

Detailed review on the paper: Information content of OCO-2 oxygen A-band channels for retrieving marine liquid cloud properties.

### I. General comments

I think this paper is very interesting and brings innovation on how to retrieve cloud properties with OCO-2. The use of optimal estimation method makes the study very robust.

I have some remarks concerning the introduction. I think you should rework it to make it more complete. Indeed you should answer the following questions:

- What are the motivations for this study?
- What has already been done?
- What does your study bring?

As those aspects are not clear. I also find your bibliography too light. We don't expect you to quote all the works done in the O2 A-band and optimal estimation, but at least some of them. You can read the paper of Merlin et al (2017) as the subject is close to yours and the bibliography is quite complete.

### II. Specific comments

p1

L 19-20, there are numerous papers that you can quote.

p2

l25: multiply scatter : not nice

l25-26-27-28: This sentence is too long

l31: This work ....: Sentence not clear

p3

l4: do contain information.... Reference is missing

l21 ECMWF meteorological fields : Reference missing

p4

l18 observed and expected  $y$  : is a value missing after "observed"?

l15 to 30: When you refer to a vector or a value you could write its symbol

l22 observation vector instead of observation state vector

l22 a point is missing after channels

l27 Shannon entropy : Reference missing

p5

l1: You don't define  $P_0$  and  $P_1$

l6 :see my comment p4 l15

l19 : Methodology **and** example atmosphere **and** cloud ..

Not nice.

p6

l1  $\rho_w$  not present in eq 8

l7: Why do you take  $Q_{ext} = 2$ ?

l7:  $0^\circ$ - $20^\circ$ ,  $20^\circ$ - $50^\circ$  and  $50^\circ$ - $90^\circ$ , you forgot the degree symbol over 0, 20 and 50.

l7: 'identified as single-layer liquid clouds by both MODIS and CaLiPSO'. It may be useful for the reader to write which product/collection you used.

l8-9: You should rewrite the 2 sentences which are not clear. For instance :

'Within each bin, all the OCO-2 ECMWF-Aux profiles (including pressure, temperature, humidity and wind speed) are averaged level-by level.'

l22: not nice. You should rewrite the description of the uncertainties, particularly for the humidity.

l25: standard deviation **of**  $\pm 1.5K$

we sample: what are you sampling?

l26: with 2000 perturbations **applied** to reff

l27: '5--95% range of 7.5--19.4  $\mu m$ ' Not sure of what it means. Try to avoid the abbreviations in the text and write a sentence.

l29: The output was **sampled**: You are using this word quite often and maybe not always with the right sense?

p7

l8: cases **described** in sect. 3.1

l12: not nice: to an error of 1.5 on  $\tau$ , of 60hPa on  $P_{top}$  and of 7.5hPa on  $\Delta P$

l14: Our uncertainty is approximately: What does it mean?

l18-19: 'more intuitive': not very nice, more qualitative ?

p9

Description of figure 3: I am confused as the caption seems to say that there are two figures (top and bottom), but only one is visible.

Description of figure 4: I don't know where to see the channels you are mentioning (l9) as the plot is in function of the OCO-pixels. It might be a good idea to show a spectra of OCO lines.

Description of figure 5:

l20 content 2. remove the 2.

l23: Again showing a spectra with your selected window might be a good idea.

Also How did you choose the thresholds?

You should justify more the choice of 75p as it is not obvious from the plot. 50p could be fine also?

p10

l2-3: Once again, showing a spectra would help the reader to follow your conclusions.

l9-10-11: Sentence too long.

### III. Technical corrections

- When you quote a paper within a sentence (p2 l3) you shouldn't put the author's name between parentheses.

This study goes beyond Richardson et al (2017) by ....

- I don't know what is the AMT policy for that but it would be better to centre your equations.
- In the bibliography, you might think to put the first authors in bold and the titles in Italic; otherwise it is very difficult to distinguish the different papers.
- Figures: In general, be careful with the size of the axis-labels which are very small (fig 2 , 4)
- The numbers of the lines restart at 0 at each page, I don't know if it is a mistake or not.