Informing IPCC accounting of forest carbon using the global forest carbon database (ForC v4.0)

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Abstract. The abstract goes here. It can also be on *multiple lines*.

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1 Introduction

(Importance of forests for climate change mitigation)

(Need for good data in international carbon accounting)

(Introduce EFDb & forc)

Here, we: (1) clarify C cycle terminology (2) describe mapping of ForC to IPCC's EFDB, (3) describe updates to ForC (ForC v4.0) (4) summarize the data in ForC that's relevant to EFDB, identifying gaps (5) provide recommendations for improving data collection, analysis, database, and accounting

2 Defining carbon stocks and incremenets

For quantifying forest role in global C cycle, we ultimately care about: (1) C stocks –stores of C that would be released to the atmosphere upon and use change (2) C increments – changes in those C stocks.

2.1 Carbon stocks

Forest ecosystem C stocks may be parsed into pools in various ways. IPCC parses into biomass (aboveground and belowground), dead organic matter (dead wood and litter), and soil organic matter (Table 1). Quantifying these requires a one-time measurement.

pool	pool	definition	major sources of estimate variation	IPCC guidance
biomass	aboveground	all biomass of living vegetation, both woody and herbaceous, above the soil	allometry, min dbh	acceptable to exclude understory
	belowground	all biomass of live roots	allometry, min dbh, assumed ratio of belowground to aboveground biomass (IPCC table 4.4)	fine roots may be excluded when they cannot be distinguished empirically from soil organic matter or litter
dead organic matter	dead wood	all non-living woody biomass not contained in the litter, either standing, lying on the ground, or in the soil	min dbh, . . .	default min dbh = 10cm, but may be chosen by country
	litter	all non-living biomass with a size greater than the limit for soil organic matter and less than the minimum diameter chosen for dead wood, lying dead, in various states of decomposition above or within the mineral or organic soil	min dbh for dead wood , ..	
soils	soil organic matter	organic carbon in mineral soils to a specified depth	sampling depth	default sampling depth = 30cm, but may be chosen by country

Figure 1. Table 1

Table 1: variables with definitions and measurement methods. Definitions from IPCC Table 1.1. (See Table 1.1 in IPCC guidance). (*Currently adding this as a figure (generated from original draft) because kableExtra doesn't seem to work in this template. Table that we want here is "figures_tables/C_pools.csv"*)

2.2 Carbon increments

C increments are defined as the change over time, in annual increments, in each C pool. These may be estimated as the difference between C stocks at two time points, or as the difference between inputs and outputs to the pool (i.e., fluxes). Quantifying these requires at least two measurements.

Fluxes are the inputs and outputs to each pool.

Figure: schematic illustrating fluxes in and out of each pool

3 Content section with citations

See the R Markdown docs for bibliographies and citations.

Copernicus supports biblatex and a sample bibliography is in file `sample.bib`. Example citation (Anderson-Teixeira et al., 2018)

4 Content section with R code chunks

You should always use `echo = FALSE` on R Markdown code blocks as they add formatting and styling not desired by Copernicus. The hidden workflow results in 42.

You can add verbatim code snippets without extra styles by using ``` without additional instructions.

```
sum <- 1 + 41
```

5 Content section with list

If you want to insert a list, you must

- leave
- empty lines
- between each list item

because the `\tightlist` format used by R Markdown is not supported in the Copernicus template. Example:

```
- leave

- empty lines

- between each list item
```

6 Examples from the official template

6.1 FIGURES

When figures and tables are placed at the end of the MS (article in one-column style), please add

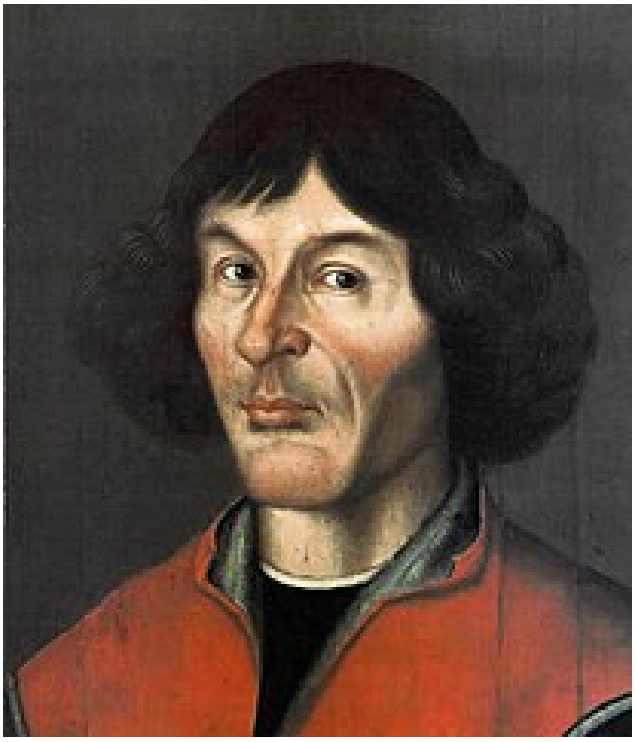

Figure 2. one column figure

between bibliography and first table and/or figure as well as between each table and/or figure.

6.1.1 ONE-COLUMN FIGURES

Include a 12cm width figure of Nikolaus Copernicus from Wikipedia with caption using R Markdown.

6.1.2 TWO-COLUMN FIGURES

You can also include a larger figure.

6.2 TABLES

You can ad LaTeXtable in an R Markdown document to meet the template requirements.

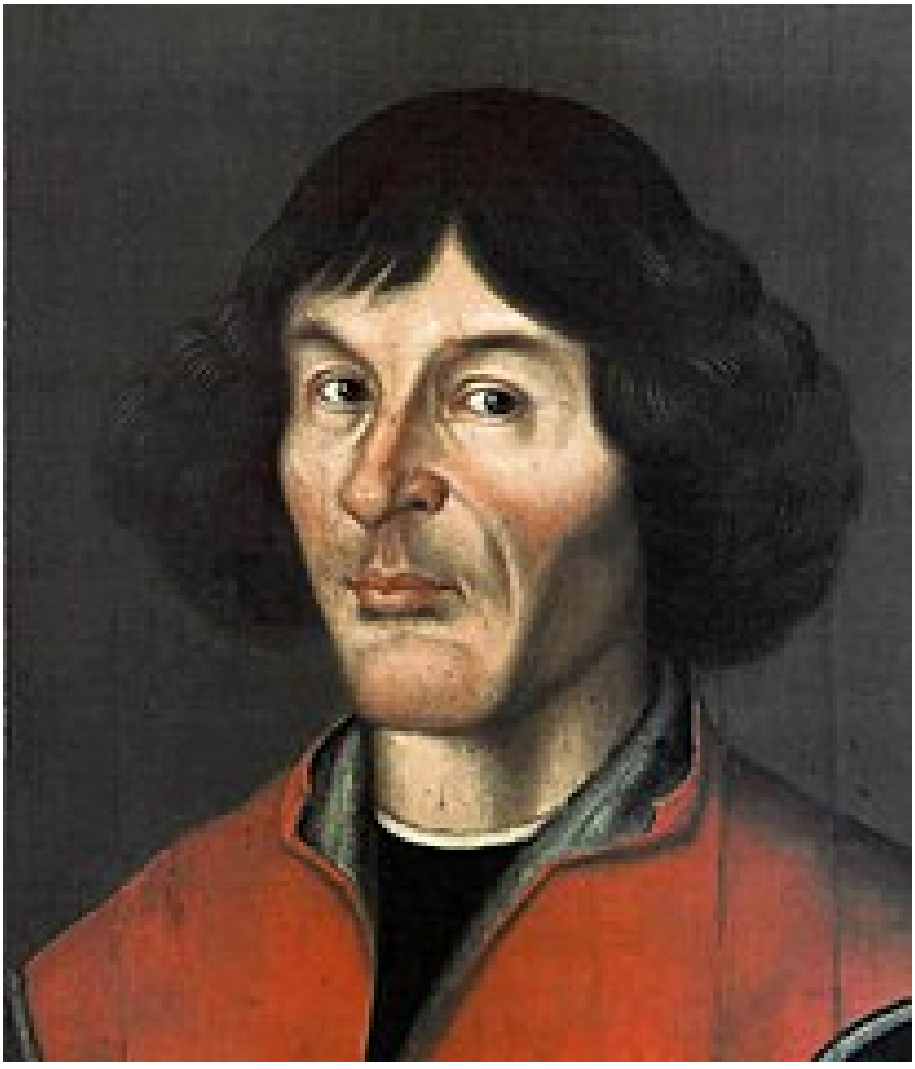

Figure 3. two column figure

Table 1. TEXT

a	b	c
1	2	3

Table Footnotes

Table 2. TEXT

a	b	c
1	2	3

Table footnotes

6.2.1 ONE-COLUMN TABLE

6.2.2 TWO-COLUMN TABLE

6.3 MATHEMATICAL EXPRESSIONS

All papers typeset by Copernicus Publications follow the math typesetting regulations given by the IUPAC Green Book (IUPAC: Quantities, Units and Symbols in Physical Chemistry, 2nd Edn., Blackwell Science, available at: http://old.iupac.org/publications/book 1993).

Physical quantities/variables are typeset in italic font (t for time, T for Temperature)

Indices which are not defined are typeset in italic font (x, y, z, a, b, c)

Items/objects which are defined are typeset in roman font (Car A, Car B)

Descriptions/specifications which are defined by itself are typeset in roman font (abs, rel, ref, tot, net, ice)

Abbreviations from 2 letters are typeset in roman font (RH, LAI)

Vectors are identified in bold italic font using $\boldsymbol{x}$

Matrices are identified in bold roman font

Multiplication signs are typeset using the LaTeX commands `\times` (for vector products, grids, and exponential notations) or `\cdot`

The character * should not be applied as mutliplication sign

6.4 EQUATIONS

6.4.1 Single-row equation

Unnumbered equations (i.e. using `$$` and getting inline preview in RStudio) are not supported by Copernicus.

$$1 \times 1 \cdot 1 = 42 \tag{1}$$

$$A = \pi r^2 \tag{2}$$

$$x = \frac{2b \pm \sqrt{b^2 - 4ac}}{2c}. \tag{3}$$

6.4.2 Multiline equation

$$3 + 5 = 8 \tag{4}$$

$$3 + 5 = 8 \tag{5}$$

$$3 + 5 = 8 \tag{6}$$

6.5 MATRICES

$$\begin{matrix} x & y & z \end{matrix}$$

$$\begin{matrix} x & y & z \end{matrix}$$

$$\begin{matrix} x & y & z \end{matrix}$$

6.6 ALGORITHM

If you want to use algorithms, you can either enable the required packages in the header (the default, see `algorithms: true`), or make sure yourself that the LaTeXpackages `algorithms` and `algorithmicx` are installed so that `algorithm.sty` respectively `algorithmic.sty` can be loaded by the Copernicus template. Copernicus staff will remove all undesirable packages from your LaTeX source code, so please stick to using the header option, which only adds the two acceptable packages.

6.7 CHEMICAL FORMULAS AND REACTIONS

For formulas embedded in the text, please use `\chem{}`, e.g. $\mathrm{A \rightarrow B}$.

The reaction environment creates labels including the letter R, i.e. (R1), (R2), etc.

Algorithm 1 Algorithm Caption

$i \leftarrow 10$
if $i \geq 5$ **then**
  $i \leftarrow i - 1$
else
  if $i \leq 3$ **then**
    $i \leftarrow i + 2$
  end if
end if

- `\rightarrow` should be used for normal (one-way) chemical reactions
- `\rightleftharpoons` should be used for equilibria
- `\leftrightarrow` should be used for resonance structures

$$A \rightarrow B \tag{R1}$$

$$Coper \rightleftharpoons nicus \tag{R2}$$

$$Publi \leftrightarrow cations \tag{R3}$$

6.8 PHYSICAL UNITS

Please use `\unit{}` (allows to save the math/`$` environment) and apply the exponential notation, for example $3.14\,\mathrm{km\,h^{-1}}$ (using LaTeX mode: `\( 3.14\,\unit{...} \)`) or $0.872\,\mathrm{m\,s^{-1}}$ (using only `\unit{0.872\,m\,s^{-1}}`).

7 Conclusions

The conclusion goes here. You can modify the section name with `\conclusions[modified heading if necessary]`.

Code and data availability. use this to add a statement when having data sets and software code available

Sample availability. use this section when having geoscientific samples available

Video supplement. use this section when having video supplements available

Appendix A: Figures and tables in appendices

Regarding figures and tables in appendices, the following two options are possible depending on your general handling of figures and tables in the manuscript environment:

A1 Option 1

If you sorted all figures and tables into the sections of the text, please also sort the appendix figures and appendix tables into the respective appendix sections. They will be correctly named automatically.

A2 Option 2

If you put all figures after the reference list, please insert appendix tables and figures after the normal tables and figures.

To rename them correctly to A1, A2, etc., please add the following commands in front of them: `\appendixfigures` needs to be added in front of appendix figures `\appendixtables` needs to be added in front of appendix tables

Please add `\clearpage` between each table and/or figure. Further guidelines on figures and tables can be found below.

Author contributions. Daniel wrote the package. Josiah thought about poterry. Markus filled in for a second author.

Competing interests. The authors declare no competing interests.

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Acknowledgements. Thanks to the rticles contributors!

References

Anderson-Teixeira, K. J., Wang, M. M. H., McGarvey, J. C., Herrmann, V., Tepley, A. J., Bond-Lamberty, B., and LeBauer, D. S.: ForC : A Global Database of Forest Carbon Stocks and Fluxes, Ecology, 99, 1507–1507, https://doi.org/10.1002/ecy.2229, 2018.