General Comments:

In this manuscript, the authors describe a data-informed numerical evaluation and instrument model for volcanic gas analysis using scattered near-infrared light. They provide an approach to estimating signal-to-noise ratio under varied conditions and thereby measurement precision for target gas species. While the text is clear in its derivation of SNR and concise in the outcome for three gas species (CO_2, HCl, and HF), the overall presentation would benefit from a stronger emphasis on the novelty of the work and impact on future directions for atmospheric measurements.

We thank the reviewer for this important and constructive feedback. In response, we have revised the manuscript to better emphasize the novelty and significance of this work, as well as its implications for future developments in atmospheric measurements. The corresponding changes are outlined below.

Specific Comments:

For example, the authors state they "developed an innovative approach of incorporating actual measurements into our estimations" to address systematic uncertainties. However, the text presents a data-informed model and analysis which did not read as new – while the pre-existing dataset itself may be unique or rare. The model was presented, and data (or previously determined correlation factors) was supplemented. Additional detail describing the unique aspects of the "information-content analysis" would strengthen the narrative.

We thank the reviewer for this important comment. We agree that the original wording overstated the novelty of incorporating actual measurements into the instrument performance analysis. While we believe that basing the analysis on measurements rather than purely synthetic data is important for obtaining realistic performance estimates, this is not the main contribution of our study. We have therefore revised the cited sentence accordingly.

Instead, we emphasize that the main contribution of this work is the assessment of the feasibility of monitoring volcanic gases absorbing in the short-wave infrared using scattered sunlight and an FTIR instrument. To strengthen this narrative, we expanded the discussion of the study's significance and included a concrete example illustrating how the proposed optimized instrument could be used to monitor HF and HCl emissions. We also point out that the presented methodology is relevant beyond volcanic applications and may be applicable to observations of large anthropogenic emitters, such as power plants.

Further, the manuscript would benefit from additional discussion around the implications or impact of the findings. It's clear that the work effort informed the authors' decision to not proceed with building a new instrument. There is a missed opportunity to emphasize why the reader should be motivated to use the results going forward. For example, a quick comparison of findings with the current measurement approaches – going beyond feasibility/utility and motivating where this technique may best be pursued (particularly for HF and HCl, where responsivity was deemed reasonable) – would help orient and motivate the reader.

We thank the reviewer for this valuable suggestion. We consider this study a contribution towards the monitoring of volcanic gases absorbing in the near-infrared by providing a data-informed assessment of instrument performance. We envision it as a starting point for further investigations of the associated radiative transfer challenges and as a baseline for the development of future measurement concepts.

To better motivate the relevance and impact of this work, we made several changes to the manuscript:

- **Introduction:** We expanded the discussion of the pioneering studies by Love et al. (1998) and Goff et al. (2001), which measured volcanic HF and HCl using sky-looking observations. However, thermal-emission measurements require the presence of sufficiently hot volcanic gases, while observations of sunlight scattered by bright high-altitude clouds are limited to very specific conditions. We believe that discussing these studies provides a clearer motivation for exploring alternative sky-looking observation geometries and places our systematic feasibility analysis into context.
- **Comparison with existing measurement approaches:** In Section 4.4, we directly compare the predicted measurement performance with that of the NOVAC SO_2 network (Galle et al., 2010). NOVAC uses scattered UV sunlight to monitor volcanic SO_2 fluxes worldwide. Our analysis indicates that a NOVAC-like sky scan for HF and HCl is feasible only under favorable observing conditions.
- **Practical measurement concept:** We now discuss a multi-instrument approach combining the proposed FTIR instrument with a co-aligned DOAS instrument and either a NOVAC station or an SO_2 camera. In this configuration, the FTIR provides HF/SO_2 and HCl/SO_2 ratios at minute-scale temporal resolution, while the independently determined SO_2 flux can be used to infer HF and HCl fluxes. This discussion illustrates a concrete application of the proposed instrument design.
- **Future research directions:** We substantially expanded the discussion of the radiative transfer challenges associated with scattered-skylight retrievals. These challenges are to some degree independent of the instrument itself and are particularly important for CO_2, where the atmospheric background is much larger than the volcanic enhancement, requiring accurate light-path modeling. We hope that this discussion will stimulate further research towards enabling routine volcanic observations of HF, HCl, and CO_2.

Finally, we now also emphasize that the methodology presented in this work is not limited to volcanic applications but is also relevant to observations of other extended atmospheric sources, including large anthropogenic emitters.