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Local scale evaluation of the simulated interactions between energy, water and vegetation in land surface model

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JC Calvet

Many thanks for this interesting work. This is an excellent contribution to the continuous model intercomparison effort.

Comment 1.1 — In order to allow the reproducibility of the simulations, it could be useful adding a Supplement with model namelists together with a Table listing key model parameters, their values, and how these values were determined.

For ISBA and ORCHIDEE, the namelists used for this experiment are added as supplement material. Additionally, tables listing some of the key plant physiology and soil physical parameter values are given as well. The architecture of the diagnostic model differs too much from the prognostic models to allow comparison of the plant physiological parameters. They are not included in these tables.
The following text has been added to section 3.1:

> “ *An overview of some key plant physiology parameters and soil physical parameters is given in the supplement material, along with full option namelists of the ISBA and ORCHIDEE runs to allow reproducibility.*
> *Most of the vegetation parameters in ISBA are derived from the TRY plant traits database (Kattge et al., 2011; Delire et al., 2020). Parameters in ORCHIDEE are derived from the same database, but are regularly calibrated using various data types, including satellite observations, in situ fluxes and surface concentrations (e.g. Kuppel et al., 2012, 2014; MacBean et al., 2015; Peylin et al., 2016). Kuppel et al. (2014) used 78 FLUXNET sites to optimize parameters related to the NEE (net ecosystem exchange) and LE fluxes (see their Table S2). Hence, whereas the ORCHIDEE parameters were not optimized using the specific dataset of this study, a part of it may have been used formerly in this regard. Similarly, key parameters of the diagnostic model have been (indirectly) derived from the global network of eddy covariance stations (Garbulsky et al., 2010; Martínez et al., 2020).* ”

PFT	V_{cmax} (mg m^{-2}s^{-1}) ISBA	ORCH	SLA (m^{2}kgC^{-1}) ISBA	ORCH
Temp DBF	2.60	1.14	15.4	26.0
Boreal ENF	2.80	1.02	5.0	9.3
Trop EBF	1.00	1.02	8.3	15.3
C3 crop	4.40	1.36	14.8	26.0
C4 crop	1.70	1.36	10.3	26.0
irr. Crop	3.40	-	10.3	-
C3 grass	3.40	1.14	14.0	42.0
C4 grass	1.70	1.14	5.7	41.0
Wetlands	3.40	-	14.0	-
Trop DBF	1.80	1.02	15.4	26.0
Temp EBF	2.60	0.91	8.3	20.0
Temp ENF	2.80	0.80	5.0	9.3
Boreal DBF	2.60	0.80	15.4	26.0
Boreal DNF	1.80	0.80	10.1	19.0
Boreal Grass	3.40	-	14.0	-
Deciduous Shrub	2.40	-	15.4	-

Table S-1: Key plant physiological parameters in ISBA and ORCHIDEE (for the conversion of V_{cmax} to g_m and A_{mmax}, see Delire et al. (2020). DBF = Deciduous Broadleaf Forest, ENF = Evergreen Needleleaf Forest, EBF = Evergreen Broadleaf Forest, DNF = Deciduous Needleleaf Forest.

Texture class	θ_s (m^{3}m^{-3})	θ_r (m^{3}m^{-3})	n (-)	α (10^{3}cm^{-1})	K_s (cm d^{-1})	θ_{fc} (m^{3}m^{-3})
Sand	0.43	0.05	2.68	14.5	7128.0	0.05
Loamy Sand	0.41	0.60	2.28	12.4	3501.6	0.07
Sandy Loam	0.41	0.07	1.89	7.5	1060.8	0.12
Silt Loam	0.45	0.07	1.41	2.0	108.0	0.24
Silt	0.46	0.03	1.37	1.6	60.0	0.26
Loam	0.43	0.08	1.56	3.6	249.6	0.17
Sandy Clay Loam	0.39	0.10	1.48	5.9	314.4	0.17
Silty Clay Loam	0.43	0.09	1.23	1.0	16.8	0.34
Clay Loam	0.41	0.10	1.31	1.9	62.4	0.27
Sandy Clay	0.38	0.10	1.23	2.7	28.8	0.27
Silty Clay	0.36	0.07	1.09	0.5	4.8	0.34
Clay	0.38	0.07	1.09	0.8	48.0	0.35

Table S-2: ORCHIDEE soil physical parameters for the Mualem-Van Genuchten model (derived from Carsel and Parrish (1988)), θ_{fc} is the water content at field capacity (not derived from the retention curve).

Texture class	θ_s (m^3m^{-3})	Φ_s (cm)	b (-)	K_s (cm d^{-1})	θ_{fc} (m^3m^{-3})
Sand	0.40	-12.10	4.05	1520.6	0.23
Loamy Sand	0.41	-9.00	4.38	1350.7	0.24
Sandy Loam	0.44	-21.80	4.90	299.5	0.32
Silt Loam	0.49	-78.60	5.30	62.2	0.46
Silt	0.49	-78.60	5.30	62.2	0.46
Loam	0.45	-47.80	5.39	60.0	0.39
Sandy Clay Loam	0.42	-29.90	7.12	54.4	0.35
Silty Clay Loam	0.48	-35.60	7.75	14.7	0.42
Clay Loam	0.48	-63.00	8.52	21.2	0.45
Sandy Clay	0.43	-15.30	10.40	18.7	0.36
Silty Clay	0.49	-49.00	10.40	8.9	0.46
Clay	0.48	-40.50	11.40	11.1	0.45

Table S-3: ISBA soil physical parameters for the Campbell model (derived from Clapp and Hornberger (1978)),θ_{fc} is the water content at field capacity.

Texture class	θ_s (m^3m^{-3})	θ_{fc} (m^3m^{-3})	θ_{wilt} (m^3m^{-3})
Coarse	0.40	0.24	0.06
Medium	0.44	0.35	0.15
Medium fine	0.43	0.38	0.13
Fine	0.52	0.45	0.28
Very fine	0.61	0.54	0.34
Organic	0.77	0.66	0.27
Loamy	0.47	0.32	0.17

Table S-4: DiagMod soil physical parameters, based on the Wösten et al. (1999) PTF.

Comment 1.2 — It should be clarified whether any of the in situ datasets used in this study as a reference was involved in previous model parameter tunings.

The global network of eddy covariance station is directly or indirectly (via derived products, e.g. FluxCom) involved in the parametrization of land surface models. This is the case in particular for ORCHIDEE and the diagnostic model. The manuscripts has been revised to clarify this (see previous response).

Comment 1.3 — Finally, how were model simulations initialized (e.g. initial root-zone soil moisture conditions)?

The initialization of ISBA is described in section 2.1.2, L133:

> *" A spin-up period of 3 years was sufficient to eliminate effects from the initial model state on the surface fluxes (respiration is not analysed in this study). "*

Concerning the initialization of ORCHIDEE, the following text was added to section 2.1.3:

> *" To initialize the simulations, a first spin-up phase was performed, where we cycled over the available FLUXNET years for at least 45 years. This enables to reach an equilibrium for the above-ground biomass and the water stocks and fluxes, as an initial state for the transient simulation. "*
>
> The diagnostic model does not require any initialization.

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