User Requirements for the Remote sensing of Eutrophication in the 2Seas coastal waters

ISECA

Abstract:
This document summarizes the results from the consultation of users regarding their requirements of the remote sensing for monitoring of eutrophication in coastal waters.

FINAL

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1 INTRODUCTION

The importance of the coastal zone in the 2Seas area is related to the large amount of economic activities, exploitation of resources and food, as well as its role as an area of settlement and recreation. However, it is also subjected to high anthropogenic stresses. One of the pressures on coastal ecosystems is due to increased supply of nutrients from land or atmospheric sources that may lead to anomalous growth of phytoplankton. This phenomenon is known as eutrophication, which is a major cause of the decreasing Water Quality (WQ) in the North Sea and English Channel.

The ISECA project was designed to develop products from ocean colour remote sensing to monitor eutrophication. However, in order to provide satellite products that are "fit-for-purpose", the potential users need to be identified and consulted. An additional aim of this dialogue between remote sensing scientists and users is to raise awareness of the satellite products and inform potential users on the current and future capabilities. Satellite products can support eutrophication monitoring in the frame of the environmental legislation (European Union Water Framework Directive and Marine Strategy Framework Directive), and there are recent examples of this approach in the scientific literature (Novoa *et al.*, 2012).

This report summarises the results from a user consultation exercise performed in order to refine and adjust the ocean colour products needed to become the tools for monitoring eutrophication in coastal areas. In order to provide a wider view of the requirements from the community, the report additionally presents the results from other two consultations, driven by the European Space Agency: the Coastcolour and the Ocean Colour Climate Change Initiative. This is very valuable and important since many users may feel that they have been consulted too often so taking account of recent, relevant questionnaires adds to the knowledge base of ISECA.

In-situ monitoring requirements from the current legislation on eutrophication (OSPAR 2003) are detailed to provide end-users with a guide to the biogeochemical parameters that should be monitored. This also facilitates identification of potential datasets from monitoring agencies and research institutes that could be used both to monitor eutrophication in the coastal zone and to validate satellite products.

2 RESULTS FROM PREVIOUS CONSULTATIONS ON OCEAN COLOUR

2.1 The ESA- CoastColour user consultation

The CoastColour project (http://www.coastcolour.org/) was intended to improve user uptake of ESA's MERIS mission for applications in the coastal zones by developing, demonstrating and validating the latest advanced techniques for retrieving information on water constituents. In particular, the project aimed to address the needs of:

•scientists studying the bio- and geophysical processes in coastal waters, and

•companies and government agencies who specialise in providing water quality information services (for example to the aquaculture industry, local authority water quality managers, etc.)

During the CoastColour User Consultation (Cork, 19-20 March 2009, see http://dup.esrin.esa.it/news/news176.asp) general requirements were identified by the participants for the development and demonstration of the advanced use of MERIS for monitoring water constituents in typically Case 2 coastal waters. These requirements covered a range of user applications, including: coastal ecosystem research, early warning for aquaculture, sediment transport, water quality and pollution monitoring.

For this project, a representative group of members of the coastal ocean colour user community was actively involved. These so-called "champion users" were asked to provide written feedback refined by one-to-one telephone interviews. The full results of the consultation are published elsewhere (Coastcolour, 2010), and a summary of the conclusions, relevant to ISECA, is presented hereafter.

- High spatial resolution was important near the coast (up to 1 nm offshore) for the fulfilment of monitoring requirements under the Water Framework Directive (WFD). However, it was noted that the current ocean colour sensors do not fulfil this requirement. Further offshore, spatial resolution was not such a strong requirement. Reduced spatial resolution imagery could be used to fill in (spatial) gaps (due to technical issues, not clouds). The need for high temporal sampling frequency (i.e. less than 1 week) was not perceived as important by users (i.e. weekly imagery would be sufficient). However, large gaps in the data were to be avoided in long time series studies (for use in the Marine Strategy Framework Directive, MSFD). For these applications, the gap-filling with reduced resolution images mentioned above could be used. Data distribution was

preferred on-line as currently done from the NASA websites sites (http://disc.sci.gsfc.nasa.gov/giovanni/overview/index.html).

- The responses from users highlighted 25 coastal areas around the globe where 26 different parameters were of considered of interest. The scientific products requirements include inherent optical properties (IOP), apparent optical properties (AOP), Chlorophyll-a concentration, phytoplankton biomass, phytoplankton types and primary production, however, no level of accuracy or precision was specified for each product.
- Finally, two important characteristics for the remote sensing of coastal products emerged from the Coastcolour report: first, the necessity to apply regional parameterisations to the global algorithms in each geographic area (or optical water type). Second, the acknowledgement of the need of uncertainty estimates in satellite products.

2.2 The ESA-Climate Change Initiative user consultation

Ocean-colour data are used in climate research from a variety of perspectives. Funded by the European Space Agency, the Climate Change Initiative (CCI, http://www.esa-cci.org/) was set to integrate satellite data from different remote sensing sources. Concerning ocean colour, one of the first activities was to do a user consultation to refine the characteristics of the data to be produced by the CCI-ocean colour project. In the consultation process, the broadest view possible was taken on the current and potential uses of ocean-colour data in climate-related studies. The study targeted the biogeochemical modellers and the remote sensing scientists. The full results of the consultation are published elsewhere (Sathyendranath, 2011), and a summary of the conclusions, relevant to ISECA, is presented hereafter.

- The user consultation was made through a meeting and a user survey. The responses revealed that requirements vary according to the type of model used for the modeller community. For example, spatial resolution of images for use in regional models needs to be in between 4 and 25 km, and temporal resolution between 1 day and 1 week. The timeliness of product delivery is required within 1 day of data acquisition for operational models, which are mostly used in coastal waters.

- Error specification was considered important by nearly all the users. Error reduction was considered desirable, but there was lack of clarity on what might be feasible in the near term (3 – 5 years).
- Many Earth Observation scientists are now using ocean-colour data directly in climate studies, but data are also relevant for studies of eutrophication according to the MSFD. For those using trend analysis, stability was very important, but characteristics, at the level of the satellite, is unknown (non-linear relationship between satellite signal and chlorophyll concentration, the high dynamic range in chlorophyll concentration, the log-normal distribution of chlorophyll in the field, all combine to make the answer difficult to establish).
- In general, the climate change research user community requires long-term, reliable, quality-controlled, stable products. As the length time series increases, its value augments considerably. As a long-term goal, it is desirable to have algorithms that work seamlessly across Case 1 and Case 2 waters. There was general interest in additional products from ocean colour that are currently emerging such as information on particle size structure, phytoplankton functional types and measures of concentrations of coloured dissolved organic matter.

3 RESULTS FROM THE ISECA USERS CONSULTATION

3.1 The approach

The user consultation presented herein had the goal of identifying requirements of ocean-colour data for eutrophication monitoring at present, and in the near future. The user requirements identified by the ESA-Coastcolour and Climate Change Initiative Ocean Colour were taken as the starting points for the survey. PML is a partner in those projects and had a first-hand knowledge of the process and outcomes, which helped with the definition of the questionnaire as well as its design. The communication with other partners within ISECA was particularly useful to define the community of users. The survey contained questions that addressed the requirements of the scientific community (remote sensing specialists) and policy makers and scientific advisors who used ocean-colour data directly to monitor eutrophication in the coastal ecosystem.

3.2 . The process

Users were consulted through various approaches: the input from experts in ocean-colour techniques and scientific advisers were solicited through a distribution list created through the ISECA A1.1 (The Great Inventory), which included nearly 100 contacts distributed across the 2Seas area, in Belgium, France, The Netherlands and United Kingdom. In addition, some individuals were contacted personally by e-mail and through one-to-one meetings seeking their inputs.

The questionnaire was a web-based survey circulated through a link in an invitation letter translated into the three languages (APPENDIX I). The design of the questionnaire was through consultation with internal project partners as well as with selected users.

The results from the report combine the one-to-one interviews results and the results from the online questionnaire. It concludes with the summary from the requirements derived from the Coastcolour, Climate Change Initiative and ISECA users' consultations.

3.3 . The results

The on-line questionnaire (APPENDIX II) had three main parts. The first gathered information about the respondent population. UK and Belgium policy advisers and scientists (non-remote sensing specialists) provided input. The responses highlight the expected different requirements for the two types of users and are summarised in Table 1

Table 1: Responses collected in the on-line questionnaire. Italic characters highlight the differences among profiles

Chlorophyll	***Scientist***	***Scientific advisor***
Spatial aggregation	*-No average - one image* -2 average (numerical) values one < 1nm and one between 1nm and the limit of EEZ	-2 average (numerical) values one < 1nm and one between 1nm and the limit of EEZ
Temporal aggregation	*-No average - one image* -Weekly composites *-Monthly composites*	-Weekly composites
Uncertainty	-Important *- [10 -25] % relative error*	-Important -[25 -50] % relative error

Justification	"*we want to use EO data to validate and extrapolate from our time series of phytoplankton development along the Belgian coast. A too large degree of uncertainty will prevent such analyses*"	"*not sure what the incidence of error is - but > 50 would make the data difficult to use*"

- It can be appreciated that requirements for chlorophyll concentration products are more stringent in the amount (full images provided with no averages) and in the quality (lesser error tolerance) for scientific users than for scientific advisors. The interview with Dr. A.McQuatters-Gollop (UK scientific advisor for eutrophication in the MSFD), confirmed the views of the scientific advisor from the on-line questionnaire.
- It was suggested, in addition, that for every composite level (i.e. spatial average values or monthly means) a measurement of the dispersion would be useful (e.g. standard deviation of the mean) as a measure of the aggregated value variability. During the interviews it also emerged that long term time trends should be produced, to be used in eutrophication assessment using upcoming legislation (MSFD).
- The requirements on suspended particulate matter (SPM), primary production and colour scale system were the same as for the Chlorophyll concentration product. One user highlighted that "*Primary production is difficult and time consuming to monitor in the lab and spatial coverage can be poor. Useful if this could be done using remote sensing*".
- Contributors were given the possibility to suggest other products from satellite. The scientific advisor proposed: "*monitoring different types of chlorophyll or pigments in phytoplankton blooms so that harmful blooms can be tracked*". This user requests the same characteristics for this product as for the Chlorophyll.
- Concerning the distribution of data there was an agreement among both types of users on the level of processing: only Level 2 and Level 3 products were required. There was also agreement on the data format (i.e. ASCII comma separated) and on the way to access data (i.e. web based). A higher frequency of data delivery (i.e. weekly data) was required for the scientific advisor, whereas the scientist required data only once a year. This is consistent with the aims of the use of data for each type of user. The one-to-one interviews confirmed all the data access and format requirements except the frequency of data delivery, where for environmental assessments (not in real time), data are only required yearly.

4 SUMMARY OF REQUIREMENTS FROM REMOTE SENSING

Distinct requirements emerged from the ISECA consultation, as a result of targeting different categories of users than in previous consultations (i.e. scientific advisors rather than scientists).

- One difference was the level of spatial aggregation required. From the responses to the questionnaire and the one-to-one interviews it emerged that scientific advisors required **condensed spatial information representative of large areas**. This has to be produced weekly or monthly and preferably avoiding large temporal gaps which could be filled with reduced resolution imagery (see Section 2.1). **Satellite data are also required close to the coast** (<1 nm away from the coast), where the current technological capabilities of the satellites and processing issues (atmospheric correction, adjacency effects and bottom effects) may not allow for reliable imagery to be produced.
- **Trends and inter-sensor consistency** (Section 2.2) was not only important for climate related studies. Legislation (e.g. MSFD) addresses whole ecosystem for the assessment of impacts. This approach requires information about shifts in the state of the ecosystem to be able to, periodically, revise definitions of good environmental status and targets according to these shifts. Uncertainty estimates were recognised as important with a tolerance level dependent on the specific use of the data (i.e. scientific applications required greater product accuracy).
- Concerning data delivery and format, there was a strong agreement in both communities on the need of **accessible satellite data over the internet**. The format of the data is preferably ASCII, so that can be readily interpreted with spreadsheet programs (such as MS Excel).
- Overall, the recommendations from this report have to be carefully weighed by the small response rate from the users. However, greater involvement of the user community is expected during the lifespan of the ISECA project, along which additional user requirements will be collected.

5 SUMMARY OF REQUIREMENTS FOR IN-SITU MONITORING

To date there has been a number of European directives that provide legislation and guidance on indicators of and levels of these to detect eutrophication. These include: EU Habitats Directive (CEC, 1992), EU Nitrates Directive (CEC, 1991a), EU Urban

Wastewater Treatment Directive (CEC, 1991b), EU Water Framework Directive (CEC, 2000) and the Marine Strategy Framework Directive (2008/56/EC). The latest assessment of the eutrophication in the UK coasts (Charting Progress 2, http://chartingprogress.defra.gov.uk/clean-seas-eutrophication), uses the definitions of the parameters to monitor eutrophication that are set out by the OSPAR Strategy to combat Eutrophication. The parameters are summarized in the Common Procedure for the Identification of the Eutrophication Status of the OSPAR Maritime Area:

"They consist of five assessment parameters and their assessment levels as defined by the Common Procedure and have been developed to form an integrated set of Ecological Quality Objectives (EcoQOs) for eutrophication for the North Sea with the overarching objective that all parts of the North Sea should have the status of non-problem areas with regard to eutrophication by 2010, as assessed under the Common Procedure". (Charting Progress 2).

The EcoQOs are summarized in Table 2 and include the above cited European Legislation.

Table 2: Ecological Quality Elements and Objectives for monitoring and assessing the biological response to nutrient enrichment (Bergen Declaration, 2002: Annex 3, Table B, as cited in Charting Progress 2 - Eutrophication)

Ecological quality element	*Ecological quality objective*
(m) Changes/kills in zoobenthos in relation to eutrophication	There should be no kills in benthic animal species as a result of oxygen deficiency and/ or toxic phytoplankton species
(q) Phytoplankton chlorophyll a	Maximum and mean chlorophyll a concentrations during the growing season should remain below elevated levels, defined as concentrations > 50% above the spatial (offshore) and/or historical background concentration
(r) Phytoplankton indicator species for eutrophication	Region/area - specific phytoplankton eutrophication indicator species should remain below respective nuisance and/or toxic elevated levels (and increased duration)
(t) Winter nutrient concentrations (dissolved inorganic nitrogen (DIN) and dissolved inorganic phosphate (DIP))	Winter DIN and/or DIP should remain below elevated levels, defined as concentrations > 50% above salinity-related and/or region-specific natural background concentrations
(u) Oxygen	Oxygen concentration, decreased as an indirect effect of nutrient enrichment, should remain above region-specific oxygen deficiency levels, ranging from 4–6 mg oxygen per liter

To reach these objectives a series of parameters need to be assessed proposed by the OSPAR Comprehensive Procedure (Table 3).

Table 3: Harmonised Assessment criteria within OSPAR Comprehensive Procedure (from Charting Progress 2)

Assessment parameter	
Category I: Degree of nutrient enrichment	*1. Riverine total N and total P inputs and direct discharges (RID)* Elevated inputs and/or increased trends (compared with previous years) *2. Winter DIN- and/or DIP concentrations* Elevated level(s) (defined as concentration >50% above salinity-related and/or region-specific background concentration) *3. Increased winter N/P ratio (Redfield N/P = 16)* Elevated *cf* Redfield (>25)
Category II: Direct effects of nutrient enrichment (during the growing season)	*1. Maximum and mean chlorophyll a concentration* Elevated level (defined as concentration >50% above spatial (offshore) / historical background concentrations) *2. Region/area specific phytoplankton indicator species* Elevated levels (and increased duration) *3. Macrophytes including macroalgae (region specific)* Shift from long-lived to short-lived nuisance species (e.g. *Ulva*)
Category III: Indirect effects of nutrient enrichment (during the growing season)	*1. Degree of oxygen deficiency* Decreased levels (<2 mg/l: acute toxicity; 2–6 mg/l: deficiency *2. Changes/kills in zoobenthos and fish kills* Kills (in relation to oxygen deficiency and/or toxic algae) Long-term changes in zoobenthos biomass and species composition *3. Organic carbon/organic matter* Elevated levels (in relation to III. Relevant in sedimentation areas)
Category IV: Other possible effects of nutrient enrichment (during the growing season)	*1. Algal toxins (DSP/PSP mussel infection events)* Incidence (related to II.2)

There are three refinements to the monitoring parameters that have been identified. Firstly concerning the phytoplankton types that could be used in the detection of eutrophication (Devlin *et al.*, 2007), in Category II.2, it has been identified that the abundance of *Phaeocystis spp.* (cells l^{-1}) should be monitored (if possible to the species level). Secondly, suspended particulate matter (SPM, in gm^{-3}) has been identified as well as a potential eutrophication indicator of the total suspended load, with the advantage that can be retrieved from remote sensing tools. In addition, OSPAR recognise that some areas are especially sensitive to eutrophication processes and respond with enhanced primary production. Increases in algal growth as a result of enhanced production linked to eutrophication may lead to a range of undesirable disturbances in the marine ecosystem such as the oxygen depletion, which can cause the death of fish and other species and significant shifts in the composition of the flora and fauna affecting habitats and biodiversity. If available, primary production and oxygen would also be desirable. Whilst OSPAR assessment criteria are currently recognised as the bench mark criteria by EU member states, not all countries measure the parameters required to monitor eutrophication at the European

level. In addition, continual review of the parameters required for eutrophication is envisaged in the EU Marine Strategy Framework Directive (2008/56/EC).

ACKNOWLEDGEMENTS

The ISECA team contributed with comments to the design of the questionnaire. The one-to-one discussions with Dr. A. McQuatters-Gollop (SAHFOS, UK) were instrumental for the design of the questionnaire and her views were used in this report to verify the questionnaire responses. Dr. W.Vyverman and an anonymous colleague are gratefully acknowledged for their inputs to the questionnaire. Feedback from scientific advisers in the Marine Management Organisation (UK) is also acknowledged here: P. Almada-Villela and D. Hume. The authors acknowledge funding from the European Union contract Information System on the Eutrophication of our Coastal Seas (ISECA) (Contract no. 07-027-FR-ISECA) funded by INTERREG IVA 2 Mers Seas Zeeen Cross-border Cooperation Programme 2007 – 2013.

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TABLE of ACRONYMS

Acronym	*Meaning*
NASA	National Administration of Space and Aeronautics
ESA	European Space Agency
MSFD	Marine Strategy Framework Directive
WFD	Water Framework Directive
SeaBASS	SeaWiFS Bio-optical Archive and Storage System
MERIS	Medium Resolution Imaging Spectrometer

APPENDIX I: Invitation to participate in the Questionnaire (English, French and Dutch)

Dear User, Plymouth, 22nd June 2012

Ocean Colour (OC) is the variable for the monitoring of eutrophication in coastal waters accessible to remote sensing. Access to reliable OC data will be crucial to increase spatial coverage and frequency of observations in order to match requirements of the EU Water Framework Directive and the upcoming Marine Strategy Framework Directive, without large economic cost.

OC from coastal waters will be studied under the umbrella of the **'Information System on the Eutrophication of our Coastal Areas '** (ISECA, http://www.iseca.eu) of **INTERREG IVA 2 Seas**. The ISECA project is intended to improve the ocean-colour products in general, and European Space Agency (ESA) - MERIS satellite products in particular, to a standard useful for monitoring coastal eutrophication. Over a three-year period, the ISECA project scientists and collaborators will be working on the development, validation and selection of algorithms for processing ocean-colour images in coastal waters and make them accessible to monitoring agencies and policy makers.

It is also the goal of the project to improve the interactions between the ocean-colour specialists and the user community, especially monitoring agencies, policy advisors and policy makers. As part of this process, we are carrying out a survey to evaluate how well ocean-colour products meet the needs of eutrophication monitoring agencies currently, and to establish what the priorities should be for further developments over the next two to three years, to enhance user engagement.

We hope you will be able to spend some 10 minutes to complete the online survey:

https://docs.google.com/spreadsheet/viewform?fromEmail=true&formkey=dENNNllMRlJiMDgxX3pESjZYdkhockE6MA

by 24th July 2012

Whenever possible, please provide justification for your answers in a few words. You only need to answer questions you are comfortable answering. Your response is important: you can help shape ocean-colour research and applications for eutrophication studies. We appreciate your co-operation.

Thanking you,

Yours sincerely,

Victor Martinez Vicente on behalf of the ISECA team.

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Appendix I : **Summary of the ISECA project**

The objective of this project is **to develop and publicise a prototype platform that combines in-situ, Earth Observation (EO) data and ecosystem models to monitor eutrophication in European coastal waters.** Eutrophication as defined by OSPAR is *"the enrichment of water by nutrients, especially nitrogen and/or phosphorus, causing an accelerated growth of algae and higher forms of plant life to produce an undesirable disturbance to the balance of organisms in the water and to the quality of water"*. According to the 2007 OSPAR Common Procedure assessment the **Southern North Sea** was identified as a "problem area" with high eutrophication regions, whilst the **Western Channel** is typically a "nonproblem" area with certain local regions under review. Both of these areas are covered by the INTERREG 2Seas Program and will be used in this project **to illustrate to the general public the impact of eutrophication on coastal ecosystems**.

The final product of the project will be a **web-based information platform**. A number of building blocks will be used to construct this tool. Firstly, the OSPAR description of eutrophication requires an operational **definition of indicators** of *"accelerated growth"* and *"undesirable disturbance"* [1]. An end-user consultation will therefore be carried out to identify the most appropriate and desirable indicators from in-situ, EO and ecosystem models.

Second, recently available full resolution EO ocean colour (i.e. 300 m per pixel) is a powerful complementary tool to identify possible eutrophic coastal areas [2]. An investigation will be carried out to to produce the best quality indicators and map eutrophication in the coastal zone on full resolution images by *reducing the uncertainties in the atmospheric correction*, by *exploring solutions to the adjacency effects of land* and by *developing in-water algorithms*.

Thirdly, **in-situ measurements** will produce data to validate and quantify the errors in the satellite maps. These data, provided by all project partners, will be combined in a **database** for the Western Channel [3, 4] and the Southern North Sea. **Harmonization of measurement protocols and data processing** will be implemented to ensure consistency. This dataset will include optical data (both atmospheric and in-water), for validating and improving EO imagery, as well ecological indicators of eutrophication, such as primary production [1] which can be estimated from EO data in coastal areas [5].

Fourth, robust EO maps of indicators will be then combined with pre existing **ecosystem model** that have the capability of detecting and predicting eutrophication events. Based on scientific feedback from user groups and using EO based maps for verification of the model, the quality of the eutrophication models will be improved.

The final task of the project will be the construction of the prototype **web-based information platform** and the demonstration to both stakeholders and scientists. The interaction with different coastal functions such as beach recreation, fisheries and aquaculture will be showcased for a few selected test 'problem' locations. This tool will be versatile enough to be expanded in the future with new data and models.

A steering committee will be established to monitor the progress of the project and provide regular feedback from the end-user. Assessments will be made to ensure that the information platform meets the demands of the public, monitoring agencies and researchers.
ISECA combines research with the latest technology to produce a user friendly demonstrative product to locate and quantify eutrophication in the coastal area, for both scientific and non-scientific applications.

References

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Cher utilisateur,

Plymouth, le 22 juin 2012

La couleur de l'eau est un paramètre de suivi de l'eutrophisation des eaux côtières, accessible à l'aide de la télédétection spatial. Des données satellitales fiables permettront à faible cout de disposer d'observations fréquentes de bonne couverture spatiale de manière à répondre aux impératifs de la directive cadre sur l'eau de la CE et de ceux à venir de la directive cadre sur le milieu marin.

Dans le cadre du projet **'Information System on the Eutrophication of our Coastal Areas '** (ISECA) de l'**INTERREG IVA 2 Mers** (http://www.iseca.eu/fr/)., nous étudions cette couleur de l'eau en eaux côtières. ISECA se propose d'améliorer en général les produits « couleur de l'eau » et en particuliers ceux de MERIS, capteur satellitaire de l'Agence Spatiale Européenne. Dans le cadre de l'eutrophisation côtière, on proposera des paramètres standards utiles au suivi de l'eutrophisation côtière. Durant les 3 années du projet, nos scientifiques et collaborateurs travailleront à la sélection, à l'amélioration et à la validation d'algorithmes de traitement de la couleur de l'eau. Ces données seront disponibles aux acteurs chargés de veiller à la qualité des eaux côtières.

Afin d'améliorer la collaboration entre la communauté scientifique de la couleur de l'eau et la communauté en charge de la gestion des eaux côtières, nous menons une enquête pour évaluer l'adéquation entre les produits couleur de l'eau et leur utilité auprès des gestionnaires. Nous voulons établir quelles sont les priorités des utilisateurs auxquelles nous devons répondre dans le cadre d'ISECA.

Nous espérons que vous serez disponible une dizaine de minutes pour répondre à notre enquête en ligne:

https://docs.google.com/spreadsheet/viewform?fromEmail=true&formkey=dENNNllMRlJiMDgxX3pESjZYdkhockE6MA

avant le 24 juillet 2012

Dans la mesure du possible, vous voudrez bien justifier vos réponses en quelques mots. Vous n'aurez pas à répondre si vous n'êtes pas à même de le faire. Vos réponse sont importantes pour cadre nos recherches et leurs applications et nous apprécions votre collaboration.

En vous remerciant

Bien sincèrement,

Victor Martinez Vicente avec l'accord de l'équipe ISECA.

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Annexe : **Résumé du projet ISECA**

L'objectif principal d'ISECA est de **développer et de rendre public un prototype de plate forme qui combine données in situ et satellitaires avec des modèles de l'écosystème** dans le cadre d'un suivi de l'Eutrophisation dans nos eaux côtières. Selon OSPAR, l'eutrophisation est définie comme *«l'enrichissement de l'eau par des éléments nutritifs (principalement nitrogène et phosphate) causant une prolifération d'algues qui nuit à l'équilibre de l'écosystème et à la qualité des eaux »*. En vertu du constat de l'OSPAR en 2007 [1] la partie septentrionale de la **Mer du Nord** fut identifiée comme problématique tandis que la **Manche Occidentale** est non problématique à l'exception de quelques zones à surveiller. Ces deux zones du programme INTERRG 2Mers seront utilisées dans ISECA pour illustrer à usage du grand public de l'impact de l'eutrophisation sur les écosystèmes.

Dans la plate forme web d'ISECA, on va premièrement inclure des indicateurs opérationnels d'eutrophisation. Notre enquête vise donc à définir avec l'aide des utilisateurs ces indicateurs, utiles pour la surveillance et la modélisation, qui seront produits en combinant mesures in situ et télédétection.

Les données télédétection à 300m de résolution spatiale permettent une meilleure identification des zones eutrophisées [2]. La qualité des indicateurs doit résulter d'une amélioration des produits en réduisant les erreurs sur *les corrections atmosphériques, en ajoutant la corrections des effets d'environnement et en développant des algorithmes d'interprétation de la couleur de l'eau.*

Une base de données in situ, en Manche [3,4] et Mer du Nord. sera réalisées avec la participation des partenaires afin de valider et de quantifier les erreurs des données spatiales. L'harmonisation des protocoles de mesures et de leur traitement sera implantée par soucis de cohérence. Les données optiques, marines et atmosphériques, seront utilisées pour la validation et l'amélioration des produits satellitaires. On y ajoutera des indicateurs écologiques de l'eutrophisation, tel que la production primaire estimée à l'aide des données spatiales [5].

Enfin, les cartes d'indicateurs issues de la télédétection, seront combinées avec des modèles d'écosystème afin de détecter et de prédire les épisodes d'eutrophication. En combinant analyse scientifique et utilisation de la télédétection spatiale, on espère ainsi améliorer la modélisation.

Notre plate forme web servira de démonstration dans des cas choisis par leur pertinence par rapport aux usages économiques du milieu côtier: tourisme, pêche, aquaculture. Cet outil sera par construction capable d'évoluer en incluant des nouvelles données et des nouveaux modèles.

Un comité de suivi nous aidera à évaluer les progrès réalisés et nous fournira le regard des utilisateurs. Ses vues nous permettrons de mieux répondre à la demande des publics concernés par l'utilisation de notre plateforme web.

ISECA combine recherche et technologie dans la réalisation de l'illustration qualitative et quantitative de l'eutrophisation de nos eaux côtières à usage d'applications scientifiques ou noon.

Références

[1] Andersen et al. (2006), JPR, 28(7), pp 621-628; [2] Shutler et al. (2007), RSE,107(4), pp 521-532; [3] Groom et al. (2009), JMS , 77(3), pp 278-295; [4] Martinez-Vicente et al. (2010), JPR , 32(5), pp 603-619; [5] Tilstone et al. (2005), JPR , 27(10), pp 1-22.

Cross-border cooperation programme 2007-2013 part financed by ERDF

Beste gebruiker, Plymouth, 22nd Juni 2012

Ocean Colour (OC) is de variabele voor de monitoring van eutrofiëring in kustwateren via remote sensing. Toegang tot betrouwbare OC data zal belangrijk zijn indien voldaan dient te worden aan de vereisten van de EU Water Framework Directive en de Marine Strategy Framework op vlak van ruimtelijke spreiding en frequentie van waarnemingen en dit met een lage economische kost.

OC in kustwateren zal bestudeerd worden in het kader van het **INTERREG IVA 2 Seas** project **'Information System on the Eutrophication of our Coastal Areas '** (ISECA, http://www.iseca.eu/nl/). ISECA richt zich op het verbeteren van ocean-colour producten, meer specifiek op de European Space Agency (ESA) - MERIS satelliet producten, naar een standaard voor de monitoring van eutrofiëring. Gedurende 3 jaar zal het ISECA consortium werken aan de ontwikkeling, validatie en selectie van algoritmes om de ocean-colour beelden van kustzones te verwerken en beschikbaar te maken voor meetinstituten en beleidsmakers.

Doel van het project is om de interactie tussen de ocean-colour specialisten en de gebruikers gemeenschap te bewerkstelligen. Als deel van dit proces, voeren we een bevraging uit om te evalueren hoe de ocean-colour producten vandaag de noden van de gebruikers dekt en wat de prioriteiten zijn binnen een verdere ontwikkeling van de producten de komende 2 tot 3 jaar.

We hopen dat je 10 minuten kan vrijmaken om deze online bevraging in te vullen:

https://docs.google.com/spreadsheet/viewform?fromEmail=true&formkey=dENNNllMRlJiMDgxX3pESjZYdkhockE6MA

tegen 24th Juli 2012

Indien mogelijk zouden we het appreciëren elk antwoord te verantwoorden in een aantal woorden. U dient enkel die vragen te beantwoorden waar u zich geroepen voelt.
Uw antwoord is belangrijk: u kunt ons helpen om het ocean-colour onderzoek en de applicaties waarmee eutrofiëring bestudeerd kan worden mee vorm te geven.
We waarderen uw medewerking hierin.

Alvast bedankt,

Vriendelijke groeten,

Victor Martinez Vicente in naam van het ISECA team.

Appendix I : **Samenvatting van het ISECA project** (*http://www.iseca.eu*)

ISECA combineert onderzoek met een innovatieve technologie om een gebruiksvriendelijk en demonstratief product te produceren waarmee eutrofiëring in kustgebieden kan gelokaliseerd en gekwantificeerd worden door een zowel wetenschappelijk als een niet wetenschappelijk publiek.

Eén van de doelstellingen van het project is de ontwikkeling en publicatie van een prototype platform dat **in-situ, Aard observatie (AO) data en ecosysteem modellen combineert om zo de eutrofiëring van Europese kustwateren op te volgen.** Eutrofiëring wordt door OSPAR omschreven als *"the enrichment of water by nutrients, especially nitrogen and/or phosphorus, causing an accelerated growth of algae and higher forms of plant life to produce an undesirable disturbance to the balance of organisms in the water and to the quality of water"*. Volgens de 2007 OSPAR Common Procedure evaluatie werd de Zuidelijke Noordzee geïdentificeerd als een "probleemgebied" met sterk geëutrofieerde gebieden, terwijl de Westelijk Kanaalzone als een typisch "niet-probleem" zone met enkele op te volgen lokale regio's, wordt beschouwd. Beide regio's behoren tot de INTERREG 2Seas gebieden en zullen in dit project gebruikt worden om de impact van eutrofiëring op onze kustecosystemen te illustreren.

ISECA beoogt de opzet van een **web-based informatie platform**. Aan de hand van bouwstenen zal een tool uitgewerkt worden. De OSPAR omschrijving van eutrofiëring vereist een definitie van indicatoren *"versnelde groei"* en *"onwenselijke verstoring"* [1]. Om de geschikte indicatoren voor in-situ metingen , AO data en ecosysteemmodellen te identificeren zullen eindgebruikers geconsulteerd worden.

Ten tweede zal onderzoek verricht worden om indicatoren van hoge kwaliteit uit te werken en de eutrofiëring in kustgebieden in kaart te brengen aan de hand van hoge resolutie beelden. Recent beschikbare AO Ocean Colour beelden in hoge resolutie (i.e. 300 m per pixel), vormen namelijk een krachtige tool om potentiële geëutrofieerde kustgebieden te identificeren [2]. Onder andere *'uncertainties' bij atmosferische correctie* zullen verminderd worden, oplossingen zullen gezocht voor de *'adjacency effects'* van land en *in-water algorithmes* zullen ontwikkeld worden.

Ten derde zullen aan de hand van **in-situ metingen** validaties uitgevoerd worden en bepalingen van fouten in de satelliet kaarten. Deze data, aangeleverd door alle project partners, zullen geïntegreerd worden in een **databank voor de Westelijke kanaalzone** [3, 4] en de **Zuidelijke Noordzee**. **Harmonisatie van meet protocols en data verwerking** zullen geïmplementeerd worden om afstemming te verzekeren. Deze databank zal zowel optische data (atmosferisch en waterkolom) voor de validatie en de optimalisatie van de AO beelden bevatten, als ecologische indicatoren voor eutrofiëring, zoals primaire productiviteit [1. Primaire productiviteit zal afgeleid worden van de AO data van de kustgebieden [5].

Ten vierde zullen robuuste AO kaarten van indicatoren gecombineerd worden met **ecosysteem modellen** die eutrofiëring kunnen opsporen en voorspellen. Aan de hand van de terugkoppeling met gebruikersgroepen en het effectieve gebruik van de AO kaarten voor de verificatie van de modellen, zal de kwaliteit van de modellen geoptimaliseerd worden.

Een laatste taak is het uitbouwen van het prototype van het **web-based informatie platform**. Dit platform zal gedemonstreerd worden aan zowel stakeholders als wetenschappers. De interactie met verschillende kustactiviteiten zoals strandrecreatie, visserij en aquacultuur zal uitgewerkt worden voor enkele 'probleem' locaties. Dit platform zal flexibel genoeg zijn om in de toekomst uitbreiding met nieuwe data en modellen toe te laten.

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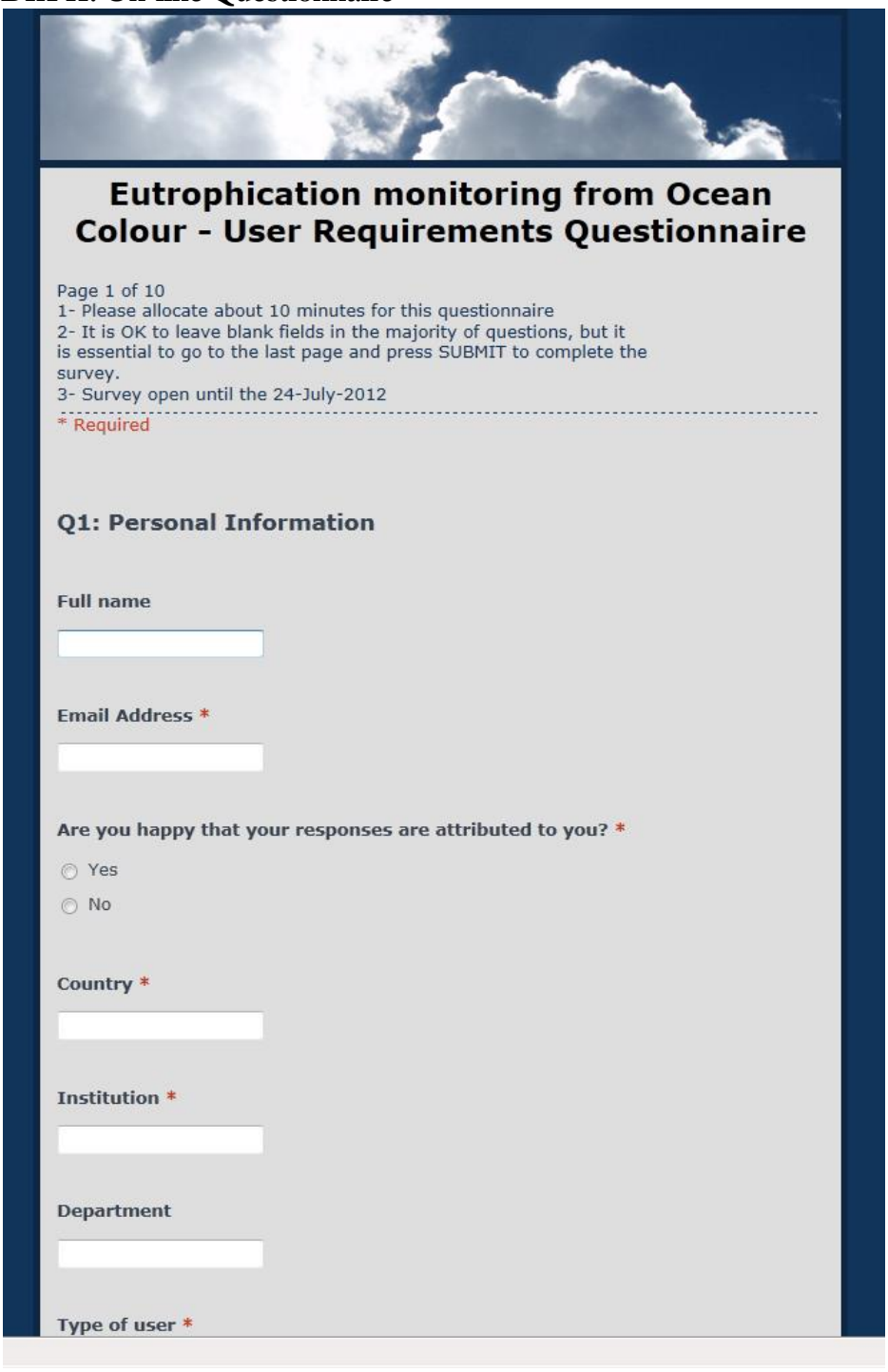
Een stuurgroep werd opgericht om de voortgang van het project op te volgen en op regelmatige basis terug te koppelen vanuit de gebruikers gemeenschap. Evaluaties zullen uitgevoerd worden om te verzekeren dat het informatie platform tegemoet komt aan de noden van het publiek, de beleidsmakers, de meetinstituten en de wetenschappelijke gemeenschap.

References

[1] Andersen et al. (2006), JPR, 28(7), pp 621-628; [2] Shutler et al. (2007), RSE,107(4), pp 521-532; [3] Groom et al. (2009), JMS , 77(3), pp 278-295; [4] Martinez-Vicente et al. (2010), JPR , 32(5), pp 603-619; [5] Tilstone et al. (2005), JPR , 27(10), pp 1-22.

APPENDIX II: On-line Questionnaire



Eutrophication monitoring from Ocean Colour - User Requirements Questionnaire

Page 1 of 10
1- Please allocate about 10 minutes for this questionnaire
2- It is OK to leave blank fields in the majority of questions, but it is essential to go to the last page and press SUBMIT to complete the survey.
3- Survey open until the 24-July-2012

* Required

Q1: Personal Information

Full name

Email Address *

Are you happy that your responses are attributed to you? *

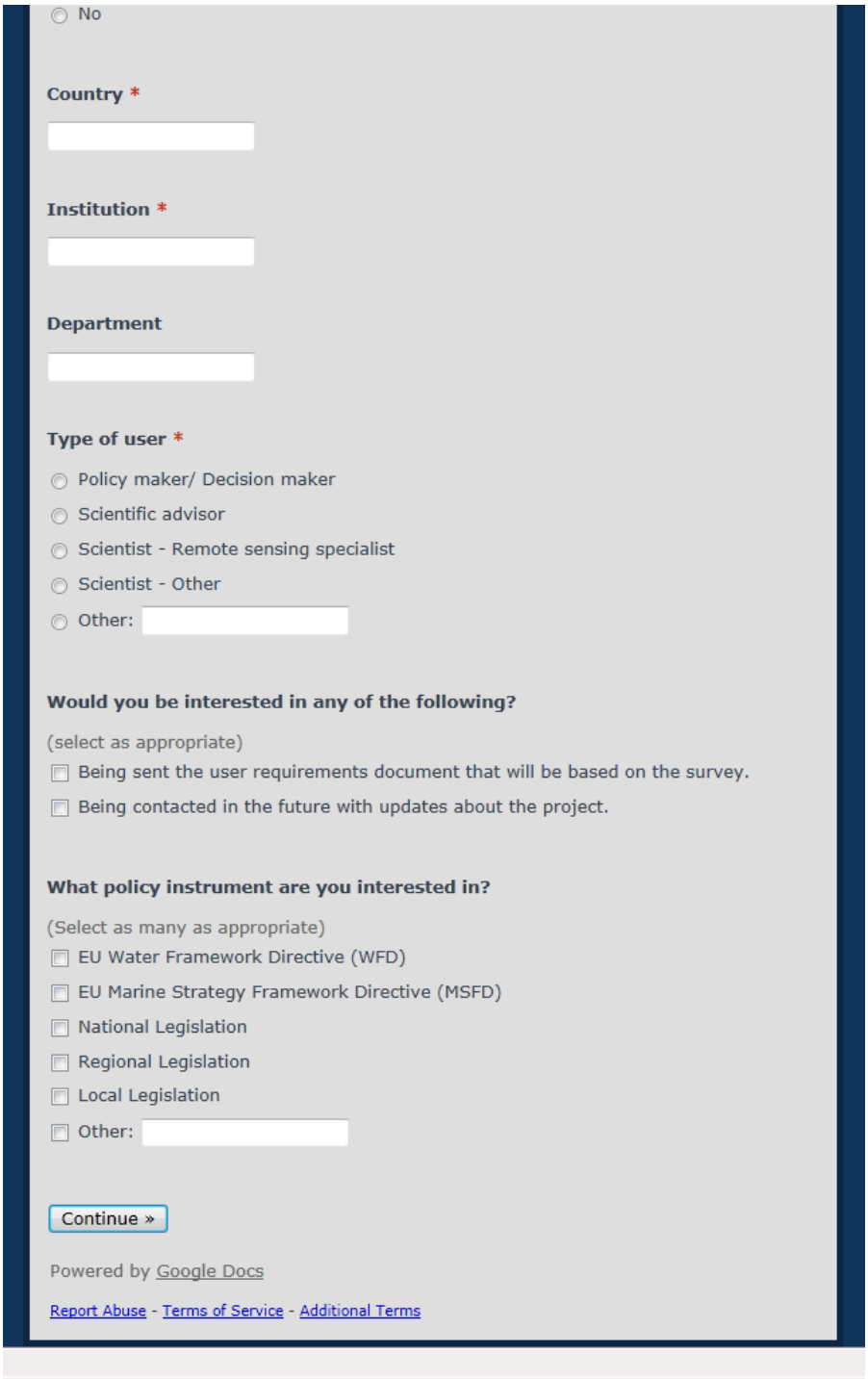
- Yes
- No

Country *

Institution *

Department

Type of user *



No

Country *

Institution *

Department

Type of user *

- Policy maker/ Decision maker
- Scientific advisor
- Scientist - Remote sensing specialist
- Scientist - Other
- Other:

Would you be interested in any of the following?

(select as appropriate)

- Being sent the user requirements document that will be based on the survey.
- Being contacted in the future with updates about the project.

What policy instrument are you interested in?

(Select as many as appropriate)

- EU Water Framework Directive (WFD)
- EU Marine Strategy Framework Directive (MSFD)
- National Legislation
- Regional Legislation
- Local Legislation
- Other:

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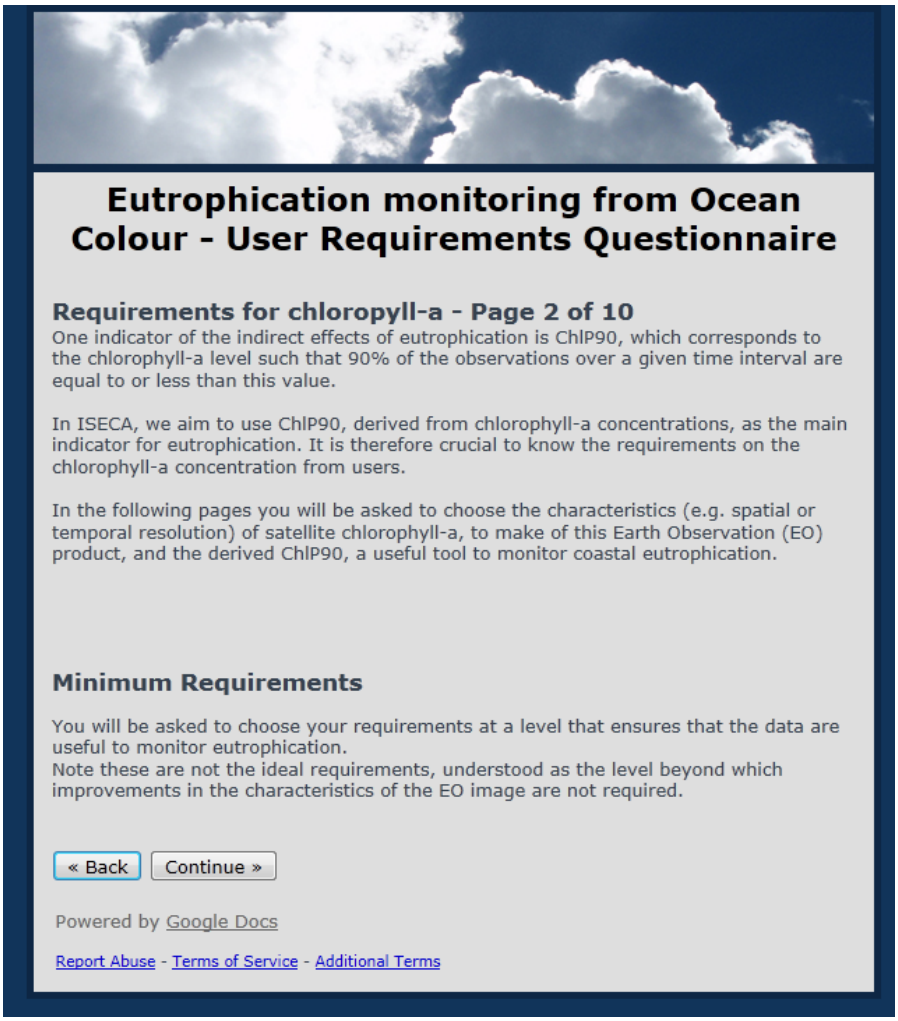

Eutrophication monitoring from Ocean Colour - User Requirements Questionnaire

Requirements for chloropyll-a - Page 2 of 10

One indicator of the indirect effects of eutrophication is ChlP90, which corresponds to the chlorophyll-a level such that 90% of the observations over a given time interval are equal to or less than this value.

In ISECA, we aim to use ChlP90, derived from chlorophyll-a concentrations, as the main indicator for eutrophication. It is therefore crucial to know the requirements on the chlorophyll-a concentration from users.

In the following pages you will be asked to choose the characteristics (e.g. spatial or temporal resolution) of satellite chlorophyll-a, to make of this Earth Observation (EO) product, and the derived ChlP90, a useful tool to monitor coastal eutrophication.

Minimum Requirements

You will be asked to choose your requirements at a level that ensures that the data are useful to monitor eutrophication.
Note these are not the ideal requirements, understood as the level beyond which improvements in the characteristics of the EO image are not required.

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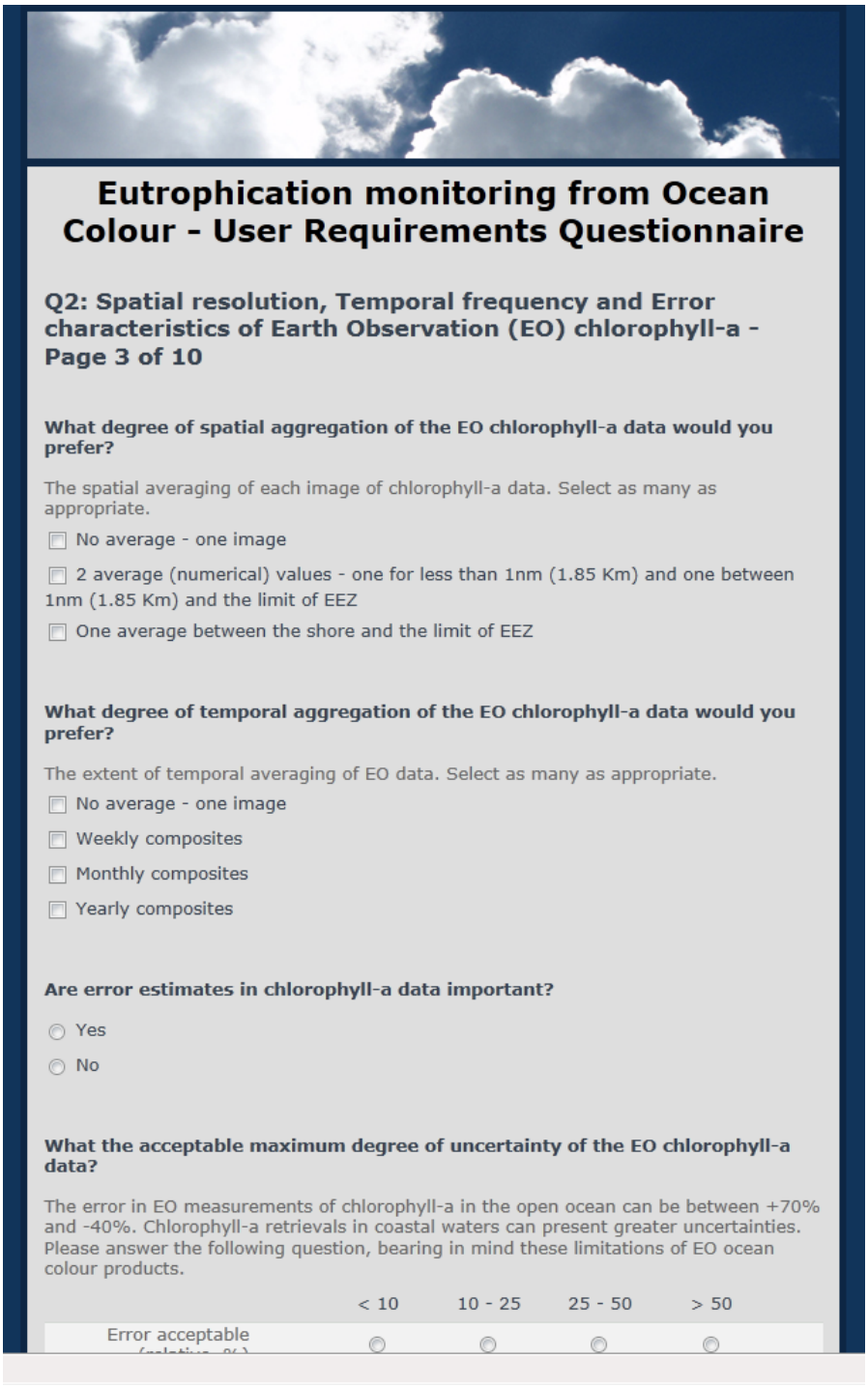


Eutrophication monitoring from Ocean Colour - User Requirements Questionnaire

Q2: Spatial resolution, Temporal frequency and Error characteristics of Earth Observation (EO) chlorophyll-a - Page 3 of 10

What degree of spatial aggregation of the EO chlorophyll-a data would you prefer?

The spatial averaging of each image of chlorophyll-a data. Select as many as appropriate.

- ☐ No average - one image
- ☐ 2 average (numerical) values - one for less than 1nm (1.85 Km) and one between 1nm (1.85 Km) and the limit of EEZ
- ☐ One average between the shore and the limit of EEZ

What degree of temporal aggregation of the EO chlorophyll-a data would you prefer?

The extent of temporal averaging of EO data. Select as many as appropriate.

- ☐ No average - one image
- ☐ Weekly composites
- ☐ Monthly composites
- ☐ Yearly composites

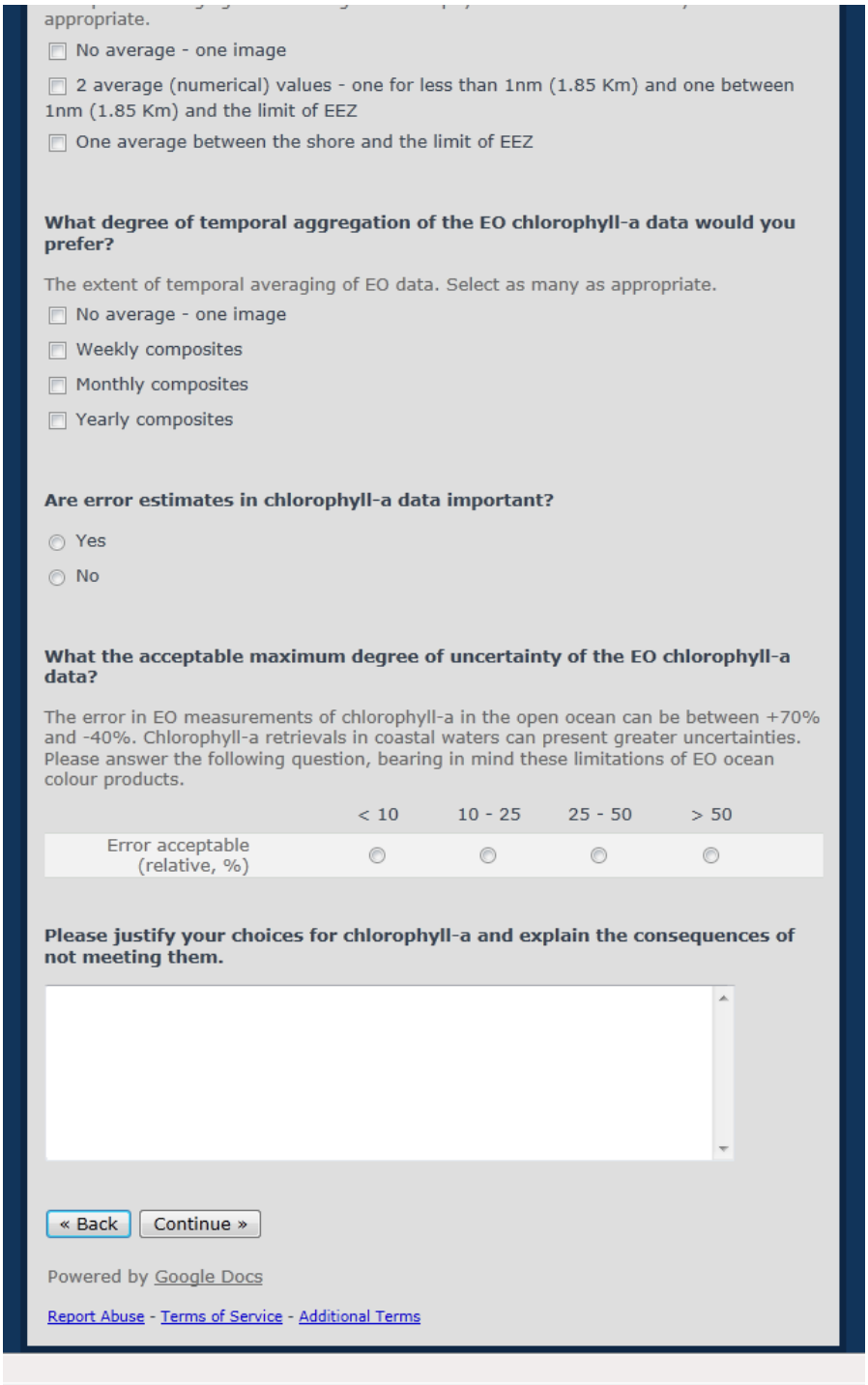
Are error estimates in chlorophyll-a data important?

- ○ Yes
- ○ No

What the acceptable maximum degree of uncertainty of the EO chlorophyll-a data?

The error in EO measurements of chlorophyll-a in the open ocean can be between +70% and -40%. Chlorophyll-a retrievals in coastal waters can present greater uncertainties. Please answer the following question, bearing in mind these limitations of EO ocean colour products.

	< 10	10 - 25	25 - 50	> 50
Error acceptable	○	○	○	○



appropriate.

- [ ] No average - one image
- [ ] 2 average (numerical) values - one for less than 1nm (1.85 Km) and one between 1nm (1.85 Km) and the limit of EEZ
- [ ] One average between the shore and the limit of EEZ

What degree of temporal aggregation of the EO chlorophyll-a data would you prefer?

The extent of temporal averaging of EO data. Select as many as appropriate.

- [ ] No average - one image
- [ ] Weekly composites
- [ ] Monthly composites
- [ ] Yearly composites

Are error estimates in chlorophyll-a data important?

- ( ) Yes
- ( ) No

What the acceptable maximum degree of uncertainty of the EO chlorophyll-a data?

The error in EO measurements of chlorophyll-a in the open ocean can be between +70% and -40%. Chlorophyll-a retrievals in coastal waters can present greater uncertainties. Please answer the following question, bearing in mind these limitations of EO ocean colour products.

	< 10	10 - 25	25 - 50	> 50
Error acceptable (relative, %)	( )	( )	( )	( )

Please justify your choices for chlorophyll-a and explain the consequences of not meeting them.

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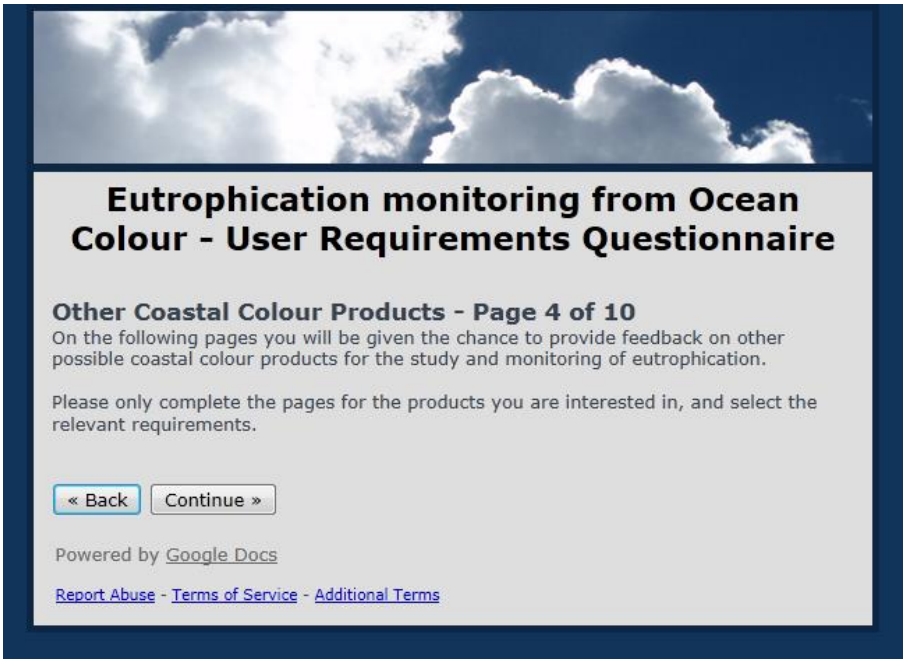
Eutrophication monitoring from Ocean Colour - User Requirements Questionnaire
Other Coastal Colour Products - Page 4 of 10
On the following pages you will be given the chance to provide feedback on other possible coastal colour products for the study and monitoring of eutrophication.
Please only complete the pages for the products you are interested in, and select the relevant requirements.
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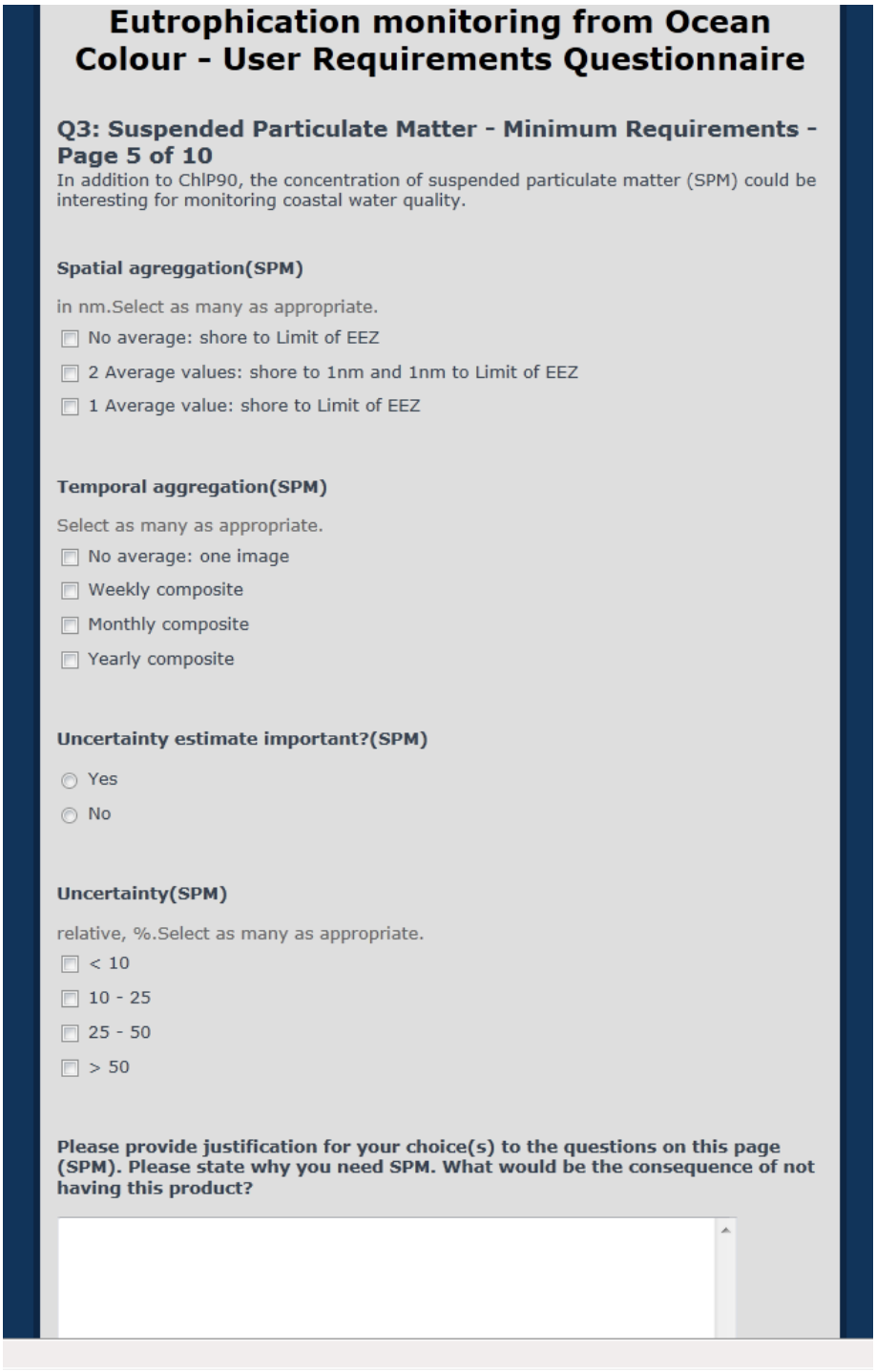


Eutrophication monitoring from Ocean Colour - User Requirements Questionnaire

Q3: Suspended Particulate Matter - Minimum Requirements - Page 5 of 10

In addition to ChlP90, the concentration of suspended particulate matter (SPM) could be interesting for monitoring coastal water quality.

Spatial agreggation(SPM)

in nm.Select as many as appropriate.

- [ ] No average: shore to Limit of EEZ
- [ ] 2 Average values: shore to 1nm and 1nm to Limit of EEZ
- [ ] 1 Average value: shore to Limit of EEZ

Temporal aggregation(SPM)

Select as many as appropriate.

- [ ] No average: one image
- [ ] Weekly composite
- [ ] Monthly composite
- [ ] Yearly composite

Uncertainty estimate important?(SPM)

- ( ) Yes
- ( ) No

Uncertainty(SPM)

relative, %.Select as many as appropriate.

- [ ] < 10
- [ ] 10 - 25
- [ ] 25 - 50
- [ ] > 50

Please provide justification for your choice(s) to the questions on this page (SPM). Please state why you need SPM. What would be the consequence of not having this product?

Eutrophication monitoring from Ocean Colour - User Requirements Questionnaire

Q4: Primary Production Minimum Requirements - Page 6 of 10

Primary production, defined as the rate of growth of phytoplankton, can be used as an indicator of Eutrophication. Anomalous phytoplankton growth could be an indicator of increased in nutrient inputs.

Spatial agreggation(PrimaryProduction)

in nm. Select as many as appropriate.

- ☐ No average: shore to Limit of EEZ
- ☐ 2 Average values: shore to 1nm and 1nm to Limit of EEZ
- ☐ 1 Average value: shore to Limit of EEZ

Temporal aggregation(PrimaryProduction)

Select as many as appropriate.

- ☐ No average: one image
- ☐ Weekly composite
- ☐ Monthly composite
- ☐ Yearly composite

Uncertainty estimate important?(PP)

- ○ Yes
- ○ No

Uncertainty(PP)

relative, %

- ☐ < 10
- ☐ 10 - 25
- ☐ 25 - 50
- ☐ > 50

Please provide justification for your choice(s) to the questions on this page (PP). Please state why you need primary production. What would be the consequence of not having this product?

Eutrophication monitoring from Ocean Colour - User Requirements Questionnaire

Q5: Colour Scale Minimum Requirements - Page 7 of 10

The EU Water Framework Directive has a scale for the evaluation of the water quality as a function of the Chl P90. According to this scale, the Chl P90 are grouped in different levels (i.e. as a "trafic light system"). For instance water quality is very good if Chl P90 values are between 0 and 5 mg Chl/m3 and bad if if Chl P90 values are greater than 40 mg Chl/m3.

Spatial agreggation(ColourScale)

in nm. Select as many as appropriate.

- [ ] No average: shore to Limit of EEZ
- [ ] 2 Average values: shore to 1nm and 1nm to Limit of EEZ
- [ ] 1 Average value: shore to Limit of EEZ

Temporal aggregation(ColourScale)

Select as many as appropriate.

- [ ] No average: one image
- [ ] Weekly composite
- [ ] Monthly composite
- [ ] Yearly composite

Uncertainty estimate important?(ColourScale)

- ( ) Yes
- ( ) No

Uncertainty(ColourScale)

relative, %

- [ ] < 10
- [ ] 10 - 25
- [ ] 25 - 50
- [ ] > 50

Please provide justification for your choice(s) to the questions on this page (ColourScale). Please state why you need primary production. What would be the consequence of not having this product?

Eutrophication monitoring from Ocean Colour - User Requirements Questionnaire

Q6: What other product from satellite would be useful to monitor Eutrophication? - Page 8 of 10

Here you have the chance to add any other parameter to monitor eutrophication from a satellite

Other satellite product

Spatial agreggation(Other)

in nm. Select as many as appropriate.

- [ ] No average: shore to Limit of EEZ
- [ ] 2 Average values: shore to 1nm and 1nm to Limit of EEZ
- [ ] 1 Average value: shore to Limit of EEZ

Temporal aggregation(Other)

Select as many as appropriate.

- [ ] No average: one image
- [ ] Weekly composite
- [ ] Monthly composite
- [ ] Yearly composite

Uncertainty estimate important?(Other)

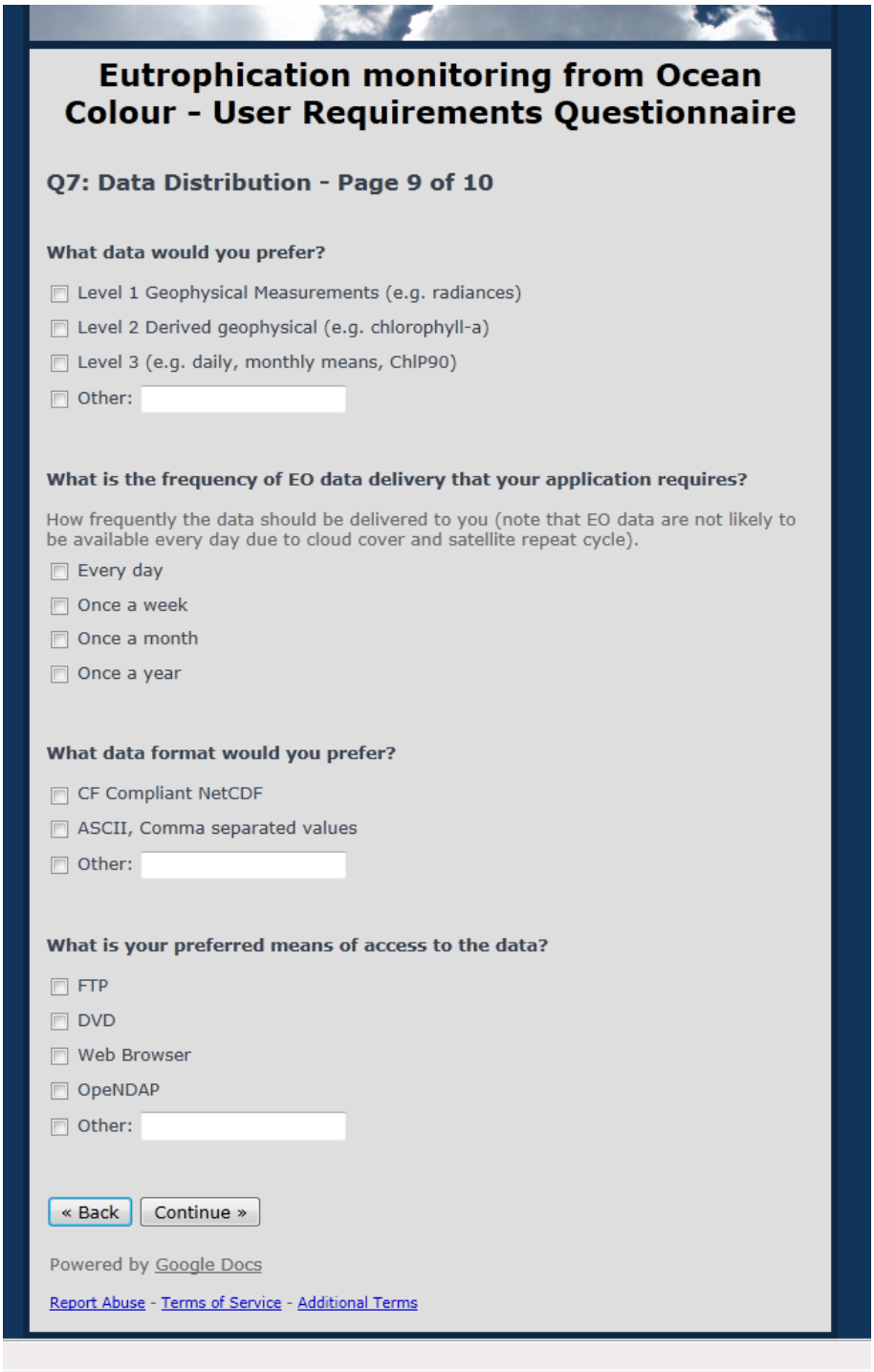
- ( ) Yes
- ( ) No

Uncertainty(Other)

relative, %

- [ ] < 10
- [ ] 10 - 25
- [ ] 25 - 50
- [ ] > 50

Please provide justification for your choice(s) to the questions on this page (Other). What would be the consequence of not having this product?



Eutrophication monitoring from Ocean Colour - User Requirements Questionnaire

Q7: Data Distribution - Page 9 of 10

What data would you prefer?

- ☐ Level 1 Geophysical Measurements (e.g. radiances)
- ☐ Level 2 Derived geophysical (e.g. chlorophyll-a)
- ☐ Level 3 (e.g. daily, monthly means, ChlP90)
- ☐ Other:

What is the frequency of EO data delivery that your application requires?

How frequently the data should be delivered to you (note that EO data are not likely to be available every day due to cloud cover and satellite repeat cycle).

- ☐ Every day
- ☐ Once a week
- ☐ Once a month
- ☐ Once a year

What data format would you prefer?

- ☐ CF Compliant NetCDF
- ☐ ASCII, Comma separated values
- ☐ Other:

What is your preferred means of access to the data?

- ☐ FTP
- ☐ DVD
- ☐ Web Browser
- ☐ OpeNDAP
- ☐ Other:

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Eutrophication monitoring from Ocean Colour - User Requirements Questionnaire
Thank You - Page 10 of 10
Thank you for your input. If you have anything else you would like to add please use the box below.
Final Notes
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