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Sun-induced Chlorophyll Products

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DATA

The empirical MPH[1] algorithm is based on a global dataset of inland optical measurements. LIMNADES is a database of more than 3500 ground bio-optical measurements collected from over 250 lakes. It incorporates more than 10 identifiable optical water types ranging from clear oceanic-type waters to highly turbid, highly productive hypertrophic lakes. Lake Geneva has been set aside as an independent study site used for validation. A summary of the LIMNADES constituent concentration range is shown in Table 1. As an input, the modified MPH algorithm uses observations of remote sensing reflectance (R_{rs}) centred on MERIS operational bands. Spectral characteristics are analysed from 620 nm to 885 nm.

Table 1. Summary statistics of LIMNADES constituent concentrations

Constituent	Average	Minimum	Maximum
Chlorophyll (mg m^{-3})	43	0.03	13297
Total Suspended Matter (mg l^{-1})	27	0.15	2533
CDOM (m^{-1})	1.3	0.03	12.3

METHODOLOGY

MPH uses spectral features to identify class of plankton before calculating concentrations of chlorophyll-a (*Chl*). The spectral location of the maximum peak, along with the sun-induced chlorophyll fluorescence peak, *SICF*, the backscattering and absorption induced reflectance peak, *BAIR*, and the sun-induced phycocyanin peak, *SIPF* are the primary classifiers. An observed peak in *SIPF* and *BAIR* and a corresponding trough in *SICF* indicates the presence of cyaonbacteria, while the inverse condition identifies eukaryotes. *Chl* is determined independently for each regime. The magnitude of the maximum peak height above a set baseline, MPH_n, produces a quantitative estimate of *Chl* for euakaryote (*euk*) and cyanobacteria (*cyan*) dominant water bodies using the following equations;

$$chl\_mph_{euk} = [15920 \times \exp(-160\ avgMPH)] \times MPH_n + [5 \times \exp(160\ avgMPH)]$$

$$chl\_mph_{cyan} = [15 \times \exp(-50\ avgMPH)] \times \exp([138 \times \exp(-15\ avgMPH)] \times MPH_n)$$

PRODUCTS (illustration)

To test the feasibility of estimating *Chl* concentration from remote sensing data the method was applied to the Geneva *in situ* dataset and a MERIS image. MPH was calculated using MERIS bands simulated from the hyperspectral data. Results were then compared with in situ estimates, as shown in Figure 1.

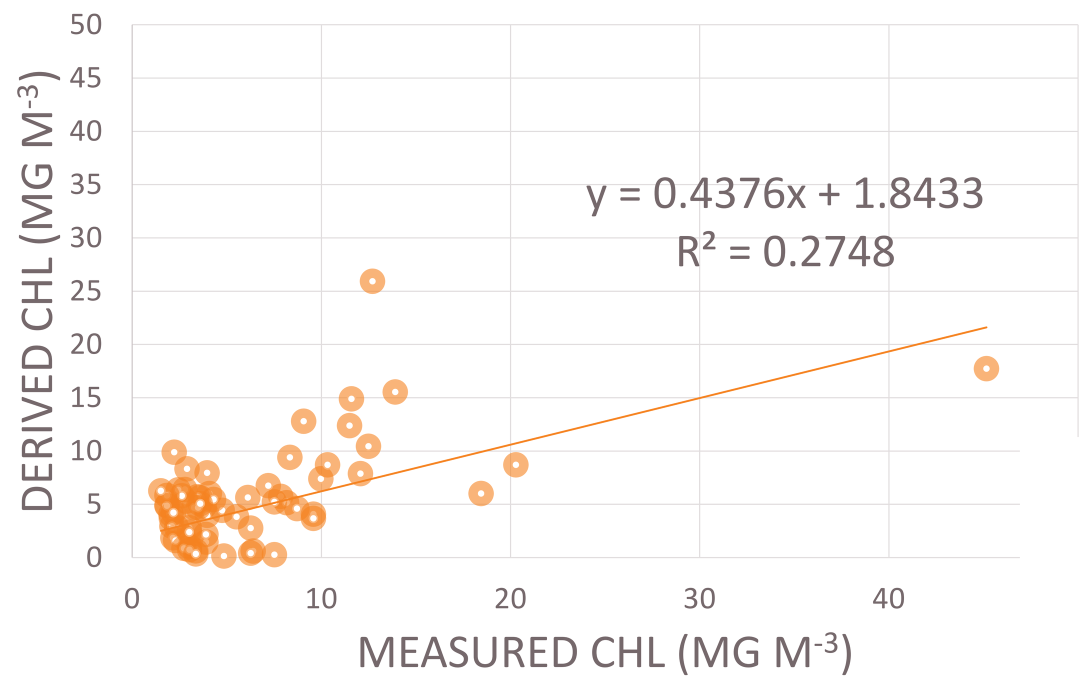

Figure 1. Validation of MPH Chl output for Lake Geneva and Lake Balaton

In general, the MPH method produces reasonable estimates of surface *Chl* concentration in lakes. While shown to underestimate total magnitude, the MPH is capable of capturing the *Chl* trend. More accurate predictions are expected in regions where a clear relationship exists between MPH_n and *Chl*.

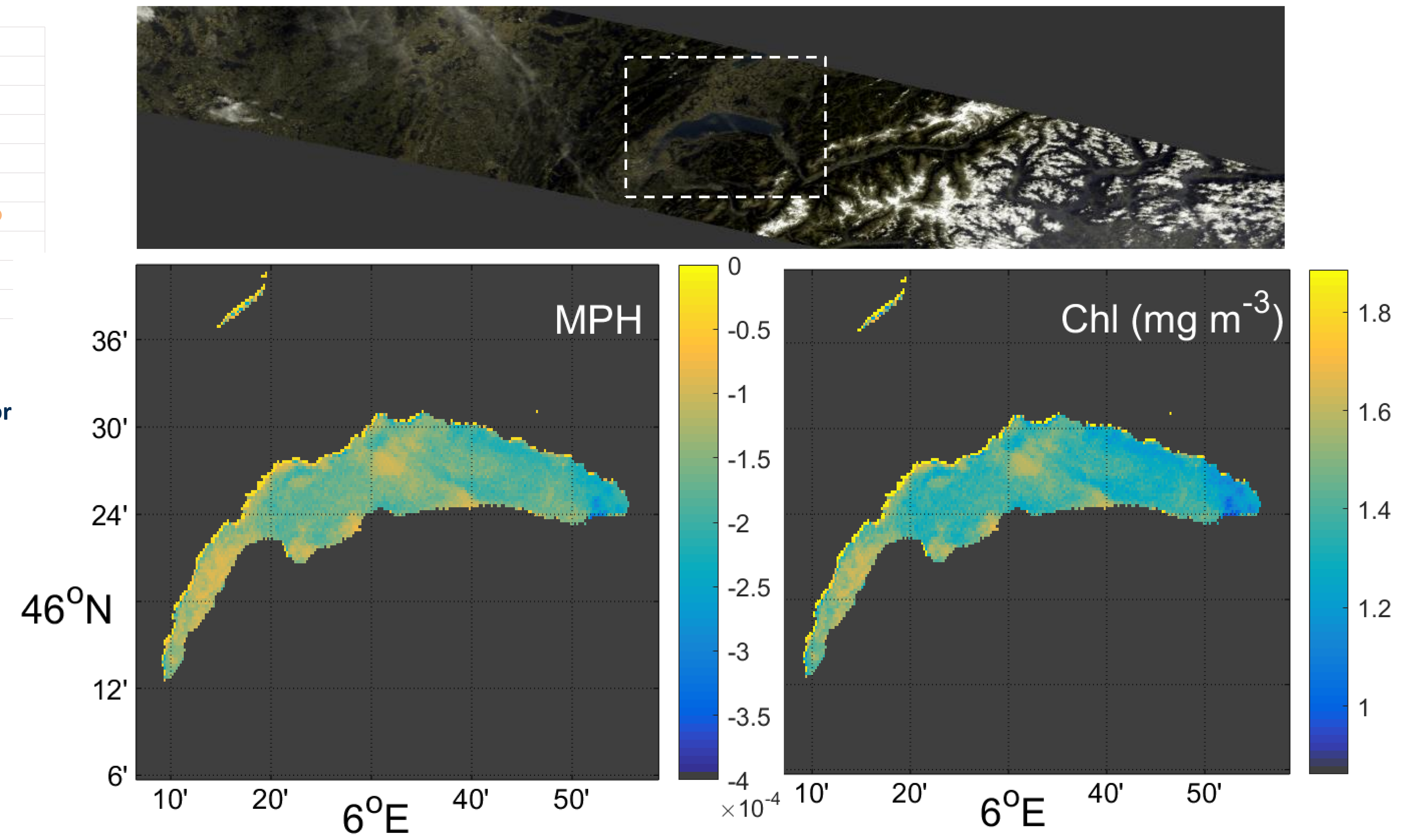

Figure 2. MERIS true colour image of Lake Geneva measured on 2nd August 2011 (a) and corresponding MPH (b) and Chl (c) products. Results are consistent with Chl surface maxima observed during this period.

REFERENCES

Matthews, M.W.; Bernard, S.; Robertson, L.,2012. An algorithm for detecting trophic status (chlorophyll-a), cyanobacterial-dominance, surface scums and floating vegetation in inland and coastal waters. Remote Sens. Environ. 124, 637–652.

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