Phenological changes in Europe are still attributable to climate change induced warming

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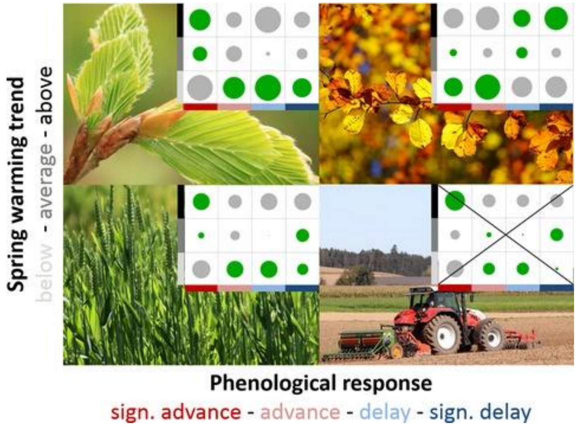

2020-05-08

Previous study of 2006 needed an update

Wild species in spring and summer matched the warming pattern in Europe during 1971-2000 but not farming activities and autumnal leaf coloring. But with insufficient winter chilling, is phenology still mirroring climate change?

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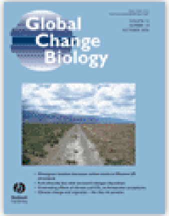

Volume 12, Issue 10
October 2006
Pages 1969-1976

European phenological response to climate change matches the warming pattern

ANNETTE MENZEL, TIM H. SPARKS, NICOLE ESTRELLA, ELISABETH KOCH, ANTO AASA, REIN AHAS, KERSTIN ALM-KÜBLER, PETER BISSOLLI, OL'GA BRASLAVSKÁ, AGRITA BRIEDE, FRANK M. CHMIELEWSKI, ZALIKA CREPINSEK, YANNICK CURNEL, ÅSLÖG DAHL, CLAUDIO DEFILA, ALISON DONNELLY, YOLANDA FILELLA, KATARZYNA JATCZAK, FINN MÅGE, ANTONIO MESTRE, ØYVIND NORDLI, JOSEP PEÑUELAS, PENTTI PIRINEN, VIERA REMIŠOVÁ, HELFRIED SCHEIFINGER, MARTIN STRIZ, ANDREJA SUSNIK, ARNOLD J. H. VAN VLIET, FRANS-EMIL WIELGOLASKI, SUSANNE ZACH, ANA ZUST ... See fewer authors

First published:21 August 2006 | https://doi.org/10.1111/j.1365-2486.2006.01193.x |

Updated study of 2020

There is still a significant and attributable phenological change pattern in Europe

Global Change Biology

INVITED PRIMARY RESEARCH ARTICLE | Open Access

Climate change fingerprints in recent European plant phenology

Annette Menzel, Ye Yuan, Michael Matiu, Tim Sparks, Helfried Scheifinger, Regula Gehrig, Nicole Estrella

First published:17 January 2020 | https://doi.org/10.1111/gcb.15000

Annette Menzel and Ye Yuan should be considered joint first author.

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Volume 26, Issue 4
April 2020
Pages 2599-2612

Materials and Methods

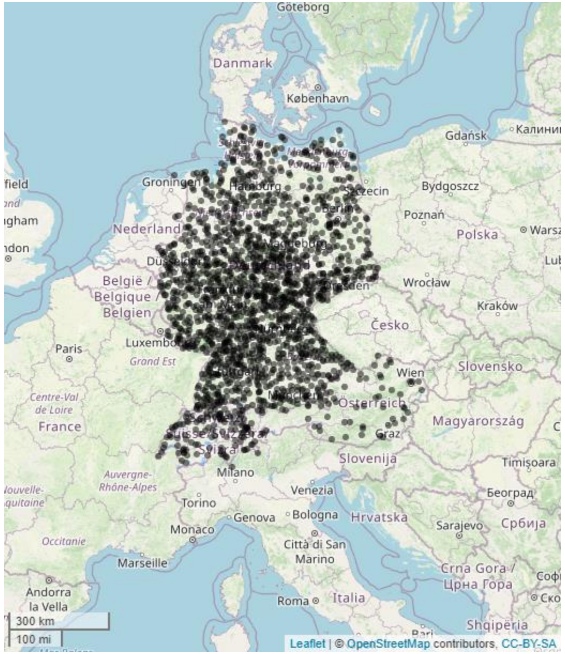
Complete phenological dataset of Germany, Austria and Switzerland (1951-2018, ~97.000 times series, corresponding to 96.3% of PEP725 data), categorized in nine phenologically relevant clusters

TABLE 1 Statistics of the phenological data set with 30+ year series in the period 1951–2018 ending ≥2000

	Observations	Series	Species	Phases	Stations
Germany	4,085,218	93,171	53	22	1,628
Austria	51,951	1,340	37	20	53
Switzerland	115,098	2,485	21	8	127

TABLE 2 Categorization of phenophases in Update comprising nine clusters and four phenological periods/seasons as compared to GCB2006

GCB2006—four phenogroups		Update—nine clusters		Update—four periods/seasons	
b0	Farmers' activities	F_{sp}	Farmer spring Sowing of spring cereals/crops (b0) and the first follow-up BBCH scale (germination, leaf development, part of b1 GCB2006)	FS	Farming Season Time period of farmers' activities from earliest phenophase in F_{sp} to the latest phenophase in F_{au} available at each station
		F_{au}	Farmer autumn Sowing of autumn cereals (b0) and the first follow-up BBCH scale before winter (germination, leaf development, part of b1 GCB2006)		
b1	Leaf unfolding, flowering	Cv_{sp}	Crop vegetative spring All BBCH macrostages from 1 (leaf development, if not in F_{sp}), 2 (tillering), 3 (stem elongation) to 4 (booting) in agricultural crops		
		Cg_{sp}	Crop generative spring All BBCH macrostages from 5 (inflorescence emergence, heading) to 6 (flowering, anthesis) in agricultural crops		
			...species vegetative spring ...rom 0 (bud sprouting), 1 ...(shoot development) in ...nt species		



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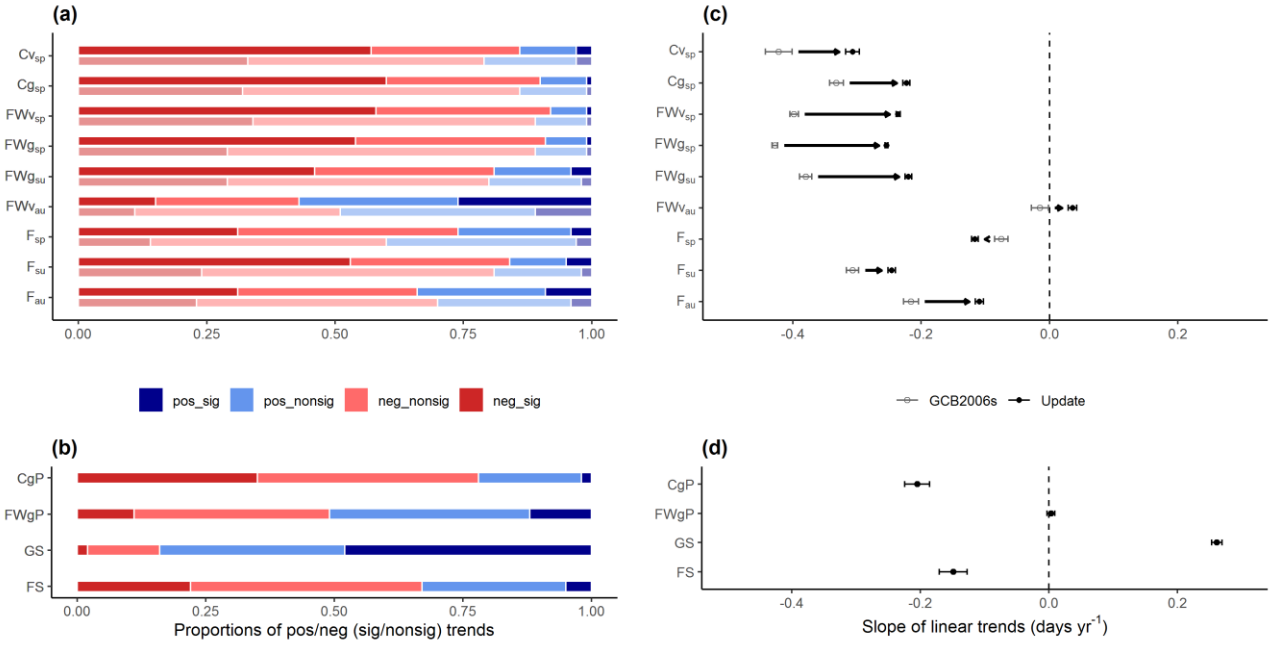
Main results

More (significantly) advancing trends (~90% and ~60% sign.) for spring and summer phases with decreased mean trend strength



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Main results

Maximum of phenological advance and warming during 1979-2008

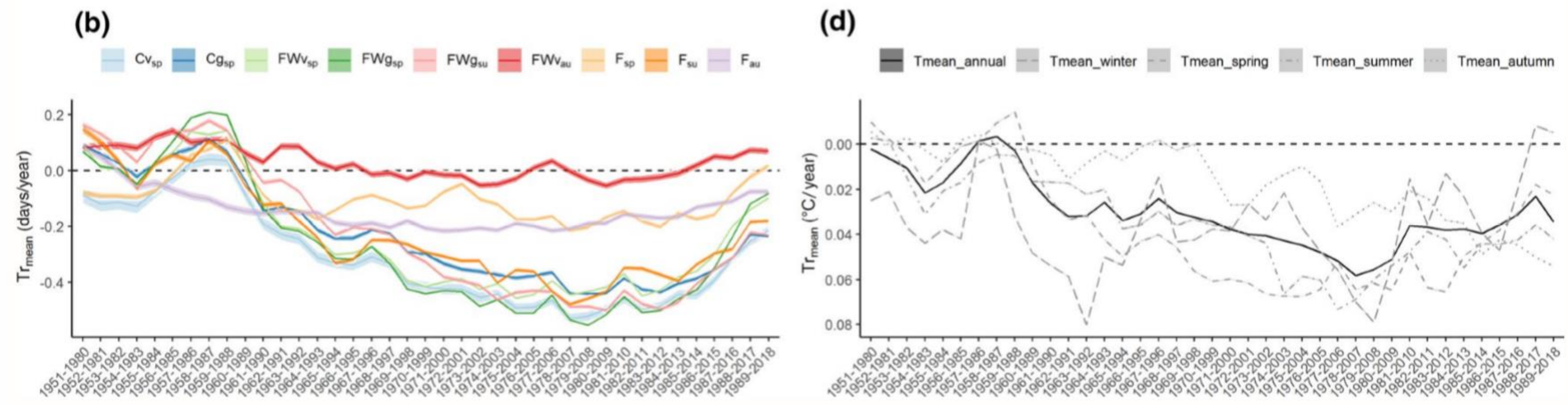

FIGURE 2 Mean slopes of linear trends (Tr_{mean}) calculated for all 15+ year phenological series in respective 30 year moving window blocks within 1951–2018 for the Update data set. Shading indicates 95% confidence intervals in all subplots. Phenophase groups according to (a) GCB2006, (b) nine clusters, and (c) four periods as defined in Table 2, (d) mean slopes of annual and seasonal mean temperature trends with inverted *y*-axis for all sites and time blocks

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Main results

Strongest advances in spring phenology for early flowering species and/or warm sites

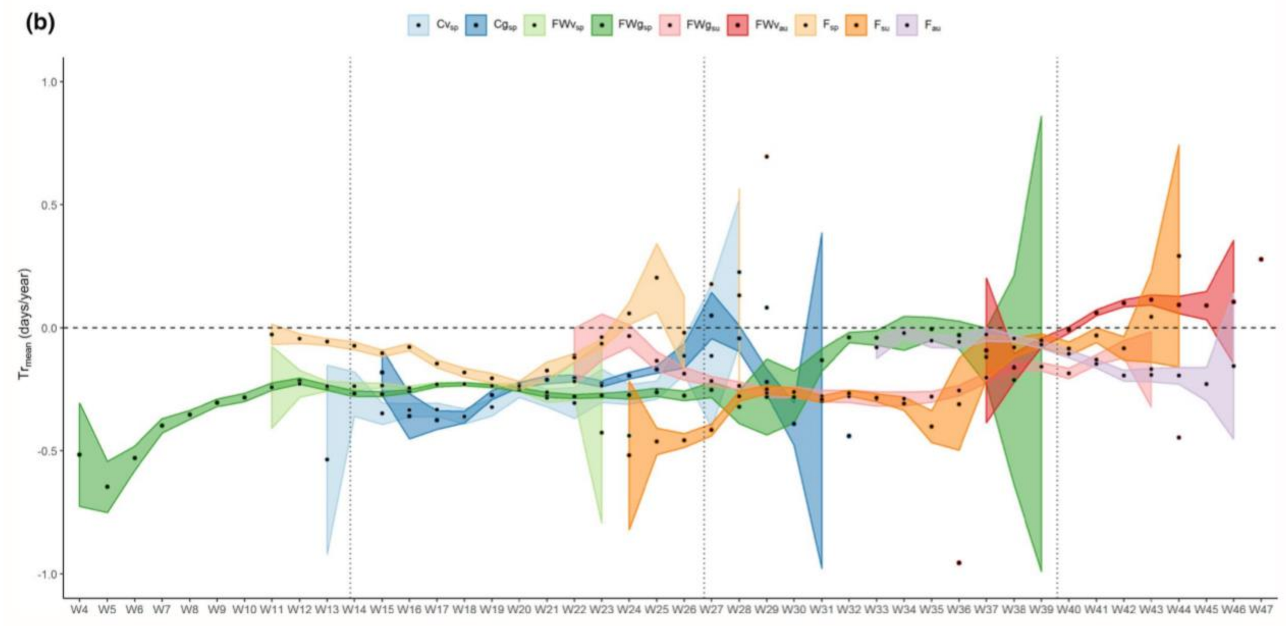

FIGURE 3 Mean slopes of linear trends per week of the year (W4–W47) calculated for all series in Update. Phenophase groups according to (a) GCB2006, and (b) nine clusters. Mean values indicated by solid black circles, vertical division at 90 day intervals. Shading indicates 95% confidence intervals (CI). CIs exceeding the *y*-axis range are not shown by default

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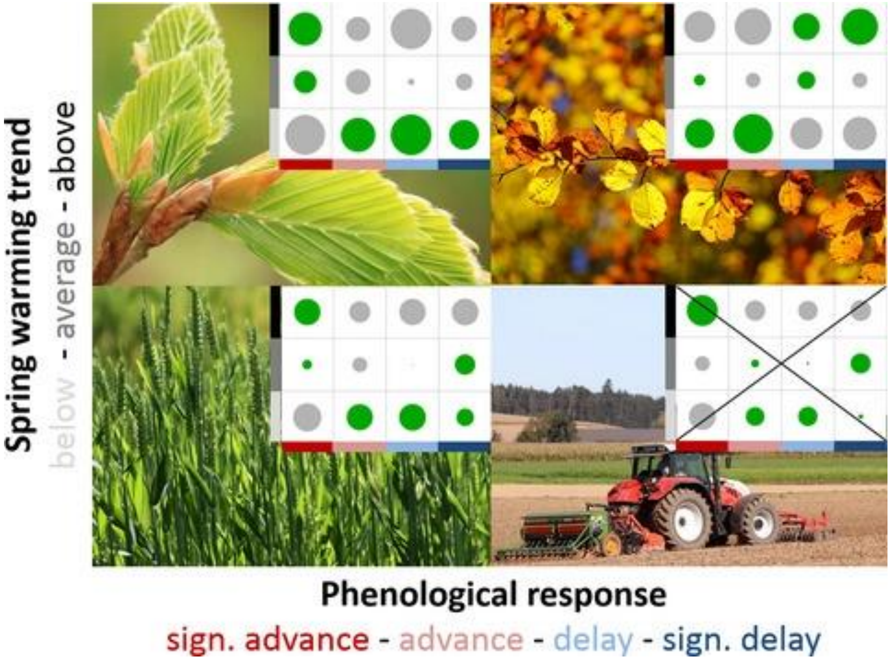
Take home message

- There is still a significant and attributable phenological change pattern in Europe
- Attention to inherent variability of trends with traits/species groups, season and time



For more details please see the following publication:
Menzel A, Yuan Y, Matiu M, et al. Climate change fingerprints in recent European plant phenology. *Glob Change Biol*. 2020;26:2599–2612. https://doi.org/10.1111/gcb.15000