Dear reviewer,
We appreciate the constructive comments, which are very helpful to improve the clarity of the manuscript. We have addressed every point in the revised manuscript, which are detailed below in blue.

Anonymous Referee #2
The manuscript by Gao et al., "Inversion of multi-angular polarimetric measurements over open and coastal ocean waters: a joint retrieval algorithm for aerosol and water leaving radiance properties" presents a study to apply the joint retrieval algorithm (to obtain the aerosol and water leaving signal simultaneously) to RSP airborne measurements. This retrieval algorithm has been validated with synthetic data earlier, while in this study the focus was to evaluate it against airborne polarimetric measurements
from the Research Scanning Polarimeter (RSP) over both open and coastal ocean waters acquired in two field campaigns: the Ship-Aircraft Bio-Optical Research (SABOR) in 2014 and the North Atlantic Aerosols and Marine Ecosystems Study (NAAMES) in 2015 and 2016. Thus the focus of the paper is clearly defined and targeted, and so are the results and conclusions that are presented. I think the manuscript suits the scope of AMT and deserves to be published. I have only few relatively minor comments that I wish are considered in the revised version.

The main comment has to do with aerosol "treatment" of the algorithm, for which I thought some further discussion might be suitable. For instance, regarding the "perturbations to the real and imaginary parts of the PCA refractive indices at 410nm and 470nm". I was thinking that it was likely the allowed perturbation particularly in imaginary index that resulted in the improvement of Figure 10b. However, this was not discussed, so the question remained which one more effectively influenced the results by these "perturbations"? If it was imaginary index, then this it is likely related to the spectral dependence of absorption by organic aerosols (Brown Carbon). It is well known that in this regard, what we nowadays know about spectral aerosol absorption, the Shettle and Fenn 1979 does not represent this understanding well. Perhaps these issues could be discussed in the revised manuscript.

We agree that the PCA representation of aerosol refractive index based on Shettle and Fenn (1979) may not be sufficient for all cases encountered. We further revised the paragraph as follows:
“Furthermore, there may be small variations in the aerosol refractive index spectrum that are not captured by the smooth representation of the PCA, which may affect the retrieval of water leaving radiance adversely. For example, organic carbon may introduce spectral dependency of light absorption (Kirchstetter, 2004), but is not considered in the datasets used for the PCA computation.”

Regarding which part, real or imaginary, of the refractive index affects the results more, our observation is that both play a role in the fitting. In our revised manuscript, we added:
“…A better agreement of the spectral shape of the retrieved Rrs can be found for both bio-optical models as shown in Figure 10(b), which is due to the additional refractive index spectral perturbation. The retrieved aerosol volume density is dominated by the fine mode aerosols with the mean values of the real refractive indices of 1.58, 1.55, 1.51 at 410, 470, 550nm, which deviates from the PCA representation by 0.06, 0.04, and 0.003. Meanwhile, the mean values for

the imaginary refractive indices are 0.014,0.021, 0.011 at 410, 470, 550nm, which differ from the PCA representation by 0.006, 0.014, and 0.004 ."

About the Figures 4,8: is it so that you do not show unitless AOD? I thought it should be extinction in 1/km, but it seems it is something else in the unit,since from that Figure I would estimate much larger AOD than what is shown for HSRL in the Figure 9b. So good to clarify what exactly is shown by these type of figures.
The cumulative AOD shown in Figures 4 and 8 are unitless. They are the AOD of the layer from the aircraft to the altitude shown in the plots. The caption of the Figure 4 is revised accordingly: "The cumulative aerosol optical depth (AOD) from HSRL, which is the AOD of the layer from the aircraft to the altitude as indicated in the plot."

Page 14, line #4. You mention that the retrieval produces larger aerosol absorption. What does this mean exactly and how it was concluded (comparing against AERONET AAOD)? This is not clear, since it seems that you retrieve only aerosol extinction and single scattering albedo is based on your assumed aerosol model. Please clarify this statement.
We do not assume an aerosol model. The volume concentrations of six modes are retrieved. Also the spectral refractive index for both fine and large modes are retrieved. Based on this information, the aerosol single scattering albedo can be calculated. To make this clearer, we added a sentence in the section 3.2 (page 7): "The PCA coefficients for both the real and imaginary refractive indices are retrieved from the algorithm."

- In many plots Wavlength -> Wavelength
Corrected in the revised manuscript.

- Page 2, line #29: soley -> solely
Corrected in the revised manuscript.