

Rrs derived via Cloud-Shadow Scheme

ZhongPing Lee ¹, Nick Tufillaro ²,
Roy Armstrong ³, William Hernandez ³

1. University of Massachusetts Boston
2. Oregon State University
3. University of Puerto Rico

The input for sub-surface properties:

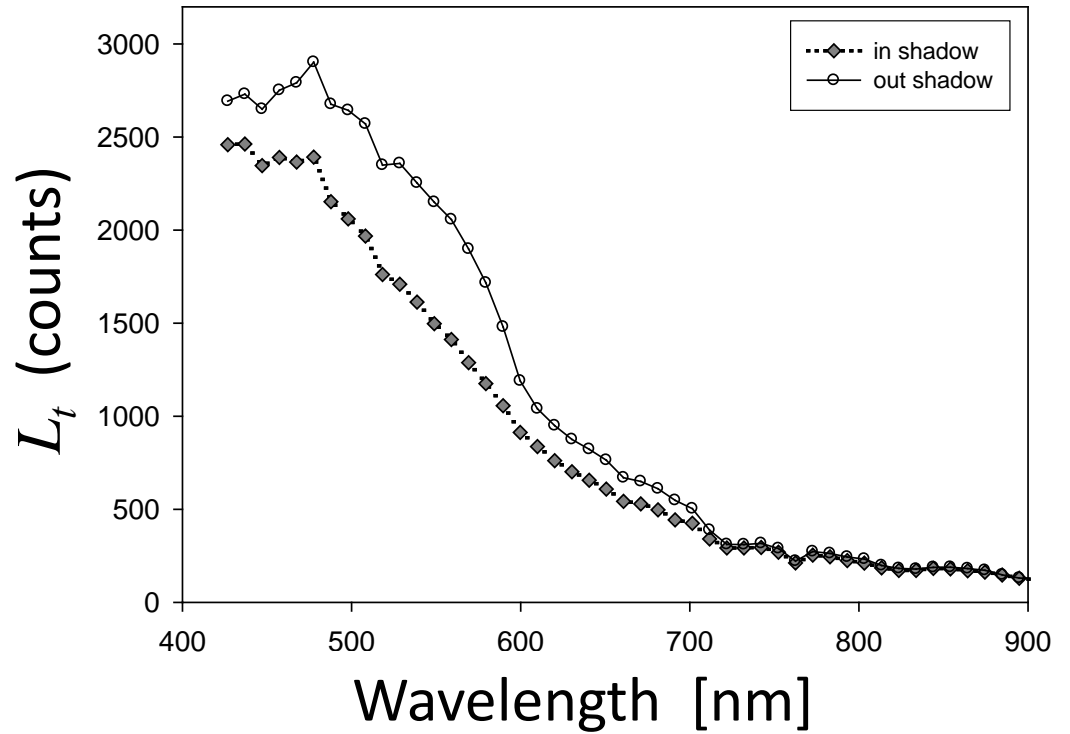
$$R_{rs}(\lambda) = \frac{L_w(\lambda)}{E_d(\lambda)}$$

$$L_t(\lambda) = L_{sky}(\lambda) + t(\lambda) L_w(\lambda)$$



$$R_{rs}(\lambda) = \frac{L_w(\lambda)}{E_d(\lambda)} = \frac{L_t(\lambda) - L_{sky}(\lambda)}{t(\lambda) E_d(\lambda)}$$

Cloud-Shadow Scheme (CSS)

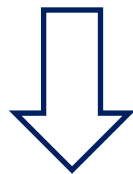


(Reinersmann et al 1998, Lee et al 2007)

$$\left\{ \begin{array}{l} L_t^{Sun}(\lambda) = L_{sky}^{Sun}(\lambda) + t(\lambda) E_d(\lambda) R_{rs}(\lambda) \\ L_t^{Sdw}(\lambda) = L_{sky}^{Sdw}(\lambda) + t(\lambda) E_d^{Sky}(\lambda) R_{rs}(\lambda) \end{array} \right.$$

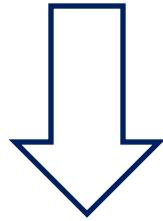
Assume:

$$L_{sky}^{Sun} \approx L_{sky}^{Sdw} \approx L_{sky}^{Sdw}$$



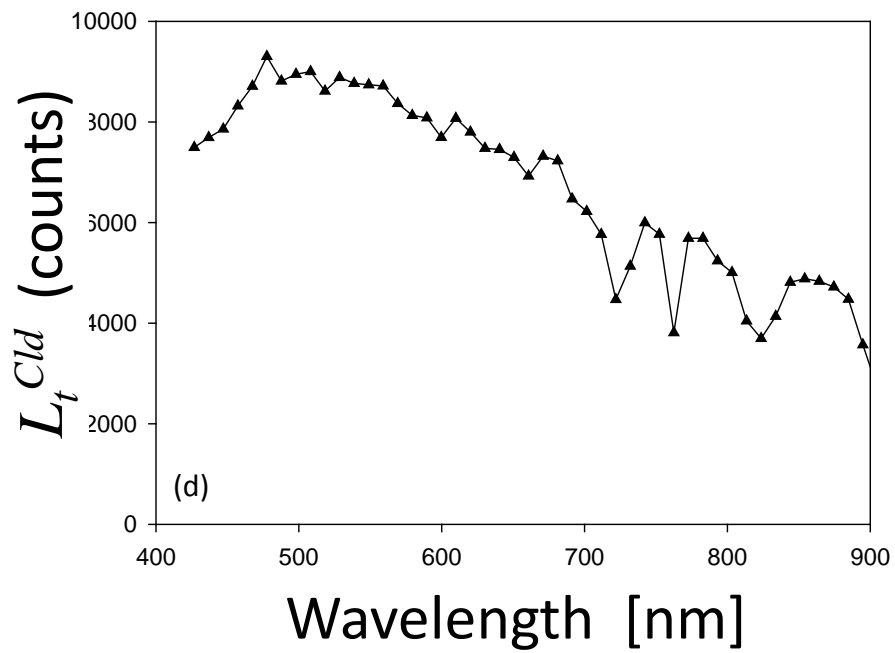
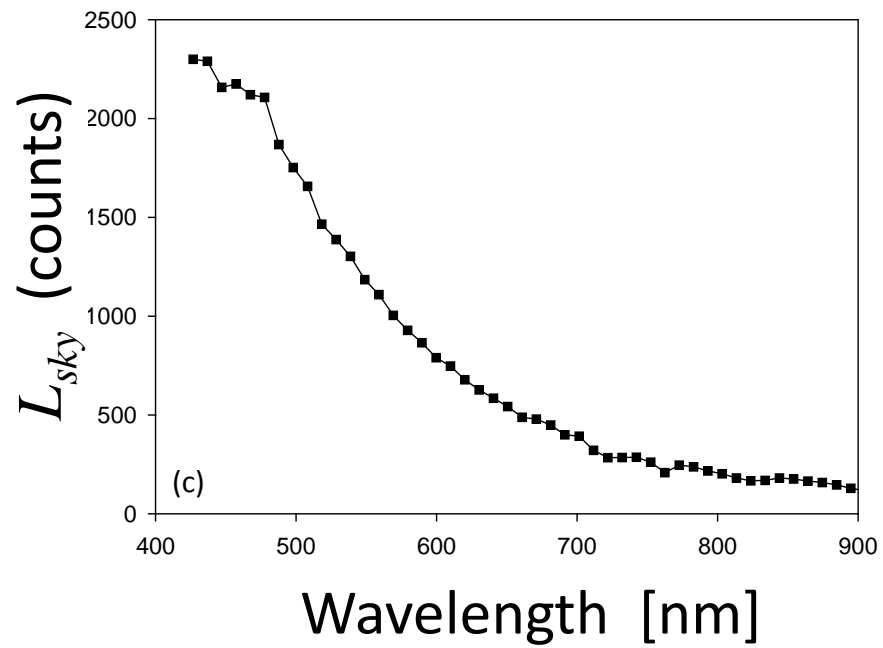
$$L_{sky}(\lambda) = L_t^{Sun}(\lambda) - \frac{L_t^{Sun}(\lambda) - L_t^{Sdw}(\lambda)}{1 - E_d^{Sky}(\lambda) / E_d(\lambda)}$$

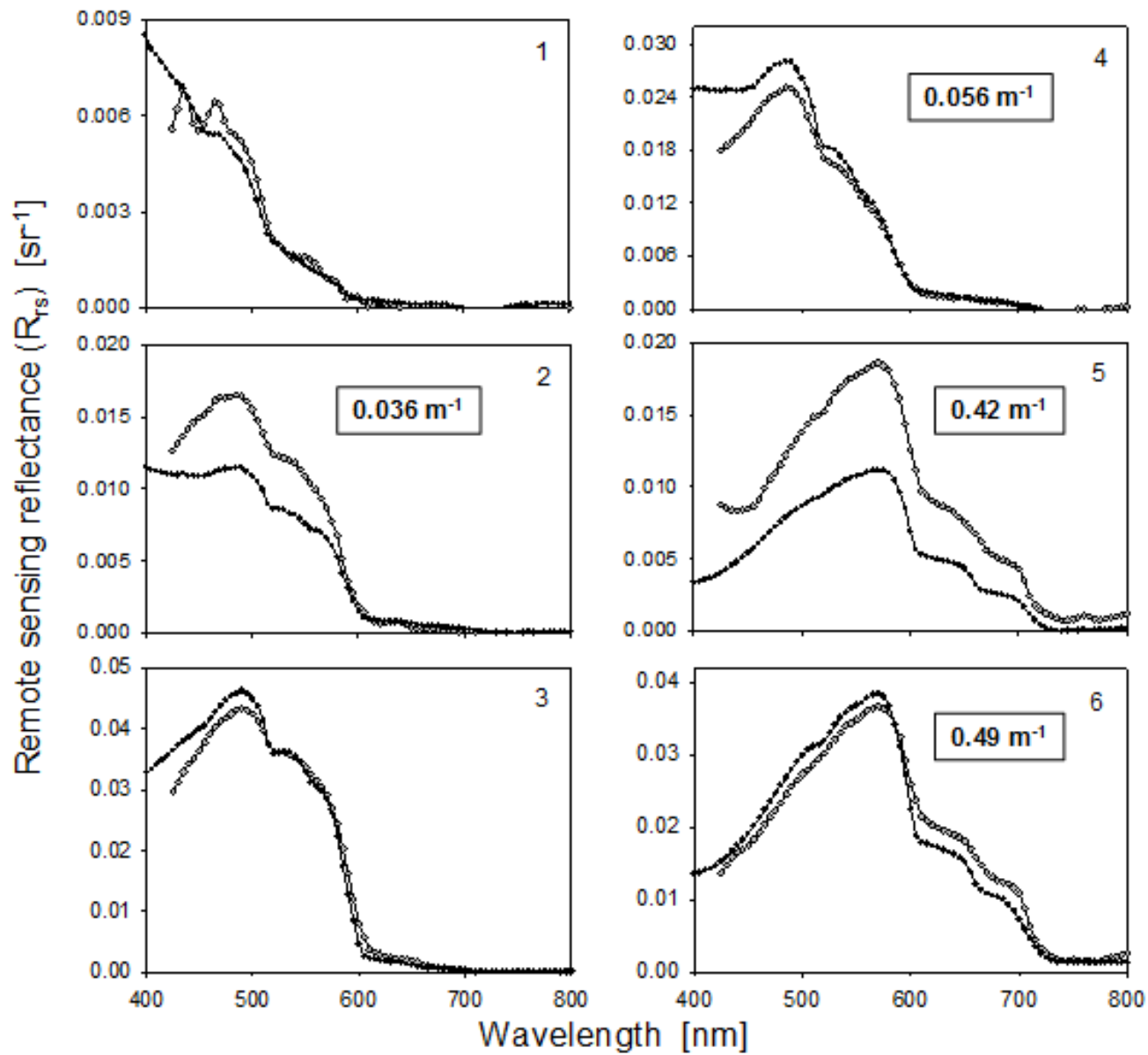
$$L_t^{Cld}(\lambda) = L_{sky}(\lambda) + t(\lambda) E_d(\lambda) \rho$$



$$R_{rs}(\lambda) = \rho \frac{L_t(\lambda) - L_{sky}(\lambda)}{L_t^{Cld}(\lambda) - L_{sky}(\lambda)}$$

Call components calculated from the image





(Lee et al 2007)

Requirements/Assumptions used by Tafkaa and CSS

Tafkaa

'Automated'

High-quality sensor calibration

Accurate account of aerosols/gases

CSS

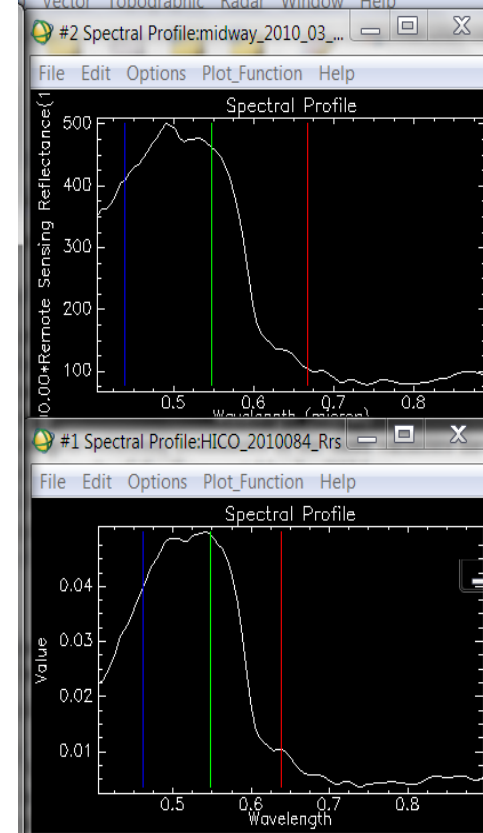
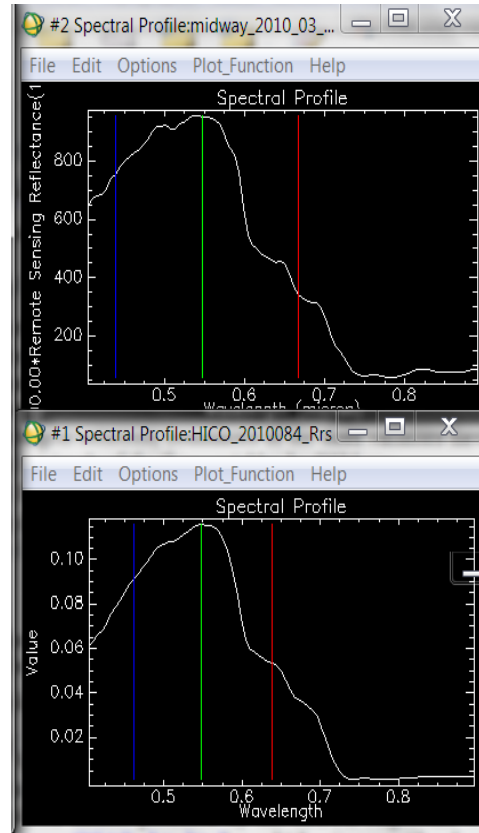
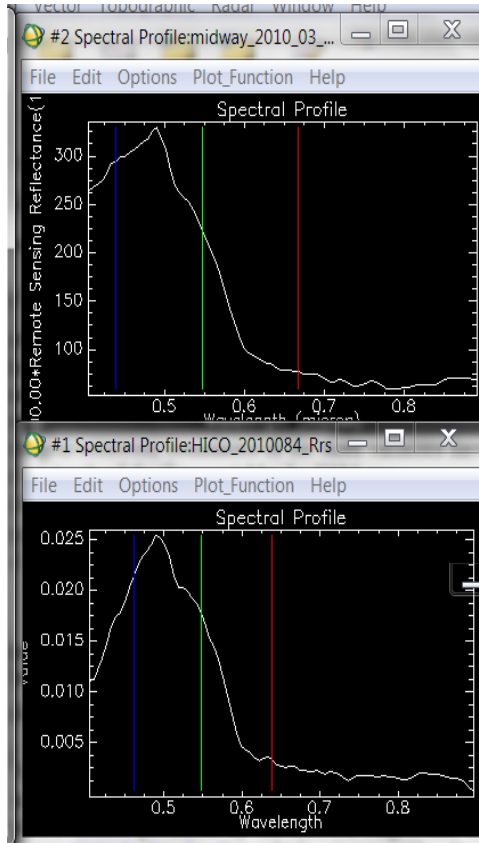
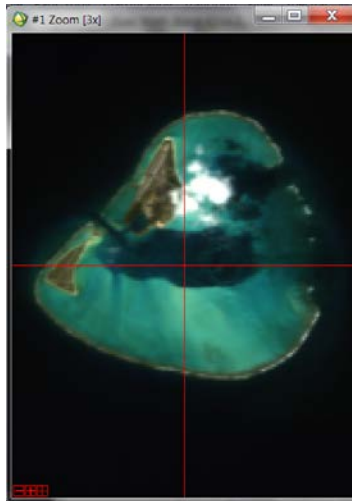
Sensor can be not-calibrated

**'uniform' atmosphere
contribution**

Clouds/shadows in the scene

Midway

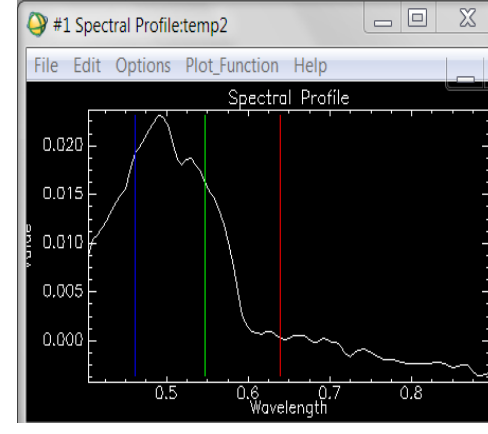
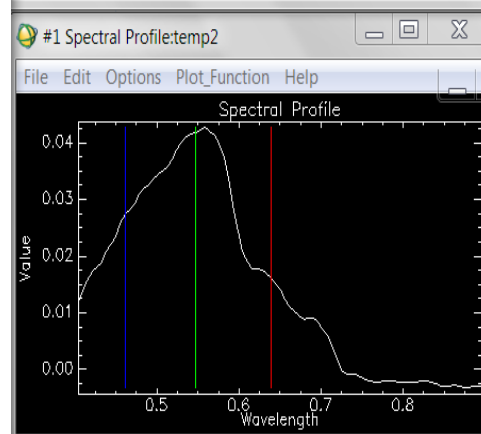
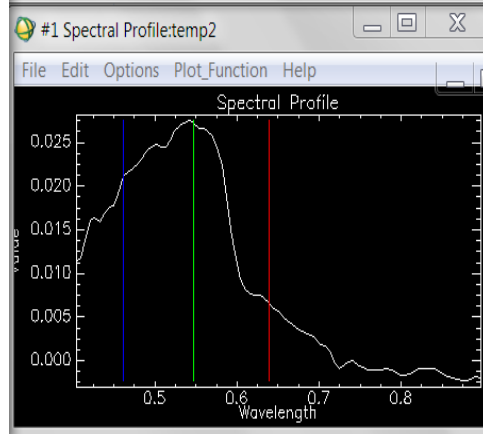
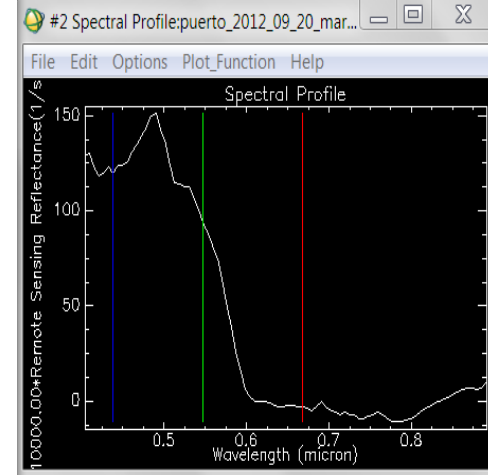
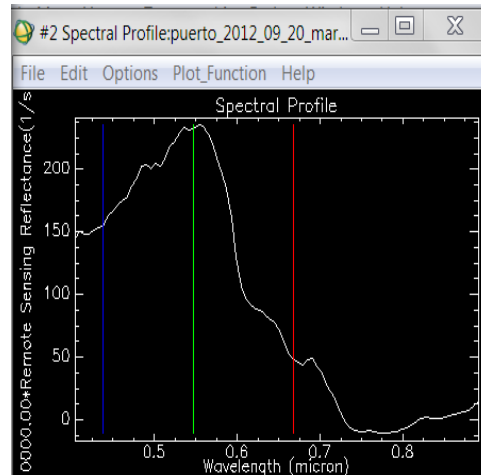
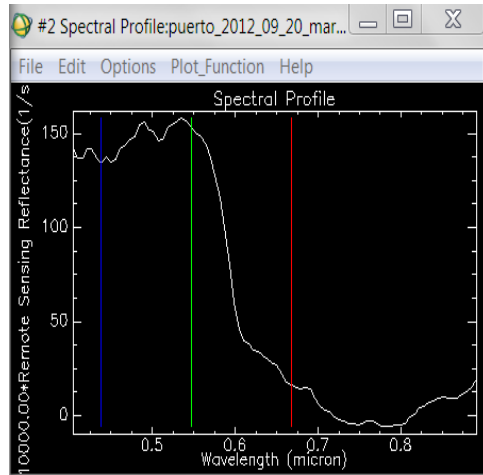
Top: Tafkaa Rrs



Bottom: CSS Rrs

Puerto Rico

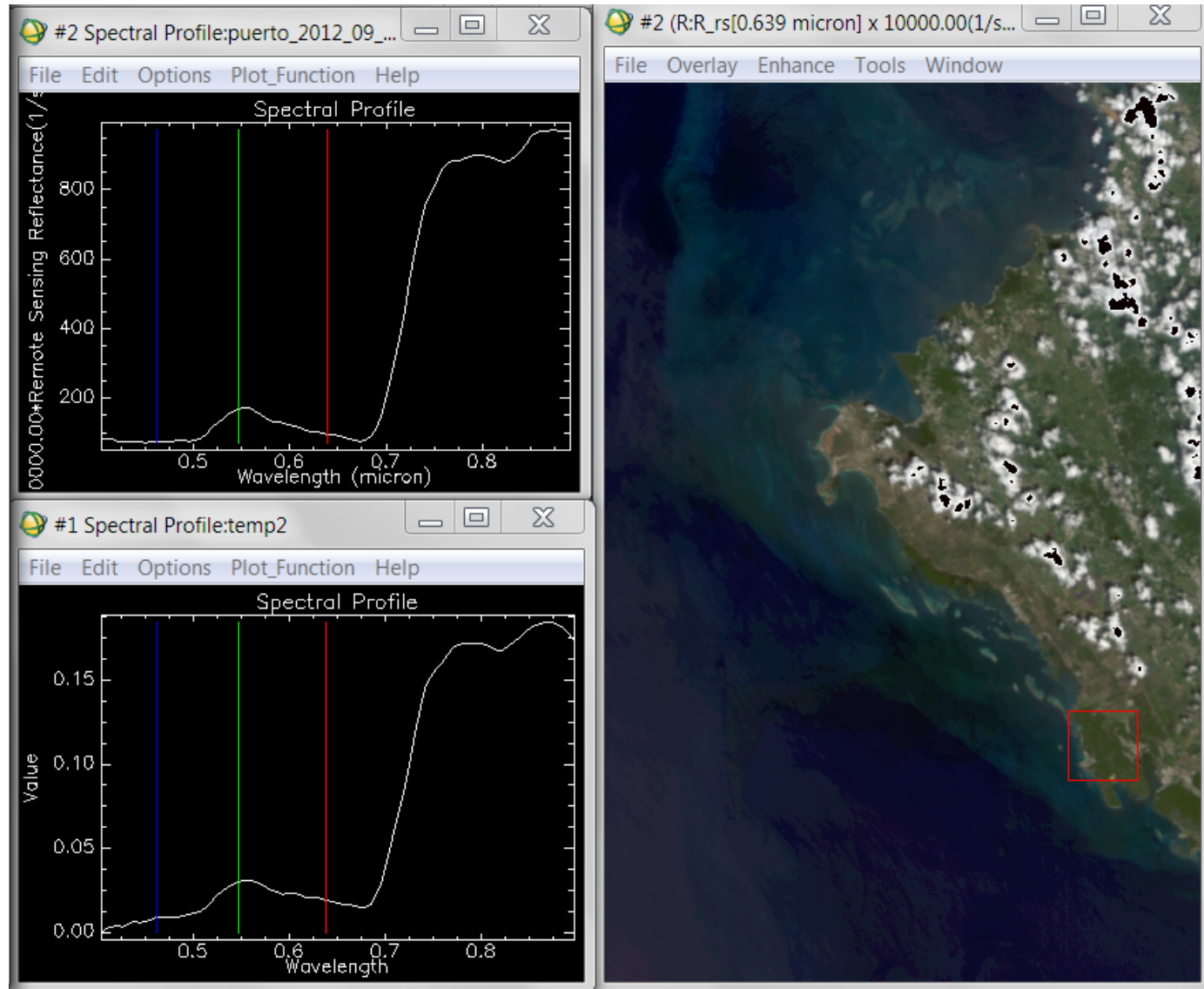
Top: Tafkaa Rrs



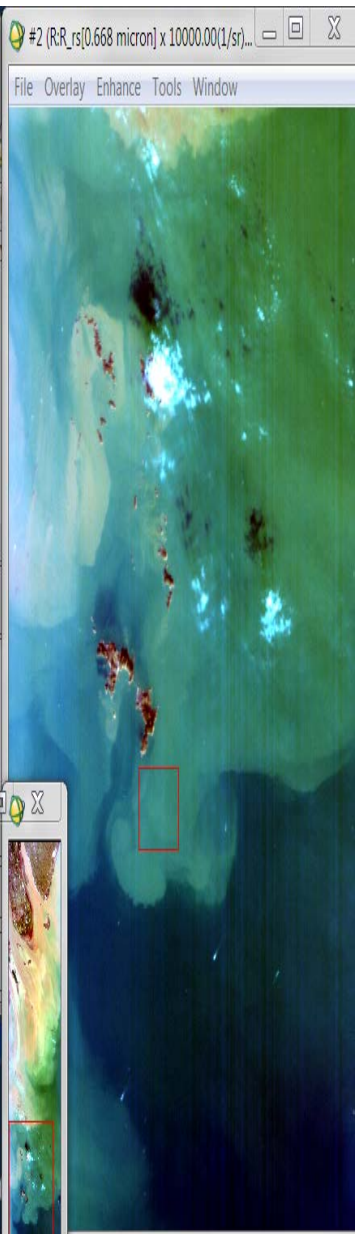
Bottom: CSS Rrs

Puerto Rico

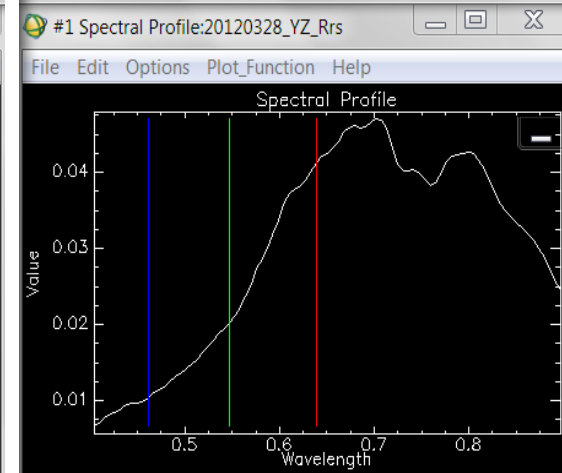
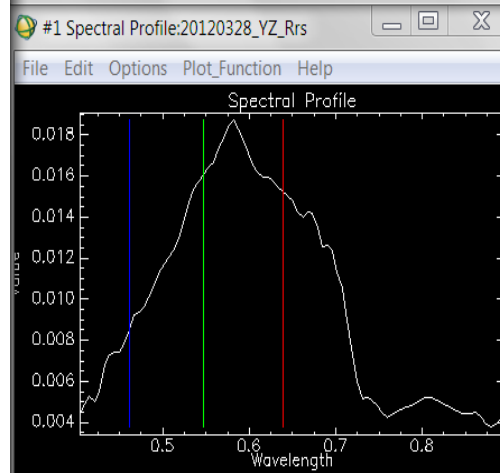
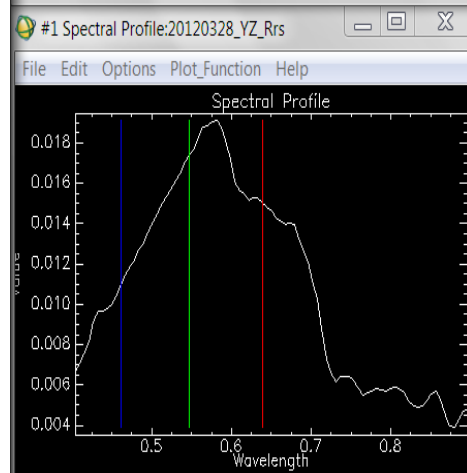
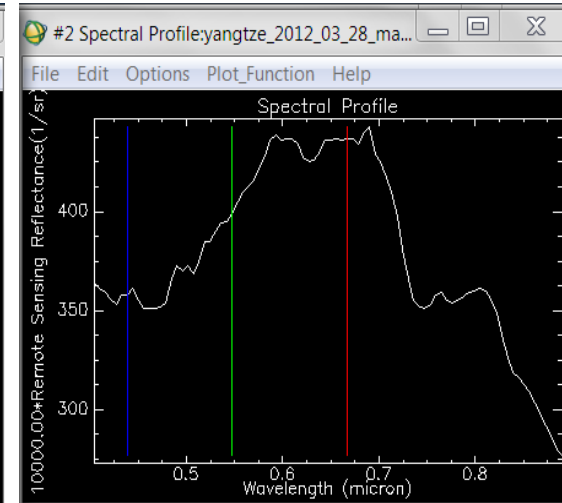
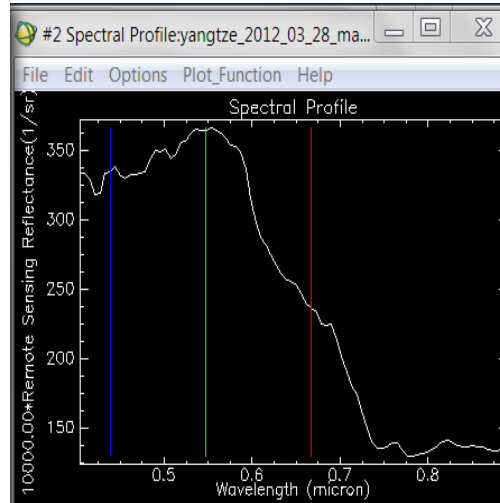
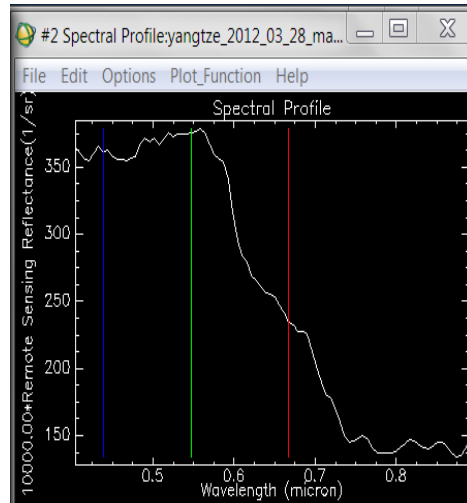
Trees as target



Yangtze River



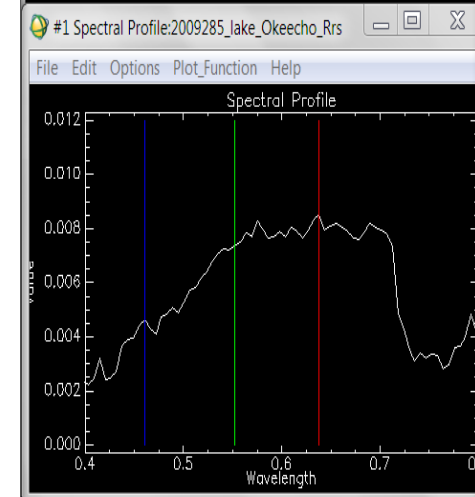
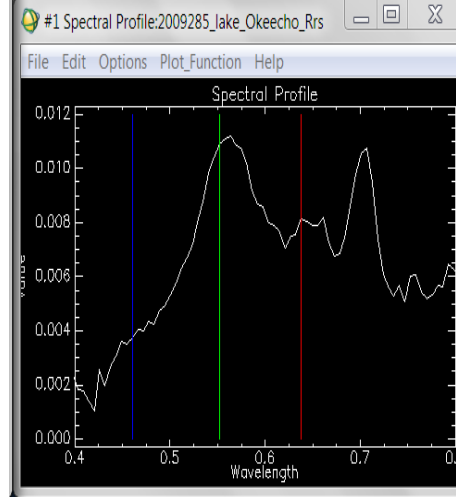
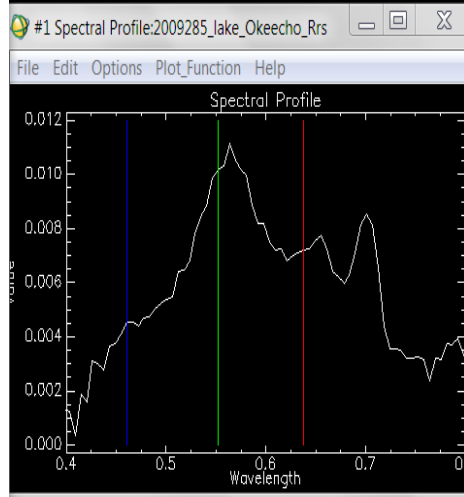
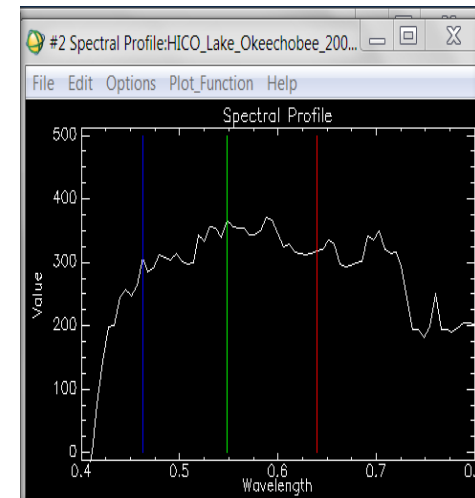
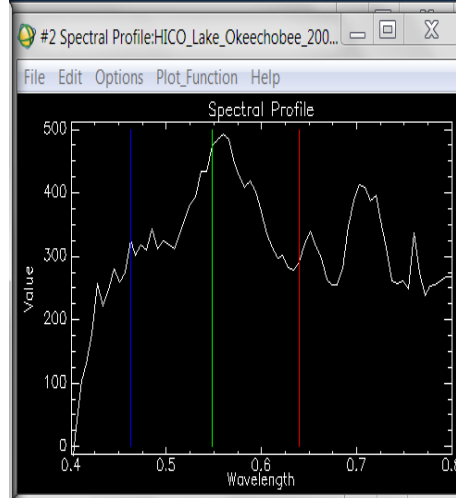
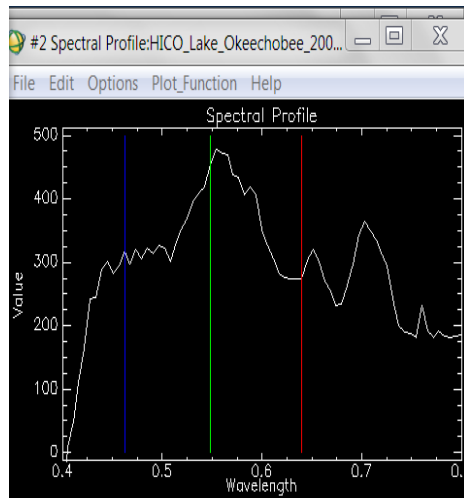
Top: Tafkaa Rrs



Bottom: CSS Rrs

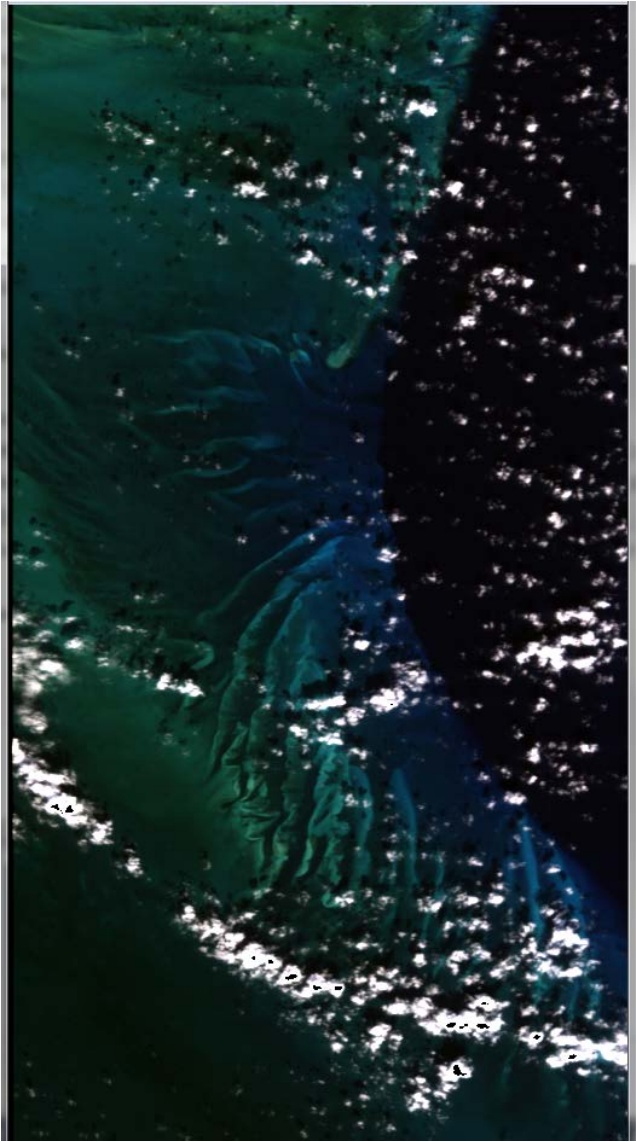
Lake Okeechobee

Top: Tafkaa Rrs

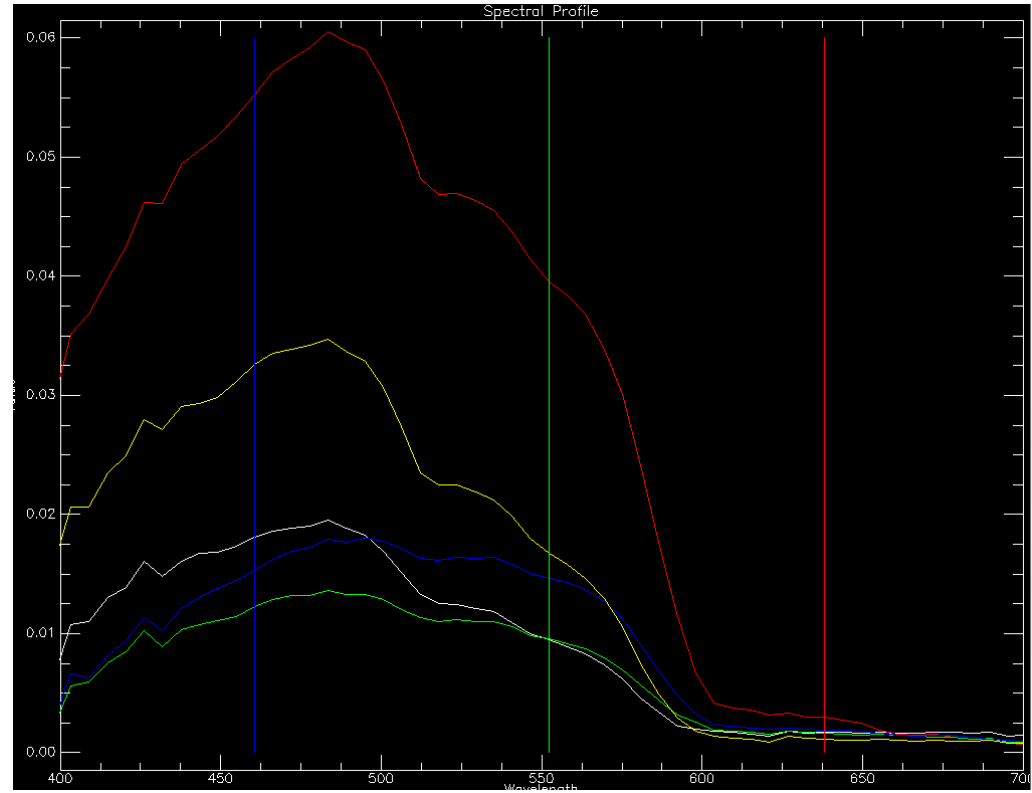


Bottom: CSS Rrs

Bahamas



Rrs [sr⁻¹]

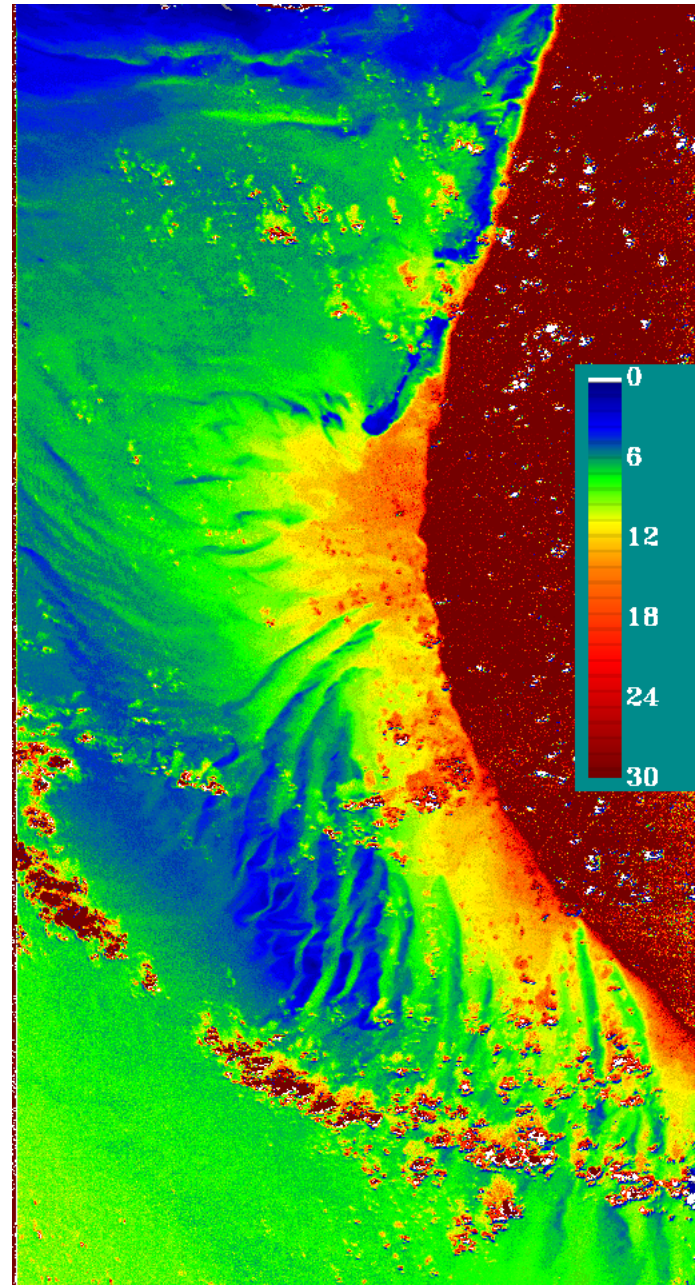
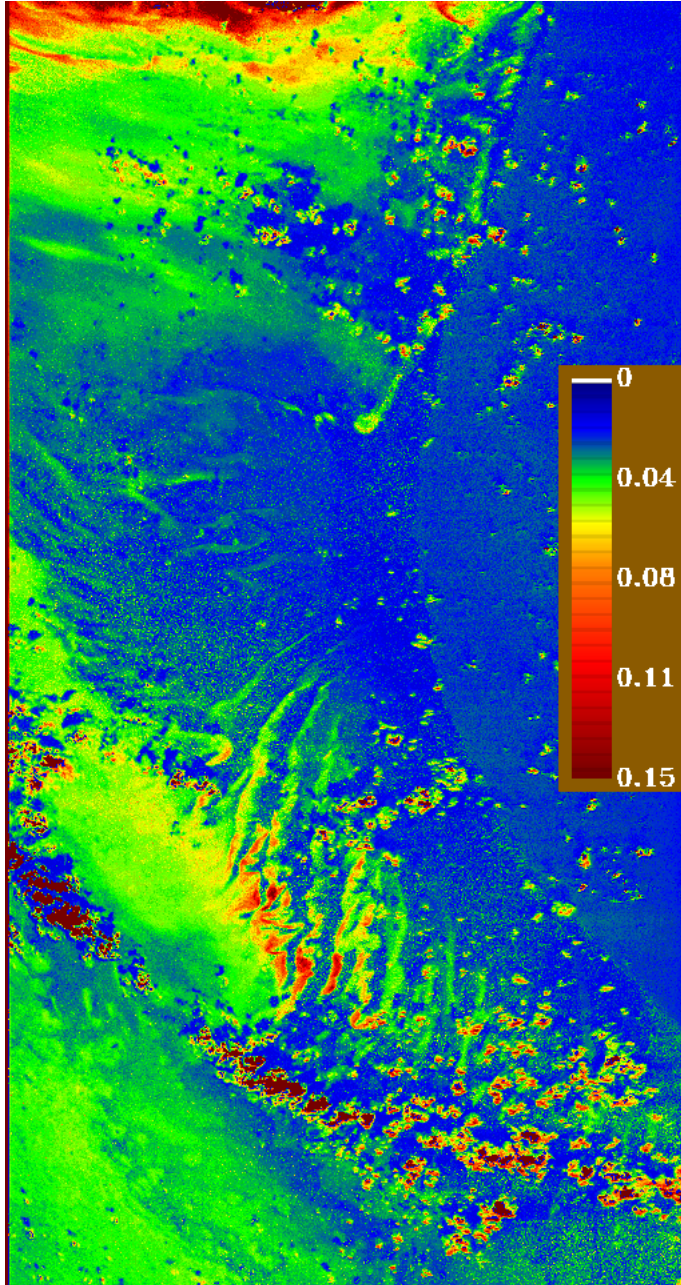


Wavelength [nm]

a(440)

HOPE Results

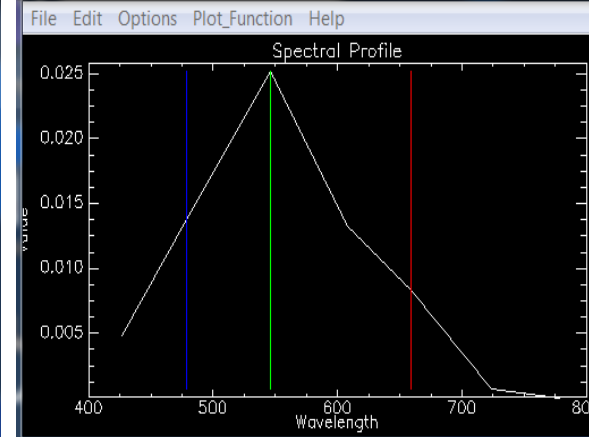
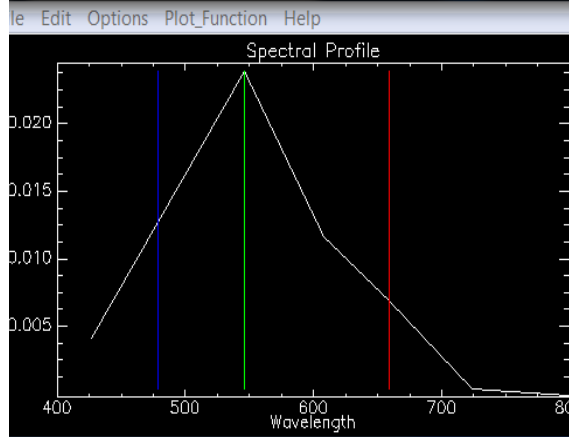
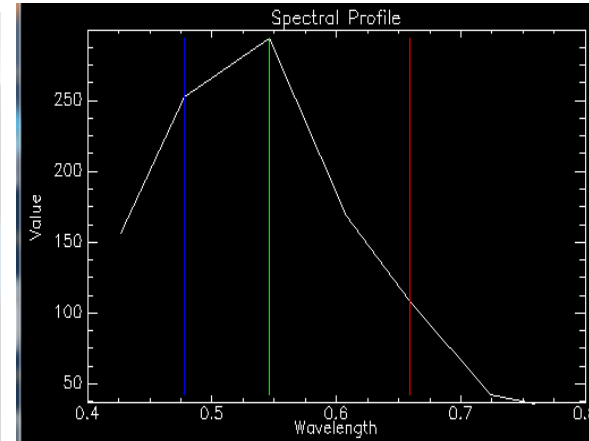
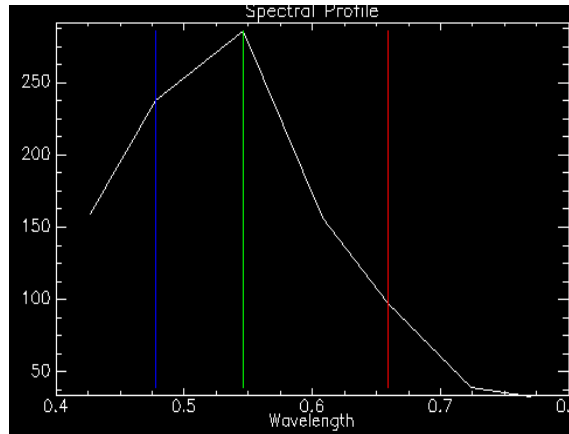
depth



CSS applied to WorldView 2

Top: Tafkaa Rrs

Freshwater beach

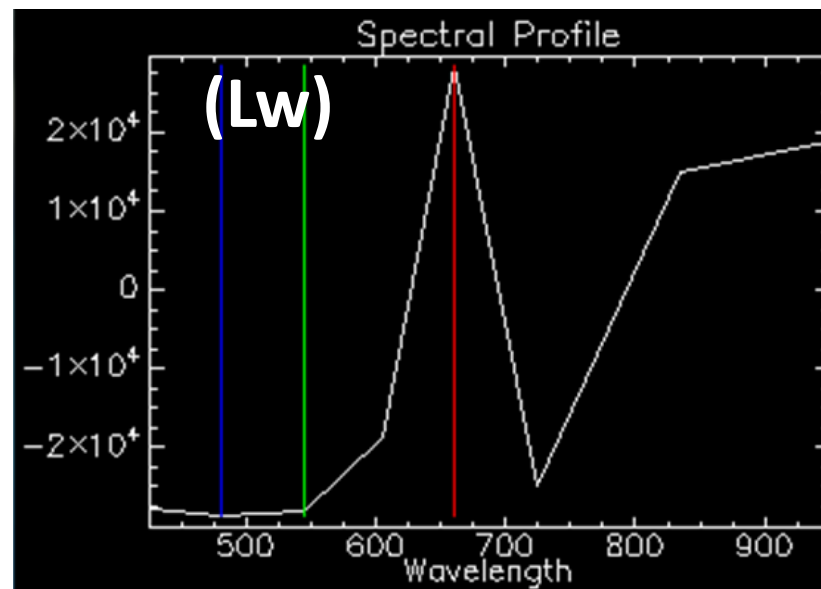


Bottom: CSS Rrs

Puerto Rico



FLAASH



CSS

