ESTIMATION OF CHLOROPHYLL-A IN EUTROPHIC INLAND WATERS USING SENTINEL 3 OCEAN AND LAND COLOR INSTRUMENT: FIRST IMPRESSIONS

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Jeremy Kravitz ¹, Mark Matthews ¹,², Derek Griffith ³

¹ Department of Oceanography, University of Cape Town, South Africa
² CyanoLakes(Pty) Ltd, Cape Town, South Africa
³ Council for Scientific and Industrial Research, Pretoria, South Africa
**BACKGROUND**

- Increased stress on South African water resources
- **Eutrophication**: accumulation of metabolic products, discoloration, increased turbidity (low light penetration), deterioration in taste, depletion of DO, enhanced occurrence of toxic cyanobacteria bloom forming species
- Radical improvement in eutrophication monitoring and management required
- Remote Sensing as a tool, however, inland remote sensing poses many problems

Oberhoister and Ashton, 2008
THE SOLUTION:
SENTINEL 3 OCEAN AND LAND COLOR INSTRUMENT (OLCI)

- Launched February, 2016
- Heritage to MERIS
- Increase to 21 Bands, better SNR
- 300m FR, 2-3 day revisit time
OBJECTIVES

**Big Picture:**
First look at quality and applicability of OLCI products for inland water Remote Sensing

**Specific Questions:**
1. Test applicability of current atmospheric corrections
2. Assess red/NIR bio-optical models for estimating Chl-a using both Bottom of Atmosphere (BOA) and Top of Atmosphere data (TOA)
VALIDATION METHODS: WATER AND ATMOSPHERE MEASUREMENTS

**Water Radiometry:**
- Above-water ASD Field Spectroradiometer
- In-water TRIOS multi-depth buoy measurements

**Atmospheric Measurements:**
- Aerosol Optical Thickness (AOT) and water-vapour column measured at time of overpass using MicroTOPS sunphotometers, cross-calibrated with Aeronet Cimel CE318 at CSIR Pretoria.

- Investigating High Priority Dams in JHB/Pretoria region
- Image processing using ESA SNAP platform
- Water samples collected for Chl-a measurements
VALIDATION METHODS:
ATMOSPHERIC CORRECTIONS AND CHL-A MODELS

Red/NIR Models:
1. 3 Band
   • Chl-a $\propto (R_{665(673)}^{-1} - R_{708}^{-1}) \times R_{753}$
2. 2 Band
   • Chl-a $\propto (R_{665(673)}^{-1} \times R_{708})$

Red/NIR Baseline Algorithms:
1. FLH / MCI
   • FLH/MCI = L2 – k * (L1 + (L3 - L1) * ((\lambda 2 - \lambda 1) / (\lambda 3 - \lambda 1))
2. MPH
   • MPH = L_{max} – L_{665} – ((L885 – L665) \times (\lambda_{max} – 665) / 885 – 664))
PRELIMINARY RESULTS: ATMOSPHERIC CORRECTIONS: 6SV1
PRELIMINARY RESULTS:
ATMOSPHERIC CORRECTIONS: C2RCC

Hartbeespoort Dam
Chl: 8 mg/m^3

Roodeplaat Dam All
Chl: 15-210 mg/m^3

Roodeplaat Dam ASD
Chl: 15-210 mg/m^3

Bronkhorstspruit Dam
Chl: 45-75 mg/m^3

Vaal Dam
Chl: 50-520 mg/m^3

Roodeplaat Dam Buoy
Chl: 15-60 mg/m^3
PRELIMINARY RESULTS:
CHL-A REGRESSIONS

Top of Atmosphere Red/NIR Relationships

Hartbeespoort 20170329
Chla = 8 mg/m^3

Roodeplaat 20170410
Chla = 208 mg/m^3

R – Squared Values

<table>
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<tr>
<th>Product</th>
<th>TOA Radiance</th>
<th>TOA Reflectance</th>
<th>BRR</th>
<th>6SV1</th>
<th>C2RCC</th>
<th>In-Situ</th>
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<td>0.414</td>
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FLH Using 673nm Lower Band TOA Radiance

y = 0.016x - 0.98
r-sqrd = 0.43

MPH BRR

y = 0.099x - 3.05
r-sqrd = 0.61

3 Band Using 673nm Lower Band in-situ Rrs

y = 0.0052x - 0.128
r-sqrd = 0.924
SUMMARY AND OUTLOOK

Summary

• Full atmospheric corrections very difficult and require very accurate atmospheric data
• Algal pigment features visible at top of atmosphere and initial results look promising using top of atmosphere data to derive chlorophyll estimates
• Addressing the adjacency issue caused by stray light could vastly improve estimates of chlorophyll-a and improve accuracy of 6SV atmospheric correction

Future

• Acquire more in-situ data to perform quantitative analysis and develop locally tuned algorithms
• Further evaluation of adjacency issue and forthcoming atmospheric corrections
• Further evaluation of use of new 673nm band and development of MPH algorithm