

This study presents a updated dataset of global and national carbon uptake by cement carbonation from 1928 to 2024 based on previous studies (Xi et al., 2016; Guo et al., 2021; Huang et al., 2023). The updated dataset of cement carbon uptake covers 163 cement-producing countries worldwide for the first time, and extends the time scale to 1928-2024. Cement carbon sink has shown substantial impacts on the Global Carbon Budget (Friedlingstein et al., 2023, 2022a, b, 2020). While this study reveals the contribution of cement carbon sequestration as a carbon sink in each country, which making it is possible to include cement carbon sink in national GHG inventories (Andersson et al., 2019).

The manuscript is well written, however there are some comments need to be addressed.

Response: We sincerely appreciate your high regard and meticulous review of our manuscript, and your positive feedback has given us great encouragement. We have thoroughly considered your suggestions and rechecked the entire text to enhance the manuscript's quality, as follows in response to your comments.

1. The data description of the article contains supplementary information, including 4 supplementary tables (<https://doi.org/10.5281/zenodo.13827861>). But it is difficult for readers to find the corresponding relations between the main texts and the data in supplementary tables. It is recommended that manuscripts have clear links to data files in the data description section. For example, in the section “2.1 Data source and treatment”, the explicit table paths should be indicated in corresponding data (Ln.104-118).

Response: Thanks for your suggestion. There are four tables in the Supplementary tables. Supplementary table 1 is the activity level data of cement clinker production and consumption, which contains five data: (1) cement production, (2) cement clinker ratio, (3) clinker imports, (4) clinker exports, and (5) revised clinker production for countries from 1928 to 2024. Supplementary table 2 is the input model parameters of cement uptake and emissions, including the parameters of

cement carbon uptake (Data 1~Data 11), and the carbon emission factors (Data 12) for countries. Supplementary table 3 shows the accounting results of cement carbon uptake, including global carbon uptake by cement material and use (Data 1), annual global carbon uptake by cement material and relevant lag time (Data 2), global carbon uptake by 163 countries and regions from 1928 to 2024 (Data 3) and process carbon emissions from cement production by region and category from 1928 to 2024 (Data 4). Supplementary table 4 is the result of uncertainty accounting for global and national carbon uptake in cement.

Changes: In the revised manuscript of line 118-119, line 185-187, and line 270-271. We have added a description of the detailed indexing of Supplementary tables.

2. Figure 1c, 1e, and Figure 3, “uptakes” should be “uptake”.

Response: Thanks for your comments. We have changed the “uptakes” in figure 1 and figure 3 to “uptake”.

Changes: In the revised manuscript, we have changed “uptakes” to “uptake” in the title of the axis coordinates of Figure 1 on line 267, and in the figure notes of Figure 3 on line 307.

3. It is recommended that “emission” in the text should be “process emission”, where the emission from energy consumption in cement industry was process emission.

Response: Thank you for your rigorous consideration. According with your advice, we have changed the expression “emission” from cement production process in the original text to “process emission”.

Changes: The original text included several descriptions of emissions associated with the cement production process. The revisions to these descriptions can be found at the following line numbers in the updated version: 88, 171, 206, 217, 278, 311-315, 319, 323, 331, 335, 344, 351, 356, 360-361, 363, and 365.

4. Why are the global cement carbon sinks in 2023 and 2024 in this study smaller than that of 2021 in previous study (Huang et al., 2023)? Please explain it more clearly.

Response: Thank you for your valuable comments. It's important to note that of the estimate of global cement carbon uptake in this study is not merely updating three years of data from previous studies. Instead, we have employed a bottom-up approach to calculate global carbon uptake. The cement carbon uptake for 2021 in this study is 0.83 Gt CO₂ (95 % CI: 0.70-0.99 Gt CO₂ yr⁻¹). While this is slightly lower than the 0.96 Gt CO₂ (95 % CI: 0.81-1.15 Gt CO₂ yr⁻¹) reported in the previous study (Huang et al., 2023), it falls within the uncertainty range of the earlier estimate. This is mainly due to the fact that the activity level data in this study is corrected cement consumption. The global cement carbon uptake in 2022 is 0.82 Gt CO₂ (95 % CI: 0.69-0.98 Gt CO₂ yr⁻¹), a decrease of 1.1% from 2021. It mainly attributable to the decline in both global cement production and apparent cement consumption in 2022, which decrease by 5.6% and 6.2% from 2021, respectively. In particular, as the largest cement producer, China's cement production and apparent consumption decreased by 11.1 %. In 2023, the global cement carbon uptake is 0.84 Gt CO₂ (95 % CI: 0.71-10.03 Gt CO₂ yr⁻¹), an increase of 2.8 % from 2022, in which the global cement production declined by 1.4 %, but the apparent consumption of cement clinker increased by 2.0 %. This suggests a strong correlation between cement carbon uptake and cement consumption. A modest recovery in global cement consumption is anticipated for 2024, primarily driven by rapidly growing markets in South-East Asia and Africa (Cheng et al., 2023). This recovery is expected to correspond with a continuation of growth in the global cement carbon uptake, which is forecasted to reach 0.86 Gt CO₂ (95 % CI: 0.73-0.99 Gt CO₂ yr⁻¹), marking an increase of 2.0 % from the 2023 levels.

Changes: We have added the description to line 220-228 of the revised draft. “The results show that global cement carbon uptake in 2022 is 0.82 Gt CO₂ (95 % CI: 0.69-0.98 Gt CO₂ yr⁻¹), a decrease of 1.1 % from 2021. It mainly attributable to the decline in both global cement production and apparent cement consumption in 2022, which decrease by 5.6 % and 6.2 % from 2021, respectively. In particular, as the largest cement producer, China's cement production and apparent consumption decreased by 11.1%. In 2023, global cement carbon uptake shows a 2.8 % increase

from 2022, in which the global cement production declined by 1.4 %, but the apparent consumption of cement clinker increased by 2.0 %. This suggests a strong correlation between cement carbon uptake and cement consumption. A modest recovery in global cement consumption is anticipated for 2024, primarily driven by rapidly growing markets in South-East Asia and Africa (Cheng et al., 2023). This recovery is expected to correspond with a continuation of growth in the global cement carbon uptake, which is forecasted to reach 0.86 Gt CO₂ (95 % CI: 0.73-10.23 Gt CO₂ yr⁻¹), marking an increase of 2.0% from the 2023 levels.”

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