A combined solar and geomagnetic index for thermospheric climate

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Triennial Earth-Sun Summit, April 26-30, 2015
Outline

• SABER measurements of infrared radiance in the thermosphere
• Observed variability over the solar cycle, including maximum in SC24
• Development of a new index for thermosphere cooling
Thermosphere Power Derivation from SABER

Radiance

Cooling Rate W m\(^{-3}\)

Radiated Flux W m\(^{-2}\)

Daily Radiated Power (W)
Solar Cycle 24 Max

Monthly Smoothed Sunspot Number

Sunspot Number

2008 2009 2010 2011 2012 2013 2014 2015 2016

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Solar Cycle 24 Max

Monthly Smoothed Sunspot Number

- SABER Global NO Power
- 60-day Running Average
- SABER Global CO₂ Power
- 60-day Running Average

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Solar Cycle 24 Max

Monthly Smoothed Sunspot Number

SABER Global NO Power
60-day Running Average

SABER Global CO₂ Power
60-day Running Average

F10.7 cm Solar Radio Flux
60-day Running Average

Ap Index
60-day Running Average

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Regression Fit of SABER NO Power

NO Thermosphere Power 60-day Average

- **SABER**
- **Regression Fit: F10.7, Ap, Dst**

Power (10^{11} W)

Year (2004-2014)
Reconstructed NO Time Series

Thermosphere Climate Index (TCI)

Power ($10^{15}$ W)

Sunspot Number

1950 1960 1970 1980 1990 2000 2010

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Relative Contribution of TCI Components

Solar UV and Geomagnetic+Storm Components of TCI

Percent

1950 1960 1970 1980 1990 2000 2010

Daily Sunspot Number

Solar UV

Geomagnetic & Storm

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Summary

• Global NO and CO2 radiated thermosphere power are highest in SC 24 in late 2014.

• The time series of NO global infrared radiate power can be fitted quite accurately with three solar and geomagnetic indices: F10.7 solar radio flux, the Ap index, and Dst.

• The NO power time series can then be reconstructed back to 1947
  – Enables tests of upper atmosphere models over six solar cycles
  – Allows relative roles of solar and geomagnetic process to be determined

Two articles on these topics have been submitted to GRL

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NO Periodicity