SURFEX SSC

CNRM/GMME (Mesoscale Group) Contributions for the V9 (and beyond)

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SURFEX SSC: GMME

Summary → Updates concerning:

- Data Assimilation
- Irrigation module
- Soil and Vegetation physics
- ECO-SG
- Urban

Data Assimilation

V9 → DA: bugfix Ensemble Kalman Filter when two types of observations are assimilated (bugfix related to dealing with NPATCH > 1)

After the release of V9:

- CoCO2 project (https://www.coco2-project.eu/) → adapt assimilation routines to the ISBA- CC (= NCB) option when developments will be made accessible through V9. This implies adapting notably the assimilation of LAI from 12 patches to 19 patch config, and perhaps adding new biomass reservoirs as control variables (i.e. in CVAR_M in NAM_VAR namelist). Will be released when validated

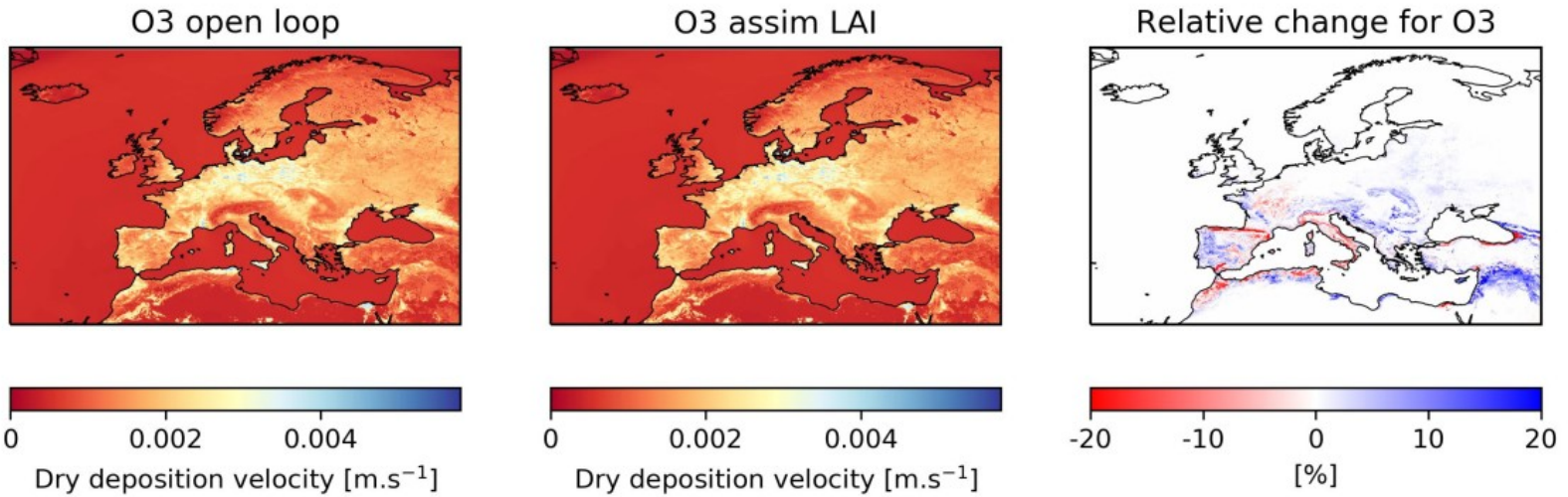
- Snow assimilation (snow water equivalent SWE and snow cover converted into SWE) with the SEKF and the snow ES scheme with 12 layers. Add SWE as a new type of observation in COBS_M in the NAM_OBS namelist and adding WSN_VEGx [snow reservoir for layer x] and RSN_VEGx [snow density for layer x] (x=1, ... 12) in CVAR_M in NAM_VAR namelist. Ongoing - will be released after validation.

- NILU (Norway) has been developing a new version of the dry deposition scheme for chemicals → CNRM currently testing running this new scheme with ISBA + assimilation of LAI as stomatal conductance impacts the deposition of chemicals (collaboration NILU - GMME/VEGEO and GMGEC/PLASMA). GMGEC will make this new scheme available in SURFEX when the project finishes.

Influence of LAI assim on deposition velocity

SEEDS
Sentinel EO-based Emission and Deposition Service

- Example: run with assimilation of LAI (CGLS, GEOV1) since Jan. 2018. ***First time deposition scheme run with land surface assimilation***
- Focus on ten days between 1st and 10th January 2019
- Averaged dry deposition velocity over the period with new scheme from NILU for **ozone** (left: without assim, centre: with assim, right: relative change)



Irrigation

Description and evaluation: Druel et al., 2022: GMD, under revision
(see → *https://doi.org/10.5194/gmd-2021-332*)

- Uses ECO-SG, can irrigate all vegetation patches (no specific irrigated nature type) → this permits representing the sub-grid nature of irrigation fractional coverage

- 3 irrigation types considered (drip, flood and sprinkler)

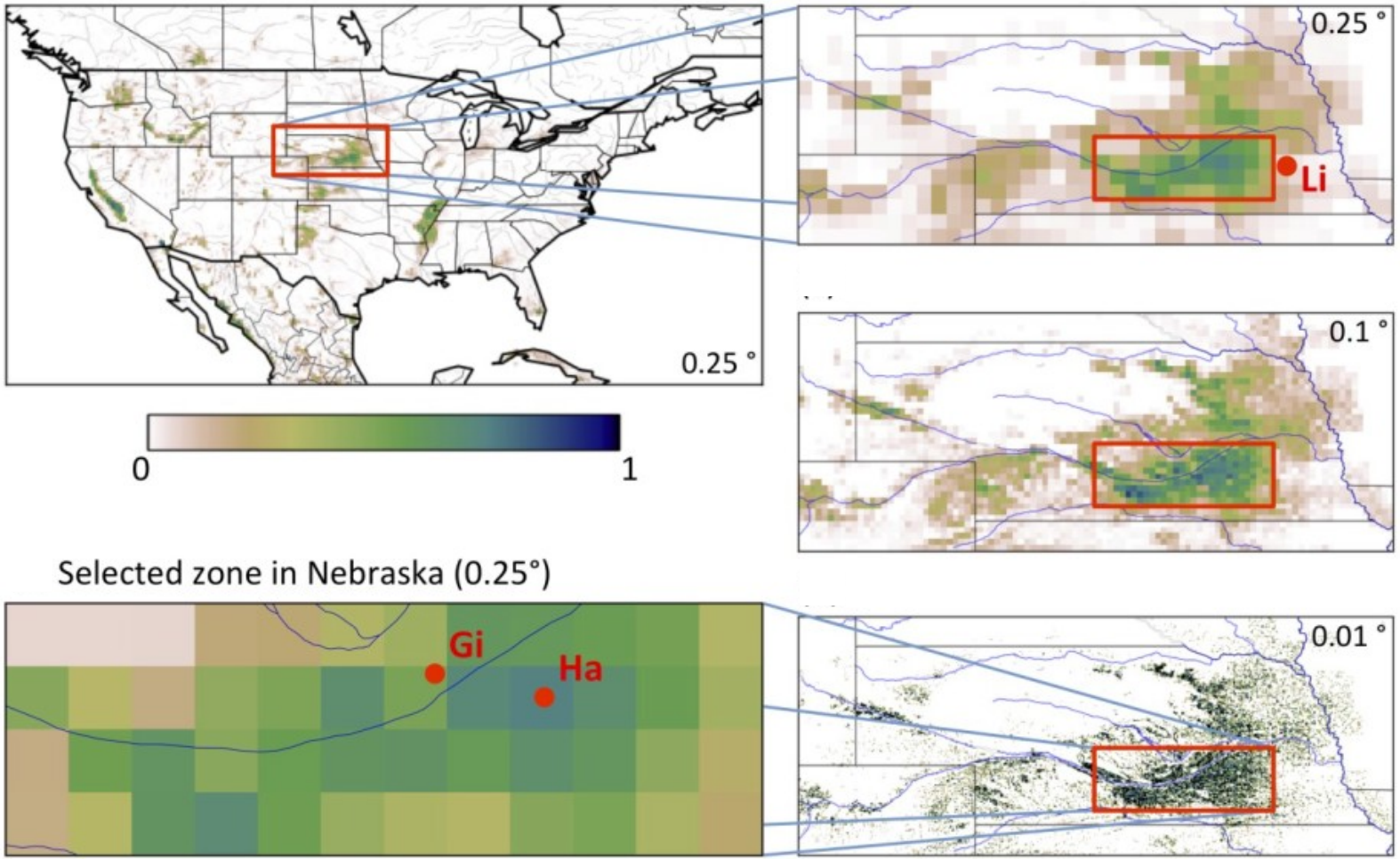
- the above results in a large amount of potential patches (120!) so rules are established to minimize this (see the above reference for details).
  → Procedure: duplicate a nature type if it is partially irrigated → attribute for each grid cell the corresponding irrigated fraction → select the irrigation type for the irrigated fraction

- Parsimonious model: only 12 parameters

- Case study over Nebraska shows that accounting for crop phenology and irrigation improves simulated LAI and photosynthesis (Druel et al., 2022)

- Future developments: Could be further improved with a representation of crop residue/litter

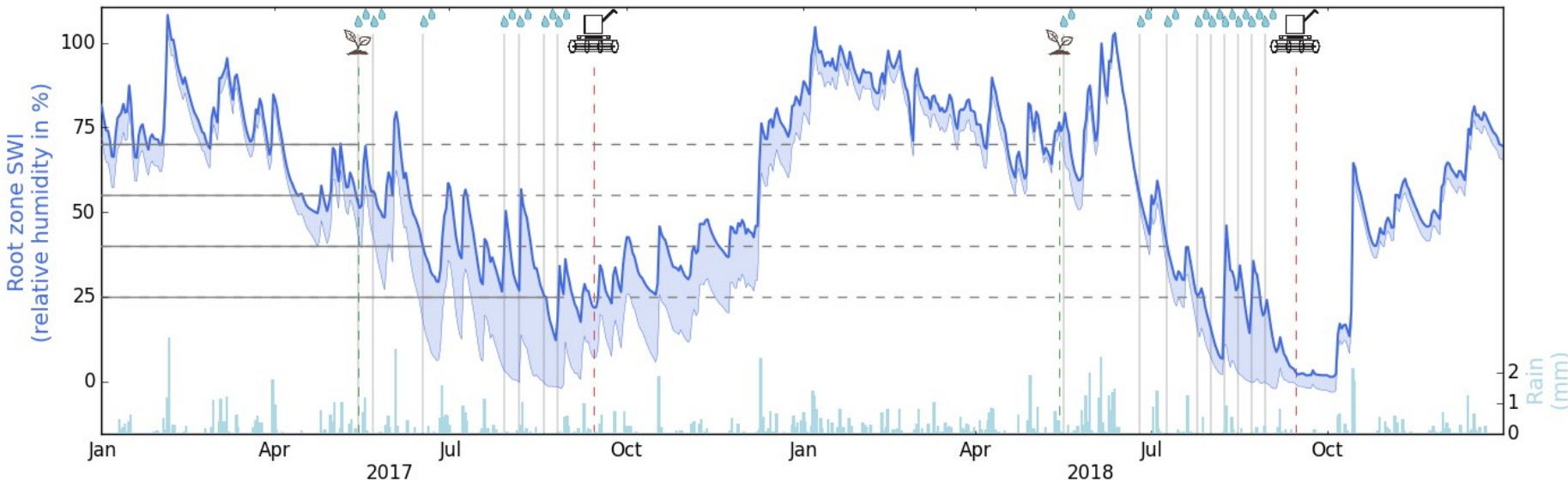
Irrigation



Druel et al., 2022

Irrigation

Evolution of a C4 crop root zone SWI with and without irrigation, in 2017 and 2018 in southwestern France.



Soil and vegetation physics related

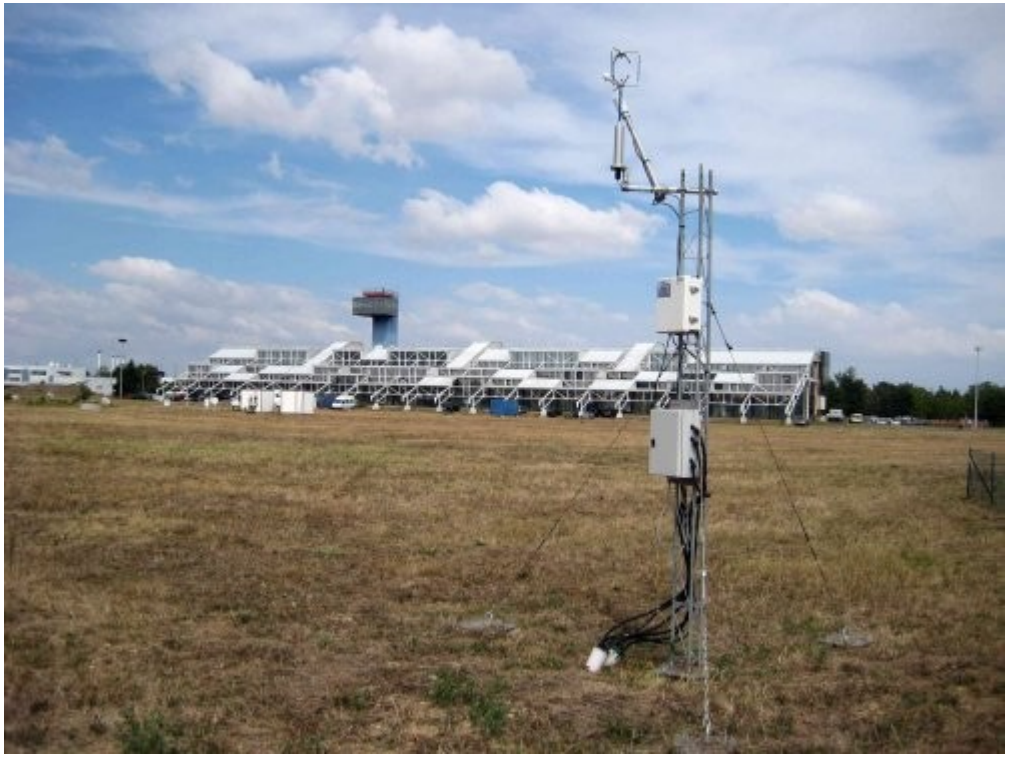
- Ability to initialize prognostic variables (TG, WG and WGI) for DIF option for each layer using SIM output (over France) for all 14 layers (Le Moigne, Noual)

- NIT option for MEB (ability to simulate temporal evolution of LAI) (Boone, Bourgois, Bonan)

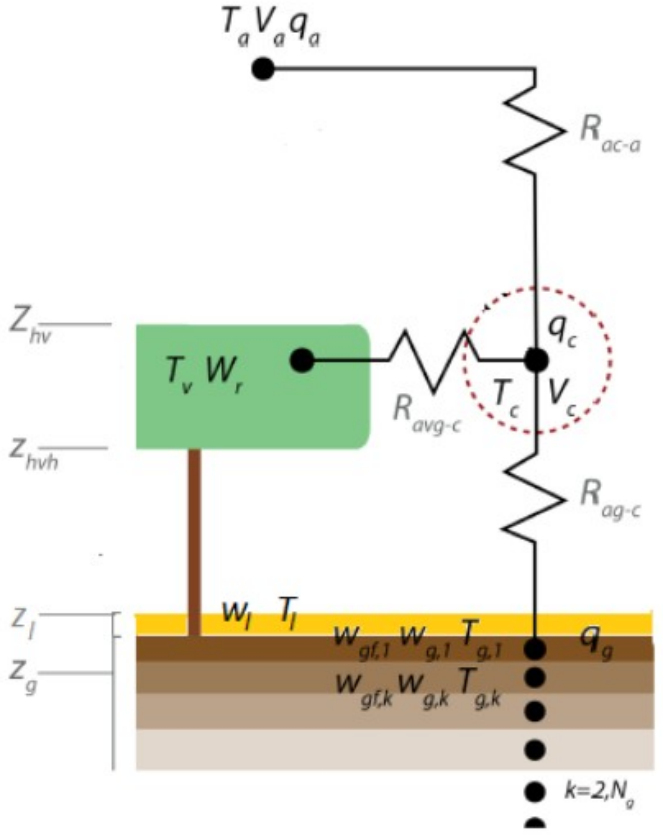
* In theory, can use MEB for low covers, but not thoroughly tested yet, although some tests done at MeteoPoleFlux site at Météo-France last summer. After V9?

Soil and vegetation physics related

MEB low veg cover → MeteoPole-Flux site (Toulouse)

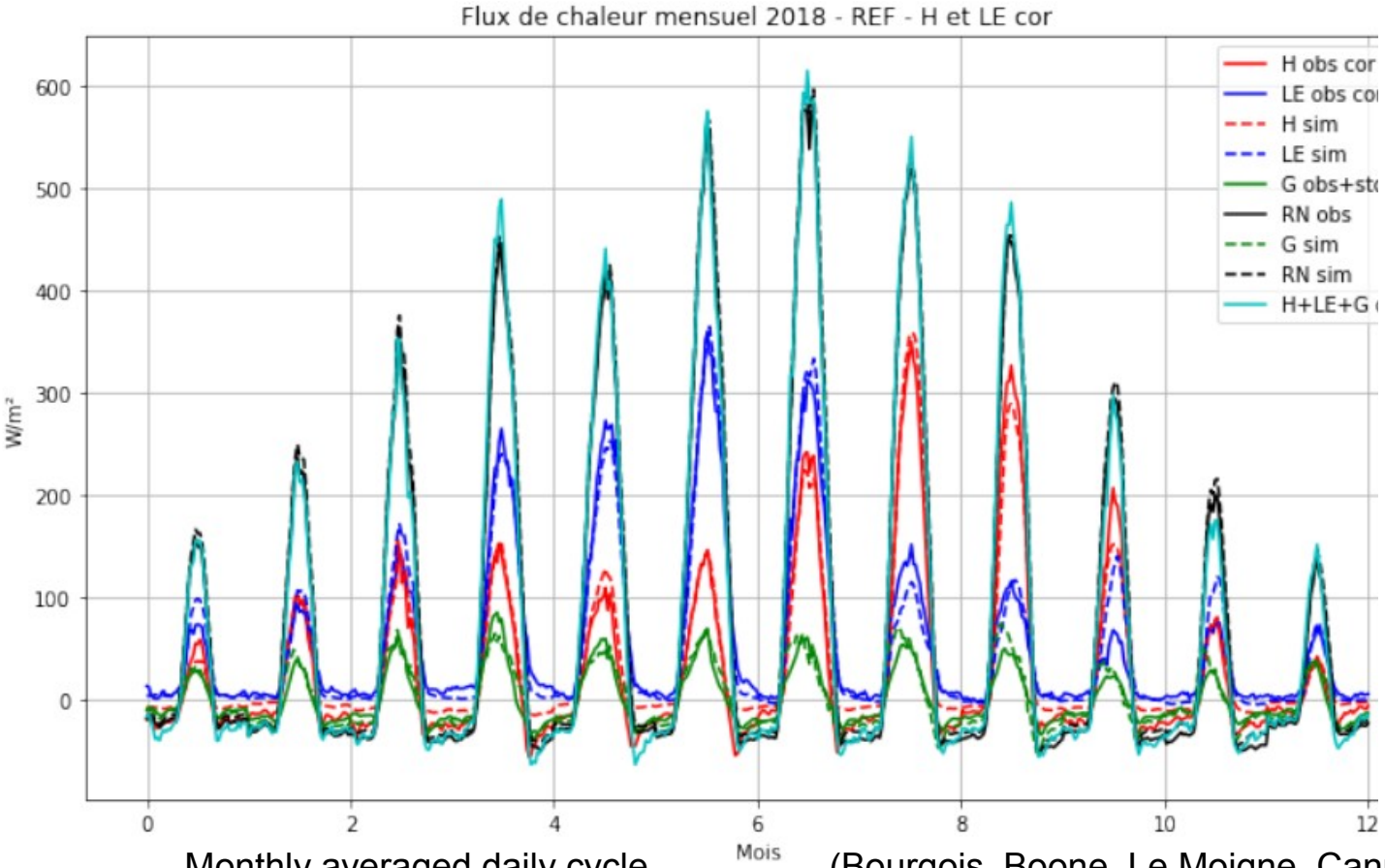


4M & TRAMM teams, ICOS label

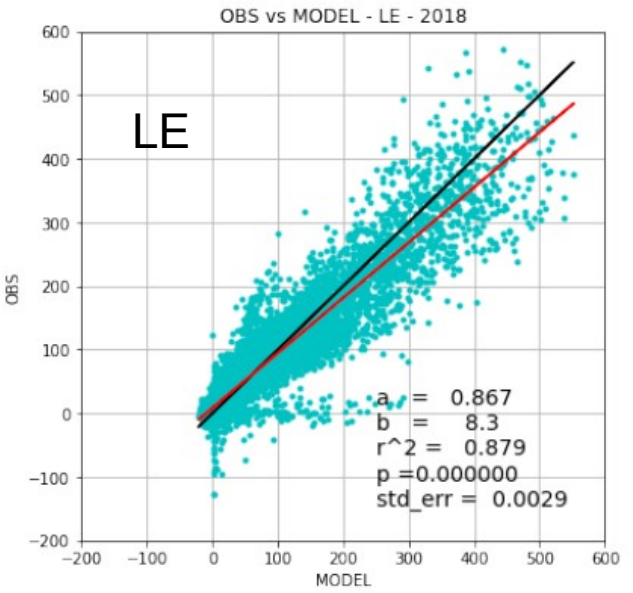


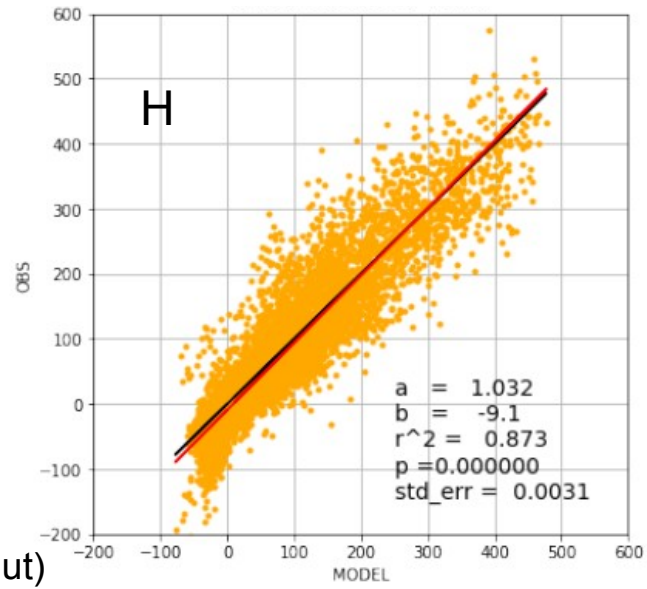
Soil and vegetation physics related

MEB low veg cover → MeteoPole-Flux site (Toulouse)



Monthly averaged daily cycle





(Bourgois, Boone, Le Moigne, Canut)

ECO-SG:

- Modification of attribution of vegetation types within urban covers. In V8.1, 3 types possible (bare-soil, temperate grass and deciduous forest).

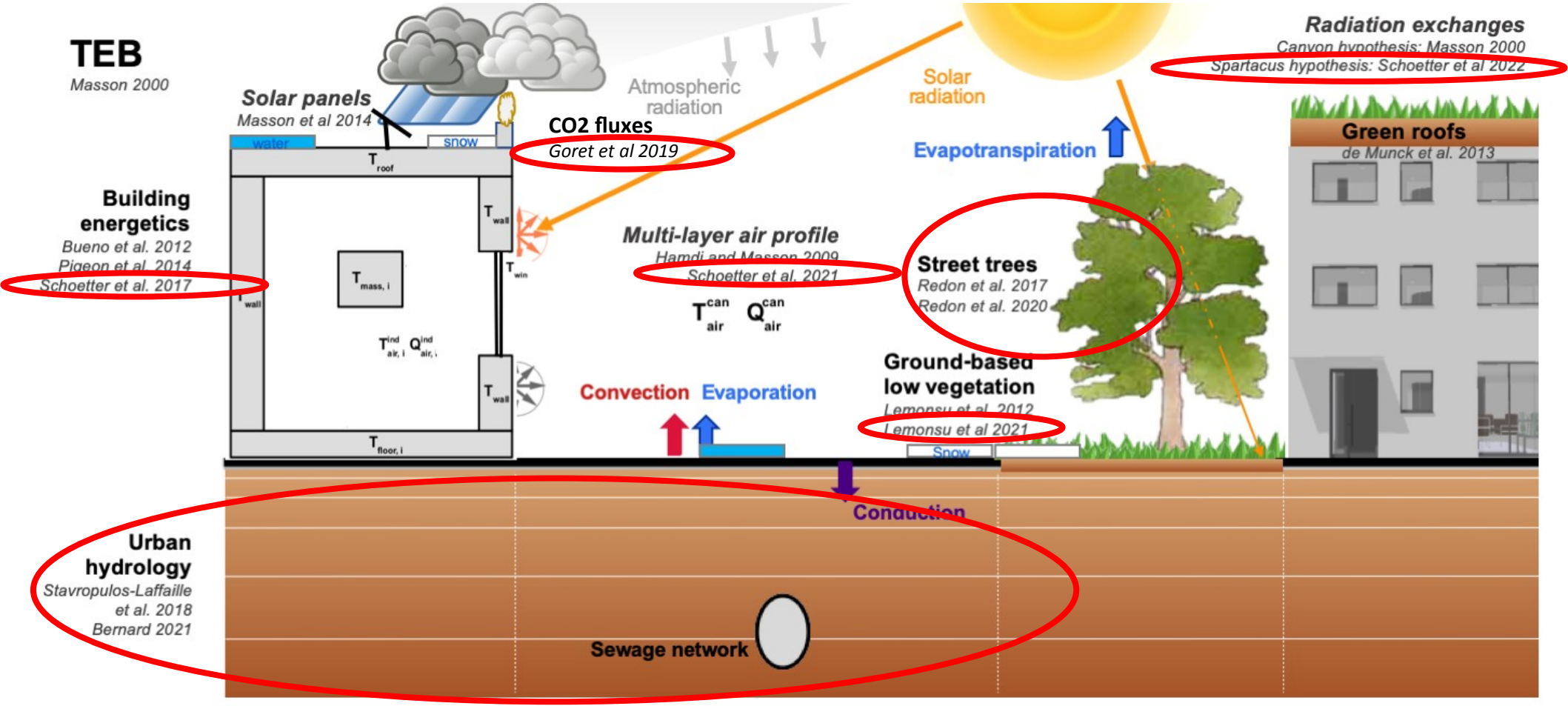
  → To avoid a possible crash in PGD (if none of these covers existed in the domain), other veg types can now be included (default if none found → grass).
  (M. Minvielle, D. Tzanos)

- Not really a code modification → an update of physiographic maps (LAI, albedo) without missing values to avoid a crash in PGD (ACCORD request) (M. Minvielle, D. Tzanos)

- ECO-SG Used in new irrigation scheme (see previous slides on irrigation)

Urban (TEB)

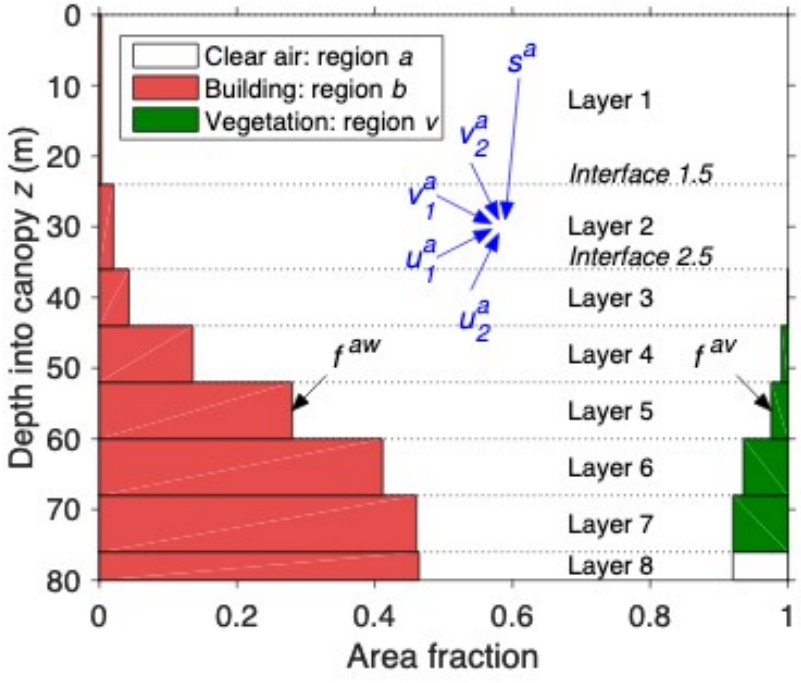
New in SURFEX V9



Urban (TEB)

Spartacus → New radiative exchanges

- New statistical sub-grid approach for radiative exchanges between elements
- No more “Canyon road” hypothesis
- Compatible with all of the other TEB parameterizations

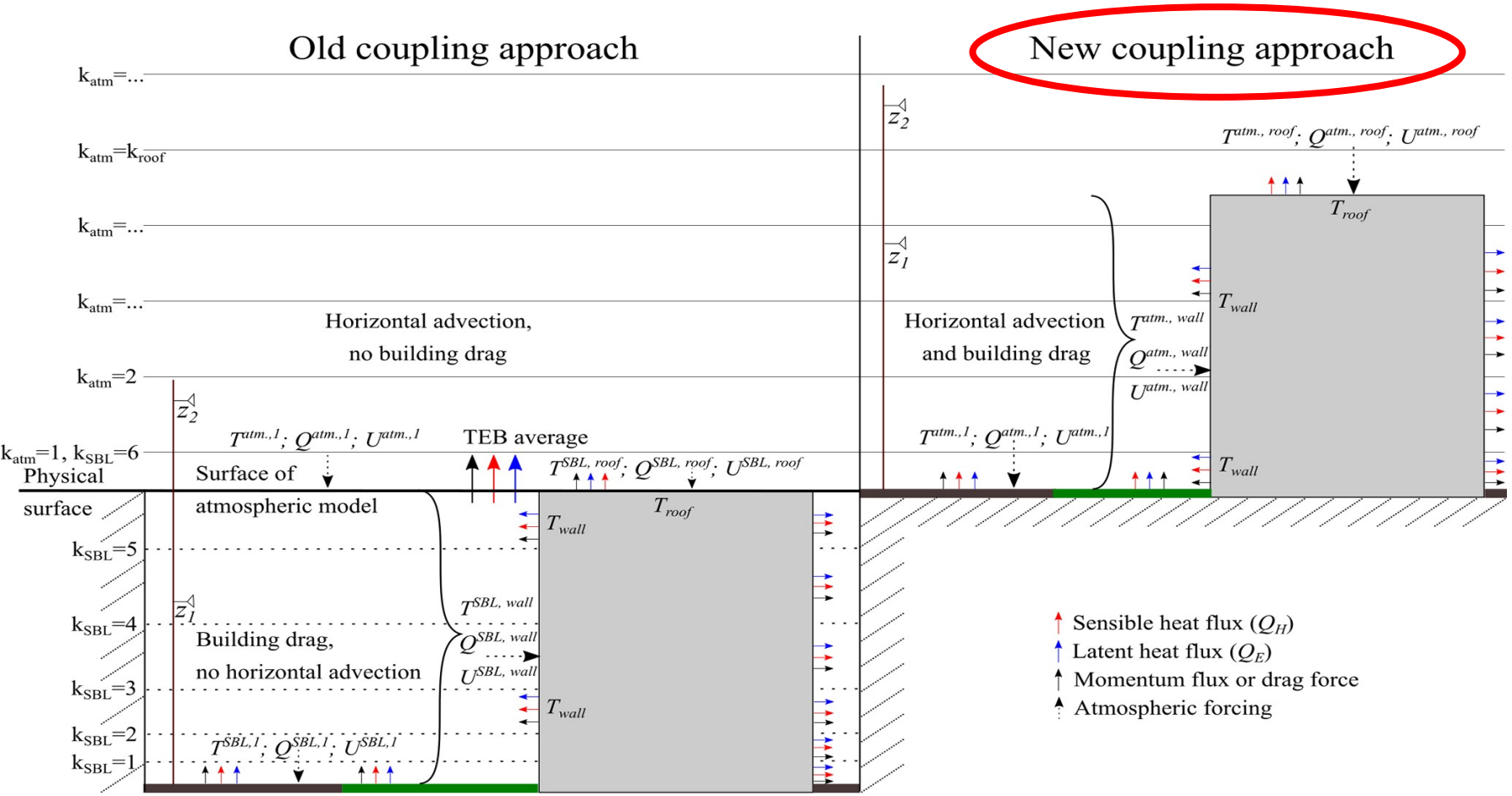


(Hogan 2019)

Left: vertical discretization of radiative exchanges with SPARTACUS developed at ECMWF (Hogan 2019) (now inTEB);
Right: the neigborhood corresponding to the statistics on the left.

Urban (TEB)

- No more CANOPY → explicit discretization extending down to the street, impacts directly several atmospheric layers



- Requires the addition of physics terms on AROME levels

- ACCORD interested

Urban (TEB)

TEB Urban Hydrology (sub-surface locally)

- Addition of water management in the road base and under buildings
  → Greater water storage available for evaporation from gardens

- Infiltration of intercepted water on roads

- Infiltration of water into the city networks (sewage, storm-water...)
  → Additional underground runoff terms

- Of specific interest owing to consideration of water in the overall urban soil (evaporation impact)

- Of interest for coherence with hydrological and reanalysis products

Urban (TEB)

New Urban Databases

Land use and building morphology parameters

- MAPUCE, URCLIM, C3S SLIM projects (geoclimate chain, LabSTICC)

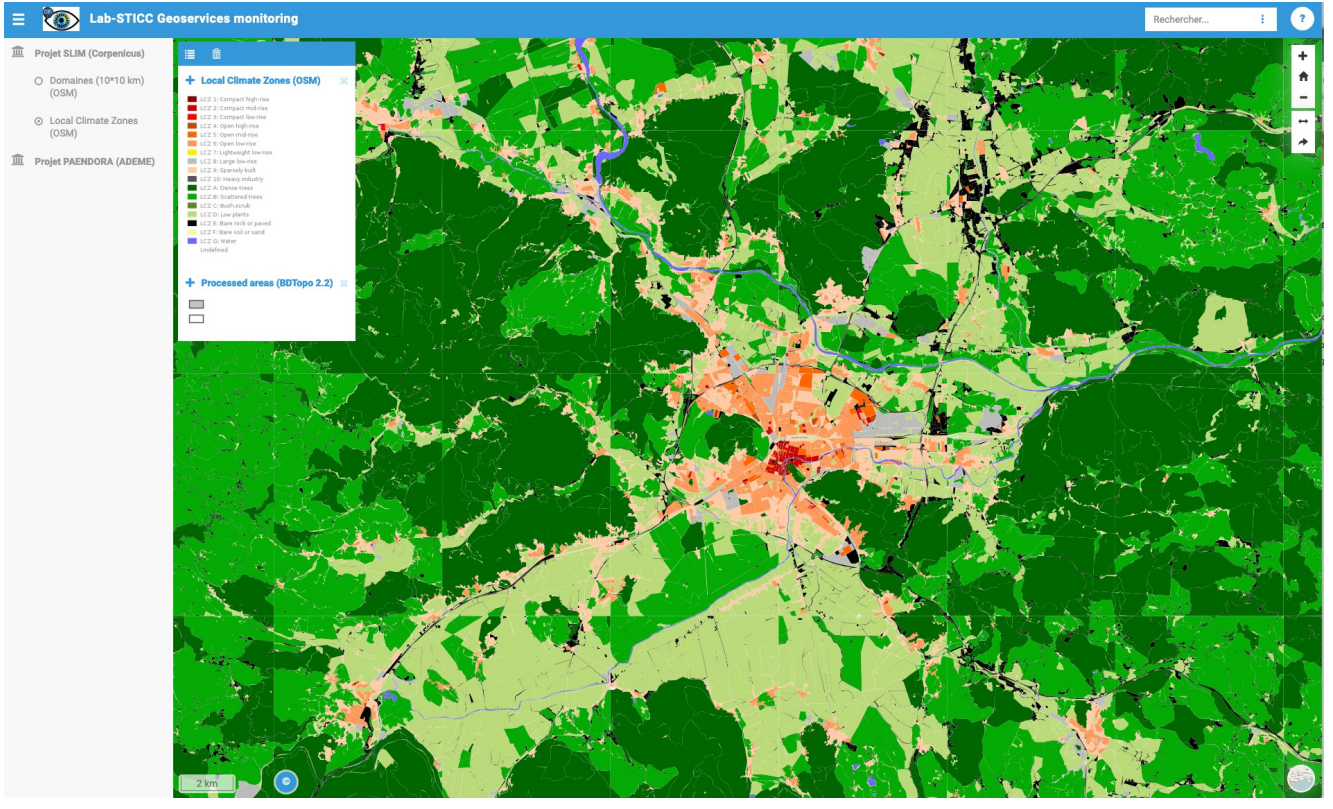
From IGN data (Bdtopo)
or *Open Street Map* data:

- land use: Local Climate Zone (LCZ), building types

- morphological parameters:
  building density, road density, average height, wall density, ...

→ Over Europe, at the block scale.
Can aggregate

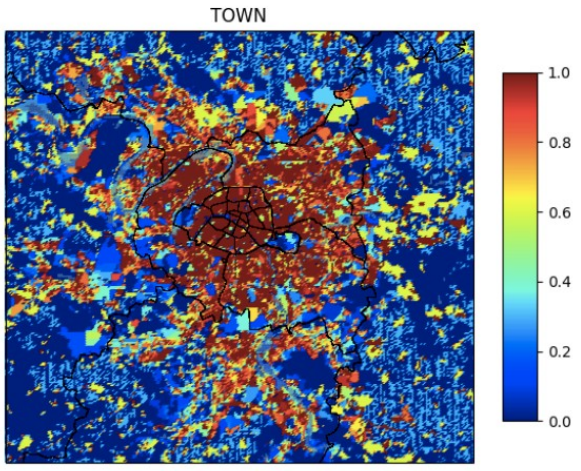
http://monitoring.orbisgis.org/



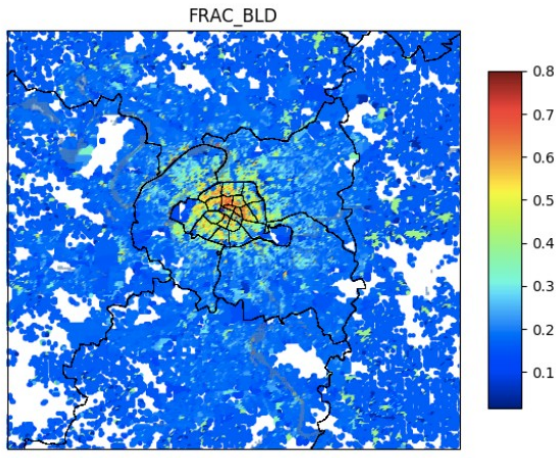
Urban (TEB)

New Urban Databases

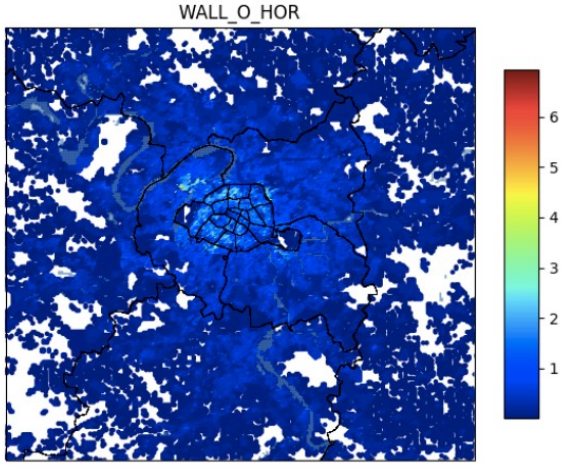
→ Example over the Paris region (MAPUCE data)



Town fraction



Building fraction in the Town area



Ratio between wall surface / town surface