MERIS Regional Case 2 Water Algorithms (C2R)

This MERIS C2R plug-in includes a processor to derive optical properties and concentrations of water constituents from MERIS level 1b top of atmosphere radiance data. It is an experimental processor in the sense that it offers several options, which can be selected by a parameter file. Furthermore, it is the first version, which has been tested only for a limited number of cases. A description of how to use the software is provided in the User Handbook, details of the algorithms are provided in the ATBDs. These documents are available on the web page of this plug in. In this readme we give some important hints.

Disclaimer

The present version of the atmospheric correction procedure includes only aerosols with an optical thickness of 0.2 at 550 nm. For hazy conditions this is not sufficient. Please check the flag rad_err.

Furthermore, aerosols with a higher angstrom coefficient are not included in the aerosol model, which can lead to water leaving radiance reflectance spectra, which are too high in the blue spectral range. This is also the reason for low gelbstoff absorption values.

The height of lakes is not included in the atmospheric correction. Thus, the atmospheric influence for lakes in heigh altitudes is not properly corrected.

All these issues will be treated in one of the next versions of this plug in.

Handling of the plug-in software

When you import a MERIS level 1b scene in VISAT the first time after launching VISAT, the path and name is included in the input file field after the MerisC2R extension is called. When you import a new level 1b scene the name of the new scene is not automatically replaced. You have to open the file select box by hand to select the new input product.

Request for response

In order to improve the algorithms and the software we appreciate reports from the users describing under which conditions the procedures work sufficiently well and when they fail.

Please provide us with the following information:

MERIS scene id (full name), area within the scene (pixel coordinates, or transect, or roi), description of problem, data used for validation. Before you report please check all flags. We are also interested in scenes with good results.

Options

Two different procedures are included in the plug in for the retrieval of water properties:

(1) the standard NN procedure uses an inverse neural network to compute inherent optical properties from the water leaving radiance reflectance. These IOPs are then converted into concentrations by factors which are provided in the parameter file. Both the IOPs and the concentrations can be switched on as products.

(2) The second procedure uses the forward NN as a model to compute water leaving radiance reflectance from concentrations or IOPs. The input values are then varied within in a Levenberg-Marquard optimization procedure to achieve a good agreement between the simulated and measured spectrum. The input values which achieve the best fit are then the values provied as the output product.

Both procedures with their products can be switched on in parallel in the parameter file.

Further options, which can be switched on, are the procedure *performSmileCorrection*, which reduces the effect of camera boundaries, which is caused by the not perfectly alignment of the cameras, and the procedure *performPolCorr,* which performs a correction of the path radiances by calculating the angular dependent polarisaton effect. For this polarization correction a neural network has been trained based on Monte Carlo simulations with and without polarisation.

Furthermore the factors for converting IOPs into concentrations can be changed and adapted to local or regional bio-optical models.

For chlorophyll concentration the present default conversion is:
<chlorophyll a mg m-3> = 21.0 * a_pig_443^1.04 ,

for total suspended matter dry weight:
<TSM g m-3> = 1.72 * b_tsm_443^1.0 .

Flagging

Any algorithm in remote sensing has its own scope, i.e. the range of conditions under which the procedure should provide reasonable results. Thus, one important step in a procedure is to detect conditions, which are out of scope. These data/pixels are then flagged.

Flagged pixels can be easily visualized by using VISAT. With the flag operator you can switch on/off flags and change the colour and transparency. For the MERIS C2R algorithm we have defined the following flags beside the level 1 flags, which are also included in the C2R product:

rad_err

This flag is switched on under hazy conditions, when the aerosol optical thickness surmounts a certain degree for which the neural network has not been trained. It is simply checked by the toa radiance reflectance in Meris band 1. Under these hazy conditions the separation between reflectance caused by the atmosphere or by turbid water can fail.

l2_land

Although the land is flagged already by the level 1 land flag and the coastline flag, conditions occur like dry fallen tidal flats, which are not included in the L1 flag. With the l2_land flag we test if the radiance reflectance in MERIS band 13 (865 nm) is above a threshold, which is provided in the parameter file. Also the rim of clouds maybe flagged.

cloud_ice

This flag indicates very high radiance reflectance indicating clouds, ice or snow. Normally it should not appear, because these pixels should have been excluded from water processing by the L1 bright flag. Algorithm works as for l2_land, the threshold is provided in the parameter file.

sunglint

This flag is presently not implemented. Sunglint is corrected as far as possible by the atmsopheric correction procedure.

ancil

This flag indicates unreasonable data for ozone or pressure, which are used in the atmospheric correction procedure.

toa_oor

This flag is on when the input radiance reflectances (top of standard atmosphere, tosa) are out of the atmosphere neural network training range.

wlr_oor

This flag is on when the input water leaving radiance reflectances (as result of the atmospheric correction) are out of the water neural network training range.

solzen

Flag is on if the solar zenith angle is out of the neural network training range.

satzen

Flag is on if the viewing zenith angle is out of the neural network training range.

atc_oor

Flag is on if the output of the atmospheric correction neural network (path radiance reflectances and transmittances) are not within the expected range.

conc_oor

Flag is on if the output of the water neural network, i.e. the inherent optical properties a_pig, b_tsm, a_yellow, are not within the expected range.

ootr

This flag indicates that the water leaving radiance reflectance as submitted to the water NN is outside the range of the spectra used for training of the NN. Flag is on if the sum of the squared deviations between the water leaving radiance reflectances (i. e. after atmospheric correction) and the water leaving radiance reflectances as simulated with the forward NN surmounts a certain threshold, which is given in the parameter file s. spectrumOutOfScopeThreshold. The degree of the deviation is also provided as the output product chi_square (set outputOutOfScopeChiSquare = true in parameter file).

whitecaps

This flag is triggered if the windspeed as provided with the MERIS product surmounts 12 m/s, which is about Beaufort 6. Note that whitecapping starts at wind speeds around 7 m/s (Beaufort 4). Large white patches , which may have a significant influence on the reflectance of the ocean, occur at wind speeds above 11 m/s (Beaufort 6). In coastal waters, the foam coverage can be influenced also by the concentration of organic material and thus may be formed even at lower windspeeds.

l2_invalid

This is the master flag, which goes on if any of the flags OOTR, wlr_oor, toa_oor, l2_land, cloud_ice, rad_err, WHITECAPS has been triggered.

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