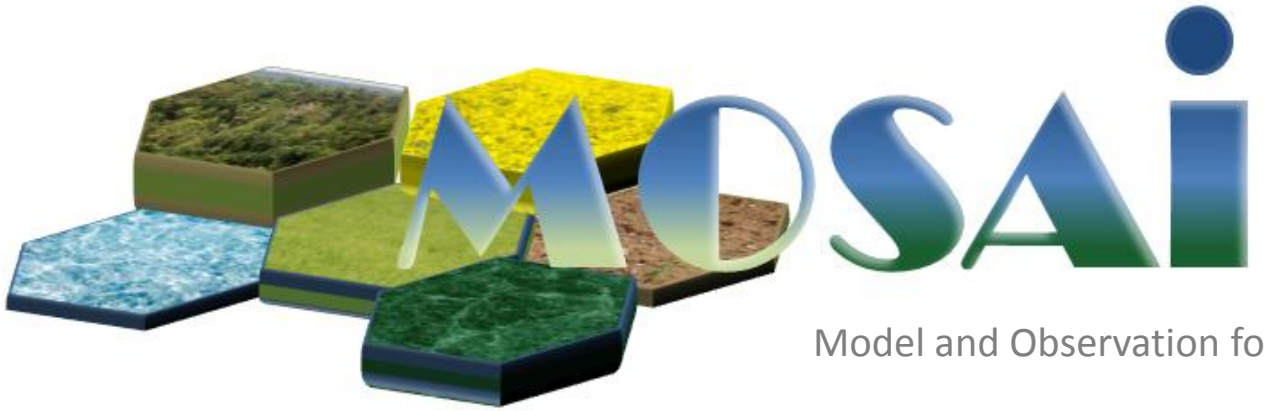


Model and Observation for Surface Atmosphere Interactions

Measure and simulate turbulent fluxes over heterogeneous surface: MOSAI

- PROJET FINANCÉ PAR L'ANR - PROJECT FUNDED BY THE ANR
ANR

Fabienne Lohou

LOTHON M., BASTIN S., BRUT A., CANUT G., CHERUY F., COHARD J.-M., COUVREUX F., DARROZES J., DUPONT J.-C., FERNANDEZ R., JOME M., LAFONT S., ROEHRIG R., ROMÁN-CASCÓN C., ZOUZOUA M., and MOSAI team

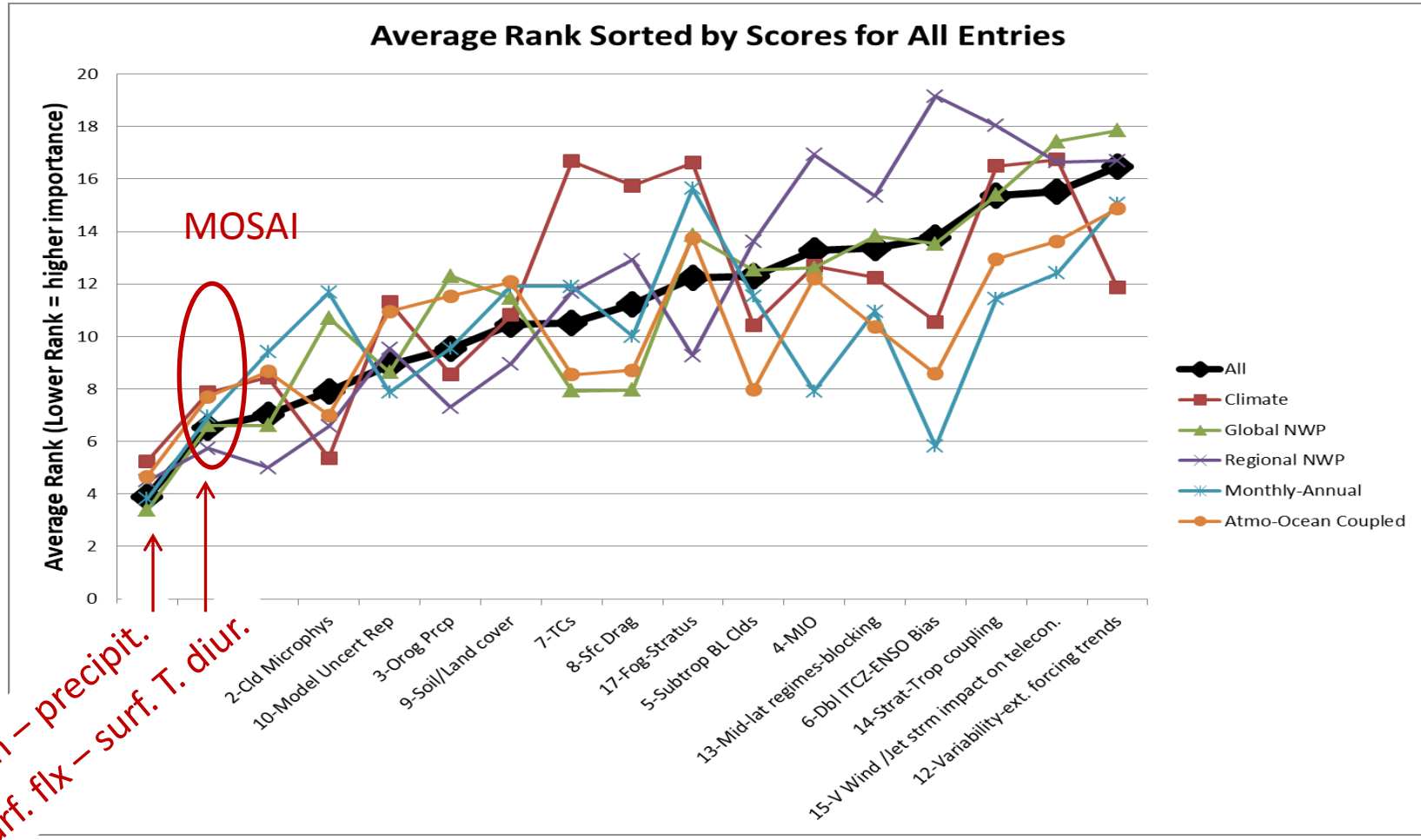
LMD IGE CNRM CESBIO LATMOS

+ INRAE
+ UiB

GET Laero Laboratoire d'Aérologie

Motivations

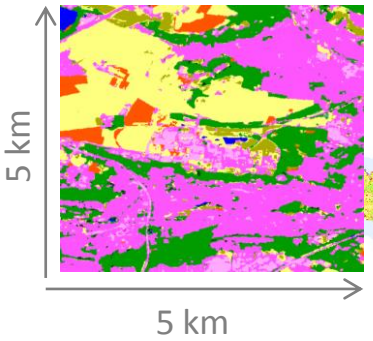
Working Group on Numerical Experimentation (Fev. 2019)



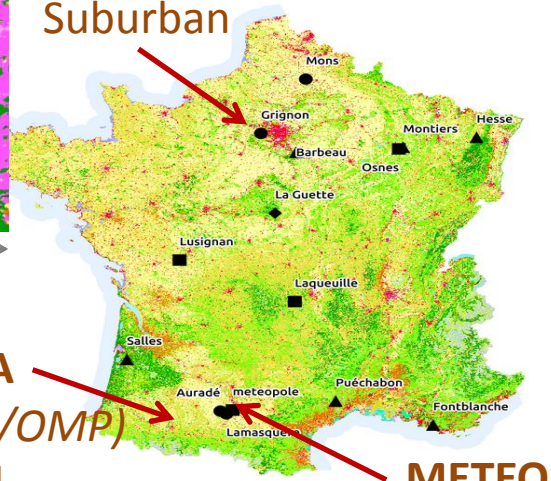
Motivations

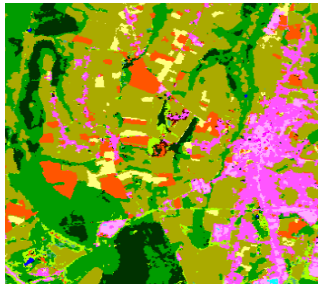
Land use map
(Sentinel-2)

- Urban
- Forest
- Grass
- Crops



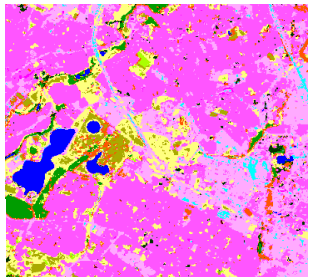
SIRTA *(IPSL)*
Suburban





P2OA
(UT3/OMP)
Rural

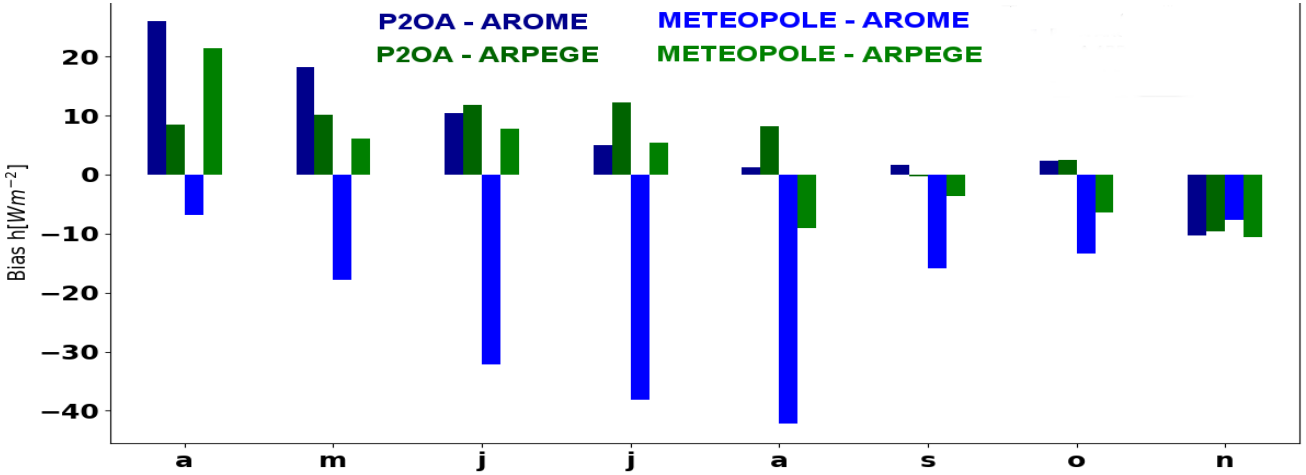
METEOPOLE-FLUX
Urban



ACTRiS FRANCE

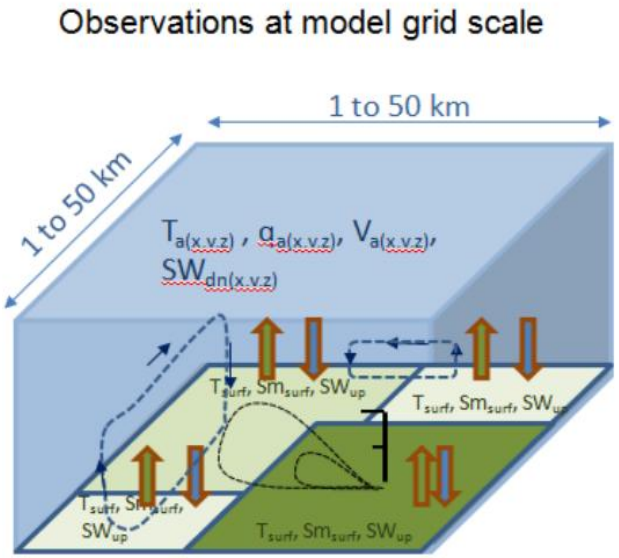
ICOS Integrated Carbon Observation System

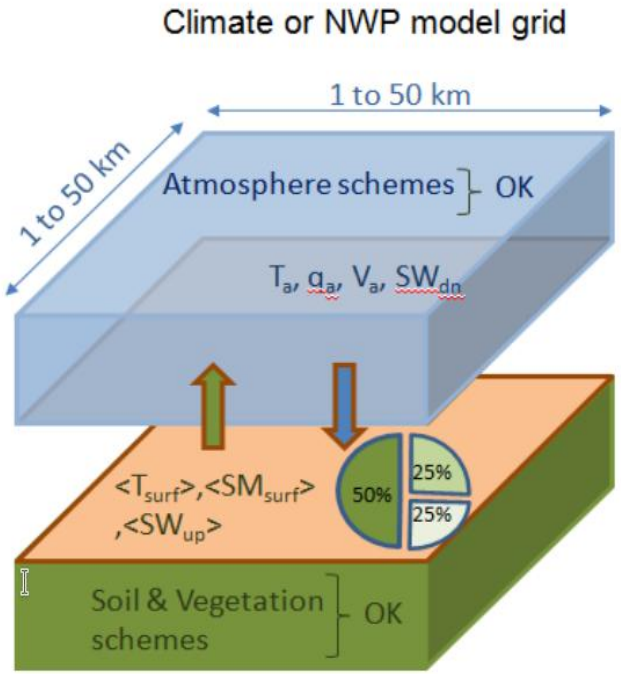
Monthly Bias (Model – Observations) for sensible heat flux



©Guylaine Canut, CNRM

MOSAI Objectives





WP1: uncertainty and horizontal representativeness of L-A exchanges measured over heterogeneous landscape

***WP3:* Improvement of the L-A models coupling**

***WP2:* Model evaluation using long-term measurements**

Outline

- Motivations
- Objectives
- Strategy
- 2023 field experiment
- Some ongoing works for each objective
  - O1: Representativity
  - O2: New methods for model evaluation
  - O3: Improving surface/atmosphere coupling

MOSAI Strategy

Permanent Observations
~ 10 years

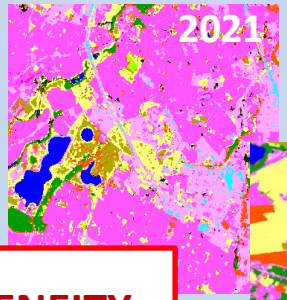
ACTRiS

ICOS Integrated Carbon Observation System

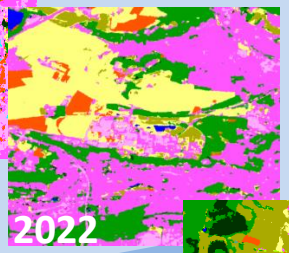
SURFACE HETEROGENEITY

Enhanced Observations
~ 1 year

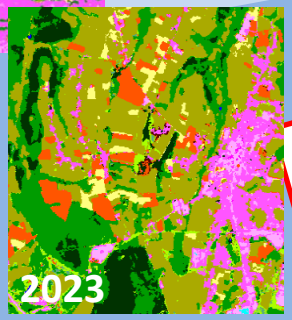
Metepole: urban



SIRTA: sub-urban



P2OA: rural

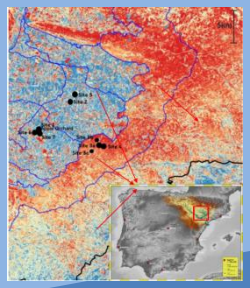


P2OA SOP

Roughness Transition

Intensive Observations

LIAISE
2021



VERTICAL STRUCTURE

Numerical Models

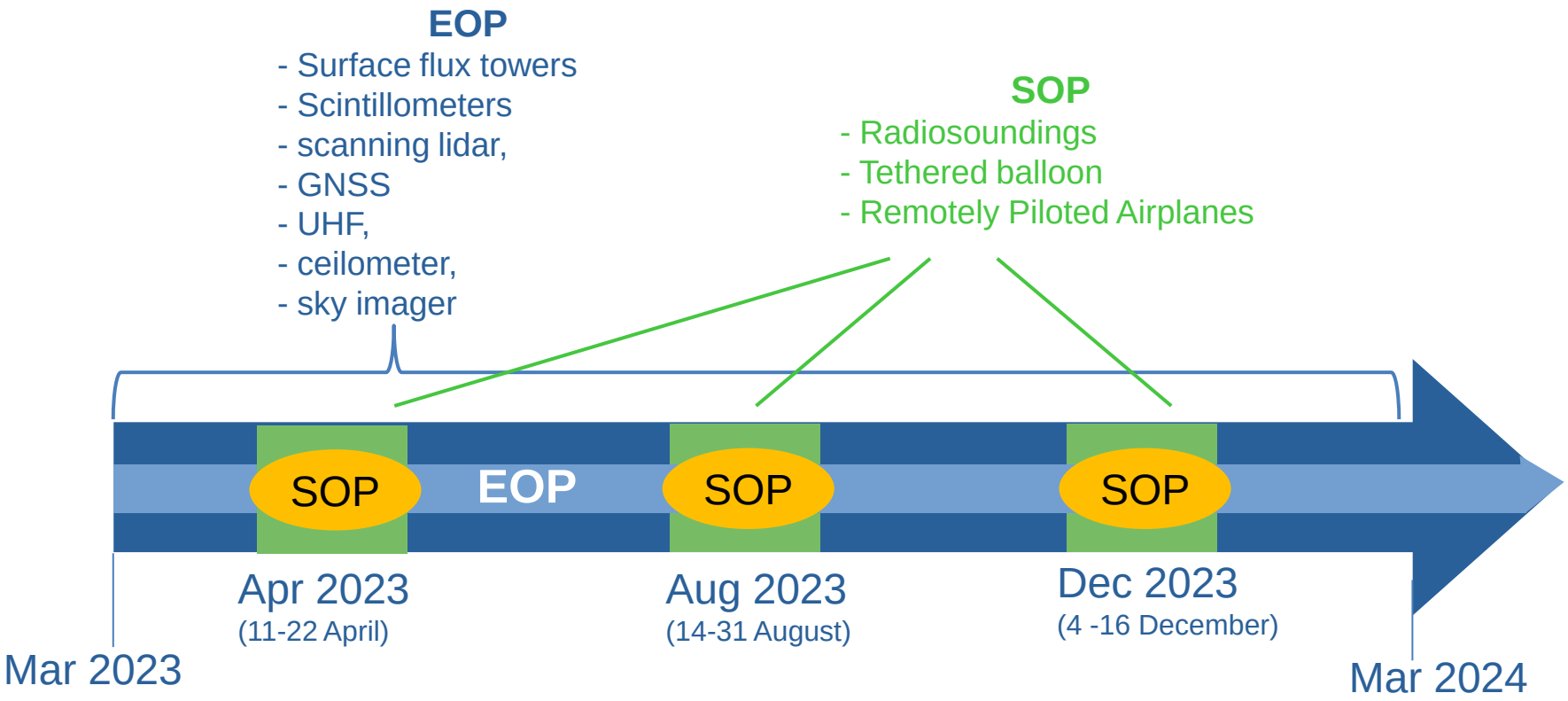
Méso-NH/ SURFEX ; LES
WRF / ORCHIDEE; Régional
AROME / SURFEX; Regional

ARPEGE / SURFEX; Cimate
LMDZ / ORCHIDEE; Climate
DYNAMICO / ORCHIDEE; Climate

Field campaign at P2OA

Main objective :

- Characterize the representativity of the P2OA 60 m tower relatively to the heterogeneous landscape
- Document the vertical structure
- Investigate the impact of a roughness transition

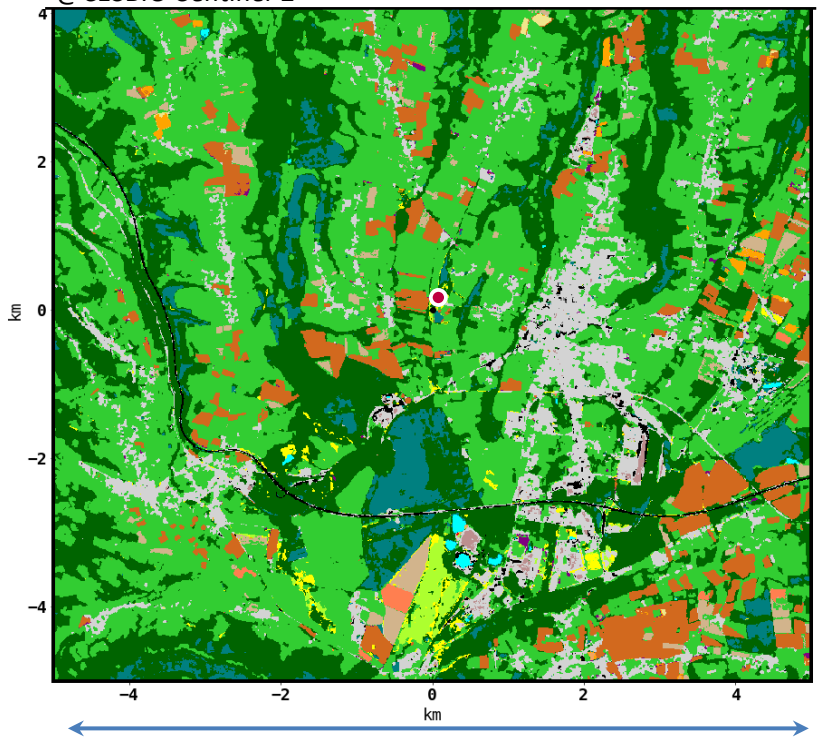


P2OA EOP: Surface heterogeneity

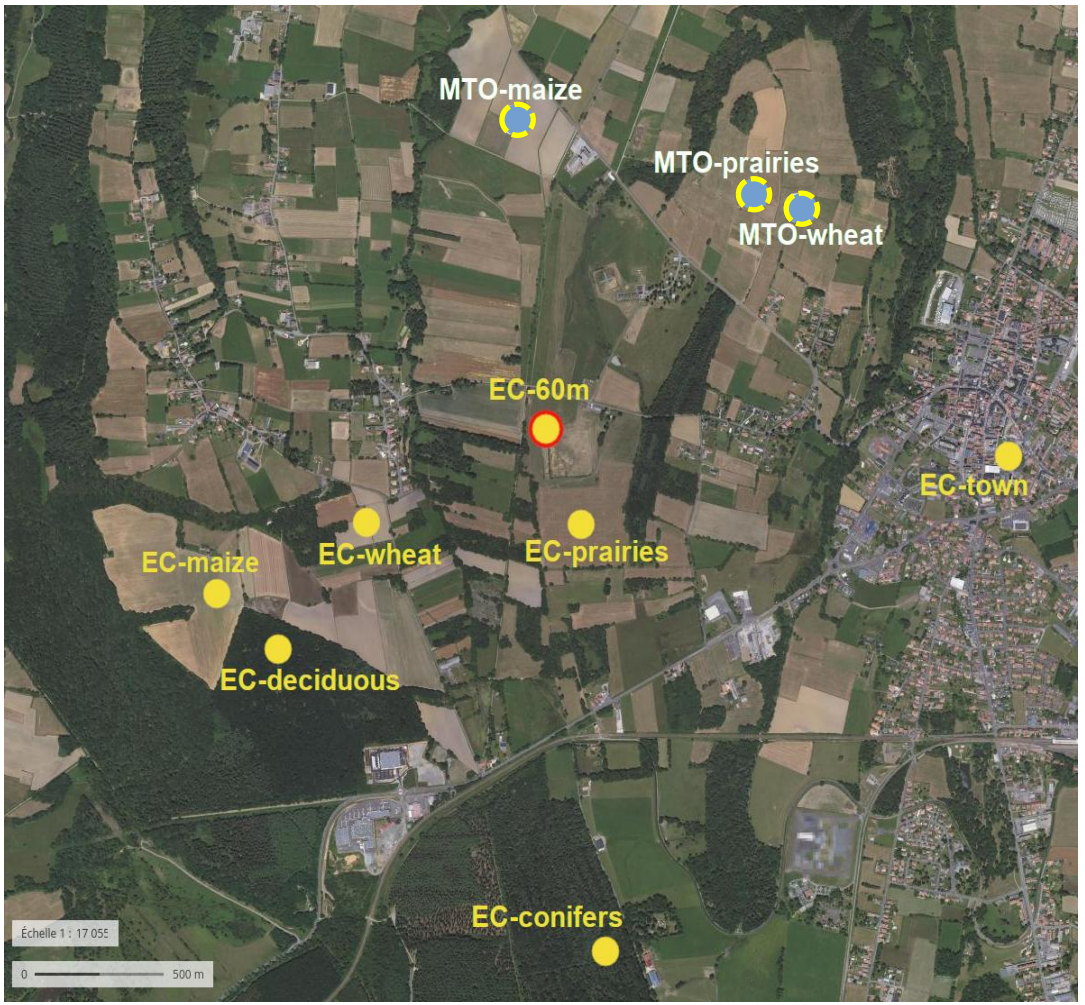
Deployment of flux stations:

- Prairies
- Deciduous forest
- Summer crops
- Urban in Lannemezan
- Winter crops
- Conifer forest / mixt forest

@CESBIO-Sentinel-2



10 km



4 km

MTO station → Flux estimates: see presentation Jomé et al

P2OA EOP: Surface heterogeneity

Deployment of flux stations:

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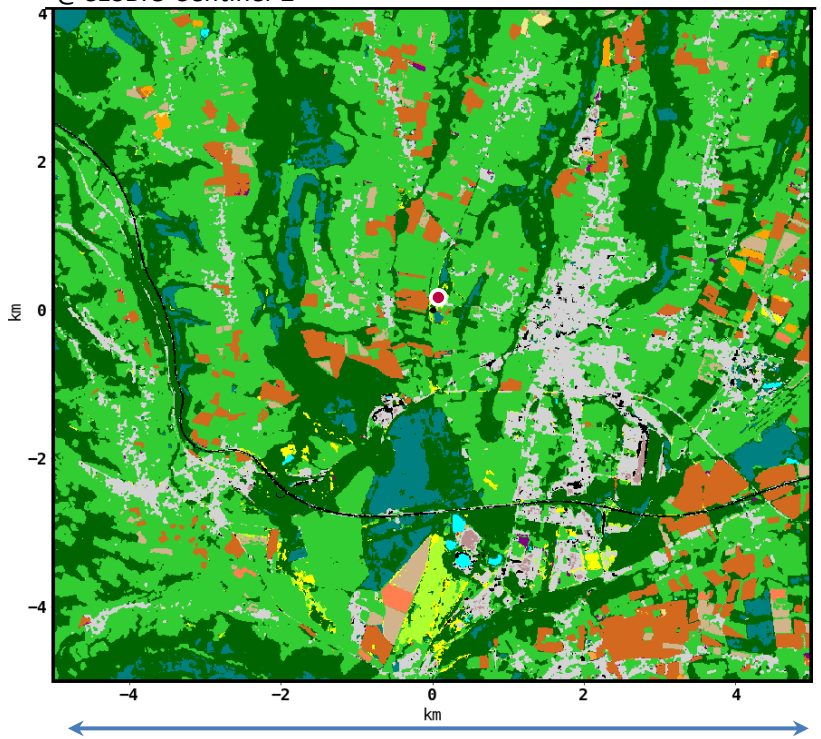
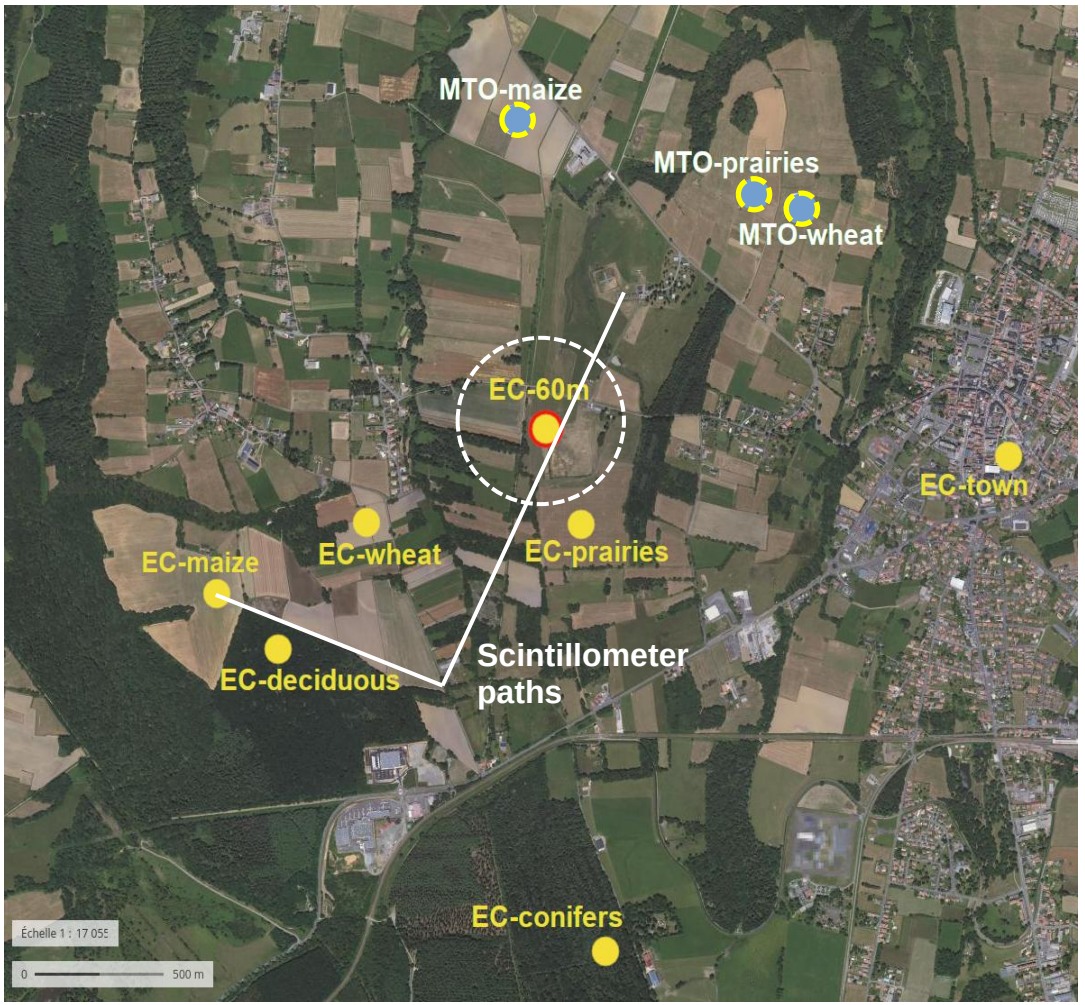
@CESBIO-Sentinel-2

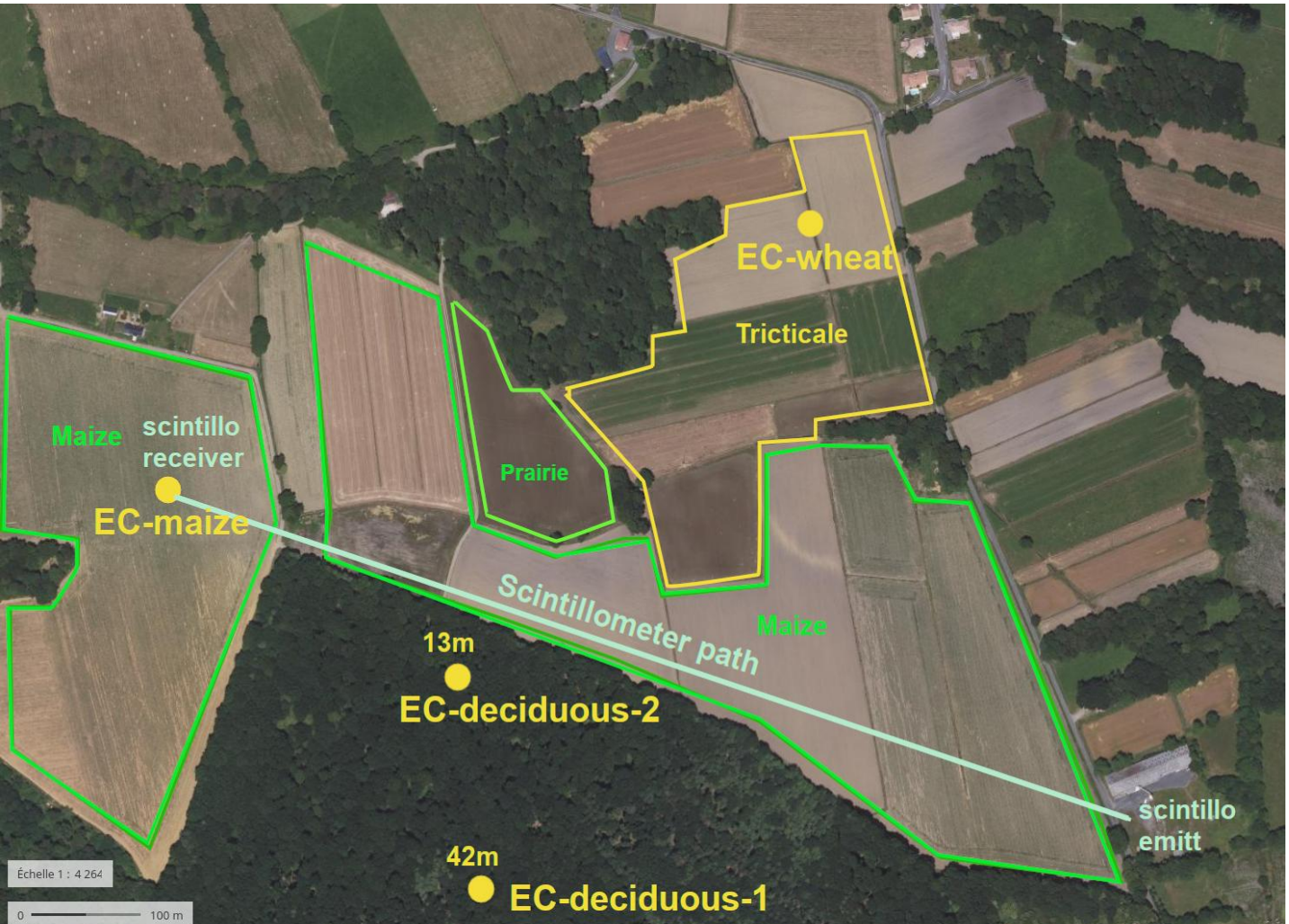


10 km



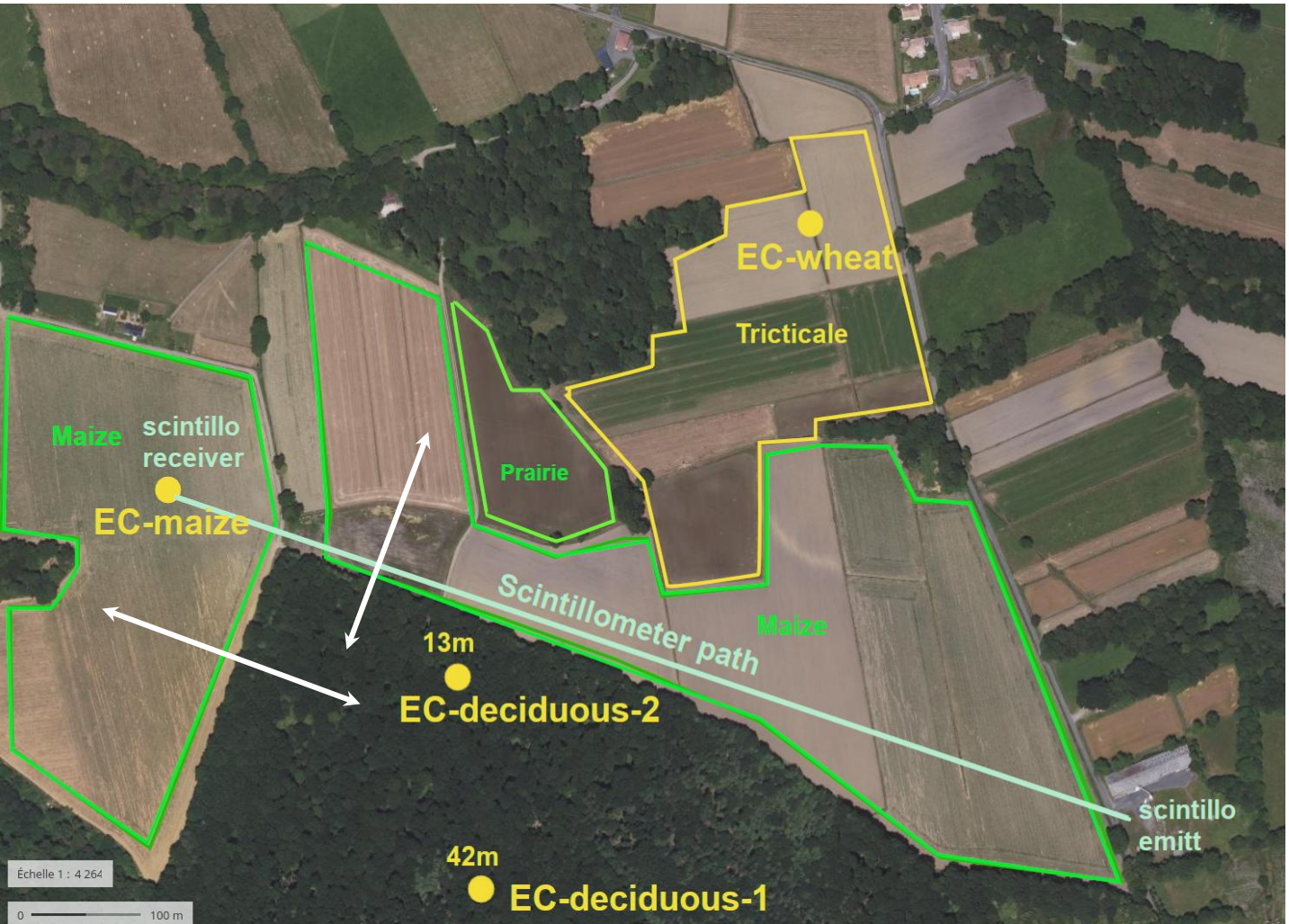
4 km

P2OA EOP: Exploring a specific transition



P2OA EOP: Exploring a specific transition

-Vertical structure across the transition
- Impact on fluxes and influence of atmospheric structures within canopees
- Effective roughness



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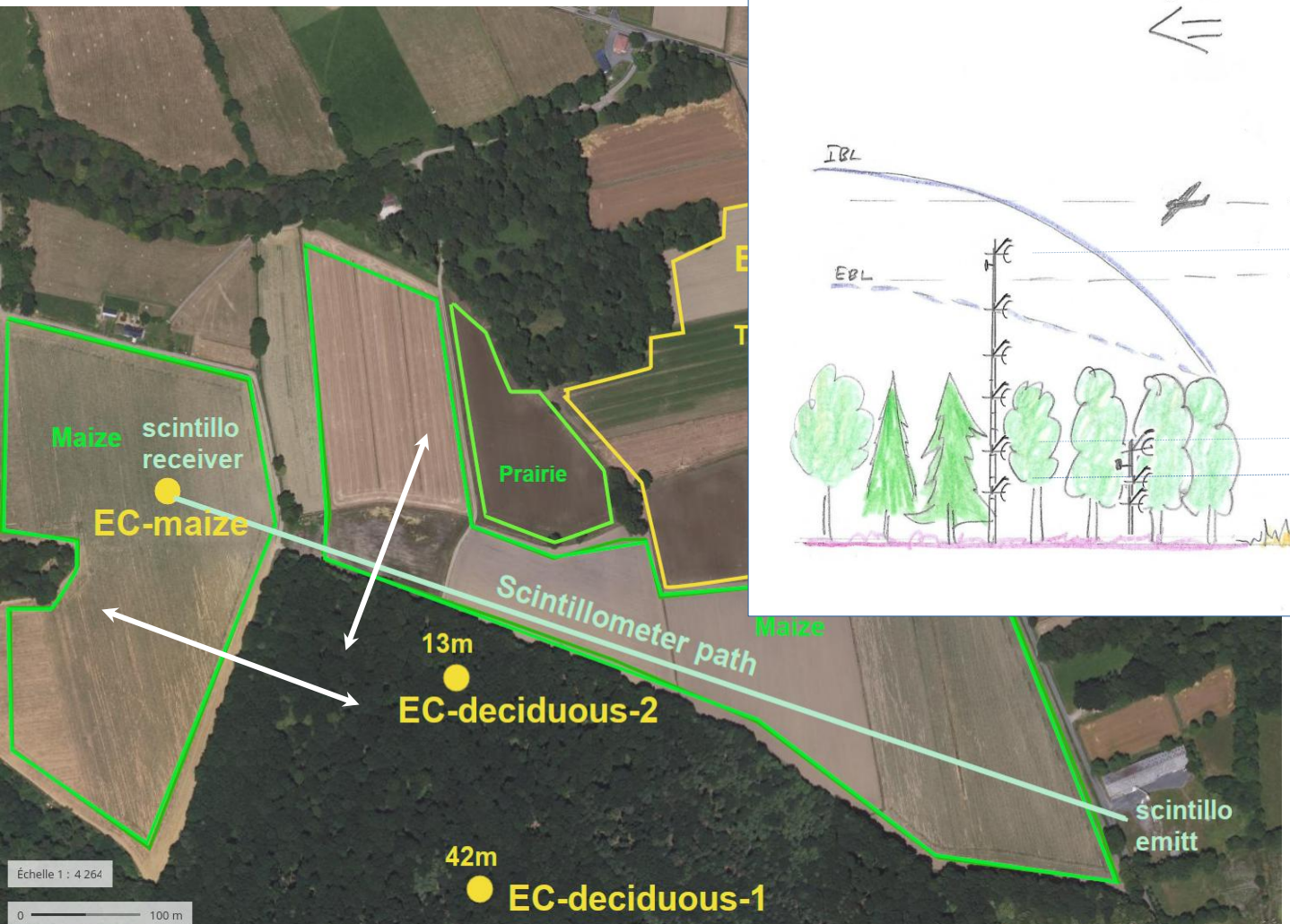
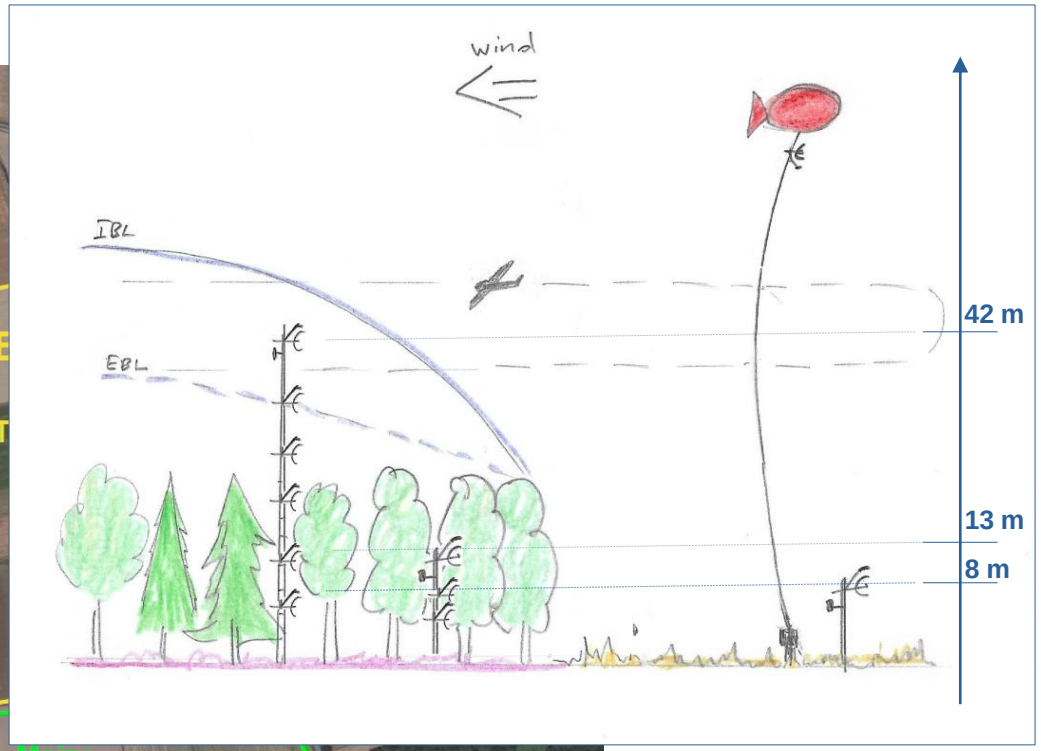




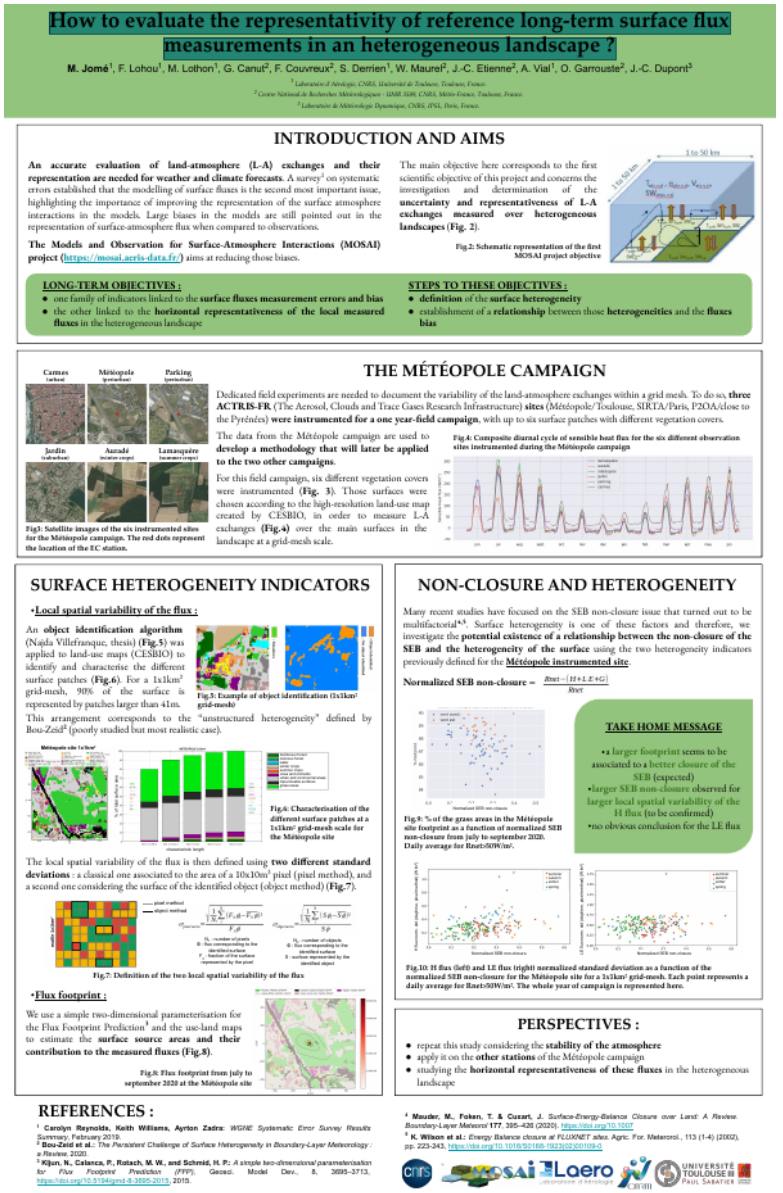
O1- Representativity

How to evaluate the representativity of reference long-term surface flux measurements in an heterogeneous landscape ?

See Poster from Mathilde Jomé (LAERO) !

Based on Meteopole EOP (2021)

- Surface heterogeneity indicators
- Link between
  surface energy budget residual
  and flux heterogeneity



How to evaluate the representativity of reference long-term surface flux measurements in an heterogeneous landscape ?

M. Jomé[1], F. Lohou[1], M. Lothon[1], G. Canut[2], F. Couvreux[2], S. Derrien[1], W. Maurel[2], J.-C. Etienne[2], A. Vial[1], O. Garrouste[2], J.-C. Dupont[3]

INTRODUCTION AND AIMS

THE MÉTÉOPOLE CAMPAIGN

SURFACE HETEROGENEITY INDICATORS

NON-CLOSURE AND HETEROGENEITY

PERSPECTIVES :

REFERENCES :

O2 - New methods for model evaluation

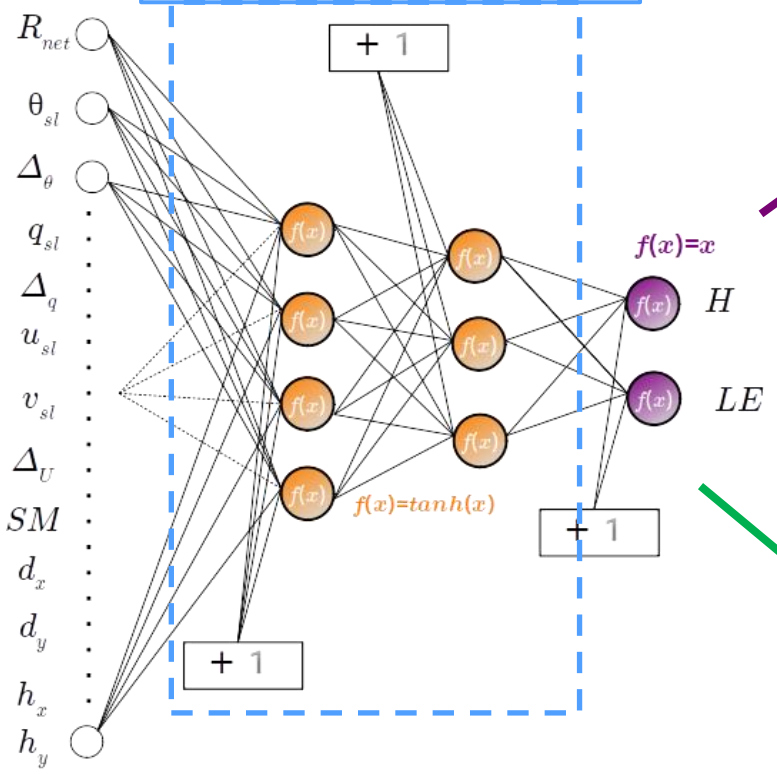
Using neural network to estimate model bias

By Maurin Zouzoua, Sophie Bastin, Marjolaine Chiriaco (LATMOS)

Objective: Make a “fair” model/obs comparison, by freeing from differences in environmental forcings.

Observed environmental variables

Multi-Layer Perceptron



MLP-based turbulent fluxes

To be compared to simulated fluxes

Simulated environmental Variables

MLP-based turbulent fluxes

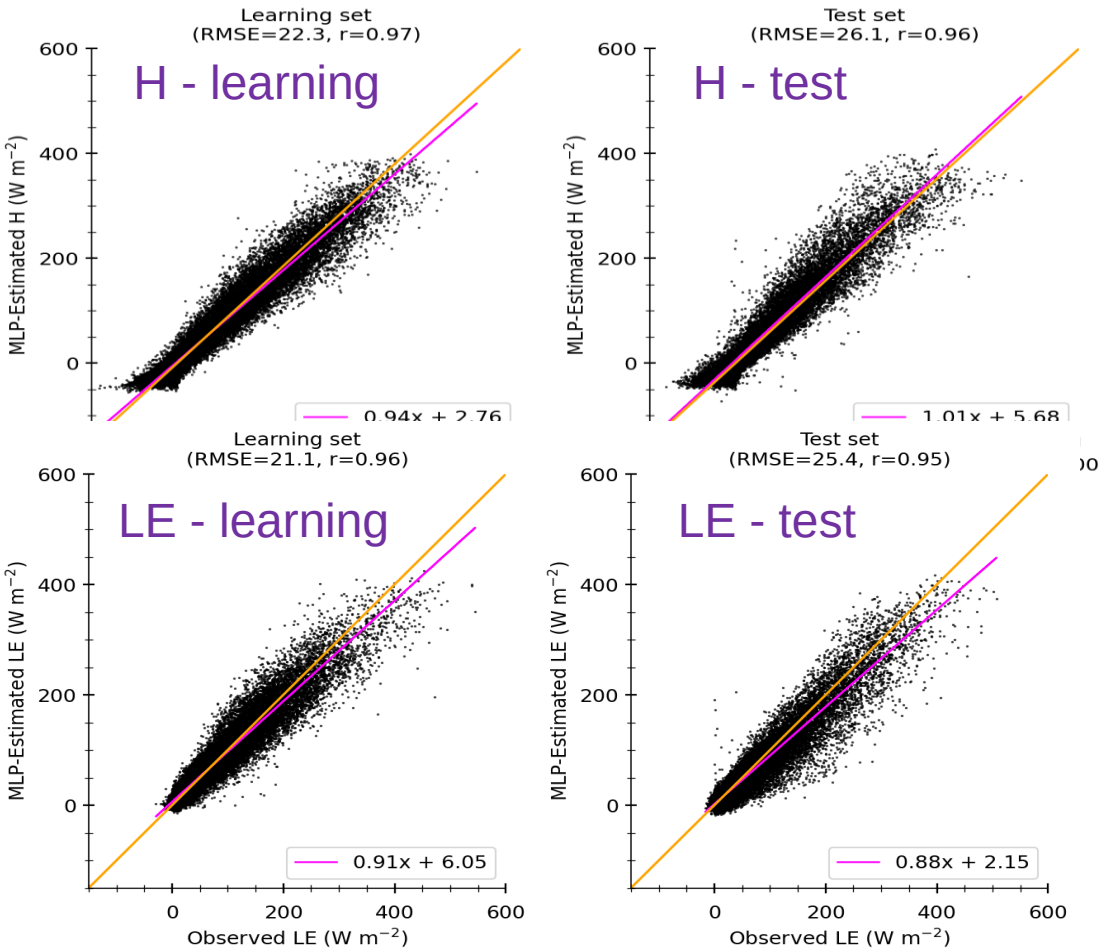
O2 - New methods for model evaluation

Using neural network to estimate model bias

By Maurin Zouzoua, Sophie Bastin, Marjolaine Chiriaco (LATMOS)

Observational data from Meteopole, Toulouse (Jun 2012 - Dec 2021)

- Trained MLP performs well
- Difficulties for H estimation in strongly stable surface layer
- Difficulties in cases of large LE

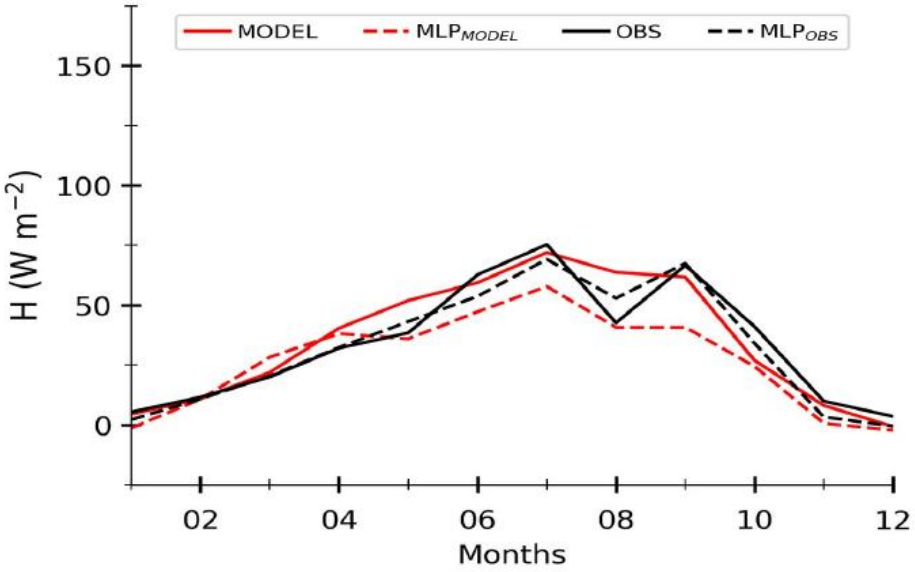


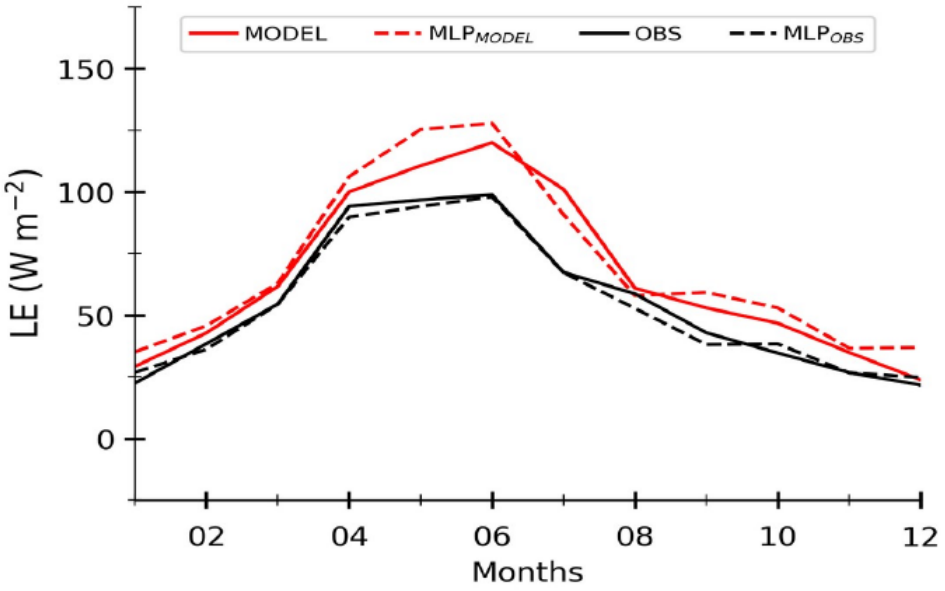
O2 - New methods for model evaluation

Using neural network to estimate model bias

By Maurin Zouzoua, Sophie Bastin, Marjolaine Chiriaco (LATMOS)

Preliminary results !!!



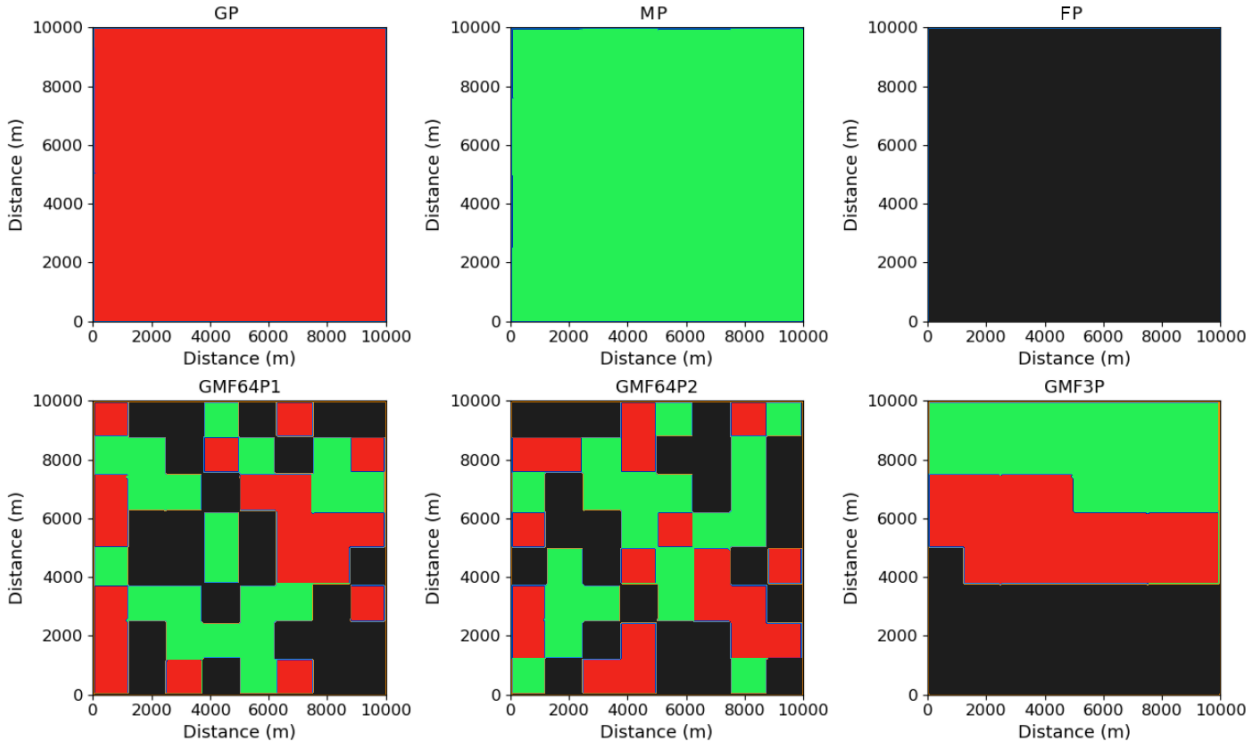


O3 : Improving surface/atmosphere coupling

Impact of surface heterogeneity on the boundary layer flow and near-surface turbulent exchanges in an LES framework.

by Royston Fernandez, Fleur Couvreux, CNRM

MesoNH/SURFEX coupled LES

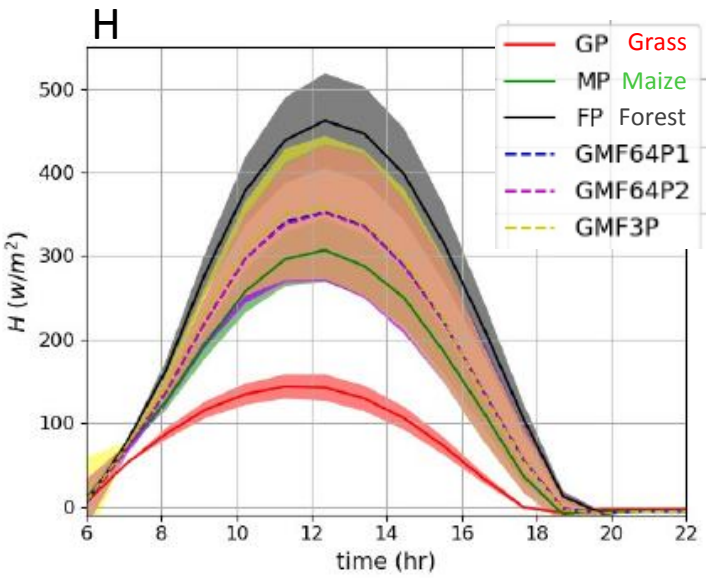


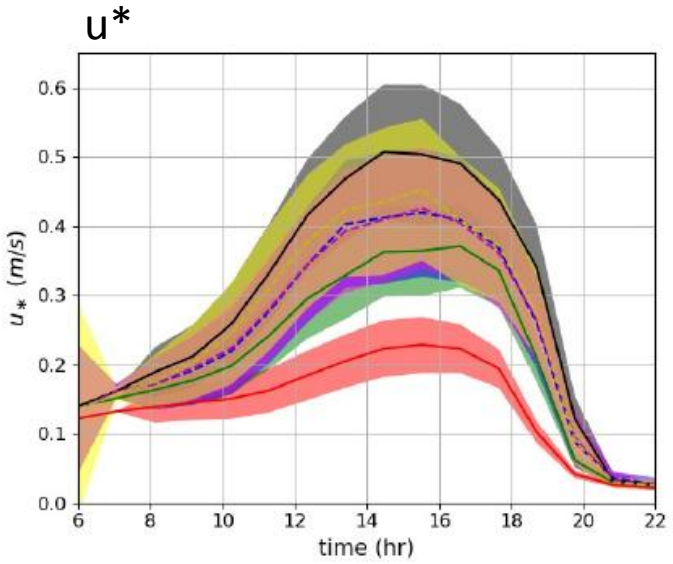
Interactive surface
10 km² x 4 km
dx = dy = 50m
dz1 = 5m, stretched grid

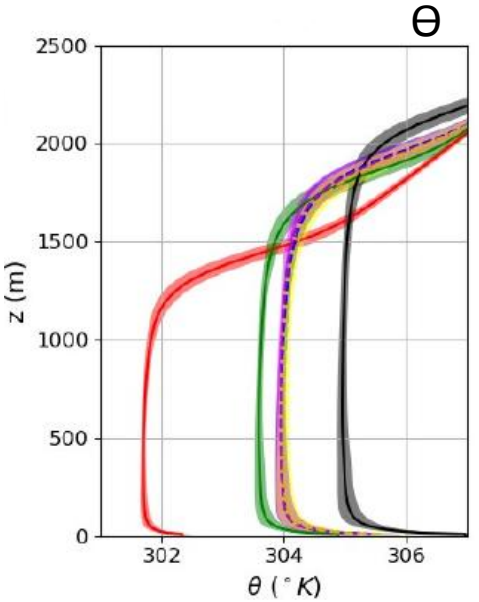
Grass
Maize
Forest

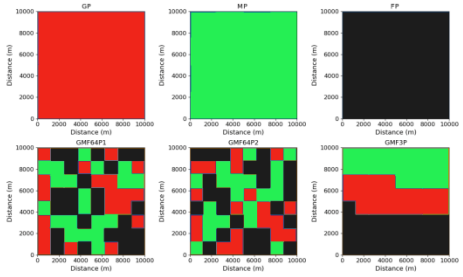
O3 : Improving surface/atmosphere coupling

Impact of surface heterogeneity on the boundary layer flow and near-surface turbulent exchanges in an LES framework.







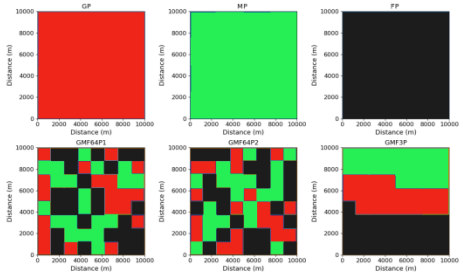


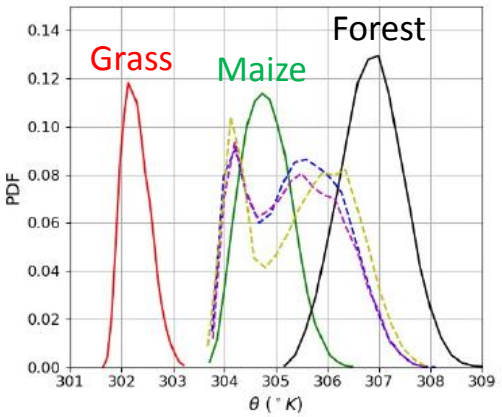
- Heterogeneity slightly increases mean flux and roughness (larger than the weighted average)
- Near surface wind is more influenced
- BL slightly deeper, but remains well homogeneous, and independent of patch size and distribution

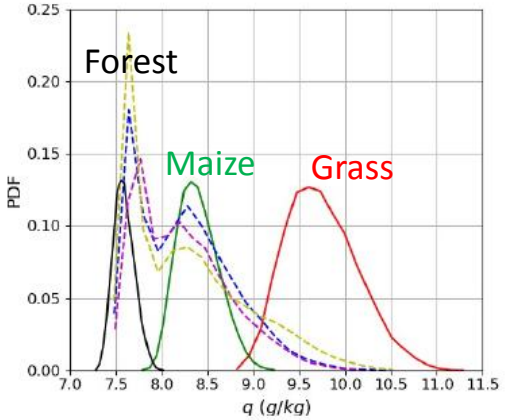
O3 : Improving surface/atmosphere coupling

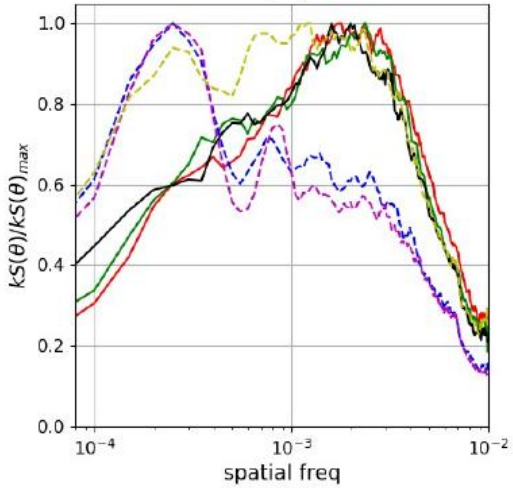
Impact of surface heterogeneity on the boundary layer flow and near-surface turbulent exchanges in an LES framework.

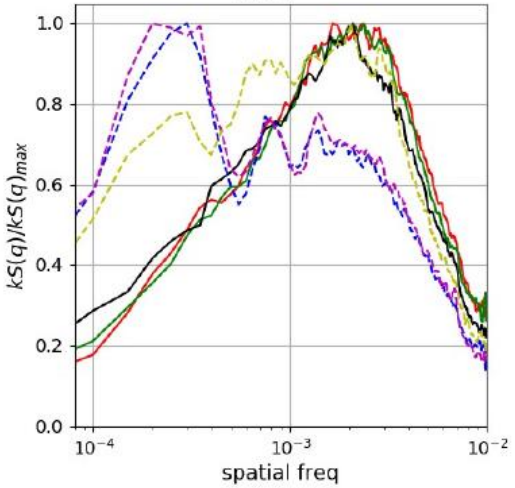
Heterogeneity induces
Bimodal distributions and excess of energy at larger scales
→ due to **secondary circulations**





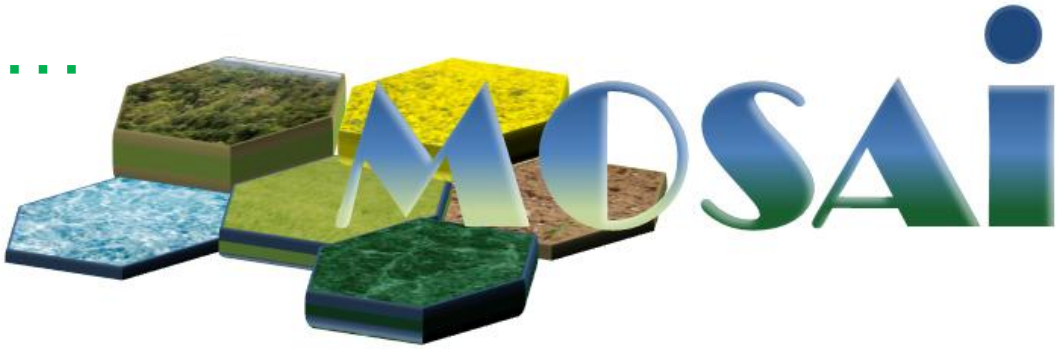






More to come soon…

Thank you !



Web site & Data base:

https://mosai.aeris-data.fr/

LMD IGE cnrm CESBIO LATMOS GET Laero Laboratoire d'Aérologie

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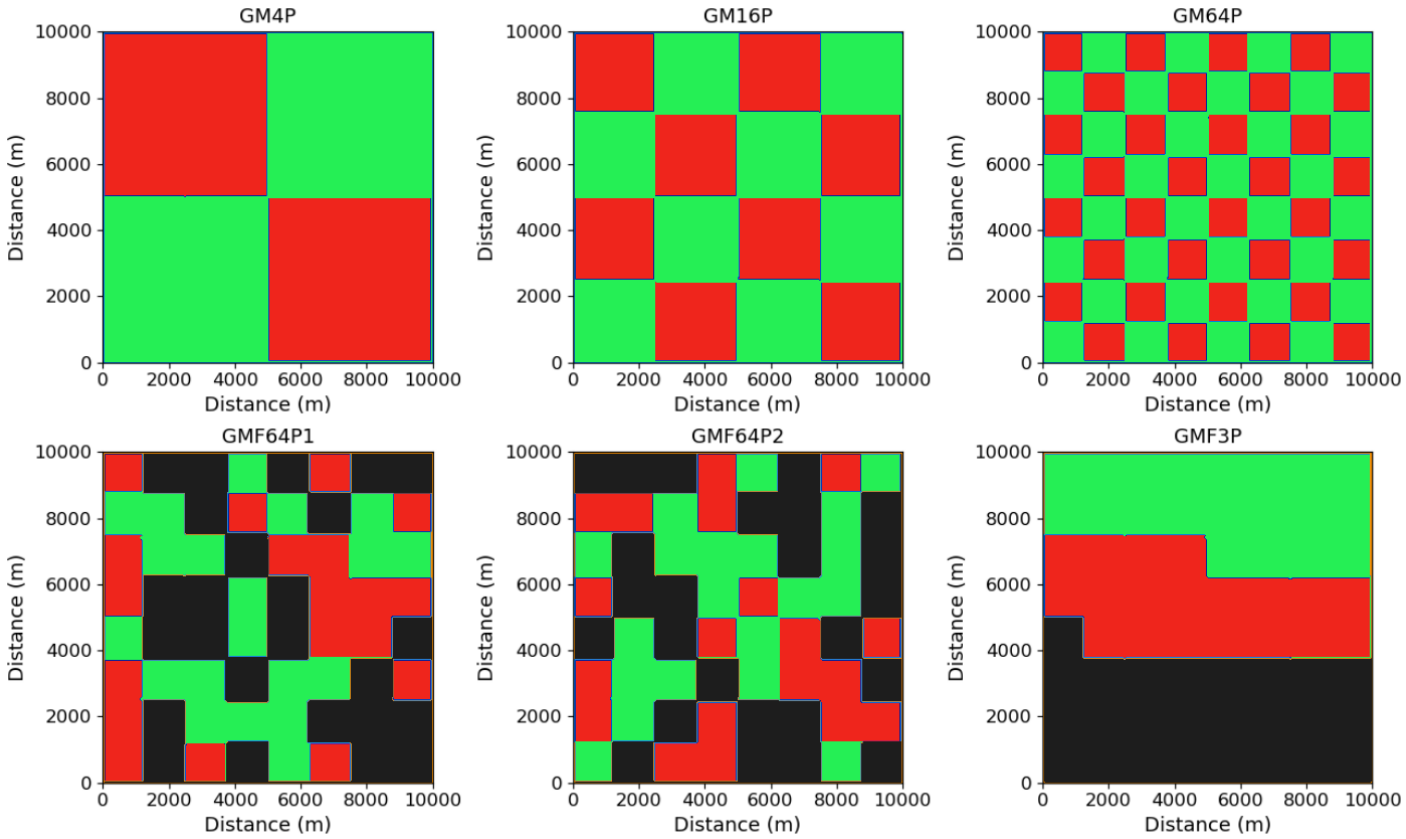

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