Inverse modeling

Semi-analytical algorithms: sensitivity analysis of the values of the backscattering spectral dependency $n$ and the $a_{nap&cdom}$ slope $S$ on two stations

Maéva DORON, Ocean Optics 2004
To begin with

- **Roesler and Perry ’95 model of inverse modeling**
- **3 basis vectors in input:**
  1. spectral slope of the absorption of NAP and CDOM $S$ (DL);
  2. spectral slope of backscattering $n$ in nm$^{-1}$;
  3. spectral absorption of chlorophyll (normalized).
- **3 parameters in output:**
  1. chl in mg.m$^{-3}$;
  2. $a_{\text{cdom}&\text{nap}}$ (440nm) in m$^{-1}$;
  3. $bb(440nm)$ in m$^{-1}$.
- **Data from the second cruise:** one station off the DMC dock and one station near the ocean.
Goal

• First idea
• Comparison of the data retrieved by the GSM model and the R&P95 model (hyperspectral & multispectral at 412, 442, 490, 510 and 555 nm);
• Sensitivity to $S$ and $n$ to the retrieved values
• Comparison of the sensitivities for the hyperspectral and the multispectral model
## Original values

**Station A – Off of DMC Dock**

<table>
<thead>
<tr>
<th></th>
<th>(a_{\text{phi}})</th>
<th>(S)</th>
<th>(n/\eta)</th>
<th>[chl], (\text{ag(443) + anap(443)})</th>
<th>(\text{bbp(443)})</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GSM – Maritorena et al. 2002</strong></td>
<td>GSM 02</td>
<td>0.0206</td>
<td>1.0337</td>
<td>2.1328</td>
<td>0.2424 0.0203</td>
</tr>
<tr>
<td><strong>Hyper RP</strong></td>
<td>CR avg.</td>
<td>0.0145</td>
<td>0 1</td>
<td>0.1827</td>
<td>0.3732 0.0161 0.0045</td>
</tr>
<tr>
<td><strong>Hyper RP</strong></td>
<td>CR avg.</td>
<td>0.01 0.02</td>
<td>0 1</td>
<td>1.3146</td>
<td>0.2535 0.1169 0.0157 0.0069</td>
</tr>
<tr>
<td><strong>RP @ GSM lambda</strong></td>
<td>CR avg.</td>
<td>0.0145</td>
<td>0 1</td>
<td>1.02</td>
<td>0.306 0.045 -0.0167</td>
</tr>
</tbody>
</table>
## Original values

### Station B – SW of Pemaquid Pt.

<table>
<thead>
<tr>
<th></th>
<th>a__phi</th>
<th>S</th>
<th>n/ \eta</th>
<th>[chl], [chl]</th>
<th>ag(443) + anap(443)</th>
<th>bbp(443)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSM – Maritorena et al. 2002</td>
<td>GSM 02</td>
<td>0.0206</td>
<td>1.0337</td>
<td>1.5502</td>
<td>0.1288</td>
<td>0.0039</td>
</tr>
<tr>
<td>Hyper RP</td>
<td>CR avg.</td>
<td>0.0145</td>
<td>0 \ 1</td>
<td>0.8828</td>
<td>0.2158</td>
<td>0.0024 \ 0.0024</td>
</tr>
<tr>
<td>Hyper RP</td>
<td>CR avg.</td>
<td>0.01 \ 0.02</td>
<td>0 \ 1</td>
<td>0.8571</td>
<td>0.0899 \ 0.1352</td>
<td>0.0028 \ 0.0024</td>
</tr>
<tr>
<td>RP @GSM lambda</td>
<td>CR avg.</td>
<td>0.0145</td>
<td>0 \ 1</td>
<td>1.00</td>
<td>0.187</td>
<td>0.0032 \ 0.0019</td>
</tr>
</tbody>
</table>
Sensitivity

• One spectral dependency $n$, instead of 0 for large particles and 1 for small particles.
• Varying the $n$ – values: from 0 to 2.
• Change the values of $S$: from 0.005 to 0.04 nm$^{-1}$:
  
  Realistic range of $Sc_{dom} = 0.007–0.013$nm$^{-1}$
  Realistic range of $S_{nap} = 0.016–0.022$nm$^{-1}$
Sensitivity for the \( n(bb) \) slope - hyperspectral
Sensitivity for the $S(cdom&nap)$ slope - hyperspectral
Sensitivity for the n(bb) dependency - multispectral
Sensitivity for the S(cdom&nap) slope - multispectral
Sensitivity for the $S$(cdom&nap) slope – multispectral- different scales
Discussion

• This was a first qualitative approach.

• The results are encouraging because realistic values of $S$ are not erratic.

• Any idea about how to test the robustness of the algorithm with multispectral data?