Recent updates to the MODIS Terra Polarization

Gerhard Meister

OBPG (Ocean Biology Processing Group)

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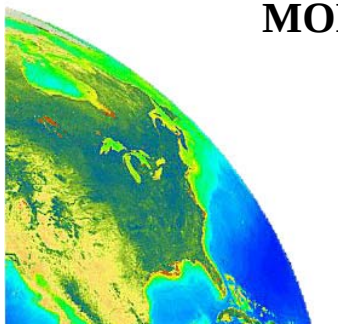


Ocean Biology Processing Group:

- Our polarization correction code is available from our website as part of the SeaDAS software package
- Website: oceancolor.gsfc.nasa.gov

Overview:

- Recently, increased interest in MODIS polarization correction from other disciplines (land, atmosphere)
- This talk will serve as a review of the methodologies and results from the OBPG
- OBPG crosscalibration method (using L3 OC products as truth)
- MODIS Terra uses MODIS Aqua as truth to derive gain and polarization corrections
- Largest effect is for 412nm, end of scan (40%)
- MODISA does not show strong changes in polarization sensitivity

How do we get MODIST 'true' TOA radiance ?

air aerosol whitecap glint water gas

$$L_t(\lambda) = [\, L_r(\lambda) + L^a(\lambda) + tL_f(\lambda) + TL_g(\lambda) + t_d(\lambda)L^w(\lambda) \,] \cdot t_g(\lambda)$$

from MODIST NIR
assumes MCST NIR band characterization

from MODISA $L^w(\lambda)$ 15-day mean

Bandpass differences: $\lambda' \rightarrow \lambda$
fit based on bio-optical models
(needed for SeaWiFS to MODIS)

Crosscalibration coefficients:

$$L_m/M_{11} = L_t + m_{12}*Q + m_{13}*U$$

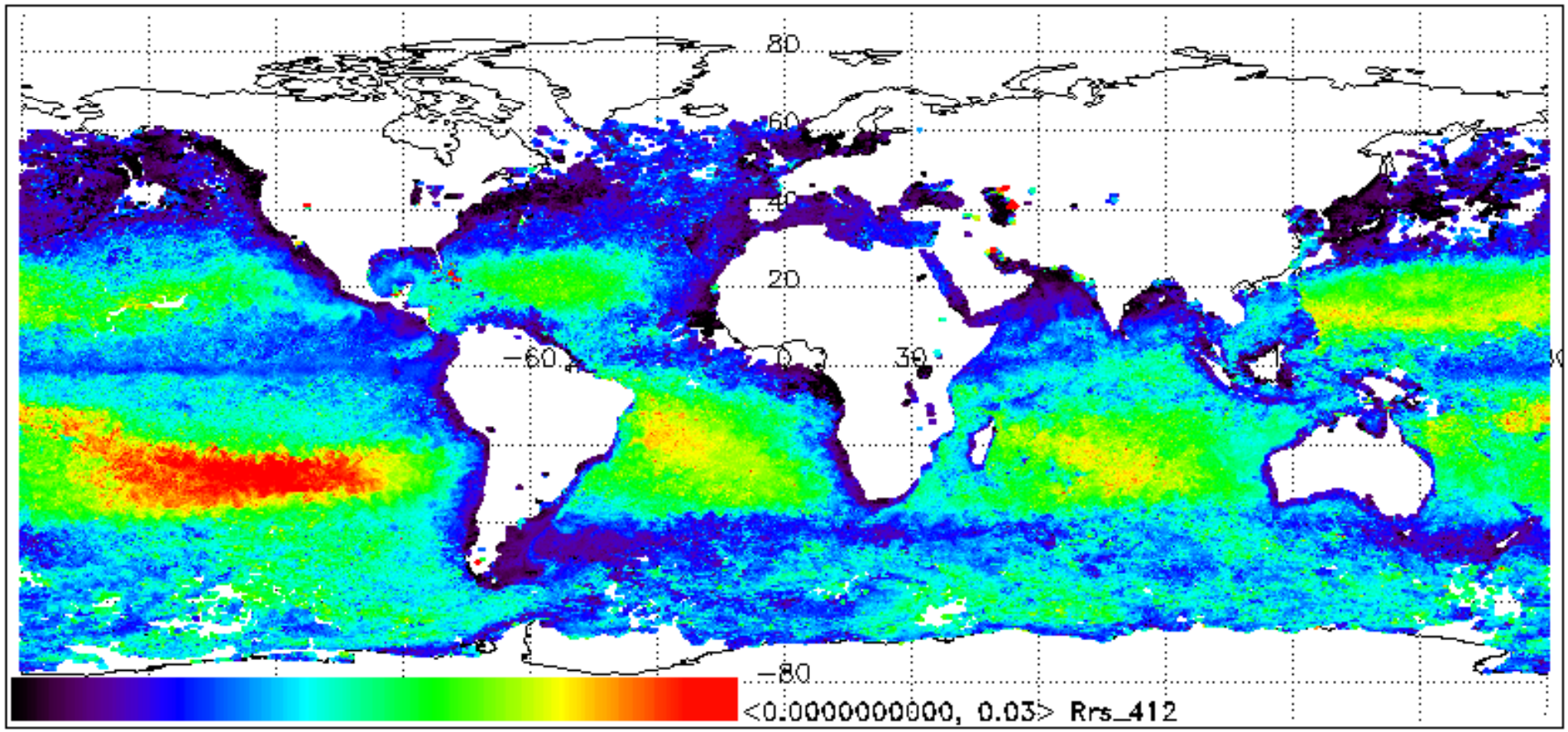
L_m: measured TOA radiance (MODIST)

L_t: true TOA radiance (from MODISA)

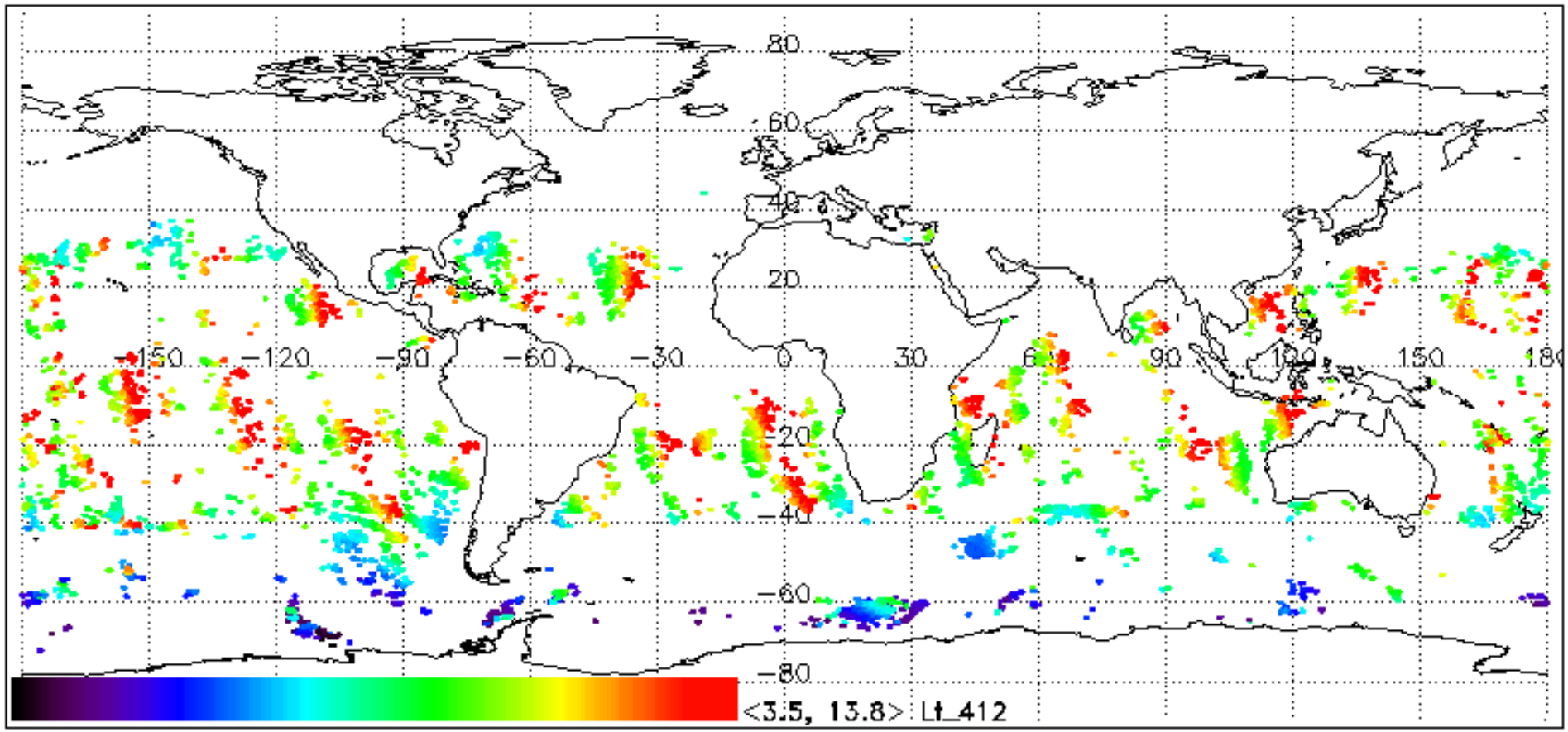
Q, U : linear Stokes vector components, modeled from Rayleigh and glint

M_{11}, m_{12}, m_{13} : fitted instrument characterization parameters (depend on band, MS, detector, scan angle (polynomial 4^{th} order for M11, 2^{nd} for m12 and m13)

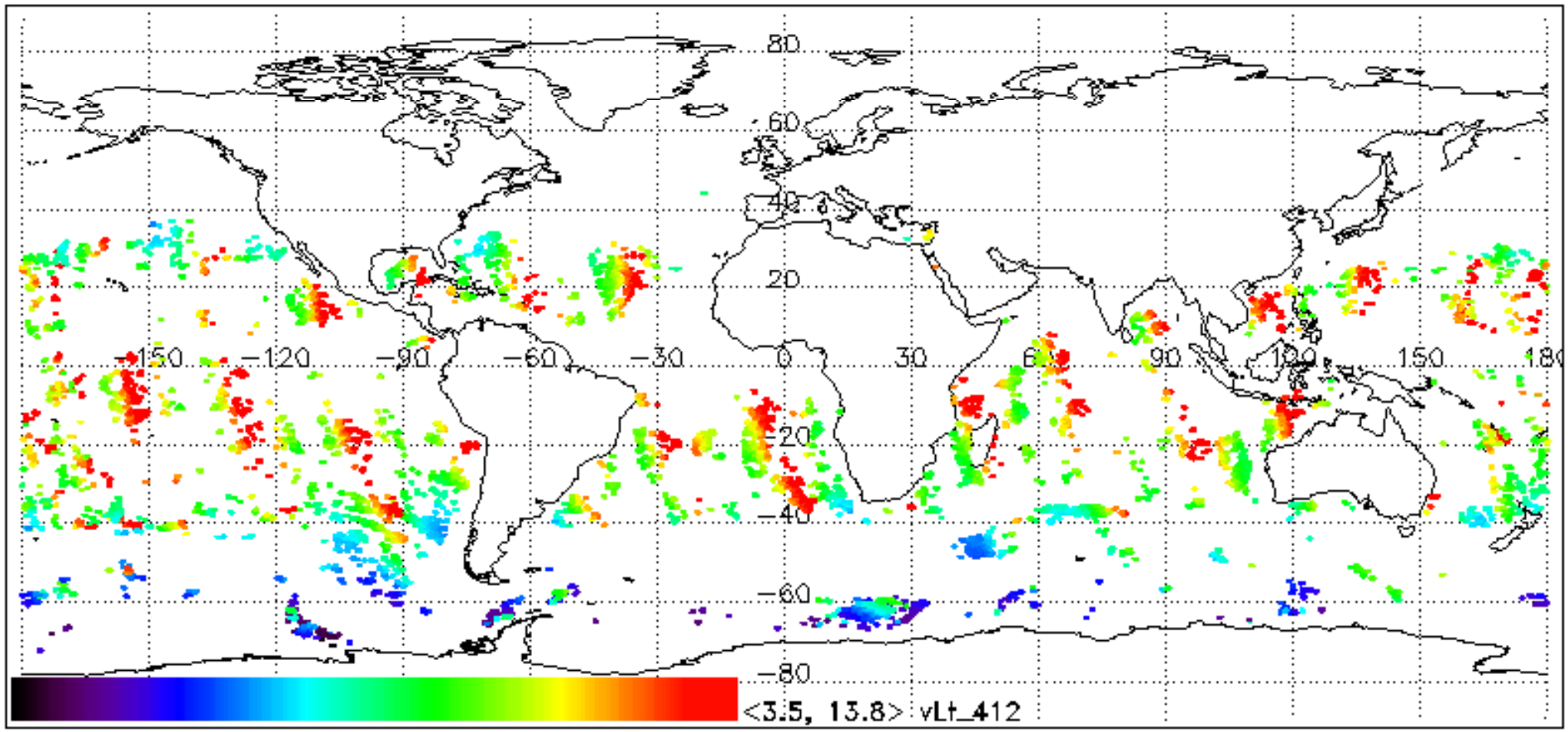
Xcal approach (Step 1): input ‘true’ L3 (15 days) Rrs



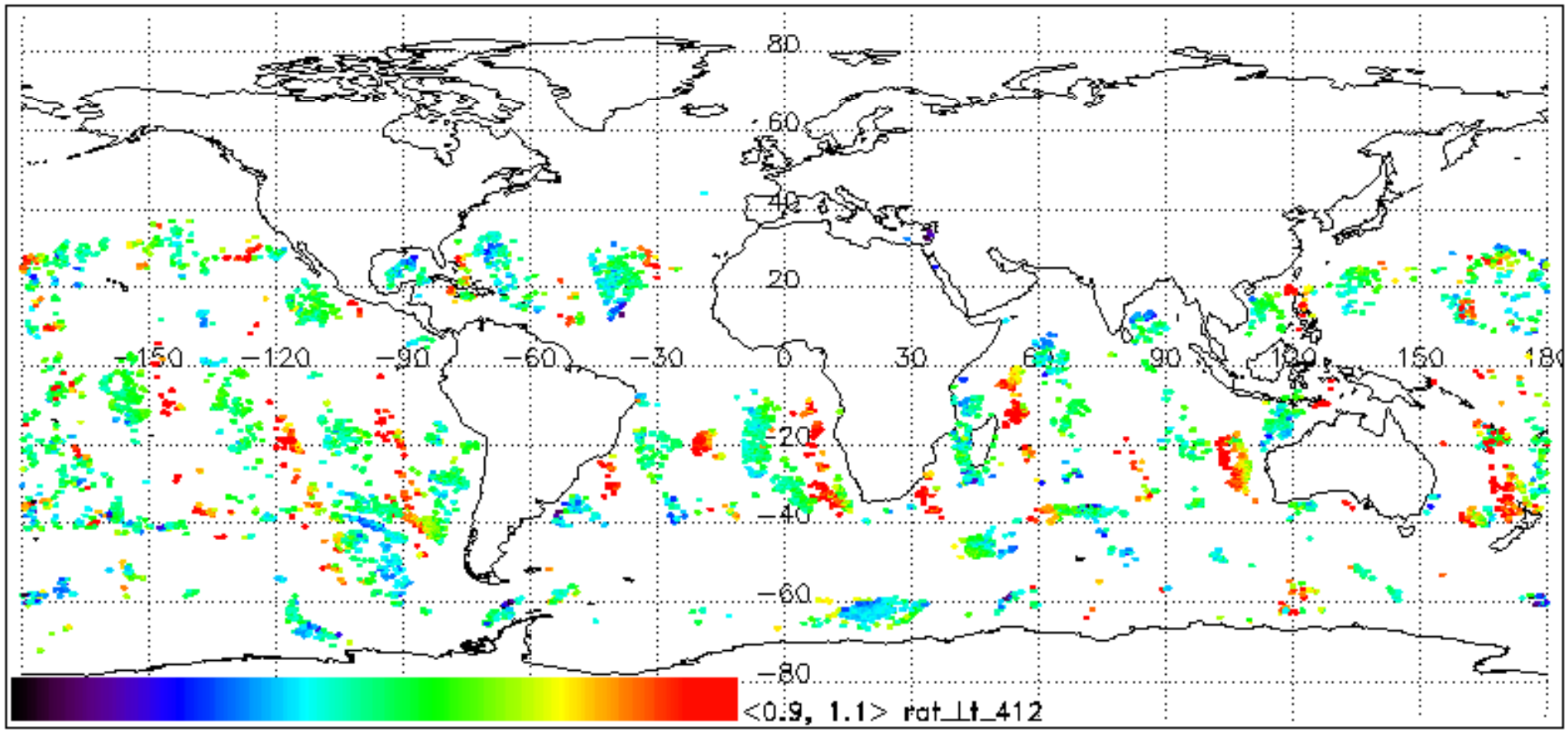
Xcal approach (Step 2): input MODIS Lm



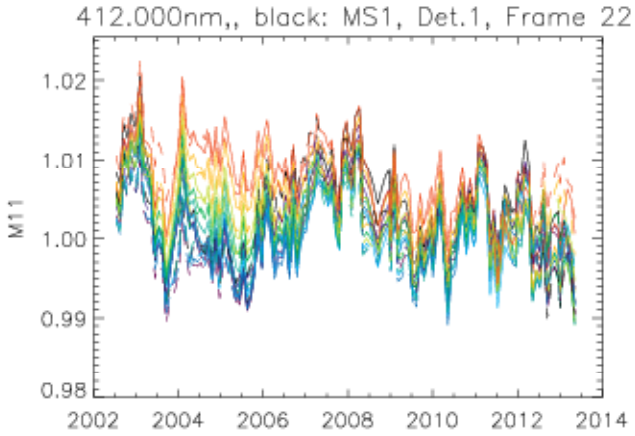
Xcal approach (Step 3): vicarious Lt (from ‘true’ L3)

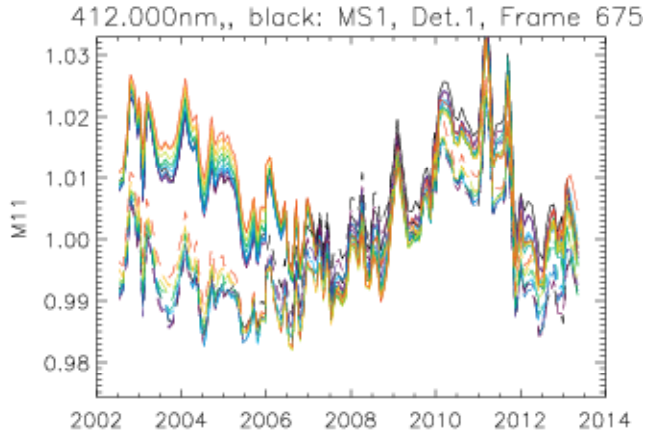


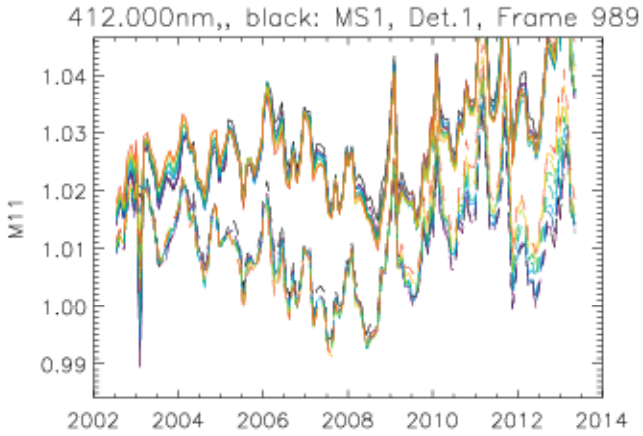
Xcal approach (Step 4): Ratio Lm/vLt

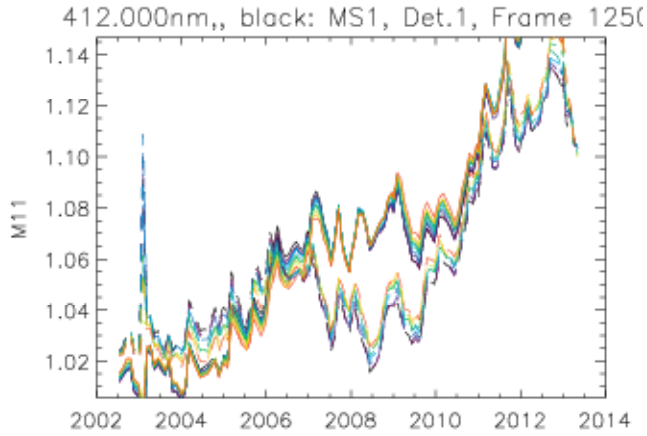


Xcal results (1 of 6, 412nm): M11 (‘gains’)



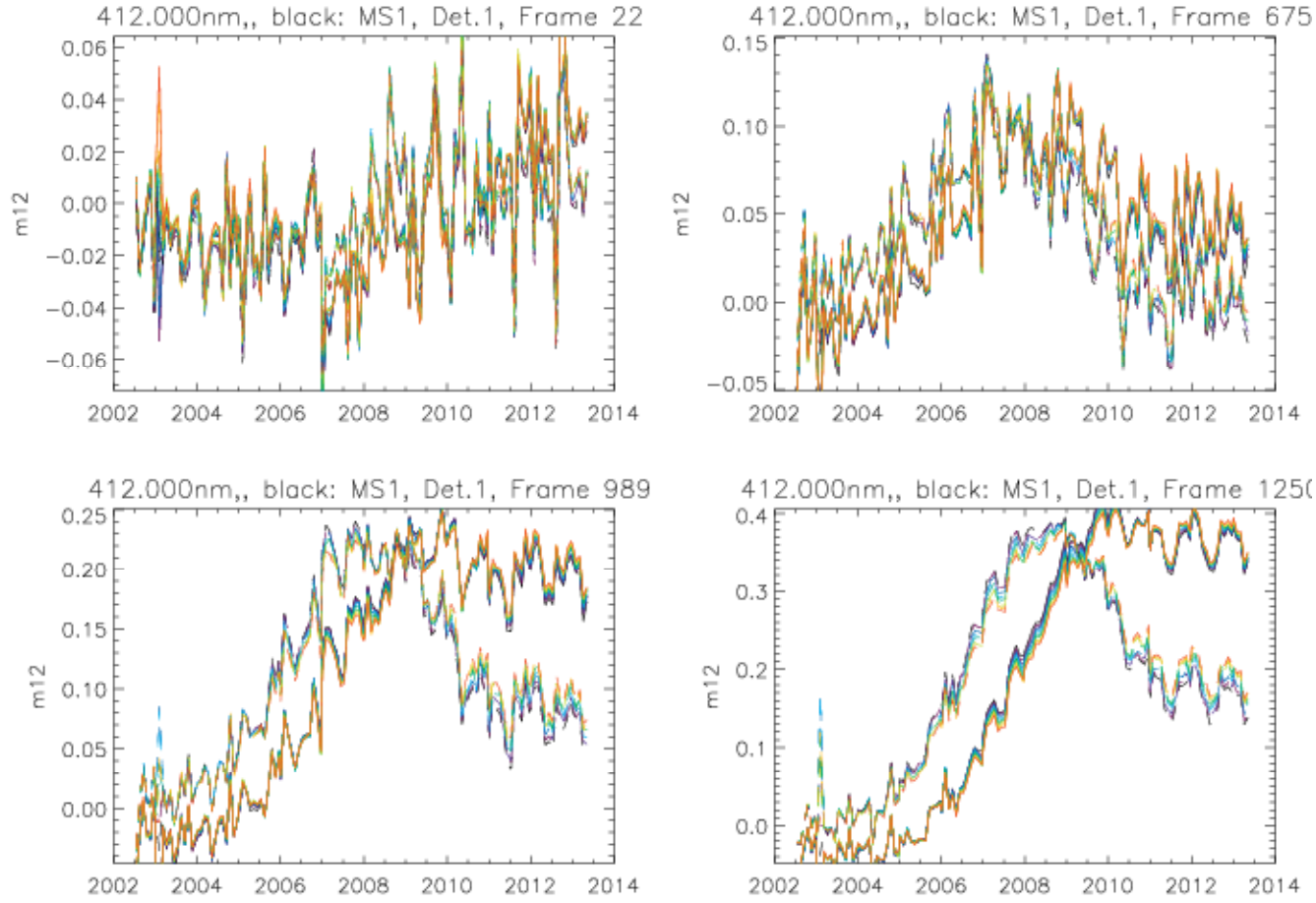


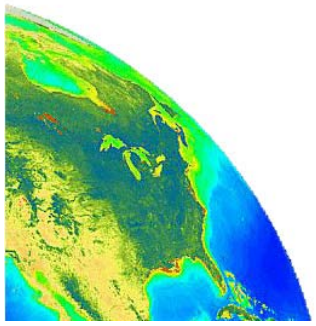




Before temporal fitting

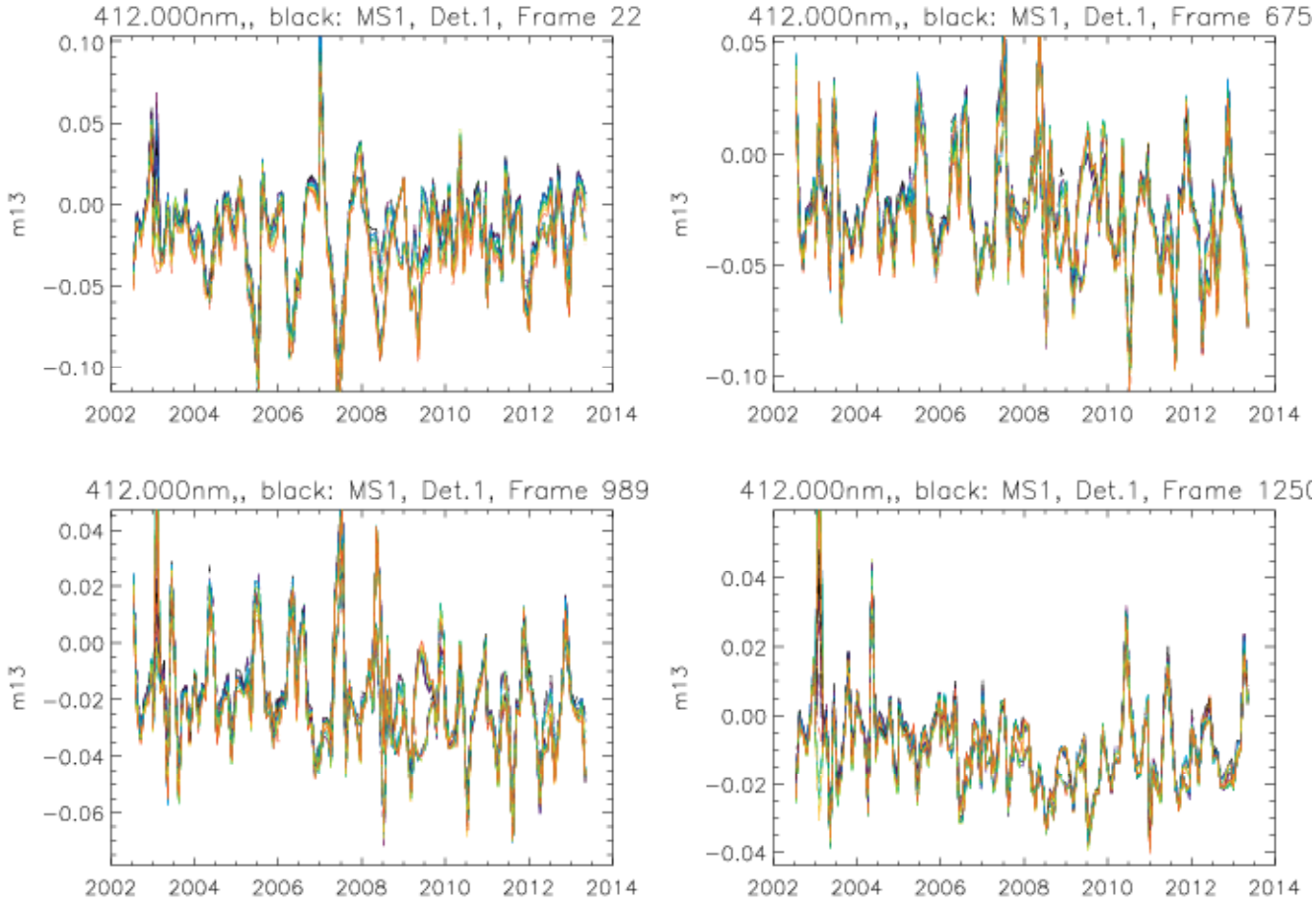
Xcal results (2 of 6, 412nm): m12 (coef. for Q)

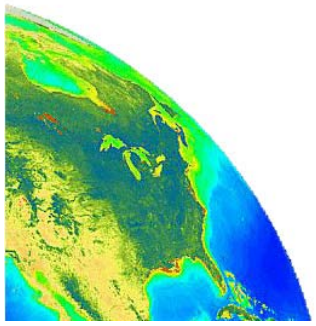




Before temporal fitting

Xcal results (3 of 6, 412nm): m13 (coef. for U)

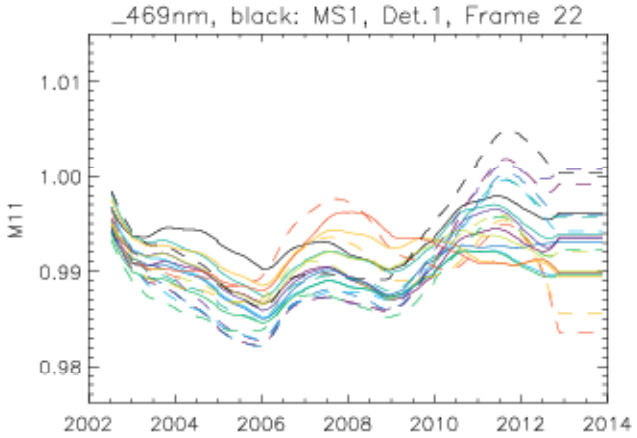


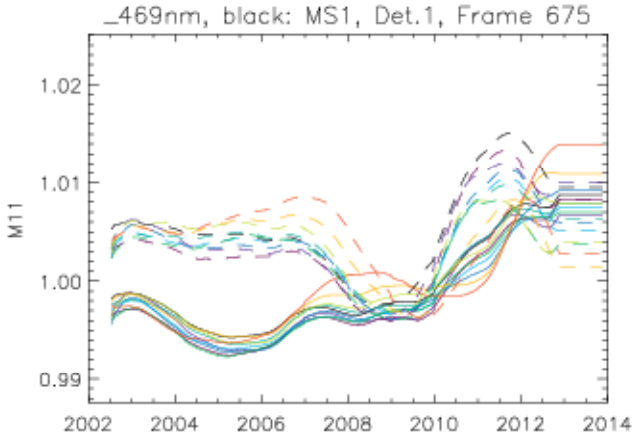


No temporal fitting

Xcal results (4 of 6, 469nm): M11 (‘gains’)

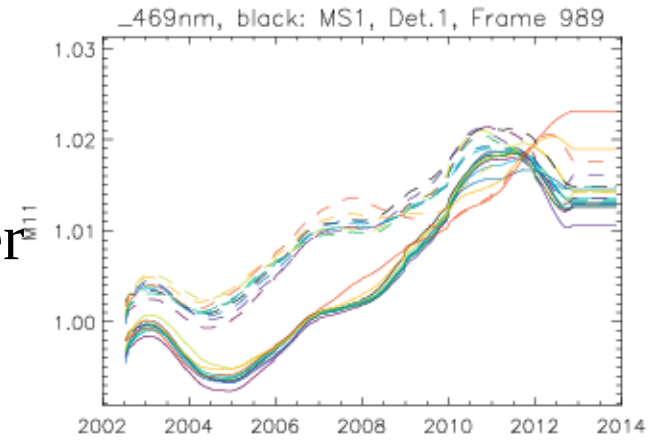
Lunar

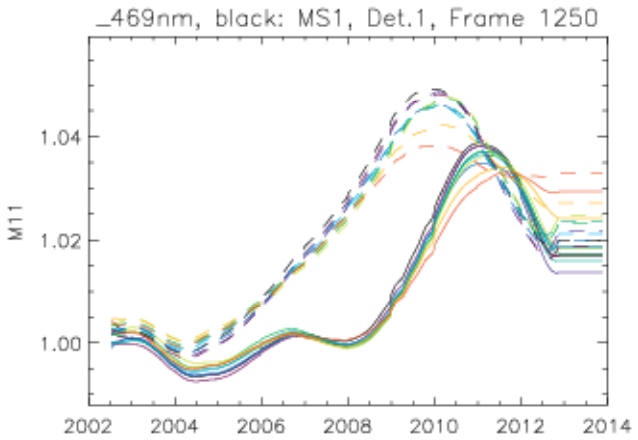




Nadir

Solar Diffuser





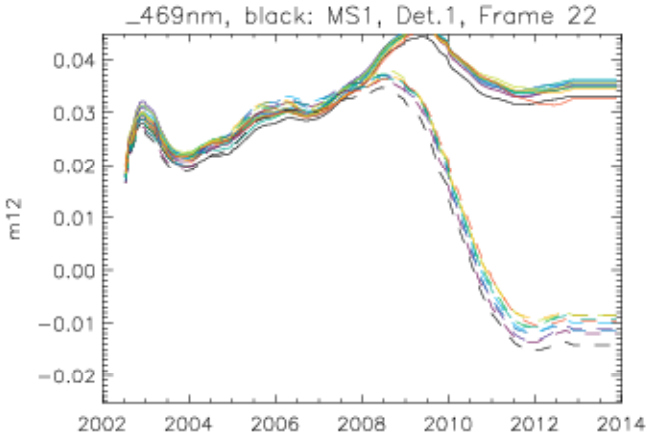
End of scan

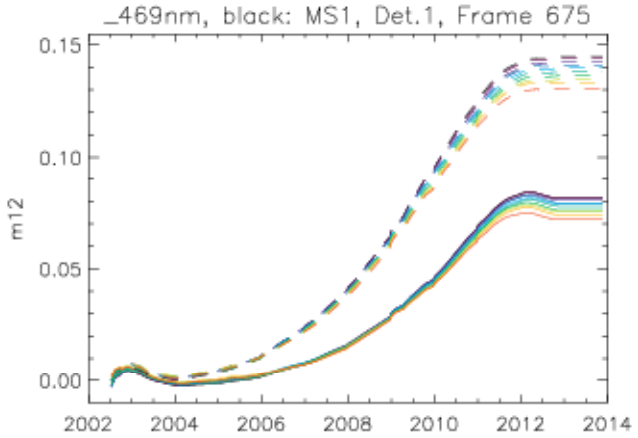
Solid/dashed line: Mirror side 1/2

Black, purple, … orange, red: detectors 1-10

Xcal results (5 of 6, 469nm): m12 (coef. for Q)

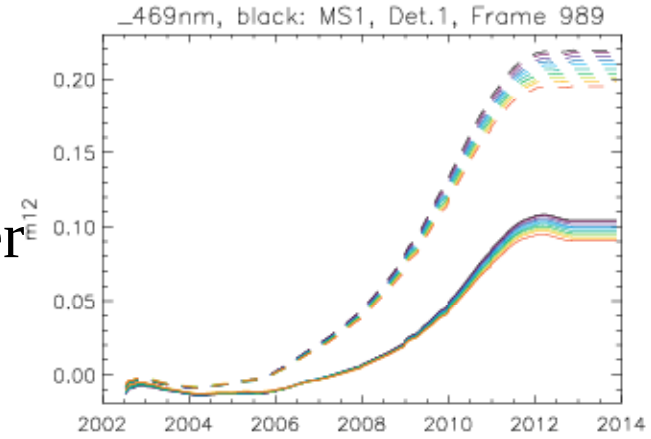
Lunar

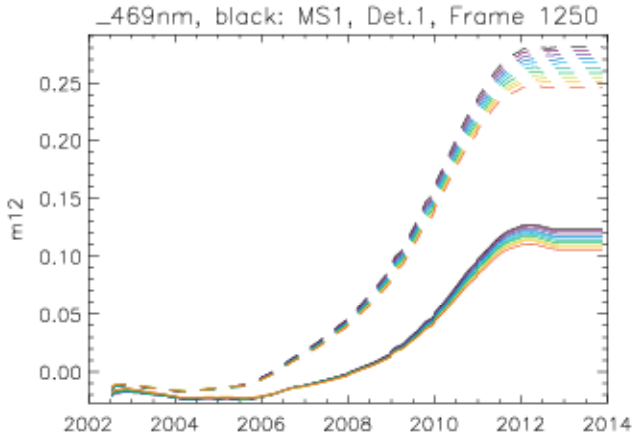




Nadir

Solar Diffuser





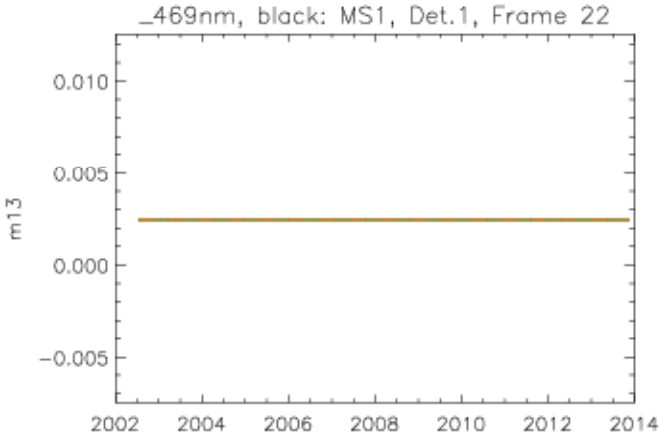
End of scan

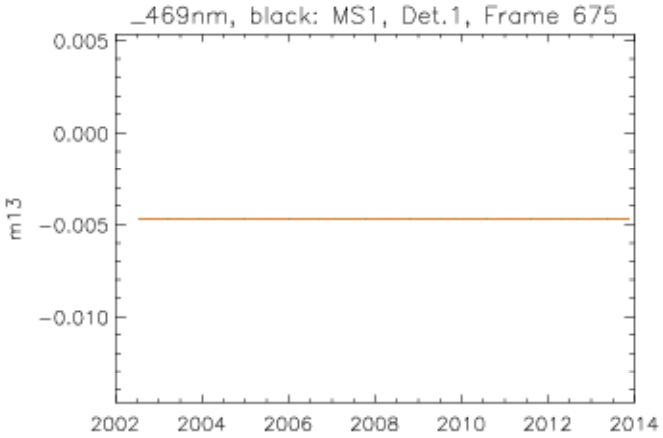
Solid/dashed line: Mirror side 1/2

Black, purple, … orange, red: detectors 1-10

Xcal results (6 of 6, 469nm): m13 (coef. for U)

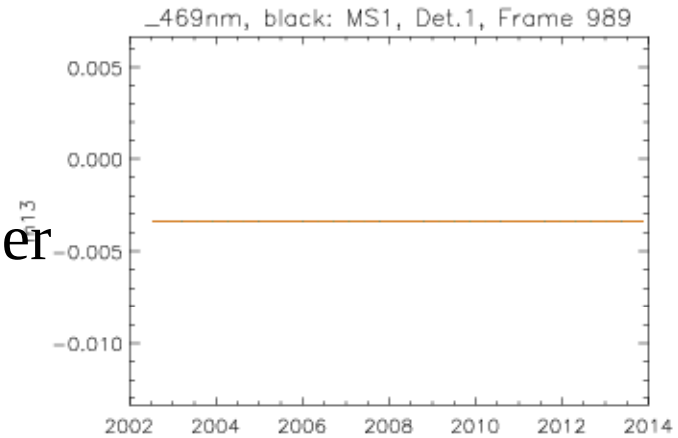
Lunar

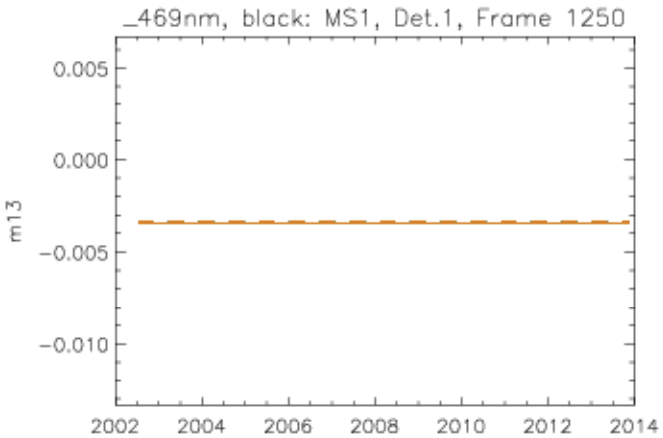




Nadir

Solar Diffuser





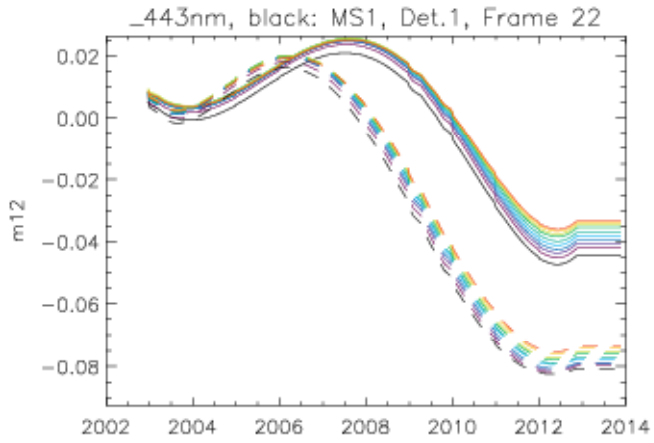
End of scan

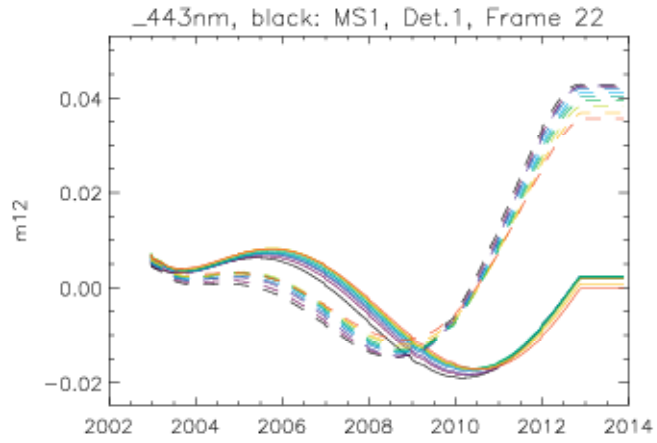
Solid/dashed line: Mirror side 1/2

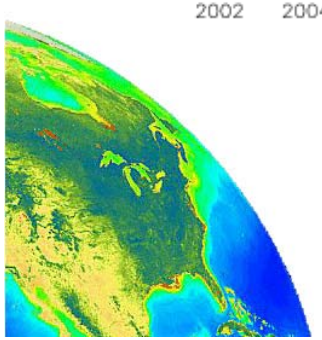
Black, purple, … orange, red: detectors 1-10

Improved Xcal results: (in progress)

-Alex Lyapustin reported overcorrection at beginning of scan
-Code issue found in xcal code (linear vs 2nd order)
-New results (right plot below) show smaller m12 correction for beginning of scan than operational results (left plot)

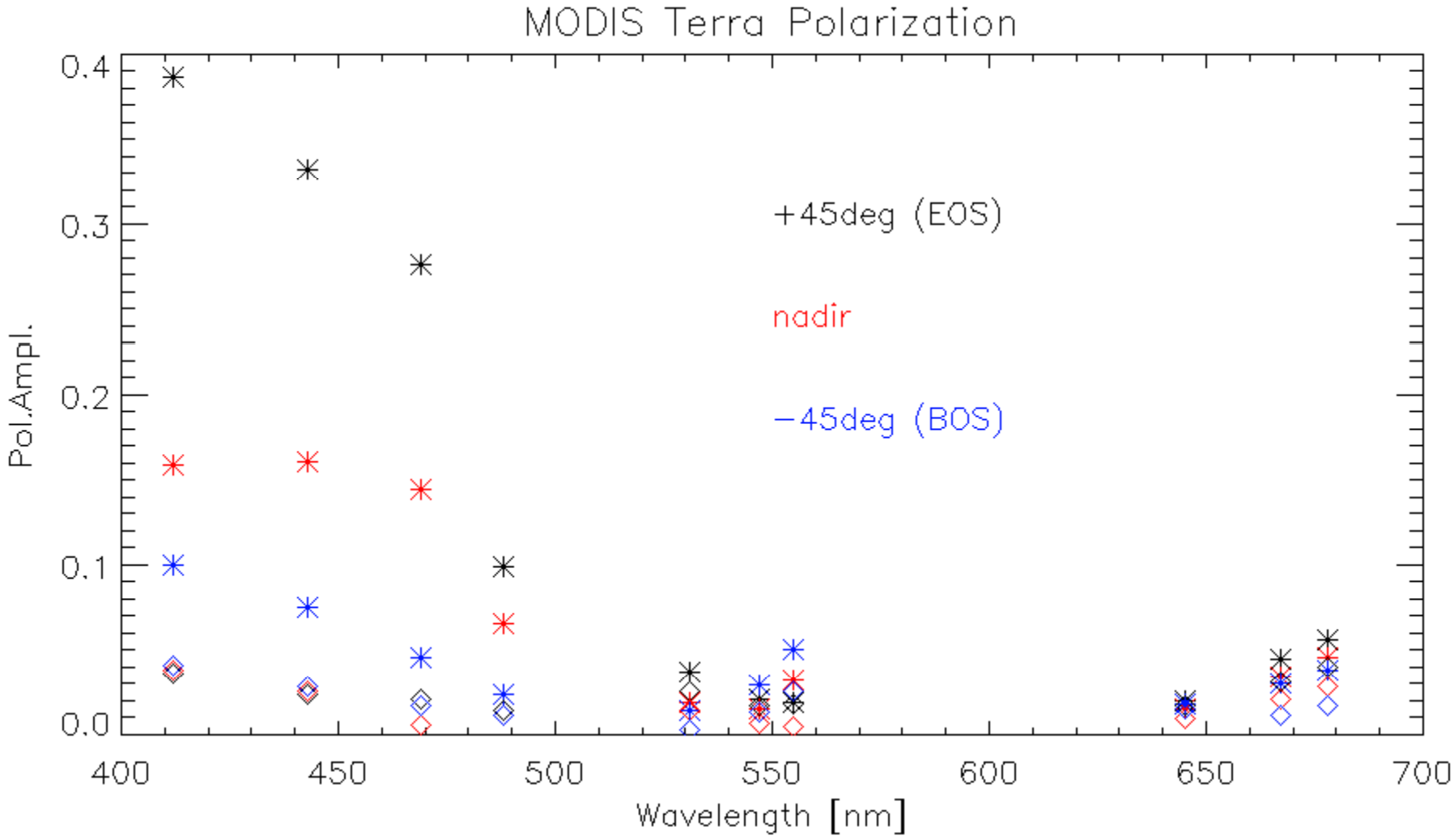


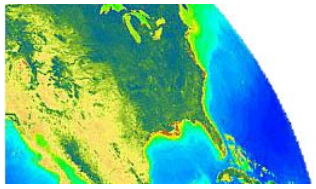




Solid/dashed line: Mirror side 1/2
Black, purple, … orange, red: detectors 1-10

Xcal results: Max. Polarization Amplitude





Stars: mission max.

Diamonds: beginning of mission

Summary:

- No large change in polarization sensitivity for MODISA
- OBPG xcal of MODIST to MODISA shows large change of polarization sensitivity for 412nm (40% at end of scan) with significant mirror side dependency
- End of scan still shows 10% difference to MCST gain trending for 412nm at end of scan, but overall MCST approach II is a huge improvement
- Evaluation performed at ocean radiances (very low, possible linearity issue) and using OBPG atmospheric correction approach ('potential' error would cancel for ocean, but probably not for other disciplines)
- Corrections for 469nm are similar to those for 443nm, but smaller (both for gain and polarization), as expected
- Wavelengths above 500nm have polarization amplitudes <5% throughout the mission

Backup