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Surface-atmosphere interactions from LIAISE: modelling framework for SCM & LES intercomparison

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LIAISE

WCRP World Climate Research Programme

Global Energy and Water Cycle Experiment GEWEX WCRP

Met Office LMD IRTA RESEARCH & TECHNOLOGY FOOD & AGRICULTURE

HyMeX HYdrological cycle in Mediterranean EXperiment

SAFIRE

observatori de l'Ebre

meteo.cat Servei Meteorològic de Catalunya

METEO FRANCE

cnrs

UIB Universitat de les Illes Balears

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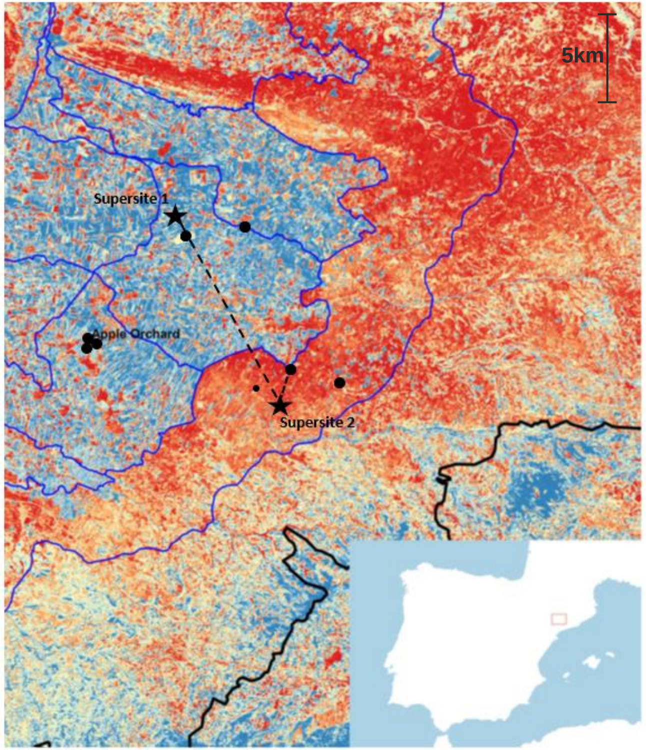
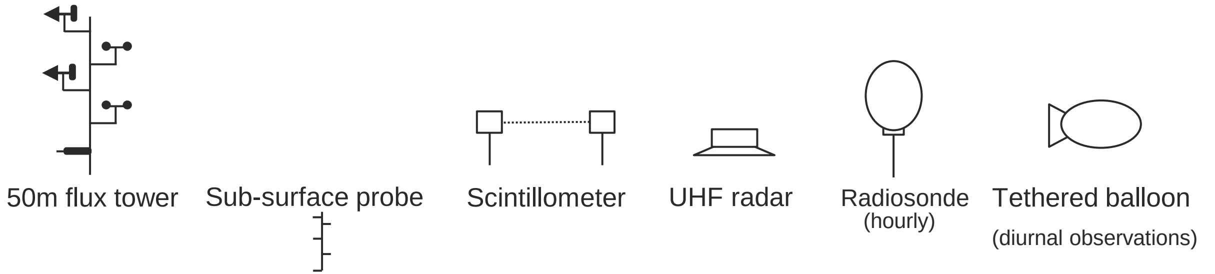
LIAISE Special Observing Periods (SOP)



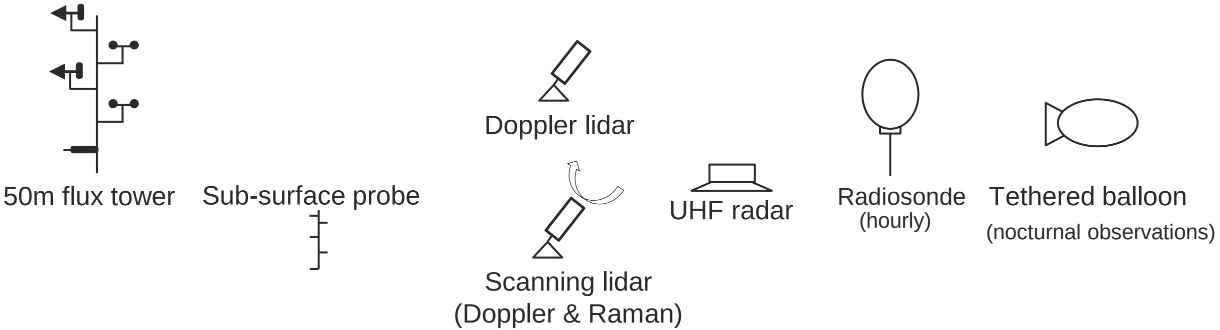
SENTINEL2 Land Surface temperature - Courtesy : H. Nieto, IRTA

Co-ordinated and co-located observations between irrigated and natural areas: surface & sub-surface measurements, remote sensing platforms, and boundary layer.

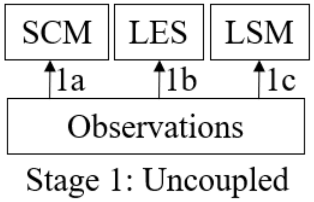
Supersite 1: Irrigated site (La Cendrosa) (CNRM/Meteo France)



Supersite 2: Natural site (Els Plans) (UKMO)



SCM & LES Intercomparison Framework

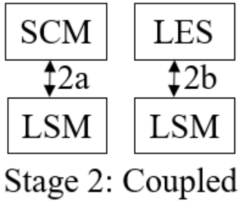


Stage 1 Uncoupled The individual components are assessed in isolation, driven and evaluated against observational data.

1a Uncoupled SCM (Single Column Model)
NWP models to be run in single-column (SCM) mode. The boundary layer process is primarily driven by the observed surface fluxes and initialised with radiosonde observations. The large-scale advective forcing terms will be derived from radiosonde observations and/or ERA5.

1b Uncoupled LES (Large Eddy Simulation)
The boundary layer process is primarily driven by the observed surface fluxes; sensible heat flux and latent heat flux and initialised with radiosonde observations. The large-scale advective forcing terms will be derived from radiosonde observations and/or ERA5.

1c Uncoupled LSM (Land Surface Model)
Land surface processes driven with the observed meteorological states. The surface schemes will be evaluated against the turbulent heat fluxes, moisture fluxes, and momentum fluxes.



Stage 2 Coupled The impact of coupling component models is investigated.

2a Coupled LSM-SCM
Coupling with interactive land surface capabilities.

2b Coupled LSM-LES
Coupling with interactive land surface capabilities.

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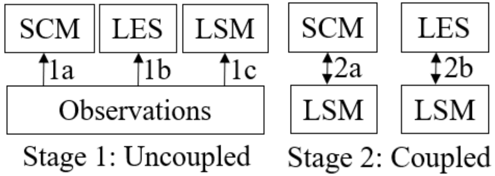
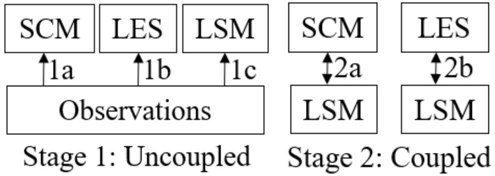
SCM & LES Intercomparison Framework

Supersite 1: Irrigated site (La Cendrosa) (CNRM/Meteo France)



Supersite 2: Natural site (Els Plans) (UKMO)



LIAISE SCM&LES modeling intercomparison protocol extends on the previous DICE project conducted under a joint activity within the Global Land Atmosphere System Study (GLASS) and Global Atmospheric System Studies (GASS) projects.

Present LIAISE modeling protocol with the aim to obtain early engagement with the international land surface and boundary layer communities.

Research Questions:

How well can SCM & LES models simulate the boundary layer evolution for irrigated and dry surfaces?

Can we understand land-surface/atmosphere interactions?

Assess the model error contribution:

1) errors in surface fluxes
2) errors in the boundary layer parameterization due to errors in the vertical distribution of heat and moisture

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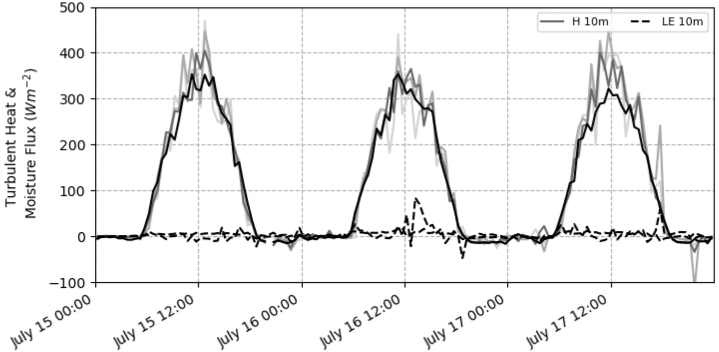
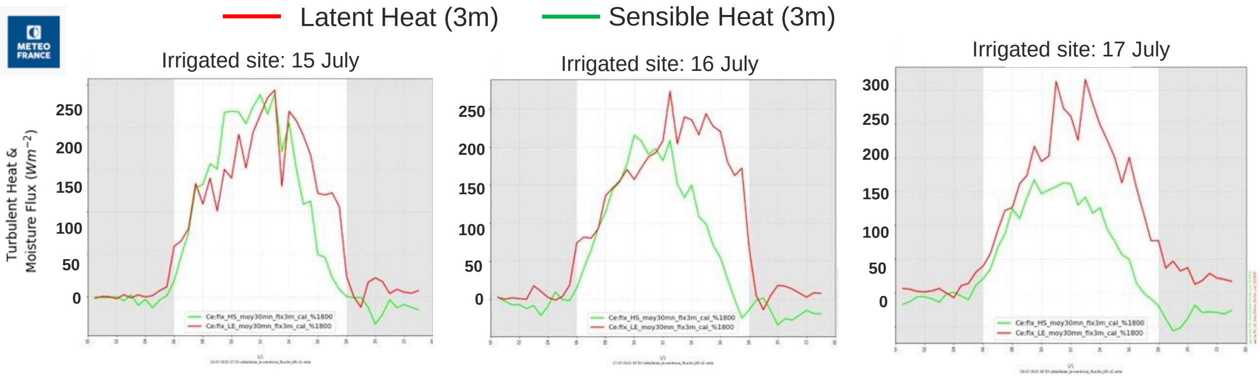
Surface fluxes: natural/rain-fed vs irrigated

Natural/rain-fed site



Irrigated site



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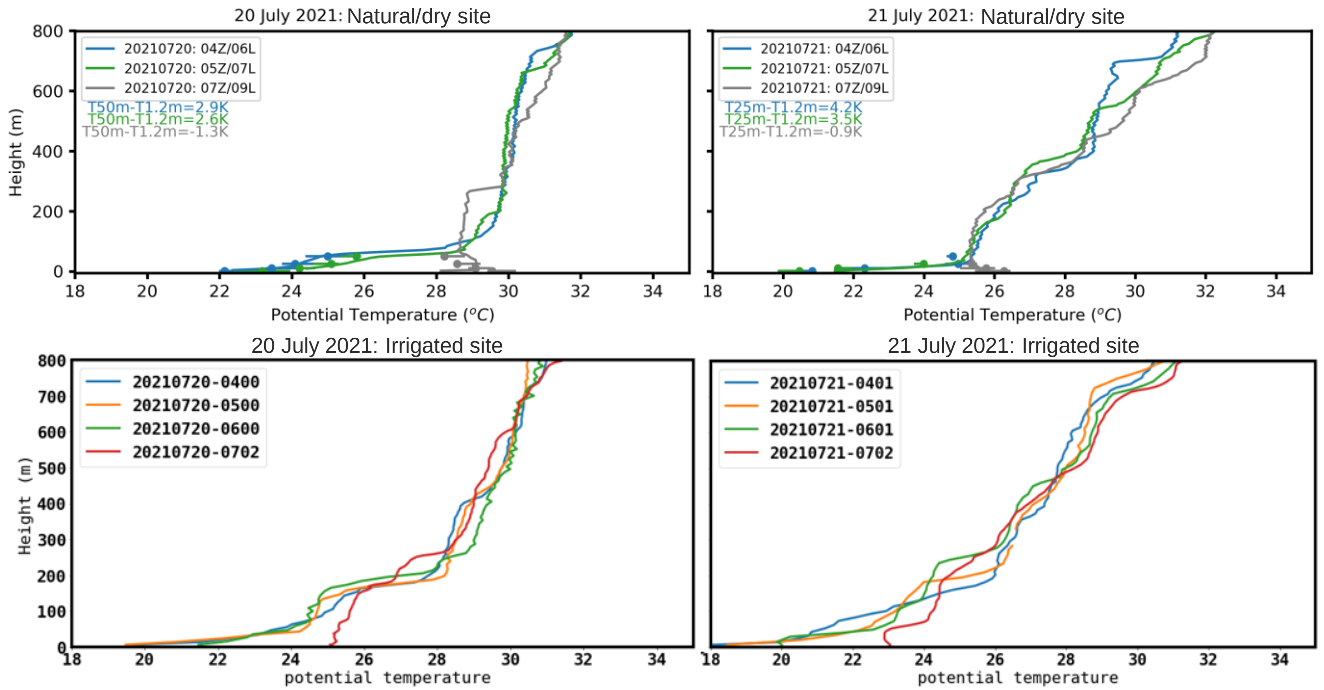
Irrigation impact on the morning transition

Potential temperature profiles at sunrise(06L), flux crossover (07L) & convective onset (09L)

Dry site (Els Plans): shallower SBL, stronger surface inversion, marginally less wind shear (not shown) which drives less mixing at the surface, and allows for a stronger surface radiation inversion to develop.
Role of nocturnal radiative cooling to be investigated.



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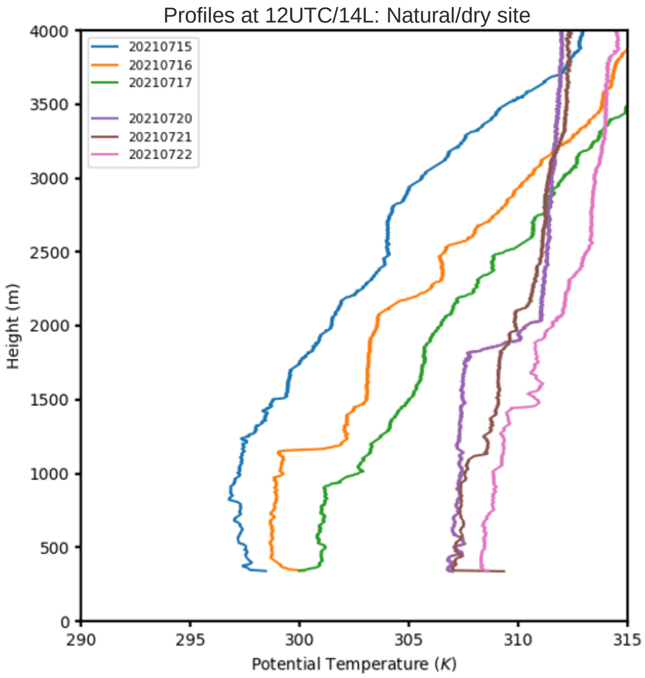
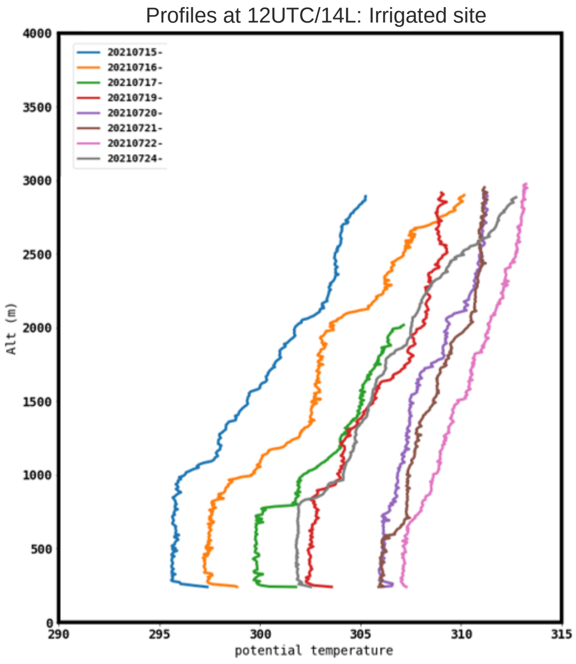
Irrigation impact on PBL growth

Warming conditions throughout SOP associated with developing anticyclonic conditions and deepening thermal low.
Warmer mixed layer, deeper PBL at dry site (Els Plans).
Inversion strength tends to be greater at dry site (Els Plans) e.g. 16 July / 20 July.





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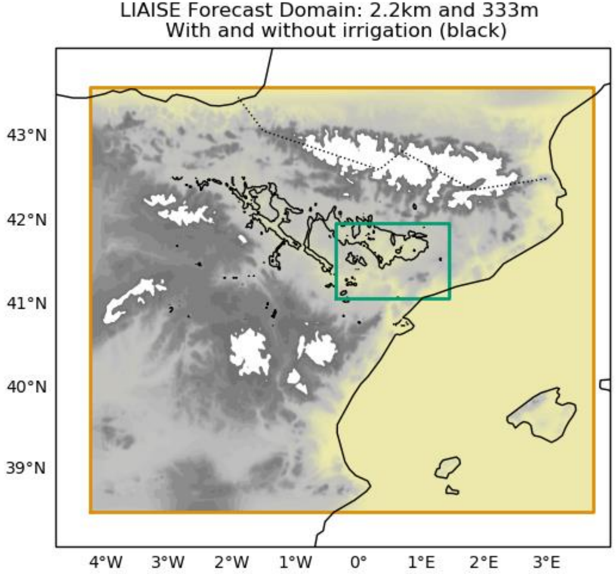
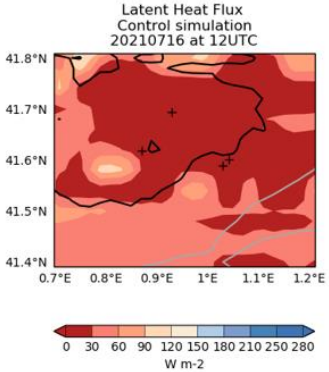
Regional simulations: Unified Model (UM)

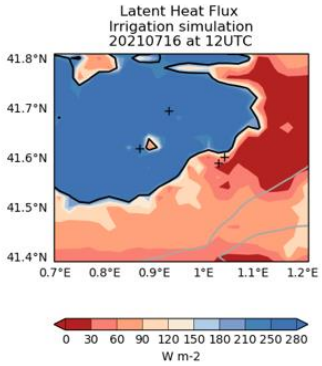
Irrigation in the UM vn12.0 see Heather Rumbold presentation

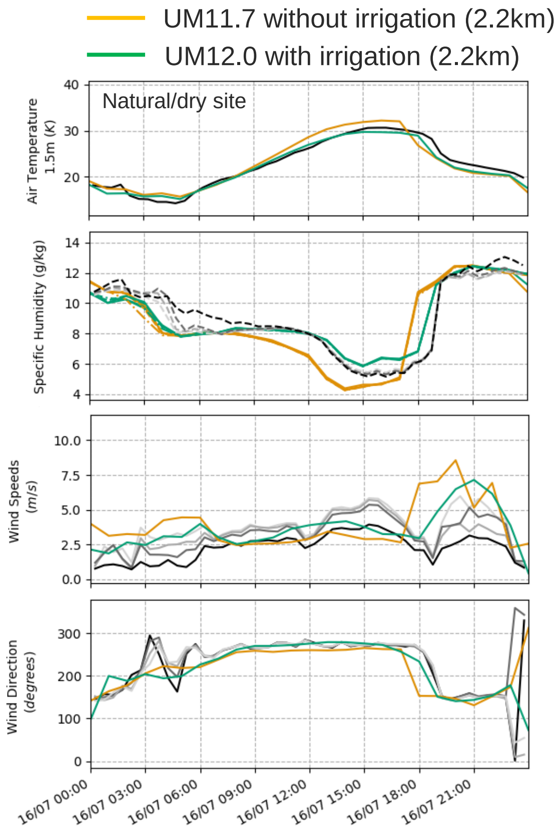
Running daily 2.2km forecasts June 21–July 22
-> plan April 22-July 22 with & without irrigation

Running daily 333m forecasts for SOP (July 21)
-> with & without irrigation









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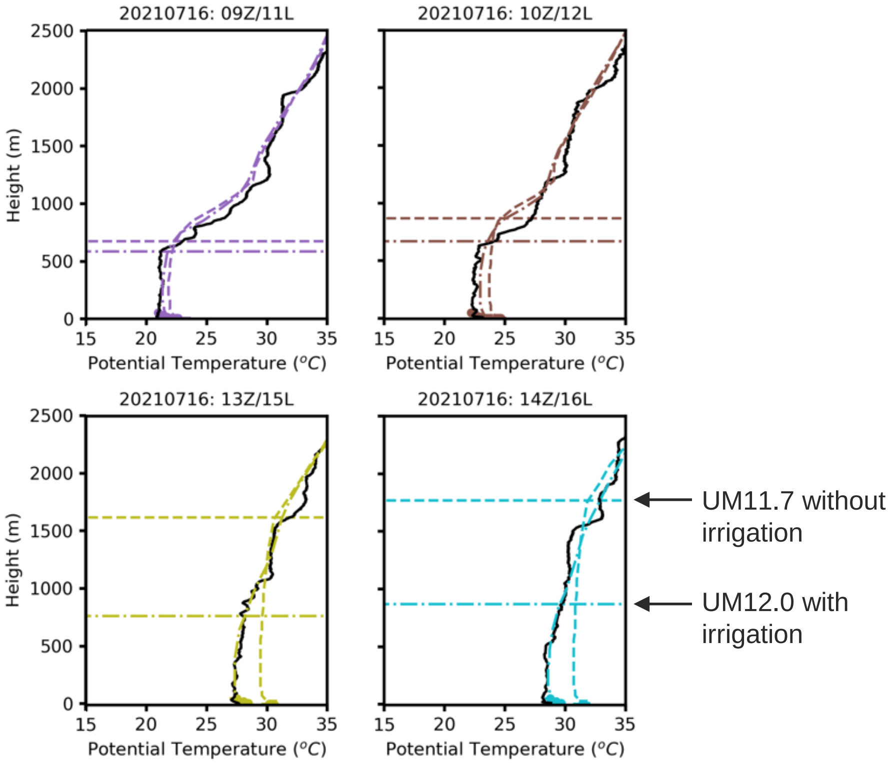
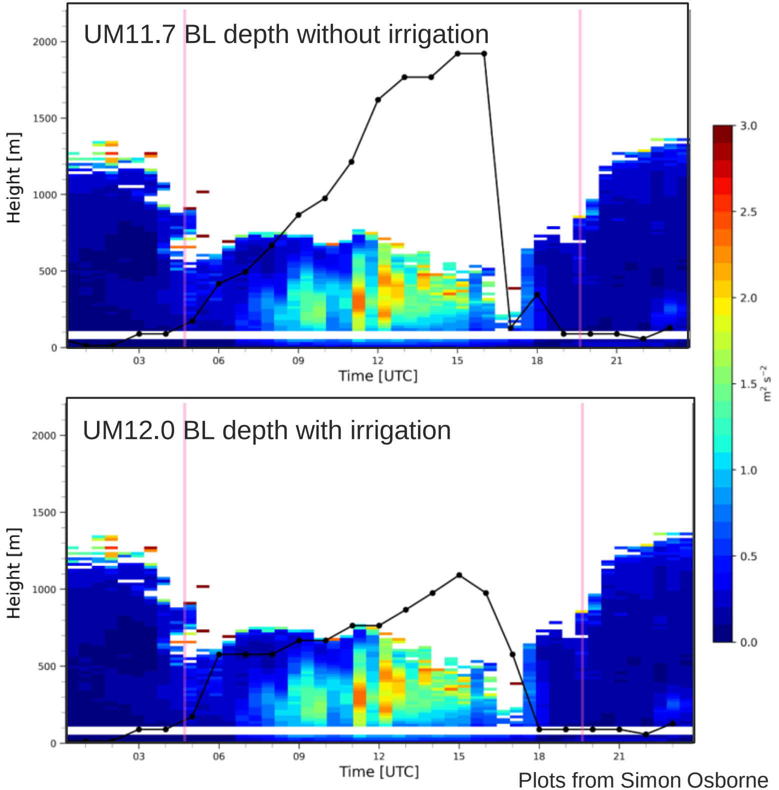
Modelling irrigation impact on PBL growth

-> Improvements in forecast performance (T & PBL depth) downwind of irrigated region.

Potential temperature: Natural/dry site



Observed vertical velocity (Doppler Lidar)



Plots from Simon Osborne

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Conclusions & Future Plans

Co-ordinated and co-located observations between irrigated and natural areas during LIAISE: surface & sub-surface measurements, remote sensing platforms, and boundary layer.

A series of community modelling experiments will be designed as part of the GEWEX (Global Energy and Water cycle Exchanges) activities. LIAISE SCM&LES modeling intercomparison protocol presented.

Morning transition at the natural/rain-fed site showed shallower, more stable near-surface profiles at sunrise/crossover. At convective onset, the temperature profile shows a warmer mixed layer, and deeper BL depth. At 12UTC, the inversion strength tends to be greater at dry site (Els Plans).

Representation of irrigation at UM vn12.0 leads to improvements in forecast performance (T, q, winds, BL depth) even at the natural/rain-fed site. Availability of observations from partners will extend the evaluation at the irrigated site and larger scale region.

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Thank you for your attention.

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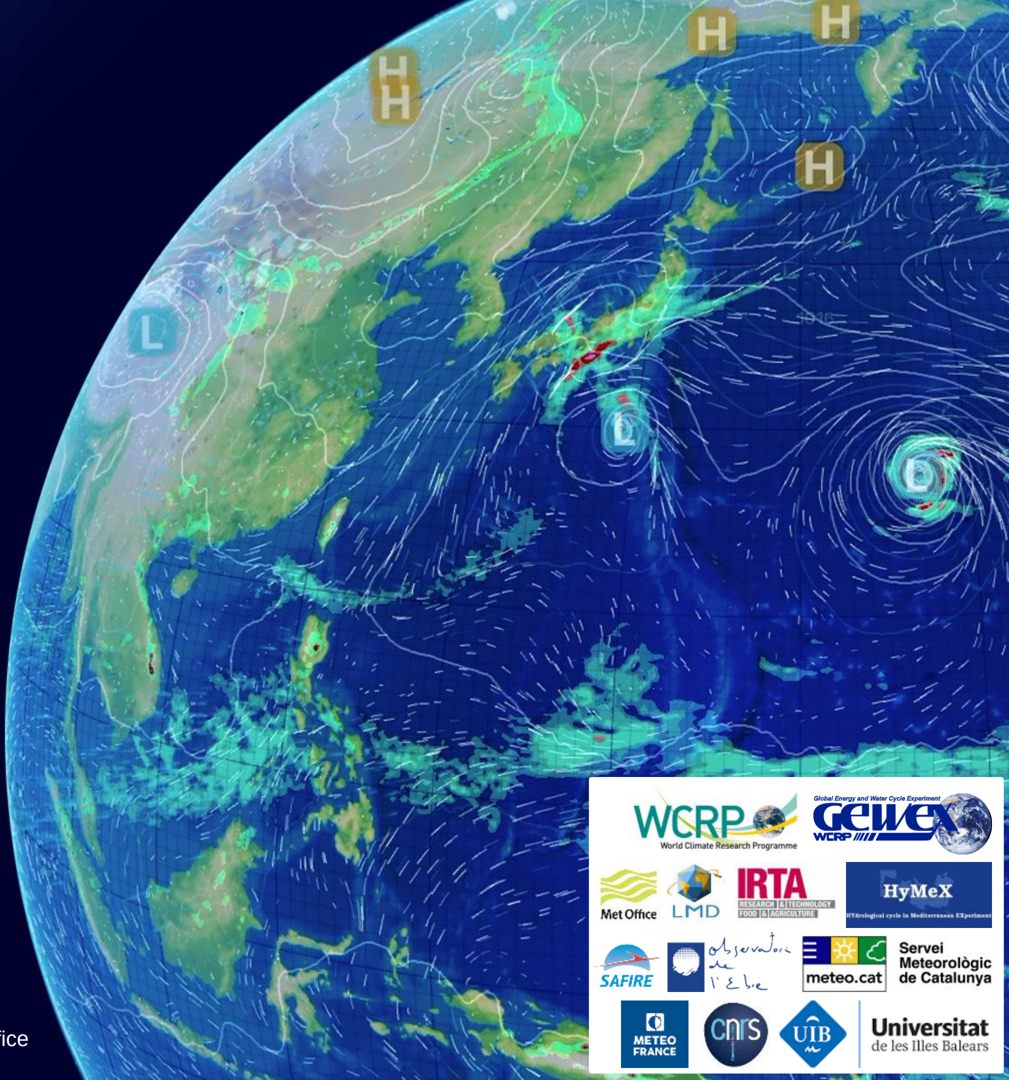

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