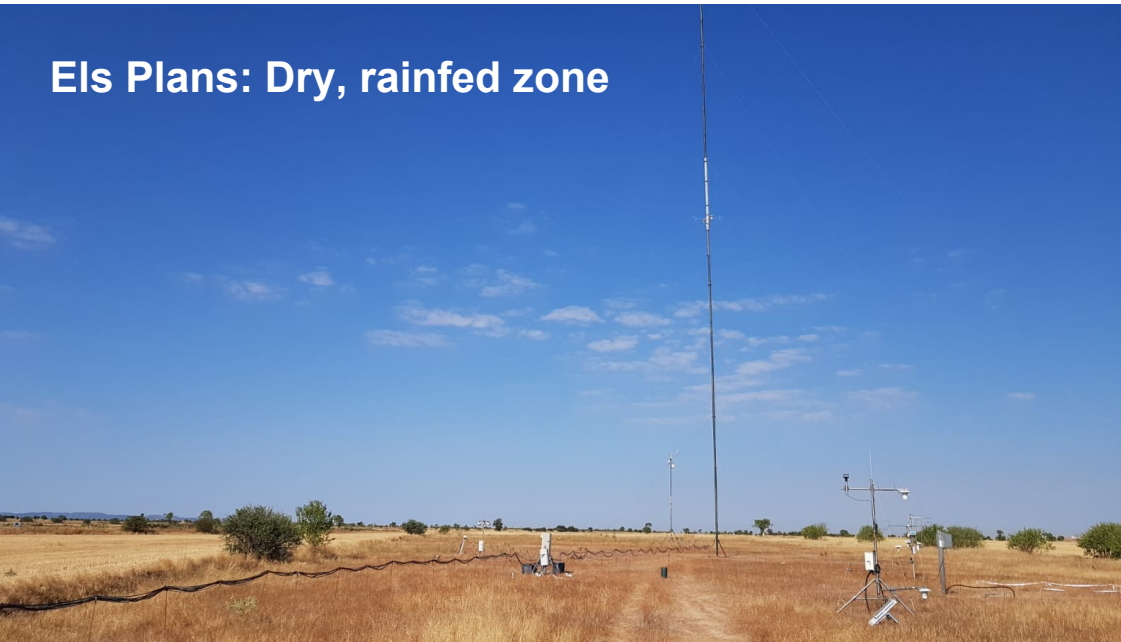
Land cover heterogeneity

- 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.

Els Plans: Dry, rainfed zone



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)
- Scintillometers (H, LE)

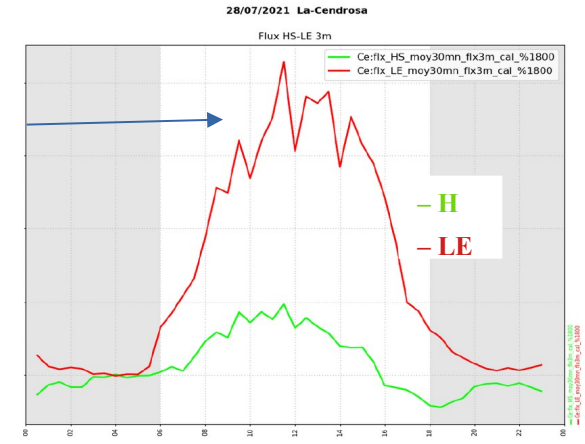
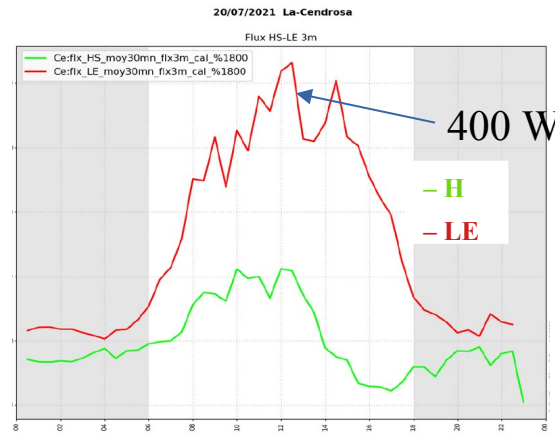
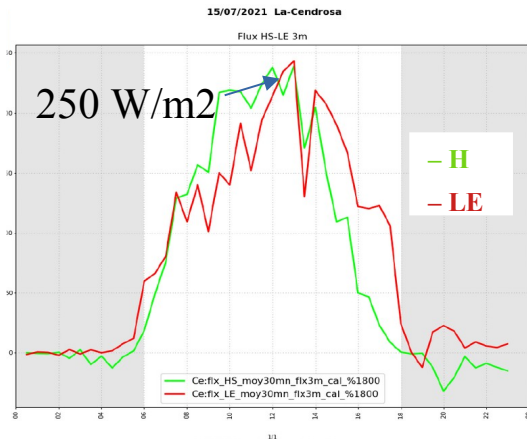
La Cendrosa: Humid, irrigated zone



Biogeophysical

- vegetation fluorescence (passive and active fluorescence and gas exchange)
- CO₂ assimilation (A-PAR)
- stomatal conductance
- photochemical yield
- chlorophyll content
- vegetation height, LAI

Diurnal cycle : 3 SOP days at La Cendrosa



Alfalfa Growth → 4 cm/day

From a height of several cm
and sparse coverage to 70
cm and an LAI ~4 m²/m²

Doppler radar WindCube

Period: 8 June -10 Oct. → La Cendrosa
Leosphere (Vaisala) Wincube7, 4 lasers
W, U, V

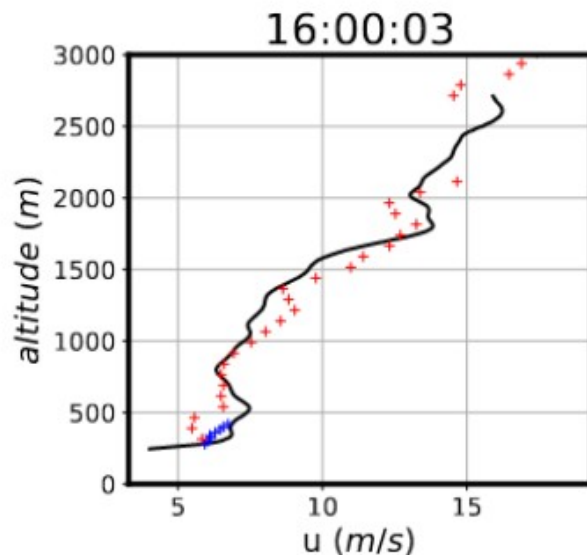
Temporal resolution : 1s and 10 minutes

Vertical resolution : 20 m

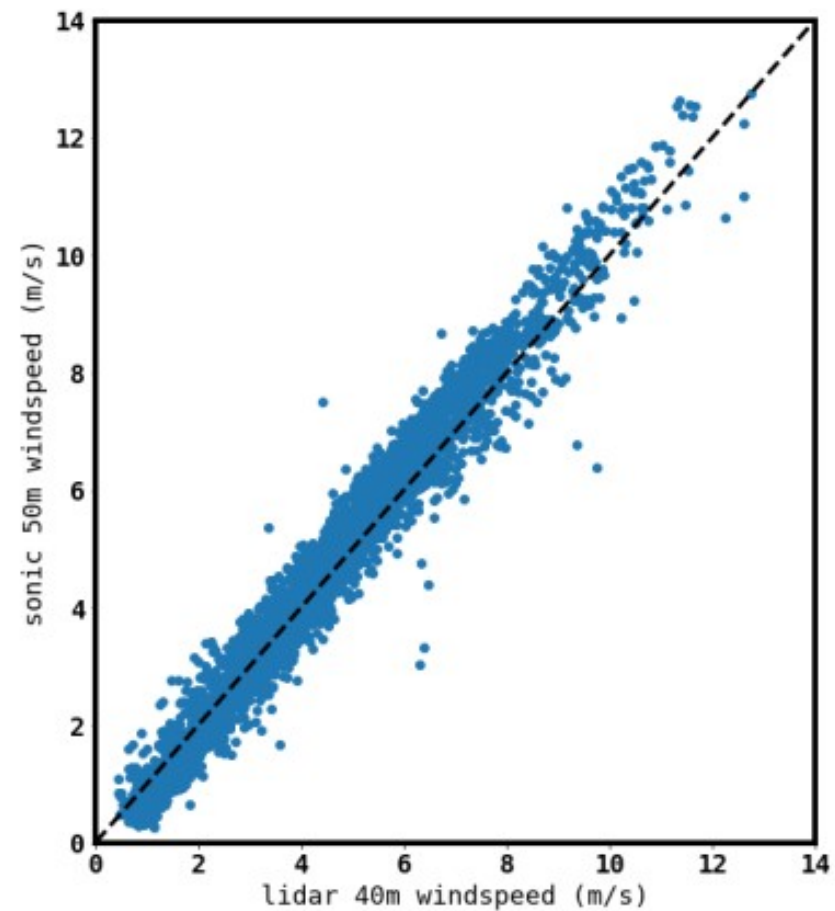
Alt min : 40m

Alt max : 240m

Research mode with data available every
second → estimation of variance and
TKE



- RS
+Lidar
+UHF

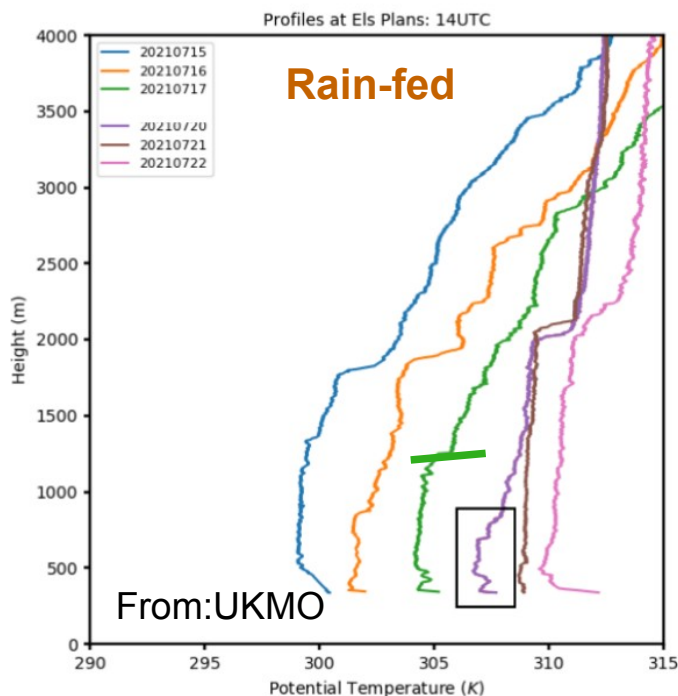
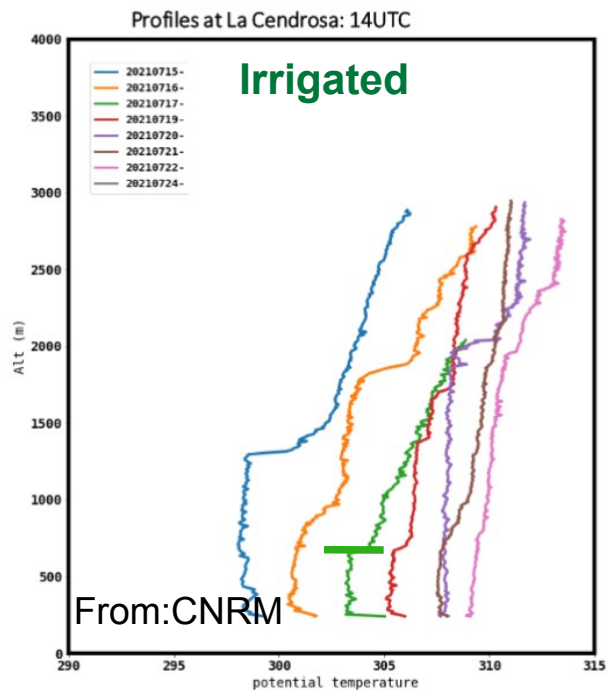
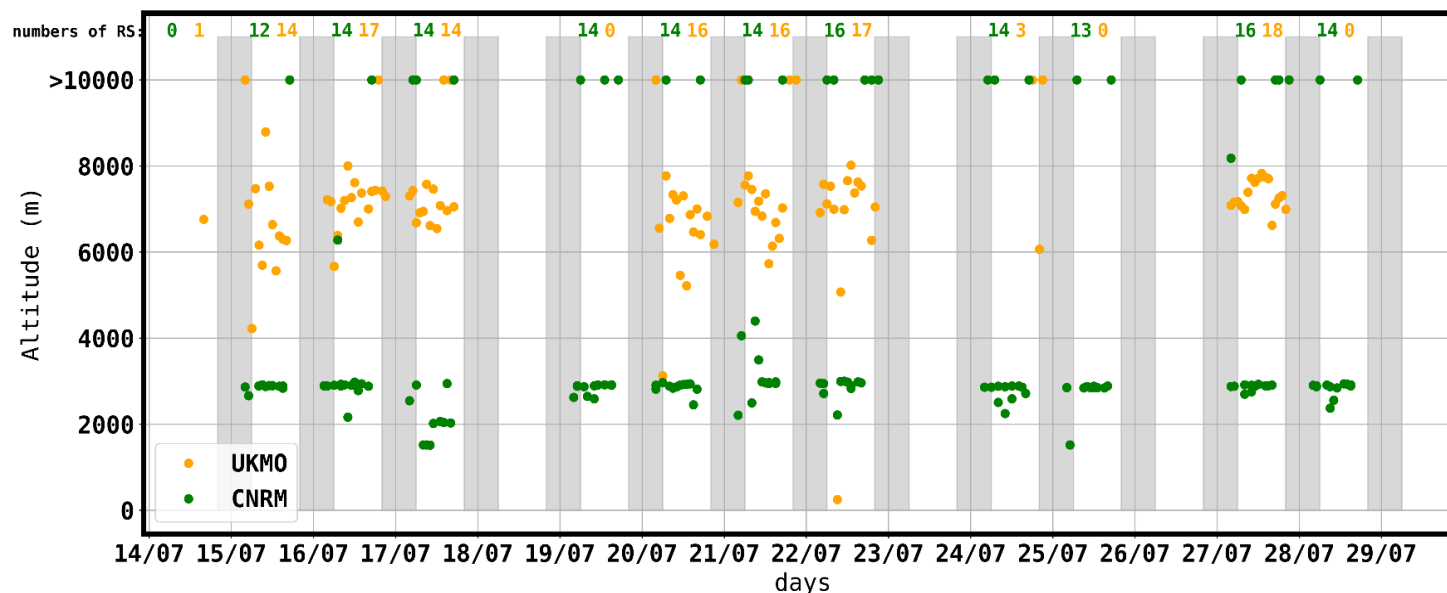


Comparison with other
measures :

Frequent Radiosounding releases during the 15-day SOP



G. Canut
(CNRM) &
J. Brooke
(UKMO)



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



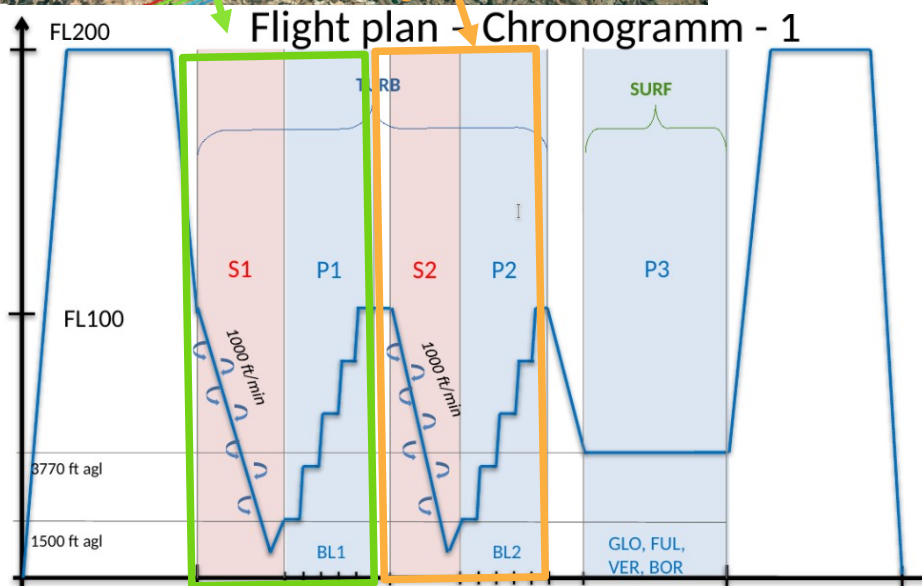
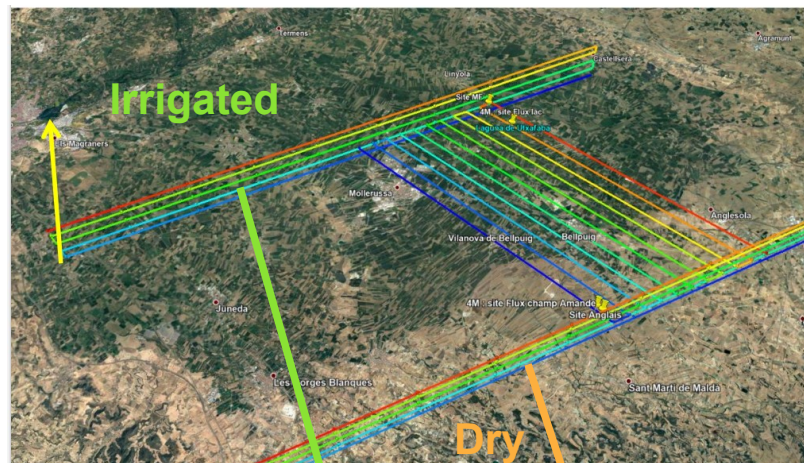
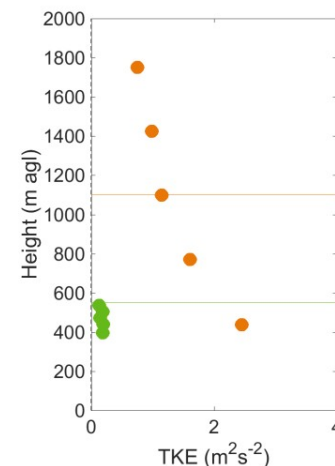
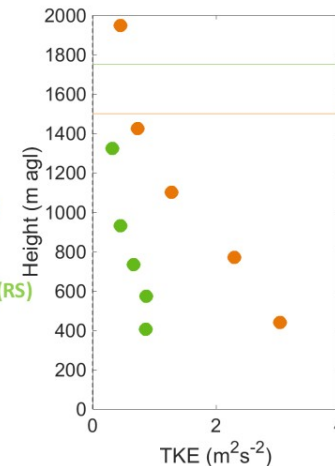
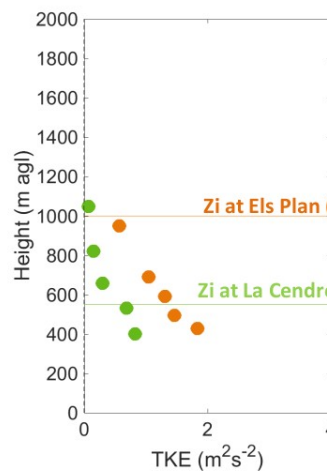
Vertical profiles of TKE

over irrigated area (La Cendrosa),
and over dry area (Els Plan)

17/07

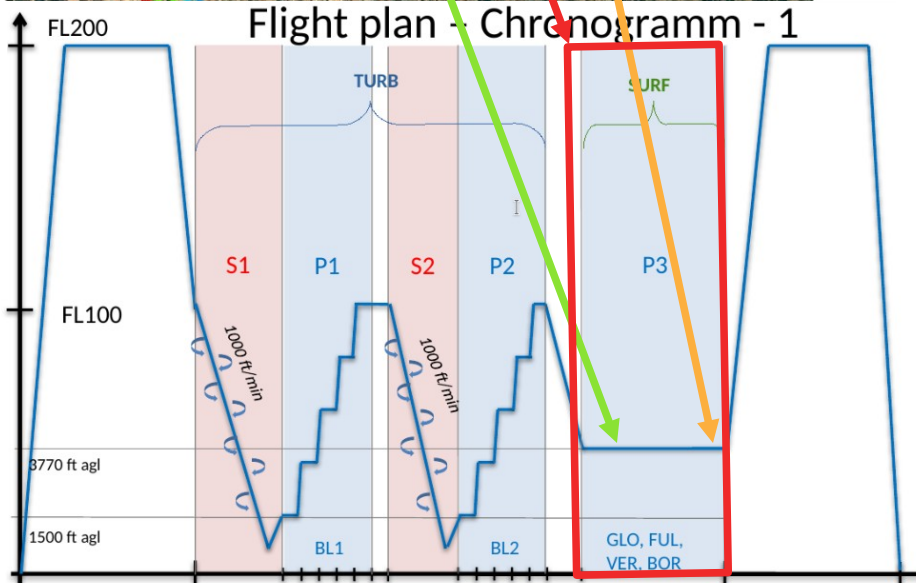
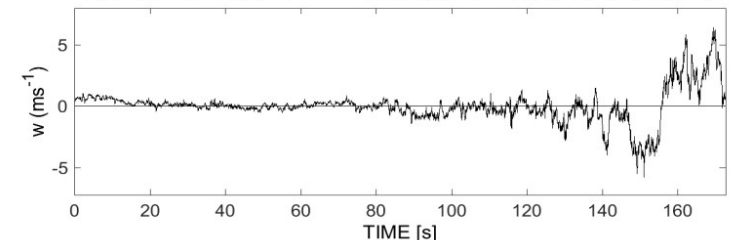
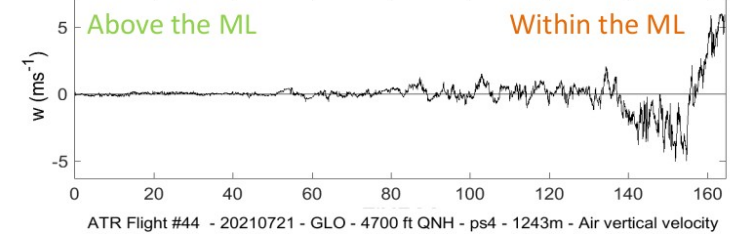
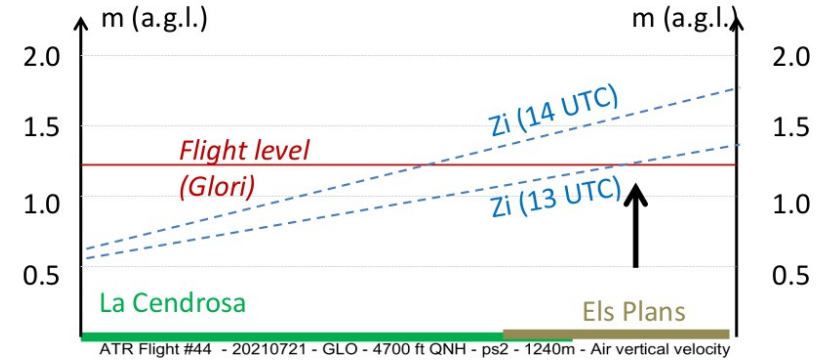
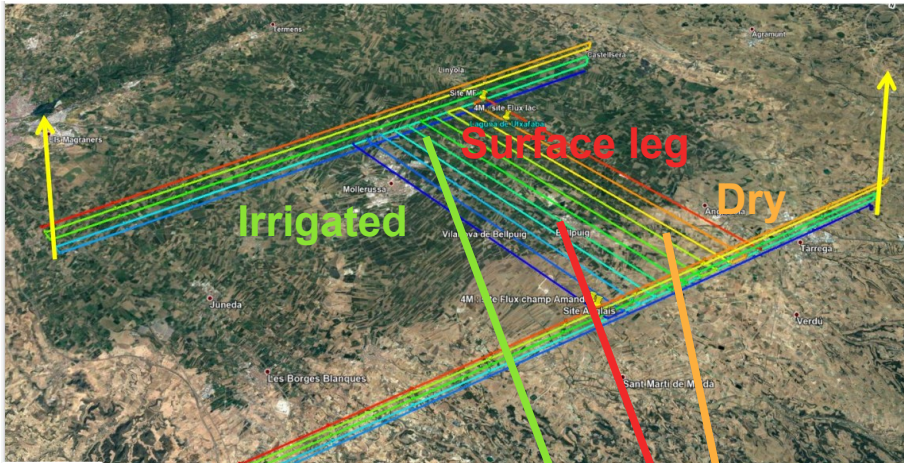
20/07

21/07





In-situ atmospheric measurements



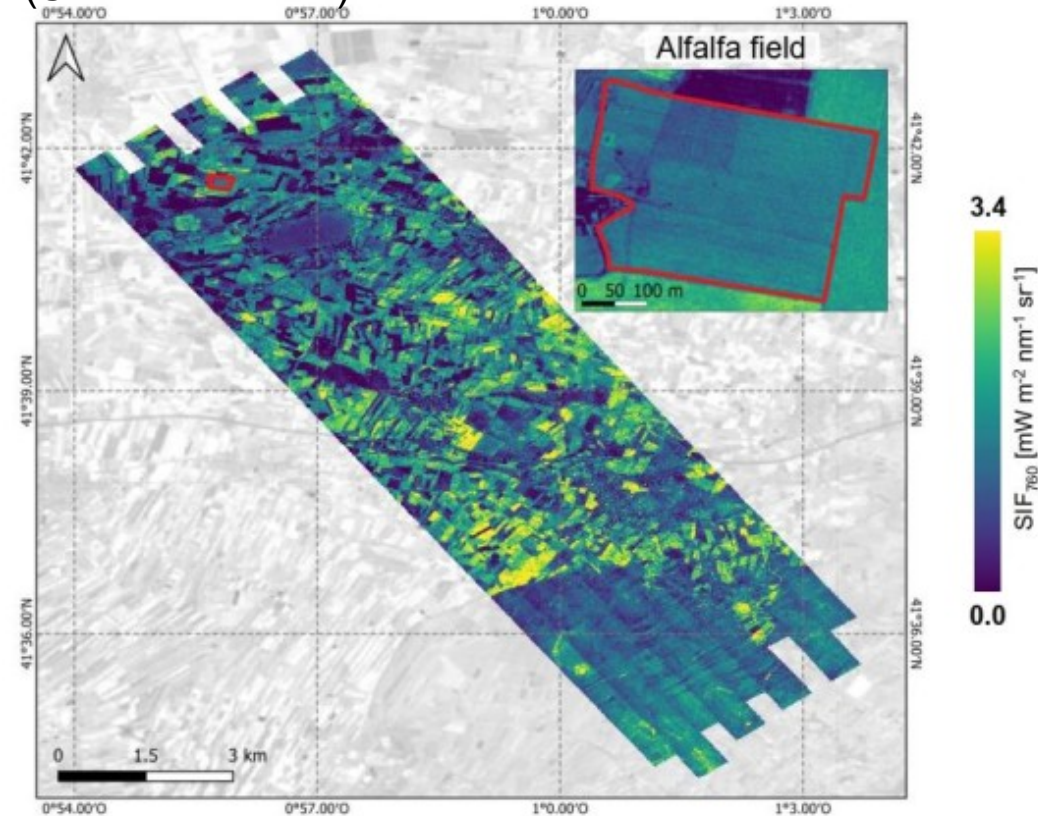
Surface Monitoring from Aircraft: July 17



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



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

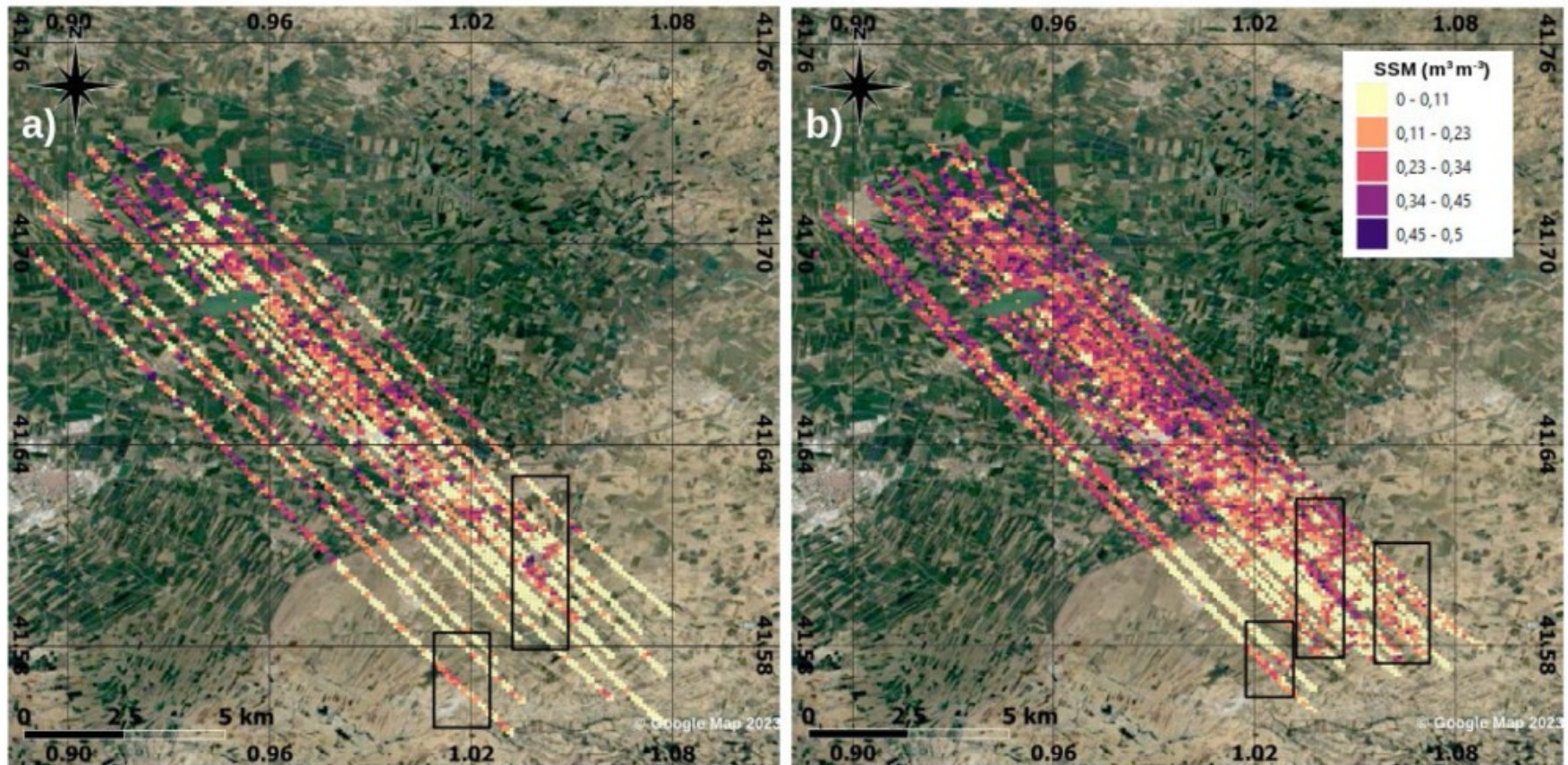


- SIF and surface reflectance (4-5m pixel res.)
- 8 flight days = 200 flight lines = 400 datasets
- + Ground-based and UAV measures of SIF
- high res or lower res (10m, for spatially dist. Modeling)

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

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

Surface Monitoring from Aircraft: July 22, 27



GLORI (GNSS-R dual polarization- from the ATR42):

Derived surface soil moisture a) 22 July, b) 27 July, 100 m res.

ALSO CzechGlobe: NIR and longwave IR hyperspectral imaging sensors

2nd LIAISE Workshop, May. 22-23, 2025, Toulouse



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Special thanks to
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Field Campaign database:

AERIS → <https://liaise.aeris-data.fr>

Environmental Information System (SIE) :

CESBIO → <https://sie.cesbio.omp.eu>

Project site:

<https://www.hymex.fr/liaise/>



- Presentations from last workshop
- Publication list
- Project updates, ancillary info

Eichier Édition Affichage Historique Marque-pages Outils Aide

RS_CNRM - LIAISE x +

https://liaise.aeris-data.fr/products/rs_cnrm/

https://bib.cnrs.fr/home/ Cours : IENM1 - Couch... PEGASE WEB Zimbra: Réception (310) srv Aircraft - LIAISE meteo ANTILOPE Nuxeo Platform Slack | général | Stage-... Stages - CNRM - Wiki ... CNRM - CNRM - Wiki ...

LIAISE

Archives Documentation

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type :
profile

parameters :
ascentRate emagramme humidity temperature theta windDirection
windSpeed

2021-07-20 : 04H

Altitude (m)

temperature profile 2021-07-20T04:00:00

ascend descent

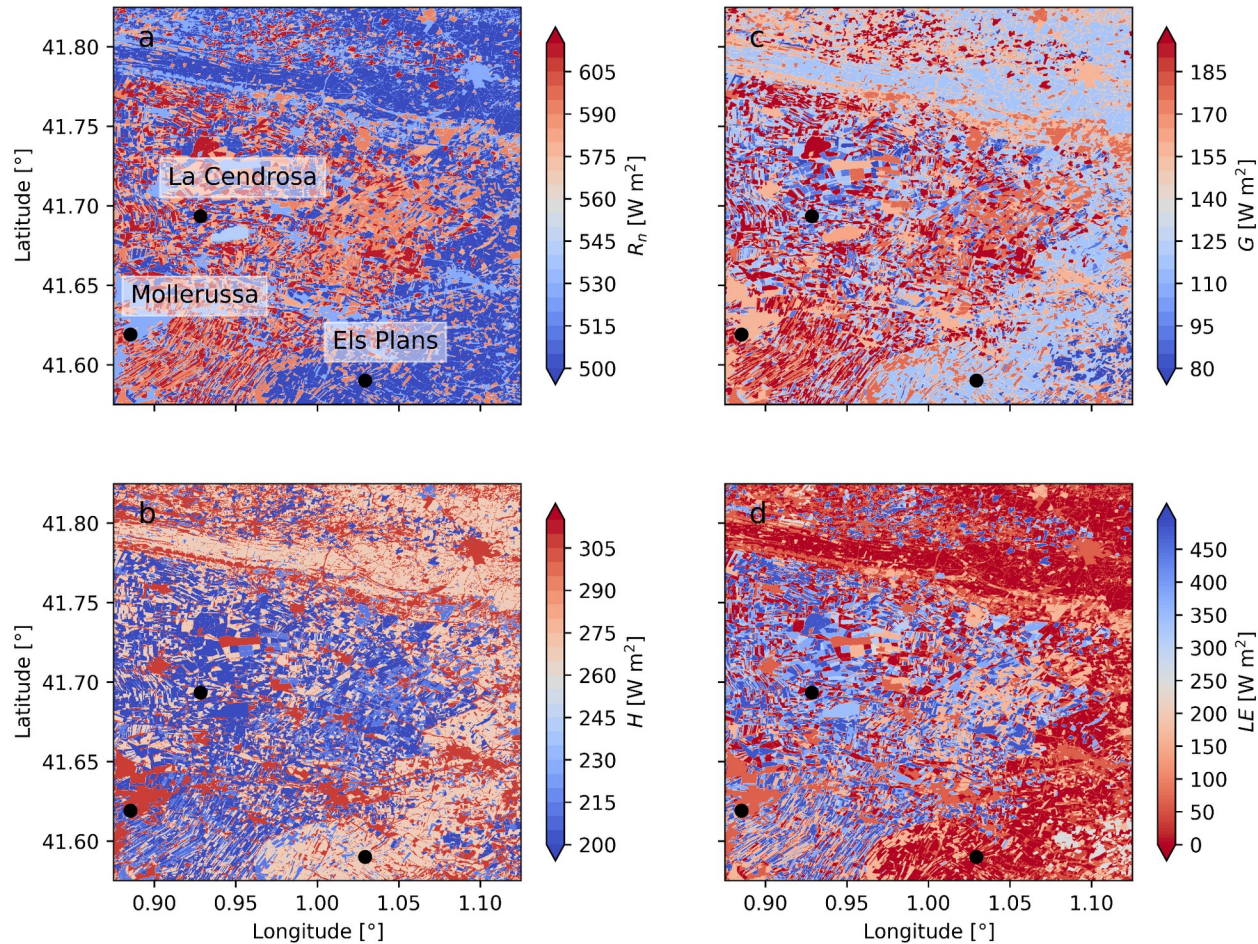
temperature (°C)

Working Groups :

- Foster exchange, possible collaboration
- Each covers main theme : surface processes, land-atmosphere interactions, hydrological processes
- 3 years worth of meetings, all presentations available online...
- What Next ?

WG1	WG2	WG3
Dec. 9, 2021, 14:00-17:00 UTC (Agenda) Presentations	Dec. 9, 2021, 14:00-17:00 UTC	Dec. 9, 2021, 14:00-17:00 UTC
Jan. 27, 2022, 16:00 CET (Agenda) Presentations	Feb. 17, 2022, 16:00-17:00 CET (Agenda) Presentations	Mar. 31, 2022, 16:00-17:00 CET (Agenda) Presentations
Apr. 28, 2022, 16:00 CEST (Agenda) Presentations	May 31, 2022, 16:00 CEST (Agenda) Presentations	Nov. 3, 2022, 16:00 CEST (Agenda)
Nov. 24, 2022, 16:00 CEST (Agenda) Presentations	Jan., 19, 2023, 16:00 CEST (Agenda) Presentations	
March 29, 2023, LIAISE first Science Conference and GEWEX Evapotranspiration Cross-cutting Workshop Presentations	March 29, 2023, LIAISE first Science Conference and GEWEX Evapotranspiration Cross-cutting Workshop Presentations	March 29, 2023, LIAISE first Science Conference and GEWEX Evapotranspiration Cross-cutting Workshop Presentations
January 25, 2024, (Agenda and minutes) Presentations	Dec. 5, 2023, 16:00-17:00 CET (Agenda) Presentations	
March 8, 2024, 15:00-16:00 CET Presentations	March 8, 2024, 15:00-16:00 CET Presentations	March 8, 2024, 15:00-16:00 CET Presentations
Sept. 24, 2024, 16:00-17:00 CET (Agenda) Presentations	July 2, 2024, 16:00-17:00 CET (Agenda) Presentations	Oct.24, 2024, 14:00-15:00 CET (Agenda) Presentations

WG1 : Surface flux (SEB components) maps



Mangan et al., 2023, Agri. and Forest. Meteorol.

Data Processing/products, modeling :

SEBs: WUR, CNRM, UKMO, UIB, SMC, IRTA, CESBIO

Scintillometers/fluxes : WUR

Ecophysiology, field scale (LIAISE-NL), JFZ...

Remote Sensing : CESBIO, WUR, JFZ, NASA

WG2 : Irrigation-atmosphere effects

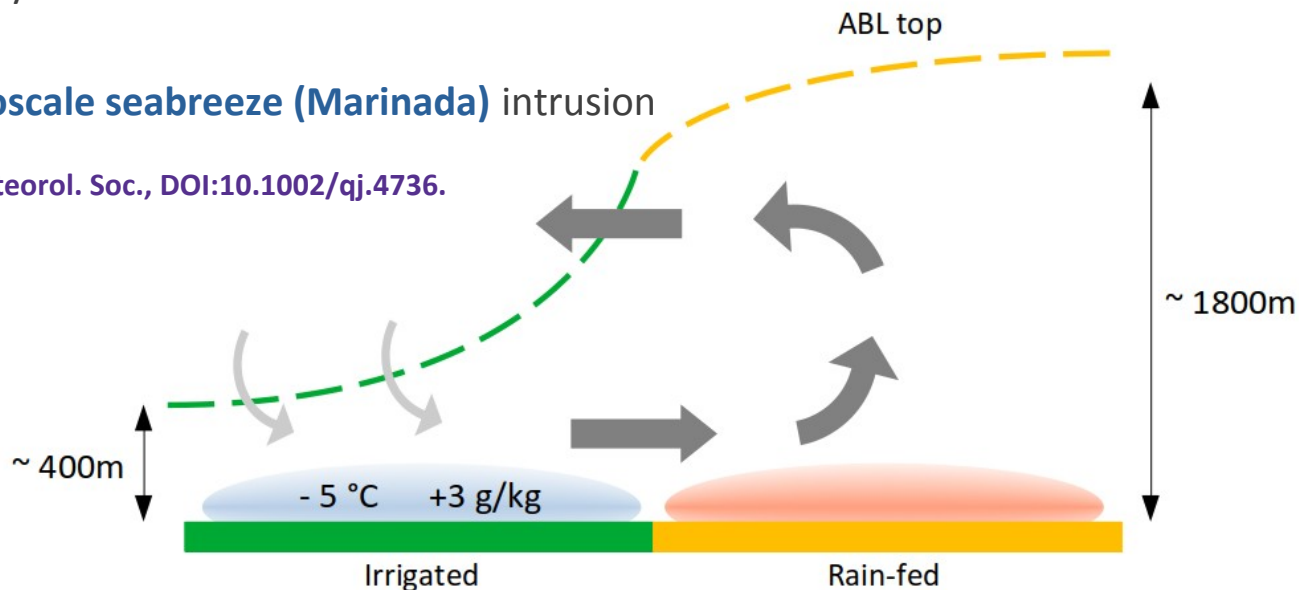


Influence of irrigation in semi-arid environment is major, and has a significant impact on near-surface conditions and circulations in the ABL over a large region in NE Spain → Breadbasket region of Europe

- **A simple parameterization of irrigation** allows for improvement in representation of surface and ABL characteristics → but only first order effect

- Irrigation **impacts the mesoscale seabreeze (Marinada)** intrusion

- Lunel, T et al., 2024 : Q. J. Roy. Meteorol. Soc., DOI:10.1002/qj.4736.



Main atmospheric modeling activities :

LIAISE-NL → LES & conceptual models

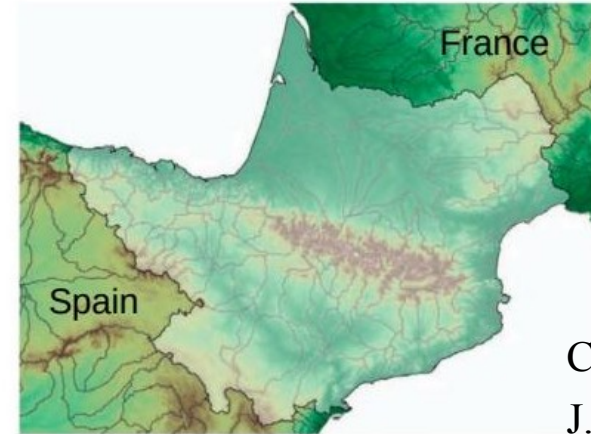
UIB → Mesoscale model intercomparison study phase 1

WG3 : Basin-scale hydrological processes, budget



Data processing : DONE

Simulation phase : just begun !



Contact :
J. Polcher

LIAISE Simulation protocol :

Figure from <https://www.opcc-ctp.org/fr/piragua> (Accessed 02/09/2023)

- Four forcing data sets have been retained to sample resolution and uncertainties :
 - *WFDE5 : 50km resolution global forcing cropped to the region*
 - *3 version of the 3km forcing dataset : ETHZ_Avg, IPSL_Alt, IPSL_Avg*
- 3 models have provided their baseline simulations :
 - **SURFEX** : *A simple configuration without routing, irrigation or urban*
 - **JULES** : *The configuration does include urban regions but no irrigation or routing.*
 - **ORCHIDEE** : *Includes routing scheme but no irrigation or urban.*
- Data processing is performed over the hydrological years from 1989 to 2013.
- All simulations conserve water and there are no significant trends in the runoff.

Next steps : future projects with multiple partners using data From the campaign or project/partners



WG1 → land surface model intercomparison project at local scale sites (M. Best)

WG2 → Mesoscale Model Intercomparison Phase 2 (with Irrigation!)...M. A. Jiminez Cortez & J. Brooke

WG3 → LIAISE-Hydro : Ebro basin-scale multi-year land surface/hydrological modeling (J. Pocher)

GEWEX support ? Larger community-wide participation...

→ Follow-on... ?

Workshop Objectives:

- Give updates of ongoing research
- Present & discuss plans for future projects, notably within GEWEX
- Discuss next steps for Wgs, continued collaboration

Meeting Logistics :

- meet here, posters at back of the room
- buffet style lunch provided
- remote link :
- wifi : sign up as a guest, then receive a pwd
- Cocktail tonight at 6pm here at the CIC