We thank the reviewer very much for reviewing our manuscript, for providing constructive criticism and useful suggestions. We respond to all comments below.

Specific Comments
A major part of the paper is the presentation and discussion of how much better the BANOS-index correlates to sea level changes in the Baltic Sea than the NAO-index. It would be helpful to the reader to discuss the BANOS-index with respect to other slp indices that have been used for the Baltic Sea. For example the BAC index in Andersson, 2002 or the BSI in Lehmann et al, 2002. How much different are those indices from the BANOS-index? Would the slp gradient over the transition zone between North Sea and Baltic Sea be different between BANOS and BAC or BANOS and BSI?

To answer the questions raised by the Reviewer, we initially contacted Andersson in order to obtain the time series of the BAC-index, but unfortunately we were informed that time series is not available any more. Therefore, we cannot make a statistical comparison between the BANOS-index and the BAC-index. Also, the BAC-index is constructed with a different method than the other indices (BSI-index, NAO-index and BANOS-index).

We also contacted Lehmann, he kindly shared the time series of the BSI-index with us. The BSI-index time series starts in 1948. Therefore, we made a correlation analysis between the BANOS-index and the BSI-index for the period 1948-2013. The time series are detrended prior to the correlation analysis. The results are shown in the following table.

Corr. Coef. (period 1948-2013)	Winter	Summer
BANOS - BSI	0.91	0.64
NAO- BSI	0.72	0.19
BANOS-NAO(corr. in the manuscript)	0.68	-0.12

Briefly, this correlation analysis indicates that the indices, BANOS and BSI, may share some similarities in wintertime, but the strength of the relation between those indices becomes much weaker in summertime. Moreover, the correlation between NAO and BSI indices seems very weak in summer, although it is statistically significant. On the other hand, there is neither a significant nor a positive relation between NAO and BANOS indices detected in summertime.

We should additionally mention that Lehmann et al. (2002) constructed the BSI index only from the analysis of winter months. They defined the BSI-index as the difference of normalised SLP anomalies at the positions of (53°N30', 14°E30') and (59°N30', 10°E30') by considering the period 1979-1998. This shows that they selected different SLP fields than we selected for the winter BANOS-index. Moreover, they concluded that a positive BSI pattern is linked to westerly winds over the Skagerrak and Kattegat, whereas in the winter BANOS-index the orientation of the winds is rather north-westerly. Regarding the BANOS-pattern related sea-level variability; we interpreted a large impact of the inverse barometer effect (IBE), which transports water from the North Atlantic towards the North Sea and the Baltic Sea. In addition, Lehmann et al. (2002) is more focused on monthly and weekly variation of the Baltic Sea level variability. Our study analyses sea-level

variability on the interannual time scale.

We should also note that similar question was raised by the Reviewer 1. The reviewer suggested a comparison between Dangendorf et al. (2014) * atmospheric proxy and the BANOS-index. Please also see our response to the first point of Reviewer 1's revisions.

*Dangendrof et al. (2014), A new atmospheric proxy for sea level variability in the southeastern North Sea: observations and future ensemble projections, Climate Dynamics, 43:447.

Is the BANOS-index usable without a gridded slp field? Can it be inferred from station data (e.g. Stockholm - Odessa), like the NAO-index and would it show good correlation the one derived from gridded data?

The station-based NAO-index is computed from the differences between two normalized SLP fields. Here, we used the same method. What the reviewer asks is whether it is possible to construct a BANOS-index from station data. It could be possible, but individual station pressure records can be affected by local effects - small-scale and transient meteorological factors - unrelated to the large-scale mode of atmospheric circulation. This problem is also addressed by Hurrell et al. via:

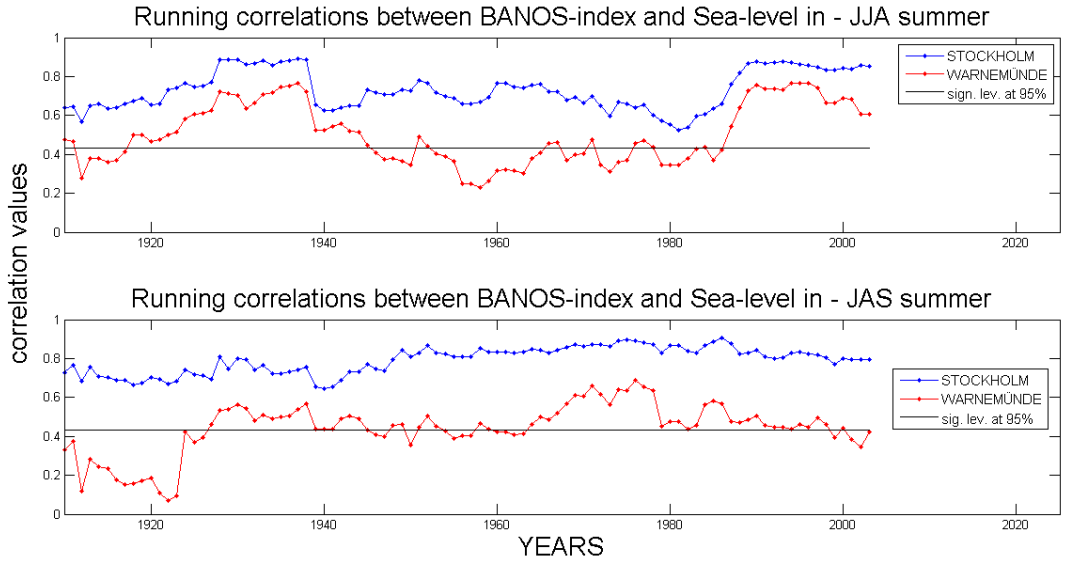
https://climatedataguide.ucar.edu/climate-data/hurrell-north-atlantic-oscillation-nao-index-station-based

Since we have the gridded SLP fields for the period of analysis, we prefer to use those data that have also been profusely used in other studies.

How sensitive are the results and the conclusions for summer when the summer was defined as the months JAS? Baltic Sea sea level in summer show little variation during these three months (e.g. Hünicke and Zorita, 2008, Meier et al., 2004). The month of June usually lies between the spring minimum and the summer values. What is the reason to choose June, July and August as the summer season?

Some authors have used other months to compute summer means. The idea by selecting those months (JJA) as summer months were that the smallest variance of sea-level occurs in those months over the last two centuries (i.e. Andersson , 2002- Figure 3).

To measure the robustness of the BANOS-index based on the method suggested by the Reviewer, we computed the 21-year running correlations of JAS mean summer variations between BANOS-index and sea-level. We also include the 21-year running correlations between BANOS-index and sea-level for the JJA summer season. Results are shown in the following figure.



The figure indicates that the Stockholm sea-level variability can be well represented by the BANOS-index for the summer of the JAS months. For the JAS summer, those correlation values - for BANOS-index and Stockholm sea-level- indicate a steady relation over time and are always higher than 0.65 over the 20st century. We should note that the relation between BANOS-index and Stockholm for the JAS summer is even stronger and more stable in time than the relation between the BANOS-index and Stockholm for the JJA summer. However, Warnemünde is weakly connected to the BANOS-index for the JAS summer over the last century.

The title of the paper suggests the investigation of North Sea and Baltic Sea sea levels. In the derivation and evaluation of the BANOS-index only Baltic Sea sea levels are taken into account. From Figures 4 and 13 one would expect that the correlation of winter mean sea levels in the North Sea improve over the NAO correlations. For summer at least in the eastern part of the North Sea. Please consider to show one or two tide gauges from the North Sea in Figure 12, or add a figure like Figure 12 for two North Sea tide gauges.

We will add tide gauges along the North Sea coasts.

Please, also see the following table for the correlation coefficients among the BANOS-index, the Cuxhaven (settled on the coast of German Bight) and Stockholm stations for the period 1900-2008.

Corr. Coeff. Winter (Summer)	Cuxhaven	Stockholm
BANOS	0.80(0.50)	0.84(0.72)
Cuxhaven	-	0.88 (0.67)

In the abstract it is said that the wind associated with the slp pattern of the BANOS-index does not lead to transport of water into the Baltic Sea. The analysis in Section 4.8.4 is a good idea, but since the return flows along the coasts and at depth are not taken into account, the statement might not hold up to a more thorough investigation.

In the abstract, we consider the case that the geostrophic wind linked to the SLP BANOS pattern does not suggest a westerly wind over the transition zone between the North Sea and Baltic Sea in wintertime. Therefore, the geostrophic wind would not push surface water from the North Sea into the Baltic Sea over the transition zone, where the bathymetry is expected to interrupt Ekman Layer. It rather plays a role in accumulating water (downwelling) towards the west coast of Norwegian Trench and German Bight.

However, the geostrophic wind linked to the SLP BANOS pattern suggests a possible transport of surface water from the North Sea into the Baltic Sea in summertime, since BANOS related geostophic wind is expected to be westerly over the transition zone, as in the case of the NAO pattern.

In our study, we did not consider the return of the water flow.

I would like to see the correlation coefficients for all of the nine stations in Table 1. Future studies might benefit from that information and for the present study the information might help with the interpretation of Figures 2 and 3.

We will include the correlation coefficients of all stations in Table 1.

Good correlations between altimetry and tide gauge data is said to indicate progress in satellite altimetry. Could the source of the improvement over earlier comparisons be specified? It is probably not the altimeter instruments themselves that have progressed so much. Information on the geoid? New algorithms? Amount of data?

Primarily, updating the geophysical corrections and usage of refined mapping parameters should be the reasons improving the correlation between altimetry and tide gauge data.

We should also indicate that main improvement of DT2014 SLA data set is achieved by changing the reference period of the SLA products to a new altimeter reference period. This reference period takes the advantage of the 20 years observations and optimizes the reduction of along-track random noise, which was largely involved in the physical signal of the previous version DT2010. For the further information, we suggest the paper of Pujol et al. (2016) - http://www.ocean-sci.net/12/1067/2016/os-12-1067-2016.pdf .

The core of improvement from their study: *"Numerous innovative changes have been introduced at each step of an extensively revised data processing protocol. The use of a new 20-year altimeter reference period in place of the previous 7-year reference significantly changes the sea level anomaly (SLA) patterns and thus has a strong user impact. The use of up-to-date altimeter standards and geophysical corrections, reduced smoothing of the along-track data, and refined*

mapping parameters, including spatial and temporal correlation-scale refinement and measurement errors, all contribute to an improved high-quality DT2014 SLA data set"

In Section 4.8.1 yet another index is introduced as the slp differences between two geographical locations that differ from the ones introduced in Section 4.4. Would you please explain why there is a need to introduce different locations where to measure slp to get at the IBE contribution? Why Denmark Strait and not Labrador Sea for the summer for example? But more importantly why not stick to the definition (5W, 45N) - (20E, 70N) for winter and (30E, 45N) - (20E, 60N) for summer?

We needed geographical points where sea-level data were available in order to estimate the sensitivity of BANOS attributed sea-level to the IBE. Therefore, the points that we selected were the optimum ones according to winter-summer BANOS patterns and sea-level data availability.

In Section 4.8.2 please indicate in the text whether the whole water column was heated or just the mixed layer (down to what depth?) to absorb the energy.

The estimated explained variance (35%) shows the potential of net energy flux contribution to explain the linkage between the BANOS-index and sea-level variability. Here, we assume that the thermal expansion coefficients do not vary with temperature or pressure. It is, therefore, a first order estimation.

Under those assumptions, we estimate that 1 unit increase in the BANOS-index can cause 1 mm sea-level rise due to the contribution of net energy flux. This estimation is independent of water depth under the stated assumption that the thermal expansion coefficients are temperature and pressure independent.

Section 4.8.4 discusses an interesting point but the argumentation stops halfway through. How is the Ekman transport different in the transition zone between North Sea and Baltic Sea for NAO- or BANOS-index related patterns? And what are the consequences for the sea-level in the Baltic Sea?

We will clarify the text according to suggestions.

In Section 4.8.4 it is argued that during summer BANOS and NAO related wind forcing (slp gradients) could be similar. I thought the main reason to introduce the BANOS index was the liberty to define an index separately for winter and summer, so that missing correlation for summer sea-level variability in the Baltic Sea could be explained. This section would benefit from a rewrite, I suppose.

We will rewrite the text for the clarification.

The Conclusions (page 18, line 28-29) mention that there is no contribution of NEF in summer. Section 4.8.2 states that summer has not been included in the analysis, because of negative correlations. Please reformulate the sentence in the conclusions, page 18, line 28-29.

We will reformulate the sentence.

For the last part of the Conclusions (page 19, line 2-4) the evidence is missing. See also the comments above on Section 4.8.4 and the Abstract.

We will clearly write the evidences in the related parts of the manuscript.

The conclusion might benefit from a restructuring. The itemized list could be shortened to contain the keywords only as a summary of a continuous text around it.

We will update the conclusion.

Technical Corrections
page 1, line 7: interannual time scales.
We will change this accordingly.

page 2, line 24: NAO-index describes weaker
We will change this accordingly.

page 3, line 19: Andersson (2002) who focused on
We will change this accordingly.

page 3, line 20: Dangendorf et al. (2014) who investigated the
We will change this accordingly.

page 3, line 20-21: investigated the North Sea, reported that atmospheric variability that differs from the NAO may still explain part of the sea-level variability.
We will change this accordingly.

page 3, line 32: different sorts of data sets
We will change this accordingly.

page 4, line 32: This study focuses on the winter
We will change this accordingly.

page 5, line 1: this study and the following section
We will change this accordingly.

page 5, line 5-7: Although the threshold of any computation involving tide gauge records was set at 75% availability of data for the considered period, seasonal means are calculated in case of availability of tide gauge records for two months. [I am not sure whether I understand it the way the authors mean it. Could this information be written a little more clearly?]

We will clarify the text.

Here we would like to mention that for the analysis period like 21-year running correlations, we prescribed a threshold of 75% data availability. However, we computed seasonal means if two months were available (means 66.6% availability of data set to compute seasonal mean).

page 5, line 23: the northeastern boundary of [If Smögen is meant by the northeastern boundary of the North Sea I recommend to call it Skagerrak.]
Here we write the names of tide gauges. When we mention about the region we write Skagerrak (i.e. Figure 1).

page 6, line 14: and produces a complete gridded data set

We will change this accordingly.

page 6, line 16: resolution of a T62 Gaussian grid [Or mention the resolution in deg or km]

Reanalysis data set has no regular grid. We will change it as the following.

Old version : "*This data set has a spatial resolution of 192x94 points with T62 Gaussian grid covering the Earth's surface*"
New version: "*This data set has spatial resolution of a T62 Gaussian grid with non-regular 192x94 points covering the Earth's surface*"

page 7, line 9: examine the correlation of the satellite [see below]

Old version:"*We first examine the coherence of the satellite altimetry observations with the tide gauge records.*"
New version: "*We first examine how the satellite altimetry observations covary with the tide gauge records.*"

page 7, line 11-13: The seasonal means ... linear regression. [This has been said in the methods section. It could be scratched.]
We will remove that part from the text.

page 8, line 30, 32 in the southern Baltic Sea
We will change this accordingly.

page 9, line 5: Figure 4-lower [see also comment below]
We wil change this accordingly.

page 9, line 28: does seem to be strongly connected to the NAO-index from 1998 in wintertime. OR does not seem to be strongly connected to the NAO-index until 1998 in wintertime.

We will correct the text. Here, the correct version should be: *"does <u>not</u> seem to be strongly connected to the NAO-index until 1998 in wintertime"*

page 9, line 30: could indicate the existence of
We will change this accordingly.

page 10, line 30: from what the NAO implies.
We will change this accordingly.

page 11, line 33: most of the time the gliding
We will change this accordingly.

page 13, line 31: region on the interannual time scale. OR region on interannual time scales.

We will correct the text. It will be "*on the interannual time scale*"

*page 14, line 27: (3.44*18.09) OR (3.44 ncdot 18.09) AND (1.39*7.02)*
We will change this accordingly.

page 15, line 3: radiation reaching the earth surface and longwave (LW) emitted
We will change this accordingly.

page 15, line 9: [SH and LH do not correspond to the naming in the equation.]
We will change this accordingly.

page 15, line 18: estimated as 3.28 W m-2 u-1)
We will change this accordingly.

page 15, line 24: of 25,505,280 (W m-2) per one unit [How much change is that? It might be easier to grasp by using something like 2.5 10 ^7 (W m-2)]

We will modify the numerical expression by using the suggestion of reviewer. :

2.5e7 (J m-2 yr-1)

For the technical question, please see our response to previous question: "In Section 4.8.2 please indicate in the text whether the whole water column was heated or just the mixed layer (down to what depth?) to absorb the energy. "

page 15, line 24: of 25,505,280 (W m-2) per one unit [Should the units be (J/winterm-2) instead of (J/s m-2)?]

We will write it as 2.5e7 (J/m-2 yr-1)

page 16, line 9: (2257 kJ kg-1)
We will change this accordingly.

page 16, line 16-17: [During summer the western North Sea is not similar in precipitation and freshwater flux.]

Old version: *"In summertime, the correlation patterns between the BANOS-index and precipitation and the between the BANOS-index and freshwater flux display similar results"*

New version: *"In summertime, the correlation patterns between the BANOS-index and precipitation and the between the BANOS-index and freshwater flux display similar results other than the western part of the North Sea"*

page 16, line 29: [It would be more concise to use the regions defined in Figure 1 when describing the correlation pattern.]
We will update the text based on the suggestion.

page 17, line 2: of sea-level would reach 10 mm per one unit
We will change this accordingly.

page 17, line 3: [Either remove the last sentence or explain why the high correlation in the north eastern part of the North Sea drainage basin (incl. Norway) does not contribute to North Sea sea level variability.]
We will remove the last sentence.

page 17, line 14: be similar to the case of the NAO.
We will change this accordingly.

page 17, line 15: assuming that the Ekman layer
We will change this accordingly.

page 17, line 16: interrupted by bathymetry.
We will change this accordingly.

page 17, line 21: if bathymetry would not interrupt
We will change this accordingly.

page 17, line 22: is generated by the BANOS-related north-easterly winds
We will change this accordingly.

page 18. line 1: [The Norwegian coastline is in the north-eastward direction. That contradicts the previous argumentation.]
Old version: *"...towards the Norwegian, German, Dutch and UK coastlines"*
New version: *"...towards the German, Dutch and UK coastlines"*

page 18, line 4: on interannual time scales. OR on the interannual time scale.
We will change it as *"on the interannual time scale"*

page 18, line 15: is more important for the
We will change this accordingly.

page 18, line 32: [The last sentence seems to contradict what has been said in the first sentence (line 30-32). Would you please specify which contributions of the freshwater flux are negligible.
Old version: *"... is negligible in the Baltic Sea and the North Sea"*
New version: *"... is negligible in the Baltic Sea and the North Sea in wintertime"*

page 19, line 4: to that related to the NAO in
We will change this accordingly.

caption Figure 14: Note the different intervals on the color scales.
We will change this accordingly.

Readability: The readability of Section 2 could be improved by omitting the sub-subsections.
We will omit subsections in the Section 2.

Figure captions: I'd recommend to change the naming of the positions in the plots from down to lower/bottom and from up to upper/top.
We will change this accordingly.

Coherency or correlation (page 7, line 9ff): Did you really look at correlations on different time scales or is "coherence" used here as a synonym for correlation? The expression coherence or coherency appears more often later on. It would be helpful to specify what is meant by coherency or perhaps just use correlation.

In the manuscript we use the term coherency in the general sense and not in the statistically related sense. We will clarify this point in the new version.

Station Smogen (page 5, line 24ff): It appears in some places in the text, it should be Smögen.

Sea level data is provided by PSMSL (www.psmsl.org). In their webpage, the name of station is written as “Smogen”. We will use the correct name and indicate that the name in the PSMSL is not totally correct.

Caption Figure 5: for the winter (solid line) and summer (dotted line) seasons.
We wil change this accordingly.

Figure 8-9: These two figures could be combined in the same way Figure 10 was done.
We will change this accordingly.

Figure 10: Why is the northern half of the figure blank? If possible, the figure should be redone. It avoids unnecessary doubts.

We will replot Figure 10 based on the suggestion of the reviewer.

To compute the correlation coefficients, we put the threshold for data availability to 75% for the considered period.

Figures 8-10: The reader might appreciate the eye be guided with a mark on the plots, where the BANOS-index is defined.

We will change it accordingly.

Figure 11: It is hard to see similarities and even more so difference between the two indices. An additional running mean could improve the figures. Red-blue bar plots like they are used for the display of the NAO-index might be an option.

We will change the plot by using the Red-blue plots, and include running means in the Figure.

Caption Figure 18: It is not clear which index or which season is displayed in the upper and lower panel of Figure 18. Also, for the sake of completeness it would be good to indicate the units and a reference vector.

We will partly rewrite the caption to clarify the winter and summer seasons. Since these representative vectors are constructed from correlation gradients, they are unitless.

Sub-sub-section 4.8.2: It would be clearer to use one name only for the net energy flux. Either Qnef or NEF. Also, in the text the "net"- and "nef"-part of names like SWnet should be a subscript. Or maybe drop the "net" altogether in the whole section.

We will use NEF instead of Qnef for the whole section.

Sub-section 4.8: In my opinion it would suffice to indicate the sensitivities with one digit after the floating point.
We will change this accordingly.