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Earth observation reveals reduced winter wheat growth and the importance of plant available water during drought

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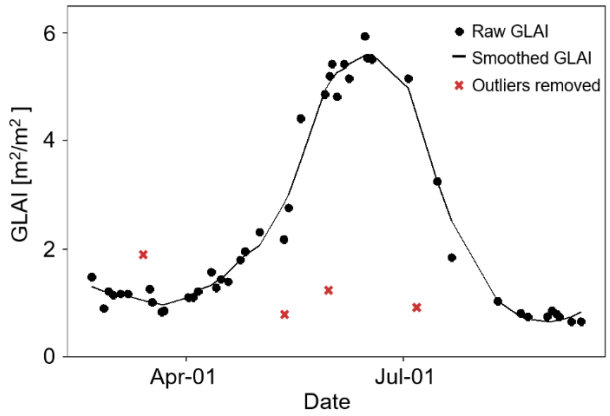

Fig. S1. Example of the temporal development of the green leaf area index (GLAI) with smoothed GLAI (black line), raw GLAI values (black dots), and removed outliers (red crosses).

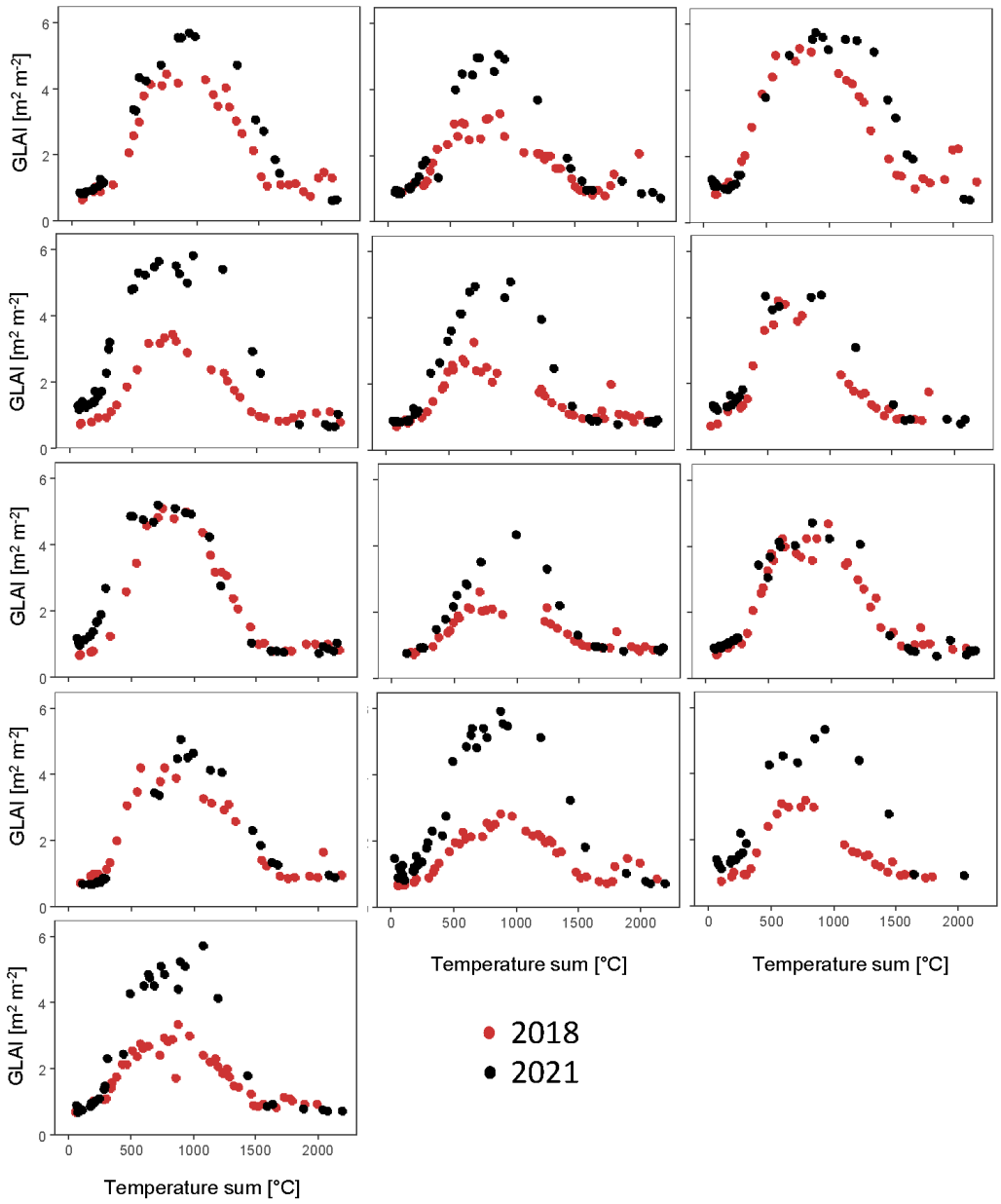

Fig. S2. Temporal evolution of GLAI during 2018 (dry year; red) and 2021 (year with normal weather conditions; black) as a function of temperature sum for each of the 13 fields.

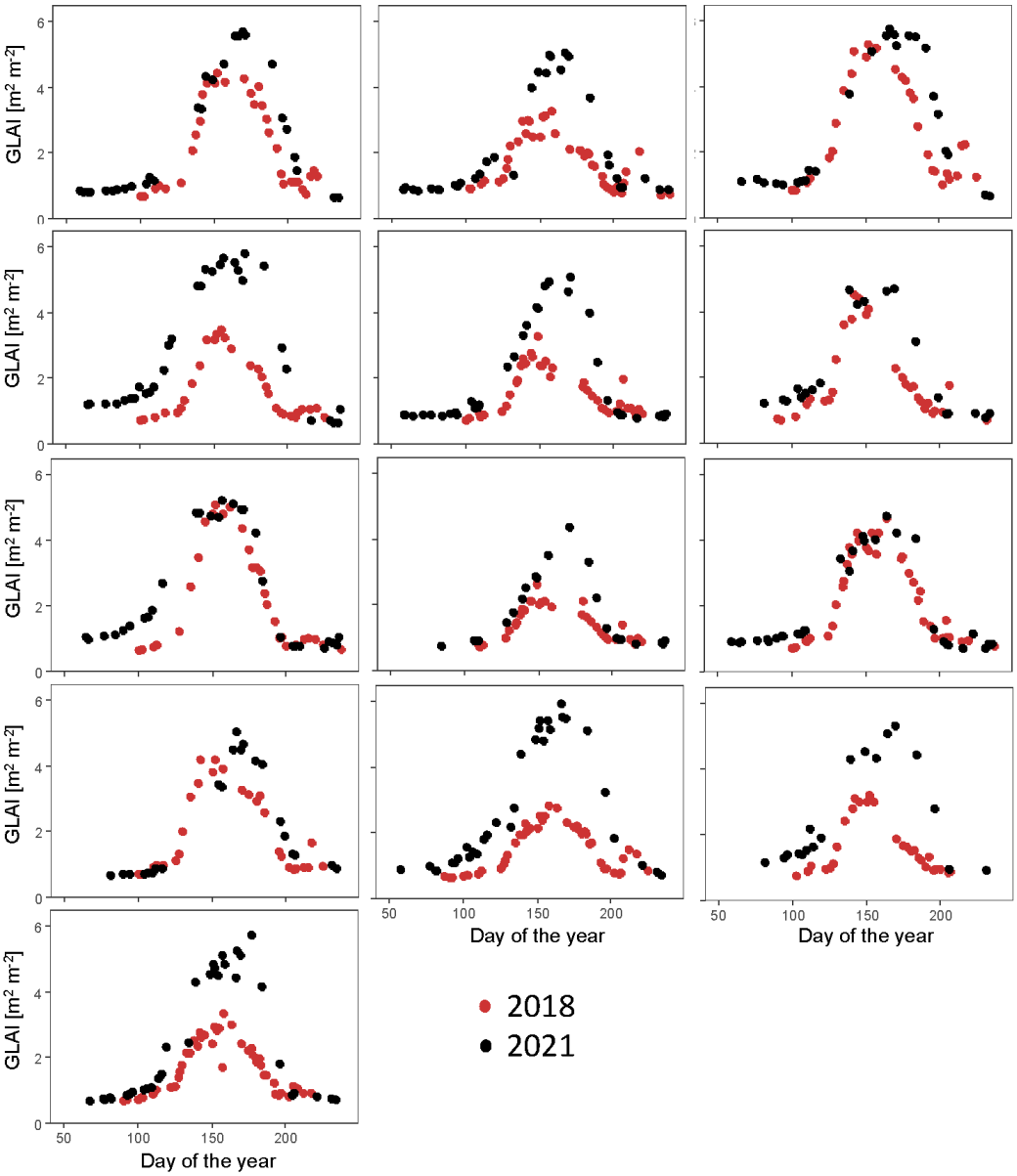

Fig. S3. Temporal evolution of GLAI during 2018 (dry year; red) and 2021 (year with normal weather conditions; black) as a function of calendar date for each of the 13 fields.

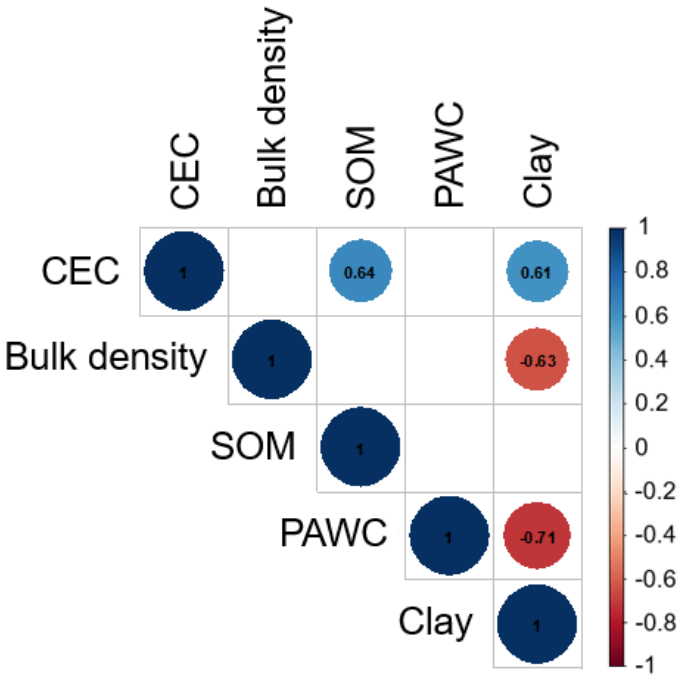

Fig. S4. Spearman correlation coefficients between the soil properties cation exchange capacity (CEC), clay content, soil organic matter content (SOM), plant available water capacity (PAWC) and bulk density. Red colour indicates a negative and blue colour a positive correlation coefficient.

Tab. S1. Minimum, maximum, and mean values of the measured soil properties across all fields. CEC: cation exchange capacity, clay: clay content, SOM: soil organic matter content, PAWC: gravimetric plant available water capacity, and bulk density.

	Minimum	**Maximum**	**Mean**
CEC [cmol kg^{-1}]	10.3	28.6	16.3
Clay [%]	10.5	58.5	31.3
SOM [%]	2.3	5.7	3.6
PAWC [m^3 m^{-3}]	0.19	0.26	0.23
Bulk density [g cm^{-3}]	1.3	1.7	1.5

Tab. S2. Ranges for combinations of leaf (PROSPECT-D) and canopy (4SAIL) parameters according to a uniform or Gaussian distribution. Mean and standard deviation are indicated in brackets.

Trait	Description	Unit	Range
PROSPECT-D (Leaf)			
N	Leaf Structure Parameter	[–]	1–2.5 (1.5, 0.2)
Cab	Leaf Chlorophyll a+b Content	[µg cm^{-2}]	redistributed based on GLAI
Car	Leaf Carotenoid Content	[µg cm^{-2}]	redistributed based on Cab
Cant	Leaf Anthocyanin Content	[µg cm^{-2}]	0.0–5.0 (2.0, 0.8)
Cbrown	Brown Pigments	[–]	0–1
Cw	Equivalent Water Thickness	[cm]	0–0.07 (0.04, 0.02)
Dm	Dry Matter Content	[g cm^{-2}]	0–0.01
4SAIL (Canopy)			
GLAI	Green Leaf Area Index	[m^2 m^{-2}]	0–8
ALA	Leaf Inclination Angle	[deg]	30–70
hspot	Hot spot Parameter	[–]	0.01–0.5
rsoil	Soil Brightness Factor	[–]	0–1
psoil	Dry/Wet Soil Factor	[–]	0–1

Tab. S3. Multiple linear regression results with coefficients and p-values for the significant relationships among the crop growth proxies derived from green leaf area index (GLAI) dynamics (growth rate, peak GLAI and temperature sum at peak GLAI) during the dry year (year 2018) and the year with normal weather conditions (year 2021). ns denotes non-significant relationships (number of fields n = 13).

	Peak GLAI		**Growth rate**	
	Coefficient	**p-value**	**Coefficient**	**p-value**
2018				
Peak GLAI	-	-	-	-
Growth rate	0.002	4.3×10^{-5}	-	-
Timing of peak GLAI		ns		ns
2021				
Peak GLAI	-	-	-	-
Growth rate		ns	-	-
Timing of peak GLAI		ns		ns