SABER Radiated Flux Data Set ReadMe

1.0 Introduction

This file provides information for the data set of SABER geolocated radiated flux values integrated over NO and CO_2 cooling rate profiles derived from the SABER Level 2 version 2.0 standard products. These flux values are also included in the SABER Cooling Rate Profiles data files but are provided in these smaller ASCII text files for those who want only the flux values and not the larger data volume of the full profiles.

1.1 Data Location

This README file and the data files are available via anonymous ftp from
ftp://saber.gats-inc.com/Version2_0/SABER_cooling/
This file is in the Documentation subdirectory, and the data files are in the NO_Fluxes and CO2_Fluxes subdirectories.

1.2 Contacts

Data questions: Linda Hunt, Linda.A.Hunt@nasa.gov
Associate PI: Marty Mlynczak, m.g.mlynczak@nasa.gov

1.3 TIMED Data "Rules of the Road & Access Policies"

- Mission scientific and model results are open to all.
- Users should contact the PI or designated team member of an instrument or modeling group early in an analysis project to discuss the appropriate use of instrument data or model results. This applies to TIMED mission team members, guest investigators, and other members of the scientific community or general public.
- Users who wish to publish the results derived from TIMED data should normally offer co-authorship to the PI (Dr. James M. Russell III, JAMES.RUSSELL@HAMPTONU.EDU) or Associate PI (Dr. Martin G. Mlynczak, m.g.mlynczak@nasa.gov) or their designated team member. Co-authorship may be declined. Appropriate acknowledgement to institutions, personnel, data sources, and funding agencies should be given.
- Users should heed the caveats of investigators as to the interpretation and limitations of data or model results. Investigators supplying data or models may insist that such caveats be published, even if co-authorship is declined. Data and model version numbers should also be specified.
- Pre-prints of publications and conference abstracts should be widely distributed to interested parties within the mission and related projects.

See http://www.timed.jhuapl.edu/scripts/mdc_rules.pl

2.0 Data Set Description

This data set contains the radiated flux values for NO and CO_2 for each SABER scan profile in the thermosphere derived from SABER measurements. There is one file for each calendar day in the SABER dataset for each species. Each line in the file is a data record for an individual scan.

The Sounding of the Atmosphere using Broadband Emission Radiometry instrument is a limb scanning radiometer that records vertical profiles of infrared emission from approximately 300 km tangent altitude down to the Earth's surface in ten distinct channels from 1.27 to 15 µm. Infrared radiance profiles (W m^{-2} sr^{-1}) for NO at 5.3 µm are inverted to yield vertical profiles (~1500 per day) of infrared cooling rates (W m^{-3}) between 100 and 250 km at approximately 0.2 km altitude spacing. For CO_2,

SABER processes radiative cooling rates in Kelvin per day; cooling rate profiles in W m^{-3} are then calculated from 100 to 140 km by applying the first law of thermodynamics.

The cooling rate profiles are vertically integrated to yield the flux (W m^{-2}) of infrared emission exiting the thermosphere, either to the atmosphere below or to space above. NO is integrated from 100-250 km and CO_2 is integrated from 100-139 km. Details of the methodology used in these calculations can be found in the Mlynczak 2005 and 2010 papers cited below. Copies of these papers are included in the Documentation subdirectory of this project on the GATS ftp site.

2.1 Version History

V1.0 is the original version. Version changes for subsequent versions will be documented here.

3.0 Data Format and Packaging

The Radiated Flux files are ASCII text files with header text indicated by a # character in the first column. There are 49 header lines in flux data files. The last line of the header has data column heading text. Below that, the data values are organized in the indicated columns, one scan record per line in the file. Parameter information is provided below and in the file header.
An example of the file header is included at the end of this document. An IDL program is provided to illustrate reading and plotting the variables in the file. See the Read Software section below.

4.0 Science Parameters

The integrated radiated flux for each SABER scan profile is the primary product in these files. Related metadata are also included for each scan. These include year, day of year, and time in milliseconds since midnight (UT). The tangent point latitude, longitude, solar local time, and solar zenith angle are also provided. These last four parameters and the time parameter are the values at the altitude in the profile where the species is generally at its maximum value. For NO, that is 130 km; for CO2 it is 115 km. The orbit number and event, or scan number, within the orbit, are also provided.

The year and day of year associated with an orbit are the value at the start of the orbit, so in each day's file, data are reported for full orbits that originated on the day indicated in the file name. Data for the last orbit that starts prior to midnight continue to be reported in the file for the start day until the end of the orbit, and the time values are calculated from midnight of the day in which the orbit started.

5.0 Read Software

An IDL program, read_fluxes.pro, is provided in the Software subdirectory to illustrate reading the data in the file and creating a plot of the global daily power values. It can be run at the IDL command line (i.e., at the IDL> prompt) either within the IDLDE or in a terminal window where IDL has been started, with a string giving the full path and file name of the data file to be read as the first and only argument, e.g.,
IDL > read_fluxes,'/Saber_cooling/NO_Fluxes/ SABER_NO_FLUX_2017_365_V1.0.txt'

6.0 Additional Information

6.1 Data Set Updates

This data set will be updated quarterly (January, April, July, October) once all orbits through the end of the previous quarter are available from the SABER processing system.

6.2 References

- Russell, J. M., III, M. G. Mlynczak, L. L. Gordley, J. J. Tansock Jr., and R. W. Esplin (1999), Overview of the SABER experiment and preliminary calibration results, Proc. SPIE, 3756, 277, doi:10.1117/12.366382.
- Mlynczak, M., et al. (2003), The natural thermostat of nitric oxide emission at 5.3 mm in the thermosphere observed during the solar storms of April 2002, Geophys. Res. Lett., 30(21), 2100, doi:10.1029/2003GL017693.
- Mlynczak, M. G., et al. (2005), Energy transport in the thermosphere during the solar storms of April 2002, J. Geophys. Res., 110, A12S25, doi:10.1029/2005JA011141. (Correction, J. Geophys. Res., 112, A02303, doi:10.1029/2006JA012008, 2007.)
- Mlynczak, M. G., et al. (2010), Observations of infrared radiative cooling in the thermosphere on daily to multiyear timescales from the TIMED/SABER instrument, J. Geophys. Res., 115, A03309, doi:10.1029/2009JA014713.

Example Data File Header

```
#SABER_NO_FLUX run 2018-02-02 02:35:13
#
#Year: 2017
#Day: 365
#Lower bound altitude:      100
#Upper bound altitude:      250
#Project metadata:
# Platform: TIMED: Themosphere Ionosphere Mesosphere Energetics and Dynamics
# Platform URL: http://www.timed.jhuapl.edu/WWW/index.php
# Instrument: SABER: Sounding of the Atmosphere Using Broadband Emission Radiometry
# Instrument URL: http://saber.gats-inc.com
# PI Name: James M. Russell, III
# PI Affiliation: Center for Atmospheric Sciences, Hampton University, Hampton, VA
# PI Contact: james.russell@hamptonu.edu
# Co-PI Name: Martin G. Mlynczak
# Co-PI Affiliation: NASA Langley Research Center, Hampton, VA
# Co-PI Contact: m.g.mlynczak@nasa.gov
# References: doi:10.1029/2009JA014713
# Institution: NASA Langley Research Center
#Dataset metadata:
# Dataset Name: SABER_NO_PROFILE_FLUX
# Dataset Version: V1.0
# Dataset Contact: Linda.A.Hunt@nasa.gov
# Dataset Description: SABER NO cooling rate daily profiles (W/m3) and fluxes (W/m2)
# SABER Data Version: 2.0
# Dataset File Time Resolution: one day
#File metadata:
# File Name: SABER_NO_FLUX_2017_365_V1.0.txt
# File Create Time:         20180202T030329
# File Time Range: Orbits beginning in day of year 365 of Year: 2017
#Variable metadata (columns):
# Year: Year of data observation
# Day: Day of year of data observation
# Time: SABER standard msec since midnight of the day in which the orbit began,
# at the scan point closest to 130 km.
#   Divide by 1.e3 to get seconds.
#   Note that the last several time values for a day have a value that is still
#   incrementing from the previous day's midnight
# Orbit: SABER/TIMED orbit number (1-based).
# Event: Scan (event) number within the orbit (1-based).
# Lon: Scan tangent point geographic longitude value closest to 130 km, values from 0 to 360 degrees east
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```
# Lat: Scan tangent point geographic longitude values closest to 130 km, values from -90 to 90 degrees north
# SZA: Scan tangent point solar zenith angle closest to 130 km
# SLT: Scan tangent point solar local time in msec closest to 130 km
# Profile Flux: cooling rate integrated over each SABER scan profile (100-250 km) in Watts/m^2
# Format statement used to write the data records:
(2x,I4,1x,I03,1x,E11.5,1x,I6,2x,I3,3x,F7.3,1x,F7.3,1x,F7.3,1x,E11.5,1x,E11.5)
#
# Year Day    Time      Orbit  Event   Lon     Lat     SZA     SolarLT   Profile Flux
  2017 365 1.24810E+06  87077    1   158.911   9.944  36.820 3.93869E+07 1.63588E-04
  2017 365 1.30726E+06  87077    2   159.438  13.274  39.534 3.95723E+07 1.38768E-04
```