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# *Interactive comment on* "Chl a trends in European seas estimated using ocean-colour products" *by* G. Coppini et al.

**G. Coppini et al.**

coppini@bo.ingv.it

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Each one of the comments of the referee #1 is marked with a bullet and it starts with 'RC:' (referee's comment). The authors' replies follow each comment and start with 'AR:' (Authors Reply).

- ————————General Comments————————

- RC: [...] There are however some important parts of the analysis that are incomplete or unclear, and insufficiently discussed. More importantly the use of the considered satellite products for trend analysis is questionable. Particularly the suitability of the Globcolour GSM-based merged product for trend analysis is to be demonstrated [...]-.

AR: We thank the referee for this important comment. We think the referee is point-



ing out one of the relevant critical aspect of the merged satellite dataset that have been used in our paper. The referee is correct that the consistency among GMS and SEAWFS especially in terms of trends was not clear and underlined enough in the paper. Following the recommendations of the referee we have add relevant references in the paper, we have added explanation in the paper answering following specific comments on this issue and we have performed the comparison of the GSM dataset (called Global Ocean GSM – MyOcean in the paper) and SEAWIFS dataset (called Global Ocean SeaWiFS RAN – MyOcean in the paper) in terms of trends. We have modified the manuscript accordingly to show the results of the GMS and SeaWiFS comparison. The comparison of the two datasets shows general similarities and some differences that are commented now in the paper. Is worth to explain that the choice of the GSM dataset is very important for our objective because we would like to propose a methodology to support EEA in the development of and indicator that should be updated every year, this requires a continuous consistent time series OC products from 1997 up to now and with annual update. At the present the GSM dataset is the only product based on merging the SeaWiFS, MODIS and MERIS data available in MyOcean providing the covering the period 1997 up to now. Nevertheless we agree with the reviewer that the consistency of this dataset should be ensured and the potential use of this product to detect the trends should be demonstrated. We think the results of the comparison between the GSM and SeaWiFS trends presented in the new version of the paper underline the necessity to have a consistent merged ocean colour products for the European Seas. This will be the main issue of MyOcean-2 project.

- RC: [...] and the use of a regional algorithm developed for Mediterranean open waters to conduct a trend analysis on the Black Sea is not supported.

AR: The reason to use the MEDOC4 regional algorithm product (called Med Regional SeaWiFS RAN – MyOcean in the paper) developed for the Mediterranean open waters also in the Black Sea was due to the fact this was the only MyOcean regional series available for the Black Sea. However, we agree with the referee that the use of

Mediterranean open water algorithm instead to global algorithm for the trend analysis in Black Sea should be demonstrated by comparing the results with in situ observation that are presently very few and does not allow a proper comparison. Therefore, in the new version of the paper, we used only MyOcean global products to analyze the Back Sea trends and we removed the part of the paper related to the Chl-a areas analysis in the Black sea (Section 4.3, new numbering of sections). Also the Chl-a areas defined in the Black Sea are not shown any more in the paper (Section 2.3 new numbering of sections).

- RC: The work uses a European-scale Chla product and a Mediterranean regional product, which is potentially interesting, but the analysis is conducted independently for the 2 products.

AR: We agree and we decided to present also the results of the Mediterranean Sea trends based on SeaWiFS regional product (Med Regional SeaWiFS RAN – MyOcean) to comment on the similarities and differences. This is now shown in figure 3 (new numbering of figure) and commented in the new section 4.2.

- ——————-Specific comments——————

- RC: The analysis of trends in ocean colour products has to consider the way these products have been created (see more details below on Section 2). For a series based on one sensor, this means making sure that the series has been created with one processing chain, including a consistent calibration table and calibration history. This has to be acknowledged in the paper and supported by appropriate references (e.g., Eplee et al. SPIE 7452, 74520X, 2009, Meister et al. IEEE, 50, 310-319, 2012, and ref. therein).

AR: We agree with the referee and we therefore have changed the description of the ocean colour dataset (Section 2.1) proving the basic information on processing used to produce the MyOcean datasets on basis on our knowledge and the information provided to the user by the MyOcean User Manual and MyOcean Quality Product doc-



umentations. The relevant papers describing the processing and the validation of MyOcean have been introduced in references list as well as the papers suggested by the reviewer. In particular we underlined that the Mediterranean SeaWiFS re-analysis dataset (Med Regional SeaWiFS RAN – MyOcean), as well as the Global SeaWiFS reanalysis dataset (Global Ocean SeaWiFS RAN – MyOcean), now introduced in the paper, are consistent time series produced at once re-processing the entire OC dataset using a consolidated archive input data, ancillary data (meteo and empheridis), last version calibration tables, and the same configuration of the software. On the contrary the GSM product which is based on L2 products provided by space agencies and updated regularly every month with a 30 days of delay there is no guaranty that the configuration is unchanged.

- RC: Using a merged product adds the issue of inter-mission biases. If there is a systematic bias between the products derived from different missions, and if the merging is performed without specifically accounting for this bias, then spurious trends might be generated. Such biases do exist and can vary between regions; they can be seen on the NASA OBPG web site but in that case they are given only for very large regions. The implication is that, without a dedicated analysis on the regions of interest, the suitability of this type of products for trend analysis is unclear. To my knowledge, the Globcolour GSM-based merged product does not comply with this requirement for trend analysis. This means that the trends documented in the paper cannot be unambiguously/fully associated with natural variability, which questions the value of the work. Unless the authors can demonstrate that inter-mission biases do not create spurious trends in the products, or that they can correct for them, then the study has to consider another product (like a SeaWiFS-only series).

AR: We believe that this Referee's comment is very relevant. The bio-optical model-based merging procedure (Maritorena et al. (2002) and Maritorena and Siegel (2005)) combines the normalized water-leaving radiances from different sensor data sets. Over each particular pixel of a geographical grid common to SeaWiFS, AQUA and MERIS,

the spectral water-leaving radiance, NLw($\lambda$) spectra from the available sensors at that pixel are selected and combined in a single, multi-source, spectrum which is then used in the inversion of the GSM01 semi-analytical ocean colour model (Maritorena et al., 2002). The used GSM model used in the production of the dataset used in this paper consists of a non linear fitting method that searches the set of retrievals that best minimizes the mean square difference between the modelled and measured spectral water-leaving radiance, NLw($\lambda$) (Maritorena et al., 2010). The GlobColour products have undergone an extensive validation based on a validation protocol derived from the SIMBIOS protocol. The GlobColour products have been derived with the GSM model and algorithm, developed by ICESS (Maritorena S. and D.A. Siegel. 2005).We agree with the referee that one potential problem of GSM model is that the method does not account for a specific inter-bias calibration effort in the production of the merged datasets. To evaluate the problem and the differences that the GMS product (Global Ocean GSM – MyOcean) may show in the estimation of the Chl-a trends we have performed a specific analysis using SeaWiFS reprocessed dataset from 1998 to 2009 (Global Ocean SeaWiFS RAN – MyOcean) and we changed the manuscript accordingly. This analysis is now presented in the paper in terms of summer chl-a trends for the European Seas calculated from the GSM and from the SeaWiFS dataset. The new figure 2 in the paper presents the results of the 2 trends (both significant and non significant trends are shown to allow a better comparison of the two trends). Even if in general the intensity of trends of detected using SeaWiFS time series are higher with the GSM once, GSM and SeaWiFS trends show similar patterns such as positive trends in the northern part of the North Sea and in the North East Atlantic, central and southern part of the Baltic Sea, Bay of Biscay, central east Atlantic, Alboran Sea, Ligurian Sea and southern part of the Gulf of Lion, southern Adriatic Sea and north-east Ionian Sea. Moreover negative trends are detected similarly by the two datasets in the Black Sea, in most of the Mediterranean Sea, in the English Channel and in the central part of the North Sea, in part of the North-east Atlantic. Main differences are found in the Gulf of Botnia, Gulf of Finland where SeaWiFS shows negative trends



while GMS shows positive trends. Moreover in the Skagerrak, Norwegian coasts and, in the English Channel, in the Po River mouth and in the western part of the Black Sea SeaWiFS show similar in sign but stronger negative trends respect to GMS products. The trend in the central part of the Baltic Sea is found stronger in SeaWiFS than in the GSM dataset. This comparison is now presented in the paper in figure 2 and also the results and conclusions are modified accordingly.

- RC: Another weakness of the analysis is to use products derived from algorithms developed for open ocean waters for coastal waters and marginal seas, including the Baltic and Black Seas that are notoriously challenging for ocean colour and bio-optical algorithms. This is acknowledged in the manuscript but the implication for what concerns the derived trends is not discussed. The scatter plot given for the GSM product on Fig.4 is fairly encouraging, even though validation statistics are varying between basins. There is also a validation analysis performed on the Med regional products for Mediterranean waters. But the use of a regional algorithm developed for Mediterranean offshore waters to conduct a trend analysis on the Black Sea (including its shelf) is not supported. The analysis of Fig.3a should be removed unless additional elements can demonstrate the appropriateness of this algorithm for Black Sea waters.

AR: We agree with the referee that highlight that the complexity of optical properties of the European coastal zone requires the use of specialized local algorithm and processing system but these products are presently not available, therefore we used the MyOcean global and regional products to investigate trend in both open ocean and coastal areas of the European Seas. The availability of in situ coastal data will be use at posterior to check potential use of MyOcean ocean colour products to estimate trends also in the coastal waters.

The validation analysis has been now redone using the full in situ dataset without filtering, the results show a decrease in terms of R2 that is now equal to 0,53 for all European Sea. As explained in a previous comment the reason to use the MEDOC4 regional algorithm product (Med Regional SeaWiFS RAN – MyOcean) developed for

the Mediterranean open waters also in the Black Sea was due to the fact this was the only MyOcean regional series available for the Black Sea. However, we agree with the referee that the use of Mediterranean open water algorithm instead to global algorithm for the trend analysis in Black Sea should be demonstrated by comparing the results with in situ observation that are presently very few and do not allow a proper comparison. Therefore, in the new version of the paper, we used only MyOcean global products to analyze the Back Sea trends and we removed the part of the paper related to the Chl-a areas analysis in the Black sea (Section 4.3, new numbering of sections).

- RC: The work uses a European-scale Chla product and a Mediterranean regional product. This could allow for a comparison between trend results associated with each data set. But Fig.2 cannot be compared with a Mediterranean equivalent based on the regional product. Fig.3 is only for the regional product, and again Fig.11 has no equivalent for the regional Chla. This would be an interesting point of discussion and could lend confidence to the results (if the trend results are consistent).

AR: We agree with the referee and we have decided to conduct the same analysis for European-scale Chla product and Mediterranean regional product. We have therefore compared the trend estimated by global products (Global Ocean GSM – MyOcean and Global Ocean SeaWiFS – MyOcean ) presented figure 2 of the new version of the paper with the trends computed with the Mediterranean regional product (Med Regional SeaWiFS – MyOcean) presented in figure 3 of the new version of the paper. Results are discussed in the results section 4.2. Results obtained with the regional product appear similar to the ones obtained using the global product Global Ocean GSM – MyOcean presented in Figure 2 but some differences appear and are discussed in the paper. The comparison of the global SeaWiFS product (Global Ocean SeaWiFS – MyOcean ) and the regional SeaWiFS product (Med Regional SeaWiFS – MyOcean) is also presented in the results section 4.2. This comparison shows very similar results but small differences are detected in front of the Po River mouth where the regional product shows weaker negative trend values, while along the Italian Adriatic coast



the negative trend appear stronger in the regional product. In the Gulf of Gabes the regional product show a negative trend that instead is detected as positive trend in the global SeaWiFS product. In front of the Nile river mouth the regional product detect a stronger positive trend with respect to the one shown in the global product.

- RC: The Section 2 “Data and Methods” should be completed. A part should deal with the in situ data (see below in Technical Comments).

AR: Following the recommendations of the referee we have completed Section 2 that now includes a part dealing with the in situ data.

- RC: The processors associated with the satellite data sets should be mentioned: which SeaDAS (for SeaWiFS and MODIS) and MEGS (for MERIS) versions? Are the data sets created with a consistent version of the processor (including calibration) through the entire time series?

AR: We believe the comment of the referee is very relevant and we have provided the additional following information in the paper in the section 2.1:

“[...] The GSM – MyOcean products have been validated by Maritorena et al (2010) and by comparing them to the data sets obtained from individual missions. This product has been available since September 1997 and the time-series is constituted of daily products delivered by MyOcean with a one-month delay. Since this product is updated monthly and is based on L2 input data proved by the space agencies therefore there is no guaranty that the configuration is unchanged. In particularly, the NASA MODIS L2 processing has been switched from R2009.1 to R2010.0 in June 2011 and the MERIS L2 processing switched from the 2nd to the 3rd MERIS reprocessing in autumn of 2012 (see MYO-OC-PUM-available on line at www.myocean.org).

The second dataset is the ‘Global Ocean SeaWiFS RAN – MyOcean’ Chl-a dataset. The full SeaWiFS time series reprocessed a consistent time series of L2 input data and using OC4-V4 algorithm for chlorophyll retrieval. This MyOcean product is associ-

ated with the latest reprocessing performed by NASA for SeaWiFS using SeaDAS 6.1 software. Temporal characteristics: this dataset comprises of standard mapped image monthly mean global sea surface chlorophyll-a maps at 9km resolution (L3 product) and is distributed by the GMES MyOcean project. The quality of this product has been evaluated in the framework of MyOcean (Melin 2011).

The last satellite dataset is the 'Med Regional SeaWiFS RAN – MyOcean' is the Mediterranean regional product based on SeaWiFS data and using the Mediterranean regional ocean colour algorithm for chlorophyll retrieval (MedOC4, Volpe et al., 2007). The MedOC4 algorithm has been validated with a large in-situ bio-optical dataset for the Mediterranean area, and its performance has been compared with global algorithms such as OC4v4 for SeaWiFS, and the results show that MedOC4 is the best algorithm for satellite chlorophyll estimates in the Mediterranean (Volpe et al., 2007). The Med regional SeaWiFS Reanalysis has been produced at once reprocessing the entire SeaWiFS L1 time series with a single software configuration and using the latest version of calibration and ancillary data using the SeaWiFS Data Analysis System (SeaDAS) software package version 6.1 available from NASA website (seadas.gsfc.nasa.gov)). The complete description of MyOcean Mediterranean processing system and results on the product validation see Volpe et al (this issue). [...]"

- RC: Satellite products are provided as daily maps for the GSM one, and daily, then monthly, for the Med regional one (by the way, considering that CNR staff are co-authors, it is surprising that daily maps are not available for the full data set).

AR: The usage of the monthly dataset has been removed and we have performed again the analysis using the daily regional dataset provided by CNR also in the framework of MyOcean project, the dataset is called in the paper Med Regional SeaWiFS Reanalysis – MyOcean. Using this new dataset that cover the period 1998-2009 we have been able to extend the analysis in the Mediterranean Sea until 2009, while before was stopped in 2006. Results related to Mediterranean trend presented in Figure 2 and Figure 5 now cover the period 1998-2009.



- RC: How is the transition to summer values actually performed? With monthly means as intermediate values? If the daily values are used directly to compute summer means, there might be biases created from one year to another if these daily values are unevenly distributed in time. Is there a check on the distribution in time of the valid Chla values? In any case, is there a threshold on the minimum number of days required to create a valid summer value (I'd argue there should be one)? In general the 'data content' of the analysis should be thoroughly documented. These post-processing aspects are important to avoid creating spurious trends.

AR: We calculate monthly mean first and then summer values. A threshold on the minimum number of days required to create a valid monthly value is fixed at the level of 10 days." We have added the following phrase to the methods section: "To calculate summer values first the monthly mean is calculated and then summer values are computed. A threshold on the minimum number of days required to create a valid monthly value is fixed at the level of 10 days."

- RC: The Chla areas should be better documented, typically by a map or from a reference where the reader can visualize them. This would be useful to fully benefit from Section 3.2.2.

AR: We agree with the referee and we have added maps presenting the Chl-a positions and extensions and a table with Chl-a areas names in the Annex 1 and we have added the following text in section 2.4 to refer to the Annex 1: "In Annex 1 we present maps with the extensions and positions of Chl-a areas and a table with the list of their names.

Annex 1 is also completed with a short introductive description to Chl-a areas.

- RC: For Section 4, the validation strategy should be clearly introduced, and the different analyzes well documented and explained: table with validation statistics, explanation of how averages are computed for the trend analysis, etc... These points are given in detail in the Technical Comments below.

AR: Following the suggestions of the referee we have added table with the validation statistics, removed the definition of tests that were not helping the validation strategy and better introduced the validation strategy in now section 3. Further details are given in the answer to the Technical Comments.

- ————————Technical comments————————-

- RC: In general, the abstract should be improved, following a logical sequence. For now, 'this work aims to develop a new indicator' (1st paragraph) and then (2nd paragraph), 'this work proposes a methodology', with in between, considerations about validation, the potential of remote sensing or the advantages of a regional algorithm. The last part, about 'Chla areas', is not clear if the reader has not read the paper.

AR: Following the referee's comment we have revised the Abstract.

- p.1482 - RC: l.14: 'transformed into Chla'

AR: Corrected

- RC: l.18: 'but': it is not clear why there is opposition between the 2 parts of the sentence.

AR: We agree that the use of 'but' was not proper, we removed it.

- p.1483 - RC: l.24: 'variables to be monitored'

AR: Corrected

- p.1484 - RC: l.22: please check the URL.

AR: The url in the world version of the paper was correct but when published in the pdf was not functioning. I will inform the editor accordingly.

- RC: l.23: there is no end to the sentence.

AR: Corrected



- RC: l.27: 'fluorometer'

AR: Corrected

- p.1485 - RC: The description of the in-situ data should be done in Section 2, with a minimum amount of information: sources, number of points, coverage in time & space (referring to Fig.1), discussion of their uncertainties...

AR: Following the recommendations of the referee we have completed Section 2 that now includes a part dealing with the in situ data. Moreover a table (now table 2) with the description of the main characteristic the in-situ data used in the paper is added.

- RC: l.6: 'fluorometers'

AR: Corrected

- RC: l.22: the authors forget that there were other ocean color sensors between CZCS and SeaWiFS (MOS, OCTS).

AR: We agree with the referee and we corrected the text adding the following text: "afterwards the MOS sensor was in operation from approximately 1997 to 2004 and OCTS from October 1996 to June 1997, finally, SeaWiFS, only started in 1997.

- RC: l.26: 'Siegel'

AR: Corrected

- RC: The last paragraph would be better located in the description of the satellite products.

AR: We agree with the referee and we have removed the following paragraph from Section 1, the same information is now present in section 2.1 Satellite and in-situ data sources:

"The ocean-colour transformation algorithms have been calibrated with in-situ data at a global scale for the GSM product (Maritorena et al., 2010; Maritorena and Siegel,

2005) and with in-situ datasets acquired in the Mediterranean Sea for the MEDOC4 product (Volpe et al., 2007)." - p.1486 - RC: l.17: 'colored dissolved organic matter'

AR: Corrected

- RC: l.22: 'these types'

AR: Corrected

- RC: l.23: 'analyses ... are ' or 'analysis ... is' l.25: what do the authors mean by 'consistent'?

AR: We have corrected to 'analyses are'. The results presented in the paper Vantrepotte and Melin 2012 are in terms of relative linear changes in the band ratio (443). These results show trends that are similar (opposite sign) to the ones presented in our paper. We used the expression 'consistent' meaning similar. Now that, following the referee comment, we add the Global Regional SeaWiFS – MyOcean product analysis in figure 2 of our paper this is even more evident. - p.1487 - RC: l.1: 'present'

AR: Corrected

- RC: l.7: 'The purpose of the paper is to:'

AR: Corrected

- p.1488 - RC: l.14: I'd suggest: 'The product was obtained from'

AR: We corrected following the referee's comment. Moreover since we have now accessed to a consistent reanalysis form MyOcean and CNR we have change and simplify the text as following:

We have removed the phrase: ' This product was accessed in two consistent time series: the first covered the period January 1998-December 2004 and is delivered by MyOcean and is constituted by daily fields of Chl a, while the second covers the period 2004-2007 and is delivered by CNR and is constituted by monthly mean of Chl a. The



SeaWiFS regional product for the period 2004–2007 was still covered by a commercial licence and was not distributed by MyOcean at the time we accessed the data.

and substituted it with the following phrase: ' The product was obtained from MyOcean and CNR.' The masking was not performed in this new dataset because it was not affecting the results presented in the paper, the phrase related to this issue has been removed from the text.

- p.1489 - RC: l.18: Gilbert 1987 and El-Shaarawi are not found in the references list.

AR: Gilbert 1987 references and El-Shaarawi et al 2011 have been added in the reference list.

-RC: In note 2: 'the Sea of Azov has'

AR: Corrected

- p.1490 - RC: l.15: 'statistically'

AR: Corrected

- RC: l.21: 'summer values'

AR: Corrected - p.1493 - RC: l.4: 'negative west-to-east' ?

AR: Yes, it the gradient is negative west-to-east, we have corrected as suggested by the referee.

- RC: l.12: '... the values by the satellite products.'

AR: Corrected

- RC: The 2 points introduced at the beginning of Section 3.2 were already given before (Section 2.2, and introduction of Section 3). Please remove the part that is not necessary.

AR: We agree with the referee's comment and we have change the introduction of

section 3.2 as following: In this section we present CSI023 (+) analysis in terms of pan-European trends map (based on the Global Ocean GSM – MyOcean product) and Chl-a area trends in the Mediterranean Sea (based on Med Regional SeaWiFS RAN – MyOcean product)

- p.1494 - RC: In Section 3.2.1, it is worth underlining that the standard deviation of Chla (in mg.m-3) is naturally high in regions of high Chla. Looking at relative changes could give a modified picture.

AR: We agree with the referee and we have added the comment as suggested. We would like to explain that the decision of normalizing the trends by the standard deviation was taken with the aim of taking into account the natural differences between high Chla concentration regions and other regions with low Chla concentration level. This approach allows to provide a unique Pan-European picture of the trends that takes into account the natural differences among the regions and try highlighting the spatial variability of the trends.

We have added the following sentence in line 4 of page 1494 (original pages and lines numbering): 'It is worth underlining that the STD of Chla (mg m-3) is naturally high in regions of high Chla. Looking at relative changes, as we do in CSI023(+), provides a Pan-European picture that highlight the spatial variability of the trends and try to minimize the natural Chla concentration differences among the European Seas.'

- RC: l.24: what is the basis for the selection of some areas? A map of the Mediterranean Sea would be useful to compare with the results of Fig.2.

AR: The specific areas were selected because we thought that it was not proper to show all the graphs of all Chla areas, they were 10 graphs. In the new version of the paper the map of the Chla areas is presented in Annex 1 and this allow the suggested comparison with figures 3 and 4 (new figure numbering). As a consequence of the decision not to use the Med Regional SeaWiFS RAN – MyOcean product in the Black Sea we removed Black Sea Chl-a areas. Moreover since we added the description of



all Chl-a areas in annex one and reduce the number of Chl-areas by removing the once related to the Black Sea we propose to present all the results for all the Chl-a areas in new figure 5.

- RC: l.25: I'd suggest : 'for presentation in Fig.3'.

AR: Corrected

- RC: l.26: '80% of Chla areas do not show significant trends.' : which means for none of the associated grid points? Or for too few?

AR: It means tow few, in fact presenting the results (80% of Chla areas) we selected the Chla areas in which significant trends were shown in a percentage of grid points between 0 and 10%. We have corrected the phrase following the next referee's comment provided for line 1 page 1495. The phrase is also change because we got new results for the new period 1998-2009 and therefore the new phrase is the following: 'The CSI023 (+) Chl-a areas indicator for the Mediterranean Sea shows that about 52% of Chl-a areas do not show significant trends (i.e., significant trends found for less than 10% of the grid points in each area). Increasing Chl-a trends (i.e., found for equal or more than 10% of the grid points in each area) were detected in 9% (12) of the Chl-a areas (in Egypt, Greece, Tunisia, Malta and Turkey coast lines) see Figures 5 e and f.'

- p.1495 - RC: l.1: I'd suggest 'Increasing Chla trends (i.e., found for more than 10%....' if this is what is meant.

AR: Corrected as suggested by the referee, see previous comment's answer.

- RC: l.5: the 2nd 'Strait' to be removed?

AR: Corrected

- RC: In this part, the acronyms should be defined (from a map or a table). Again, the paper should allow for a visualization of the regions.

AR: We agree with the referee and we have added the Chla areas map and table in

annex 1.

- p.1496 - RC: The validation of satellite products (direct comparisons with in situ data) could be better placed after the description of the data, and before the description of trends. Moreover, comparing monthly satellite products and in-situ values in coastal waters is really questionable.

AR: Following the advice of the referee we have placed the section 'Validation against in-situ data' (previously section 4, now section 3) after the section "Data and Methods' (Section 2) and the section 'Results' (Previously section 3, now section 4).

The comparison of monthly values was done only for the Mediterranean since only monthly ocean-colour values were available for the period 2004–2007. In the present version of the paper we are not using any more monthly values for the Mediterranean sea because we took daily products from MyOcean and CNR. We therefore corrected the text of the paper removing the phrase from line 19 to 21 of page 1496. Moreover we explain now in the paper (Section 3 Validation against in-situ data) how the comparison between in situ and satellite products is done: 1) in-situ Eionet observations are regridded on the satellite products spatial grids 2) for each in situ data of a specific day we check if there is a corresponding satellite daily data for that specific day (in the case of the Mediterranean Regional product we decided to enlarge the spatial searching window to 4 grid points) 3) we build a datasets of daily mach-up in situ and satellite data 4) summer and yearly mean values are calculated by averaging all the corresponding in situ and satellite data of the same day for that summer of year.

The comparison is therefore done on summer values built upon corresponding daily values. The section 3 is changed and corrected accordingly whit the usage of the new dataset Med Regional SeaWiFS RAN – MyOcean.

- RC: l.11: The use (and usefulness) of Table 2 is not so clear.

AR: We agree with the comment of the referee and we decided to remove table 2 since



all the information are explained in the Section 3 'Validation against in-situ data'.

- p.1497 - RC: l.1: 'averaged': in space. In time as well?

AR: In time as well, now the text has been removed because was not relevant anymore since we are using daily dataset in the Mediterranean Sea.

- RC: l.7: 'products differ'

AR: Corrected

- RC: l.10-11: 'without rounded at the minutes value': what does this mean precisely? ('without rounded' is incorrect grammatically).

AR: We wanted to explain that in some cases the geographical coordinates of the in situ data were provided only with degree and minutes and with no information on the seconds, though with lower precision. We propose the following rephrasing: 'without precise rounding at the minutes value, and therefore with possible uncertainties on the geographical location of the sampling position.'

- RC: l.15-16: match-ups exhibiting large differences are 'eliminated'. This filtering excludes 16% to 21% of the match-ups, which goes beyond the exclusion of a few outliers. This issue should be better supported. Providing validation statistics for the filtered and unfiltered match-up sets would be appropriate.

AR: Following the referee's comment we decided not to exclude any outlier and provide the unfiltered statistic, we anyhow would like to comment that the quality of the in-situ dataset and the fact that it is mainly coastal might bring, when we compare in situ and satellite data, to a low performance of the ocean colour products in some coastal regions. We therefore propose to remove the part of the text related to the above-mentioned filtering and add the following phrase at line 24 of page 1497 (previous version numbering): 'For this reason we expect that the validation will be worse in some coastal regions.'

Validation figures (5-9) and text have been updated consequently and now include the entire corresponding data with no filtering. Moreover, taking into account a comment of referee#2 we extended the analysis also to the annual period and not only to the summer one.

- p.1498 - RC: 1st paragraph: Fig.5 to 8 could be removed, or at least reduced to 2 by using different colors for the match-ups from different basins. More importantly, validation statistics should be provided with 2 digits for RËĘ2 and slope/intercept of linear regression. They should be completed by the number of points and indicators of differences (typically RMSD and bias). A table containing these statistics for the European seas and each basin would be appropriate. The same point applies to the regional product.

AR: Following the referee's comment we have aggregated the 5-8 figures in 3 figures: the first for the European Seas, the second for the Baltic, North Sea and North East Atlantic, the third for the Mediterranean Sea and Black Sea. We added Black Sea that was erroneously not reported in the previous version of the paper. We also added a table (now table 3) as suggested by the referee. Following the referee#2 comment we include the statistic, in the table 2, for the validation of both full year and summer period and we decided to present in the paper the figure for the validation related to the full year only.

- RC: 2nd paragraph: I am not sure that Test 2 (and Fig.9) is useful. It is for one year and mostly qualitative.

AR: We agree with the referee comment and we have therefore removed the test 2 and Fig.9.

- RC: 3rd paragraph: There are problems of signs with the trends. On the figures, some trends are negative whereas they look positive. Fig.10 to 14 could be combined in one plate. What is the degree of significance of the trends of Fig.10 to 14?



AR: It is true, the figures presented some errors. Moreover the figures were obtained with the filtered datasets that are not used anymore. We propose to remove the figure 10 to 14 and substitute them with two new figures, one is a scatter plot of trend (Sen's slope) (Figure and the second is a map of trend from in situ and satellite.

- RC: l.12: How are summer means and trends computed here? Are all in situ data just averaged for the summer period? Are the satellite products averaged for the locations corresponding to in situ data or for the different basins? Is it possible that the observed trends are partly the result of a varying spatial coverage? It is essential to be very clear about the areas concerned by Fig.10 to 14, and about the matching of satellite and in situ trends, to be able to interpret these results. From Fig.10, one might deduce that Chla increased by 1.6 mg.m-3 over the last 10 years (i.e., more than doubled) for the European seas. The least the authors could do is to comment on that. The fact that the trend obtained for the European seas is larger than the trends obtained for the single basins is puzzling and worth discussing.

AR: The summer mean (now presented in figure 10 and 11) for the chl-a and trends comparison are calculated base on corresponding in situ and ocean colour daily value. For trends comparison, using the unfiltered dataset, we have identified 47 locations in which there were long enough (9 years) time series of corresponding summer mean. It is true that the previously observed trends might be partly the result of a varying spatial coverage, now that we do not aggregate summer mean at basin level we do not take the risk. Now the trends are calculated only for corresponding time series. Figure 10 has been removed because we are not using this validation plot any more in the new version of the paper.

- RC: l.16: 'where no significant trend'

AR: Erased from the paper with figure 11.

- RC: l.17: 'similar': this description is questionable: the trends differ by a factor 2 to 3.5. 4th paragraph: An equivalent to Fig.11 for the regional product appears as a logical

thing to do. The scatter plot on Fig.15 seems to show that there is an overestimate for high Chla values.

AR: The trend validation calculated with the Global Ocean GSM – MyOcean product is now presented in figure 10 and 11. As far as it concerns validation of the Med Regional SeaWiFS RAN – MyOcean product, A new scatter plot is produced and replace figure 15. Now the validation of the regional product is presented in figure 9. The satellite and in-situ chl-a trends comparison is not performed at the level of Mediterranean Chl-a areas because only few corresponding time series are detectable and can not represent the different Chl-a areas.

- RC: l.25: 'preferable with respect'

AR: Corrected

- p.1499 - RC: l.17: 'investigations need to be performed to compare the trends at the level of Chl areas': I would have expected to see some of that in this paper.

AR: The satellite and in-situ chl-a trends comparison is not performed at the level of Mediterranean Chl-a areas because only few corresponding time series are detectable and can not represent the different Chl-a areas. To be clearer on the reason why we did not perform any trend comparison at the level of Chl-a areas we have completed the phrase above as following: '[...]investigations need to be performed to compare the trends at the level of Chl-a areas as well when more coastal in situ chl-a time series will be available or when new, long enough, satellite products produced with coastal algorithm will be available. '

- RC: l.25: 'consist'

AR: Corrected

- References: - RC: Lavender et al and O'Reilly et al are not cited in the paper.

AR: It is true, it was cited in a previous draft of the paper. We now removed it from the



paper references.

- RC: Table 2: Test 1 / Aggregation level: I'd say 'daily'. Test 3: 'at the level of European seas' 'no significant trend is detected' Test 4 / Aggregation level: 'daily' or 'monthly'?

AR: Table 2 has been removed from the new version of the paper.

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Interactive comment on Ocean Sci. Discuss., 9, 1481, 2012.