



Supplement of

Resolving effects of leaf pigmentation changes and plant residue on the energy balance of winter wheat cultivation in the ORCHIDEE-CROP model

Ke Yu et al.

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Additional Supporting Information

1. Additional Figures S1 to S16
2. References

Section S1 Additional figures

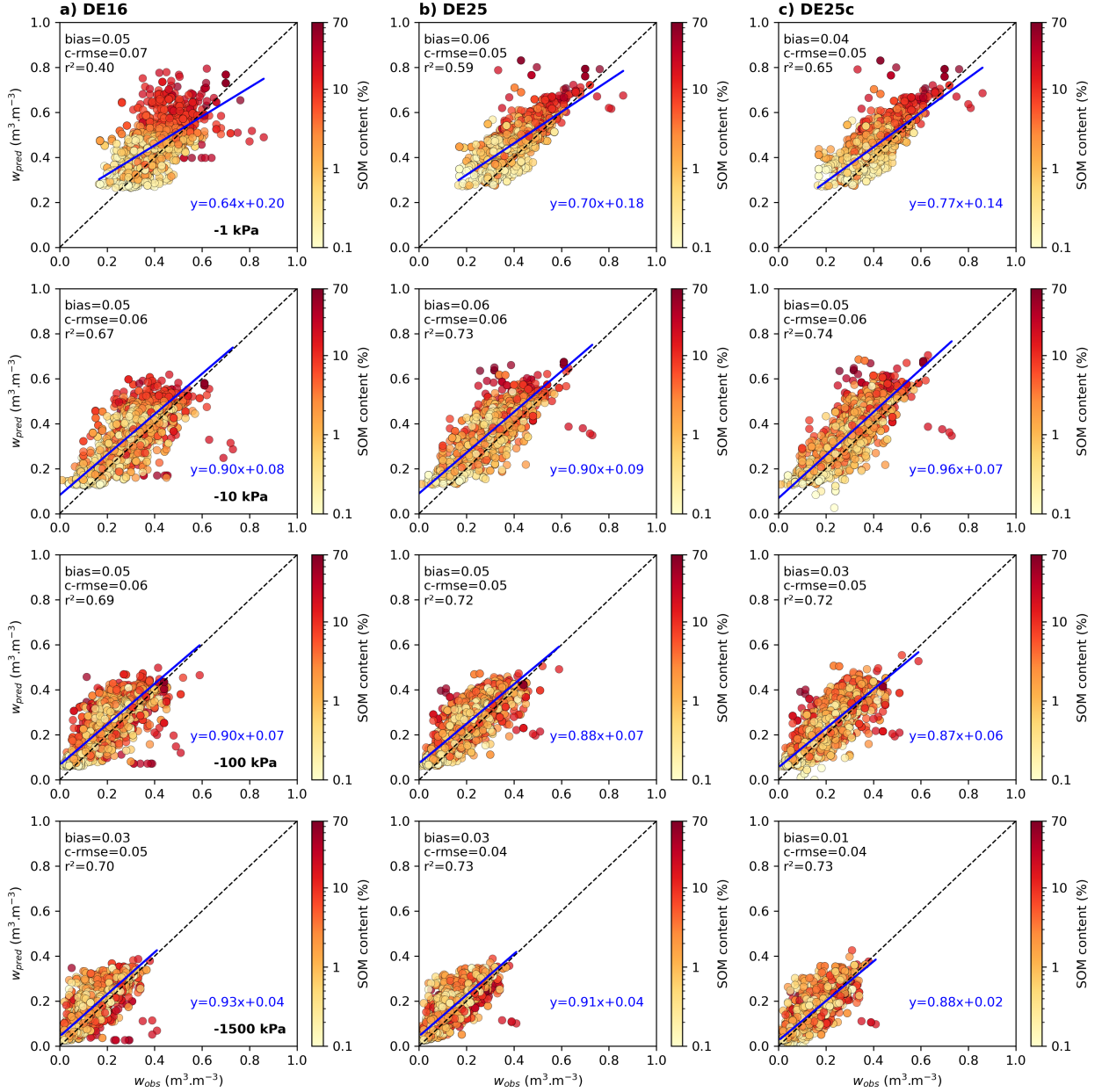


Figure S1. Comparison between predicted and observed volumetric water contents, w ($\text{m}^3 \cdot \text{m}^{-3}$), at four matric potentials (-1, -10, -100, and -1500 kPa) for the Kristensen et al. (2019) water-retention dataset. The figure follows the same design as Figure 5 in the companion paper (Decharme, 2025), but reports results for the three parameterizations considered here: (a) DE16, (b) DE25, and (c) DE25c. Points are colored by soil organic matter (SOM) content (%), the blue line shows the least-squares regression and the dashed line indicates the 1:1 relationship. Regression diagnostics (equation, bias, c-rmse, and r^2) are provided in each panel.

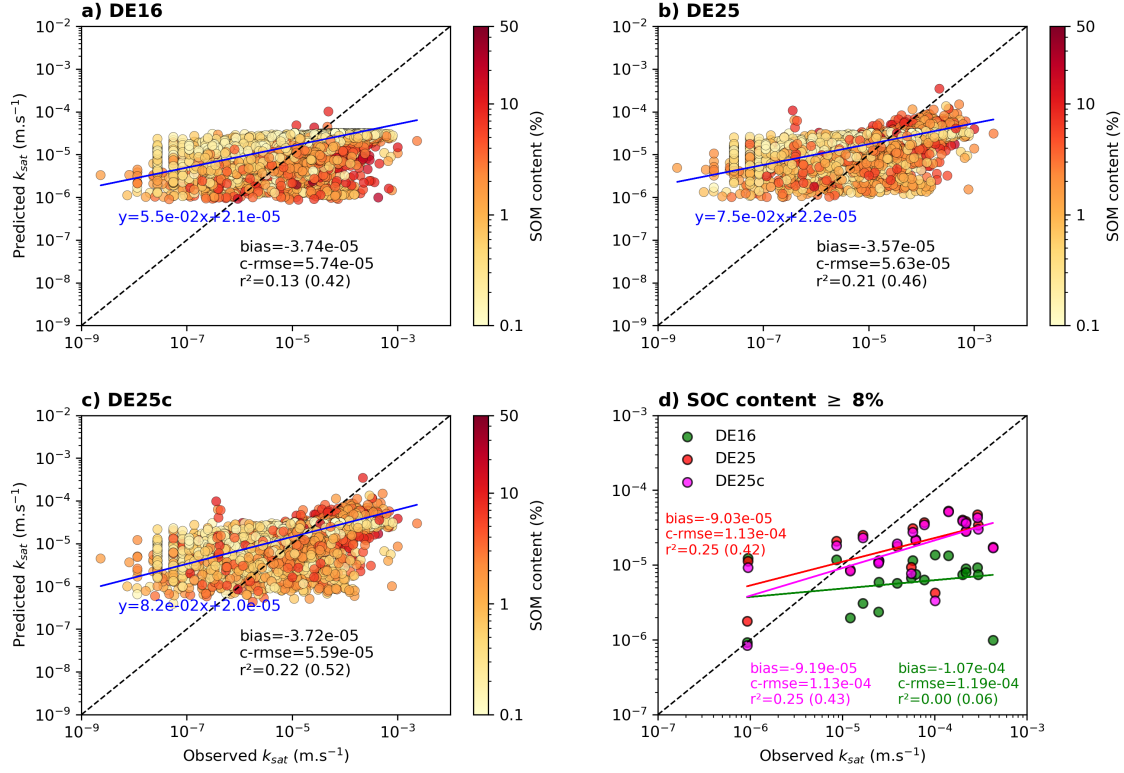


Figure S2. Comparison between predicted and observed saturated hydraulic conductivity, k_{sat} (m.s⁻¹), using the SoilKsatDB dataset (Gupta et al., 2021). The figure follows the same design as Figure 8 in the companion paper (Decharme, 2025), but reports results for the three parameterizations considered here: (a) DE16, (b) DE25, and (c) DE25c. Points are colored by soil organic matter (SOM) content (%); the blue line shows the least-squares regression and the dashed line indicates the 1:1 relationship. Regression diagnostics (equation, bias, c-rmse, and r^2 , with the value in parentheses computed in log-space) are provided in each panel. Panel (d) focuses on samples with SOC content $\geq 8\%$.

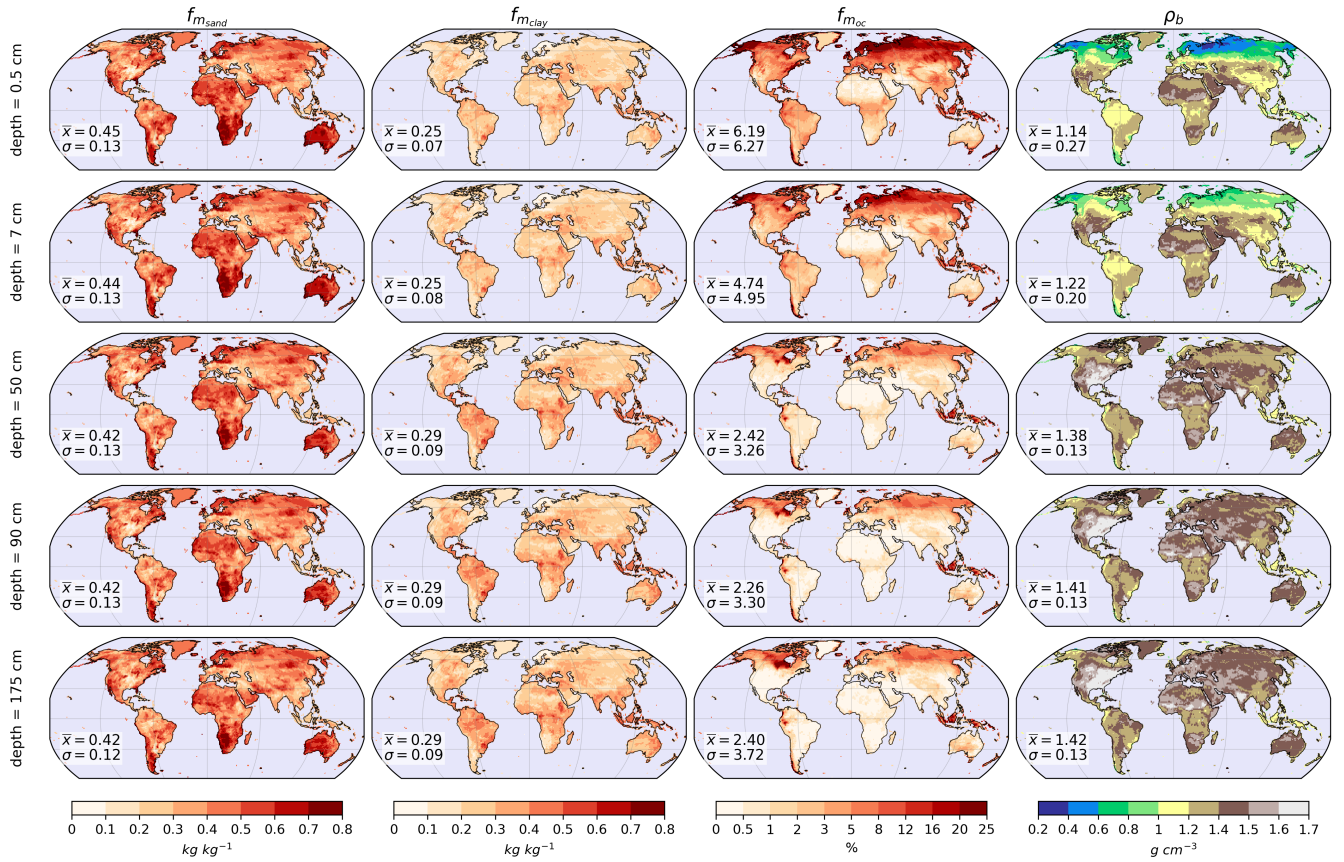


Figure S3. Global distributions of SoilGrids input variables sampled at five representative depths (0.5, 7, 50, 90, and 175 cm) along the ISBA soil vertical profile. From left to right, the panels show the sand mass fraction ($f_{m_{sand}}$), the clay mass fraction ($f_{m_{clay}}$), the soil organic carbon mass fraction ($f_{m_{oc}}$), and the bulk density (ρ_b). For each map, the global mean ($\bar{x}$) and standard deviation (σ) are indicated.

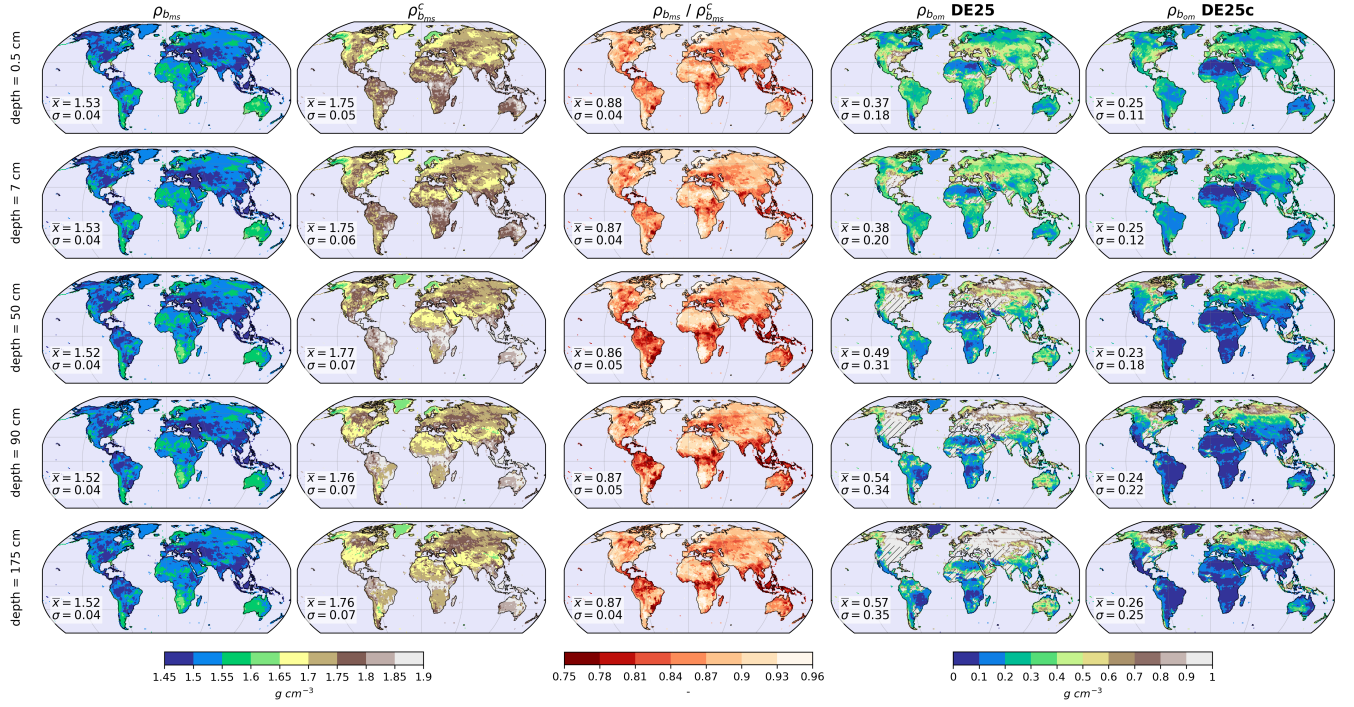


Figure S4. Global distributions of the mineral-phase bulk density $\rho_{b_{ms}}$ diagnosed in DE25, the compacted mineral-phase bulk density $\rho_{b_{ms}}^c$ diagnosed in DE25c, and their ratio $\rho_{b_{ms}} / \rho_{b_{ms}}^c$ (dimensionless), together with the diagnosed organic-phase bulk density $\rho_{b_{om}}$ for DE25 and DE25c, following the same layout and annotations as Supplementary Figure S3. Bulk densities are expressed in g cm^{-3} . Hatched areas in the $\rho_{b_{om}}$ panels indicate grid cells where the numerical regularization is active, i.e., where $f_{m_{om}}^* > f_{m_{om}}$ in the computation of $\rho_{b_{om}}$ (Equations 2 and 3).

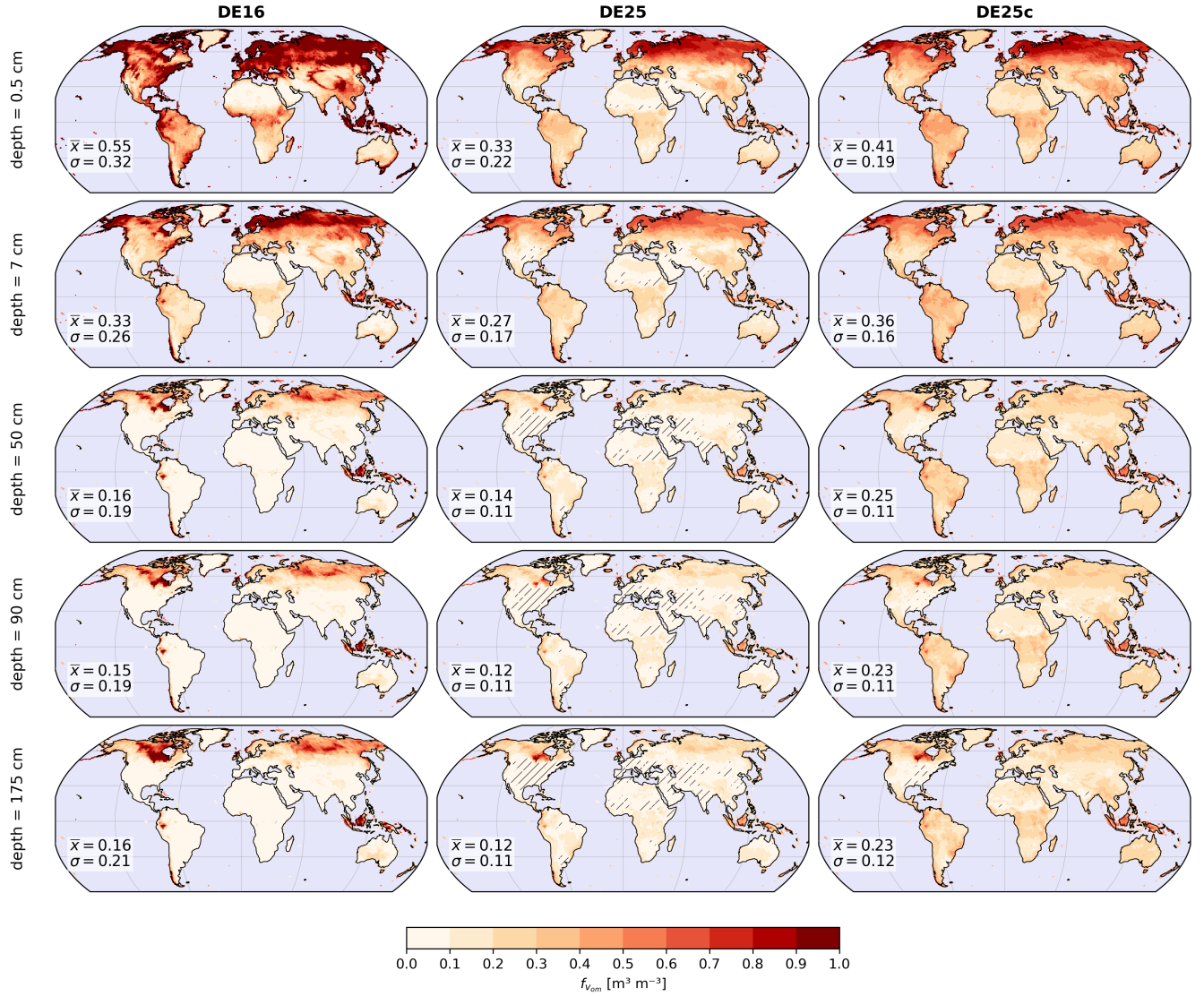


Figure S5. Global distributions of the volumetric organic matter fraction, f_{vom} ($\text{m}^3 \text{m}^{-3}$), diagnosed on the ISBA grid for the three parameterizations considered here (columns: DE16, DE25, and DE25c), using the same layout and annotations as Supplementary Figure S3. Hatched areas in the DE25 and DE25c panels indicate grid cells where the numerical regularization $f_{m_{om}}^*$ is active as in Figure S4.

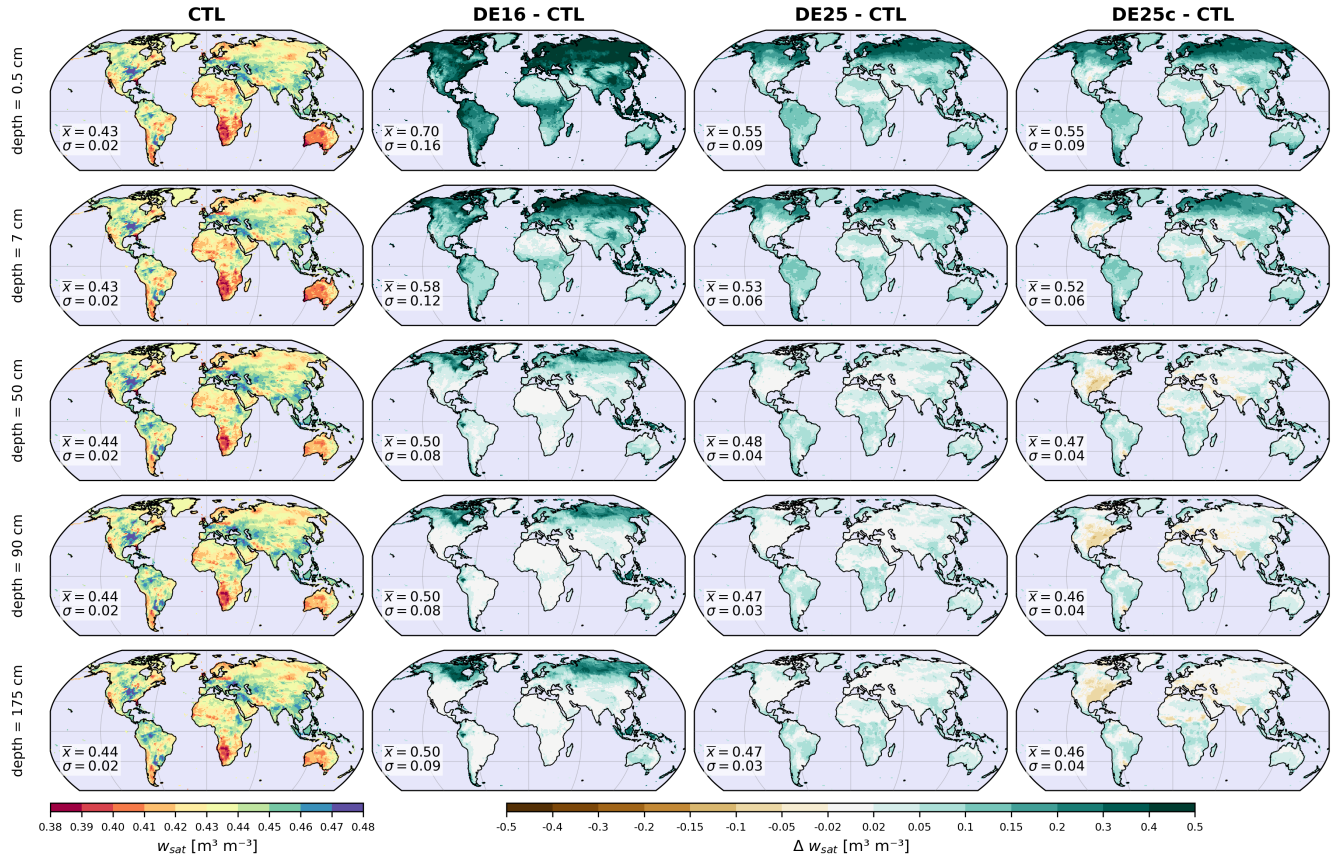


Figure S6. Global distributions of the ISBA soil porosity at saturation, w_{sat} (m³ m⁻³), diagnosed at five representative depths of the soil profile (0.5, 7, 50, 90, and 175 cm). The first column shows w_{sat} in the mineral control experiment (CTL). The three other columns show differences relative to CTL (noted Δw_{sat}) for DE16, DE25, and DE25c. For each map, the inset reports the spatial mean $\bar{x}$ and standard deviation σ over land points for the corresponding experiment (not for the differences).

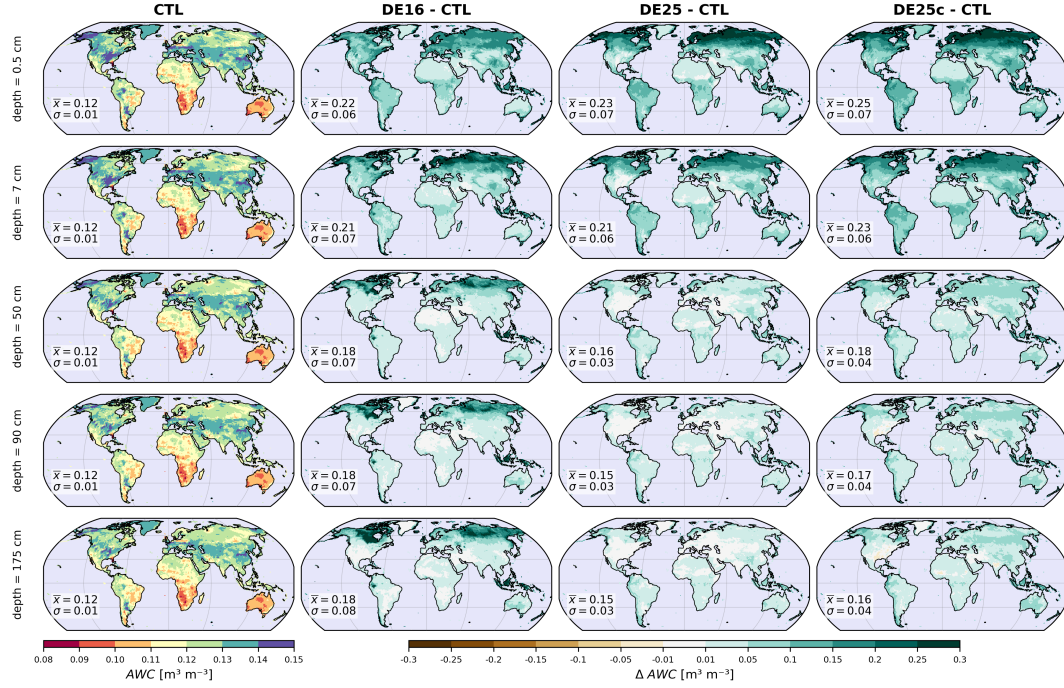


Figure S7. As in Supplementary Figure S6, but for the soil available water content, AWC , defined as $w_{fc} - w_{wilt}$ ($\text{m}^3 \text{m}^{-3}$)

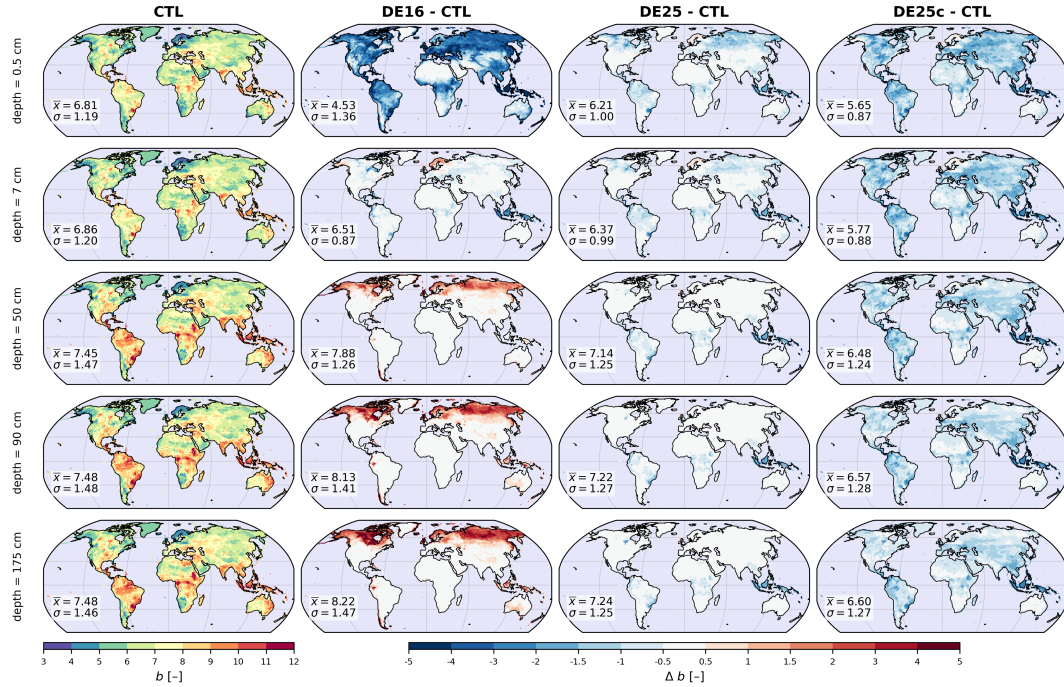


Figure S8. As in Supplementary Figure S6, but for the dimensionless pore-size distribution index, b , of the Brooks and Corey (1964) model.

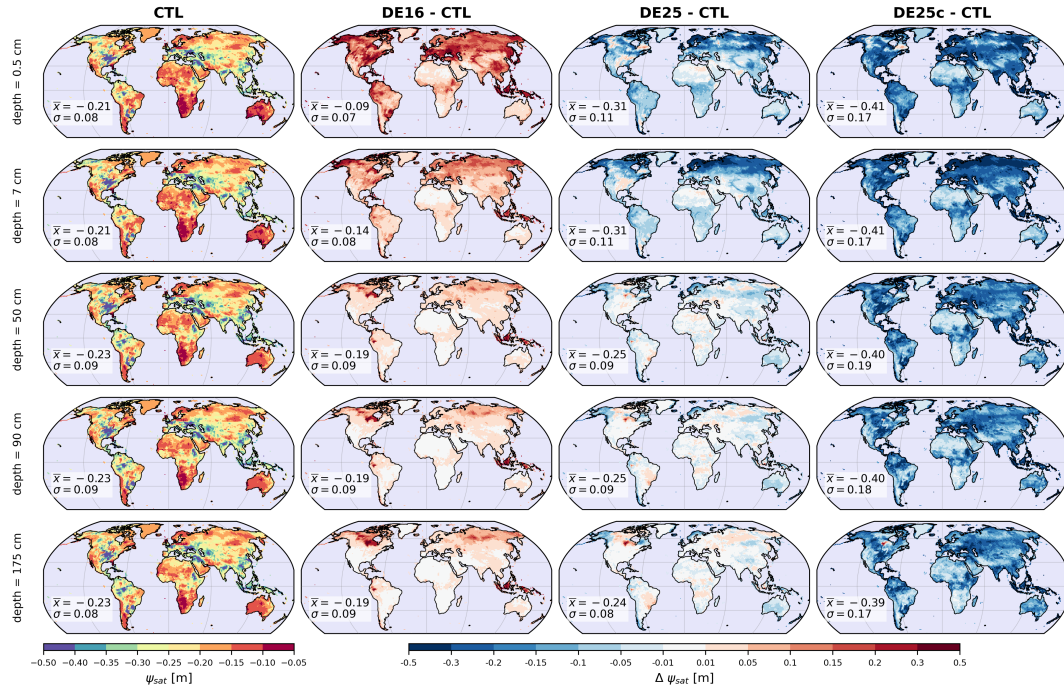


Figure S9. As in Supplementary Figure S6, but for the soil air-entry pressure head, ψ_{sat} (m).

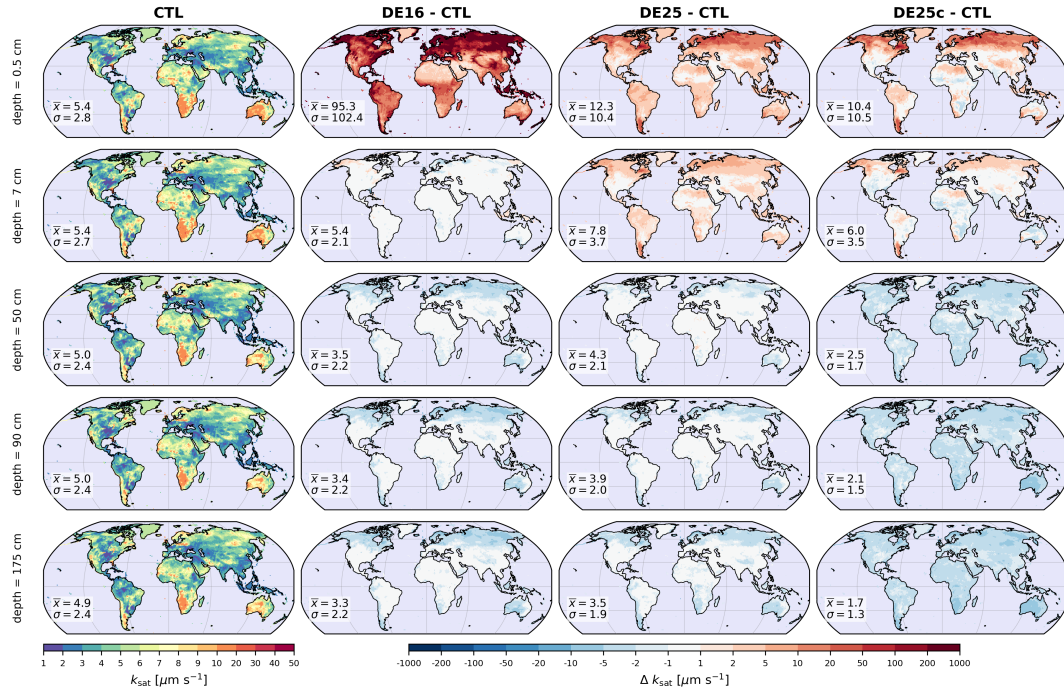


Figure S10. As in Supplementary Figure S6, but for the saturated hydraulic conductivity, k_{sat} (10^{-6} m.s $^{-1}$).

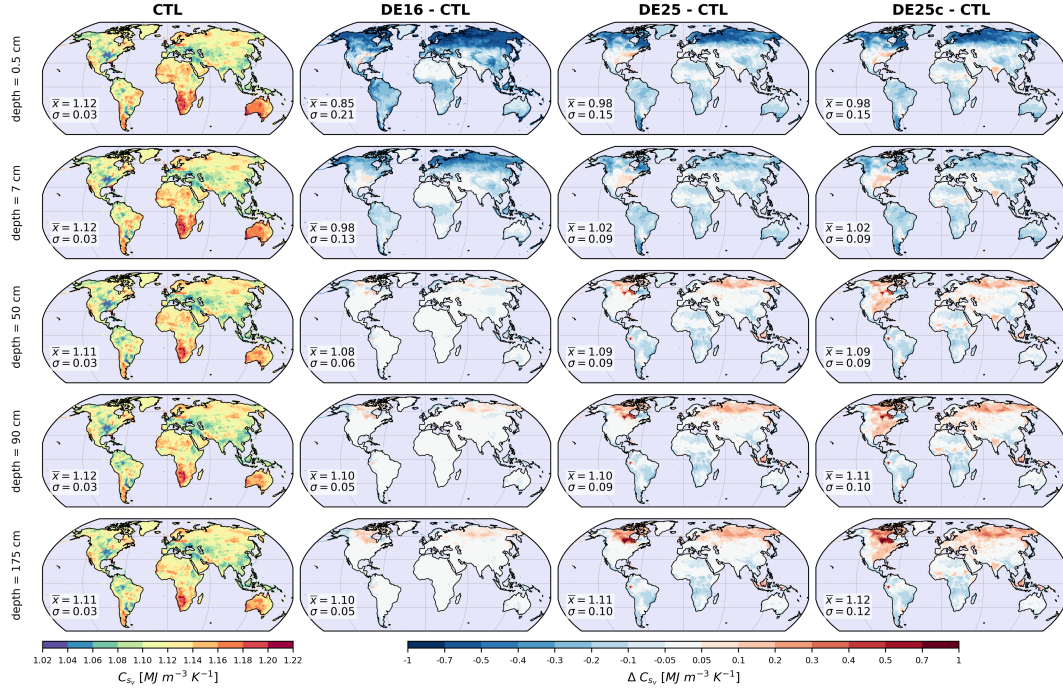


Figure S11. As in Supplementary Figure S6, but for the volumetric heat capacity of the dry solid matrix, C_{sv} ($10^6 \text{ J m}^{-3} \text{ K}^{-1}$).

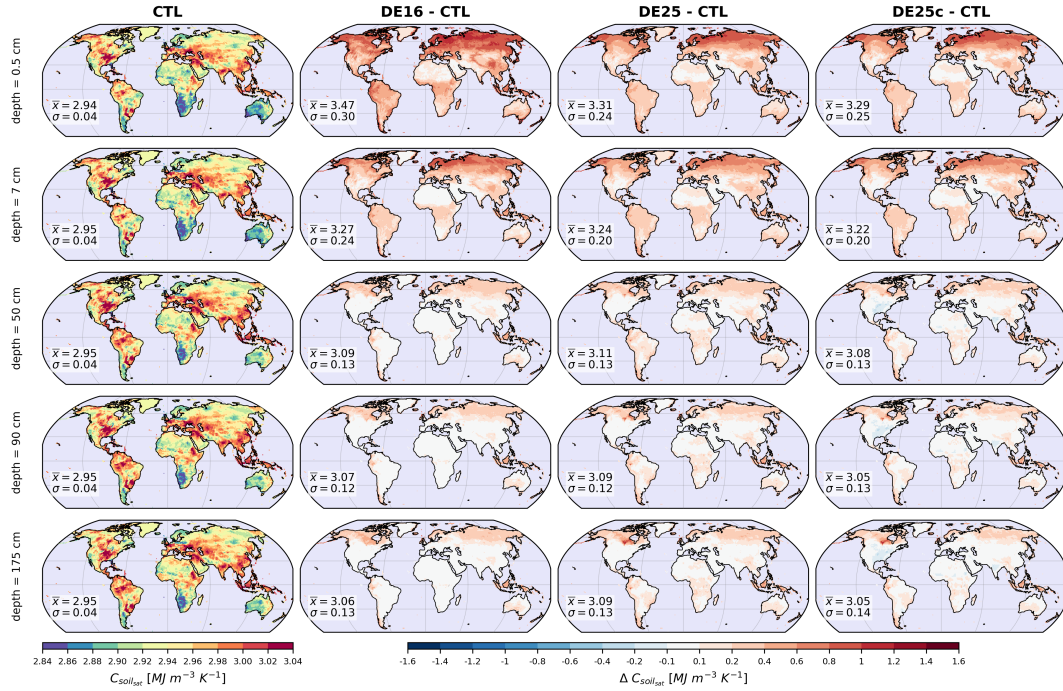


Figure S12. As in Supplementary Figure S6, but for the volumetric soil heat capacity at saturation, $C_{soil\,sat} = C_{sv} + C_{w\,sat}$ ($10^6 \text{ J m}^{-3} \text{ K}^{-1}$).

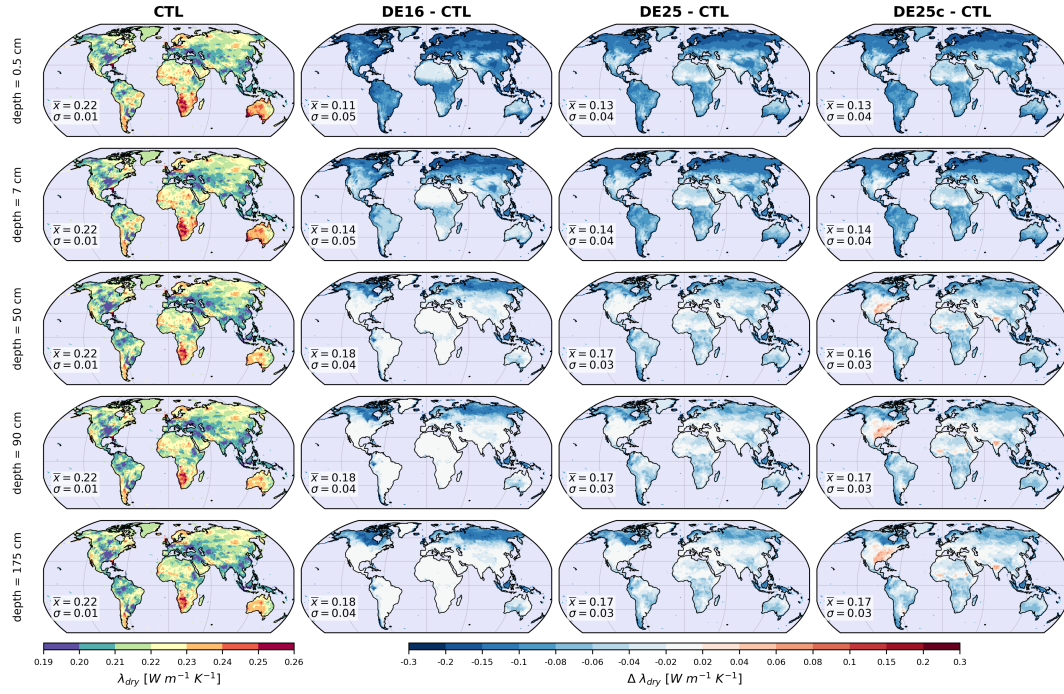


Figure S13. As in Supplementary Figure S6, but for the soil dry thermal conductivity, λ_{dry} ($\text{W m}^{-1} \text{K}^{-1}$).

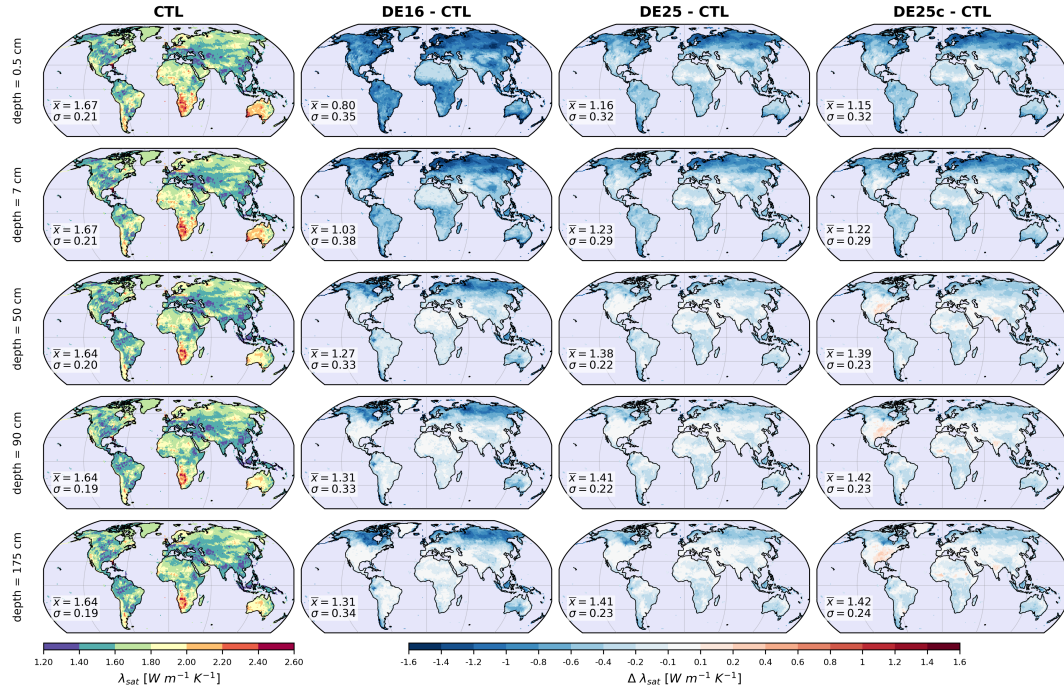


Figure S14. As in Supplementary Figure S6, but for the soil saturated thermal conductivity, λ_{sat} ($\text{W m}^{-1} \text{K}^{-1}$).

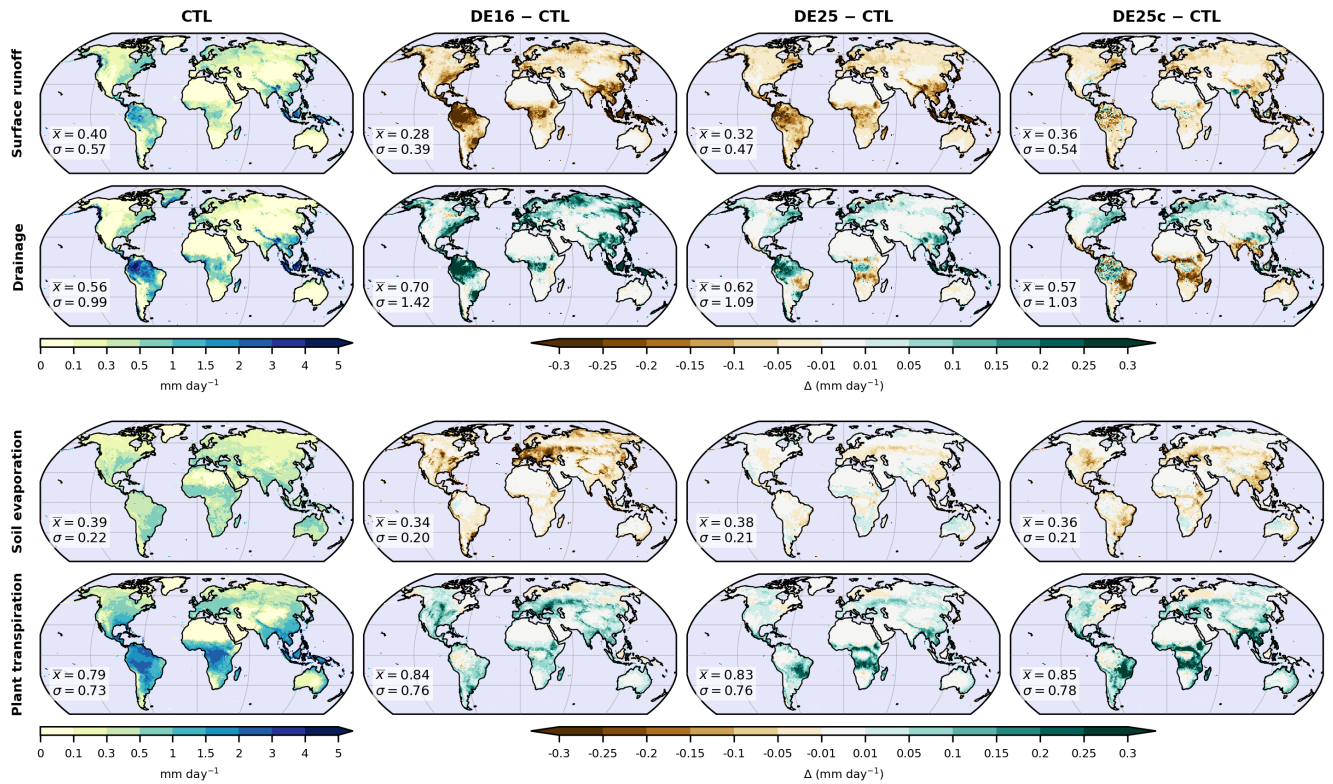


Figure S15. As in Figure 9, but for the 1979–2010 mean surface runoff, drainage, bare soil evaporation, and plant transpiration. Surface runoff and drainage are the two components of total runoff considered here, while bare soil evaporation and plant transpiration are shown to document the main land-surface partitioning of total evapotranspiration.

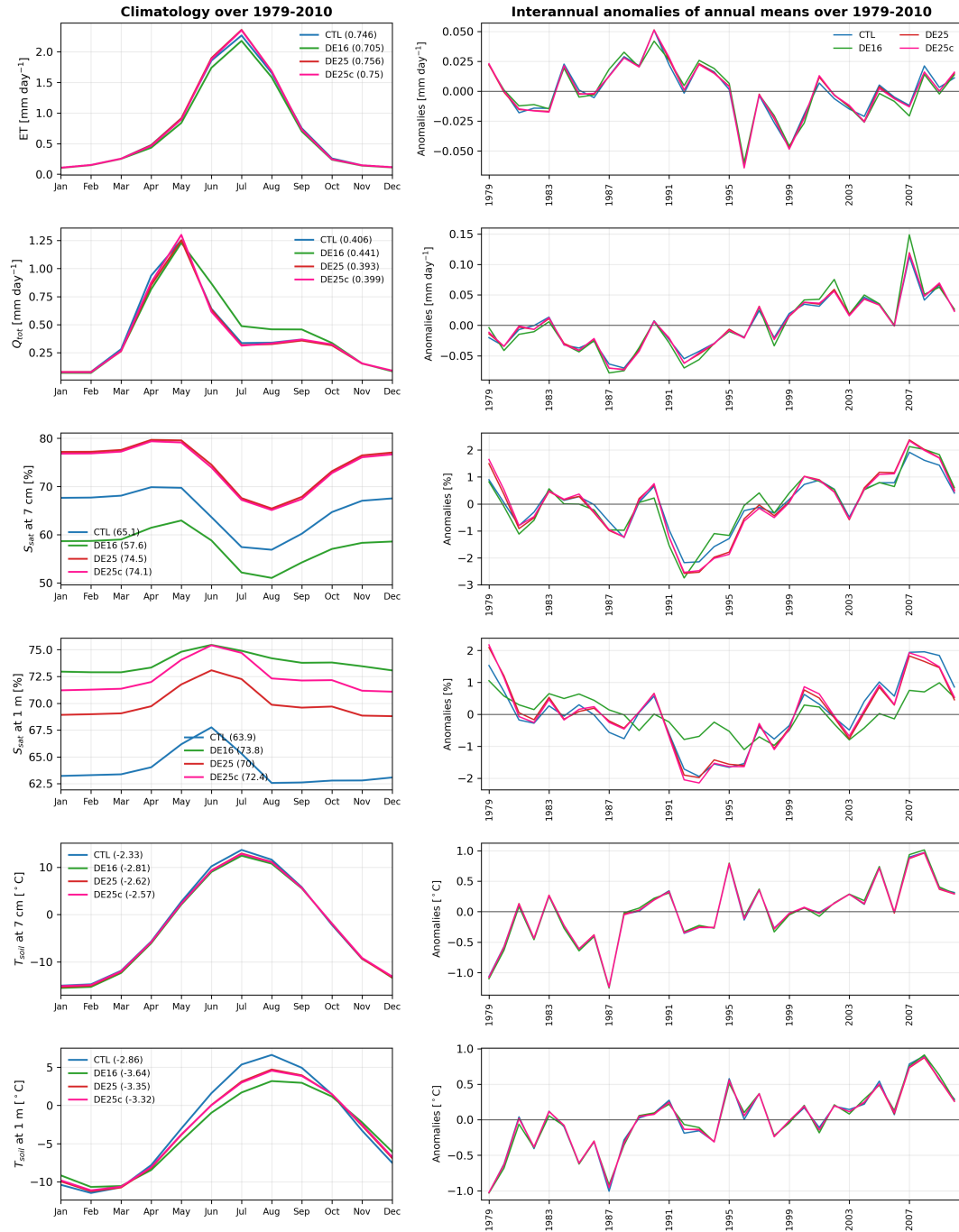


Figure S16. Regional temporal diagnostics over a SOC-rich Siberian domain, 40°E to 180°E and 45°N to 85°N, for CTL, DE16, DE25, and DE25c over 1979 to 2010. The left column shows monthly climatological cycles of evapotranspiration, ET , total runoff, Q_{tot} , soil saturation degree, S_{sat} , at 7 cm and 1 m depth, and soil temperature, T_{soil} , at 7 cm and 1 m depth. Values in parentheses in the legends indicate the corresponding 1979 to 2010 means. The right column shows interannual anomalies of annual means, computed after removing the 1979 to 2010 mean of each experiment.

5 References

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- 10 Gupta, S., Hengl, T., Lehmann, P., Bonetti, S., and Or, D.: SoilKsatDB: Global database of soil saturated hydraulic conductivity measurements for geoscience applications, Earth System Science Data, 13, <https://doi.org/10.5194/essd-13-1593-2021>, 2021.
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