TAILORED ALGORITHMS FOR OCEAN COLOUR APPLICATIONS AT REGIONAL SCALES: GEOGRAPHIC AND OPTICAL APPROACHES

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1. BACKGROUND

There is requirement to describe a considerable amount of variability in parameterising inversion algorithms to be applicable at global scale yet remain quantitatively accurate in both the open ocean and coastal/shelf seas. It is accepted that this is unlikely to be achieved in the foreseeable future, with a single representation of algorithm parameters (i.e. a statistical fit coefficients or IOP subcomponent models). Additionally there is a persistent request from users of products derived from ocean colour radiometry for information on the uncertainties of the products at the regional scale. In many cases researchers, and users in general, are increasingly interested in (developing) specific algorithms and products for their region of interest.
Here we provide an overview of the state of the art of regional algorithm development, considering both approaches where algorithms are applied to a specific geographic region as well as techniques that are based on the distinction of different optical-water-types. Additionally we propose an international initiative which will provide a central location where users can go to find more information on: exiting regional and type-based approaches and their related uncertainties (including the relevant bibliography), protocols for deriving their own new algorithms and a background optical mapping of global optical water types using a variety of approaches.

2. ALTERNATIVE APPROACHES AND APPLICATIONS

This rationale is the background around which we developed a statistical approach, which is presented here as an example of an objective statistical method which when used in conjunction with ocean colour datasets, provide's an effective mean of operationally applying different inversion algorithm for different optical-water-types. The method, which we refer to as Universally Tailored Optical Parameter Inversion Algorithm (UTOPIA), uses fuzzy logic to define and identify in radiance space distinct bio-optical provinces that implicitly reduce the variance in the Inherent Optical Property (IOP) subcomponent models.
A large, globally representative, dataset (i.e. NOMAD) of match-up AOP - IOPs has been used. From this dataset, using a fuzzy c-means clustering algorithm and objective validity functions, an optimum number of 8 optical classes were identified. These classes occupy multi-spectral radiance space associated with "traditional" Case I: oligotrophic, mesotrophic and eutropic waters as well as multiple classes for high absorption ad highly scattering waters.
The statistics retrieved from the clustering procedure were used to map the optical water classes with multiple years worth of MERIS and MODIS data at the global and regional scales. Initial attempts to identify empirical model fit parameters and IOP sub-component models for each of the classes are presented, allowing variability in terms such as the spectral slope of yellow substance, the power-law

slope of backscattering and the specific absorption coefficient of phytoplankton.
Example applications of both the optical-water-type based approach discussed above and the more traditional approach based on the geographical subdivision of in-situ datasets. Specifically application these different approaches are shown for case studies in various European regions and coastal regions around South Africa (including the Benguela region).

3. PROPOSED INITIATIVE

As mentioned above, in view of advancing research and adoption of the methods such as those discussed here we are also proposing an initiative on these topics. The motivation for such an initiative has been recently made in a number ongoing international activities concerned with the applications of ocean colour datasets. Specifically an explicit request for a coordinating activity addressing regional algorithms was made in reports produced by both the ChloroGIN task and Coastal water quality working group of GEO. Regional algorithms are also of interest in the context of the European GMES Marine Core Service, which is structured for processing and implementation on a regional basis.
We propose a more interactive access to the information through a web-based interface. To achieve this we suggest that the initiative to undertake the following tasks: provide a live map-based bibliography of regional algorithms for the global oceans, this would also include the mapping of optical water type from satellite based ocean colour data including "traditional" Case I, Case II, Jerlov water types as well as various statistical (Fuzzy Logic, Principle Component Analysis, Gaussian Mixture Models) approaches. The initiative will also provide a series of synthesized protocols (5-10 pages each) documenting agreed approaches for defining a regional empirical and semi-analytical algorithms (including data requirements, available tools e.g. BEAM regional reflectance model module, etc.) and perform a round robin exercise comparing different regional and class-based algorithms with standard global products within different geographic regions so as to characterize the reduced uncertainties and variance of the different approaches.