



*Supplement of*

## **Quantifying the influence of wood carbon fractions on tree- and forest ecosystem-scale carbon estimation in a temperate forest**

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1 **Sect. S1**

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3 **Table S1.** Species-specific wood carbon fractions (CFs) employed in estimating tree-level carbon ( $C_{tree}$ ) stocks.

4 Different tree-level C estimates used in our analysis were calculated based on five separate wood CF assumptions as  
5 follows:  $C_{tree1}$ ) generated using species-specific wood CF data;  $C_{tree2}$ ) generated assuming wood CFs for temperate  
6 biome trees specific to conifers and angiosperms;  $C_{tree3}$ ) generated assuming non-biome-specific wood CFs for  
7 conifers and angiosperms;  $C_{tree4}$ ) generated assuming a single IPCC default wood CF assumption;  $C_{tree5}$ ) generated  
8 assuming a single 50% wood CF assumption.

| Species                       | Wood CF used in<br>estimating $C_{tree1}$ | Wood CF used in<br>estimating $C_{tree2}$ | Wood CF used in<br>estimating $C_{tree3}$ | Wood CF used in<br>estimating $C_{tree4}$ | Wood CF used in<br>estimating $C_{tree5}$ |
|-------------------------------|-------------------------------------------|-------------------------------------------|-------------------------------------------|-------------------------------------------|-------------------------------------------|
| <i>Abies balsamea</i>         | 0.5                                       | 0.501                                     | 0.485                                     | 0.467                                     | 0.5                                       |
| <i>Acer pensylvanicum</i>     | 0.478                                     | 0.465                                     | 0.468                                     | 0.467                                     | 0.5                                       |
| <i>Acer rubrum</i>            | 0.481                                     | 0.465                                     | 0.468                                     | 0.467                                     | 0.5                                       |
| <i>Acer saccharum</i>         | 0.484                                     | 0.465                                     | 0.468                                     | 0.467                                     | 0.5                                       |
| <i>Acer spicatum</i>          | 0.465                                     | 0.465                                     | 0.468                                     | 0.467                                     | 0.5                                       |
| <i>Alnus viridis</i>          | 0.465                                     | 0.465                                     | 0.468                                     | 0.467                                     | 0.5                                       |
| <i>Amelanchier humilis</i>    | 0.465                                     | 0.465                                     | 0.468                                     | 0.467                                     | 0.5                                       |
| <i>Amelanchier laevis</i>     | 0.465                                     | 0.465                                     | 0.468                                     | 0.467                                     | 0.5                                       |
| <i>Amelanchier</i> spp.       | 0.465                                     | 0.465                                     | 0.468                                     | 0.467                                     | 0.5                                       |
| <i>Betula allegheniensis</i>  | 0.479                                     | 0.465                                     | 0.468                                     | 0.467                                     | 0.5                                       |
| <i>Betula cordifolia</i>      | 0.465                                     | 0.465                                     | 0.468                                     | 0.467                                     | 0.5                                       |
| <i>Betula papyrifera</i>      | 0.486                                     | 0.465                                     | 0.468                                     | 0.467                                     | 0.5                                       |
| <i>Corylus cornuta</i>        | 0.465                                     | 0.465                                     | 0.468                                     | 0.467                                     | 0.5                                       |
| <i>Fagus grandifolia</i>      | 0.479                                     | 0.465                                     | 0.468                                     | 0.467                                     | 0.5                                       |
| <i>Fraxinus americana</i>     | 0.483                                     | 0.465                                     | 0.468                                     | 0.467                                     | 0.5                                       |
| <i>Fraxinus nigra</i>         | 0.474                                     | 0.465                                     | 0.468                                     | 0.467                                     | 0.5                                       |
| <i>Ilex verticillata</i>      | 0.465                                     | 0.465                                     | 0.468                                     | 0.467                                     | 0.5                                       |
| <i>Ilex mucronata</i>         | 0.465                                     | 0.465                                     | 0.468                                     | 0.467                                     | 0.5                                       |
| <i>Ostrya virginiana</i>      | 0.482                                     | 0.465                                     | 0.468                                     | 0.467                                     | 0.5                                       |
| <i>Pinus strobus</i>          | 0.504                                     | 0.501                                     | 0.485                                     | 0.467                                     | 0.5                                       |
| <i>Picea glauca x mariana</i> | 0.501                                     | 0.501                                     | 0.485                                     | 0.467                                     | 0.5                                       |
| <i>Prunus serotina</i>        | 0.482                                     | 0.465                                     | 0.468                                     | 0.467                                     | 0.5                                       |
| <i>Prunus virginiana</i>      | 0.465                                     | 0.465                                     | 0.468                                     | 0.467                                     | 0.5                                       |
| <i>Quercus rubra</i>          | 0.476                                     | 0.465                                     | 0.468                                     | 0.467                                     | 0.5                                       |
| <i>Thuja occidentalis</i>     | 0.513                                     | 0.465                                     | 0.468                                     | 0.467                                     | 0.5                                       |
| <i>Tilia americana</i>        | 0.476                                     | 0.465                                     | 0.468                                     | 0.467                                     | 0.5                                       |
| <i>Tsuga canadensis</i>       | 0.501                                     | 0.501                                     | 0.485                                     | 0.467                                     | 0.5                                       |
| <i>Viburnum alnifolium</i>    | 0.465                                     | 0.465                                     | 0.468                                     | 0.467                                     | 0.5                                       |

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**Table S2.** Parameters from an Analysis of covariance (ANCOVA) model predicting differences in tree-level carbon (C) estimates (measured in kg C tree<sup>-1</sup>) as a function of an intercept term (corresponding to an average C stock difference among C<sub>tree</sub> estimates), taxonomic division (as a categorical factor), DBH, a second-order polynomial DBH term (DBH<sup>2</sup>), as well as division-by-DBH and division-by-DBH<sup>2</sup> interaction terms. Differences in tree-level C estimates were calculated based on five separate tree-level C estimates, denoted as C<sub>tree</sub> as follows: C<sub>tree1</sub>) generated using species-specific wood CF data; C<sub>tree2</sub>) generated assuming wood CFs for temperate biome trees specific to conifers and angiosperms; C<sub>tree3</sub>) generated assuming non-biome-specific wood CFs for conifers and angiosperms; C<sub>tree4</sub>) generated assuming a single IPCC default wood CF assumption; C<sub>tree5</sub>) generated assuming a single 50% wood CF assumption. The taxonomic division term is based on a categorical variable with two values (angiosperm and conifer), such that angiosperms are the reference group in ANCOVA models. Sample sizes for all four ANCOVA models was  $n=39,064$  trees distributed across angiosperms ( $n=27,589$ ) and conifers ( $n=11,475$ ).

| C estimation difference                 | Parameter                  | Estimate | Std. Error | <i>t</i> ( <i>p</i> -value) | Partial <i>r</i> <sup>2</sup> | Model <i>p</i> | Model <i>r</i> <sup>2</sup> |
|-----------------------------------------|----------------------------|----------|------------|-----------------------------|-------------------------------|----------------|-----------------------------|
| C <sub>tree1</sub> - C <sub>tree2</sub> | Intercept                  | 0.101    | 0.01       | 10.4 (<0.001)               | 0.003                         | <0.001         | 0.9151                      |
|                                         | Conifer                    | 0.127    | 0.02       | 6.3 (<0.001)                | 0.001                         |                |                             |
|                                         | DBH                        | -0.063   | 0.002      | -34.3 (<0.001)              | 0.029                         |                |                             |
|                                         | DBH <sup>2</sup>           | 0.011    | 0.00004    | 257.5 (<0.001)              | 0.629                         |                |                             |
|                                         | Conifer * DBH              | -0.026   | 0.003      | -8.2 (<0.001)               | 0.002                         |                |                             |
|                                         | Conifer * DBH <sup>2</sup> | -0.009   | 0.0001     | -119.6 (<0.001)             | 0.268                         |                |                             |
| C <sub>tree1</sub> - C <sub>tree3</sub> | Intercept                  | 0.064    | 0.063      | 1.0 (0.311)                 | 0.000                         | <0.001         | 0.3257                      |
|                                         | Conifer                    | -3.947   | 0.13       | -30.3 (<0.001)              | 0.023                         |                |                             |
|                                         | DBH                        | -0.046   | 0.012      | -3.9 (<0.001)               | 0.000                         |                |                             |
|                                         | DBH <sup>2</sup>           | 0.009    | 0.0003     | 32.2 (<0.001)               | 0.026                         |                |                             |
|                                         | Conifer * DBH              | 1.385    | 0.021      | 66.0 (<0.001)               | 0.100                         |                |                             |
|                                         | Conifer * DBH <sup>2</sup> | -0.028   | 0.001      | -57.2 (<0.001)              | 0.077                         |                |                             |
| C <sub>tree1</sub> - C <sub>tree4</sub> | Intercept                  | 0.076    | 0.138      | 0.6 (0.583)                 | 0.000                         | <0.001         | 0.2656                      |
|                                         | Conifer                    | -8.591   | 0.287      | -30.0 (<0.001)              | 0.022                         |                |                             |
|                                         | DBH                        | -0.051   | 0.026      | -2.0 (0.048)                | 0.000                         |                |                             |
|                                         | DBH <sup>2</sup>           | 0.01     | 0.001      | 15.8 (<0.001)               | 0.006                         |                |                             |
|                                         | Conifer * DBH              | 3.0      | 0.046      | 65.0 (<0.001)               | 0.097                         |                |                             |
|                                         | Conifer * DBH <sup>2</sup> | -0.052   | 0.001      | -48.7 (<0.001)              | 0.057                         |                |                             |
| C <sub>tree1</sub> - C <sub>tree5</sub> | Intercept                  | -0.33    | 0.006      | -56.5 (<0.001)              | 0.076                         | <0.001         | 0.9714                      |
|                                         | Conifer                    | 0.36     | 0.012      | 29.6 (<0.001)               | 0.022                         |                |                             |
|                                         | DBH                        | 0.133    | 0.001      | 120.7 (<0.001)              | 0.272                         |                |                             |
|                                         | DBH <sup>2</sup>           | -0.014   | 0.00003    | -513.3 (<0.001)             | 0.871                         |                |                             |
|                                         | Conifer * DBH              | -0.143   | 0.002      | -73.6 (<0.001)              | 0.122                         |                |                             |

|  |                            |       |         |                |       |  |  |
|--|----------------------------|-------|---------|----------------|-------|--|--|
|  | Conifer * DBH <sup>2</sup> | 0.015 | 0.00004 | 325.1 (<0.001) | 0.730 |  |  |
|--|----------------------------|-------|---------|----------------|-------|--|--|

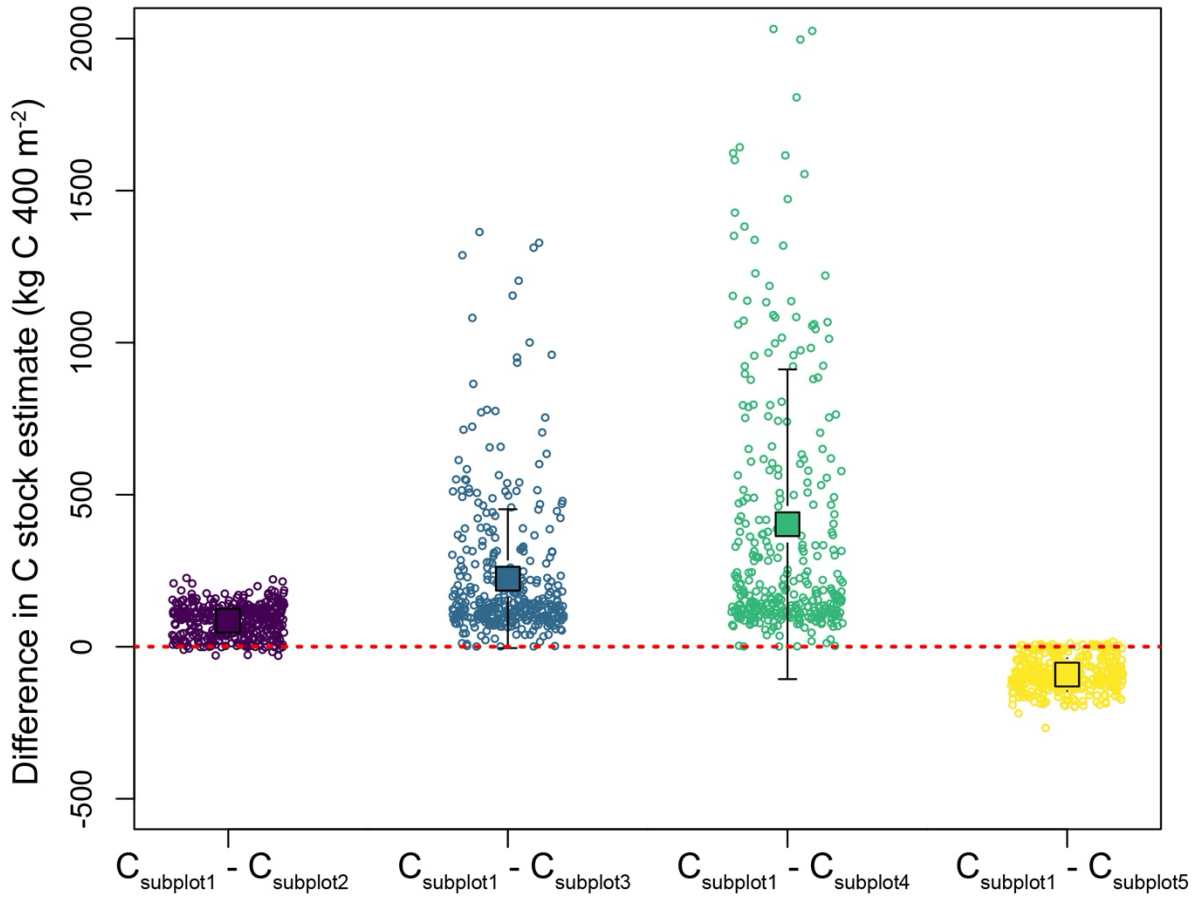
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**Table S3.** Parameters from linear models predicting differences in 400-m<sup>2</sup> subplot-level carbon (C) estimates (measured in kg C subplot<sup>-1</sup>) as a function of an intercept term (corresponding to an average C stock difference among C<sub>subplot</sub> estimates), as well as the following subplot-scale variables: large tree (i.e., ≥10 cm DBH) biomass, small tree (1-10 cm DBH) biomass, second-order polynomial terms of large and small tree, and the proportion of total biomass represented by conifer tree species. Differences in subplot-level C estimates were calculated based on five separate tree-level C estimates, denoted as C<sub>tree</sub> as follows: C<sub>subplot1</sub>) generated using species-specific wood CF data; C<sub>subplot2</sub>) generated assuming wood CFs for temperate biome trees specific to conifers and angiosperms; C<sub>subplot3</sub>) generated assuming non-biome-specific wood CFs for conifers and angiosperms; C<sub>subplot4</sub>) generated assuming a single IPCC default wood CF assumption; C<sub>subplot5</sub>) generated assuming a single 50% wood CF assumption. Sample sizes for all four linear models was  $n=368$  400-m<sup>2</sup> subplots (presented visually in Fig. 3).

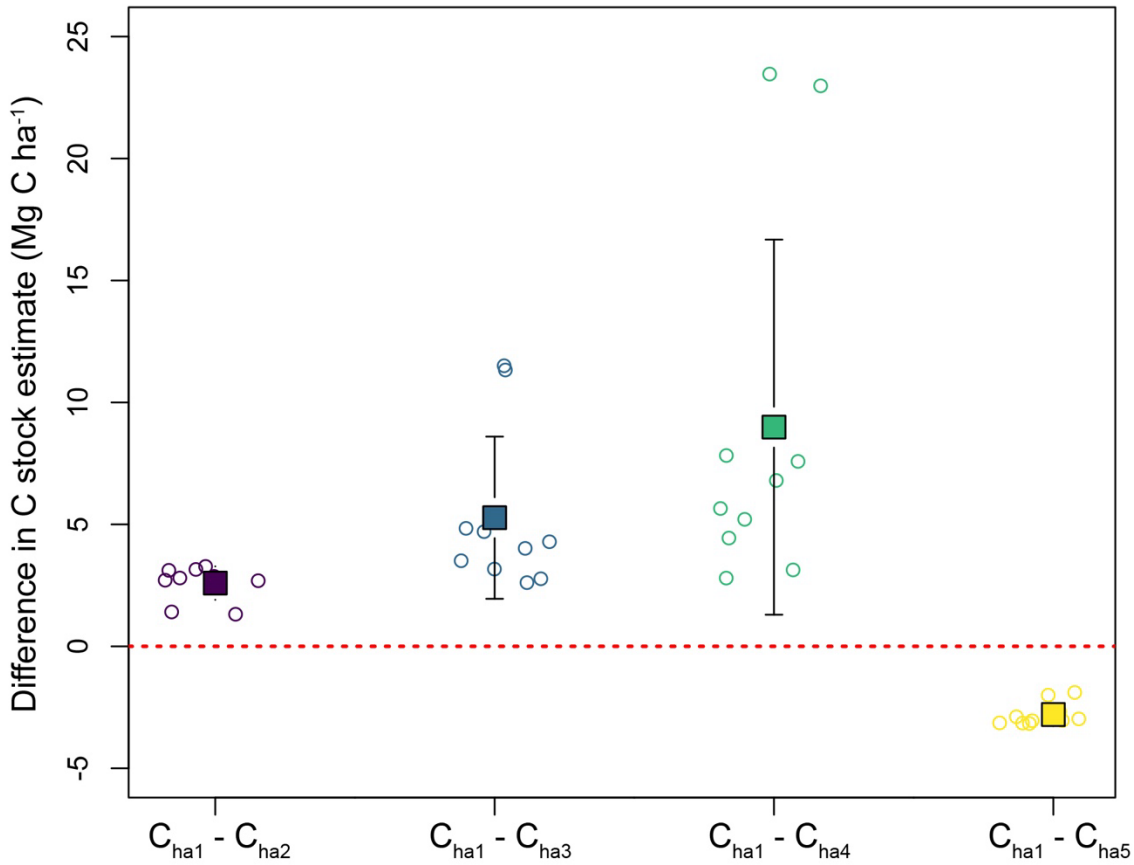
| C estimation difference                       | Parameter                       | Estimate | Std. Error | <i>t</i> ( <i>p</i> -value) | Partial <i>r</i> <sup>2</sup> | Model <i>r</i> <sup>2</sup> | Model <i>p</i> |
|-----------------------------------------------|---------------------------------|----------|------------|-----------------------------|-------------------------------|-----------------------------|----------------|
| C <sub>subplot1</sub> - C <sub>subplot2</sub> | Intercept                       | 111.3    | 2.859      | 39.0 (<0.01)                | 0.81                          | 0.7648                      | <0.001         |
|                                               | Large tree biomass              | 0.004    | 0.0004     | 10.5 (<0.01)                | 0.221                         |                             |                |
|                                               | Large tree biomass <sup>2</sup> | 0.0001   | 0.0001     | -10.4 (<0.01)               | 0.235                         |                             |                |
|                                               | Small tree biomass              | 0.001    | 0.002      | 0.3 (0.776)                 | 0.0002                        |                             |                |
|                                               | Small tree biomass <sup>2</sup> | 0.0001   | 0.0001     | -1.2 (0.237)                | 0.004                         |                             |                |
|                                               | Conifer proportion              | -120.4   | 4.652      | -25.9 (<0.01)               | 0.654                         |                             |                |
| C <sub>subplot1</sub> - C <sub>subplot3</sub> | Intercept                       | 0.37     | 1.246      | 0.295 (0.769)               | 0.0002                        |                             |                |
|                                               | Large tree biomass              | 0.0143   | 0.0002     | 93.0 (<0.01)                | 0.961                         | 0.9975                      | <0.001         |
|                                               | Large tree biomass <sup>2</sup> | 0.0001   | 0.0001     | 3.2 (0.002)                 | 0.027                         |                             |                |
|                                               | Small tree biomass              | 0.02     | 0.002      | 18.3 (<0.01)                | 0.487                         |                             |                |
|                                               | Small tree biomass <sup>2</sup> | 0.0001   | 0.0001     | 1.1 (0.258)                 | 0.004                         |                             |                |
|                                               | Conifer proportion              | 11.85    | 2.03       | 5.8 (<0.01)                 | 0.088                         |                             |                |
| C <sub>subplot1</sub> - C <sub>subplot4</sub> | Intercept                       | -98.91   | 3.22       | -30.8 (<0.01)               | 0.727                         |                             |                |
|                                               | Large tree biomass              | 0.03     | 0.001      | 69.6 (<0.01)                | 0.932                         | 0.9967                      | <0.001         |
|                                               | Large tree biomass <sup>2</sup> | 0.0001   | 0.0001     | 10.6 (<0.01)                | 0.241                         |                             |                |
|                                               | Small tree biomass              | 0.03     | 0.002      | 15.0 (<0.01)                | 0.389                         |                             |                |
|                                               | Small tree biomass <sup>2</sup> | 0.0001   | 0.0001     | 1.8 (<0.01)                 | 0.009                         |                             |                |
|                                               | Conifer proportion              | 130.2    | 5.24       | 24.9 (<0.01)                | 0.635                         |                             |                |
| C <sub>subplot1</sub> - C <sub>subplot5</sub> | Intercept                       | -98.91   | 3.22       | -30.8 (<0.01)               | 0.727                         |                             |                |
|                                               | Large tree biomass              | -0.01    | 0.001      | -13.4 (<0.01)               | 0.335                         | 0.7166                      | <0.001         |
|                                               | Large tree biomass <sup>2</sup> | 0.0001   | 0.0001     | 10.6 (<0.01)                | 0.241                         |                             |                |
|                                               | Small tree biomass              | -0.002   | 0.002      | -1.1 (0.292)                | 0.003                         |                             |                |
|                                               | Small tree biomass <sup>2</sup> | 0.0001   | 0.0001     | 1.8 (0.077)                 | 0.009                         |                             |                |
|                                               | Conifer proportion              | 130.2    | 5.24       | 24.9 (<0.01)                | 0.635                         |                             |                |

**Table S4.** Parameters from linear models predicting differences in per ha carbon (C) estimates (measured in Mg C subplot<sup>-1</sup>) predicted as a function of an intercept term (corresponding to an average C stock difference), as well as the following per ha-scale variables: large tree (i.e.,  $\geq 10$  cm DBH) biomass, small tree (1-10 cm DBH) biomass, second-order polynomial terms of large and small tree, and the proportion of total biomass represented by conifer tree species. Differences in per ha C estimates were calculated based on five separate tree-level C estimates, denoted as  $C_{\text{tree}}$  as follows:  $C_{\text{ha1}}$ ) generated using species-specific wood CF data;  $C_{\text{ha2}}$ ) generated assuming wood CFs for temperate biome trees specific to conifers and angiosperms;  $C_{\text{ha3}}$ ) generated assuming non-biome-specific wood CFs for conifers and angiosperms;  $C_{\text{ha4}}$ ) generated assuming a single IPCC default wood CF assumption;  $C_{\text{ha5}}$ ) generated assuming a single 50% wood CF assumption. Sample sizes for all four linear models was  $n=10$  has (presented visually in Fig. 4).

| C estimation difference           | Parameter                       | Estimate | Std. Error | $t$ ( $p$ -value) | Partial $r^2$ | Model $r^2$ | Model $p$ |
|-----------------------------------|---------------------------------|----------|------------|-------------------|---------------|-------------|-----------|
| $C_{\text{ha1}} - C_{\text{ha2}}$ | Intercept                       | -1487.0  | 1440.0     | -1.0 (0.36)       | 0.211         | 0.966       | <0.001    |
|                                   | Large tree biomass              | 0.033    | 0.01       | 3.2 (0.034)       | 0.716         |             |           |
|                                   | Large tree biomass <sup>2</sup> | 0.0001   | 0.0001     | -3.4 (0.028)      | 0.741         |             |           |
|                                   | Small tree biomass              | 0.007    | 0.01       | 0.7 (0.538)       | 0.102         |             |           |
|                                   | Small tree biomass <sup>2</sup> | 0.0001   | 0.0001     | -2.0 (0.112)      | 0.509         |             |           |
|                                   | Conifer proportion              | -4998.0  | 1157.0     | -4.3 (0.012)      | 0.824         |             |           |
| $C_{\text{ha1}} - C_{\text{ha3}}$ | Intercept                       | -904.5   | 1517.0     | -0.6 (0.583)      | 0.082         | 0.998       | <0.01     |
|                                   | Large tree biomass              | 0.021    | 0.011      | 1.9 (0.124)       | 0.486         |             |           |
|                                   | Large tree biomass <sup>2</sup> | 0.0001   | 0.0001     | -0.5 (0.621)      | 0.0667        |             |           |
|                                   | Small tree biomass              | 0.012    | 0.011      | 1.1 (0.337)       | 0.229         |             |           |
|                                   | Small tree biomass <sup>2</sup> | 0.0001   | 0.0001     | 0.3 (0.757)       | 0.027         |             |           |
|                                   | Conifer proportion              | -945.3   | 1219.0     | -0.8 (0.481)      | 0.131         |             |           |
| $C_{\text{ha1}} - C_{\text{ha4}}$ | Intercept                       | -383.4   | 1795.0     | -0.2 (0.841)      | 0.011         | 0.999       | <0.01     |
|                                   | Large tree biomass              | 0.015    | 0.013      | 1.1 (0.325)       | 0.239         |             |           |
|                                   | Large tree biomass <sup>2</sup> | 0.0001   | 0.0001     | 1.6 (0.191)       | 0.382         |             |           |
|                                   | Small tree biomass              | 0.02     | 0.013      | 1.6 (0.197)       | 0.375         |             |           |
|                                   | Small tree biomass <sup>2</sup> | 0.0001   | 0.0001     | 2.0 (0.117)       | 0.498         |             |           |
|                                   | Conifer proportion              | 2681.0   | 1442.0     | 1.9 (0.137)       | 0.463         |             |           |
| $C_{\text{ha1}} - C_{\text{ha5}}$ | Intercept                       | -383.4   | 1795.0     | -0.2 (0.841)      | 0.011         | 0.889       | 0.01      |
|                                   | Large tree biomass              | -0.019   | 0.013      | -1.4 (0.227)      | 0.337         |             |           |
|                                   | Large tree biomass <sup>2</sup> | 0.0001   | 0.0001     | 1.6 (0.191)       | 0.382         |             |           |
|                                   | Small tree biomass              | -0.013   | 0.013      | -1.0 (0.369)      | 0.204         |             |           |
|                                   | Small tree biomass <sup>2</sup> | 0.0001   | 0.0001     | 2.0 (0.117)       | 0.498         |             |           |
|                                   | Conifer proportion              | 2681.0   | 1442.0     | 1.9 (0.137)       | 0.463         |             |           |



**Fig. S1.** Differences in 400-m<sup>2</sup> subplot-level carbon ( $C_{\text{subplot}}$ ) stocks (measured in kg C subplot<sup>-1</sup>) estimated using different wood carbon fraction (CF) assumptions. Subplot-level differences are calculated as the difference between  $C_{\text{subplot1}}$  (generated using species-specific wood CF data) vs.  $C_{\text{subplot2}}$  (generated assuming wood CFs for temperate biome trees specific to conifers and angiosperms);  $C_{\text{subplot3}}$  (generated assuming non-biome-specific wood CFs for conifers and angiosperms);  $C_{\text{subplot4}}$  (generated assuming a single IPCC default wood CF assumption); and  $C_{\text{subplot5}}$  (generated assuming a single 50% wood CF assumption). Red dotted line denotes differences between the two C estimation values of 0. Therefore i) all values above 0 indicate instances where species-specific wood CFs ( $C_{\text{subplot1}}$ ) are higher compared to estimates generated using generalized wood CF assumptions ( $C_{\text{subplot2}}-C_{\text{subplot5}}$ ), and ii) all values below 0 indicate instances where species-specific wood CFs ( $C_{\text{subplot1}}$ ) are lower compared to estimates generated using generalized wood CF assumptions ( $C_{\text{subplot2}}-C_{\text{subplot5}}$ ). Open circles denote individual subplots ( $n=368$  subplots total) and closed symbols denote mean differences for a given comparison ( $\pm 1$  s.d.). Values here are presented visually in Fig. 3 and summarized in Table 2 in the main text.



**Fig. S2.** Differences in per ha subplot-level carbon ( $C_{ha}$ ) stocks (measured in  $\text{Mg C ha}^{-1}$ ) estimated using different wood carbon fraction (CF) assumptions. Per ha-level differences are calculated as the difference between  $C_{ha1}$  (generated using species-specific wood CF data) vs.  $C_{ha2}$  (generated assuming wood CFs for temperate biome trees specific to conifers and angiosperms);  $C_{ha3}$  (generated assuming non-biome-specific wood CFs for conifers and angiosperms);  $C_{ha4}$  (generated assuming a single IPCC default wood CF assumption); and  $C_{ha5}$  (generated assuming a single 50% wood CF assumption). Red dotted line denotes differences between the two C estimation values of 0. Therefore i) all values above 0 indicate instances where species-specific wood CFs ( $C_{ha1}$ ) are higher compared to estimates generated using generalized wood CF assumptions ( $C_{ha2}$ - $C_{ha5}$ ), and ii) all values below 0 indicate instances where species-specific wood CFs ( $C_{ha1}$ ) are lower compared to estimates generated using generalized wood CF assumptions ( $C_{ha2}$ - $C_{ha5}$ ). Open circles denote individual ha of forest ( $n=10$  individual ha total) and closed symbols denote mean differences for a given comparison ( $\pm 1$  s.d.). Values here are presented visually in Fig. 4 and summarized in Table 2 in the main text.