Supplementary Material
Phylogenetic estimates of species-level phenology improve ecological forecasting

December 29, 2022

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Extended Methods

Interpretation of λ_j and σ_j^2 on slopes and intercepts

Most current phylogenetic regression approaches aimed at controlling for phylogenetic non-independence of analysis units (i.e. species, see Revell, 2010) assume the λ scaling parameter is constant across the full set of predictors in the model. Thus, λ is estimated as a single parameter based on one single residual term VCV matrix. While useful for correcting for phylogenetic non-independence this approach does not allow the phylogeny to differentially affect different predictors (i.e. environmental cues in our example). In models with multiple cues, species responses to all cues are estimated as similarly phylogenetically structured, but this may not be the case. For example, in a PGLS model with three cues, it would be possible to have a high (i.e. close to 1) value of λ, due to either a strong phylogenetic signal in the response, but no phylogenetic structuring in the cues, or one or more predictors being strongly phylogenetically structured. In the latter case, phylogenetic structuring of responses to cues could be correlated (i.e., responses to cues evolving in a correlated fashion) or uncorrelated (i.e., independent evolution of responses to cues). Discerning these different situations is not trivial as they would inform whether responses to predictors configure in a structured fashion along the evolutionary process. However, most current approaches act as a black box regarding this information; they simply inform whether or not model residuals are phylogenetically structured (i.e. in PGLS) or the amount of model variance attributable to the phylogeny and independent from other sources of variation (i.e., in PMM, see Housworth et al. (2004)).

Because we are specifically interested in estimating the phylogenetic structure of each cue, our approach explicitly partitions variance into specific components relative to the model intercept and predictor (cue) slopes (see equation **??**). The multivariate normal distributions of the intercept and slope terms include each a variance term (see equation **??**), modelled with a λ scaling parameter. The interpretation of λs in our models are analogous to Pagel's λ (Pagel, 1999) parameter (Housworth et al., 2004), constrained to range from 0 to 1, with values of 0 indicating absence of phylogenetic relatedness, and values of 1 indicating *Brownian Motion* evolution (BM). Estimated λs are not fully equivalent to computing phylogenetic signal of the slopes of each cue separately (i.e., fitting a multilevel regression model with species as a grouping factor on intercepts, and subsequently estimating phylogenetic signal for model slopes). Instead, they are a relative metric of phylogenetic relatedness allowing us to compare among responses known to interact with each other and estimated simultaneously. This approach has the further benefit of adjusting our partial pooling ('random effect' of species) based on evolutionary distance, more strongly pooling closely related species, and only weakly pooling distantly related species (see Gaussian process models in Gelman et al., 2014).

A traditional interpretation of σ^2s under Brownian Motion evolution, is an 'evolutionary rate' or phenotypic accumulation over time (Revell et al., 2008). In PGLS, σ^2_ϵ is estimated for the model error term, which is distributed as a multivariate normal with VCV matrix given by $\sigma^2_\epsilon \mathbf{\Sigma_i}$. Here, similar to our approach to λ, we estimate four σ^2 values, corresponding to each model parameter. In our particular case (i.e., modelling a phenological response to three environmental cues), σ^2_α for the intercept could be interpreted as the phenological variation across species accummulated along evolution independently from the cues. The $\sigma^2_{\beta 1}$, $\sigma^2_{\beta 2}$, and $\sigma^2_{\beta 3}$, corresponding to model slopes, would represent the phylogenetic variance linked to species responses to each of the modelled cues (i.e., forcing, chilling, and photoperiod, respectively). This is, the variability in how species shift their phenology responding to temperature and light, accummulated along the evolutionary process and considered in concert.

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Supporting Figures and Tables

Table 1: Estimated sensitivities of 191 tree species to three environmental cues: chilling (b.chill), forcing (b.force) and photoperiod (b.photo), along with their corresponding 2.5% (low) and 97.5% (up) Credible Intervals. Values correspond to the full model accounting for phylogenetic relationships.

Species	b.chill	low	up	b.force	low	up	b.photo	low	up
Populus deltoides	-15.16	-25.05	-5.82	-6.43	-13.73	1.82	-0.97	-5.39	3.23
Populus koreana	-8.65	-18.98	1.84	-7.47	-15.61	1.11	-0.87	-5.03	3.22
Populus tremula	-1.94	-7.35	3.60	-7.41	-10.54	-4.23	0.05	-2.11	2.28
Populus grandidentata	-14.08	-21.56	-6.90	-9.98	-15.90	-4.64	-1.18	-5.12	2.65
Euonymus europaeus	-3.61	-15.78	8.88	-6.23	-17.68	5.35	-1.15	-5.80	3.39
Euonymus latifolius	1.12	-9.12	11.97	-6.32	-17.69	5.22	-1.01	-5.32	3.41
Nothofagus antarctica	-10.16	-22.40	1.95	-6.62	-17.37	4.52	-1.63	-6.10	2.79
Carya cordiformis	-15.52	-25.34	-6.01	-4.51	-14.91	6.16	-2.65	-7.00	1.57
Carya laciniosa	-17.48	-27.47	-7.95	-4.03	-14.28	6.79	-1.72	-6.04	2.60
Alnus incana	-1.73	-5.59	2.12	-10.18	-14.56	-5.96	-0.52	-2.82	1.82
Alnus glutinosa	-5.85	-12.14	0.49	-10.25	-15.37	-5.24	-0.60	-3.06	1.93
Alnus maximowiczii	-5.35	-14.90	4.33	-7.32	-16.89	2.55	-1.05	-5.26	3.15
Betula nana	-5.76	-14.88	3.60	-5.15	-13.97	3.61	-0.92	-4.90	3.08
Betula pendula	-4.33	-5.44	-3.23	-1.38	-3.58	0.76	-0.42	-1.41	0.59
Betula pubescens	-2.13	-3.47	-0.83	-6.64	-9.29	-4.11	-0.75	-1.85	0.33
Betula populifolia	-5.30	-14.54	4.00	-5.48	-14.46	3.60	-0.86	-4.88	3.16
Betula papyrifera	-27.28	-33.48	-21.06	-5.69	-10.02	-1.32	1.25	-2.24	5.13
Betula alleghaniensis	-11.23	-18.21	-4.10	-6.99	-10.69	-3.42	-1.47	-5.48	2.47
Betula lenta	-3.33	-10.33	3.85	-4.84	-12.37	2.89	-0.98	-5.16	2.98
Corylus cornuta	-6.20	-17.60	5.56	-7.24	-15.02	0.13	-1.35	-5.69	2.86
Ostrya carpinifolia	-5.52	-14.52	3.75	-4.92	-14.08	3.93	-0.92	-4.91	3.01
Ostrya virginiana	-11.38	-20.74	-2.10	-4.75	-14.01	4.43	-0.75	-4.80	3.43
Carpinus laxiflora	-8.99	-19.72	1.53	-4.74	-13.68	3.95	-0.91	-5.22	3.32
Carpinus betulus	-12.30	-18.99	-5.82	-2.59	-7.41	2.38	-0.59	-4.06	3.02
Carpinus monbeigiana	-5.66	-14.75	3.82	-4.73	-13.83	4.11	-0.89	-4.97	3.20
Rosa majalis	-4.26	-14.32	5.85	-7.15	-17.85	3.38	-0.94	-5.20	3.37
Rosa hugonis	-6.88	-18.69	5.08	-7.23	-17.86	3.75	-1.03	-5.49	3.50
Aronia melanocarpa	-2.38	-10.96	6.08	-5.07	-12.57	2.62	-0.74	-4.72	3.33
Photinia villosa	-2.92	-11.68	5.92	-5.86	-14.58	2.79	-0.76	-4.64	3.30
Spiraea japonica	-3.74	-12.85	5.42	-6.66	-16.49	3.07	-0.71	-4.74	3.41
Spiraea chamaedryfolia	-4.02	-13.48	5.21	-6.72	-16.37	3.13	-0.73	-4.89	3.58
Spiraea canescens	-5.16	-16.13	5.65	-6.78	-16.48	2.85	-0.79	-5.14	3.64
Prunus tenella	-3.89	-15.10	7.59	-7.19	-16.37	2.29	-0.93	-5.27	3.29
Prunus serrulata	-4.63	-15.76	6.60	-7.08	-15.83	2.23	-0.78	-4.88	3.43
Prunus pensylvanica	-3.85	-14.58	7.26	-7.01	-14.53	0.66	-0.91	-5.02	3.29
Prunus serotina	-7.40	-16.97	2.22	-6.26	-14.41	2.36	-0.83	-4.90	3.31
Prunus padus	-1.76	-7.09	3.46	-10.44	-14.27	-6.74	-0.96	-2.96	1.03
Prinsepia uniflora	-5.04	-16.35	6.67	-6.97	-16.85	3.27	-0.72	-4.89	3.49
Prinsepia sinensis	-5.07	-17.10	6.91	-7.03	-16.88	3.01	-0.80	-5.04	3.55

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Table 1: Estimated sensitivities of 191 tree species to three environmental cues: chilling (b.chill), forcing (b.force) and photoperiod (b.photo), along with their corresponding 2.5% (low) and 97.5% (up) Credible Intervals. Values correspond to the full model accounting for phylogenetic relationships.

Species	b.chill	low	up	b.force	low	up	b.photo	low	up
Oemleria cerasiformis	-4.93	-15.87	6.42	-6.84	-16.51	3.03	-0.75	-4.99	3.60
Ulmus minor	-16.20	-20.78	-11.59	-10.39	-14.29	-6.49	-2.57	-6.32	0.98
Ulmus glabra	-18.61	-25.10	-12.12	-10.25	-17.35	-2.78	-1.49	-5.16	2.38
Ulmus macrocarpa	-17.08	-23.91	-10.39	-10.51	-18.27	-2.82	-1.49	-5.27	2.54
Ulmus pumila	-12.48	-17.10	-7.94	-10.68	-14.62	-6.65	-1.81	-5.35	1.76
Ulmus parvifolia	-15.59	-20.21	-10.92	-9.42	-13.49	-5.28	-2.39	-6.08	1.18
Ulmus laevis	-16.26	-25.01	-7.62	-9.63	-17.46	-1.30	-1.64	-5.64	2.43
Ulmus americana	-13.53	-22.09	-4.68	-9.81	-17.57	-1.43	-1.59	-5.51	2.44
Ulmus villosa	-15.74	-20.40	-11.06	-11.92	-15.90	-8.04	-1.94	-5.59	1.65
Caragana pygmaea	-5.09	-16.95	6.79	-4.36	-14.86	6.22	-1.14	-5.42	3.32
Robinia pseudoacacia	-5.49	-15.64	4.60	-0.16	-5.50	5.18	-0.98	-5.30	3.51
Amorpha fruticosa	-1.98	-12.24	8.75	-3.88	-13.42	5.70	-1.04	-5.35	3.42
Cercis chinensis	-0.91	-10.52	9.36	-5.45	-16.53	5.76	-1.86	-6.37	2.54
Cercis canadensis	-4.02	-13.75	5.85	-5.15	-15.95	6.47	-1.45	-6.00	3.10
Tilia japonica	-2.93	-11.73	6.09	-8.03	-16.42	0.99	-1.26	-5.59	3.04
Tilia cordata	-3.70	-8.16	0.93	-9.91	-14.05	-5.82	-2.55	-6.15	0.92
Tilia dasystyla	-7.53	-17.00	1.52	-7.95	-16.41	1.18	-1.28	-5.47	2.95
Tilia platyphyllos	-4.30	-13.23	4.64	-7.95	-16.40	1.33	-1.27	-5.57	3.13
Hibiscus syriacus	0.01	-9.30	10.00	-7.50	-17.14	2.41	-1.26	-5.54	3.08
Aesculus flava	-14.90	-24.42	-5.70	-1.49	-10.89	7.74	-1.45	-5.58	2.77
Aesculus parviflora	-12.63	-21.95	-3.69	-2.00	-11.47	7.49	-2.00	-6.23	2.02
Aesculus hippocastanum	-8.33	-16.34	-0.34	1.57	-4.06	7.72	-1.33	-5.34	2.74
Toona sinensis	-3.77	-13.34	6.19	-4.78	-15.53	6.37	-1.31	-5.70	2.94
Orixa japonica	-5.76	-15.83	4.15	-4.75	-15.49	6.38	-1.21	-5.45	3.25
Ptelea trifoliata	-4.44	-14.20	5.45	-4.60	-15.22	6.67	-1.23	-5.57	3.14
Ribes divaricatum	-11.44	-23.49	0.20	-6.57	-18.06	4.68	-1.25	-5.82	3.30
Ribes glaciale	-7.39	-17.37	2.48	-6.69	-18.49	4.88	-0.96	-5.39	3.52
Ribes alpinum	-9.60	-21.69	2.07	-6.65	-18.27	4.94	-1.07	-5.56	3.50
Hamamelis virginiana	-8.19	-20.19	3.97	-9.99	-19.60	-0.73	-1.60	-6.28	3.08
Hamamelis vernalis	-12.75	-22.86	-2.86	-7.46	-18.49	3.77	-1.08	-5.47	3.33
Hamamelis japonica	-8.81	-18.66	1.17	-7.47	-18.61	3.42	-1.11	-5.53	3.31
Sinowilsonia henryi	-4.90	-15.08	5.12	-7.03	-18.68	4.55	-1.22	-5.58	3.34
Corylopsis sinensis	-7.56	-19.20	4.40	-7.10	-18.43	3.99	-1.33	-5.75	3.21
Corylopsis spicata	-7.91	-20.00	4.03	-7.06	-18.29	4.06	-1.42	-5.81	3.03
Liquidambar styraciflua	-7.91	-17.96	1.79	-6.68	-17.99	4.77	-1.51	-5.92	2.83
Liquidambar orientalis	-2.27	-12.08	7.89	-6.81	-18.31	4.47	-1.21	-5.61	3.23
Cercidiphyllum japonicum	-9.19	-20.49	2.23	-6.65	-17.89	4.96	-1.24	-5.71	3.26
Cercidiphyllum magnificum	-9.91	-19.98	-0.03	-6.58	-17.94	4.98	-1.30	-5.65	3.18
Parrotia persica	-8.06	-20.72	4.46	-6.62	-17.88	4.72	-1.01	-5.32	3.49
Paeonia rockii	-6.41	-18.74	6.05	-6.63	-18.19	5.11	-1.17	-5.66	3.44

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Species	b.chill	low	up	b.force	low	up	b.photo	low	up
Syringa villosa	-5.04	-15.49	5.54	-4.17	-12.82	4.14	-0.89	-5.19	3.46
Syringa vulgaris	-4.55	-13.61	4.73	-1.79	-6.08	2.68	-0.93	-5.22	3.18
Syringa josikaea	-4.34	-14.73	6.34	-4.07	-12.75	4.47	-0.96	-5.36	3.41
Syringa reticulata	-4.51	-15.06	5.98	-4.12	-12.75	4.24	-0.88	-5.17	3.50
Ligustrum tschonoskii	-4.45	-14.78	5.75	-4.13	-12.79	4.31	-0.88	-5.20	3.49
Forsythia ovata	-4.34	-14.99	6.24	-4.68	-14.36	4.83	-0.88	-5.23	3.38
Forsythia suspensa	-4.40	-13.57	5.01	-4.73	-14.22	4.57	-0.83	-5.14	3.55
Cephalanthus occidentalis	-2.38	-12.22	7.91	-5.37	-16.10	5.42	-1.11	-5.46	3.35
Viburnum buddleifolium	-10.26	-21.58	0.26	-4.75	-13.53	4.42	-0.23	-4.45	4.30
Viburnum carlesii	-7.53	-18.46	2.95	-5.33	-14.31	3.30	-0.86	-5.13	3.60
Viburnum cassinoides	-4.06	-11.31	3.10	-4.63	-10.55	1.19	-1.07	-4.93	2.89
Viburnum lantanoides	-8.43	-15.76	-1.23	-7.04	-12.94	-1.20	-1.27	-5.27	2.77
Viburnum plicatum	-9.13	-20.55	1.66	-5.00	-13.89	4.25	-0.49	-4.90	4.04
Viburnum opulus	-6.20	-15.54	3.42	-5.27	-14.19	3.75	-0.80	-5.10	3.44
Viburnum betulifolium	-7.78	-18.78	3.06	-5.35	-14.50	3.79	-0.99	-5.29	3.27
Weigela coraeensis	-4.55	-14.12	4.95	-4.97	-15.03	5.46	-0.70	-4.94	3.65
Weigela florida	-5.05	-16.05	6.17	-5.02	-15.07	5.15	-0.72	-5.01	3.64
Weigela maximowiczii	-5.99	-15.36	3.50	-4.92	-15.24	5.49	-0.67	-4.88	3.66
Heptacodium miconioides	-4.27	-15.74	7.38	-5.05	-14.97	4.95	-0.78	-5.20	3.75
Symphoricarpos albus	-6.84	-16.49	2.74	-3.29	-8.35	1.96	-0.74	-5.02	3.60
Lonicera maximowiczii	-4.60	-16.20	6.94	-5.01	-14.15	4.06	-0.71	-4.96	3.80
Lonicera alpigena	-4.83	-16.11	6.80	-4.91	-14.25	4.31	-0.61	-4.86	3.79
Lonicera canadensis	-4.56	-16.34	7.44	-5.48	-13.30	1.79	-0.87	-5.28	3.53
Lonicera caerulea	-4.96	-17.41	7.31	-5.19	-14.44	3.80	-0.77	-5.21	3.86
Eleutherococcus sieboldianus	-3.08	-12.87	6.67	-5.51	-16.16	5.23	-0.75	-5.07	3.58
Eleutherococcus setchuenensis	-3.74	-15.08	7.72	-5.47	-16.29	5.56	-0.86	-5.32	3.72
Eleutherococcus senticosus	-3.20	-12.73	6.71	-5.45	-16.37	5.49	-0.72	-4.90	3.73
Ilex mucronata	-2.88	-10.53	4.87	-6.00	-12.28	0.16	-1.91	-6.17	2.25
Rhododendron prinophyllum	-3.02	-14.99	9.25	-11.17	-20.26	-2.67	-0.97	-5.49	3.70
Rhododendron canadense	0.00	-9.69	9.99	-10.20	-19.93	-0.41	-0.78	-4.94	3.73
Rhododendron dauricum	-1.90	-13.20	9.95	-10.15	-20.05	0.24	-0.66	-5.05	3.89
Rhododendron mucronulatum	-2.54	-14.20	9.05	-10.38	-20.08	-0.54	-0.78	-5.24	3.88
Kalmia angustifolia	-2.93	-14.96	9.56	-12.80	-21.36	-4.83	-1.53	-6.00	2.93
Vaccinium myrtilloides	-1.69	-13.89	10.77	-9.51	-17.61	-1.70	-0.80	-5.17	3.86
Lyonia ligustrina	-3.56	-15.92	9.13	-11.82	-20.72	-3.04	-0.99	-5.57	3.76
Nyssa sylvatica	-6.22	-19.01	6.72	-8.05	-17.75	1.31	-1.44	-6.02	3.16
Cornus alba	-4.43	-14.38	5.63	2.72	-4.19	9.86	-1.48	-5.75	2.74

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Species	b.chill	low	up	b.force	low	up	b.photo	low	up
Cornus kousa	-2.92	-12.91	6.78	-2.84	-12.93	7.21	-1.30	-5.77	3.02
Cornus mas	-4.83	-14.88	5.25	-2.17	-8.45	4.40	-1.15	-5.51	3.30
Hydrangea arborescens	-8.72	-18.61	0.95	-5.11	-16.13	6.25	-0.91	-5.30	3.50
Hydrangea involucrata	-8.38	-17.92	1.10	-5.18	-16.24	6.18	-0.96	-5.14	3.46
Hydrangea serrata	-7.90	-19.38	3.71	-5.24	-16.55	6.05	-0.95	-5.30	3.43
Deutzia gracilis	-5.33	-16.70	6.09	-5.43	-16.20	5.60	-0.87	-5.24	3.65
Deutzia scabra	-3.84	-13.80	6.13	-5.30	-16.00	5.63	-0.87	-5.16	3.50
Decaisnea fargesii	-8.07	-21.12	4.95	-6.02	-18.26	5.96	-1.05	-5.68	3.54
Berberis dielsiana	-5.03	-18.26	8.40	-6.23	-18.11	6.06	-0.98	-5.72	3.80
Liriodendron tulipifera	-12.23	-26.09	1.05	-6.28	-18.58	5.93	-1.57	-6.32	3.20
Acer pseudoplatanus	-10.59	-16.87	-4.06	-9.06	-12.19	-5.96	-1.30	-4.58	2.05
Acer saccharinum	-7.95	-12.05	-3.92	-3.33	-10.91	4.47	-1.20	-5.57	3.07
Acer rubrum	-15.89	-22.63	-9.17	-0.34	-5.01	4.46	-0.42	-4.11	3.53
Acer barbinerve	-9.88	-20.06	0.71	-4.03	-12.65	4.64	-1.19	-5.29	2.92
Acer negundo	-11.88	-21.14	-2.52	-2.89	-10.66	5.24	-1.30	-5.54	2.85
Acer pensylvanicum	-9.42	-16.45	-2.35	-5.80	-11.67	-0.04	-1.97	-5.94	1.83
Acer platanoides	-10.35	-19.35	-1.41	-3.77	-12.18	4.69	-1.21	-5.25	2.80
Acer campestre	-11.25	-20.38	-2.26	-3.71	-12.17	5.09	-1.10	-5.10	3.04
Acer tataricum	-9.05	-18.10	0.14	-2.60	-10.40	5.71	-1.18	-5.31	3.01
Acer ginnala	-9.18	-19.83	1.23	-3.93	-12.38	4.92	-1.22	-5.43	3.05
Amelanchier laevis	-5.13	-15.80	6.01	-5.88	-14.63	2.85	-0.91	-5.08	3.31
Amelanchier florida	-6.02	-15.05	2.89	-5.86	-14.55	3.07	-0.72	-4.73	3.36
Buddleja davidii	-3.03	-15.36	9.46	-5.45	-15.85	5.04	-0.75	-5.13	3.84
Buddleja alternifolia	-2.79	-14.91	9.62	-5.45	-15.69	5.26	-0.83	-5.19	3.75
Buddleja albiflora	-3.35	-15.38	8.66	-5.48	-16.42	4.90	-0.79	-5.21	3.92
Celtis laevigata	-12.47	-22.42	-2.60	-7.60	-18.51	3.47	-1.60	-5.81	2.64
Celtis occidentalis	-7.70	-19.65	3.89	-7.48	-18.18	3.43	-1.40	-5.77	3.03
Celtis caucasica	-10.86	-20.81	-1.13	-7.54	-18.07	2.98	-1.29	-5.60	3.02
Cladrastis lutea	-9.69	-19.88	0.48	-4.68	-15.83	6.43	-1.93	-6.40	2.32
Elaeagnus ebbingei	-7.93	-20.04	4.44	-8.29	-19.52	2.52	-1.09	-5.42	3.40
Fagus crenata	-13.85	-22.96	-4.61	-7.94	-16.59	0.62	-3.49	-8.02	1.21
Fagus engleriana	-13.94	-22.98	-5.04	-7.93	-16.88	0.24	-3.39	-7.90	1.36
Fagus grandifolia	-13.77	-21.02	-6.50	-8.83	-14.77	-2.89	-4.52	-8.88	-0.31
Fagus orientalis	-16.38	-25.68	-7.38	-8.06	-16.89	0.26	-4.00	-8.52	0.42
Fagus sylvatica	-14.31	-15.89	-12.74	-2.91	-4.92	-0.92	-9.37	-11.91	-6.71
Fraxinus excelsior	-6.70	-15.49	1.96	-5.66	-13.56	1.70	-1.34	-5.59	2.76
Fraxinus ornus	-11.44	-20.97	-2.69	-4.07	-12.57	4.71	-0.88	-4.99	3.28
Fraxinus nigra	-6.30	-16.53	4.27	-7.89	-15.98	-0.64	-1.49	-5.81	2.64
Fraxinus pennsylvanica	-4.76	-13.81	4.38	-4.04	-11.90	4.08	-1.06	-5.25	3.18
Fraxinus americana	-7.23	-11.63	-2.76	-3.87	-11.48	4.02	-0.98	-5.27	3.39
Fraxinus latifolia	-7.66	-16.43	1.07	-4.63	-13.19	3.81	-1.45	-5.61	2.74

Table 1: Estimated sensitivities of 191 tree species to three environmental cues: chilling (b.chill), forcing (b.force) and photoperiod (b.photo), along with their corresponding 2.5% (low) and 97.5% (up) Credible Intervals. Values correspond to the full model accounting for phylogenetic relationships.

Species	b.chill	low	up	b.force	low	up	b.photo	low	up
Fraxinus chinensis	-5.94	-14.92	2.99	-4.40	-12.35	3.60	-0.95	-5.04	3.16
Juglans cinerea	-11.11	-20.91	-1.25	-2.91	-12.33	7.19	-1.45	-5.75	2.70
Juglans ailantifolia	-11.61	-21.18	-2.29	-2.85	-12.14	7.07	-1.51	-5.90	2.77
Parrotiopsis jaquemontiana	-5.83	-15.63	3.89	-7.40	-18.44	3.63	-1.11	-5.55	3.32
Pyrus ussuriensis	-6.05	-16.71	4.34	-5.98	-14.58	2.52	-0.73	-4.74	3.31
Pyrus elaeagnifolia	-6.92	-15.89	1.86	-5.85	-14.48	3.13	-0.80	-4.83	3.31
Quercus faginea	-20.99	-32.47	-10.85	-12.86	-18.58	-7.15	-3.69	-8.03	0.37
Quercus bicolor	-15.08	-23.84	-6.01	-9.69	-16.58	-1.46	-2.31	-6.48	1.89
Quercus alba	-14.33	-24.51	-3.88	-12.84	-19.68	-5.59	-2.69	-6.74	1.39
Quercus coccifera	-21.14	-32.27	-10.79	-12.91	-20.09	-5.50	-2.50	-6.73	1.85
Quercus rubra	-18.25	-24.21	-12.29	-11.54	-15.11	-7.89	-2.56	-6.10	1.07
Quercus ellipsoidalis	-17.47	-27.04	-7.96	-13.15	-20.62	-5.69	-2.63	-6.89	1.63
Quercus velutina	-14.69	-25.24	-3.81	-13.13	-20.18	-6.08	-2.47	-6.65	1.80
Quercus shumardii	-17.04	-25.91	-8.41	-12.12	-19.62	-4.18	-2.40	-6.36	1.79
Quercus ilex	-23.29	-34.81	-13.14	-17.73	-24.27	-11.90	-2.57	-6.69	1.78
Quercus petraea	-16.47	-22.58	-10.32	-12.45	-15.88	-9.04	-2.64	-6.62	1.38
Quercus pubescens	-14.74	-25.34	-3.62	-16.42	-24.65	-9.56	-2.33	-6.61	2.28
Quercus robur	-13.18	-19.40	-6.83	-11.66	-15.22	-8.02	0.28	-3.49	4.35
Rhamnus cathartica	-4.58	-12.27	3.22	-11.90	-22.38	-2.51	-1.93	-6.12	2.18
Rhamnus alpina	-11.53	-21.67	-2.00	-8.90	-19.55	1.61	-1.14	-5.42	3.13
Rhamnus frangula	-6.98	-18.76	4.88	-10.67	-19.83	-1.62	-1.29	-5.82	3.19
Salix gracilistyla	-7.38	-18.54	3.62	-6.15	-15.42	3.21	-1.03	-5.34	3.26
Salix smithiana	-5.00	-11.20	1.20	-4.71	-10.10	0.96	-1.98	-6.28	2.08
Salix repens	-9.73	-19.17	-0.53	-6.02	-14.86	3.35	-1.16	-5.36	3.15
Sambucus tigranii	-8.12	-20.14	3.49	-5.33	-15.53	5.07	-0.83	-5.23	3.56
Sambucus pubens	-8.30	-20.17	3.35	-5.33	-15.75	5.11	-0.79	-5.26	3.70
Sorbus aucuparia	-5.67	-15.28	4.26	-5.60	-10.21	-0.98	-0.80	-4.24	2.58
Sorbus torminalis	-8.15	-17.44	0.37	-6.21	-14.71	2.47	-0.83	-4.46	2.95
Sorbus aria	-8.86	-18.00	0.08	-5.67	-14.08	2.86	-0.86	-4.74	3.09
Sorbus decora	-6.40	-15.18	2.22	-5.78	-14.19	2.78	-0.85	-4.88	3.17
Sorbus commixta	-5.84	-14.68	3.21	-5.88	-14.37	2.63	-0.77	-4.82	3.39
Spirea alba	-2.58	-14.70	10.38	-5.51	-13.84	2.80	-0.99	-5.28	3.46
Stachyurus praecox	-6.22	-18.40	6.27	-6.02	-16.95	5.21	-1.08	-5.46	3.37
Stachyurus sinensis	-6.14	-16.90	4.62	-5.65	-17.01	5.99	-0.97	-5.47	3.62

Table 2: Estimated sensitivities of 191 tree species to three environmental cues: chilling (b.chill), forcing (b.force) and photoperiod (b.photo), along with their corresponding 2.5% (low) and 97.5% (up) Credible Intervals. Values correspond to the non phylogenetic model.

Species	b.chill	low	up	b.force	low	up	b.photo	low	up
Populus deltoides	-18.11	-28.51	-7.77	-6.23	-15.95	4.03	-1.26	-5.84	3.32
Populus koreana	-7.92	-20.17	4.43	-7.42	-18.36	3.81	-1.10	-5.60	3.35
Populus tremula	-0.58	-6.21	5.09	-7.44	-10.70	-4.20	0.08	-2.10	2.32
Populus grandidentata	-15.62	-23.79	-7.77	-11.33	-17.49	-5.03	-1.32	-5.36	2.76
Euonymus europaeus	-8.27	-20.53	4.41	-7.49	-17.98	2.90	-1.18	-5.65	3.40
Euonymus latifolius	0.39	-10.11	10.84	-7.43	-18.03	3.43	-0.92	-5.14	3.40
Nothofagus antarctica	-10.50	-23.34	2.22	-7.46	-17.74	3.05	-1.38	-5.87	3.14
Carya cordiformis	-14.04	-24.40	-3.93	-7.85	-18.59	2.95	-2.62	-7.25	1.74
Carya laciniosa	-17.27	-27.99	-6.99	-6.61	-17.22	4.39	-1.16	-5.49	3.25
Alnus incana	-1.59	-5.55	2.37	-10.38	-14.59	-6.15	-0.55	-2.95	1.88
Alnus glutinosa	-6.51	-13.31	0.43	-10.42	-15.83	-5.14	-0.61	-3.13	1.88
Alnus maximowiczii	-6.18	-16.56	4.39	-7.15	-17.62	3.58	-1.21	-5.73	3.36
Betula nana	-6.39	-16.31	3.94	-7.15	-17.95	3.49	-1.13	-5.50	3.18
Betula pendula	-4.32	-5.43	-3.24	-1.34	-3.51	0.83	-0.43	-1.41	0.55
Betula pubescens	-2.11	-3.42	-0.79	-6.88	-9.54	-4.20	-0.78	-1.88	0.31
Betula populifolia	-5.25	-15.53	5.25	-7.38	-18.12	3.16	-1.08	-5.38	3.30
Betula papyrifera	-29.62	-35.81	-23.48	-5.80	-10.59	-0.96	1.37	-2.37	5.36
Betula alleghaniensis	-9.92	-17.11	-2.60	-6.93	-10.75	-3.03	-2.03	-6.13	1.95
Betula lenta	-2.29	-9.47	5.25	-5.99	-14.69	2.79	-1.23	-5.54	3.13
Corylus cornuta	-6.37	-19.26	7.06	-9.25	-17.67	-1.12	-1.62	-5.98	2.70
Ostrya carpinifolia	-4.10	-14.33	6.22	-7.40	-18.07	3.12	-1.08	-5.33	3.33
Ostrya virginiana	-13.26	-23.48	-3.08	-6.97	-17.59	3.71	-0.85	-5.04	3.54
Carpinus laxiflora	-9.40	-22.06	3.28	-7.33	-18.04	3.19	-1.13	-5.57	3.27
Carpinus betulus	-13.38	-20.38	-6.35	-2.12	-7.22	3.01	-0.62	-4.38	3.08
Carpinus monbeigiana	-4.43	-14.44	6.14	-7.23	-17.98	3.60	-1.05	-5.41	3.16
Rosa majalis	-4.90	-14.82	5.20	-7.49	-18.17	2.80	-0.91	-5.30	3.54
Rosa hugonis	-8.24	-20.58	4.29	-7.48	-17.98	2.93	-1.01	-5.44	3.50
Aronia melanocarpa	-2.26	-12.02	8.08	-5.30	-13.53	3.41	-1.01	-5.18	3.30
Photinia villosa	-3.69	-13.75	6.68	-7.29	-17.69	3.12	-0.99	-5.24	3.28
Spiraea japonica	-5.62	-15.79	4.68	-7.23	-17.59	3.41	-0.90	-5.24	3.44
Spiraea chamaedryfolia	-6.08	-16.17	4.00	-7.35	-17.96	3.50	-0.90	-5.25	3.53
Spiraea canescens	-8.77	-21.15	3.53	-7.52	-17.64	3.02	-1.05	-5.46	3.37
Prunus tenella	-6.68	-18.91	6.02	-7.50	-18.67	3.50	-1.11	-5.55	3.30
Prunus serrulata	-8.11	-20.34	4.47	-7.26	-17.51	2.93	-0.94	-5.47	3.52
Prunus pensylvanica	-6.31	-18.71	6.34	-6.83	-14.73	1.34	-1.14	-5.66	3.25
Prunus serotina	-10.58	-21.02	-0.14	-5.49	-14.91	4.23	-1.09	-5.41	3.21
Prunus padus	-2.17	-7.46	3.09	-10.81	-14.58	-6.99	-1.02	-3.02	0.93
Prinsepia uniflora	-7.80	-20.33	4.82	-7.62	-18.52	3.05	-0.96	-5.31	3.54
Prinsepia sinensis	-8.08	-21.71	5.47	-7.73	-18.30	2.92	-1.03	-5.45	3.47
Oemleria cerasiformis	-7.71	-19.80	4.48	-7.38	-17.76	2.99	-0.89	-5.29	3.44
Ulmus minor	-15.63	-20.50	-10.78	-9.99	-14.32	-5.72	-2.53	-6.44	1.32
Ulmus glabra	-17.95	-25.56	-10.49	-8.23	-17.95	1.42	-0.95	-5.10	3.26

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Table 2: Estimated sensitivities of 191 tree species to three environmental cues: chilling (b.chill), forcing (b.force) and photoperiod (b.photo), along with their corresponding 2.5% (low) and 97.5% (up) Credible Intervals. Values correspond to the non phylogenetic model.

Species	b.chill	low	up	b.force	low	up	b.photo	low	up
Ulmus macrocarpa	-16.04	-23.67	-8.80	-8.41	-18.61	1.26	-0.98	-5.12	3.21
Ulmus pumila	-11.49	-16.11	-6.71	-10.23	-14.42	-6.11	-1.42	-5.28	2.43
Ulmus parvifolia	-15.06	-19.83	-10.22	-8.70	-12.86	-4.46	-2.26	-6.03	1.52
Ulmus laevis	-14.85	-25.33	-4.77	-7.03	-17.89	3.92	-1.09	-5.44	3.11
Ulmus americana	-10.02	-20.18	0.50	-7.25	-17.66	3.23	-1.08	-5.43	3.28
Ulmus villosa	-15.17	-19.92	-10.37	-11.93	-16.26	-7.68	-1.64	-5.41	2.16
Caragana pygmaea	-6.71	-18.99	6.14	-7.62	-17.95	2.61	-1.00	-5.50	3.49
Robinia pseudoacacia	-6.86	-17.21	3.40	-0.60	-5.78	4.61	-0.75	-5.06	3.72
Amorpha fruticosa	-2.88	-13.18	7.81	-6.49	-15.80	3.00	-0.89	-5.06	3.46
Cercis chinensis	-1.56	-11.77	9.06	-7.60	-17.89	2.95	-1.74	-6.21	2.63
Cercis canadensis	-6.58	-16.76	3.84	-7.05	-17.67	3.67	-1.16	-5.52	3.17
Tilia japonica	-4.13	-14.09	6.20	-7.27	-17.82	3.35	-0.92	-5.13	3.38
Tilia cordata	-4.07	-8.65	0.70	-10.14	-14.18	-6.13	-2.80	-6.50	0.72
Tilia dasystyla	-11.94	-21.87	-2.13	-7.08	-17.24	3.43	-0.97	-5.30	3.48
Tilia platyphyllos	-6.54	-16.83	3.82	-7.15	-17.61	3.34	-0.95	-5.30	3.35
Hibiscus syriacus	-0.59	-11.02	10.10	-7.26	-17.56	3.34	-1.01	-5.34	3.55
Aesculus flava	-16.49	-27.49	-6.45	-6.64	-16.97	4.11	-1.19	-5.56	3.16
Aesculus parviflora	-12.49	-22.79	-2.37	-7.72	-18.11	3.24	-2.03	-6.34	2.29
Aesculus hippocastanum	-6.13	-14.54	2.27	0.38	-5.66	6.53	-1.15	-5.18	2.96
Toona sinensis	-4.10	-14.20	6.30	-7.25	-17.75	3.20	-1.17	-5.46	3.17
Orixa japonica	-6.50	-16.39	3.67	-7.19	-18.04	3.52	-1.13	-5.59	3.42
Ptelea trifoliata	-5.10	-15.40	5.25	-7.18	-17.65	3.19	-1.13	-5.31	3.00
Ribes divaricatum	-13.67	-26.45	-1.51	-7.57	-17.79	2.87	-1.34	-5.84	3.10
Ribes glaciale	-6.68	-16.53	3.71	-7.52	-18.12	3.24	-0.93	-5.24	3.38
Ribes alpinum	-10.17	-22.66	2.37	-7.55	-18.28	2.77	-1.09	-5.59	3.36
Hamamelis virginiana	-8.61	-21.51	4.26	-10.91	-20.31	-2.12	-1.71	-6.07	2.63
Hamamelis vernalis	-14.59	-24.87	-4.51	-6.98	-17.43	3.98	-0.99	-5.36	3.38
Hamamelis japonica	-9.15	-19.59	1.08	-7.27	-17.57	2.99	-1.06	-5.29	3.44
Sinowilsonia henryi	-5.24	-15.18	4.75	-7.49	-18.03	2.98	-1.18	-5.49	3.06
Corylopsis sinensis	-8.51	-21.07	3.86	-7.55	-18.23	3.10	-1.28	-5.87	3.26
Corylopsis spicata	-9.18	-22.03	3.41	-7.43	-17.82	3.06	-1.39	-5.73	2.99
Liquidambar styraciflua	-11.04	-21.08	-0.87	-7.33	-17.56	2.99	-1.53	-5.94	2.77
Liquidambar orientalis	-1.35	-11.39	9.46	-7.50	-17.89	2.68	-1.10	-5.42	3.36
Cercidiphyllum japonicum	-9.68	-22.12	2.60	-7.37	-17.85	2.64	-1.21	-5.57	3.14
Cercidiphyllum magnificum	-10.65	-20.75	-0.52	-7.40	-18.14	3.44	-1.26	-5.51	3.06
Parrotia persica	-9.39	-21.92	2.89	-7.29	-17.70	3.04	-0.96	-5.35	3.61
Paeonia rockii	-7.59	-19.89	4.62	-7.50	-17.90	2.67	-1.11	-5.54	3.45
Syringa villosa	-7.83	-20.07	4.59	-7.56	-17.94	3.00	-0.96	-5.47	3.67
Syringa vulgaris	-6.30	-16.36	3.99	-1.65	-6.09	2.84	-1.10	-5.37	3.20
Syringa josikaea	-6.60	-19.15	6.33	-7.45	-18.02	2.72	-1.06	-5.44	3.39
Syringa reticulata	-6.89	-19.47	5.72	-7.39	-17.73	3.23	-0.99	-5.25	3.46

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Table 2: Estimated sensitivities of 191 tree species to three environmental cues: chilling (b.chill), forcing (b.force) and photoperiod (b.photo), along with their corresponding 2.5% (low) and 97.5% (up) Credible Intervals. Values correspond to the non phylogenetic model.

Species	b.chill	low	up	b.force	low	up	b.photo	low	up
Ligustrum tschonoskii	-6.63	-19.20	6.28	-7.60	-18.30	3.08	-0.97	-5.36	3.50
Forsythia ovata	-6.77	-19.55	5.87	-7.44	-17.72	2.73	-1.05	-5.50	3.29
Forsythia suspensa	-6.12	-16.36	4.09	-7.35	-17.43	3.19	-0.91	-5.26	3.49
Cephalanthus occidentalis	-4.96	-14.92	5.38	-7.24	-17.89	3.24	-1.20	-5.44	3.08
Viburnum buddleifolium	-14.54	-27.32	-2.15	-6.42	-16.75	4.49	-0.33	-4.81	4.32
Viburnum carlesii	-8.95	-21.76	3.97	-7.51	-18.21	3.24	-1.24	-5.64	3.15
Viburnum cassinoides	-3.71	-11.38	3.89	-5.17	-11.27	1.16	-1.47	-5.57	2.67
Viburnum lantanoides	-9.24	-16.57	-1.67	-8.47	-14.62	-2.48	-1.61	-5.72	2.45
Viburnum plicatum	-12.20	-25.12	0.40	-6.78	-16.97	3.77	-0.68	-5.11	3.94
Viburnum opulus	-6.92	-17.13	3.34	-7.13	-17.59	3.54	-1.07	-5.31	3.32
Viburnum betulifolium	-9.67	-21.96	2.29	-7.35	-18.04	2.93	-1.35	-5.71	3.06
Weigela coraeensis	-6.56	-16.50	3.63	-7.28	-17.73	3.12	-0.97	-5.39	3.55
Weigela florida	-7.68	-20.09	4.64	-7.44	-17.87	2.82	-1.02	-5.43	3.48
Weigela maximowiczii	-8.92	-19.08	1.20	-7.17	-17.88	3.39	-0.93	-5.25	3.48
Heptacodium miconioides	-6.82	-19.04	5.69	-7.43	-18.06	3.16	-1.06	-5.51	3.45
Symphoricarpos albus	-9.52	-19.78	0.77	-3.21	-8.44	2.01	-0.99	-5.31	3.30
Lonicera maximowiczii	-7.39	-19.31	5.44	-7.68	-18.06	2.94	-0.99	-5.42	3.58
Lonicera alpigena	-7.78	-20.33	4.51	-7.44	-18.17	3.04	-0.91	-5.30	3.73
Lonicera canadensis	-5.93	-18.81	7.24	-6.98	-14.79	0.81	-1.10	-5.56	3.39
Lonicera caerulea	-8.21	-21.52	5.31	-7.69	-18.25	2.78	-1.07	-5.56	3.48
Eleutherococcus sieboldianus	-5.41	-15.51	4.71	-7.38	-17.99	3.12	-0.93	-5.20	3.20
Eleutherococcus setchuenensis	-7.57	-20.49	5.35	-7.35	-17.75	2.96	-1.11	-5.57	3.36
Eleutherococcus senticosus	-5.49	-15.94	5.09	-7.28	-17.96	3.46	-0.85	-5.16	3.48
Ilex mucronata	-3.79	-11.32	3.87	-6.56	-12.55	-0.46	-1.95	-6.21	2.13
Rhododendron prinophyllum	-8.09	-20.84	4.67	-9.26	-18.33	-0.45	-1.15	-5.60	3.14
Rhododendron canadense	-2.62	-12.72	7.74	-7.23	-17.42	3.14	-0.97	-5.29	3.32
Rhododendron dauricum	-6.80	-19.00	5.68	-7.19	-17.73	3.19	-0.78	-5.16	3.84
Rhododendron mucronulatum	-7.40	-20.33	5.50	-7.54	-18.22	3.36	-0.93	-5.24	3.42
Kalmia angustifolia	-7.32	-19.73	5.25	-12.11	-20.86	-4.08	-1.88	-6.36	2.60
Vaccinium myrtilloides	-5.98	-18.81	6.75	-7.41	-15.38	0.43	-0.96	-5.29	3.52
Lyonia ligustrina	-8.15	-21.11	4.80	-10.43	-20.28	-1.38	-1.13	-5.67	3.42
Nyssa sylvatica	-8.31	-20.67	4.49	-9.52	-18.51	-0.80	-1.39	-5.88	3.14
Cornus alba	-6.41	-16.04	3.37	1.92	-5.09	9.28	-1.53	-5.67	2.62
Cornus kousa	-4.68	-14.61	5.57	-7.39	-17.85	2.97	-1.23	-5.54	3.10
Cornus mas	-6.61	-16.98	3.82	-3.77	-10.09	2.70	-1.00	-5.49	3.49
Hydrangea arborescens	-10.58	-20.66	-0.37	-7.14	-17.55	3.55	-1.00	-5.24	3.33
Hydrangea involucrata	-10.15	-20.14	-0.07	-7.34	-18.13	3.41	-1.09	-5.52	3.30
Hydrangea serrata	-9.89	-22.57	2.80	-7.40	-17.99	3.12	-1.05	-5.61	3.29

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12

Table 2: Estimated sensitivities of 191 tree species to three environmental cues: chilling (b.chill), forcing (b.force) and photoperiod (b.photo), along with their corresponding 2.5% (low) and 97.5% (up) Credible Intervals. Values correspond to the non phylogenetic model.

Species	b.chill	low	up	b.force	low	up	b.photo	low	up
Deutzia gracilis	-7.60	-20.50	4.96	-7.50	-18.00	2.96	-0.97	-5.22	3.39
Deutzia scabra	-5.07	-15.20	5.25	-7.38	-17.61	2.97	-0.96	-5.33	3.45
Decaisnea fargesii	-9.88	-22.56	2.67	-7.29	-18.05	3.42	-1.04	-5.49	3.53
Berberis dielsiana	-6.59	-19.04	6.31	-7.55	-18.15	3.04	-1.03	-5.46	3.38
Liriodendron tulipifera	-13.64	-26.59	-1.43	-7.48	-17.99	2.87	-1.54	-6.05	2.97
Acer pseudoplatanus	-9.70	-16.44	-2.92	-9.89	-12.97	-6.82	-1.04	-4.56	2.52
Acer saccharinum	-7.59	-11.67	-3.57	-5.92	-14.96	3.57	-1.10	-5.65	3.47
Acer rubrum	-16.72	-23.81	-9.65	-0.57	-5.33	4.18	-0.11	-3.91	3.89
Acer barbinerve	-8.41	-20.80	4.09	-7.50	-17.88	3.24	-1.09	-5.44	3.39
Acer negundo	-11.74	-22.34	-1.06	-5.75	-15.29	4.11	-1.25	-5.65	3.01
Acer pensylvanicum	-8.87	-16.22	-1.40	-7.87	-13.96	-1.91	-2.06	-6.16	1.94
Acer platanoides	-9.84	-20.42	0.22	-7.16	-17.34	2.95	-1.08	-5.44	3.22
Acer campestre	-10.97	-21.18	-0.77	-7.11	-17.69	3.50	-0.95	-5.30	3.32
Acer tataricum	-7.79	-18.03	2.46	-5.40	-14.64	4.07	-1.15	-5.40	3.14
Acer ginnala	-7.24	-19.58	5.24	-7.49	-18.33	3.43	-1.12	-5.68	3.44
Amelanchier laevis	-8.10	-21.11	5.19	-7.37	-17.58	3.14	-1.20	-5.72	3.31
Amelanchier florida	-8.42	-18.53	1.88	-7.19	-17.84	3.50	-0.98	-5.22	3.36
Buddleja davidii	-6.63	-18.75	5.87	-7.44	-17.88	3.29	-0.89	-5.27	3.52
Buddleja alternifolia	-6.14	-18.70	6.71	-7.50	-17.98	2.95	-0.99	-5.35	3.43
Buddleja albiflora	-6.94	-19.44	5.67	-7.57	-17.97	2.86	-0.92	-5.35	3.61
Celtis laevigata	-12.78	-22.93	-2.58	-7.23	-17.80	3.21	-1.47	-5.78	2.81
Celtis occidentalis	-6.21	-18.44	6.36	-7.09	-17.45	3.03	-1.26	-5.69	3.24
Celtis caucasica	-10.47	-20.58	-0.58	-7.13	-17.53	3.27	-1.10	-5.50	3.24
Cladrastis lutea	-12.14	-22.62	-1.82	-7.49	-17.74	3.05	-1.87	-6.32	2.42
Elaeagnus ebbingei	-7.84	-20.50	4.78	-7.59	-18.36	3.17	-0.94	-5.27	3.50
Fagus crenata	-9.96	-20.36	0.39	-7.46	-17.89	2.82	-1.39	-5.68	2.90
Fagus engleriana	-10.08	-20.42	-0.09	-7.30	-17.89	3.21	-1.29	-5.55	3.13
Fagus grandifolia	-12.35	-20.21	-4.58	-9.72	-16.07	-3.46	-3.14	-7.46	0.95
Fagus orientalis	-14.05	-24.38	-3.82	-7.67	-17.96	2.80	-2.12	-6.56	2.13
Fagus sylvatica	-14.21	-15.81	-12.65	-2.65	-4.64	-0.66	-9.51	-12.05	-7.03
Fraxinus excelsior	-8.32	-18.52	1.93	-8.54	-17.44	0.30	-1.54	-5.89	2.75
Fraxinus ornus	-16.69	-27.23	-6.40	-6.19	-16.38	4.61	-0.79	-5.22	3.63
Fraxinus nigra	-8.33	-21.58	4.78	-11.81	-20.23	-3.87	-1.66	-6.24	2.85
Fraxinus pennsylvanica	-5.37	-15.49	5.02	-6.09	-15.47	3.72	-1.14	-5.50	3.25
Fraxinus americana	-7.61	-12.04	-3.03	-5.48	-14.63	4.13	-1.11	-5.73	3.57
Fraxinus latifolia	-10.54	-20.86	-0.45	-7.26	-17.74	3.42	-1.68	-6.06	2.61
Fraxinus chinensis	-7.27	-17.55	3.05	-6.59	-15.87	3.19	-0.98	-5.29	3.43
Juglans cinerea	-8.76	-19.59	2.18	-6.49	-15.82	2.86	-1.05	-5.29	3.25
Juglans ailantifolia	-9.49	-20.35	1.28	-6.42	-15.56	2.82	-1.17	-5.49	3.22
Parrotiopsis jaquemontiana	-5.61	-15.90	4.64	-7.37	-17.60	2.86	-1.06	-5.36	3.28
Pyrus ussuriensis	-8.49	-21.12	4.01	-7.50	-17.79	3.05	-1.01	-5.40	3.50

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Table 2: Estimated sensitivities of 191 tree species to three environmental cues: chilling (b.chill), forcing (b.force) and photoperiod (b.photo), along with their corresponding 2.5% (low) and 97.5% (up) Credible Intervals. Values correspond to the non phylogenetic model.

| Species	b.chill	low	up	b.force	low	up	b.photo	low	up
Pyrus elaeagnifolia	-9.48	-19.57	0.58	-7.28	-18.02	3.53	-1.07	-5.26	3.22
Quercus faginea	-18.47	-33.56	-5.41	-11.03	-17.86	-4.45	-3.11	-7.94	1.24
Quercus bicolor	-8.94	-19.24	1.46	-6.42	-15.74	3.46	-1.21	-5.63	3.23
Quercus alba	-9.45	-22.53	3.34	-11.13	-20.45	-2.23	-1.97	-6.64	2.55
Quercus coccifera	-18.01	-32.31	-4.98	-8.90	-18.92	0.86	-1.25	-5.73	3.27
Quercus rubra	-16.88	-23.01	-10.62	-10.78	-14.60	-6.94	-2.17	-6.10	1.72
Quercus ellipsoidalis	-13.69	-25.01	-2.52	-7.55	-17.79	2.46	-1.22	-5.78	3.27
Quercus velutina	-9.87	-23.30	3.02	-11.53	-21.17	-2.22	-1.60	-6.14	2.87
Quercus shumardii	-12.36	-22.59	-2.46	-7.18	-17.39	3.45	-1.31	-5.42	3.02
Quercus ilex	-22.78	-36.98	-10.07	-18.72	-25.67	-12.04	-1.40	-5.94	3.15
Quercus petraea	-14.19	-21.05	-7.52	-12.70	-16.43	-9.14	-1.64	-5.91	2.50
Quercus pubescens	-5.83	-19.07	7.80	-15.90	-26.67	-6.44	-0.98	-5.62	3.61
Quercus robur	-10.11	-16.66	-3.51	-11.38	-15.34	-7.53	1.99	-1.51	5.79
Rhamnus cathartica	-4.04	-11.63	3.79	-11.39	-21.57	-1.84	-1.89	-6.25	2.37
Rhamnus alpina	-13.28	-23.56	-3.29	-6.84	-17.38	3.86	-0.92	-5.18	3.57
Rhamnus frangula	-7.45	-20.31	5.55	-9.97	-19.23	-0.83	-1.15	-5.51	3.37
Salix gracilistyla	-7.77	-20.03	5.07	-7.52	-17.74	2.88	-0.98	-5.36	3.50
Salix smithiana	-4.74	-11.00	1.55	-4.61	-10.32	0.93	-2.27	-6.68	2.05
Salix repens	-11.68	-21.88	-1.57	-7.11	-17.62	3.43	-1.11	-5.42	3.22
Sambucus tigranii	-10.43	-22.84	1.55	-7.40	-17.95	3.27	-1.05	-5.56	3.38
Sambucus pubens	-10.68	-23.03	1.36	-7.42	-17.88	3.17	-1.03	-5.39	3.43
Sorbus aucuparia	-8.39	-20.03	3.44	-6.35	-11.41	-1.50	-1.11	-4.81	2.58
Sorbus torminalis	-10.89	-21.41	-0.75	-8.01	-18.33	2.39	-1.09	-5.06	2.89
Sorbus aria	-13.07	-23.69	-2.74	-6.98	-17.30	3.44	-1.08	-5.35	3.24
Sorbus decora	-8.57	-18.81	1.94	-7.34	-17.48	2.93	-1.09	-5.39	3.30
Sorbus commixta	-7.51	-17.66	2.70	-7.38	-17.75	3.10	-1.01	-5.41	3.50
Spirea alba	-5.95	-18.47	6.94	-6.51	-14.74	1.51	-1.05	-5.49	3.46
Stachyurus praecox	-7.90	-20.29	4.77	-7.55	-17.73	2.86	-1.05	-5.54	3.43
Stachyurus sinensis	-7.56	-18.17	3.53	-7.03	-17.41	3.35	-0.99	-5.43	3.44
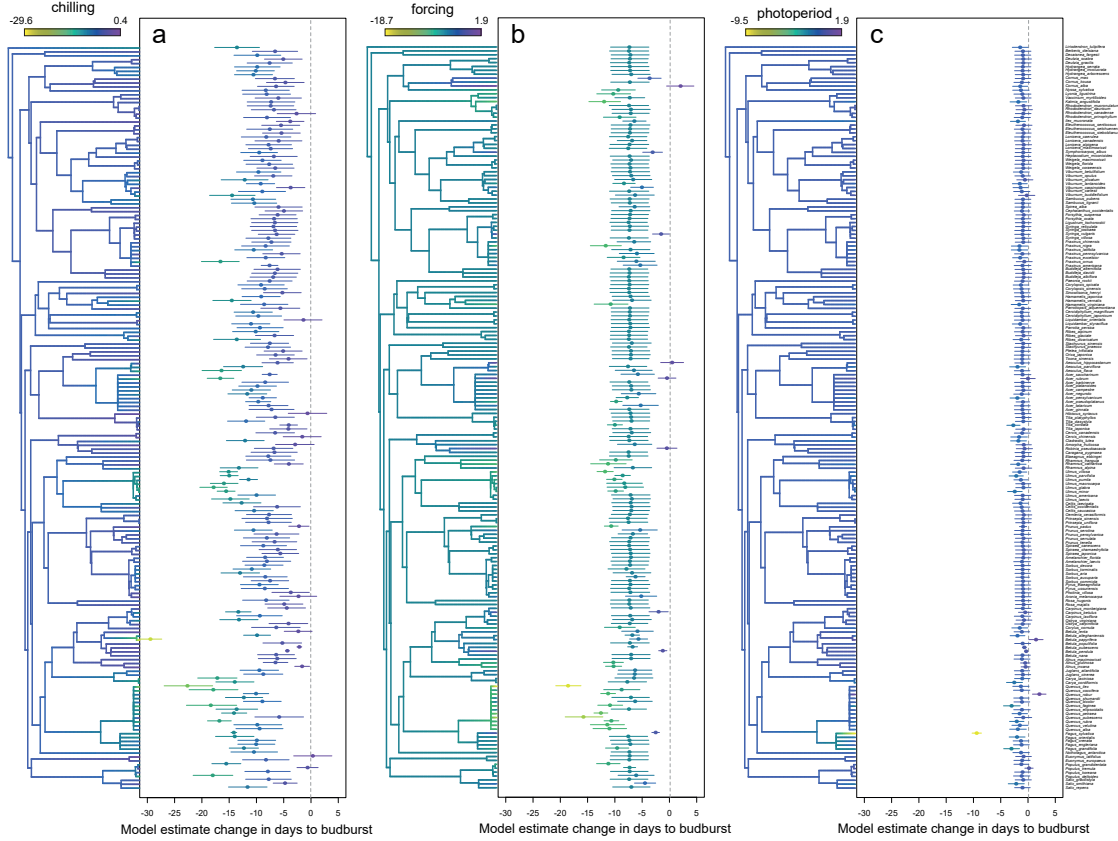
Figure 1: Non-phylogenetic phenological sensitivity to three environmental cues, chilling (a), forcing (b) and photoperiod (c) measured in change in days to budburst per standardized unit (z-transformation) of the cues across 191 tree species. Sensitivity estimates are computed by commonly used hierarchical model where phylogenetic distances are not accounted for ($\lambda =$ 0). The same phylogenetic tree is shown in each panel, colored acording to an estimation of ancestral character states, being the states at the tips the species' sensitivities to a cue. Species sensitivities are shown along with 50% Credible Intervals in the diagrams. Note that the color scale varies in each panel. Total tree depth is 81. My.
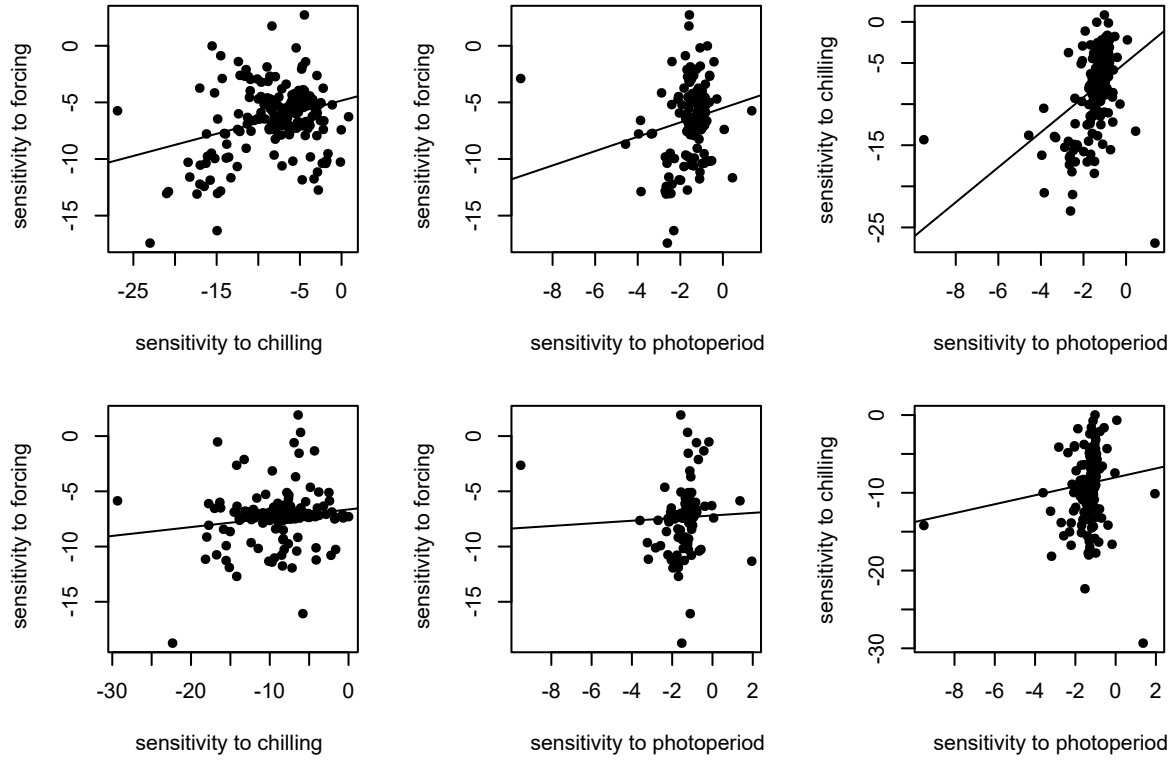
Figure 2: Correlations among estimated sensitivities to the environmental cues comparing forcing vs. chilling (a,d), forcing vs. photoperiod (b,e) and chilling vs. photoperiod (c,f). Upper panels show correlations among estimated sensitivities by the phylogenetic model and lower panels show results for the non-phylogenetic model.
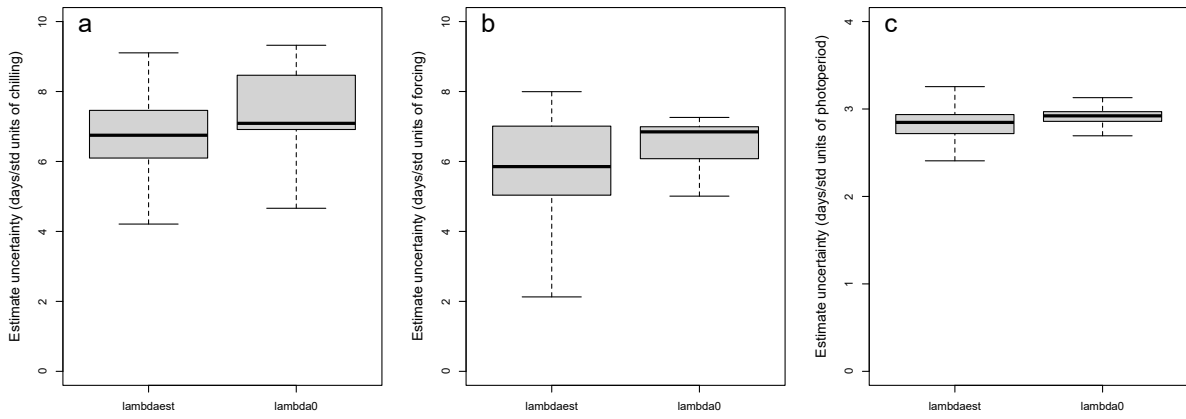
Figure 3: Comparison of uncertainty around estimated sensitivities to chilling (a), forcing (b) and photoperiod (c) of individual species between the phylogenetic model with estimated λ (lambdaest), and the non-phylogenetic model with $\lambda = 0$ (lambda0). The non-phylogenetic model increases uncertainty.
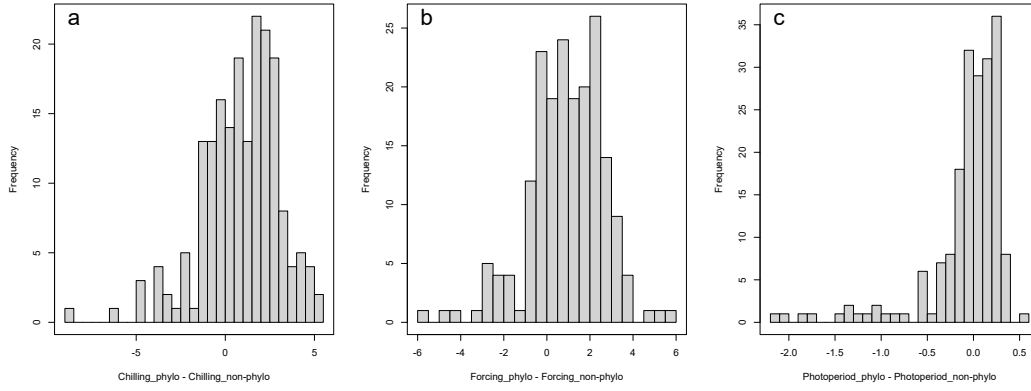
Figure 4: Bias in estimation of sensitivity to chilling (a), forcing (b) and photoperiod (c). Histograms show the difference between the phylogenetic model with estimated λ against the non-phylogenetic model with $\lambda = 0$. Positive values indicate that sensitivities estimated by the non-phylogenetic model are smaller than those estimated by the phylogenetic model.
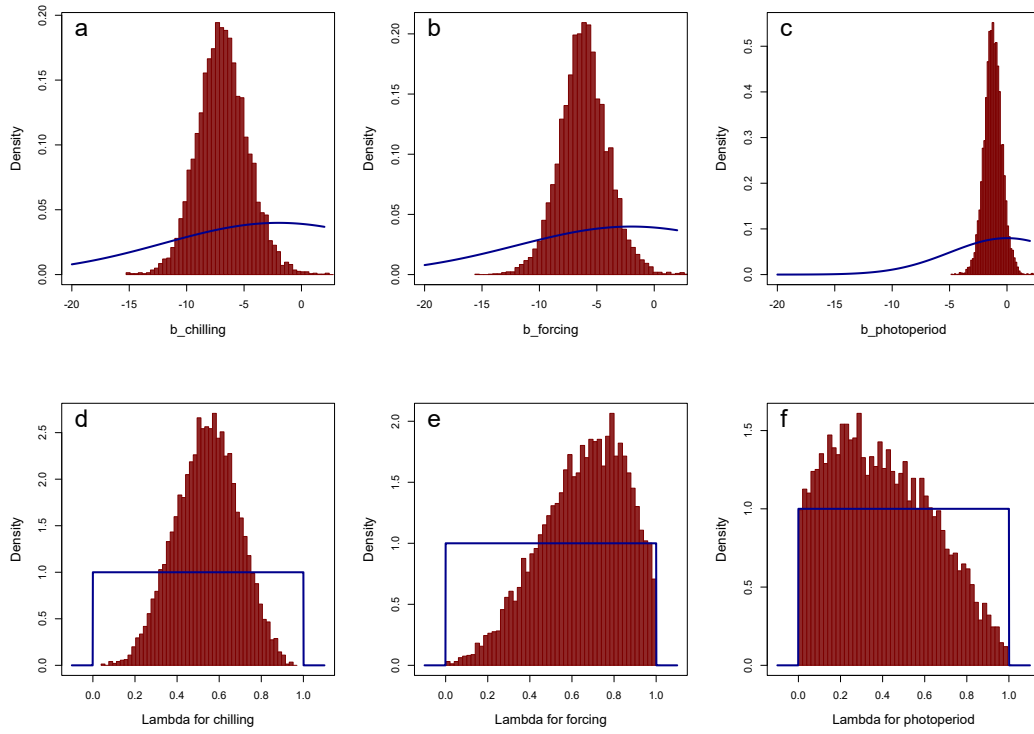
Figure 5: Marginal plots contrasting the posterior distributions (in red) of estimated sensitivities to chilling (a), forcing (b) and photoperiod (c) against prior distributions (blue). Lower panels show marginal plots for the posterior distributions of phylogenetic parameter λ fitted for chilling (d), forcing (e) and photoperiod (f).