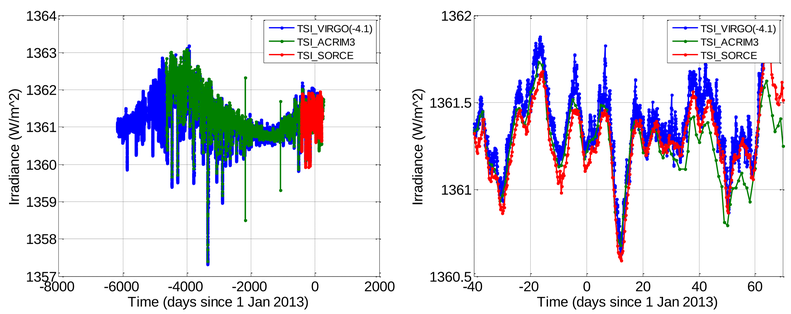
Effect of Solar Irradiance Fluctuations on S-NPP Reflective Band Calibration

Y. Savranskaya[a], J. Wicker[a], E. Haas[a], J. Cardema[a], and F. De Luccia[a]
[a]The Aerospace Corporation, 2310 E. El Segundo Blvd., El Segundo, CA 900245

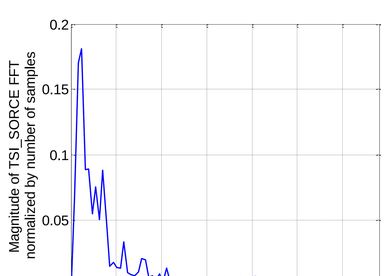
I. Total Solar Irradiance (TSI) Fluctuations

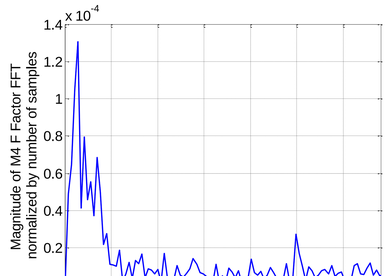
- Long term (~11 years)
- Short Term (days/weeks)
- Multiple data sources (from SORCE, VIRGO and ACRIM3) show good agreement



II. Fluctuations in VIIRS F-Factor

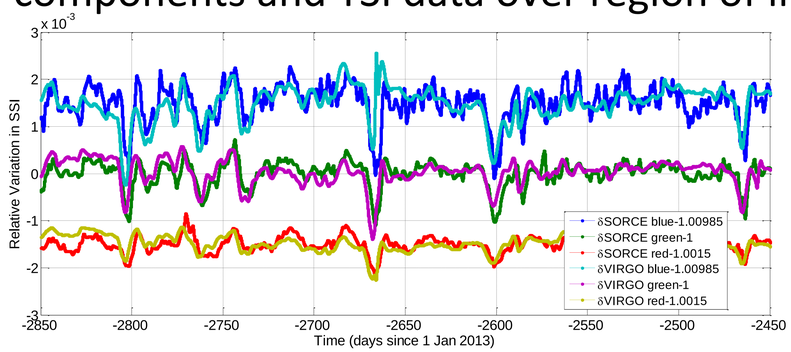
- VIIRS F-Factor is a radiometric calibration coefficient
- Frequency-domain analysis revealed similar frequency content for TSI and F-Factor fluctuations





III. Solar Spectral Irradiance (SSI) Fluctuations

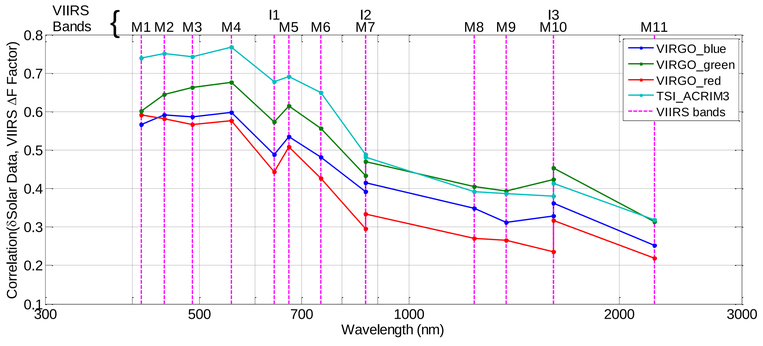
- Two sources of SSI data considered: SORCE SIM and VIRGO SPM (used here)
- Plot below shows region of good agreement for VIRGO SPM's three (blue,green,red) spectral bands
- Table below shows good correlation between SSI components and TSI data over region of interest

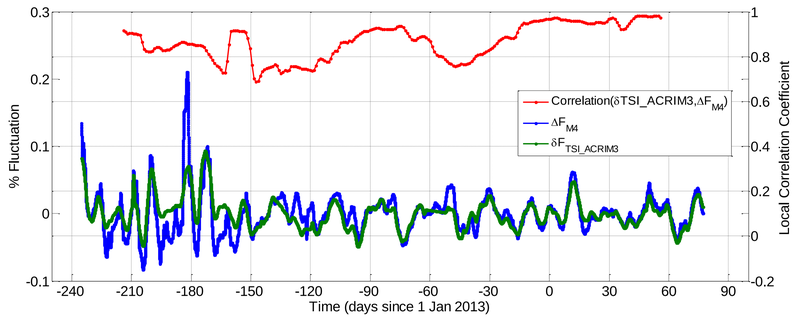


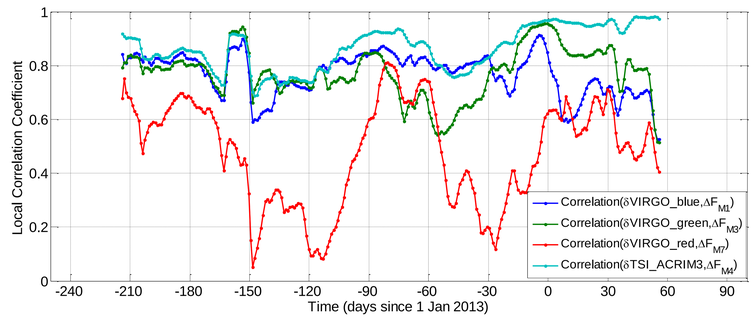
	SSI VIRGO Blue	SSI VIRGO Green	SSI VIRGO Red	TSI ACRIM3
SSI VIRGO Blue (402nm)	1	0.9037	0.8544	0.7067
SSI VIRGO Green (500nm)	0.9037	1	0.9204	0.7457
SSI VIRGO Red (862nm)	0.8544	0.9204	1	0.7199
TSI ACRIM3	0.7067	0.7472	0.7199	1

IV. Correlation of TSI and SSI with F-Factor Fluctuations

- TSI data generally correlates with F-Factor better than does SSI data
- Correlation is best at short wavelengths
- Time-domain plots below show strong local correlation (6-wk sliding window) for TSI data (around 0.8 or greater)







V. Summary

- Based on strong correlation of observed F-Factor fluctuations with solar irradiance fluctuations (especially for shorter wavelength VIIRS bands), solar variability is a significant source of radiometric fluctuations
- SSI data does not show significantly better correlation with F-Factor than TSI data does

SENSOR/MISSION ACRONYMS

SORCE: Solar Radiation and Climate Experiment
SORCE SIM: SORCE Spectral Irradiance Monitor
VIRGO: Variability of Solar Irradiance and Gravity Oscillations (part of SOHO: Solar and Heliospheric Observatory)
VIRGO SPM: VIRGO 3-channel Sun Photometer
ACRIM3: Active Cavity Radiometer Irradiance Monitor 3 instrument

EXTENTED ABSTRACT REFERENCES

1. Cardema, J. C., Rausch, K. W., Lei, N., Moyer, D. I., and De Luccia, F. J., "Operational Calibration of VIIRS Reflective Solar Band Sensor Data Records," Proc. SPIE 8510 (2012).
2. Haas, E., Moyer, D., De Luccia, F., Rausch, K., and Fullbright, J., "VIIRS Solar Diffuser Bidirectional Reflectance Distribution Function (BRDF) degradation factor operational trending and update," Proc. SPIE 8510 (2012).
3. Ermolli, I., Matthes, K., Dudok de Wit, T., Krivova, N. A., Tourpali, K., Weber, M., Unruh, Y.C., Gray, L., Langematz, U., Pilewskie, P., Rozanov, E., Schmutz, W., Shapiero, A., Solanki, S. K., and Woods, T. N., "Recent variability of the solar spectral irradiance and its impact on climate modeling," Atmos. Chem. Phys., vol. 13, pp. 3945-3977, 2013.
4. Frohlich, C., and Wehrli, C., "Variability of Spectral Solar Irradiance from VIRGO/SPM Observations," Physikalish-Meteorologisches Observatorium Davos, World Radiation Center internal report, 2002.