A TSIS & SORCE Status Overview

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Laboratory for Atmospheric and Space Physics

Welcome to the 2018 Sun-Climate Symposium

The State of the TSI and SSI Climate Records at the Junction of the SORCE and TSIS Missions

Mission Status

Tom Woods

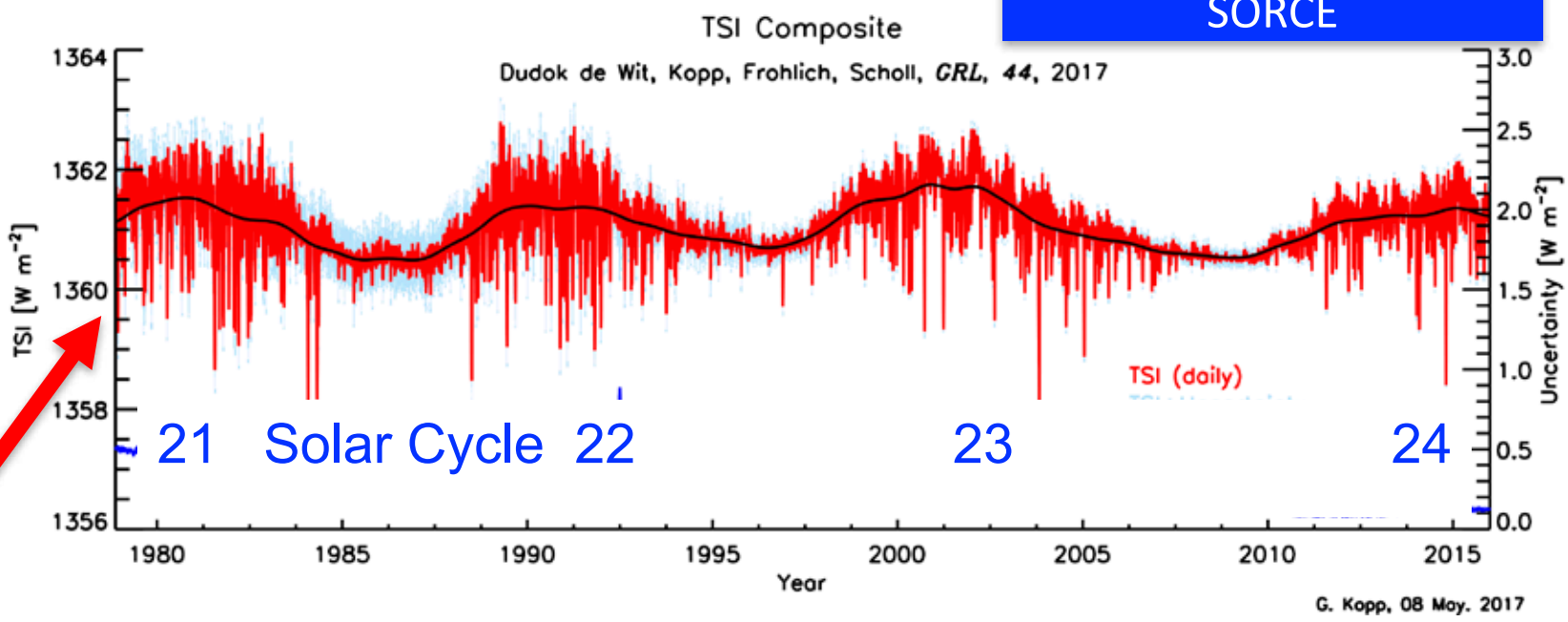
LASP / University of Colorado

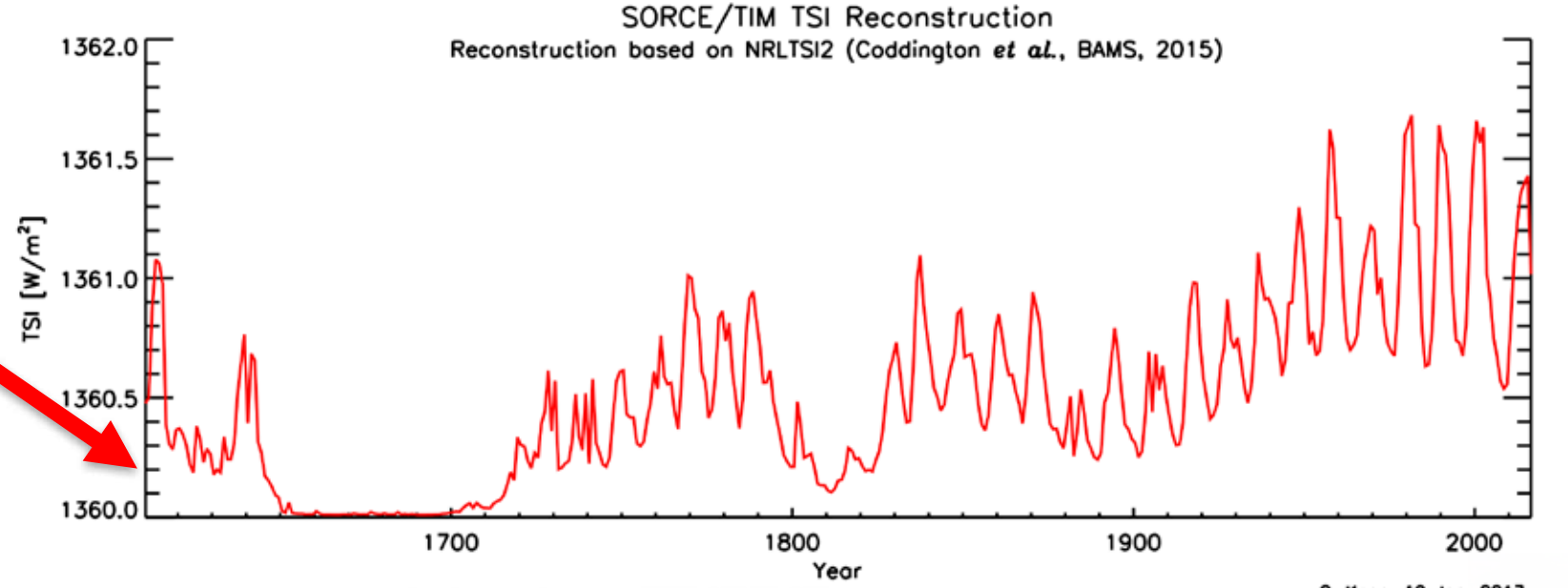
SORCE TIM Extends the TSI Record

SORCE covers 40% of the TSI Climate Record

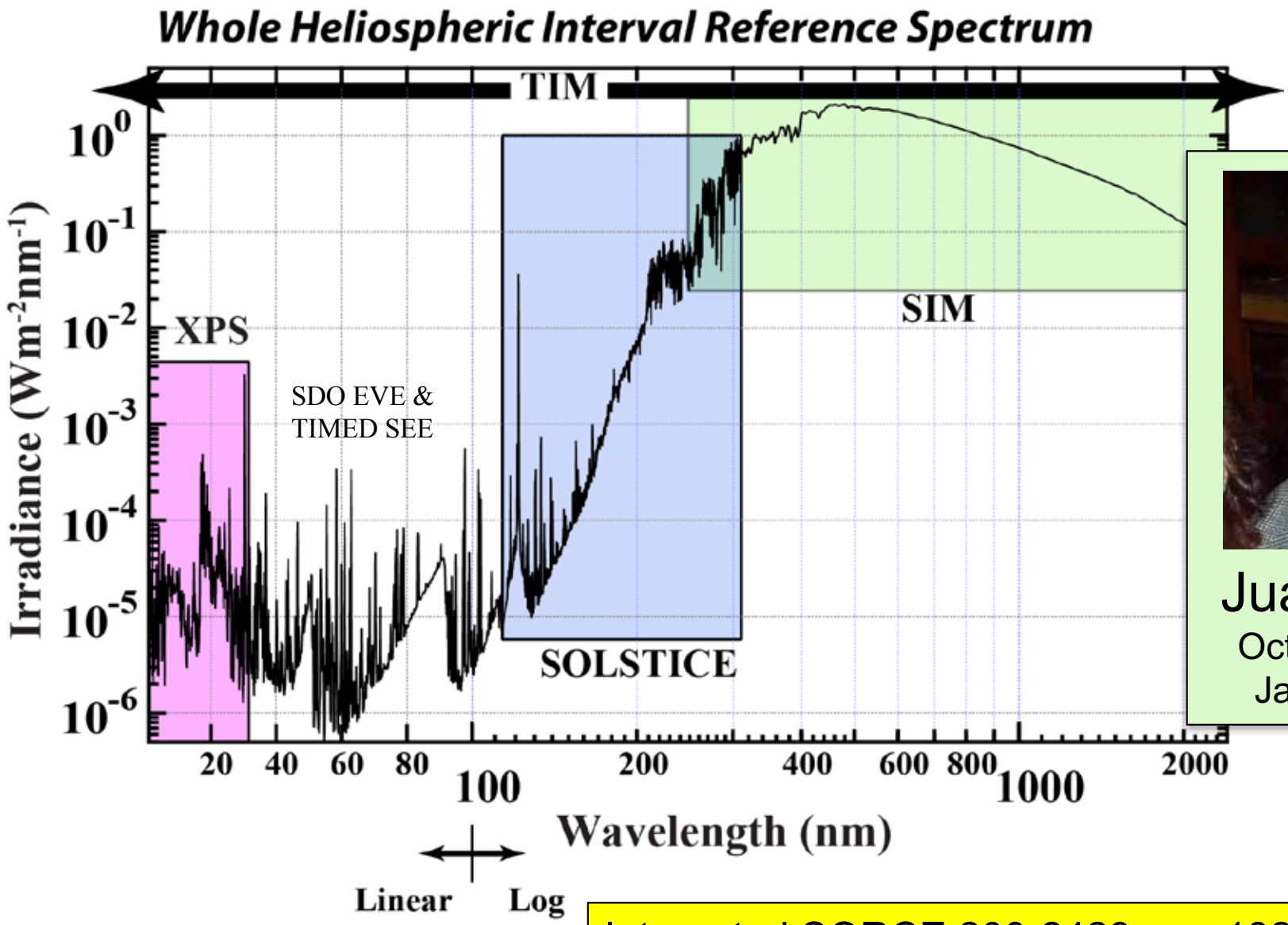
Accurate TSI Record

New Models of TSI Variability





SORCE Starts New SSI Record for Visible-NIR



Juan Fontenla

October 28, 1948 – January 11, 2018

Integrated SORCE 200-2423nm =1324.49 Wm^{-2}
~ 97.3% of TSI

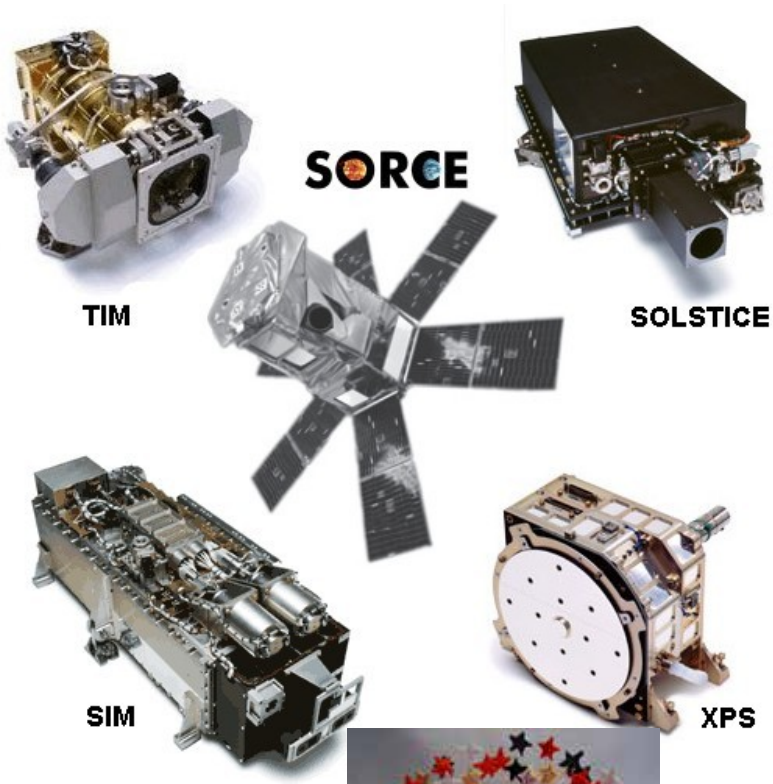
Infrared portion >2423nm ~ 36.32 Wm^{-2}

SORCE Mission Overview

A Mission of Solar Irradiance for Climate Research

- SORCE Measurements
  - Total Solar Irradiance (TSI)
  - Solar Spectral Irradiance (SSI)
    - 0.1-27 nm and 115-2400 nm
  - Important Earth science measurements for studying radiative forcing, dynamics, and photochemistry in atmosphere
- SORCE Mission
  - Launched in 2003
  - Its mission has been extended to overlap with ISS-TSIS in 2018-2019
  - Spacecraft and instruments are making routine daily measurements in its Day-Only Operations (DO-Op) mode (due to battery issues)

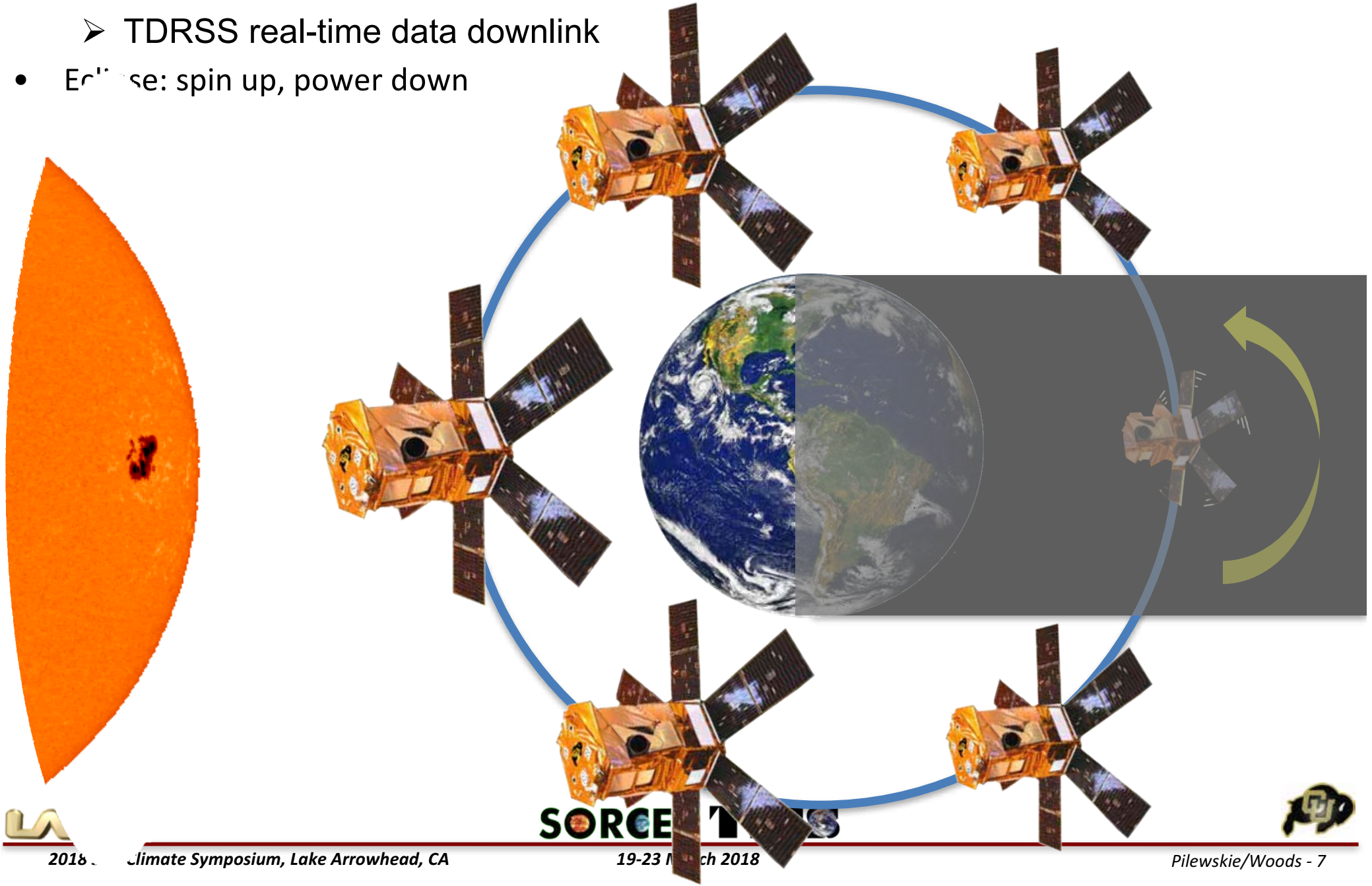
lasp.colorado.edu/home/sorce/



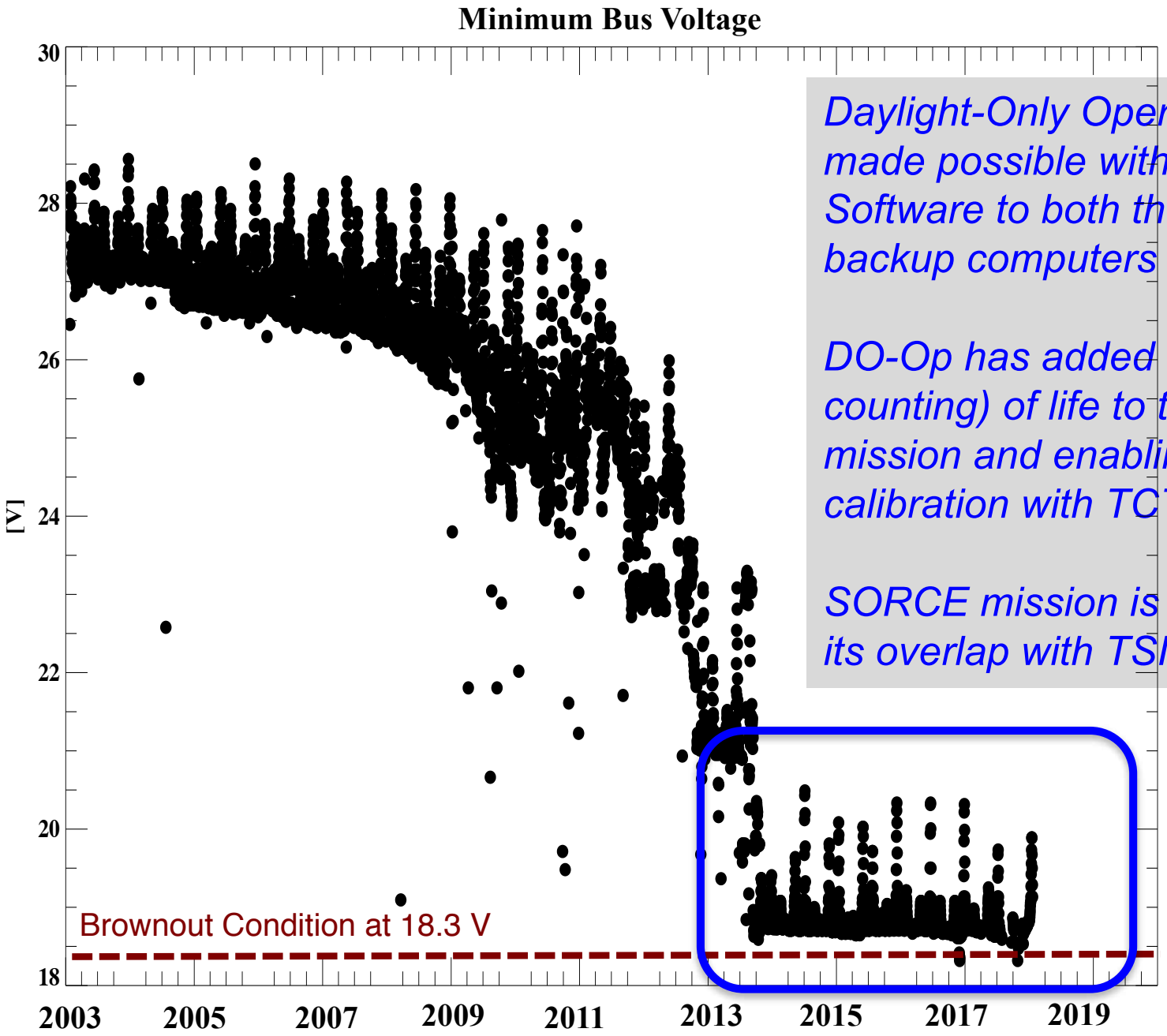
15-years in Orbit

SORCE Day Only Operations (DO-Op)

- Sunlight: power up, de-spin, solar observations
  - TDRSS real-time data downlink
- Eclipse: spin up, power down



SORCE Battery Has Stabilized in DO-Op

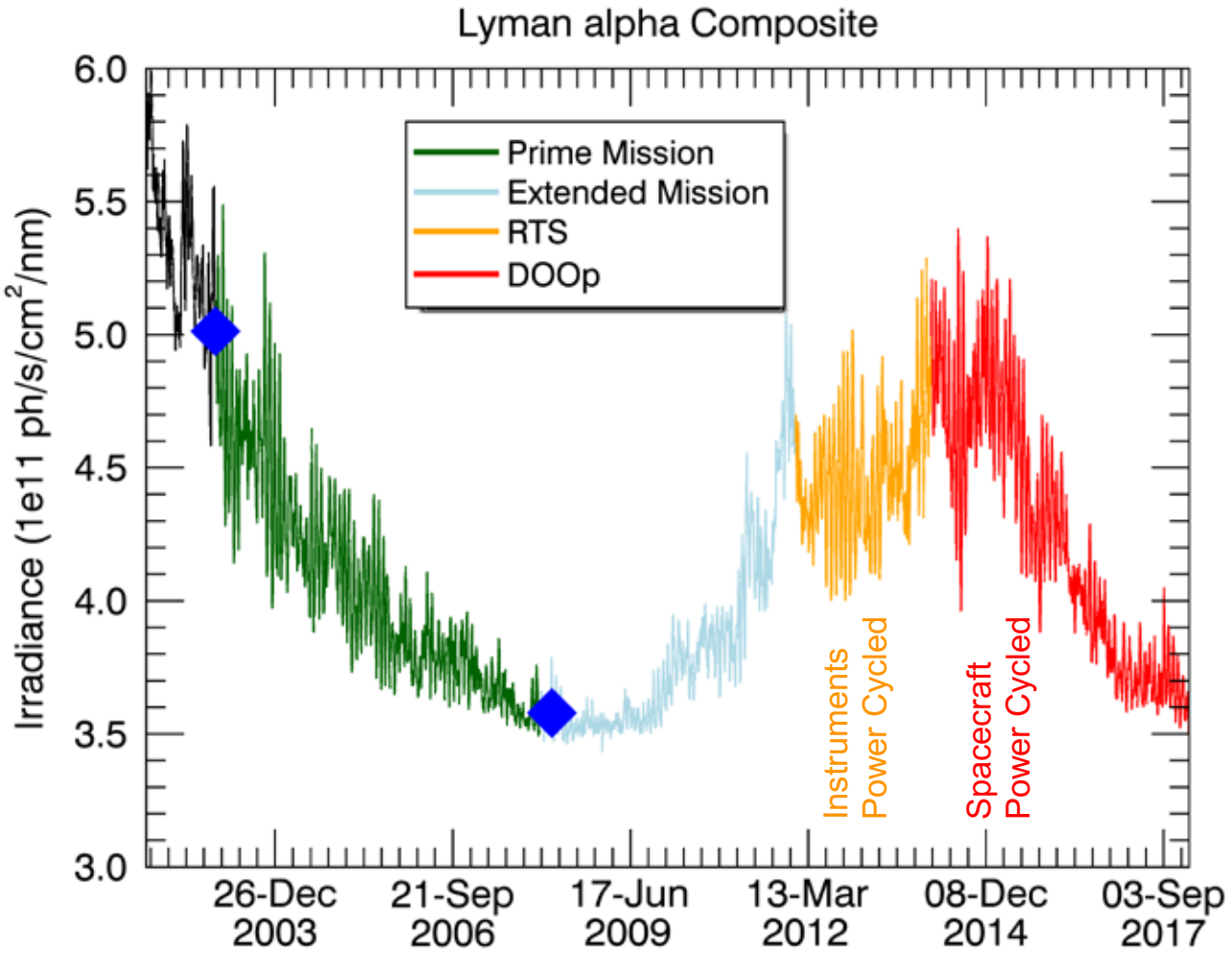


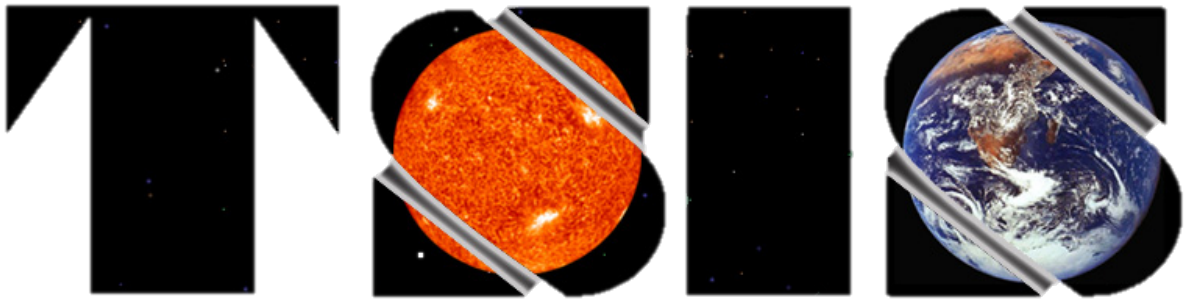
Daylight-Only Operations (DO-Op) made possible with new Flight Software to both the primary and backup computers aboard SORCE.

DO-Op has added 4+ years (and counting) of life to the SORCE mission and enabling the cross-calibration with TCTE and TSIS-1.

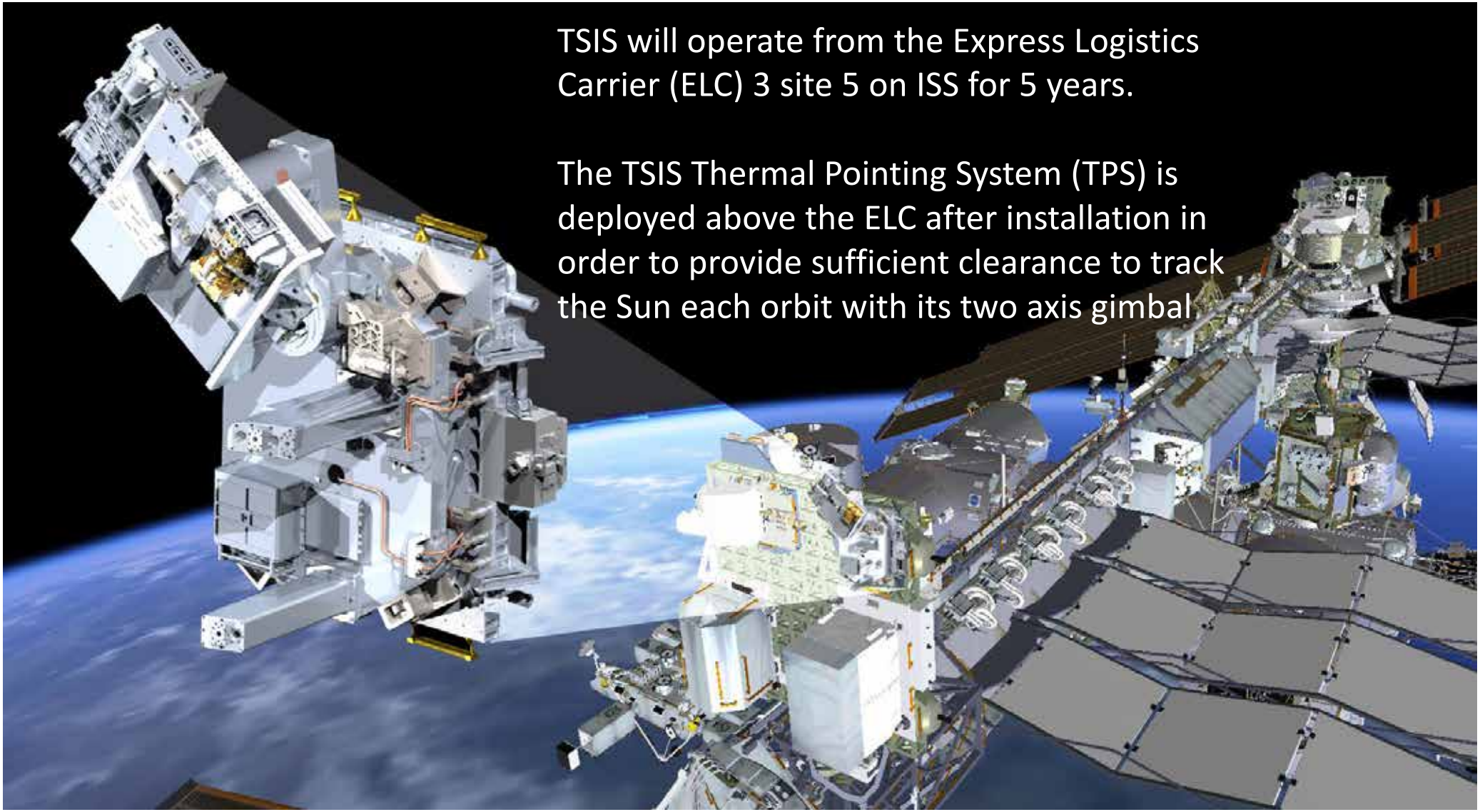
SORCE mission is scheduled to end its overlap with TSIS-1 in June 2019.

SORCE Observations Remain High Quality During Extended Mission




TSIS

The Total and Spectral Solar Irradiance Sensor



- TSIS delivered to KSC in July 2017; launched to ISS in December 2017.
- Launched in the SpaceX-13 Dragon trunk, externally on an Express Pallet Adapter (ExPA) using a Flight Releasable Attachment Mechanism (FRAM).

A TSIS Timeline

It all started with NPOESS …

1994: NOAA, NASA and DoD Integrated Program Office (IPO) established.

1995: National Polar-orbiting Operational Environmental Satellite System (NPOESS) established.

1997: Integrated Operational Requirements Document (IORD) establishes climate measurement (including solar irradiance) requirements.

1999: TSIM, what later became SORCE, awarded to LASP.

2001: LASP awarded NPOESS contract as PI instrument provider.

2003: SORCE launched.

2006: TSIS de-manifested following Nunn-McCurdy.

2008: TSIS re-manifested to fly on NPOESS C1

2010: NOAA-NASA Joint Polar Satellite System replaces NPOESS

2011: Glory fails to reach orbit.

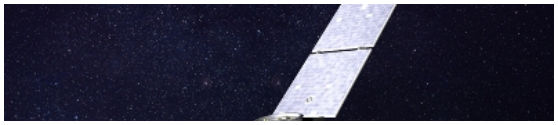
2013: TCTE launched on STP-Sat3.

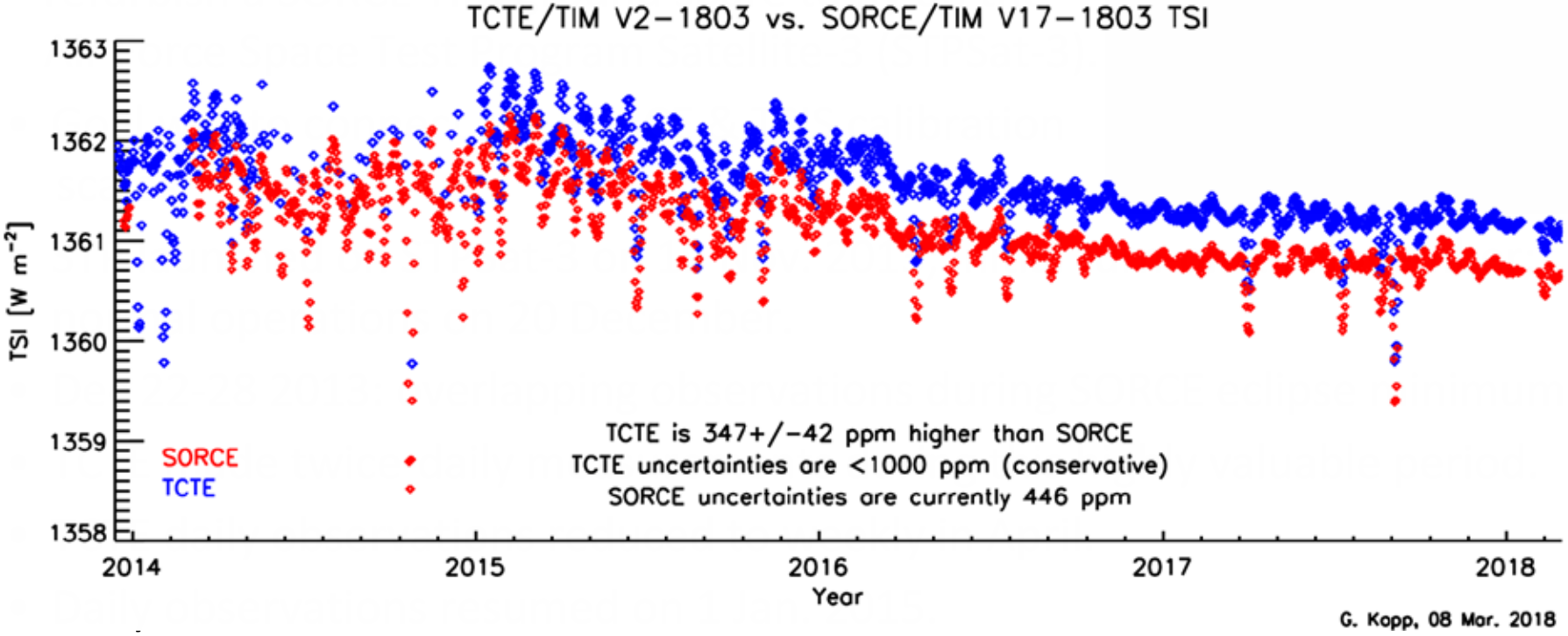
2014: Decision is made to deploy TSIS on ISS.

2016: Transfer of TSIS back to NASA.

TSI Calibration Transfer Experiment: TCTE

- 6-month implementation began in 2012 to refurbish a SORCE TIM ground spare to fly on the





- STPSat-3 mission extended through 2018 overlap with TSIS.

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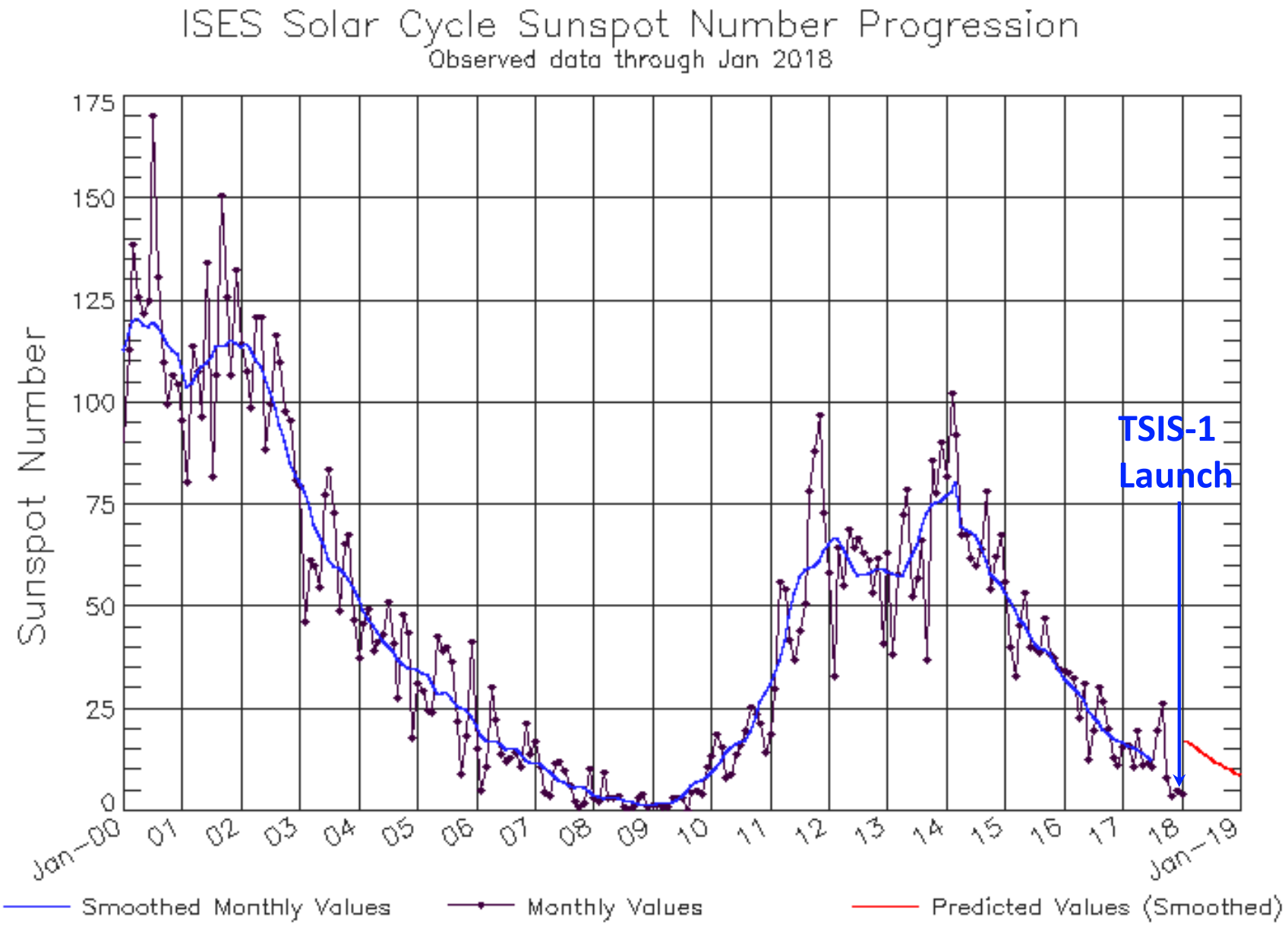
2017: TSIS-1 launched to ISS on 15 Dec.

Requirement for a Timely TSIS Launch



TSIS Launch on 15 December 2017

TSIS Launch on SpX-13

Dragon Separation

TSIS Launch on 15 December 2017

TSIS TPS Going Through its Paces

TSIS Makes Two Measurements

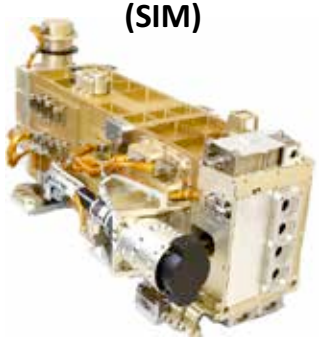
The Total and Spectral Solar Irradiance Sensor-1 (TSIS-1) provides two measurements critical for understanding solar influences on Earth climate.

Total Irradiance Monitor (TIM)

Total solar irradiance (TSI)

- Earth's predominant energy source.
- The TSIS-1 Total Irradiance Monitor (TIM) will continue a 40-year long uninterrupted measurement record of TSI.

Spectral Irradiance Monitor (SIM)

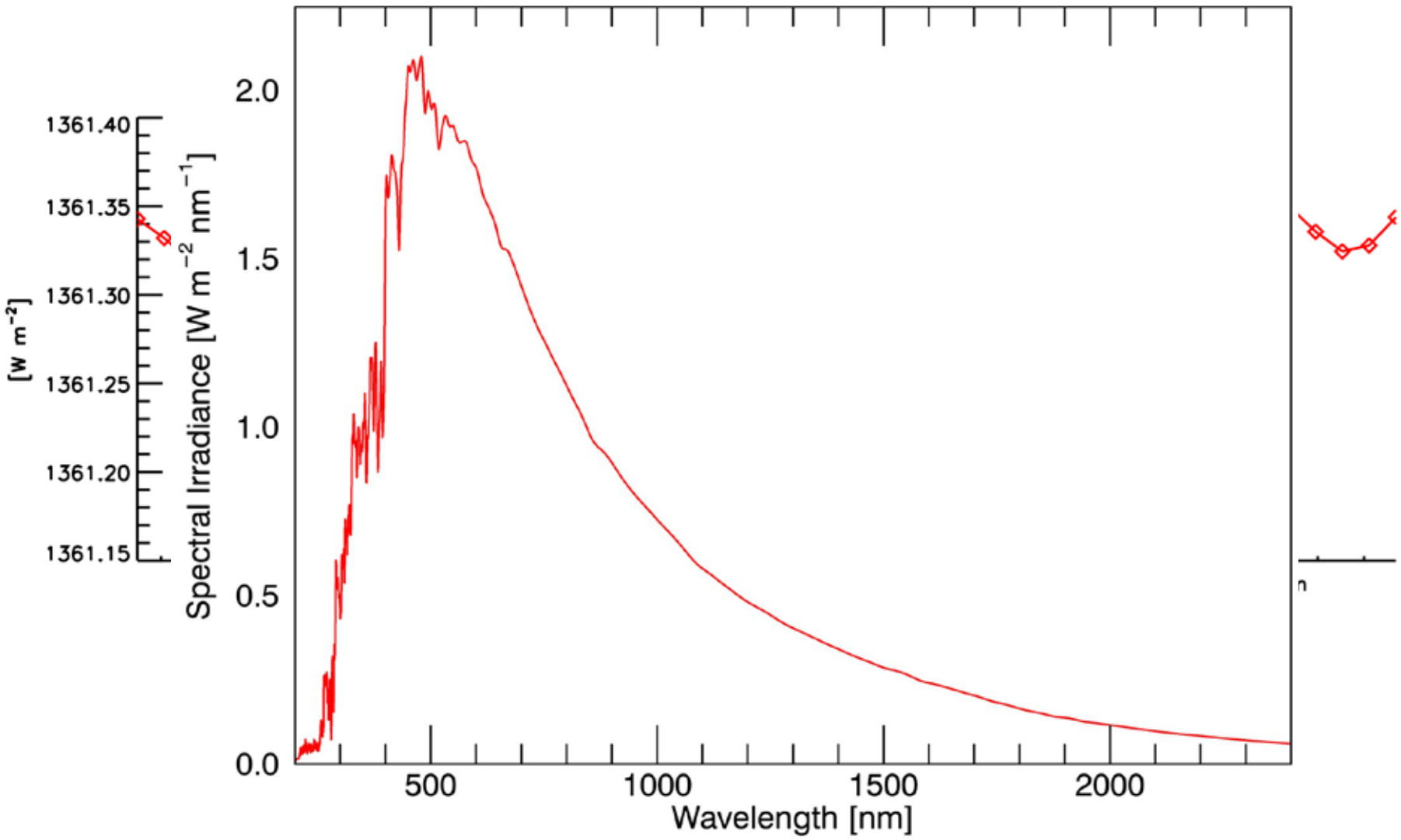


Solar spectral irradiance (SSI)

- Measured by the TSIS-1 Spectral Irradiance Monitor (SIM).
- Identifies the regions of atmosphere that are affected by solar variability and the mechanisms of response.

TSIM First Light

March 5 - 8 (2018/064-01:05:26 - 2018/067-08:00:00 GMT)



TSIS First Light

Session 2 this afternoon: *The state of the TSI and SSI climate records near the end of the SORCE Mission*

2:15 PM: Greg Kopp, *The TIM Trilogy*

3:10 PM: Erik Richard, *TSIS SIM Solar Spectral Irradiance: First Light and Early Observations*

TSIS Summary

- Science requirements are being met or are expected to be met.
- Greatest challenge is obscurations – but this was anticipated.
- Predictions needed to reduce uncertainties.
- First light data come with disclaimers – but results thus far are promising.

Introduction to the 2018 Sun-Climate Symposium

1. The creation, significance, and applications of accurate Climate Data Records (Chairs: *Odele Coddington & Peter Pilewskie*)
2. The state of the TSI and SSI climate records near the end of the SORCE Mission (Chairs: *Marty Snow & Greg Kopp*)
3. Next generation of solar and atmospheric observations (Chairs: *Erik Richard & Tom Sparn*)

   Poster Session I

4. Impacts of solar variability on the terrestrial environment during Solar Cycle 24 (Chairs: *Jerry Harder & Dong Wu*)
5. Stellar variability and connections to the Sun (Chairs: *Doug Rabin & Charles Ichoku*)

   Poster Session II

6. What are the expectations for the next solar minimum and Solar Cycle 25? (Chair: *Tom Woods*)

Wednesday, 21 March, Afternoon & Evening

Big Bear Solar Observatory

12:15 pm Bus #1 (GOLD coin) departs LACC (arrives BBSO 1:15 pm)
1:00 pm Bus #2 (GREEN coin) departs LACC (arrives BBSO 1:15 pm)
2:45 pm Bus #1 departs BBSO (arrives LACC 3:45 pm)
3:30 pm Bus #2 departs BBSO (arrives LACC 4:30 pm)

Poster Session/ Reception I

4:30 – 6:30 pm

Special Evening Presentation 8:00 – 9:00 PM

Gary Rottman, LASP, University of Colorado – Boulder
How the Sun abandoned the Incas during the Maunder Minimum

Thank you!

Organizing Committee

Odele Coddington, Jerry Harder, Charles Ichoku, Greg Kopp, Jae Lee, Doug Rabin, Erik Richard, Marty Snow, Tom Woods, & Dong Wu

And a special thank you to Vanessa George