GENERAL COMMENTS

This study is focused on the mixed layer depth in the North East Atlantic near the Porcupine Abyssal Plain for May 2013.

This phenomenon is studied using in-situ observations and the hindcast/forecasts products from 4 different forecasting systems.

An introduction and contextualization of the studied process is missing as well as a short general evaluation of the four forecasting systems.

The structure of this paper is not very well organized and it is quite difficult to follow the discussion (in particular subsection 4.2 and 4.3).

The methodology applied is not always clearly explained and justified. There is a very detailed description of the results but their interpretation is very poor.

Both the abstract and the conclusion paragraphs are quite general without a clear focus on the aim/results of this study. The achievements of this work are not very clear.

Why have you decided to use 5-day forecast even if the 4 forecasting systems considered in this work produced 7-day forecast?

SPECIFIC COMMENTS

ABSTRACT:
Page 1436 line 14-15: reformulate this sentence. It is not clear the meaning of "forecast time delay" and the general statement of this sentence.

1. INTRODUCTION:
Page 1437 line 5-6-7: please specify which is/are the physical process/es involved
Page 1437 line 17 : "forecast length" → please specify what "forecast length" means.
Page 1437 line 17-18: " several …. Atmospheric forcing were used" → It seems from the description of the 4 forecasting systems that are all 4 forced by the same ECMWF analysis/forecast fields. Please explain.

2. FORECAST PRODUCTS AND OBSERVATIONS
Page 1438 line 2: Is the Atl12 a stand-alone system or it is nested into the GLo4 or GLo12 system?
Page 1438 line 16 – Table 1 – Could you please specify if you assimilate L3 or L4 SST products?
Page 1438 line 26-27: Please explain why the ATL12 free experiment has been necessary. This is an ad hoc experiment carried out for this study. The reader doesn't have to wait till section 4 to understand it.
Page 1439 line 10: Please explain what do you mean as "system" in this contest.
Page 1439 line 12-13: which criteria is adopted to subsampled to one observation profile for each instrument per day?
The description given is very short and not detailed. Please clarify and give a detailed description and explanation.
Page 1439 line 17: why don't you (re-)write the equation used for the mixed layer computation ?
Page 1440 line 1-2-3: there is some literature about this phenomenon?

Page 1440 line 7-8: it continues to be not very clear which kind of pre-processing, interpolation, mean .... has been done to sub-sampled, filter, ... the available pool of observations (see also comment on Page 1439 Line 12-13). Please explain.

STATICS
Page 1441 formula (1) : please explain why you have decided to use H instead of Obs. Give a more detailed explanation on how you have compute the Persistence of initial state and of the observations.
Page 1441 line 18-19: Explain why the Glo4 performs like this.
Page 1441 line 21-22 "The results are very similar for H up until the 1 day forecast": don't you expect higher accuracy for H respect the forecast?
Page 1441 line 22-23-24 "The dispersion for all the systems is small.." do you have an explanation ?
Page 1442 line 2 → to fully understand this statement, I need to know exactly how you compute the persistence (see first question on this section)
Page 1442 line 4 " ...except F0 in GLO4": explain why
Page 1442 line 6: ok but it is important also to state that from F0 to F1 the relative increment of the forecast respect the persistence is the highest .

4 MIXED LAYER DEPTH FORECAST DURING MAY 2013
4.1 Description of the mixing and stratification events

Pag. 1443 line 23: "..while for M3 the response is faster (only one day)": could it be because the wind relative increase is the biggest (around 10 m/s) (for M1 and M2 is around 5-7 m/s) and because there are 3 consecutive days of constantly increasing wind ? In M1 there is 1 day of increasing wind and in M2 there is a less homogeneous wind increasing phenomenon.

4.2 Evaluation of the hindcasts

First part (comments of figure 7): the description is quite detailed but there are very few explanation of the characteristics/differences described.
Second part: it is mainly based on figures 9-10. These figures are not very clear. The fields in the small dotted box are difficult to inter-compare among the different systems. A zoom in is needed to better understand the comments done in this section.
The observations represented in figure 2 should be overlapped to this figure in order to have a full view of the situation.

Page 1445 line 15-16-17: this consideration should have been written in the previous section where the method and the experiments strategy are explained.

4.3 Discussion for the forecasts

4.3.1 Forecast of the 1st mixing event (M1)
Page 1446 line 12-13-14-15: such a sentence needs an adequate explanation. In principle the hindcast and the first days of forecast have a better atmospheric forcing and should perform better than the 3/4-day forecast.

Page 1446/1447 line 24-3: are there differences in the wind field used for the forecast only between the GLO4 and all the others systems (IBI36, ATL12, GLO12)? In figure 8, top panel there are shown only the wind from GLO4 and Atl12. The ECWMF forecast fields used by one system could have been released 24hr before the ECMWF fields used by another system?

Page 1447 line 3: "(using for example the previous analysis cycle)": please could you explain? It's evident from figure 8 that there are several differences for F4.

4.3.2 Forecast of the 1st re-stratification (S1) and 2nd mixing (M2) events

Same comment done for figures 9 -10 in the previous section.

4.3.3 Forecast of the 2nd and 3rd stratification (S2, S3) and 3rd mixing (M3) events

4.3.4 Atmospheric forcing vs. initial state in the uncertainties

Is the statics of the atmospheric forcing computed on the original ECMWF analysis/forecast fields or the fields computed via bulk formula from the model ? It seems that is it the latter. In this case as explained in the previous section (section 4.3.1, page 1446, lines 24-27), there is no homogeneity in the atmospheric forcing used by each system (see comment on Page 1446/1447). Can you quantify how this inhomogeneity is taken into account by your statics?

Page 1449 line 14-15 : "This small decrease in correlation indicates that the initial state has a small effect" → justify this sentence, the explanation given in the text is quite poor and not clear.
Page 1449 line 19-20-21: as above, provide a stronger justification to this sentence.
Page 1449 line 24: "… error id due to fresh water flux" … can you explain why, as shown in fig. 11 top panel, F2 water flux correlation is less than F1?
Page 1450 line 10-11: explain better this sentence or remove it.
Page 1450 line 22-23: is the ATL12 FREE experiment initialized with the same Initial Condition of Atl12? Please specify.
Page 1452 Line 4-5-6: this sentence is quite ambitious. The description and explanations you give are quite preliminary and not very detailed.

5. Conclusions
Page 1453 line 2: ".. less than 20m…": this number is strongly dependent from the model vertical discretization, it should be written and explained.
Page 1454 line 19-20: " The effect of horizontal circulation, particularly around eddies or along strong fronts, have been illustrated for the model mixed layer": in this work there isn't a detailed study of these phenomena.
Page 1454 line 26-27: this sentence is very general. Please specify better which developments can have a strong impact on the improvement in the mixed layer depth forecast.

TECHNICAL CORRECTIONS

Page 1437 line 18-23: the numbers of the sections does not correspond. Please correct.

Page 1444 line 2 . "Fig. 8": fig. 8 is mentioned here but is not commented in the following lines.

Page 1454 line 16: typing error …"atmospheric focing" → atmospheric forcing

Page 1454 line 22: typing error "..validate properly, The coverage…" → "…validate properly. The coverage.."

Figure2: most of the numbers of the circles are not readable.

Figure 8: bottom-right panel→ typing error in the title "Frash"→ "Fresh"

Figure 12: the title of each panel is difficult to read. The character font is too small.