NOAA-20 VIIRS RSB Calibration Comparisons between NASA and NOAA

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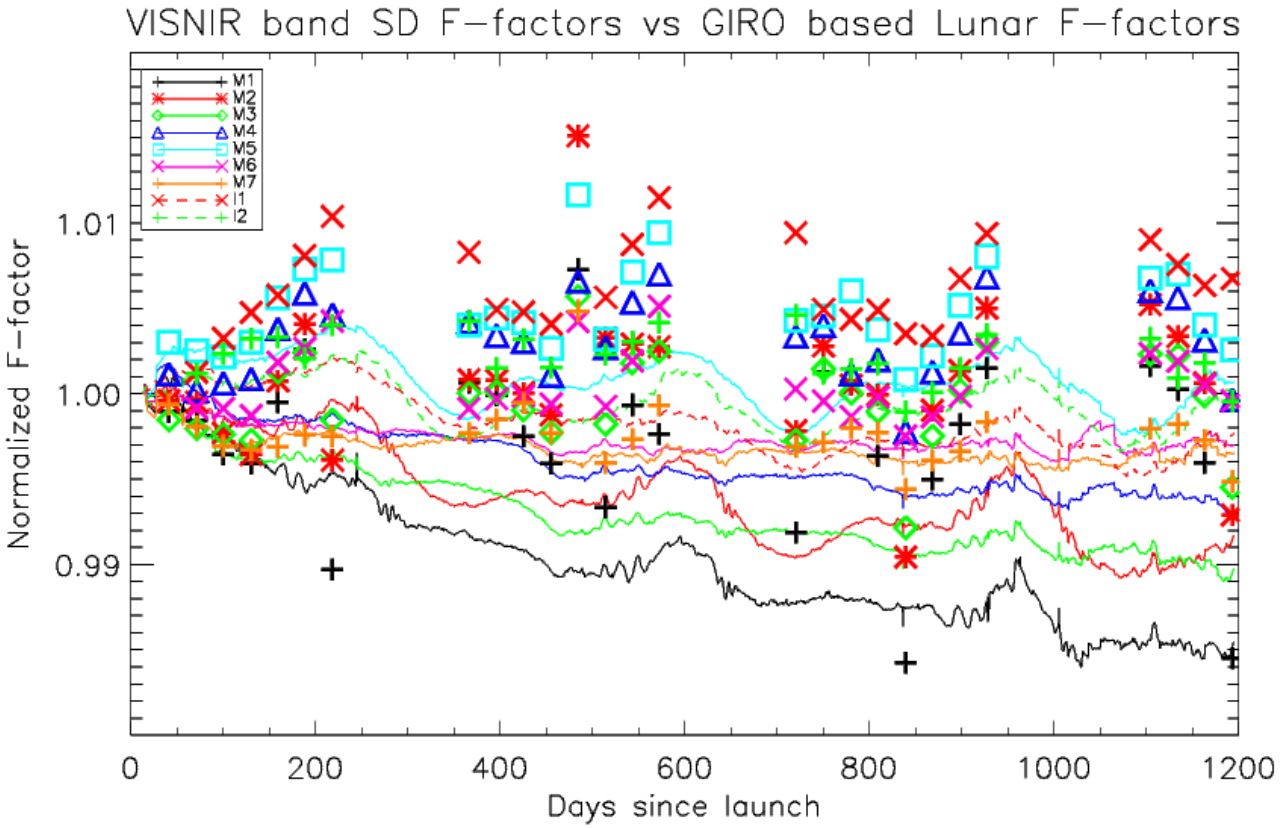
With inputs from NASA VCST

Background

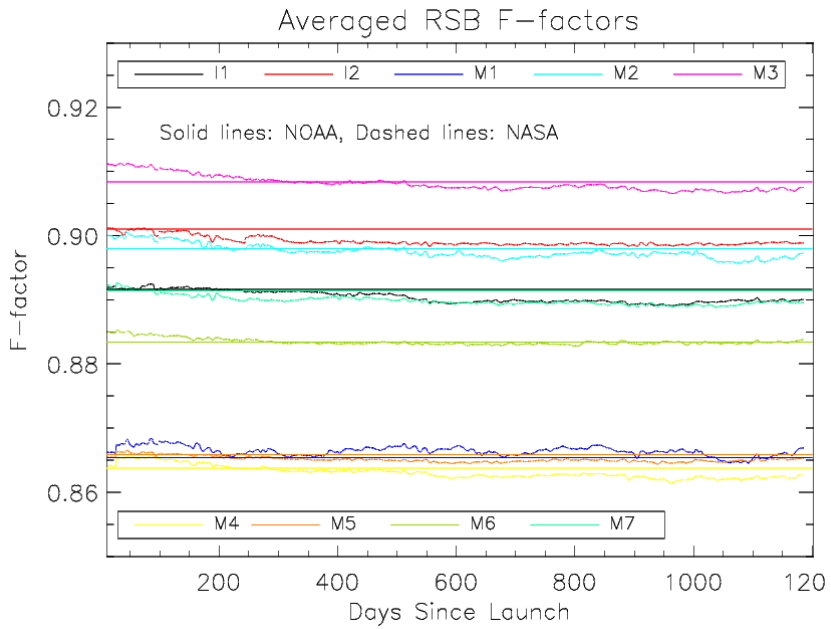
- NOAA-20 VIIRS has been performing very well since launch with excellent Earth observation data.
- Users' have option to choose NOAA-20 VIIRS SDRs (calibrated radiance, reflectance, geo) based on:
  - NOAA operational product (https://www.class.noaa.gov)
  - NASA product (https://ladsweb.modaps.eosdis.nasa.gov/archive/allData/5200/)
- Using NOAA-20 VIIRS data for long term climate records requires stringent calibration quality (both absolute calibration accuracy and temporal stability).
- In addition, radiometric consistency between multiple sensors and radiometric products is one of the key factors.
- This presentation focus on:
  - The NOAA-20 VIIRS calibration and comparison with NASA, and lunar based monitoring at NOAA
  - Comparison of NOAA processed radiance product with NASA
- As the two major VIIRS data providers, the calibration difference between NOAA and NASA products needs to be quantified and monitored regularly to help users understand the impact on higher level Environmental Data Products (EDRs).

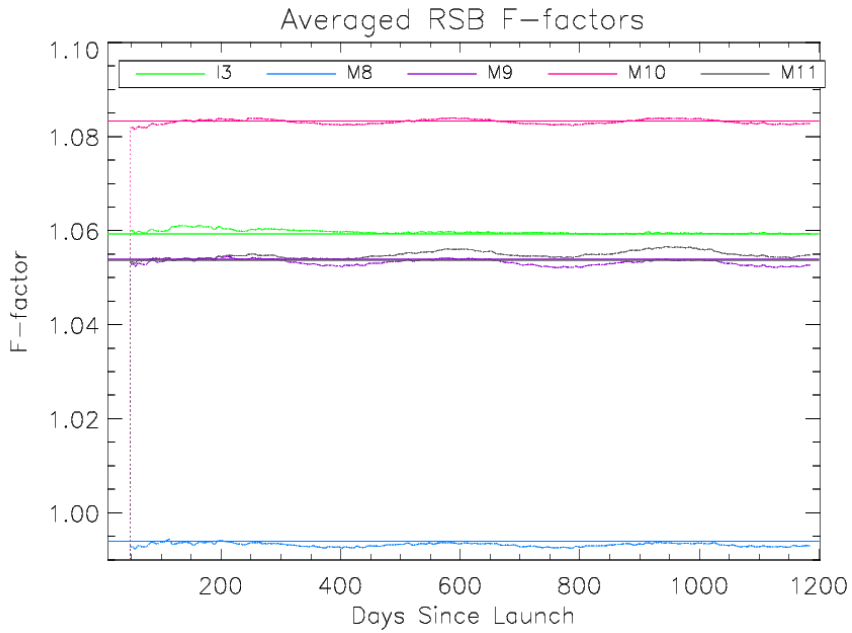
Using Lunar Trends to Monitor NOAA-20 VIIRS Performance

- **Lunar F-factors suggest stable sensor response in all the RSB bands with no noticeable trends.**
- **NOAA uses constant F-factors in operational calibration**
- NOAA's offline version of the SD F-factors show different trends compared to lunar F-factors especially in the short wavelength bands (M1~M4).
- Lunar F-factors dropped with the no roll maneuver collections in M1~M4.
  - Closer to earth limb and affected by stronger earth shine.



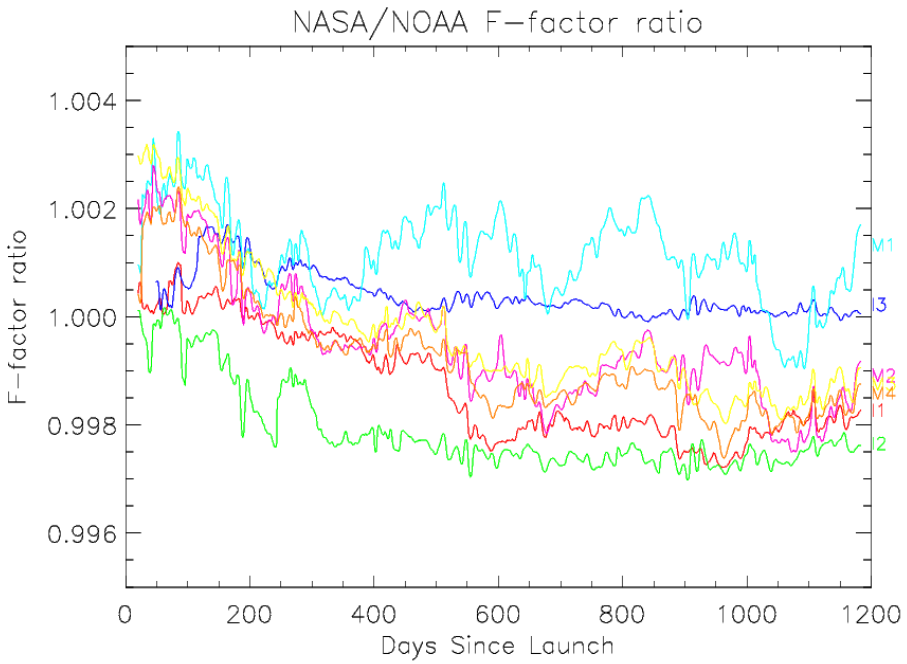
NOAA and NASA F-factor Comparisons

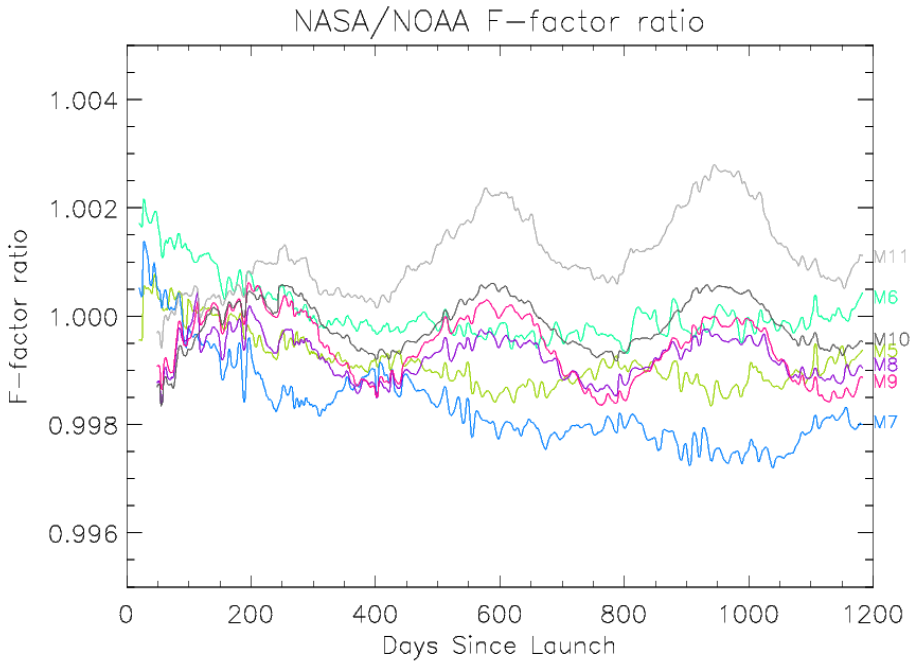




- **NOAA's operational F-factors for NOAA-20 VIIRS RBSs are fixed since April 2018**.
  - Lunar F-factors, DCC, SNOx and PICS trends indicate stable sensor response.
- **NASA and NOAA VIIRS calibration difference: mostly within 0.2%**
- Annual oscillations are observed in NASA's SD F-factors. Note: NOAA's offline version also has annual oscillations.

NASA and NOAA Operational F-factor Ratio



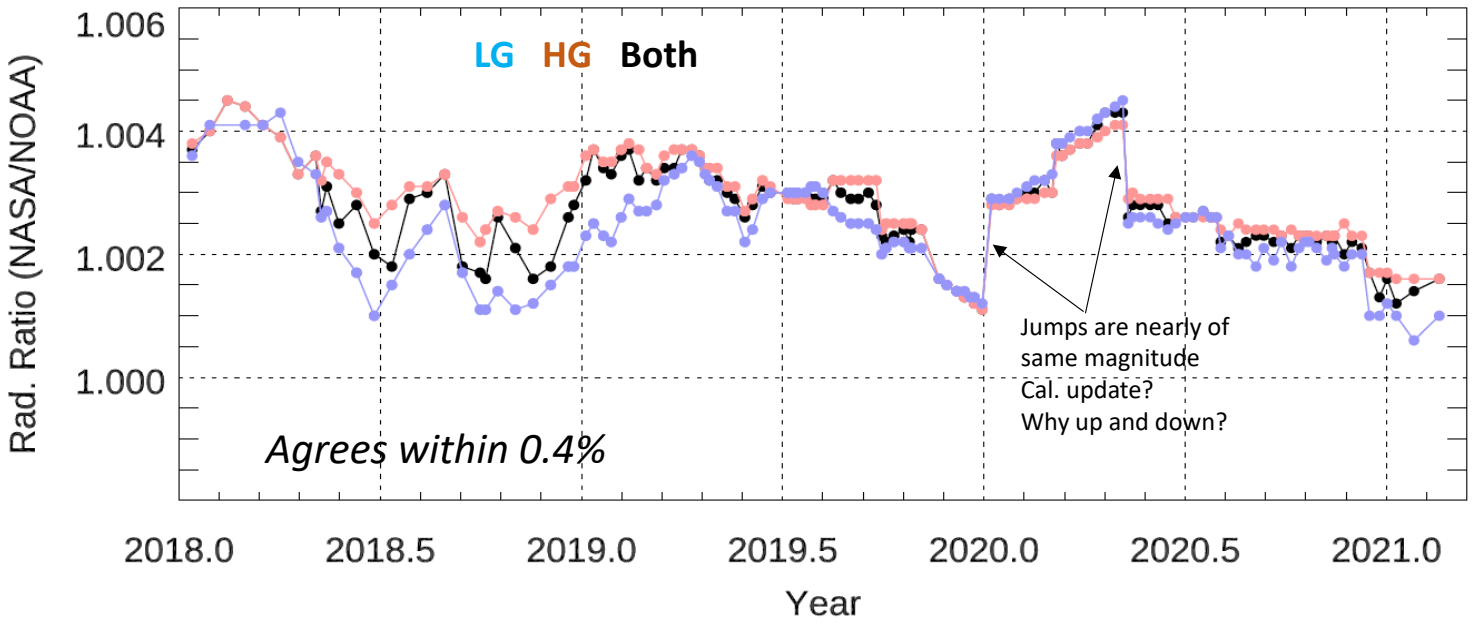


- **NASA and NOAA RSB calibrations are mostly within 0.2% level.**
- NASA's F-factors for some VISNIR bands show change of ~-0.1% to -0.2% over 3 years.
- NASA's SWIR bands F-factors shows annual oscillation patterns.

Comparing NOAA and NASA Radiance Product

- NOAA-20 VIIRS radiance produced at NOAA are compared to NASA SIPS
- Datasets used:
  - NOAA: Operational data
  - NASA: 5200 (collection 2) https://ladsweb.modaps.eosdis.nasa.gov/archive/allData/5200/
- For each granule, non-bow region from center used: ~1000*768 samples for each
- For dual gain bands, HG and LG ratios are also shown
- Derived temporal trending of radiance ratio (NASA/NOAA) to show the calibration differences
  - Results should agree with the ratios shown in above slides using F-factors

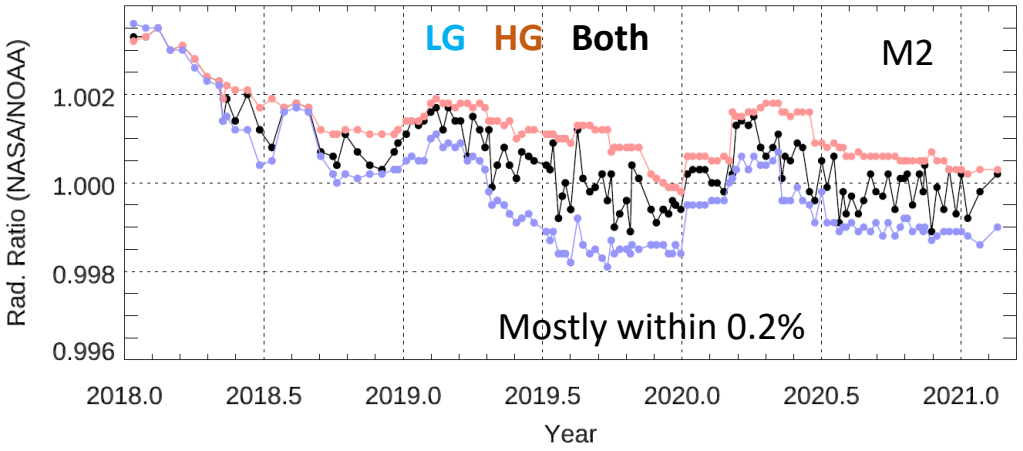
Comparing NOAA-20 VIIRS M1 Radiance

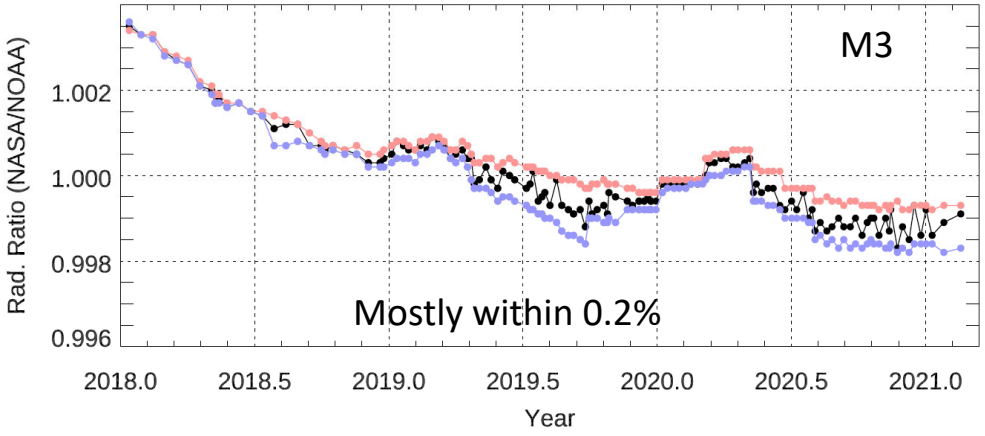


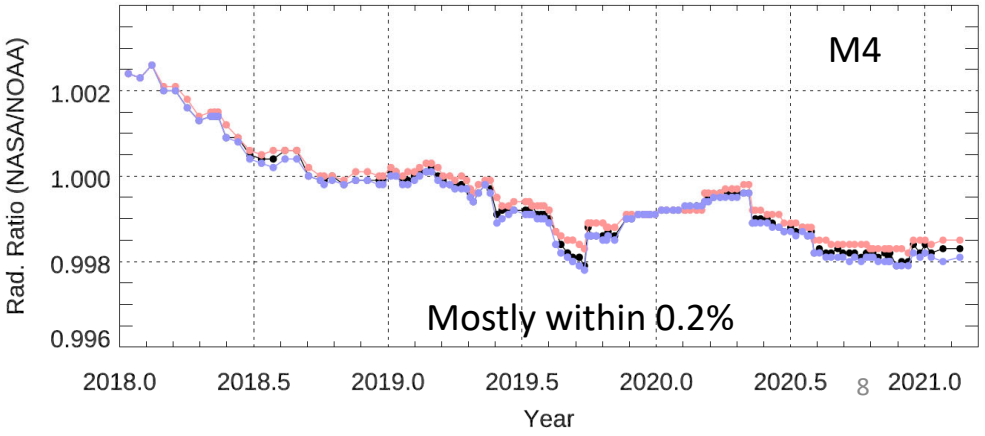
- M1 NASA Radiance are higher than NOAA, agreeing to mostly within 0.4%
- Two noticeable discontinuities (0.2%) are observed in early 2020
  - Since we didn't observe this jump at NOAA, are these the calibration updates at NASA
  - Interesting that the up and down jumps are almost of same magnitude.

Comparing NOAA and NASA VIIRS Radiance (M2-4)

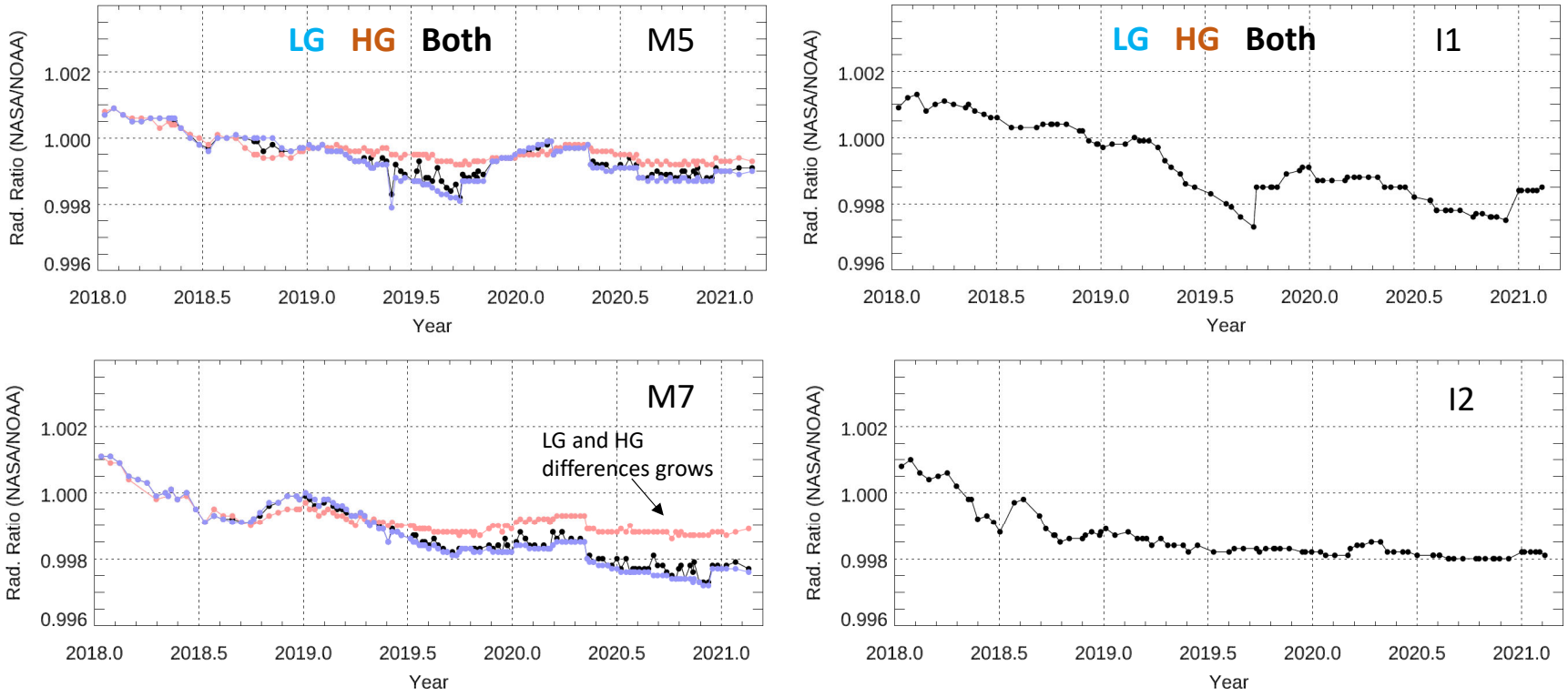
- NOAA and NASA radiance agrees mostly to within 0.2%
- Unlike M1, M2-4 ratio suggest more than 0.2% decreasing trend during 1st year (2018)
- HG and LG ratios indicate larger differences for M2 by mostly up to 0.2%





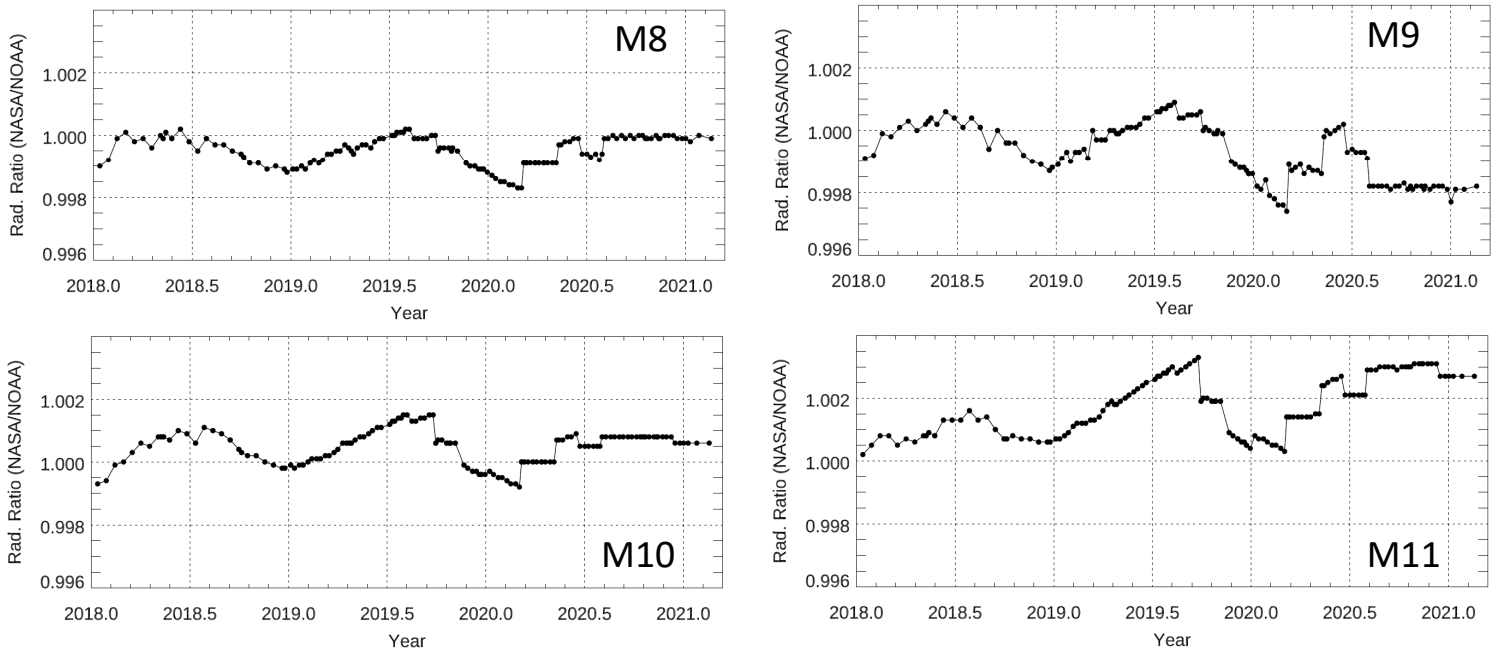


Comparing NOAA and NASA VIIRS Radiance (M5-7, I1-2)



- NOAA and NASA radiance agrees mostly to within 0.2%

Comparing NOAA and NASA VIIRS Radiance (M6, M8-10, I3)

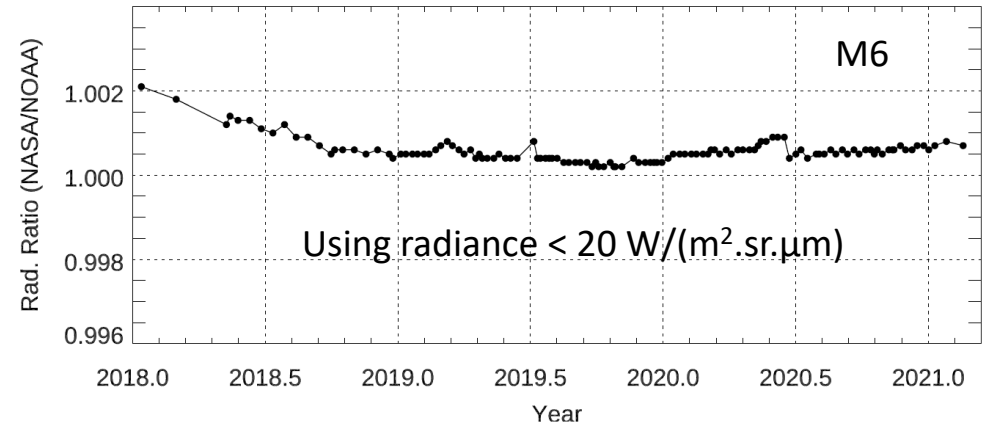


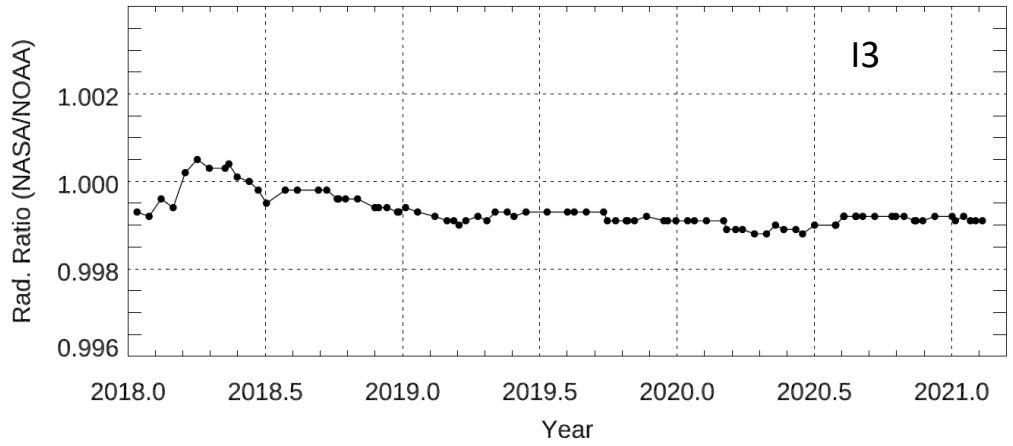
- SWIR bands between NOAA and NASA agree to within 0.2%.
- Unlike VISNIR bands,
  - Oscillations appear in the ratio trending for all SWIR bands except I3.
  - multiple discontinuities observed in the trend for all SWIR bands except I3.

Conclusion

- NOAA-20 VIIRS has been showing very stable response, as indicated by independent validation techniques such as lunar trending, DCC (next presentation) and vicarious techniques.
  - NOAA operational calibration has been using constant gain
- Compared NOAA and NASA calibration differences for RSBs, 1) using F-factors and 2) using radiance products.
- The F-factors comparison suggest that the NOAA and NASA agrees mostly to within 0.2%.
- NOAA-20 VIIRS radiance for RSBs, produced at NOAA agree with NASA SIPS generated radiance to mostly within 0.2% for most bands except for M1.
- NASA derived M1 radiance is consistently higher than NOAA by mostly 0.2-0.4%.
- Most VISNIR bands radiance ratio (NASA/NOAA) indicate downward trending during 2018 (0.1-0.2%).
- SWIR bands ratio shows annual oscillation (0.1-0.2% peak-to-peak), except I3, with NOAA and NASA calibration agreeing to mostly within 0.2%, although with multiple discontinuities.

Backup


M6
Using radiance < 20 W/(m2.sr.µm)
Rad. Ratio (NASA/NOAA)
1.002
1.000
0.998
0.996
2018.0
2018.5
2019.0
2019.5
2020.0
2020.5
2021.0
Year


I3
Rad. Ratio (NASA/NOAA)
1.002
1.000
0.998
0.996
2018.0
2018.5
2019.0
2019.5
2020.0
2020.5
2021.0
Year