MERIMON-2000

MERIS for water quality monitoring in the Belgian-Dutch-German coastal zone

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Executive Summary

The MERIMON project aims to bring together past experience and knowledge on water quality remote sensing of the Dutch North Sea and the current state of remote and close sensing technology in order to define options for MERIS validation. Recent achievements in ocean/inland water colour monitoring in the Netherlands include:

- The operationalisation of the EPS-A airborne multispectral sensor on the coastguard airplane
- The operationalisation of transect monitoring of suspended matter in the Marsdiep by NIOZ using above water measurements of subsurface reflectance
- The operationalisation of point measurements of subsurface reflectance using handheld spectrometers by NIOZ, NIOO-CL and IVM
- Advanced insights in optical modelling and especially in model inversion techniques using e.g. Matrix Inversion Methods

These measurement systems have been demonstrated in several case studies including case studies in this report. It was concluded that each method, at its own scale is able to deliver (depending on a number of circumstances) reasonably accurate water reflectance spectra, suitable for validation of MERIS spectra. An integrated validation of the ensemble measurements using these instruments has not been possible mainly because of logistics (not yet an operational standard processor for MERIS products) and because of data quality problems (sun/glint and aerosol gradients in EPS-A images).

MERIMON has studied existing algorithms to select appropriate formulations for MERIS to produce regional correct estimations of TSM and CHL. In this the viewpoint of monitoring was taken. Comparative algorithm evaluation was done to study the applicability and theoretical weaknesses of various types of algorithms for water quality parameters retrieval.

It was noted that comparison of various algorithms requires a rigid treatment of the Q and f factors and the B factor as well which has implications for the standardization of ground truth $R(0-)$ measurements as well as satellite $R(0-)$ observations. MERIS standard algorithms could not be studied by this project because the definitive parameterisation of the MERIS processor still had to be decided upon in October 2000.

In view of the preparation to the use of MERIS products, this project has tested (and developed) other state of the art algorithms. Based on the outcome of this study and further sensitivity studies, in the next step, the best regional (algorithms calibrated on regional datasets) alternative for MERIS standard algorithms will be selected and calibrated.

The MERIMON results show that concentration ranges in spring 2001 are not consistent with the ranges in the PMNS-data set, therefore it was concluded that the variability of
concentrations on the North Sea is still not well understood. It remains therefore important to keep monitoring concentration ranges during remote sensing studies.

In the Netherlands quite some progress has been achieved in the understanding and facilitation of above water measurements of $R(0-)$. MERIMON found that that various methods can produce good results, especially if the reflected sky radiance term is taken into account.

Algorithms were tested on PR650 observations with the outcomes: that the standard PMNS TSM algorithm for MERIS tends to overestimate TSM in the Marsdiep and to underestimate TSM in the Belgian waters. The PMNS study has proposed 2 CHL algorithms for MERIS. When both are applied to PR650-Gons-L1 observations results are good for the simple band ratio algorithm and bad for the MRA-algorithm. The POWERS algorithm seems to underestimate TSM at low concentrations (less than 20 mg/l) and to overestimate at higher concentrations (>20 mg/l). RMI is a possibly a suitable technique to map TSM but the scaling differences between simulated spectra (using RMI retrieved concentrations) and measured spectra remains an issue of concern. The MERIS band settings are suitable for TCHL retrieval using RMI in the North Sea coastal waters.

From comparative SIOP analysis it was found that the Marsdiep is very atypical for North Sea waters. Furthermore, there are distinct differences between Belgian coastal water and Dutch coastal waters, which has probably to do with the absorption of the organic fraction of TSM and the differences in absorption of CDOM. The Mitra transect is ideal to monitor a relatively representative mean North Sea Water composition.

From a test case for satellite image processing it was concluded that the results are hopeful in the sense that independent TSM, TCHL and CDOM products seem to be feasible from satellite observations such as from MERIS. The results should however be seen as a rough approximation of MERIS results because of the coarse and sparse band settings of SeaWiFS.

The test case allowed to do a preliminary transect validation of the products. It was found that TCHL is in good agreement with the values obtained along the Mitra transect and that TSM is in disagreement (SeaWiFS 6 May, Mitra 8-9 May) therefore it is recommended that the performance of the RMI method for TSM should be further evaluated.