

On Continuation of the Use of Daily TSI for CERES Processing

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CERES Science Team Meeting

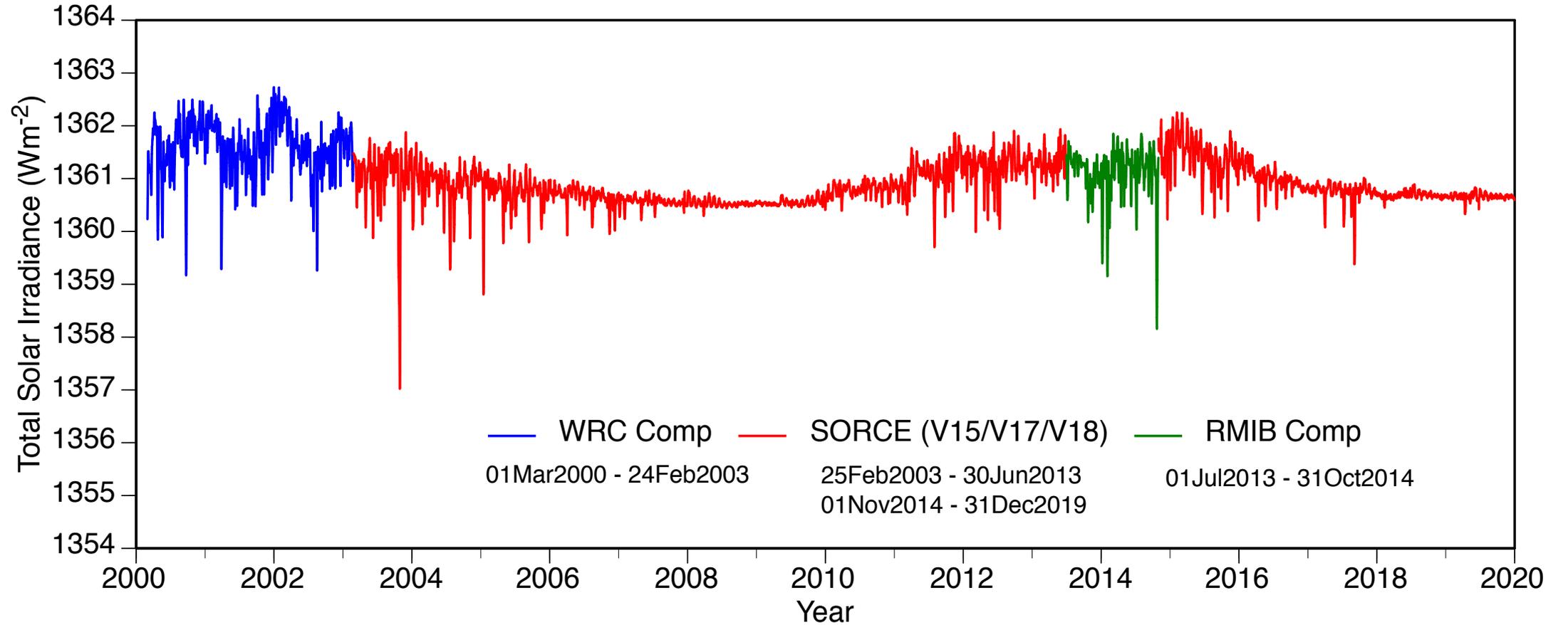
Hampton, VA 23666

28-30 April 2020

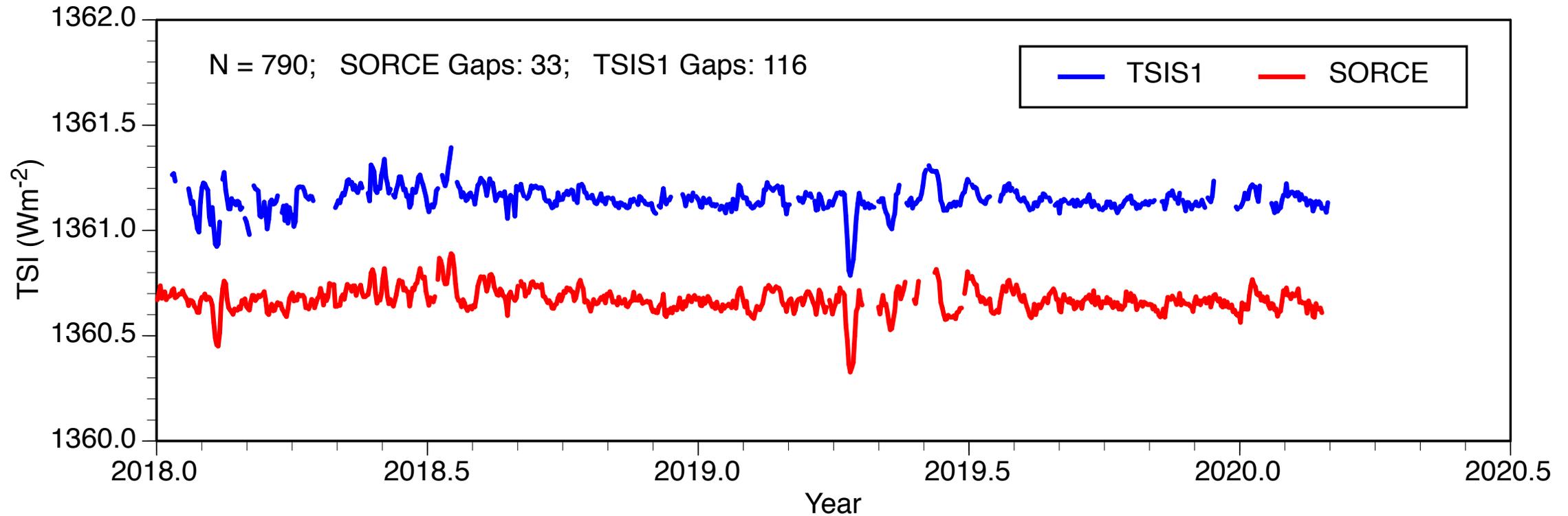
Background

- Use of daily TSI data started with CERES Edition-4 processing.
- SORCE data covers most of this period with some gaps.
(CERES period: March 2000 – present)
- Complete coverage of CERES period accomplished as follows:
Mar2000 – Feb2003: WRC Data
Mar2003 – Jun2013: SORCE (Version15)
Jul2013 - Oct2014: RMIB Composite (SORCE interruption)
Nov2014 - Feb2020: SORCE (SORCE passivated 25Feb2020)
Mar2020 – present: TSIS1
- TSIS1 and SORCE overlap period: Jan2018 – Feb2020
- Allows intercomparison (intercalibration) of the two timeseries
- Allows development of a unique method of gap-filling in both

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

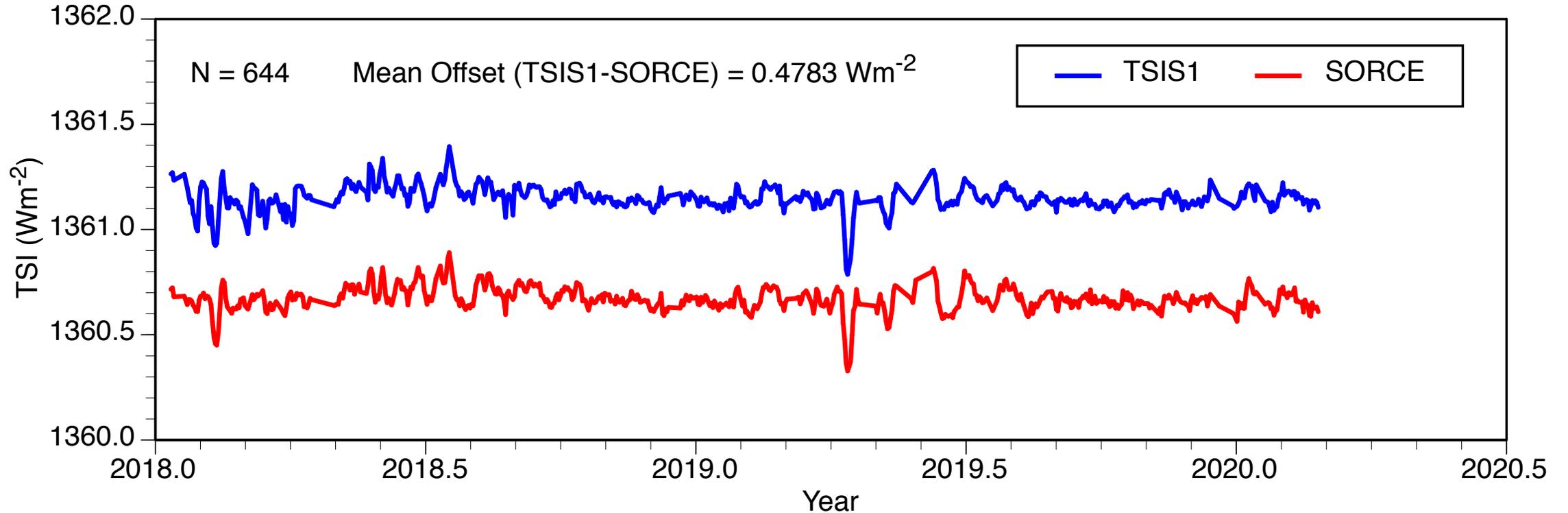


TSIS1 and SORCE Timeseries (Unfilled) - 201801-202002



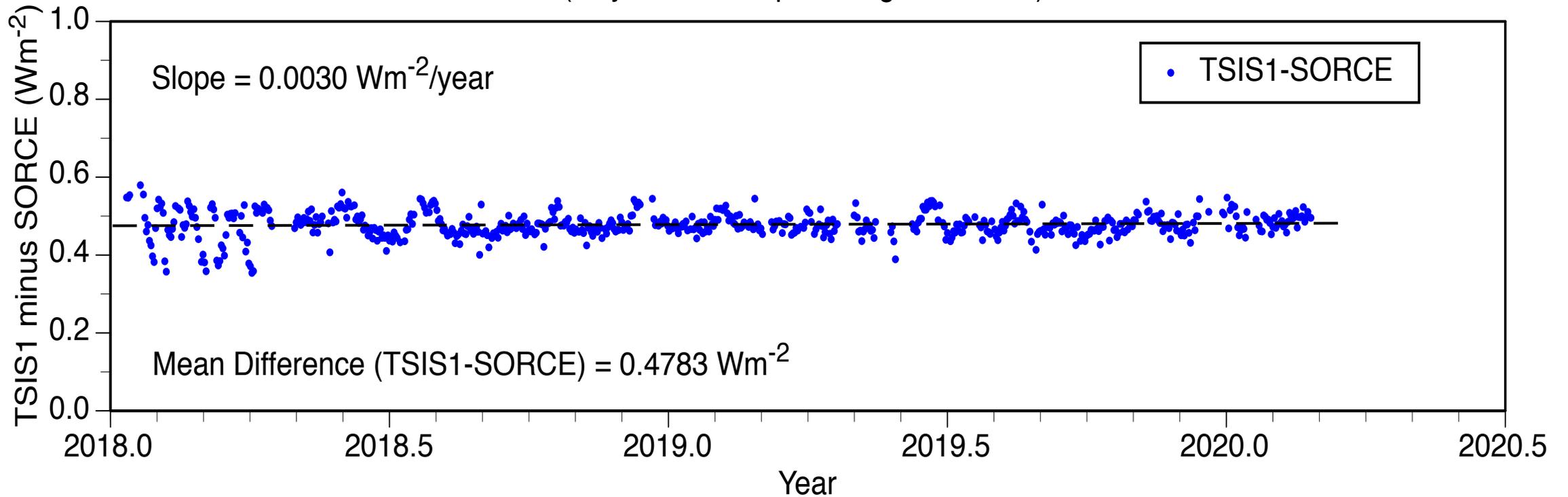
Over the 26-month overlap period, both timeseries show gaps. Numbers above show that TSIS1 data gaps are more frequent and longer. Strong temporal correlation and a steady offset between the two timeseries can be clearly seen. Note that gaps in the two timeseries are not temporally correlated.

TSIS1 and SORCE Timeseries - 201801-202002
(Only points when both provide good values)



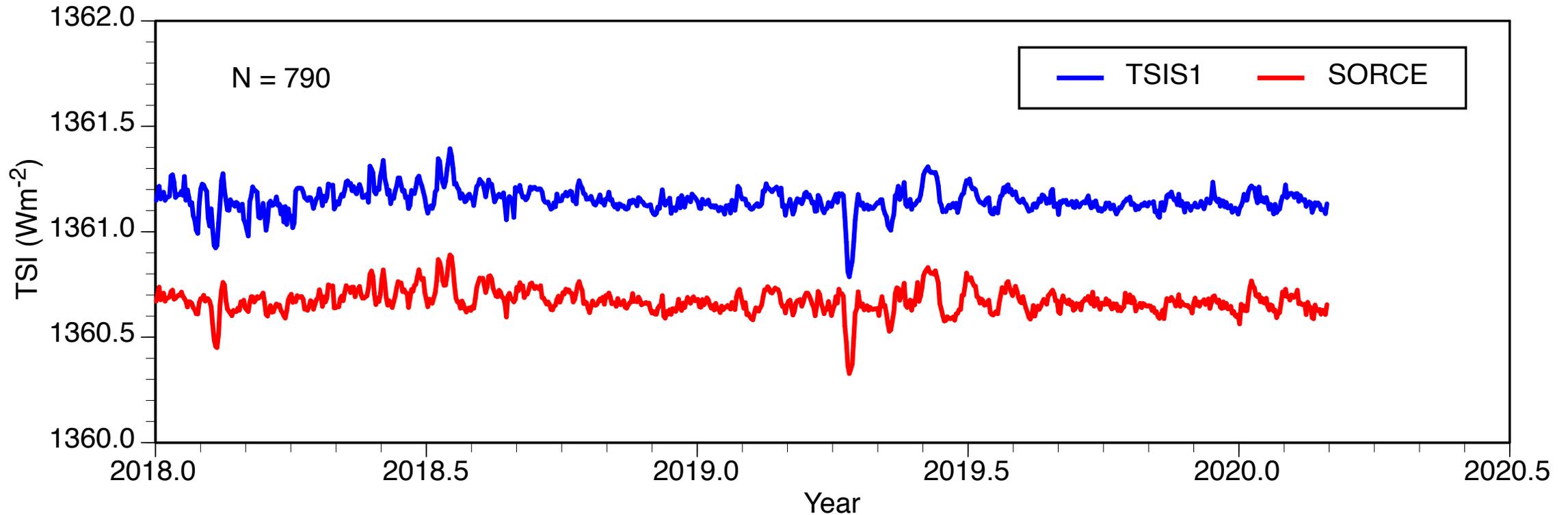
The difference is determined by creating new timeseries constituted by only those days that have good measurements in both timeseries. The number of days and the mean difference are shown above. This difference is well within the absolute accuracy of SORCE (350 ppm) and TSIS1 (410 ppm) and has not triggered any action by providers.

TSIS1 minus SORCE Timeseries - 201801-202002
(only when both provide good values)



We tried to determine if there was any drift/trend in this difference plot but did not find any. We also ascertained that there was no significant trend in either SORCE or TSIS1 timeseries individually (plots not included)

TSIS1 and SORCE Timeseries (Filled) - 201801-202002



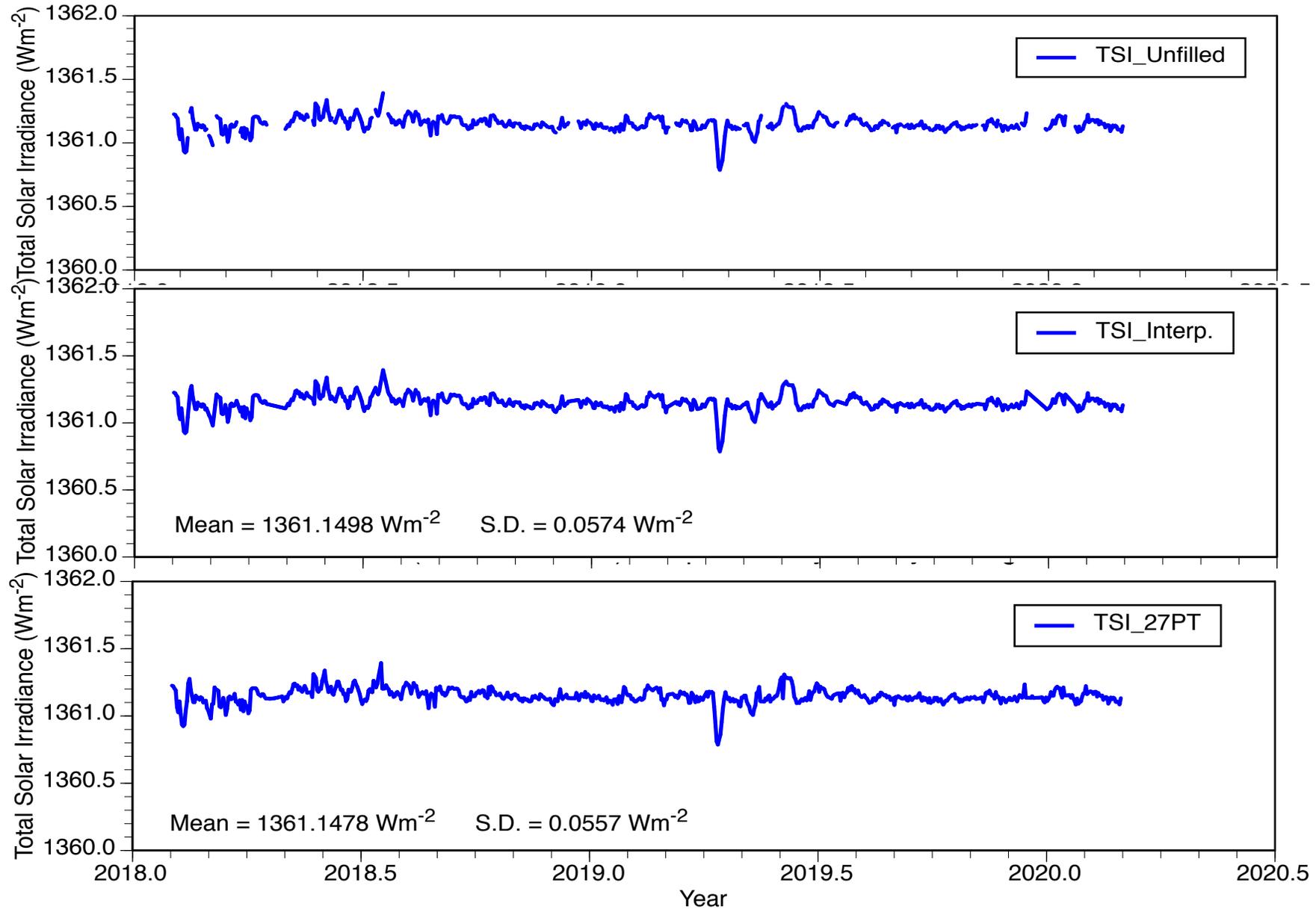
The non-correlation of gaps allows us to fill most gaps applying this mean difference to both timeseries. A very few gaps (total of 3) remain on days when neither dataset has a good value. Those are still filled by linear interpolation.

I CALL THIS DATASET MY TRUTH DATASET

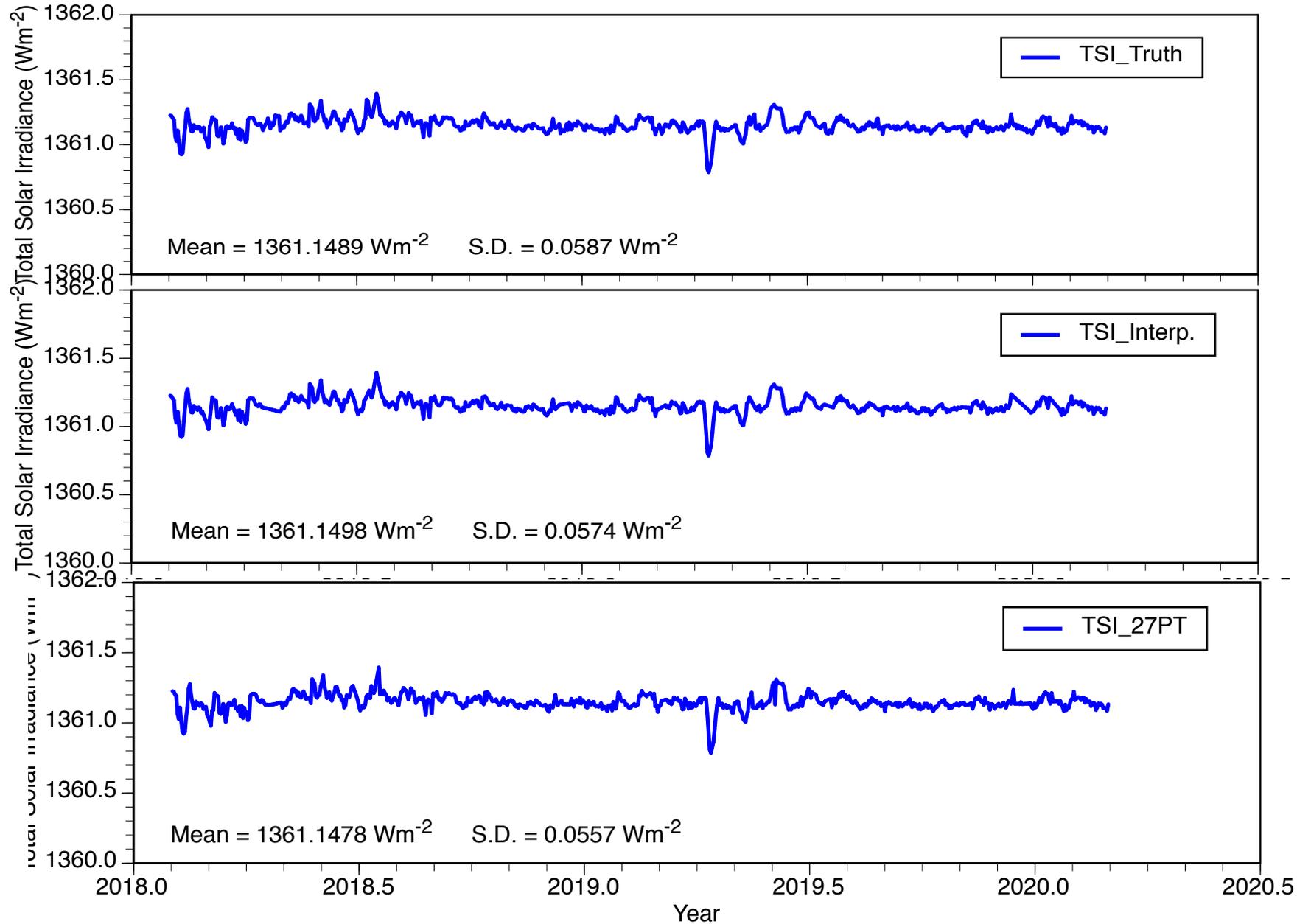
TSIS1 Gaps and Gap-Filling After the Overlap Period

- TSIS1 data shows more frequent and longer gaps, why?
 - 1) Obstruction of the TSIS1 FOV by Space Station structure, and
 - 2) Frequent extra-vehicular activities around the Space Station.Need: Look for a different gap-filling strategy for use with TSIS1 data.
- Used linear interpolation as for SORCE and tried one more method with TSIS1 data and compared results of the two methods.
- The completely filled “truth” dataset provides a testbed for evaluating any filling strategy:
 - 1) Tried linear interpolation for filling gaps like before, and
 - 2) Tried an average over one solar rotation (27 days) immediately before the gap
 - a. Used Jan2018 data for computing the initial value of the 27-day average
 - b. Then filled gaps in the remaining 25-month timeseries with averages of the preceding 27 days.

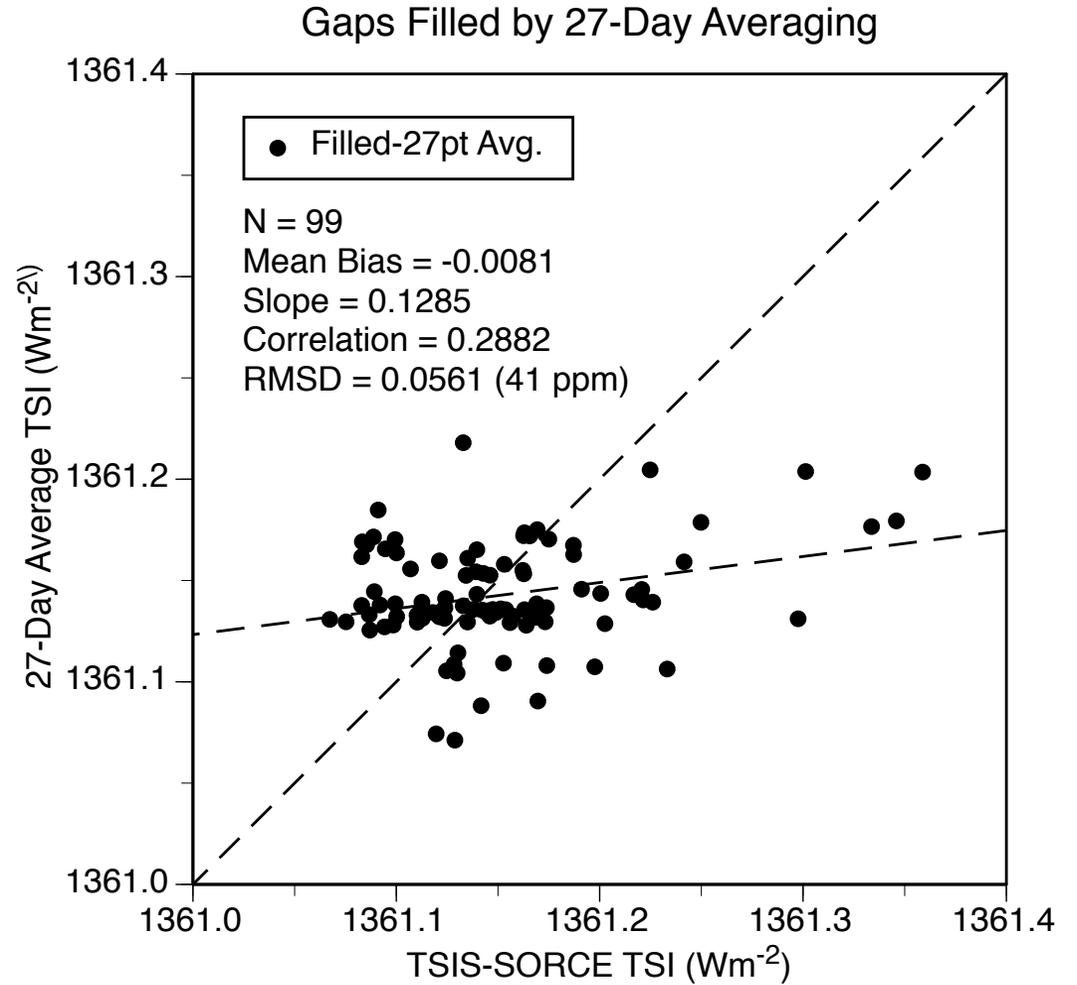
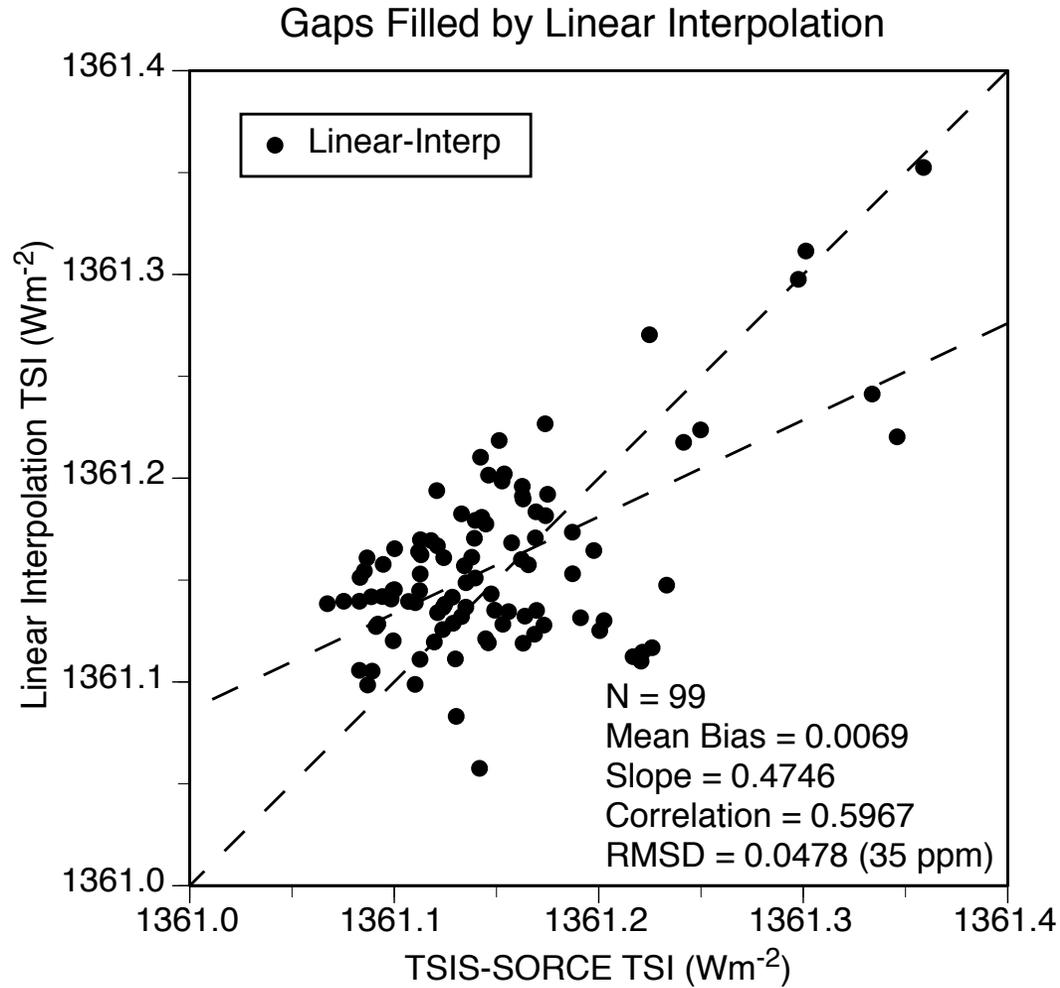
Gap-filling in TSIS1 data by two methods (201802-202002)



Comparison of the filled datasets with the truth



Comparison of the Two Filling Method Results



Summary

- More frequent and longer gaps in TSIS1 data are caused by:
 - 1) Obstruction of the TSIS1 FOV by Space Station structure, and
 - 2) Frequent extra-vehicular activities around the Space Station.
- Hence, longer and more frequent gaps may continue indefinitely.

Solution: Linear interpolation appears to be adequate at this time.
Averaging over a solar rotation does not appear to offer any advantage.

- The offset of 0.4783 Wm^{-2} in TSI may affect the quality of CERES SW products.

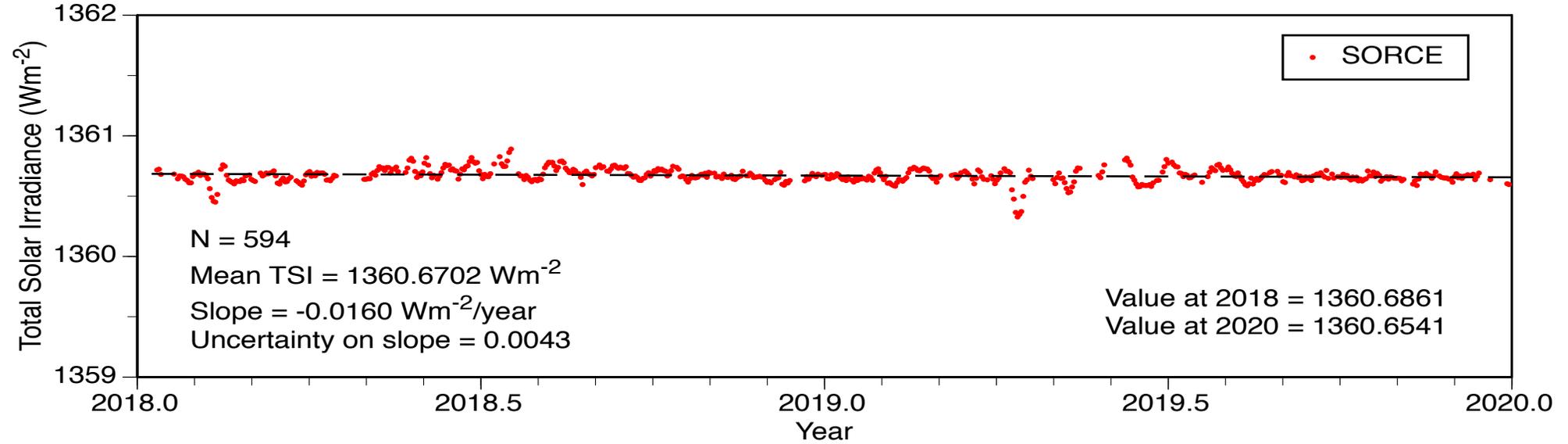
Solution: Offset TSIS1 data to SORCE V15 level as long as Edition-4 is being processed. Revisit when Edition-5 or other processing is undertaken.

Backup Slides

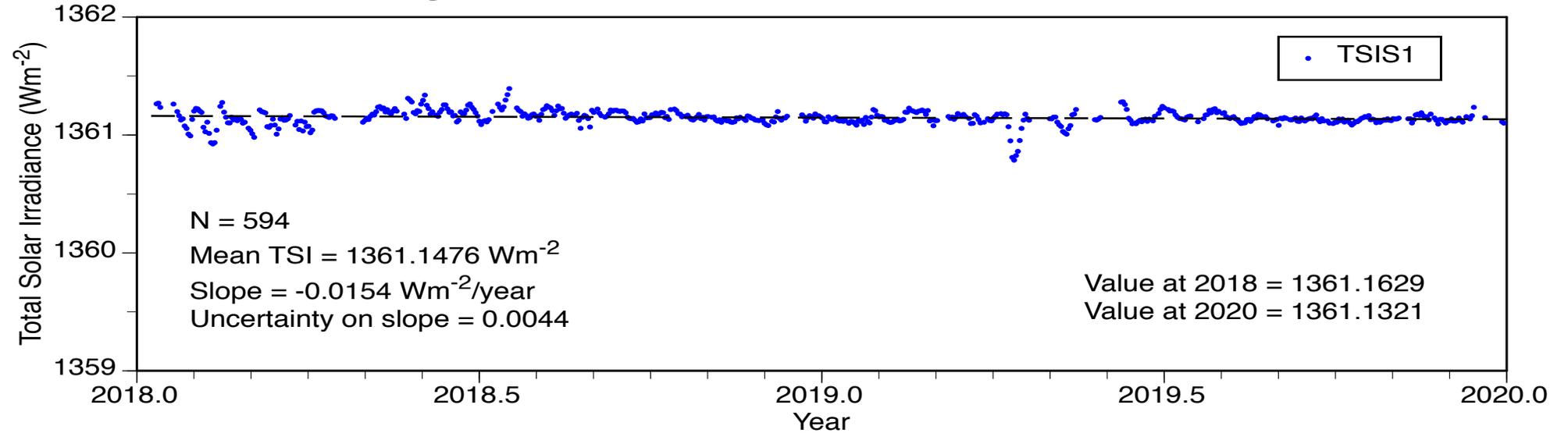
Outline

- Background
- Stitching together a daily TSI dataset for the entire CERES record (March 2000 – present)
- Intercomparison and gap-filling during the SORCE and TSIS1 overlap period
- Causes of frequent and longer gaps in TSIS1 data
- Gap-filling after the overlap period

Straight Line Fit to SORCE TSI - Jan2018-Dec2019



Straight Line Fit to TSIS1 TSI - Jan2018-Dec2019



Comparison of Gap Distribution in TSIS1 and SORCE

(In the 25-month timeseries)

TSIS1 Gaps

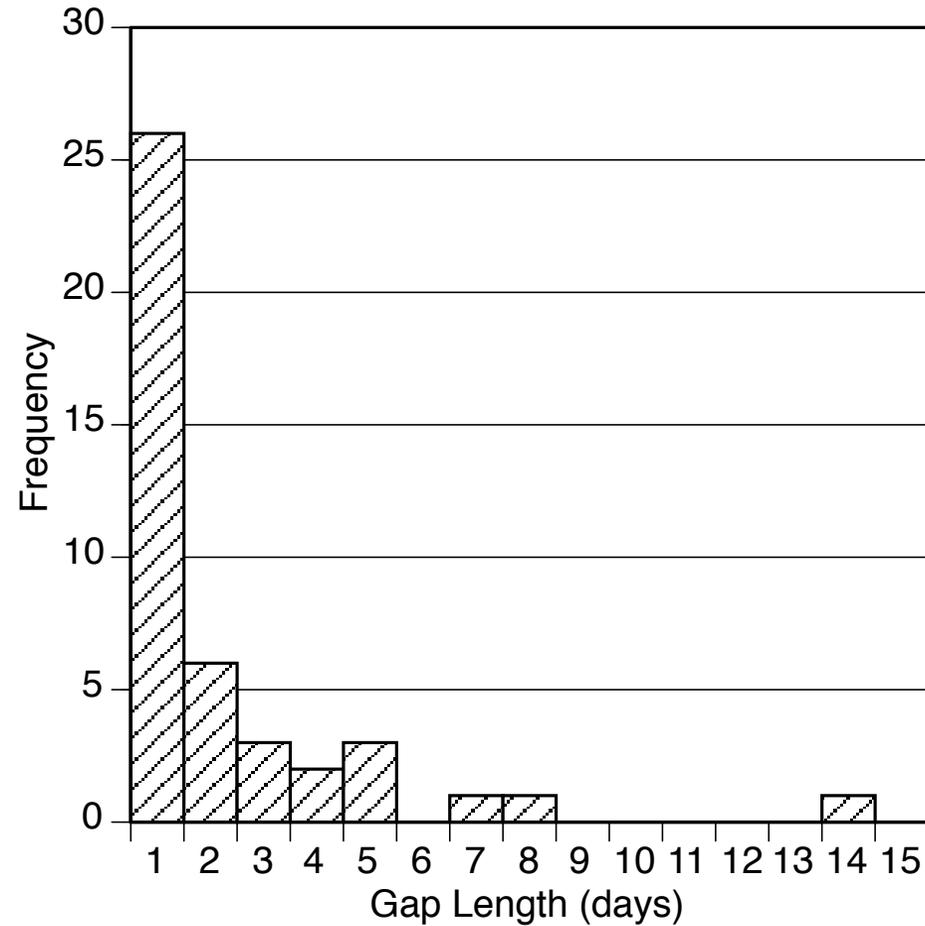
Gap Length	Frequency	No. of Gaps
1	26	26
2	6	12
3	3	9
4	2	8
5	3	15
6	0	0
7	1	7
8	1	8
9	0	0
10	0	0
11	0	0
12	0	0
13	0	0
14	1	14
15	0	0
---	---	Total Gaps = 99

SORCE Gaps

Gap Length	Frequency	No. of Gaps
1	4	4
2	0	0
3	0	0
4	1	4
5	1	5
6	0	0
7	0	0
8	0	0
9	0	0
10	2	20
---	---	Total Gaps = 33

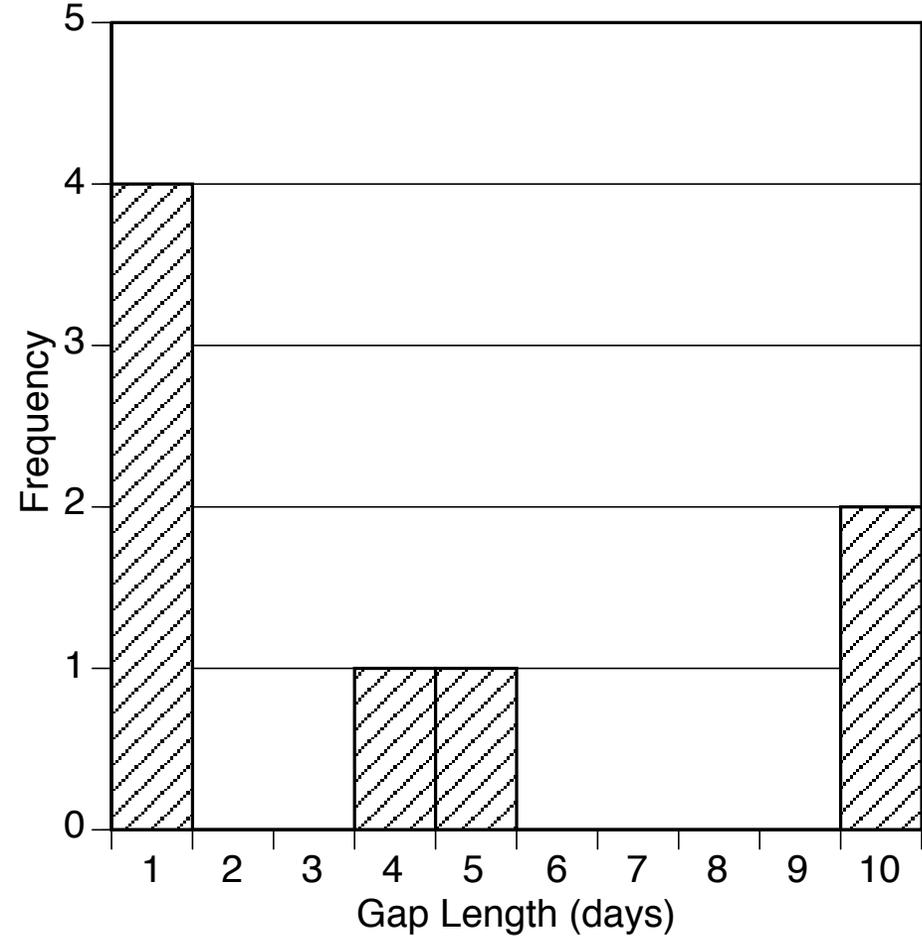
Frequencies of Gap Sizes in TSIS1 and SORCE Data

Frequencies of Gap Sizes in TSIS1 Data



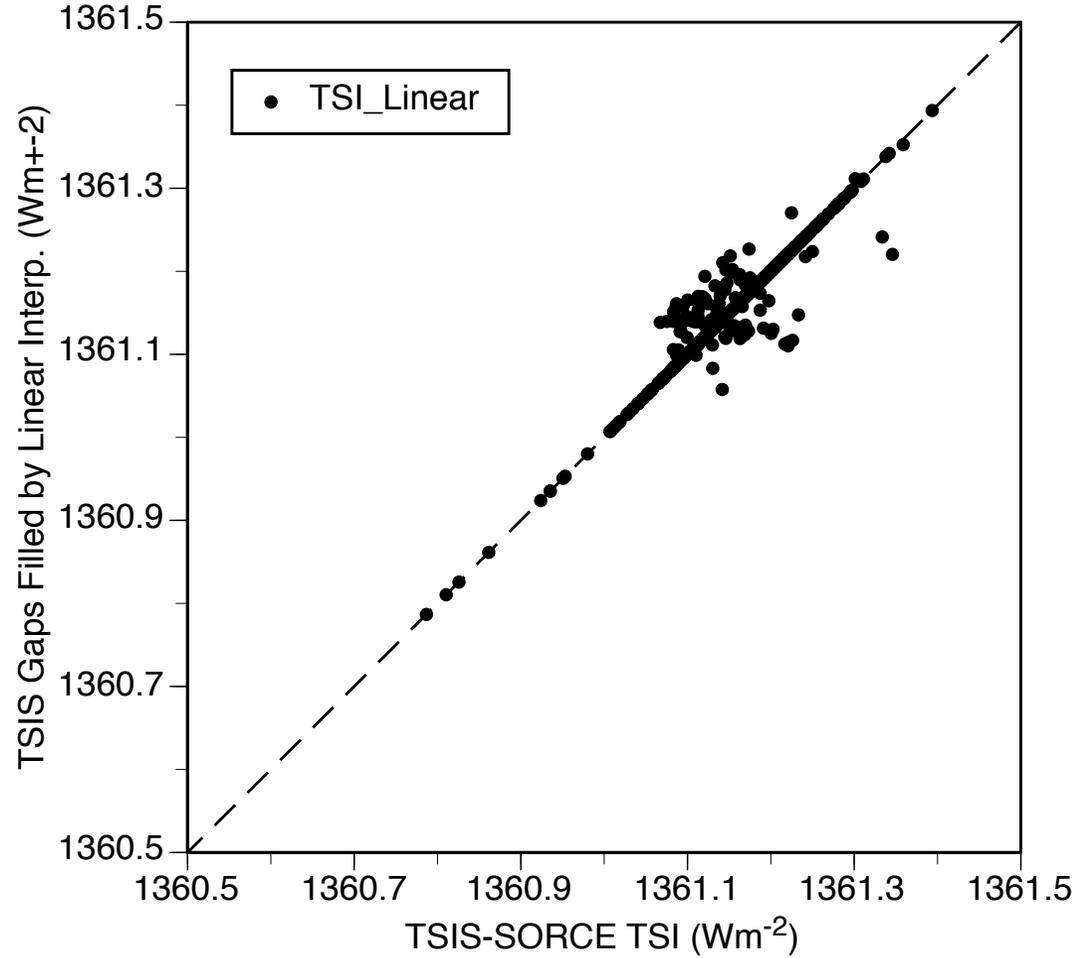
Total Number = 99

Frequencies of Gap Sizes in SORCE Data

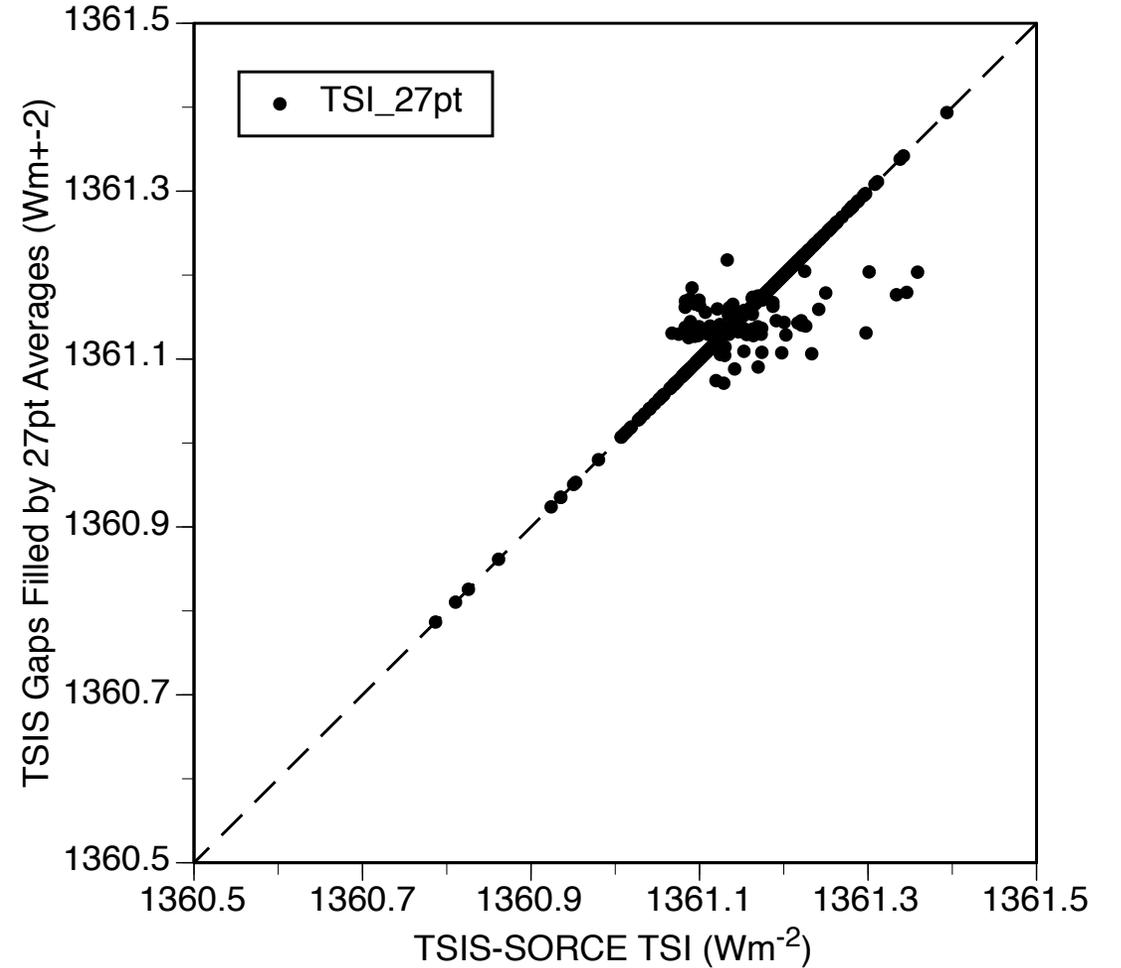


Total Number = 33

Gaps Filled by Linear Interpolation



Gaps Filled by 27pt. Averaging



Points other than those created for gaps are the same in both datasets