

Practical Calibration and Validation

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Calibration \neq Validation

an obvious, but necessary distinction

similarities:

- 🌍 use of radiometric *in situ* data
- 🌍 coincident in time/space with satellite measurement

differences:

- 🌍 forward vs. inverse atmospheric correction processing
 - 🌍 calibration is performed at TOA
 - 🌍 validation is done at the surface
- 🌍 calibration data requires lower measurement uncertainties

calibration and validation are NOT everything

in situ data are useful for other endeavors:

- 🌍 algorithm development
- 🌍 water-quality monitoring
- 🌍 data assimilation
- 🌍 ecosystem monitoring

all are not equal
...but that's not a bad thing

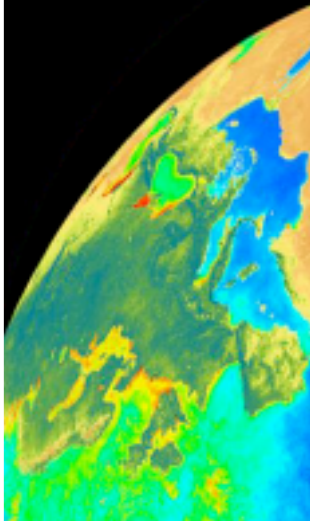
there IS a hierarchy for data

(in my corner of the world anyway...):

1. calibration
2. validation / algorithm development
3. general research
4. monitoring activities

things we can^(should) control

- where in situ data is collected
 - stable environment
 - spatially and temporally homogenous
 - known atmospheric conditions
- when it is collected
 - as close to satellite overpass as possible
 - as often as possible
- what is collected
 - all measurements necessary to produce GOOD water-leaving radiance data
- how the data are collected
 - with well characterized and calibrated instruments
 - appropriate deployment methodology
- how the data are processed
 - consistency is the key!



the big bad atmosphere

Percent of water-leaving radiance to TOA signal

	Oligotrophic ($C_a < 0.1 \text{ mg m}^{-3}$)	Mesotrophic ($C_a 0.1 > 1 \text{ mg m}^{-3}$)	Eutrophic ($C_a > 1 \text{ mg m}^{-3}$)
443 nm	17.25%	11.9%	6.67%
555 nm	6.67%	8.5%	16.1%
670 nm	1%	1.5%	6.8%

80 to 99% (or more) of the at-sensor radiance comes from the atmosphere...

so, for validation ...
what does this mean?

🌍 our *stated* goal for radiometric accuracy is 5%

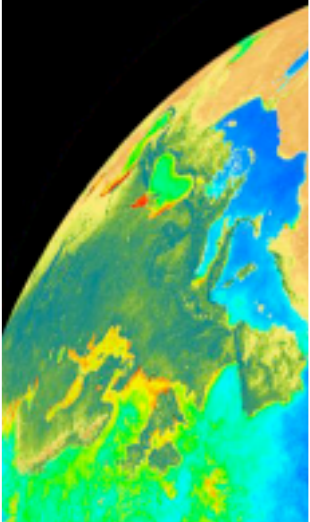
–Vol 1, SeaWiFS Technical Report Series

🌍 assuming

– L_w is about 15% of TOA

– 5% uncertainty on the *in situ* data

... we need to know satellite calibration to 1.5%...

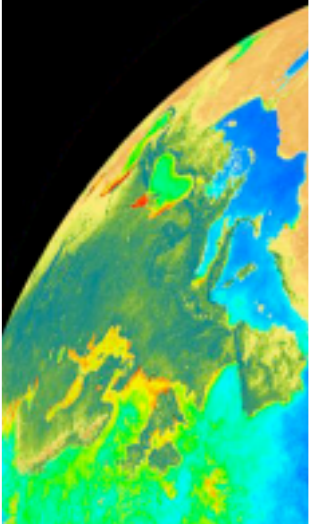


how about calibration?

- 🌍 using the same assumptions...but with the additional restriction that the in situ is 'truth' (i.e. perfect) we need to know the sensor-algorithm system 'calibration' to no worse than 0.75%

are we there?

Ocean Color



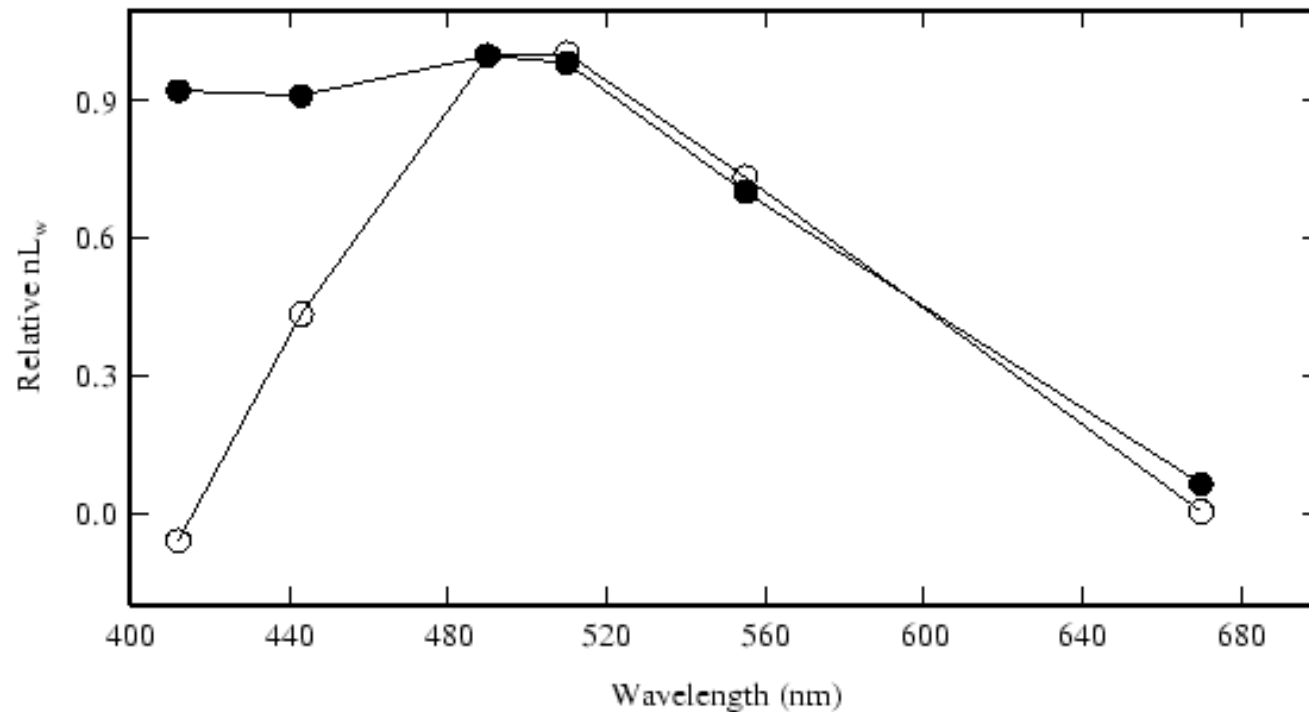
nope...but close...
(about 0.9%)

January 14th, 2009

NASA AOP Workshop

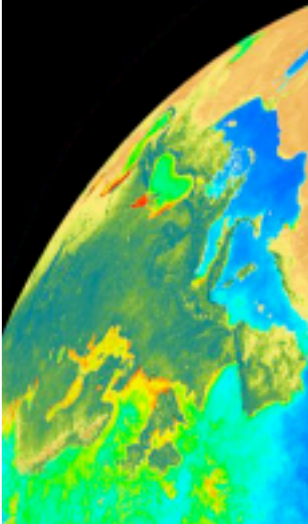
Ocean Color

more of that atmosphere

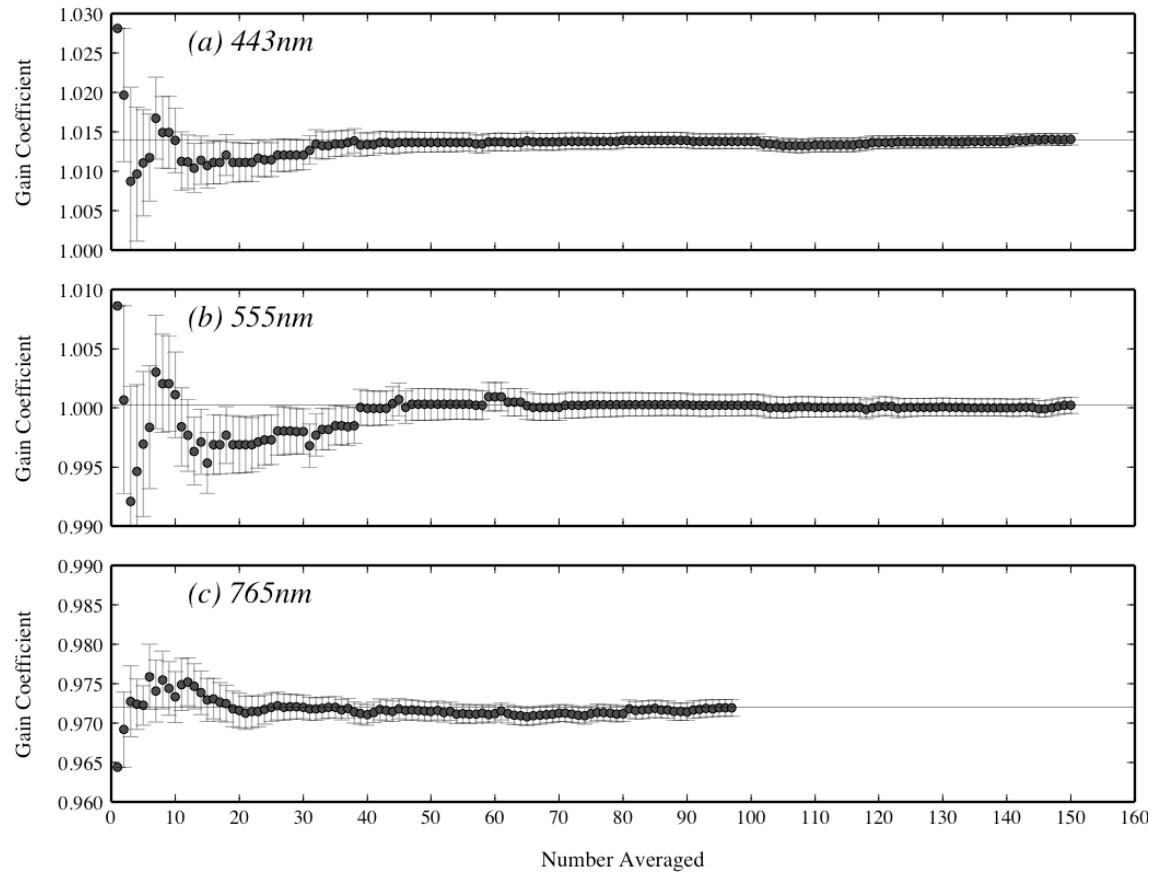


solid: *in situ* open circles: SeaWiFS
Jan 21, 2001 Santa Barbara Channel

Ocean Color



the count matters



calibration requirements

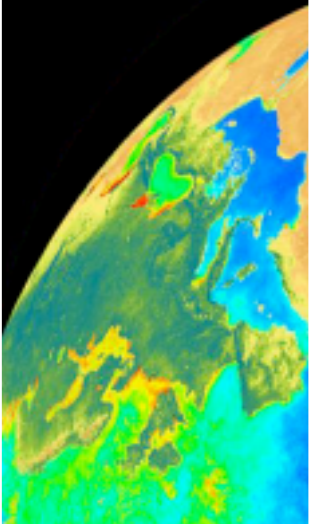
conventional wisdom

- clear maritime atmosphere
- clear-water site
- horizontally homogeneous water mass
- hyperspectral instrumentation
- extraordinary calibration
- daily-to-weekly monitoring
- avoidance of platform perturbation
- cloud-free site
- coincident aerosol measurements
- atmosphere free of terrestrial influence
- free from biofouling

calibration requirements

A reality check

- clear maritime atmosphere - not critical
- clear-water site - not critical
- **horizontally homogeneous water mass**
- hyperspectral instrumentation - not critical
- extraordinary calibration - critical, how extraordinary is debatable...
- daily-to-weekly monitoring - not necessary
- **avoidance of platform perturbation**
- cloud-free site - not critical
- coincident aerosol measurements - not critical
- atmosphere free of terrestrial influence - not critical
- **free from biofouling**



what's really important?

- 🌍 instrument calibration and characterization
- 🌍 how the data are collected
- 🌍 how the data are processed