First of all, we would like to thank Dr. Kostas Tsiaras for his true evaluation of our paper and his encouraging comments. We have modified the manuscript according to his comments. We think that the new manuscript has been accordingly improved.

Specific comments:

1) K. Tsiaras: "In Page 14946 (Line 6) you mention that the Chl-a time-series were normalized in order to minimize the impact of the satellite algorithm artifacts. Unless I'm missing something, It seems that since in your (clustering/time series) analysis you are interested in chl-a differences between different areas, using the absolute Chl-a would probably give the same results. The Chl-a normalization is very useful however in order to plot different areas on the same scale and probably also to remove any difference (in terms of bias) of the two satellite datasets. If this is the case, I suggest you rephrase your reasoning for normalizing Chl-a."

Author's response:

> We agree with the referee. We normalized the annual time series of $[Chl]_{surf}$ to minimise the potential errors (i.e. bias from the satellite algorithms) in the $[Chl]_{surf}$ estimates, but also to efficiently apply the clustering technique, which cannot be used on time series of absolute values of $[Chl]_{surf}$, because the values' range of variability is too high to provide a relevant clustering. As the referee correctly pointed out, we aimed to analyse the different areas on the same scale. To clarify our reasoning:

Page 14946, line 6 – the text was substituted with "Consequently, as in DR09, to minimize the impact of the $[Chl]_{surf}$ algorithms artifacts and in order to focus on the seasonal variations of the $[Chl]_{surf}$ (regardless the existing difference between the Mediterranean Sea areas in the values of $[Chl]_{surf}$), each annual time series was normalized by its maximal value."

2) K. Tsiaras: "Please provide some reference for the "Chebyshev distance" (P14946, L22)."

27 Author's response:

28 >The Chebyshev distance between two time series $X=(x_1,x_2...x_n)$ and $Y=(y_1,y_2...y_n)$ is defined

29 as,

30 $$d_{XY} = \lim_{p \to \infty} \left(\sum_{i=1}^{n}|x_i - y_i|^p\right)^{\frac{1}{p}} = \max_i |x_i - y_i| \tag{1}$$

31 with $n = 46$. In the manuscript:

32 Page 14946, line 21 – the text was substituted with "2. The similarity between the "annual"
33 time series and each of DR09 trophic regimes is evaluated using the Chebyshev distance (e.g.
34 Han et al., 2011), with only the 8-day averages of nChl as variables (i.e. 46 variables).
35 Between two time series $X=(x_1,x_2...x_n)$ and $Y=(y_1,y_2...y_n)$ the Chebyshev distance (d_{XY}) is
36 defined as,

37 $$d_{XY} = \lim_{p \to \infty} \left(\sum_{i=1}^{n}|x_i - y_i|^p\right)^{\frac{1}{p}} = \max_i |x_i - y_i| \tag{1}$$

38 with $n = 46$.".

39 The reference added is:

40 - Han, J., Kamber, M. and Pei, J.: Data Mining: Concepts and Techniques, third Edn., The
41 Morgan Kaufmann Series in Data Management Systems, Morgan Kaufmann, Boston, 2011.

42

43 3) K. Tsiaras: "It is not totally clear (also in DR09) how you do the clustering from the annual
44 time series. From the dataset tables in Fig.1 it seems that you use the different 8-day Chl-a
45 averages (w1-w46) as different "variables" in the clustering. If this is case or some other
46 method (e.g taking some properties of the time series as "variables") is used, please describe
47 this explicitly in the methods section."

48 Author's response:

49 > The referee is right. As in DR09, we only used the 8-day averages of [Chl]$_{surf}$ as variables
50 (i.e. 46 variables). To clarify:

51 Page 14946, line 21 – the text was substituted with "The similarity between the "annual" time

52 series and each of DR09 trophic regimes is evaluated using the Chebyshev distance (e.g. Han

53 et al., 2011), with only the 8-day averages of nChl as variables (i.e. 46 variables)."

54

55 5) K. Tsiaras: "You mention (P14948, L5) that Fig.3 represents "16 annual maps of the spatial

56 distribution of the 11 trophic regimes". How are these annual maps generated? Do you follow

57 the same procedure (as in step4, section 2.2), comparing each pixel annual time-series with

58 the time-series of the clusters (DR09+anomalous)? Please explain in the text. Perhaps it

59 would be also useful, in terms of methodology, to discuss how these maps would be different

60 with the maps based on performing clustering on each year separately."

61 Author's response:

62 > The referee is right. The origin of the maps in Fig. 3 was not clear and the description of the

63 method was misleading. In fact, each annual map is generated as follows:

64 Firstly, we identified, for each "annual" time series, the DR09 trophic regime with the most

65 similar time series. When the "annual" time series is too different (i.e. an important

66 Chebyshev distance) from the time series of this DR09 trophic regime, the "annual" time

67 series is considered as "non-assigned" (steps 1 to 4 in the description of the method page

68 14946-14947). These first four steps are thus carried out on an annual basis. The result of

69 these first four steps are 16 annual maps (not shown in the manuscript) illustrating the spatial

70 distribution of the DR09 trophic regimes and also the spatial distribution of the pixels with a

71 "non-assigned" time series.

72 Secondly, all the "non-assigned" time series, irrespectively of the year, are classified with a

73 clustering analysis (i.e. a K-means clustering) to generate the "anomalous" trophic regimes

74 (step 5). This last clustering provided a way to classify all the pixels whose time series after

75 the step 4 was "non-assigned" to a DR09 trophic regime.

76 So, we did not perform two different analyses (one with only the DR09 trophic regimes and

77 one with the DR09 + the anomalous), rather, we first assigned the pixels on the basis of the

78 DR09 trophic regimes, then, for the remaining "non-assigned" pixels, we performed a cluster

79 analysis to generate the "anomalous" trophic regimes. See also next comments.

80

81 4) K. Tsiaras: "Step 5 (section 2.2 and Fig.1) also is not totally clear. You mention "from all

82 16 years combined". How does this works? You put all the years of an "anomalous" pixel one

83 below the other, as implied by the table in Fig.1 (e.g having 2000 below 1999 etc). This is

84 slightly different from the clustering in DR09. Does this affects the procedure since there is

85 the case that in one year a pixel is "anomalous" and in another is based on DR09? Please

86 expand your description in methods to make this clearer for a reader not (necessarily) familiar

87 with clustering techniques."

88 Author's response:

89 > As explained in the previous comment, the "anomalous" trophic regimes are obtained by

90 clustering all the time series that were "non-assigned" after the first four steps of our method.

91 This is not inconsistent with the possibility, for one pixel, to show year-to-year variations in

92 its associated trophic regime. However, our text was incomplete and misleading and we agree

93 with the referee that the description should be strongly improved. For this reason, and because

94 of the previous points, we modified the Methods section (Sect. 2.2):

95 Page 14946, line 11 – the text was substituted with "The method proposed here initially uses

96 the trophic regimes identified by DR09 to classify pixels on an annual basis. The method

97 consists in identifying, for each "annual" time series of each pixel, the DR09 trophic regime

98 with the most similar time series. After this first classification, some time series remain

99 unclassified (i.e. "non-assigned"). These "non-assigned" time series are then clustered to

100 identify new trophic regimes, which were somehow hidden in the DR09 approach.".

Page 14947, line 11 – this text was added "At this stage, 16 annual maps (not shown) were obtained, indicating either the membership of the pixels among one of the DR09 trophic regimes, or if they were still "non-assigned".

Page 14947, line 12 – the text was substituted with "5. All of the "non-assigned" time series (from all the 16 years combined) were classified using the K-means clustering (Hartigan and Wong, 1979) (Fig. 1, step 5)."

Page 14947, line 24 – this text was added "The pixels whose times series were "non-assigned" at the step 4 are thus now classified as one of the "Anomalous" trophic regimes."

6) K. Tsiaras: "It would be useful to provide in Table 1 also the absolute Chl-a values (e.g in parenthesis after the normalized values) to permit a rough comparison between different clusters in terms of productivity. For example, is No_Bloom1 that is permanently observed in the Levantine the most "oligotrophic"?"

Author's response:

> We agree. In Table 1, we added the absolute $[Chl]_{surf}$ values for the other indices of the time series (i.e. mean summer value and the annual maximum), in order to clarify the trophic status of each trophic regimes.

7) K. Tsiaras: "By "minimum rate of change" (e.g P14948, L25) I guess you mean negative values, describing a stronger decrease. You can add a note in the text to make this more apparent."

Author's response:

> The referee is right. We changed: Page 14948, line 25 – "…whereas the dates of the minimum rate of change (i.e. the date of the lowest first derivative of the nChl time series)…"

with "…whereas the dates of the minimum rate of change (i.e. the date of the lowest first derivative of the nChl time series, the most negative value)…".

Author's response:

> The maximum value of the "Bloom #5" is 0.82 nChl, whereas its amplitude is 0.66 nChl (i.e. the difference between the mean summer values and the annual maximum values of nChl). Thus the sentence reported (Page 14949, line 2) is correct.

Author's response:

> We would like to indicate that the nChl time series of the "Anomalous #4" is flatter than the one of the "No Bloom #3" because the timing of the maximal value is more variable for the "Anomalous #4". It is not due to a lower maximal value for the "Anomalous #4", which has an amplitude in $[Chl]_{surf}$ more important. The explanation is more explicit with the maximum values, and thus we changed: Page 14950, line 12 – "the "Anomalous #4" trophic regime presents a lower maximal value of nChl (0.60 nChl) than the "No Bloom #3" trophic regime (0.86 nChl), indicating a variability in the timing of the peak between individual time-series, but a higher amplitude of $[Chl]_{surf}$ (0.48mg m^{-3} for the "Anomalous #4" and 0.25 for the "No Bloom #3").", with:

149 "the "Anomalous #4" trophic regime presents a higher maximum value of $[Chl]_{surf}$ (0.68 mg

150 m^{-3}) than the "No Bloom #3" trophic regime (0.35 mg m^{-3}), but a lower maximum of nChl

151 (0.60 nChl for the "Anomalous #4" and 0.86 nChl for the "No Bloom #3"), indicating a

152 variability in the timing of the peak between individual time-series."

153

154 10) K. Tsiaras: "P14957, L1: "The bimodal pattern" Not sure what you mean here with

155 bimodal."

156 Author's response:

157 > We agree, the expression "bimodal" was changed with "unimodal".

158

159 11) K. Tsiaras: "P14958, L13: With regard to the influence of the Black Sea Water, You

160 could also refer to Petihakis et al. (2015)."

161 Author's response:

162 > Done.

163

164 12) K. Tsiaras: "P14962, L15 "the new approach had permitted to demonstrate that when the

165 16 years are considered separately, the patterns in the seasonality of the phytoplankton

166 described by DR09 (except the "Coastal #7" trophic regimes) were always recovered." Not

167 sure what you mean by "considered separately" in this context."

168 Author's response:

169 > We used the expression "considered separately" to accentuate the fact that it was not a

170 climatological study but an interannual analysis. To clarify the conclusion, we changed:

171 Page 14962, line 14 – "In fact, the new approach had permitted to demonstrate that when the

172 16 years are considered separately, the patterns in the seasonality of the phytoplankton

173 described by DR09 (except the "Coastal #7" trophic regimes) were always recovered.", with:

"In fact, the new interannual approach allowed to demonstrate that the patterns in the seasonality of the phytoplankton described by DR09 (except the "Coastal #7" trophic regimes) were recovered for every year.".

13) K. Tsiaras: "P14960, L2 "..more than the deep convection events, the permanent cyclonic circulation in this region was the primary factor inducing favorable conditions for phytoplankton bloom, by bringing the nitracline depths close to surface. Relatively shallow mixed layers.. " Usually deep convection sites are found in areas with cyclonic circulation due to the dome shape of the density that favours deep mixing and I think the phytoplankton bloom mechanism is mostly related to the vertical mixing. Therefore, the "relatively shallow mixed layers" might be misleading. I suggest you rephrase this."

Author's response:

> We agree. We removed the misleading sentences:

Page 14949, line 27 – "This uplift of the nitracline by the cyclonic circulation should allow an efficient replenishment of nitrate at the surface."

Technical corrections:

K. Tsiaras: "-Page 14943, Line 3 & Line 8: Replace "dynamic" with "dynamics".

   -Page 14943, Line 5 : Replace "that kind" with "those kind".

   -Page 14943, Line 6 : Replace "impact on the" with "impact the".

   -Page 14943, Line 21 : Replace "factors affecting ecosystem function" with "factors affecting the ecosystem functioning".

   -Page 14943, Line 22 : Rephrase "has been relatively under considered" with e.g "has received less consideration".

   -Page 14944, Line 17 : Replace "has been already used" with "has already been used"

213   Author's response:

214   > We agree with all technical corrections made by K. Tsiaras and modified the manuscript

215   and all the figures by considering all these corrections. The manuscript was also proofread by

216   an English native speaker.