Total Solar Irradiance (TSI) and Solar Spectral Irradiance (SSI) CDR

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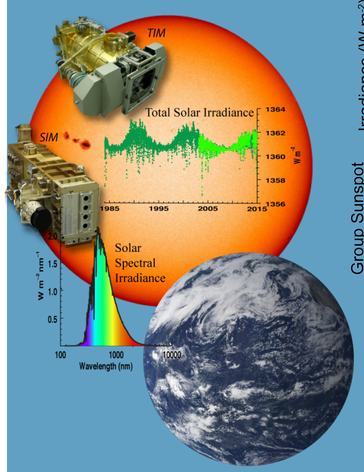
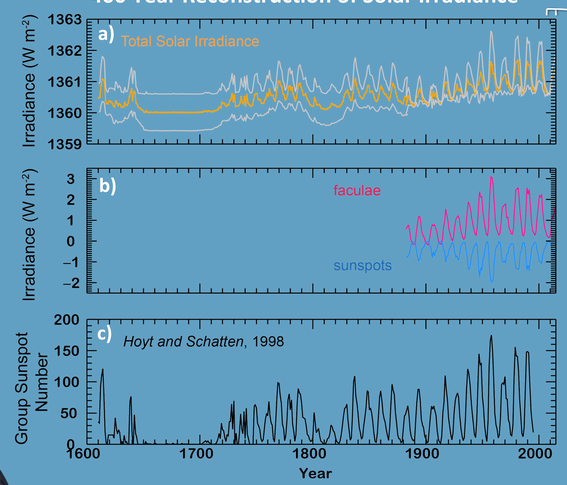
The Solar Irradiance CDR determines the magnitude of irradiance change from quiet Sun conditions using linear regression analysis of the SORCE TIM and SIM measurements with proxies of solar magnetic activity.

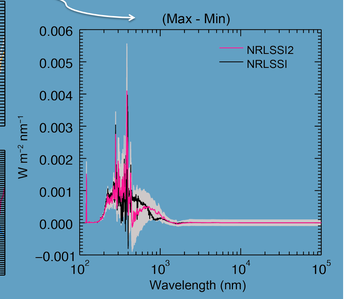


400 Year Reconstruction of Solar Irradiance



(a) Yearly-averaged TSI from 1610 to 2014, with associated uncertainties and (b) time series of the contributions to TSI from faculae and sunspots and (c) relationships between proxies and the Group Sunspot Number establish the link to historical irradiance.

Solar Spectral Energy Change



Spectral irradiance changes over a solar cycle, in energy units by two models: NRLSSI (original model; black) and NRLSSI2 (used in this CDR; pink) with associated uncertainties (grey).

Solar Irradiance CDR Specifications:

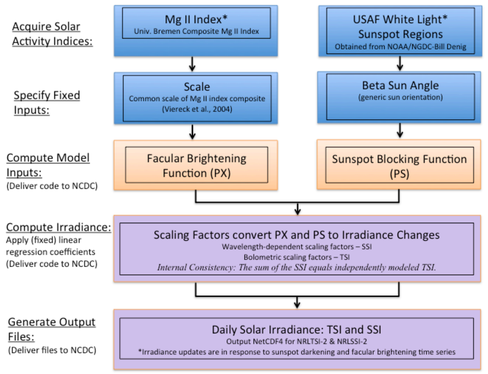
- Global Product
- 1882-current (daily and monthly)
- 1610-current (yearly)
- Periodic, quarterly updates

Inputs to the Solar Irradiance CDR:

- Adopted quiet Sun irradiance
- Univ. of Bremen composite Mg II index
- US Air Force sunspot location and areas

Development & Improvement:

- Automating production system for near real time, and short-term forecasts
- Automating aspects of algorithm validation approaches
- Improve uncertainty estimates to include model assumptions
- Move to higher spectral resolution (0.001 to 0.02 nm, suitable for line-by-line radiative transfer models
- Augment irradiance constructions with future measurements



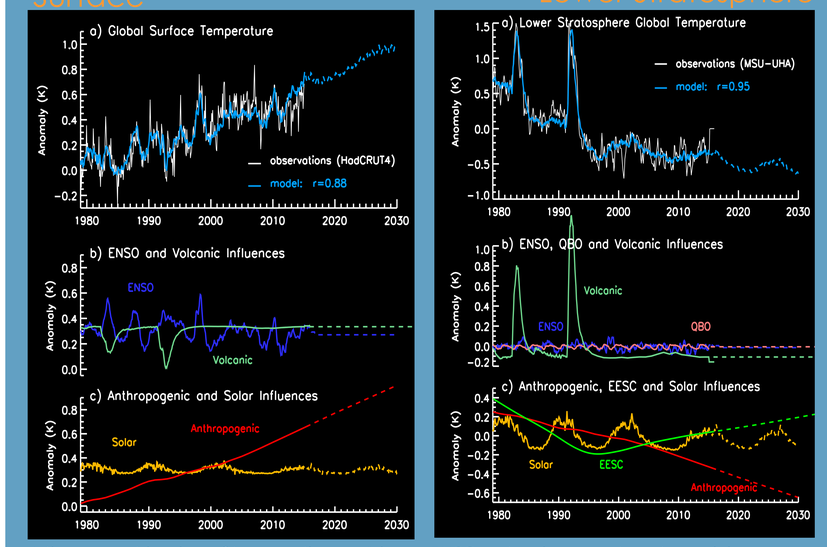
User Communities:

- Earth Climate Modeling (IPCC studies)
- Stratospheric Chemistry Climate Modeling
- Community Radiative Transfer Models
- Ozone Data Processing (OMI data analysis)
- Water Resource Modeling
- Photovoltaic Cell Research & Development for Renewable Energy Applications

A Few CDR Applications

Understanding and Forecasting Global Climate Change

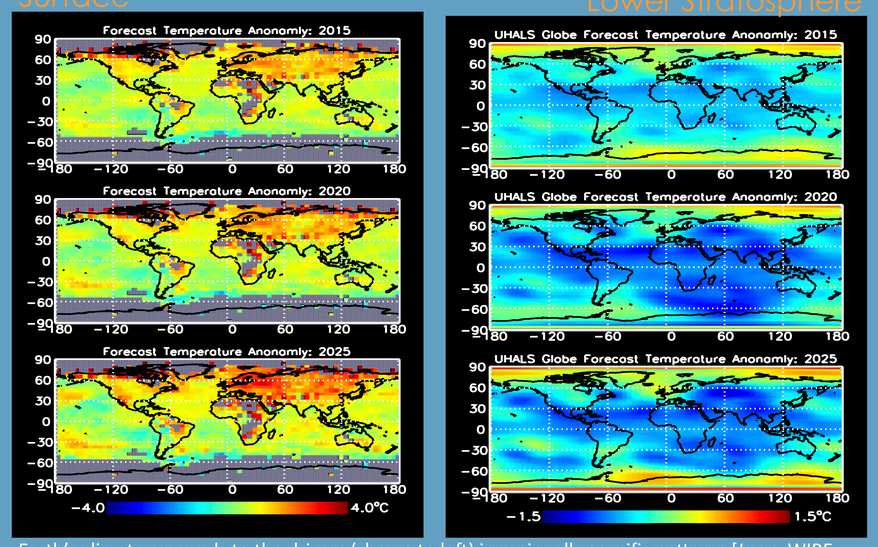
Surface | Lower Stratosphere



A linear combination of known climate drivers: ENSO, volcanic aerosols, solar activity, and anthropogenic greenhouse gas emissions can be used to explain observed surface temperature variance (left) and stratospheric temperature variance (right)) [*Kopp and Lean*, 2011]. Future predictions are made assuming the past is prologue.

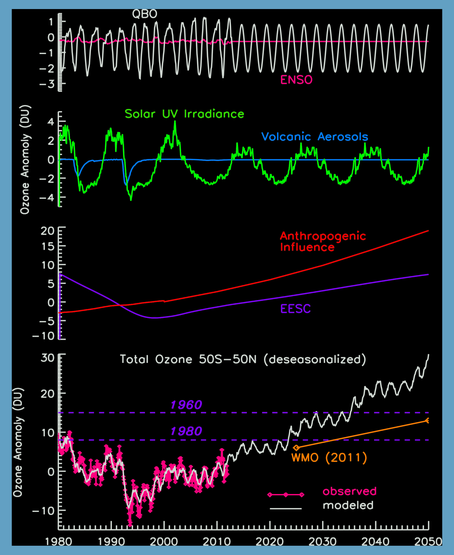
Modeling and Predicting Future Regional Response to Global Climate Forcing

Surface | Lower Stratosphere



Earth's climate responds to the drivers (shown to left) in regionally specific patterns [*Lean*, WIRE, 2011] as shown in these surface temperature anomaly maps (left) and lower stratospheric temperature anomaly maps (right) . Future near-term climate projections show regions of warming and cooling.

Predicting Future Stratospheric Ozone Changes



Solar Ultraviolet radiation creates the ozone layer. A modeled (linear) combination of climate drivers known to affect ozone amount such as UV radiation, the Quasi-Biennial oscillation, volcanic aerosols, and anthropogenic greenhouse gases can be used to understand stratospheric chemistry-climate interactions and extend/interpolate data records.

Laboratory for Atmospheric and Space Physics and the Naval Research Laboratory

NOAA Climate Data Record Program

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