The manuscript by Riess et al. discusses the capabilities of the TROPOMI satellite in the context of shipping emissions in Europe, the improvements of the satellite retrievals due a better cloud product, and finally the impact of the COVID lockdowns on shipping emissions. Overall, I found the manuscript to be well written with a good introduction, great instrument description and good discussion on how the FRSCO+wide cloud product improves the NO2 columns. The weakest part of this study is how the emissions changes are estimated from the NO2 columns (details can be found below). After addressing the comments listed below, I recommend the paper to be published; it would be of great interest for the readers of AMT.

General comments

The weakest part of this study is the "relationship between NOx emissions and columns". There are several points that are not discussed or considered here:

1) The β values are from 2006, and essentially the β determine whether or not the area is a NOx limited or saturated area, this changed very likely in some cities, not sure if shipping is areas over water would be affected by this. But this part definitely needs more discussion.
2) In the publications cited (Vinken and Verstraeten), there is the use of a γ value, which is the difference between the model and the observations over the same time period (year and month). Following the equation to look at the differences it is assumed here (but not discussed) that γ value is the same for 2019 and 2020. This might be justifiable for an entire year – where meteorology averages out. But it is an incredible simplification to assume that this would be the same for 1 month (Fig.10 and F1 show monthly changes in emissions), meteorology has a large impact on the NOx columns and it varies from year to year. This could be one of the reasons why the changes in top-down emissions are so much larger.
3) The areas chosen to estimate the emission changes: is this over water only or over shipping routes only. The relative changes of emissions is extremely influenced on the region that is chosen, including for example areas where there are no sources (background areas) tend to reduce the impact of emission change. More details on the area wold be helpful: e.g. is land excluded, is this where the majority of shipping lanes are, …
4) β value over the areas: what is the range of the β values, in Fig.10 and Fig.F1 only one single value is shown. Is this the average of the β values in that area? If so the spread should also be included – that way you will be able to add error bars in Fig.10 and F1 (e and f) that are currently missing. In Sect. 2.4 include the typical range of β, how much does this value impact the emission estimates?
5) The resolution of the β value could be an issue, the method was previously used to determine emissions over a much larger area. Is this broad resolution enough for shipping lanes and also enough for TROPOMI's relatively high resolution?

Overall, I wouldn't dispute this completely, but more discussion of the assumptions and especially weaknesses and uncertainties of using this method to determine the impact

of shipping emissions during COVID lockdowns is necessary here. Error bars should be included in Fig. 10 and F1 (d-f).

Specific comments

l. 34: When have these stringent regulations been implemented?

l.48/49: This sentence sounds a little too certain about the prospects that satellites can be used for emission monitoring for ships – what are the uncertainties like? Maybe tune it down a bit – something like "..it's worth investigating if satellites can be used… "

p.5: footnote, could be included in the main text, this would flow better and the reader doesn't have to search for the footnote. It's actually important information on the difference in eh version. Also please specify the "improvements in the algorithm itself"

l.153/154: What is the relation between cloud optical thickness and cloud albedo exactly, it would be good to include the equation here.

l. 159: Is there a threshold when partly cloudy becomes "cloudy"?

l. 163: Do you have an idea how often (to what percentage) ice clouds appear. Is there maybe a different relationship that could be used for ice clouds or is this not worth it because it only happens for a small number of clouds?

l. 170: If possible, a sketch might be useful to include visualizing the relationship between the angles, if you have one handy, this would also be useful in any sort of presentations.

l. 198: $E=L^2*v^3$ is confusing, the units don't add up this would be m^5/s^3? Maybe better to use the term proportional some sort of factor would be missing here.

Fig.1: Include a, b, c in the panels, as done for most other figures, it's better to be consistent; also why is the inventory in the middle? To me it would be more intuitive to display the two satellite images next to each other.

Fig.2: Include label a, b, c, d

l.243: At first I was a little confused how the winds impact the albedo, but it makes sense in terms of waves (as explained a little further down), maybe put the explanation up front. Also, where does this albedo come from? From the TROPOMI files?
Fig.5: I don't quite understand the difference between a and b. what is M_{geo} versus M_{trop}? The caption says the distribution of the tropospheric NO2 columns in both cases.

Fig.8: Is the difference v1-v2 or the other way around?

l.365/366: for which region? Gibraltar? Also discuss the results from the Mediterranean briefly.
l.369 ff: Here is some discussion on the weakness of the β value method, more needs to be were the method is described.

Supplement (2 COVID): For both Figures, the TROPOMI shipping NO2 in panel c is normalized to what? Include the area that is considered in the caption, I think it is the same as in the main manuscript l. 184, but this is not clear. The labels a, b, c should be above, for consistency.

Technical corrections

l. 18: "AIS" please define
p.5: footnote: "NO2" needs to be subscripted
l.141: remove "/" from VIIRS, these should simply be spaces
p.8: why a footnote? This can be just in brackets.
l.224: typo: tropospheric
l.294: molec cm^{-2} shouldn't be italics, this appears a few times throughout the text, please correct all of them
p.15: why include this as a footnote? This can be put in brackets inside the text instead.
Fig.8 caption: clearness->clarity
Fig.10: other than including error bars as mentioned previously, the panel labels should be above and not below the figure as in the other figures, it's confusing to suddenly switch.
l.358: in Fig. F1 and Supplementary Fig. S2 (otherwise it sounds like F1 is in the Supplement)
l.463: molec cm^{-2} shouldn't be italics
l.464: molec cm^{-2} shouldn't be italics

References should be tidied up a little, many contain typos; I found the following, but there are possibly more:
l. 491 NO 2, SO 2
l. 523: incomplete
l. 540 De Ruyter de Wildt
l. 558: incomplete: journal, volume, page number missing
l. 576: Capitals?
l.639: NO 2
l. 644: Typo: Cuurent
l.645: is this the best URL?
l.653: npj Climate?
l.658: NO 2, v2 . 2
l.682 f: missing spaces
l.685: NO </sub>2</sub>