

A Comparative Examination of SORCE and TSIS-1 TSI Data During Overlap Period

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Presentation Outline

- **SORCE Daily TSI data used in CERES processing**
- **Background on the use of SORCE Data in CERES**
- **SORCE and TSIS1 comparison during overlap period**
- **Gap occurrence in SORCE and TSIS-1 data**
- **Gap-filling in both using temporal coherence**
- **Analysis of characteristics of the two datasets**
- **Questions?**

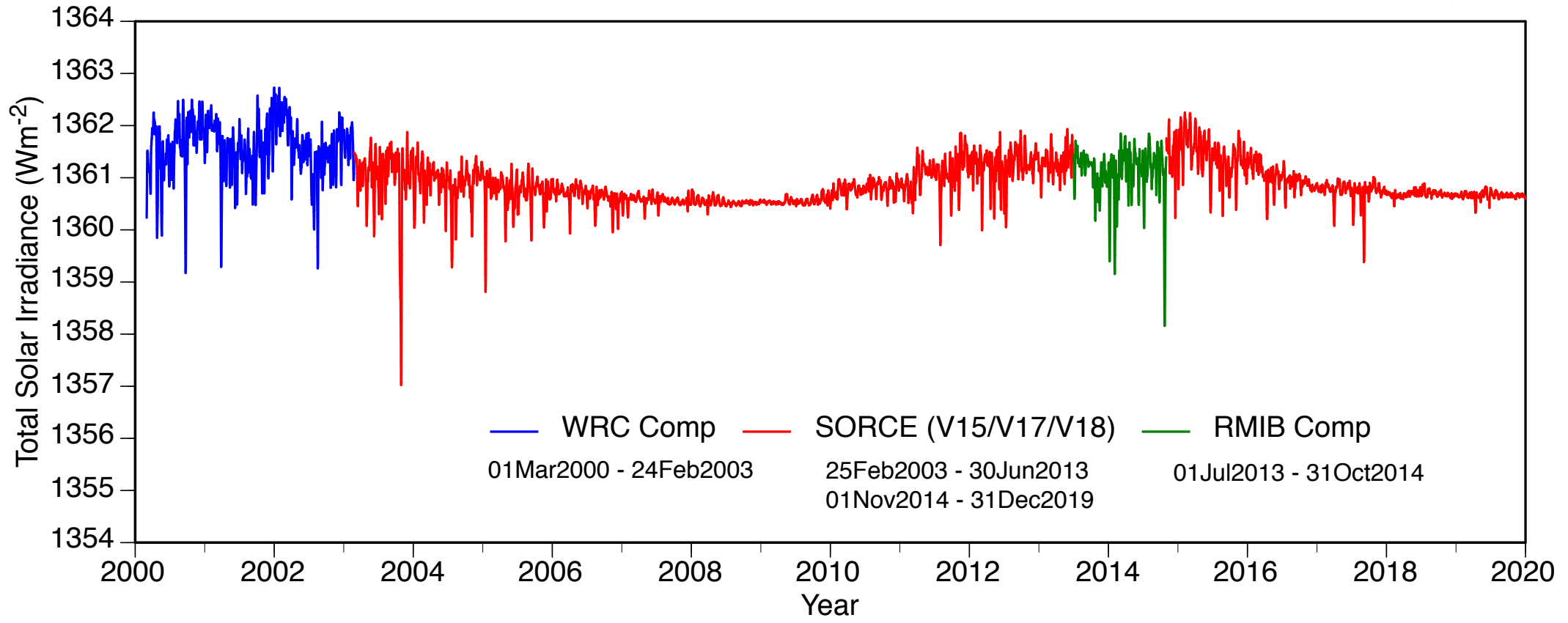
Background on the Use of SORCE in CERES

- Daily SORCE TSI data use started with CERES Edition-4 processing.
- Edition-4 period: Terra – 01 March 2000-present; Aqua – 01 July 2002-present.
- SORCE data covers 25 March 2003 to 15 January 2020 with several versions.
- Period prior to SORCE covered with WRC data.
- An interruption occurred during mid July 2013 to early March 2014.
- The 2013-14 gap covered with RMIB-composite data.
- All datasets used were normalized to SORCE Version-15 level.

WRC: World Radiation Centre Davos

RMIB: Royal Meteorological Institute of Belgium

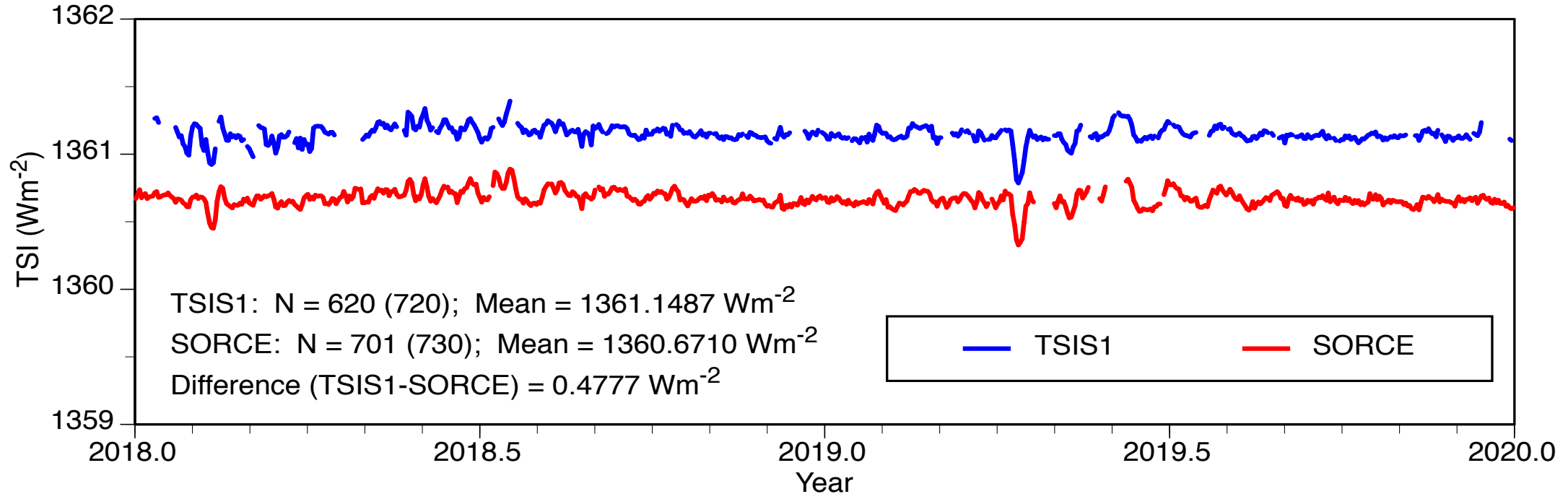
Total Solar Irradiance for CERES Edition-4 (20000301 - 20191231)



TSIS-1 Data

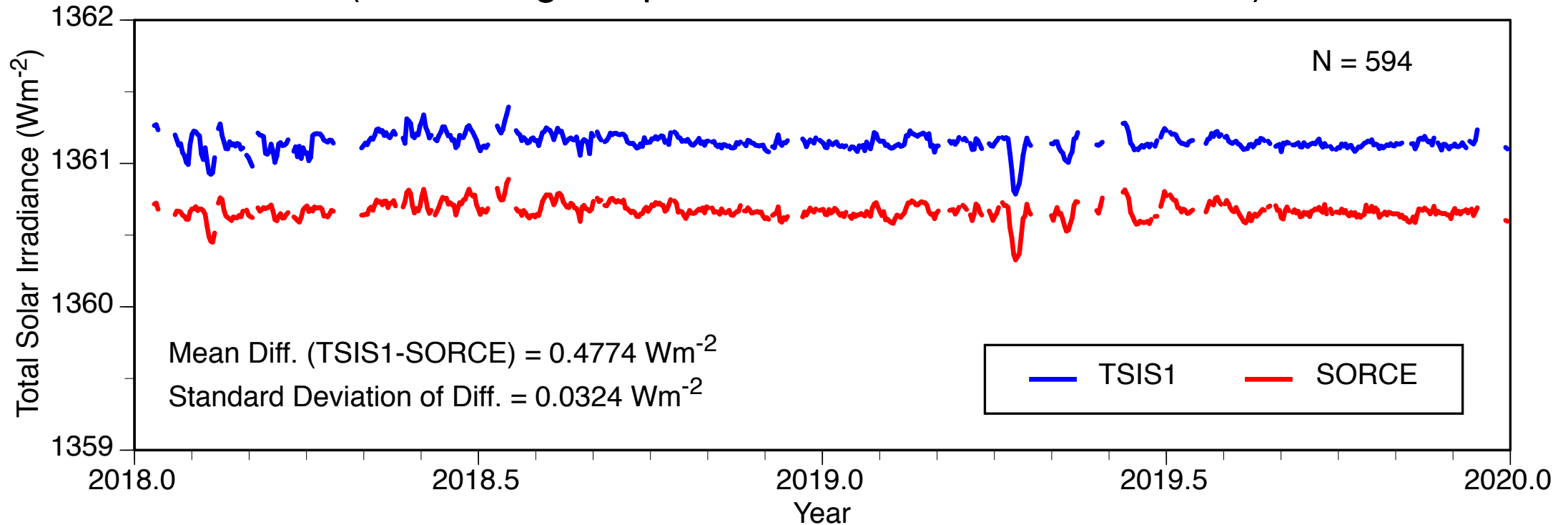
- Starting Jan2020, we will be using TSIS1 data in CERES.
- Compared SORCE and TSIS-1 timeseries during the overlap period.
- TSIS-1 data starts 11 January 2018 and continues...
- SORCE and TSIS-1 timeseries show a steady difference and a strong temporal coherence
- Both timeseries show frequent gaps uncorrelated with each other.
- Temporal coherence used to fill most gaps in both timeseries.

TSIS1 and SORCE TSI (Unfilled) - Jan2018-Dec2019



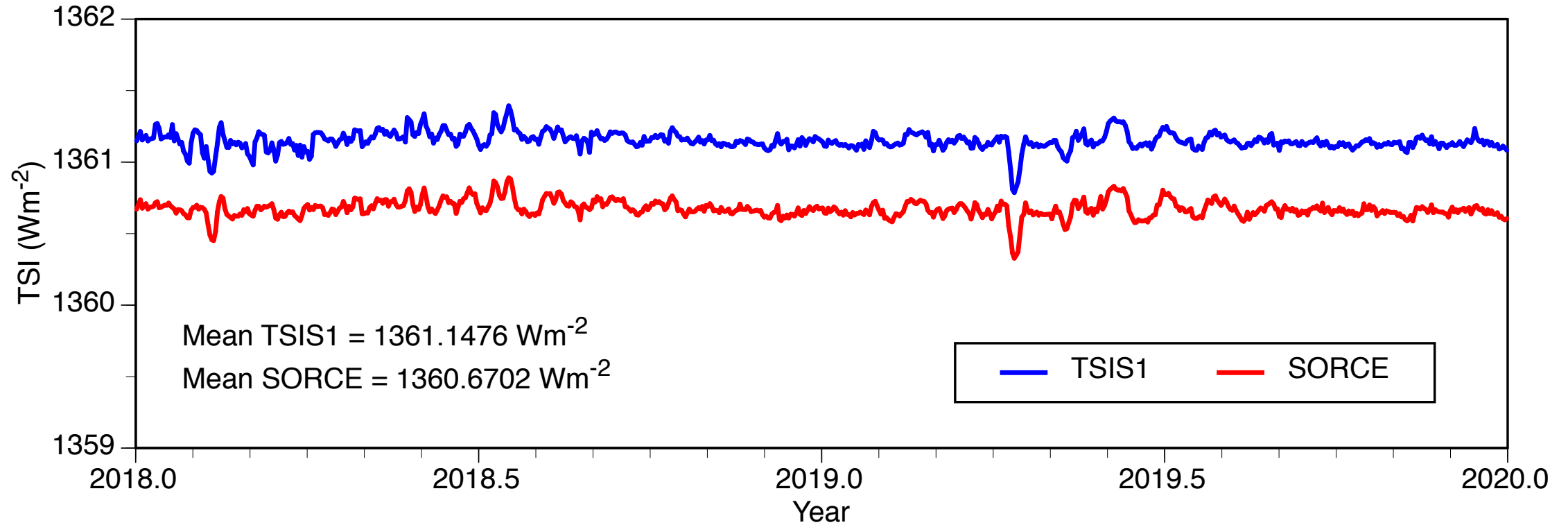
TSIS1 data have considerably more gaps than SORCE data. Gap frequency seemed to be decreasing with time but then two large gaps appeared in Dec2019. However, there is strong temporal coherence between the two datasets.

Comparison of TSIS1 and SORCE TSI - Jan2018-Dec2019 (between good points common to both datasets)



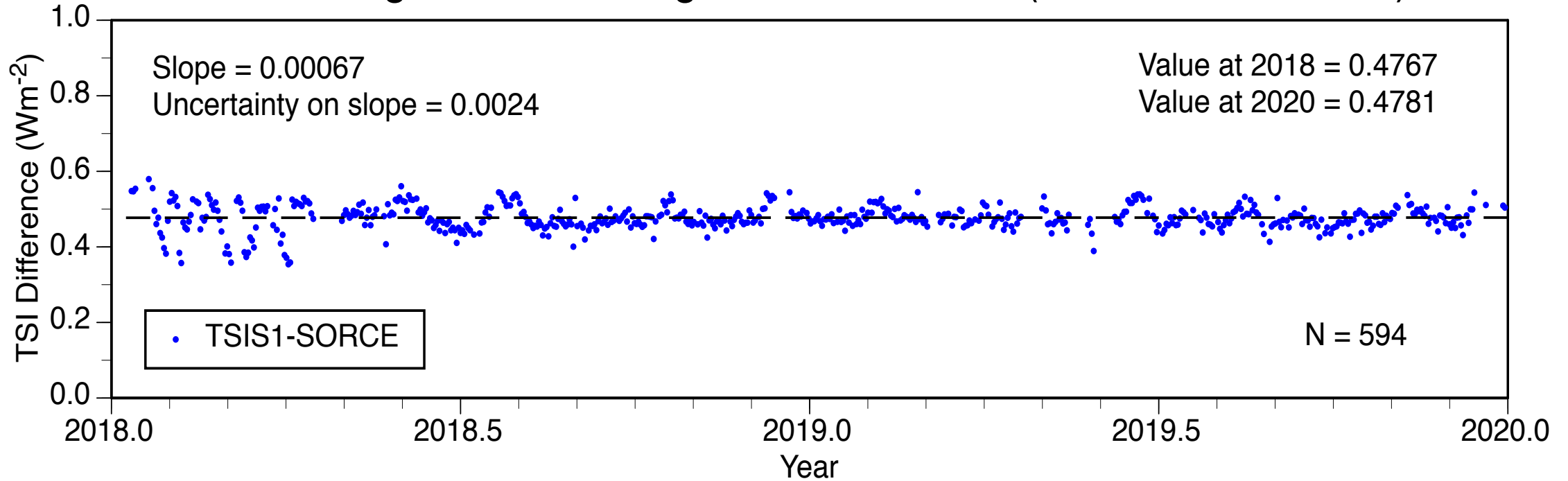
Timeseries shown above were created using days that have good values in both datasets. Mean difference between the two timeseries: $\text{TSIS1-SORCE} = 0.4774 \text{ Wm}^{-2}$. This difference is within the absolute accuracy for SORCE (350 ppm or 0.48 Wm^{-2}) and lower than absolute accuracy for TSIS1 (410 ppm or 0.56 Wm^{-2}). Gaps were filled using the temporal coherence. A few gaps still remained and were filled by linear interpolation.

TSIS1 and SORCE TSI (Filled) - Jan2018-Dec2019



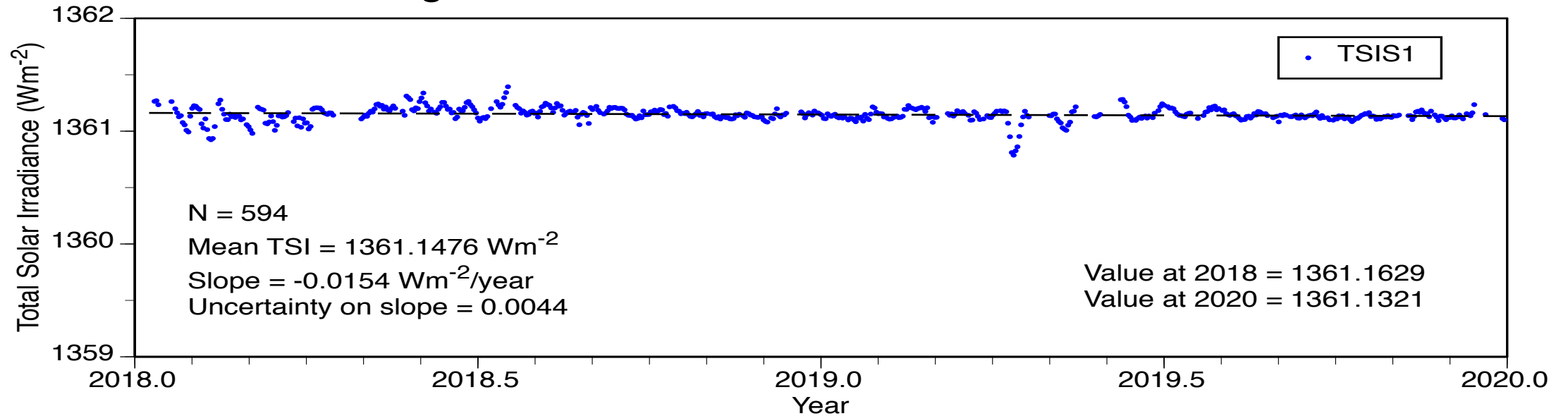
Filling was done by applying the difference 0.4774 Wm^{-2} to gaps in either timeseries.

Linear Regression Through TSI Difference (Jan2018-Dec2019)

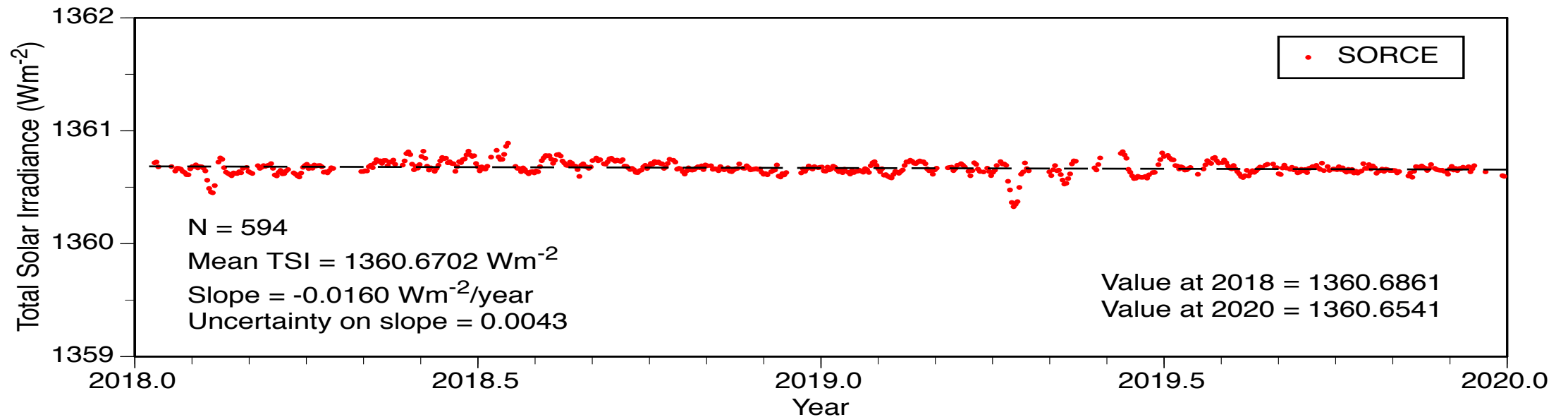


Examined the difference between the two and looked for some trend. None was obvious. The slope is extremely small and quite uncertain. So, we looked for trends separately in each dataset. Those trends are also small and comparable to each other (next two slides).

Straight Line Fit to TSIS1 TSI - Jan2018-Dec2019



Straight Line Fit to SORCE TSI - Jan2018-Dec2019



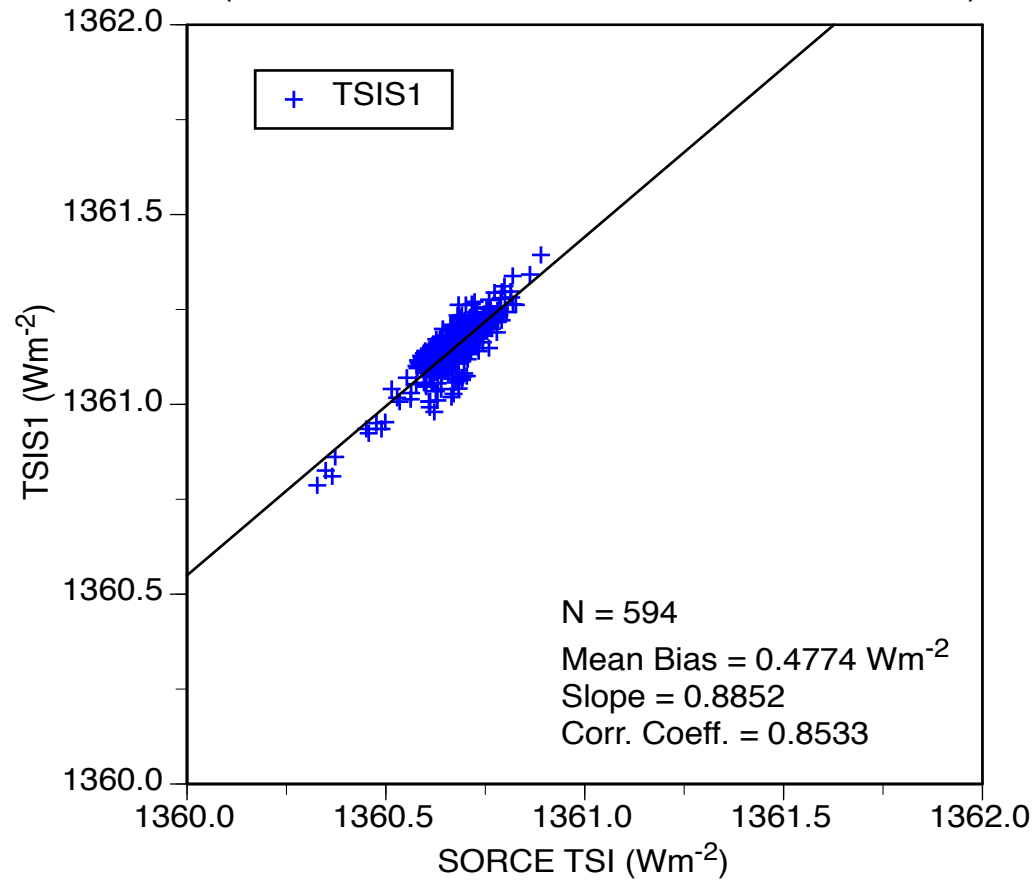
Summary

- Looking forward to use of TSIS1 data in CERES processing starting January 2020.
- Examined TSIS1 data vis-à-vis SORCE data during the overlap period (2018-2019).
- Mean TSIS1 value is 0.48 Wm^{-2} higher than SORCE value over this period.
- TSIS1 data still has large gaps; larger than in SORCE data during this period.
- Difference between the two timeseries is steady and does not show any trend.
- Gap-filling during the last two years was done using temporal coherence between SORCE and TSIS1 timeseries.
- SORCE greatly helped in filling gaps in TSIS1 timeseries and will be sorely missed. Currently, no other TSI data are available with such low latency to take its place.

Questions:

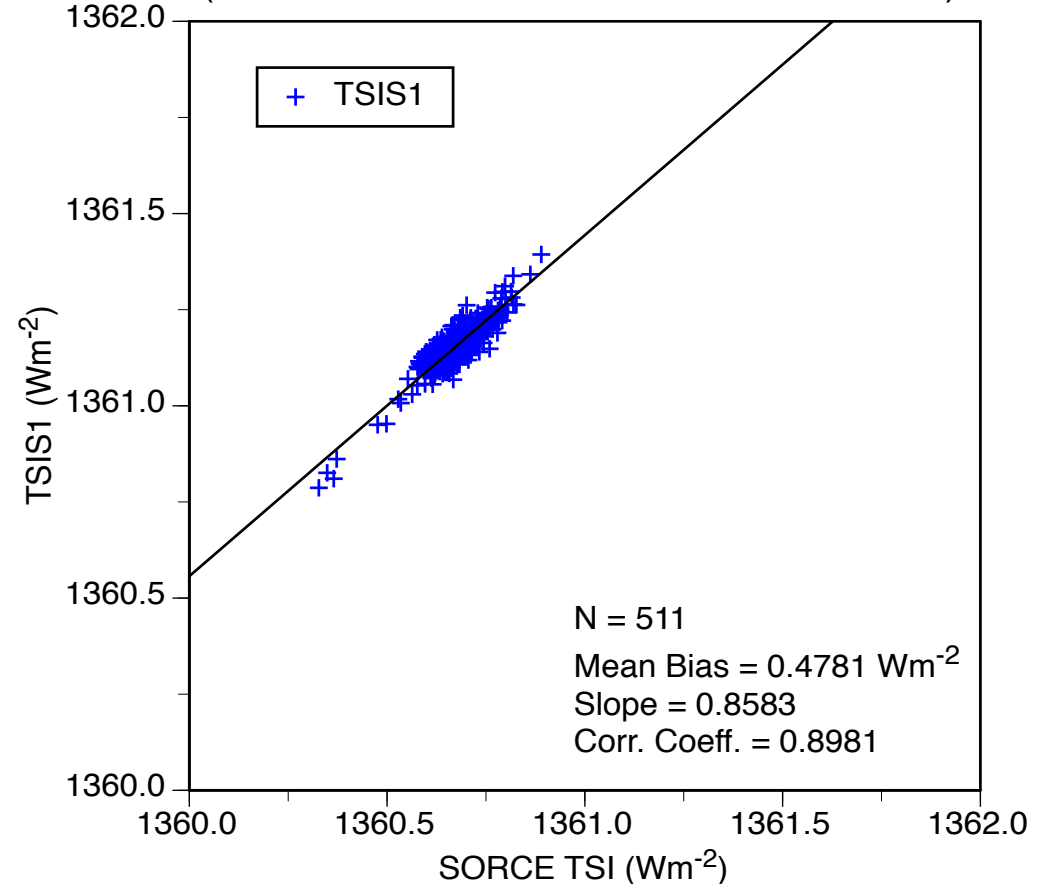
1. The difference (0.4774 Wm^{-2}) is well within the absolute accuracy for both. Do we apply this difference when we blend TSIS1 data with existing SORCE data?
2. More frequent and larger gaps (at least so far) in TSIS1 data are a concern. Not yet been able to find a definitive answer. Suggestions received so far:
 - Orbital characteristics of the Space Station
 - Need to frequently boost the Space Station in orbit
3. Should we expect these gaps to decrease in frequency and length in the future?
4. Open to suggestions on methods for quickly filling gaps in TSIS1 data.

Comparison of SORCE and TSIS1 TSI (201801-201912)
(when both datasets have measured values)



95% confidence interval on
the slope = 0.8916 +/- 0.0447

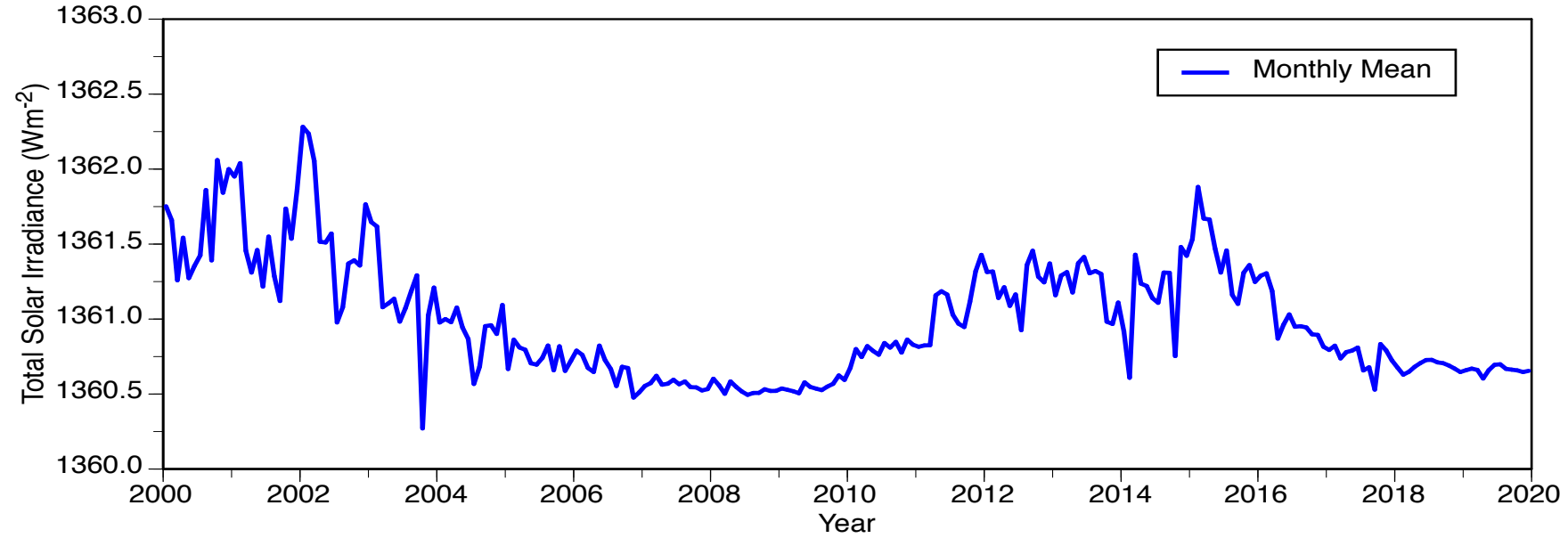
Comparison of SORCE and TSIS1 TSI (201805-201912)
(when both datasets have measured values)



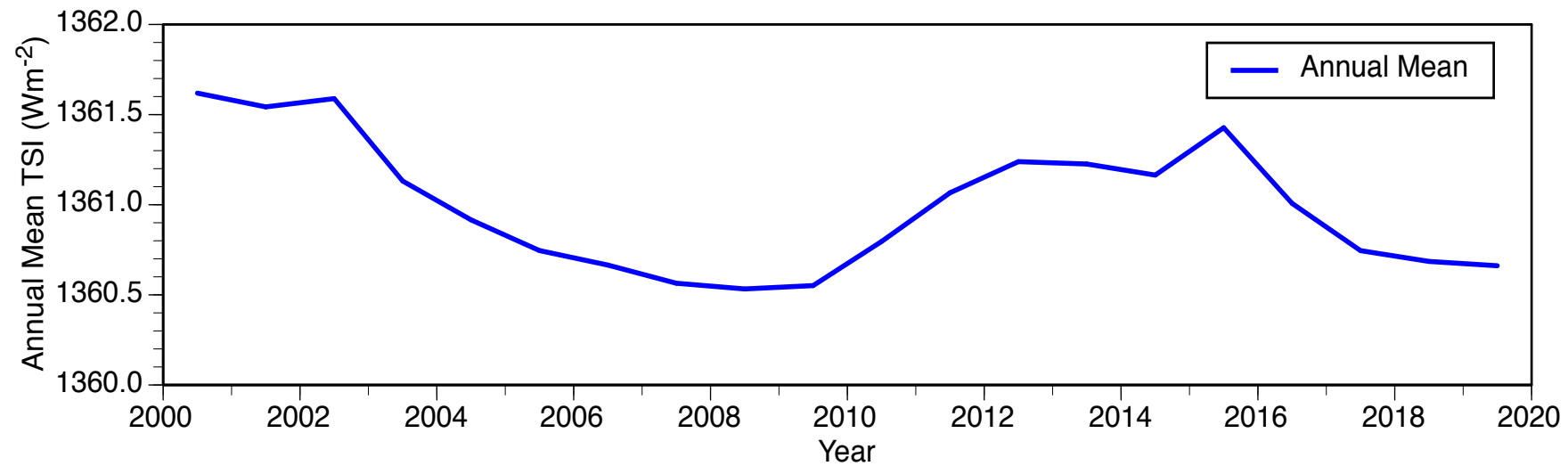
95% confidence interval on
the slope = 0.8650 +/- 0.0447

The left plot contains all data and in the right one, the noisy points (83) were dropped. The slope deteriorated some while correlation improved a bit. No net benefit really,

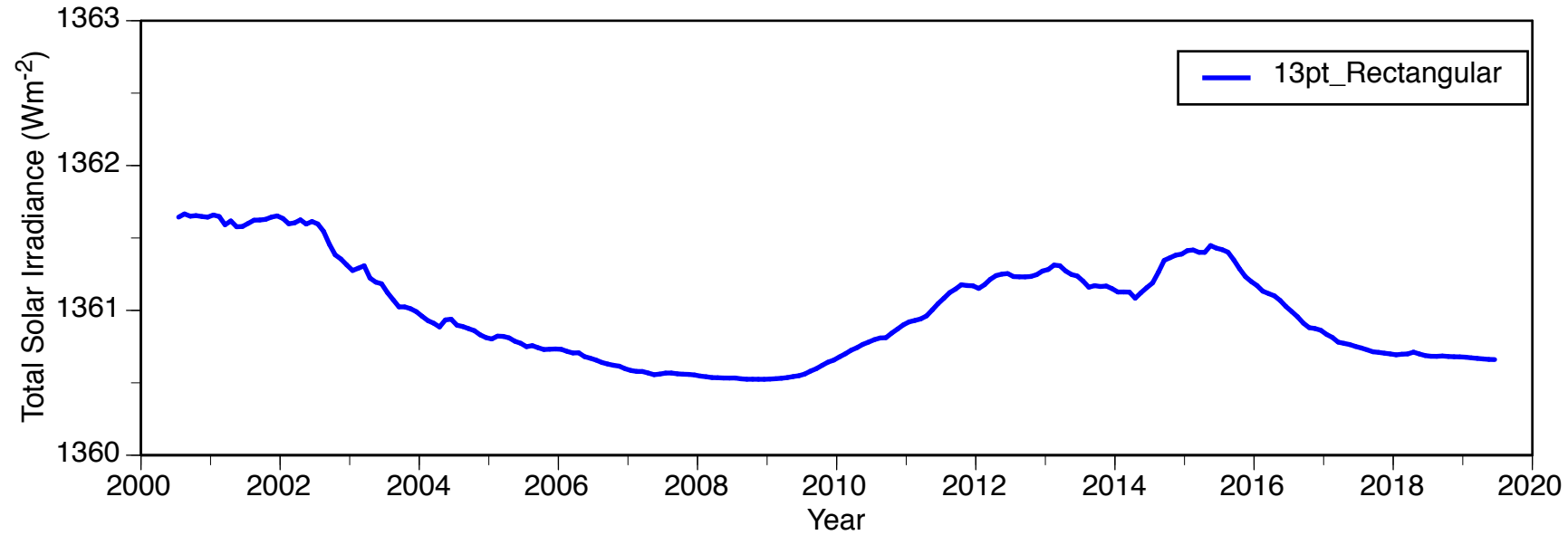
Monthly Mean Total Solar Irradiance: 2000-2020



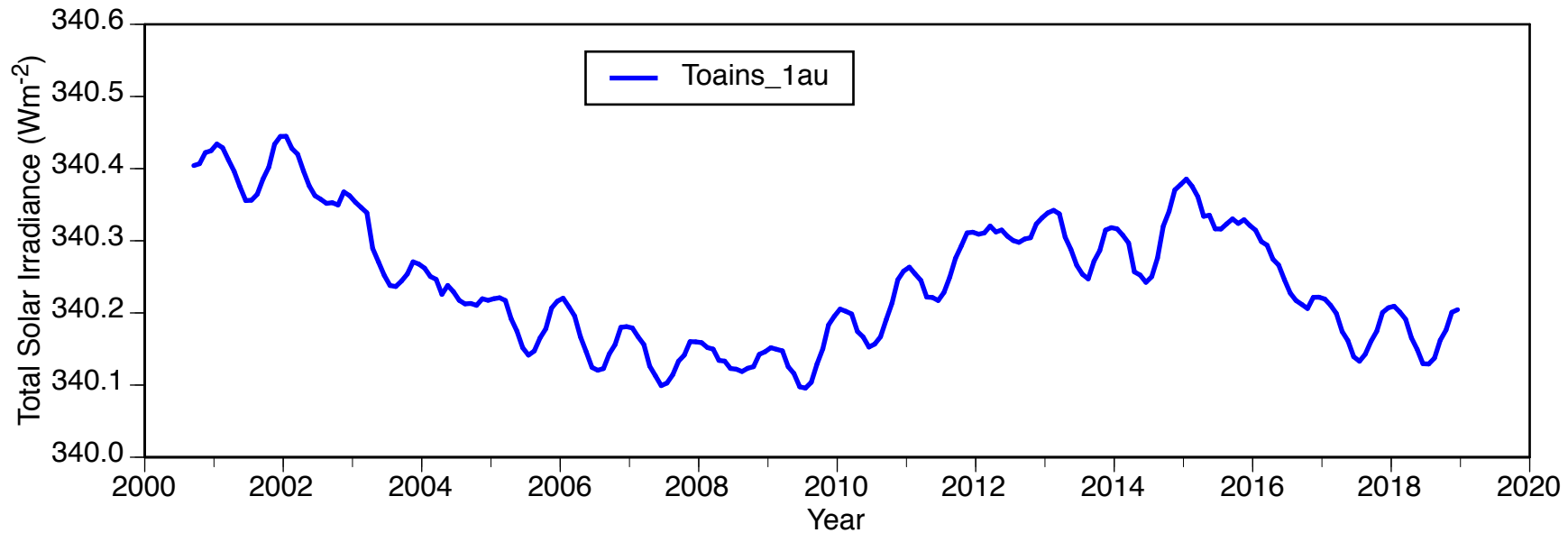
Annual Mean Total Solar Irradiance: 2000-2020



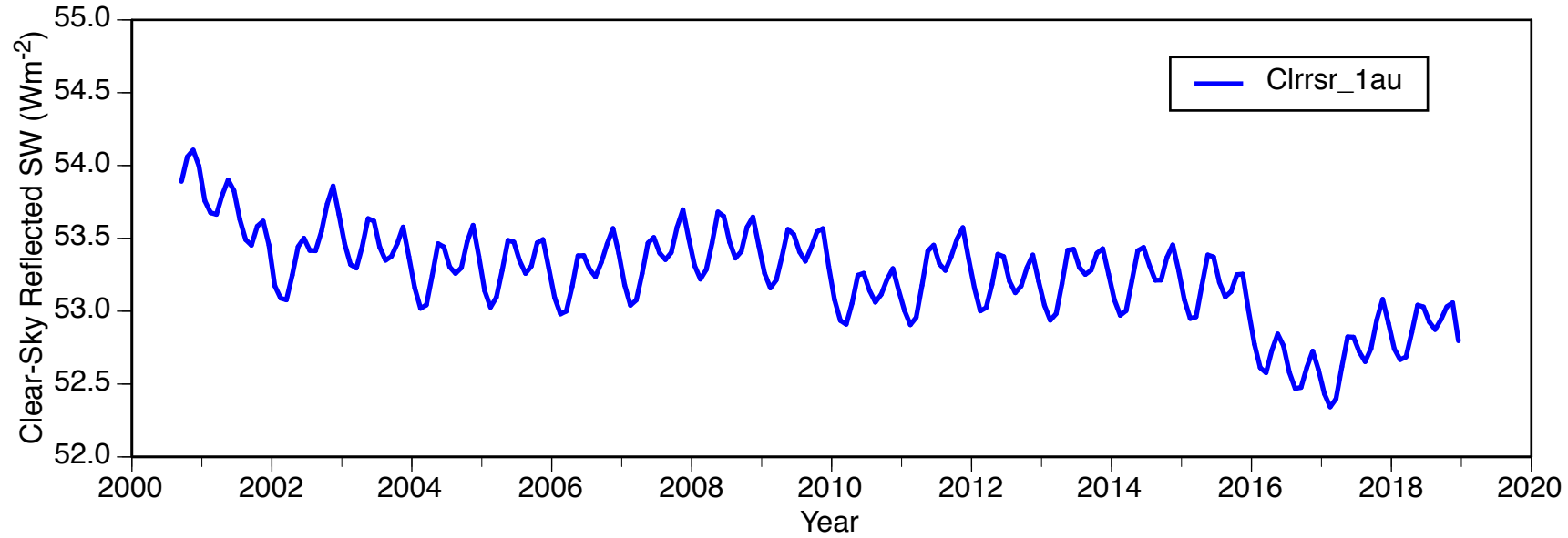
13-pt Sliding Average of Monthly TSI from SORCE



TOA Insolation - Global Average: March 2000 - June 2019 (13pt smoothed)



Clear-Sky Reflected SW - Global Average: March 2000 - June 2019 (13pt smoothed)



All-Sky Reflected SW - Global Average: March 2000 - June 2019 (13pt smoothed)

