

# Total and Spectral solar Irradiance Sensor (TSIS-1) Project Overview

## 2015 Sun-Climate Symposium

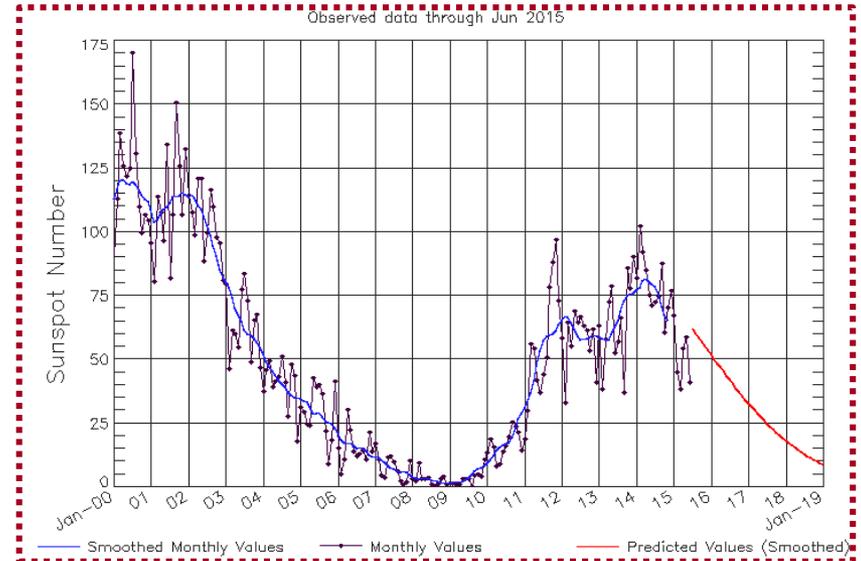
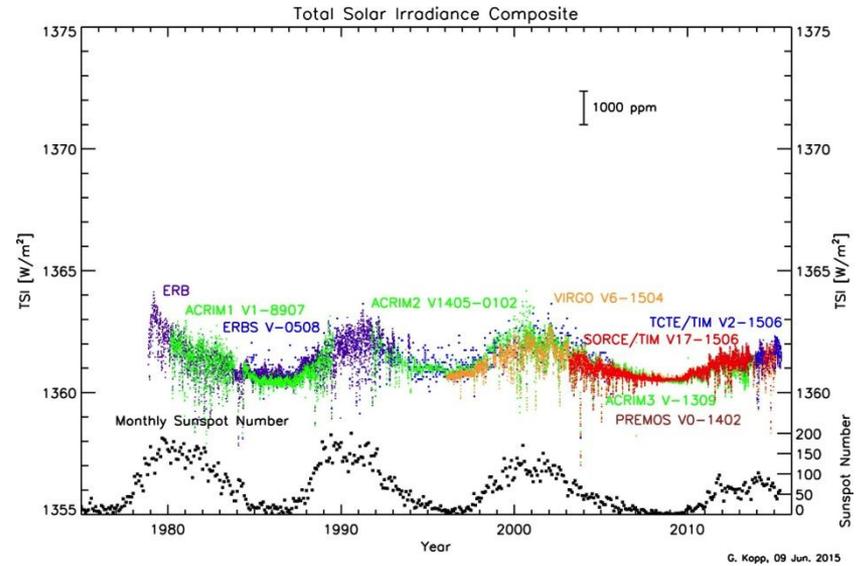
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| ▪ <b>Chief Safety and Mission Assurance Officer:</b> | <b>Renee Robinson</b>                |
| ▪ <b>TSIS-1 Instrument Contractor:</b>               | <b>University of Colorado – LASP</b> |



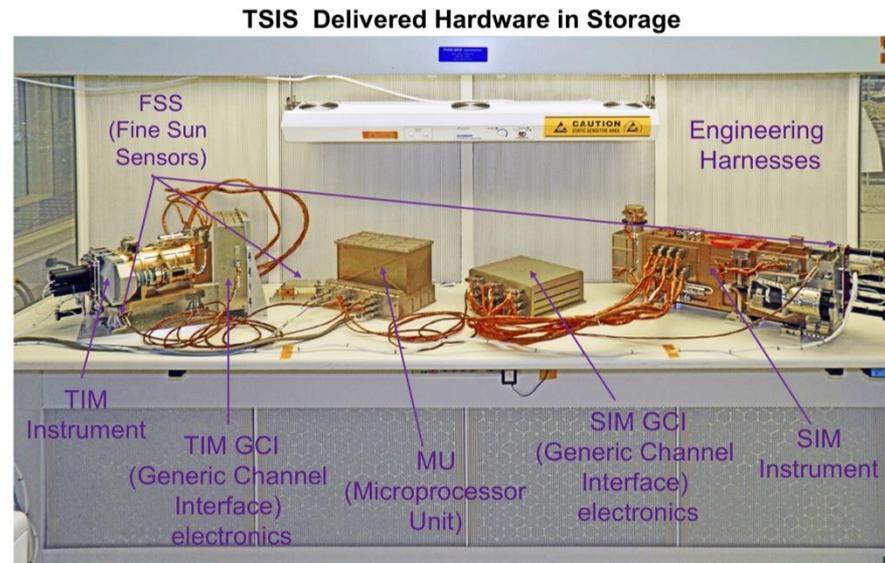
# Science Background: Need for a 2017 TSIS-1 launch



- TSIS-1 needed on-orbit as soon as practical to provide total and spectral solar irradiance measurements needed to maintain 35+ year climate data record continuity
  - Solar irradiance data record is critical for determining solar influences on Earth climate
  - Solar Radiation and Climate Experiment (SORCE), launched in 2003 with a 5-year design life, currently provides these measurements
  - Total Solar Irradiance Calibration Transfer Experiment (TCTE), built from “spare parts” and launched November 2013 on Air Force Space Test Program Satellite (STPSat-3, 2-3 year design life), will provide calibration between SORCE and TSIS-1 total solar irradiance measurements
- If TSIS-1 is flying the upcoming solar minimum (~2017-2018) will be the first time consecutive minima have been observed at such high accuracy
  - Solar minimum in 2008-09 was observed with SORCE Total Irradiance Monitor
  - Solar minima, rather than maxima, are better at revealing long-term trends in solar output



- TSIS-1 instruments: Total Irradiance Monitor (TIM), Spectral Irradiance Monitor (SIM)
  - Upgraded versions of SORCE instruments
- TSIS-1 was originally planned for the nadir-pointing National Polar-orbiting Operational Environmental Satellite System (NPOESS) spacecraft and then a Polar Free Flyer (PFF)
- TSIS-1 instrument for NPOESS/PFF was designed, built, tested, and completed full suite of reviews, including critical design review (2009) and pre-ship (2013)
- TSIS-1 sensors in storage at Laboratory for Atmospheric and Space Studies (LASP) at the University of Colorado
  - TSIS-1 re-calibration performed periodically (~6 month cycle)

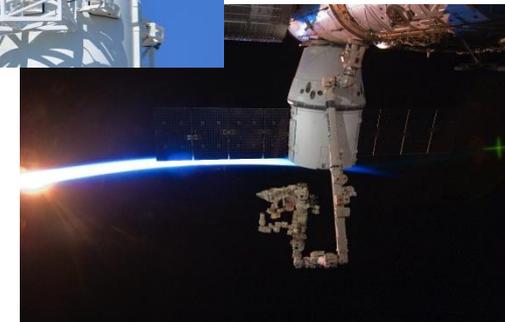
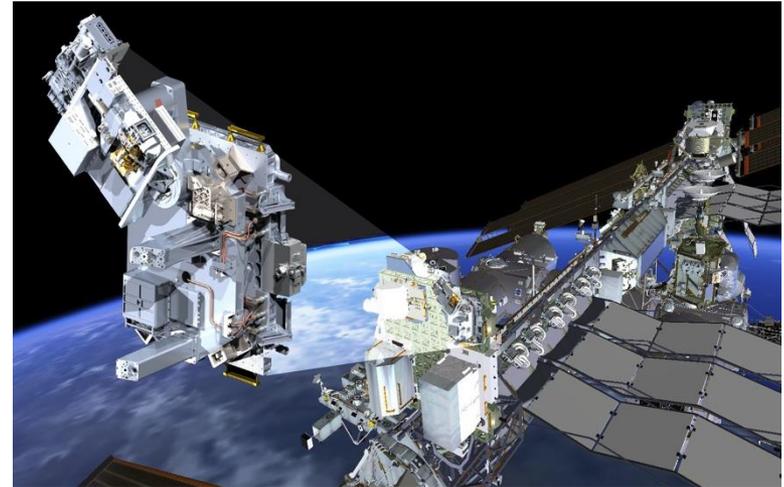




# TSIS-1 on ISS Concept



- Decision to accommodate TSIS-1 on International Space Station (ISS) April 2014
- New hardware development: Thermal Pointing System
  - Deploys the instrument (from stowed configuration) and tracks the sun
  - ISS interface electronics
- TSIS-1 launch on SpaceX Falcon 9 launch vehicle in Dragon trunk
  - Planned for SpaceX-15, August 2017 (to be confirmed)
- Robotic installation onto Expedite the Processing of Experiments to Space Station (EXPRESS) Logistics Carrier (ELC-3)
- 5 years operations
  - Solar Tracking during sunlight
    - Total Irradiance Monitor, 7 configurations
    - Spectral Irradiance Monitor, 13 configurations
  - 2 year extension possible pending Senior Review

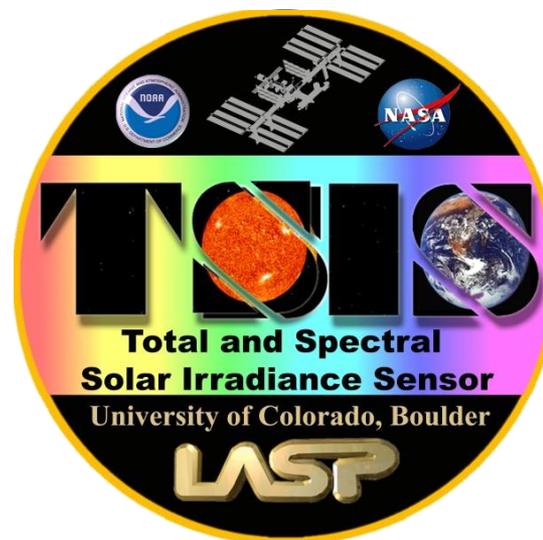
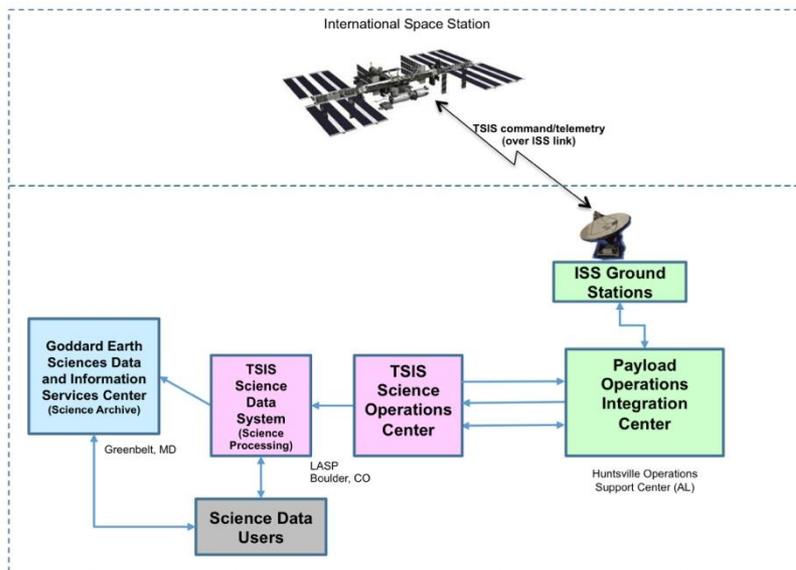




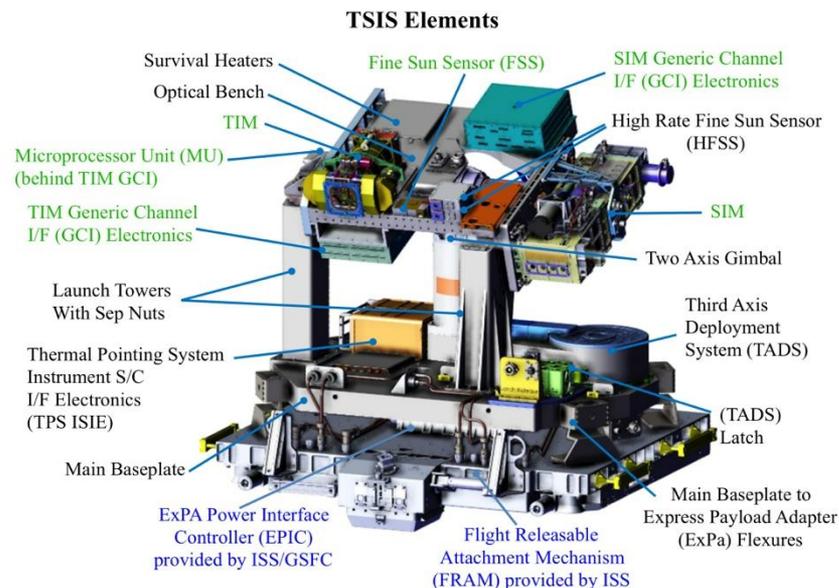
# Who's Who



- NASA's Goddard Space Flight Center
  - TSIS-1 project: project management, system engineering, safety and mission assurance, and engineering oversight for the TSIS-1 payload
  - Earth Science Data and Information System (ESDIS) Project/Goddard Earth Sciences Data and Information Services Center (GES DISC): archive and distribution for TSIS-1 data
- University of Colorado Laboratory for Atmospheric and Space Physics (LASP, Boulder, CO): design, development and testing of TSIS-1, support for ISS integration, science operations of the TSIS-1 instrument, data processing, data evaluation and delivery to the GES DISC
  - TSIS-1 Science Operations Center, TSIS-1 Science Data System
- International Space Station Program: launch services and robotic installation of the TSIS-1 payload onto an ISS Express Logistics Carrier, mission operations, and communications
  - ISS interface: ISS Payload Operations Integration Center, (Huntsville Operations Support Center, AL)



- Making excellent progress toward accommodating TSIS-1 on International Space Station (ISS)
  - ISS technical interchange meetings held frequently and progressing well
  - Payload Interface Agreement and Interface Control Document baselined
  - ISS Phase 0/1 (Dec. 2014) and Phase 2 (Oct. 2015) Payload Safety Reviews successfully completed
- TSIS-1 delta-Critical Design Review successfully completed July 2015
- NASA assumed responsibility for TSIS-1 as of October 1, 2015
  - TSIS-1 project (and LASP contract) are funded



*\*green denotes completed hardware currently in storage*



# Coming Attractions



- Thermal pointing system flight hardware procurement/build in progress!
- Key Decision Point C (NASA agency baseline commitment) first quarter 2016
- University of Colorado upgrading existing chamber for TSIS-1 thermal vacuum testing
- Environmental testing: late 2016/early 2017
- Delivery to Kennedy Space Center for integration: mid 2017 (to be confirmed)
- Launch: late 2017 (to be confirmed)
- 90-day check-out period
- Five years of TSIS-1 operations
  - 2 year extension possible pending Senior Review