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

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SIMEC Environment Correction Background

A "similarity" NIR reflectance spectrum is defined by normalization at 700 nm (Ruddick et al., 2006).

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, No. 21, 2011

SIMEC application to MERIS: inland lakes

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

Because of pure water absorption and atmospheric windows

Pure water absorption coefficient (Pope & Fry, 1987; Koc et al., 1983)

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!

Using new ocean color satellites

> Incorporation of SWIR wavelengths in ocean color satellites

Sentinel-3 (OLCI) SARIAMAR GCOM-C(SGLI)

> Hyperspectral sensors

HYSPIRI APEX
SWIR potentially interesting!
For atmospheric correction and TSM retrieval:
- Extreme turbid waters: new atmospheric correction <-> TSM retrieval (saturation at shorter wavelengths?) (Shi and Wang, 2009)

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:

For a threshold reflectance of 0.002 at 1020 nm:
- Limit of 35 mg L\(^{-1}\) for TSM concentration
- 45.7 FNU for turbidity

For the same threshold at 1071 nm:
- Limit of 17.5 mg L\(^{-1}\) for TSM concentration
- 23.3 FNU for turbidity

Simulations with Hydrolight and SIOPS from the Scheldt:

APEX water reflectance spectra
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.

**SEAWIR: REMOTE SENSING OF TURBID WATERS IN THE SHORT WAVE INFRARED**

- Determine the variability of marine reflectance in SWIR
- Analyze the effects of 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)