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Geoscientific Model Development
Discussions
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Interactive comment on "The GREENROOF module (v7.3) for modelling green roof hydrological and energetic performances within TEB" *by* C. S. de Munck et al.

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Our response to referee # 2 is in the supplement pdf document attached. It refers to the pages and paragraphs of a revised version of the manuscript. Indeed, the comments of referee # 2 lead us to re-think the analysis of the case study simulations, which were re-run with a slightly improved version of the model. Consequently a revised version of the manuscript was written. The case study part of the manuscript is quite different. We have split comments into key paragraphs to answer them.

Please also note the supplement to this comment:

http://www.geosci-model-dev-discuss.net/6/C959/2013/gmdd-6-C959-2013-supplement.pdf

Interactive comment on Geosci. Model Dev. Discuss., 6, 1127, 2013.

Table 4. Hydrological characteristics tested for green roof calibration exercise.

	Characteristics (unit)	Value	Method (Source)	
SUBSTRATE	Porosity ($m^3 m^{-3}$)	**0.674**	Supplier information (Falienor 2010)	
		0.411	Measured (Bouzouidja 2012)	
	Saturated hydraulic conductivity ($m s^{-1}$)	**1.073 10^{-3}**	Supplier information (Falienor 2010)	
		2.162 10^{-3}	Measured (Bouzouidja 2012)	
	Matrix potential at saturation (m)	**-0.10**	Value fitted on observed water retention curves (Appendix A)	
	b-coefficient for water retention curve (-)	**2.9**	Deducted from water retention curve (Figure A1) porosity of 0.674 and matrix potential of -0.10	
		3.9	Deducted from water retention curve (Figure A2) with porosity of 0.411 and matrix potential of -0.10	
	Water content at field capacity	**0.37**	Deducted from observations	
	Water content at wilting point ($m^3 m^{-3}$)	**0.15**	Deducted from observations	
DRAINAGE	Porosity ($m^3 m^{-3}$)	**0.553**	Deducted from supplier density data (Table 3)	
		0.9	Literature (Ochs et al. 2006) & manufacturer information (Argex 2012)	
	Saturated hydraulic conductivity ($m s^{-1}$)	**3.32 10^{-3}**	(Bouzouidja 2012)	
		1 10^{-2}	Technical specification (Leca® 2012)	
	Matrix potential at saturation (m)	**-0.010**	Values for organic matter	OM
	b-coefficient for water retention curve (-)	**2.7**	(Lawrence and Slater 2008)	
	Matrix potential at saturation (m)	**-0.121**	Values for sand in ISBA	SAND
	b-coefficient for water retention curve (-)	**4.05**	(Clapp and Hornberger 1978)	
	Matrix potential at saturation (m)	**-0.405**	Values for clay in ISBA	CLAY
	b-coefficient for water retention curve (-)	**11.4**	(Clapp and Hornberger 1978)	

Fig. 1.

Table 5. Statistical scores for the simulations of the OM ensemble over the evaluation time period (R the correlation coefficient , RMSE the Root Mean Square Error, MBE the Mean Bias Error, PBE the Mean Bias Error expressed in percentages, CBE the Bias Error estimated on the variable accumulated over the period, and SD the Standard Deviation). Score units depend on the variable analysed.

	SUBS. WATER CONTENT				OUTLET DRAINAGE				SUBS. TEMPERATURE				DRAIN. LAYER TEMPERATURE			
SCORES	**R**	**RMSE**	**MBE**	**SD**	**R**	**RMSE**	**PBE**	**CBE**	**R**	**RMSE**	**MBE**	**SD**	**R**	**RMSE**	**MBE**	**SD**
UNIT	-		$m^3 m^{-3}$		-	$m^3 day^{-1}$	%	m^3	-		°C		-		°C	
OM mean	0.86	0.11	- 0.10	0.04	0.81	0.06	126.7	3.3	0.91	4.32	2.68	6.92	0.89	3.69	1.10	6.73
OM min	0.50	0.04	- 0.01	0.02	0.48	0.05	32.2	1.9	0.88	3.59	2.25	6.35	0.85	2.90	0.69	6.16
OM max	0.87	0.18	- 0.18	0.06	0.88	0.08	246.1	5.0	0.92	5.29	3.23	7.63	0.92	4.74	1.64	7.49
S1 mean	0.71	0.16	- 0.16	0.02	0.83	0.06	192.4	4.2	0.90	4.85	2.99	7.31	0.87	4.25	1.39	7.13
S2 mean	0.86	0.06	- 0.05	0.05	0.66	0.07	61.0	2.3	0.92	3.81	2.37	6.53	0.91	3.15	0.81	6.36
OBS				0.02								4.54				4.25

Fig. 2.

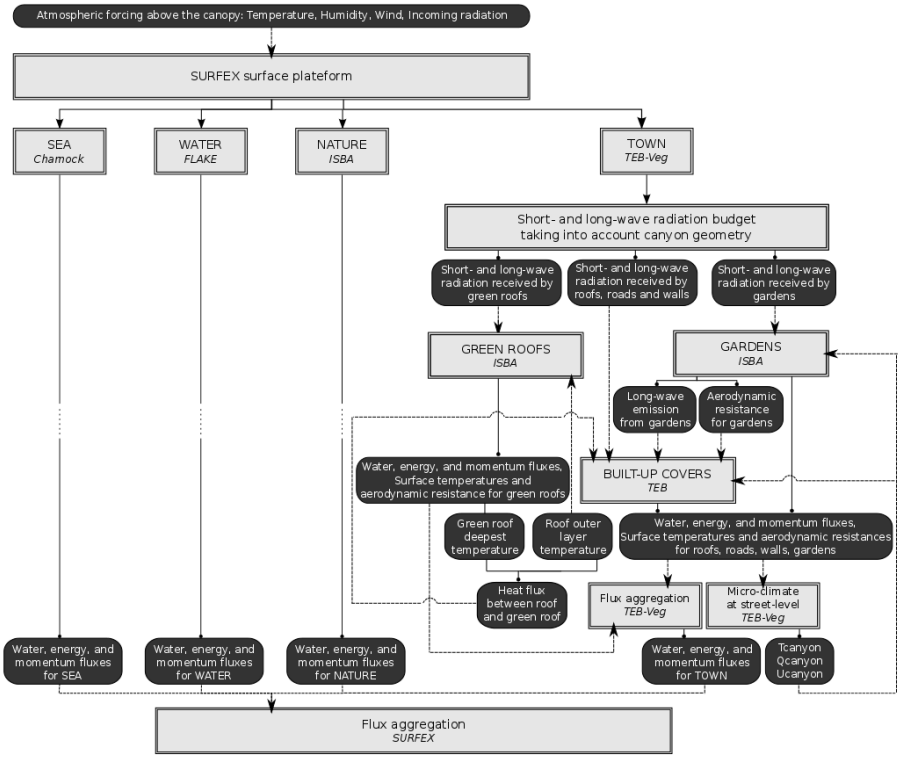

Atmospheric forcing above the canopy: Temperature, Humidity, Wind, Incoming radiation
SURFEX surface plateform
SEA
Chamock
WATER
FLAKE
NATURE
ISBA
TOWN
TEB-Veg
Short- and long-wave radiation budget taking into account canyon geometry
Short- and long-wave radiation received by green roofs
Short- and long-wave radiation received by roofs, roads and walls
Short- and long-wave radiation received by gardens
GREEN ROOFS
ISBA
GARDENS
ISBA
Long-wave emission from gardens
Aerodynamic resistance for gardens
Water, energy, and momentum fluxes, Surface temperatures and aerodynamic resistance for green roofs
BUILT-UP COVERS
TEB
Green roof deepest temperature
Roof outer layer temperature
Water, energy, and momentum fluxes, Surface temperatures and aerodynamic resistances for roofs, roads, walls, gardens
Heat flux between roof and green roof
Flux aggregation
TEB-Veg
Micro-climate at street-level
TEB-Veg
Water, energy, and momentum fluxes for SEA
Water, energy, and momentum fluxes for WATER
Water, energy, and momentum fluxes for NATURE
Water, energy, and momentum fluxes for TOWN
Tcanyon Qcanyon Ucanyon
Flux aggregation
SURFEX

Fig. 3.

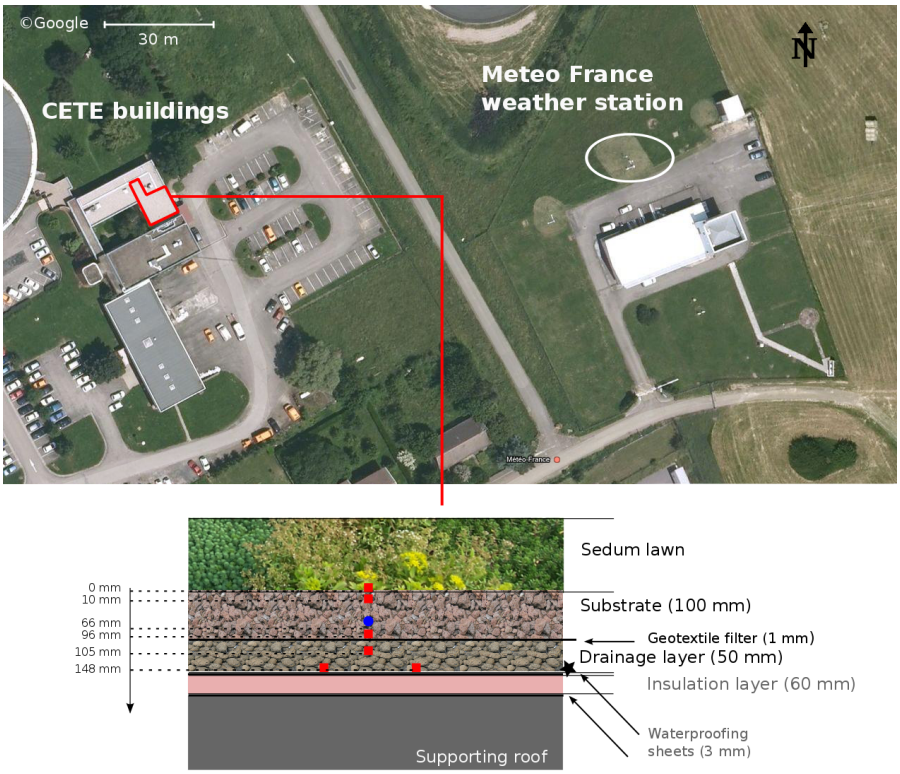

©Google
30 m
CETE buildings
Meteo France weather station
N
Sedum lawn
Substrate (100 mm)
Geotextile filter (1 mm)
Drainage layer (50 mm)
Insulation layer (60 mm)
Waterproofing sheets (3 mm)
Supporting roof
0 mm
10 mm
66 mm
96 mm
105 mm
148 mm

Fig. 4.

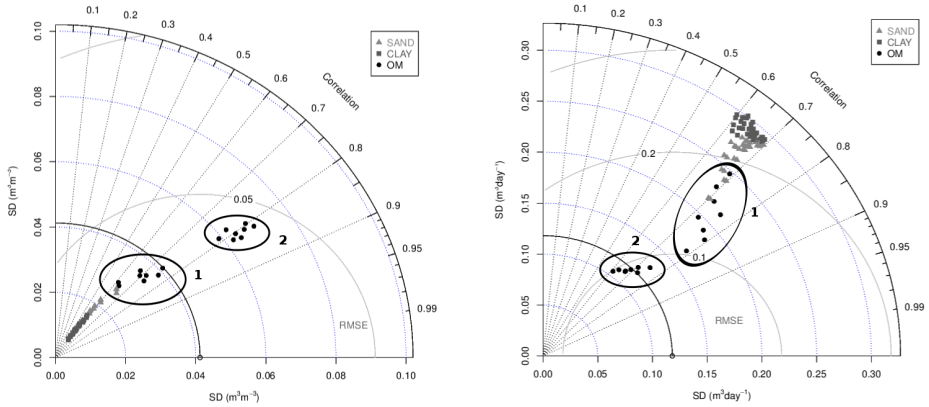
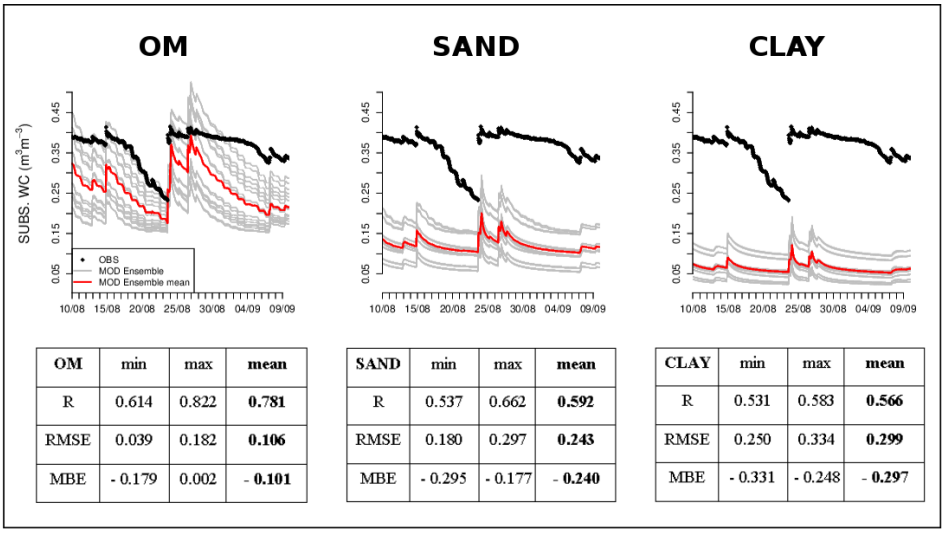


Fig. 5.

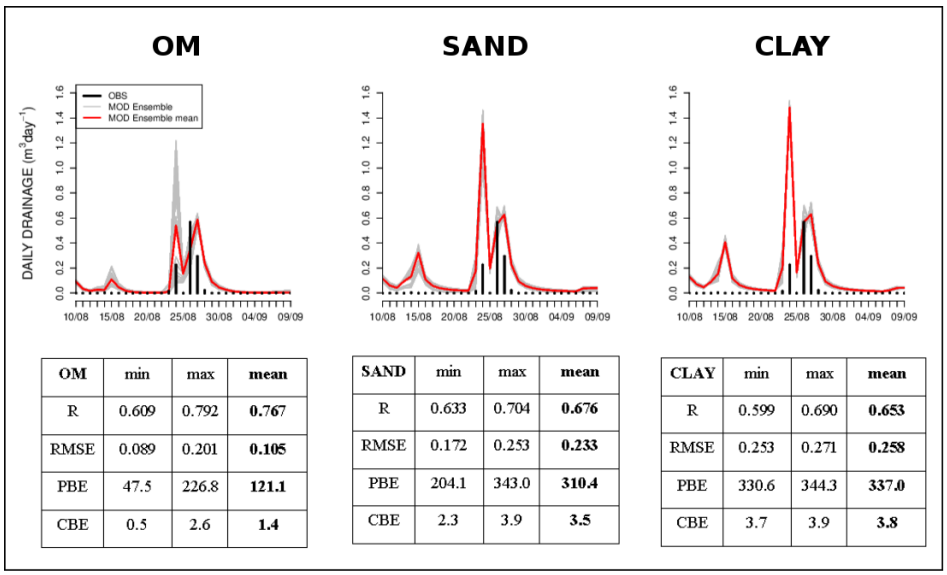


OM	min	max	mean
R	0.614	0.822	**0.781**
RMSE	0.039	0.182	**0.106**
MBE	- 0.179	0.002	- **0.101**

SAND	min	max	mean
R	0.537	0.662	**0.592**
RMSE	0.180	0.297	**0.243**
MBE	- 0.295	- 0.177	- **0.240**

CLAY	min	max	mean
R	0.531	0.583	**0.566**
RMSE	0.250	0.334	**0.299**
MBE	- 0.331	- 0.248	- **0.297**

Fig. 6.



OM	min	max	mean
R	0.609	0.792	**0.767**
RMSE	0.089	0.201	**0.105**
PBE	47.5	226.8	**121.1**
CBE	0.5	2.6	**1.4**

SAND	min	max	mean
R	0.633	0.704	**0.676**
RMSE	0.172	0.253	**0.233**
PBE	204.1	343.0	**310.4**
CBE	2.3	3.9	**3.5**

CLAY	min	max	mean
R	0.599	0.690	**0.653**
RMSE	0.253	0.271	**0.258**
PBE	330.6	344.3	**337.0**
CBE	3.7	3.9	**3.8**

Fig. 7.

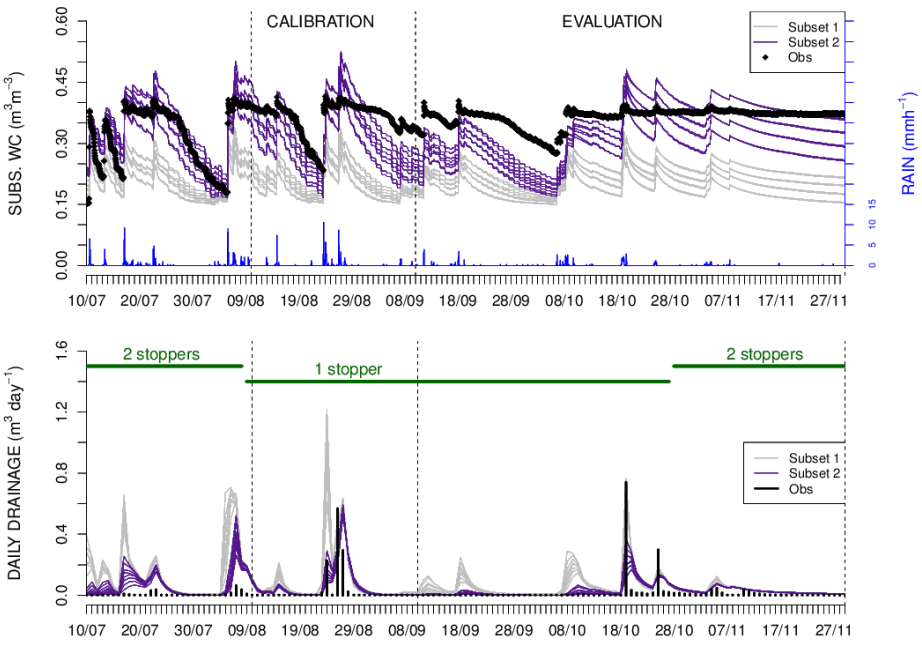


Fig. 8.

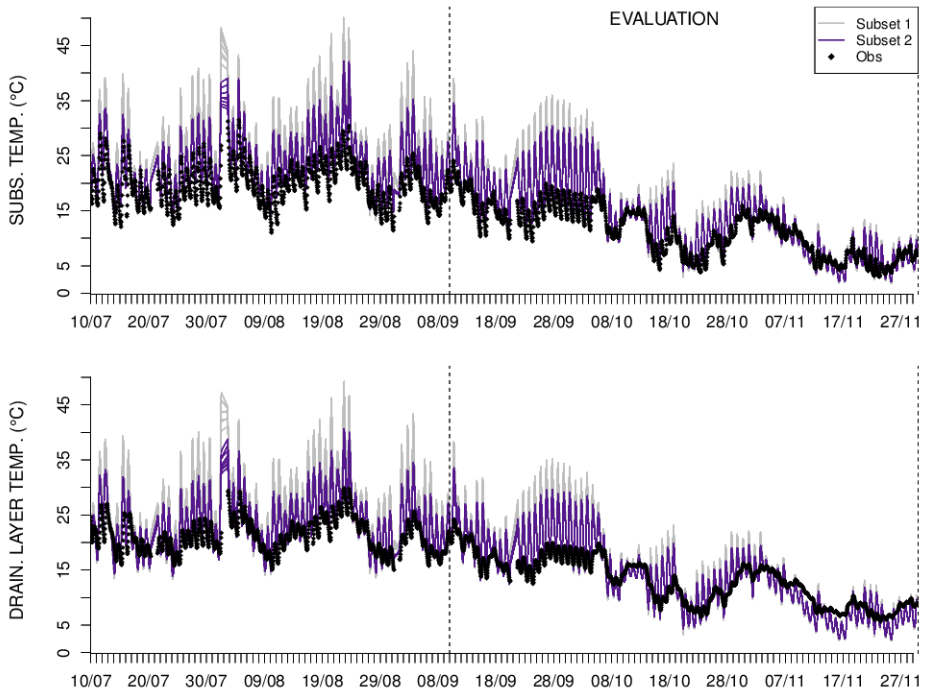

EVALUATION
Subset 1
Subset 2
Obs
SUBS. TEMP. (°C)
DRAIN. LAYER TEMP. (°C)
0
5
15
25
35
45
10/07
20/07
30/07
09/08
19/08
29/08
08/09
18/09
28/09
08/10
18/10
28/10
07/11
17/11
27/11

Fig. 9.