Comparisons of MODIS-Terra/Aqua and SeaWiFS L3b daily global oceans data

SIMBIOS Project

Ewa Kwiatkowska

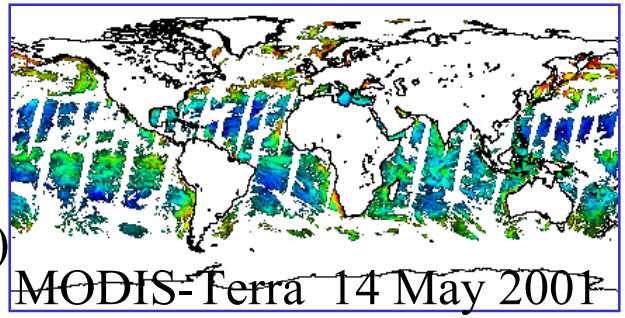
19 March 2003

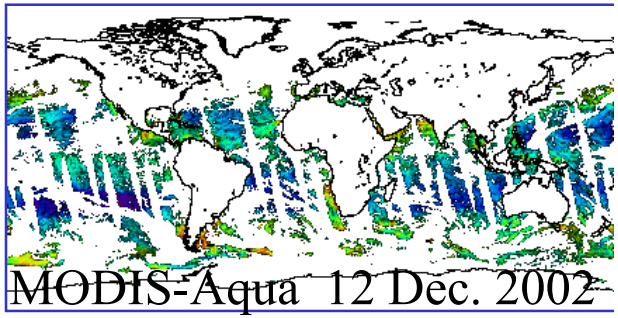
Objectives

1. Estimation of daily discrepancies in MODIS-Terra/Aqua and SeaWiFS data.
2. Evaluation of temporal trends in these discrepancies and seasonality of the trends.
3. Analysis of MODIS oceans data scan angle dependence (based on SeaWiFS scan stability).
4. Analysis of MODIS oceans data latitudinal dependence (based on SeaWiFS latitudinal stability).

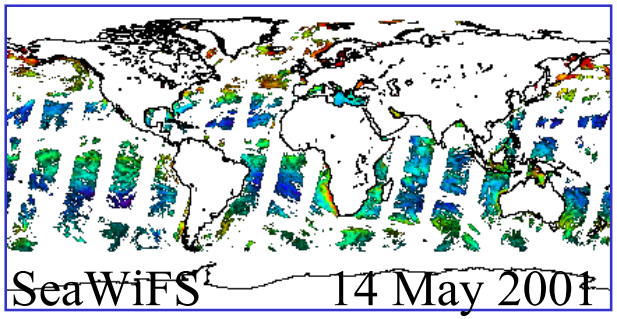
MODIS and SeaWiFS L3 binned daily global data at 9km resolution

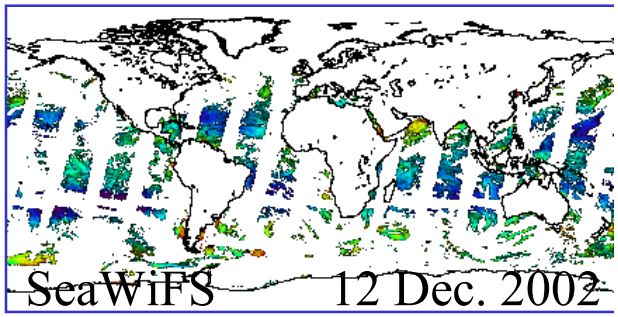
MODIS
L3 binned 9km resolution
Terra - collection 4
Aqua – collection 3
chlor_a_2 chlorophyll (OC3M)
“good” quality only (0 quality)



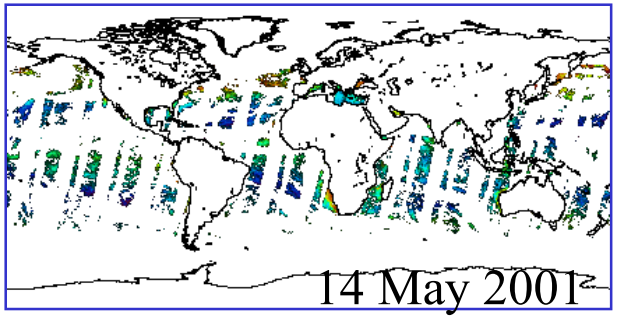


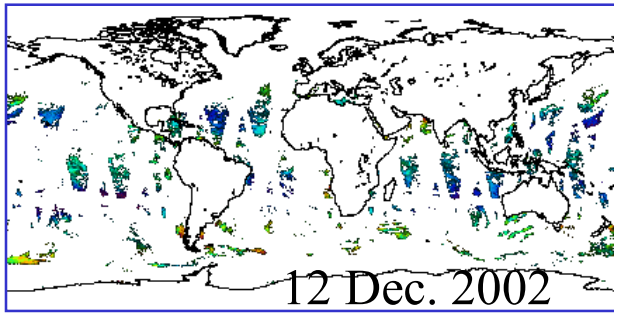
SeaWiFS
L3 binned 9km resolution
reprocessing 4
chlor_a chlorophyll (OC4v4)
L3b standard quality





common daily bin coverage
MODIS ∩ SeaWiFS





MODIS and SeaWiFS matchups

TIME SERIES

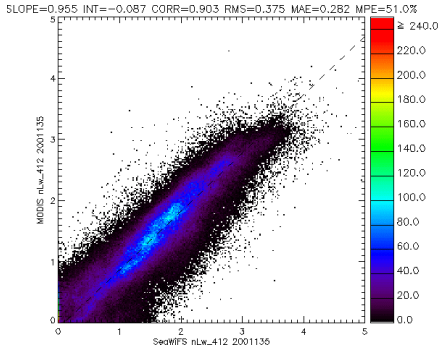
- MODIS-Terra and SeaWiFS - 28 Feb. 2000 to 31 Dec. 2002, individual days in 15-day intervals, total 74 days
- MODIS-Aqua and SeaWiFS - 29 Nov. 2002 to 1 Mar. 2003, individual days in every 4th day intervals, total ~24 days

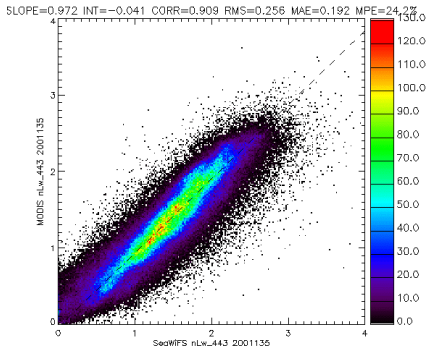
MATCHUPS

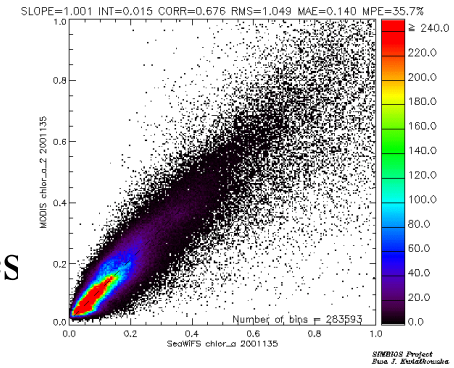
- daily scatter plots of SeaWiFS vs. MODIS data for each day and each product
- nLw_412, nLw_443, and chlorophyll-*a* concentration
- data from overlapping MODIS and SeaWiFS daily bin coverage

MATCHUP STATISTICS

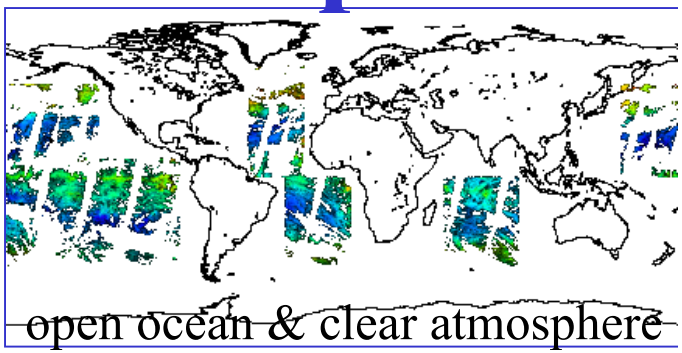
- slope (SLOPE) and intercept (INT) of the linear fit a bisector SeaWiFS vs. MODIS and MODIS vs. SeaWiFS
- correlation (CORR)
- root mean squared error (RMS)
- mean percentage error (MPE) in percentages of SeaWiFS values
- mean absolute error (MAE)
- mean difference (SeaWiFS–MODIS difference)







MODIS and SeaWiFS matchups cont.

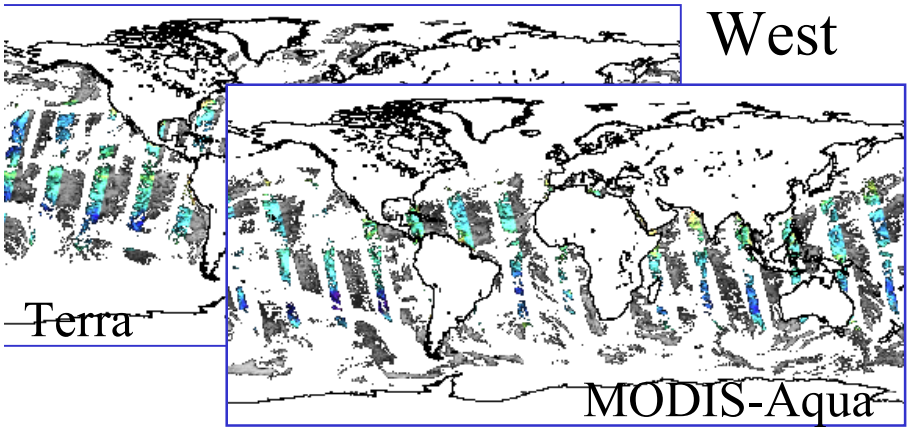


DATA SUBSETTING

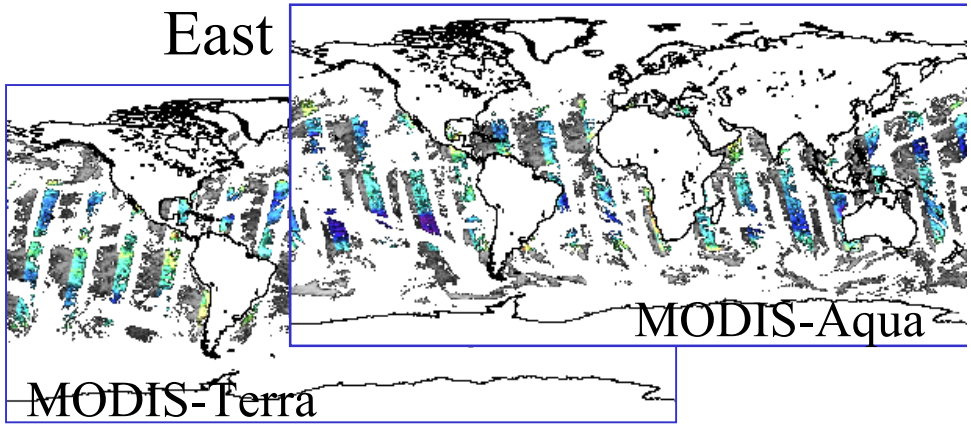
- open ocean and clear atmosphere (AOT < 0.2)
- low chlorophyll-a concentration (chlor < 0.1 mg/m^3)
- MODIS scan angle portions (|Latitude| < 40^0)

West (TerraZenith<-25^0 AquaZenith>25^0) East (TerraZenith>25^0 AquaZenith<-25^0)

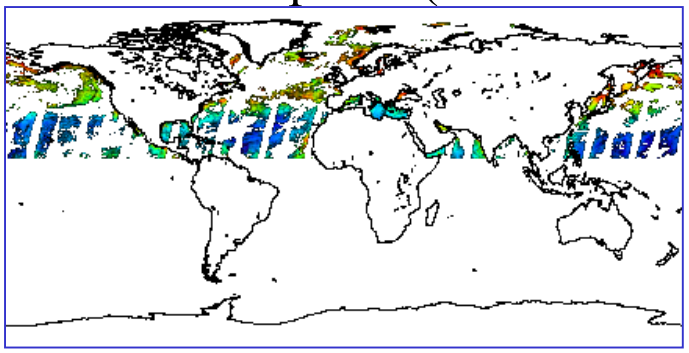
West



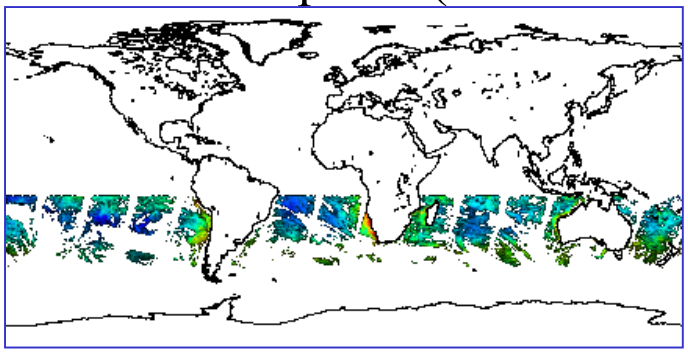
East



- Northern Hemisphere (Latitude > 10^0)



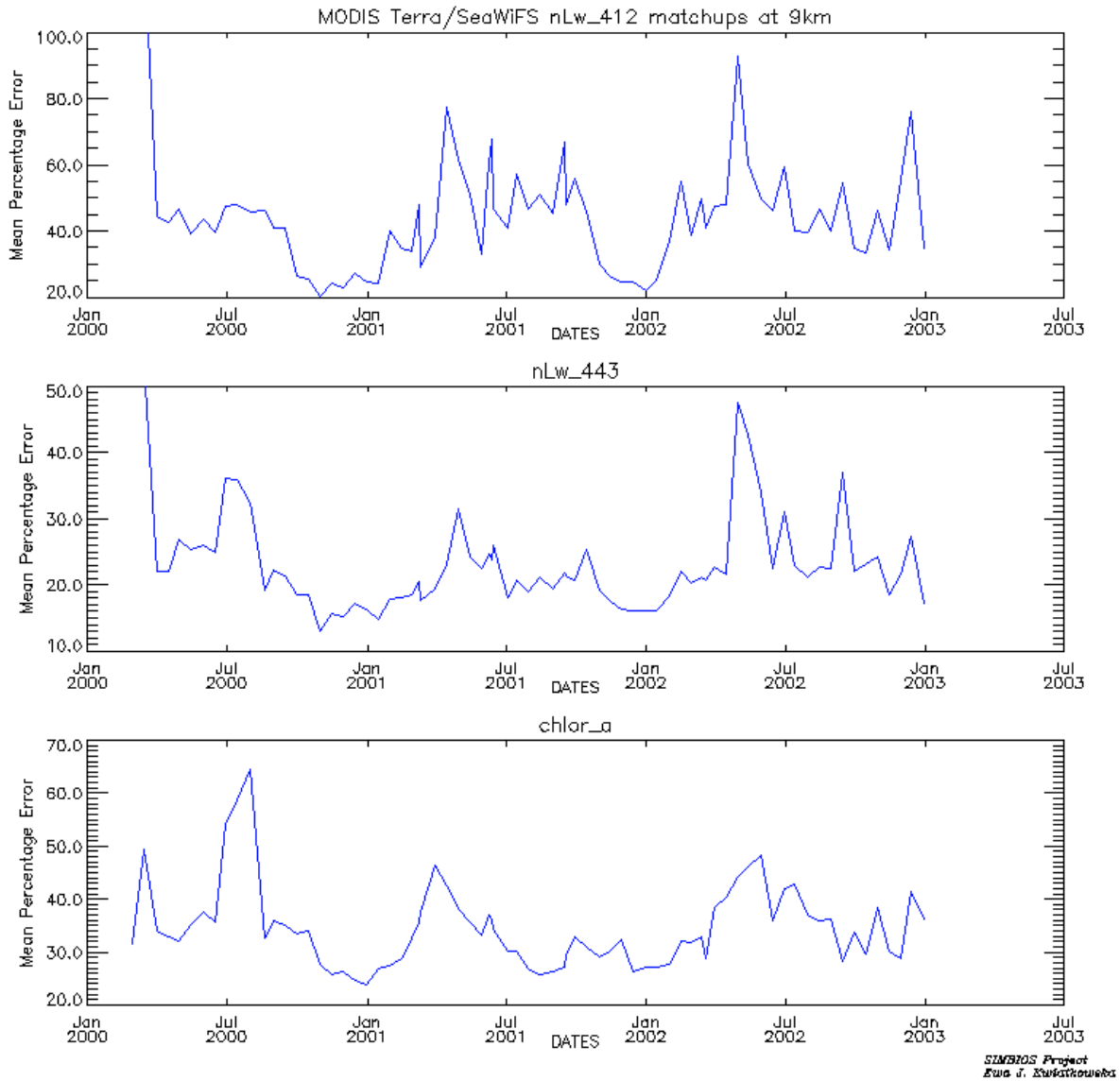
Southern Hemisphere (Latitude < -10^0)



MODIS-Terra and SeaWiFS

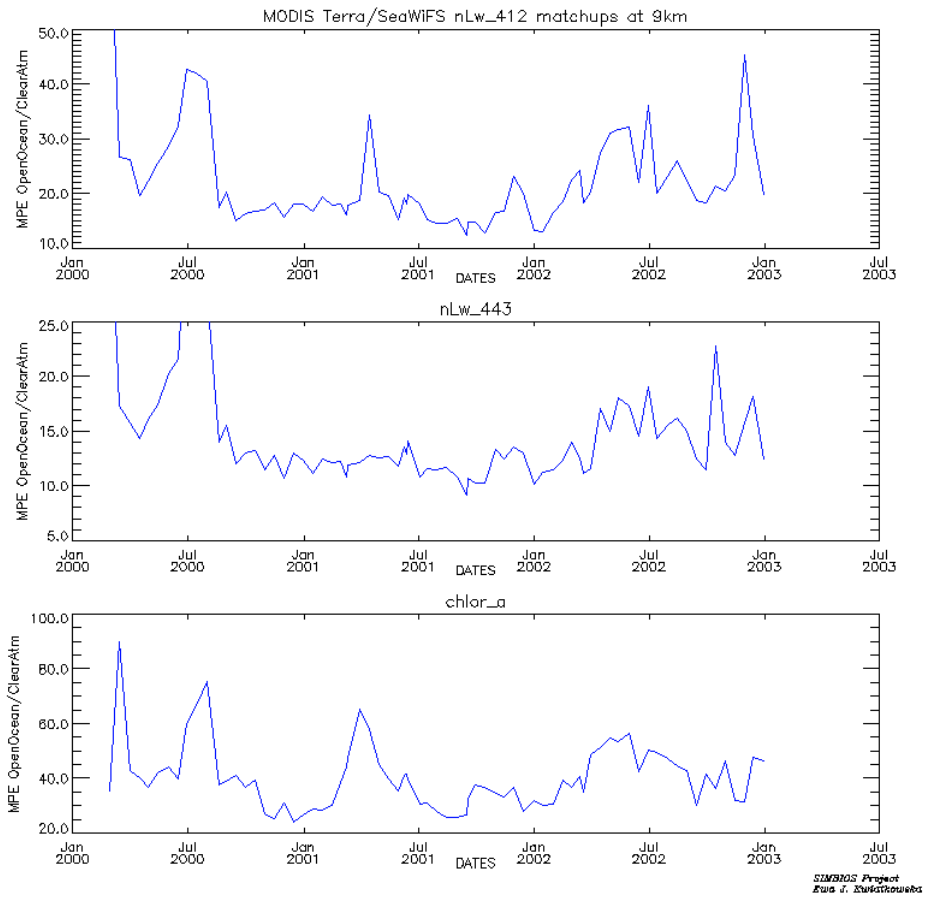
MODIS-Terra and SeaWiFS Temporal trends in data differences

Global Mean Percentage Error

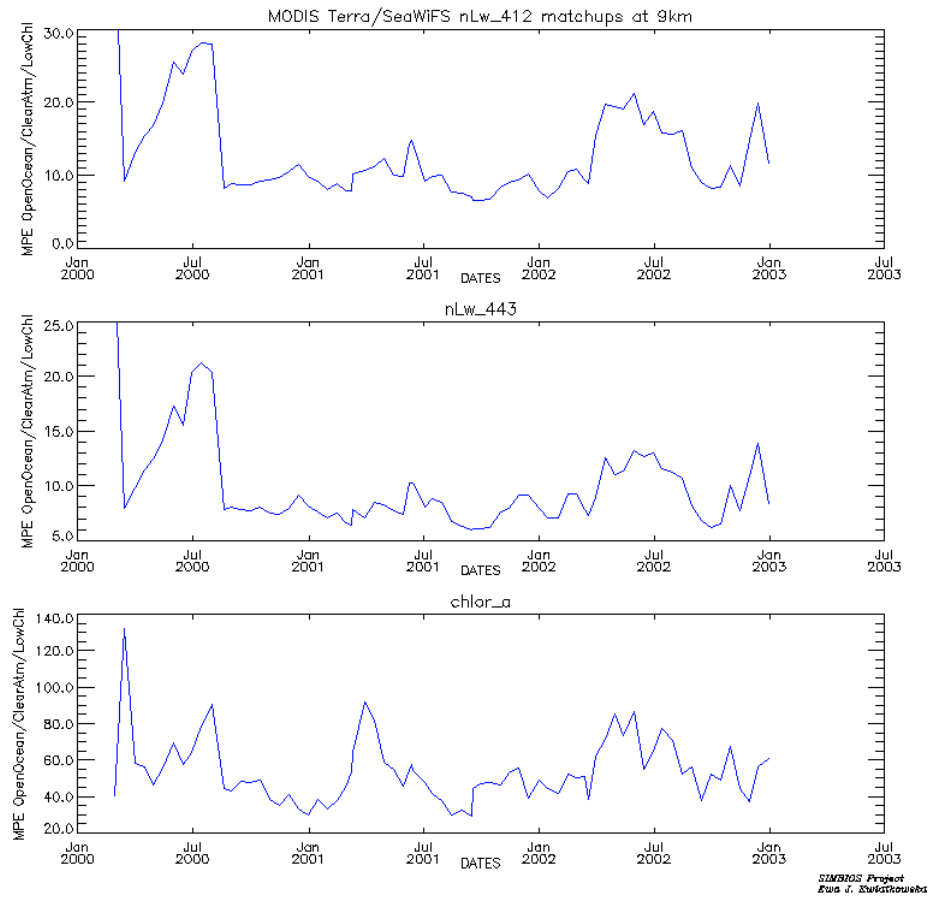


MODIS-Terra and SeaWiFS Temporal trends in data differences

Mean Percentage Error Open Ocean/Clear Atmosphere



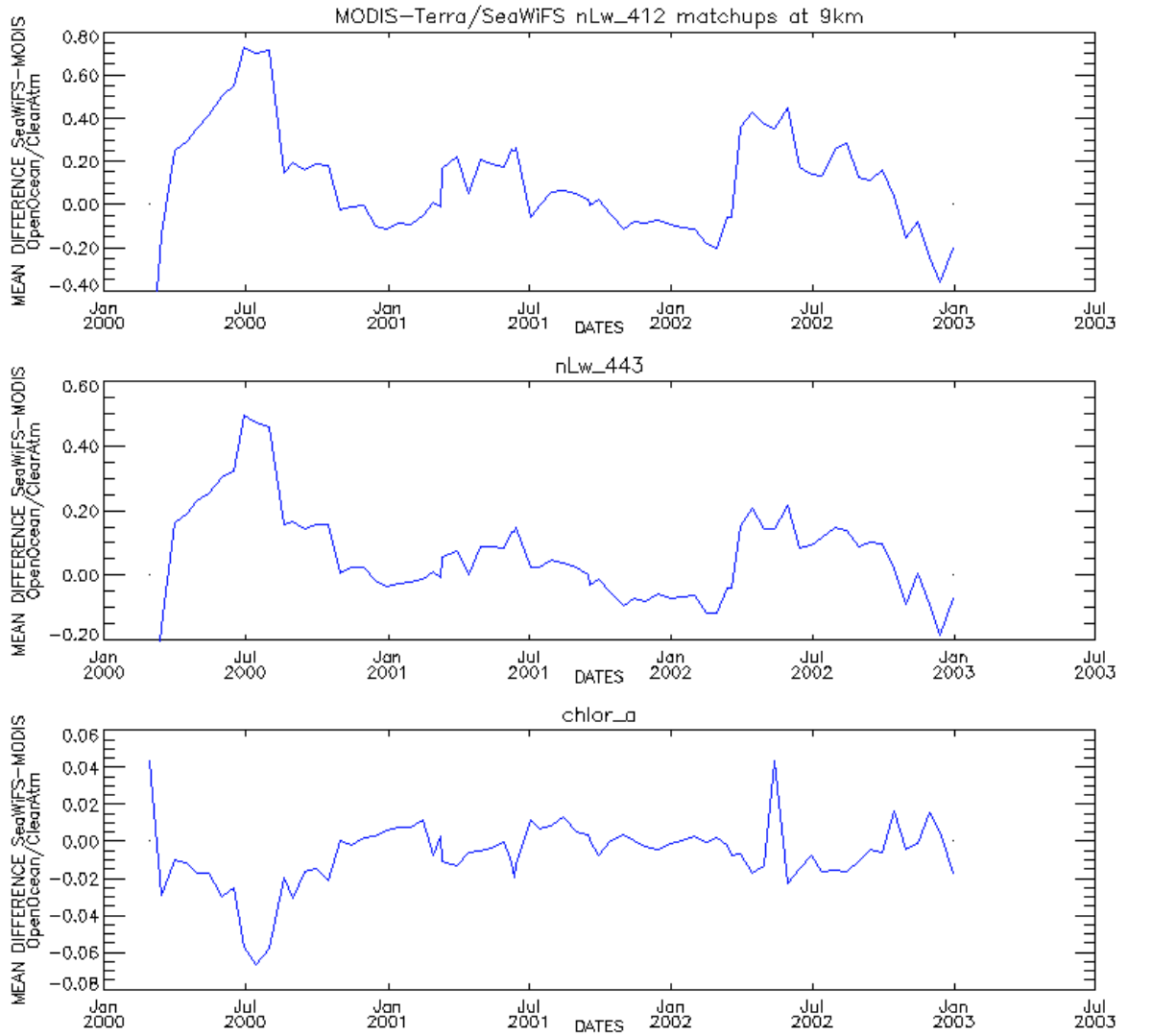
Mean Percentage Error Low Chlorophyll/Open Ocean/Clear Atmosphere



MODIS-Terra and SeaWiFS Temporal trends in data differences

Mean Difference
SeaWiFS–MODIS

Open ocean /clear atmosphere



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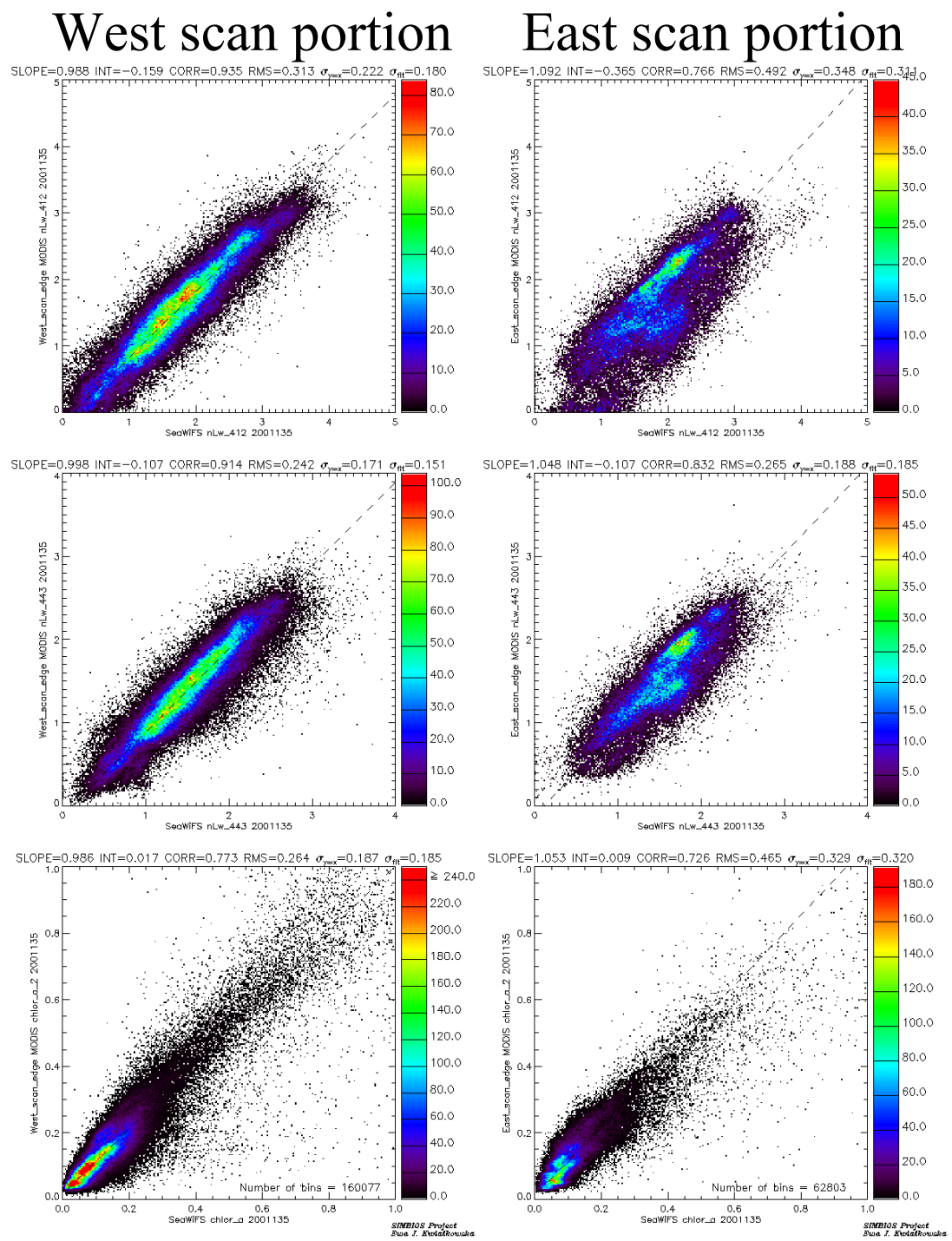
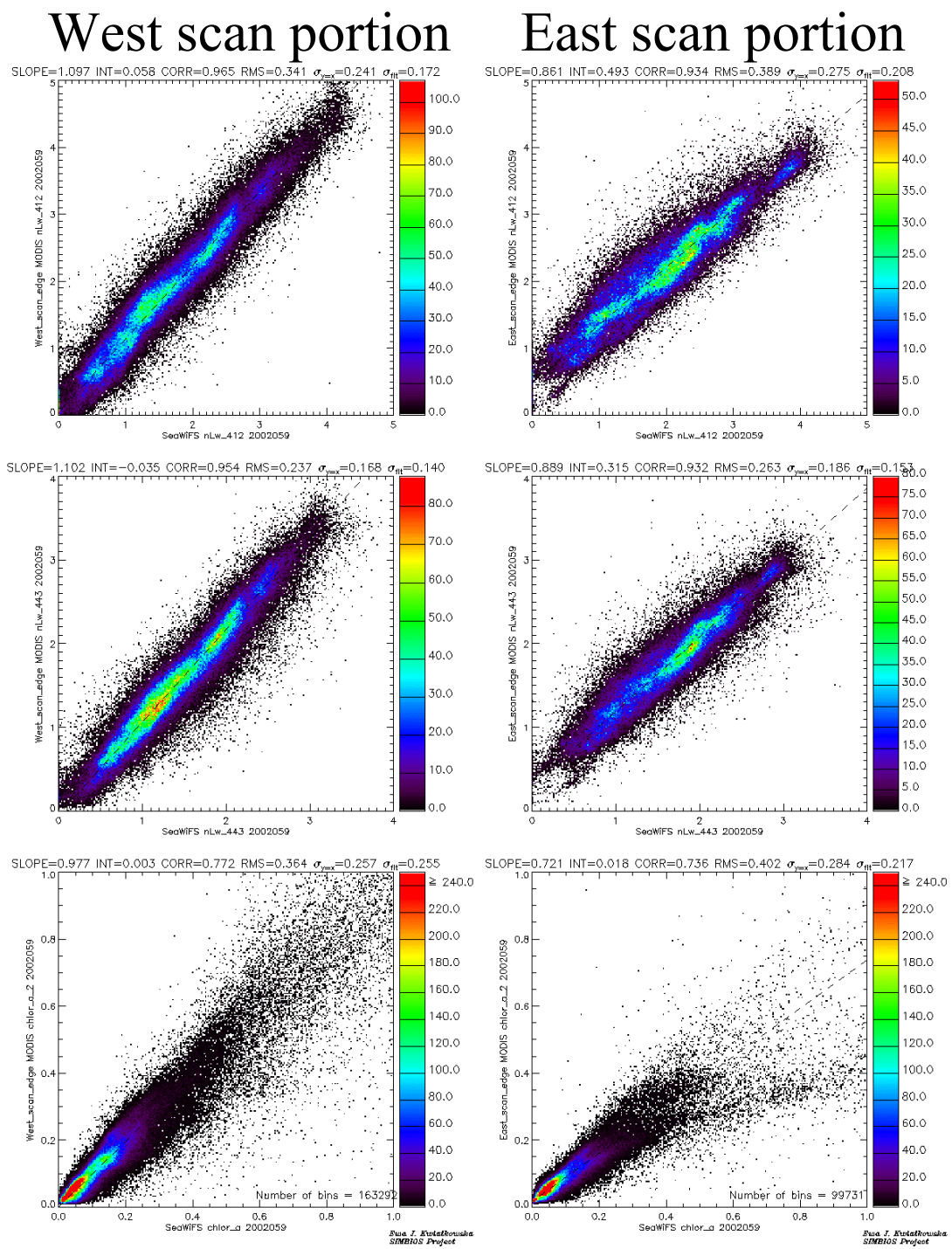
Separate MODIS-Terra West scan and East scan portion matchups with SeaWiFS 14 May 2001



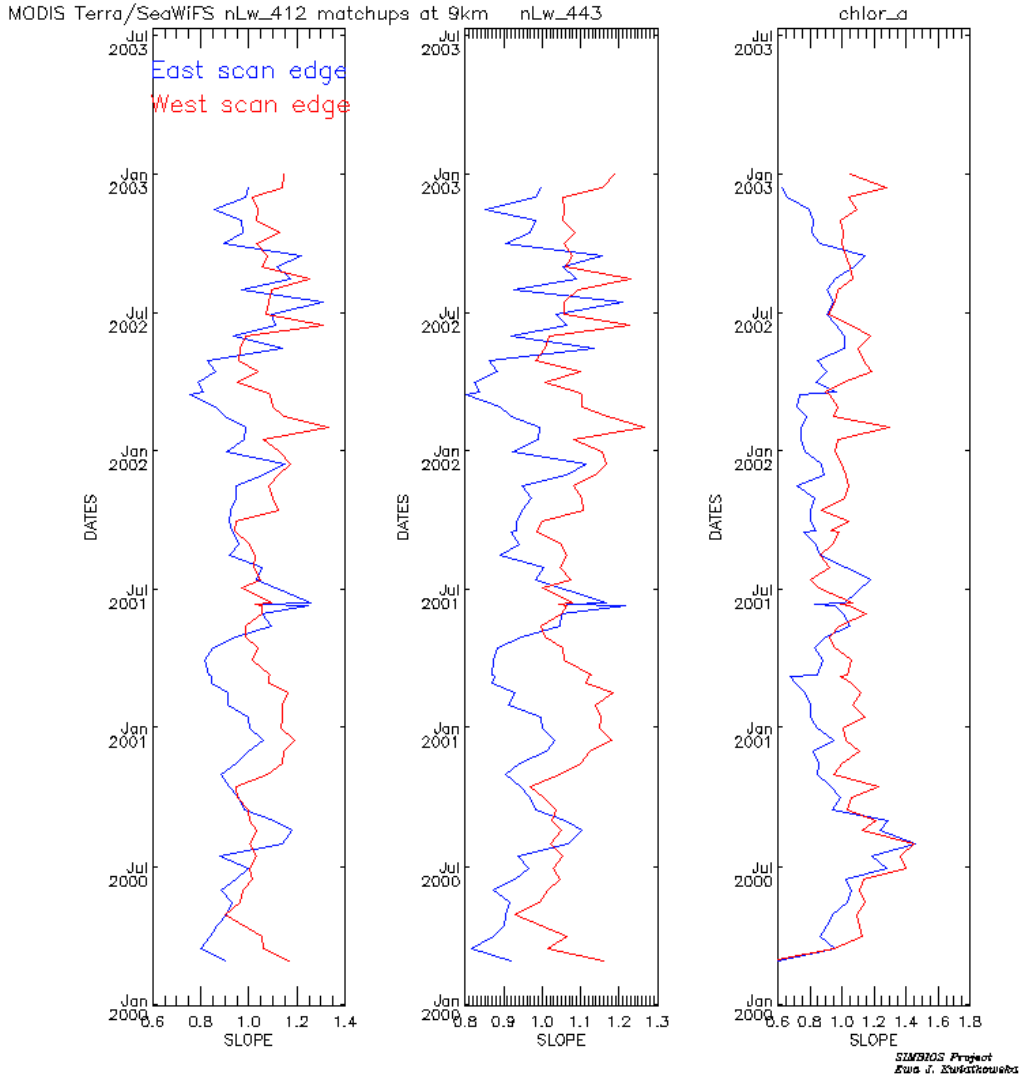
Separate MODIS-Terra West scan and East scan portion matchups with SeaWiFS 28 Feb. 2002



Slope and intercept are good indicators of differences between the West and East matchup plots

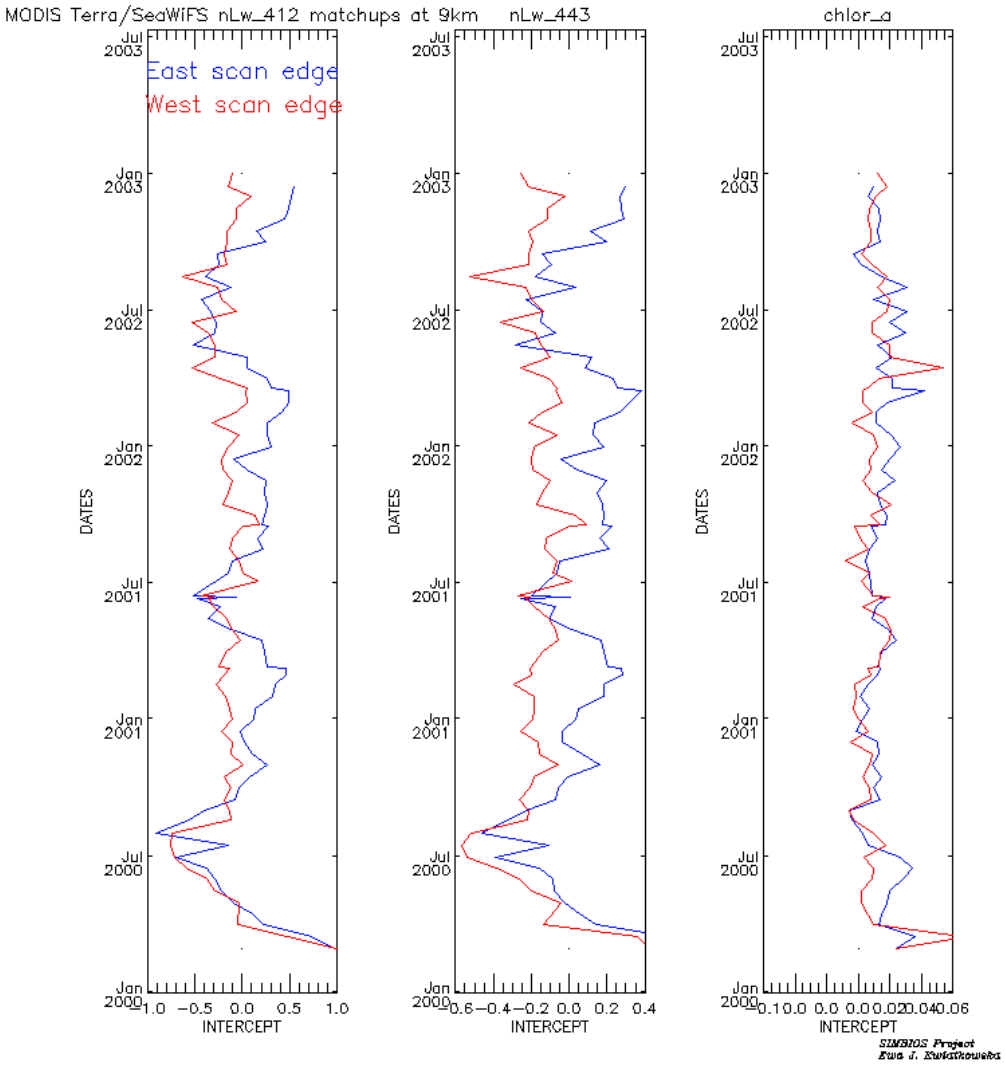
MODIS-Terra and SeaWiFS Temporal trends in MODIS scan angle dependencies

Slope in the linear fit SeaWiFS vs. MODIS



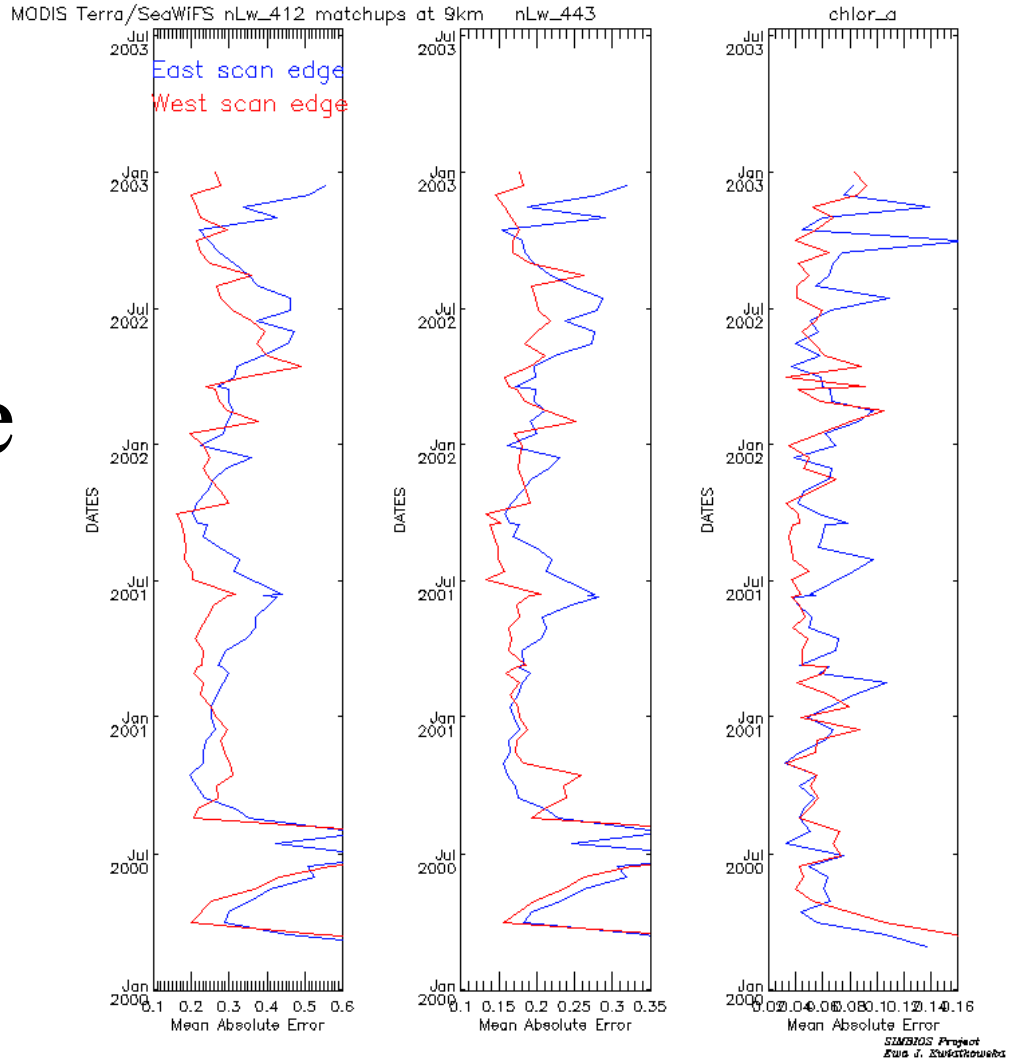
MODIS-Terra and SeaWiFS Temporal trends in MODIS scan angle dependencies

Intercept in the linear fit SeaWiFS vs. MODIS

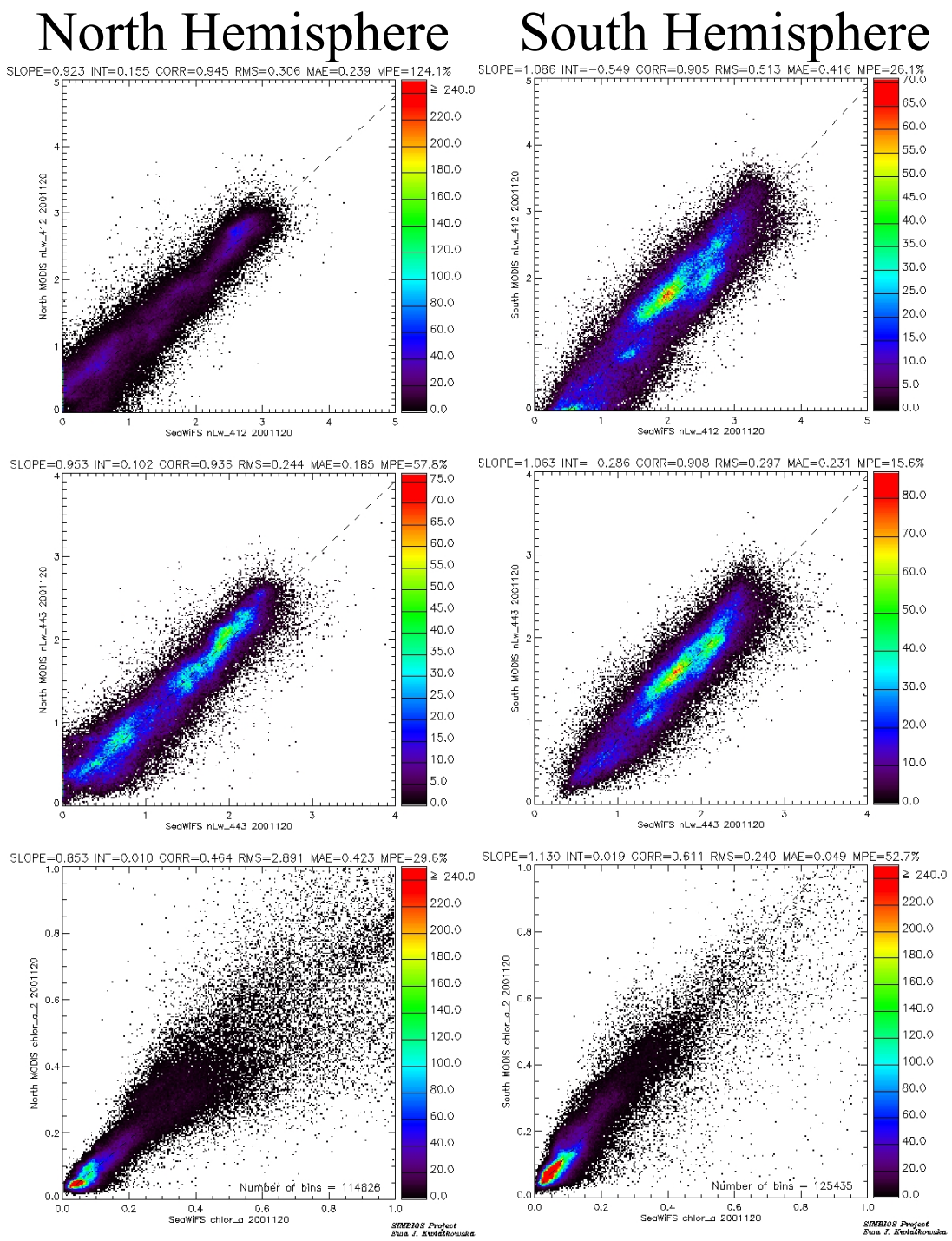


MODIS-Terra and SeaWiFS Temporal trends in MODIS scan angle dependencies

Mean Absolute Error

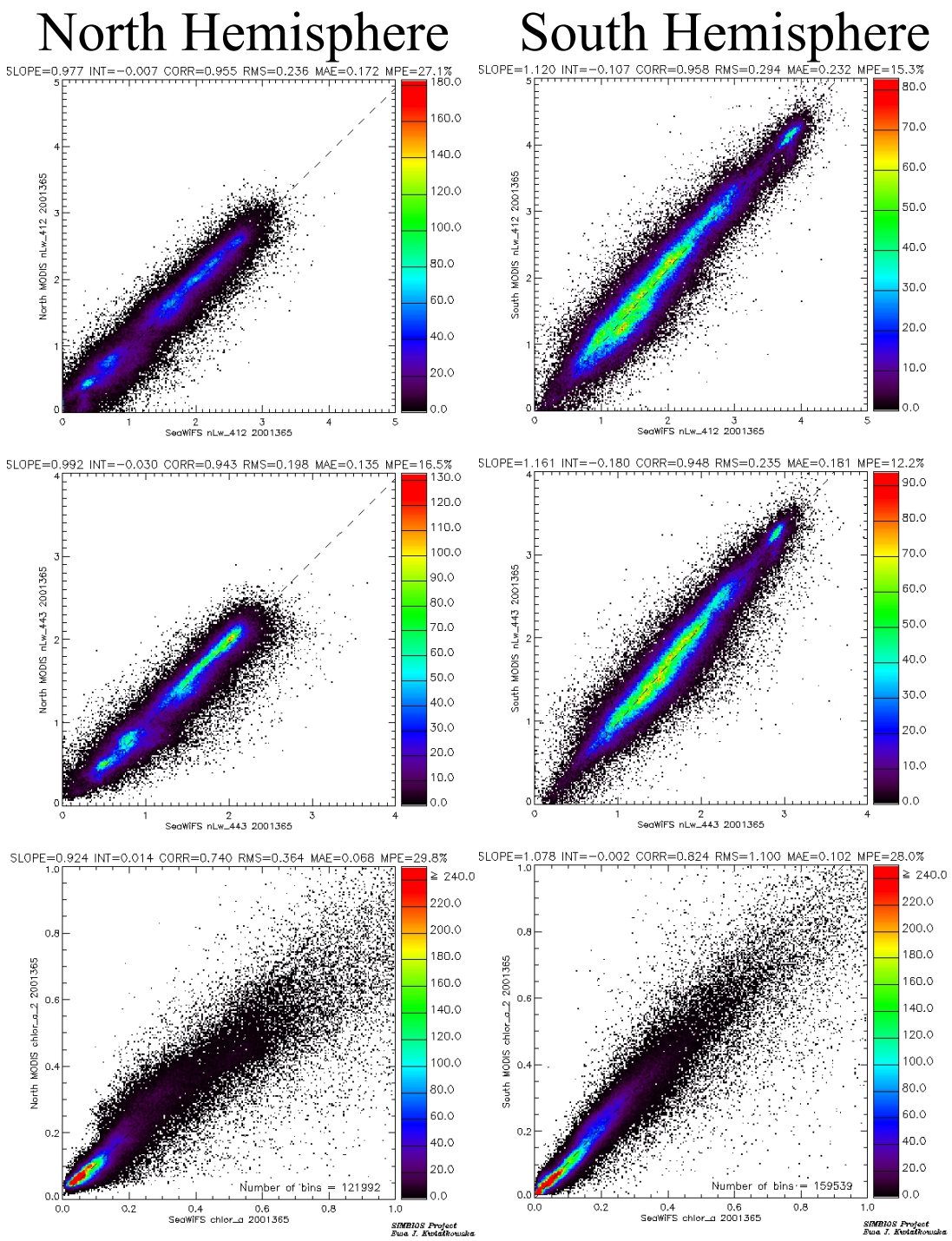


Separate Northern Hemisphere and Southern Hemisphere matchups 30 April 2001



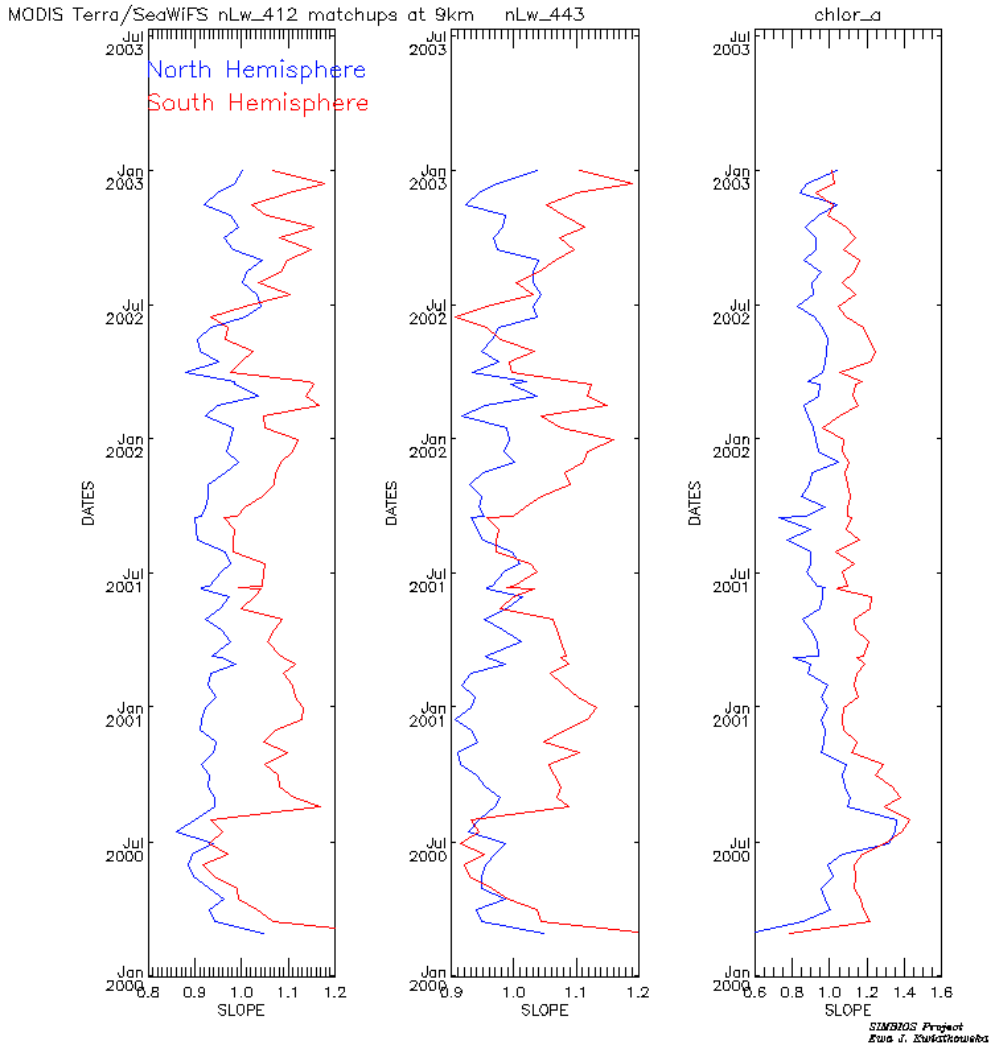
Separate Northern Hemisphere and Southern Hemisphere matchups 31 Dec. 2001

Slope and intercept are good indicators of differences between the North and South matchup plots



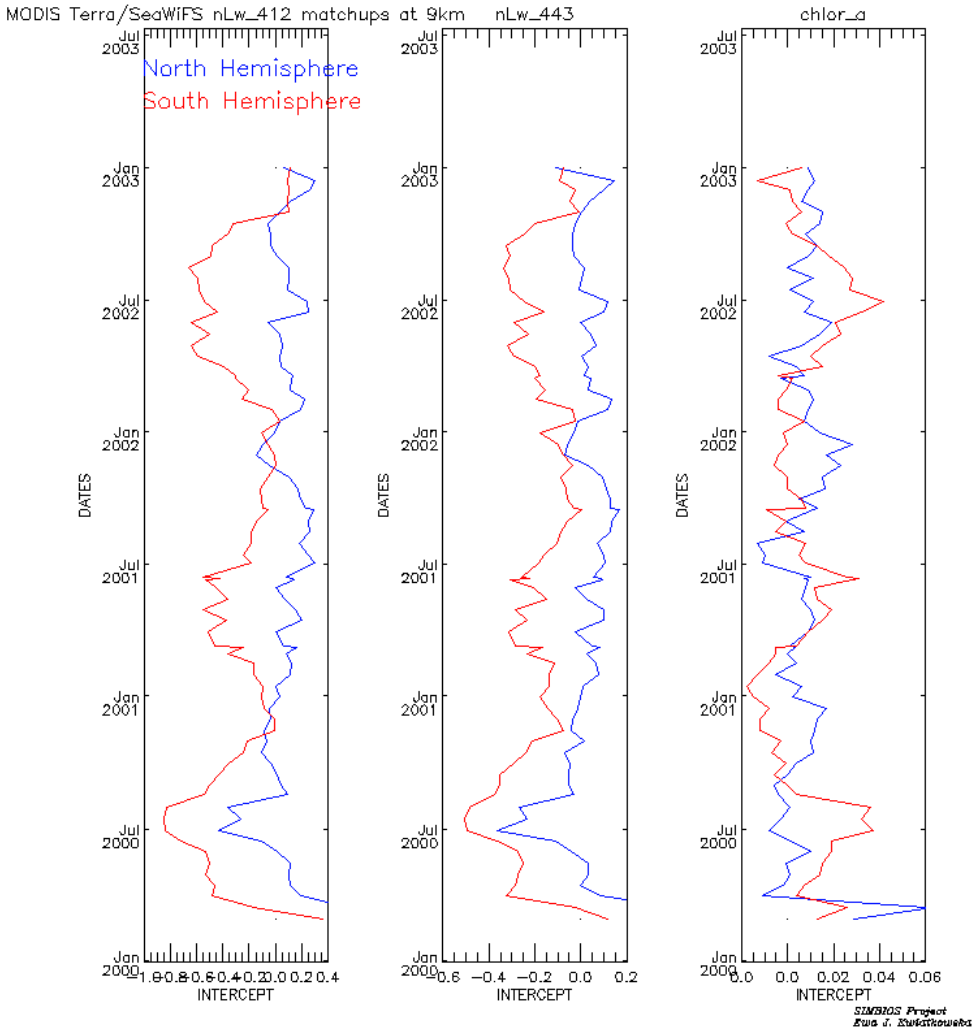
MODIS-Terra and SeaWiFS Temporal trends in MODIS latitudinal discrepancies

Slope in the linear fit SeaWiFS vs. MODIS



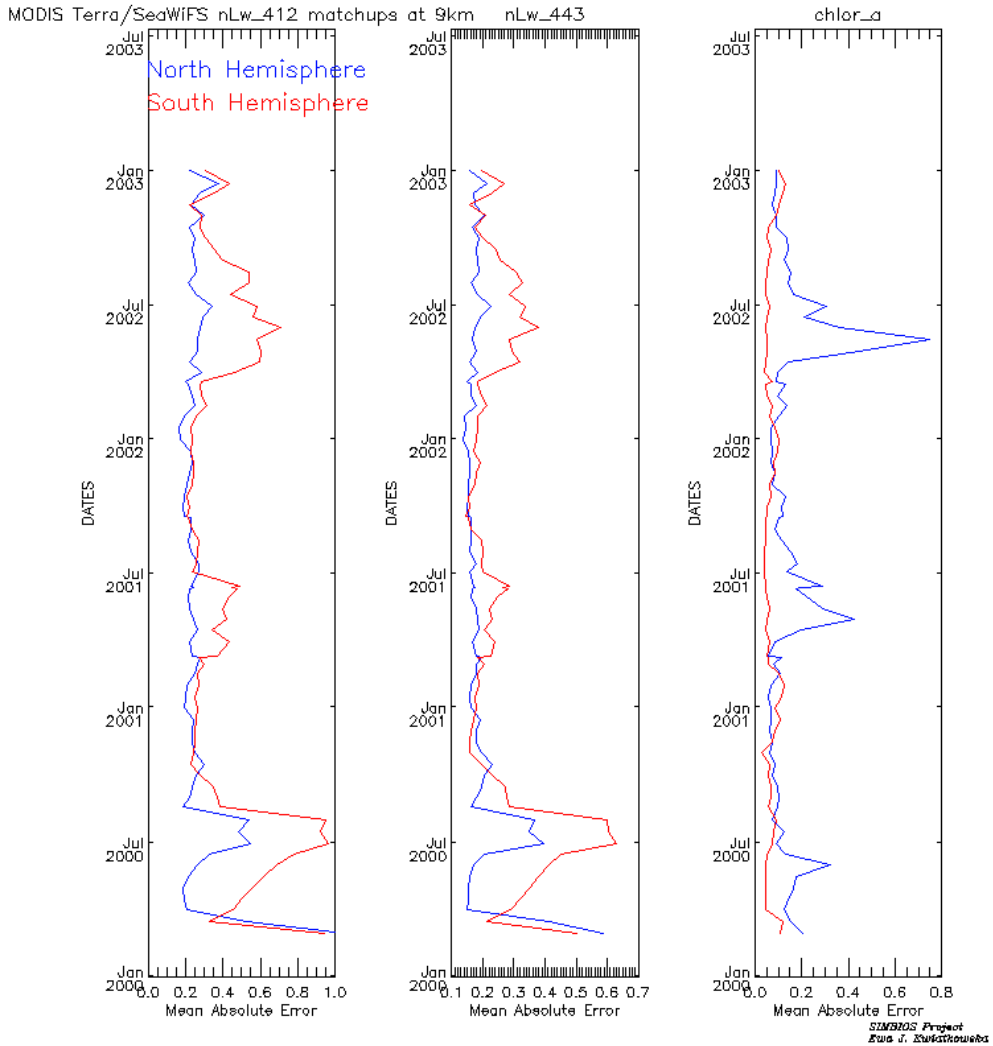
MODIS-Terra and SeaWiFS Temporal trends in MODIS latitudinal discrepancies

Intercept in the linear fit SeaWiFS vs. MODIS



MODIS-Terra and SeaWiFS Temporal trends in MODIS latitudinal discrepancies

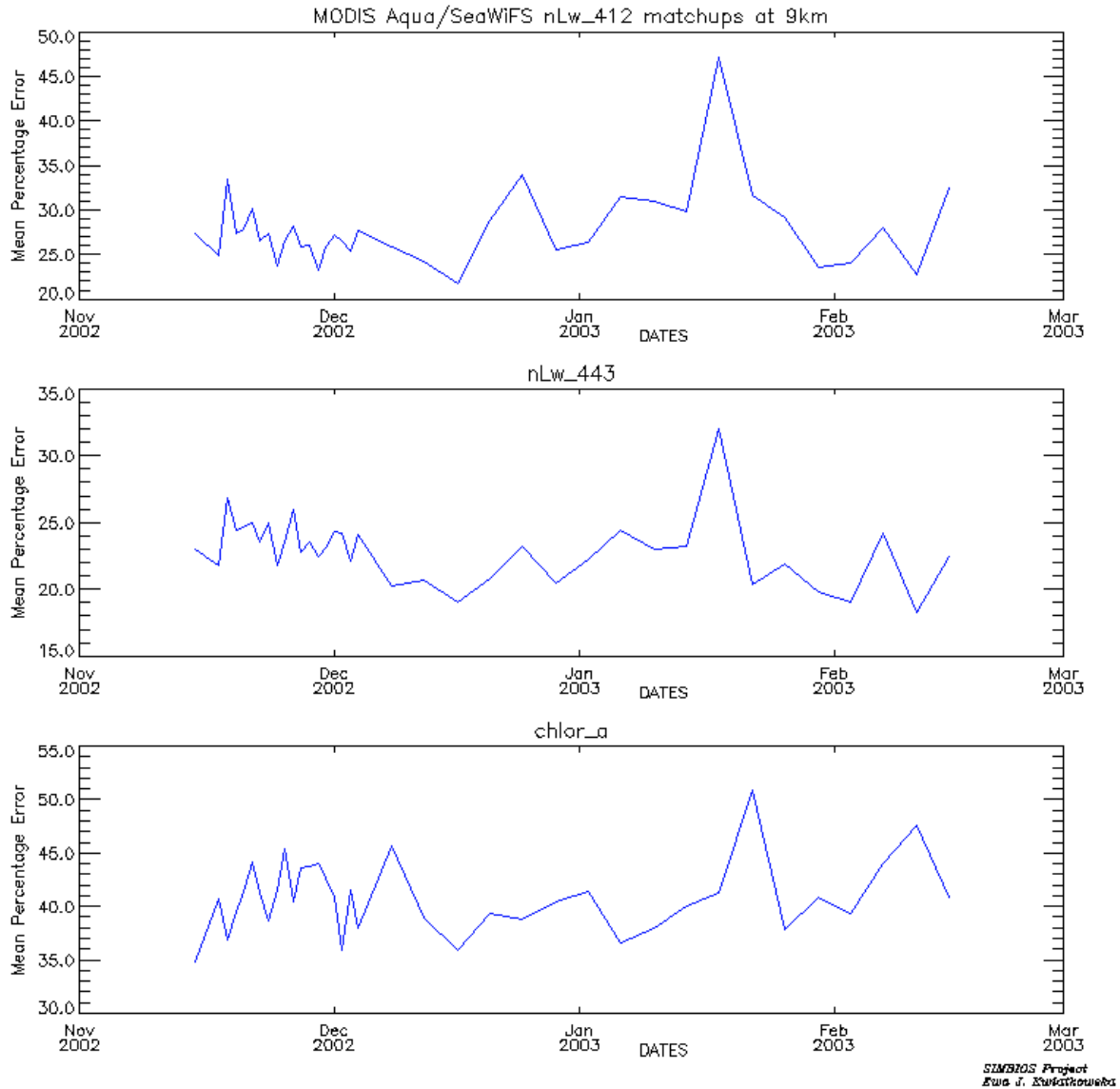
Mean Absolute Error



MODIS-Aqua and SeaWiFS

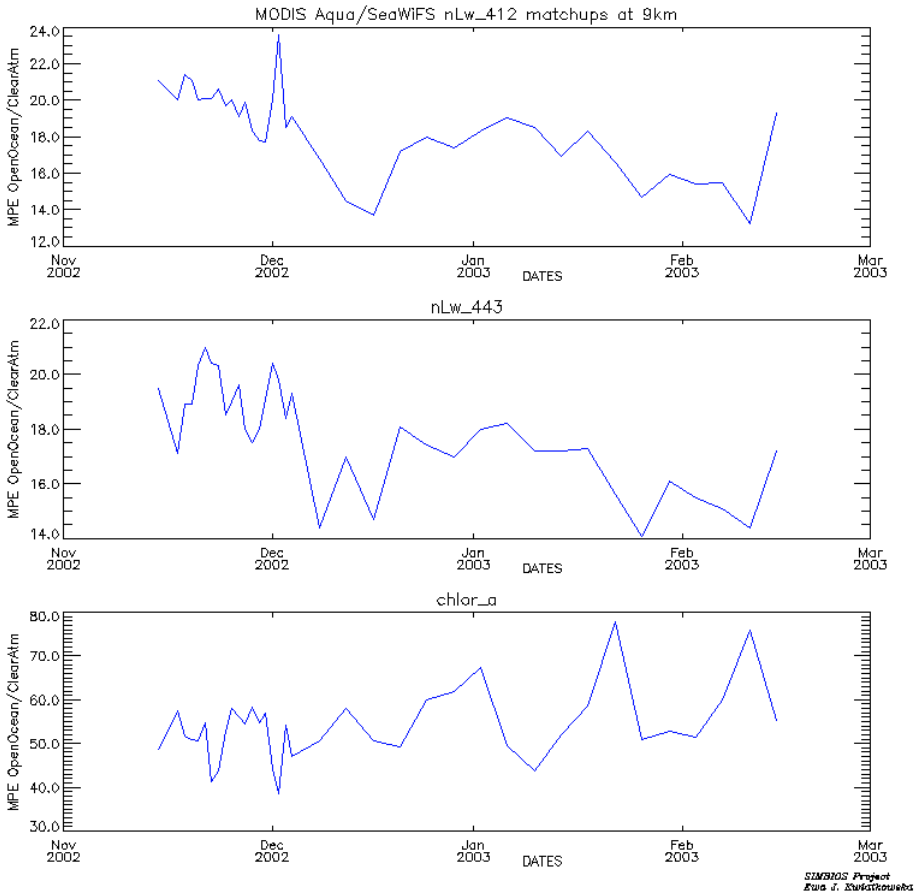
MODIS-Aqua and SeaWiFS Temporal trends in data differences

Global Mean Percentage Error

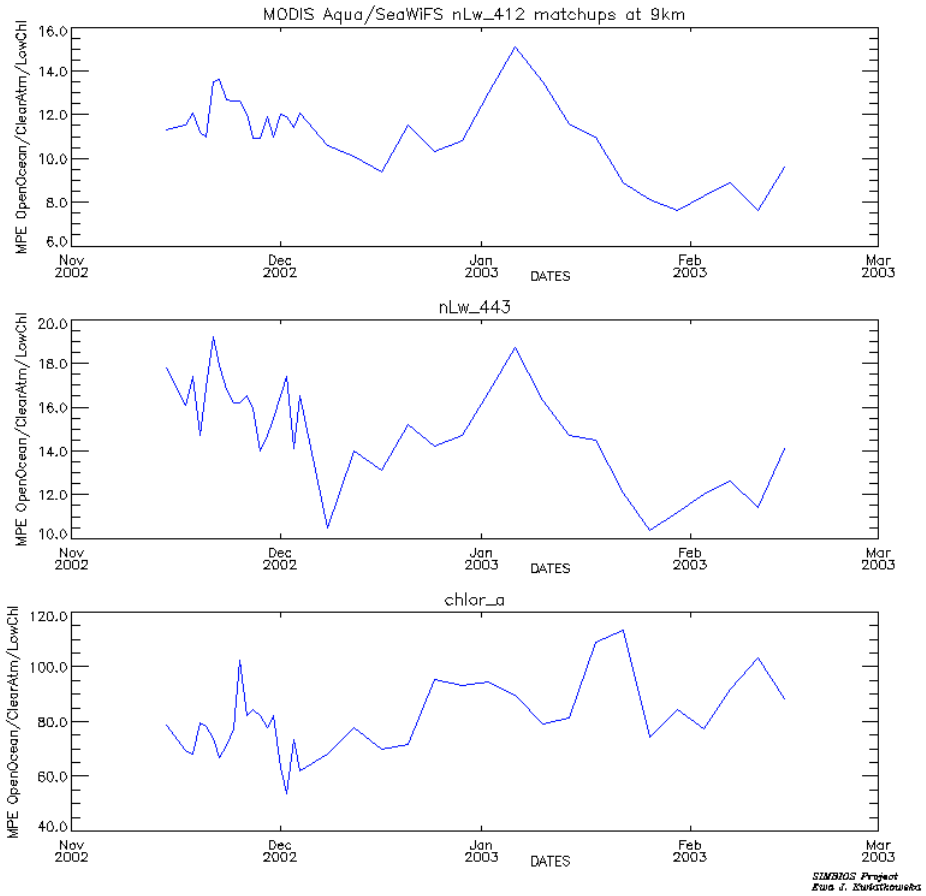


MODIS-Aqua and SeaWiFS Temporal trends in data differences

Mean Percentage Error Open Ocean/Clear Atmosphere



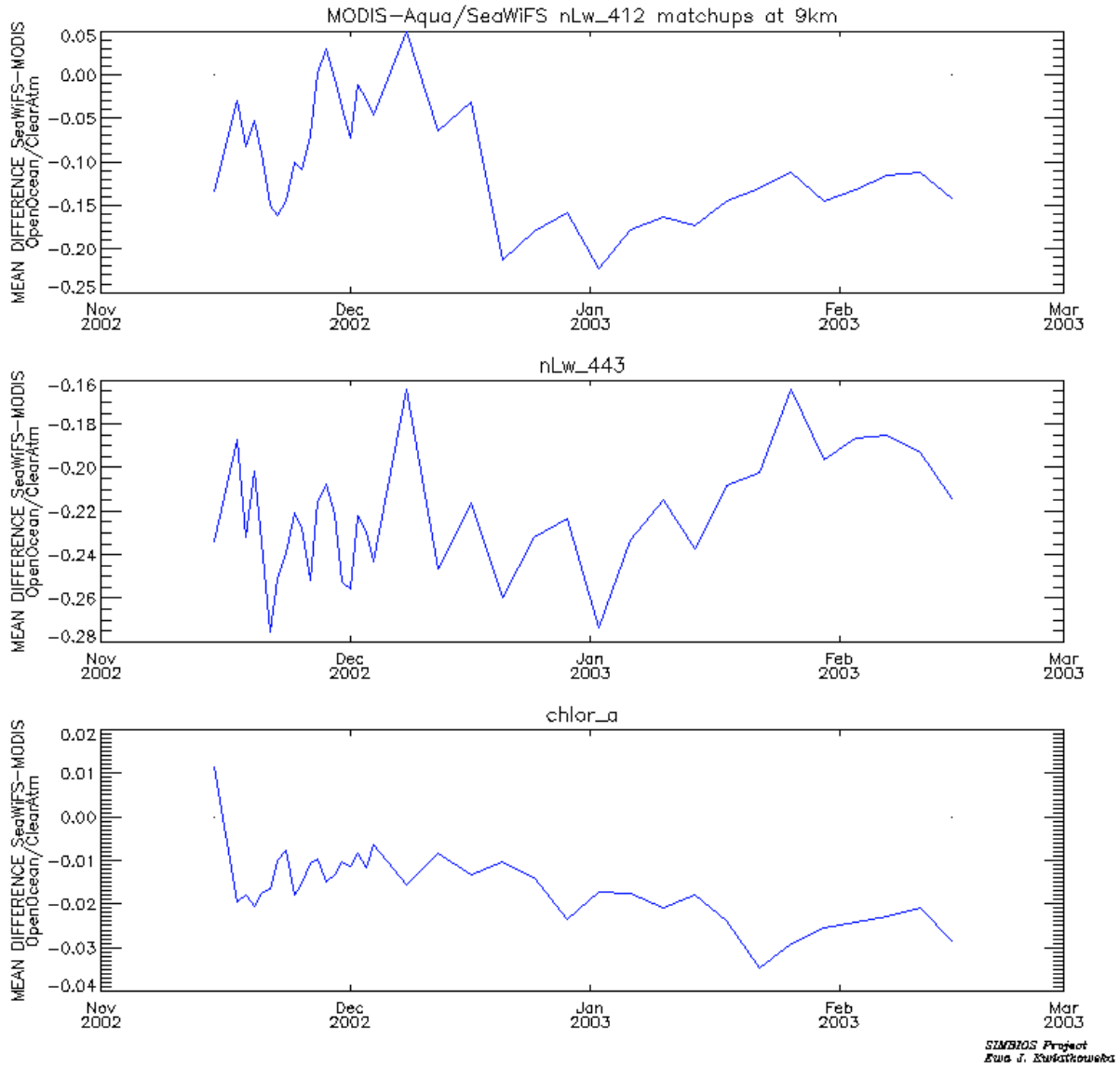
Mean Percentage Error Low Chlorophyll/Open Ocean/Clear Atmosphere



MODIS-Aqua and SeaWiFS Temporal trends in data differences

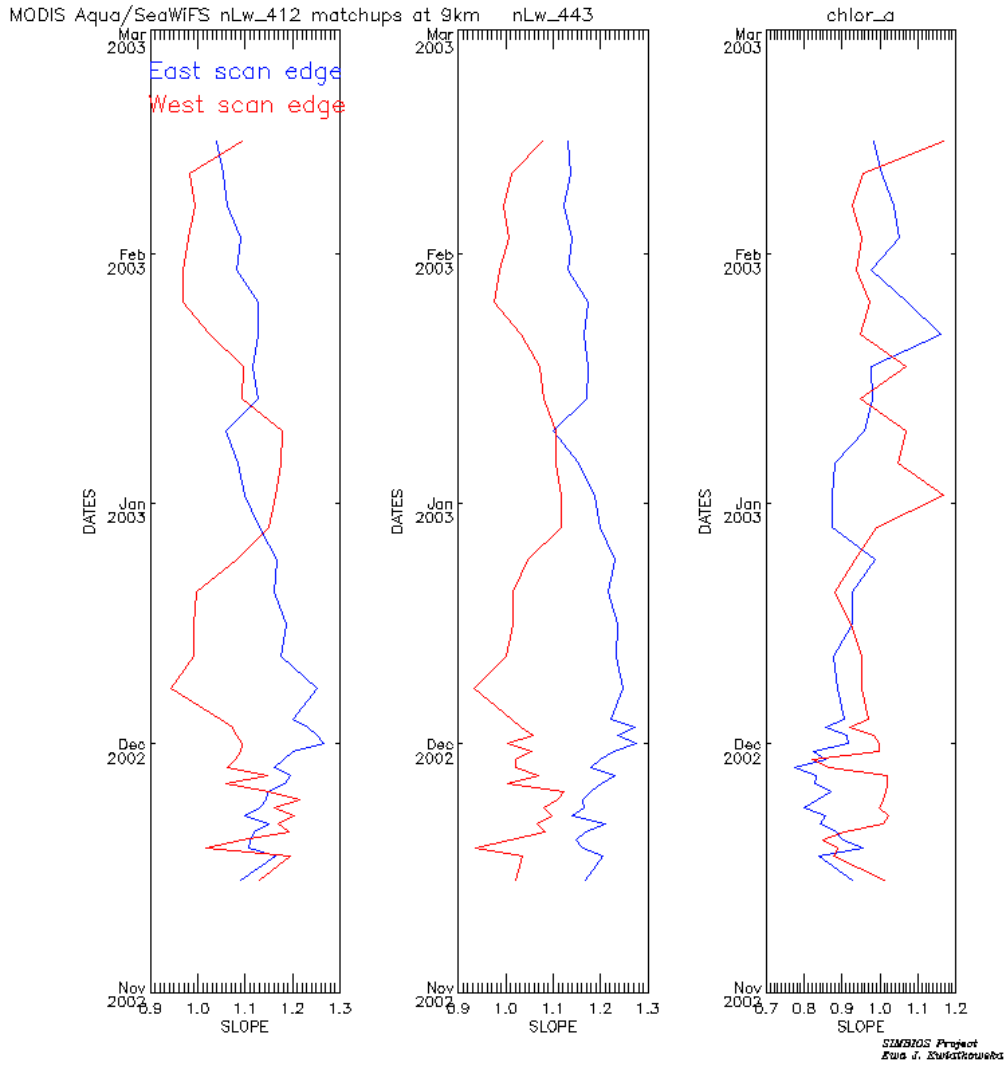
Mean Difference
SeaWiFS–MODIS

Open ocean /clear atmosphere



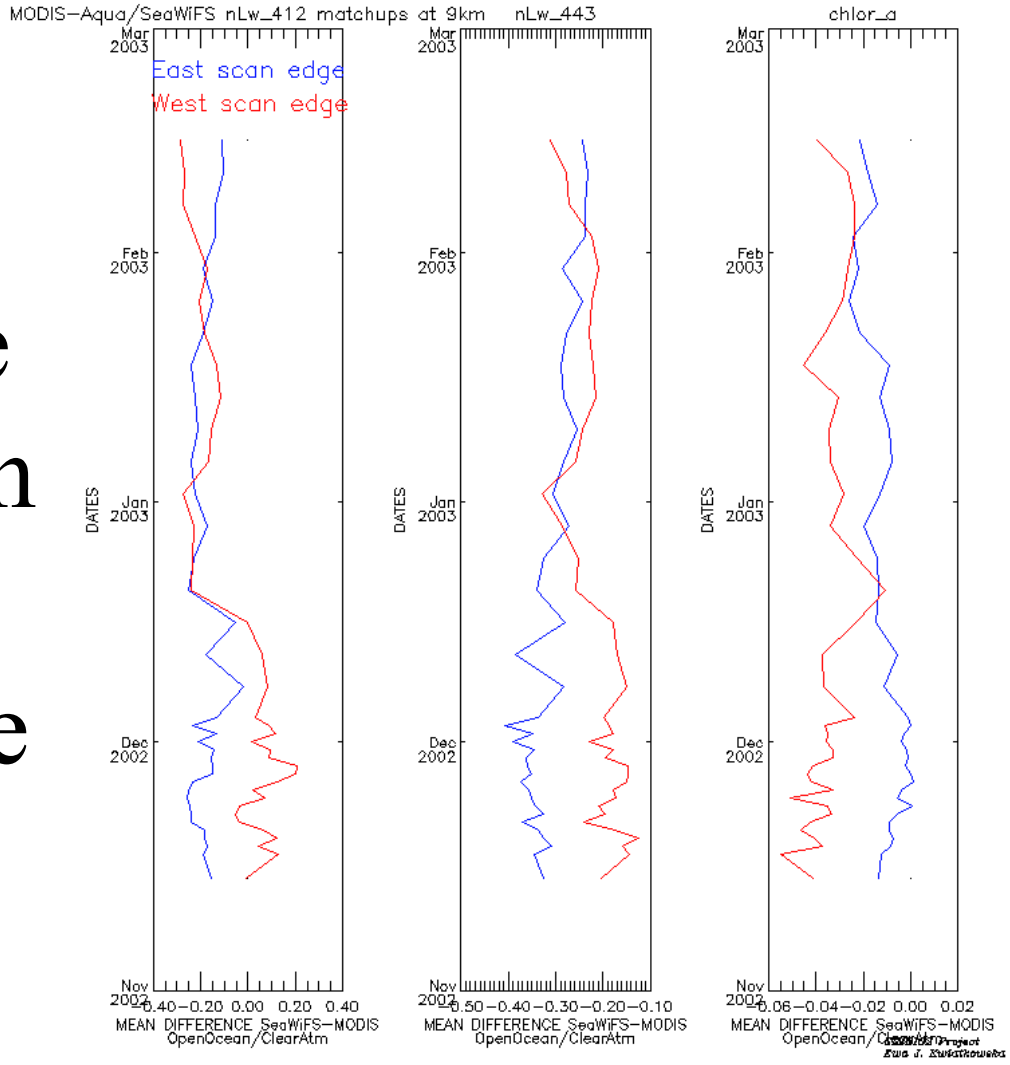
MODIS-Aqua and SeaWiFS Temporal trends in MODIS scan angle dependencies

Slope in the linear fit SeaWiFS vs. MODIS



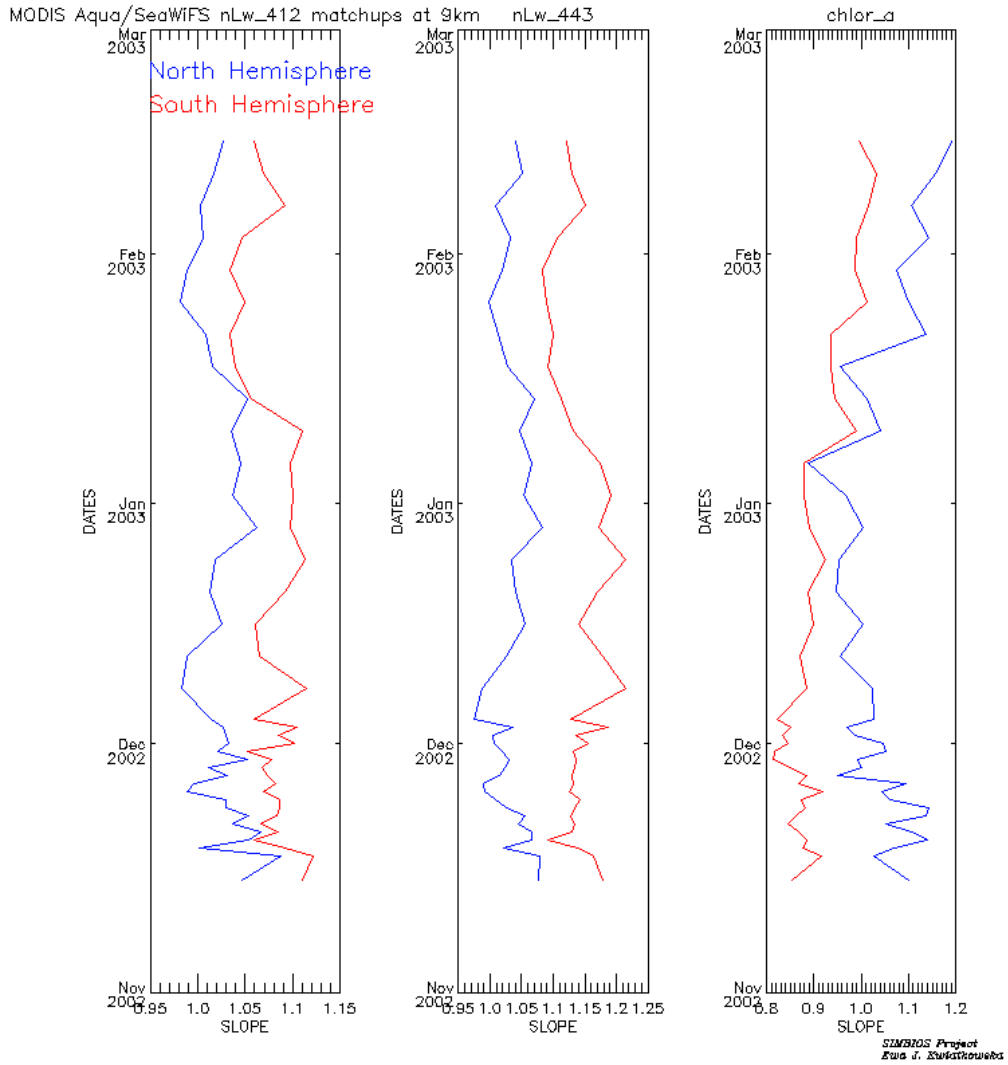
MODIS-Aqua and SeaWiFS Temporal trends in MODIS scan angle dependencies

Mean Difference Open ocean clear atmosphere



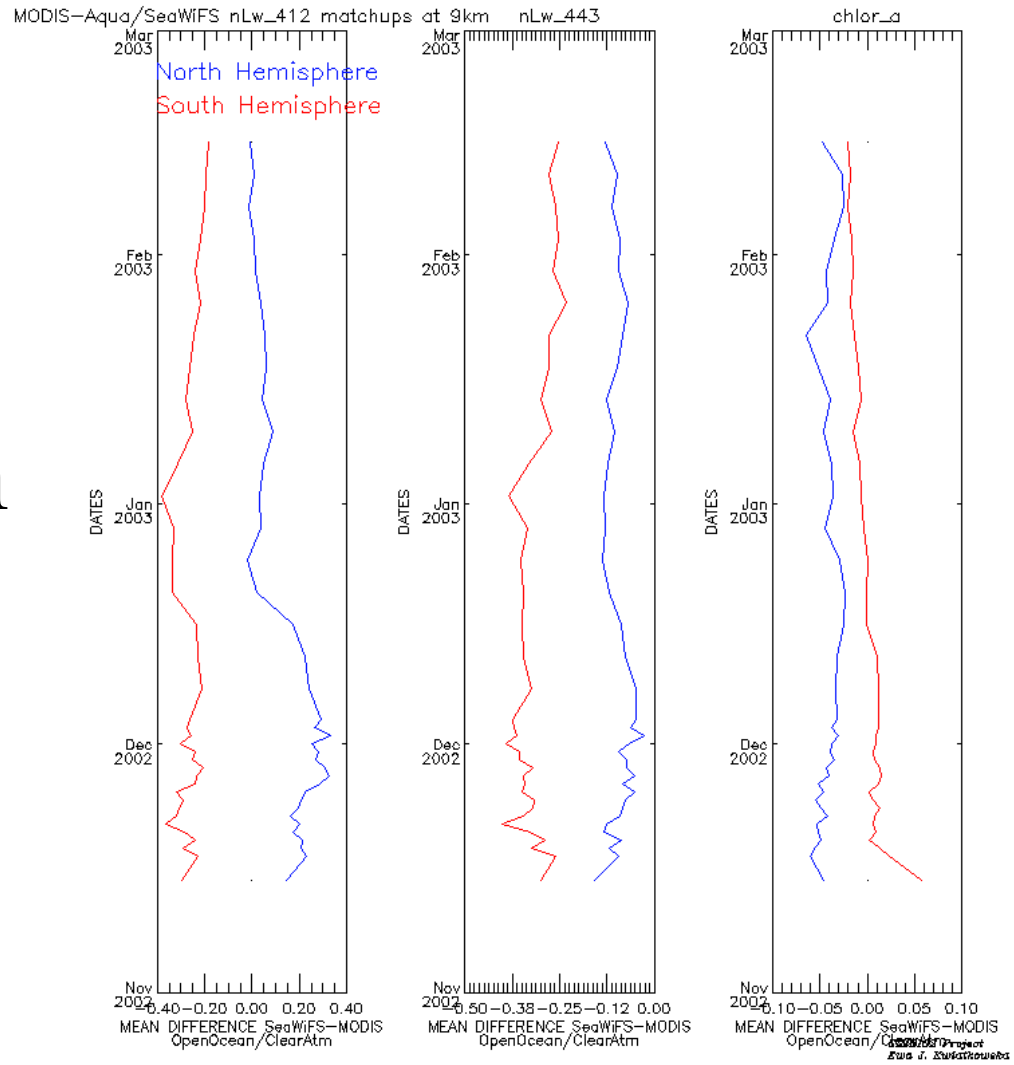
MODIS-Aqua and SeaWiFS Temporal trends in MODIS latitudinal discrepancies

Slope in the linear fit SeaWiFS vs. MODIS



MODIS-Aqua and SeaWiFS Temporal trends in MODIS latitudinal discrepancies

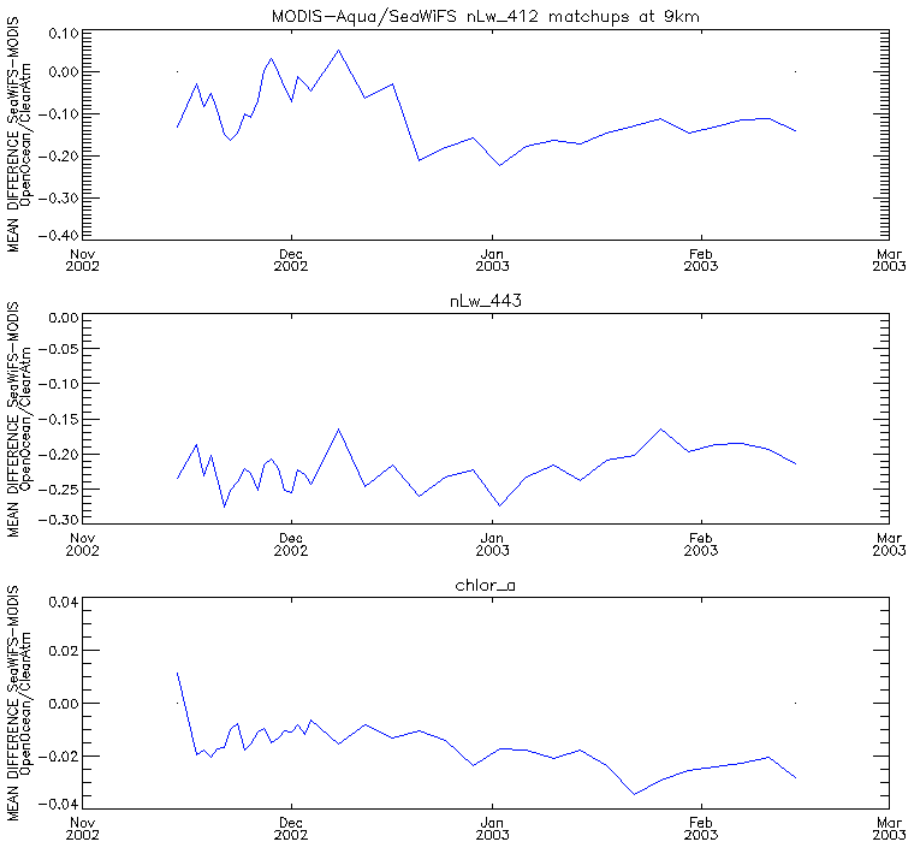
Mean Difference Open ocean clear atmosphere



MODIS-Aqua/Terra and SeaWiFS (same time period)

MODIS-Aqua/Terra and SeaWiFS Temporal trends in data differences (SeaWiFS–MODIS)

Aqua



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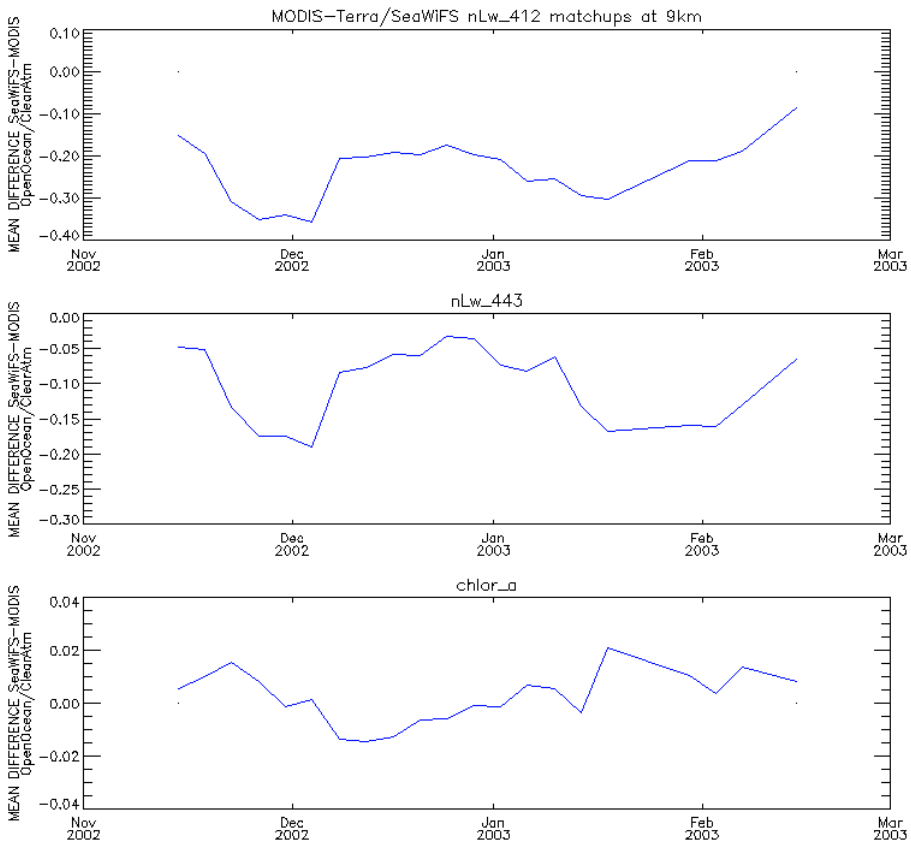
Terra



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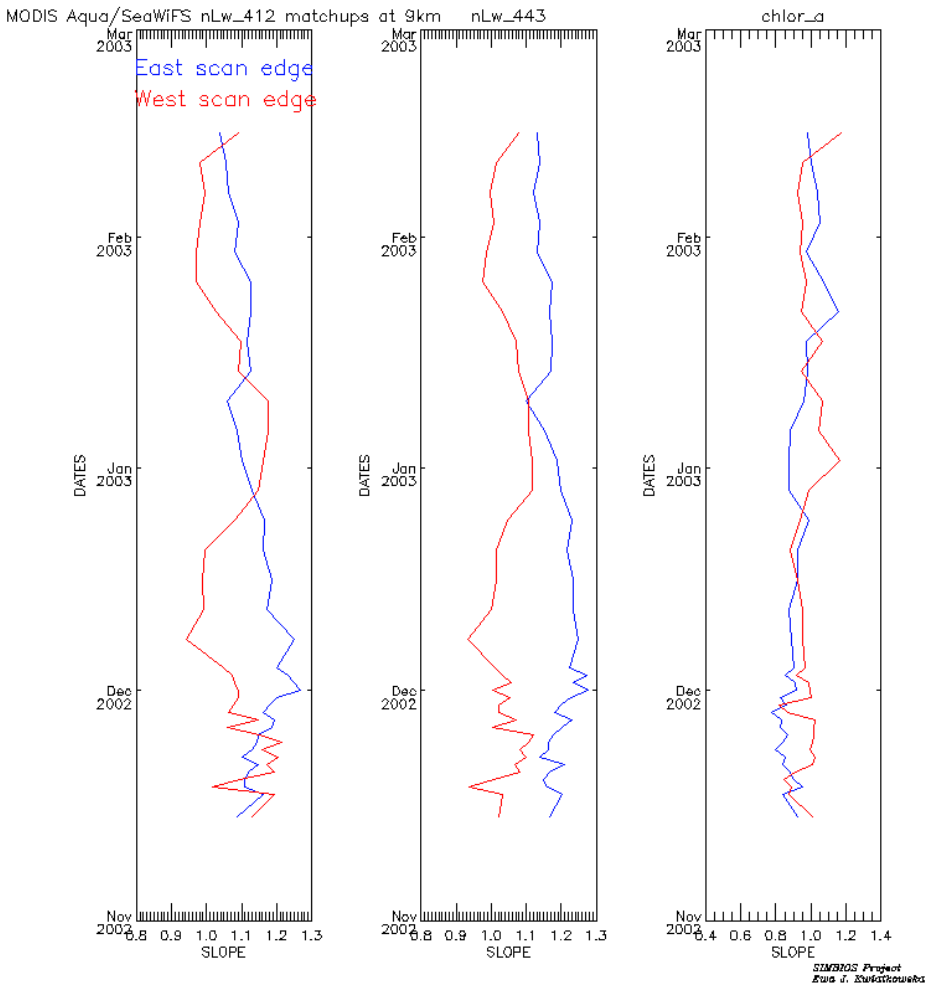
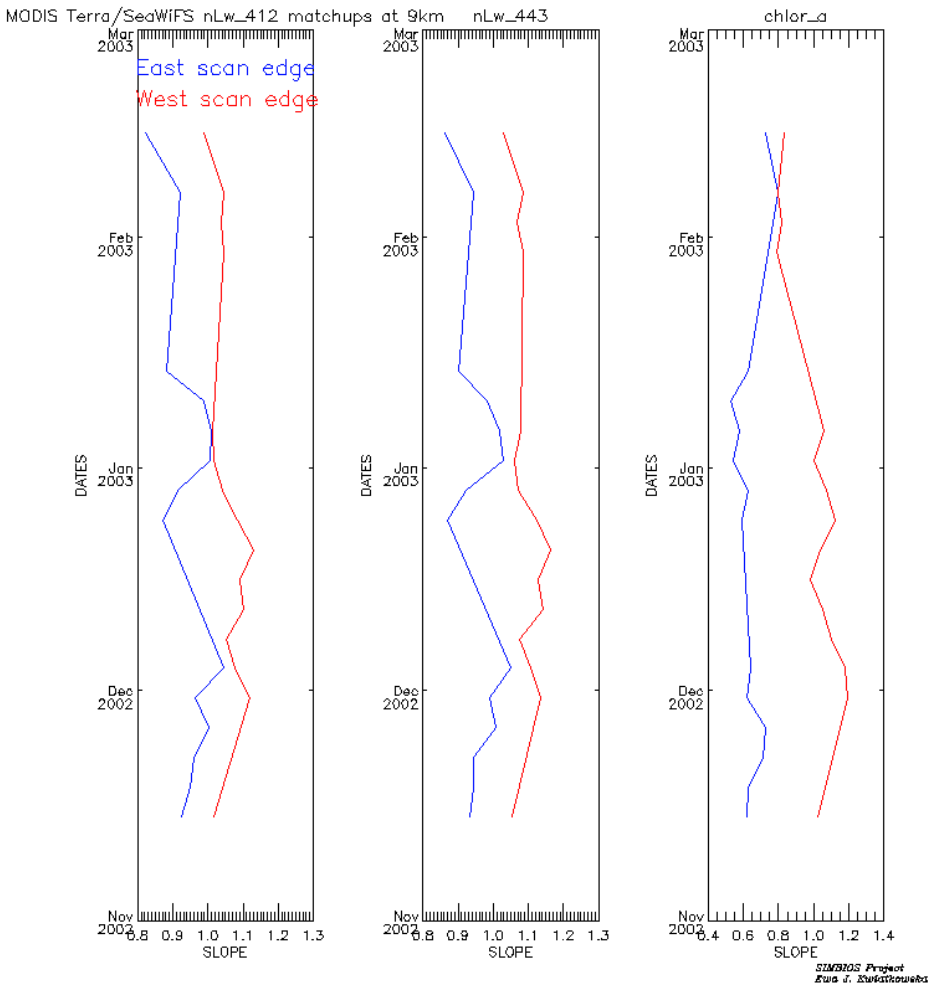
MODIS-Aqua/Terra and SeaWiFS Temporal trends in MODIS scan angle dependencies (SLOPE)

Aqua

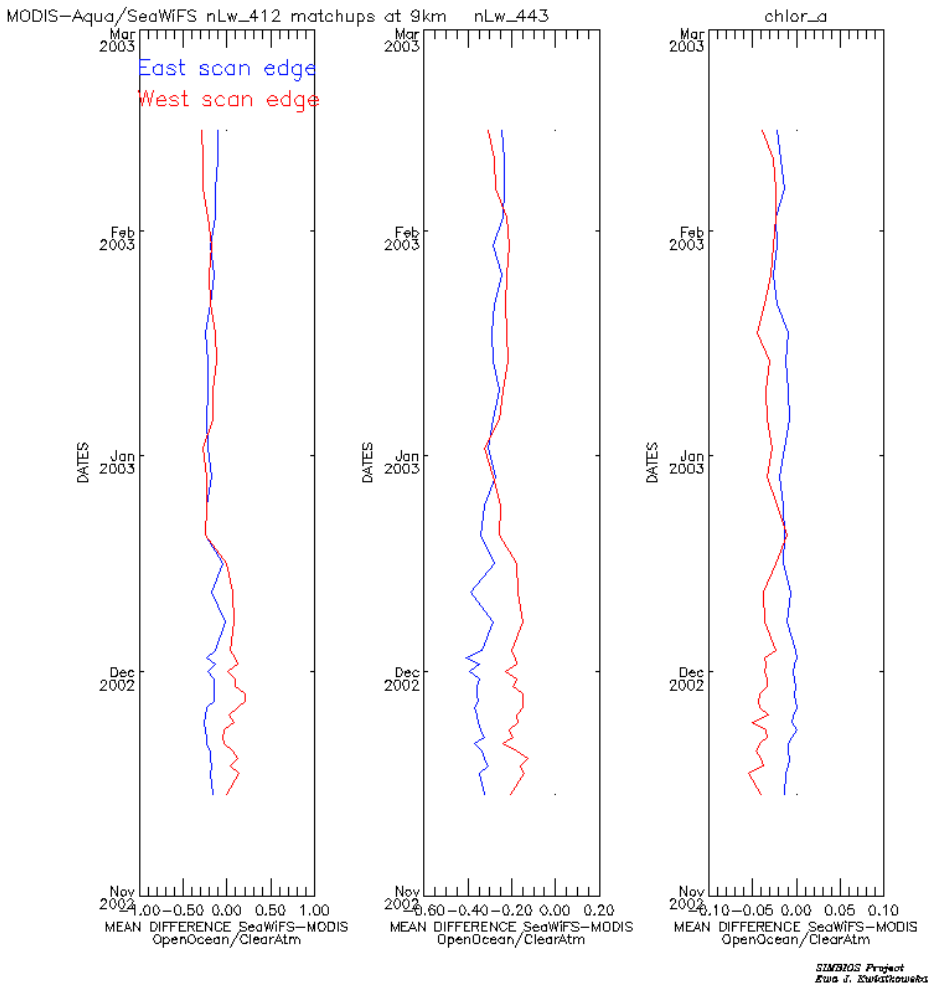


Terra

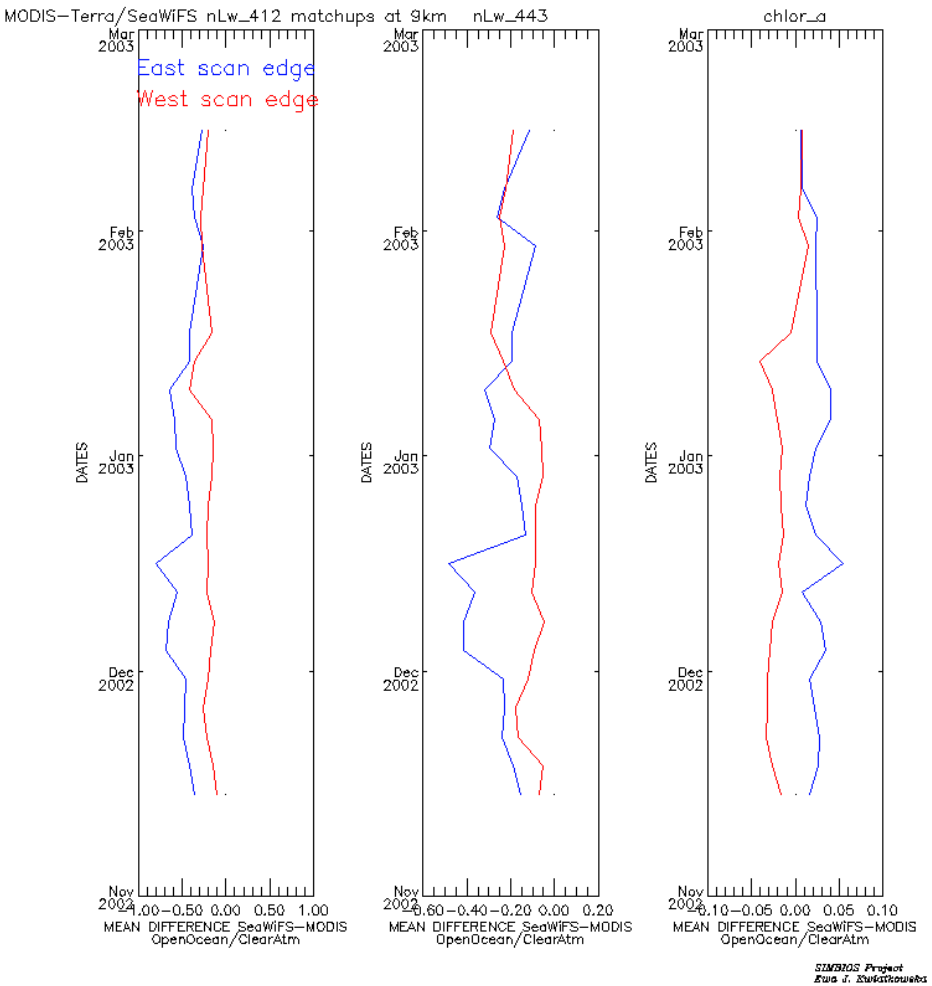


MODIS-Aqua/Terra and SeaWiFS Temporal trends in MODIS scan angle dependencies (SeaWiFS–MODIS)

Aqua

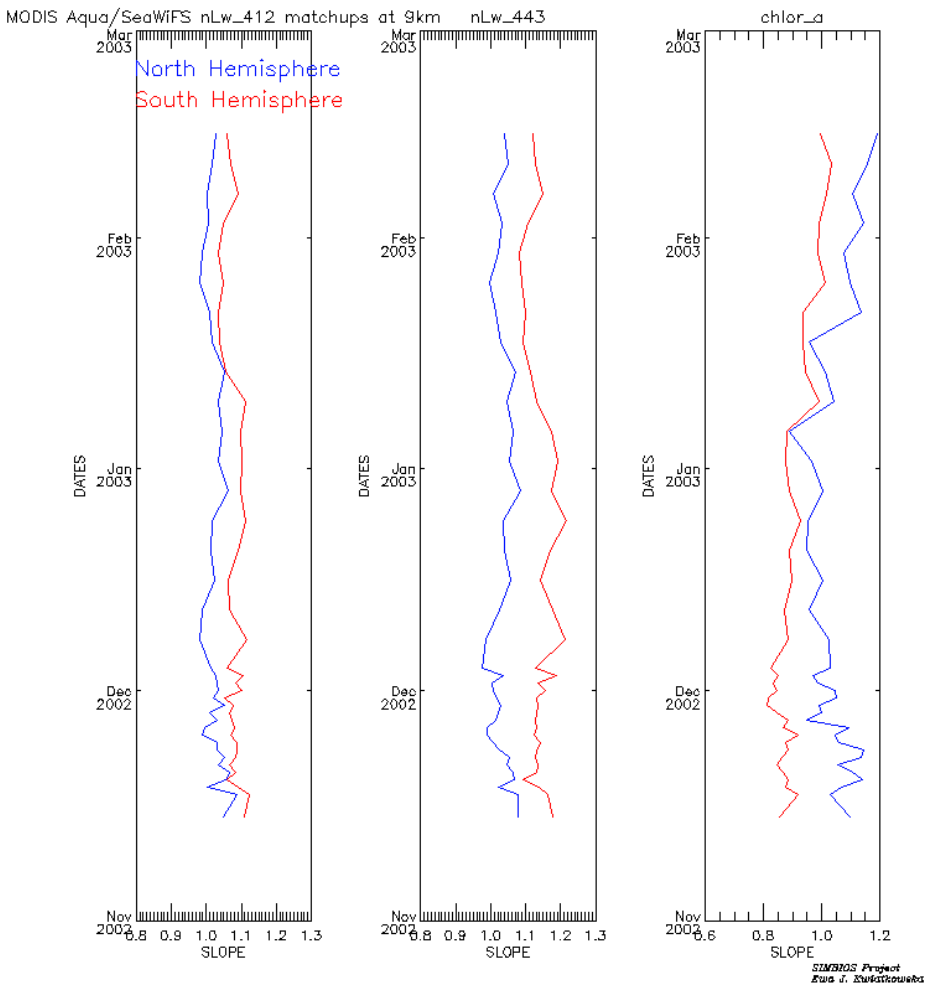


Terra

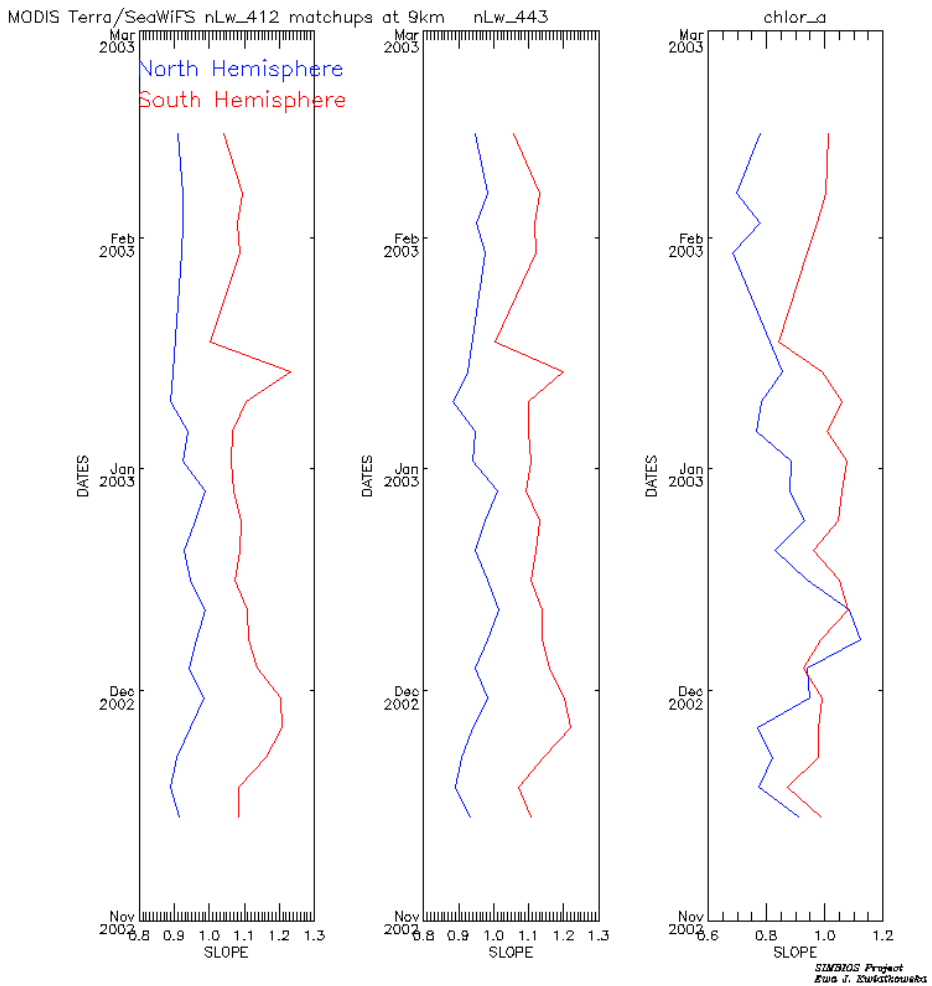


MODIS-Aqua/Terra and SeaWiFS Temporal trends in MODIS latitudinal discrepancies (SLOPE)

Aqua

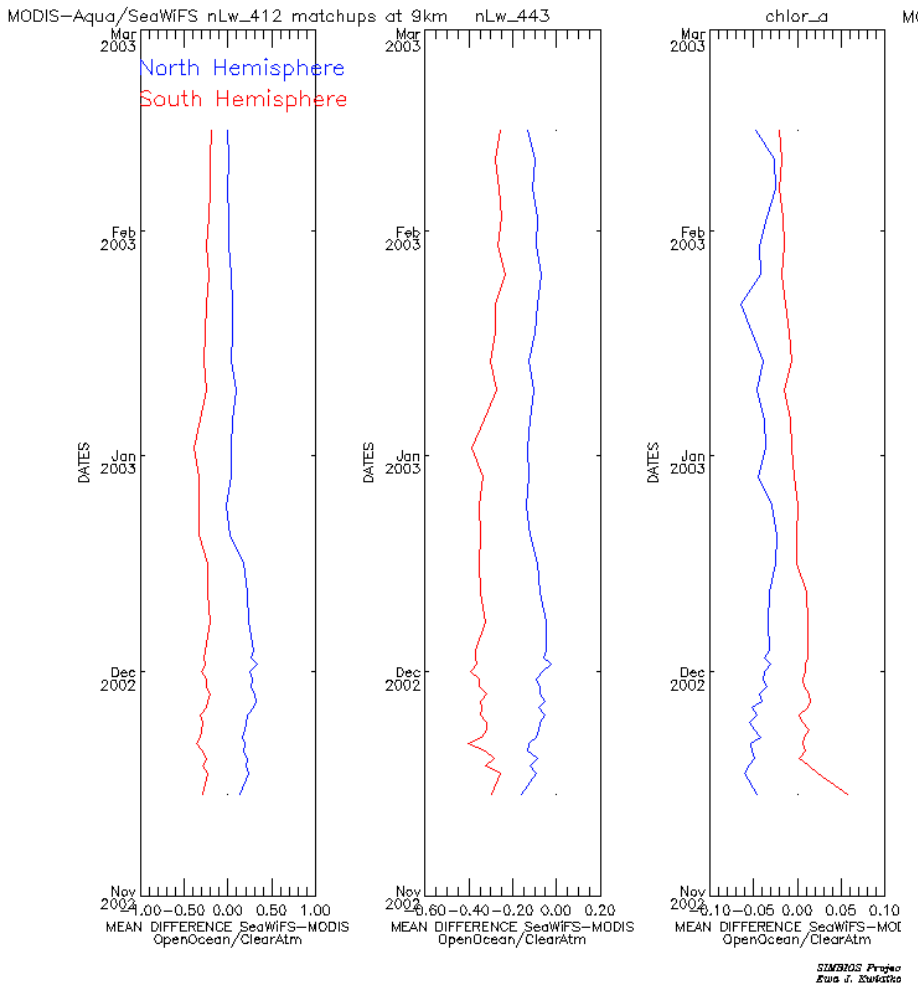


Terra

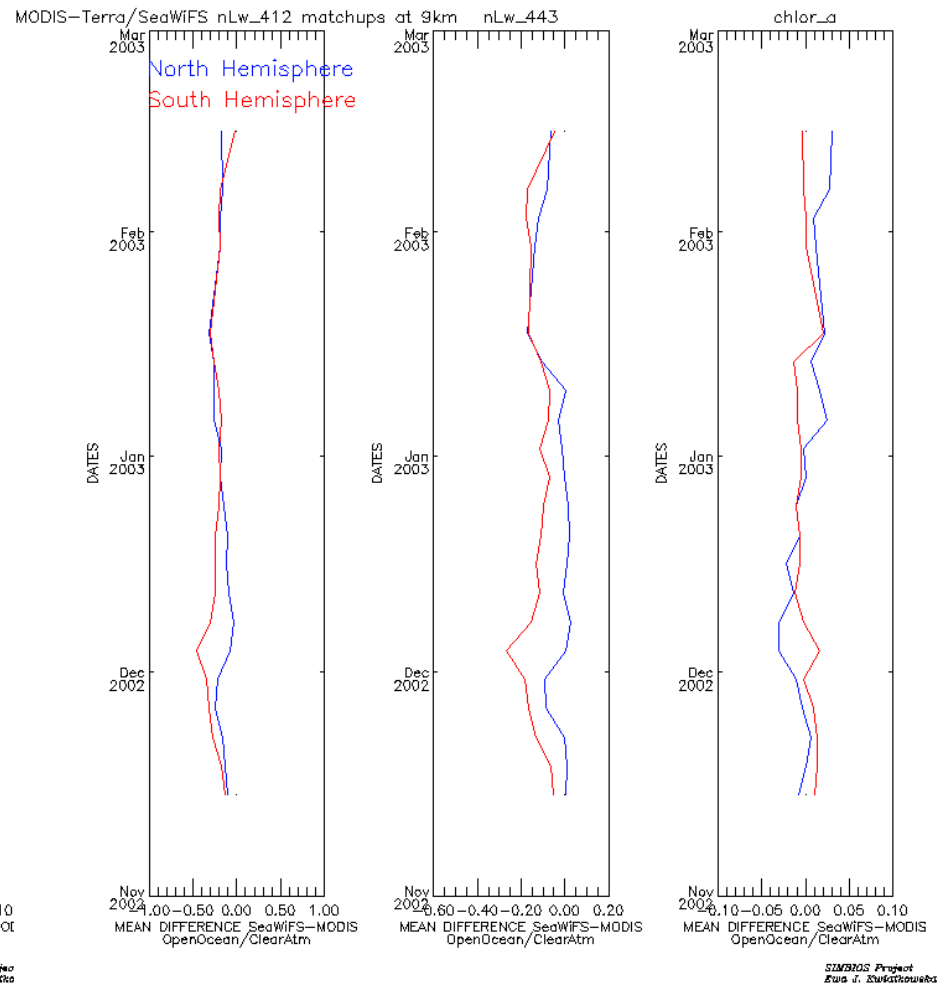


MODIS-Aqua/Terra and SeaWiFS Temporal trends in MODIS latitudinal discrepancies (SeaWiFS–MODIS)

Aqua



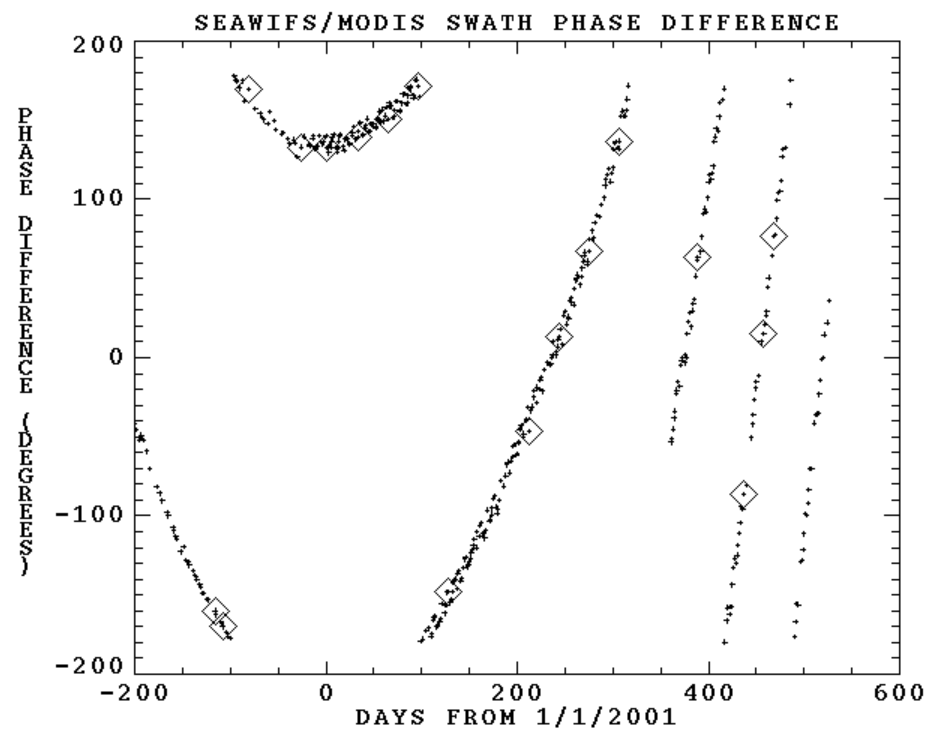
Terra



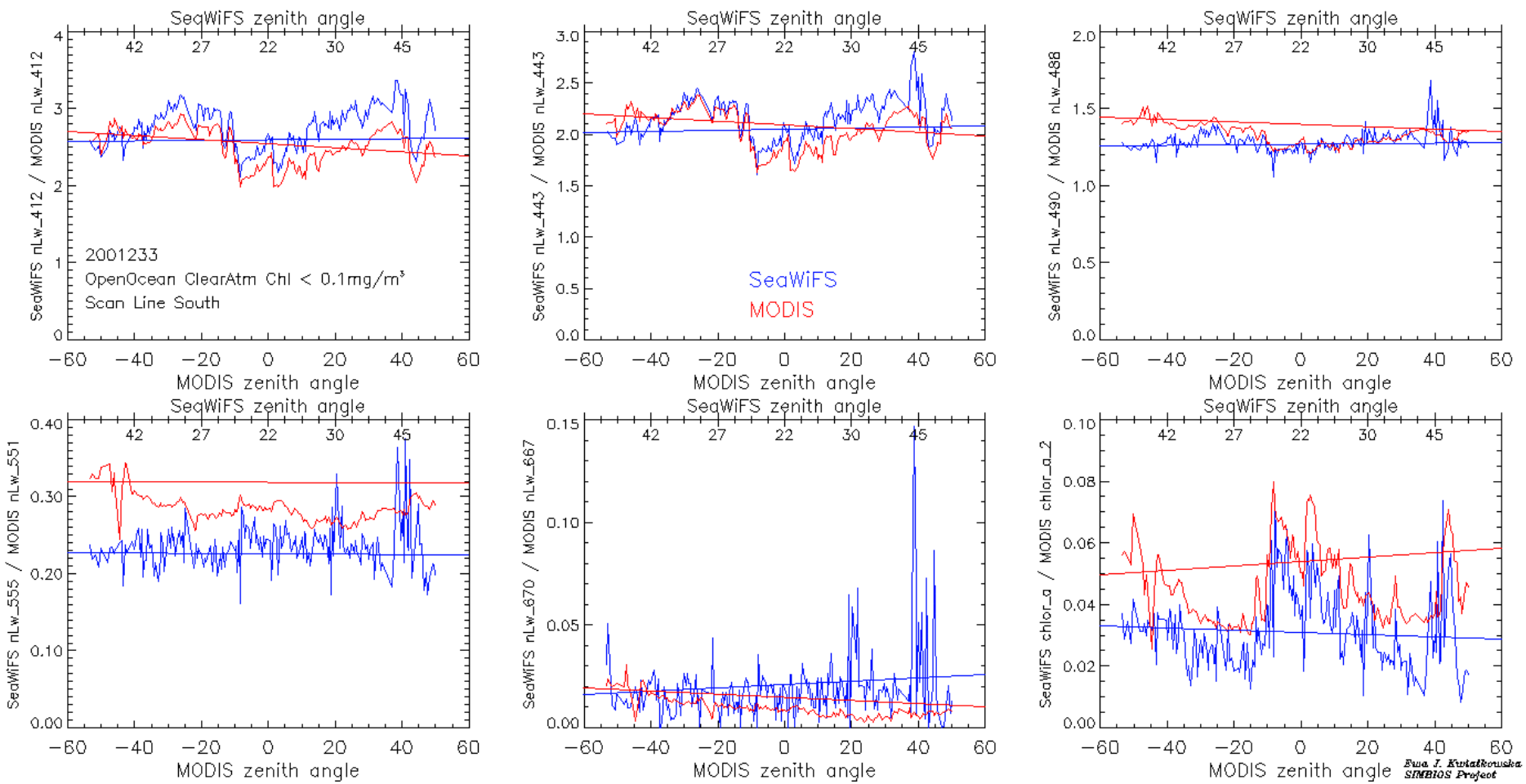
MODIS-Terra and SeaWiFS overlapping scan lines

Overlapping scan lines between MODIS-Terra and SeaWiFS

- $15^0 < |$ Latitude $| < 30^0$ (ocean gyres)
- open ocean
- clear atmosphere (AOT < 0.2)
- low chlorophyll (chlor_a < 0.1mg/m^3)
- dates with the closest MODIS-Terra and SeaWiFS swath overlap:
- search for scan lines with large amounts of overlapping data within the swath

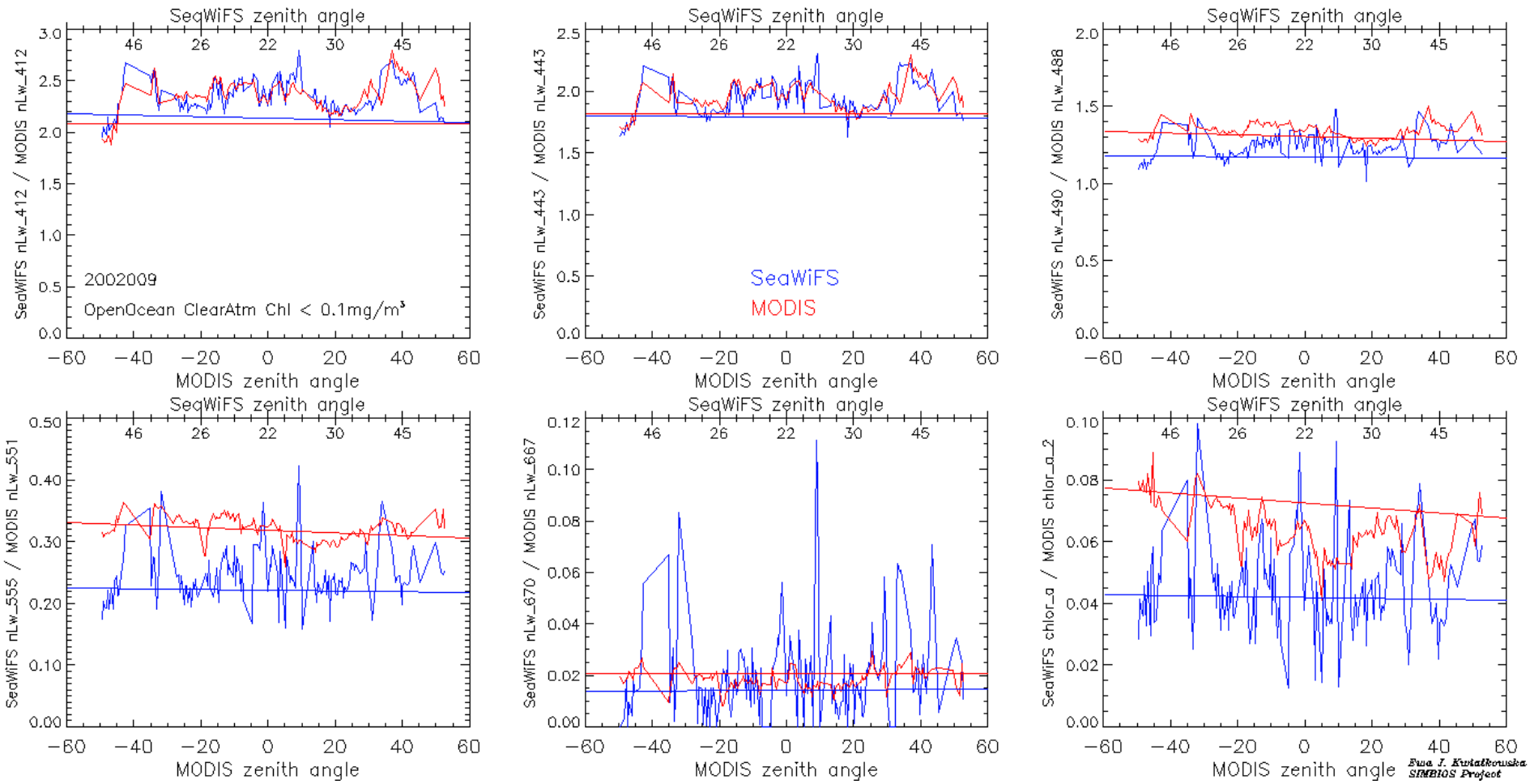


Scan-line sensor zenith angle dependence, 21 August 2001



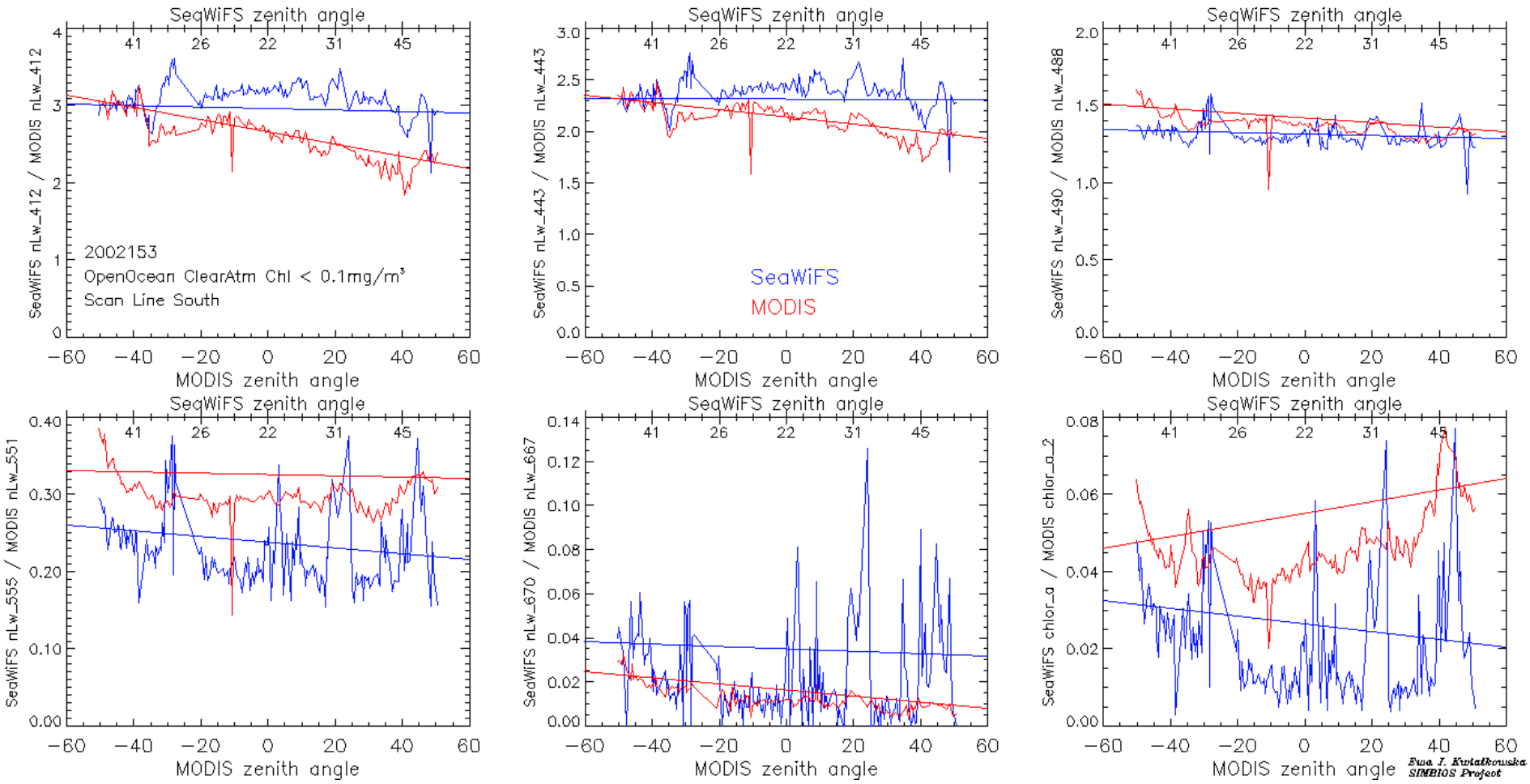
Lines- linear fit for all extracted scan lines across satellite zenith angles

Scan-line sensor zenith angle dependence, 9 January 2002



Lines- linear fit for all extracted scan lines across satellite zenith angles

Scan-line sensor zenith angle dependence, 2 June 2002



Lines- linear fit for all extracted scan lines across satellite zenith angles

Conclusions

1. Trends in data discrepancies between MODIS-Terra/Aqua and SeaWiFS oceans data are not consistent and vary spatially and temporally.

2. The discrepancies show seasonal patterns (MODIS-Terra).

3. MODIS-Terra/Aqua oceans data exhibit scan angle and latitudinal dependencies.

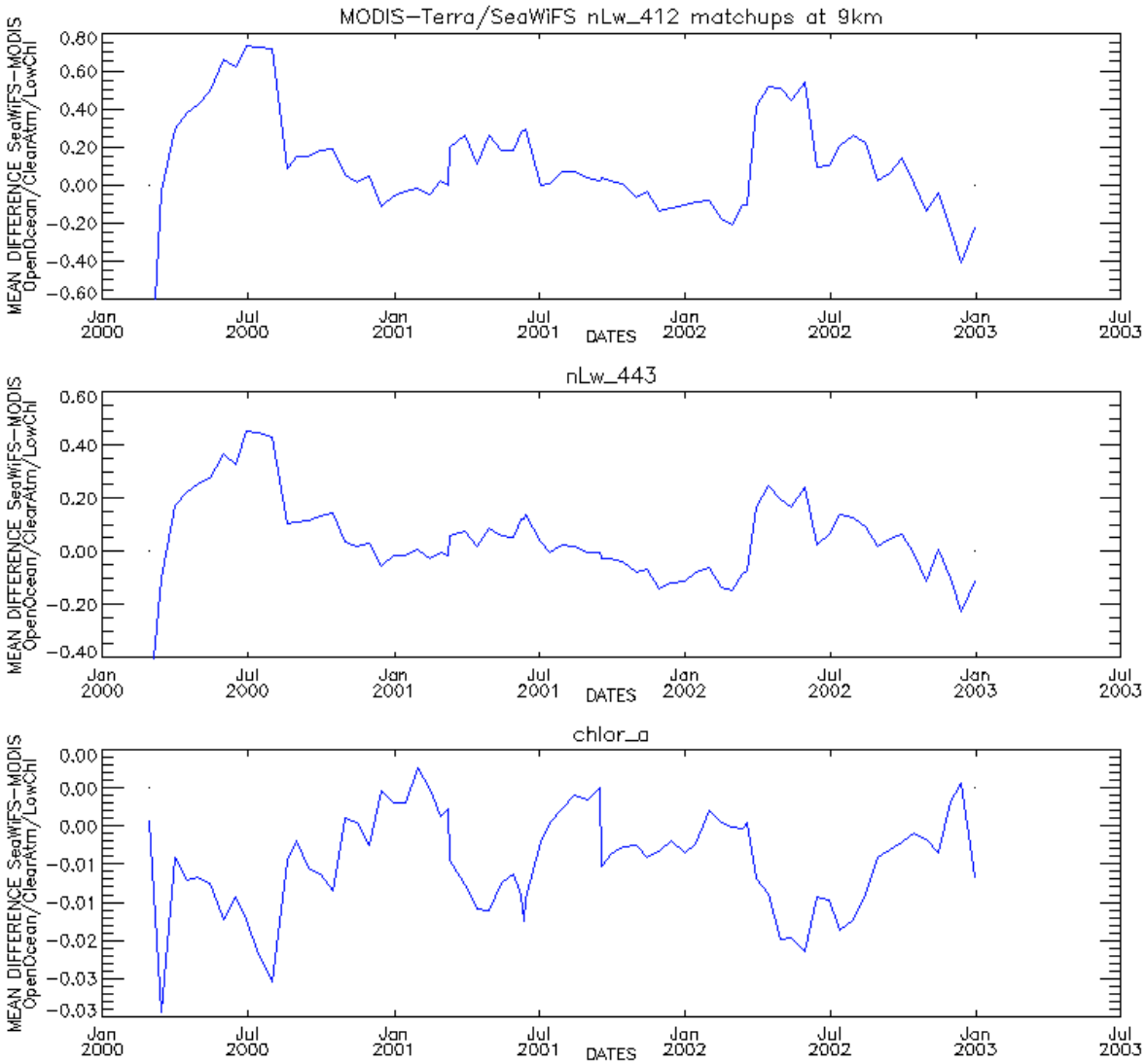
4. The scan angle and latitudinal dependencies display seasonal variability (MODIS-Terra).

5. MODIS-Aqua oceans data within the initial time range show similar artifacts as MODIS-Terra data.

MODIS-Terra and SeaWiFS Temporal trends in data differences

Mean Difference
SeaWiFS–MODIS

Open ocean /clear atmosphere /low chlorophyll



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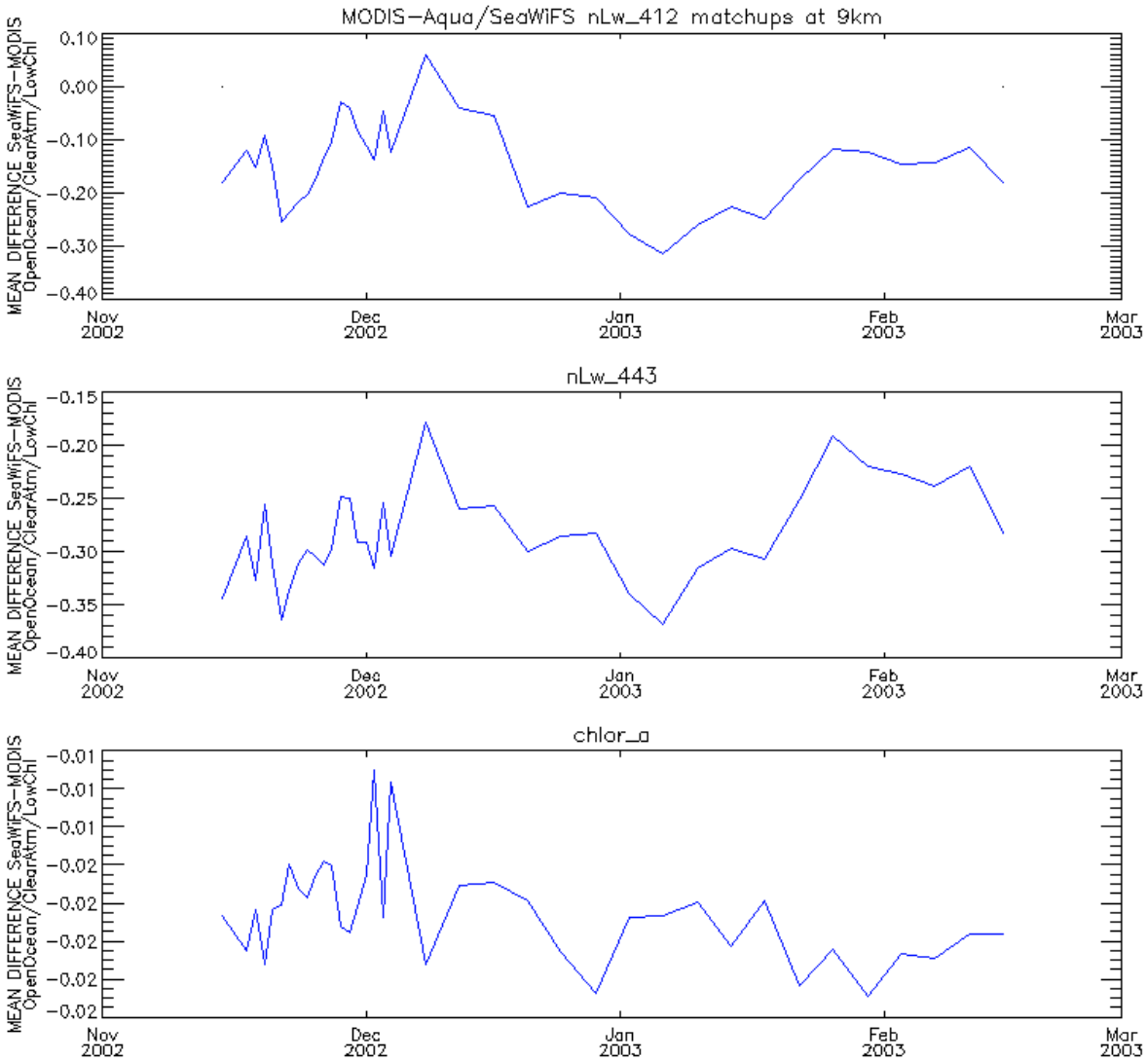
MODIS-Aqua and SeaWiFS Temporal trends in data differences

Mean Difference
SeaWiFS–MODIS

Open ocean /clear atmosphere /low chlorophyll



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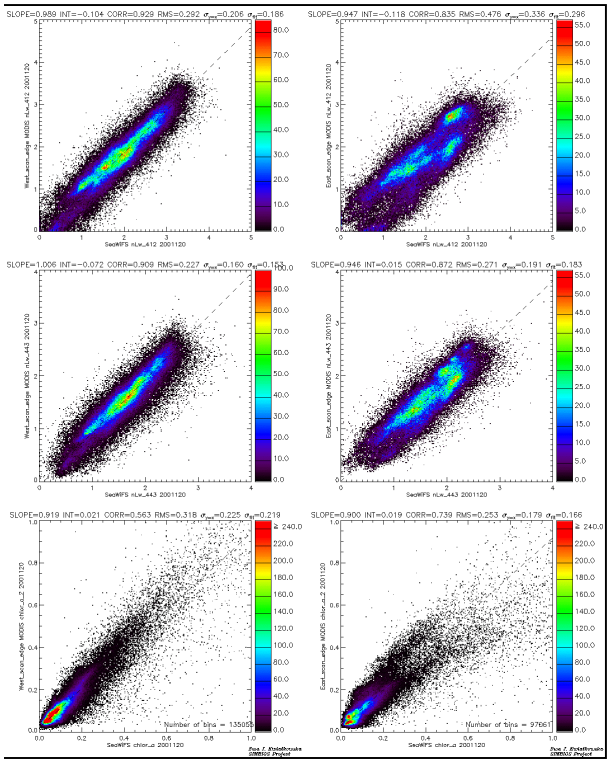
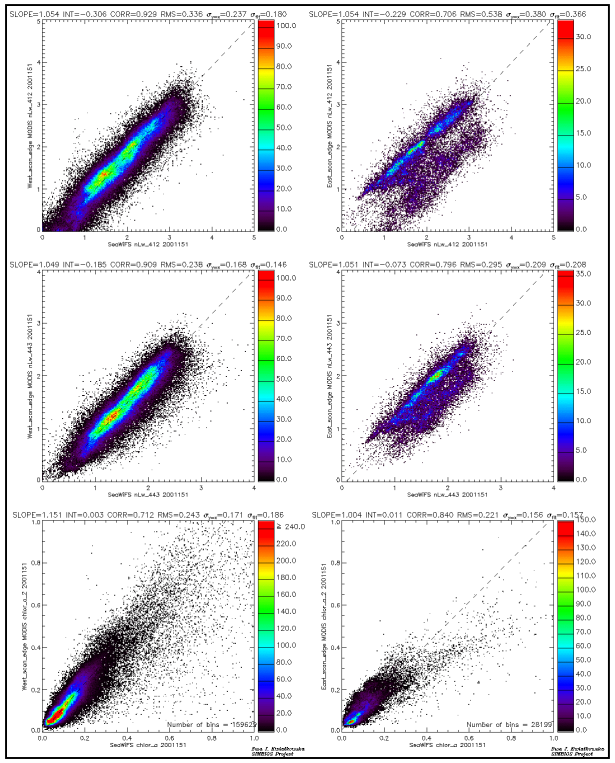
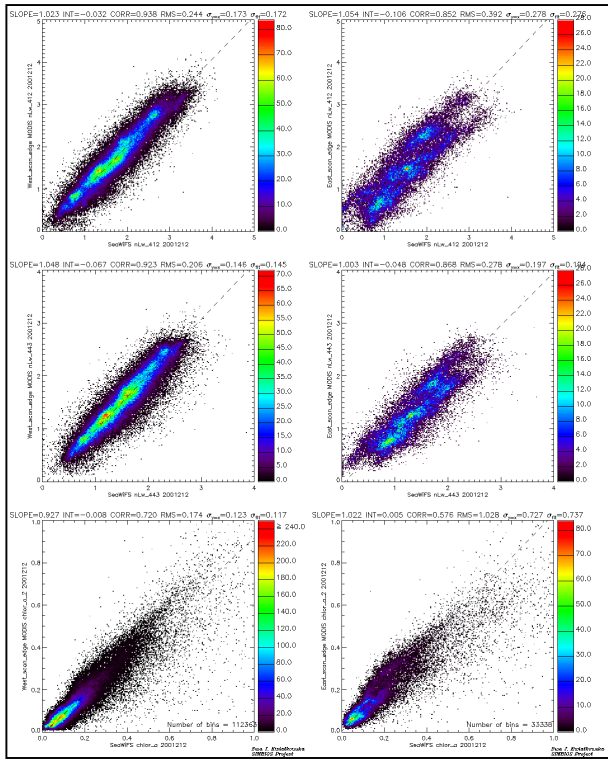
Multiple scatter plot distributions for MODIS Eastern scan edge data

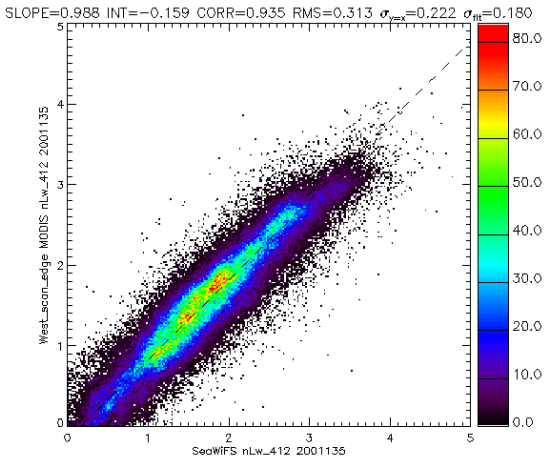
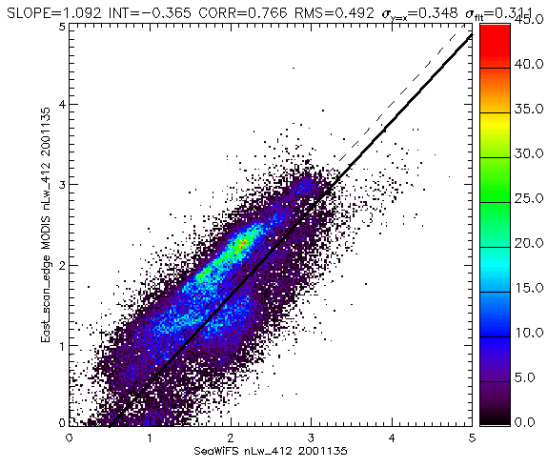
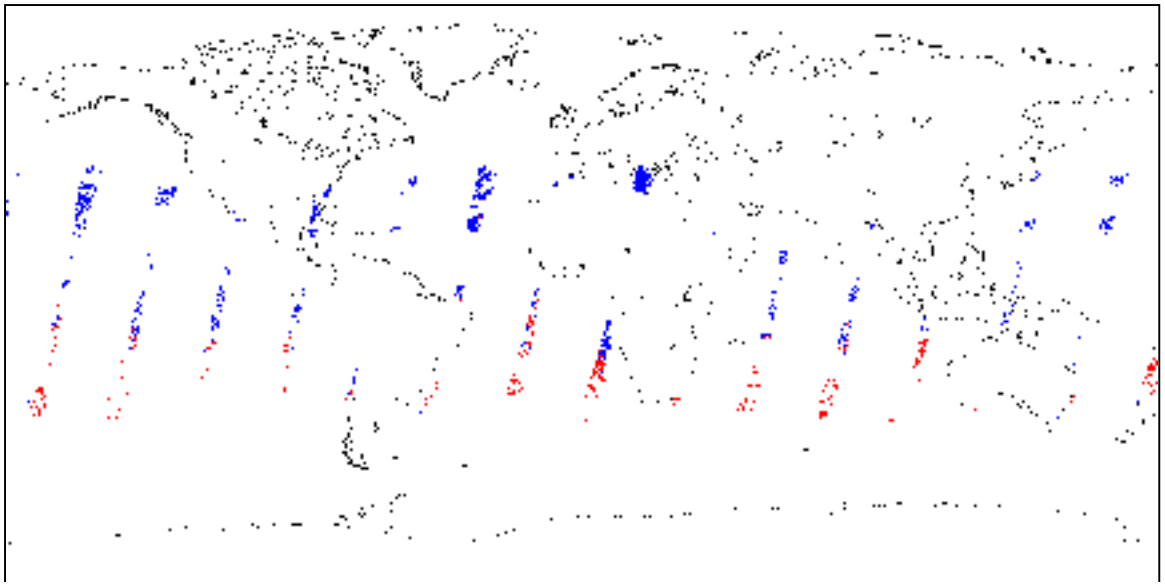


30 April 2001



31 May 2001



31 July 2001

Separation of two scatter plot distributions for MODIS Eastern scan edge data