A wavelet approach for estimating Chl-a from inland waters with reflectance spectroscopy

Eva M. Ampe [1, 3], Erin L. Hestir [2], Elga Salvadore [1, 3], Ludwig Triest [4], Okke Batelaan [1, 5]

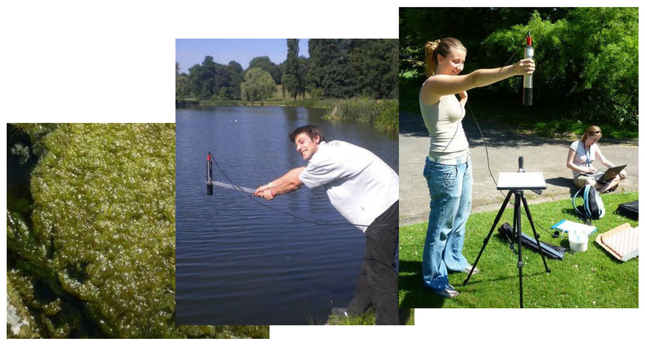
[1] Department of Hydrology and Hydraulic Engineering, VUB, Brussels, Belgium.
[2] CSIRO, Land and Water, Canberra, Australia.
[3] VITO, Flemish Institute for Technological Research, Mol, Belgium.
[4] Department of Biology, Plant Science and Nature Management, VUB, Brussels, Belgium.
[5] School of the Environment, Flinders University, Adelaide, Australia.

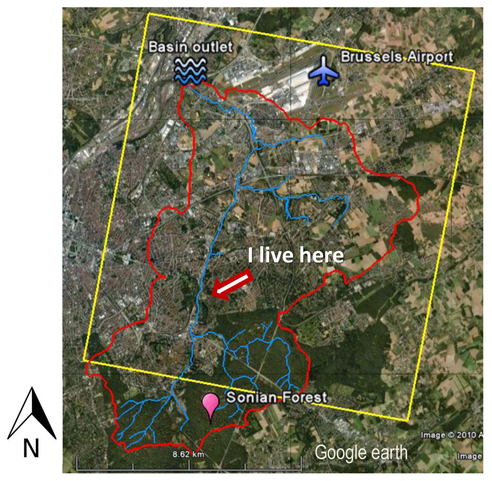
Can we use remote sensing to estimate water quality?

- Optically active constituents influence upwelling light
- Inland waters are a challenge
  - Chl-a feature detection may be impeded by the combined influence of other optically active constituents
  - Chl-a spectral absorption features vary
- Can we benefit from the signal shape?

Study site: 21 artificial shallow ponds in Brussels, Belgium

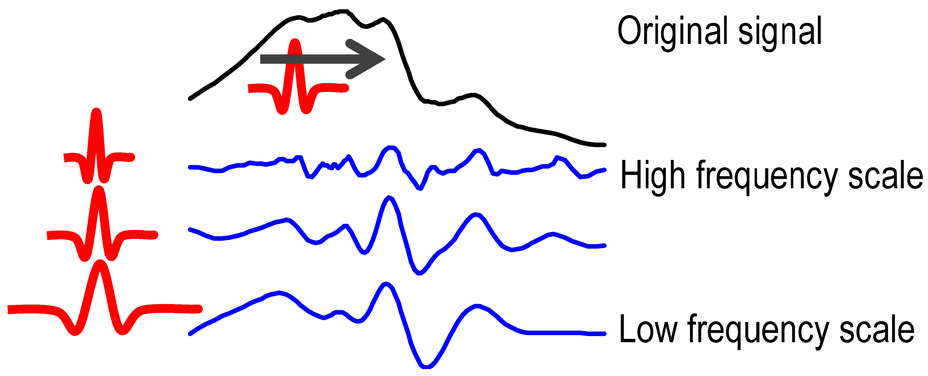
- Chl-a concentration: 2 - 478 µg/l





The continuous wavelet decomposes the signal in multiple frequency scales

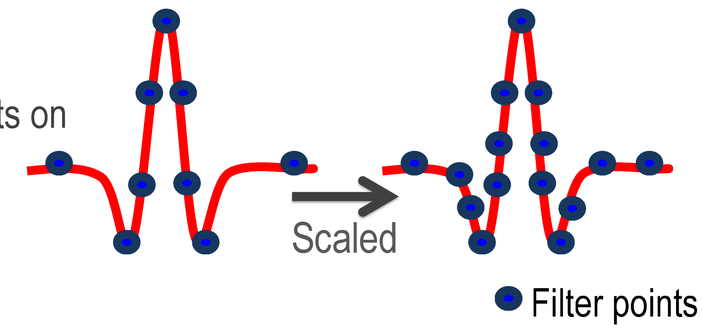
- Band pass filters that return localized information
- Wavelet decomposition enhances extraction of information
- Wavelets synthesize information across wavebands
- Reduced sensitivity to noise



Scales are obtained by convolving the signal and the filter
Each time the filter is shifted and scaled

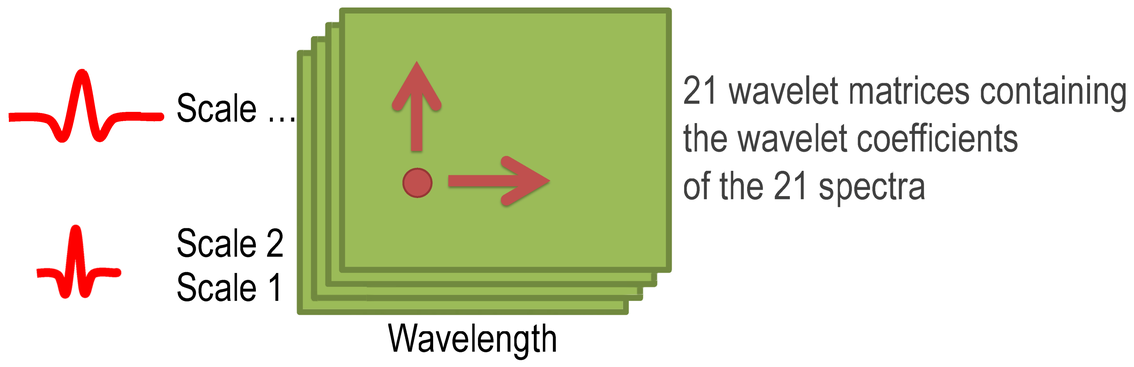
Mexican hat wavelet

- Filter is scaled by adding points on the Mexican hat function



2D correlation scalogram

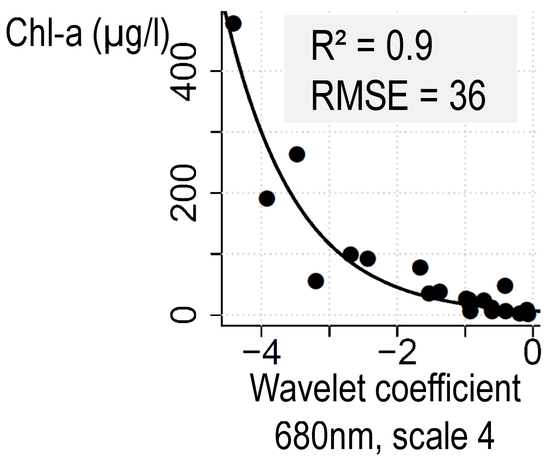
- Each scale is a different representation of the signal
  - We use the wavelet coefficients to estimate Chl-a from the signal
- For each wavelength and scale we calculate the correlation between the wavelet coefficients and the Chl-a concentration at each pond



21 wavelet matrices containing the wavelet coefficients of the 21 spectra

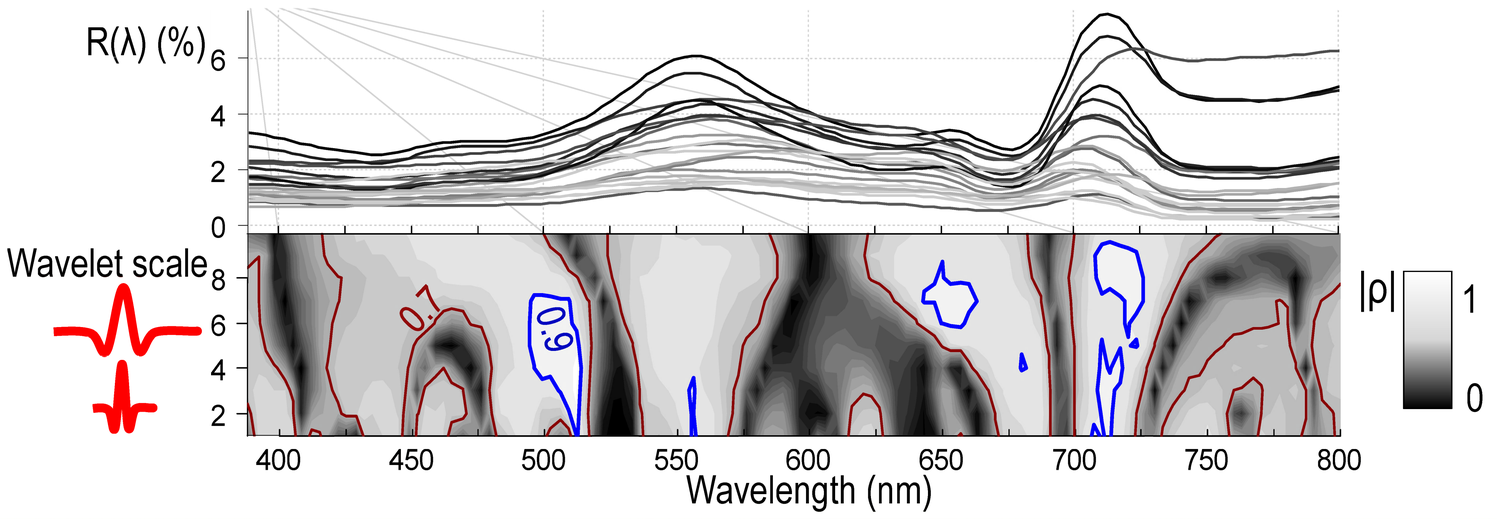
The optimal wavelet feature is used in an exponential regression

- This feature is diagnostic of Chl-a absorption and the second reflectance peak around 710 nm



We can now simultaneously assess narrow and broad Chl-a reflectance features

- Scalogram shows where the Chl-a features are located, and at which wavelet scale
- Features are related to absorption & scattering of Chl-a and the confounding factors



VLIZ Young Marine Scientists' Day
Bruges, Belgium
15 February 2013

Contact: eva.ampe@vub.ac.be

E. M. Ampe, E. L. Hestir, M. Bresciani, E. Salvadore, V. E. Brando, A. Dekker, T. J. Malthus, M. Jansen, L. Triest, and O. Batelaan. A wavelet approach for estimating chlorophyll-a from inland waters with reflectance spectroscopy. IEEE Geoscience and Remote Sensing Letters, in revision.