SBUV/OMPS: present and future work

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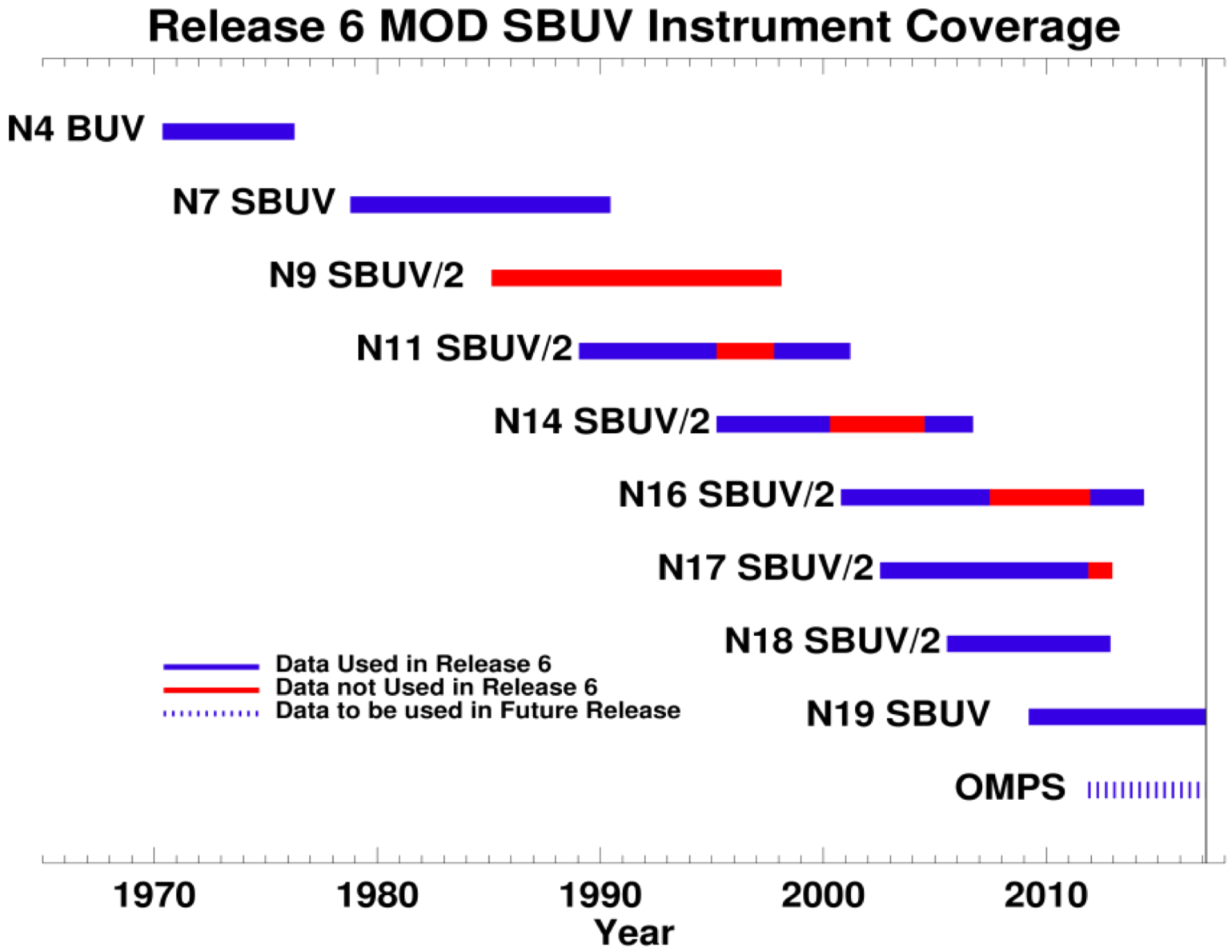
CEOS meeting, May 2-4, 2018, College Park, MD

Time series of NASA's BUV nadir instruments



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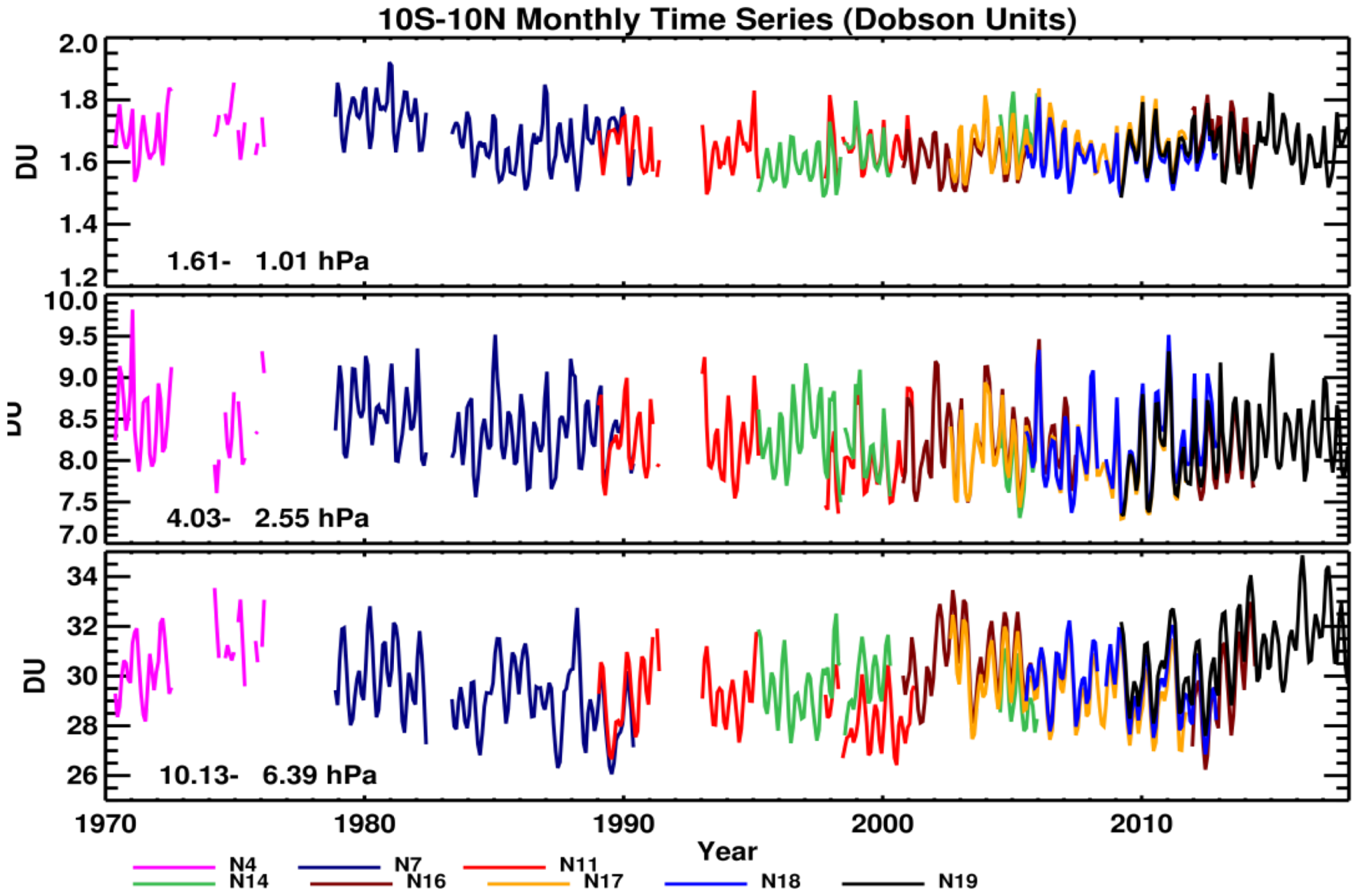

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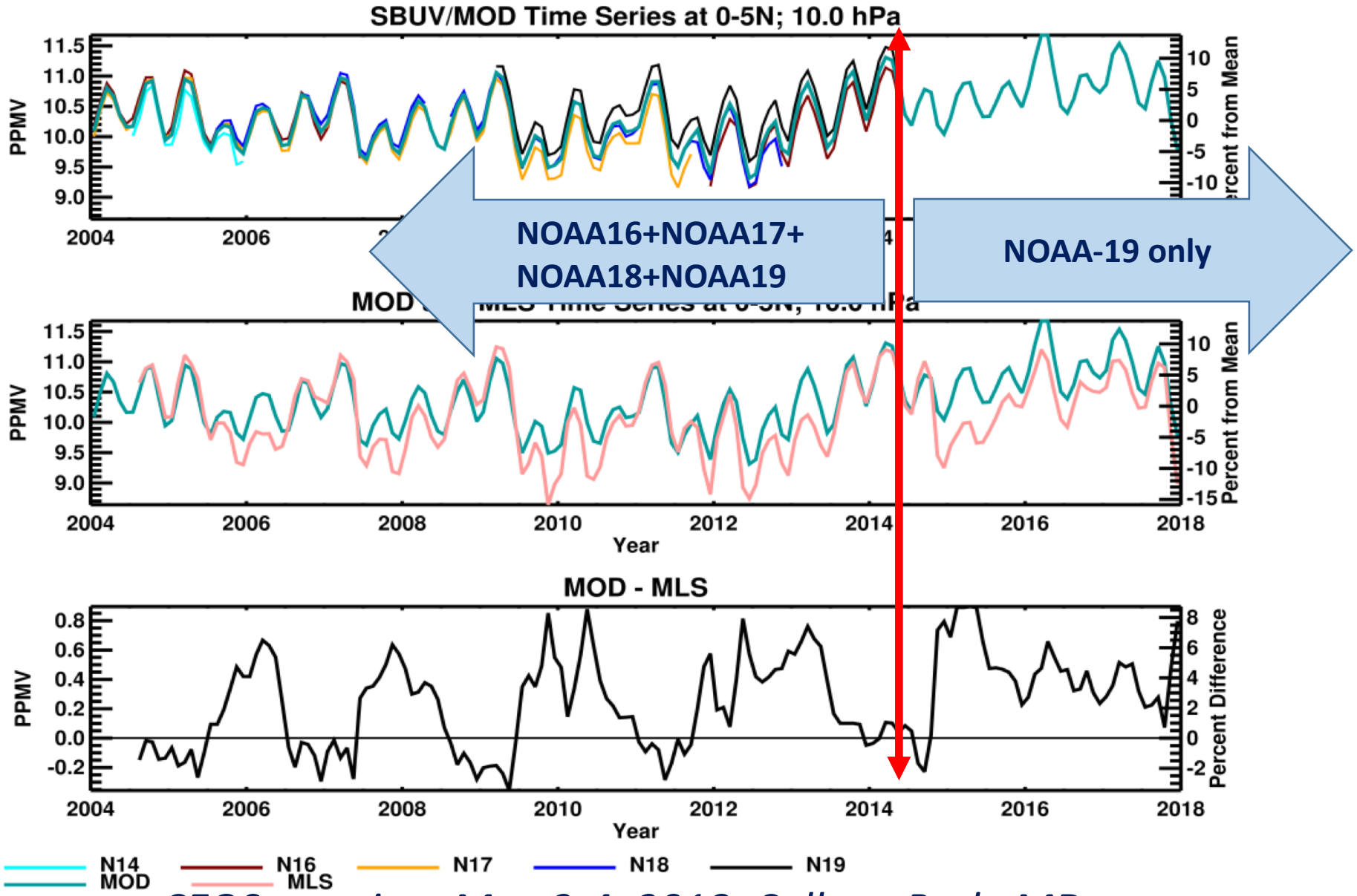
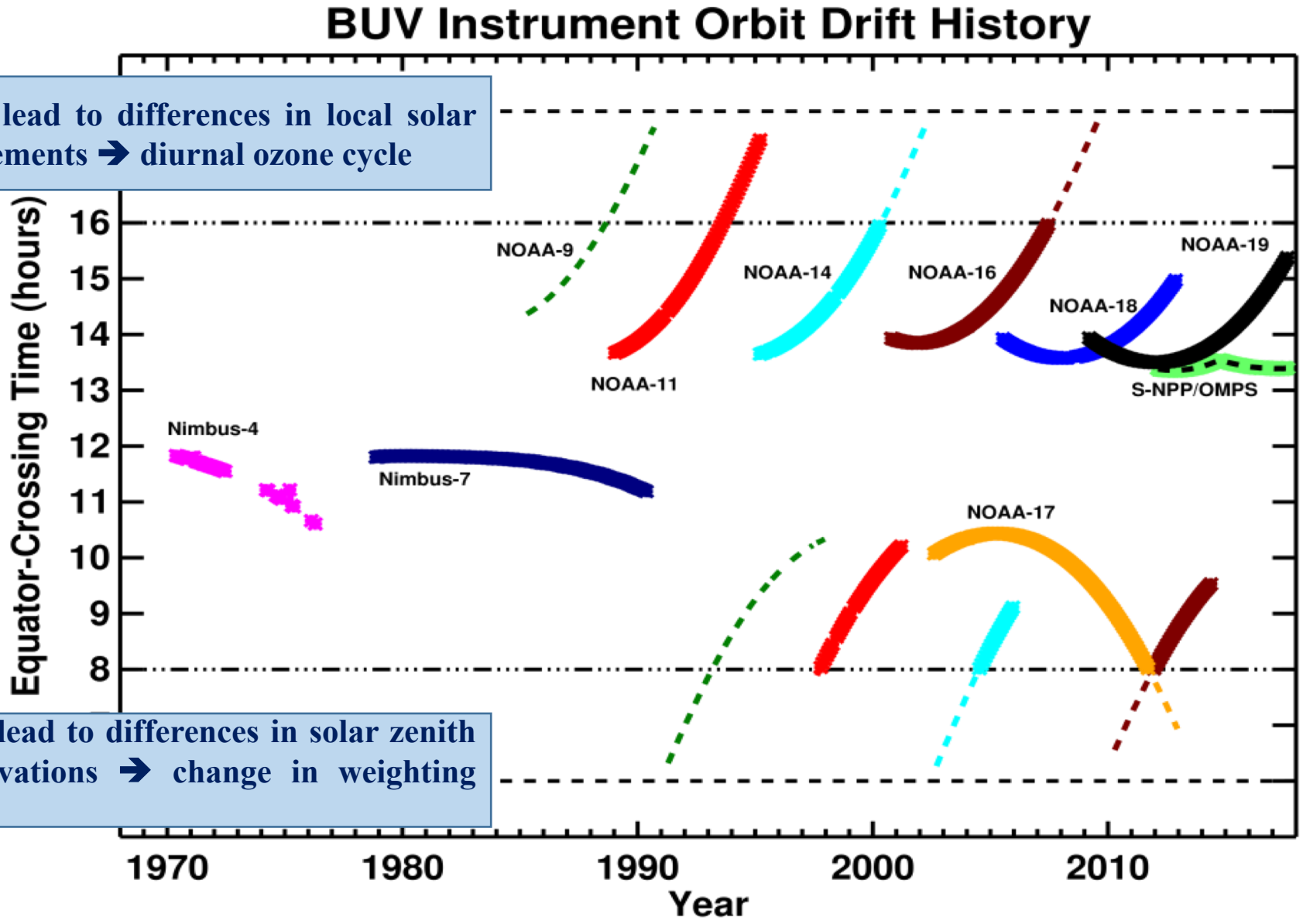
MOD SBUV ozone time series against Aura MLS



Equatorial crossing time for SBUV instruments

Drifting orbits lead to differences in local solar time of measurements ➔ diurnal ozone cycle



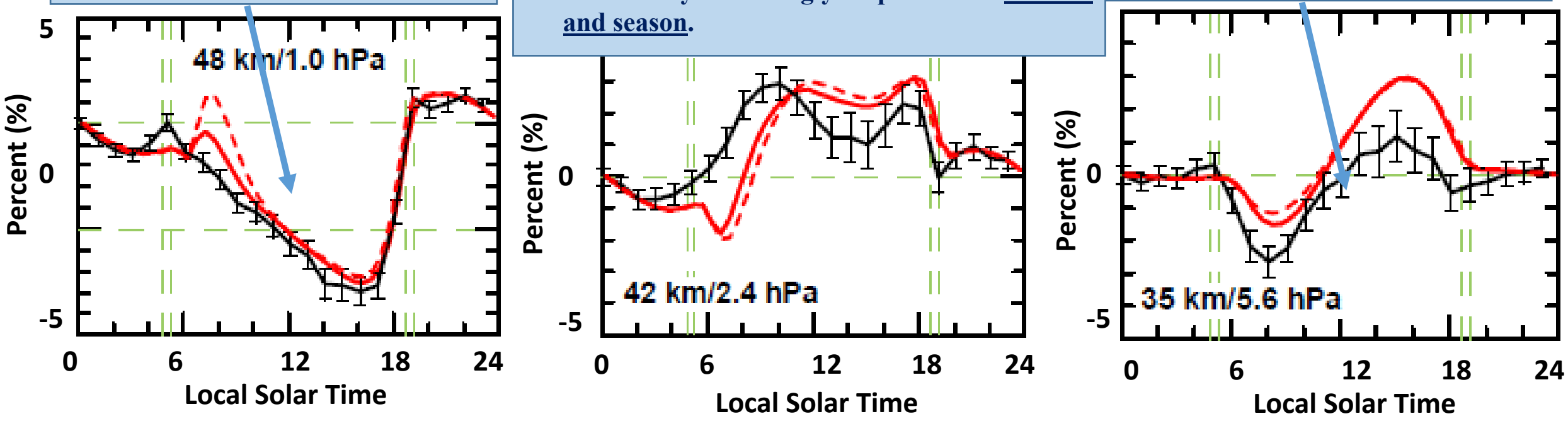
Drifting orbits lead to differences in solar zenith angle of observations ➔ change in weighting functions

Diurnal Ozone Variation

Almost a linear change from the morning to late afternoon

- ✓ Diurnal ozone cycle is not a simple function of SZA;
- ✓ Diurnal cycle strongly depends on altitude and season.

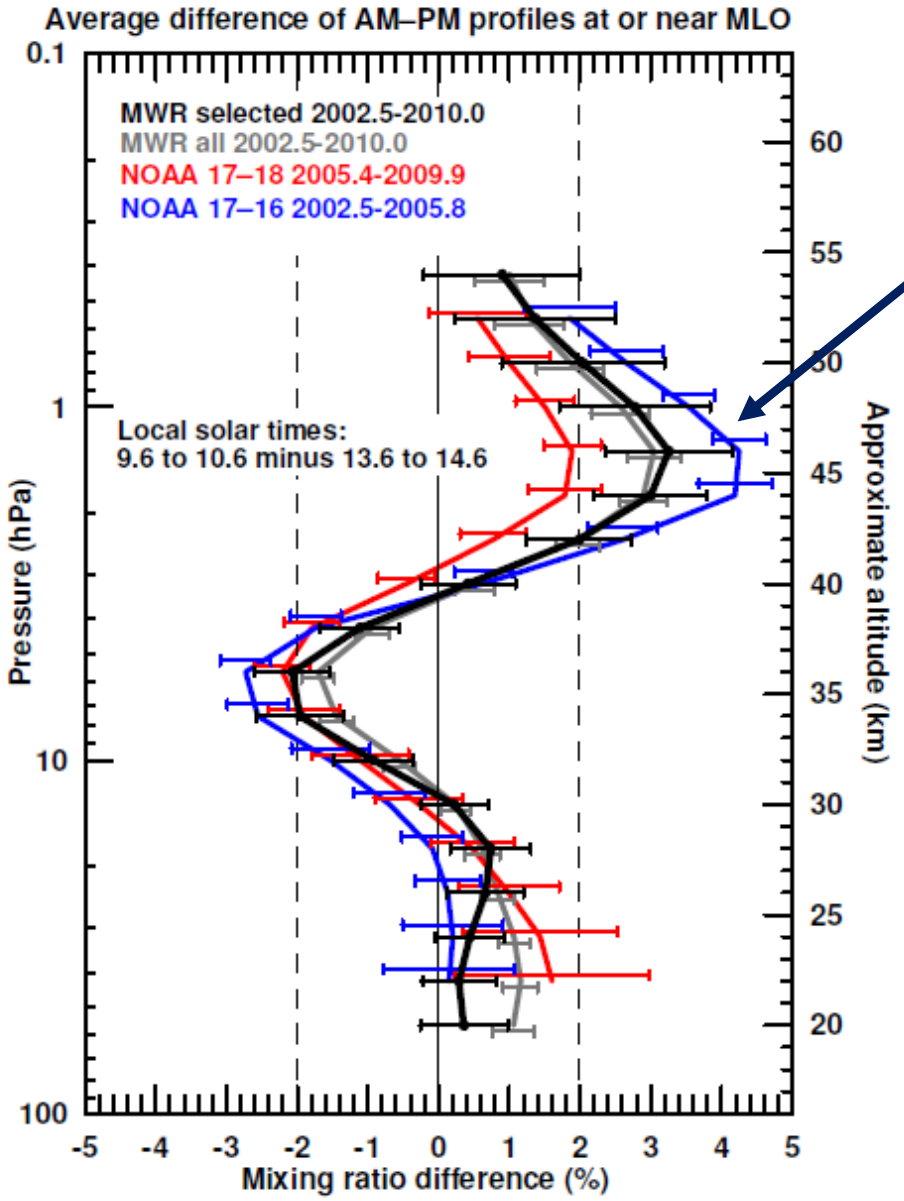
Change in sign of anomalies around noon



__Mauna-Loa microwave
__GEOSCCM model

A. Parrish et al., "Diurnal variations of stratospheric ozone measured by ground-based microwave remote sensing at the Mauna Loa NDACC site: measurement validation and GEOSCCM model comparison", ACP, 2014

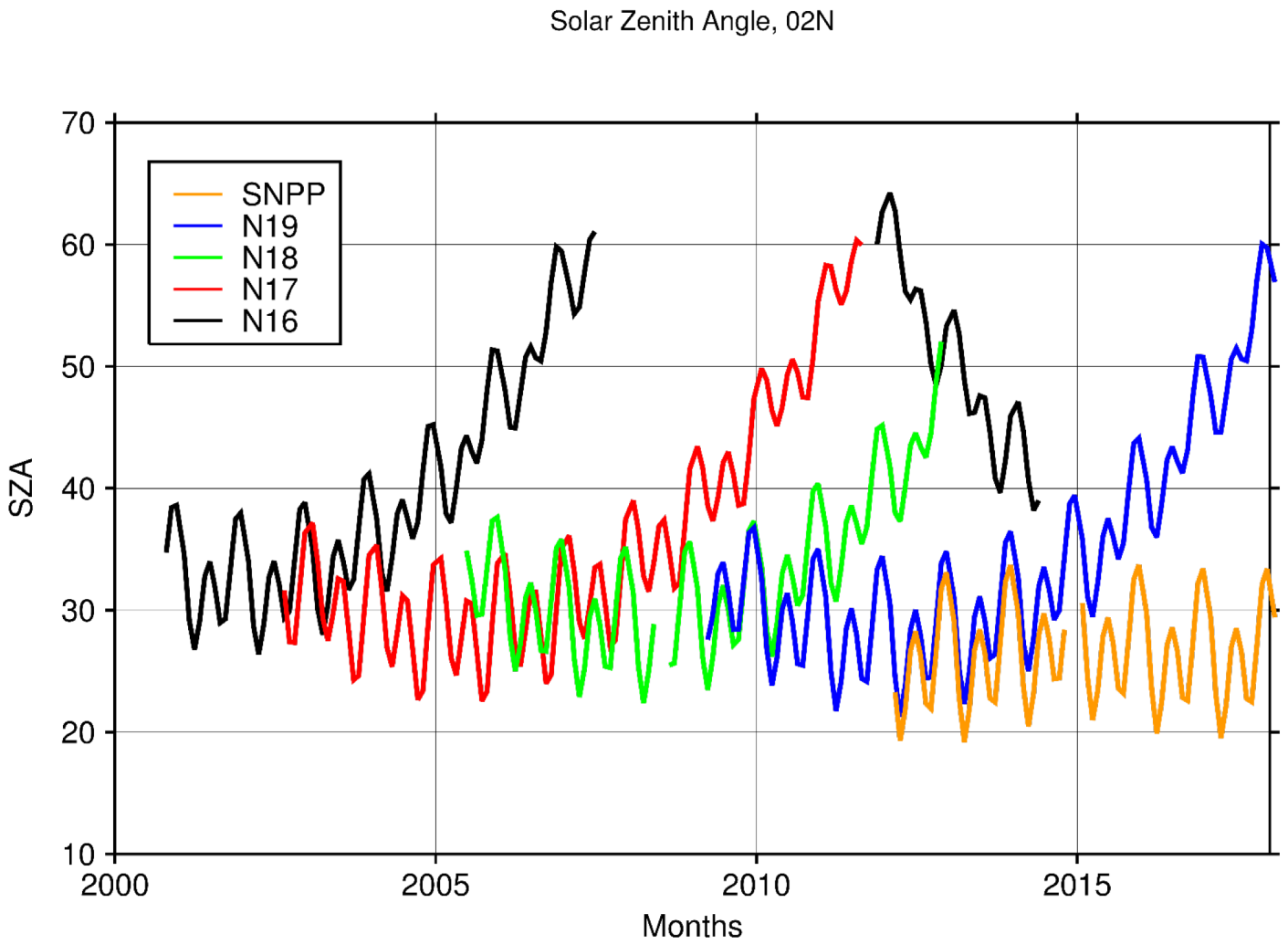
Diurnal Ozone Variation

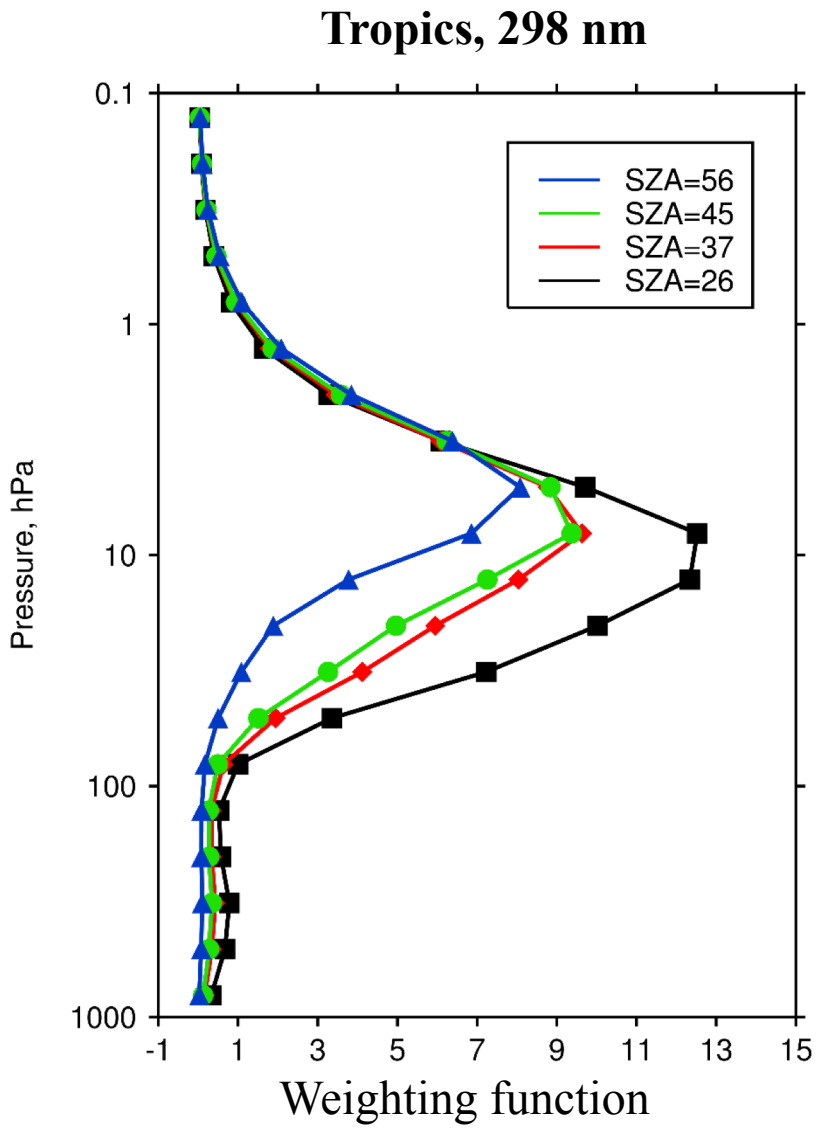


- Differences between the morning and afternoon SBUV measurements follow the pattern;
- However, there are differences between N17/N18 and N17/N16;

A. Parrish et al., "Diurnal variations of stratospheric ozone measured by ground-based microwave remote sensing at the Mauna Loa NDACC site: measurement validation and GEOSCCM model comparison", ACP, 2014

Change in sensitivity of SBUV measurements with SZA





New approach to calibrate SBUV instruments

O3 seasonal Climatology +
Geometry of observations

→ TOMRAD

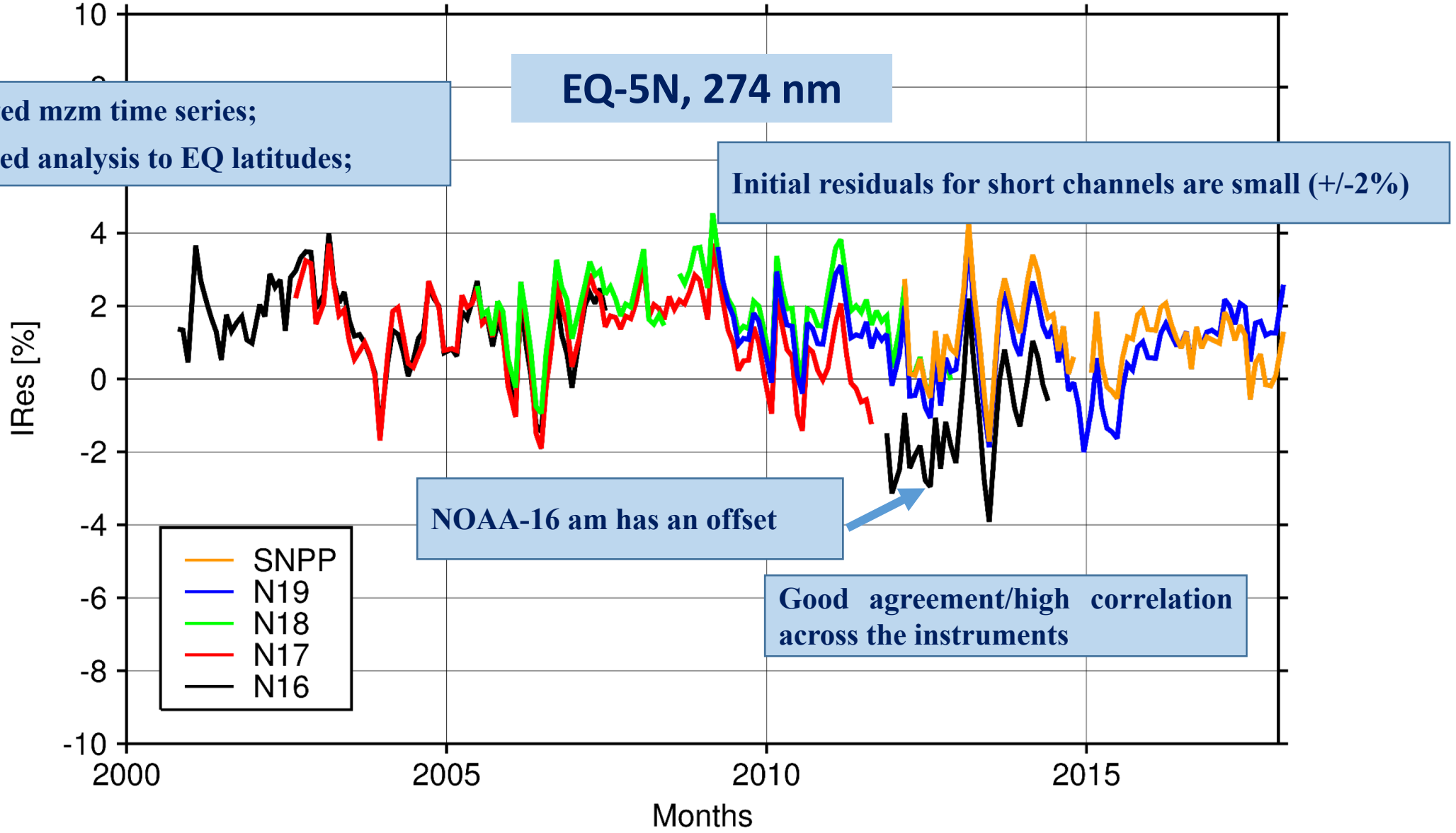
↓ Calculated Radiances

Initial residuals = Calculated Radiances − Measured Radiances

- ✓ Geophysical variability not captured by the seasonal climatology (e.g. QBO, diurnal, trends);
- ✓ Algorithmic effects (change in weighting functions with SZA);
- ✓ Instrumental calibrations (drifts and offsets).

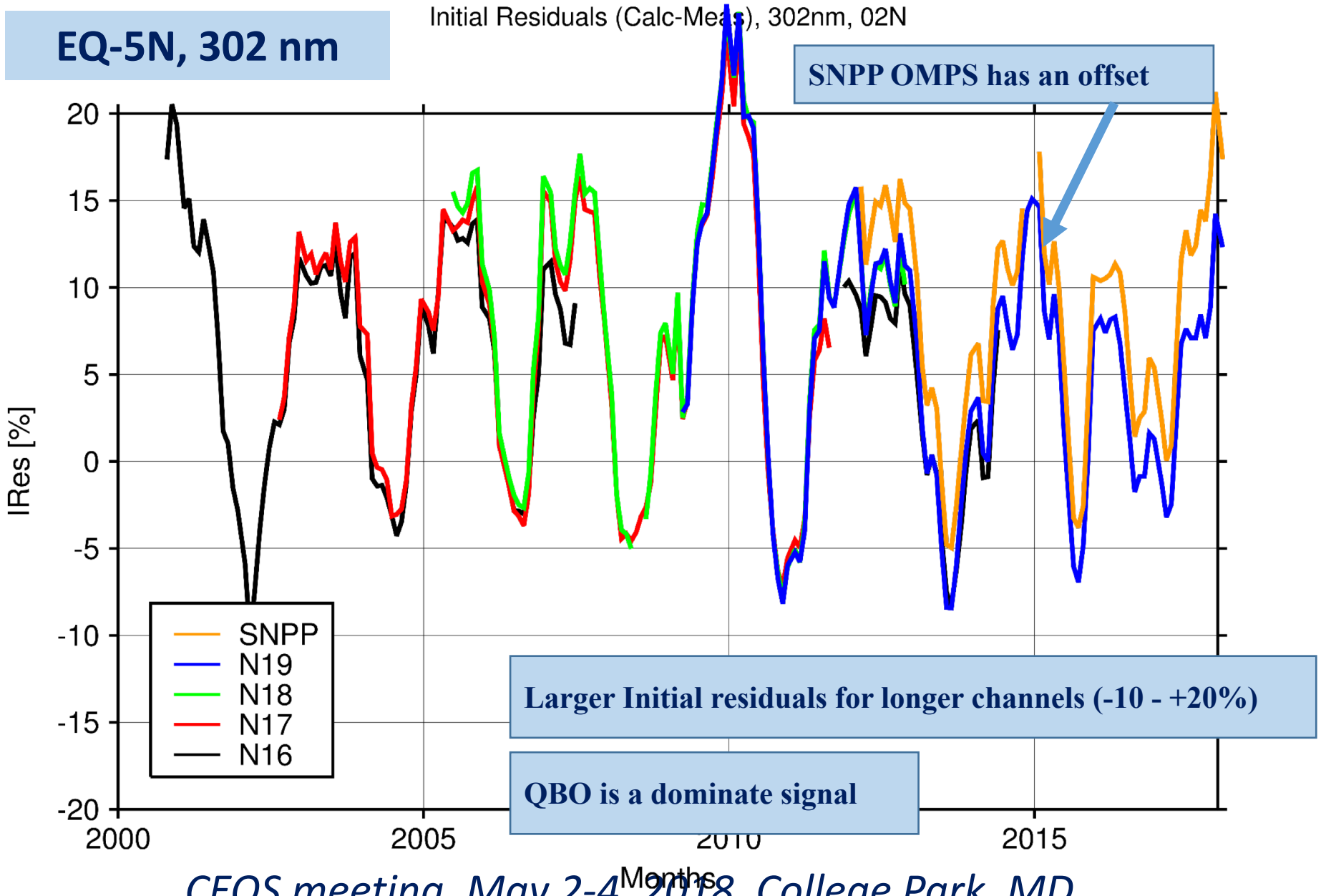
Analysis of Initial Residuals (Calculated-Measured)

- Created mzm time series;
- Limited analysis to EQ latitudes;



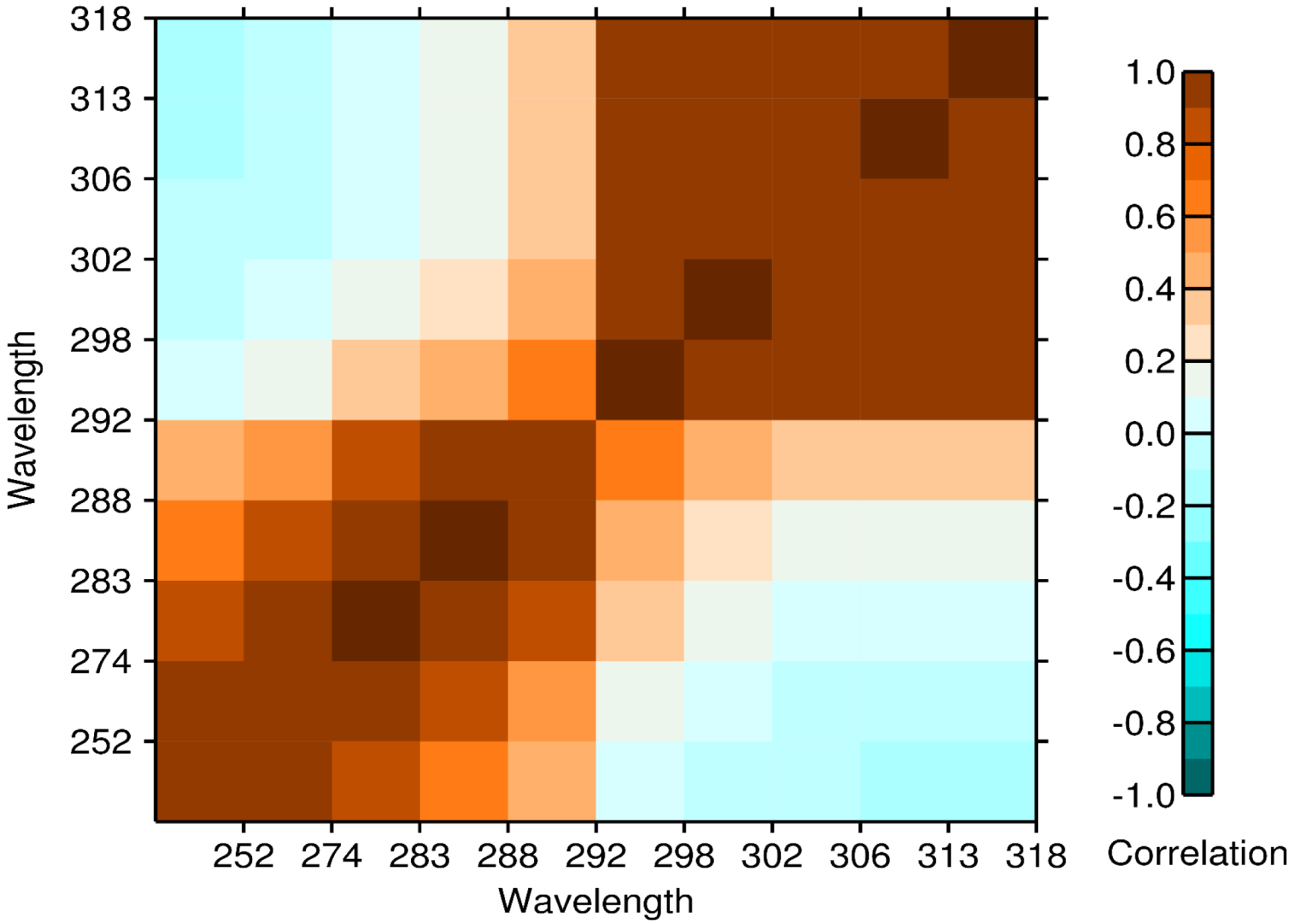
Analysis of Initial Residuals (Calculated-Measured)

EQ-5N, 302 nm



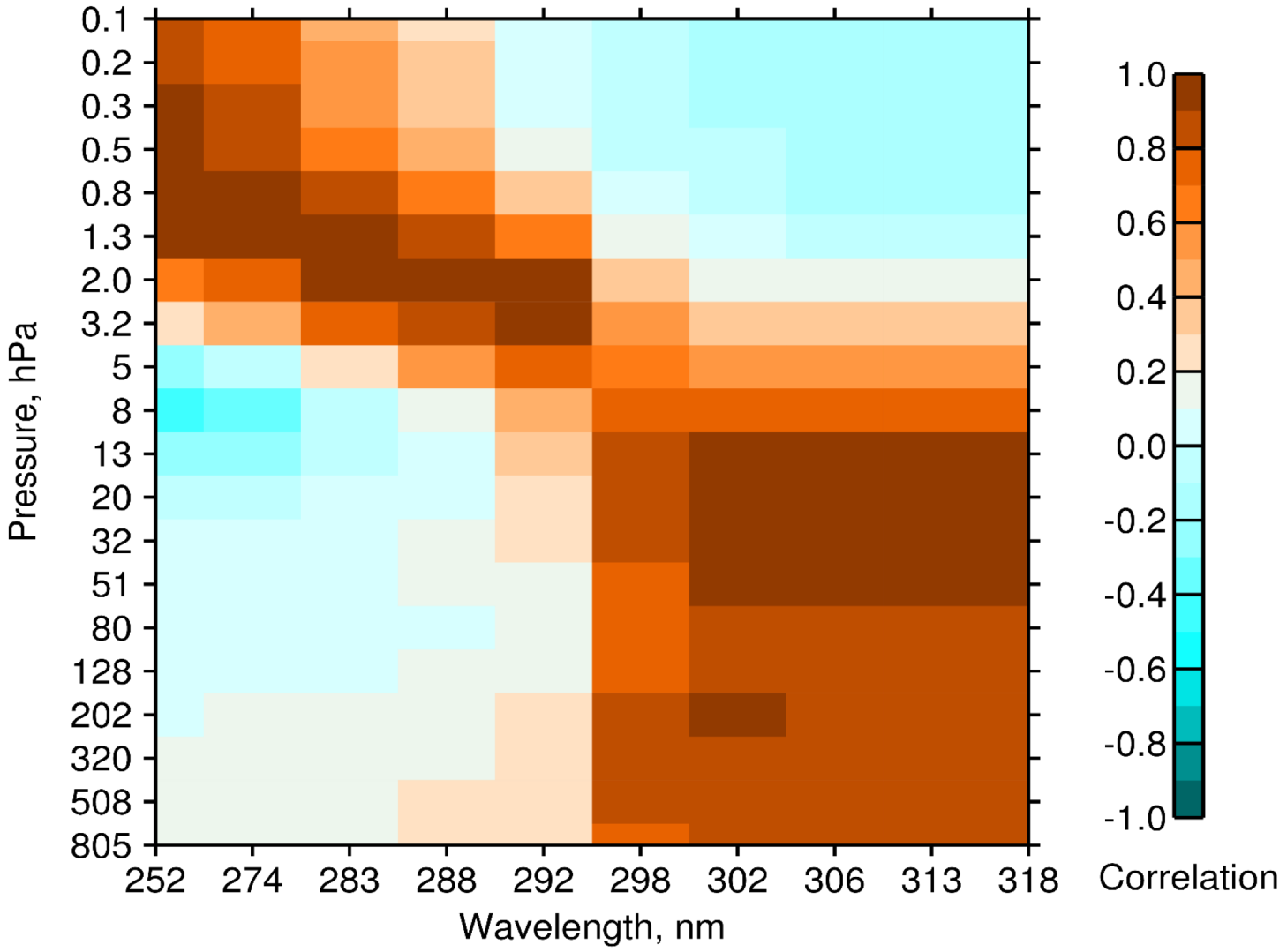
Analysis of Initial Residuals (Calculated-Measured)

Correlation among channels



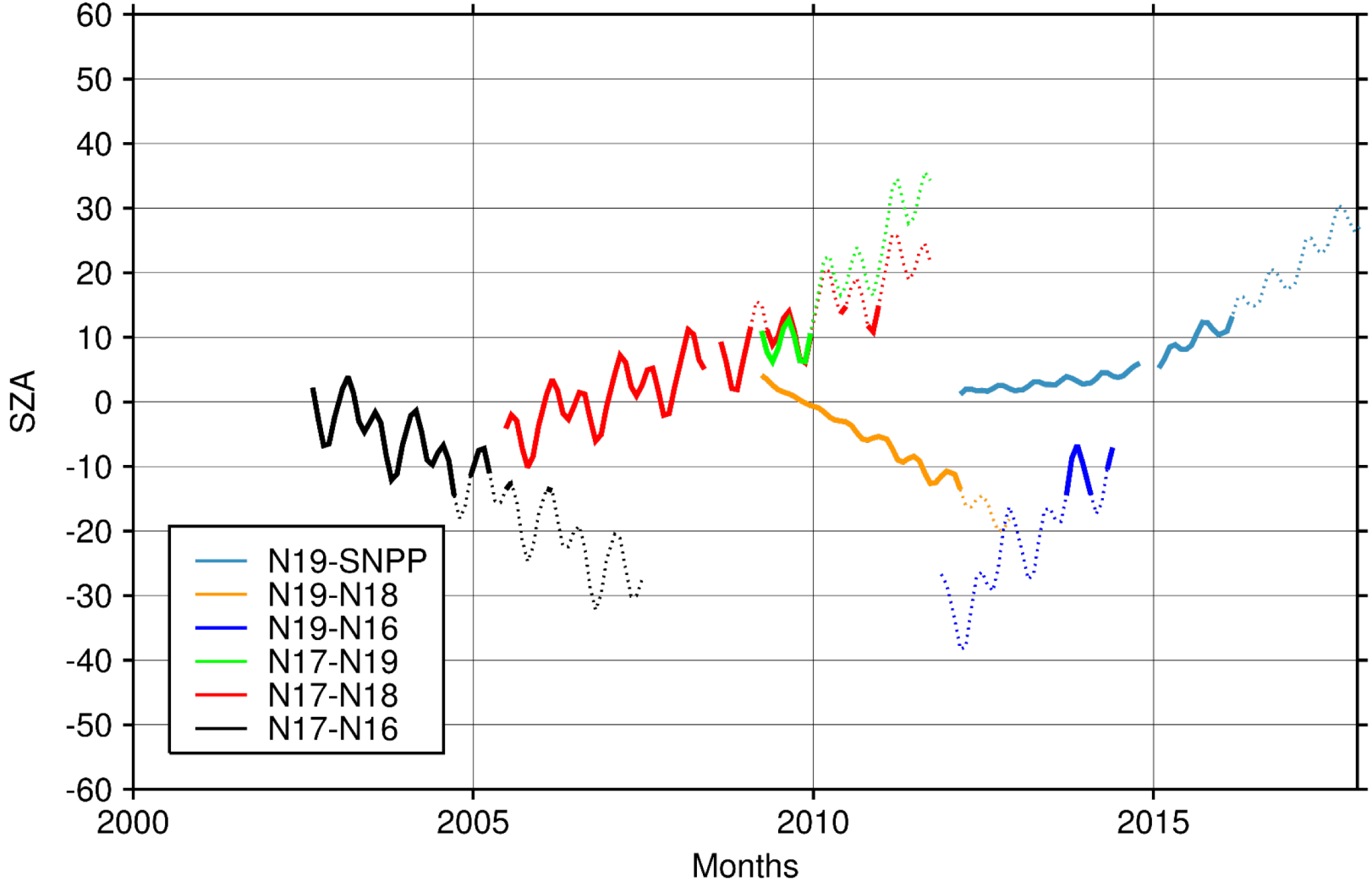
Analysis of Initial Residuals (Calculated-Measured)

Correlation of Initial Residuals with layer ozone



Analysis of Initial Residuals (Calculated-Measured)

Differences in SZA of SBUV observations, Tropics EQ-5N

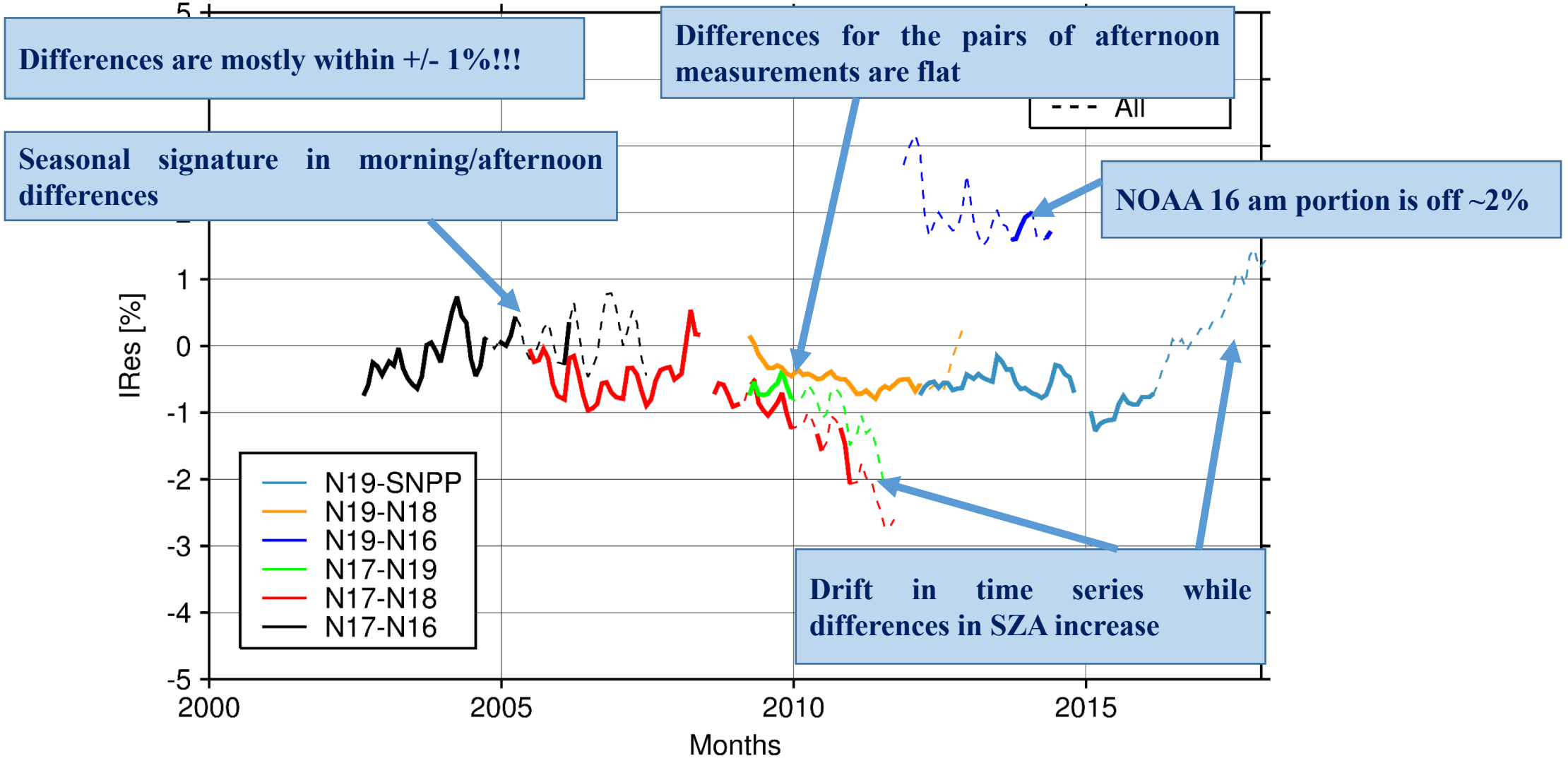


To remove geophysical variability we calculate differences between initial residuals for overlapping pairs of instruments.

Limit to time periods when SZA are within +/-15 degrees

Analysis of Initial Residuals (Calculated-Measured)

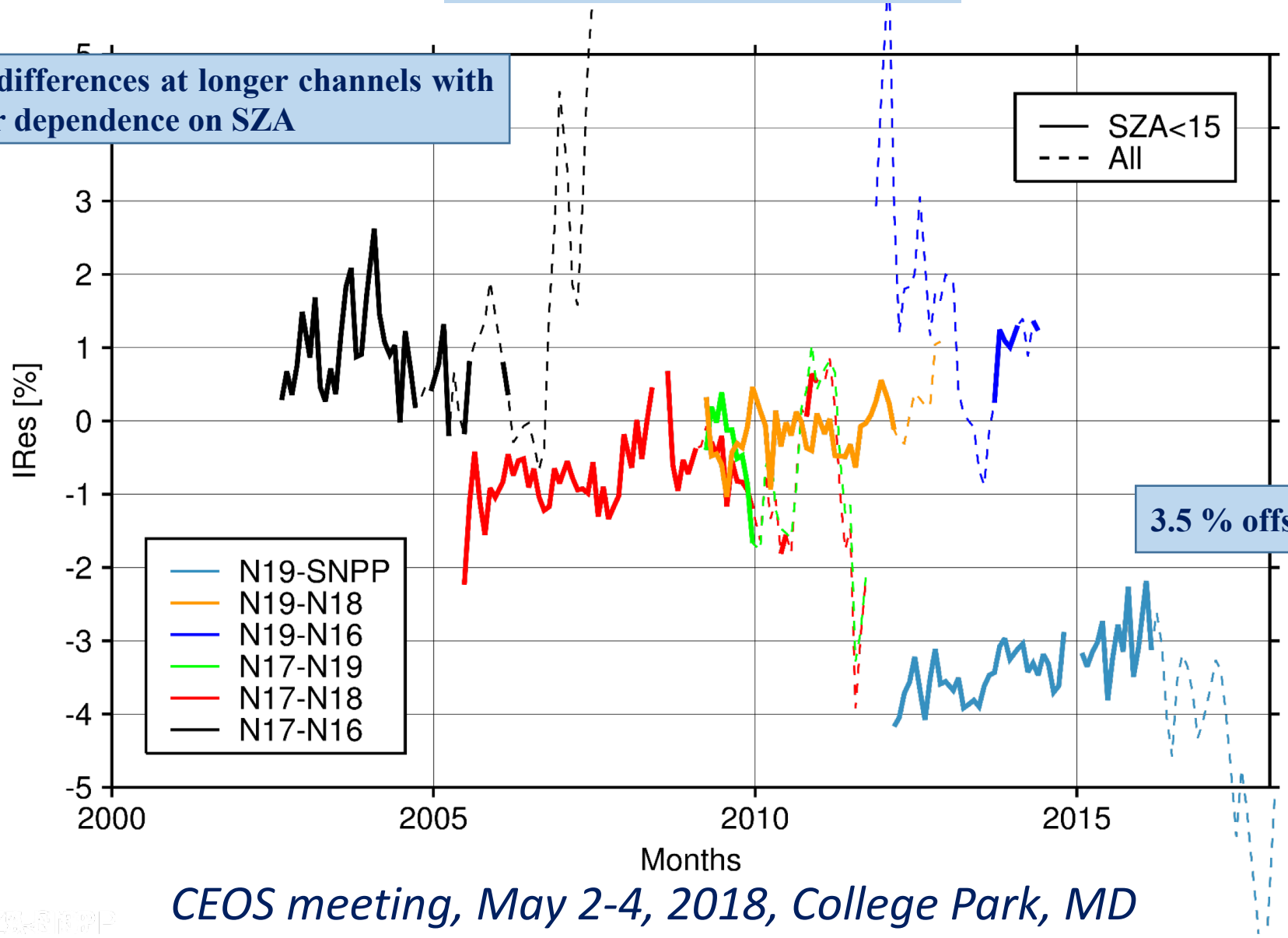
EQ-5N, 274 nm



Analysis of Initial Residuals (Calculated-Measured)

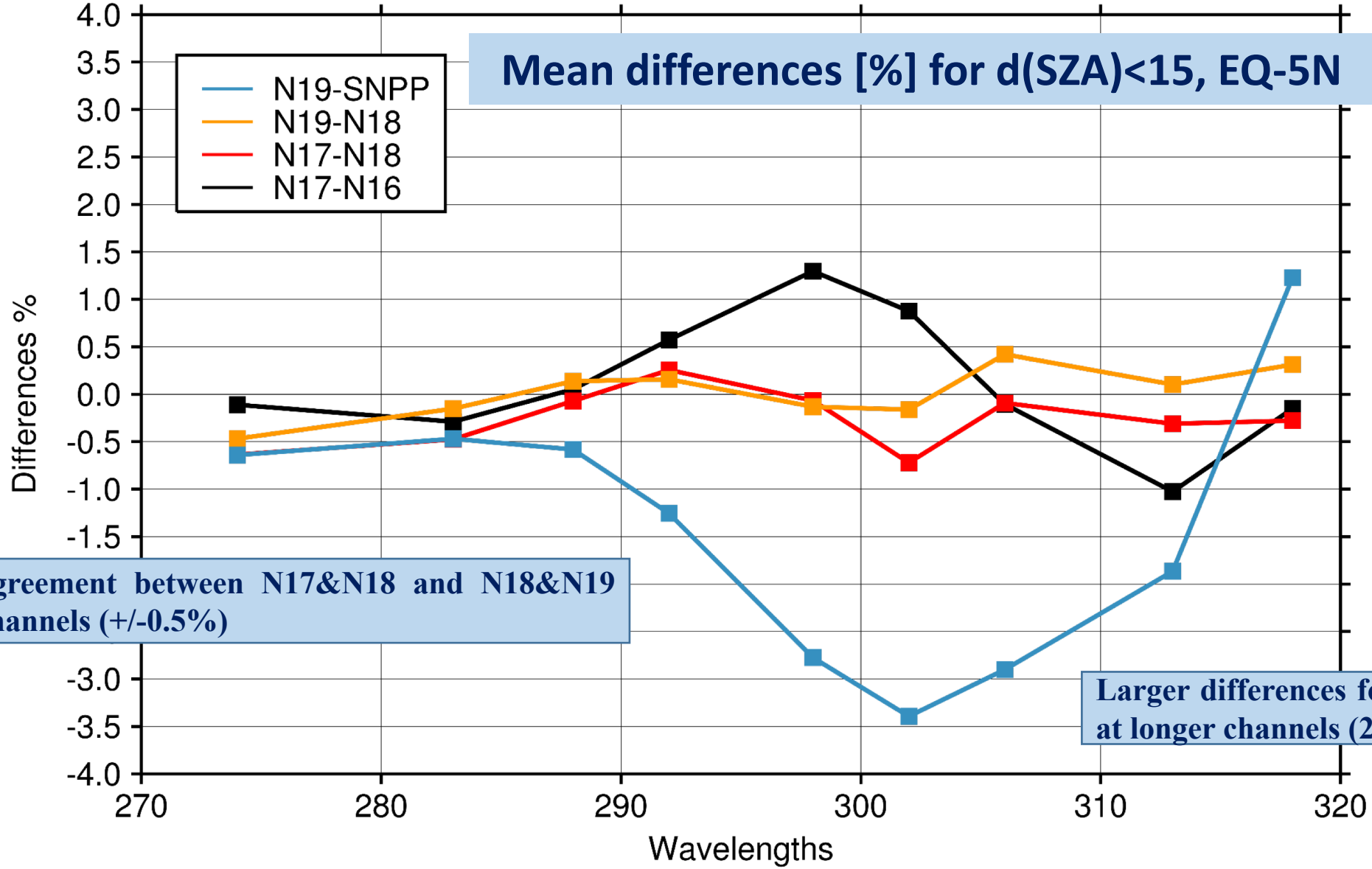
EQ-5N, 302 nm

Larger differences at longer channels with stronger dependence on SZA



3.5 % offset for SNPP

Analysis of Initial Residuals (Calculated-Measured)



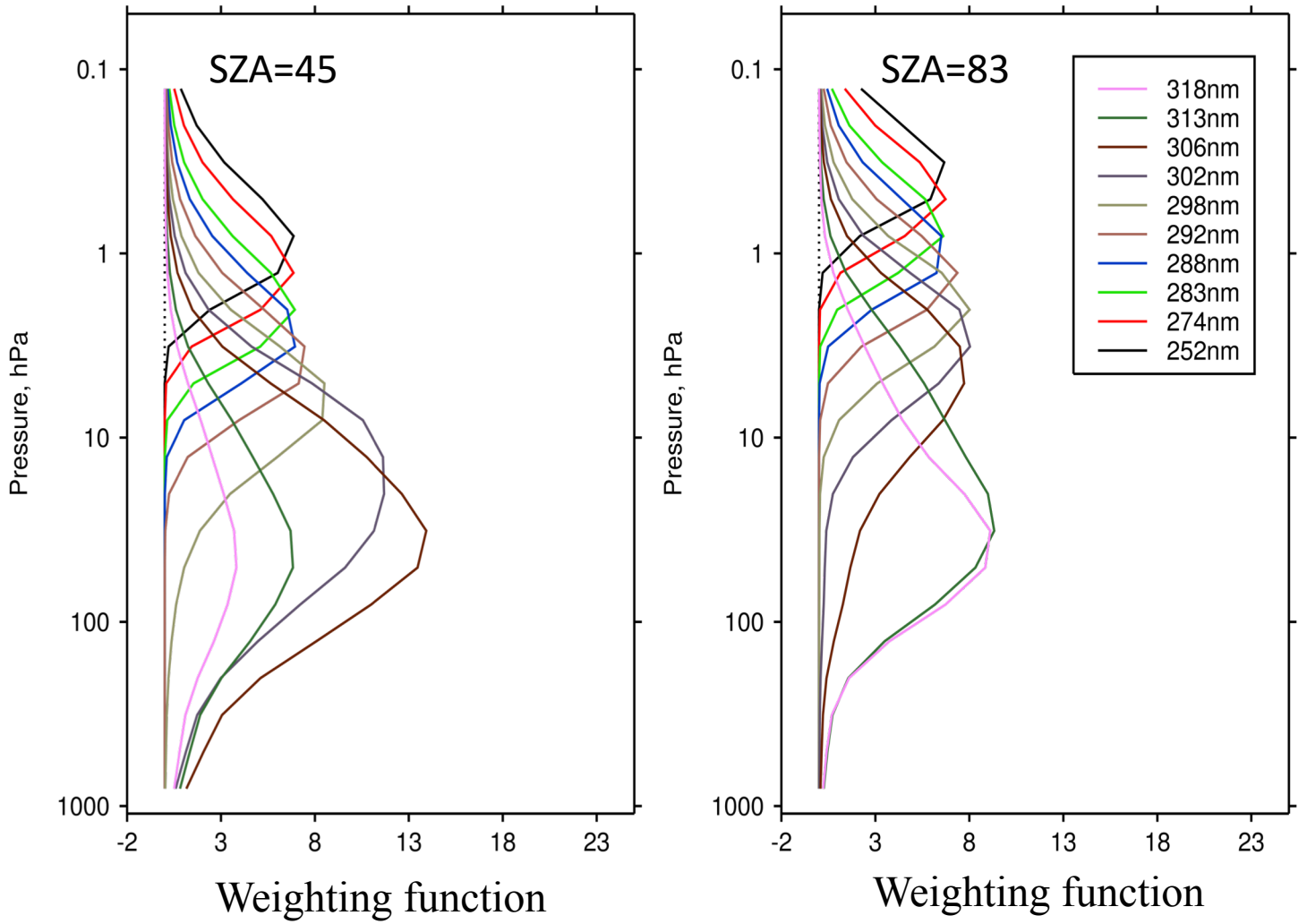
Good agreement between N17&N18 and N18&N19 for all channels (+/-0.5%)

Larger differences for SNPP and N16 at longer channels (292-318 nm)

Future plans: Ascending vs Descending comparison

-Around summer solstice SBUV instruments make measurements at ascending and descending parts of the orbit.

-Comparison of ascending and descending retrievals can help to check calibrations.



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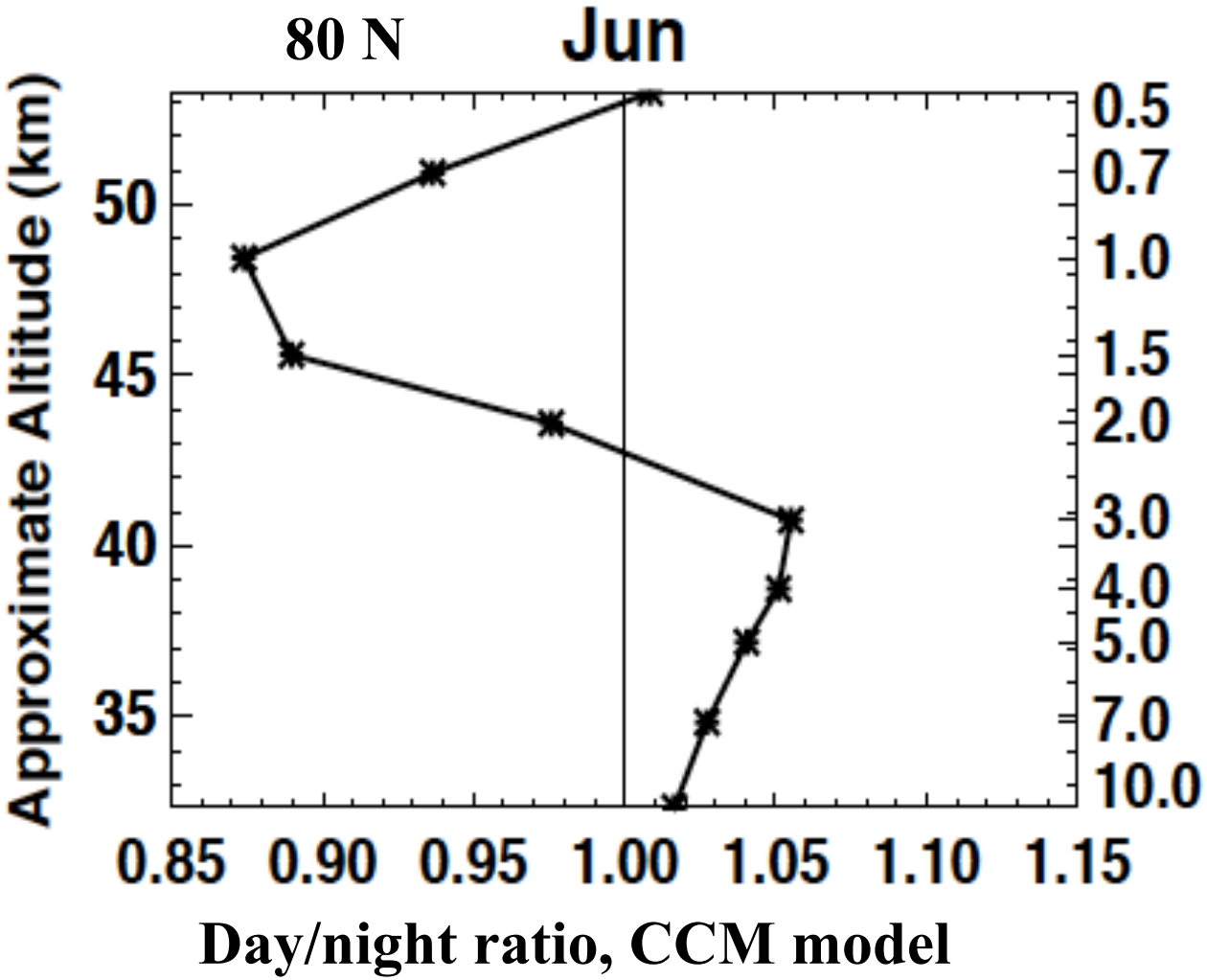
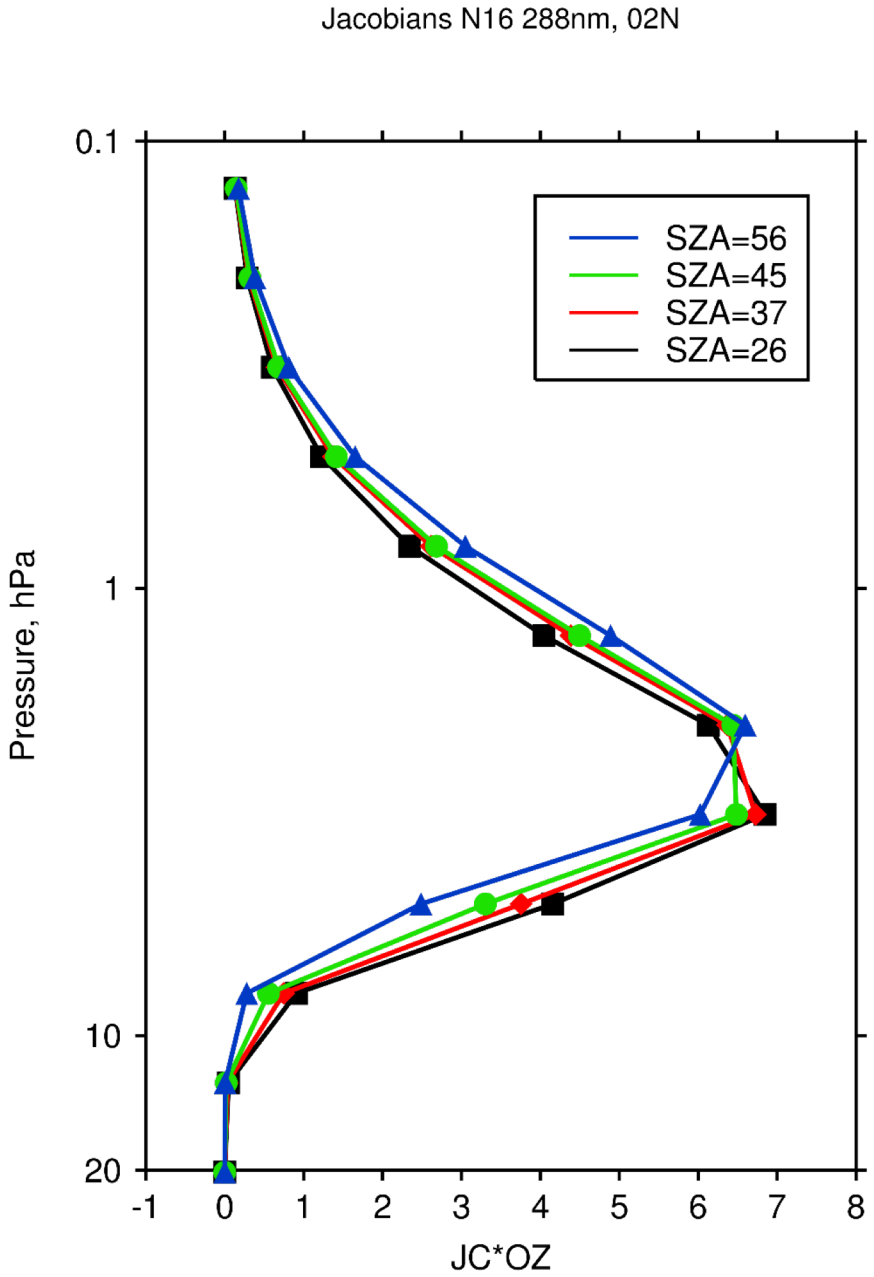
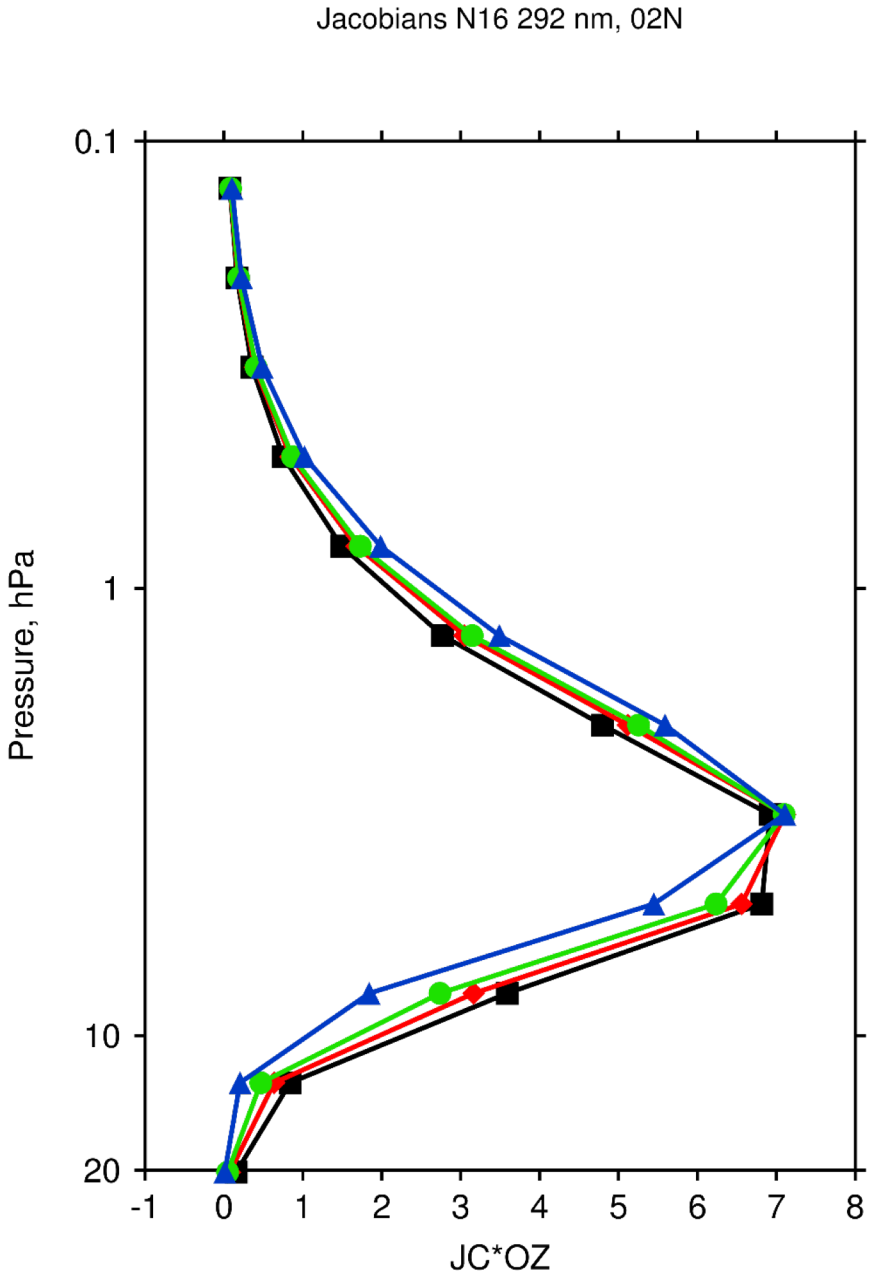


Future plans

- ✓Diurnal cycle: analysis of observations (MLS, SMILES, SABER and MLO) in combination with the CCM model to derive a diurnal cycle;
- ✓Estimate responses at each SBUV channel on the diurnal cycle with TOMRAD;
- ✓Estimate effects of changes in weighting functions due to SZA on ozone retrievals;
- ✓Reduce sensitivity to the calibration errors by reducing vertical resolution;
- ✓Cross calibrate SNPP with the SBUV record

Backup slides


Jacobians N16 288nm, 02N
SZA=56
SZA=45
SZA=37
SZA=26
Pressure, hPa
0.1
1
10
20
-1
0
1
2
3
4
5
6
7
8
JC*OZ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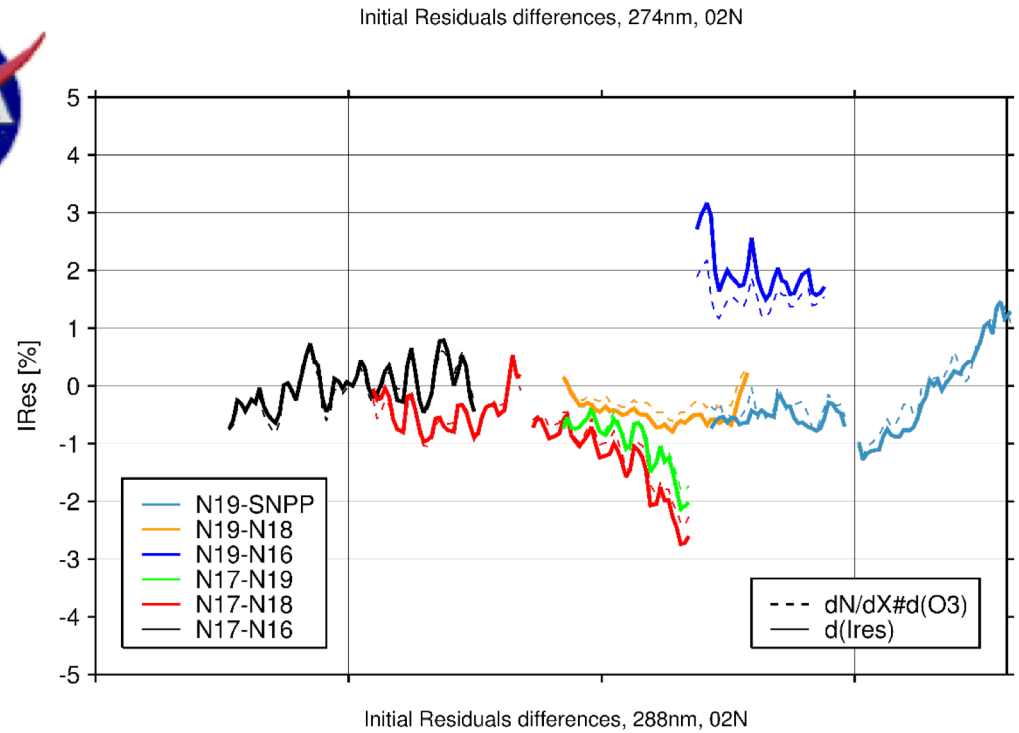
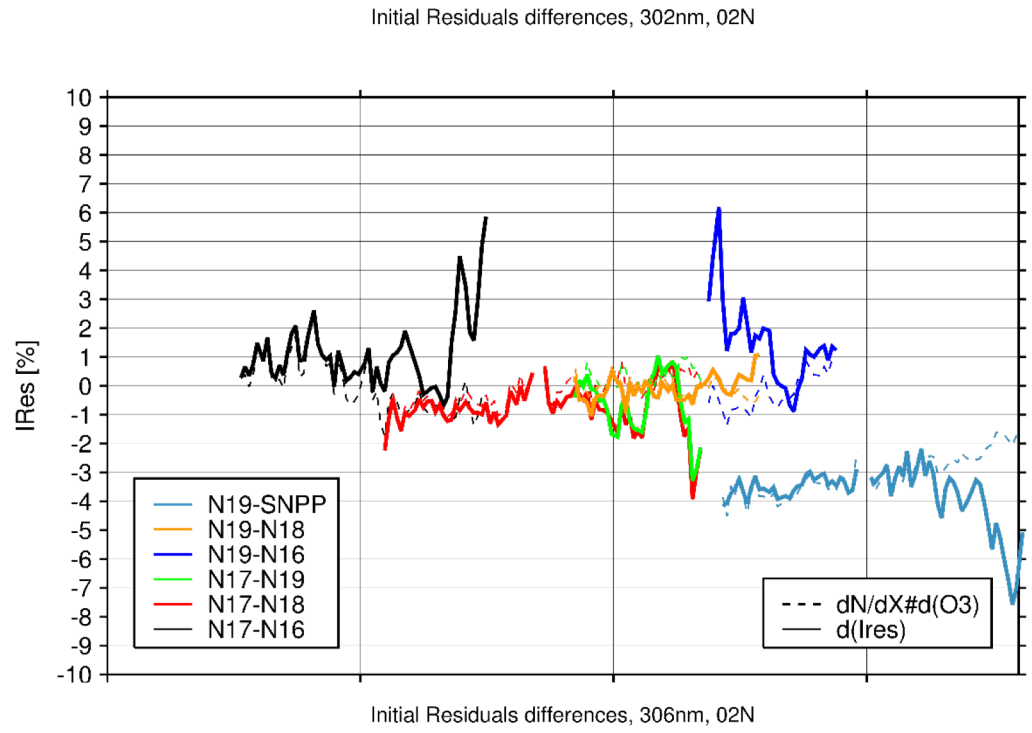

Initial Residuals differences, 274nm, 02N
IRes [%]
N19-SNPP
N19-N18
N19-N16
N17-N19
N17-N18
N17-N16
dN/dX#d(O3)
d(Ires)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N19-N18
N19-N16
N17-N19
N17-N18
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dN/dX#d(O3)
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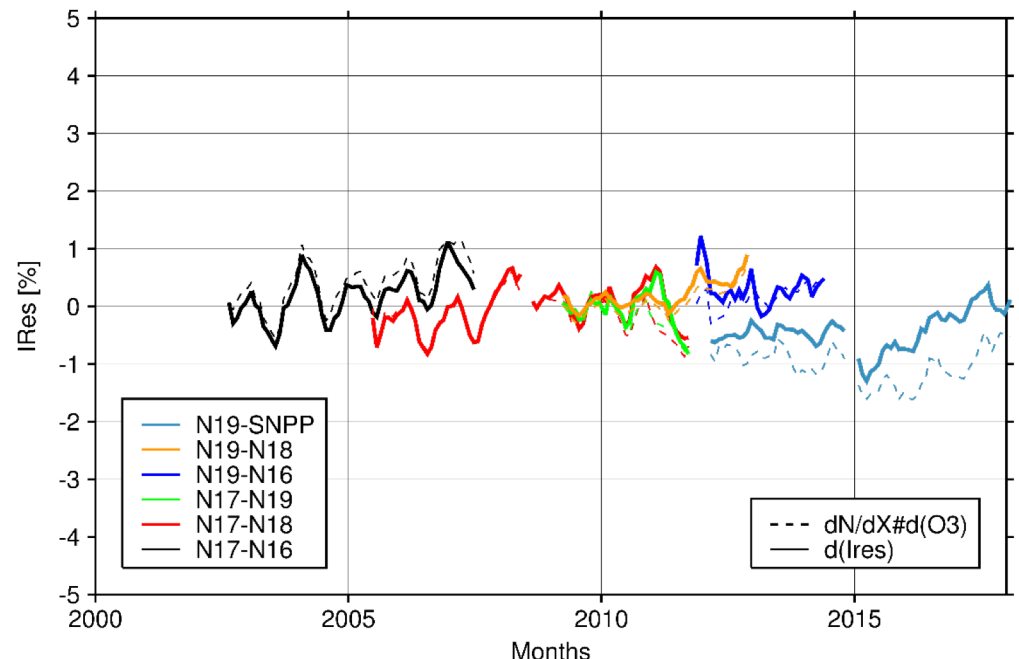
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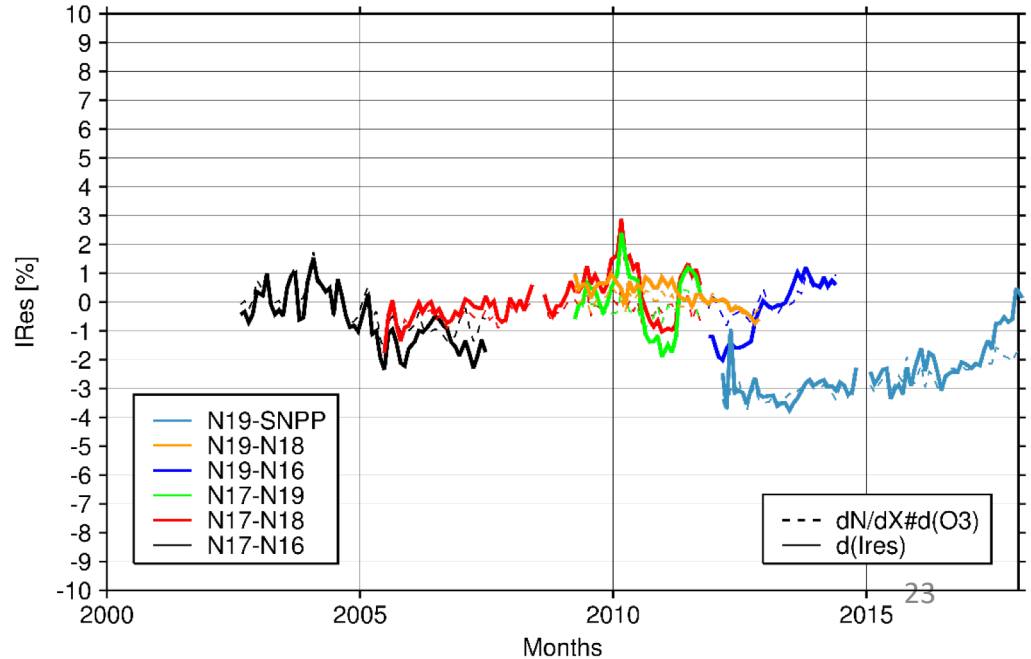
N19-SNPP
N19-N18
N19-N16
N17-N19
N17-N18
N17-N16
dN/dX#d(O3)
d(Ires)
Months


Initial Residuals differences, 306nm, 02N
IRes [%]
N19-SNPP
N19-N18
N19-N16
N17-N19
N17-N18
N17-N16
dN/dX#d(O3)
d(Ires)
Months