Global and national CO_2 emission from lime production process and carbonation sink from 1930 to 2024 TS1

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Abstract. Accurate quantification of lime process emissions and subsequent carbonation uptake is needed to represent the lime carbon cycle in global carbon-budget assessments. We developed a source-prioritized and internally cross-checked dataset for 1930–2024 by harmonizing USGS statistics, national statistical yearbooks, industrial records, and explicitly identified proxy-based reconstructions. The framework resolves 11 major lime-producing countries, collectively representing 78.9 % of global lime production, and derives country-specific process-emission factors from sectoral lime-use structures and CaO-content requirements. Annual global lime carbonation uptake increased from 4.1 Mt CO_2 yr^{-1} (95 % CI: 3.5–4.8 Mt CO_2 yr^{-1}) in 1930 to 136.1 Mt CO_2 yr^{-1} (95 % CI: 107.9–171.5 Mt CO_2 yr^{-1}) in 2024, corresponding to a compound annual growth rate of 3.8 %. Cumulative process emissions reached 11.3 Gt CO_2 (95 % confidence interval (CI): 10.7–11.9 Gt CO_2), of which construction and metallurgy contributed 3.9 Gt CO_2 (34.5 %) and 3.8 Gt CO_2 (33.5 %), respectively. Cumulative carbonation uptake reached 4.8 Gt CO_2 (95 % CI: 3.9–5.8 Gt CO_2), offsetting 42.2 % of process emissions, 3.4 % higher than the 38.8 % estimate for 1930–2020 reported by Bing et al. (2023). China contributed 5.5 Gt CO_2 of process emissions (48.3 % of the global total) and 1.9 Gt CO_2 of carbonation uptake (40.7 %). Uncertainties associated with data sources, historical reconstruction, and material parameters were propagated through 10 000 Monte Carlo iterations. Metallurgical by-products and construction materials dominated cumulative uptake. Country-level trajectories indicate that most developed economies have passed their lime process-emission peaks, whereas China remains on a growth trajectory and Brazil retains substantially higher emissions than its early historical levels despite a modest decline after its 2013 peak. This dataset provides a consistent empirical basis for representing lime-related carbon sources and sinks in global carbon-cycle assessments and is archived in the Science Data Bank at https://doi.org/10.57760/sciencedb.45314 (Bing et al., 2026).