**Response to reviewer #1.**

Authors response: We thank the reviewer for the positive assessment of our manuscript and for the constructive comments. We appreciate the recognition of the relevance of this study for the long-term Schauinsland greenhouse gas record. In the revised manuscript, we have addressed all comments raised below.
Our detailed responses to each comment are provided below, with the reviewer comments depicted in black, the author reply in blue.

**General comments**

This manuscript by Großmann et al. presents a comparison between the in-situ $CO_2$ and $CH_4$ time series recorded at two different sampling heights at the atmospheric monitoring station Schauinsland (Germany). Schauinsland is one of the global reference sites for greenhouse gas observations and hosts the longest $CO_2$ time series in Europe. To minimize the potential impact of local perturbations on the measured $CO_2$ and $CH_4$ signals, the station—previously operating with a 12 m a.g.l. sampling inlet since 2011—has recently been equipped with an additional inlet at 35 m a.g.l.

This study specifically analyzes the consistency of the $CO_2$ and $CH_4$ signals obtained from the two sampling inlets and quantifies systematic biases in the diurnal and seasonal cycles associated with using the higher inlet.

The topic is well within the scope of AMT. The paper is clearly written, the methodology is appropriate, and the results are robust and well described. Moreover, this work represents an important reference for users of the Schauinsland data series. I therefore recommend publication after the authors address the following minor points.

**Specific comments**

**Line 90:** What is the inner diameter of the inlet tube, and what is the residence time of air within it?

Authors response: Thank you for this helpful comment. We have added this information to the manuscript. The revised text now reads as follows: "A SynFlex tube with an inner diameter of 10.8 mm is installed from the air intake at the top of the tower to its base and continues underground over a distance of 70 m to the basement of the station, from where the sample air is routed to the analyzer. The corresponding residence times are approximately 13 s for the 35 m tower section at a flow rate of 15 L $min^{-1}$ and 52 s for the 70 m underground section at a flow rate of 18 L $min^{-1}$. A refrigeration unit located at the base of the tower pre-dries the air at 2 °C to reduce the moisture content."

**Section 2.5 (Data treatment):** Is the residence time of air in the 70 m long tube of the 35 m inlet considered in the comparison?

Authors response: For the comparison of the hourly mean mole fractions, the difference in residence time between the two inlet systems is negligible and therefore does not affect the analysis. However, for the spike detection analysis (Section 3.4), the minutely data from the two intake systems are synchronized to account for the difference in residence time of approximately 1 min between the sampling lines. We have clarified this in the manuscript by adding the following sentence in section 2.5:
"To account for the difference in residence time between the two intake lines, which is

approximately 1 min, the minutely data from the two intake systems were first synchronized in time. The synchronized data were then aggregated to hourly means."

**Section 2.6 (Robust Extraction of Baseline Signal — REBS) spike detection algorithm:** I recommend specifying here the beta and bandwidth values used in evaluating the spike detection method.

Authors response: We agree that the parameter settings used for the REBS spike detection algorithm should be stated explicitly in the Methods section. We have therefore added the following text to Section 2.6:

"In this study, the β parameter is set to 8 and to 3 for a more stringent configuration, with sensitivity tests being performed on values between 1 and 10 (Fig. S4, S5, and S6). A bandwidth of 60 minutes was used according to respective sensitivity tests (Fig. S7)."

**Line 181:** "However, on certain days, elevated $CO_2$ mole fractions are observed at the 12 m intake, occasionally reaching $CO_2$ enhancements of up to 2 ppm compared to the 35 m intake, most notably during the night of 1 to 2 February 2024 and again on 4 February 2024."
Could you discuss possible causes for these enhancements that appear only in the 12 m inlet?

Authors response: Thank you for this valuable comment. We agree that a discussion of the likely origin of these enhancements improves the interpretation of the observed differences between the two intake heights. We have therefore added the following text to the manuscript:

"Such enhancements, which are monitored at the 12 m but not at the 35 m intake, are presumably related to local $CO_2$ fluxes that are more important at the lower intake height. During winter nocturnal soil fluxes may lead to an accumulation of $CO_2$ near the surface, thereby affecting the 12 m intake while leaving the 35 m intake largely unaffected."

**Figures 6, 7, 13, S1, S2:** Please specify what the error bars represent.

Authors response: We have revised the captions of Figs. 6, 7, 13, S1, and S2 to include the following clarification:

"The error bars represent the standard error of the seasonal mean."

**Line 302:** Based on the data distributions, it appears that even in winter the differences are skewed toward higher values, suggesting occurrences of elevated $CH_4$ at the 12 m inlet. What might be the cause? Is the soil snow-covered during winter?

Authors response: We agree that the distribution in Fig. 9 suggests the occurrence of a few elevated $CH_4$ events at the 12 m intake during winter. The soil at Schauinsland is occasionally snow-covered during this period, but the source of these enhancements remains unclear. They may be related to sporadic local $CH_4$ sources affecting the lower inlet; however, we cannot identify their origin with the available data.

**Line 381:** Please provide the fractions of paired data that exceeded the WMO compatibility goal for both the original and the despiked datasets.

Authors response: The fraction of minutely $CH_4$ mole fraction between the two intake heights that exceed the 2 ppb threshold is 16.9 % for the despiked data with β = 3, 18.6% for β = 8, and 19.5 % for the original data set. This percentage is not included in the manuscript as we find that it only partly describes the effectiveness of the algorithm, since the influence of the spikes on the time series is masked by natural variability. In order to evaluate the influence of the algorithm on the time series, table 2 refers to the difference between original and despiked data set.

**Line 411:** Has a similar analysis been performed comparing the 6 m and 12 m air inlets?

Authors Response: Thank you for this comment. This manuscript focuses on the comparison of the $CO_2$ and $CH_4$ time series from the 12 m and 35 m inlet systems. Unfortunately, no parallel measurements were available for a direct comparison between the previous 6 m and 12 m inlet heights. Therefore, the results presented here cannot directly assess the impact of the earlier change in inlet height. We are currently re-evaluating the historical measurements, and the analysis of the transition from 6 m to 12 m will be included in a separate study.

**Line 435:** Could you provide recommendations for ensuring consistent use of the historical dataset together with the new 35 m inlet data?

Authors response: Thank you for this comment. We agree that recommendations for the consistent use of the historical $CH_4$ record together with the new 35 m inlet data are important. The applicability of spike detection methods, however, depends on the temporal resolution of the measurements. The historical $CH_4$ record at Schauinsland includes GC measurements until 2015 with a lower temporal resolution (approximately 5 min), whereas CRDS measurements since then provide continuous high-resolution data suitable for automated spike detection approaches such as REBS. Therefore, the REBS-based filtering approach discussed in this manuscript can only be applied to the CRDS period. For the historical dataset, we are currently re-evaluating the available measurements and will investigate appropriate strategies for identifying local $CH_4$ contamination events. A comprehensive assessment of the historical record, including recommendations for combining the different measurement periods with the new 35 m inlet data, will be addressed in a future study. We will add:

“Therefore, for the CRDS-based $CH_4$ record, the application of a spike detection algorithm to identify local contamination events in the 12 m measurements should be considered. For earlier measurements with lower temporal resolution, further investigation is required to develop appropriate quality-control strategies."