Temporal Variability in MERIS water constituents modeled by STL decomposition in SW Iberian Peninsula: Sagres

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Abstract

Satellite ocean colour remote sensing provides a valuable source of information on the status of marine ecosystems. From 2002 till 2012 the MEdium Resolution Imaging Spectrometer (MERIS) ocean colour sensor onboard the ENVISAT satellite of the European Space Agency measured radiances emerging from the sea to quantify optically significant constituents \[1\]; chlorophyll \textit{a} (Chl\textit{a}, obtained through MERIS standard Algal Pigment Index 1 algorithm), total suspended matter (TSM) and yellow substances (YS). This data provides information on phytoplankton biomass and transparency through Chl\textit{a} and TSM, respectively, at large temporal and spatial scales, allowing an understanding of ecological dynamics \[2\]. The concentrations of Chl\textit{a} and TSM also contributes to assessments for the “good ecological status” of the European Union (EU) Water Framework Directive 2000/60/EC, and for the “good environmental status” of the EU Marine Strategy Framework Directive, 2008/56/EC.

The present study evaluated the temporal variability of the MERIS water constituents off Sagres, in southwest Iberian Peninsula. This is one of the MERIS validation study sites, where \textit{in situ} water samples and radiometric measurements were taken from 2008 till 2012, to assess the uncertainties related with the MERIS ocean colour products \[3, 4\]. To study the time series for Chl\textit{a}, TSM, and YS, a Seasonal-Trend decomposition procedure based on Loess (STL) \[5\] was applied to decompose the trend ($T_t$), seasonal ($S_t$), and irregular ($I_t$) components using non-parametric regression. The STL decomposition was chosen over other decomposition methods, because it has several advantages, including changing the seasonal component over time and specifying a decomposition that is robust to outliers.

The authors have developed an algorithm that selects the best STL model for each combination of the seasonal and trend smoothing parameters, supported by the idea that the best data fitting will lead to a model that best describes the stochastic behaviour of a time series; i.e. the one that best captures the dynamics of the time series.
The selection is based on the Root Mean Square Error accuracy measure, and the new stl.fit() procedure in R software (version 3.2.1) [6]. The daily satellite products, extracted from MERIS Level 2 reduced resolution images, were aggregated into monthly means, and the missing observations were estimated by linear interpolation.

Overall, the study characterizes the seasonal and trend patterns of the satellite-derived data, and then relates these patterns to environmental changes and possible causes. These components are useful for a better understanding of the temporal variability, and also explain the influence of each of the MERIS constituent products.

References


