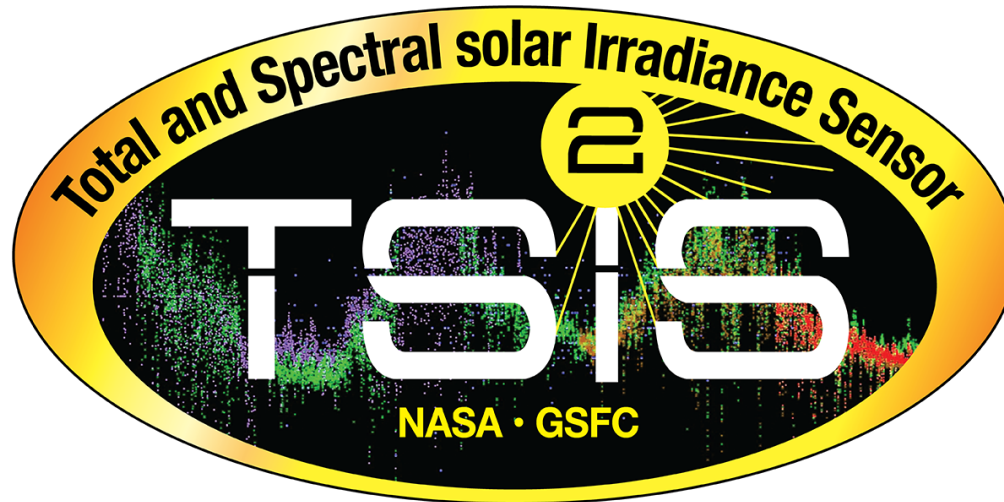


TSIS-2: Continuing the Solar Irradiance Data Record

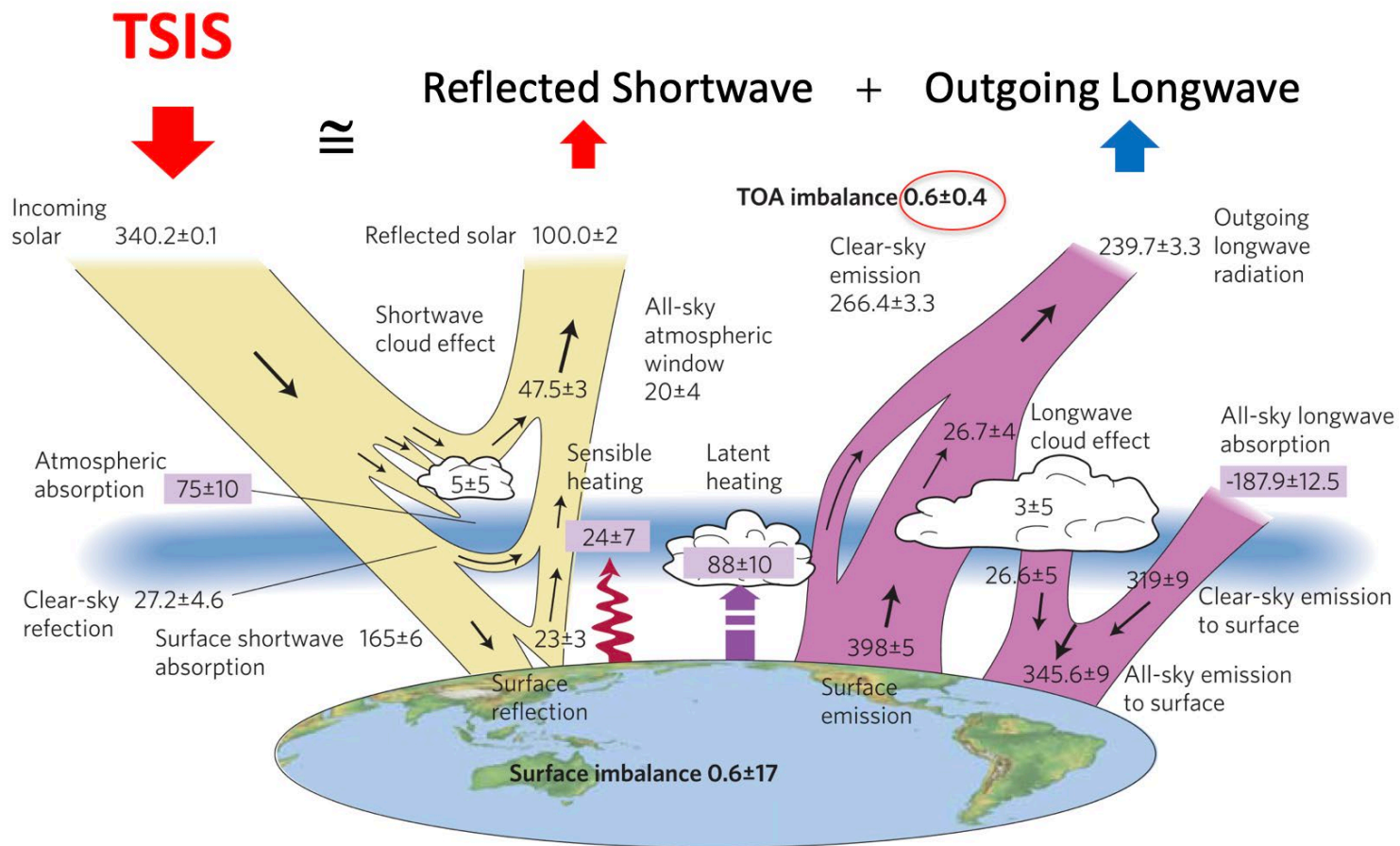


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⁽¹⁾NASA Goddard Space Flight Center, ⁽²⁾University of Maryland/Baltimore County,

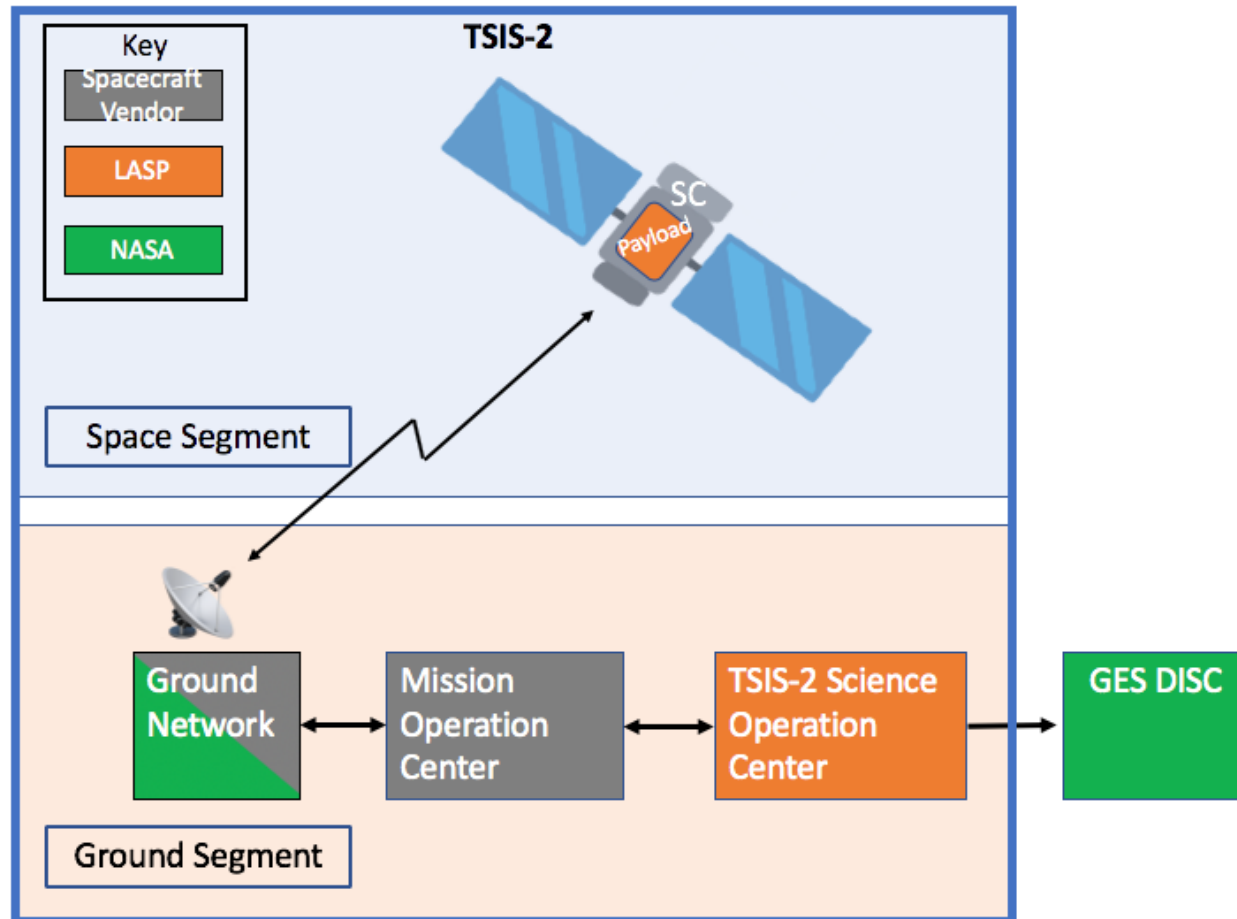
⁽³⁾Science Systems and Applications, Inc.

The 2017 National Academy of Sciences Decadal Survey for Earth Sciences and Applications from Space recommended that NASA sustain a multidecadal global measurement of solar irradiation



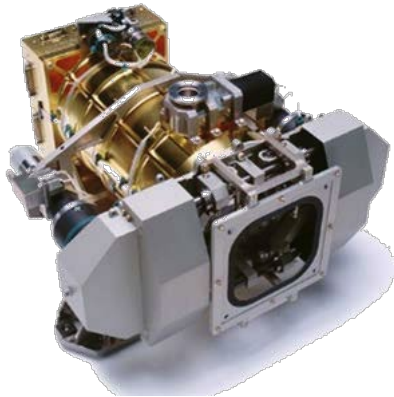
Stephens et al., Nature Geo., 2012

In March 2019, NASA Goddard Space Flight Center was directed to develop TSIS-2 as a low-cost, Class D mission to provide continuity with TSIS-1 for measurement of total solar irradiance (TSI) and Spectral Solar Irradiance (SSI) for climate research.



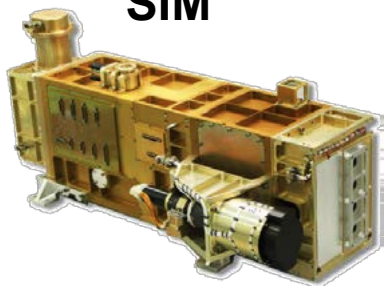
As in TSIS-1, TSIS-2 provides two measurements critical for understanding influences of solar forcing on Earth climate:

TIM



Total solar irradiance is the dominant energy source driving the Earth's climate system. The TSIS TIM contains four ESRs to provide full-disk TSI measurements with the capability to track degradation. It will continue a 40-year uninterrupted measurement record of TSI.

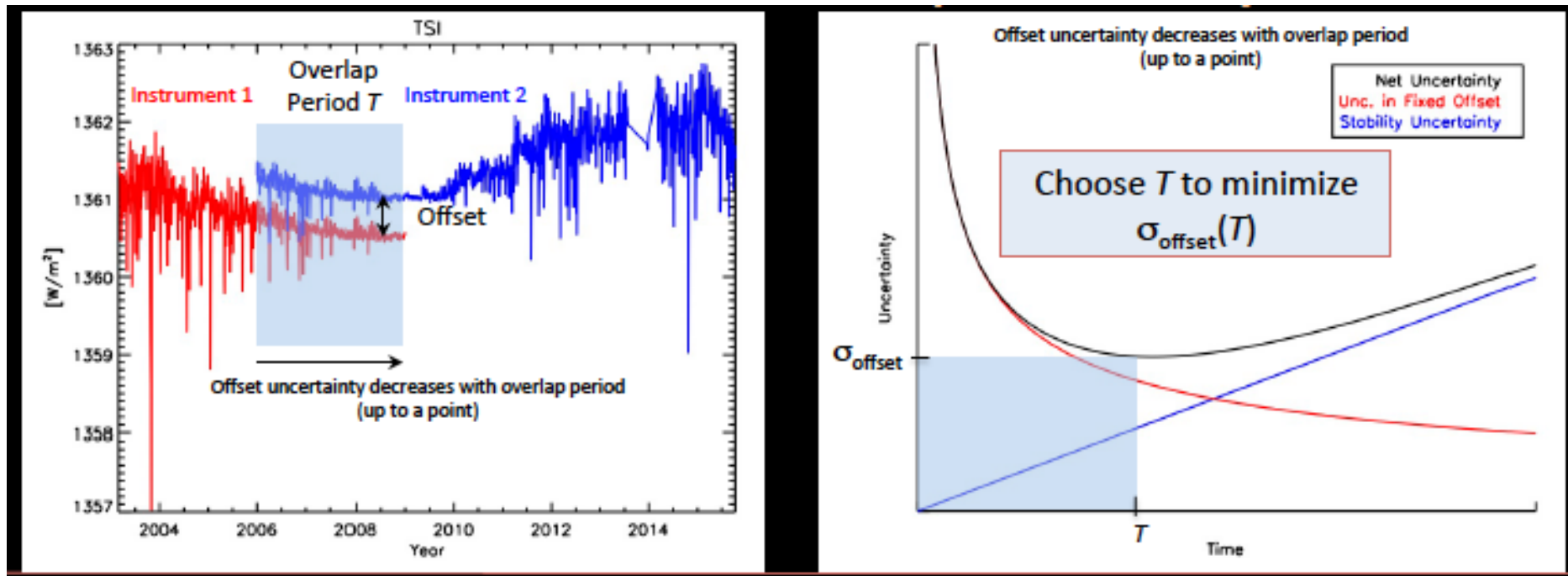
SIM



Solar spectral irradiance is solar energy as a function of wavelength, needed to understand how the Earth system responds to changes in irradiance. The TSIS SIM is a 3-channel prism spectrometer to measure full-disk SSI at 200 –2400 nm wavelengths.

TSIS-2 TIM and SIM will be built by LASP

- Overlap with TSIS-1 to achieve climate-quality TSI and SSI records; and the overlap lengths recommended to maintain continuity are:
 TSI: 3 months after TSIS-2 commissioning
 SSI: 6 months after commissioning



Kopp, SORCE Senior Review, 2015

Parameter	TSI Requirement		SSI Requirement	
	Baseline	Threshold	Baseline	Threshold
Spectral Range	Total Integrated spectrum		200 - 2400 nm	
Accuracy	Equivalent to TSIS-1	No more than 5% worse than TSIS-1	$\leq 0.2\%$	$\leq 1\%$
Stability	$\leq 0.001\%$ per year	$\leq 0.002\%$ per year	$\leq 0.05\%/yr$ ($< 0.4 \mu m$) $\leq 0.01\%/yr$ ($> 0.4 \mu m$)	$\leq 0.1\%/yr$ ($< 0.4 \mu m$) $\leq 0.02\%/yr$ ($> 0.4 \mu m$)
Spectral Resolution	N/A		2 nm: ($< 0.28 \mu m$) 5 nm: ($0.28 \mu m$ to $0.4 \mu m$) 45 nm: ($> 0.4 \mu m$)	
Reporting Frequency	4 six-hourly averages per day		2 spectra per day, sampled every 12 hours	

Space Segment Requirements

- Mission lifetime ≥ 3 years
- Orbit LEO
- Observing time ≥ 40 minutes per orbit
- On-orbit checkout ≤ 60 days
- Maximum orbital lifetime 25 years

Ground Segment Requirements

- TSIS Science Operations Center (TSOC) at LASP
 - Update TSOC developed for TSIS-1
- MOC to provide raw TSIS-2 science data and spacecraft ancillary data to the TSOC

Science Data Management Requirements

- Data product levels 0 – 3 to be developed at LASP
- Data to be delivered from LASP to GES DISC for archival storage and public dissemination
 - Initial data delivery latency ≤ 6 months
 - Subsequent data delivery latency ≤ 14 days
- Data product formats to conform with NetCDF-4/HDF5 standard

TSIS-1

- Instrument Suite
 - TIM
 - SIM
- Platform—ISS with pointing platform
- 1553 Command and Data Handling interface
- Launch—Commercial Resupply Service (SpaceX)
- Lifetime Requirement—5 years
- Class C

TSIS-2

- Instrument Suite
 - TIM—same as TSIS-1
 - SIM—same as TSIS-1
- Platform—Dedicated free-flyer spacecraft
- RS422 Command and Data Handling interface
 - TCTE had RS422 interface
- Launch—Dedicated rocket or primary payload on a shared launch
- Lifetime Requirement—3 years
- Class D

- HQ delegation of authority from Science Mission Directorate Associate Administrator to Earth Sciences Division Director
- Streamlining project reviews
 - Elimination of 2 high-level HQ reviews, with informal briefings replacing the reviews
 - Early project reviews eliminated or combined
- Streamlining project documentation
 - Combination of plans
 - Delegation of signature authority
- Acceptance of higher risk posture to meet 3-year mission lifetime requirement
 - Proceeding with instrument development prior to spacecraft and launch vehicle selection
 - Acceptance of single-string design, with possibility of single point failures
 - Reduction in government inspections at vendor sites
 - Broader opportunity for non-traditional spacecraft and launch vehicle vendors
 - Consideration of Inherited Items Risk Assessment process to reduce documentation requirements
 - Goddard process is under development and assessment