



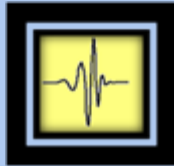
Monitoring Inland and Coastal Waters with APEX  
**A wavelet approach**

Dries Raymaekers, Els Knaeps, Sindy Sterckx, Dani Odermatt  
VITO, RSL

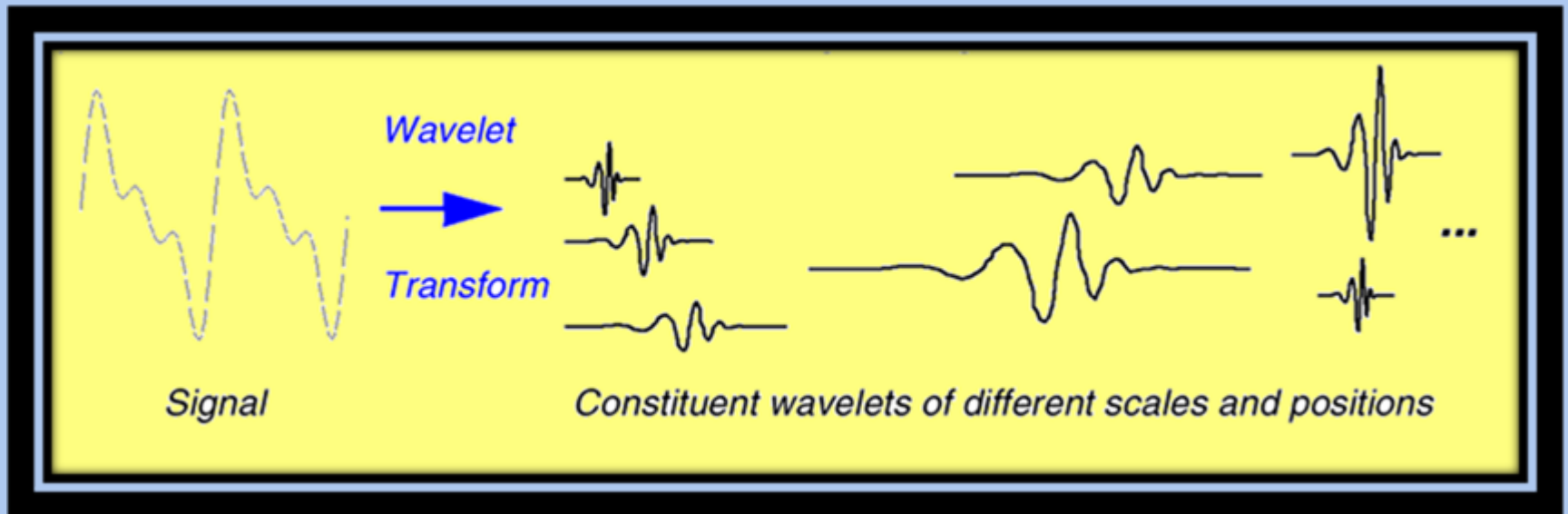
# Remote sensing on Inland and Coastal Waters

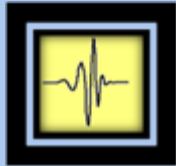


Monitoring Inland and Coastal waters with the APEX sensor – MICAS  
BEO day– 06 May 2010



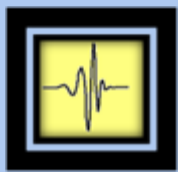
## Wavelet transformation





## APEX processing



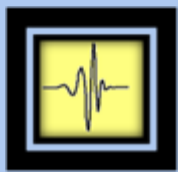


# Remote sensing on Inland and Coastal Waters

- Monitor Water Quality Parameters
  - Algae [CHL]
  - Total Suspended Material [TSM]
  - Colored Dissolved Organic material [CDOM]

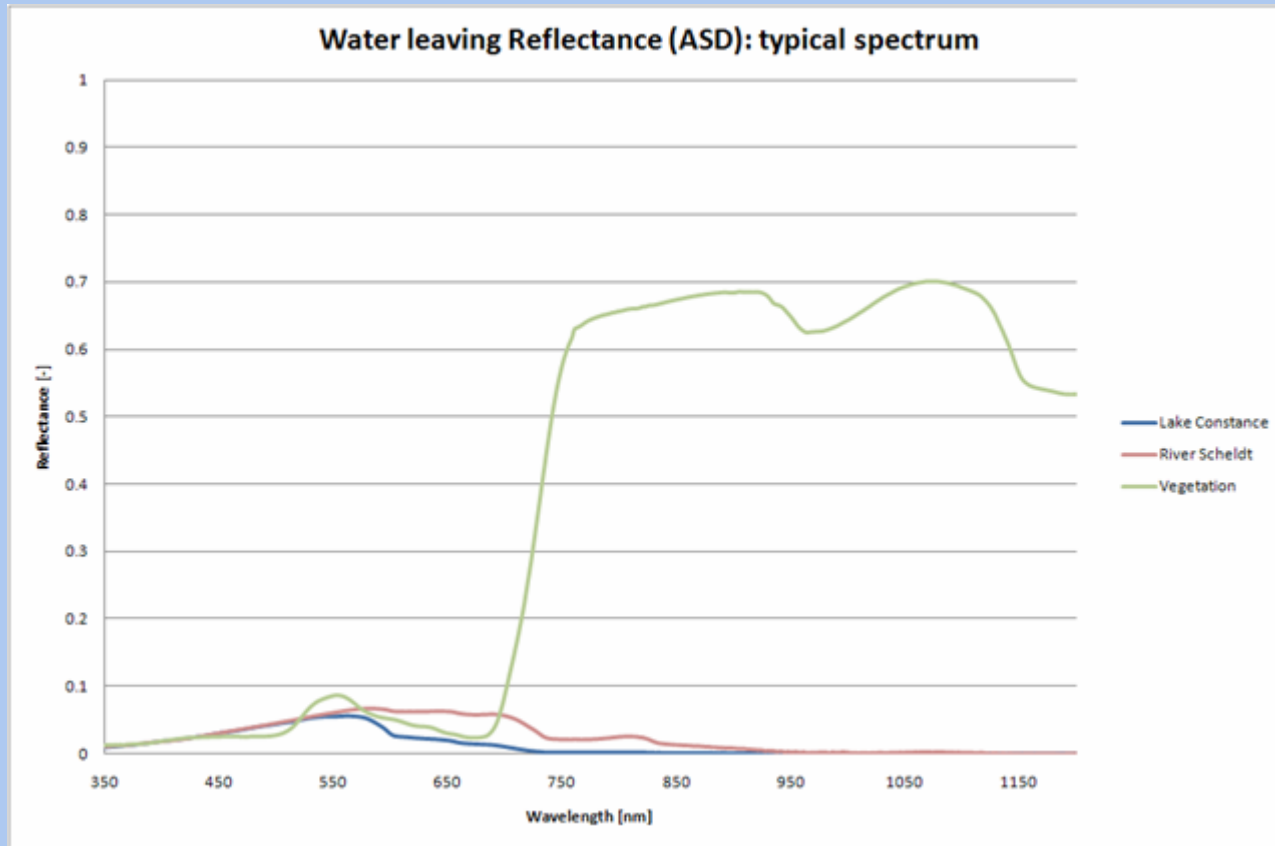
Concentration

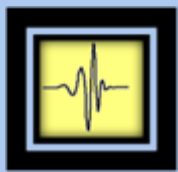




# Remote sensing on Inland and Coastal Waters

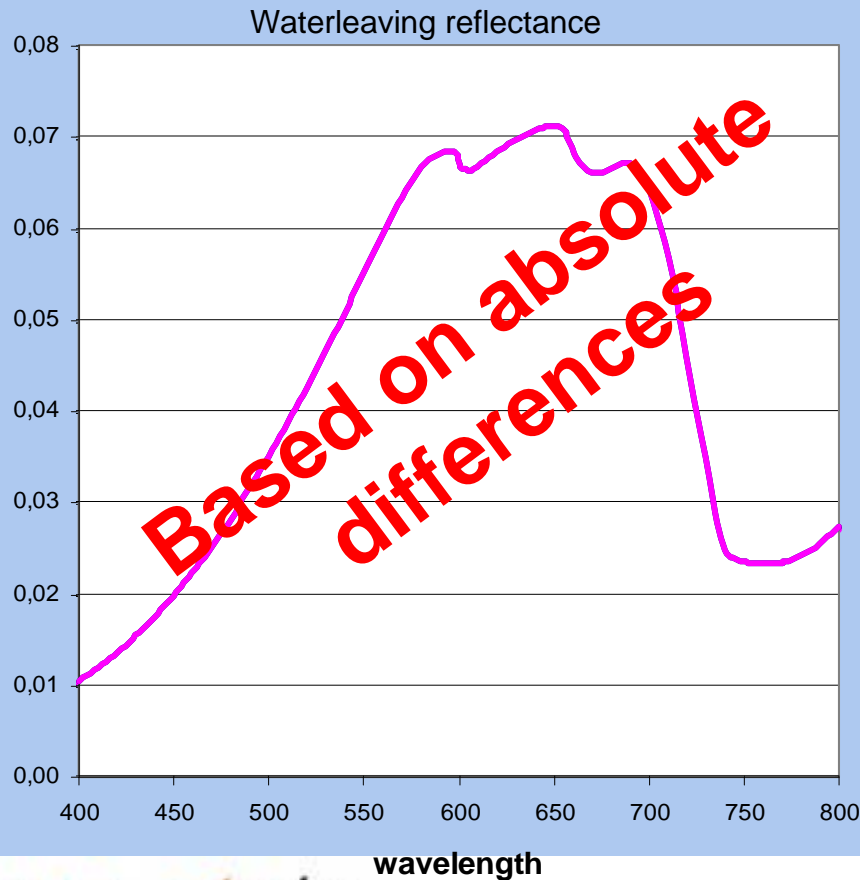
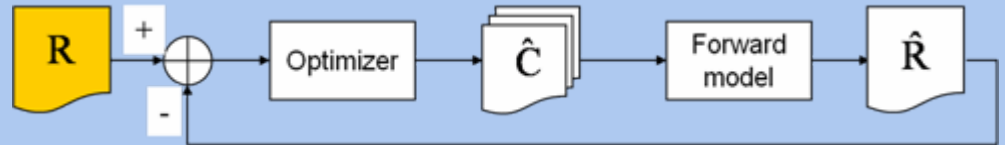
- Typical spectra





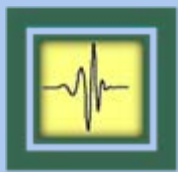
# Remote sensing on Inland and Coastal Waters

- Curve fitting approach



Legend	
CHL( $\mu\text{g/l}$ )	15
TSM( $\text{mg/l}$ )	60
CDOM( $1/\text{a}$ )	1.5

— Measured  
— Modeled



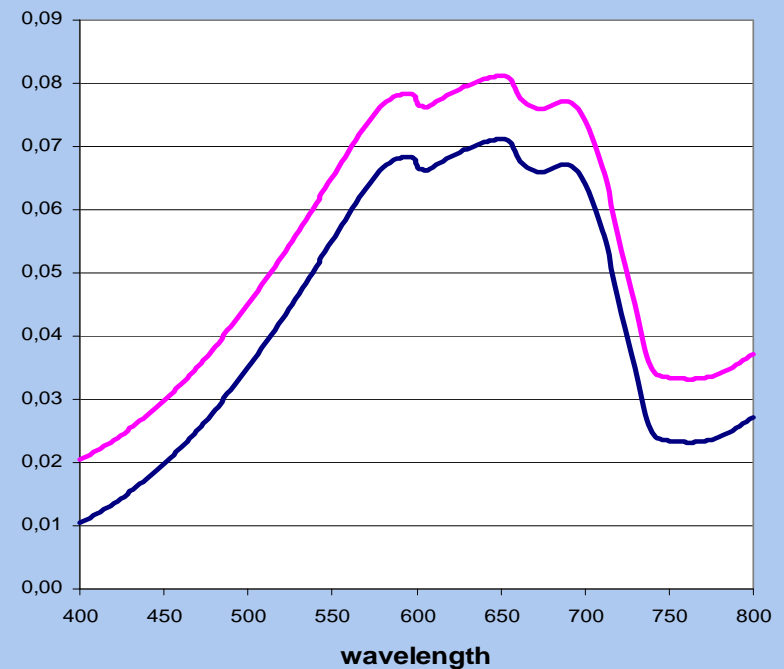
# Wavelet transformation

**Idea: introduce a new curve fitting technique based on the wavelet transform method.**

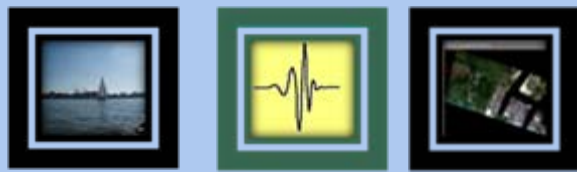
-> similarity between the two spectra (modelled versus measured) can be investigated based on it's **shape**:

Use:

- Account for white noise
- Identify sensor specific noise
- Account for adjacency effects
- ...



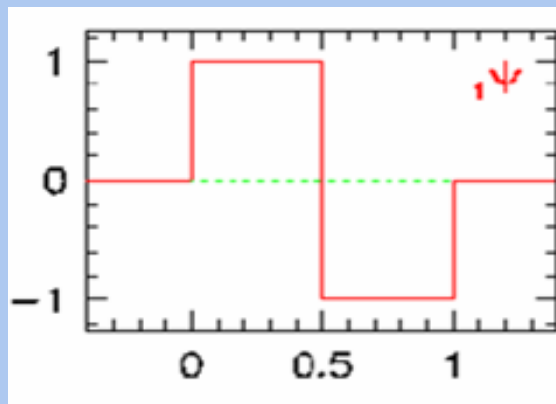




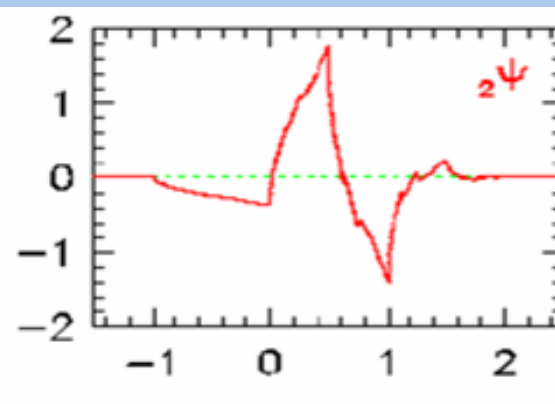
# Wavelet transformation

- Wavelet or 'little wave' = a waveform of effectively limited duration that has an average value of zero.

HAAR-wavelet

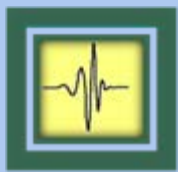


Daubeshies-wavelet



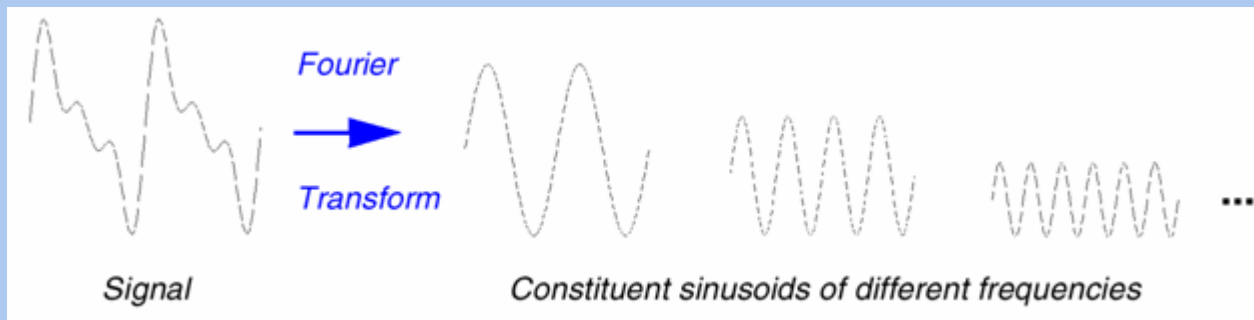
$$\Psi_{a, b}(x) = \frac{1}{\sqrt{a}} \Psi\left(\frac{x-b}{a}\right)$$

- b – shift coefficient
- a – scale coefficient

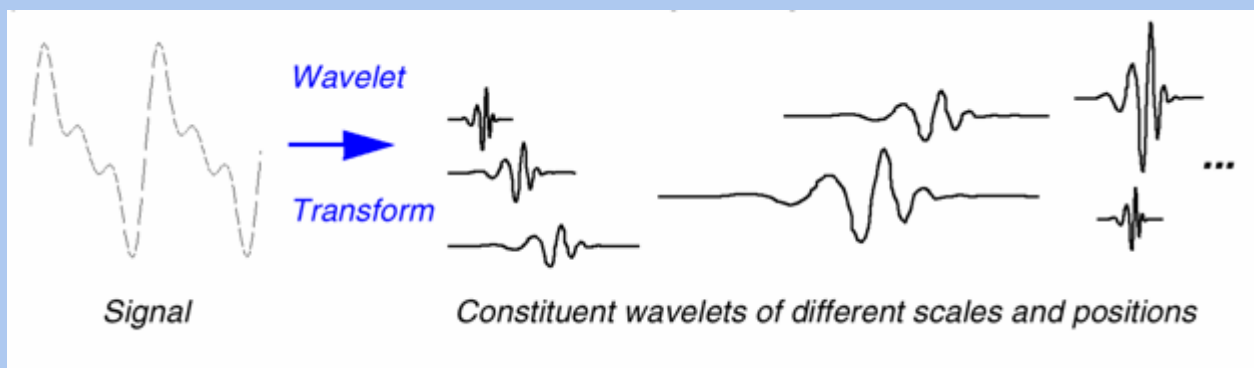


# Wavelet transformation

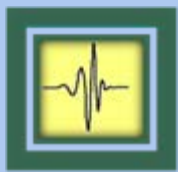
- Wavelet transform = sum over all time of the signal multiplied by scaled and shifted versions of the wavelet function



we lose the time/position information

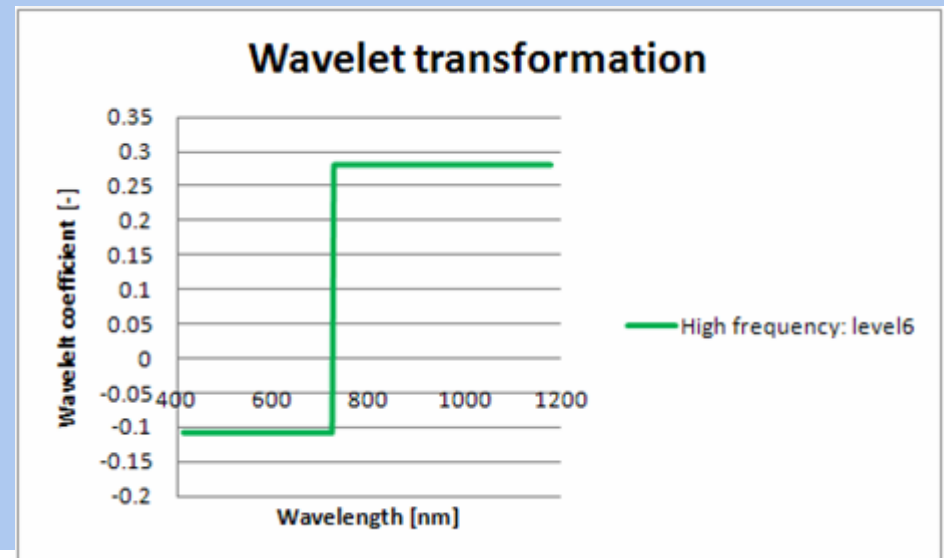
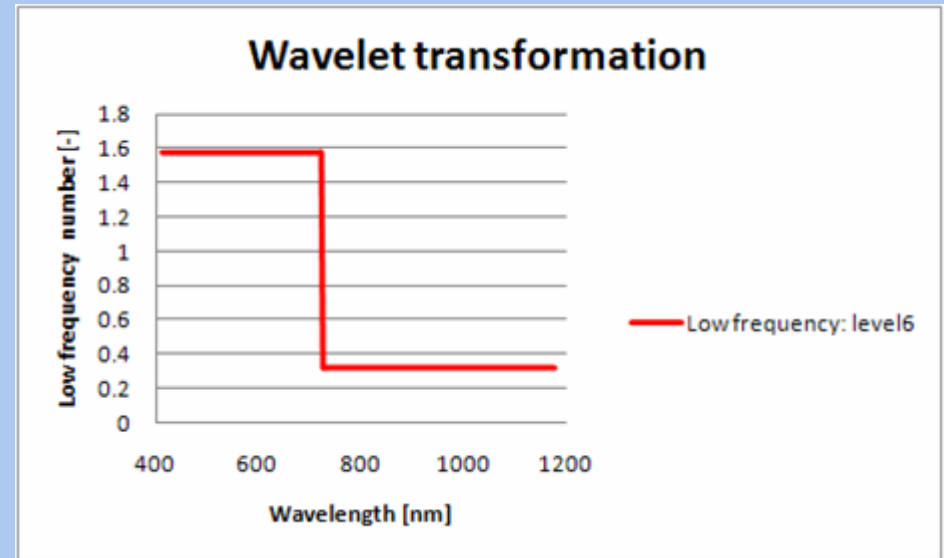
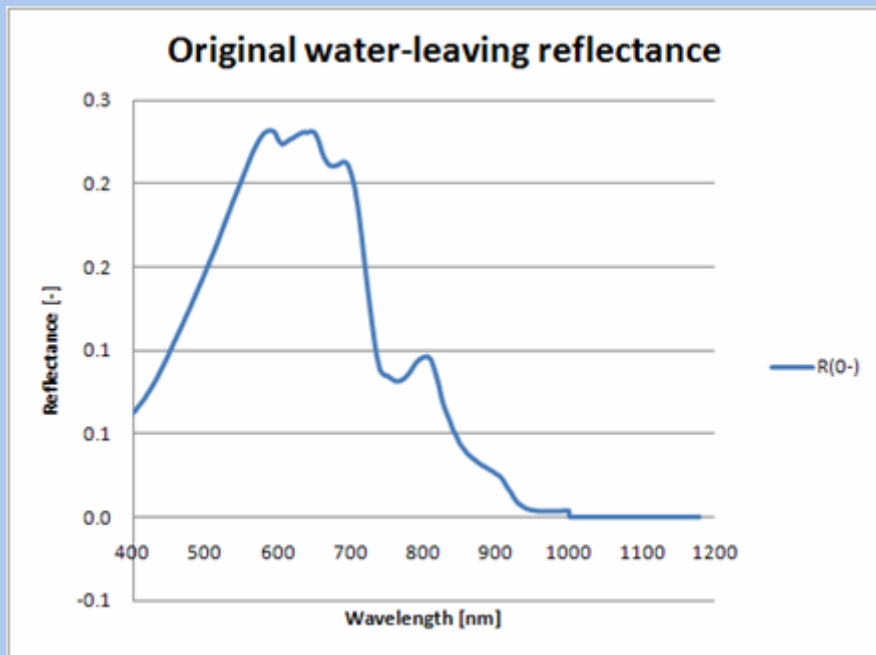


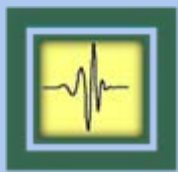
Wavelet analysis produces a time-scale view of the signal.



# Wavelet transformation

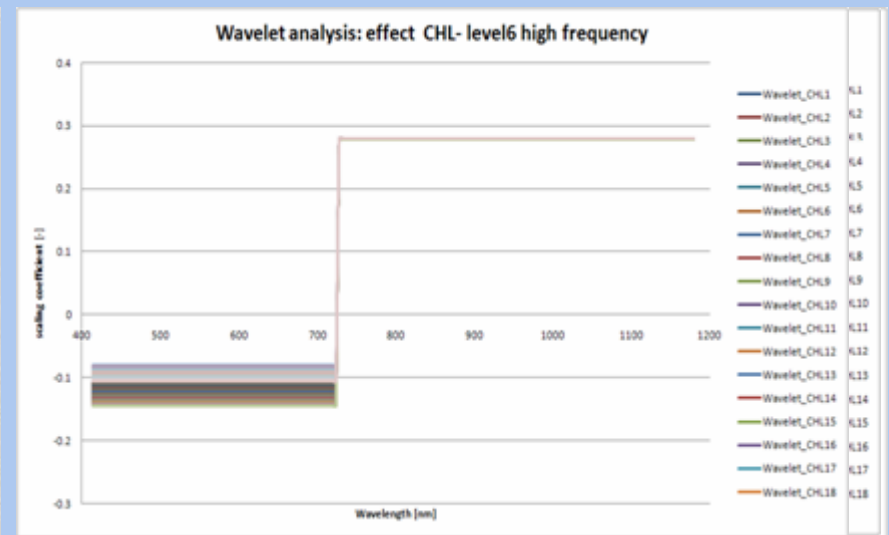
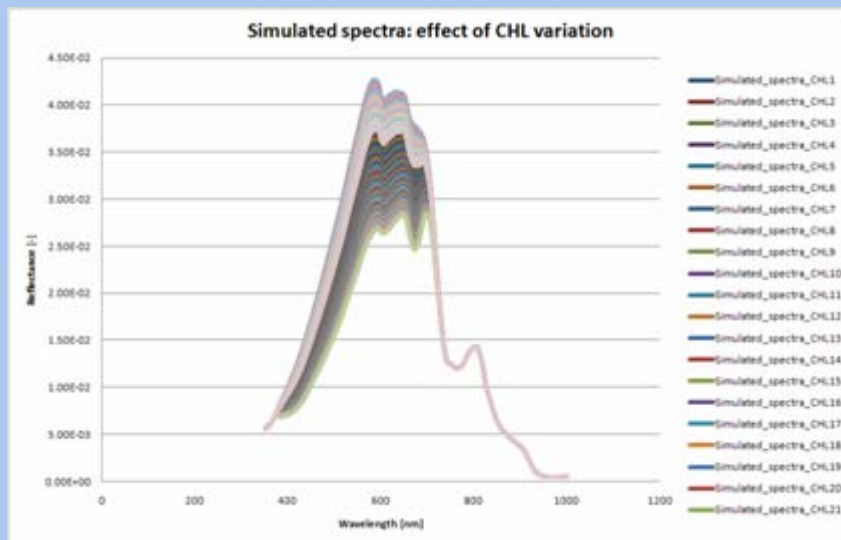
- An example:

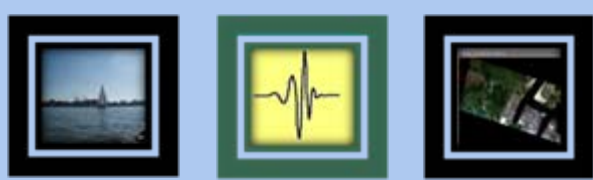




# Wavelet transformation

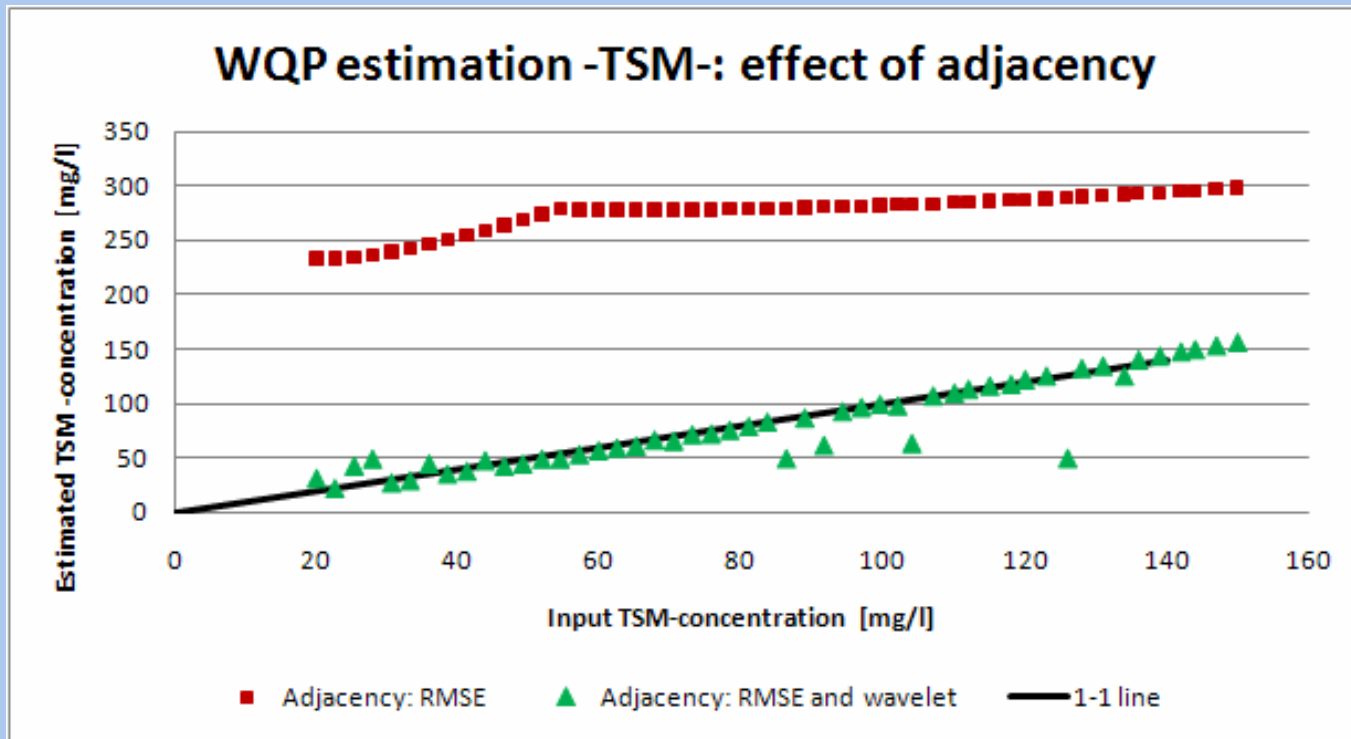
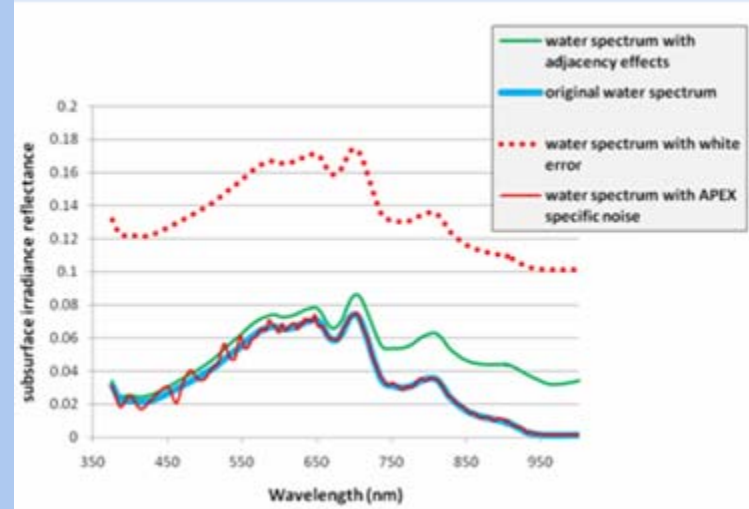
- Improvement of model: Select scales and features
  - A lot of simulations with varying WQP
  - Select those features with highest variation
  - Do this for TSM, CHL, CDOM
  - Add noise (white, random, adjacency, ..) to the spectrum

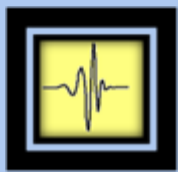




# Wavelet transformation

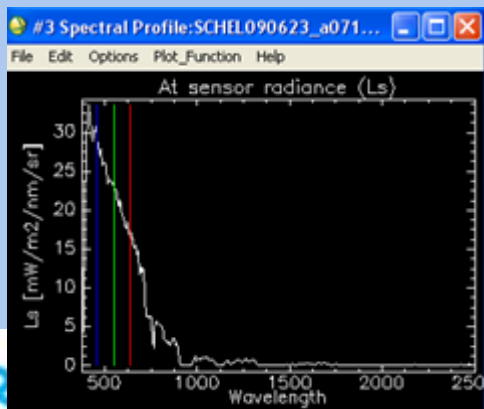
- Some first results: TSM

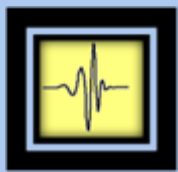




# APEX preprocessing

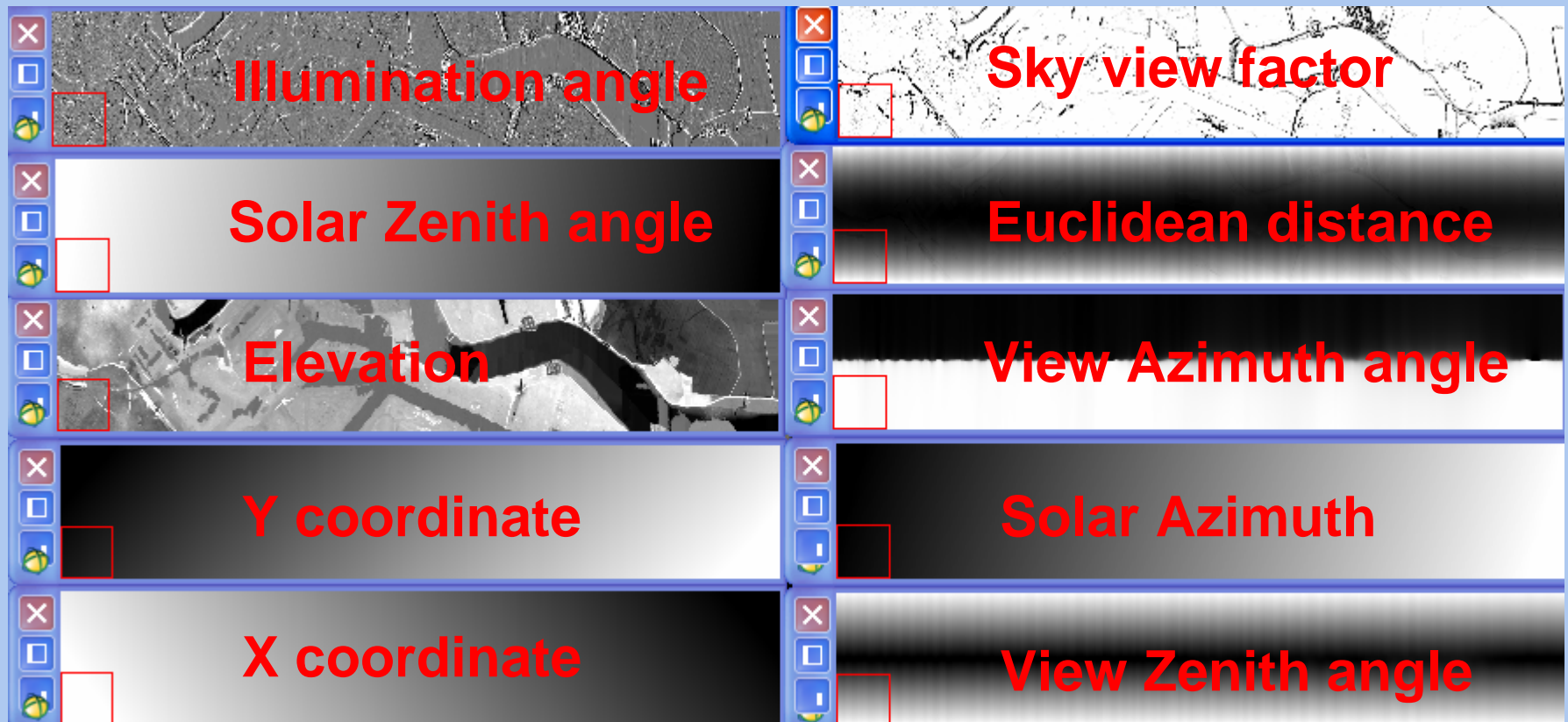
- Details about APEX: see presentation Koen M.
- For MICAS project: 18/06/2009 and 23/06/2009
- 8 flight lines over the Scheldt & 10 flight lines over Lake Constance
- Level 1- data: example

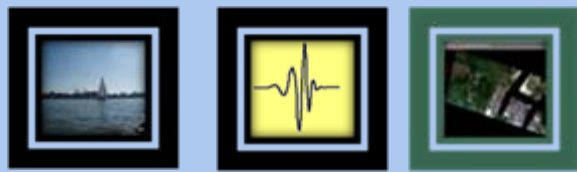




# APEX preprocessing

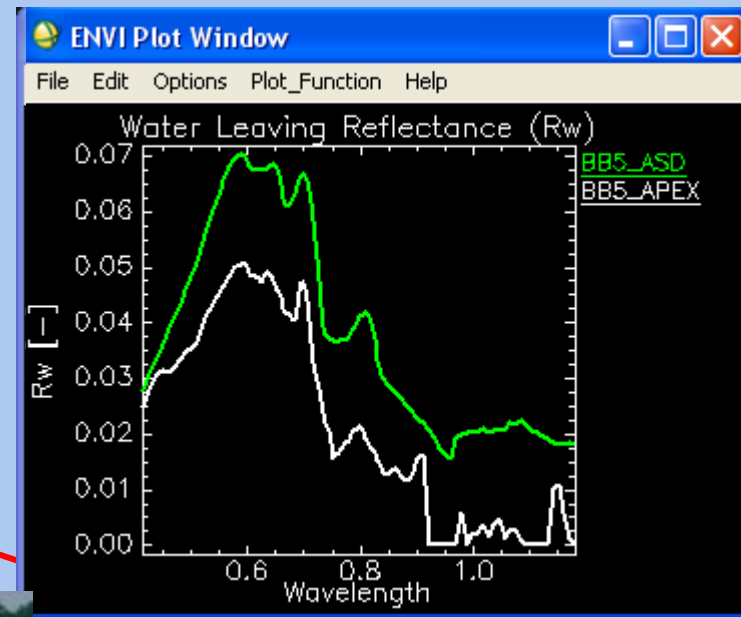
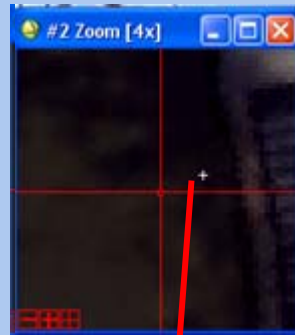
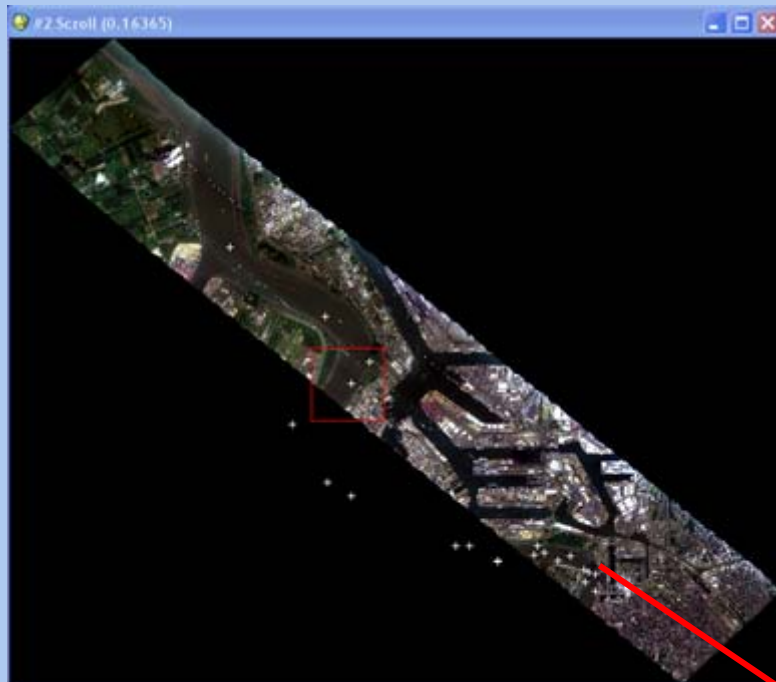
- Georeferencing: Central Data Processing Centre @ VITO





# APEX preprocessing

- Atmospheric correction (Modtran)
- Correction for reflected skylight (Modtran)
- Geographical Resampling







End