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Atmospheric Measurement Techniques Discussions

Interactive comment on "Preliminary verification for application of a support vector machine based cloud detection method to GOSAT-2 CAI-2" *by* Yu Oishi et al.

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Dear anonymous referee #1,

We are very grateful for your polite comments and carefully indications to our manuscript. We have carefully revised our manuscript. (Yellow highlights of the attached file)

The answers to the comments are as follows.

1. The language throughout the paper needs to be improved, the topic of this study is mainly on the cloud detection, while in Introduction section, the discussion is mainly on

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the CO2 product. I suggest to reorganize the Introduction section and provided more background knowledge on the motivation of this work.

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Thank you for your opinion. The role of GOSAT CAI L2 cloud flag products and GOSAT-2 CAI-2 L2 cloud flag products is not only cloud discrimination of satellite images but also cloud discrimination to increase accuracy of CO2 concentration estimates. Greenhouse gases observing satellites have many targets and roles, such as to monitor CO2 hot spots, to monitor climate change, to monitor the impacts of human activities, and to contribute to climate science and climate change related policies. Among them, we focused on the role as MRV for climate change related policies. If we focus on CO2 hot spots monitoring, it may be better to remove all cloud and ambiguous pixels. However, to reduce the uncertainty of flux estimation in tropical rain forests, it is also necessary to increase the number of clear-sky FTS data. This means that both omission error and commission error need to be lower at the same time. Meanwhile, these products don't optimize thresholds to specific local regions because they are required to be calculated under the same condition all over the world. Under these situations, we need to compare between CLAUDIA1-CAI and CLAUDIA3-CAI in tropical rain forests. In other words, introduction section needs to describe not only cloud detection of satellite images but also CO2 concentrate estimation and climate change related policies.

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2. In the abstract, the authors referred the algorithm is developed in another paper (Page 1, Line 19-20), there is no detailed discussion on the difference between these two close related works.

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Thank you for your question. We described the detail of two algorithms (CLAUDIA1 and CLAUDIA3) in section 2.2 and 2.3. CLAUDIA1 performs multiple thresholding tests,

and then integrate the results. On the other hand CLAUDIA3 uses a machine learning method. Therefore CLAUDIA3 can automatically identify the optimized thresholds using clear-sky training data, although CLAUDIA1 requires setting various thresholds by radiative transfer calculation results and fine tuning in some method.

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3. The uncertainty of the CLAUDIA-CAI is not fully analyzed and discussed. Several cases are shown in Figure 9 and 10 to describe the performance of CLAUDIA-CAI over various land cover types, however, there is no quantitative results and discussion. There needs to be a better description in Section 3.1.

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Thank you for your suggestion. I added data statistics in Section 3.1.

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4. Figure 6 and 7 are very similar with each other in the upper panel. It would be more concise to combine these two figures.

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Thank you for your opinion. Your indication “Figure 6 and 7 are very similar with each other in the upper panel” is right. On the other hand, we think that flow chart of different algorithm should be divided to facilitate coding and easy to understand.

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5. Page 2 line 24-25: what is meant by “Accuracy 16 times higher than at present is required assuming that the MRV for REDD+ and JCM needs an accuracy of 10 %”?

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Thank you for your indication. We revised it as follows. “It is required to reduce the uncertainty of the L4A CO2 product by a factor of 16 assuming that the MRV for REDD+

and JCM needs an accuracy of 10 %."

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6. Page 5 line 21-30: "GOSAT returns to a similar footprint after 44 orbits (44 CAI paths) in three days. The satellite ground path of one orbit is divided into 60 equidistant CAI frames. We used the GOSAT CAI L1B product, which general users could download from the GOSAT User Interface Gateway (GUIG, https://data.gosat.nies.go.jp), for various land cover types on the beginning of the month from 2012 to 2014 in the same as the previous study (Oishi et al., 2017) (Table 2), and for rainforests (Table 3). Currently GUIG has been changed to GOSAT Data Archive Service (GDAS, https://data2.gosat.nies.go.jp/index_en.html). The spatial resolution of these products (pixel size at nadir) is 500 m, the image size is 2048 $\times$ 1355 pixels (approximately 1000 $\times$ 680 km). The CLAUDIA algorithm requires a land/sea mask and a surface albedo data. The CAI L1B product includes the Shuttle Radar Topography Mission's 15" land/sea mask. For areas with latitudes higher than $\pm 60^{\circ}$, the USGS Global Land 1-KM AVHRR Project mask is used. Surface albedo data at $1/30^{\circ}$ resolution was generated from the CAI L1B data from 10 recurrent cycles by separating the land and water regions." This section describes the data involved in the validation of algorithm, while the spatial resolution is inconsistent, did you resample the data?

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Thank you for your indication. Because our description was unclear, I modified it as follows. "The CAI L1B product includes a land/sea mask with 500 m resolution which is generated from the Shuttle Radar Topography Mission's 15" land/sea mask and the USGS Global Land 1-KM AVHRR Project mask for areas with latitudes higher than $\pm 60^{\circ}$."

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7. Page 7 table 2: the last line "1 April 2012–1 March" data lacks the information of the

year.

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Thank you for your carefully indication. I added the year.

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8. Page 7 table 3: the GOSAT product applied to Borneo seems only half of that to Amazon, why?

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Thank you for your question. We mainly used CAI Path 7 Frame 31 for Borneo and CAI Path 29_32 for the Amazon, and their surroundings CAI data. Borneo can be covered by 2 CAI scenes, but Amazon needs 9 scenes (see Figure 4). For this reason, the number of CAI scenes for the Amazon is larger than that for Borneo.

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9. Page 8 figure 6: “Solar Zenith Angle >=85 (Night)” Could the authors provide some related references?

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Thank you for your question. The algorithm theoretical basis document (ATBD) for GOSAT CAI L2 cloud flag product is open to the public. https://data2.gosat.nies.go.jp/GosatDataArchiveService/doc/GU/ATBD_CAIL2CLDFLAG_V1.0_en.pdf On the other hand, the ATBD for GOSAT-2 CAI-2 L2 cloud discrimination product has not been open to be the public yet.

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10. Page 12 line 4-5: “clear despite cloudy” and “cloudy despite clear” are vague, and these terms should be replaced with already explained alphabets. Furthermore, it is better to provide references to the two formulas.

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Thank you for your suggestion, but we couldn't find out relevant items.

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11. Page 14 figure 9, Page 17 figure 11, Page 18 figure 12, Page 21 figure13-14: the name of vertical axis just like "Percent" could be added.

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Thank you for your indication. I changed "%" to "Percent" in Figures 9, 11-14.

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12. Page 19 table 5: the second CLAUDIA3-CAI 0.56 should be corrected to 0.5.

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Thank you for your carefully review comment. I corrected it.

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13. Page 23 line 9-10: The authors wrote the results that "The averaged accuracy of CLAUDIA3 used with GOSAT CAI data (CLAUDIA3-CAI) was approximately 89.5 % in tropical rainforests, which was greater than that of CLAUDIA1-CAI (85.9 %) for the test cases presented here." But how to calculate 89.5% and 85.9% two values?

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Thank you for your question. We think that accuracy of cloud discrimination is different between in Borneo and the Amazon. For this reason, we handled them as being independent, and then averaged 87.0 and 84.8 for CLAUDIA1 and averaged 92.0 and 86.9 for CLAUDI3.

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14. Page 23 line 6: purposeâËŸAËĞT> the purpose

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Thank you for your carefully review comments. I corrected it.

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15. Page 24 line 8: formâËŸAËĞT> from

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Thank you for your carefully review comments. I corrected it.

Yours sincerely,

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Please also note the supplement to this comment:
https://www.atmos-meas-tech-discuss.net/amt-2017-464/amt-2017-464-AC2-supplement.pdf

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