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Open Access Earth System Science Data Discussions

Interactive comment on "Southern Ocean Cloud and Aerosol data: a compilation of measurements from the 2018 Southern Ocean Ross Sea Marine Ecosystems and Environment voyage" *by* Stefanie Kremser et al.

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1 Response to Nadine Borduas-Dedekind and her students

The reviewers of this manuscript are a research group in atmospheric chemistry at theUniversity of British Columbia led by Dr. Nadine Borduas-Dedekind. The group met twice for a combined time of 3 h to review and discuss the manuscript, the instrumentation, the data and the data visualization. The discussion was led by undergradu-ate stu-

dent Max Aragon Cerecedes and this report was compiled and edited by Dr.Borduas-Dedekind. Additional graduate and undergraduate student co-authors of this review include (in alphabetic order): Ayomide Akande, Sophie Bogler, Isabelle Lao,Rickey Lee, Madri Jayakody and Jon Went.

We would like to thank Dr. Nadine Borduas-Dedekind and her students for taking the time to review this paper and for their helpful comments and suggested changes that improved the paper. Their comments are repeated below in blue with our reply in black.

General overview: First and foremost, we congratulate the authors for the extraordinary team effort in collecting valuable cloud, aerosol and seawater data in the Southern Ocean. This paper presents an open access data set shared on Zenodo, and describes the instrumentation deployed and the data collected during the voyage of R/V Tangoroa in February-March 2018 from New Zealand to the Ross Sea, off the coast of Antarctica. As it stands, the data is presented at different processing levels depending on the instrumentation and will be undeniably useful for evaluating aerosol-cloud interactions in weather and climate models, including the biogeochemical cycling of sulfur compounds. To help the authors have their data used more quickly, easily and efficiently, we have compiled a list of recommendations, clarifications and critical comments.

Our critical feedback on the structure of the paper includes working on the flow of the manuscript. Leading a large collaborative effort such as this manuscript has its challenges, including producing a unifying storyline of all the measurements undertaken during the voyage. In general, presenting the data by instrument is a useful and efficient way to categorise and present the data, and we command the authors for this structure. Nonetheless, even if multiple authors wrote different sections, we encourage the authors to ensure each section addresses all the information listed below, and we can suggest this type of format: (for example, we thought section 3.3. was particularly well written and structured).

1. Describe why this parameter was measured and what it will (or could) be used for in the future.

2. Describe the instrument operation in detail (ESSD serves as supplementary information, so every detail for operation should be included).

3. Comment on why the instrument was chosen over other alternatives or models.

4. Describe how the data was collected and, when applicable, processed.

5. Show the data in figures/tables.

6. End each section by relating which goal is being addressed (from the list in pages5-6, which can be numbered in order to refer to easily).

7. Avoid data interpretation, as required by the ESSD format. Note that some sections have added data interpretation (ex: 4.2.4) which should be removed.

We thank the reviewers for this suggestion and we worked through the instrument description again and, where appropriate, we added additional material to the sections. We have now also clarified in Table 2 which research aim is addressed by which instrument and created a 'traceability matrix' with Table 2. We believe that Table 2 contains most if not all the information (including parameters measured) that a user of the data might need. The individual sections on each instrument then explain in more detail the measurements and their uncertainties and describe the measurement techniques, if a detailed explanation about the technique is warranted. We have used our judgement to balance supplying specific details needed for interpretation and the overall size of the paper. We ensured that we mention any modifications that were made to standard instruments as this is important information required for the reader and potentially user of the data sets.

The direct interpretation of some data sets is required to highlight and emphasize the quality, usability, and accessibility of the data sets, however, we kept the descriptions to a minimum and any detailed analysis that people might want to report on in future research articles were not included. With our presentation of the data sets and the limited interpretation provided, we want to demonstrate to future users the potential of this valuable data set obtained in such a remote location. To limit the length of the paper, we do not show every data set that is available in the Zenodo repository. The data sets are provided in netCDF files following the CF conventions and are described in such a way that it should be relatively easy for any user to plot the data using a tool such as panoply. We put a lot of effort into providing well formatted netCDF files including detailed descriptions. netCDF files are a commonly known format in the scientific community.

To further help with the readability of the manuscript, a table of contents would be really useful as a reference for the future reader.

Thank you for this suggestion and we have now included a table of contents at the beginning of the revised manuscript.

Furthermore, the authors describe instruments which were taken onboard, but which didn't collect data due to malfunctions or errors.

All instruments that are described in our manuscript collected data, at least for part of the voyage. Some instruments didn't record data continuously for various reasons (which are described in the paper) and we lost the UAV during the voyage. Despite losing the UAV we successfully present the value of profile measurements in the paper by showing the data set that we obtained during the first flight.

However, we do note that we present underway SST and SSS measurements but failed to describe the instrumentation. We have updated the revised manuscript accordingly and added a brief description of the instrument (including accuracy) and measurements.

The goal in relating this instrument information can be to further instruct scientists of lessons learned, and we think these instrument descriptions are worthwhile additions to the manuscript. However, we suggest that comments faulting inexperienced controllers should be omitted (in the spirit of sportsmanship) (for example lines 196-197).

We understand the concerns of the reviewer in that our statement may impact other researchers who want to perform experimental field measurements with a high risk of failure because of the environmental conditions, and it might send the wrong message. We would like to mention the difficulties the operators were facing as otherwise it might be difficult to understand why the data weren't included/potentially not all that useful. Also note that the operator is a co-author on this paper and aware and supportive of our statement.

We also suggest to the authors to group "unused" instrumentation to a separate section called "lessons learned" or more objectively, "instrument malfunctions". Nevertheless, we appreciated the transparency offered by the authors of the instrumentation malfunctions.

We agree with the reviewer that it is important to mention any malfunctions and failures of instrumentation during any measurement campaign. However, we would prefer to mention the failures and malfunction of instrumentation in their respective sections to avoid repetition in any additional sections and to avoid extending the already very long paper further. We are not presenting any 'unused' equipment, as mentioned before, every instrument described here provides some measurements.

We wondered whether the authors may have one or two suggestions to add to these sections in order for future readers to be better prepared for their own voyage (Figure 18 - is it useful if the data will not be used? Perhaps not worth plotting?)

We think that data in Fig. 18 are useful despite the potential contamination by ship exhaust at certain levels. They provide a rare profile of aerosol concentration measurements in the surface layer of the atmosphere in the Southern Ocean and they

demonstrate the value of helikite and UAV measurements despite their challenges.

Specific manuscript comments:

Line 4: Could the authors comment on the direction of the "persistent biases"? An added qualification such as bias low or high would be more precise.

In the abstract we refrained from talking about positive/negative biases as it depends on what variable one is looking at (as described in the introduction). For example, climate models produce too little clouds over the Southern Ocean leading to an underestimation (negative bias) of the reflected solar radiation at the top of the atmosphere and an overestimation (positive bias) of the downwelling solar radiation at the ocean surface. As the details about the biases are described in the introduction, we would like to keep 'persistent biases' in the abstract without any indication about negative or positive, but we included an example of such a persistent bias in the abstract of the revised manuscript.

Line 8: According to the Earth System Science Data manuscript preparation and file submission: Ship names are italic, but their prefixes are roman (e.g. RV Polarstern).

Thank you for catching this mistake and we have corrected this in the revised manuscript.

Line 52. Reference format is different from the rest of the paper and should be double checked.

It is not clear to us what the reviewer is referring to here as we believe the formatting is correct. We followed the ESSD guidelines.

Line 77-78 Which cruise was the first to probe OCS concentrations and sources? Could the authors add the reference? Or indicate it in the table 1?

The first voyage that collected OCS measurements was described in Staubes and Georgii (1993) and we have now included this reference in the revised manuscript.

Reference:

Staubes, R. and Georgii, H.-W.: Biogenic sulfur compounds in seawater and the atmosphere of the antarctic region, Tellus, 45B, 127–137, 1993.

Table 1: Very useful for context and for future readers and data users! The authors could also add their own ship campaign at the bottom of the table with a "this work" reference.

We like this suggestion by the reviewers and have now added 'this work' in Table 1.

Line 86. Could the authors briefly explain their motivation for spending most of the voyage's time (30 days) south of 60° S? Does 60° S represent a reference point for some measurements for example?

The focus of the voyage was to conduct measurements in the Southern Ocean. The Southern Ocean comprises the southernmost waters of the World Ocean, generally taken to be south of 60° S latitude and encircling Antarctica; the lands of which are south of 60° S as defined in the Antarctic Treaty System. That is why we are referring to the region south of 60° S as the Southern Ocean (see line 528) and that's why the ship spent most of its time south of 60° S. We included an additional sentence to clarify this to the reader.

Lines 92-93. The authors mention the characterisation of radiation but list only the lidar, ceilometer and sky cameras. How was this parameter measured? Wasn't there a radiometer or pyranometer on board which should be added to this list?

Well spotted. While we didn't mention the instrumentation at line 92-93, radiation measurements are included and described in the paper (e.g. instrument description in Section 2.2, Line 118 and Section 4.1). The measurements are also provided together with all other meteorological variables from the DAS (Tangaroa Data Acquisition System). We have now included both radiometers and the AWS in Table 2 and adapted the sentence in question.

Lines 92-101. The authors mention seven research objectives (line 88) but only list six (92-101). Is there a goal missing? In addition, was there a priority within these goals?

We apologize for the confusion. Overall the Tangaroa Marine Environment and Ecosystem Voyage aimed at addressing seven key research objectives:

1. Physical oceanography
2. Aerosol-cloud interactions
3. Microbial planktonic communities
4. Seabed habitats and fauna
5. Cetacean studies
6. Zooplankton
7. Mesopelagic fauna

These research objectives are not listed or described in the manuscript, as we only want to focus on the measurements that were taken in support of one key research objective, i.e. '2. Aerosol-cloud interactions'. The items listed between line 92-101 represent the individual goals to be addressed using the measurements described in this paper and thereby addressing the overall research objective. We have clarified the wording in the revised manuscript - we are now referring to research objective and underlying research aims in the revised manuscript.

Lines 92-101: Give each goal a number to refer to these goals in each instrument section throughout the manuscript.

We have followed the reviewer's advice and numerated the research aims. Rather than referring to these research aims throughout the manuscript, we have added another column to Table 2 to connect the research aims with the instruments/measurements.

Table 2: Can the authors ensure that all the items in the column “location on the ship”in Table 2 are also written in Figure 3? For example, where is the fantail located?

That is a good point by the reviewer. We have now updated Figure 3 and named all locations of the instruments.

Line 117. How did the authors correct the wind speed according to the ship heading and speed?

The true wind speed and direction is calculated through vector-based correction performed by the Tangaroa DAS which uses ship speed and heading relative to the true north.

Also with (Popinet et al., 2004)? Please clarify and/or refer to the appropriate section.

We have now added material that points to the appropriate section and Figure in Popinet et al. and modified the text in the manuscript.

Line 166. Wind speed accuracy is stated as 5%. Can the authors comment on whether this accuracy is typical for this instrument? What was the wind direction accuracy?

The accuracy of the wind direction is determined by the accuracy of the GPS sensor and the frequency of received samples and therefore no number is provided here http://windsond.com/windsond_catalog_Feb2019.pdf. The information sheet about the instrument can be found here. The absolute sensor accuracy and resolution for this instrument type and as provided are typical characteristics at 25° C.

We added the following sentence: “The accuracy of the wind direction depends on the GPS conditions and is therefore determined by the accuracy of the GPS sensor.”

Line 180-185. The authors’ UAV’s battery was drastically reduced due to low atmospheric temperatures. Which UAV model was used, which battery?

The UAV model was Swellpro Splash Drone 3 as mentioned in Table 2. We used the original batteries as well as additional 4S LiPo batteries with a capacity of 5200 mAh.

Section 3.3 – Particularly well written and structured section (see our comment on general flow and structure at the beginning of this review). Line 221. “The maximum range is 30km but the effective range was lower than that”. Can the authors specific the effective range?

We have extended the description about the effective range statement for clarification.

Line 273: Can the authors link the use of the sky camera to one of their objectives?

The measurements obtained using the sky camera were made in support of research aim 1. We have now associated the research aims with the instrumentation in Table 2.

Line 280. Is the technique HDR? Mertens 2009 explicitly proposed exposure fusion as an alternative to HDR to produce a highâ ÌĘAËĞRquality, low dynamic range image. Did they authors use the correct reference here?

We thank the reviewers for pointing that out and apologize for the confusion, the referral to HDR was incorrect, it should have been exposure fusioning. The Mertens 2009 reference is correct we have reworded the sentence in the revised manuscript.

Line 282. The ELIFAN algorithm crops the sky pictures to remove the distortion before estimating cloud fraction. Did the authors remove the distortion of the allskypi pictures? What was the field of view of the fisheye lens?

Yes, the image is cropped, and masks are applied for the ship structure, solar disk and horizon. We limit the field of view to a zenith angle of 70° (20° above the horizon). The actual field of view of the lens is 180 degrees. Close to the horizon, cloud thresholding techniques do not perform well, and the generous mask described also excludes ship structure. We have added additional material to the revised manuscript.

Could the authors comment on the cloud cover uncertainty (for example in Figure 7)?

Cloud cover uncertainty, when expressed in oktas will be low (order of ± 0.5 oktas) depending on cloud type and observing conditions. As cloud fraction is typically used for

QA/QC of other measurements, it does not warrant a full uncertainty analysis. Furthermore, a full uncertainty analysis would require a manual analysis of imagery obtained during the voyage, which is typically unpractical.

Line 291: Can the authors specify how rare clear-sky conditions were on their voyage?

Clear sky conditions are described later in text and in Section 4.1. Figure 7 provides additional information about clear sky conditions, showing that clear sky, as observed by allskypi, occurred less than 2% of the time during the voyage. We edit the text in the revised manuscript accordingly.

If the authors' goals were to study aerosol-cloud interactions, could the authors briefly comment on the value of the sun photometer measurement?

As reviewers note, this paper is looking at characterization of aerosol, clouds and their interactions. Measurements were made over a broad range of size and properties. One of the ways in which aerosol can be compared between different voyages is through the sun photometry done under the Aeronet Maritime Aerosol Network (MAN) programme where centrally calibrated Microtops photometers are used. In spite to the very few measurements possible on this voyage due to cloudiness, those measurements have value as part of the MAN database that allows for analysis of the spatial distribution of aerosol properties by latitude/region etc. for AOD (aerosol optical depth) and derived properties such and relative fraction of coarse and fine aerosol. Over 600 voyages, including this one, have contributed to the MAN database to date providing a valuable global resource for analyses, see e.g. Smirnov et al (2011, 2009) and use in validation and model development of important aerosol components such as oceanic sea-salt (Bian et al., (2019)).

References:

Smirnov, A., Holben, B. N., Giles, D. M. et al.: Maritime aerosol network as a component of AERONET – first results and comparison with global aerosol models and

satellite retrievals, Atmos. Meas. Tech., 4, 583–597, https://doi.org/10.5194/amt-4-583-2011, 2011.

Smirnov, A., et al. (2009), Maritime Aerosol Network as a component of Aerosol Robotic Network, J. Geophys. Res., 114, D06204, doi:10.1029/2008JD011257.

Bian, H., Froyd, K., Murphy, D. M., Dibb, J., Darmenov, A., Chin, M., Colarco, P. R., da Silva, A., Kucsera, T. L., Schill, G., Yu, H., Bui, P., Dollner, M., Weinzierl, B., and Smirnov, A.: Observationally constrained analysis of sea salt aerosol in the marine atmosphere, Atmos. Chem. Phys., 19, 10773–10785, https://doi.org/10.5194/acp-19-10773-2019, 2019.

Line 459: In section 3.10.1 title, the word chromatograth is misspelled.

We have corrected that spelling mistake.

Line 552. How was the % of cloud types calculated? Was this calculation performed by human observations, sky camera pictures and the ceilometer? Did the authors use an automatic algorithm to derive cloud types? Additional information would be useful to understand the data presented.

The cloud types were identified by human observations (weather_obs_level_0). While the original observations were not on regular intervals, in the revised manuscript we interpolated these observations at 6-hourly synoptic times (00, 06, 12, 18 UTC). The calculated fractions of cloud type were calculated from these records. We added additional information to the revised manuscript. We added the following material to the paper: "Synoptic weather observations were performed throughout the voyage and revealed that the most frequently observed cloud types were stratus..."

Section 4.2.4 (lines 673-693) has too much interpretation (not in the realm of ESSD's scope) and can be rewritten to specify the sample collection details, the operating procedure of the instrument, why this instrument was chosen and the data collected. The data collected should include the frozen fractions as well as the INP concentrations.

Thank you for this considered feedback. In the ESSD guidelines they suggest that "material required to understand the essential aspects of the paper such as experimental methods, data, and interpretation should preferably be included in the main text". Hence, the guidelines do indicate that interpretation is acceptable to "understand the essential aspects". However, we appreciate ours may be excessive and have reduced it to encompassing only the comparisons with other studies, and the note that the three samples between 40 and 50° S had recent terrestrial influences.

Sample collection details and the operating procedure of the Ice Spectrometer (IS) are already given in Section 3.9, but we have added some details there of the background correction procedure. With regard to explaining why we chose the sampling approach, and the IS, we have added some introductory text to the start of section 4.2.4.

To correct for contaminating INPs present on filters, we applied a correction using a regression from the combined results from three field blank filters. Since this regression was a parametric equation (in comparison with the non-parametric count data obtained from the IS) this prevents us from providing frozen fractions for this background-corrected data.

Comments on Figures:

During the discussion of this manuscript as a group, we gathered images of each instrument and found this process to be very helpful in visualizing the instruments. We can recommend to the authors to do the same, by adding pictures for each instrument to each section. (The authors can also contact us for these pictures (bordua@chem.ubc.ca and aragon@gamma.ttk.pte.hu , as we've gathered them already for our discussion.)

We thank the reviewers for that suggestion and we have now included some schematics. Adding images for all instruments is not always appropriate as some of the instruments are very complicated and the whole instrument doesn't fit into one single picture. Without any proper labels, adding only images might confuse the reader. We also note

that adding images would extend the length of the paper significantly.

Figure 2: The figure design can be improved for clarity by identifying the level of data analysis (raw vs calculated). The boxes can also be aligned for a cleaner figure.

Thank you for this suggestion, we have re-designed the figure for clarity.

Figure 3: Do the authors want to further describe the aerosol container lab? Or alternatively show a picture of the inside? The ship's exhaust should be highlighted as it is a big part of the discussion and of the data interpretation. The authors could also adda real picture of the ship (we had to google for a picture) for improved visualization.

The midship and aft exhaust have been highlighted in Figure 3 in the revised manuscript. We unfortunately do not have a useful reference picture of the inside of the container laboratory as not all instruments could be captured in frame. Instead, we've added a schematic layout of the particle counting instrumentation along with the relevant plumbing. We did not include a real image of the ship for copyright reasons and because an image of the ship can easily be obtained from google. Furthermore we added additional material to Section 3.8.

Figure 5: Along the left panel, the mean values can be added for clarity and readability. The numbering can be rethought, for example labels (b, d, f, h, i, l) could be removed.

We have removed the labels as suggested by the reviewers, however, we decided not to include mean values for clarity as adding mean values would make the figure even more busy and much of the data are not normally distributed as shown by the histogram plots. Here we only want to present an overview of the data.

Figure 6: This data is useful to highlight how the tropopause is shallower closer to the pole. With that point in mind, could the authors arrange the panels as a function of latitude instead of as a function of time of the voyage?

Good point by the reviewers and we have followed their suggestions and re-ordered the individual panels.

Figure 8: Can the authors add the number of points included in each boxplot? Can the authors also specify the values of the whiskers?

The number of data points included in the boxplots refers to the 1 minute data values within each latitude band during daylight (i.e. when the radiation was greater than 3 W m-2). The greatest amount of voyage time was spent in the -70o latitude band (-67.5o to -72.5o). The number of data points included in each box plot are:

Latitude band / data points -40 (1975), -45 (1818), -50 (2077), -55 (1812), -60 (3325), -65 (7837), -70 (16032), -75 (1629).

The box is presenting the interquartile range (Q1 to Q3), the whiskers are $\pm$ 1.5 * interquartile range, and outliers are shown as points. We have updated the figure caption to include the number of data points as suggested by the reviewer.

We weren't sure where the 0.86 coefficient for the atmospheric transmission coefficient came from; could the authors add a description and a reference? Finally, how do the authors explain values above one?

The visible radiation transmission coefficient was a simplified approach modelled with a single expected value for marine boundary-layer surface measurements taken as 0.86 (e.g. Longman et al (2012)) and verified by showing good correspondence of radiometer measurement against the modelled clear sky radiation expected at the ship for the chosen transmission coefficient, on the rare few clear-sky days around solar noon. Data were quality controlled, low sun angles (<3 Wm-2) and nighttime data were excluded. Values above 1 were rare but can occur when the solar beam is not obscured but clouds are present to increase the forward scattered component or through variation in the transmission coefficient with sun angle and aerosol loading that were not accounted for. We have updated the text in the revised manuscript and added a reference.

Reference:

Longman, R.J., Giambelluca, T.W., Frazier, A.G. (2012) Modeling clear-sky solar radiation across a range of elevations in Hawai'i: Comparing the use of input parameters at different temporal resolutions. Journal of Geophysical Research: Atmospheres, 117(D2). https://doi.org/10.1029/2011JD016388

Figure 9: We struggled to understand this figure and perhaps it can be made clearer. What are the bins representing? Could they be better depicted as a histogram/bargraph? Could the percentage and cumulative occurrences be displayed on two graphs? The x-axis at the top and bottom of the plot for percentage is different, maybe color coding the axis labels to the plot line could help. One of the plot lines doesn't show up in the legend.

We have updated and re-designed the figure to address the reviewers' concerns. Cumulative and percentage occurrence are now separated into two different plots, and bars used to aid clarity. The histogram bins are now clearly visible. We modified the text in the manuscript accordingly.

Figure 11. It would be worth adding a title to each plot to clarify the graph. The letter a of the plot a) has a smaller size than the other ones and Y-axis titles aren't aligned well. The colour bars should avoid white, otherwise the information cannot be seen particularly true for the vertical velocity plot (b)).

Thank you for pointing out the font size error. We have corrected this and also changed the colour scale for the vertical component of the velocity.

Figure 12: Small note that there is a blue dot on at x=0 value. Could the authors double check? Can the authors comment on how realistic a value of 520ppm of CO_2 from an exhaust is?

Yes, this is a real data point and represents the first 5-min average from the Picarro for this voyage. The blue colour indicates that it has been classified as good data, i.e. the measurements were not contaminated by ship exhaust. The CO_2 concentration at the beginning of the voyage was higher (416.3 ppm) than the baseline value of 403 - 404 ppm observed subsequently. This is to be expected due to the close proximity to Wellington, which has many sources of CO2 from industry, traffic etc. at the beginning of the voyage.

A 5-min mean value of 520 ppm is entirely reasonable for ship exhaust mixed with background air. "Instantaneous" (about 1 s) Picarro measurements are often observed in the range 500 - 700 ppm on Tangaroa voyages. An upper bound on what is possible is obviously the CO2 concentration in pure ship exhaust (i.e. un-mixed with background air). This depends very much on engine operating conditions, but a typical value is around 5% vol., = 50000 ppm.

Figure 13: Could the authors remove the graph lines to help clarity?

We prefer to leave the grid lines in Figure 13 as it helps the reader to identify the data associated with the measurement. We have increased the size of the figure.

Figure 14. In the figure caption, the figures should be labelled a, b, c, d and e. We can also recommend to the authors to add the name of each instrument along each panel for better readability. We recommend plotting the CCN data on a separate graph.

Thank you for spotting the mis-labeling, which we have now fixed. We also included the instrument names in the title of each panel. We prefer to leave the CCN data plotted here together with the other particle concentrations as measured by the other instruments to better identify any relationships between these.

Figure 15: We appreciated this figure to visualise the merger of the datasets on particle diameters and numbers. Thank you! Figure 17: Nice!

Thank you, we appreciate your positive feedback.

Figure 21: It would be useful to have titles on the plots themselves.

We followed the suggestion by the reviewer and labeled each panel individually.

Figure 22: This figure contains a lot of information and additional panels would help the clarity of this data.

We have updated the figure for clarity and split the figure into separate panels.

Dataset and code availability comments: We recommend to the authors to add photographs of each one of their instruments for improved visualization of the equipment used in this voyage.

See response above; where appropriate we have added schematics for some instruments where we seemed it to be appropriate.

Weather_obs_level_0→ What are the codes of weather types (1-4)?

The weather type classifies the cloud situation as observed into four different categories (see below). It may be of limited interest to external users. We note that there are no clear sky records in the human observations. This is because, by coincidence, either none of them were made during the time periods of clear sky, or because clear sky as detected by a ceilometer or sky camera only means clear sky within their field of view. For human observations, a clear sky would mean there are no clouds visible in any direction.

We now provide an explanation of the numbers in the additional note section of the data set on Zenodo. The weather types are defined as follows: 1. Low-level stratus cloud, 2. Precipitation associated with nimbostratus, 3. Low-level stratocumulus, 4. Mid-level altocumulus or altostratus.

The automatic weather station data appear to be complete and all information is available. Line 299. Why is the sun photometer data only found in the Maritime Aerosol Network? Is it possible to add it to the authors' Zenodo data set too?

We would prefer not to include the sun photometer data in our Zenodo archive as the data are openly accessible from MAN repository at the link provided.

Line 780. ALCF tool was downloaded, checked and confirmed after communication with one of the authors, Peter Kuma. The script now worked well. Thank you for sharing this resource!

You are very welcome.

Line 783. The authors provide the website for COARE gas exchange algorithm but in Table A1 in the “das” Data Acquisition System ReadMe_file the authors also provide the Matlab script to calculate fluxes. It might be worth mentioning this script in the Code Availability.

Good idea and we now mentioned the script in the Code Availability section.

We would also encourage the authors to explore the possibility of providing their data as an open API through https://developers.zenodo.org/

Thank you for that suggestion. We believe that the data set becomes available through the API automatically, but we will investigate that further.

We end this review by once again commanding the authors and scientists for their hard work and effort in gathering this dataset. We wish the authors all the best with their future data analyses and with addressing their scientific research goals.

Thank you very much and we appreciate your positive feedback.

Interactive comment on Earth Syst. Sci. Data Discuss., https://doi.org/10.5194/essd-2020-321, 2020.