Comment on essd-2022-213
Anonymous Referee #2


General comments:

The authors put together a comprehensive analysis and study on atmospheric CO2 observations, aimed in informing countries’ C budgets. The use of atmospheric observations (and OCO-2 MIP outputs in this case) is useful and greatly needed in the view of future CO2M development and in the context of the Paris Agreement global reduction targets. The authors mention often the Paris Agreement and its GST but nowhere in this study UNFCCC reported estimates are presented. Do these atmospheric observations agree or not with the NGHGIIs, or better say complement them? How do OCO-2 MIP observations could/will be used for the “informing” purpose? I would highly recommend a section dedicated to this.

Specific comments:

Introduction: The first three paragraphs contain text widely used in previous studies, references are needed, e.g. VERIFY H2020 project and references therein

Line 27: The 5 sectors specified by the IPCC 2006 guidelines are: Energy, IPPU, Agriculture, LULUCF and Waste. The AFOLU (Agriculture + LULUCF) is defined in the 2019 Refinement to the 2006 Guidelines and IPCC ARs reports. However, in their NGHGIIs, countries report separate the two sectors.

Line 30: “quantified and understood” please reference
Line 40: I would not use “verification system” but complementing, informing..

Line 60: “several previous studies “ how about European BU vs TD studies? Ciais et al., add RECCAP2, as well as Grassi et al., 2022 preprint informing on consistent comparison for the land-se fluxes

Line 64: explain CAMS

Line 90: comma (,) before Including

Lines 94-95: The first two sentences don’t read well, rephrase please

Figure 1 caption: I think number 2 should be moved to forests/logs, to the reservoir itself (under GPP), same as its done for agriculture and water, now its on the urban areas. Add (BB) after biomass burning.

Line 157: can add examples for DGVMs priors

Line 187 Section 2: a table summarizing all data sources for all lateral fluxes and not only would be of great help.

Line 190: can reference (Fig. 1) after ocean

Line 195: Reco already explained (L116)

Line 219: Please mention EU27

Line 328: add “including ‘those’ from”...

Line 249: not clear to which network they belong to. In situ collection is referenced as
Masarie et al., 2014, perhaps add this ref to the Abstract where you mention first in situ. It appears late in the text (line 185)

Line 276, Eq 4: what does 1.35 stands for?

Line 322: reference DLEM

Line 326: please explain DIC, DOC and POC

Line 358: can you please explain why 30%?

Line 491: FUR already explained in Fig. 7 caption, then in 5.2, then again here

Line 538: How about future CO2M mission, what do authors recommend for estimating fluxes at smaller scale (regions, cities etc.)

Line 721: perhaps worth mentioning RECCAP2 initiative. I think this paragraph should be in the Introduction

Line 807: agree with improving sub-national and sub-annual estimates of lateral fluxes, however its not the aim of the NGHGI's.

Line 811: can use ‘GST’

Line 817: “We recommend that each party provide a mask” very well thought and optimistic, however very hard to achieve, countries do not invest in it as it’s not really required by guidelines, however several newly EU funded projects might look into it for some key countries.

Line 824: FUR ok, how about the distribution of the observation network?

Line 838: a bit more text on how this analysis should inform GSTs and countries’ budgets
is needed (as for the moment GST is designed for country NGHGIIs only), and, as mentioned in the beginning, the UNFCCC and country reported data is missing in this study.