

Supplementary Information

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Appendix S1. Methods for reconstruction of DBH

This is still rough/ mostly notes.

For each core, *DBH* can be reconstructed outside-in (based on recent *DBH*, subtracting growth recorded in tree rings) or inside-out (summing Δr from the inside out). We generally gave precedence to the outside-in approach. Specifically, when *DBH* was taken at the time of coring,

At some of our sites where *DBH* was not taken at the time of coring (*SCBI*), *DBH* measurements taken before or slightly after the time of coring could be used. (see issue #19 in ForestGEO_dendro) If before, ... If after... For all outside-in reconstructions, if a negative *DBH* was predicted...

When there were more than one cores for a tree, the *DBH* reconstructions from each core were averaged to produce a single estimate of the tree's *DBH* through time. When the start or end dates of the records from the cores differed, we extrapolated growth of the shorter core to match the years covered by the longer core. Specifically, to fill in years at the more recent end, we assumed that the average growth rate of the ten years prior to the missing records applied to the missing years. To fill in years at the beginning of the tree's lifespan, we likewise assumed that the ten years adjacent to the missing record applied to the missing years; however, if this yielded a negative *DBH* estimate for the earliest year in the reconstruction, we divided the existing minimum *DBH* by number of years missing and applied that value to each year. We note that these reconstructed growth records were used only for the reconstruction of *DBH* and were not included as response variables in any of our analyses.

In either case we need bark thickness—ideally allometries describing the relationship between *DBH* and bark thickness (Table S4). This is especially critical for thick-barked species. When bark thickness data were available, we generated allometries (issue #8 in ForestGEO_dendro)... lognormal model with intercept forced to zero: `lm(bark_depth.mm ~ -1 + log(dbh_no_bark.cm+1):bark_species, data = bark)`. When bark thickness data were not available, we used published bark allometries from other sources (Table S4)

Appendix S2. Methods for comparing climwin results with traditional methods

(**ISSUE #35 in ForestGEO-climate-sensitivity

This is in process. For ~4 selected species (well-studied), we will build chronologies that exactly match the data used in this analysis. We'll then generate a figure like Fig. S1. We expect a pretty good match, as our results are basically consistent with previous studies at all these sites.

Appendix S3. Dealing with rapidly changing climate and tree growth

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Our analysis included two sites where climate change has had pronounced effects on tree growth: Scotty Creek, NW Territories, Canada (SC) and Little Tesuque, New Mexico, USA (LT). At SC, [temperatures have increased by X ° over X years]..., resulting in negative growth trends in basal area index (*BAI*) starting around 1950 and significant growth declines since 1970 in 56% of trees [@sniderhan_growth_2016]. At LT, (*drought has increased dramatically*), resulting in many missing rings in recent years.

This is in process. We will try and compare 3 methods: (1) our standard approach, (2) detrending the climate variables (#53), (3) applying the climwin step only for older records--before the most rapid climate change. We will work with SC and LT researchers to determine which makes most sense, and use that as the main approach for these sites.

Table S1. Site Details

| site code | site name | latitude | longitude | elevation (m.a.s.l.) | cores within ForestGEO plot? | canopy positions | tree statuses | date range | dormant season | months in climwin |
|-----------|--|----------|-----------|-------------------------|------------------------------------|---------------------|---------------|------------|----------------|-------------------|
| BCI | Barro Colorado Island | 9.15430 | -79.8461 | 120-160 | no | canopy | live, dead | 1931-2014 | Nov-Apr | pOct-cDec |
| HKK | Huai Kha Khaeng | 15.63240 | 99.2170 | 549-638 | no | all | live | 1903-2011 | | pOct-cDec |
| LT | Little Tesuque | 35.73838 | -105.8382 | n.a. | | all | live | 1903-2018 | | pMay-cAug |
| CB | Utah Forest Dynamics Plot | 37.66150 | -112.8525 | 3020-3169 | | | | 1903-2007 | | pMay-cAug |
| SCBI | Smithsonian Conservation Biology Institute | 38.89350 | -78.1454 | 273-338 | yes | all | live, dead | 1903-2017 | Oct-Apr | pMay-cAug |
| LDW | Lilly Dickey Woods | 39.23590 | -86.2181 | 230-303 | | | canopy | live, dead | 1903-2019 | |
| HF | Harvard Forest | 42.53880 | -72.1755 | 340-368 | yes | all | live, dead | 1903-2014 | | pMay-cAug |
| NB | Niobrara/Hansley | 42.78000 | -100.0210 | 644-702 | | | | | | pMay-cAug |
| ZOF | Zofin Forest Dynamics Plot | 48.66380 | 14.7073 | 745-822 | some | all | | 1903-2013 | | pMay-cAug |
| SC | Scotty Creek | 61.30000 | -121.3000 | 258-274 | no | all | live, dead | 1903-2013 | | pMay-cAug |

Table S2. Species analyzed, their characteristics, and bark allometries applied*(ISSUE #72 in ForestGEO-climate-sensitivity)*

NOTE: bark.allometry field is not yet right– we will have just one latin name per site, corresponding to allometries in Table S4. But it does give correct info for what is currently applied. We also intend to find and apply more allometries.

| species.code | family | latin.name | sites.sampled | leaf.type | leaf.phenology | light.requirements | bark.allometry |
|--------------|--------------|--------------------------------|---------------|------------|---------------------------|--------------------|--|
| ABAL | Pinaceae | <i>Abies alba</i> | ZOF | needleleaf | evergreen | | neglected in Zofin |
| ABBI | Pinaceae | <i>Abies bifolia</i> | CB | needleleaf | evergreen | | neglected in Cedar Breaks |
| ACRU | Sapindaceae | <i>Acer rubrum</i> | HF | broadleaf | deciduous (cold) | | acru in Harvard |
| ACSA | Sapindaceae | <i>Acer saccharum</i> | LDW | broadleaf | deciduous (cold) | | acru in Lilly Dickey, acru in Lilly Dickey |
| AFXY | Fabaceae | <i>Afzelia xylocarpa</i> | HKK | broadleaf | deciduous (drought) | | neglected in HKK |
| BEAL | Betulaceae | <i>Betula alleghaniensis</i> | HF | broadleaf | deciduous (cold) | | neglected in Harvard |
| BELE | Betulaceae | <i>Betula lenta</i> | NA | broadleaf | deciduous (cold) | | neglected in Harvard |
| BEPA | Betulaceae | <i>Betula papyrifera</i> | NA | broadleaf | deciduous (cold) | | neglected in NB |
| CACO | Juglandaceae | <i>Carya cordiformis</i> | SCBI | broadleaf | deciduous (cold) | | caco in SCBI |
| CAGL | Juglandaceae | <i>Carya glabra</i> | SCBI | broadleaf | deciduous (cold) | | cagl in SCBI |
| CAOV | Juglandaceae | <i>Carya ovata</i> | LDW | broadleaf | deciduous (cold) | | cagl in Lilly Dickey |
| CAOVL | Juglandaceae | <i>Carya ovalis</i> | SCBI | broadleaf | deciduous (cold) | | caovl in SCBI |
| CATO | Juglandaceae | <i>Carya tomentosa</i> | SCBI | broadleaf | deciduous (cold) | | cato in SCBI |
| CHTA | Meliaceae | <i>Chukrasia tabularis</i> | HKK | broadleaf | brevi-deciduous (drought) | | neglected in HKK |
| FAGR | Fagaceae | <i>Fagus grandifolia</i> | HF, SCBI | broadleaf | deciduous (cold) | | neglected in Harvard, neglected in Lilly Dickey, neglected in SCBI |
| FASY | Fagaceae | <i>Fagus sylvatica</i> | ZOF | broadleaf | deciduous (cold) | | neglected in Zofin |
| FRAM | Oleaceae | <i>Fraxinus americana</i> | LDW, SCBI | broadleaf | deciduous (cold) | | fram in Lilly Dickey, fram in SCBI |
| FRNI | Oleaceae | <i>Fraxinus nigra</i> | SCBI | broadleaf | deciduous (cold) | | fram in SCBI |
| JACO | Bignoniaceae | <i>Jacaranda copaia</i> | BCI | broadleaf | deciduous (drought) | light-demanding | JCO in BCI |
| JUNI | Juglandaceae | <i>Juglans nigra</i> | SCBI | broadleaf | deciduous (cold) | | juni in SCBI |
| LITU | Magnoliaceae | <i>Liriodendron tulipifera</i> | LDW, SCBI | broadleaf | deciduous (cold) | | litu in Lilly Dickey, litu in Lilly Dickey, litu in SCBI |
| MEAZ | Meliaceae | <i>Melia azedarach</i> | HKK | broadleaf | deciduous (drought) | light-demanding | neglected in HKK |
| NEOB | Lauraceae | <i>Neolitsea obtusifolia</i> | NA | broadleaf | evergreen | | neglected in HKK |
| PIAB | Pinaceae | <i>Picea abies</i> | HF | needleleaf | evergreen | | neglected in Harvard, neglected in Zofin |
| PIFL | Pinaceae | <i>Pinus flexilis</i> | CB | needleleaf | evergreen | | Pinus monticola in Cedar Breaks |
| PILO | Pinaceae | <i>Pinus longaeva</i> | CB | needleleaf | evergreen | | neglected in Cedar Breaks |
| PIMA | Pinaceae | <i>Picea mariana</i> | SC | needleleaf | evergreen | | PIMA in Scotty Creek |
| PIPO | Pinaceae | <i>Pinus ponderosa</i> | LT | needleleaf | evergreen | | Pinus jeffreyi in Little Tesuque, Pinus jeffreyi in NB |
| PIST | Pinaceae | <i>Pinus strobus</i> | HF, SCBI | needleleaf | evergreen | | neglected in Harvard, pist in SCBI |
| PIST2 | Pinaceae | <i>Pinus strobus</i> | LT | needleleaf | evergreen | | Pinus monticola in Little Tesuque |
| PSME | Pinaceae | <i>Pseudotsuga menziesii</i> | CB | needleleaf | evergreen | | PSME in Cedar Breaks |
| QUAL | Fagaceae | <i>Quercus alba</i> | LDW, SCBI | broadleaf | deciduous (cold) | | qual in Lilly Dickey, qual in SCBI |
| QUMO | Fagaceae | <i>Quercus montana</i> | LDW, SCBI | broadleaf | deciduous (cold) | | qupr in Lilly Dickey, qupr in SCBI |
| QURU | Fagaceae | <i>Quercus rubra</i> | HF, LDW, SCBI | broadleaf | deciduous (cold) | | quru in Harvard, quru in Lilly Dickey, quru in SCBI |
| QUVE | Fagaceae | <i>Quercus velutina</i> | LDW, SCBI | broadleaf | deciduous (cold) | | quve in Lilly Dickey, quve in SCBI |
| TEPA | Burseraceae | <i>Tetragastris panamensis</i> | BCI | broadleaf | evergreen | shade-tolerant | TPA in BCI |
| TOCI | Meliaceae | <i>Toona ciliata</i> | HKK | broadleaf | deciduous (drought) | | neglected in HKK |
| TRTU | Meliaceae | <i>Trichilia tuberculata</i> | BCI | broadleaf | evergreen | shade-tolerant | TTU in BCI |
| TSCA | Pinaceae | <i>Tsuga canadensis</i> | HF | needleleaf | evergreen | | neglected in Harvard |

*Bark allometry field indicates the species and site sampled to construct the bark allometry. When neither raw data nor an allometric equation for the study species was available, we selected the most appropriate equation that could be located for similar species. Equations are given in Table S4.

Table S3. Sampling details for species by site*(ISSUE #73 in ForestGEO-climate-sensitivity)*

| site | species.code | n.trees.all | n.cores.all | n.trees.dbh | n.cores.dbh | dbh.range.sampled | dbh.range.reconstructed* | date.range |
|------|--------------|-------------|-------------|-------------|-------------|-------------------|--------------------------|------------|
| BCI | JACO | 12 | 18 | 11 | 17 | 30.2-63.5 | 3.8-59.4 | 1931-2014 |
| BCI | TEPA | 18 | 29 | 17 | 26 | 22.1-59.5 | 2.6-51.2 | 1931-2014 |
| BCI | TRTU | 23 | 37 | 20 | 31 | 20.7-43.6 | 5.3-42.4 | 1931-2014 |
| CB | PIFL | 9 | 13 | NA | NA | NA | NA | 1903-2007 |
| CB | PILO | 11 | 12 | NA | NA | NA | NA | 1903-2007 |
| CB | PSME | 10 | 13 | NA | NA | NA | NA | 1903-2007 |
| HF | ACRU | 18 | 59 | 18 | 59 | 10.1-22.1 | 1-20.4 | 1903-2013 |
| HF | BEAL | 13 | 44 | 13 | 44 | 10.2-37.9 | 1.6-20.5 | 1904-2013 |
| HF | QURU | 74 | 180 | 73 | 177 | 19.5-53 | 1.6-48.3 | 1903-2014 |
| HF | TSCA | 32 | 83 | 32 | 83 | 10.6-37 | 0.6-34.4 | 1923-2014 |
| HKK | AFXY | 39 | 127 | 39 | 127 | 20.1-98.7 | 0.1-81.4 | 1903-2011 |
| HKK | CHTA | 28 | 70 | 28 | 70 | 16-64.6 | 0.2-59.5 | 1904-2010 |
| HKK | MEAZ | 46 | 130 | 46 | 130 | 25.6-98.1 | 3.8-80.3 | 1914-2011 |
| HKK | TOCI | 45 | 143 | 45 | 143 | 16.6-116.4 | 1.7-80.5 | 1903-2011 |
| LDW | ACSA | 35 | 66 | 34 | 64 | 9-64.6 | 0-53.4 | 1903-2019 |
| LDW | CAOV | 9 | 18 | 8 | 16 | NA-NA | 0.6-38.3 | 1903-2013 |
| LDW | LITU | 15 | 28 | 14 | 26 | NA-NA | 1.4-70.5 | 1903-2019 |
| LDW | QUAL | 10 | 20 | NA | NA | NA | NA | 1903-2013 |
| LDW | QUMO | 10 | 20 | 8 | 16 | NA-NA | 1.4-54.1 | 1903-2013 |
| LDW | QUVE | 9 | 18 | NA | NA | NA | NA | 1903-2013 |
| LT | PIPO | 10 | 20 | 10 | 20 | 23.2-52.8 | 13.3-48.5 | 1903-2018 |
| LT | PIST2 | 7 | 14 | 7 | 10 | 25.7-39.8 | 3.5-34.4 | 1903-2018 |
| SCBI | CACO | 15 | 15 | 15 | 15 | 10.62-38.52 | 2.6-32.3 | 1903-2015 |
| SCBI | CAGL | 39 | 39 | 36 | 36 | 10.28-52.31 | 1.6-50.5 | 1903-2015 |
| SCBI | CAOVL | 25 | 25 | 24 | 24 | 15.11-60.32 | 2.7-48.4 | 1903-2015 |
| SCBI | CATO | 15 | 15 | 14 | 14 | 12.86-35.95 | 4.6-29.5 | 1903-2015 |
| SCBI | FAGR | 76 | 76 | 76 | 76 | 10.05-41.02 | 0.1-41.2 | 1920-2009 |
| SCBI | FRAM | 66 | 66 | 63 | 63 | 6.85-94.73 | 0.2-86.4 | 1903-2016 |
| SCBI | FRNI | 12 | 12 | 12 | 12 | 11.04-39.2 | 1.5-28.4 | 1903-1996 |
| SCBI | JUNI | 30 | 30 | 29 | 29 | 20.4-76.19 | 5.9-61.2 | 1903-2010 |
| SCBI | LITU | 106 | 106 | 105 | 105 | 10-91.42 | 0.1-82.2 | 1903-2010 |
| SCBI | PIST | 36 | 36 | 36 | 36 | 13.92-50.96 | 1.6-45.2 | 1931-2010 |
| SCBI | QUAL | 66 | 66 | 66 | 66 | 11.4-76.73 | 0.4-72.3 | 1903-2009 |
| SCBI | QUMO | 67 | 67 | 67 | 67 | 10.22-84.59 | 0.4-71.2 | 1903-2017 |
| SCBI | QURU | 71 | 71 | 70 | 70 | 11.07-87.65 | 2.6-79.5 | 1903-2016 |
| SCBI | QUVE | 82 | 82 | 81 | 81 | 16.02-82.33 | 0.6-79.4 | 1903-2009 |
| SC | PIMA | 443 | 443 | 395 | 395 | 24-Jul | 0.1-18.5 | 1903-2013 |
| ZOF | ABAL | 55 | 55 | 52 | 52 | 41-121 | 21.3-108.5 | 1903-2011 |
| ZOF | FASY | 1369 | 1369 | 1368 | 1368 | NA-NA | 0.1-115.3 | 1903-2013 |
| ZOF | PCAB | 644 | 644 | 635 | 635 | NA-NA | 0-126.4 | 1903-2011 |

*Maximum reconstructed DBH's analyzed are less than maximum sampled DBH's because we discard size ranges with < 3 conspecific trees.

Table S4. Allometric equations for bark thickness

| species | equation | n | DBH.range.cm | site | source |
|--------------------------------|--|----|--------------|------------------------------|---|
| <i>Acer rubrum</i> | bark.mm = 0.619 * log(dbh.cm + 1) | 10 | 8.2-39.6 | SCBI | Anderson-Teixeira et al. (2015) |
| <i>Carya cordiformis</i> | bark.mm = 0.793 * log(dbh.cm + 1) | 9 | 5.9-68.2 | SCBI | Anderson-Teixeira et al. (2015) |
| <i>Carya ovalis</i> | bark.mm = 1.531 * log(dbh.cm + 1) | 8 | 6.4-63.1 | SCBI | Anderson-Teixeira et al. (2015) |
| <i>Carya ovata</i> | bark.mm = 1.035 * log(dbh.cm + 1) | 8 | 19.1-78 | SCBI | Anderson-Teixeira et al. (2015) |
| <i>Carya tomentosa</i> | bark.mm = 1.105 * log(dbh.cm + 1) | 8 | 5-57.3 | SCBI | Anderson-Teixeira et al. (2015) |
| <i>Fraxinus americana</i> | bark.mm = 2.223 * log(dbh.cm + 1) | 9 | 6.1-94.2 | SCBI | Anderson-Teixeira et al. (2015) |
| <i>Jacaranda copaia</i> | bark.mm = 2.993 * log(dbh.cm + 1) | 5 | 45.6-75 | Panama | Raquel Alfaro-Sanchez (unpublished data) |
| <i>Juglans nigra</i> | bark.mm = 2.107 * log(dbh.cm + 1) | 9 | 13.6-85.4 | SCBI | Anderson-Teixeira et al. (2015) |
| <i>Liriodendron tulipifera</i> | bark.mm = 1.637 * log(dbh.cm + 1) | 9 | 27.5-136.5 | SCBI | Anderson-Teixeira et al. (2015) |
| <i>Picea mariana</i> | bark.mm = 3.726 * log(dbh.cm + 1) | 12 | 6.9-7.9 | Scotty Creek | Anastasia Sniderhan and Jennifer Baltzer (unpublished data) |
| <i>Pinus flexilis</i> | bark.mm = (1.299 * $\sqrt{dbh.cm}$) ^{0.609}) ² | 29 | 10-130 | California (3 montane sites) | Zeibig-Kichas et al. (2016) |
| <i>Pinus ponderosa</i> | bark.mm = (1.298 * $\sqrt{dbh.cm}$) ^{0.802}) ² | 81 | 5-160 | California (4 montane sites) | Zeibig-Kichas et al. (2016) |
| <i>Pinus strobus</i> | bark.mm = 1.568 * log(dbh.cm + 1) | 1 | 28.4-28.4 | Illinois | Miles and Smith (2009) |
| <i>Pseudotsuga menziesii</i> | bark.mm = (0.785 * $\sqrt{dbh.cm}$) ² | 30 | 10-200 | California (3 montane sites) | Zeibig-Kichas et al. (2016) |
| <i>Quercus alba</i> | bark.mm = 1.828 * log(dbh.cm + 1) | 10 | 9.3-101.8 | SCBI | Anderson-Teixeira et al. (2015) |
| <i>Quercus montana</i> | bark.mm = 2.083 * log(dbh.cm + 1) | 8 | 5.8-99.1 | SCBI | Anderson-Teixeira et al. (2015) |
| <i>Quercus rubra</i> | bark.mm = 0.98 * log(dbh.cm + 1) | 10 | 24.1-143.2 | SCBI | Anderson-Teixeira et al. (2015) |
| <i>Quercus velutina</i> | bark.mm = 1.394 * log(dbh.cm + 1) | 8 | 16.2-110.7 | SCBI | Anderson-Teixeira et al. (2015) |
| <i>Tetragastris panamensis</i> | bark.mm = 1.672 * log(dbh.cm + 1) | 4 | 22.7-48.8 | Panama | Raquel Alfaro-Sanchez (unpublished data) |
| <i>Trichilia tuberculata</i> | bark.mm = 1.367 * log(dbh.cm + 1) | 12 | 21-40.5 | Panama | Raquel Alfaro-Sanchez (unpublished data), Pete Kerby-Miller and Helene Muller-Landau (unpublished data) |

For assignments of species as proxies for those with out available bark allometries, see Table S2.

Table S5. Frequency of *DBH*-climate interactions across all sites and growth metrics

Figure S1. Comparison of our approach with traditional methods of identifying climate signals

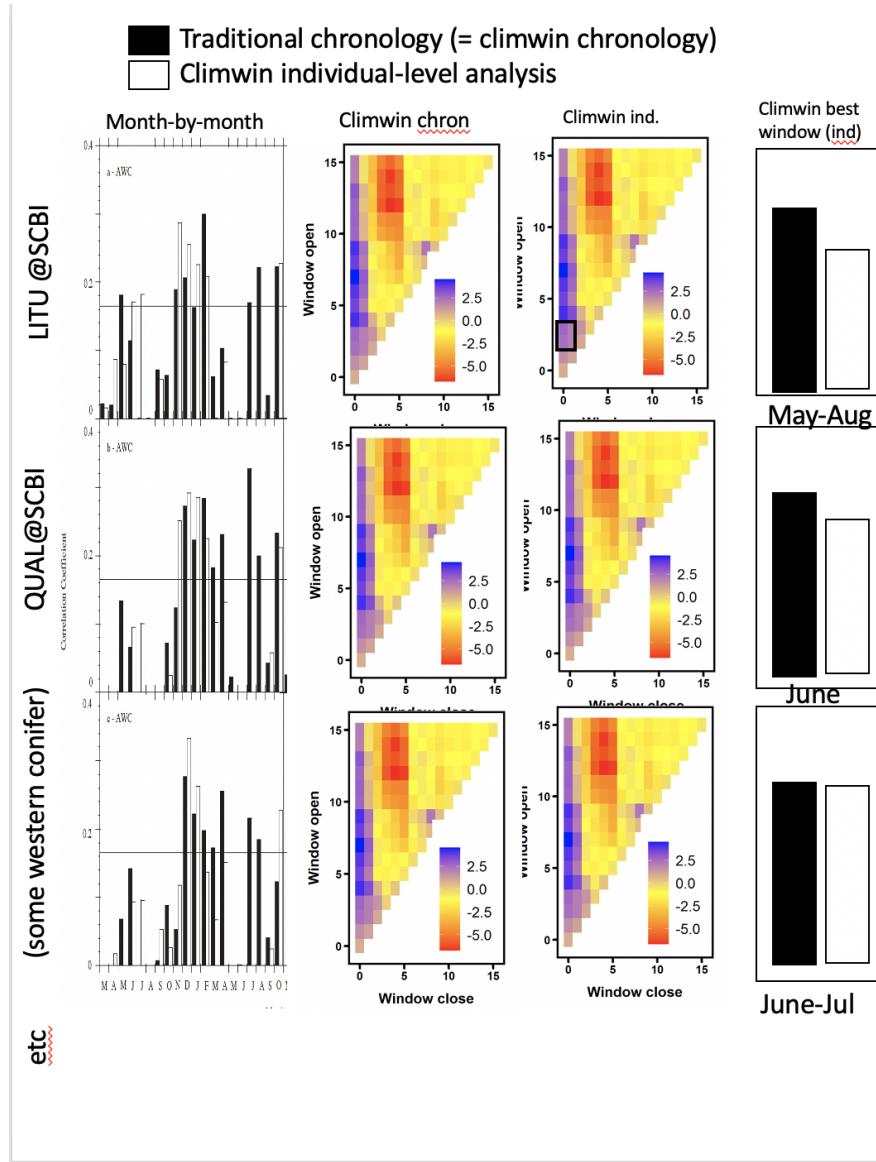


Figure S1 | (Comparison of traditional approaches with ours). (THIS FIGURE IS JUST A MOCK-UP –NOT REAL DATA. REAL FIGURE WILL INCLUDE 3-4 COMMONLY STUDIED SPECIES FROM DIFFERENT SITES.)

Figure S2. Comparison of climwin output across growth metrics for the temperature variable group at Little Tesuque (New Mexico, USA)

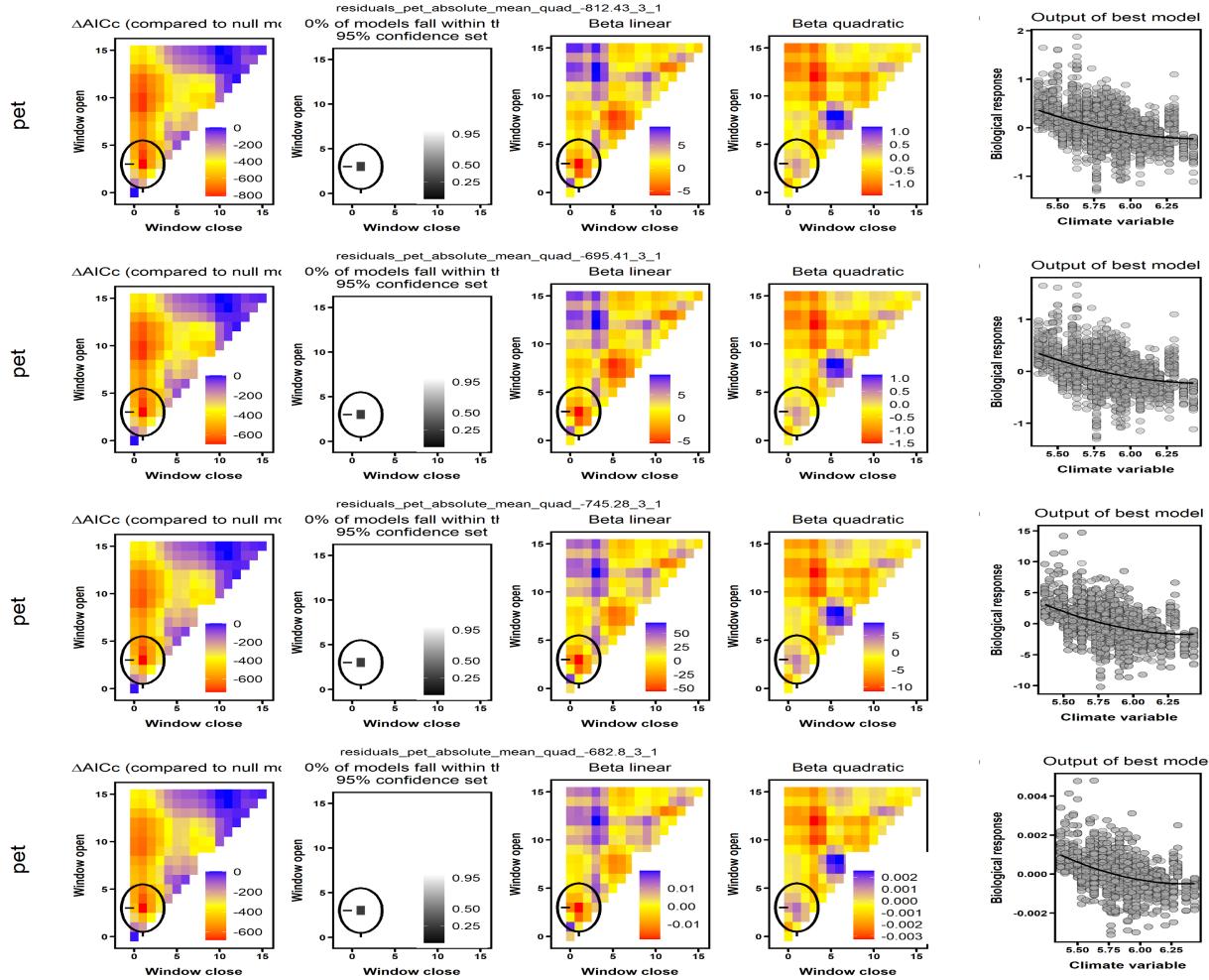


Figure S2 | Comparison of climwin output across growth metrics for the temperature variable group at Little Tesuque (New Mexico, USA). Here, *climwin* identified potential evapotranspiration (*PET*) as the strongest climate variable across all three metrics of growth (Δr , BAI, ΔAGB) and regardless of whether all cores were included in the analysis, or only those for which DBH could be reconstructed (Δr -trees with *DBH*, BAI, ΔAGB).

Figure S3. Comparison of climwin output across growth metrics for the precipitation variable group at Little Tesuque (New Mexico, USA)

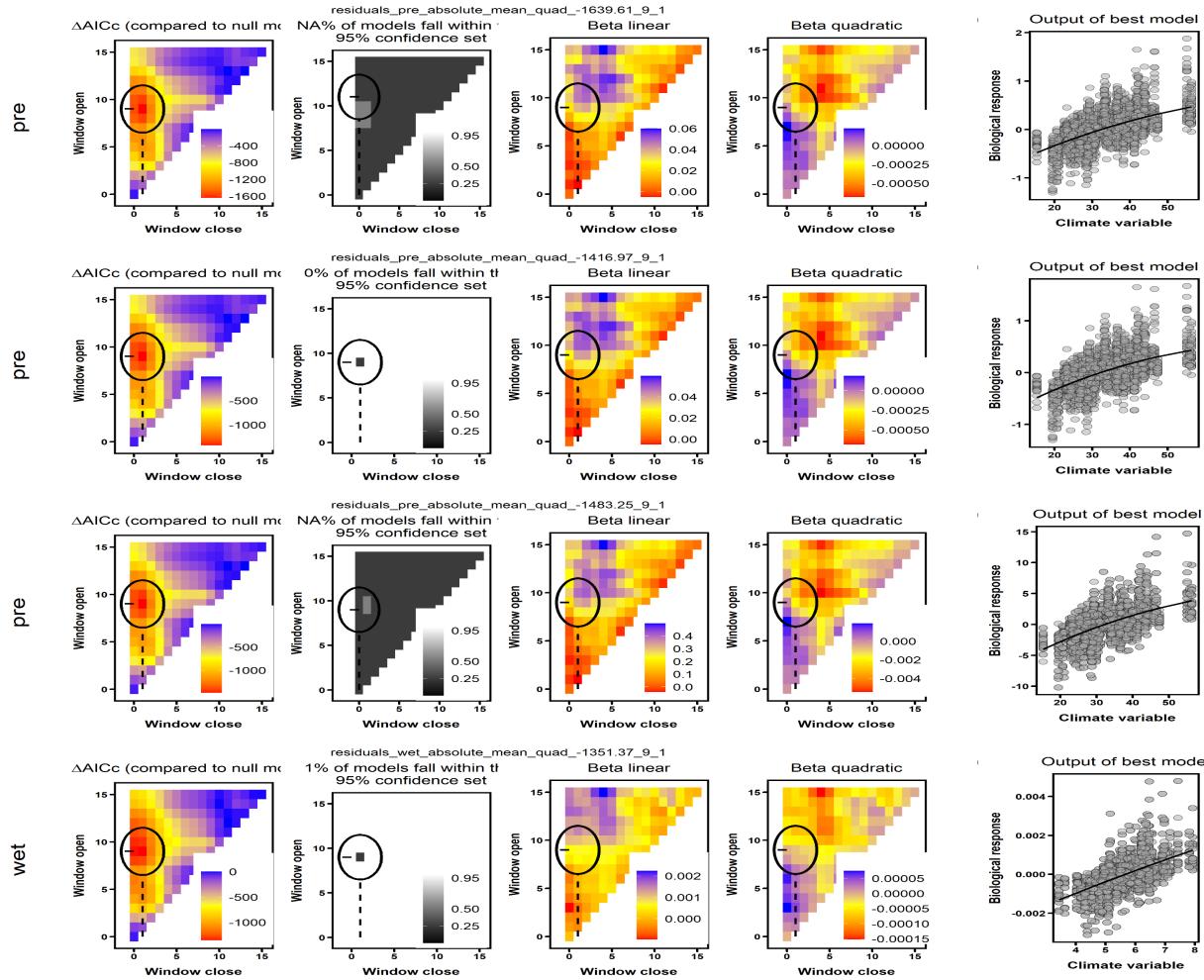


Figure S3 | Comparison of climwin output across growth metrics for the precipitation variable group at Little Tesuque (New Mexico, USA). Here, *climwin* identified precipitation (PRE) as the strongest climate variable for Δr and BAI , but precipitation day frequency (WET) as the strongest climate variable for ΔAGB .

Figure S4. Comparison of climwin output across growth metrics for the precipitation variable group at Harvard Forest (Massachusetts, USA)

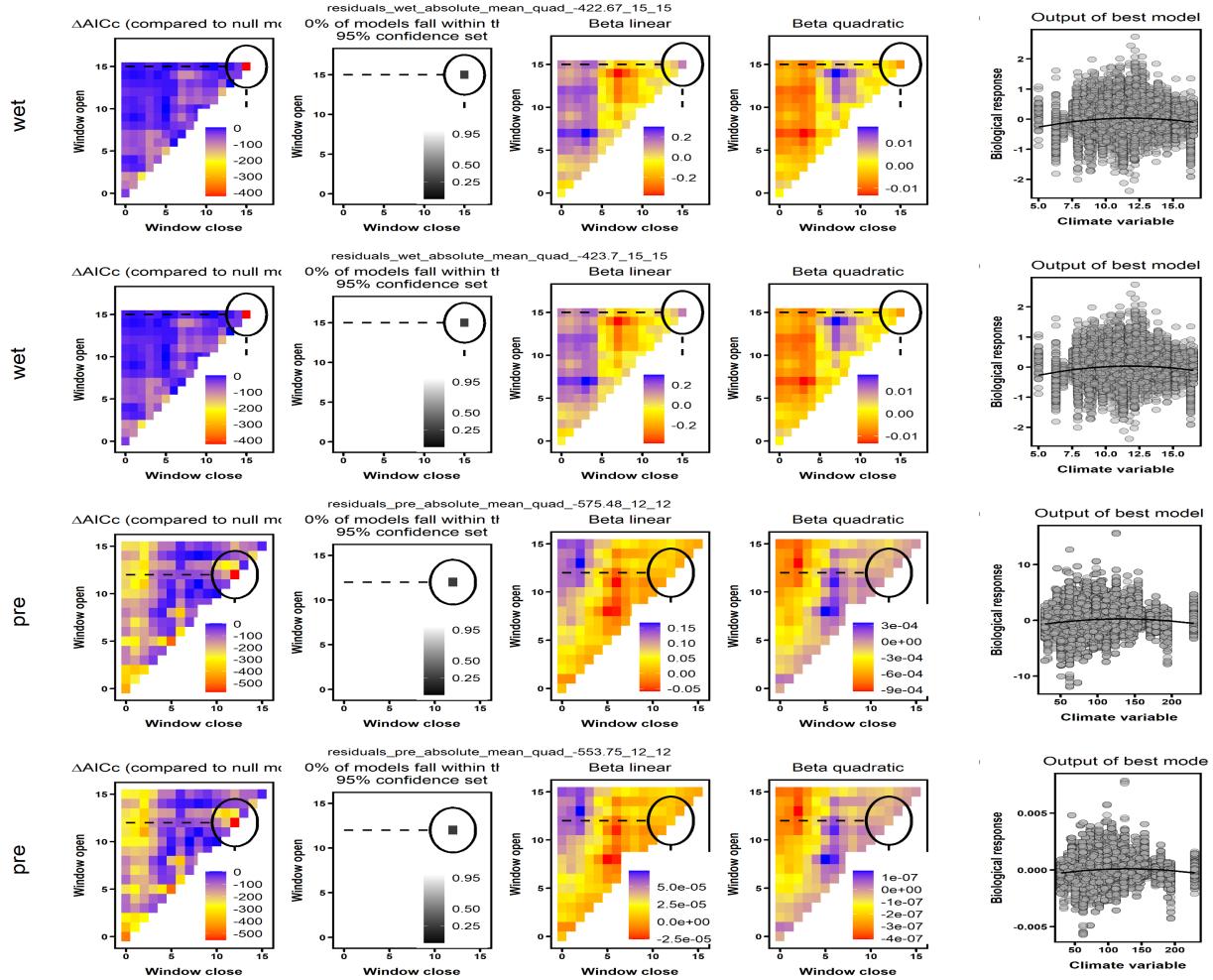


Figure S4 | Comparison of climwin output across growth metrics for the precipitation variable group at Harvard Forest (Massachusetts, USA). Here, *climwin* identified precipitation frequency (WET) as the strongest climate variable for Δr , but precipitation amount (PRE) as the strongest climate variable for BAI and ΔAGB . The optimal time window (circled) also differed across growth metrics.

Figure S5. Best GLS models for Barro Colorado Island (Panama)

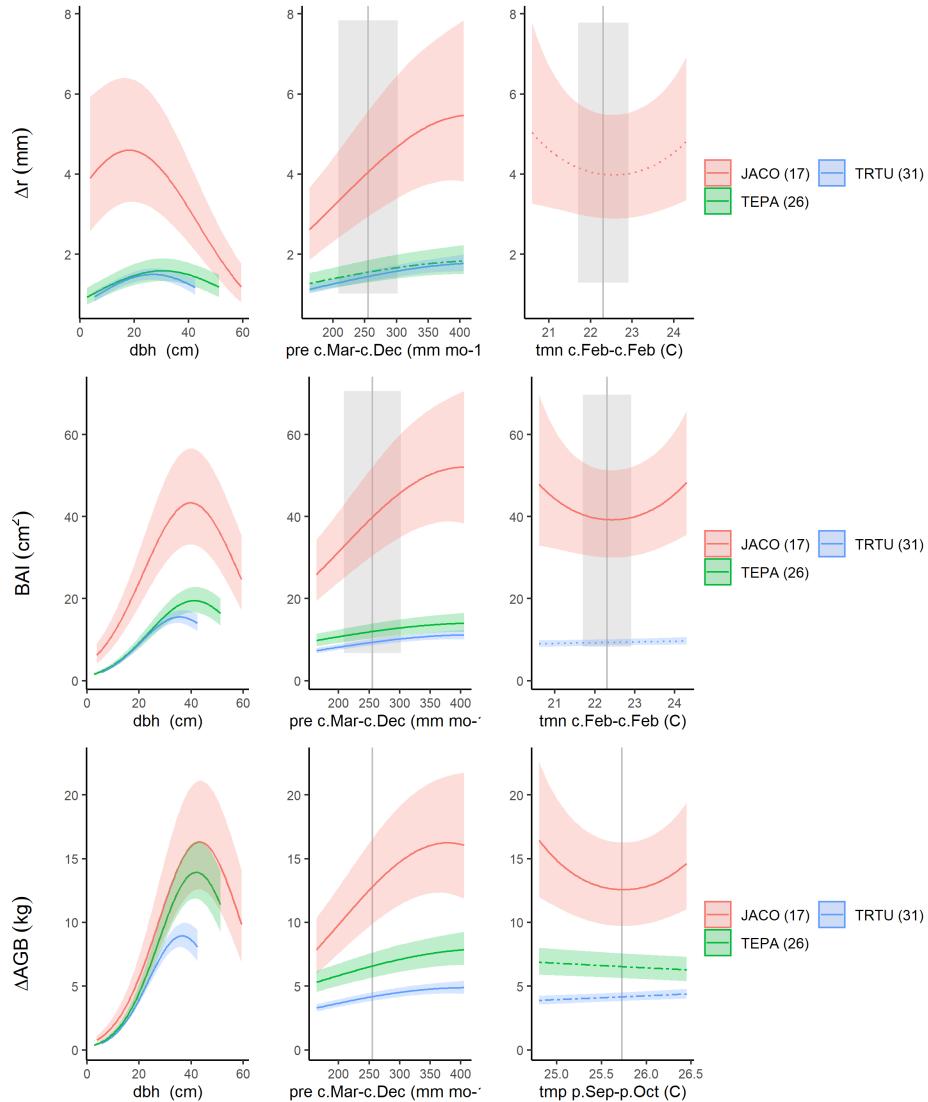


Figure S5 | Best GLS models for Barro Colorado Island (Panama) for all three growth metrics: Δr , BAI, and ΔAGB . Precipitation and temperature group variables are as selected by *climwin* (p=previous year, c=current year). For each species, relationships are plotted if included in top model, with best-fit polynomials plotted with solid lines when both first- and second-order terms are significant, dashed lines when only one term is significant, and dotted lines when neither is significant. Transparent ribbons indicate 95% confidence intervals. Vertical grey lines indicate the long-term mean for the climate variable, shading indicates 1 SD.

Figure S6. Best GLS models for Huai Kha Khaeng (Thailand)

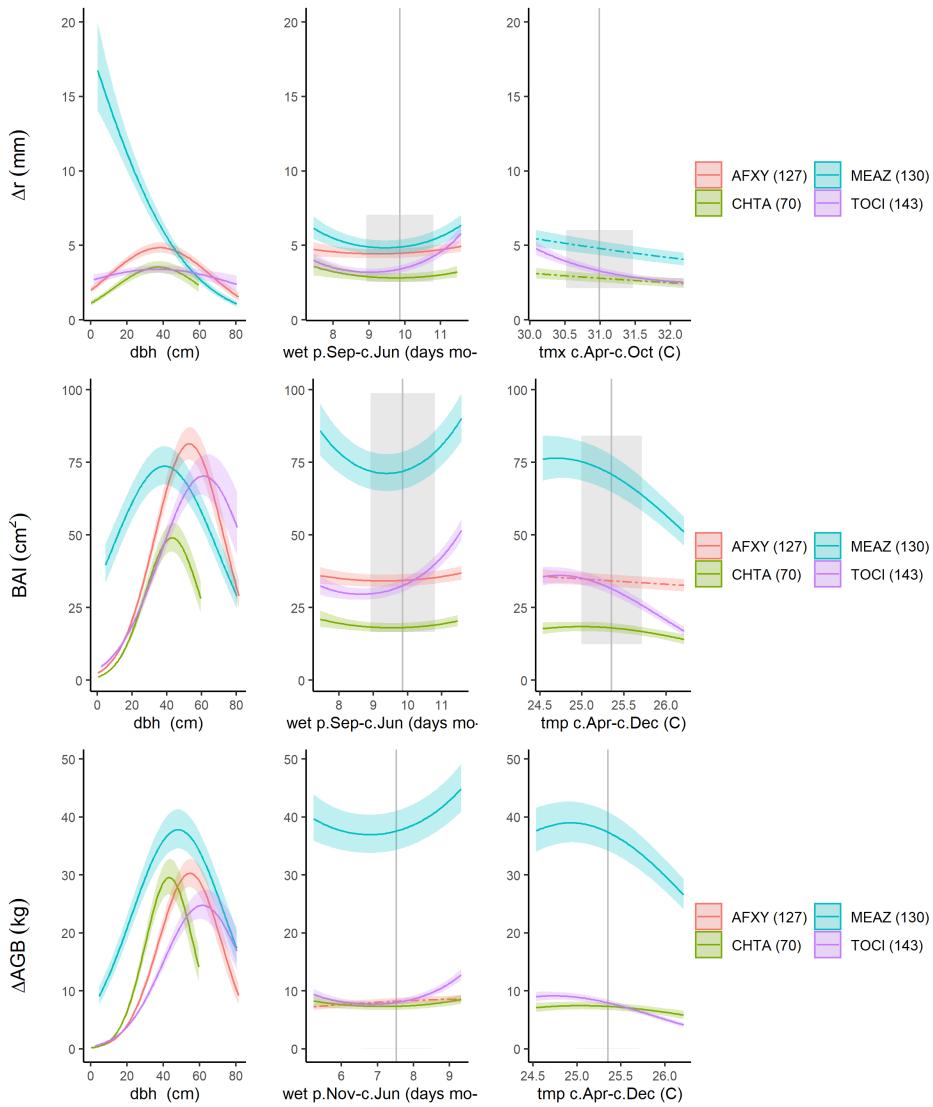


Figure S6 | Best GLS models for Huai Kha Khaeng (Thailand) for all three growth metrics: Δr , BAI , and ΔAGB . Precipitation and temperature group variables are as selected by *climwin* (*p*=previous year, *c*=current year). For each species, relationships are plotted if included in top model, with best-fit polynomials plotted with solid lines when both first- and second-order terms are significant, dashed lines when only one term is significant, and dotted lines when neither is significant. Transparent ribbons indicate 95% confidence intervals. Vertical grey lines indicate the long-term mean for the climate variable, shading indicates 1 SD.

Figure S7. Best GLS models for Little Tesuque (New Mexico, USA)

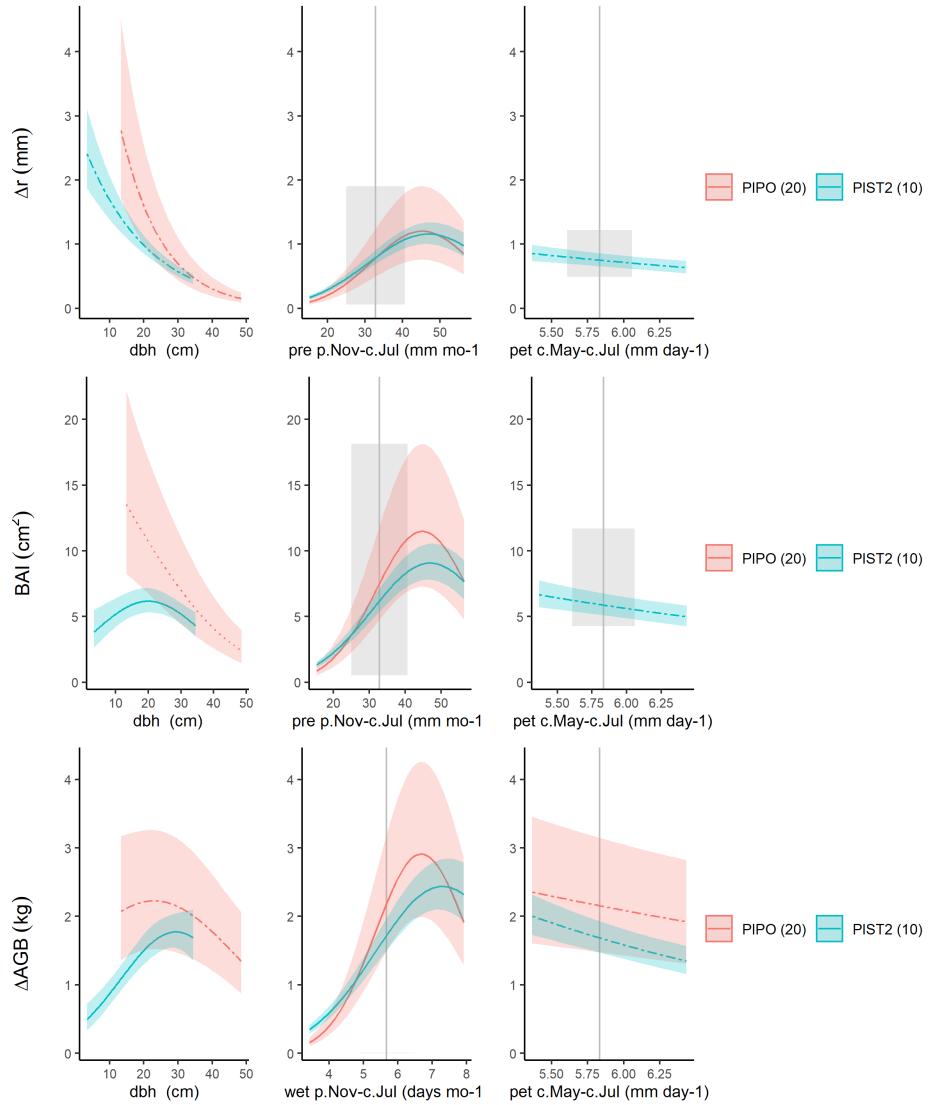


Figure S7 | Best GLS models for Little Tesuque (New Mexico, USA) for all three growth metrics: Δr , BAI, and ΔAGB . Precipitation and temperature group variables are as selected by *climwin* (*p*=previous year, *c*=current year). For each species, relationships are plotted if included in top model, with best-fit polynomials plotted with solid lines when both first- and second-order terms are significant, dashed lines when only one term is significant, and dotted lines when neither is significant. Transparent ribbons indicate 95% confidence intervals. Vertical grey lines indicate the long-term mean for the climate variable, shading indicates 1 SD.

Figure S8. Best GLS models for Cedar Breaks (Utah, USA)

[Figure S8 | Best GLS models for Cedar Breaks (Utah, USA) for all three growth metrics: Δr , BAI , and ΔAGB . Precipitation and temperature group variables are as selected by *climwin* (p=previous year, c=current year). For each species, relationships are plotted if included in top model, with best-fit polynomials plotted with solid lines when both first- and second-order terms are significant, dashed lines when only one term is significant, and dotted lines when neither is significant. Transparent ribbons indicate 95% confidence intervals. Vertical grey lines indicate the long-term mean for the climate variable, shading indicates 1 SD.]

Figure S9. Best GLS models for SCBI (Virginia, USA)

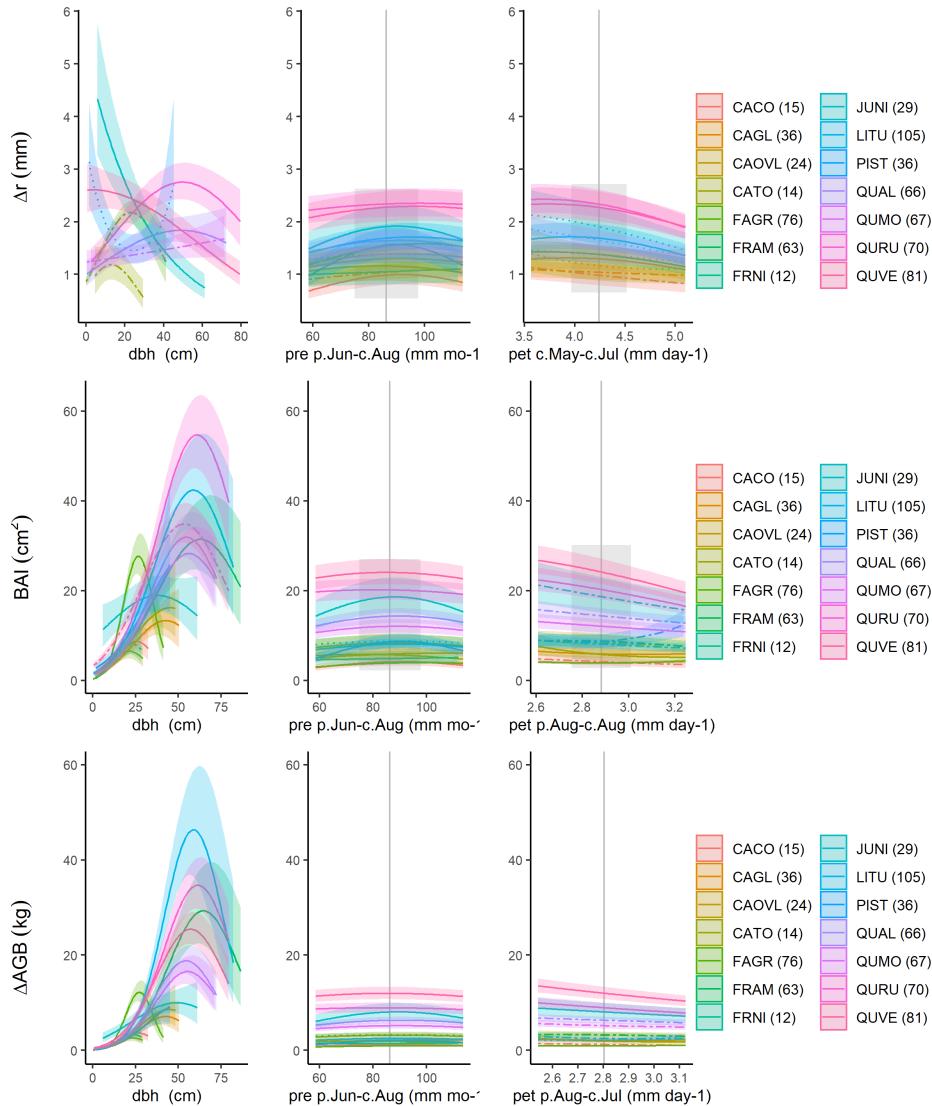


Figure S9 | Best GLS models for SCBI (Virginia, USA) for all three growth metrics: Δr , BAI, and ΔAGB . Precipitation and temperature group variables are as selected by *climwin* (p=previous year, c=current year). For each species, relationships are plotted if included in top model, with best-fit polynomials plotted with solid lines when both first- and second-order terms are significant, dashed lines when only one term is significant, and dotted lines when neither is significant. Transparent ribbons indicate 95% confidence intervals. Vertical grey lines indicate the long-term mean for the climate variable, shading indicates 1 SD.

Figure S10. Best GLS models for Lilly Dickey Woods (Indiana, USA)

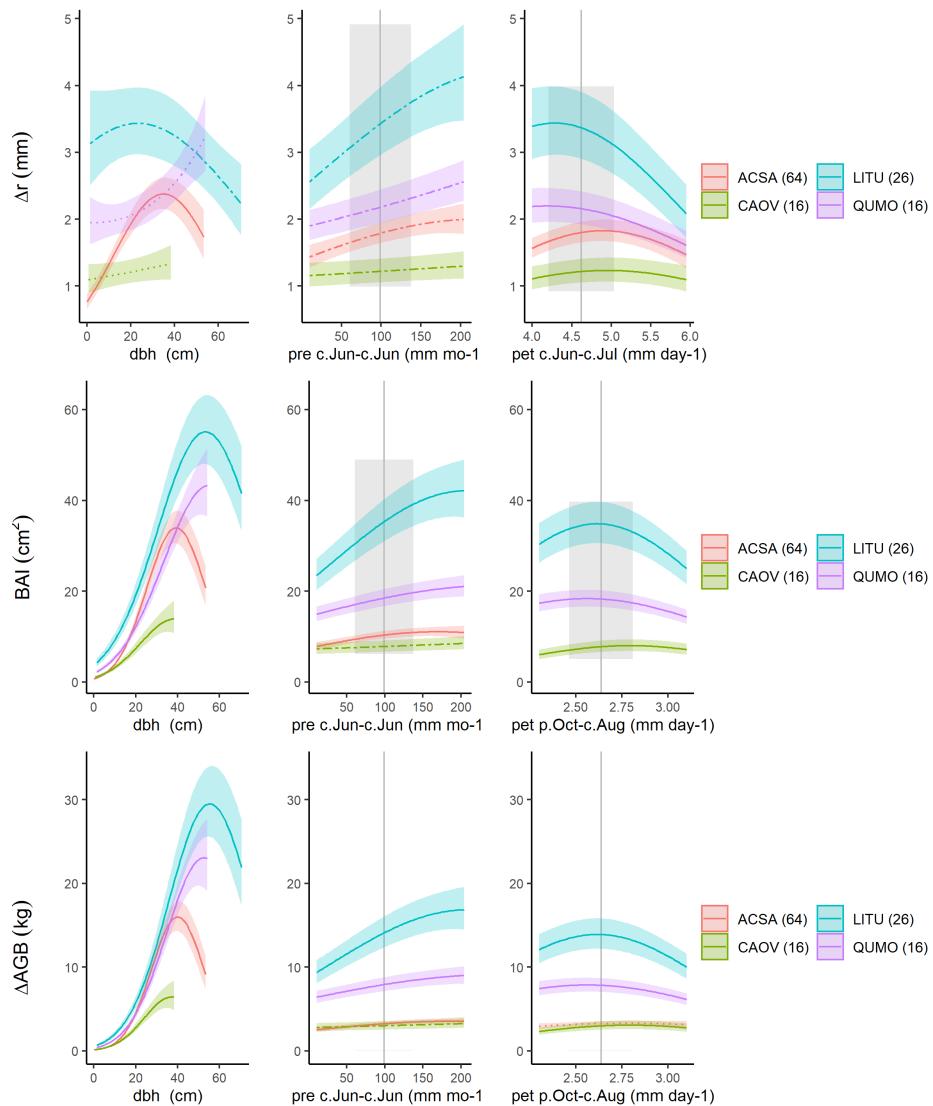


Figure S10 | Best GLS models for Lilly Dickey Woods (Indiana, USA) for all three growth metrics: Δr , BAI , and ΔAGB . Precipitation and temperature group variables are as selected by *climwin* (p =previous year, c =current year). For each species, relationships are plotted if included in top model, with best-fit polynomials plotted with solid lines when both first- and second-order terms are significant, dashed lines when only one term is significant, and dotted lines when neither is significant. Transparent ribbons indicate 95% confidence intervals. Vertical grey lines indicate the long-term mean for the climate variable, shading indicates 1 SD.

Figure S11. Best GLS models for Harvard Forest (Massachusetts, USA)

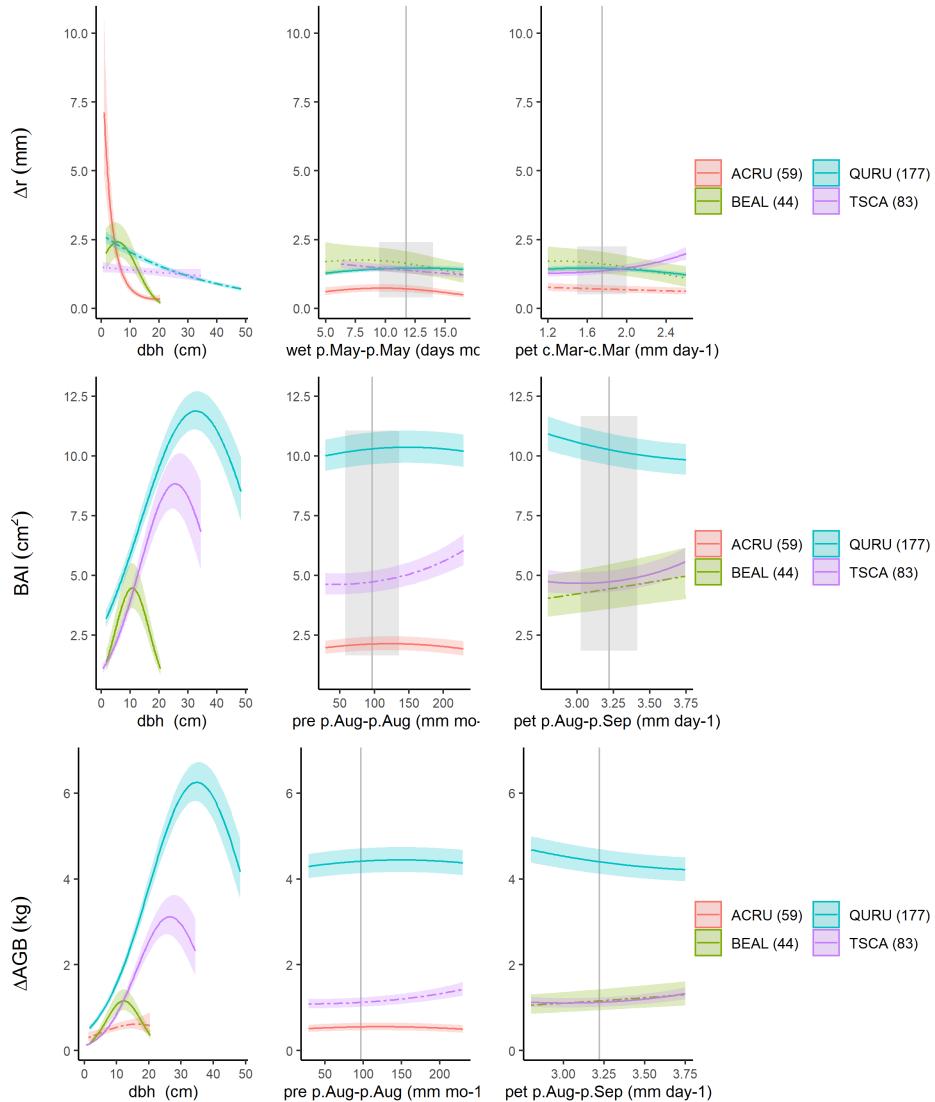


Figure S11 | Best GLS models for Harvard Forest (Massachusetts, USA) for all three growth metrics: Δr , BAI , and ΔAGB . Precipitation and temperature group variables are as selected by *climwin* (p =previous year, c =current year). For each species, relationships are plotted if included in top model, with best-fit polynomials plotted with solid lines when both first- and second-order terms are significant, dashed lines when only one term is significant, and dotted lines when neither is significant. Transparent ribbons indicate 95% confidence intervals. Vertical grey lines indicate the long-term mean for the climate variable, shading indicates 1 SD.

Figure S12. Best GLS models for Niobrara/ Hansley (Nebraska, USA)

Figure S13. Best GLS models for Zofin (Czech Republic)

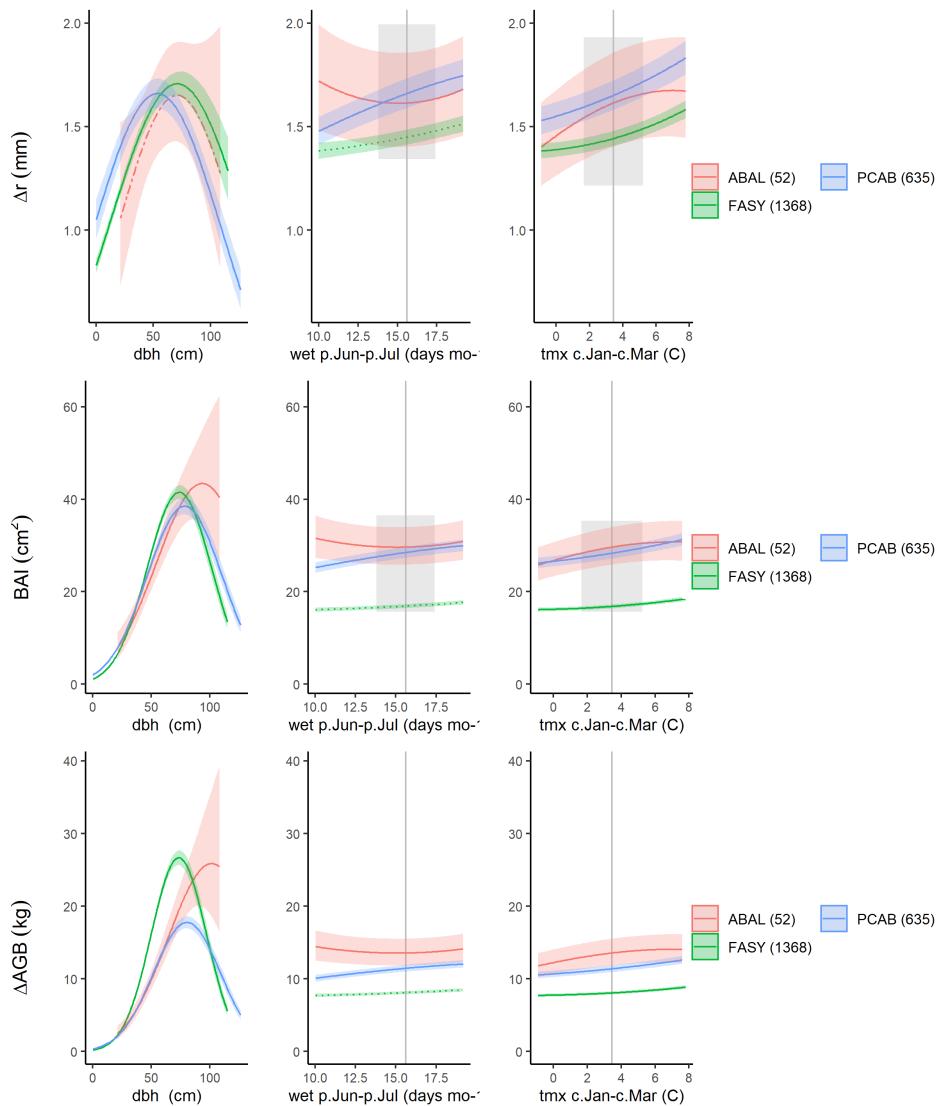


Figure S13 | Best GLS models for Zofin (Czech Republic) for all three growth metrics: Δr , BAI, and ΔAGB . Precipitation and temperature group variables are as selected by *climwin* (*p*=previous year, *c*=current year). For each species, relationships are plotted if included in top model, with best-fit polynomials plotted with solid lines when both first- and second-order terms are significant, dashed lines when only one term is significant, and dotted lines when neither is significant. Transparent ribbons indicate 95% confidence intervals. Vertical grey lines indicate the long-term mean for the climate variable, shading indicates 1 SD.

Figure S14. Best GLS models for Scotty Creek (NW Territories, Canada)

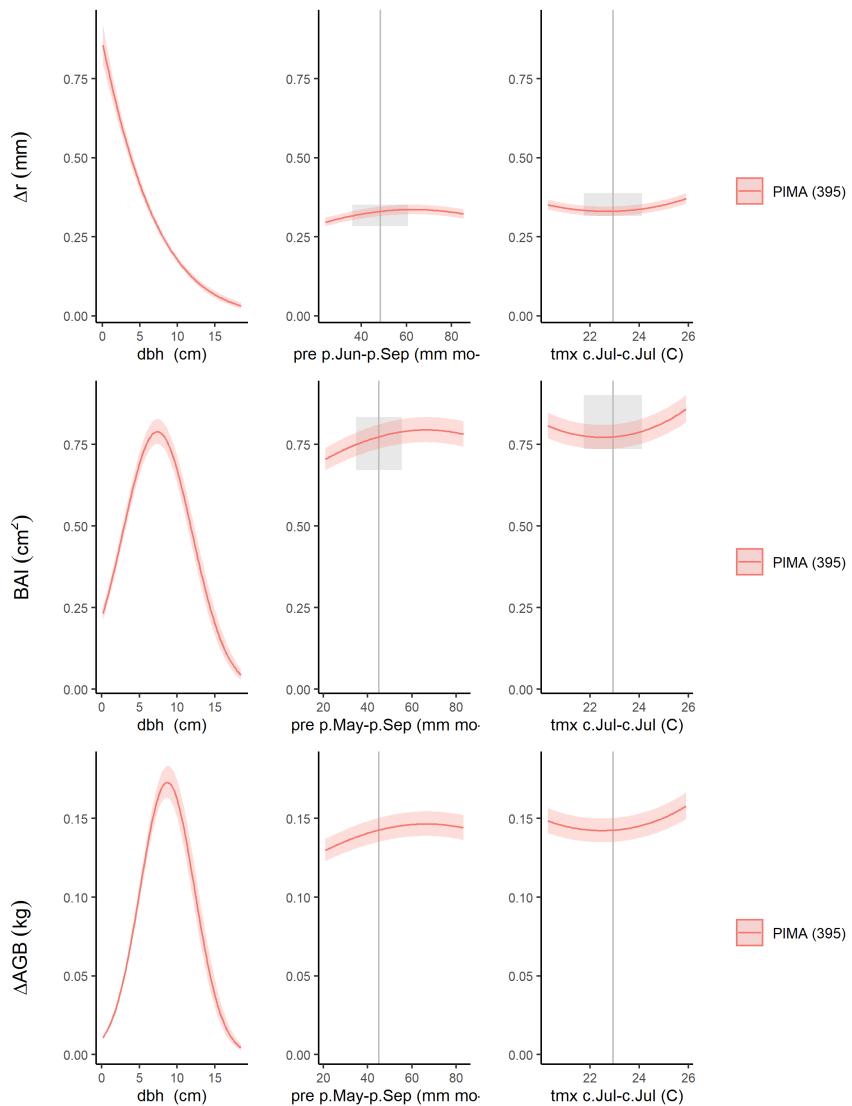


Figure S14 | Best GLS models for Scotty Creek (NW Territories, Canada) for all three growth metrics: Δr , BAI, and ΔAGB . Precipitation and temperature group variables are as selected by *climwin* (p=previous year, c=current year). For each species, relationships are plotted if included in top model, with best-fit polynomials plotted with solid lines when both first- and second-order terms are significant, dashed lines when only one term is significant, and dotted lines when neither is significant. Transparent ribbons indicate 95% confidence intervals. Vertical grey lines indicate the long-term mean for the climate variable, shading indicates 1 SD.