### Relevance for climate change prediction and mitigation

The future of forest C cycling (Song *et al* 2019) will shape trends in atmospheric CO2 and the course of climate change (Schimel et al. 2015 10.1073/pnas.1407302112). Our findings, and more generally the data contained in *ForC* and summarized here, can help to meet two major challenges.

First, improved representation of forest C cycling in models is essential to improving predictions of the future course of climate change, for the simple reason that by definition future projections extend our existing observations and understanding to conditions that do not currently exist on Earth (cites). To ensure that models are giving the right answers for the right reasons (Sulman et al. 2018 10.1007/s10533-018-0509-z), it is important to benchmark against multiple components of the C cycle that are internally consistent with each other (Collier et al. 2018 10.1029/2018MS001354, Wang et al. 2018 10.5194/gmd-11-3903-2018). ForC’s tens of thousands of records are readily available in a standardized format, and our analyses here indicate their internal consistency is reasonably high. Integration of *ForC* with models is a goal (Fer et al., in revision).

Second, *ForC* can serve as a pipeline through which forest science can inform forest-based climate change mitigation efforts. Such efforts will be most effective when informed by the best available data, yet it is not feasible for the individuals and organizations designing such efforts to sort through literature, often behind paywalls, with data reported in varying units, terminology, etc. One goal for *ForC* is to serve as a pipeline through which information can flow efficiently from forest researchers to decision-makers working to implement forest conservation strategies at global, national, or landscape scales. This is already happening: *ForC* has contributed to updating the IPCC guidelines for carbon accounting in forests [IPCC 2019; Requena Suarez *et al* (2019); Rozendaal et al in prep], mapping C accumulation potential from natural forest regrowth globally (Cook-Patton *et al* 2020), and informing ecosystem conservation priorities (Goldstein *et al* 2020).

It is also interesting to consider the complementary utility of global-scale but spatially discontinuous databases such as *ForC* and remote wall-to-wall remote sensing products. The latter provide unparalleled insight into aboveground carbon stocks, but less constraint on belowground stocks or carbon fluxes in general (Bond-Lamberty et al. 2016, <http://dx.doi.org/10.1002/ecs2.1380>, Anav et al. 2015 <http://dx.doi.org/10.1002/2015RG000483>). Combining observational data and remote observations may provide a much more comprehensive and accurate picture of global forest C cycling, particularly when used in formal data assimilation systems (Konings et all 2019 10.5194/bg-16-2269-2019, Liu et al. 2018 10.1088/1748-9326/aad5ef). AGB is the largest stock, and most of the emphasis has traditionally been on this variable. Remote-sensing driven AGB estimates (e.g. Saatchi et al. 2011 <http://dx.doi.org/10.1073/pnas.1019576108>), calibrated based on high-quality ground-based data (Schepaschenko *et al* 2019, Chave *et al* 2019), are well suited for this task. Note however that factors such as stand age and disturbance history (except in very recent decades are important but difficult to detect this way (Hansen *et al* 2013, Song *et al* 2018, Curtis *et al* 2018). Ground-based data such as *ForC* Are therefore valuable in defining age-based trajectories in biomass, as in Cook-Patton *et al* (2020), and thus constraining variables such as carbon sink potential (Luyssaert et al. 2007 http://dx.doi.org/10.1038/nature07276).

*In contrast,* respiration fluxes cannot be remotely sensed. Efforts such as the Global Carbon Project (**le quere http://dx.doi.org/10.5194/essd-11-1783-2019**) and NASA’s Carbon Monitoring System (Liu et al. 2018 10.1088/1748-9326/aad5ef) typically compute respiration as residuals of all other terms (Bond-Lamberty et al. 2016 <http://dx.doi.org/10.1002/ecs2.1380>, Harmon et al. 2011 <http://dx.doi.org/10.1029/2010JG001495>). This means that the errors on respiration outputs are likely to be large and certainly poorly constrained, offering a unique opportunity for databases such as ForC and SRDB (Jian et al. 2020) to provide observational benchmarks. For example, Konings et al. (2019 http://dx.doi.org/10.5194/bg-16-2269-2019) produced a unique top-down estimate of global heterotrophic respiration that can both be compared with extant bottom-up estimates (Bond-Lamberty et al. 2018 <http://dx.doi.org/10.1029/2018EF000866>) and used as an internal consistency check on other parts of the carbon cycle (Phillips et al. 2016).

In terms of C stocks, there is a paucity of data on dead wood and organic layer (Pan et al. ?). These can be significant. (**Note that we’ve given a lot of emphasis to dead wood (work by Abby), and as a result this work really advances knowledge of dead wood. We’ll want to highlight that here.**) *(give some stats/ cite figures)*.

**Move to data availability statement, or methods?**: We recommend that use of *ForC* data go to the original database, as opposed to using “off-the-shelf” values from this publication. This is because (1) *ForC* is constantly being updated, (2) analyses should be designed to match the application, (3) age equations presented here all fit a single functional form that is not necessarily the best possible for all the variables.

As climate change accelerates, understanding and managing the carbon dynamics of forests will be critical to forecasting, mitigation, and adaptation. The C data in ForC, as summarized here, will be valuable to these efforts.