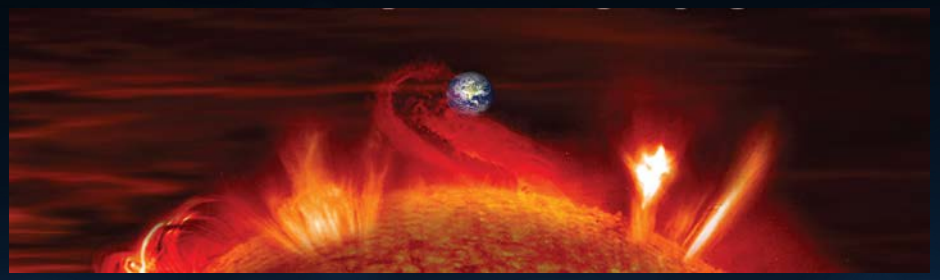
TIMED SABER Data Enables Scientists to Derive a 70-year Time Series of the Thermosphere's Infrared Energy Budget

With its long, comprehensive dataset, the Heliophysics TIMED mission provides scientists the data they need on Earth's thermosphere to help us see a clearer picture.



Outlined in a paper published in December by the *Geophysical Research Letters,* a team of scientists developed a 70-year long time series of infrared energy emitted by the nitric oxide and carbon dioxide molecules in Earth's thermosphere (>100 km). This infrared energy regulates the temperature of the thermosphere in response to energy input from the sun. The 15-year-long dataset of infrared emissions measured by the SABER instrument on NASA's TIMED satellite is a critical contributor to the time series.

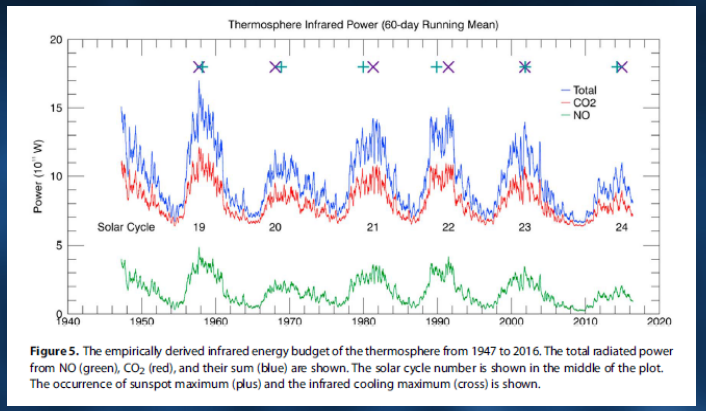


Figure 5. The empirically derived infrared energy budget of the thermosphere from 1947 to 2016. The total radiated power from NO (green), CO_2 (red), and their sum (blue) are shown. The solar cycle number is shown in the middle of the plot. The occurrence of sunspot maximum (plus) and the infrared cooling maximum (cross) is shown.

This figure shows the 70-year time series of infrared cooling and the occurrence of the infrared radiative cooling maximum (cross) and the occurrence of the sunspot maximum (plus).

From the long TIMED database, scientists were able for the first time to establish a statistical relationship between the energy output of the upper atmosphere and solar and geomagnetic indices that proxy energy input into the upper atmosphere. They then used this relationship to extend the energy output series back in time to cover five solar cycles, providing new, direct terrestrial context (thermal structure of the upper atmosphere) to these indices.

When the authors integrated the solar index over the time span of each individual solar cycle, they found that the total energy is nearly constant from solar cycle to solar cycle. They also found a similar small variation in the total infrared energy emitted by the Earth's upper atmosphere when integrated by solar cycle. This result was totally unexpected – typically we think of 11-year cycles as being "strong" or "weak," and that the overall cycles have been getting "weaker" over the past several decades. This new research disputes these views.

Mlynczak, M. et al., (2016), *The global infrared energy budget of the thermosphere from 1947 to 2016 and implications for solar variability*, Geophys. Res. Lett., 43, 11,934–11,940, doi:10.1002/2016GL070965