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Interactive comment on "Drainage of organic soils and GHG emissions: Validation with country data" *by* Giulia Conchedda and Francesco N. Tubiello

Anonymous Referee #1

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This study presents the approach and main results of a new methodology developed for FAOSTAT. By combining overlays of maps of land cover with the distribution of wetland soils (histosols) and IPCC emission factors, the authors present a global annual dataset of peatland drained area and greenhouse gas emissions (CO2 and N2O) over a time series encompassing three decades (1990–2019). This allows the authors to identify trends in drained areas and emissions over time and to validate the FAO emissions estimates with country data. Sources of uncertainty are discussed. Importantly, the FAO dataset currently provides the only available country/regional/global time series data on GHG emissions from drained organic soils, thereby supporting analysis of trends and the identification of current or emerging emissions hotspots that could be targeted for mitigation measures. The paper is generally well written with a clear

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description of methodological approach, limitations and uncertainties, although I do have some suggestions for further improvement of several aspects relating to uncertainty. The results are very relevant to current actions to reduce land-use derived GHG emissions; they are generally well presented and discussed. I recommend publication following minor revision – see my specific comments and suggestions below. Specific comments: Line 25 – change wet soils ecosystems to wet soil ecosystems Line 46 – by citing Rieley & Page (2016) you are only referring to tropical peatlands please include an additional balancing reference for northern peatlands Section 2 – can the authors acknowledge that by using data on the distribution of histosols as a proxy for peat soils, some areas of histosols will be included that are not strictly defined as peat soils (e.g. if one followed the definition of a minimum peat depth of 40 cm with organic content > 65% Line 105 – suggest rephrase: In order to support crop cultivation activities, organic soils need to be drained Lines 106 – 107 – sentence on livestock needs to be rephrased – sense is not clear : grazing per se does not result in drainage Lines 115-116 – what are the range of values for soil carbon content, pH, water storage content used to characterise histosols? Line 122 – replace Spatial with Space (European Space Agency Line 147 – replace climatic zones with climate zone Line 164 – remove 'and' Line 165 – section 2.6 Limitations and uncertainty – a) Would the authors consider applying and including emissions based on the revised IPCC emission factors presented in the updated 2013 IPCC guidelines? Perhaps presented alongside the EFs from the 2006 guidelines? For the most part, the 2013 EFs are based on a wider literature base and provide a more accurate assessment of Tier 1 emissions across land-use categories/climate zones. Alternatively, the authors should at least acknowledge and discuss how use of the 2013 EFs would alter their emissions estimates b) Can the authors consider adding a further couple of sentences into this section on the uncertainties that arise, over time, from peat wastage – i.e. where drainage leads to the depletion and eventual loss of organic matter from shallow peat soils there is the potential for a change in the scale of emissions. Without accurate country data on peat depth and rate of peat loss it will not be possible to estimate peat depletion rates but

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this could at least be acknowledged. N.B. At least in drained temperate peatlands, a reduction in soil organic carbon does not necessarily result in a reduction in CO2 emissions (e.g. see Tiemeyer et al. 2016 - https://doi.org/10.1111/gcb.13303), but in tropical peatlands peat loss is usually accompanied by an increasing occurrence of flooding which will necessarily reduce CO2 emissions over time. Line 187 – the authors could considering clarifying here, or in the discussion, that whilst the analysis is only for drained peat soils under cropland and grassland, in fact in some countries (e.g. Indonesia) there are extensive additional areas of peatland subject to drainage that are under other land covers (e.g. degraded forest, scrub in the case of countries in SE Asia) and emissions from these land covers are not captured in this analysis. Line 211 – add a full stop after ranges; change estimates to estimate. Line 218 and following – there is indeed a discrepancy between estimates in Page et al. (2011) and the data presented by Gumbricht et al. (2017), particularly in relation to S. America. The authors might wish to expand here on why these discrepancies could have arisen e.g. the remote sensing approach (remote sensed wetness index) used by Gumbricht provides very limited data over tropical forested peatlands and therefore in these areas their estimates appear to be more based on topography, climatic wetness etc – which may be reasonable assumptions for predicting the location of wetlands but cannot be used to determine whether or not these wetlands are peat forming systems. The estimates for Brazil likely therefore indicate extensive areas of wetland, but not necessarily peatland. Line 224 – replace 'both about a third' with 'but both estimates are about a third of ..... Line 232 – change explains to explain. Line 233 – change 'For one percent' to 'For a one percent . . Line 239 – change consistently to consistent. Line 242 – change peatlands to peatland. Line 243/section 4.1 – I would encourage the authors to also mention that their estimates of emissions do not, for example, include emissions from water surfaces (e.g. CO2/CH4 evasion from drainage channels, e.g. in plantation landscapes). Nor do they include fire emissions. In SE Asia, GHG emissions from peat fires can be of a comparable magnitude to emissions arising from peat oxidation driven by drainage and agricultural uses. But peat fires are also an increasing feature

of other drained peatlands – e.g. in Russia. Line 261 – change organic area to organic soil area. Line 270 – change 'due to' to 'be due to'. Line 278 – country name is missing before the final bracketed numbers. The difference here in emissions seems particularly large (16 vs. 0.2 kt N20) – do the authors have an explanation for this? Line 285 – can the authors provide some more detail on why the Tiemeyer emissions estimates for organic soils in Germany are so much higher than FAOSTAT emissions? Line 288 – replace fourty with forty. Section 4.2.2. – at the start of this section you refer to both Indonesia and Malaysia, but then go on to only compare the FAOSTAT and country data on emissions for Indonesia. For completeness, is it possible to also include a comparison of the Malaysian datasets? Also, Miettinen et al (2016) give the area of peatland under crops (plantations and smallholder agriculture) in Indonesia as 6.3 Mha compared with the FAOSTAT estimate of 5 Mha. Perhaps worth mentioning this difference. Does the 5 Mha area estimated in FAOSTAT include all plantations (including pulpwood) or only oil palm and other food crop plantations? Your Table 6 implies you include all types of plantations (but this should be clarified). Line 302 – insert 'a' before 'main driver'. Line 303 – Hooijer is mis-spelt (2010 citation). Lines 317 – 318 – improve expression – sense not clear. Line 320 – insert 'be' after 'may'. Line 335 – should 'disseminated' read 'disaggregated'? Sense not clear. Line 352 – insert 'to' before 'whether'. Table 6 – please clarify whether the 'all plantations' category includes pulpwood plantations as well as oil palm and other food crop plantations (e.g. coconut) (see point above on Section 4.2.2). Table 7 – correct mis-spelling of Hooijer. Also, some of these studies (e.g. Hooijer et al. 2012, Cooper et al. 2020) take account of the initial pulse of carbon that is lost from peat soils in the immediate (up to 5) years following peatland drainage and deforestation. Other studies, however, do not account for this initial pulse and represent emissions once the peat landscape has stabilised under the new land use (+5 years after drainage). Figure 5 – the figure caption should indicate that the emission factors are derived from IPCC (2006). Figure 13 – in the relevant part of the discussion, the discrepancy in the FAOSTAT estimate of emissions and the country reported emissions in Indonesia should be addressed. Could the dis-

crepancy (lower FAOSTAT estimate) but due to the in-country data reporting emissions from all forms of degraded peatland land covers/uses, i.e. not just cropland/grassland? For example, the INCAS (Indonesian Carbon Accounting System) reports emissions from degraded, non-agricultural peatland (e.g. degraded forest and scrub).

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