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Using NIR and SWIR wavelengths for turbid water corrections:
the SIMEC Environment Correction
and
in-situ evidence of non-zero reflectance

Els Knaeps, Sindy Sterckx, Dries Raymaekers, Kevin Ruddick (MUMM), Ana Dogliotti (IAFE)

Presented at Workshop on atmospheric correction of ocean color satellite data in coastal waters: algorithms and uncertainties; 13-14 June, 2012 Wimereux, France

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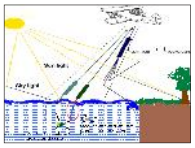
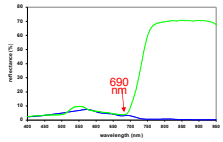
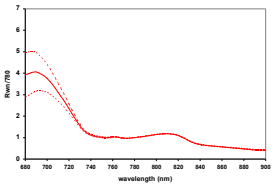
SIMEC Environment Correction Background





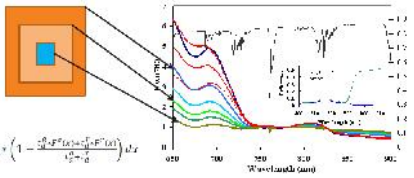
A "similarity" NIR reflectance spectrum is defined by normalization at 780 nm (Ruddick *et al.*, 2006).



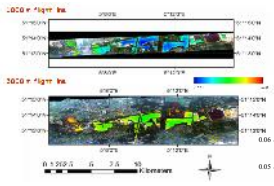
-> can be used to **detect** and **correct** adjacency effects

SIMEC Background: Workflow

- Atmospheric correction (Modtran based)
  - AOT from land targets or sun photometer readings
  - ignoring adjacency effects
- Normalization at 780 nm
- Deviations from the NIR similarity spectrum = measure of the magnitude of the adjacency effect.
- Iteratively calculate contributing background until agreement with NIR similarity spectrum



SIMEC application to airborne data



Sterckx S., Knaeps E., Ruddick K. International Journal of Remote Sensing Vol. 32, Iss. 21, 2011

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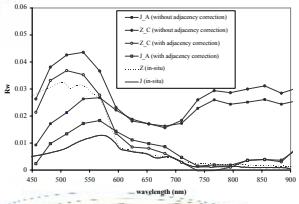
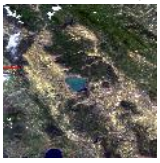
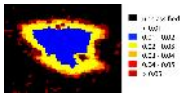
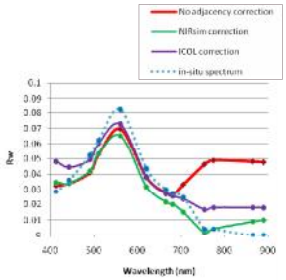


SIMEC application to MERIS : inland lakes

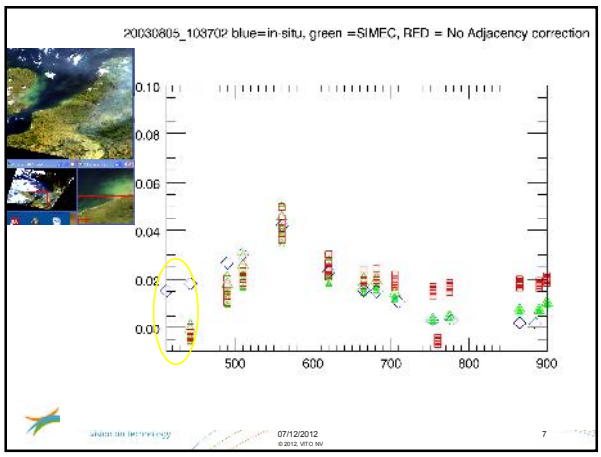
Lake Trasimeno (Italy)



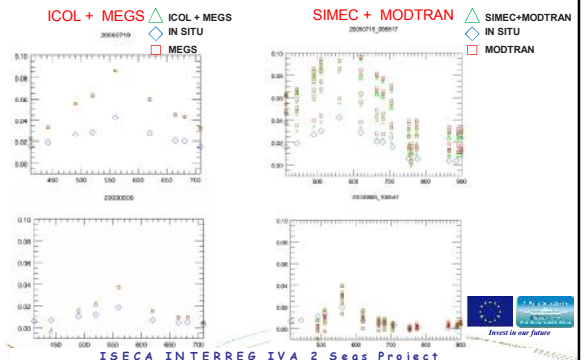




Knaeps, E., S. Sterckx, K. Ruddick, C. Giardino, B. Proceedings of Ocean Optics XX , 2010



SIMEC application to MERIS : coastal waters
ICOL-SIMEC intercomparison



ISECA INTERREG IVA 2 Seas Project
'Information System on the Eutrophication of our Coastal Areas'

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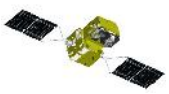
SWIR potentially interesting !
Using new ocean color satellites

MERIS	OLCI
412.5	400
442.5	412.5
490	442.5
510	490
560	510
620	560
665	620
681.25	665
708.75	673.75
753.75	681.25
778.75	708.75
865	753.75
885	761.25
900	764.375
	767.5
	778.75
	865
	885
	900
	940
	1020

- Incorporation of SWIR wavelengths in ocean color satellites

Sentinel-3 (OLCI)

SABIA/MAR



GCOM-C(SGLI)

- Hyperspectral sensors

HYSPIRI

APEX

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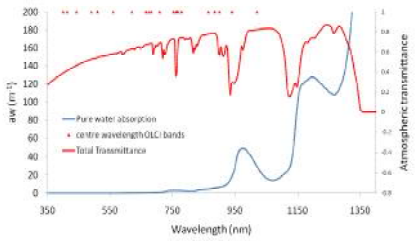
SWIR potentially interesting ! -
Because of pure water absorption and atmospheric windows



Pure water absorption coefficient (Pope & Fry, 1997; Kou *et al.*, 1993)

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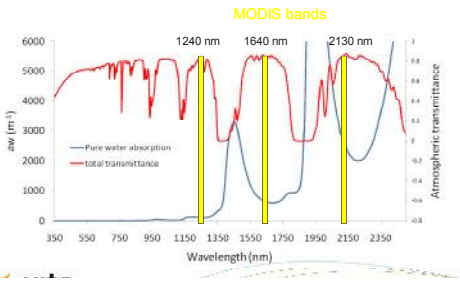
SWIR potentially interesting !
For atmospheric correction and TSM retrieval

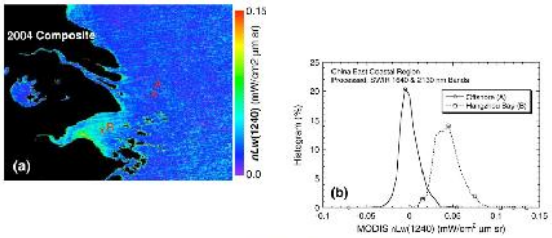
- **Clear and turbid waters** : SWIR black pixel assumption (Wang and Shi, 2007; Gordon and Wang, 1994).



SWIR potentially interesting !

For atmospheric correction and TSM retrieval

- **Clear and turbid waters** : SWIR black pixel assumption (Wang and Shi, 2007; Gordon and Wang, 1994)
- **Extreme turbid waters**: new atmospheric correction <-> TSM retrieval (saturation at shorter wavelengths?) (Shi and Wang, 2009)

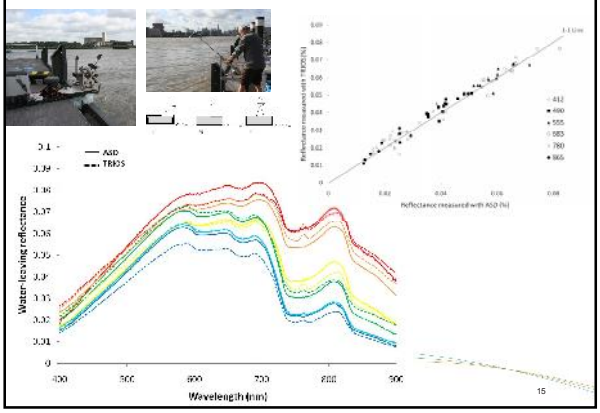


SWIR potentially interesting !

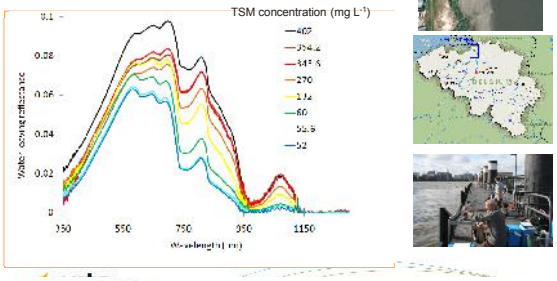
BUT

- only little knowledge available
- instrumentation lacking
  - to measure IOPS in the SWIR
  - to measure water reflectance in the SWIR

Intercomparison of ASD and TRIOS water reflectance measurements;



Knaeps, E., Raymaekers, D., Sterckx, S, Ruddick, K., Dogliotti, A.I., In situ evidence of non-zero reflectance in the OLCI 1020nm band for a turbid estuary, *Remote Sensing of Environment, Sentinel special issue*. 133-144,2012



For a threshold reflectance of 0.002 at 1020nm:

limit of 35 mg L^{-1} for the TSM concentration
46.7 FNU for the turbidity

For the same threshold at 1071 nm:

a limit of 17.5 mg L^{-1} for the TSM concentration
23.3 FNU for the turbidity.

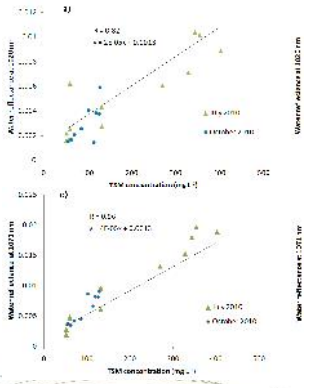
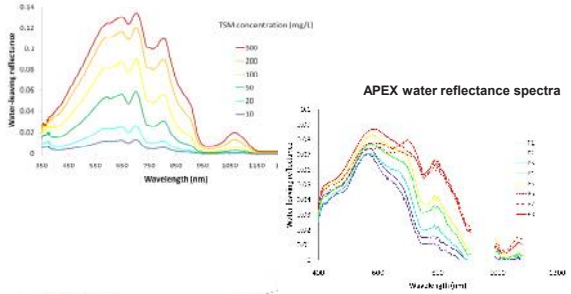


Figure 10: a) Correlations between TSM and a) water reflectance at 1020 and c) water reflectance at 1071; Correlations between turbidity and b) water reflectance at 1020 and d) water reflectance at 1071 .

Simulations with Hydrolight and SIOPS from the Scheldt



CONCLUSIONS

- black pixel assumption invalid for scheldt estuary. A significant increase in reflectance was observed between 950 and 1150 nm where pure water absorption has a local minimum.
- SNR and atmospheric influences does not seem to alter these findings.
- WARNING when using the SWIR black pixel assumption for atmospheric correction
- need for an **adjusted atmospheric correction for highly turbid waters**. (Incorrect use of the black pixel assumption in atmospheric correction can lead to an overestimation of the aerosol contribution and a significant underestimation of the derived water reflectance!)
- correlation of water reflectance with TSM concentration.
- Suggest that spectral bands beyond 1000 **nm contain information on the concentrations of optical constituents.**

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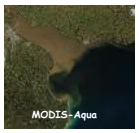
SEASWIR: REMOTE SENSING OF TURBID WATERS IN THE SHORT WAVE INFRARED

- Determine the variability of marine reflectance in SWIR
- Analyze the effects misapplication of the SWIR black pixel assumption
- Provide information for exploitation of SWIR bands on the next generation of ocean colour sensors

Scheldt (Belgium) up to 400 mg l^{-1}

Yangtze (China) up to several g l^{-1}

La Plata (Argentina) up to 400 mg l^{-1}



Gironde (France) up to several g l^{-1}

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