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Interactive comment on "Hyperspectral longwave infrared reflectance spectra of dry anthropogenic plastics and natural materials" *by* Shungudzemwoyo P. Garaba et al.

Anonymous Referee #3

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This manuscript describes a dataset of reflectance/emissivity spectra of dry manmade and natural materials from 6000 nm to 14000 nm. The dataset has the potential to be very useful for identification of litter in marine and coastal environments as there doesn't seem any other plastic spectral libraries available (nor even plastics in other spectral libraries such as the ECOSTRESS spectral library) and research into marine and plastic pollution is clearly gaining interest and awareness.

In general, I think the manuscript is organised well and a promising accompaniment to the dataset. However, I think a few revisions are needed before this should be published, primarily to the methodology section in order to enable maximum clarity for

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users. I've gone into some details about what I think should be addressed – apologies for the length but I think it's because the dataset has the potential to be really useful.

Since this is to accompany a dataset, it needs to be very clear for the reader how the samples were collected, prepared and measured. I think it's clear from the manuscript how the samples were collected but there is limited information about preparation and further clarity is required about the sample measurement, particularly since there isn't any data available on accuracy of the HyLogger. Questions I might want to know if I were to use this dataset which are absent from the methodology include:

i. How long was there between collection and measurement?

ii. How and why were there samples dried? This is important as surface moisture has been shown to impact surface reflectance in the LWIR (e.g. see https://doi.org/10.1016/j.rse.2010.02.002). Surely wet samples might be more representative of the conditions you'd see in marine environments?

iii. What is this 'inside' and 'outside' that is mentioned in the results – did you cut into the samples to measure the 'inside'? You need to describe this since the impact this has on reflectance/emissivity is non-negligible.

iv. Was a background radiance measurement made as detailed in Schodlok et al 2016?

v. Is there any information about signal-to-noise for the instrument and the measurements?

vi. You discuss spectra being grouped into associated materials (l.27, p.4) – what are these group and how were these groups determined? Do you just mean e.g. all sands, all styrofoams?

vii. The authors refer to 'length' in line 10, p.4. What does this refer to, length of the tray or length of time?

viii. Where were the measurements made? Were the samples sent to CSRIO Australia

for measurement on the setup detailed in Schodlok et al (2016) or is there a setup in Chile where they were measured? If measurements were made using a different setup to the one in Schodlok et al (2016), I would suggest you include some more information about it and perhaps an example image of the setup during a measurement for the user. You could also perhaps could include table to present number of scans by sample/tray of samples which would be useful for the user.

ix. How did you get the spectra from the HyLogger imagery? Are your spectra the average of multiple spatial pixels?

If the samples and measurement protocol presented in this paper are the same considered in Acuña-Ruz et al. (2018), the authors could answer some of the above simply by referencing that. However, I'm not sure they are since this paper talks about 76 samples while the Acuña-Ruz et al (2018) paper talks about over 144 samples.

In terms of accompanying figures and tables, generally these are good although I think a few of the figures could benefit from further explanation in the captions. In Figure 1 for example, I think the sample key needs to explained in more detail in the caption. Also, which of the pictured repeats for N37, N44 and N47 are the 'inside' and 'outside'?

The results and discussion are in general well presented with good consistency for each subsection in the results. A couple of points I had here:

- Is the end-member presented in each subsection the mean spectra of multiple scans? Unclear from the text

- I think you would benefit from further discussion of UPD and variability as it's not clear why you have considered this nor how you have used it. If you're using it to be a measure of how trustworthy the spectra is (as I think you are?), a comparison of the different UPDs would be useful to see in the discussion

- I don't think Figure 10 is necessary

- I was surprised to see no discussion of other spectral libraries (e.g. ECOSTRESS

spectral library, SLUM spectral library) in the introduction and/or discussion given that this dataset will have a complementary role to these. If possible I would suggest you show an inter-comparison with data from these spectral libraries or other papers to help the user understand the comparable performance of your dataset since you don't have calibration or accuracy information for the HyLogger. This is especially important as you are observing unrealistic negative reflectances which could suggest inaccurate measurements. As noted earlier however, I couldn't find any plastics in the ECOSTRESS spectral library so you'd probably have to do this comparison with the sand, styrofoam or algae samples if you could find similar samples.

In terms of usefulness of this dataset, there are two points I wanted to make:

1) You identify in your discussion that a limitation of your dataset is that you don't have information on the chemical composition of your samples. However, I think using terms like 'other plastics' is very vague and will limit the use in applications – could you be at all more specific? For example, 'other plastics' seems to have multiple absorption lines, which one will users know to use? Also, in the accompanying sample pictures, are these the 'buoy samples' and 'buoy2_samples'?

2) If you're advising the user that this dataset can be used with TIR satellite sensors, you really need to address the issue of spatial and spectral resolution. Would ASTER or Landsat 8's spatial resolution really be high enough to detect samples of this kind? Even the highest resolution TIR sensors (ECOSTRESS, HyspIRI e.g.) have spatial resolutions of 60m + and with SLSTR you're looking at 1 km. If you're going to argue that this dataset can be used for satellite sensors, you'll need something similar to the discussion in e.g https://doi.org/10.1038/s41598-020-62298-z to show suitability of thermal sensors for plastic detection in oceans (and therefore why spectral library is required). If the plastic observed is < 60m, I would advise instead moving the introduction and discussion a bit more towards hyperspectral airborne TIR remote sensing (e.g. using NASA's HyTES, Specim's OWL, TASI) and thermal UAVs. Use of hyperspectral airborne sensors has the benefit of avoiding the issue of absorption features

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being outside satellite spectral bands.

Regarding the dataset itself, it's accessible and easy to use (although note that the KML file is not mentioned in the accompanying publication). You could consider separating the metadata and the data for ease of use. I would also advise including a key with the sample images. The abstract here could benefit from copy-editing.

Finally, the manuscript was in general well-written but there are a few typos and incomplete sentences in the manuscript that suggest the need for a copy edit. A few I noticed in the manuscript:

1. p.14 line 7 has missing end to sentence

2. line 7 on p. 3 incorrectly says 'Were believe'

3. line 15 p.6, should this be 12000 nm rather than 1200 nm?

4. The sentence commencing l.23 on p.4: 'An inter-comparison of...' needs to be rewritten

Also, a very minor point but I would consider changing the units from nanometre to micrometre throughout as the thermal infrared spectroscopy community tends to use microns more.

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