Early phase evaluations of GLI vicarious calibration factors for ocean-color channels

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This work

• The Global Imager (GLI) was launched on December 14, 2002. (GLI has 19 visible and near-infrared channels.)

• GLI calibration team performed vicarious calibrations using MOBY measurement.
  - relative to two near-infrared channels
  - using aerosol optical thickness observation

• This presentation reports the early results of the evaluations.
Methodology 1

\[ \rho_T = \rho_{TA} + t \cdot N \rho_W \cdot t_0 \]

\( \rho_T \): Top of Atmospheric Reflectance
\( \rho_{TA} \): Atmospheric Reflectance
\( N \rho_W \): Normalized Water Leaving Reflectance
\( t_0 \): Diffuse Transmittance (sun ⇔ sea surface)
\( t \): Diffuse Transmittance (sensor ⇔ sea surface)

(Gordan and Wang, 1994)

Method 1:
Relative to channels 13, 19

1. Determine the aerosol optical thickness to give satellite-observed reflectance \( \rho_T(ch19) \).
2. Select the aerosol model to minimize the difference between the simulated and the actual \( \rho_T(ch13) \) (from candidate aerosol models.)
Methodology 2

\[ \rho_T = \rho_{TA} + t \cdot N\rho_W \cdot t_0 \]

- \( \rho_T \): TOAR
- \( \rho_{TA} \): Atmospheric Reflectance
- \( N\rho_W \): Normalized Water Reflectance
- \( t_0, t \): Diffuse Transmittances

Method 2: Use the observation of aerosol optical thickness

1. Select the aerosol model whose dependence of the optical thickness on the wavelength correspond with that of the observation.
2. Obtain the aerosol optical thickness from the observation data.
GLI

- Selects the GLI data which isn’t contaminated by clouds and sun glint.

The data used for the calibration

- 6 February 2003
  (Method 1 only: no \( \tau_a \) observation)
- 7 February 2003
- 8 April 2003
- 6 May 2003
Data

$P_{NLW}$
(normalized water-leaving radiance)

MOBY
(the Marine Optical Buoy system)
observation off the Hawaiian Island

Ancillary Data

Total ozone concentration: TOVS
Sea-surface pressure:
JMA object analysis data

Aerosol Optical Thickness (case: Method 2)
The observation at Lanai. (released in AERONET)
Candidate Aerosol Model

- Tropospheric
  (28% tropospheric, 72% oceanic)
- Coastal
  (16% tropospheric, 84% oceanic)
- Maritime
  (16% tropospheric, 84% oceanic)

Relative Humidity: 60, 80, 98 (%)
Result (Methodology1)

Calculated assuming the intercept equals to 0

\[ y = 1.032 \times x \quad \text{sigma} = 0.00699 \]

\[ y = 1.036 \times x \quad \text{sigma} = 0.00645 \]

\[ y = 0.960 \times x \quad \text{sigma} = 0.00686 \]

\[ y = 1.036 \times x \quad \text{sigma} = 0.00868 \]
Result (Methodology2)

Select the best aerosol model whose dependence of the optical thickness on the wavelength correspond with that of the observation.

Candidate Aerosol Model
- Mixture of Tropospheric and Oceanic (21 patterns)
* Relative Humidity: 60, 80, 98 (%) 

Selected Aerosol properties (case: 2003/04/08)
Model: 55% tropospheric
45% oceanic
RH 80%
\( \tau_A \) (500nm): 0.086
Result (Methodology2)

Candidate Aerosol Model
- Mixture of Tropospheric and Oceanic (21 patterns)
  * Relative Humidity: 60, 80, 98 (%)

Selected Aerosol properties (case: 2003/04/08)
Model: 55% tropospheric
45% oceanic
RH 80%
\[ \tau_A (500\text{nm}) : 0.086 \]
Result

Vicarious Calibration Coefficient

0.9
0.95
1
1
1.05
1.1

GLI channel

Coefficient

Ch13,19 Relative (standard error)
AERONET (standard error)

<method1> relative to ch13,19
- GLI radiance should be corrected
  2.5 ~ 4% in channels 1, 2, 4, 5, 9
  -4% in channel 3

Water-vapor absorption ?

Result

Water-vapor absorption ?
Result

<method2> absolute

- GLI overestimates the radiance in near-infrared channels,
  (It may be due to the inaccuracy of the optical thickness measurement.)

=> Analysis with more data is necessary in the future.

Water-vapor absorption?
Adaptation test (Methodology 1)

Test by GLI standard atmospheric correction algorithm.
- Correct the observed radiance using the derived coefficient in method 1.
- Calculate the normalized water-leaving radiance by GLI standard atmospheric correction algorithm.

MOBY Observation:
17.9 W/m^2/micron/sr
(2003/04/08 ch4 (443nm))

The vicarious calibration coefficient is effective.
We carried out early phase evaluations of GLI-observed radiances by vicarious calibration. For the calibration we used two methods.
- relative to two near-infrared channels
- using aerosol optical thickness observation (AERONET)

We derived the following vicarious calibration coefficients.

<table>
<thead>
<tr>
<th>channel</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>19</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method1</td>
<td>1.032</td>
<td>1.036</td>
<td>0.960</td>
<td>1.036</td>
<td>1.026</td>
<td>1.000</td>
<td>1.004</td>
<td>0.991</td>
<td>1.032</td>
<td>0.985</td>
<td>0.982</td>
<td>0.991</td>
<td>0.999</td>
<td>1.012</td>
<td>1.045</td>
<td>1.000</td>
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<td>1.025</td>
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<td>1.020</td>
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<td>0.943</td>
<td>0.952</td>
<td>0.954</td>
<td>0.987</td>
<td>0.918</td>
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</tbody>
</table>

In future, the investigation with more data is necessary.