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Land-surface and boundary-layer evolution and the associated modelling framework from the LIAISE campaign.

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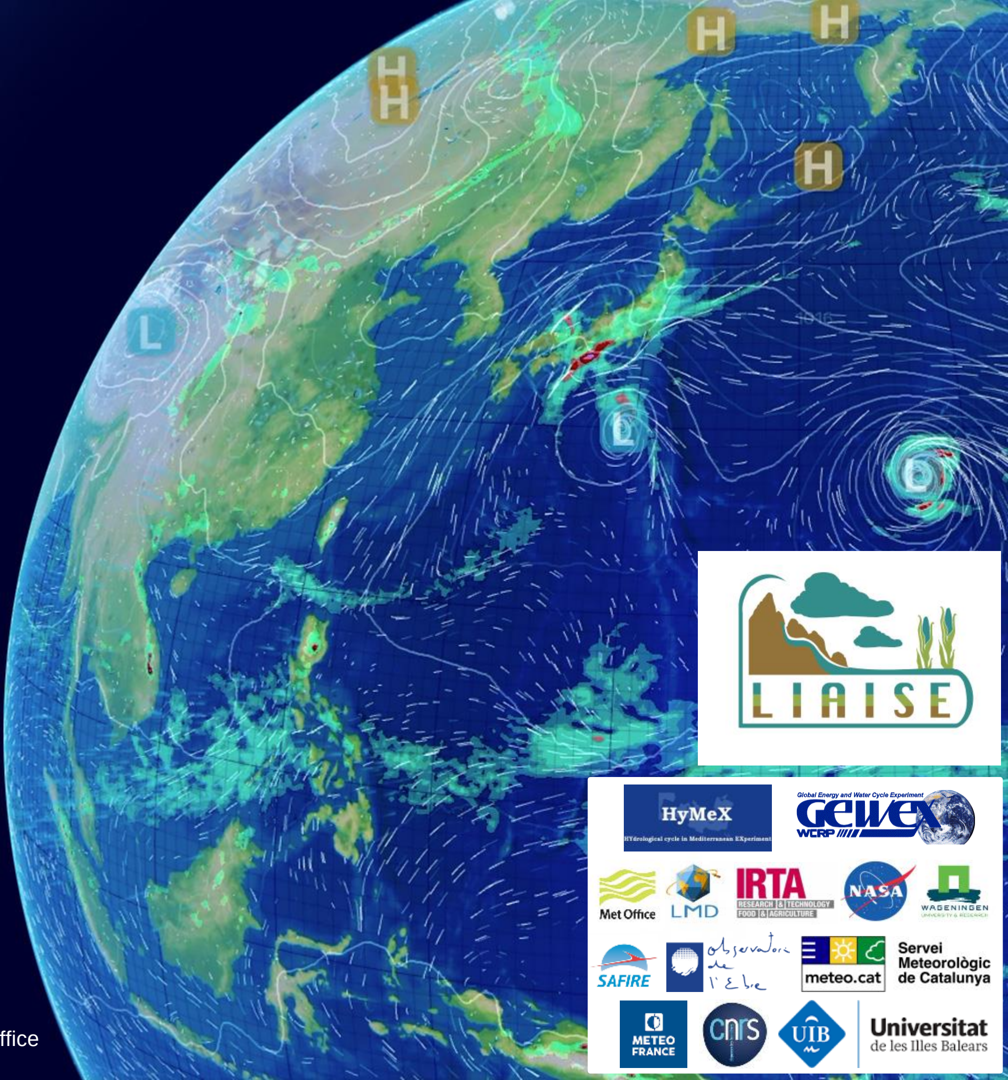

LIAISE: Land surface Interactions with the Atmosphere over the Iberian Semi-arid Environment

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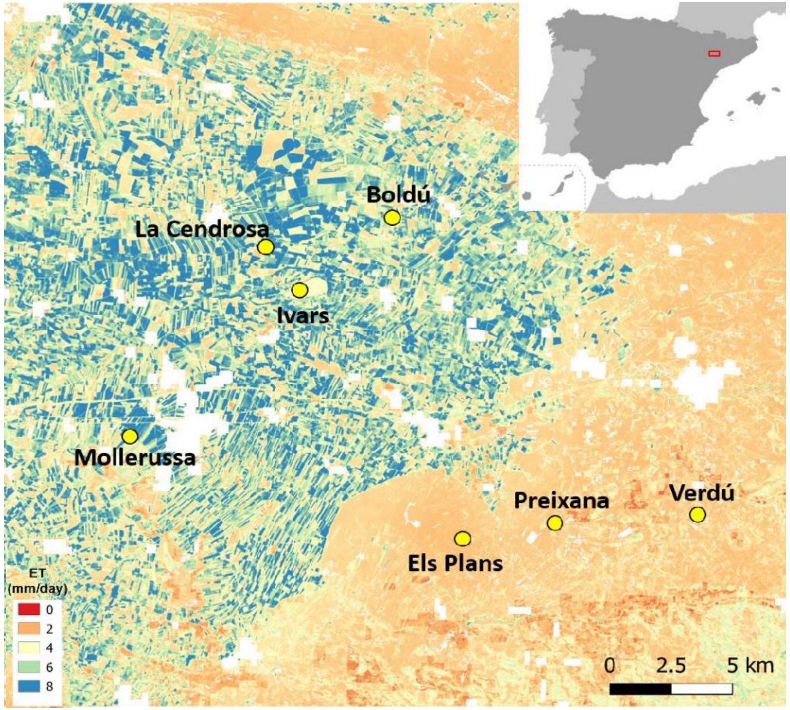


Crop evapotranspiration (17 July 2021) from Two-Source Energy Balance (TSEB) model using Sentinel-2 and Sentinel-3. Prepared by IRTA (J. Bellvert).

LIAISE is an international observational field campaign located in the Ebro river basin, Catalonia (north-east Spain) & associated modelling program.

‘Impact of human activity on the water cycle in terms of land-atmosphere-hydrology interactions in a semi-arid environment’

Co-located long term surface observations (6-18 months, site dependent)

- ★ Two super-sites with 50m masts
- ● Eddy-covariance flux stations (7 locations)
- Heterogeneous land cover
- Irrigated and natural sites

Special Observing Period (SOP) 2021

- 2 weeks during July 2021.
- Maximum irrigation/natural contrasts.

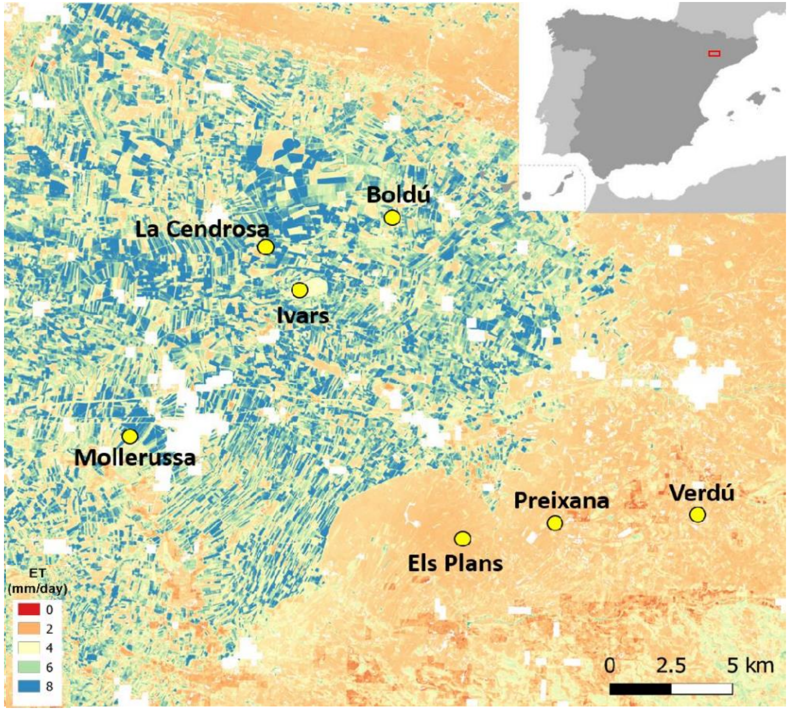
Research aircraft

- NASA King Air (SLAP soil moisture)
- SAFIRE ATR-42 (turbulence, GLORI soil moisture)

Spring Special Observing Period (SOP) 2022

- Start of the soil moisture dry-down (Els Plans)
- Stable boundary layer experiment (Els Plans)

LIAISE Special Observing Periods (SOP)



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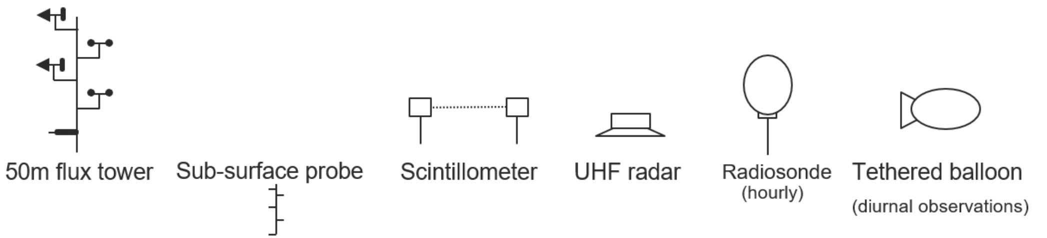
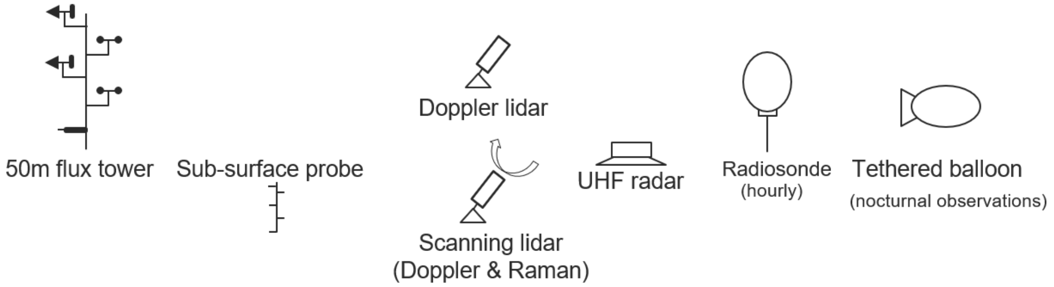
Co-ordinated and co-located observations between irrigated and natural areas: surface & sub-surface measurements, remote sensing platforms, and boundary layer.

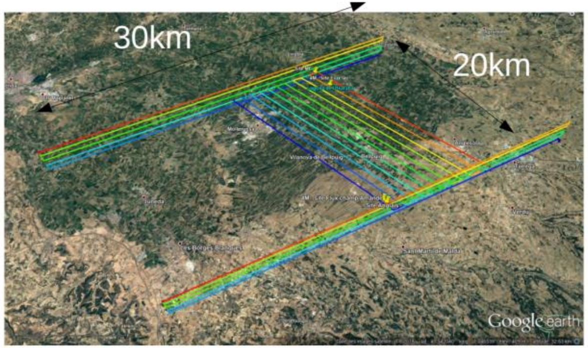
Supersite 1: Irrigated site (La Cendrosa)



Supersite 2: Natural site (Els Plans)

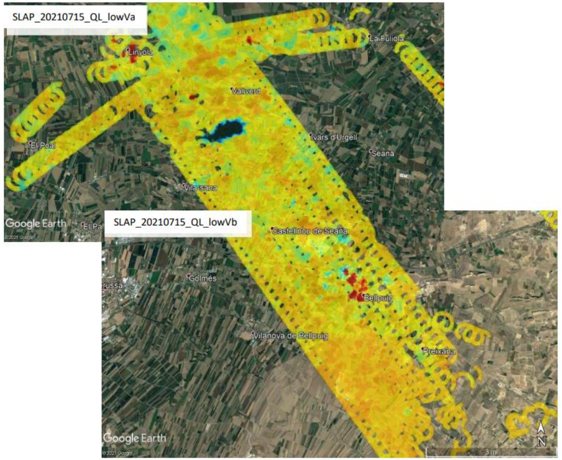


LIAISE Special Observing Periods



SAFIRE flight-track. Image credit: Marie Lothon, SAFIRE

NASA SLAP soil moisture. Image credit: Ed Kim/Albert Wu



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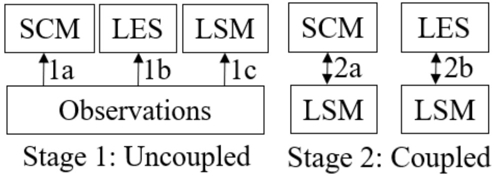
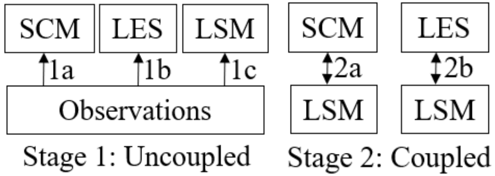
SCM & LES Intercomparison Framework

LIAISE

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:

What is the impact of surface fluxes (dry & irrigated) on the boundary layer evolution?

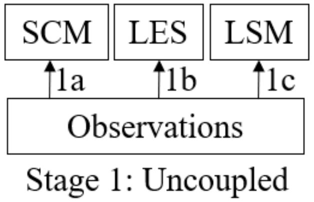
How well can SCM&LES models simulate the boundary layer evolution for irrigated and dry surfaces?

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

SCM & LES Intercomparison Framework

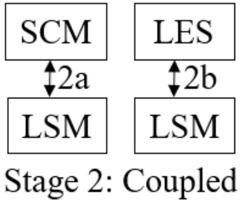


Stage 1 Uncoupled The individual components are assessed in isolation, driven and evaluated against observational data.

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.

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.

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.



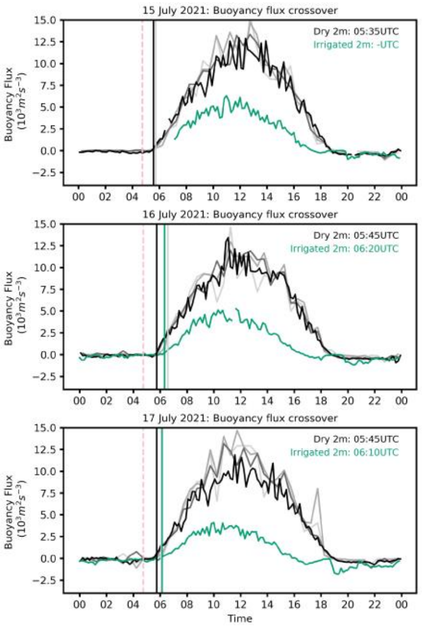
Stage 2 Coupled The impact of coupling component models is investigated.

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

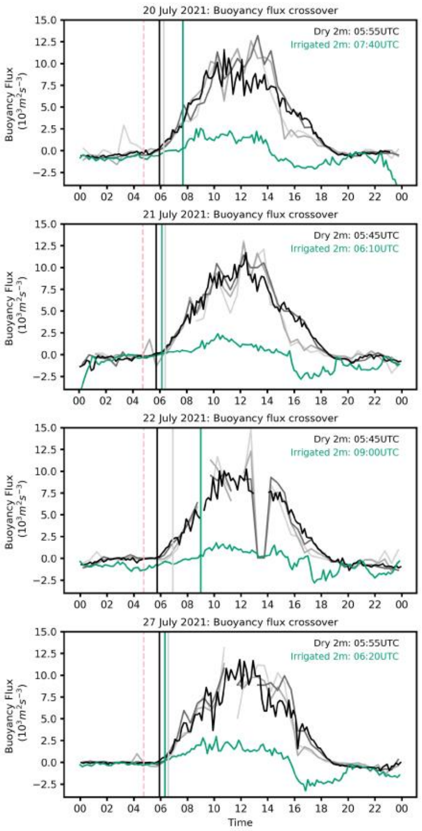
2b Coupled LSM-LES
Coupling with interactive land surface capabilities.

Buoyancy fluxes: natural/rain-fed vs irrigated

Westerly flow IOPs



Anticyclonic IOPs



Westerly flow IOPs & short irrigated canopy:

Buoyancy flux x2 magnitude (4.3 $m^2 s^{-3}$ vs 10.1 $m^2 s^{-3}$)

Natural site flux cross-over: T+55min (after sunrise)

Irrigated site flux cross-over: T+90min (after sunrise)

Anticyclonic IOPs & taller irrigated canopy:

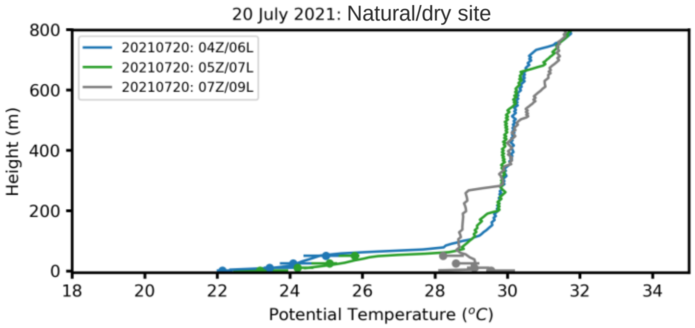
Buoyancy flux x5 magnitude (1.6 $m^2 s^{-3}$ vs 8.9 $m^2 s^{-3}$)

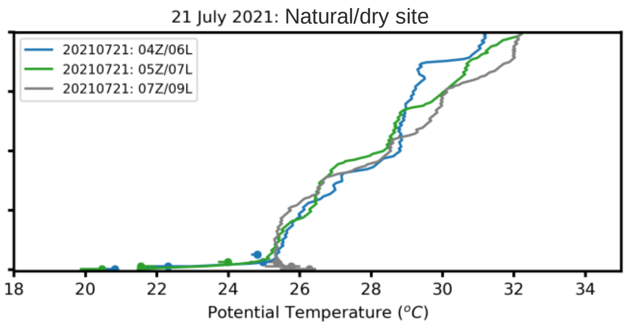
Natural site flux cross-over: T+60min (after sunrise)

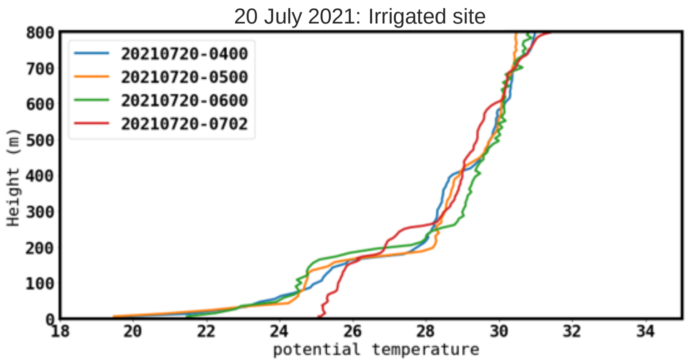
Irrigated site flux cross-over: T+140min (after sunrise)

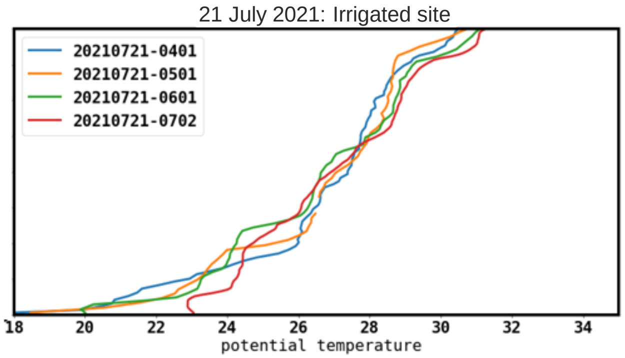
Irrigation impact on the morning transition

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



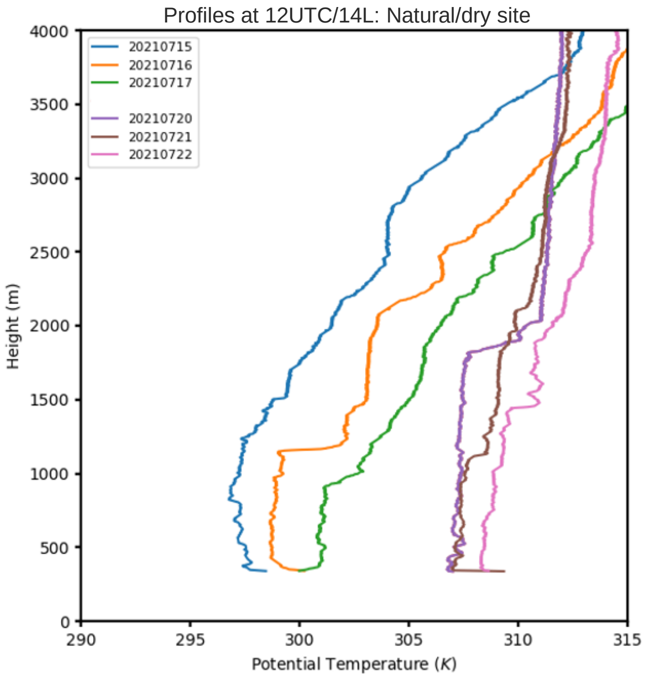


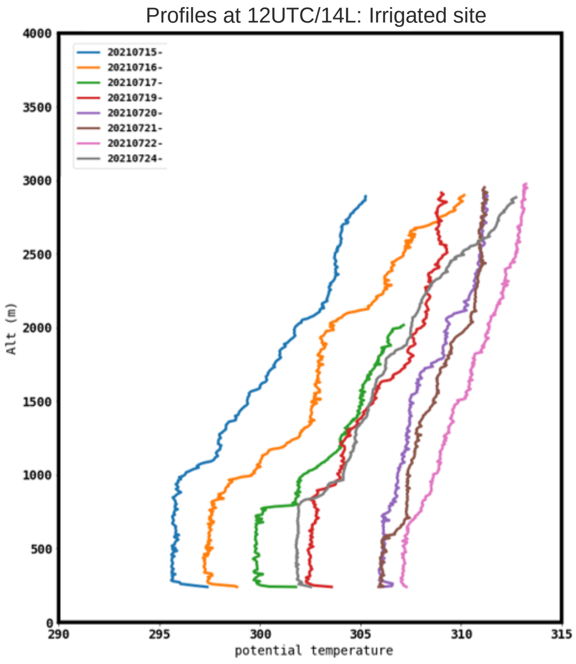




Irrigation impact on PBL growth

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.





Conclusions & Future Plans

LIAISE is an international observational field campaign to better understand the impact of human activity on the water cycle in terms of land-atmosphere-hydrology interactions in a semi-arid environment.

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

Irrigation leads to significant contrasts in surface and boundary layer evolution.

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.

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Thank you for your attention.

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