

Supplementary material

Monitoring the responses of deciduous forest phenology to 2000-2018 climatic anomalies in the Northern Hemisphere

Kevin Bórnez ^{1,2*}, Aleixandre Verger ^{1,2}, Adrià Descals ^{1,2} and Josep Peñuelas ^{1,2}

¹CREAF, Cerdanyola del Vallès, Bellaterra 08193, Barcelona, Spain; a.verger@creaf.uab.cat (A.V.); a.descals@creaf.uab.cat (A.D.); Josep.Penuelas@uab.cat (J.P.).

²CSIC, Global Ecology Unit CREAM-CSIC-UAB, Bellaterra 08193, Barcelona, Spain.

³CSIC, National Museum of Natural Sciences, Madrid 28006, Spain.

*Corresponding author: Kevin Bórnez (k.bornez@creaf.uab.cat)

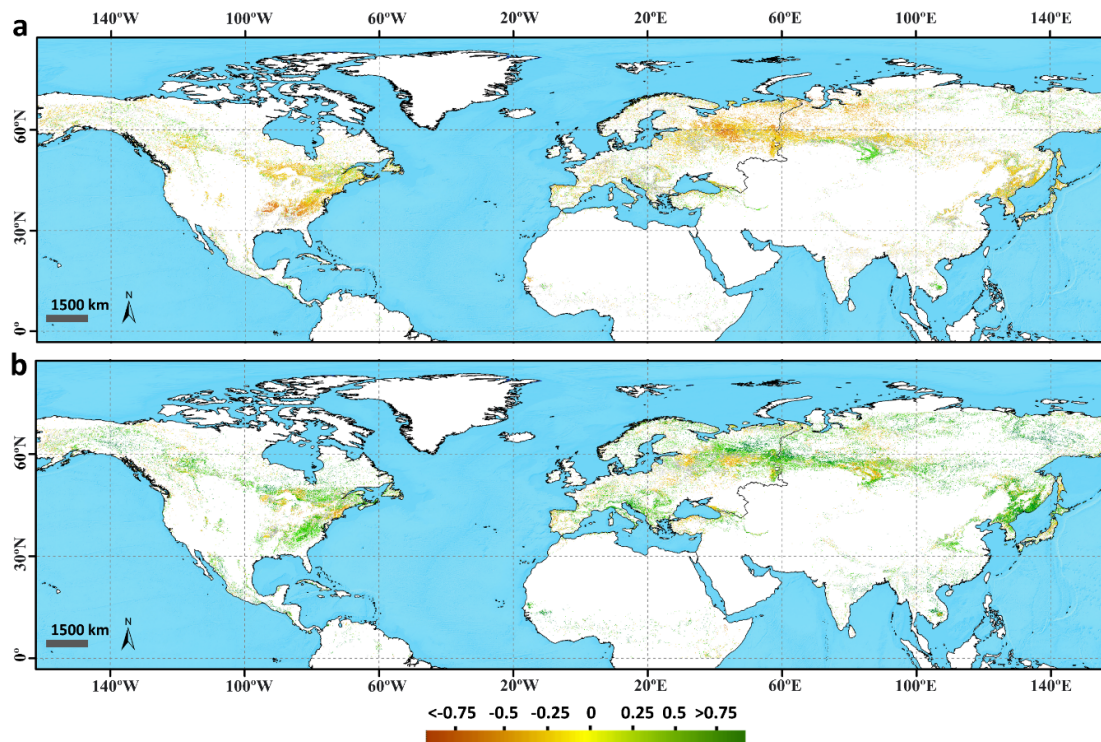


Figure S1. Spatial patterns of partial correlation coefficients between pre-season temperature and (a) SoS and (b) EoS for 2000-2018 in the Northern Hemisphere. The color scale represents the maximum correlation coefficients recorded for each pixel, independently of the SPEI timescale. White indicates unvegetated areas and areas with no deciduous forests, and light gray indicates vegetated areas with nonsignificant correlations ($P > 0.05$).

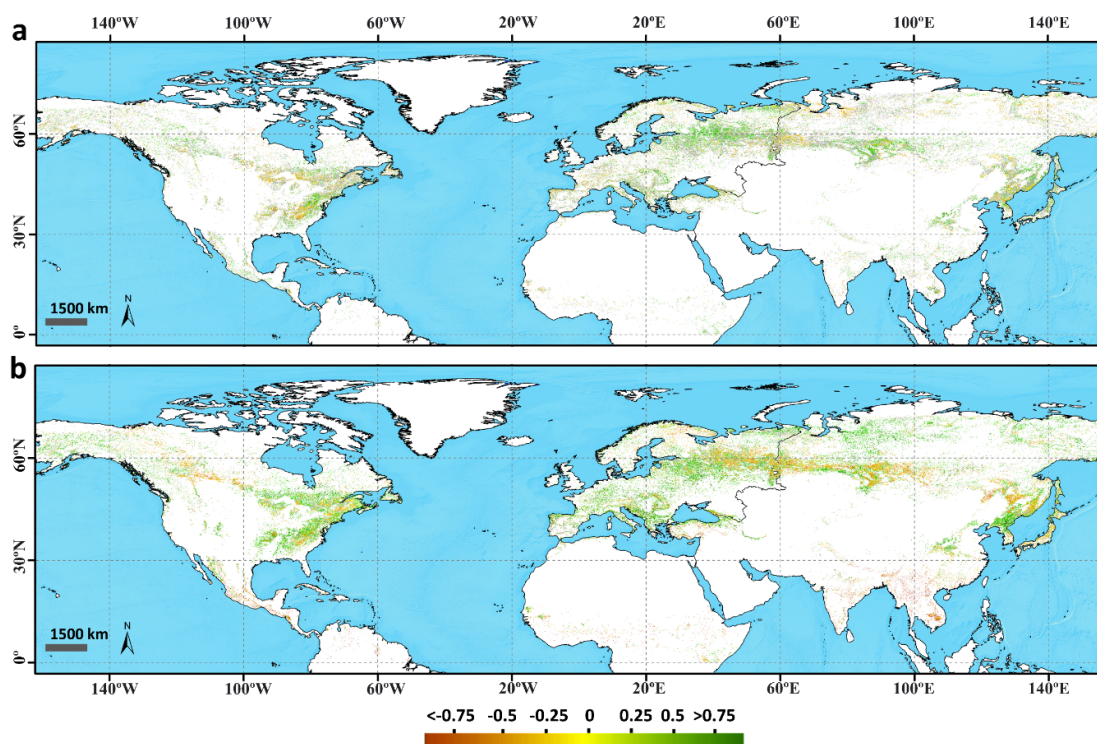


Figure S2. Spatial patterns of partial correlations between presenescence accumulated precipitation and (a) SoS and (b) EoS for 2000-2018 in the Northern Hemisphere. The color scale represents the maximum correlation coefficients recorded for each pixel, independently of the SPEI timescale. White indicates vegetated areas and areas with no deciduous forests, and light gray indicates vegetated areas with nonsignificant correlations ($P > 0.05$).

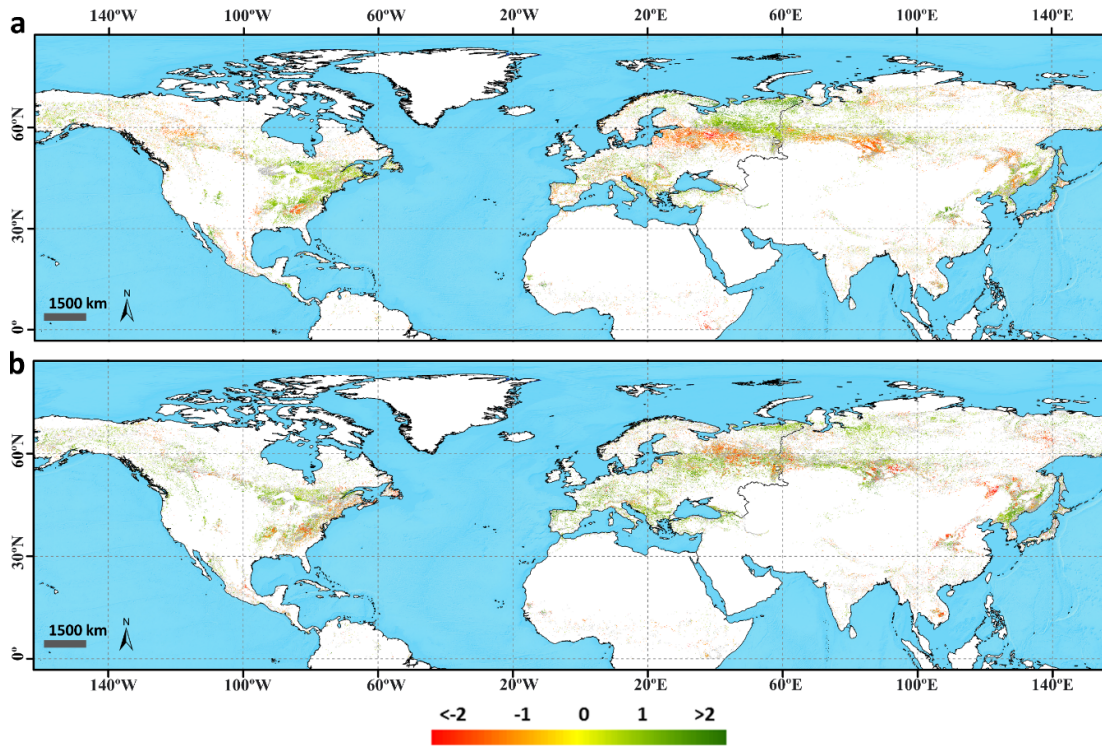


Figure S3. Spatial distributions of the coefficients (color scale) for the sensitivity of (a) SOS and (b) EoS to pre-season SPEI. White indicates unvegetated areas and areas with no deciduous forests, and light gray indicates vegetated areas with nonsignificant correlations ($P > 0.05$).

Table S1. Areas with significant trends ($P \leq 0.05$) in the time series (2000-2018) for the timing of SoS and EoS. The slope of the regression line is also provided in the table.

Metric	Area (%)	Positive trends	Negative trends	Slope (d/y)
		(%)	(%)	
SoS	20.5	38.54	61.46	-0.08
EoS	23.8	40.51	59.49	-0.1

Table S2. Percentages of pixels with positive and negative correlations ($P \leq 0.05$) between phenology and climatic variables, indicating whether these correlations represent an advance or delay in phenology. The highest correlation values (positive or negative) are shown in bold.

Metric	Variable	Positive correlation		Negative correlation	
		Advance (%)	Delay (%)	Advance (%)	Delay (%)
SoS	Temperature	7.12	7.82	35.8	21.39
	Precipitation	20.87	21.43	12.36	7.71
	SPEI	8.65	8.92	6.21	3.66
EoS	Temperature	9.27	14.3	7.55	13.2
	Precipitation	15.11	19.33	13.12	15.30
	SPEI	13.2	15.58	4.25	4.79

Table S3. Percentage of pixels with significant partial correlations between anomalies of phenology, temperature, precipitation, and SPEI at different time lags. Bold values show the timescale in which a higher percentage of significant correlations were found.

Variable	Timescale (months)	SoS (%)	EoS (%)
Temperature	1	47.27	74.08
	3	52.73	25.92
	6	7.13	5.80
Precipitation	1	58.69	31.13
	3	20.77	31.23
	6	20.55	37.64
SPEI	1	33.12	30.22
	3	23.73	27.05
	6	20.99	18.20
	12	22.16	24.53