Reviewer 1:

General comments:

This study investigates seasonal and interannual variations of sea surface salinity (SSS) in the North-Eastern Tropical Atlantic by means of several observational products and high-resolution regional model simulations forced by different runoff and precipitation data sets. It provides a thorough comparison between these different products and highlights how the choice in forcing data sets can impact the simulation of surface salinity in ocean models.

The manuscript is generally well written and provides a number of interesting insights into the factors impacting surface salinity in this region. I find, however, that it reads rather technical and that the value of the study lies mainly in exploring differences between various precipitation and runoff data sets and their impact on simulations of salinity while the dynamical understanding of the salinity variability remains rather vague.

Specific comments:

Major:

1. I am missing a bit more of a motivation that is then revisited in the conclusions. Why are interannual variations in salinity important?

We have emphasized the importance of studying salinity and its variability at the end of the introduction drawing on past studies that show the link between salinity variability and the water cycle (lines 69 - 74): "The aforementioned studies demonstrate the usefulness of salinity as a tracer for variations in the water cycle, both from the perspective of the seasonal cycle and interannual variability. However, to our knowledge, no study has yet focused on interannual variability. This is the aim of this study, in which we aim to differentiate the effects of precipitation from those of river discharges on coastal salinity in the e-NTA region. To achieve this, the surface ocean dynamics is simulated by the Coastal and Regional Ocean Community (CROCO) model with various configurations of climatological or interannual forcings."

2. I find it very hard to bring together the first part of the results section (3.1) with the corresponding figure in the Appendix. Instead of just referring to Appendix B, it would be helpful to refer to specific subplots and lines (something like "red line in Fig. B1(a)"). Also, the legend entries are hard to interpret and don't seem to always match the figure caption.

Following the reviewer's comment, we have included the figures from Appendix B into the main body of the article to facilitate reading and have modified all the legends of the figures in the paper for clarification. Appendices are now moved to a supplementary material file, where figures are numerated from S1 to S10, as suggested by reviewer 3, and this notation is used for references in the article.

3. While the case studies of years with strong robust SSS anomalies in section 3.3 is very interesting, the 2018 case remains rather inconclusive. It didn't become clear to me what actually caused this anomaly.

For the year 2018, the analysis is more complex because the SSS positive anomaly results from a combined effect of precipitation and river runoff: it is initiated by positive precipitation anomalies (i.e. rain deficit) in both ERA5 and IMERG datasets and is then modulated by river runoff anomalies of different signs depending on the product used. We also corrected a small inconsistency in the computation of the trend anomalies, slightly modifying Figure 6g (see answer of Major comment 4 of reviewer 2). We have modified section 3.3.3 to clarify this point (see lines 451 - 456):

"In conclusion, the 2018 SSS anomaly is due to the combined effects of precipitation anomalies and river discharges. It is primarily caused by a strong precipitation negative anomaly (observed in both forcing datasets), which is not entirely compensated by entrainment (Figure 6c). This is then accompanied by a river discharge negative (positive) anomaly of ISBA (GloFAS) runoff, thereby accentuating (mitigating) the salinity anomaly through advection. This runoff anomaly explains the CROCOprclm SSS anomaly. The

large GloFAS runoff is surprising as it is opposite to the rain deficit over the oceanic region during this period (Figure 5c).”

4. One of the main conclusions of the study is that in the SSS budgets, the precipitation term is largely compensated by the entrainment term. What drives this compensation, i.e. why does entrainment react to the surface freshwater input?

Indeed, we found that the precipitation term is largely compensated by the entrainment term, both in the climatological cycle and during interannual anomalies. This can be explained as follows: when precipitation occurs, surface waters become less saline, and a vertical gradient of salinity is formed in the surface layer. As the mixed layer depth deepens during night-time, saline subsurface water is incorporated (entrained) into the mixed layers, leading to an increased mixed layer salinity. This diurnal salinisation of the mixed layer occurs even when the mixed layer tends to decrease at a seasonal time scale (Figure 2d). Thus, the larger the precipitation, the larger the salinity vertical gradient, the larger the entrainment and compensation by salinisation of the mixed layer.

We added a paragraph in the conclusion section 4 (lines 551 - 556)

Minor:

1. I would suggest to reword the title to “Influence of Freshwater Fluxes on the Interannual Variability of Sea Surface Salinity in the North-Eastern Tropical Atlantic”

We accept the title suggestion and have changed it accordingly.

2. The region considered here can just be called “North-Eastern Tropical Atlantic” as in the title. There is no need to add an extra “southern” (line 13, 50 and elsewhere).

Agreed

3. As there are several units for salinity (psu, pss, g/kg) it would be good to comment on the unit used here.

Agreed. We use the same unit (pss)

4. Please specify the time period of all the used data sets.

We have added information on the availability period of each dataset, as well as their resolution, where it was missing:

“TSG data are available from 1993 to present, between 5 to 15 m depth, and we use the hourly product.” (lines 125 – 126).

“ERA5 hourly fields are available over the period 1950-2023 at a horizontal resolution of 31 km” (lines 173 - 174)

“IMERG data are available from 2000 to present, at a resolution of 0.1° every half-hour.” (lines 185 - 186)

The GloFAS hydrological model simulations are available from 1979 to present at a daily and 0.1° resolution.” (line 197 - 198)

“ISBA-CTRIP data is available daily from 1979 to June 19, 2019, at a 0.5° resolution.” (line 209 - 210)

5. Section 2.2.4: I guess the model uses more than one baroclinic mode.

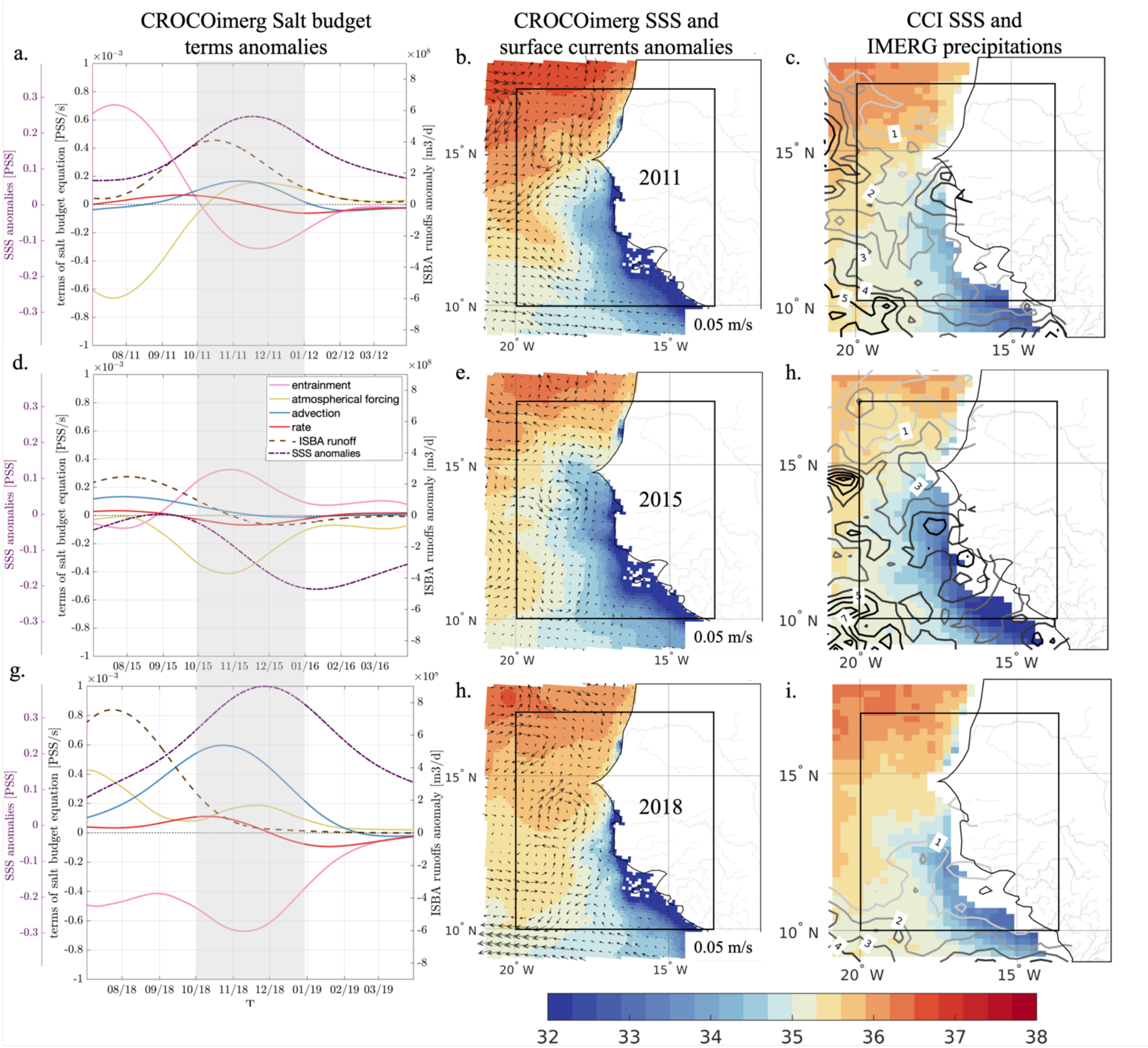
There was a misunderstanding as CROCO does not compute the evolution of baroclinic modes separately. We rephrased as follows: "The slow mode and the fast barotropic mode are computed separately using a time-splitting algorithm (Shchepetkin and McWilliams 2009)" (Lines 142 – 144).

6. In line 301, it should probably read "deeper" instead of "thinner mixed layer"?

Agreed.

7. In Figure 6, it would be helpful to also show SSS anomalies.

After attempting to add salinity anomalies to Figure 6 (see below), we considered the resulting figure to be too cluttered. Moreover, the anomalies are already visible in Figure 5, and the salinity anomaly can be deduced from the "rate", which is its time derivative.



8. Looking at Figure 5, I wouldn't say that that interannual variations are "very consistent" between model simulations and observations.

We rephrased as follows (line 557): "Despite the systematic model bias, modelled and observed SSS interannual variations are overall in good agreement »

9. There is a huge number of subsections, and I believe some of them could be merged. This applies to section 4.3 and 4.5. in particular.

Sections 2.2.4, 2.2.5, 2.2.6, 2.3, 2.4 are now merged in section 2.2. Sections 2.5 and 2.6 are now in section 2.3. Sections 4.2 and 4.4 are merged in section 4.2.

Technical corrections:

- line 28: As many waves are wind-forced themselves, waves shouldn't be lumped together with wind as a forcing.

Agreed. We removed waves from the list. (Line 27)

- line 30: Not sure what is meant by "exogenous" here.

We suppressed this term.

- line 31: "they lower the density" instead of "they make the density decrease"

We reformulated the sentence as suggested.

- line 139: "August" (with capital A)

Agreed.

- line 278: "linked to the salinity budget"

Agreed.

- line 298: I am not sure "attenuates" is a good expression in this context.

We replace the corresponding sentence by: "The ocean transfers this freshwater input towards the ocean interior through vertical advection (not shown) and entrainment." (line 299)

- line 377: "band-pass filtered" instead of "band-passed"

Agreed

- line 413: "lower magnitude"

Agreed

- line 456: There are no brown lines in Figure 7.

The mention of brown lines on line 456 was an error.

- line 553: It is not clear here whether "maximum difference" refers to the seasonal range or difference between products.

We have specified to which quantity the difference applies (the seasonal range) (Line 591).