Nitric Oxide Cooling and Concentrations Derived from SABER
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**Motivation and Objective:**
- **Nitric Oxide (NO):** Is a thermostat of the thermosphere.
- **Objectives:**
  - Derive the NO cooling from SABER measurements by using new unfiltered factor.
  - Derive the NO concentration from SABER NO cooling and MSIS simulations.

**Introduction:**
- **Energy:**
  - Is input to the system externally from the Sun.
  - Is also input from the atmosphere below.
  - Between 100 km and 200 km is the “heat sink” region.
  - Emission and escape of infrared radiation is the only mechanism that the Earth’s surface and atmosphere lose thermal energy to space.
  - O, NO, CO2 are three major radiators in Earth’s atmosphere.
  - CO2 and NO radiative cooling are the major cooling mechanism that cool the thermosphere between 100 km and 200km.

**Background:**
- Thermosphere Ionosphere Mesosphere Energetics and Dynamics (TIMED) satellite
  - Launched on 7 December 2001
  - Into a 74.1° inclination orbit at 630 km altitude
  - A period of 1.6 hours.
  - Scans the Earth’s limb from 400 km to the hard surface.
  - Measures profiles of infrared limb radiance in a spectral interval.
  - Encompasses ~50% of the emission lines from NO bands of 1 to 0, 2 to 1, and 3 to 2.

**Introduction:**
- **Objective:**
  - Derive the NO concentration from SABER NO cooling and MSIS simulations.

**Results:**
- **NO Cooling**
  - Global mean for 2003 to 2009 new results
  - NO concentration
    - Global annual mean NO density from 2003 to 2009
    - NO concentration (molecules/ml)

**Comparison:**
- **Global mean for 2009**
  - SABER-NO concentration is larger than SD-WACCM simulation for both 2009 (solar minimum year) and 2014 (solar maximum year) below 200 km.

**Road Map:**
- **In Band NO cooling**
  - Alt.
  - Lat.
  - Lon.
- **Full Band SABER NO cooling**
- **Temperature at 4-9 km**
- **Radiative Excitation Rate**
- **Solar rate**
- **Earth Shine**
- **Original SABER data**
  - NO concentrations 100 - 250 km

**Summary:**
- **NO cooling and NO concentration are derived from SABER measurements with the new unfiltered factor and MSIS 2.0 simulations.**
- **The newly derived NO cooling profiles are smaller than the old NO cooling profiles as expected.**
- **The difference between the newly derived NO cooling and the old NO cooling profiles are smaller during solar maximum year (2014) than during solar minimum year (2009).**
- **The NO concentration is peak at ~ 110 km as expected.**
- **The NO concentration and the upper limit of the NO concentration data are varying with the solar cycle.**
- **SABER NO concentration is larger than SD-WACCM simulation for both 2009 (solar minimum year) and 2014 (solar maximum year) below 200 km.**
- **Next Step:**
  - Compare SABER NO concentration data to NOEM simulations
  - Conduct error analysis of the SABER NO concentration data.

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**Reference:**