Answers - GLaSS Training material, Lesson #6

Part 1 The effect of wind

The table shows that the region 400-600 nm is influenced by a mixture of particles. In the region 600-700 nm only Chl and TSM influence the reflectance spectrum, while in the range > 700 nm only TSM and water influence the reflection. The Chl concentration is not known, which makes two unknowns. In the region > 700 nm the total absorption of water is fixed (the 'concentration of water' does not change). Therefore, TSM is the only substance with an influence on the intensity of the reflectance in this part of the spectrum. This near-infrared (NIR) region will be used for the analysis.

Wavelength range (nm)	400-500 blue	500-600 green	600-700 red	> 700 NIR
Absorption by (substance)	Chl, TSM, CDOM	water, Chl, TSM, CDOM	water, Chl, TSM	water
Scattering by (substance)	water, TSM	TSM	TSM	TSM
Influence TSM visible?	yes	yes	yes	yes
Other substances disturbing TSM signal?	yes: Chl, CDOM, water	yes: water, Chl, CDOM	yes, Chl	yes, water

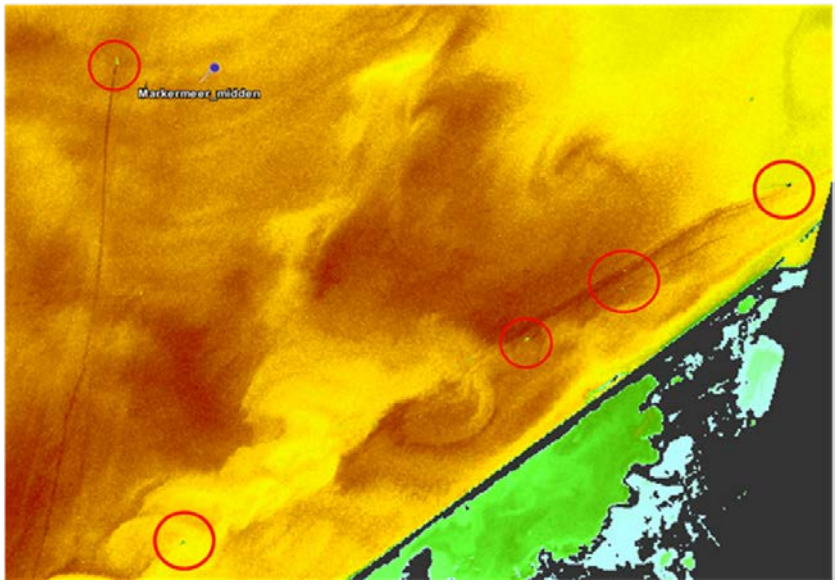
Examples of reflectance spectra with increasing TSM concentrations are shown by Doxaran et al. (2003).

The wind velocities and directions were as follows:

- 17 April 2006 the hourly wind 7.2 m s^{-1} from the west, with an average of 4.8 m s^{-1} in the 24 hours before image acquisition
- 10 May hourly wind 5.5 m s^{-1} from the northeast, with an average of 5.3 m s^{-1} in the 24 hours before image acquisition
- 11 May hourly wind speed dropped to 2.1 m s^{-1}, from the northeast, with an average of 3.2 m s^{-1} in the 24 hours before image acquisition

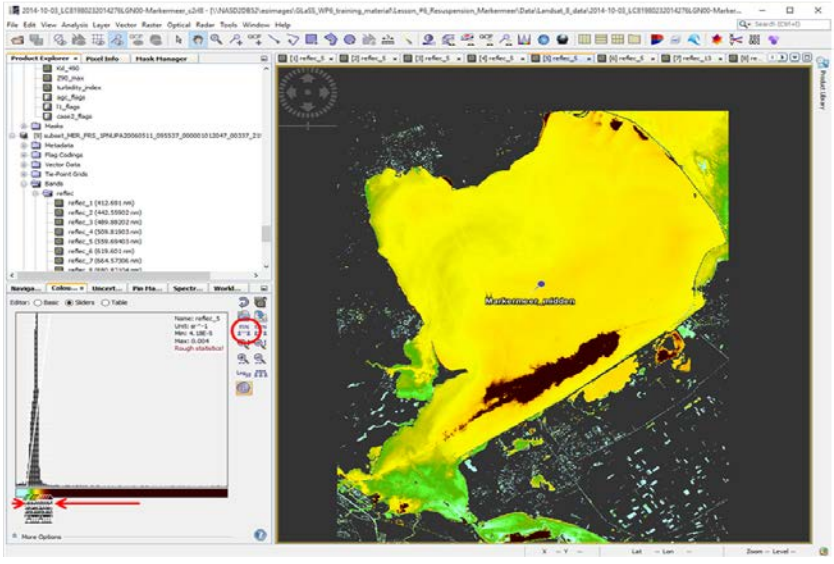
Part 2 The added value of high resolution EO data

The line-shaped area with a distinct distribution pattern of TSM along the south-eastern shores of Lake Markermeer is a main shipping route. In the image below it is even possible to see the ships (in the red circles). The ships go from the locks to Lake IJsselmeer to the harbour of Amsterdam (see Figure 2 in the exercise). The shipping channel is (kept) deeper than most of the lake. If large ships pass by they cause resuspension (although in the image below the thin lines behind the ships are probably white foam). At other times, the deeper channel allows the sediment particles to settle (sink) to the bottom and the concentration of surface TSM might be lower. In any case, the deep shipping lane influences the water movements. This is visible in the MERIS imagery, but for example the eddies (swirls) in the reflectances (as indicator for concentrations) are only visible in the L8 imagery.

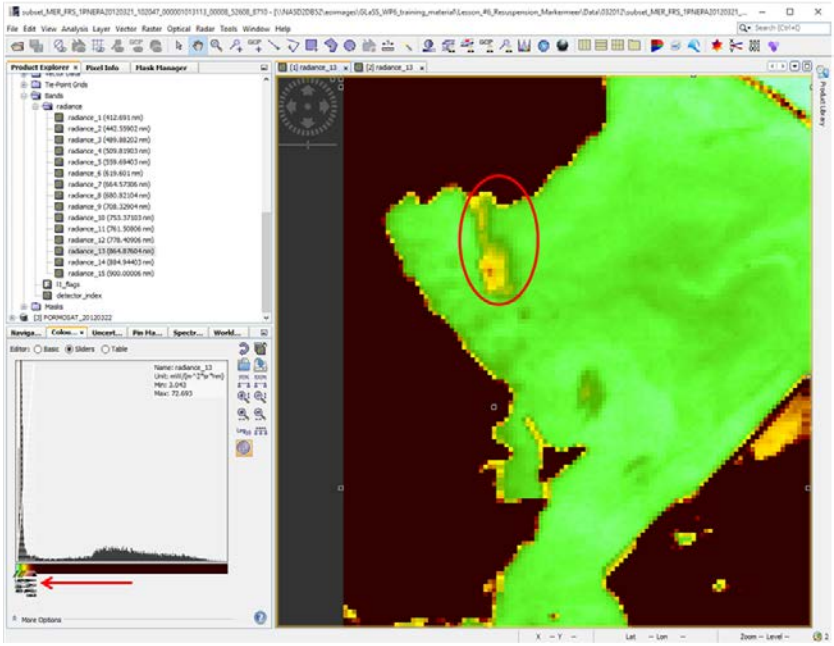


The images of 17 September 2014 and 3 October 2014 show some extremely high concentrations in the shipping lane. Even after stretching the colour scale (Colour Manipulator > Auto-adjust to 95% of the pixels and then move the sliders manually to the peak in the histogram (see image below)), there continues to be an extremely dark brown area, indicating very high concentrations.

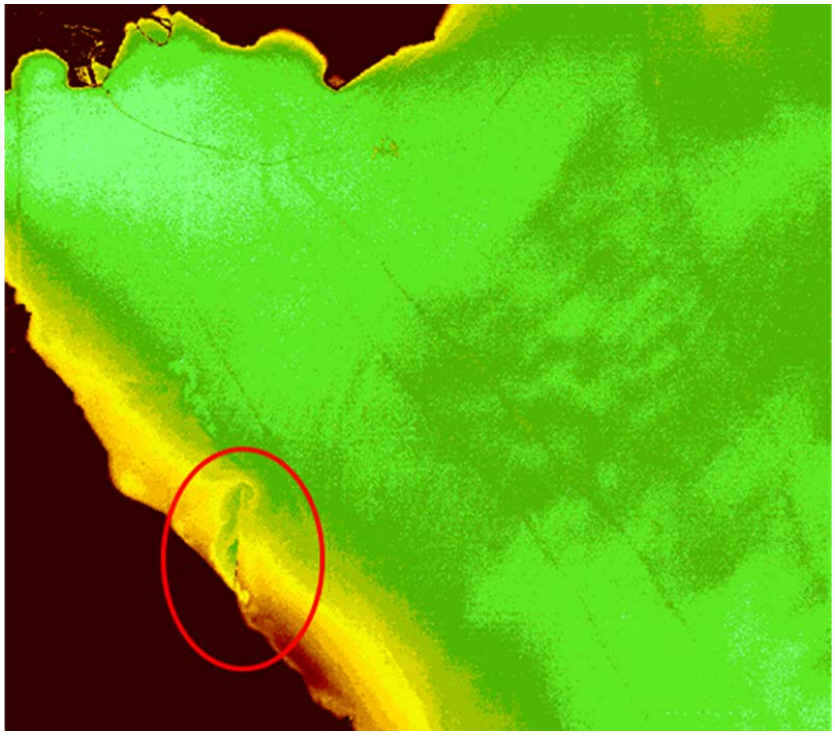
Probably the main shipping lane is being dredged.



In March 2013 there was a MERIS acquisition the day before (March 21) and after (March 23) after a Formosat acquisition (March 22). On the two MERIS images, there is no indication of a fence in the eastern part of the lake. The spot with higher NIR reflection (in the circle in the image below) is actually a cloud (this can be found by checking out the RGB view).

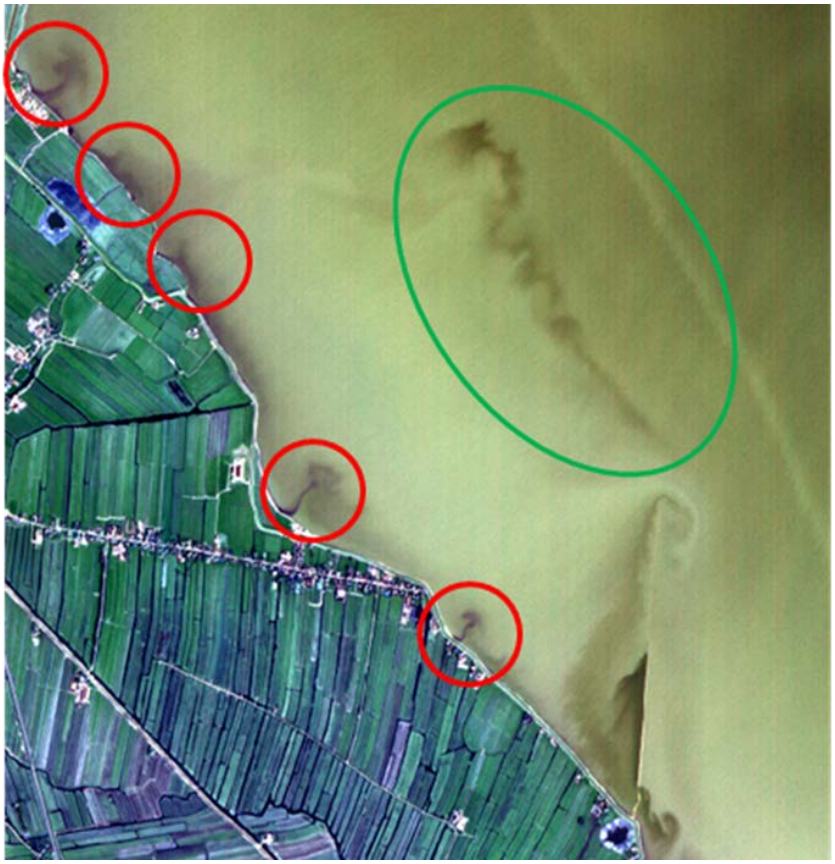


The Formosat image shows the fence, both in its NIR band and in RGB view (below)



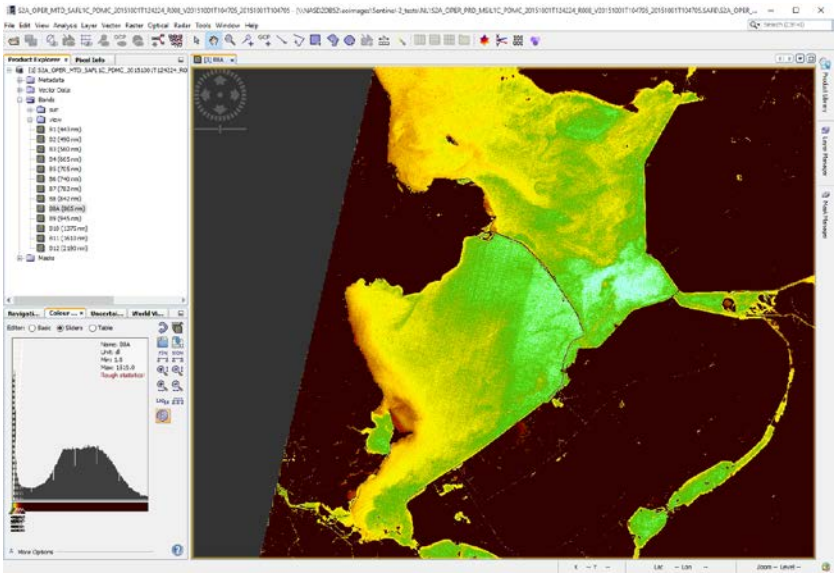
In the coastal areas around the fence are also discharges or runoff events visible (small plumes that origin from the land). If you open bands 1, 2, and 3 also separately, it can be seen that the reflectances of this discharged water are lower in each band. This indicates water with an high absorption, probably rich in organic matter and without much suspended sediments. If you know that the small line-shaped grasslands on the land indicate former peat-land which is now turned into agricultural area, this explanation makes sense.

It also shows the eddies in the water and TSM concentrations, which are caused by the fence, in the direction of the main current.



The Sentinel 2 image in true colour:

S2 NIR band:



These images can be used to monitor the results of the dredging during the restoration project. It is expected that the effect on wind waves of the new islands (blocking the wind and sheer stress of the wind over the water, damping the waves with its soft shorelines) will also be visible.