MODIS Solar Diffuser Spectral Analysis

MODIS Calibration Workshop @
Science Team Meeting
March 22, 2005

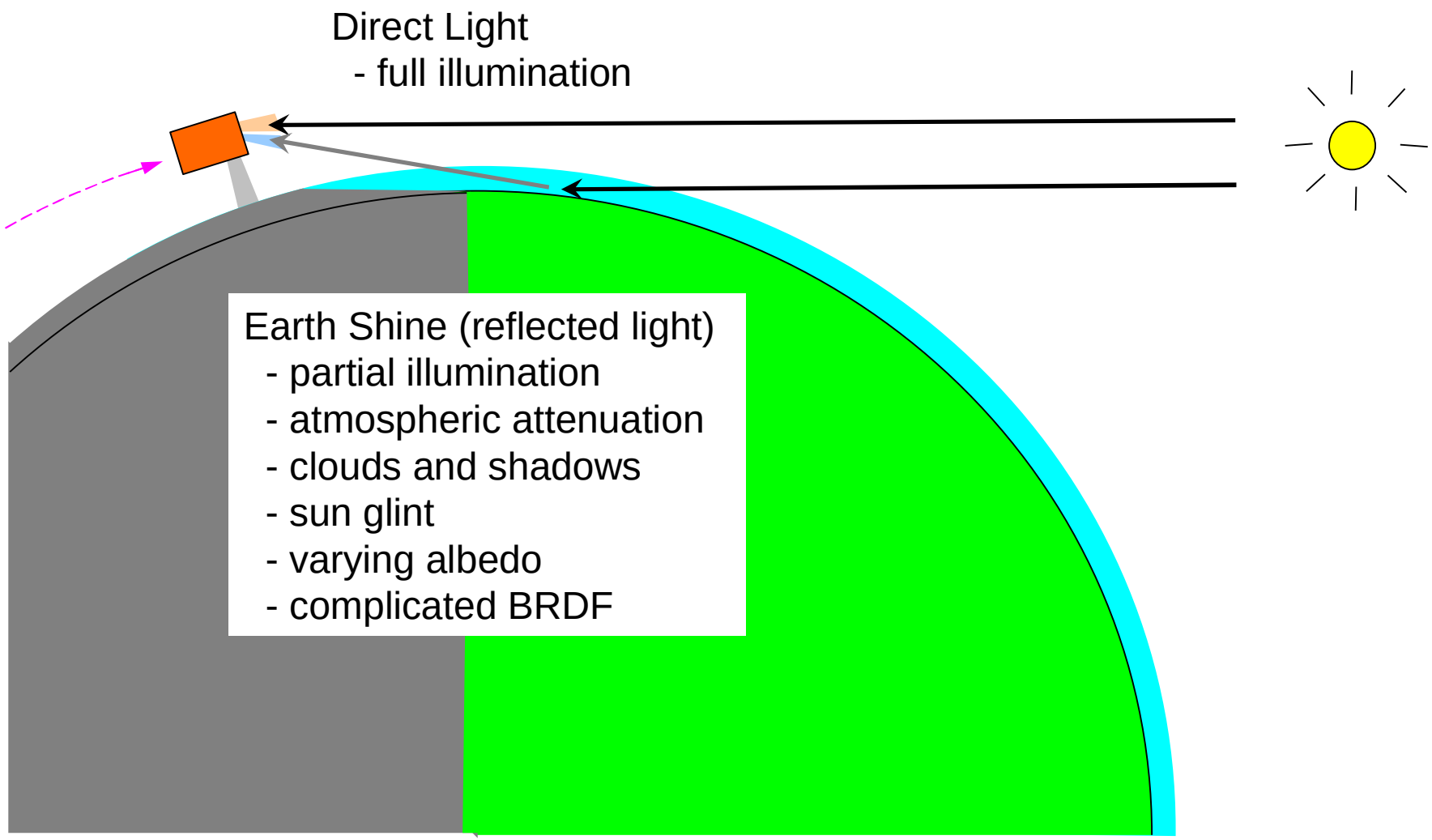
Robert Wolfe

MODIS Science
Support Team
NASA/GSFC
Code 614.5

Outline

- Overview and modeling
- 1 week of Earthshine (with browse)
- 1 year of Earthshine
- Summary

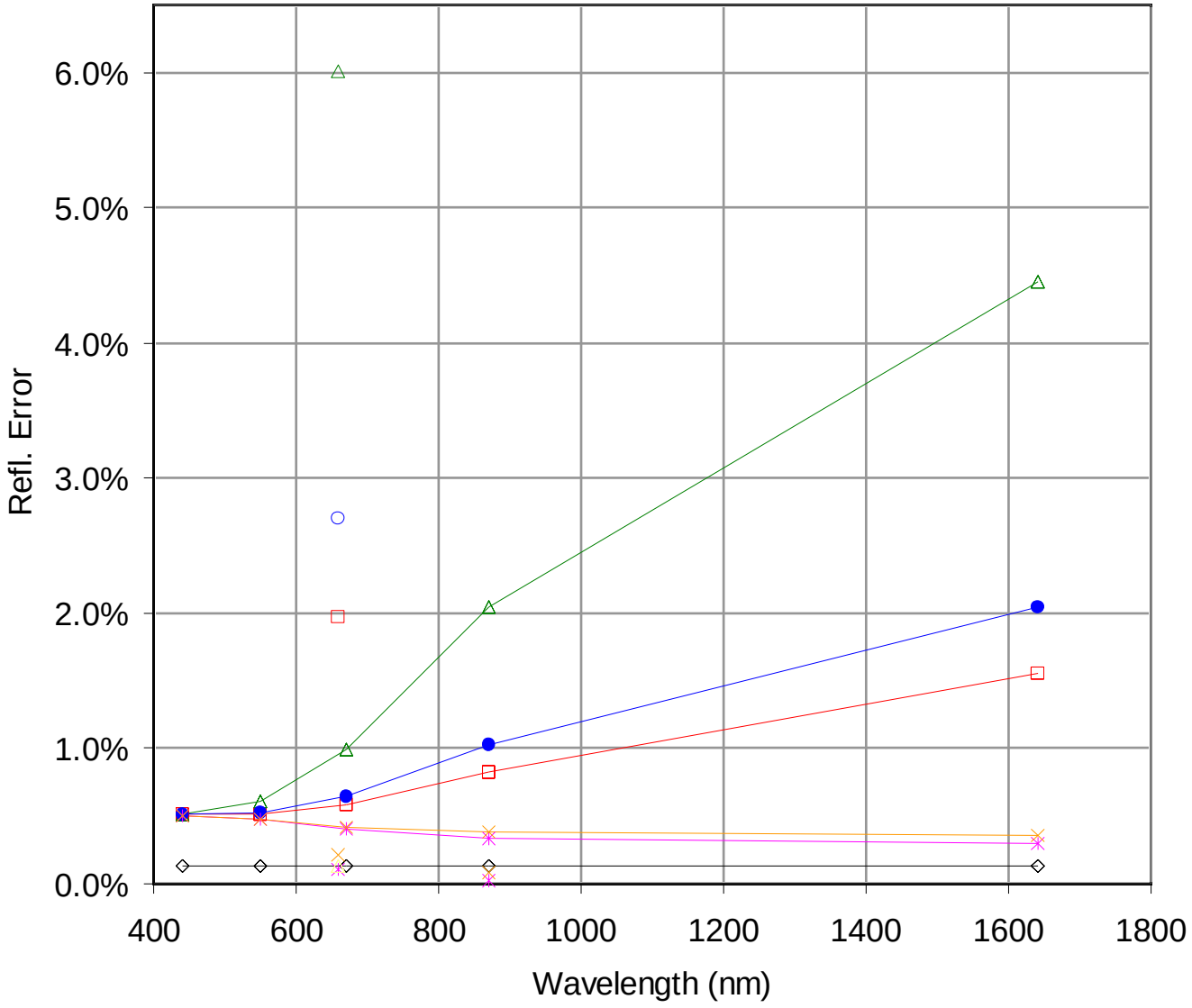
Simplified Solar Diffuser Geometry



Frame 10805 Time: 10:17:01Z Nadir Sun El: -05

Pacific Ocean 07/21/2003 ISS007E 377 km Alt.

MODIS Simulated Earthshine Effect



Solar Diffuser mean at Sweet-spot (SS) center (12.5 degrees elevation)

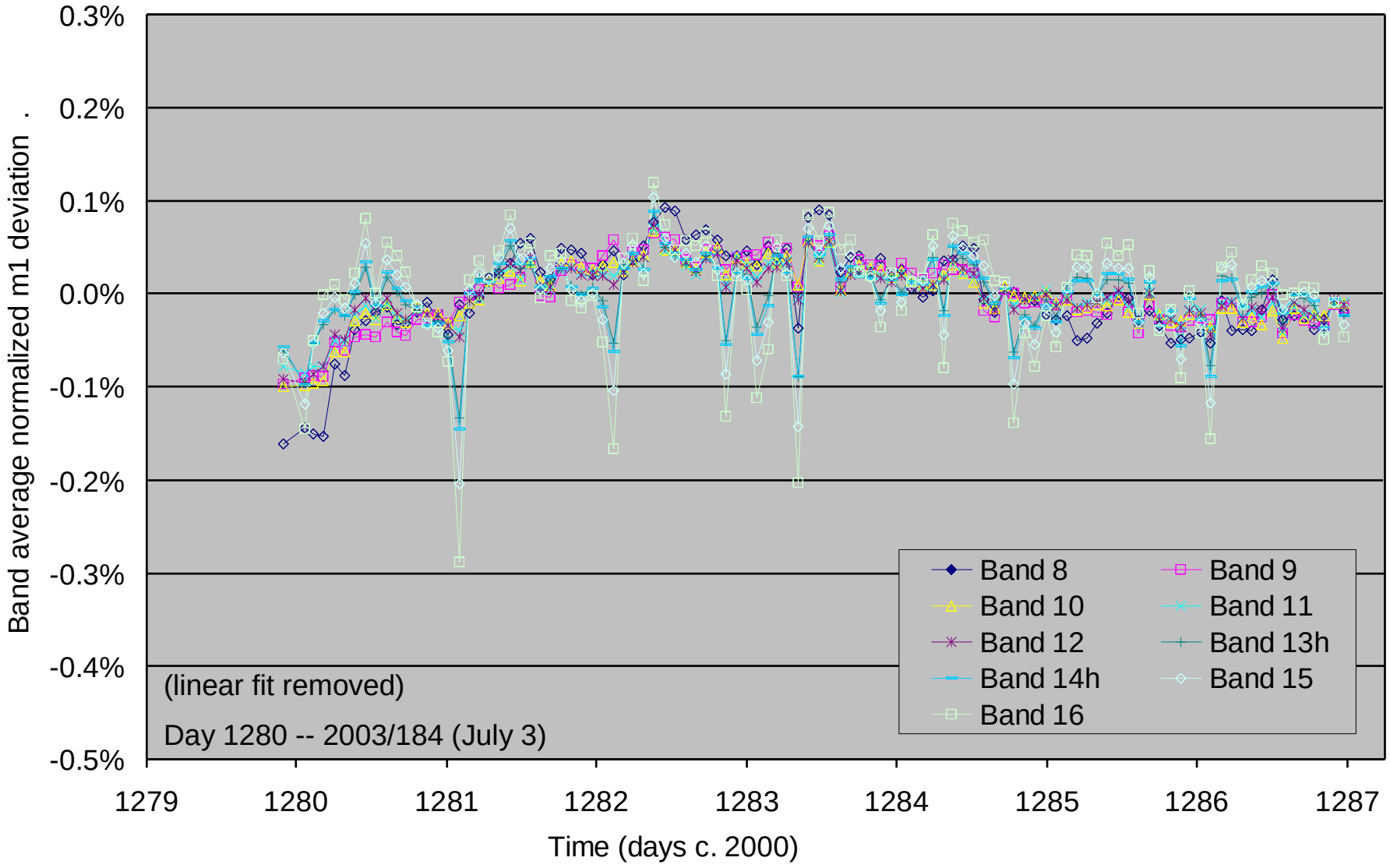
- Diffuse noAtm
- Ocean 11ms wAtm
- Ocean 1ms wAtm
- Ocean 7ms wAtm
- Spruce wAtm
- Conifers wAtm
- Ocean 11ms noAtm
- Ocean 1ms noAtm
- Ocean 7ms noAtm
- Spruce noAtm
- Conifers noAtm

Earthshine BRDF and Atmosphere Modeling

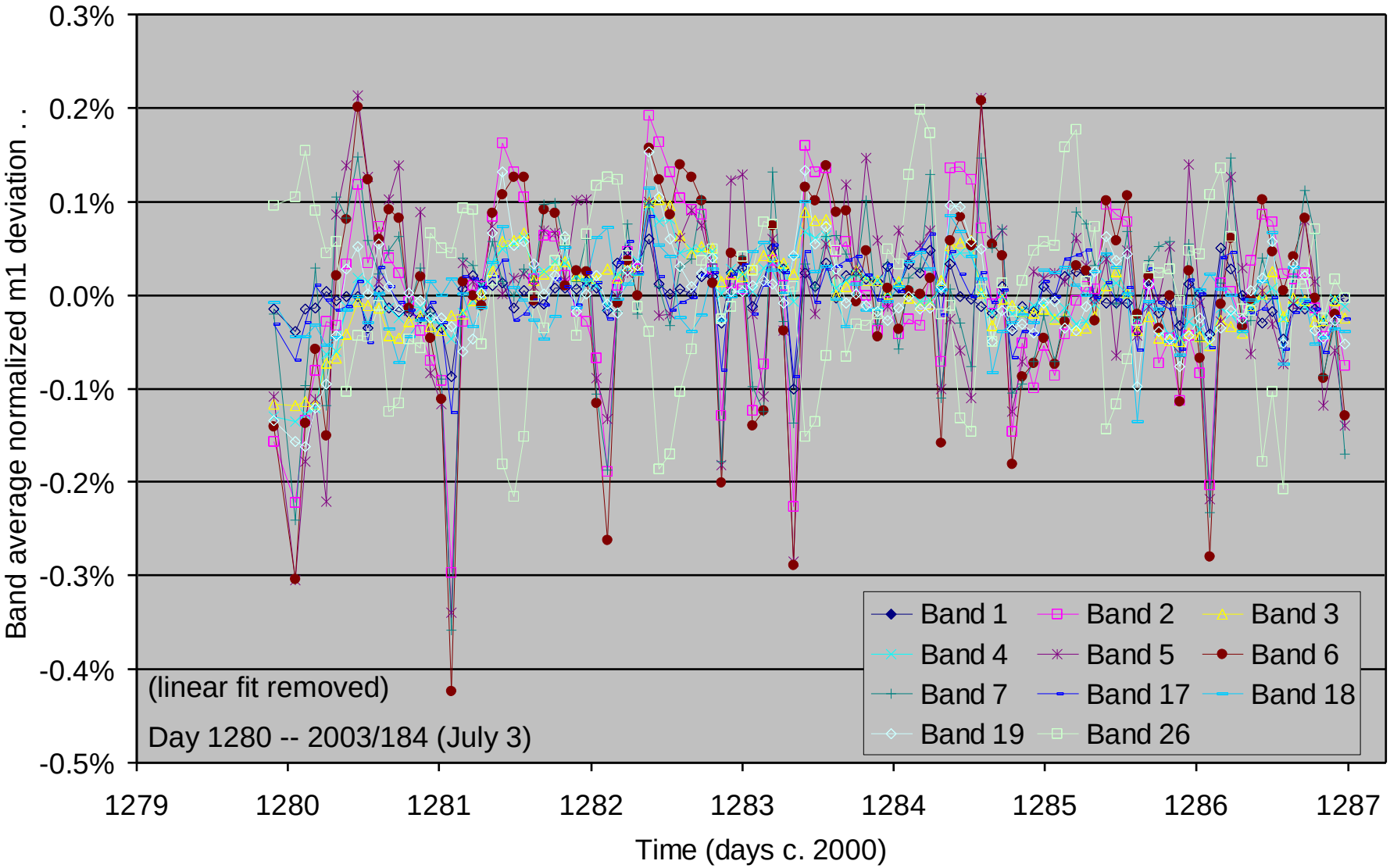
- Atmosphere: represented by one of the AERONET retrievals for clear conditions (bi-modal size distribution, continental)
  - uses aerosol phase function in 5 wavelengths
  - aerosol optical thickness: 0.11
  - single scattering albedo: 0.88
- Ocean surface BRDF model: Nakajima & Tanaka model (related to Cox & Munk) with the wave mutual shadowing.
- Land surface BRDF Model: Modified Li-Strahler model which is called Li-transit model (by Gao, Li, Strahler et al.).
  - Corrects the BRDF behavior at high zenith angles.
  - 3 model parameters derived by the least squares fit to the PARABOLA measurements over conifer and spruce forests.
- Reasonable agreement with VIIRS (Steve Mills) calculations. Some disagreements may be due to:
  1. difference in view geometry, aperture location/size and no screen (our calculations are for MODIS)
  2. difference in the ocean reflectance model. We use the azimuthally independent model; NGST most likely used the model of Cox Munk with Grams-Charlier expansion which depends on the wind direction.

BRDF and Atmosphere modeling by: Alexei Lyapustin

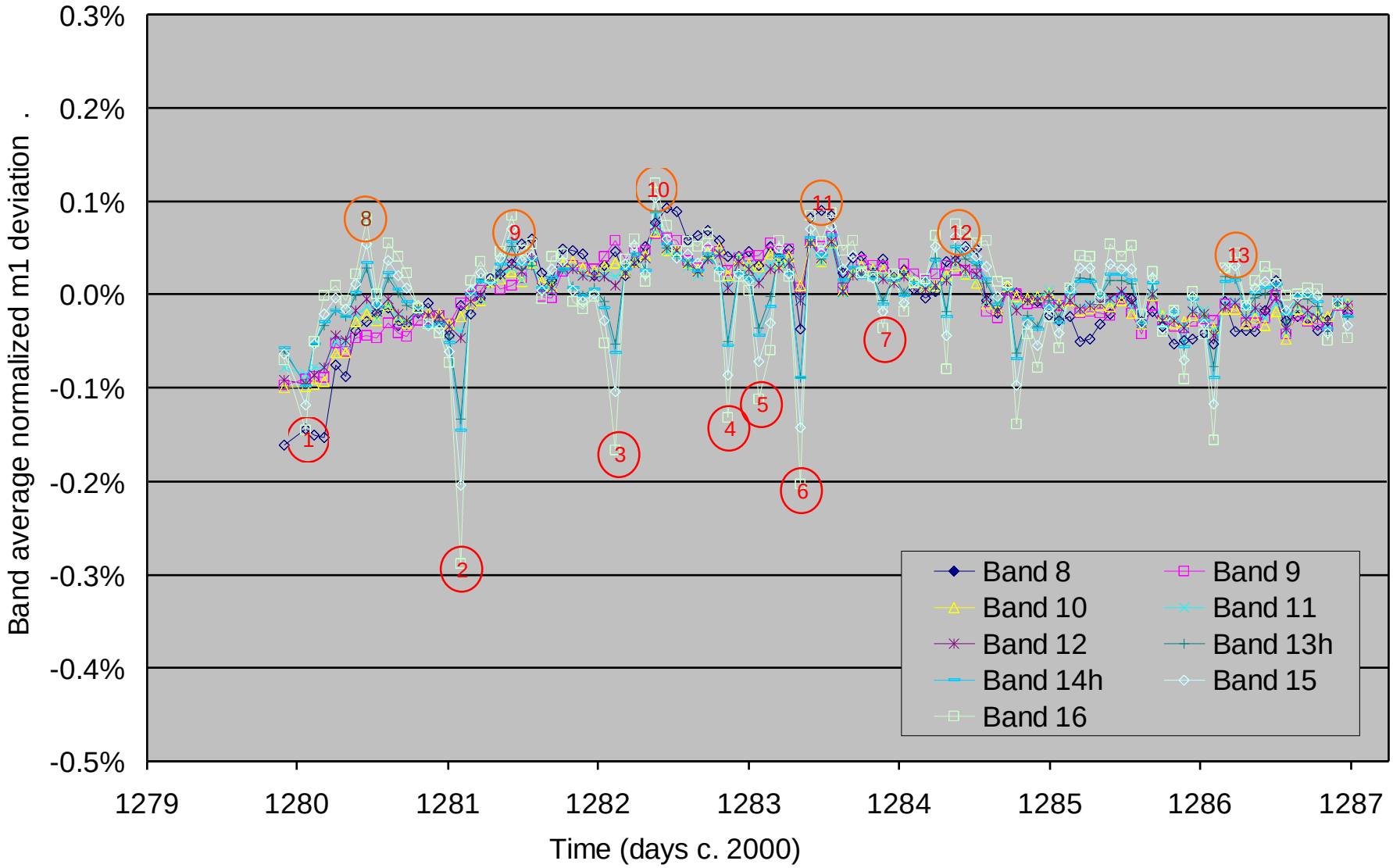
MODIS/Terra m1s (7 days, Ocean bands)



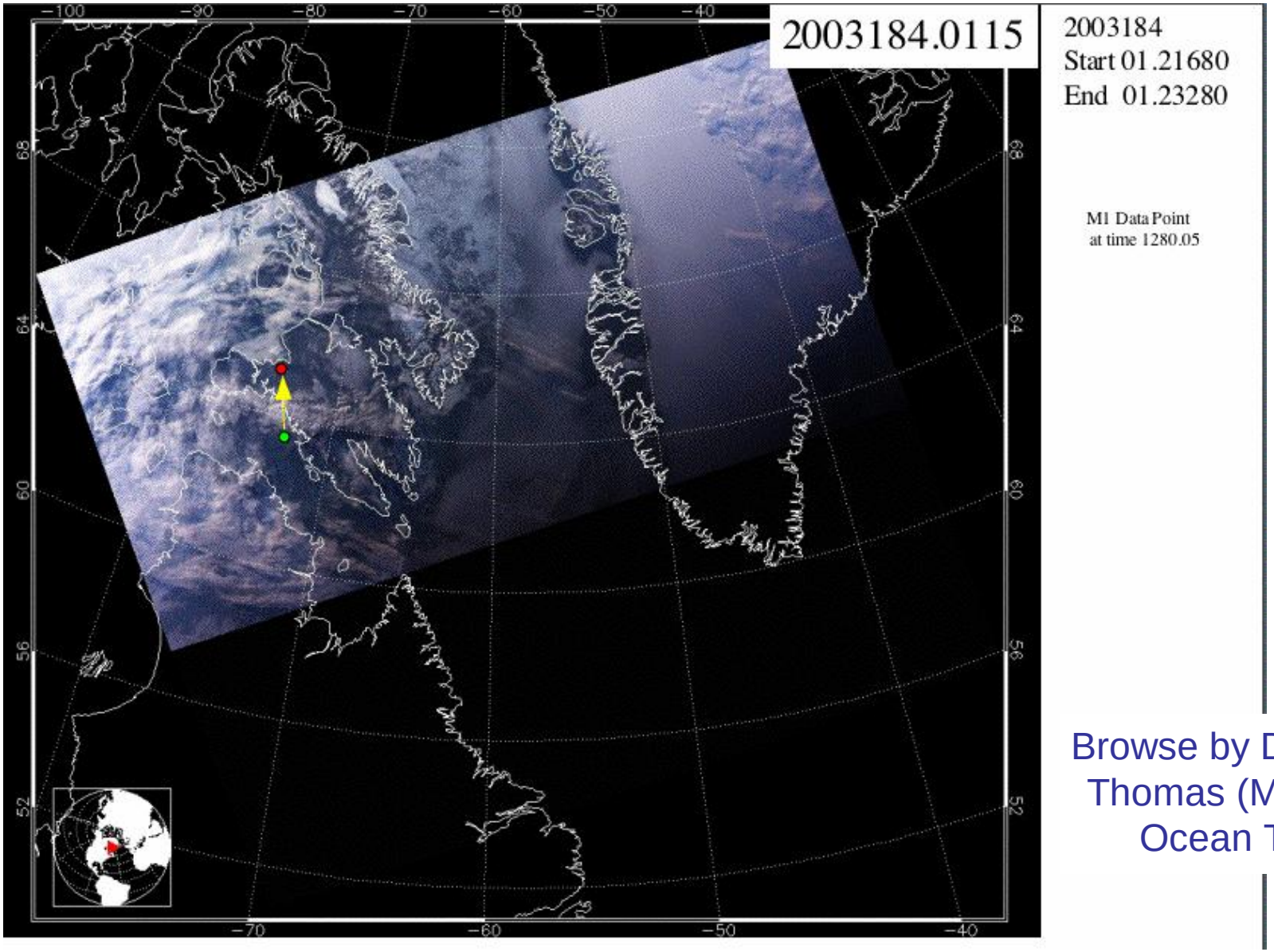
MODIS/Terra m1s (7 days, Land/Atmos. bands)



MODIS/Terra Browse Examples

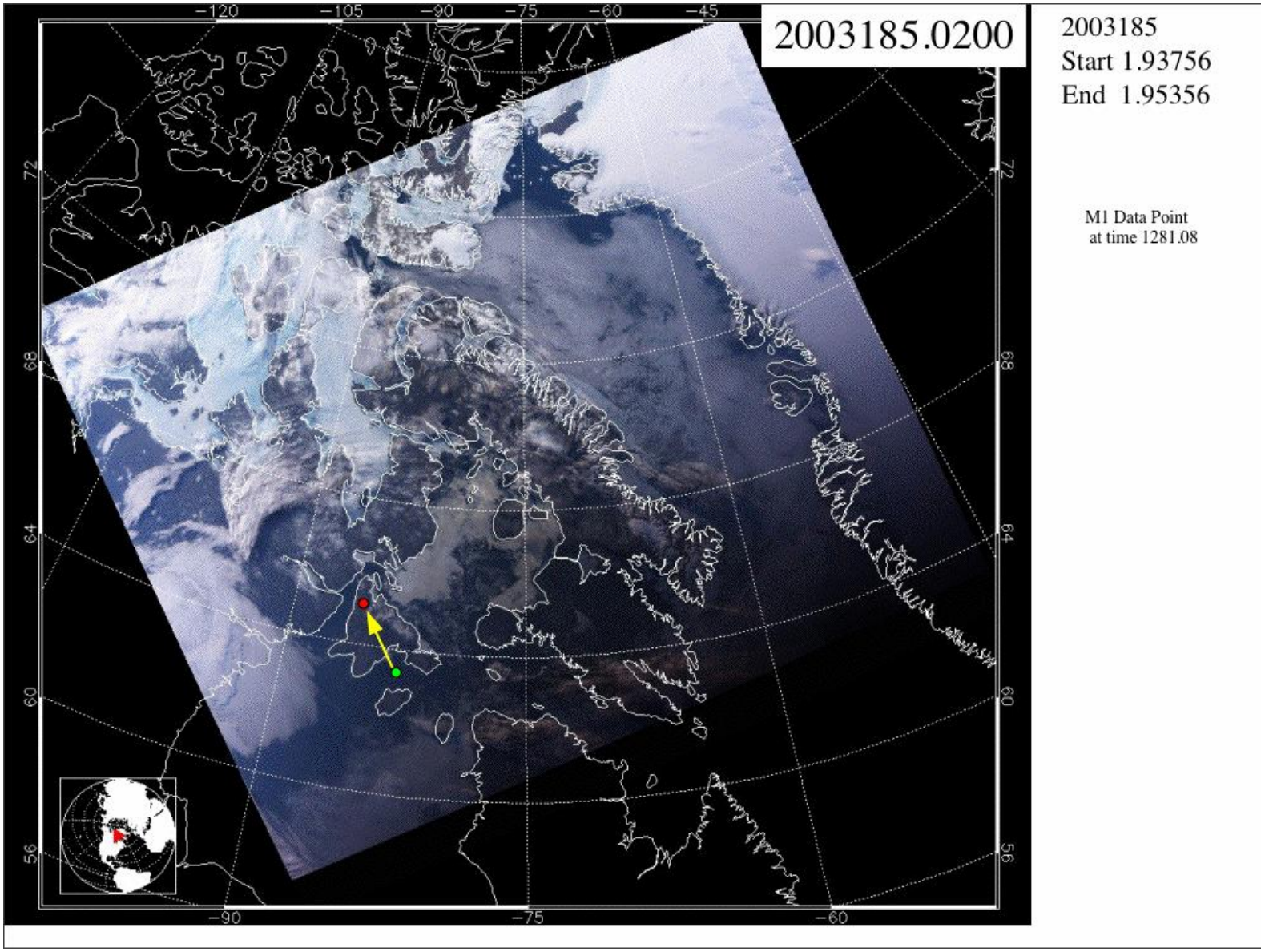


1. -0.15 (band 16 m1 residual)

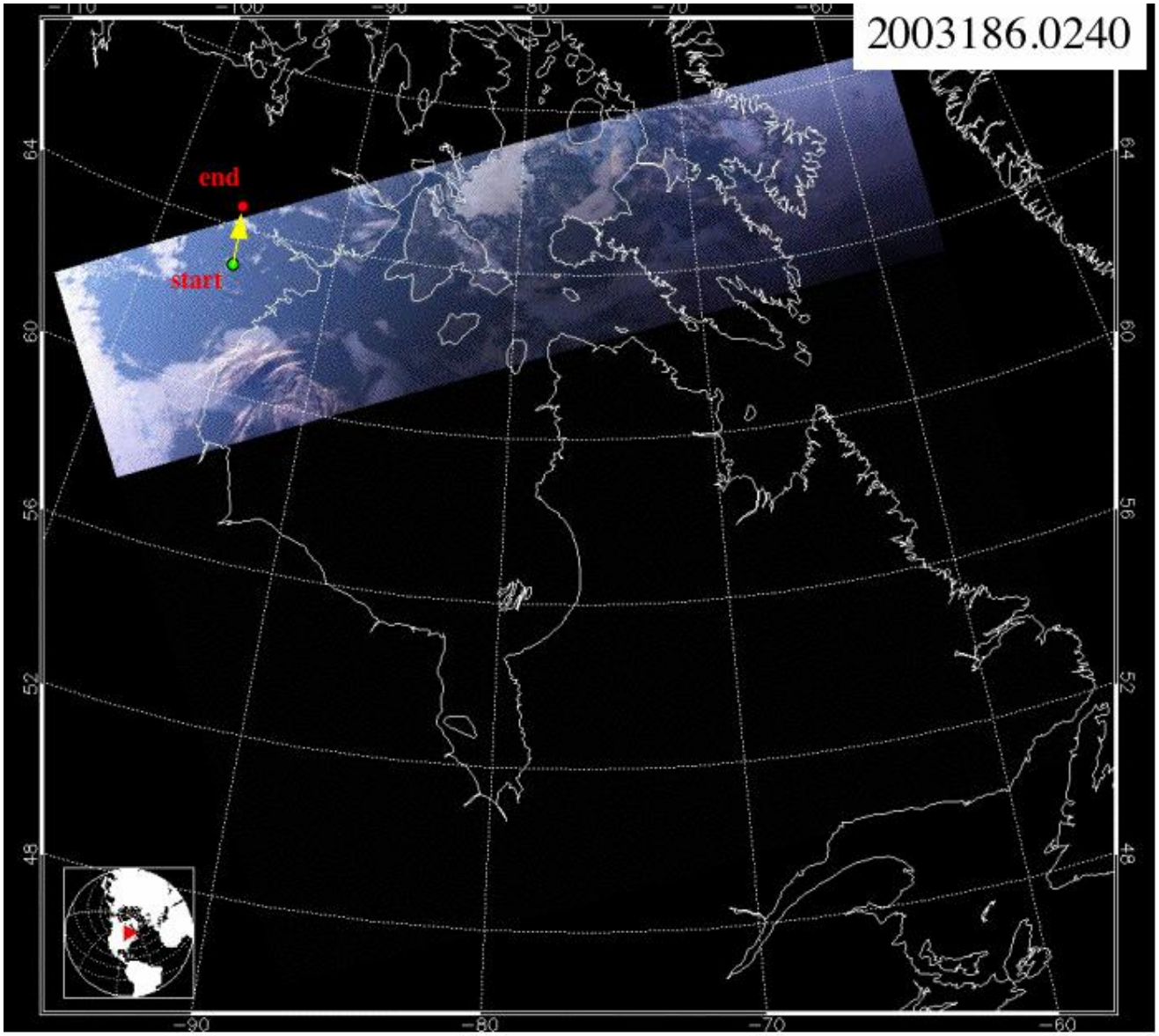


Browse by Donna Thomas (MODIS Ocean Team)

2. -0.29


2003185.0200
2003185
Start 1.93756
End 1.95356
M1 Data Point
at time 1281.08
−120
−105
−90
−75
−60
−45
72
68
64
60
56

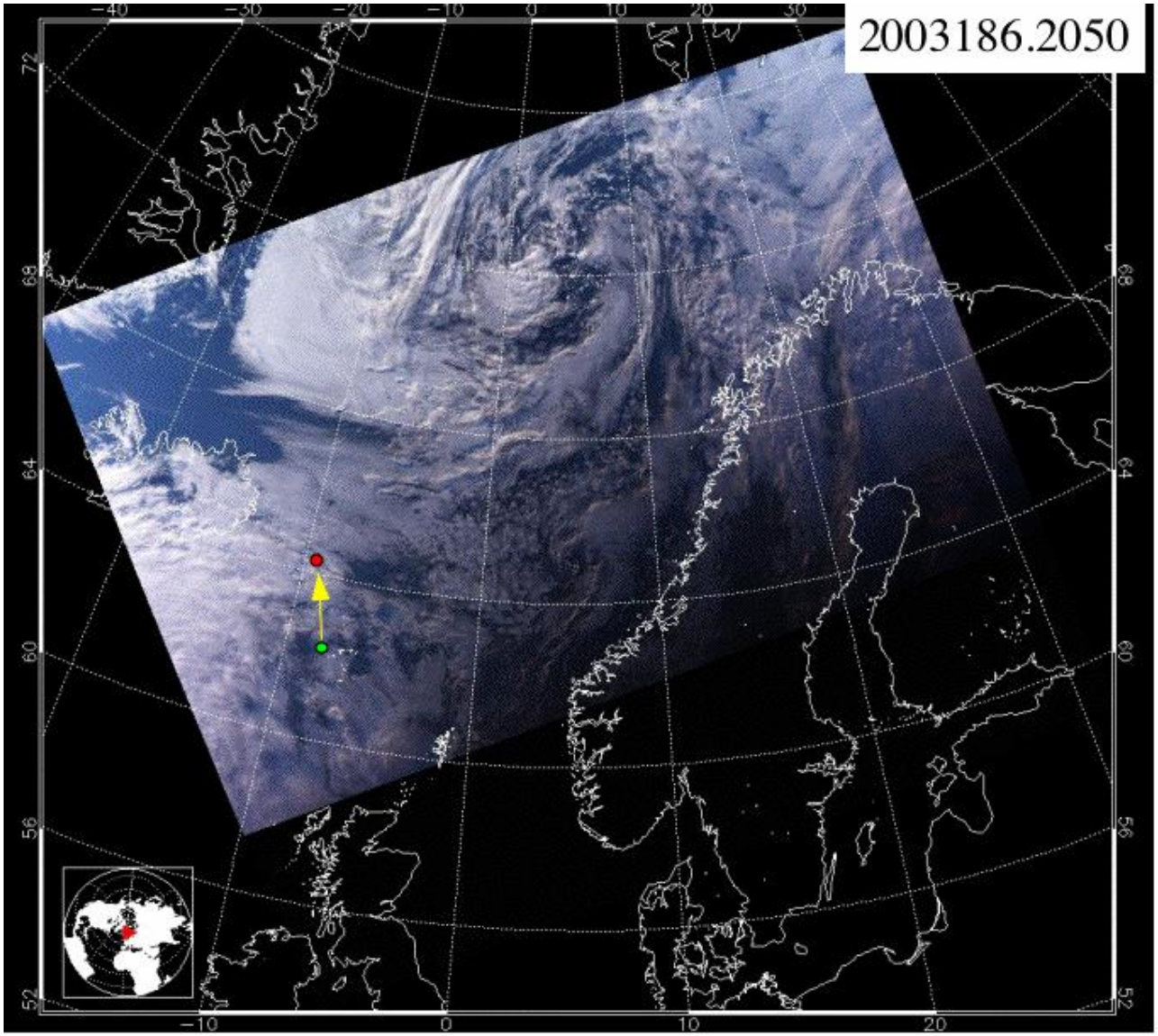
3. -0.17



2003186
Start 02.65832
End 02.67432

M1 Data Point
at time 1282.11

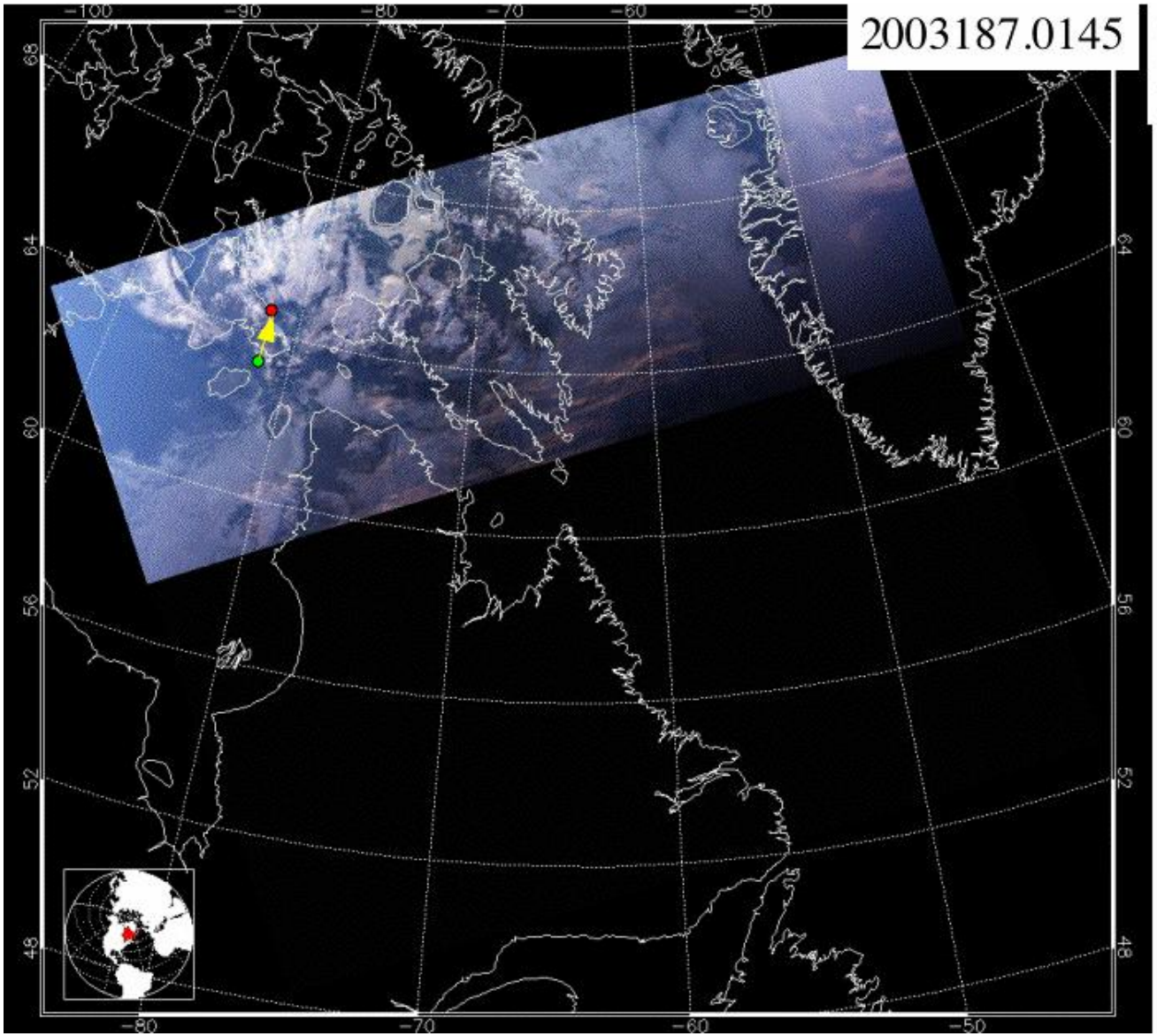
4. -0.13



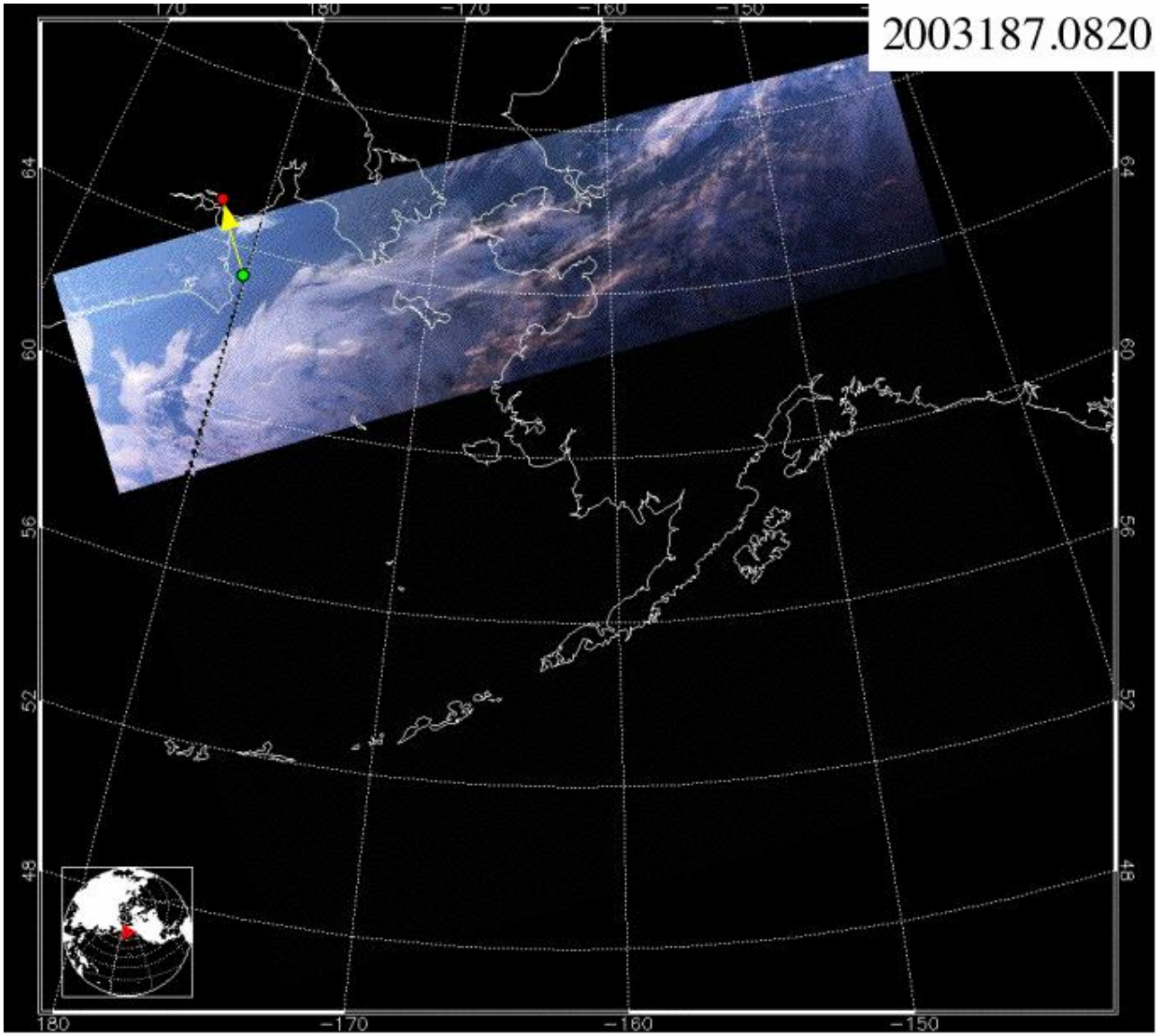
2003186
Start 20.78693
End 20.80293

M1 Data Point
at time 1282.86

5. -0.11


2003187.0145
2003187
Start 01.73124
End 01.74725
M1 Data Point
at time 1283.07
-100
-90
-80
-70
-60
-50
68
64
60
56
52
48

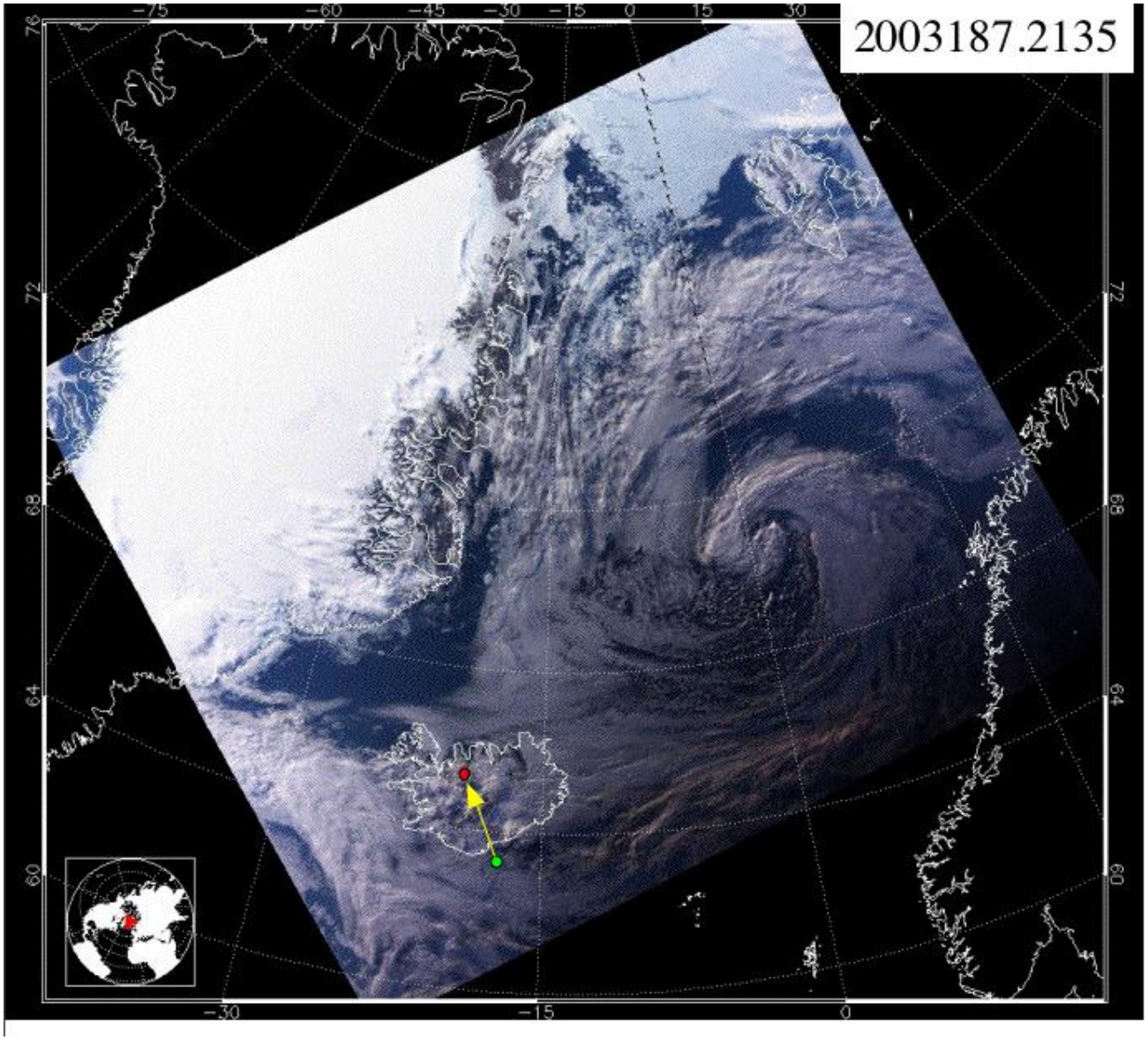
6. -0.20



2003187
Start 08.32339
End 08.33939

M1 Data Point
at time 1283.34

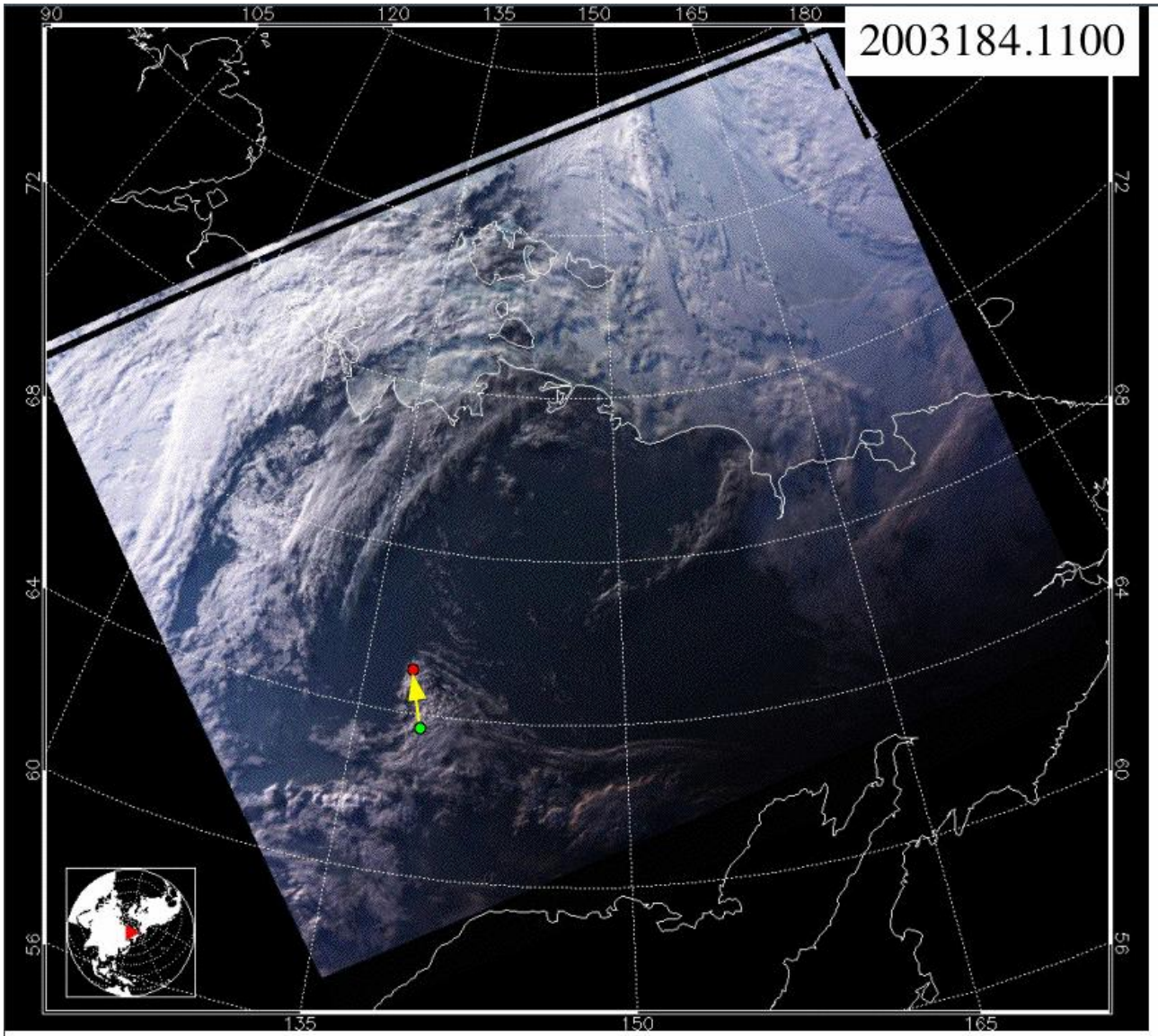
7. -0.04



2003187
Start 21.50810
End 21.52410

M1 Data Point
at time 1283.89

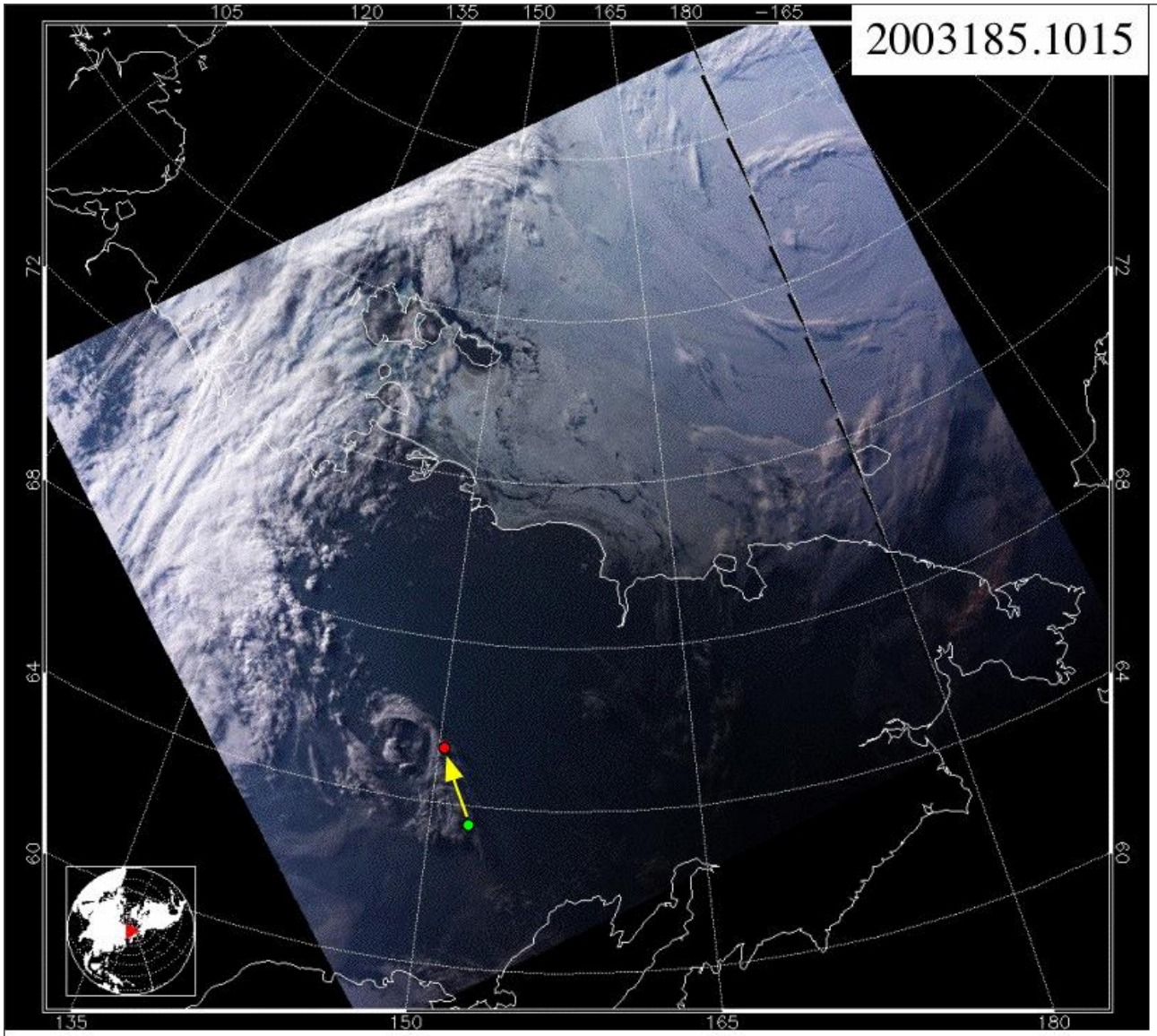
8. 0.08



2003184
Start 11.10502
End 11.12103

M1 Data Point
at time 1280.46

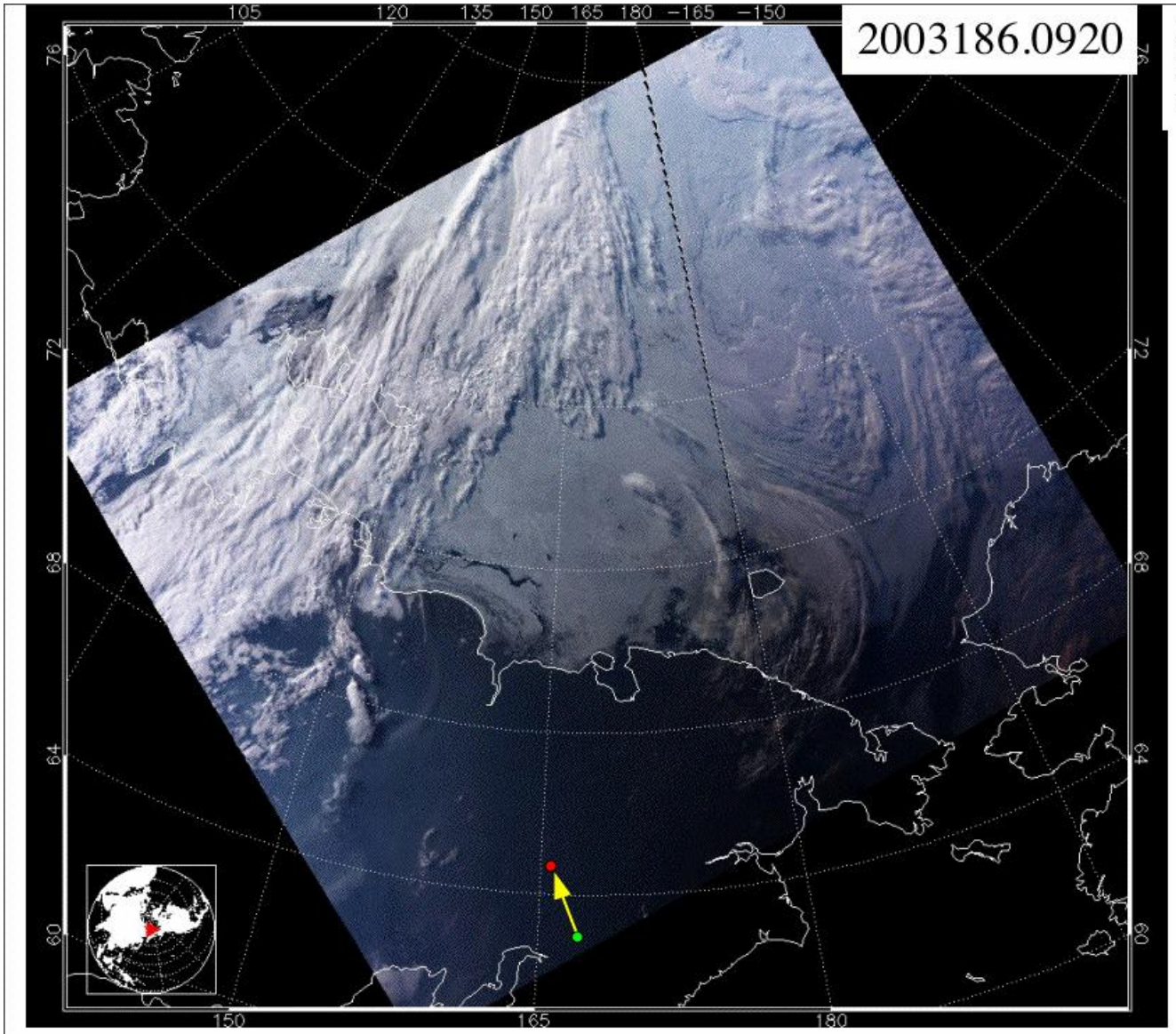
9. 0.08



2003185
Start 10.17795
End 10.19395

M1 Data Point
at time 1281.42

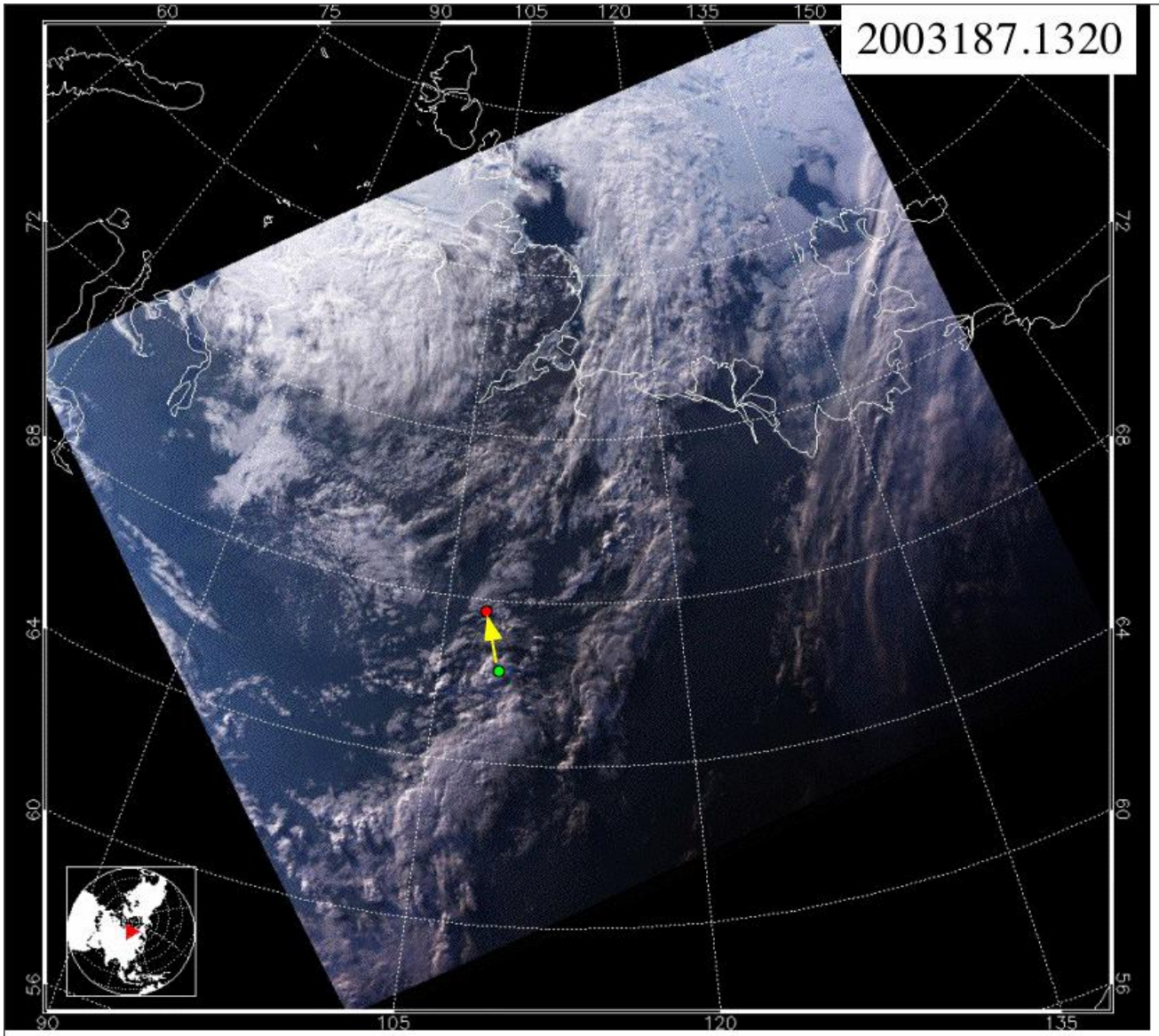
10. 0.12



2003186
Start 9.25088
End 9.26688

M1 Data Point
at time 1282.38

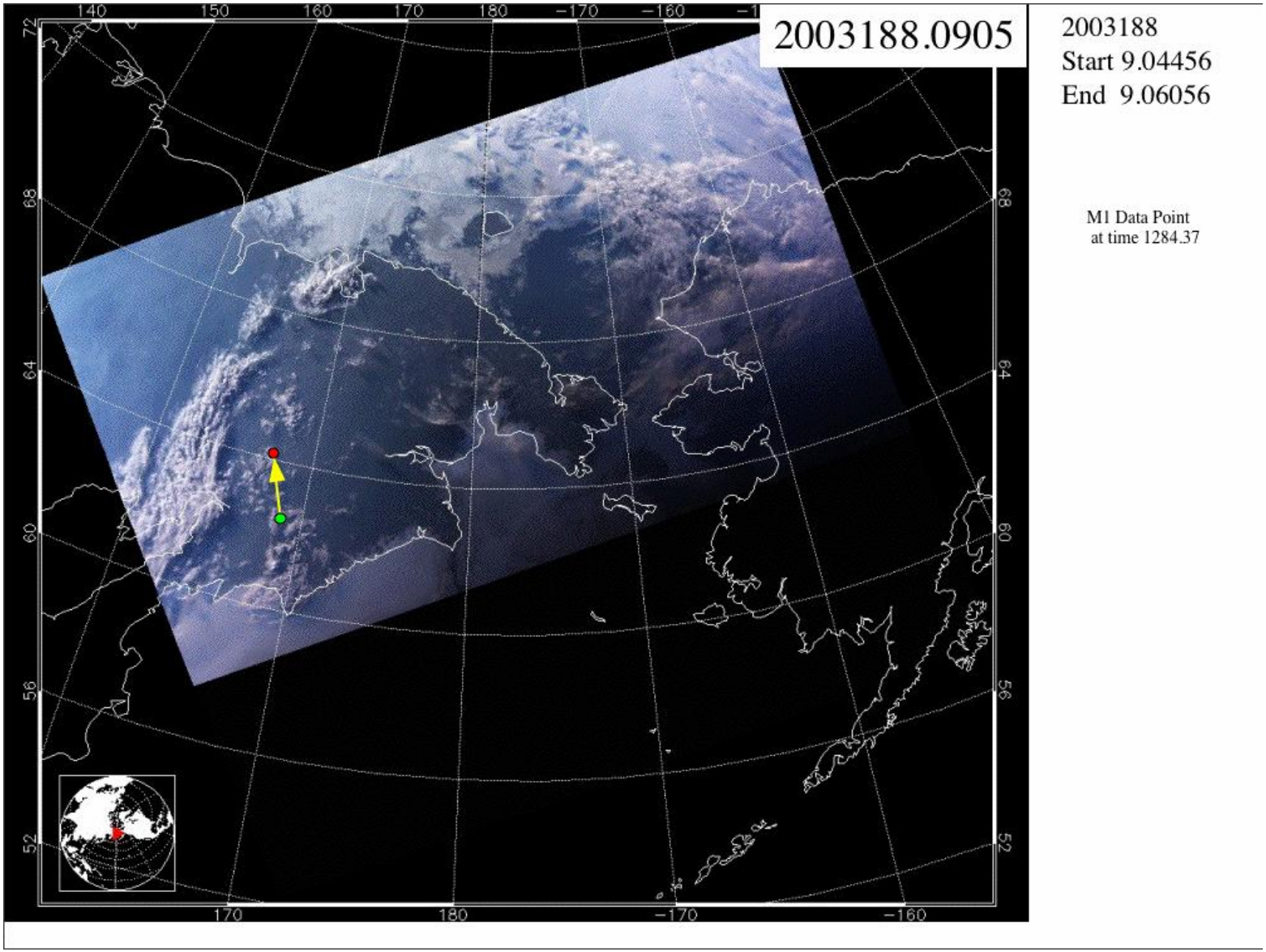
11. 0.09



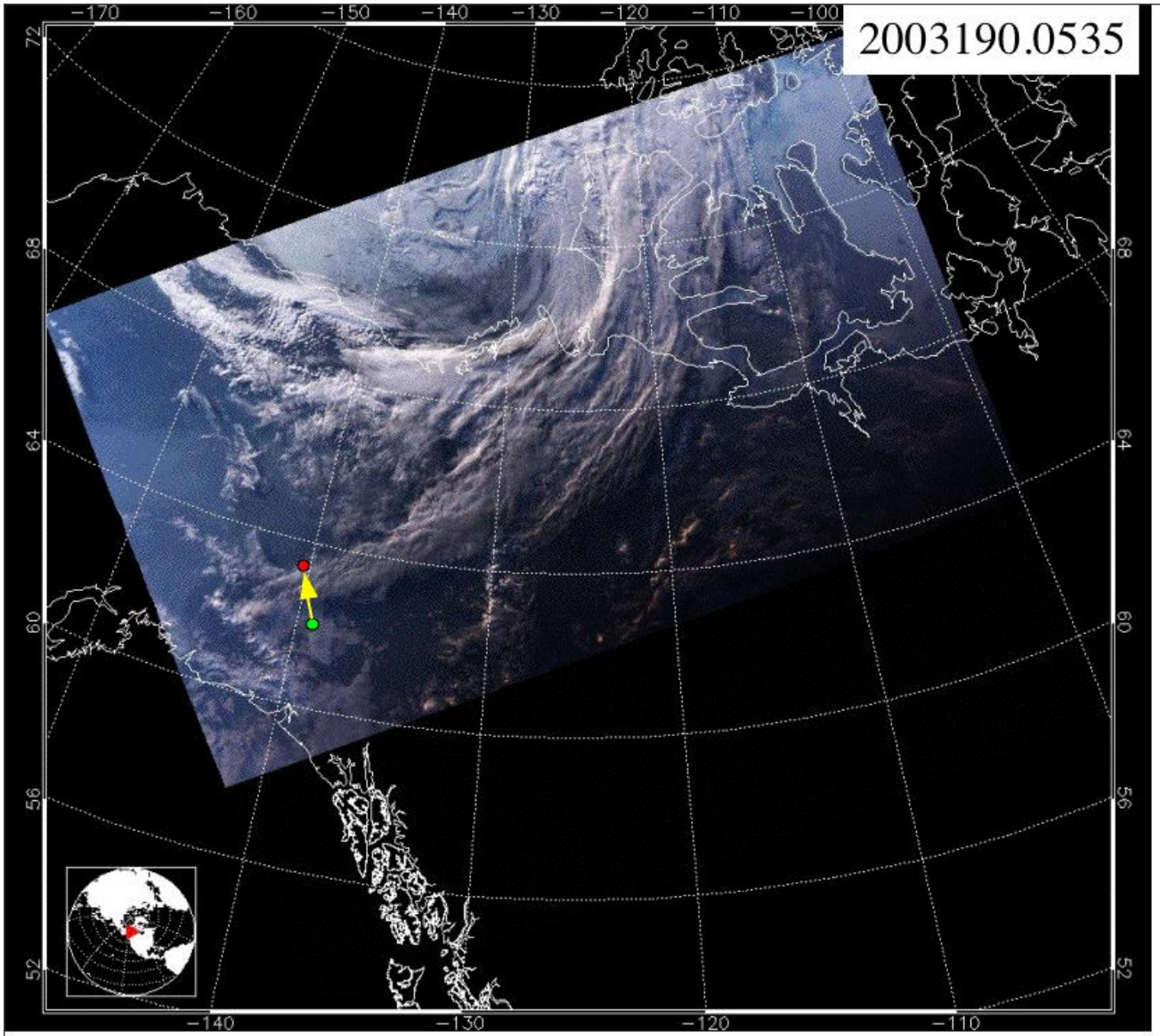
2003187
Start 13.26771
End 13.28371

M1 Data Point
at time 1283.55

12. 0.08


2003188.0905
2003188
Start 9.04456
End 9.06056
M1 Data Point
at time 1284.37
140
150
160
170
180
−170
−160
72
68
64
60
56
52

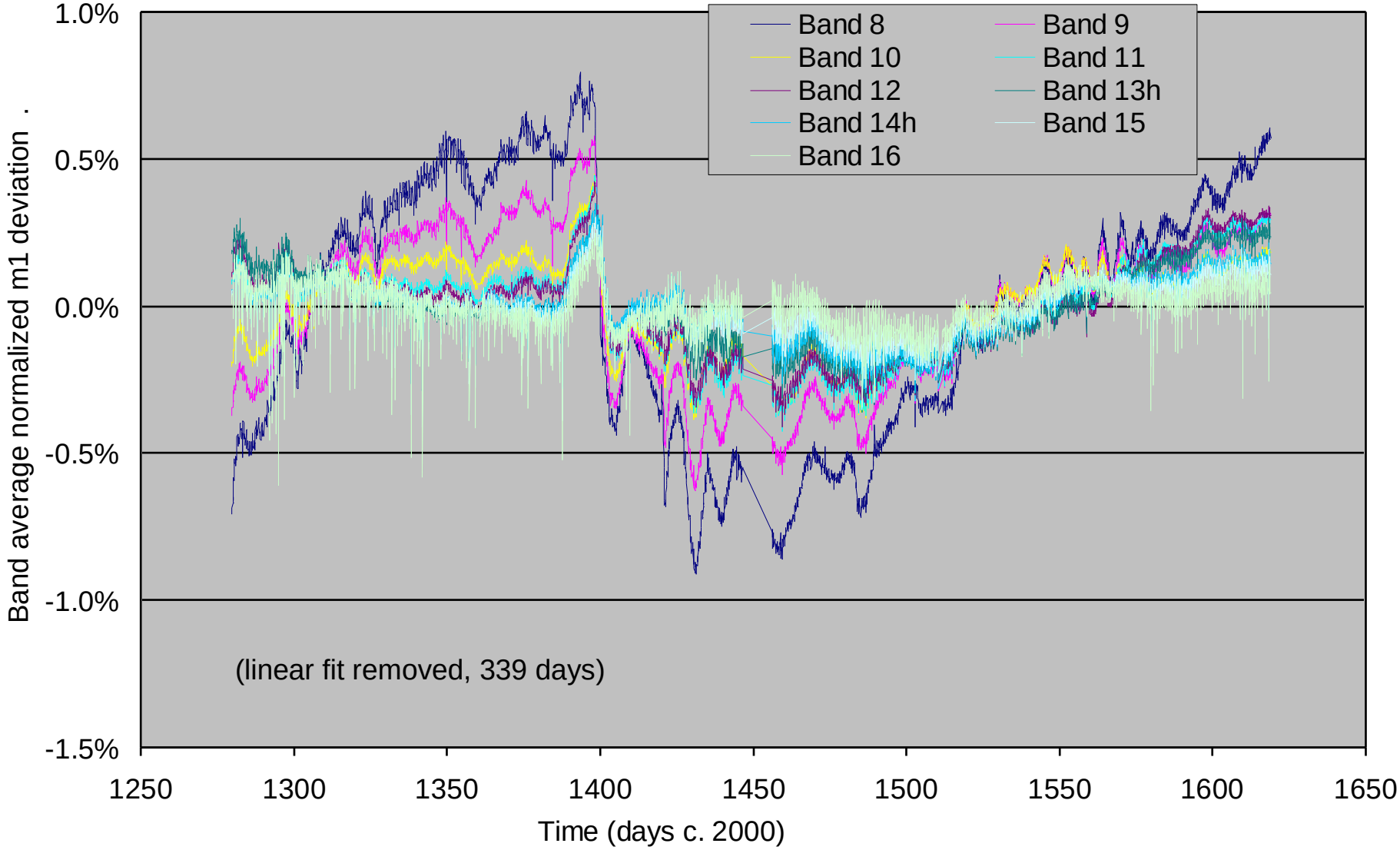
13. 0.04



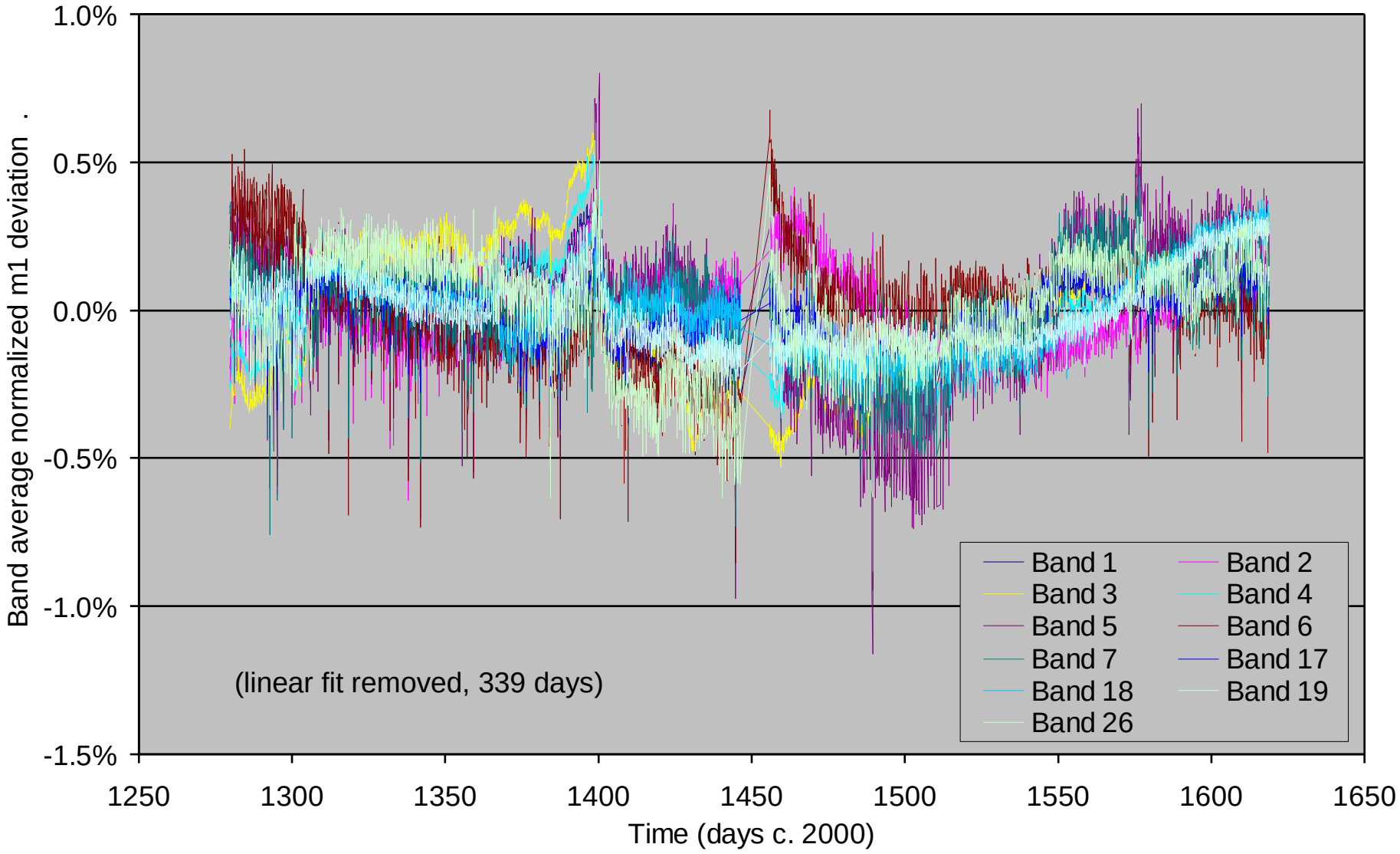
2003190
Start 5.54217
End 5.55817

M1 Data Point
at time 1286.23

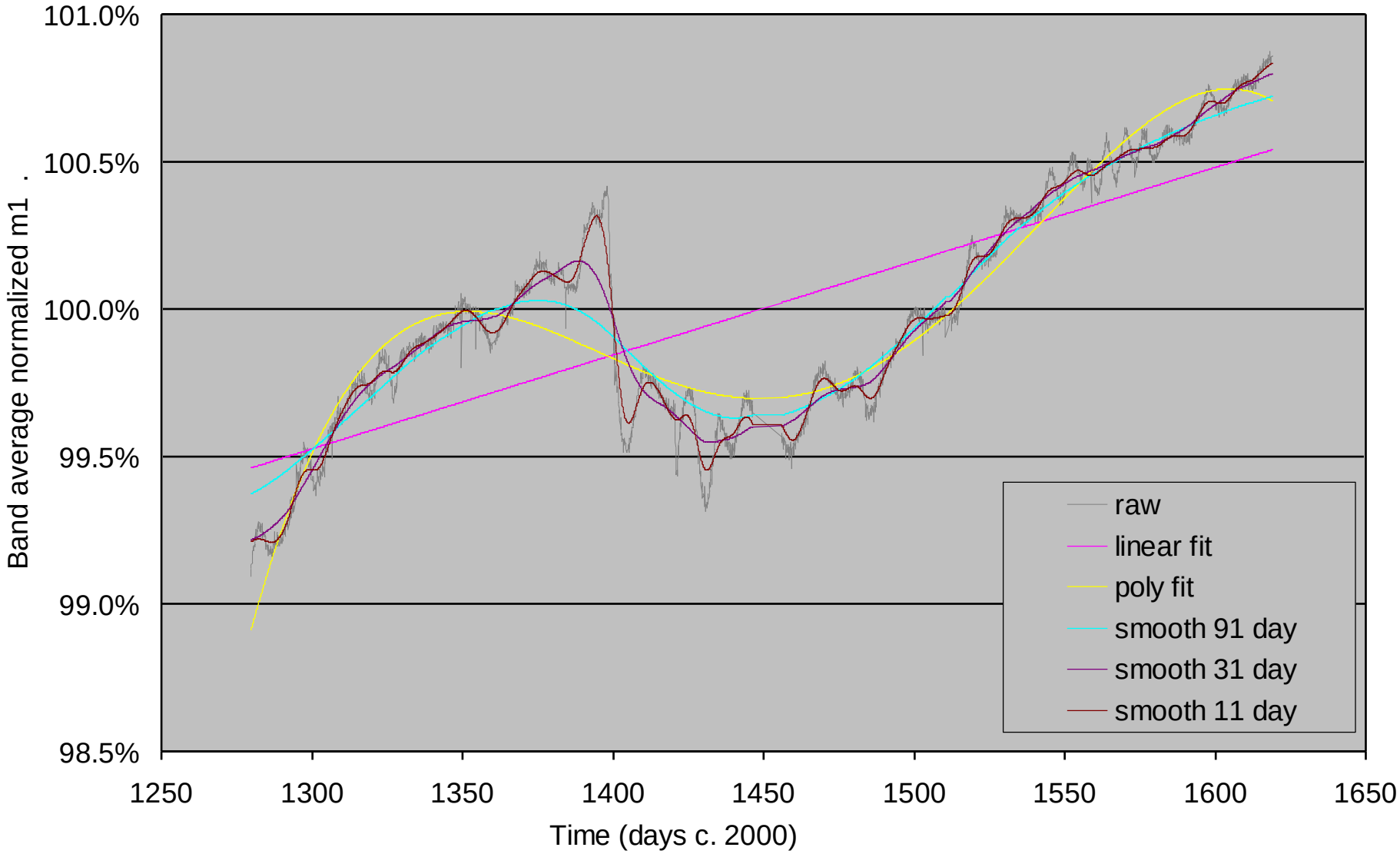
MODIS/Terra m1s (1 year, Ocean bands)



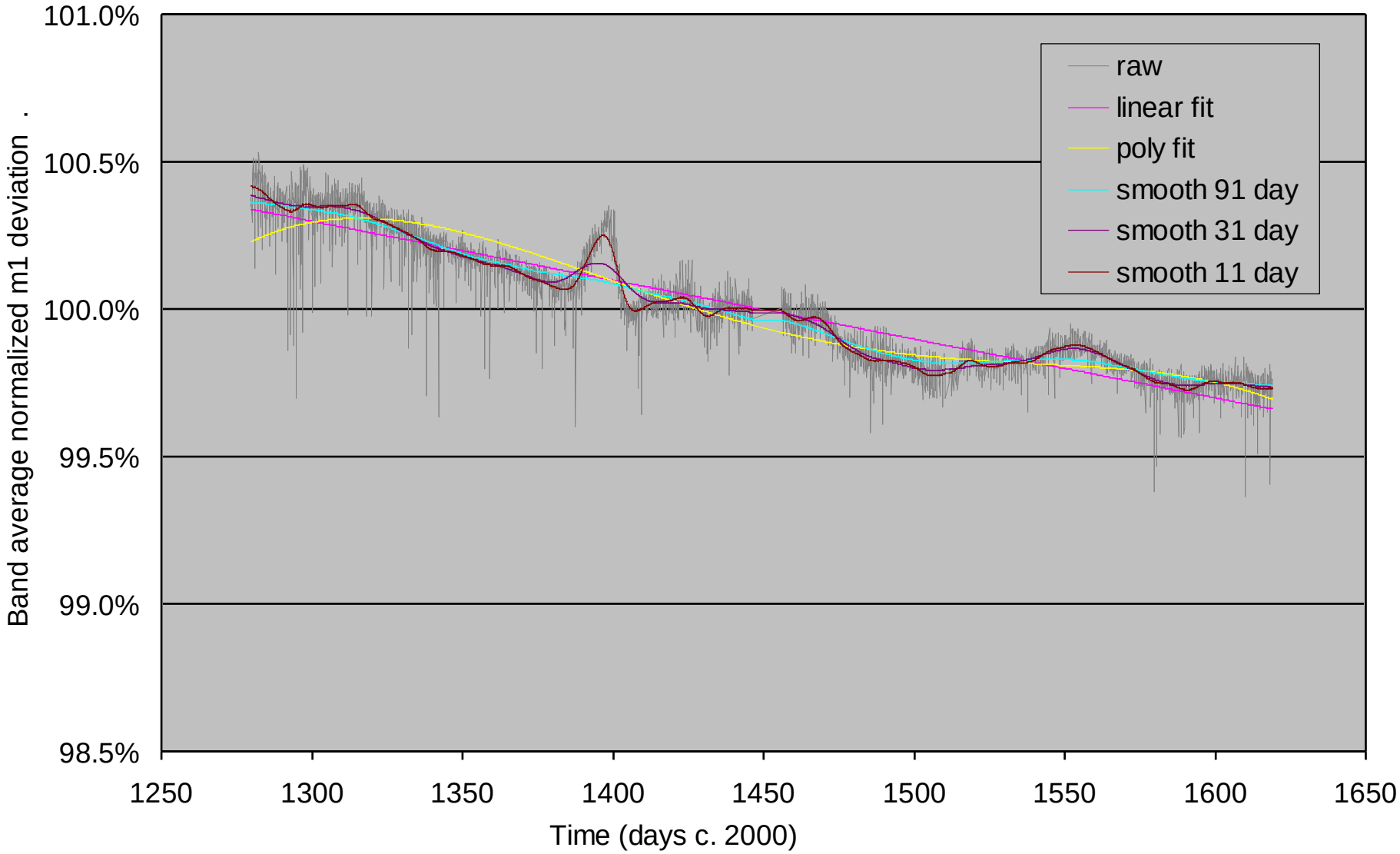
MODIS/Terra m1s (1 year, Land/Atmos. bands)



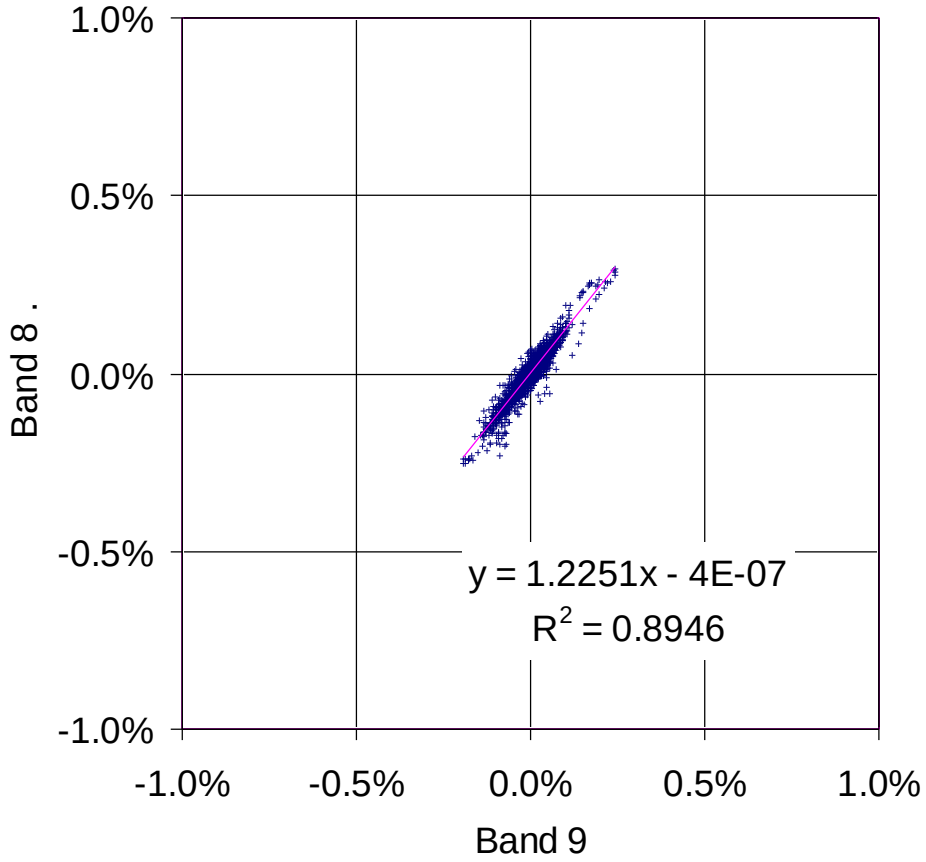
Band 9 – smoothing and fitting

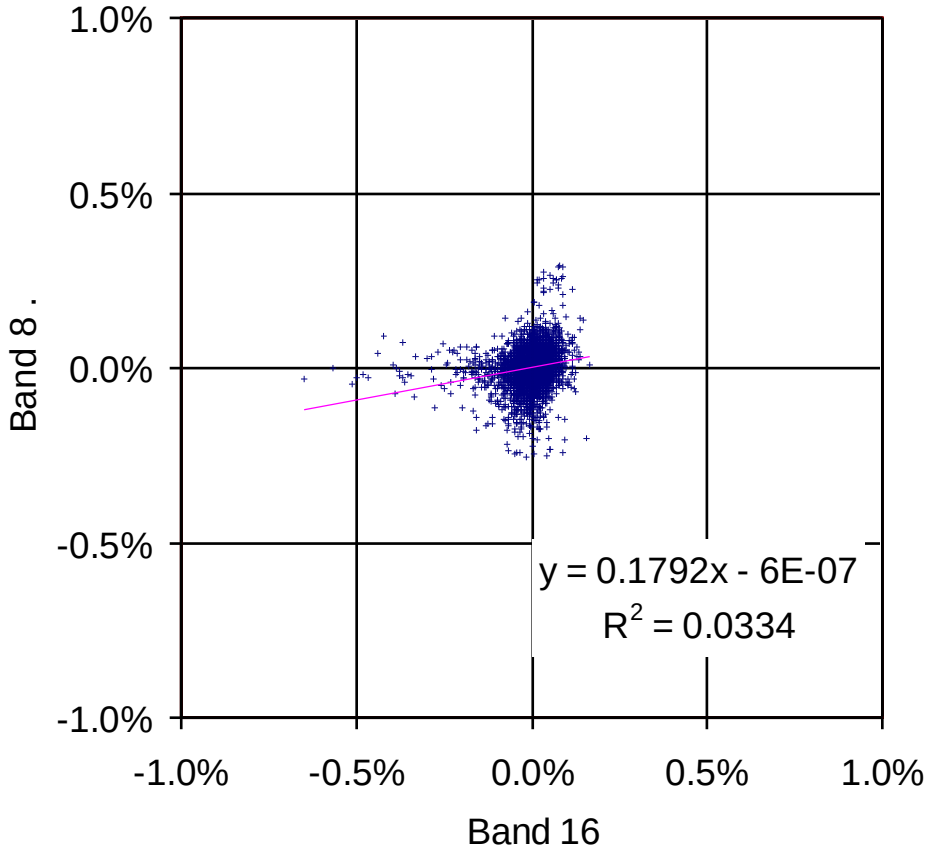


Band 16 – smoothing and fitting



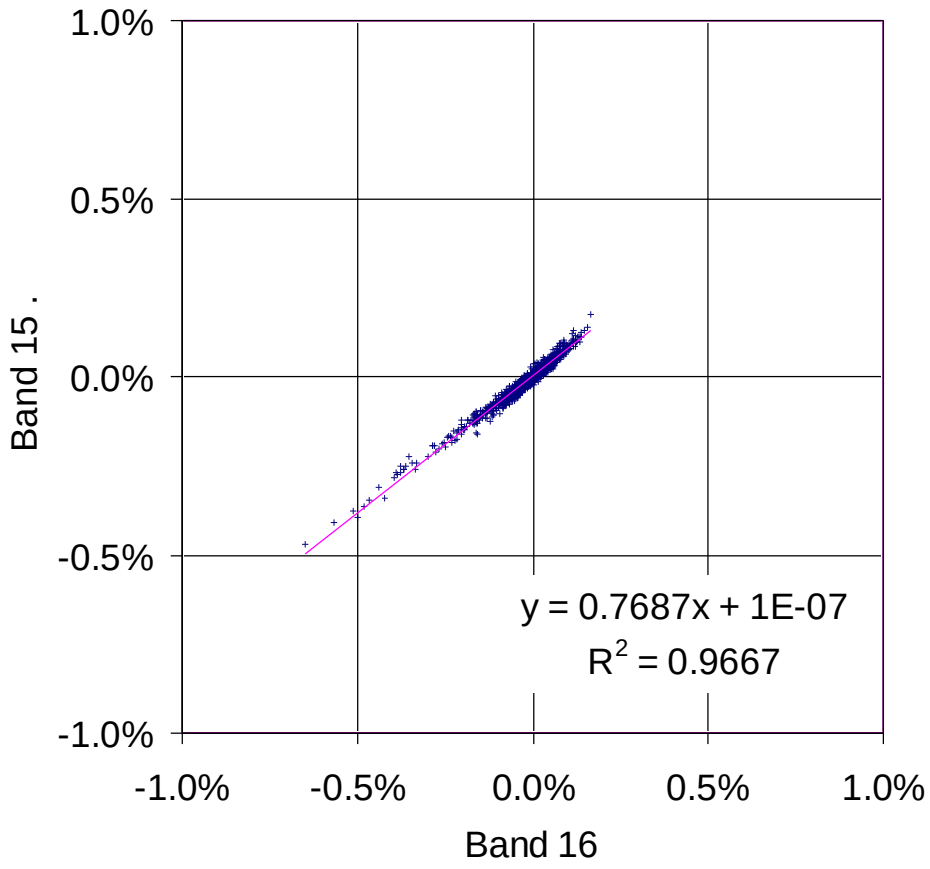
Band 8 vs. 9 and 16

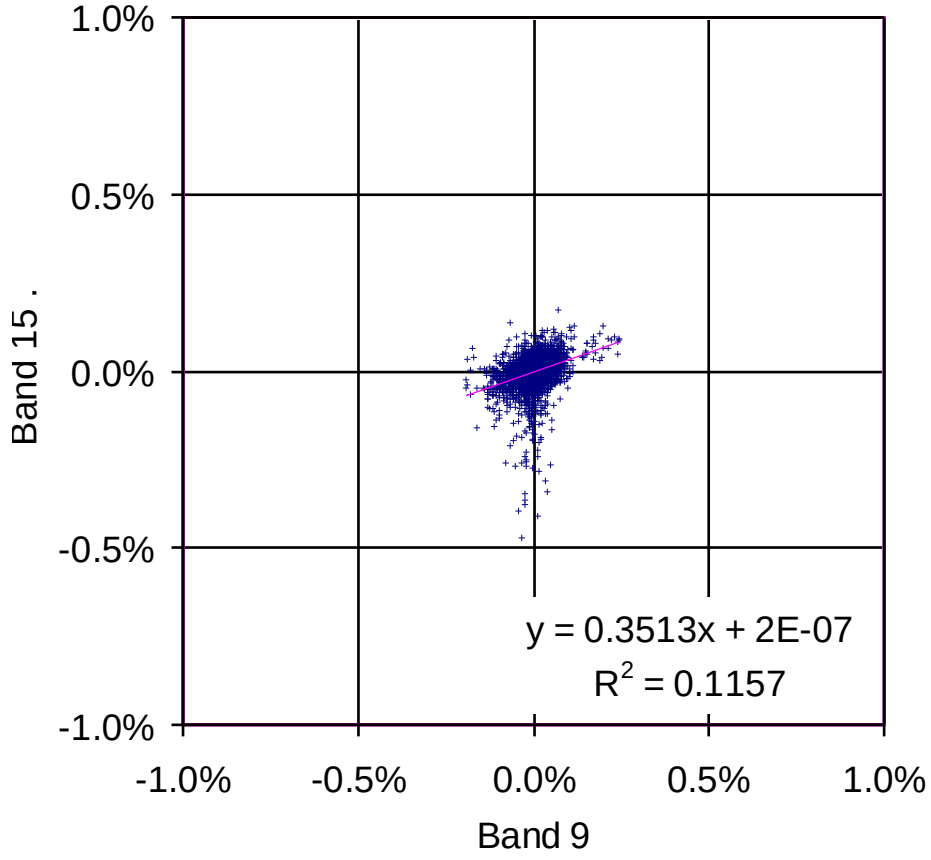




(after 11 day smooth fit removed)

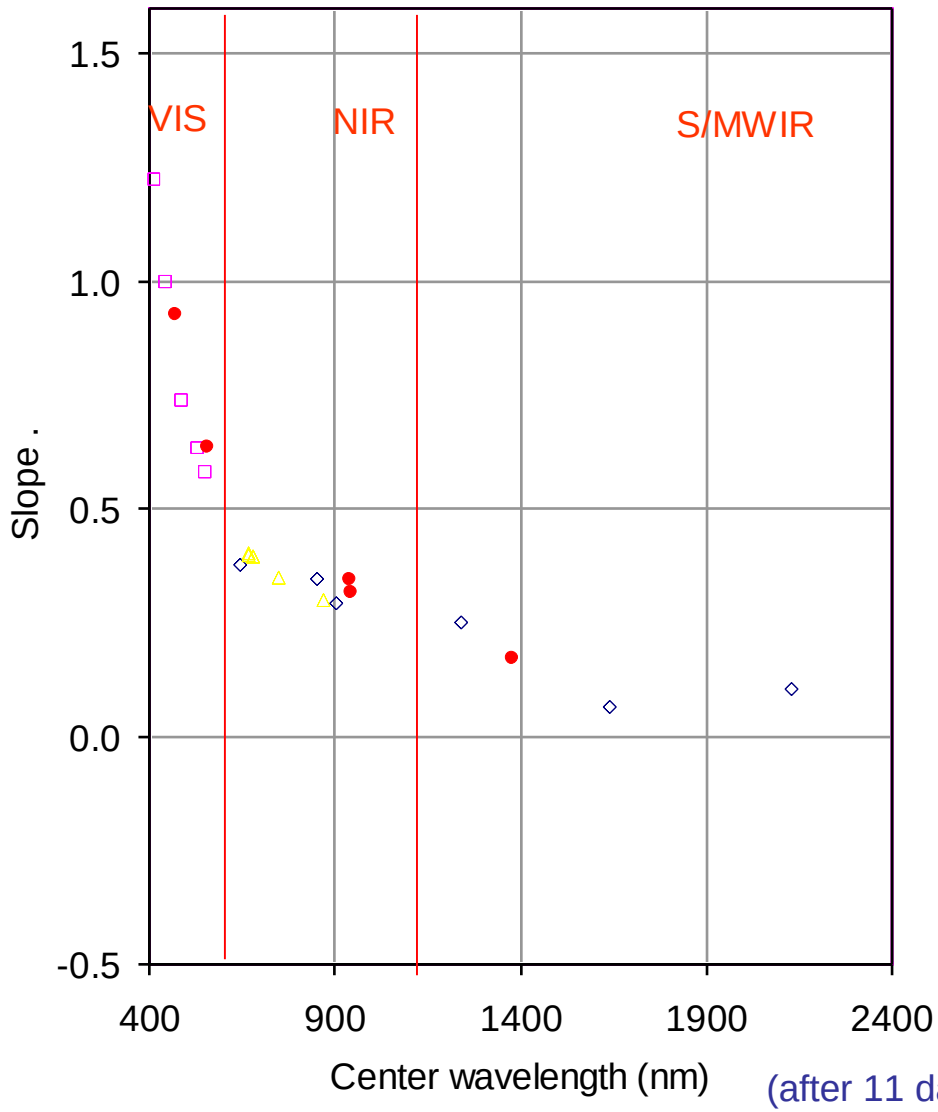
Band 15 vs. 9 and 16

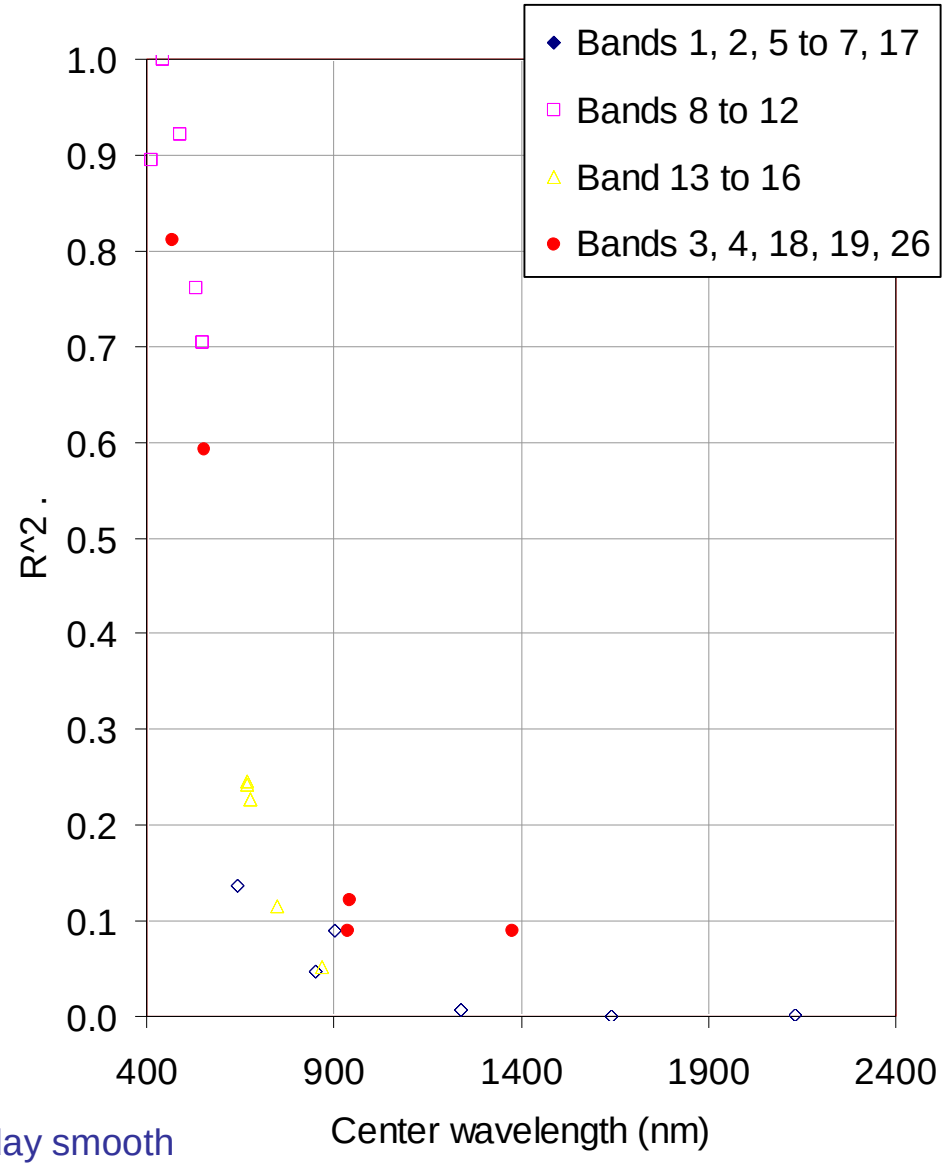




(after 11 day smooth fit removed)

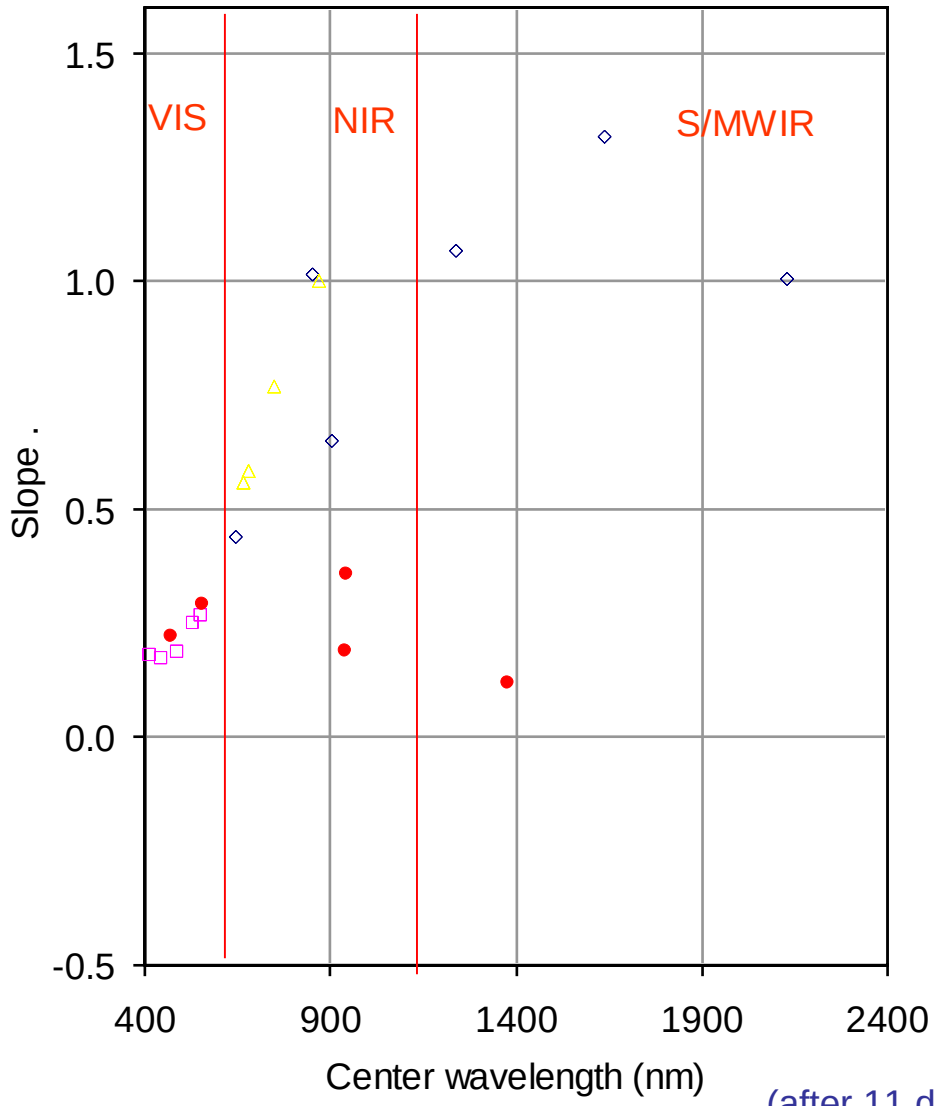
All bands vs. Band 9

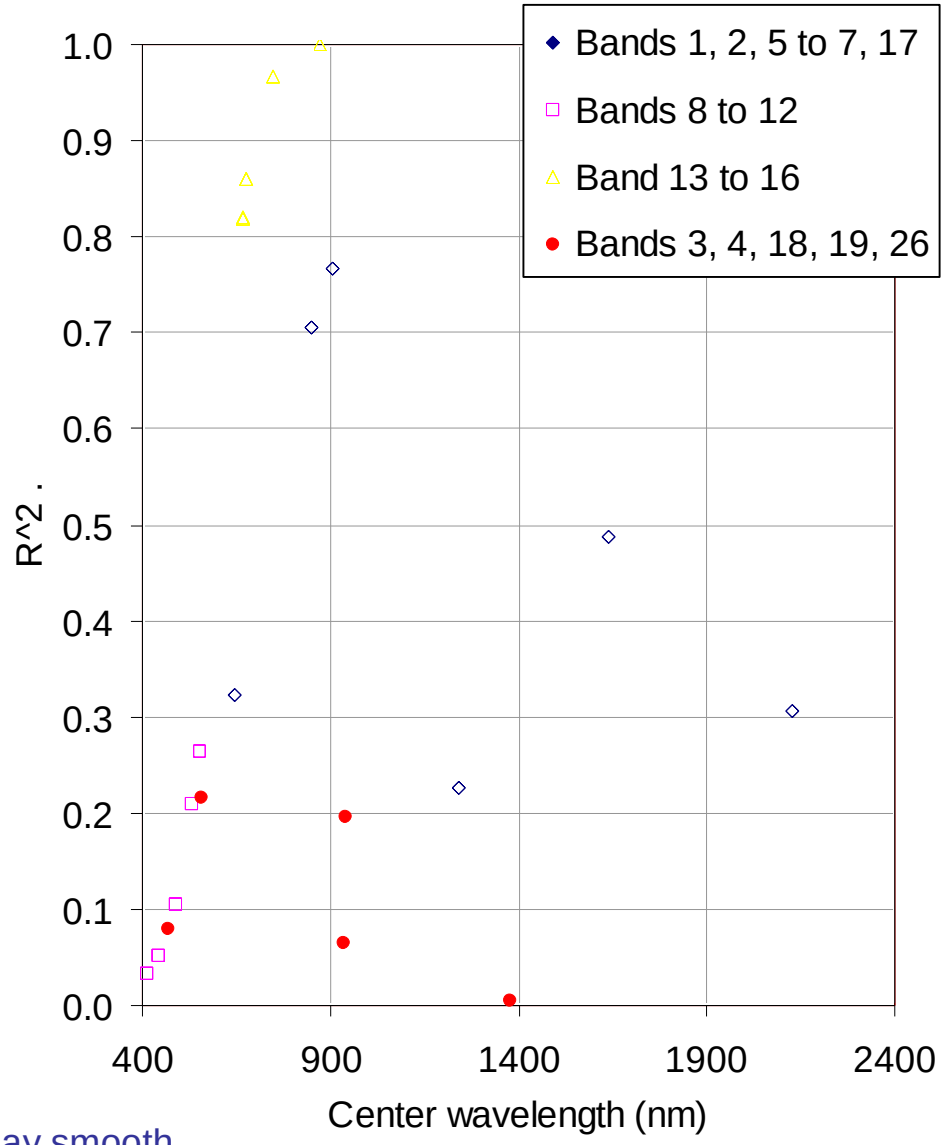




(after 11 day smooth fit removed)

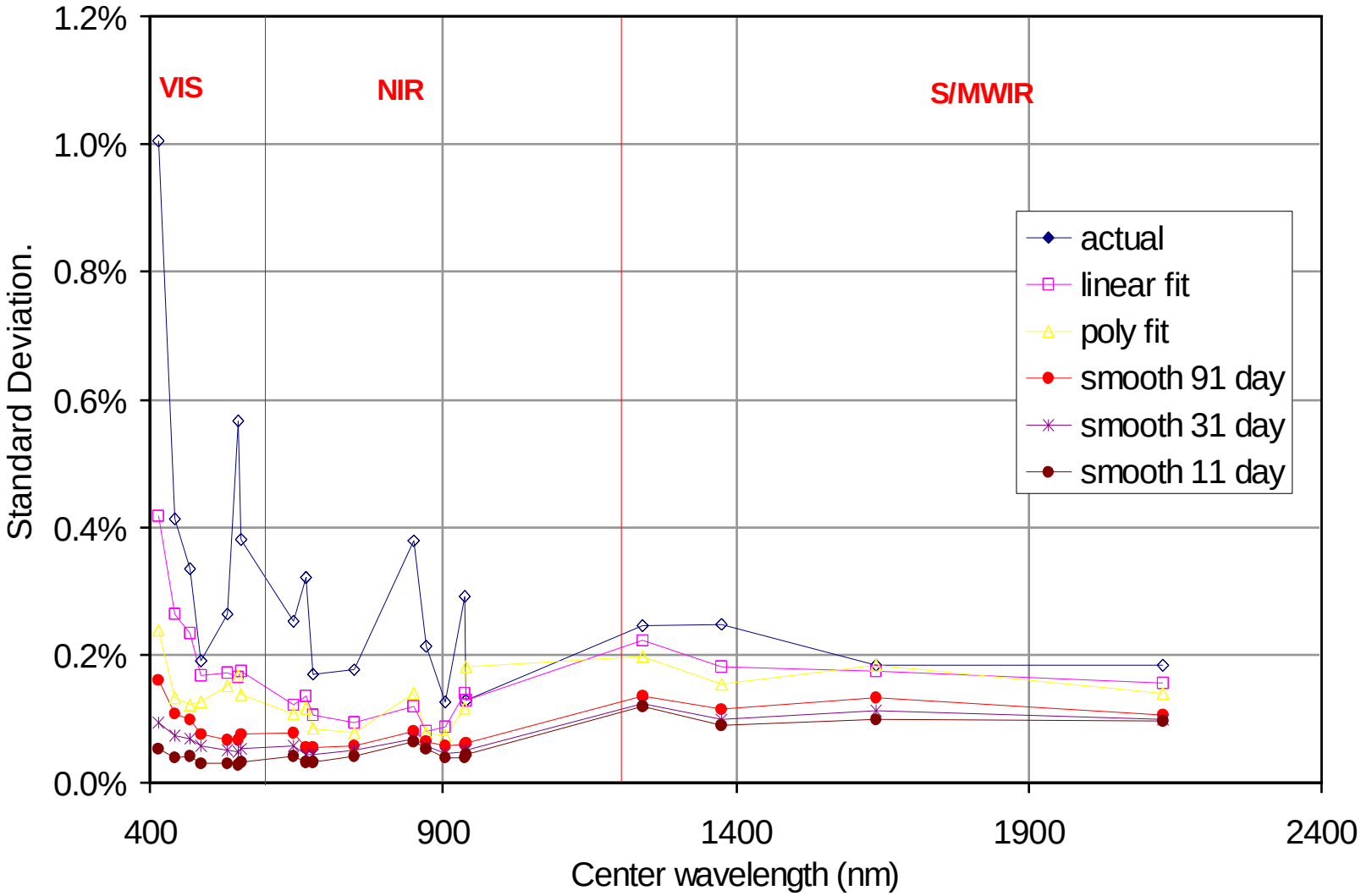
All bands vs. Band 16





(after 11 day smooth fit removed)

Deviation (all bands)



Summary

- Early Terra SD measurements (before July 2003) and Aqua SD measurements are done once per week and not averaged (smoothed) so individual measurements may be contaminated
- The Earthshine bias (~0.5%) should be estimated
- Non-uniform illumination of SD may contribute to detector striping
- A better understanding is needed of atmosphere and cloud contribution to the short (VIS) wave lengths
- Possible SD/Earthshine model improvements: atmosphere, sea-surface, polarization, etc.