11   Additional Figures S

Figure S 1 Rest of SOC simulations from Ultuna (top left), Bad Lauchstädt (top right), Kraichgau field 1 (bottom left) and Swabian Jura Field 1 (bottom right). Initializations were done (i) assuming steady state using the formula of Bruun and Jensen, (2002) with turnover rates of Mueller et al., (1997) and Bruun et al., (2003) and (ii) by the ratio of the 2930 cm-1 to the 1620 cm-1 peak of DRIFTS spectra at different drying temperatures using both turnover rates for simulations. Bars indicate standard deviation of all plots per field.
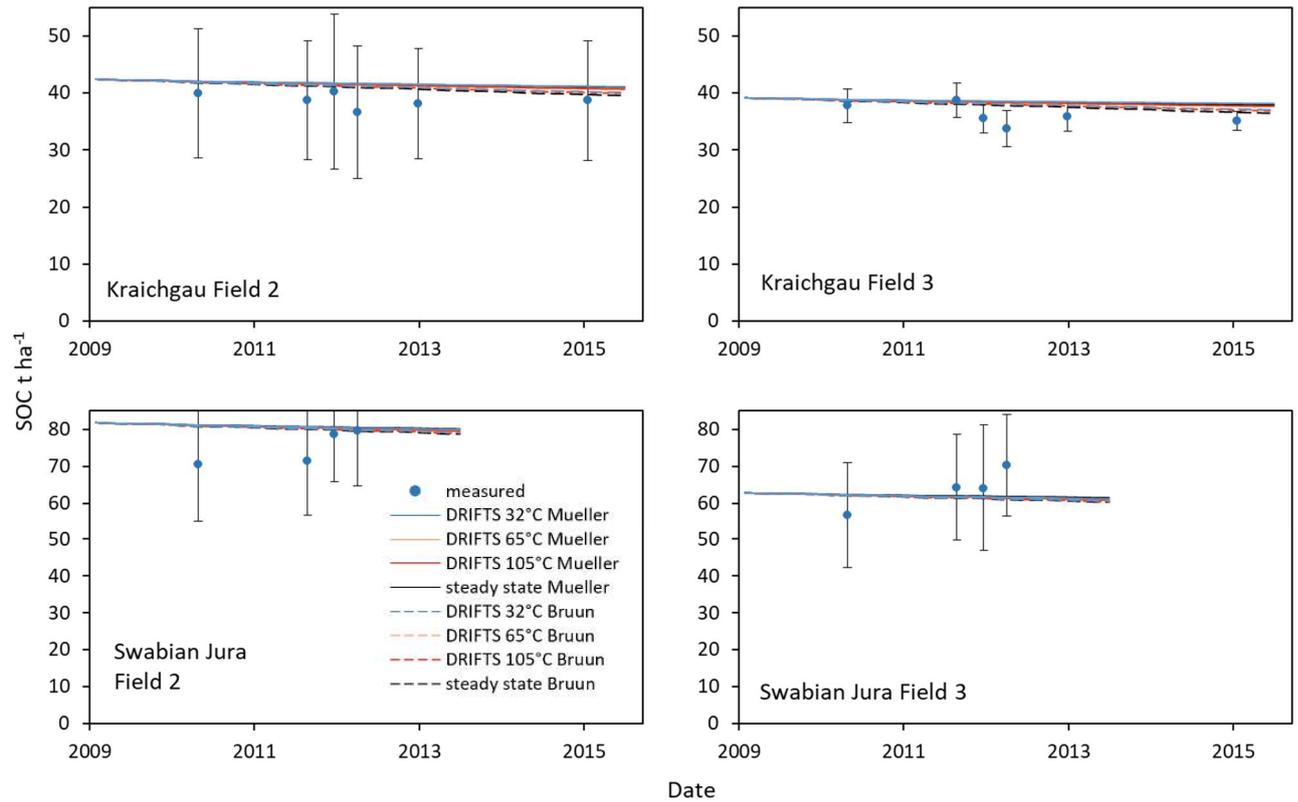
Figure S 2 Rest of the SOC simulations for Kraichgau field 2 (top left) and field 3 (top right) as well as for Swabian Jura field 2 (bottom left) and field 3 (bottom right). Initializations were done (i) assuming steady state using the formula of Bruun and Jensen, (2002) with turnover rates of Mueller et al., (1997) and Bruun et al., (2003) and (ii) by the ratio of the 2930 cm⁻¹ to the 1620 cm⁻¹ peak of DRIFTS spectra at different drying temperatures using both turnover rates for simulations. Bars indicate standard deviation of all plots per field.
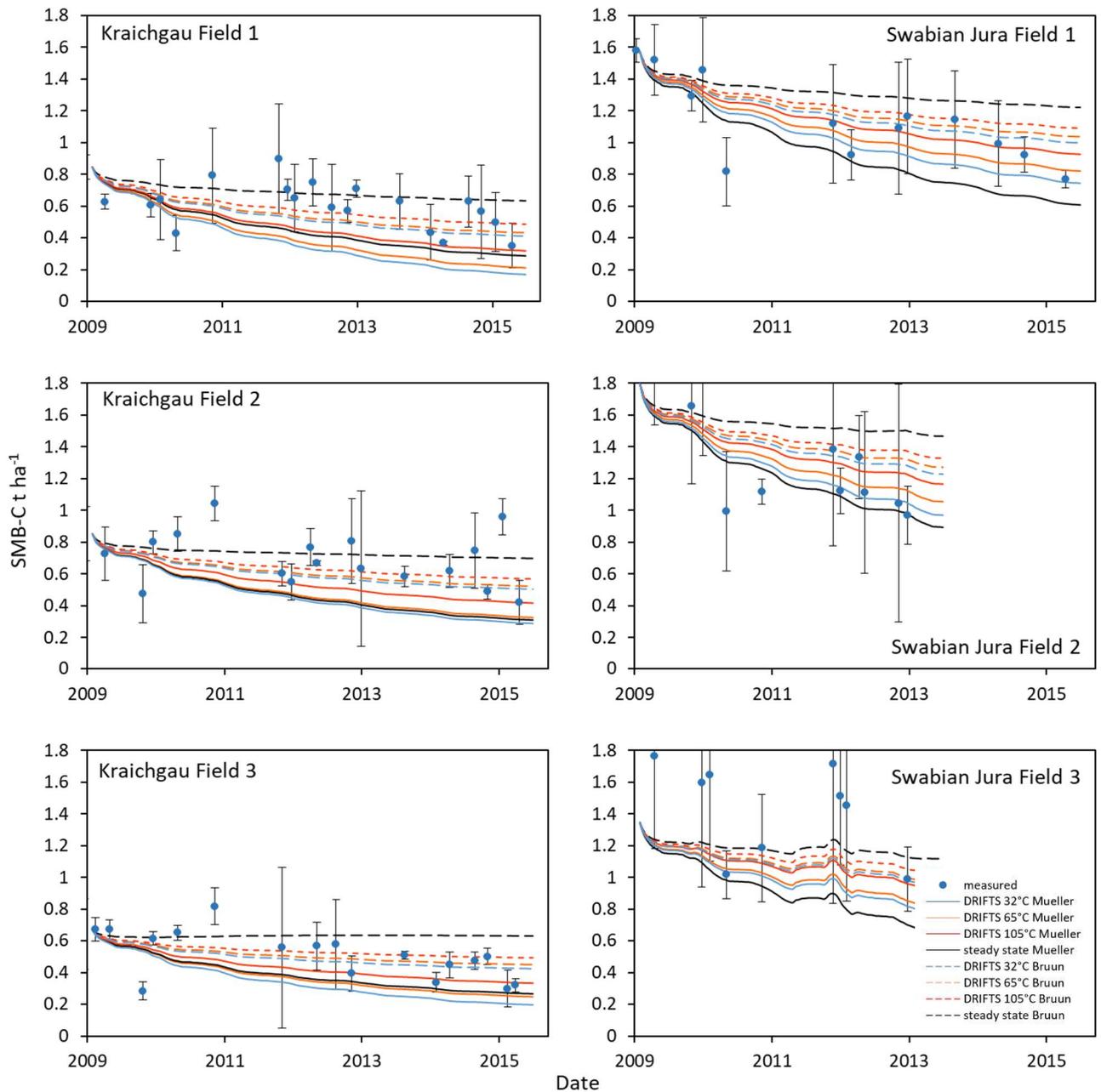
Figure S 3 SMB-C simulations for Kraichgau field 1, 2 and 3 as well as for Swabian Jura field 1, 2 and 3. Initializations were done (i) assuming steady state using the formula of Bruun and Jensen, (2002) with turnover rates of Mueller et al., (1997) and Bruun et al., (2003) and (ii) by the ratio of the 2930 cm^{-1} to the 1620 cm^{-1} peak of DRIFTS spectra at different drying temperatures using both turnover rates for simulations. Bars indicate standard deviation of all plots per field.
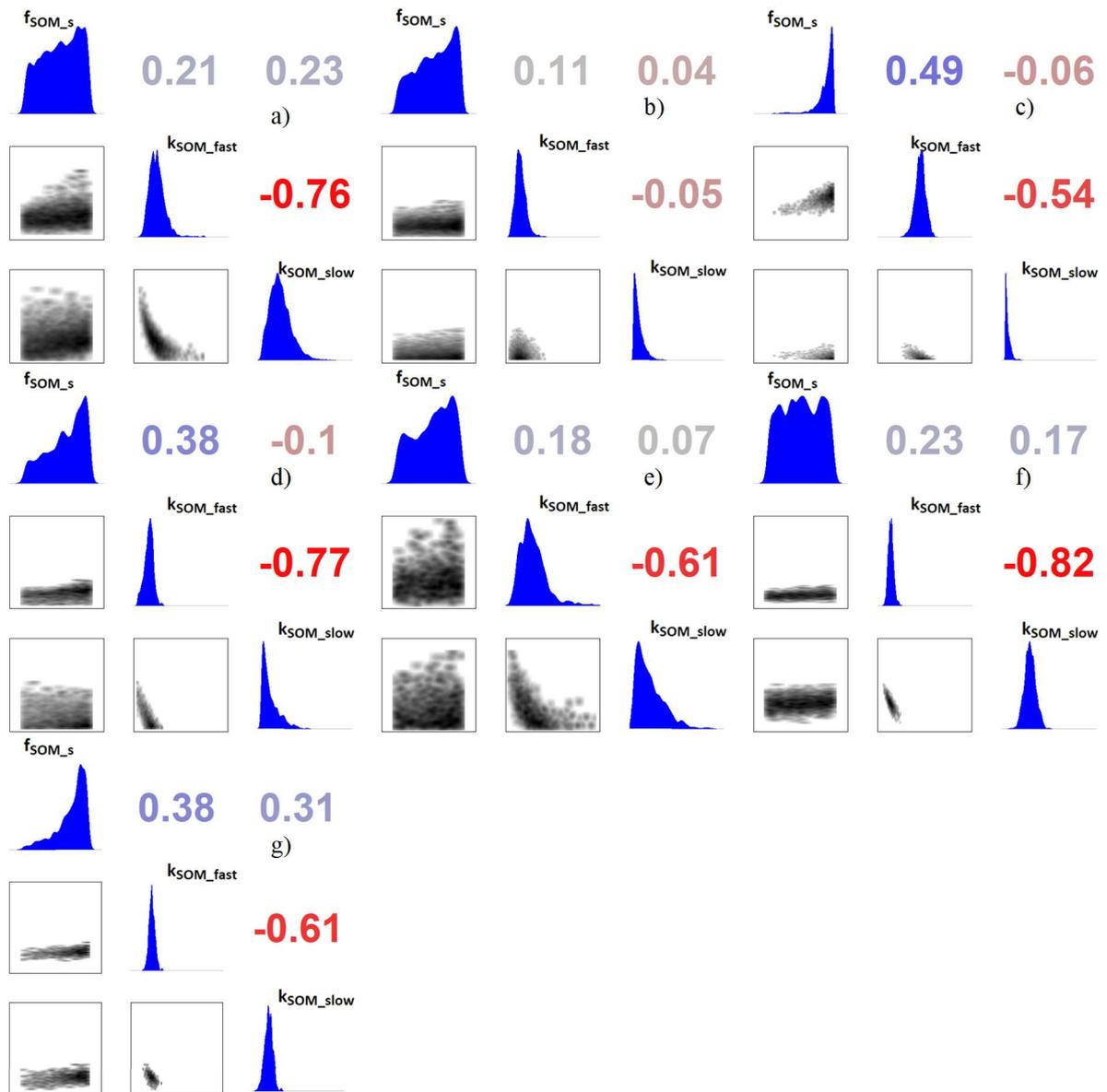
Figure S 4 Correlation matrices of the posterior distributions of different simulations from top left to bottom right: a) Ultuna b) Bad Lauchstädt, c) Kraichgau, d) Swabian Jura e) All combined with equal weights(using DSI) f) All combined without DSI and g) All combined with original weights (using DSI).
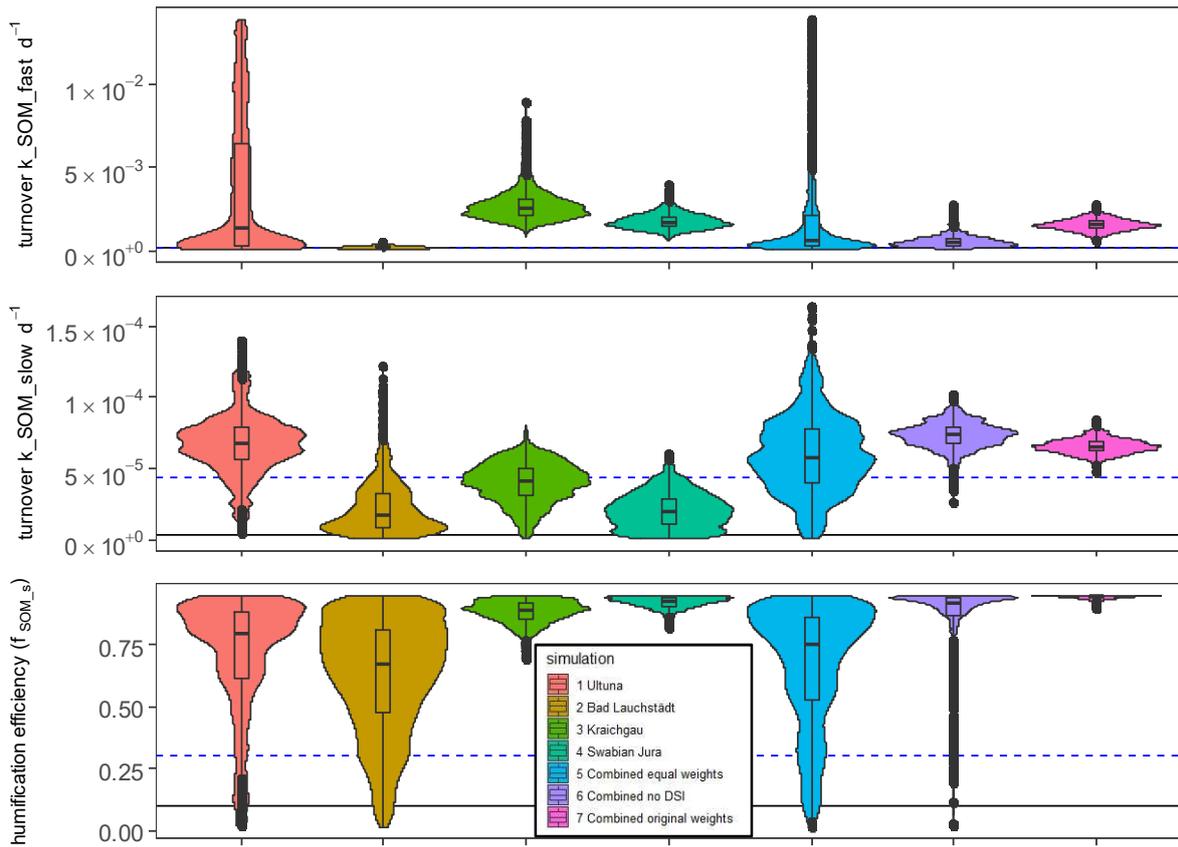
Figure S 5 Violin plots of the parameters, obtained by the Bayesian calibration when f$_{SOM\_slow}$ was constrained to 95 %. The black line corresponds to the parameters of Mueller (1997), the blue dashed line to the parameters of Bruun (2003).
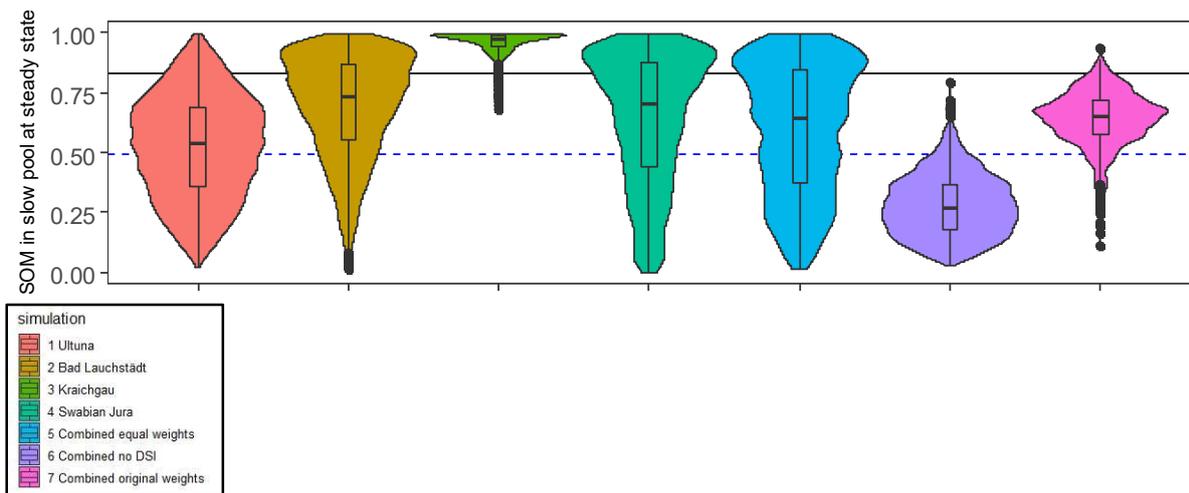
Figure S 6 Violin plots of the amount of SOM that would be in the slow pool at steady state for different Bayesian calibrations. The black line corresponds to the parameters of Mueller (1997), the blue dashed line to the value of Bruun (2003).

12 Supplementary Material:

12.1 SAS code of models used in for analysis of the model error

```
TITLE " final TOC for KR SJ) Temporal covariance structure sph";
ods graphics on;
proc glimmix data=Errors plots=residualpanel(conditional marginal);
ods output covparms FitStatistics diffs=diffs lsmeans=lsmeans;
class initialization turnover field days_passed_class;
model       E_TOC_root=       initialization       turnover       days_passed
initialization*turnover    turnover*days_passed    initialization*days_passed
initialization*days_passed*turnover /ddfm=KR;
random days_passed_class /sub=field type=sp(sph)(days_passed) ;
random       days_passed_class       /sub=field*       initialization*turnover
type=sp(sph)(days_passed)residual;
run;
ods graphics off;

TITLE " final full Cmic KR SJ) Temporal covariance structure POW";
ods graphics on;
proc glimmix data=Errors plots=residualpanel(conditional marginal);
ods output covparms FitStatistics diffs=diffs lsmeans=lsmeans;
class initialization turnover field days_passed_class;
model       E_Cmic_abs=       initialization       turnover       days_passed
initialization*turnover    turnover*days_passed    initialization*days_passed
initialization*days_passed*turnover /ddfm=KR;
random days_passed_class /sub=field type=sp(pow)(days_passed) ;
random       days_passed_class       /sub=field*       initialization*turnover
type=sp(pow)(days_passed)residual;
run;
ods graphics off;

TITLE " final SOC for Ultuna) Simple random effect";
ods graphics on;
proc glimmix data=Errors plots=residualpanel(conditional marginal);
ods output covparms FitStatistics diffs=diffs lsmeans=lsmeans normal;
class initialization turnover days_passed_class;
model       E_TOC_abs=       initialization       turnover       years_passed
initialization*turnover    turnover*years_passed    initialization*years_passed
initialization*years_passed*turnover /ddfm=KR;
random days_passed_class;
run;
ods graphics off;

TITLE " final SOC for Bad Lauchstädt) Temporal covariance structure Sph";
ods graphics on;
proc glimmix data=Errors plots=residualpanel(conditional marginal);
ods output covparms FitStatistics diffs=diffs lsmeans=lsmeans;
class initialization turnover days_passed_class;
model       E_TOC_sqr=       initialization       turnover       years_passed
initialization*turnover    turnover*years_passed    initialization*years_passed
initialization*years_passed*turnover /ddfm=KR;
random       days_passed_class       /sub=       initialization*turnover
type=sp(Sph)(years_passed) residual;
run;
ods graphics off;
```

 12.2 Selection of parameters subject to Bayesian calibration based on their importance within our model simulations

Here we explain, why only k_{SOM_slow}, k_{SOM_fast} and the humification efficiency (f_{SOM_s}) were considered to be important parameters for Bayesian calibration of bare fallow plots within this study. We give a calculation example of internal recycling from SOM going to SMB and back to SOM.

60 The amount of remaining SOM as one part SOM cycles through SMB one time and then is stabilized as SOM again is defined as:

$$SOM_{rec} = CUE * \frac{d_m}{m_m + d_m} * f_{SOM\_f} \quad (8)$$

Where SOM_{rec} is the percentage of recycled native SOM after one cycle of microbial use, CUE is the carbon use efficiency, d_m is the microbial death rate, m_m is the microbial maintenance respiration rate, and f_{SOM_f} is the

65 amount of dead microbial biomass going back to the fast SOM pool as microbes die. The results using the parameters of both parameter sets are identical here: 50% x 9% x 40% = 1.8% for the fast SOM pool, and 40% x 9% x 40% = 1.44% for the slow SOM**Fehler! Verweisquelle konnte nicht gefunden werden.**. From this very low recycling rates, it follows that without carbon inputs, the recycling parameters are irrelevant for simulation of SOM content and only the speed of decomposition and humification determine how much is left at a certain

70 point in time.