Response to reviewer 2:

Thank you for taking the time to read and comment on our manuscript, we appreciate your insights and feedback. We have made changes to the text where you have noted typos or have suggested more appropriate wording or descriptive revision. We feel that these changes have improved the flow and clarity of the manuscript.

Title: "Part 1" here the Arabic numeral is used, while throughout the paper Part is always followed by Roman numerals "I", "II", please make a consistent choice; Have chosen and used "I"

line 24: "15 mm" -> "15 μm"; Done

line 30: add a comma between "that do" and "tend"; Done

line 43: "as0 required" -> "as required"; Done

line 59 add a comma between "Far-IR" and "FINESSE"; Done

line 66: "repeat" -> "repeated"; Done

line 120 delete "of the order"; Done

line 141: can you quote the uncertainty of CO2 probe?; This uncertainty is now included

line 163: I suggest to add the resolution used; Done

Fig. 3A: in the Y-axis label: 'Codes' is this a typo?(see also Figs. 4A, 6A); No this is not a typo, the use of codes is heritage from working with voltage read-outs for satellite detectors. It's an arbitrary detector signal response to incident radiance and we have now given an explanation of this in the text.

line 220: add a comma after cavity; Done

Eq. 5: this is not consistent with Eq.4 (and Eq. 8), e_eff -> ε_{eff} ; L(σ,T) -> B(σ,T)

This is a good catch, equation 5 used L (scene radiance terminology) instead of B (Planckian radiance). There were omissions in the dependencies for some terms. All these have been corrected or expanded to provide consistency between the equations.

Fig. 4(E) the curve and the legend color for emissivity @150 C don't match; This has been changed to match.

line 450: clarify how L^{ext}_{hot} (L^{ext}_{hot}) is determined/modelled when calculating L_{scene}; This is now explained where we have equation 8.

line 468: a "signal-to-noise" of NESR sounds odd perhaps -> "assessment"?; Done

line 470: "we take the square root of the spectrally resolved NESR described above as the resultant single scan NESR", please clarify this part. I have two issues here:
1 - the square root of the rms of the radiance differences would have a measurement units of sqrt(RU)

2 - if I followed your line of reasoning, the NESR on a single scan should be the NESR estimate divided by the square root of 2

1) This was nonsensical and has been corrected. 2) Your reasoning was correct, we do divide by root(2) as the difference combines the noise from 2 measurements. We have now changed the text to reflect this.

line 506: I suggest to change "surface emission temperature" to "blackbody surface emission temperature", since at the end of the next line surface temperature, humidity ... are mentioned the latter being ground surface; Done

line 509 and 510: "15 mm" -> "15 μm"; Done