Notes from fall 2022 reading group

1. Week 1: Dow *et al. 2022* and skim Gantois 2022
    (a) Curious about standardizing ... why they did it what way? Do results hold up with other methods?
    (b) What about autocorrelations in climate?
    (c) Heartwood! Roots!
    (d) What about VPDI? They should do analyses with that
    (e) They did not have much data in the end ... especially given they don't define how big an effect they expect to find or how big an effect they could detect (simulate data people!)
    (f) Why did Gantois exclude March from the spring?
    (g) Lots of good citations in Dow on other hypotheses/latitudinal variation to review!
2. Week 2: Zohner *et al. 2022* solstice pre-print
    (a) Paper diverges from Keenan work cited where longer seasons mean more carbon storage
    (b) Things that could explain the shift over time that looks to go with solstice and that earlier means you stop growing sooner (if you are tree)
        i. Drought correlates with earlier springs
        ii. NEW **cool** hypothesis from Alana: EOS_{10} is just a measure of herbivory ... so maybe this paper just means that earlier springs means earlier onset of 10% herbivory
        iii. Running out of nutrients?
        iv. Limited leaf lifespan
        v. Specific to some species?
        vi. Something about radiation
        vii. enumerate
        viii. Kavya suggests they needed a daylength experiment to make the solstice argument convincing
        ix. No changes over latitude seem weird
        x. Thermal optimum of leaf tissue can change up to 10C on the SAME tree each year, says Alana.
        xi. See also the to do list below
        xii. Misc.
            A. Some of the error reported is ODDLY small, suggesting the models are wrong somehow.
            B. Needs better measures of senescence says Fredi – check A_{max} and other measurements and see how they correlate with MODIS

C. We're not sure that MODIS is not just measuring radiation also ... in which case part of the paper is circular but that does not explain the ground observational data

D. Radiation? ... constructing leaf tissue, increase productivity (not sure what I meant here says Lizzie looking at her notes later)

E. enumerate

(c) Week 3: Schofield *et al. 2016* tree rings

i. This paper compares tree ring methods in a joint Bayesian models and shows that when you model altogether you get WILDLY different temperatures.

ii. Cat and Lizzie loved the math and paper, others found it dense and frustrating ... and we all agreed the figures are bad.

iii. Ruben found discussions of uncertainty in the step-wise approach and in cross-dating important and cool.

iv. Who has cited this paper?

v. Lizzie really enjoyed how they used the models to show support for classic approach and less support for RCS and how much a slightly more realistic biology sucked up variation and climate stuff.

vi. New paper idea from JHRL: Write an ecological paper with a joint model and show that you get something NEW out of it

(d) Week 4: Tumajer *et al. 2020* the VS lite model, which gives your start of wood growth and end of wood growth from annual tree ring data via a process-based model ... See Fig. 1 in the supp for how well the model fits to real xylogenesis data

(e) About the paper

i. No one is sure about the model – what's with all the tuning (what does tuning mean)? Did they tune to sites or not? We need to understand the validation stuff better, and it would be cool to know how their model works if you run white noise through it versus a model where you generate data from the VS model and then add noise or such.

ii. Ruben asked – is this model possible? Do we believe you could build it? Alana says if these things do work, then where in the tree you measure this would matter...

(f) Other things we discussed ...

i. Does growth change with longer seasons? Depends on whether you're talking about ind. species versus communities? Communities should get longer, but we're not sure on species ... but most of the authors seem to be assuming all species act the same.

ii. Earlier leaf phenology does not mean more wood, because leaves go into sugar not obviously wood... says Alana.

iii. Physic-focused vs. observational/statistical groups of physiologists ... and who works on tree rings? (The latter.)

iv. What do we know about xylogenesis? Does winter temperature matter? It could says Alana, esp. with winter embolusism but she's not sure of anyone working on this.

(g) Week 5: Soolananayakanahally *et al.* 2013

What do we want to do next?

There are sort of two big possible ways to go – think broadly about what could drive trends (or lack thereof) between season length and growth (and ideally jot down a concept paper) *or* or dive in on some data and related analyses we want to do. These sort of overlap ... if we start with the latter we likely need to return to the former.

(a) Where is this all going and how do we get there?
   i. Are we talking about community or species-level trends?
   ii. If you had all the data, and all the models are correct; what is most urgent? What is most important to know?
   iii. If we can link phenology to cambial growth; could we understand how this shifts with climate change and thus carbon sequestration? [Relating to above, can we make that link?]
   iv. Scroll to last page maybe – see 'Lizzie's earlier notes'

(b) Can we link leaf phenology to tree ring growth? ... with some data...
   i. Maybe through common garden data? (Aitken lab etc.) ... Do we have tree ring, bud-set, start of season data? Someone must have done dendro?
   ii. Can we get good high-resolution satellite data to look at EOS by species (we asked Kavya)? Some cool 'cubesat' stuff ... Cat added: GEDI is now 30m x 30m resolution

Paper ideas

Interesting papers to read:

(a) `https://besjournals.onlinelibrary.wiley.com/doi/full/10.1111/1365-2745.13464` (Some of Jucker last papers, super interesting approach, used something similar to the RCS but then use those to calculate the over/under production. Is not phenology, but shows I think a bit better how to use dendro in a better way)

(b) VS-lite models: this is a way to build physiological constrains (very similar to what they did in Schofield paper with the thresholds) to decompose tree ring into intra-annual patterns and then model it forward. It's really interesting and loads of paper but it really feels like it shouldn't work. I would be curious to dig in and get people's feedback, specially of those most experience in these. Definitively has more links to phenology if we consider it robust:
   i. "Original" paper: Tolwinski-Ward: `https://link.springer.com/article/10.1007/s00382-010-0945-5`

ii. Example of application: https://onlinelibrary.wiley.com/doi/full/10.1111/geb.13377

(c) Aloni R (2022) How the Three Organ-Produced Signals: Auxin, Cytokinin and Gibberellin, Induce and Regulate Wood Formation and Adaptation. In: Auxins, Cytokinins and Gibberellins Signaling in Plants. T Aftab (Ed), Springer Nature, Cham, Switzerland.

(d) Decoupled leaf-wood phenology in two pine species from contrasting climates: Longer growing seasons do not mean more radial growth

(e) A photoperiod-budset paper

(f) Papers on VPDI and heartwood? (sink limitation)

(g) Any other papers on phenology and tree growth??!!

From Ruben:

Groups/people doing 'modern ecology' with tree-rings to keep an eye on:

(a) Margaret Evans. Arizona. https://scholar.google.com/citations?hl=en&user=IGG0ZKQAAAAJ&view_op=list_works&sortby=pubdate

(b) Charlotte Grossiord. Lausanne. https://scholar.google.com/citations?hl=en&user=RsHW0OsAAAAJ&view_op=list_works&sortby=pubdate

(c) Tommasso Jucker. Bristol. https://scholar.google.com/citations?hl=en&user=s0x7E5wAAAAJ&view_op=list_works&sortby=pubdate

(d) Valerie Trouet. Belgium. https://scholar.google.com/citations?hl=en&user=-hF1HN8AAAAJ&view_op=list_works&sortby=pubdate

(e) Loic D'Orangeville. New Brumswick. https://scholar.google.com/citations?hl=en&user=CwBKApgAAAAJ&view_op=list_works&sortby=pubdate

(f) Dario Martin-Benito. Madrid. https://scholar.google.com/citations?hl=en&user=Qiooe3EAAAAJ&view_op=list_works&sortby=pubdate

Zhao et al. 2018 is the paper where we commented about this project together with Shoudong of characterizing the bias of the ITRDB and where we proposed some ideas on how to tackle it. It is the base for the ERC proposal but not much else went with it afterwards (and the database went again back to get filled with problems, but well... we tried)

To do items ... maybe?

(a) Email Keenan to see his perspectives on Zohner preprint; also ask Norby? ... Keenan, T. F. et al. Net carbon uptake has increased through warming-induced changes in temperate forest phenology. Nat. Clim. Chang. 4, 598–604 (2014). Do they also use MODIS GPP?

(b) Check refs of earlier spring = later EOS in Zohner preprint and COMPARE the papers

(c) For the Zohner preprint: Check if budbset is earlier in years with early springs (from common gardens with multiple years of data)

(d) Review refs in Pederson for latitude and other things ... here's all the ones Lizzie highlighted (last 3 are latitude).

i. Ahlstrom, A., Schurgers, G., Arneth, A. & Smith, B. Robustness and uncertainty in terrestrial ecosystem carbon response to CMIP5 climate change projections. Environ. Res. Lett. 7, 044008 (2012).

ii. Zweifel, R. et al. Why trees grow at night. New Phytol. 231, 2174–2185 (2021).

iii. Tumajer, J., Scharnweber, T., Smiljanic, M. & Wilmking, M. Limitation by vapour pressure deficit shapes different intra-annual growth patterns of diffuse- and ring-porous temperate broadleaves. New Phytol. 233, 2429–2441 (2022).

iv. Cabon, A. et al. Cross-biome synthesis of source versus sink limits to tree growth. Science 376, 758–761 (2022).

v. D'Orangeville, L. et al. Drought timing and local climate determine the sensitivity of eastern temperate forests to drought. Glob. Chang. Biol. 24, 2339–2351 (2018).

vi. Helcoski, R. et al. Growing season moisture drives interannual variation in woody productivity of a temperate deciduous forest. New Phytol. 223, 1204–1216 (2019).

vii. Anderson-Teixeira, K. J. et al. Joint effects of climate, tree size, and year on annual tree growth derived from tree-ring records of ten globally distributed forests. Glob. Chang. Biol. 28, 245–266 (2022).

viii. Banbury Morgan, R. et al. Global patterns of forest autotrophic carbon fluxes. Glob. Chang. Biol. 27, 2840–2855 (2021).

ix. Churkina, G., Schimel, D., Braswell, B. H. & Xiao, X. Spatial analysis of growing season length control over net ecosystem exchange. Glob. Chang. Biol. 11, 1777–1787 (2005).

(e) Check who has cited Schofield et al. 2016 since it was published!

(f) VS lite model: How to know what the null trends or findings are (Tumajer paper discussion notes above: would be cool to know how their model works if you run white noise through it versus a model where you generate data from the VS model and then add noise or such).

Lizzie's earlier notes below

Background: As springs shift growing seasons lengthen and plants are expected to grow longer. Especially trees, but tree rings suggest growth may not be increasing with earlier seasons in temperate zones.

Hypotheses:

(a) Statistical – Non-stationarity in temperature (climate) data may make accurately estimating phenological change and tree growth change accurately difficult. Check this early and often.

(b) Climate correlations – warmer springs may be associated with factors that reduce plant growth such as drought (and/or did someone write something about winter chilling?). Relates to climate hazards work.

(c) Ecology – shifting competitive landscapes (or something else?)

(d) Evolution – It may not be a long-term stable strategy to try to adjust growth dramatically year-to-year, so should we really expect this correlation? If this is true, you predict:

   i. Latitudinal variation in length of growing season and tree growth. (May connect back to Ailene's Putnam – predicts species from warmer provenances would better exploit longer growing seasons?) ... also these papers cited in Dow 2022: 44. Anderson-Teixeira, K. J. et al. Joint effects of climate, tree size, and year on annual tree growth derived from tree-ring records of ten globally distributed forests. Glob. Chang. Biol. 28, 245–266 (2022). 45. Banbury Morgan, R. et al. Global patterns of forest autotrophic carbon fluxes. Glob. Chang. Biol. 27, 2840–2855 (2021). 46. Churkina, G., Schimel, D., Braswell, B. H. & Xiao, X. Spatial analysis of growing season length control over net ecosystem exchange. Glob. Chang. Biol. 11, 1777–1787 (2005).

   ii. Species diversity: species should vary in how much they try to take advantage of interannual variation in climate (likely early-active species show the highest correlation? Again, Ailene's Putnam focused on this.)