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Interactive comment on “Sea surface temperature patterns in Tropical Atlantic: principal component analysis and nonlinear principal component analysis” by S. C. Kenfack et al.

Anonymous Referee #1

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The study applies a nonlinear PCA (NLPCA) to the SST anomalies in the tropical south Atlantic with two main objectives in mind: (1) determine if the variability of the cold tongue is symmetric and (2) if NLPCA can reproduce the interannual variability.

The methodology applied is sound, but the results are not very significant and should be strengthened before publication. The authors found that the SST variability in the region of interest is weakly nonlinear and the cold tongue shows weak and strong regimes, which are slightly asymmetric. They argue the linear PCA can not capture this difference and it might be true. However, it is not clear if the asymmetry is due to real physical processes or due to the shortness of the time series used (only 24 years). This is an important issue that should be addressed using longer data sets available.

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The discussion in section 3.2 is hard to follow and needs to be rewritten. Moreover, it is not clear that NLPCA gives different results than a simple composite using an SST index for the cold tongue to study the evolution of extreme warm and cold events. PCA and composite techniques are usually complementary because the latter allows to study the nonlinear behavior. It would be very useful to compare the results of compositing versus that of NLPCA: if authors can show that NLPCA is superior it would strengthen the manuscript substantially, and would prompt other authors to use this complex technique.

Figure 9 suggests that PCA and NLPCA might be complimentary as they have maxima over different regions. It seems to me that the NLPCA is more localized in space and therefore seems to be able to isolate different processes. On the other hand, it is well known that PCAs should be rotated to better reflect physical processes as they only try to explain maximum covariance over the region. The rotated PCAs are usually more localized. Is it possible that the leading rotated PCA would have a similar pattern of correlation as the leading NLPCA?

Finally, the manuscript is not very clearly written and there are paragraphs that are difficult to follow because of the language and because the content is all mixed. For example the last paragraph of page 239 and first paragraph of page 240 in the introduction is quite confusing. The authors review here the literature on the seasonal cycle and interannual variability and compare the tropical Atlantic with the Pacific: (1) Why is the meridional mode at all mentioned? It peaks in MAM and is not considered later in the study, (2) the Atlantic Nino peaks in JJA as mentioned, but ENSO in the Pacific peaks in DJ, which suggests that in the Atlantic interannual variability is directly linked to the seasonal cycle while in the tropical Pacific this connection is more indirect; this is not mentioned. This has to do apparently with the different connection between SSTa and thermocline depth anomalies in both oceans (Li and Philander 1997, Burls et al 2011).

Other corrections and comments:

page 239, last sentence: 10E

page 240, line 22: what does it mean: “weakening of the ocean circulation in the Atlantic...”

page 245, last sentence: 256?

page 246: why are the PCA of the total SST presented? It is not clear Figure 2 is necessary. Also, how do we know that EOF2 describes the equatorial mode? It has a different structure than the leading EOFa.

Do the NLPCA change if the PCAs are rotated before they are used to compute the NLPCAs?

How do NLPCAs depend on the number of PCAs considered? Are they robust?

Page 249, line 19-21: it is not clear how it is possible to conclude that: “Unlike in the Pacific ocean, the spatial variability of this equatorial mode... than the latter.” Where does this conclusion come from?

Page 250, line 26: “the type of ACT depends on SSTa activity”. What does this mean? What kind of SSTa activity? Where? What kind of physical process are we talking about?

Page 251, line 9: papers from 1977 and 1983 can not be referred as “recently”.

Page 251, line 26: 1D(?) NLPCA

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