ADEOS-II/GLI ocean color atmospheric correction: early phase result

H. Fukushima,[1] and M. Toratani,[1] A. Tanaka[2], W-Z Chen[3], H. Murakami[3], R. Frouin,[4] G. Mitchell,[4] and M. Kahru[4]

[1] *Tokai University* [2] *Nagasaki University,*
[3] *GLI Algorithm Implement Team, NASDA/EORC,*
[4] *Scripps Institution of Oceanography.*

At SPIE's 48th Annual Meeting, San Diego, August 5, 2003

Contents:

- **Outline of the algorithm**
- **Early phase validation results**

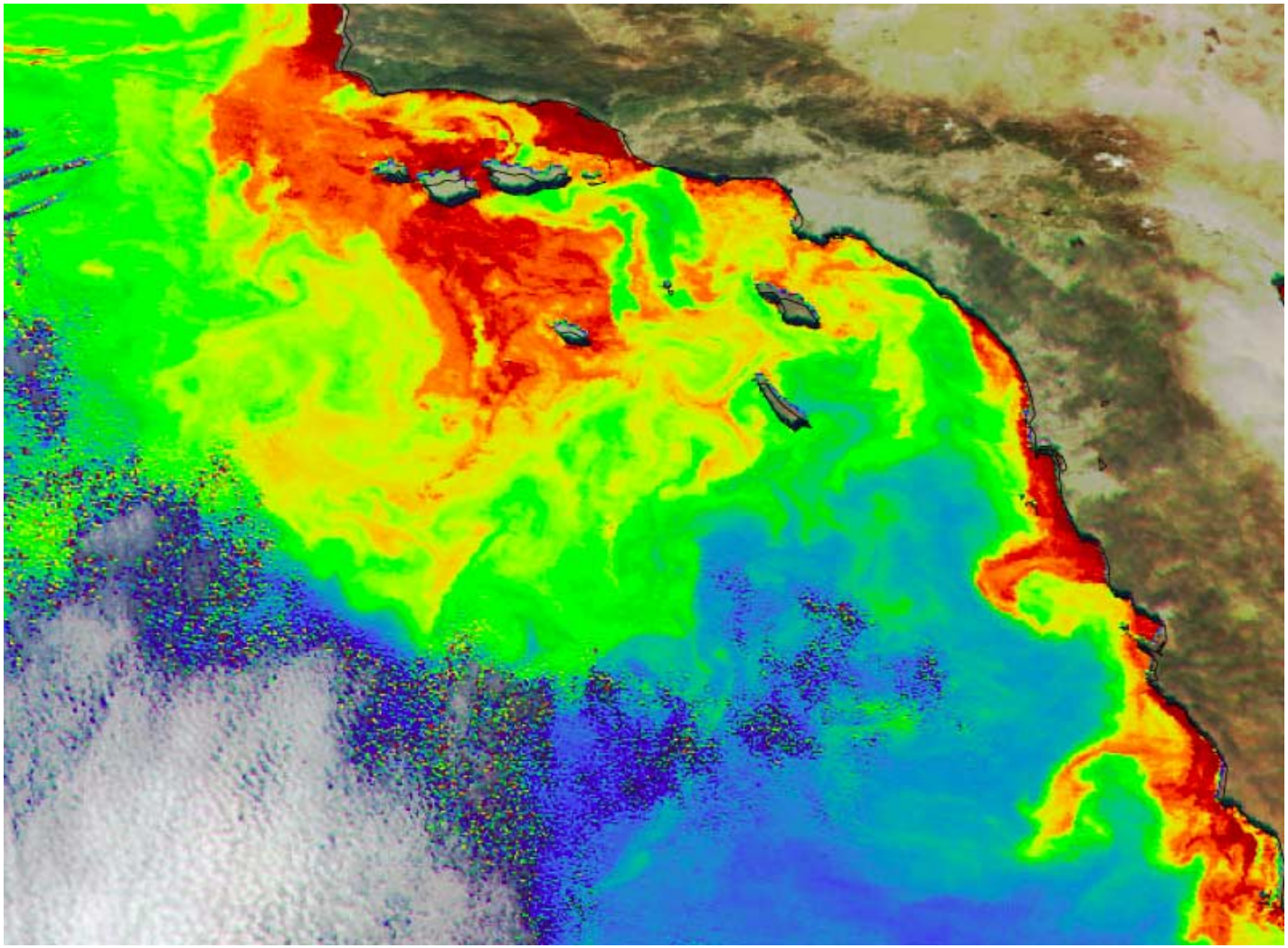
Outline of the OTSK1a algorithm

- **Shares basic structure with the OCTS/SeaWiFS algorithms**
  - Robust and proven algorithm rather than innovative but possibly risky one
- **Use of 678 and 865nm bands for determining ρ_A and ρ_{MA} in the shorter wavelength region**
  - **The 678/865 combination selected to avoid the "low-saturation" problem with the originally planned 749/865 bands**
- **Look-up tables: Rayleigh, aerosol (τ_A vs. $\rho_A+\rho_{MA}$),**
- **Input L1 bands: 380, 400, 412, 443, 460, 490, 520, 545, 565, 625, 666, 680, 710, 749, 865, 1050, and 1240 nm**
- **Output parameters: nL_W(380-710), L_A(749-1240), α(749, 865), t_A(865), QC Flags**

Outline of the OTSK1a algorithm (contn'd)

- **Aerosol models: 9 non-absorptive aerosols**
- **Sun-glitter correction and mask (Cox and Munk model)**
- **Frouin's whitecap correction algorithms**
- **Iterative procedure for productive case I and possibly for case II waters**
  - **With a neural network to estimate SS and Chl-a concentrations, as well as CDOM absorption coefficient at 440 nm**
  - **To feed a "semi-analytical in-water model", to predict $\rho_W(678)$ and $\rho_W(865)$, to improve the ρ_A estimates in the NIR bands**
- **L2 chl-a/K-490/CDOM abs. by G. Mitchel**
- **SS by M. Kishino**

GLI chl-a image on April 9, 2003



Early phase evaluation of atmospheric correction performances

- **Match-up data set**
  - **prepared by A. Mukaida and his team at RESTEC**
- **Comparison/evaluation of calibration correction factors**
  - **SeaWiFS-based vicarious calibration (by H. Murakami)**
  - **MOBY-based vicarious calibration (by M. Yoshida)**
- **Match-up results**
  - **nLw(443), nLw(490), nLw(565)**
  - **chlorophyll-a concentration**

Collected and used data

	Ship		Satellite		Match-up	
	Number of data		Number of scenes		Number of samples	
	nLw	chl	L1B	L2	nLw	chl
CalCOFI 0304 Chl-a by CalCOFI program		90		23		35
CalCOFI 0304 PRR by Mitchell & Kahru	39		~20		3 -> 2	
IMECOCAL 0304 SIMBAD by Frouin	79		~20		5 -> 4	
MOBY Feb. - May., 2003 by D. Clark	7		9		6 -> 4	

Atmospheric correction: conditions

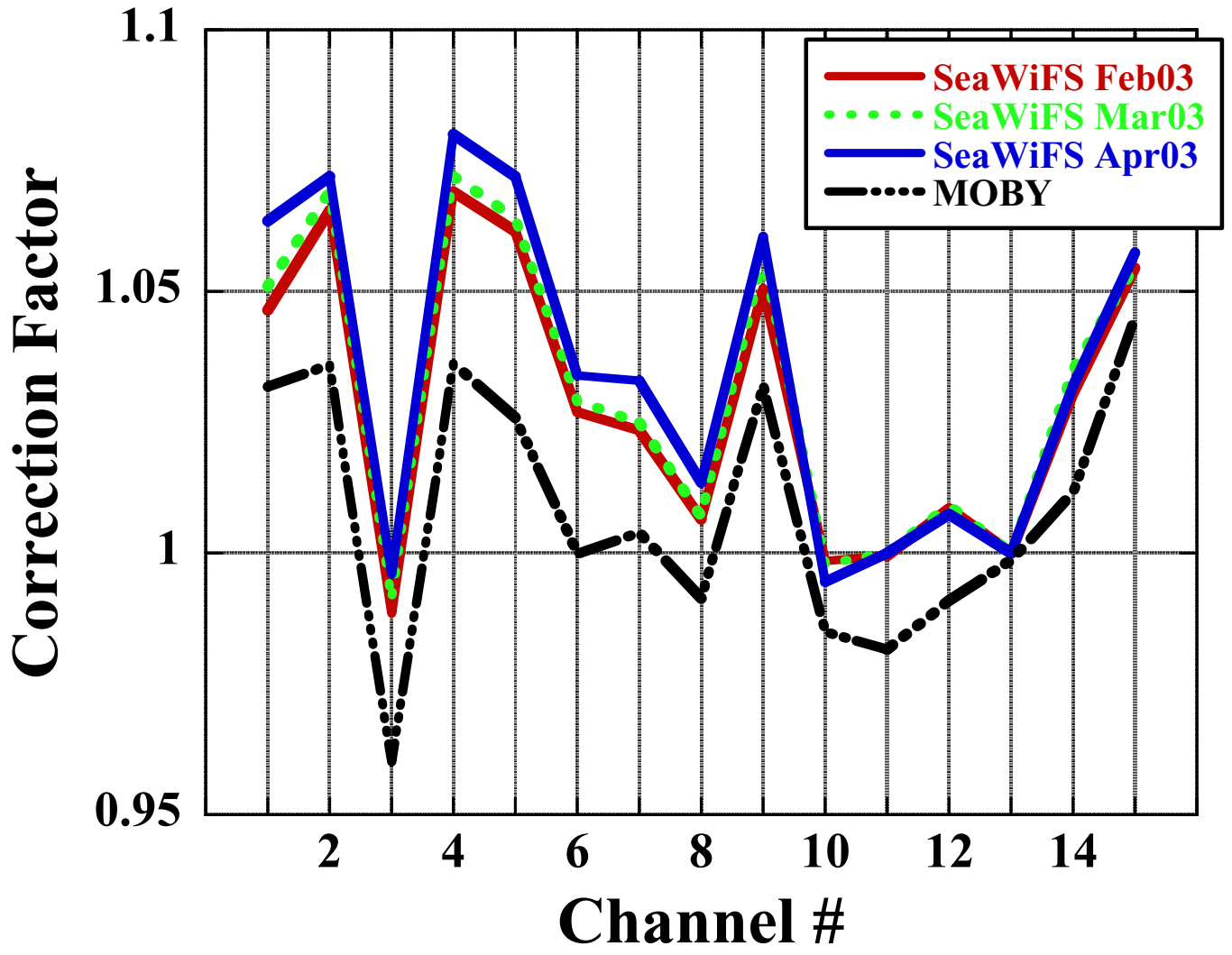
- GLI standard algorithm (ver.1)
- Model aerosol fixed per each sub-scene to minimize the noise effect in 678/865 nm bands
  - With 24 by 24 median filter applied
- Cloud mask
  - Simple threshold: $\rho_A(865) = 0.022$
  - Local variance and "adjacency masking" not applied yet
- Sunglint/whitecap corrections kept "off"

Calibration correction factors

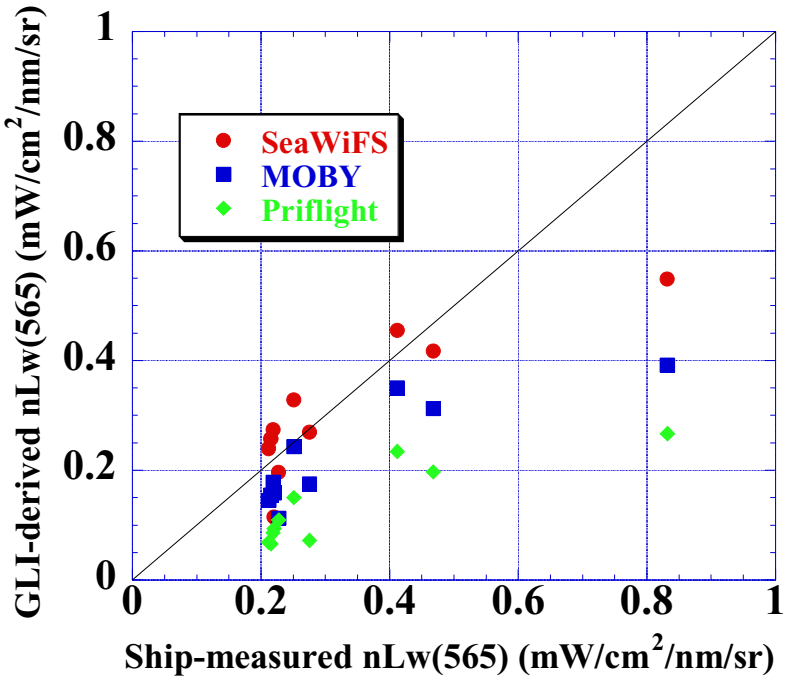
Channel#	Center wavelength [nm]	SeaWiFS Feb03	SeaWiFS Mar03	SeaWiFS Apr03	MOBY
1	380	1.0465	1.0510	1.0635	1.0318
2	400	1.0655	1.0690	1.0720	1.0359
3	412	0.9885	0.9910	0.9960	0.9600
4 B[1)]	443	1.0690	1.0720	1.0800	1.0363
5 B	460	1.0615	1.0640	1.0720	1.0259
6	490	1.0270	1.0290	1.0340	0.9999
7 B	520	1.0235	1.0250	1.0330	1.0039
8 B	545	1.0065	1.0070	1.0135	0.9914
9	565	1.0505	1.0570	1.0605	1.0321
10	625	0.9985	0.9980	0.9945	0.9848
11	666	0.9995	1.0000	1.0000	0.9816
12	680	1.0085	1.0090	1.0075	0.9909
13 H[2)]	678	1.0000	1.0000	1.0000	0.9986
14	710	1.0305	1.0350	1.0320	1.0116
15 H	710	1.0545	1.0550	1.0575	1.0452
19 H	865	1.000	1.000	1.000	1.000

1) Channels with “B” has bi-linear gain.
2) Channels with “H” has high saturation level.

Calibration correction factors

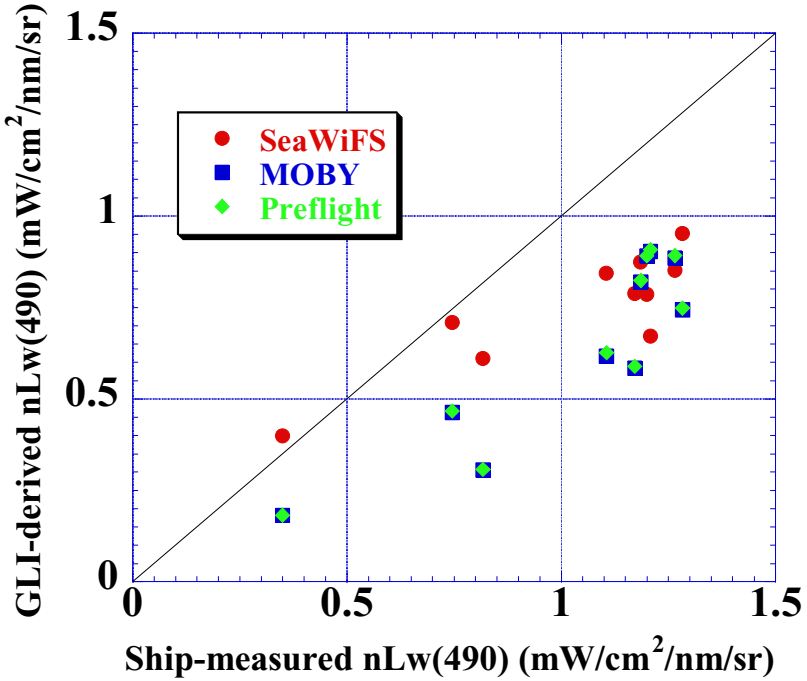


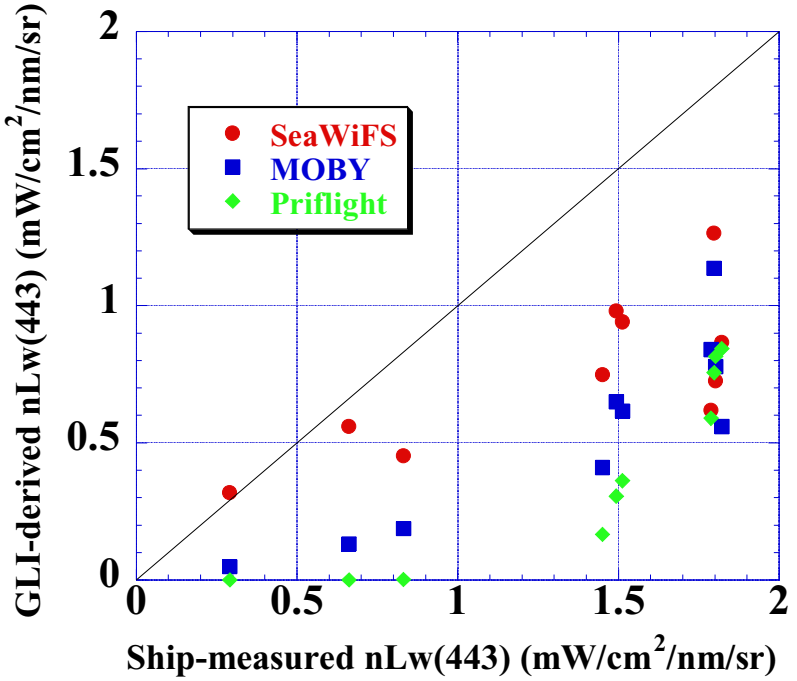
Comparison of different calibrations at $nL_W(565)$



- **Three different sets of calibration tried and compared**
  - **Preflight calibration**
    - **tend to underestimate**
  - **Vicarious cal. on MOBY**
    - **to underestimate slightly**
  - **Vicarious cal. on SeaWiFS**
    - **Three sets, but not much different each other**
    - **Better than others**
- **SeaWiFS-based correction factors used for further analysis**

Comparison of different calibrations (cont'd)

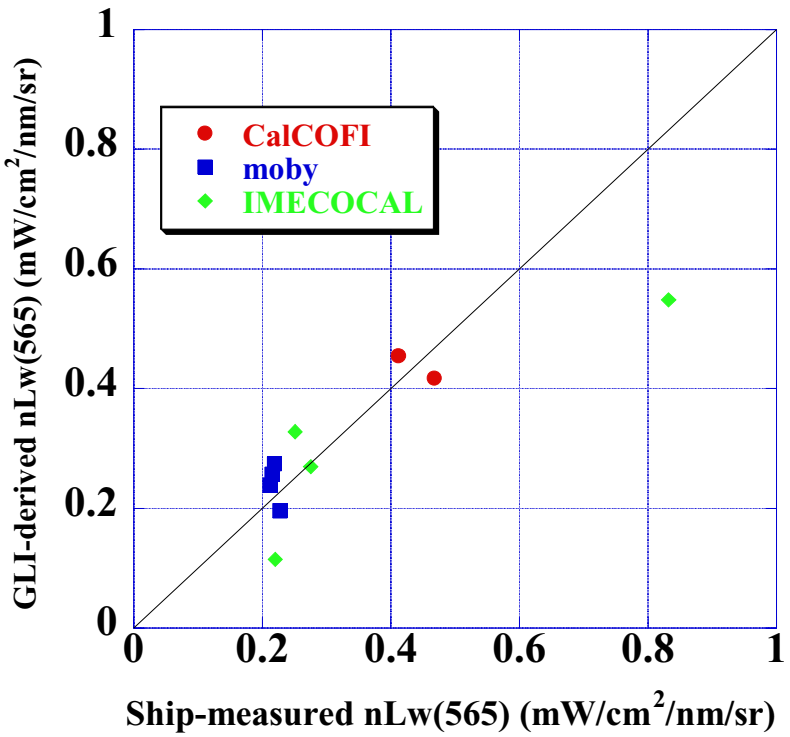


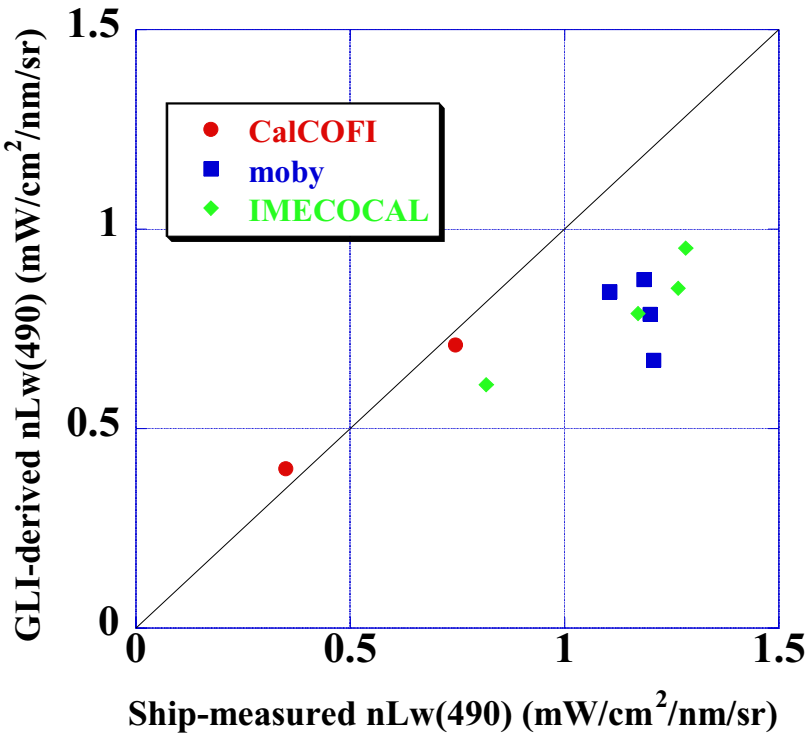


nLw match-up analysis

- **Data sets:**
  - **CalCOFI 0304 nLw by G. Mitchell/M. Kahru**
  - **IMECOCAL 0304 SIMBAD-based nLw by R. Frouin**
  - **MOBY in Feb. - May, 2003, by D. Clark**
- **Evaluated bands**
  - **443, 490, 565nm**
- **Data screening criterion**
  - **Same day (within few hrs from the satellite overpass)**
  - **Clear sky condition, with no sun-glint contamination**
- **Calibration correction factors: SeaWiFS-based (v3)**

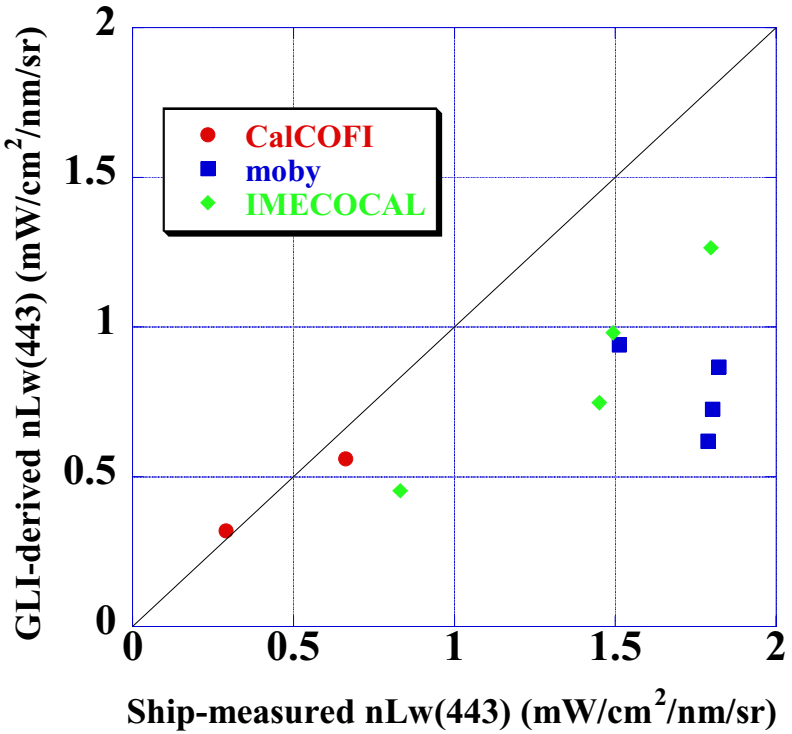
nLw match-up (565 and 490 nm bands) under SeaWiFS-based calibraton



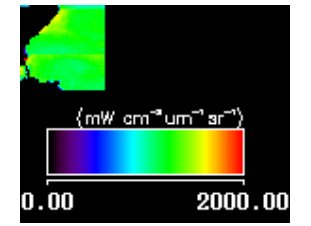


nLw match-up at 443 nm band under SeaWiFS-based calibraton

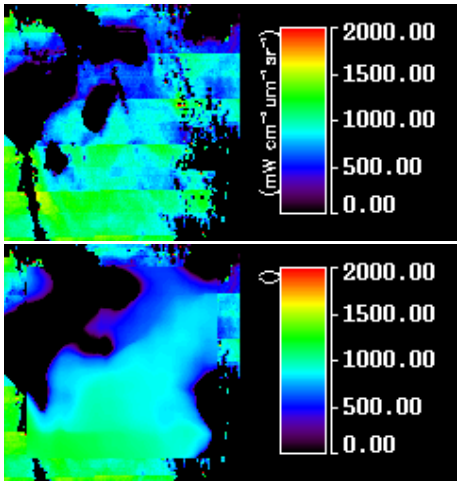
- Lower nLw estimates in blue bands in MOBY and IMECOCAL area
- Possibly because of
  - Case II waters (at IMECOCAL) and/or
  - Sampling strategy (at MOBY site)



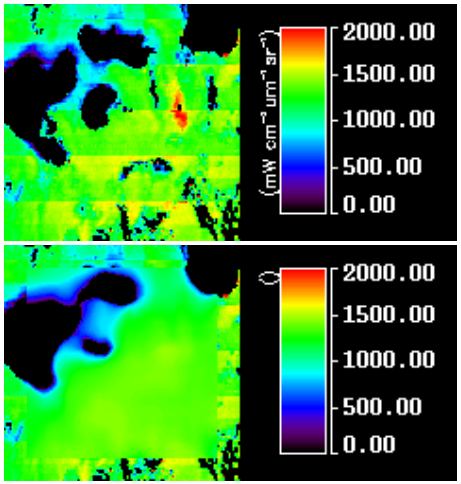
Filtering and sampling at MOBY site
(showing original and filtered nLw(443) imageries



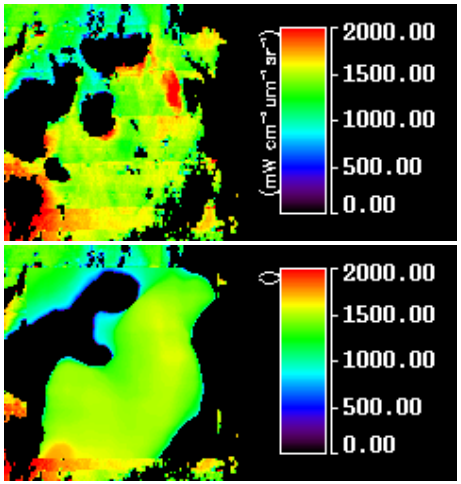
0206



0207



0408



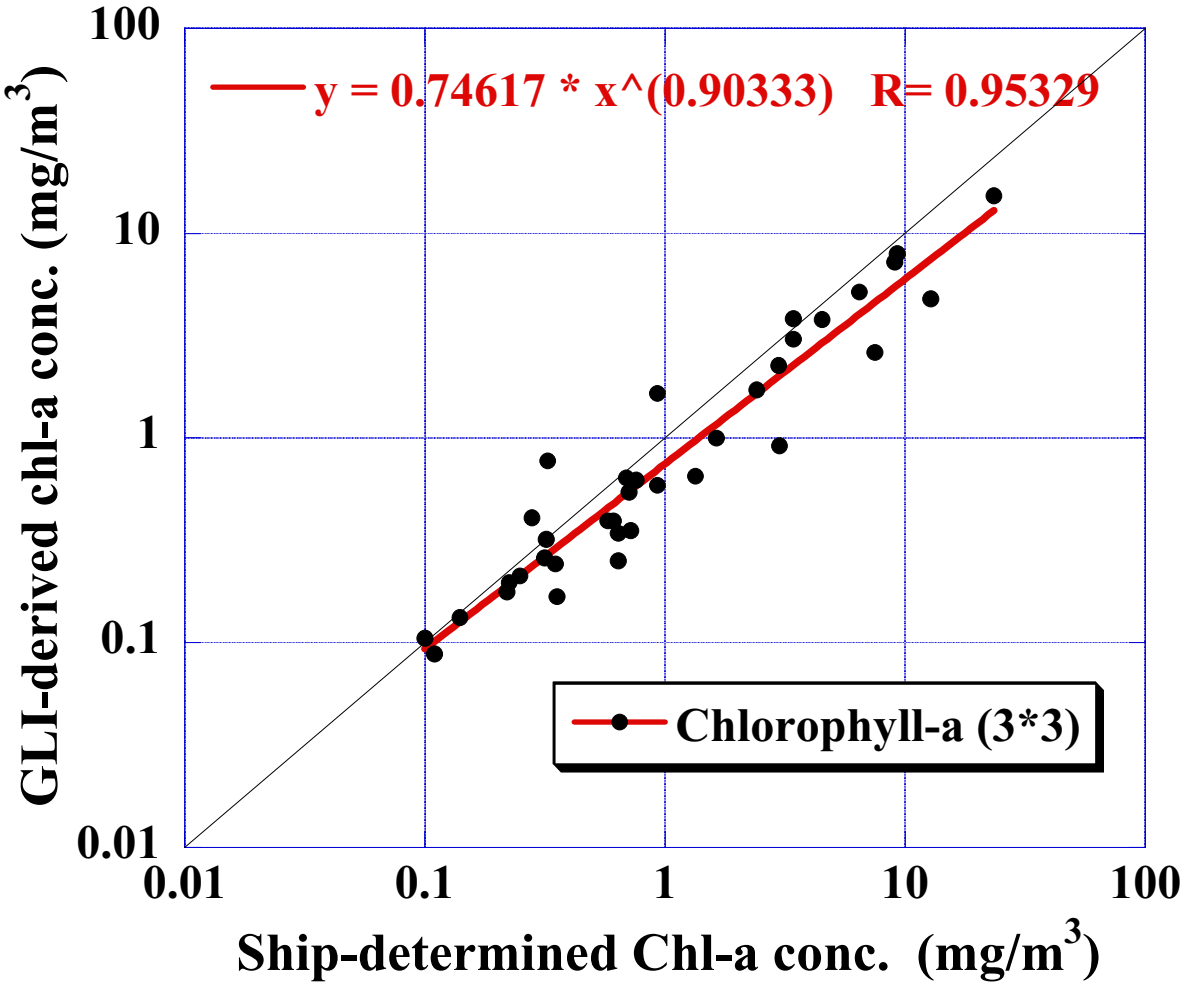
0506

- 24 by 24 averaging filter was applied to minimize the noise effect
- May pick up some biased value
- Needs more enhanced sampling strategy, after getting enough amount of data and accomplishing quality de-striping procedure

Early chlorophyll-a match-up analysis based on CalCOFI 0304 ship-measurement

- **Used GLI L2 chl-a data**
  - **Prepared by H. Murakami (NASDA), with tentative de-striping processing under SeaWiFS-based calibration correction**
- **Ship-determined chl-a data set**
  - **90 chl-a data point from CalCOFI 0304**
  - **35 screened, with ±24hour criterion**

Comparison between ship-determined and GLI-derived chl-a concentration in CalCOFI 0304



Concluding remarks

- **Atmospheric correction algorithm can be evaluated as to meet the basic requirement**
  - **Showing no unwanted characteristics, like non-linearity against chl-a estimates**
- **Needs further work on match-up analysis, with the efforts on sensor calibration, characterization, and de-striping**