MODIS Terra Gain and Polarization Updates

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2018/10/19

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Overview

- OBPG R2018 reprocessing: update Aqua calibration and Terra crosscalibration (xcal) to extend gain and polarization correction
- OBPG xcal method uses Aqua/SeaWiFS L3 OC products as truth to derive Terra gain and polarization corrections (once a month).
- Largest effect in blue bands, end of scan (> 40%), decrease at longer wavelengths
- R2018 forward processing: monthly xcal forward update to maintain accuracy

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 $L^w(\lambda)$ 7-day mean

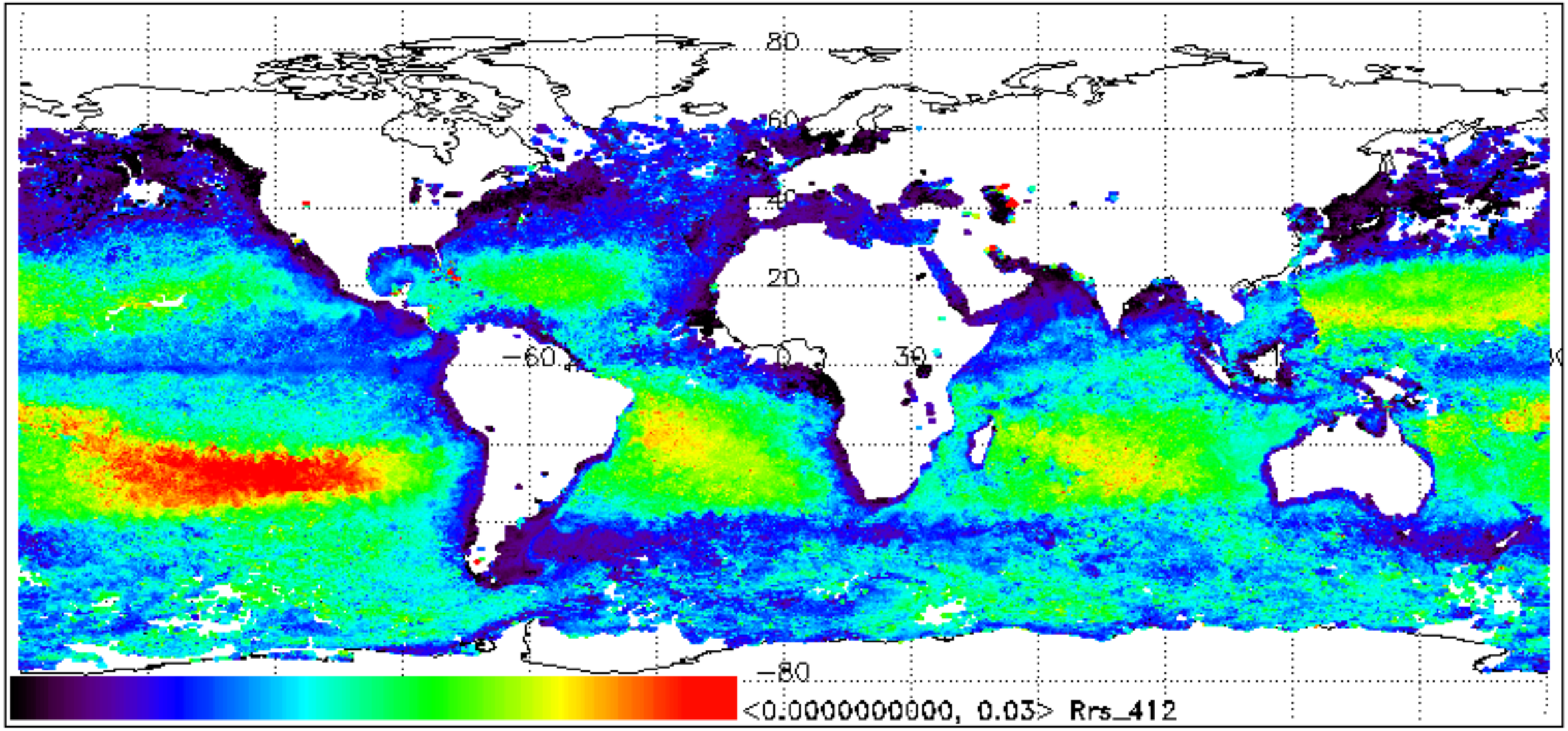
Bandpass differences: $\lambda' \rightarrow \lambda$
fit based on bio-optical models
(needed for SeaWiFS to MODIS)

OBPG Crosscalibration coefficients

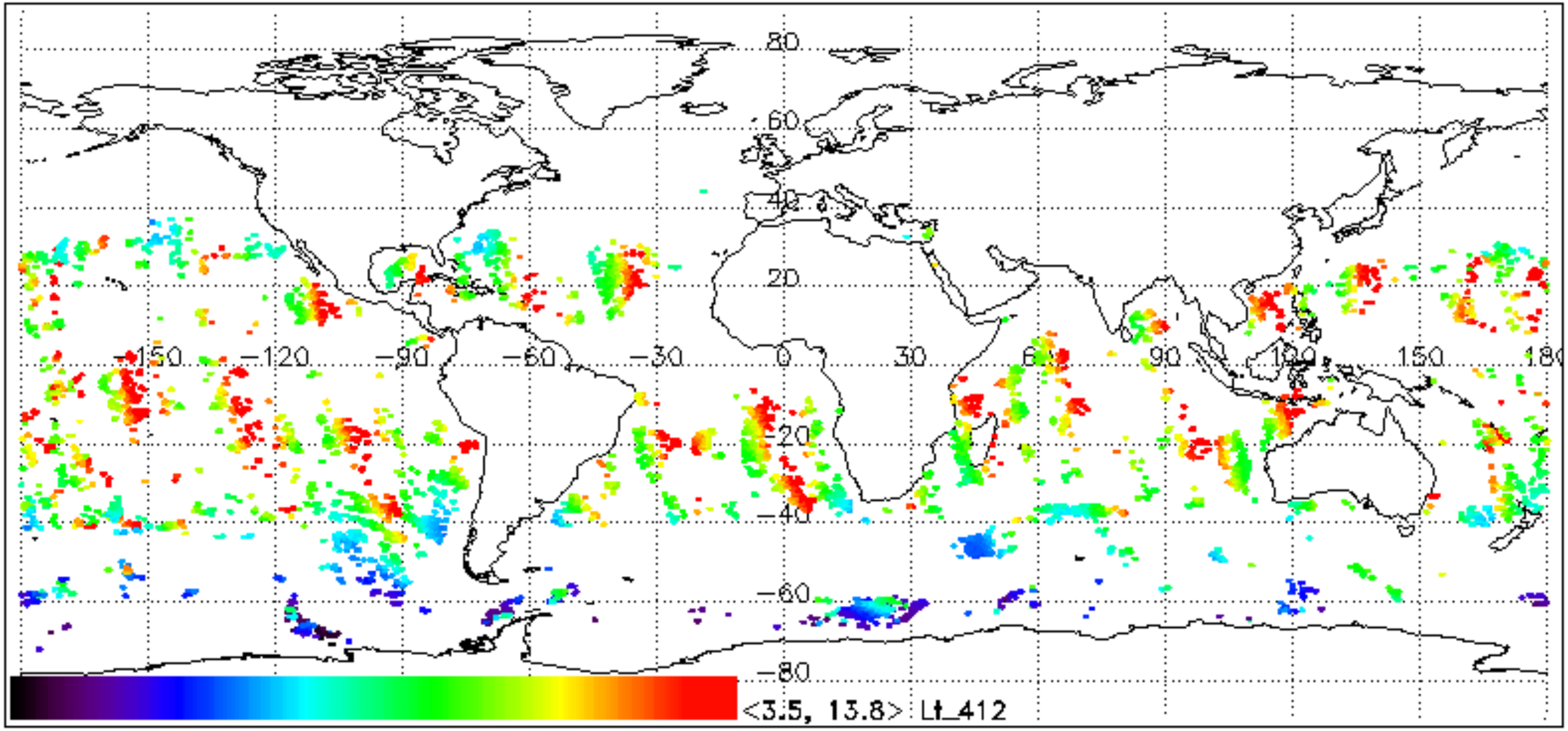
$$L_m/M_{11} = L_t + m_{12}*Q + m_{13}*U$$

- L_m: measured TOA radiance (MODIST)
- L_t: true TOA radiance (from MODISA/SeaWiFS)
- Q, U : linear Stokes vector components, modeled from Rayleigh and glint
- M_{11}, m_{12}, m_{13} : fitted instrument characterization parameters; depend on band, mirror side, detector, scan angle (4^{th} order polynomial)
- Xcal LUT: M11, m12, m13 estimated once a month, 3-month temporal smoothing

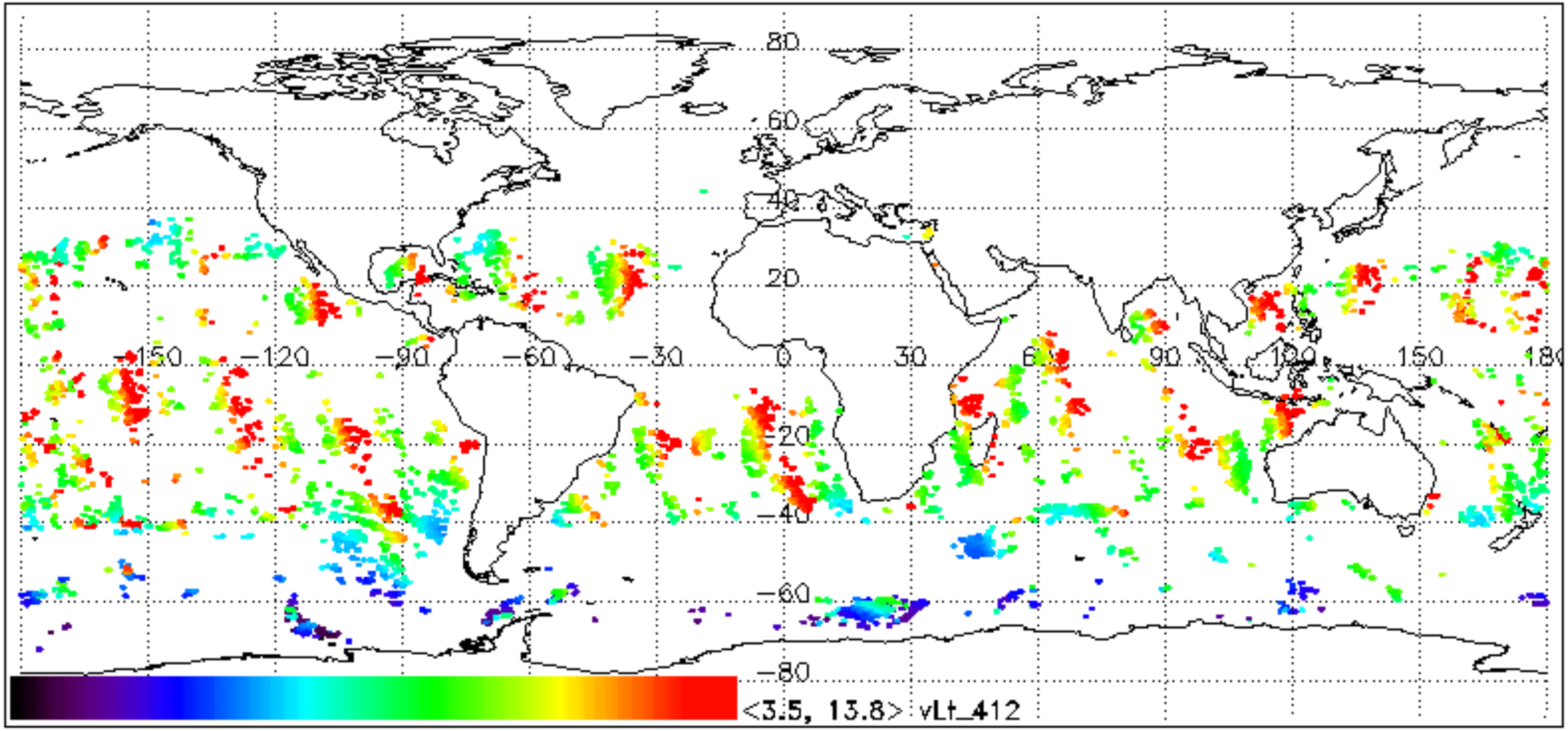
Xcal approach (Step 1): input ‘true’ L3 (7 days) Rrs



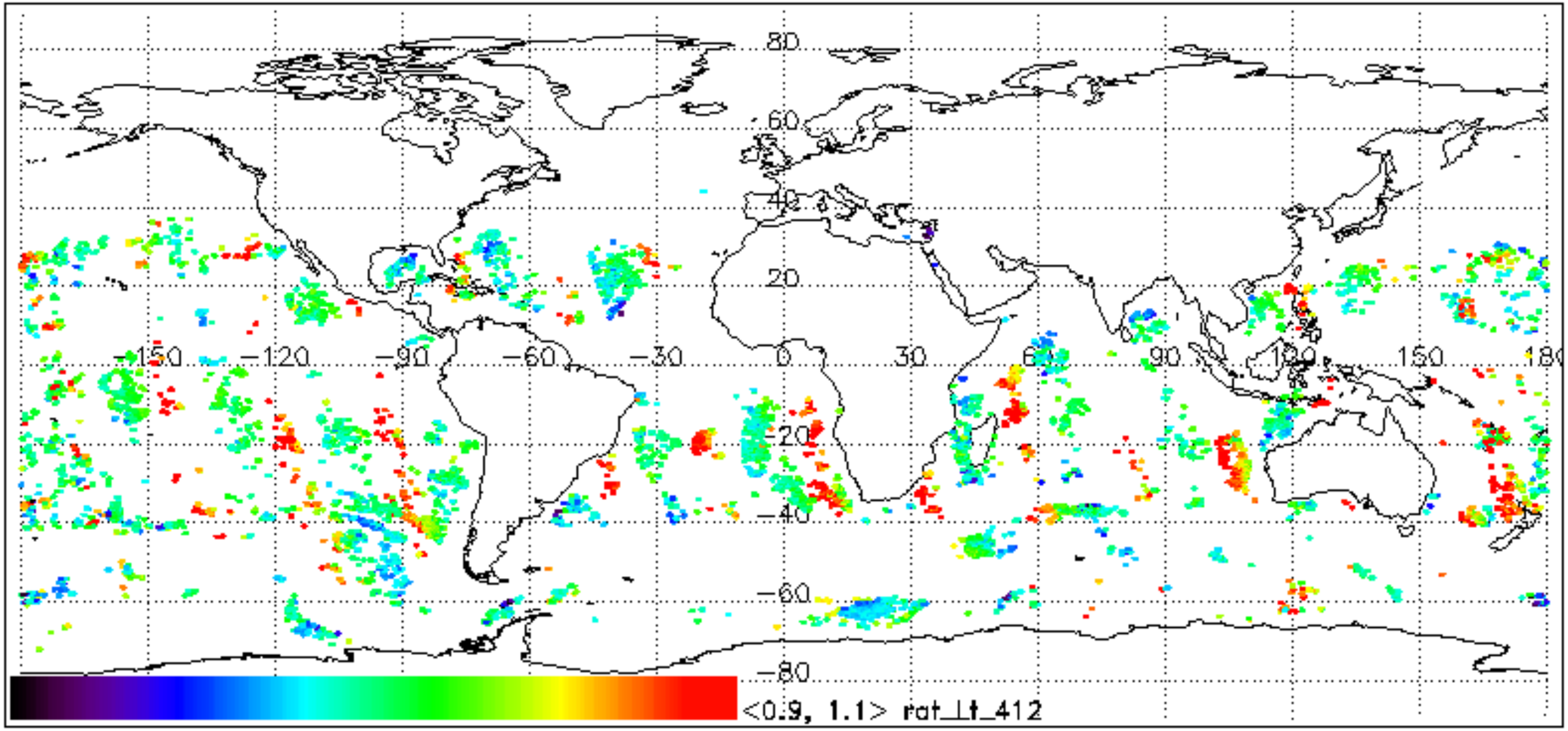
Xcal approach (Step 2): input MODIS Lm



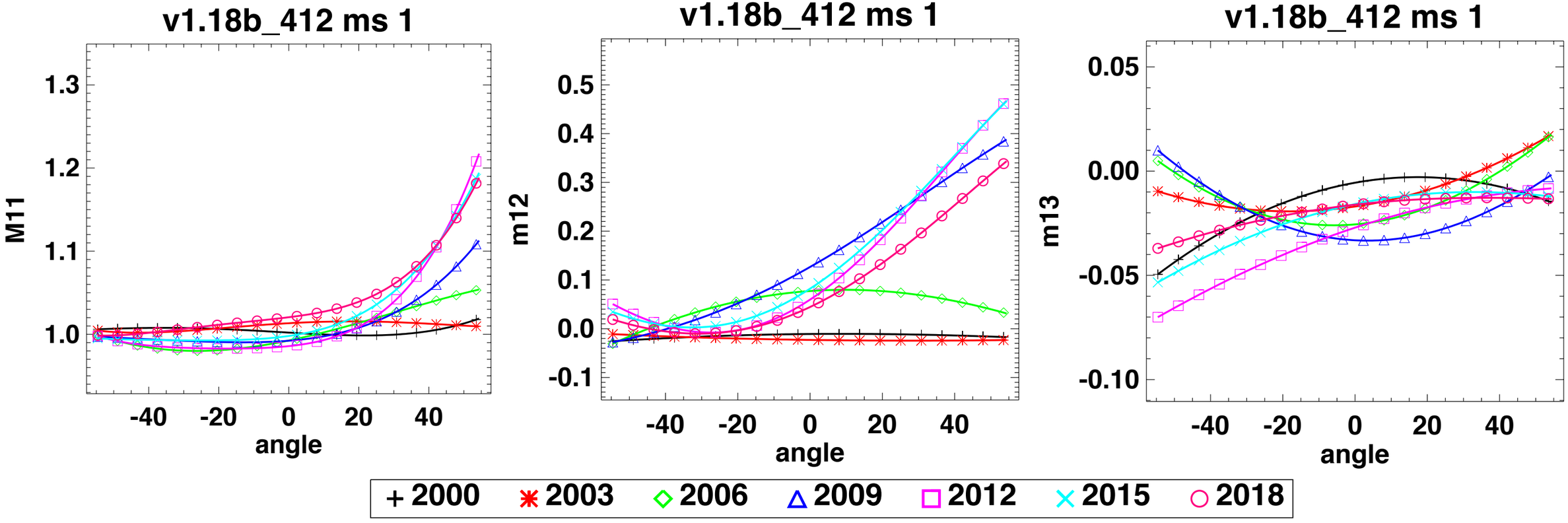
Xcal approach (Step 3): vicarious Lt (from ‘true’ L3)



Xcal approach (Step 4): Ratio Lm/vLt

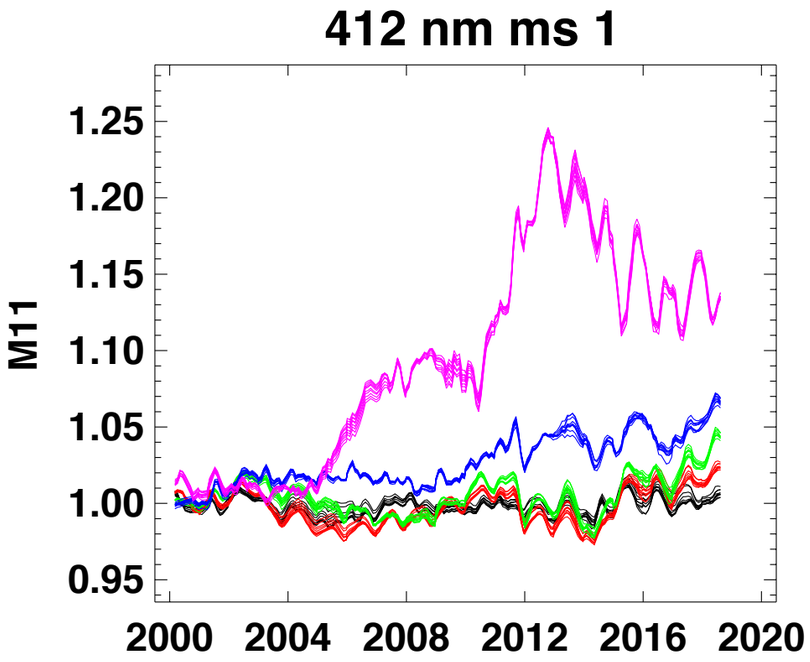


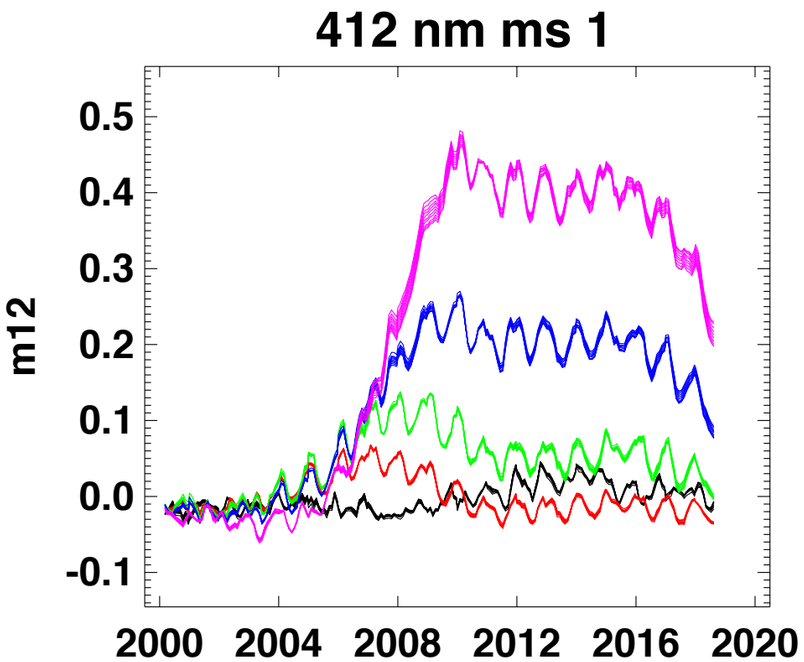
Results

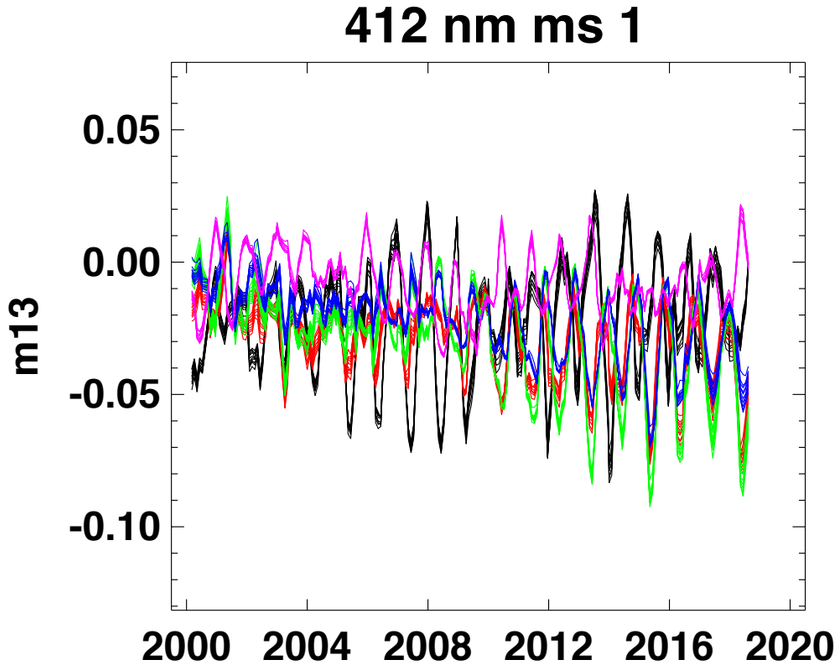


- M11, m12 have large correction at end of scan
- Temporal change in all parameters (M11, m12, m13)

Temporal trends





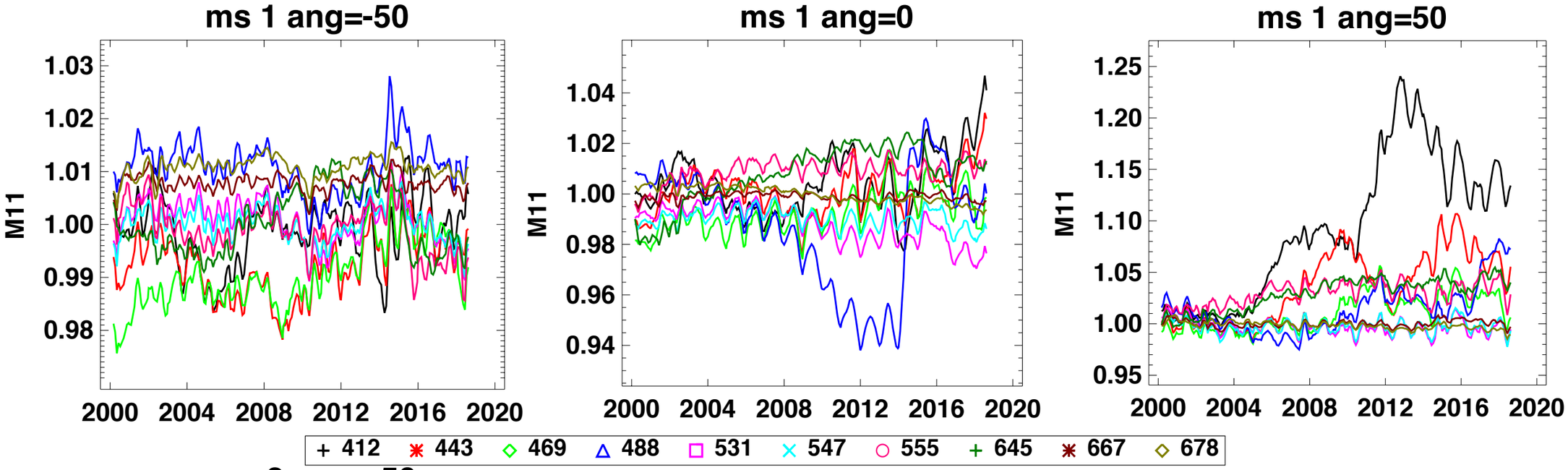


- Larger oscillation after 2012 (Terra cal lut forward update)
- Largest change at EOS (+50)

- stable between 2010 – 2016
- start decreasing after 2016
- Consistent among detectors

m12, m13 seasonal cycle (under investigation)

M11 vs. Wavelength vs. mirror side

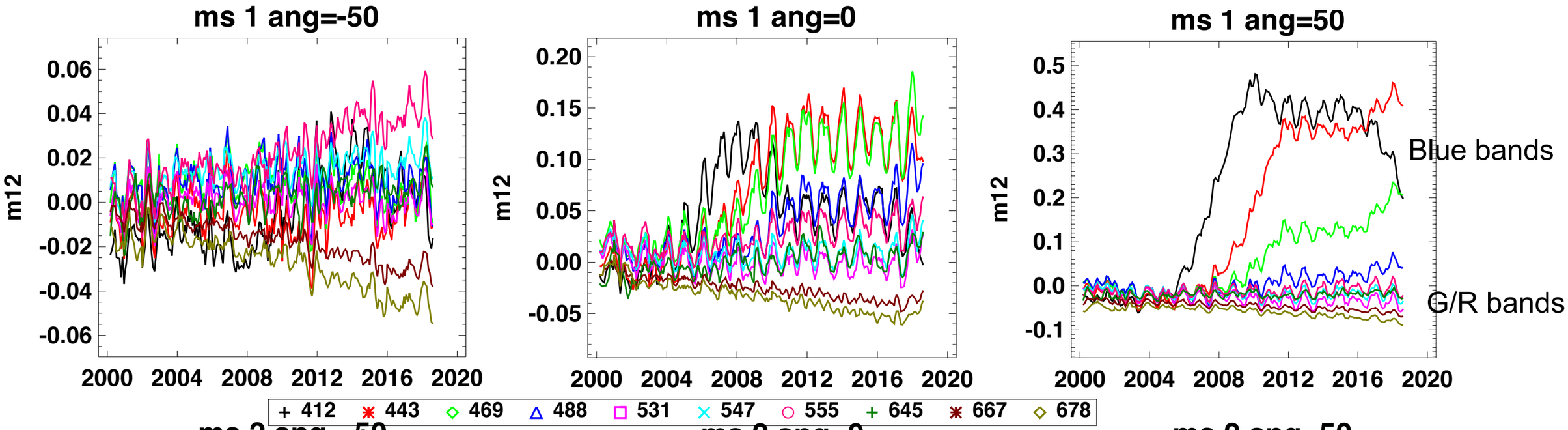


Blue bands

G/R bands

Large correction at EOS for blue bands

m12 vs. Wavelength vs. mirror side

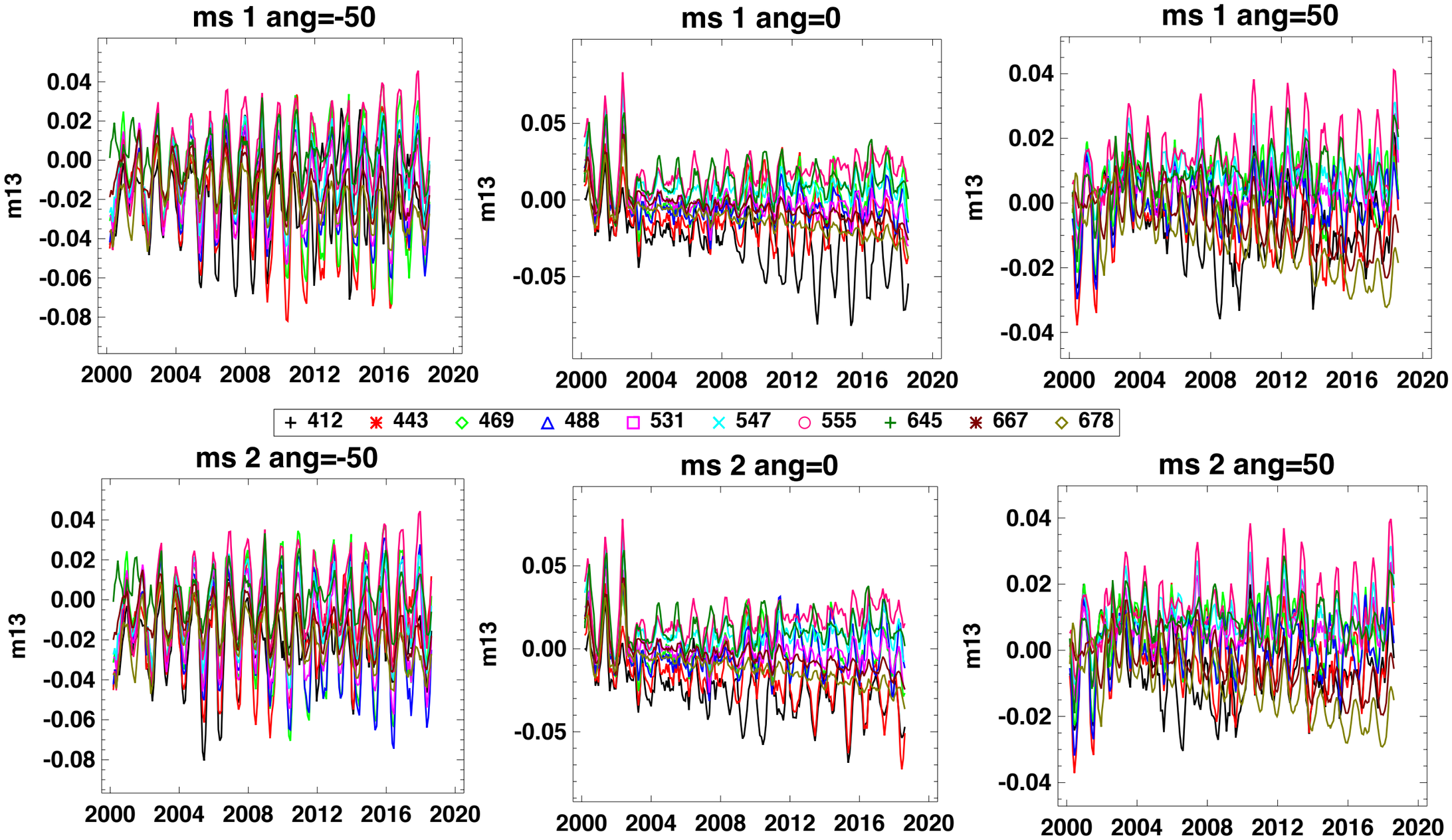


Blue bands

G/R bands

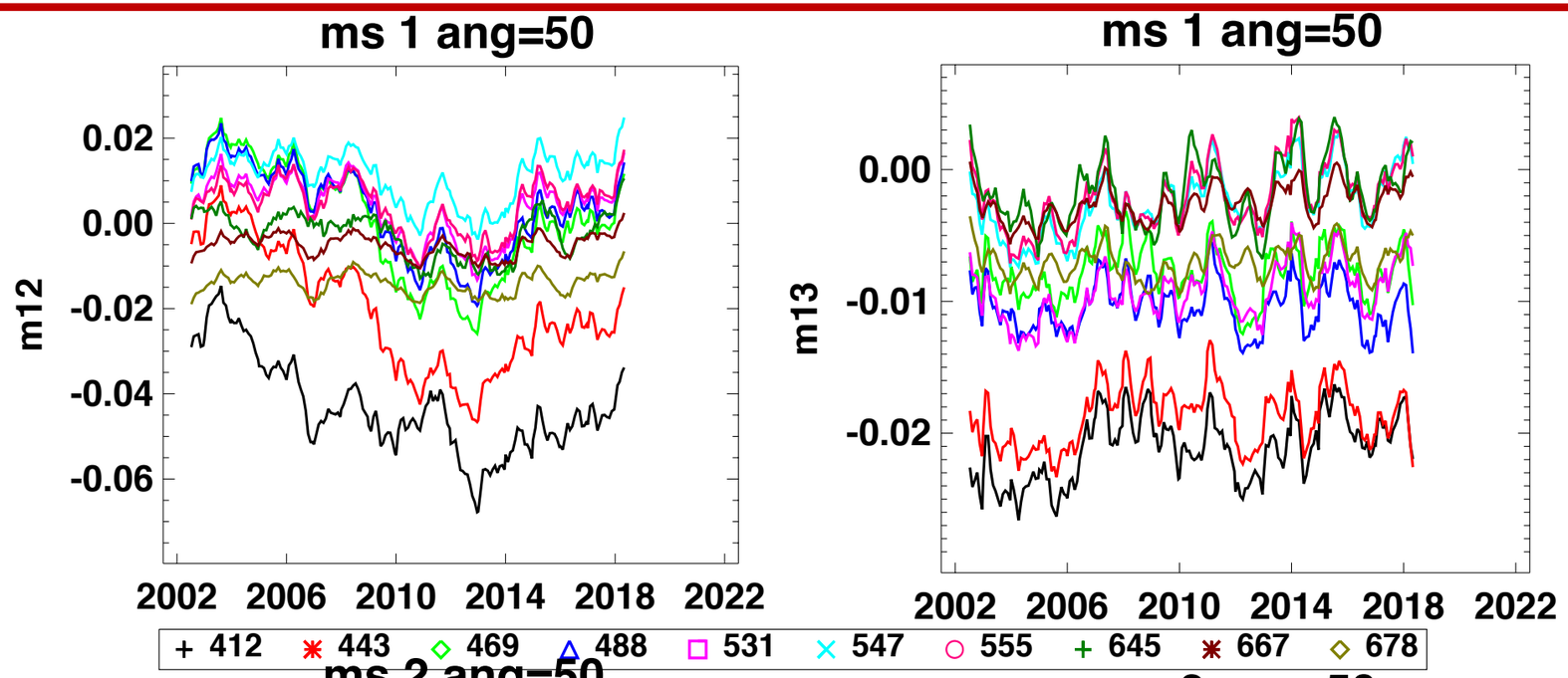
Large mirror side, scan angle, wavelength dependency

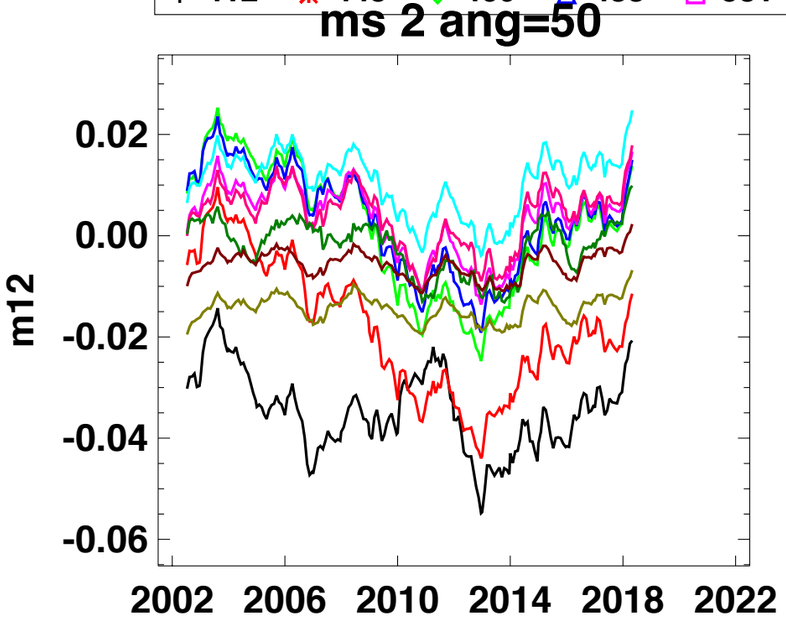
m13 vs. Wavelength vs. mirror side



M13 small and stable overtime

Aqua xcal





- Aqua polarization estimated by xcal
- Xcal to itself, results not as accurate
- Results indicate no temporal change in polarization

Summary

- No large change in polarization sensitivity for MODISA
- OBPG xcal of MODIST to MODISA shows large change of polarization sensitivity for blue bands (>40% at end of scan) with significant mirror side dependency
- Up to 20% gain difference between Xcal and MCST at end of scan
- Wavelengths above 500nm have smaller polarization amplitudes (<8%) and temporal variation
- 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)
- OBPG R2018 processing implemented a monthly forward update