Concerns about reported harvests in European forests

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ARISING FROM G. Ceccherini et al. *Nature* https://doi.org/10.1038/s41586-020-2438-y (2020)

Ceccherini et al.[1] reported an abrupt increase in harvested forest—in terms of both biomass and area—in Europe from 2016, and suggested that this reflected expanding wood markets encouraged by the bioeconomy policies of the European Union (EU). They used Global Forest Watch[2] and GlobBiomass[3] data together with an analysis that sought to remove natural disturbances from forest losses, which overall resulted in estimates of 49% for the increase in harvested forest area and 69% for the increase in harvested forest biomass. We argue that the reported changes reflect analytical artefacts, with inconsistencies in the forest change time series, misattribution of natural disturbances as harvests, and a lack of causality with the suggested bioeconomy policy frameworks. There is an urgent need to re-examine available forest information that can accurately and reliably inform the ongoing policy discussions in the framework of the EU Green Deal, particularly the upcoming post-2020 EU Forest Strategy.

Ceccherini et al.[1] used an existing Global Forest Change (GFC)[2] product derived from Landsat satellite data[4] to estimate annual forest loss. This product has limitations that preclude the analysis of trends. The availability of improved Landsat data and more-sensitive change detection models since 2013, with a major enhancement in 2015, influences the consistency of GFC data[5]. Specifically, the detection and identification of selective logging and natural forest disturbances (for example, wind, fire, and insect outbreaks) has improved markedly[6]. Although full documentation of the changes to the algorithm awaits publication of the next temporally consistent GFC product in the scientific literature, the Global Forest Watch website[2] warns about these inconsistencies and advises against using the GFC product for the analysis of temporal trends. Here we advise users on good practice guidelines for the use of GFC data in subsequent studies.

Although Ceccherini et al.[1] acknowledge certain problems with the GFC data, they ultimately judged their findings to be reliable. We contend that the abrupt changes are largely an artefact that stems from incorrect use of the GFC data time series. We note that similar abrupt increases appear in GFC data that were recorded in other regions of the world over the same period (Fig. 1). Ceccherini et al.[1] quantify change using map pixel counts, rather than using a statistically rigorous sampling approach that is more appropriate for the estimation of area change[7]. Moreover, although Ceccherini et al.[1] considered false positives (incorrect detection of forest loss) in their sample analyses, they did not consider false negatives (undetected forest loss). This is a crucial oversight, because forest losses (before 2015) may be inaccurately attributed to a year later than that in which they occurred, if they were detected after the model sensitivity improved. The harvest estimated by Ceccherini et al.[1] is affected by the accuracy of the GFC product (Fig. 1d), because the detection is more sensitive to partial change in forest cover in the 2015–2018 period than in the 2011–2014 period. The omission of selective logging before 2015, already detected in ref. [5], also raises questions about interpretation—for example in Sweden and Finland, countries in which two-thirds of the total harvested area is derived from thinnings[8]. These countries are identified by Ceccherini et al.[1] as those that have the largest increase in harvest. Further, Ceccherini et al.[1] combine their estimated 49% increase in harvested area with GlobBiomass data[3] to state an increase of 69% biomass loss. However, GlobBiomass is known to be unsuitable for such analyses owing to considerable pixel level uncertainties[9]. The use of sub-pixel resampling adds to this uncertainty and unsuitability.

Sample-based reference data provide the primary source for area change estimation[7], and independent sample-based analyses of the trends in forest-canopy change in Europe[10] do not support the abrupt increases in harvest that are suggested by Ceccherini et al.[1]. Users of GFC data must recognize that area change totals cannot be calculated by simple pixel counts from maps[7], owing to inconsistencies in the

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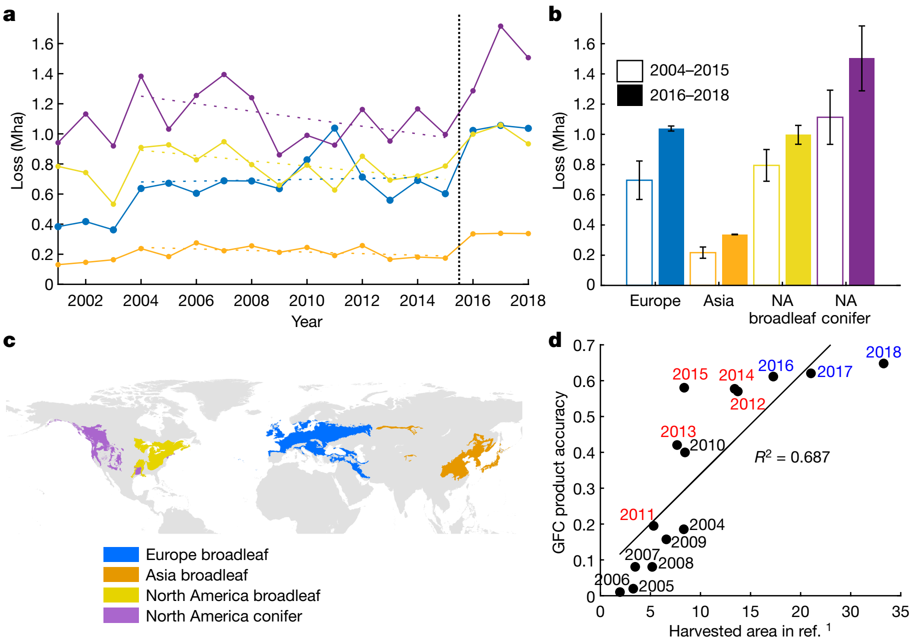

Fig. 1 | Abrupt changes in GFC after 2015 are visible in many temperate regions. This reflects the various improvements in detection that were noted in ref. [2]. **a**, Annual forest cover loss from GFC data in four forest regions: Europe broadleaf (blue); Asia broadleaf (orange); North America broadleaf (yellow) and North America conifer (purple). The vertical dashed line marks the point of the increase in loss reported by Ceccherini et al.[1]. Dashed coloured lines are linear regressions over the period 2004–2015. **b**, The mean annual loss over 2004–2015 and 2016–2018; error bars show ±1 s.d. (sample size is number of years each). **c**, The locations of the four forest regions. **d**, A comparison between the harvested area proposed by Ceccherini et al.[1] for Italy and the accuracy of the GFC forest loss as measured in ref. [5] (based on comparison against harvested areas mapped in the field). The increase in estimated harvest from the GFC largely reflects changes in detection. Different colours denote the periods compared by Ceccherini et al.[1].

detection of change between years. Instead, stratified sample estimation procedures[11] are better suited to GFC data[6]. Such analyses, which address both omission and commission errors, offer accurate and unbiased results of forest change. Moreover, sample reference data tailored to the specific purpose of a given study can be used to discriminate proportions of loss due to natural disturbances within the overall forest loss rates[12].

Ceccherini et al.[1] argue that the socio-economic context and the policy framework are the most important drivers explaining the abrupt increase in harvest area because their analyses excluded natural

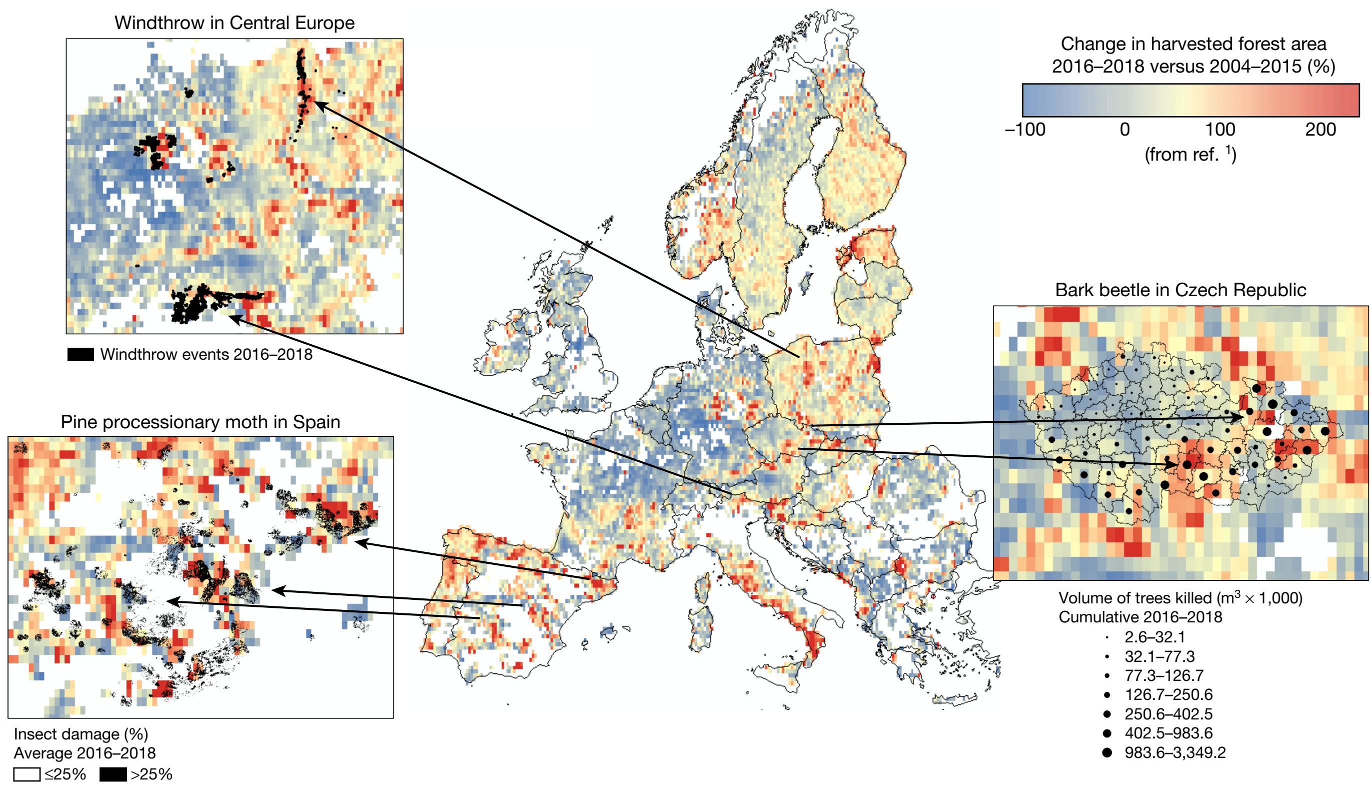

Fig. 2 | Areas identified as natural disturbances. The spatial distribution of many areas that were estimated as hotspots for increased harvesting by Ceccherini et al.[1] have been identified by us as natural disturbances, and thus these areas were not properly compensated for in the calculations in ref. [1]. The European map in the centre (reproduced from ref. [1], Springer Nature) shows the percentage variation of European harvested forest area for 2016–2018 compared with 2004–2015 (blue to red colours according to figure 2b in Ceccherini et al.[1]). Three examples of omissions are given in the insets and overlay forest disturbance information sources (all in black). Top left, 2016–2018 windthrow events from the FORWIND v2 database[13]. Bottom left, 2016–2018 averaged insect attacks in which more than 25% of trees were affected, courtesy of the Spanish Ministry of Agriculture, Fisheries and Food. Right, district-wise statistics from the Czech Republic of the cumulative cubic metres of salvaged trees that were killed by bark beetle in 2016–2018. Country boundaries © ESRI and Garmin International have been added for reference.

disturbances such as forest fires, salvage logging after major windstorms, and insect outbreaks. However, we argue that this is incorrect, as many areas of known natural disturbance wrongly appear as harvest in their analyses (Fig. 2). Their default attribution was to allocate any forest loss to harvesting if not identified to be otherwise, while disregarding many natural disturbance processes. We found that many areas that Ceccherini et al.[1] argue as being affected by increased harvest result from known disturbances, such as insect attacks (for example, in Spain and Czech Republic) or windthrow events (for example, in Germany, Poland and Austria) (Fig. 2). Thus, we are confident that natural disturbances were not correctly excluded. To factor out wind damage, Ceccherini et al.[1] used an ad hoc method (equation (2) in ref. [1]) that is not appropriate. The FORWIND database on wind disturbances in European forests[13] would have provided a basis for more direct attribution (Fig. 2). In any case, there is still only partial evidence, and further research is needed using a robust sampling strategy that directly addresses the discrimination of specific types of natural disturbance. As an example, ref. [12] uses a probability sample that addresses the issue of differentiating deforestation from natural disturbance.

The conclusion of Ceccherini et al.[1] that the reported increase in the rate of forest harvest is the result of a recent expansion of wood markets under the bioeconomy is not supported by their analyses. Although Ceccherini et al.[1] acknowledge that they show neither proof nor quantification of a causal connection, they suggest socio-economic stimuli and policies in the context of bioeconomy as the most probable drivers of increases in harvested area. We argue that conclusions regarding the drivers of harvest increases should be based on analyses that consider the factors that determine the net effect of forest bioeconomy markets on forest management and harvesting[14,15]. Timber harvest in Europe's forests increased by approximately 6% in 2016–2018 relative to 2011–2015, mostly because of economic recovery after the 2008–2012 recession[16]. However, Ceccherini et al.[1] neglect economic cycles and consider that increasing harvests reflect bioeconomy policies alone.

Of particular note is that natural disturbances have an unprecedented and increasing role in Europe[17]. To better understand the effects of climate change, natural disturbances and forest management on European forests, there is an increasing need for a collective European effort to obtain data at different spatial and temporal levels, as well as from different disciplines, countries and sources. Such information and knowledge are crucial to develop science-based, climate-smart forestry strategies[18] to ensure that European forests continue to be an important carbon sink and a key ecosystem service provider in relation to the protection of biodiversity and the development of the bioeconomy.

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Author contributions M.P. and G.-J.N. conceived and initiated the study. R.V., C.S., N.A., T.A.M.P., G.C., S.F., T.H., B.J.W.L. and D.A. ran different parts of the analyses and demonstrations. M.P., R.V., G.-J.N., C.S., T.A.M.P., J.S., R.S., B.G. and L.H. drafted the initial version of the manuscript. P.P. provided first-hand experience of the algorithms involved in the production of GFC data. All authors offered insights from their own national statistics and local knowledge, which focused the analyses and the argumentation, and contributed critically to the interpretation of the results, revising and approving the final version of the manuscript.

Competing interests The authors declare no competing interests.

Additional information
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