

## References

1. Parmesan, C., Ryrholm, N., Stefanescu, C., Hill, J. K., Thomas, C. D., Descimon, H., Huntley, B., Kaila, L., Kullberg, J., Tammaru, T., Tennent, W. J., Thomas, J. A., and Warren, M. Poleward shifts in geographical ranges of butterfly species associated with regional warming. *Nature* **399**(6736), 579–583, June (1999).
2. Rosenzweig, C., Karoly, D., Vicarelli, M., Neofotis, P., Wu, Q., Casassa, G., Menzel, A., Root, T. L., Estrella, N., Seguin, B., Tryjanowski, P., Liu, C., Rawlins, S., and Imeson, A. Attributing physical and biological impacts to anthropogenic climate change. *Nature* **453**(7193), 353–357, May (2008).
3. Parmesan, C. and Yohe, G. A globally coherent fingerprint of climate change impacts across natural systems. *Nature* **421**(6918), 37–42, January (2003).
4. Cleland, E., Chuine, I., Menzel, A., Mooney, H., and Schwartz, M. Shifting plant phenology in response to global change. *Trends in Ecology & Evolution* **22**(7), 357–365, July (2007).
5. Lieth, H., Jacobs, J., Lange, O. L., Olson, J. S., and Wieser, W., editors. *Phenology and Seasonality Modeling*, volume 8 of *Ecological Studies*. Springer Berlin Heidelberg, Berlin, Heidelberg, (1974).
6. Woolway, R. I., Sharma, S., Weyhenmeyer, G. A., Debolskiy, A., Golub, M., Mercado-Bettín, D., Perroud, M., Stepanenko, V., Tan, Z., Grant, L., Ladwig, R., Mesman, J., Moore, T. N., Shatwell, T., Vanderkelen, I., Austin, J. A., DeGasperi, C. L., Dokulil, M., La Fuente, S., Mackay, E. B., Schladow, S. G., Watanabe, S., Marcé, R., Pierson, D. C., Thiery, W., and Jennings, E. Phenological shifts in lake stratification under climate change. *Nature Communications* **12**(1), 2318, April (2021).
7. Menzel, A., Sparks, T. H., Estrella, N., Koch, E., Aasa, A., Ahas, R., Alm-Kübler, K., Bissolli, P., Braslavská, O., Briede, A., Chmielewski, F. M., Crepinsek, Z., Curnel, Y., Defila, C., Donnelly, A., Filella, Y., Jatzak, K., Mestre, A., Peñuelas, J., Pirinen, P., Scheifinger, H., Striz, M., Susnik, A., Van Vliet, A. J. H., Wielgolaski, F., Zach, S., and Züst, A. European phenological response to climate change matches the warming pattern. *Global Change Biology* **12**(10), 1969–1976, October (2006).
8. Duputié, A., Rutschmann, A., Ronce, O., and Chuine, I. Phenological plasticity will not help all species adapt to climate change. *Global Change Biology* **21**(8), 3062–3073, August (2015).
9. Wolfe, D. W., Schwartz, M. D., Lakso, A. N., Otsuki, Y., Pool, R. M., and Shaulis, N. J. Climate change and shifts in spring phenology of three horticultural woody perennials in northeastern USA. *International Journal of Biometeorology* **49**(5), 303–309, May (2005).
10. Chmielewski, F.-M. and Rötzer, T. Response of tree phenology to climate change across Europe. *Agricultural and Forest Meteorology* **108**(2), 101–112, June (2001).
11. Fu, Y. H., Piao, S., Op De Beeck, M., Cong, N., Zhao, H., Zhang, Y., Menzel, A., and Janssens, I. A. Recent spring phenology shifts in western Central Europe based on multiscale observations. *Global Ecology and Biogeography* **23**(11), 1255–1263, November (2014).
12. Chuine, I. Why does phenology drive species distribution? *Philosophical Transactions of the Royal Society B: Biological Sciences* **365**(1555), 3149–3160, October (2010).
13. Peñuelas, J. and Filella, I. Responses to a Warming World. *Science* **294**(5543), 793–795, October (2001). Publisher: American Association for the Advancement of Science.

14. Gallinat, A. S., Primack, R. B., and Wagner, D. L. Autumn, the neglected season in climate change research. *Trends in Ecology & Evolution* **30**(3), 169–176, March (2015).
15. Jeong, S. and Medvigy, D. Macroscale prediction of autumn leaf coloration throughout the continental United States. *Global Ecology and Biogeography* **23**(11), 1245–1254, November (2014).
16. Cooke, J. E. K., Eriksson, M. E., and Junttila, O. The dynamic nature of bud dormancy in trees: environmental control and molecular mechanisms. *Plant, Cell & Environment* **35**(10), 1707–1728, October (2012).
17. Flynn, D. F. B. and Wolkovich, E. M. Temperature and photoperiod drive spring phenology across all species in a temperate forest community. *New Phytologist* **219**(4), 1353–1362, September (2018).
18. Körner, C. and Basler, D. Phenology Under Global Warming. *Science* **327**(5972), 1461–1462, March (2010). Publisher: American Association for the Advancement of Science.
19. Delpierre, N., Vitasse, Y., Chuine, I., Guillemot, J., Bazot, S., Rutishauser, T., and Rathgeber, C. B. K. Temperate and boreal forest tree phenology: from organ-scale processes to terrestrial ecosystem models. *Annals of Forest Science* **73**(1), 5–25, March (2016).
20. Keenan, T. F., Gray, J., Friedl, M. A., Toomey, M., Bohrer, G., Hollinger, D. Y., Munger, J. W., O’Keefe, J., Schmid, H. P., Wing, I. S., Yang, B., and Richardson, A. D. Net carbon uptake has increased through warming-induced changes in temperate forest phenology. *Nature Climate Change* **4**(7), 598–604, July (2014).
21. Dow, C., Kim, A. Y., D’Orangeville, L., Gonzalez-Akre, E. B., Helcoski, R., Herrmann, V., Harley, G. L., Maxwell, J. T., McGregor, I. R., McShea, W. J., McMahon, S. M., Pederson, N., Tepley, A. J., and Anderson-Teixeira, K. J. Warm springs alter timing but not total growth of temperate deciduous trees. *Nature* **608**(7923), 552–557, August (2022).
22. Green, J. K. and Keenan, T. F. The limits of forest carbon sequestration. *Science* **376**(6594), 692–693, May (2022).
23. Silvestro, R., Zeng, Q., Buttò, V., Sylvain, J.-D., Drolet, G., Mencuccini, M., Thiffault, N., Yuan, S., and Rossi, S. A longer wood growing season does not lead to higher carbon sequestration. *Scientific Reports* **13**(1), 4059, March (2023).
24. Richardson, A. D., Keenan, T. F., Migliavacca, M., Ryu, Y., Sonnentag, O., and Toomey, M. Climate change, phenology, and phenological control of vegetation feedbacks to the climate system. *Agricultural and Forest Meteorology* **169**, 156–173, February (2013).
25. Swidrak, I., Schuster, R., and Oberhuber, W. Comparing growth phenology of co-occurring deciduous and evergreen conifers exposed to drought. *Flora - Morphology, Distribution, Functional Ecology of Plants* **208**(10-12), 609–617, December (2013).
26. Kolář, T., Giagli, K., Trnka, M., Bednářová, E., Vavřík, H., and Rybníček, M. Response of the leaf phenology and tree-ring width of European beech to climate variability. *Silva Fennica* **50**(2) (2016).
27. Zohner, C. M., Mirzaghali, L., Renner, S. S., Mo, L., Rebindaine, D., Bucher, R., Palouš, D., Vitasse, Y., Fu, Y. H., Stocker, B. D., and Crowther, T. W. Effect of climate warming on the timing of autumn leaf senescence reverses after the summer solstice. *Science* **381**(6653), July (2023).

28. Tyree, M. T. and Zimmermann, M. H. *Xylem Structure and the Ascent of Sap*. Springer Series in Wood Science. Springer Berlin Heidelberg, Berlin, Heidelberg, (2002).
29. Choat, B., Brodribb, T. J., Brodersen, C. R., Duursma, R. A., López, R., and Medlyn, B. E. Triggers of tree mortality under drought. *Nature* **558**(7711), 531–539, June (2018).
30. Li, Y., Zhang, W., Schwalm, C. R., Gentine, P., Smith, W. K., Ciais, P., Kimball, J. S., Gazol, A., Kannenberg, S. A., Chen, A., Piao, S., Liu, H., Chen, D., and Wu, X. Widespread spring phenology effects on drought recovery of Northern Hemisphere ecosystems. *Nature Climate Change* **13**(2), 182–188, February (2023).
31. Trenberth, K. E., Dai, A., Van Der Schrier, G., Jones, P. D., Barichivich, J., Briffa, K. R., and Sheffield, J. Global warming and changes in drought. *Nature Climate Change* **4**(1), 17–22, January (2014).
32. Change, I. P. O. C. Detection and Attribution of Climate Change: from Global to Regional. In *Climate Change 2013 – The Physical Science Basis*, 867–952. Cambridge University Press 1 edition, March (2014).
33. Chiang, F., Mazdiyasni, O., and AghaKouchak, A. Evidence of anthropogenic impacts on global drought frequency, duration, and intensity. *Nature Communications* **12**(1), 2754, May (2021).
34. Polgar, C. A. and Primack, R. B. Leaf-out phenology of temperate woody plants: from trees to ecosystems. *New Phytologist* **191**(4), 926–941, September (2011).
35. Reinmann, A. B., Bowers, J. T., Kaur, P., and Kohler, C. Compensatory responses of leaf physiology reduce effects of spring frost defoliation on temperate forest tree carbon uptake. *Frontiers in Forests and Global Change* **6**, 988233, February (2023).
36. Morin, X., Roy, J., Sonié, L., and Chuine, I. Changes in leaf phenology of three European oak species in response to experimental climate change. *New Phytologist* **186**(4), 900–910, June (2010).
37. Primack, R. B., Laube, J., Gallinat, A. S., and Menzel, A. From observations to experiments in phenology research: investigating climate change impacts on trees and shrubs using dormant twigs. *Annals of Botany* **116**(6), 889–897, November (2015).
38. Cabon, A., Kannenberg, S. A., Arain, A., Babst, F., Baldocchi, D., Belmecheri, S., Delpierre, N., Guerrieri, R., Maxwell, J. T., McKenzie, S., Meinzer, F. C., Moore, D. J. P., Pappas, C., Rocha, A. V., Szejner, P., Ueyama, M., Ulrich, D., Vincke, C., Voelker, S. L., Wei, J., Woodruff, D., and Anderegg, W. R. L. Cross-biome synthesis of source versus sink limits to tree growth. *Science* **376**(6594), 758–761, May (2022).
39. Augspurger, C. K. and Bartlett, E. A. Differences in leaf phenology between juvenile and adult trees in a temperate deciduous forest. *Tree Physiology* **23**(8), 517–525, June (2003).
40. Vitasse, Y. Ontogenic changes rather than difference in temperature cause understory trees to leaf out earlier. *New Phytologist* **198**(1), 149–155, April (2013).
41. Berra, E. F., Gaulton, R., and Barr, S. Assessing spring phenology of a temperate woodland: A multiscale comparison of ground, unmanned aerial vehicle and Landsat satellite observations. *Remote Sensing of Environment* **223**, 229–242, March (2019).

42. Piao, S., Liu, Q., Chen, A., Janssens, I. A., Fu, Y., Dai, J., Liu, L., Lian, X., Shen, M., and Zhu, X. Plant phenology and global climate change: Current progresses and challenges. *Global Change Biology* **25**(6), 1922–1940 (2019).
43. Teng, M., Ouaknine, A., Laliberté, E., Bengio, Y., Rolnick, D., and Larochelle, H. Bringing SAM to new heights: Leveraging elevation data for tree crown segmentation from drone imagery, , June (2025). arXiv:2506.04970 [cs].
44. Chapin, F. S., Schulze, E., and Mooney, H. A. The Ecology and Economics of Storage in Plants. *Annual Review of Ecology and Systematics* **21**(1), 423–447, November (1990).
45. Landhäusser, S. M., Pinno, B. D., Lieffers, V. J., and Chow, P. S. Partitioning of carbon allocation to reserves or growth determines future performance of aspen seedlings. *Forest Ecology and Management* **275**, 43–51, July (2012).
46. Lawrence, B. T. and Melgar, J. C. Variable Fall Climate Influences Nutrient Resorption and Reserve Storage in Young Peach Trees. *Frontiers in Plant Science* **9** (2018).
47. Martens, L. A., Landhäusser, S. M., and Lieffers, V. J. First-year growth response of cold-stored, nursery-grown aspen planting stock. *New Forests* **33**(3), 281–295, May (2007).
48. Schott, K. M., Pinno, B. D., and Landhäusser, S. M. Premature shoot growth termination allows nutrient loading of seedlings with an indeterminate growth strategy. *New Forests* **44**(5), 635–647, September (2013).
49. Dox, I., Mariën, B., Zuccarini, P., Marchand, L. J., Prislan, P., Gričar, J., Flores, O., Gehrmann, F., Fonti, P., Lange, H., Peñuelas, J., and Campioli, M. Wood growth phenology and its relationship with leaf phenology in deciduous forest trees of the temperate zone of Western Europe. *Agricultural and Forest Meteorology* **327**, 109229, December (2022).
50. Kramer, K., Bijlsma, R.-J., Hickler, T., and Thuiller, W. Why Would Plant Species Become Extinct Locally If Growing Conditions Improve? *International Journal of Biological Sciences* **8**(8), 1121–1129 (2012).
51. Baumgarten, F., Gessler, A., and Vitasse, Y. No risk—no fun: Penalty and recovery from spring frost damage in deciduous temperate trees. *Functional Ecology* **37**(3), 648–663, March (2023).
52. D’Andrea, E., Rezaie, N., Battistelli, A., Gavrichkova, O., Kuhlmann, I., Matteucci, G., Moscatello, S., Proietti, S., Scartazza, A., Trumbore, S., and Muhr, J. Winter’s bite: beech trees survive complete defoliation due to spring late-frost damage by mobilizing old C reserves. *New Phytologist* **224**(2), 625–631, October (2019).
53. Chamberlain, C. J. and Wolkovich, E. M. Late spring freezes coupled with warming winters alter temperate tree phenology and growth. *New Phytologist* **231**(3), 987–995, August (2021).
54. Lian, X., Piao, S., Li, L. Z. X., Li, Y., Huntingford, C., Ciais, P., Cescatti, A., Janssens, I. A., Peñuelas, J., Buermann, W., Chen, A., Li, X., Myneni, R. B., Wang, X., Wang, Y., Yang, Y., Zeng, Z., Zhang, Y., and McVicar, T. R. Summer soil drying exacerbated by earlier spring greening of northern vegetation. *Science Advances* **6**(1), eaax0255, January (2020).

55. Zhang, J., Gou, X., Alexander, M. R., Xia, J., Wang, F., Zhang, F., Man, Z., and Pederson, N. Drought limits wood production of *Juniperus przewalskii* even as growing seasons lengthens in a cold and arid environment. *CATENA* **196**, 104936, January (2021).
56. Anderson-Teixeira, K. J., Herrmann, V., Banbury Morgan, R., Bond-Lamberty, B., Cook-Patton, S. C., Ferson, A. E., Muller-Landau, H. C., and Wang, M. M. H. Carbon cycling in mature and regrowth forests globally. *Environmental Research Letters* **16**(5), 053009, May (2021).
57. D'Orangeville, L., Maxwell, J., Kneeshaw, D., Pederson, N., Duchesne, L., Logan, T., Houle, D., Arseneault, D., Beier, C. M., Bishop, D. A., Druckenbrod, D., Fraver, S., Girard, F., Halman, J., Hansen, C., Hart, J. L., Hartmann, H., Kaye, M., Leblanc, D., Manzoni, S., Ouimet, R., Rayback, S., Rollinson, C. R., and Phillips, R. P. Drought timing and local climate determine the sensitivity of eastern temperate forests to drought. *Global Change Biology* **24**(6), 2339–2351, June (2018).
58. McMahon, S. M. and Parker, G. G. A general model of intra-annual tree growth using dendrometer bands. *Ecology and Evolution* **5**(2), 243–254, January (2015).
59. Zohner, C., Rockinger, A., and Renner, S. Increased autumn productivity permits temperate trees to compensate for spring frost damage. *The New phytologist* **221** 2, 789–795 (2018).
60. Klein, T., Vitasse, Y., and Hoch, G. Coordination between growth, phenology and carbon storage in three coexisting deciduous tree species in a temperate forest. *Tree Physiology* **36**(7), 847–855, July (2016).
61. Kramer, K., Leinonen, I., and Loustau, D. The importance of phenology for the evaluation of impact of climate change on growth of boreal, temperate and Mediterranean forests ecosystems: an overview. *International Journal of Biometeorology* **44**(2), 67–75, August (2000).
62. Ball, J. G. C., Hickman, S. H. M., Jackson, T. D., Koay, X. J., Hirst, J., Jay, W., Archer, M., Aubry-Kientz, M., Vincent, G., and Coomes, D. A. Accurate delineation of individual tree crowns in tropical forests from aerial RGB imagery using Mask R-CNN. *Remote Sensing in Ecology and Conservation* **9**(5), 641–655, October (2023).
63. Ulku, I., Akagunduz, E., and Ghamisi, P. Deep Semantic Segmentation of Trees Using Multispectral Images. *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing* **15**, 7589–7604 (2022).
64. Cloutier, M., Germain, M., and Laliberté, E. Influence of temperate forest autumn leaf phenology on segmentation of tree species from UAV imagery using deep learning. *Remote Sensing of Environment* **311**, 114283, September (2024).
65. Fawcett, D., Bennie, J., and Anderson, K. Monitoring spring phenology of individual tree crowns using drone-acquired NDVI data. *Remote Sensing in Ecology and Conservation* **7**(2), 227–244, June (2021).