This study aims to explore the stability of various SOC fractionation using a centennial-scale resampling approach on a bare fallow site to. Research that tests methodological reliability like this is instructive for both our understanding of carbon cycle processes and the optimization of carbon models. However, the core conclusions remain open to question:

1. The authors infer the **persistence** of rSOC based on changes in carbon **content** over time. In a bare fallow experiment with no carbon inputs, this approach may be partially valid. However, the authors acknowledge an unquantified **black carbon input** during World War II. Black carbon is not absolutely stable. Microorganisms can process it into short-chain compounds and microbial products, which may subsequently contribute to rSOC and other fractions. Additionally, other SOC fractions can also be a source of rSOC. Therefore, inferring centennial-scale persistence solely from content changes is insufficient. The key conclusion requires more direct evidence, such as radiocarbon ($\Delta^{14}C$).
2. The reported **mass recovery rates are implausibly high**, reaching over 200%. Such anomalies compromise the reliability of results.
3. Some results are based on **subjective visual inspection** (Figure 4), which is questionable.

Together, the current evidence is not sufficient to support their core conclusions. The detailed comments are as follows:

Title： I suggest explicitly stating “centennial-scale” rather than “long-term.”

L27： I recommend that the authors insert a paragraph break, so that the meaning of the fractionation is introduced first, followed by a description of the specific techniques used.

L27-38： The section opens with the assertion that physical fractionation is more reliable than chemical methods. However, the majority of the paragraph is devoted to thermal analysis techniques. This structural imbalance distracts from the core message and may confuse readers about the primary focus of the section.

L39-45： I am curious whether the five Zimmermann’s fractions correspond one-to-one with the RothC pools. The statement in L45-46 seems to imply such a strict correspondence. However, the BIO pool in RothC is difficult to characterize using the Zimmermann fractions. It may be more closely related to MBC instead.

L74-82： How were the soil samples preserved? For a centennial-scale experiment, preservation conditions are critical to the reliability of the measurements.

L104： Does ultrasonic dispersion carry a risk of aggregate disruption, potentially leading to an underestimation of the S+C fraction?

L138-142： The elemental analyzer measures the carbon content per unit mass of each fraction, but the mass of each fraction differs. Has the carbon content been normalized to that per unit mass of air-dried soil?

L146： Major concern! The mass recovery rates in 1962 and 2021 are anomalous (in some cases exceeding 200%). This seriously undermines my confidence in the reliability of the results. This means that the authors started with 30 g of air-dried soil but ended up with 60 g of recovered soil fractions? This is physically impossible and difficult to understand.

Based on the mean mass recovery (98.16% to 100.05%, L145), I suspect that only a few samples have anomalous recoveries. I respect the authors’ transparency in reporting all data, but I

recommend that they conduct a sensitivity analysis by excluding the samples with excessively high mass recoveries to test the robustness of results. In addition, reporting the carbon recovery rates is also necessary.

L175-180： The authors rely solely on visual observation to infer the source of POM and temporal changes in black carbon content. Such subjective analysis is inappropriate for presentation as formal results. Strictly, carbon source should be based on quantitative methods such as biomarker or molecular fingerprinting (e.g., ^{13}C-NMR, Py-GC/MS). While I understand that the authors may lack the resources for such analyses, presenting subjective visual observations as evidence is scientifically unrigorous.

Discussion: The discussion would benefit from explicitly linking the findings back to the RothC model. If rSOC represents only a portion of stable SOC, then using rSOC as a direct proxy for IOM pool in RothC may systematically underestimate the soil carbon sequestration potential.

Figure 2： Please clarify the definition of sensitive and resistant SOC.