

# Introduction to the breakout discussion on: *practices for the construction of in situ-satellite matchups, their application to the System Vicarious Calibration (SVC)*

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# Some references on the SVC of Ocean color satellites

## Not exhaustive

**Instrumentation**

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# Different data sources can give different gain's

Relative percent differences  $\Delta g$  between SeaWiFS  $g$ -factors determined using Eq. 4 applied to data in Table 2. The values in bold indicate  $\Delta g$  exceeding  $\pm 0.3\%$  in the blue-green spectral regions and  $\pm 0.1\%$  in the red.

| Data Source | $\Delta g$ [412] | $\Delta g$ [443] | $\Delta g$ [490] | $\Delta g$ [510] | $\Delta g$ [555] | $\Delta g$ [670] |
|-------------|------------------|------------------|------------------|------------------|------------------|------------------|
| MOBY-MS     | <b>+0.32</b>     | +0.04            | <b>+0.31</b>     | <b>-0.45</b>     | <b>-0.35</b>     | <b>-0.39</b>     |
| BOUSSOLE    | <b>+0.33</b>     | -0.03            | <b>+0.43</b>     | <b>+0.33</b>     | +0.14            | <b>-0.59</b>     |
| NOMAD       | +0.26            | +0.03            | <b>+0.49</b>     | -0.20            | -0.04            | <b>-0.37</b>     |
| AAOT        | <b>+0.55</b>     | +0.11            | <b>+0.51</b>     | -0.05            | <b>+0.41</b>     | <b>+0.93</b>     |
| HOT-ORM     | <b>-0.66</b>     | <b>-0.45</b>     | <b>-0.39</b>     | -0.03            | <b>+0.53</b>     | <b>-0.11</b>     |
| BATS-ORM    | -0.22            | <b>-1.11</b>     | <b>-1.05</b>     | <b>-0.41</b>     | +0.23            | +0.02            |

This is the difference between MOBY derived gains and those from different sources...Note this is top of the atmosphere, so would cause fairly large differences.

Table from Zibordi et al. RSE, 2015 but based on Bailey et al. 2008, Melin and Zibordi 2010, Werdell et al. 2007.

# But then there are other choices

Quality Flags: Land, Clouds and Ice, Sunglint, straylight, turbid water, coccoliths(bright),

Size of Satellite matchup: 3 x 3, 5 x 5, 100 x 100

Median, mean, other value selected from box?

Upper limit of COV allowed in matchup box (0.1, 0.2, ?)

Solar zenith angle: < 70 deg

Satellite view zenith angle <56 deg

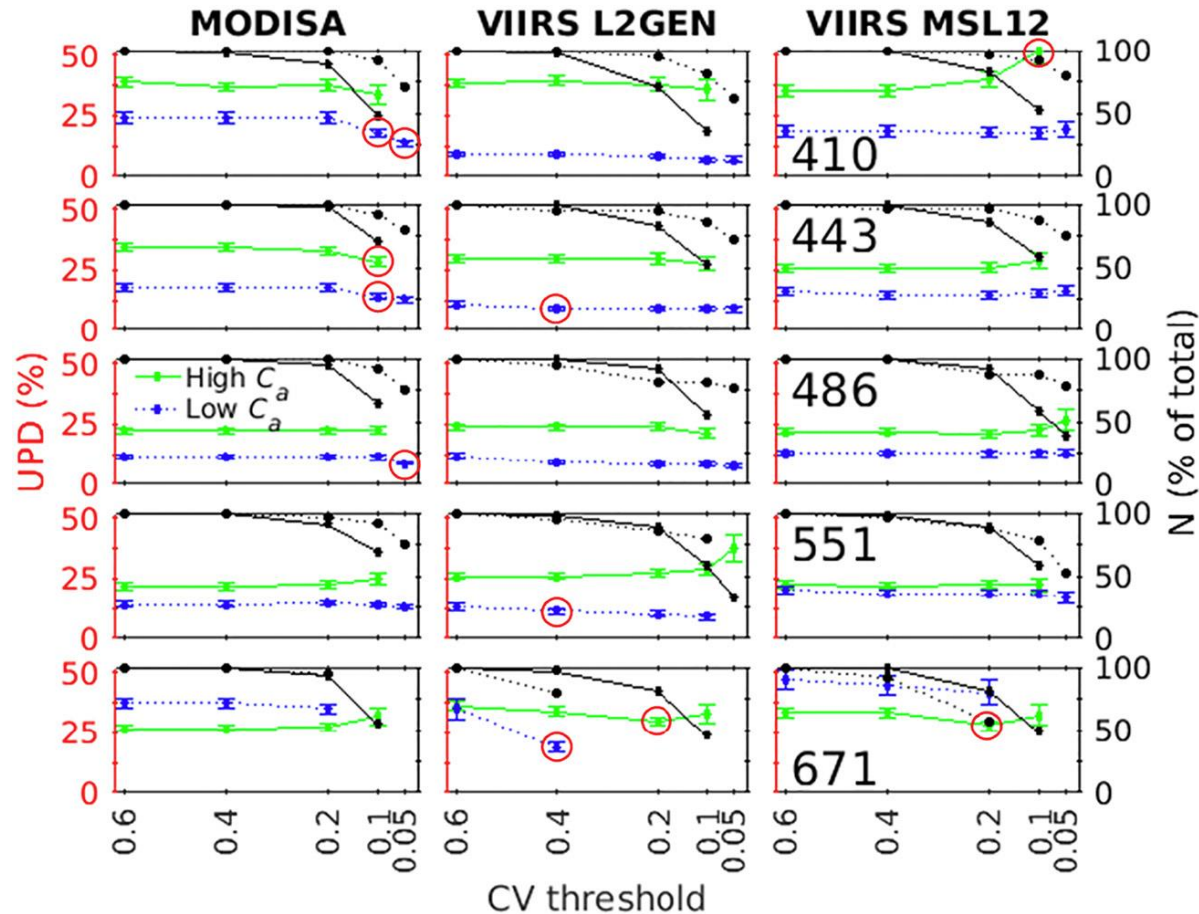
Aerosol optical depth allowed: <0.1, 0.15

Wind speed restriction?

Chla: <0.2 mg/m<sup>3</sup>

Time window: 1 hr, 2 hrs, ?

# Recent study on validation by Barnes et al. (RSE 2019)



In this study they looked at several aspects of validation matchups to see the effect on the results. For example in this case the Unbiased percent difference vs CV threshold.

A similar internal study has probably been done by each group that does vicarious calibration when they set the parameters looking at how much the gain result changed as parameters are relaxed to get more matchup points...but not generally available.

# Workshop objectives

- Agree on fundamental requirements for in situ measurements supporting SVC
- Agree on fundamental methods to enforce equivalence of satellite and in situ data (e.g., application of identical corrections for BRDF effects, corrections for minimizing the impact of different spectral bands, ...).
- Agree *i.* on criteria for the construction of matchups (e.g., local spatial/ temporal variability, observation conditions, time-lags between in situ and satellite data...) and additionally, *ii.* on methods and criteria for the statistical analysis of matchup data and the following presentation of summary results (e.g., how do you handle the different gain factors from each matchup pair ...).



# Talking points

## Talking points *(separated for Regional/Environmental and Global/Climate applications)*

|                           |   |
|---------------------------|---|
| In Situ Data: Generic     | Quantities, measurement methodology, illumination conditions, distance from the coast, bottom depth, water type, multiple sites/sources |
| In Situ Data: Radiometric | Uncertainties, spectral resolution, spectral matching, BRDF corrections, band-shift corrections   |
| Matchup Construction      | Number of image elements, time-lag, agency suggested flags, viewing and illumination geometries, thresholds on variation coefficients   |
| Matchup Statistics        | Minimum number of matchups, bias index, dispersion index, rmsd, ranges, distributions   |



# In Situ Data: Generic

| Talking Point           | Specification                                 | Notes/Comments  |
|-------------------------|---|---|
| Quantity                | Radiometry (Rrs , Lwn, Lw)                    | Lw has lower uncertainties, but Lwn could be more stable        |
| Measurement methodology | Above-water<br>In-water<br>Protocols.....     | Recent Protocol document  |
| Illumination condition  | Clear sky, clouds less than xx%?              | For SVC, can there be any clouds?                               |
| Distance from coast     | 5 nautical miles?                             | Depends on sensor/atmosphere PSF                                |
| Bottom depth            | Preference for optically deep, for uniformity | If not optically deep, probably not uniform                     |
| Water type              | Oligotrophic or mesotrophic                   | Oligotrophic most often chosen, but then very dependent on Chla |
| Multiple sites?         | equivalency                                   | Good to provide more data quickly, bad if not consistent        |



# In Situ Data: Radiometric

| Talking Point       | Specification   | Notes/Comments   |
|---------------------|---|--|
| Uncertainties       | Lower than 5% for Rrs in blue-green spectral region           | If measurement has reduced uncertainty, does this reduce number of required matchups? Or is the noise driven more by atmospheric correction? |
| Spectral Resolution | 1 nm? 3 nm?   | Recent Protocol document   |
| Spectral matching   |   | Allowed?   |
| BRDF corrections    | Must be done with system consistent with satellite processing |  |

# Matchups Construction

| Talking Point      | Specification           | Notes/Comments        |
|--------------------|-------------------------|-----------------------|
| Pixel dimensions   | 3x3, 5x5, 100x100       | Why one versus other? |
| Solar Zenith angle | 60 deg.                 | Seems consistent      |
| Sat. View Zenith   | 56 deg                  | Seems consistent      |
| Chla               | 0.2, 0.25, ?            | Slight variation      |
| AOD(870)           | 0.1, 0.15, ?            |                       |
| COV Lw490          | <10%,20%, ?             |                       |
| Quality Flags      | Basically none set      |                       |
| Es                 | Measured, modeled?      | Advantages to each    |
| Wind speed         | Checked? <5m/s          | No whitecaps          |
| What quantity      | Average, MSIQR, median? | varies                |

# Matchup statistics

| Talking Point   | Specification                                    | Notes/comments  |
|---|--|---|
| Minimum number of matchups                              | 30?40? How dependent on measurement uncertainty? | If measurement uncertainty is reduced, does it reduce the number of matchups, or does AC drive this also. |
| What quantity is used?                                  | Mean g?  | Is there another choice?  |
| For SVC do you want variability in site characteristics |  | My opinion no, but?   |
| Anything else?  |  |   |
|   |  |   |