Comment on amt-2021-377
Anonymous Referee #2


General Comments

The manuscript presents a scheme for the detection of cloud shadows in observations made by the spaceborne imaging spectrometer TROPOMI. The scheme is new in the sense that it is based on the measurements of a spectrometer (rather than on multi-spectral measurements from imagers). Undetected cloud shadows can cause significant biases in the TROPOMI L2 products. The flag produced by the scheme enables the analysis of such biases and the masking of affected observations and is therefore of interest to the remote sensing community. The description of the scheme is concise and clear up to a few items listed below. The testing and validation of the scheme with imager data is adequate to showcase the performance of the scheme and is well presented.

Specific Comments

1. Novelty

It is reported that heritage cloud shadow detection algorithms often use a combination of geometric and spectral schemes. The new scheme described in the present manuscript follows this strategy and is not new in that sense. Please clarify, probably best in the introduction, in which sense(s) the new scheme is different from heritage schemes.
2. Strategy

While it is stated that the scheme is the first one that works on spectrometer measurements (rather than on multi-spectral measurements from imagers), it does not exploit the high spectral resolution capability of the spectrometer. For TROPOMI observations, co-located VIIRS imager data are available with observation time differences of a few minutes. Therefore it seems valid to consider an alternative approach applying a performant cloud shadow detection algorithm to VIIRS data. Please discuss the benefits (e.g., availability of additional TIR information, better spatial resolution, wrt TROPOMI) and drawbacks (e.g., changes in clouds within the observation time difference (now discussed in the context of validation), dependence on another sensor and processing chain) of this alternative approach.

3. Performance

The performance is reported in terms of omission and commission errors and a derived score without reference to the performance of other cloud shadow flags. Please discuss the performance also in the context of the comparable products, as far as such performance data is available.

Technical Corrections

The processing flow chart (Figure 1) is inaccurate. Please distinguish data and processing steps clearly; Identify input data and output data, per processing step; Identify which parameters is passed on from one processing step to the next; distinguish climatological input from dynamic input from TROPOMI observations.

In the introduction (Section 2.2, line 194) it is stated that the actual cloud shadow flag (ACSF) is raised “based on the darkness of the shadowed pixels with respect to non-shadowed pixels”, which suggests that multiple pixels in a field of regard are evaluated, for each pixel. In contrast, according to Section 2.2.3, the ACSF is raised based on radiometric criteria for each pixel independently. Please clarify and align.

Criteria
- Does the paper address relevant scientific questions within the scope of AMT? Yes
- Does the paper present novel concepts, ideas, tools, or data? Yes
- Are substantial conclusions reached? Yes
- Are the scientific methods and assumptions valid and clearly outlined? Yes
- Are the results sufficient to support the interpretations and conclusions? Yes
- Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? Yes
- Do the authors give proper credit to related work and clearly indicate their own new/original contribution? Yes
- Does the title clearly reflect the contents of the paper? Yes
- Does the abstract provide a concise and complete summary? Yes
- Is the overall presentation well structured and clear? Yes, up to a few issues identified.
- Is the language fluent and precise? Yes
- Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? Yes
- Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? No
- Are the number and quality of references appropriate? Yes
- Is the amount and quality of supplementary material appropriate? N.a.