Fact Sheet

National Aeronautics and
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Langley Research Center
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SABER: A Pioneer in Atmospheric Science

Evidence suggests that Earth and its atmosphere are changing due to both natural and human-induced effects. Scientists need to understand current atmospheric processes so they will be better able to determine future changes and assess the consequences for society. The upper atmosphere is one of the least explored regions of Earth, making accurate information about it essential for global climate change studies. A new NASA spaceborne instrument called SABER (Sounding of the Atmosphere using Broadband Emission Radiometry) will allow researchers to learn more about the upper atmosphere by helping produce the first comprehensive global measurements of this region. It will provide a never before seen view of the atmosphere and pave the way for a new area of science. SABER, built by Utah State University Space Dynamics Laboratory and managed by NASA Langley Research Center, is one of four instruments on the TIMED (Thermosphere, Ionosphere, Mesosphere, Energetics and Dynamics) spacecraft scheduled to begin its 2-year mission with launch in late 2001.

The TIMED mission will study the natural variability of the Mesosphere and Lower Thermosphere/Ionosphere or the MLTI region. The technique that SABER will use to sound, or make measurements in the atmosphere, has never before been used to study the MLTI region in such detail. SABER's limb measurements are made as the instrument views radiation emitted by the atmosphere such as in the form of airglow. (Fig. 1) These limb scans provide measurements of the temperature and chemical structure of the atmosphere between 10 and 110 miles in altitude. The experiment will provide fundamental information on the radiation budget, chemistry and dynamics of the upper atmosphere.

The Upper Atmosphere's Radiation Budget

SABER will enhance knowledge of the radiation budget—the balance between Earth's incoming and outgoing energy—by making the first comprehensive global measurements of the energy balance in Earth's upper atmosphere. SABER will measure infrared radiation or heat emitted by the atmosphere over a broad altitude and spectral range in this region. It will also accurately determine how strongly the upper atmosphere is heated by ultraviolet radiation from the Sun. SABER's observations will lay the foundation for a new area of science in radiation budget studies. Its measurements in an altitude range where the energy and chemistry are unique from other atmospheric

regions are the first of their kind. As compared to lower atmospheric regions, there are fewer molecules in the MLTI, affecting how the atmosphere radiates and absorbs heat. New research in the area will influence how scientists understand the warming and cooling of the Earth in the MLTI region.

Key Gases in the Upper Atmosphere

Ozone, water vapor and carbon dioxide are important gases that warm and cool the MLTI region through absorption of solar radiation and emission of infrared radiation (heat energy). SABER will measure the vertical distribution of these gases by directly observing the infrared energy they emit. These observations will significantly enhance our knowledge of how these gases influence the temperature and chemistry of the upper atmosphere—an area where these processes are least understood due to the previous lack of measurements. SABER, for example, will make the first-ever measurements of the global distribution of carbon dioxide concentrations in the MLTI region. It will also measure the infrared energy emitted by nitric oxide, a chemically active gas that strongly influences the natural cooling of the upper atmosphere. SABER will also provide the first measurements of ozone during the day and at night in the MLTI region.

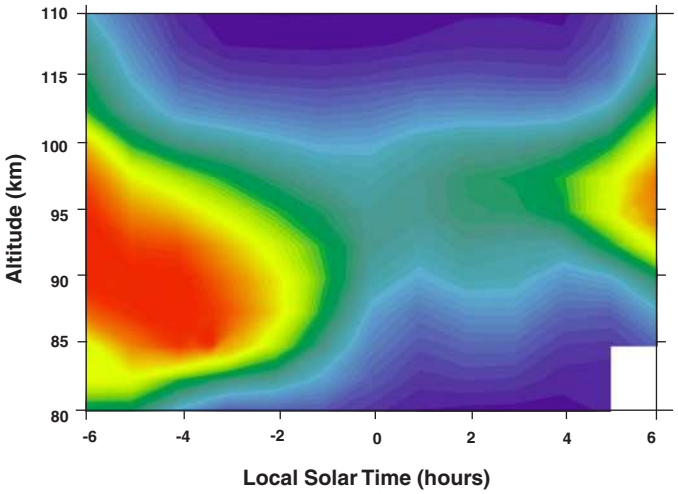

Fig. 1 SABER will make significant improvements upon airglow measurements like those in the above image taken from the Wind Imaging Interferometer or WINDII instrument on the Upper Atmosphere Research Satellite. Airglow occurs when the atmosphere emits energy through photochemical processes that begin when sunlight comes into contact with chemically active molecules. Red represents high airglow emission and blue represents low emission.

Atmospheric Structure and Dynamics

SABER's comprehensive global measurements of the flow of energy in Earth's upper atmosphere will also greatly increase what scientists know about the structure and the motion of air (dynamics) of the atmosphere. SABER's observations will provide new information about how temperature, density and pressure change with altitude. They will also track the movement of air between the poles, from lower to upper atmospheric regions, from season to season and around the globe. During the mission, SABER will produce a global picture of how the MLTI region changes over time.

For more information, please contact:

NASA Langley Research Center
Public Affairs Office
Mail Stop 115
Hampton, VA 23681-0001
(757) 864-6124
http://www.larc.nasa.gov/

Or see the SABER Home Page:
http://asd-www.larc.nasa.gov/saber/ASDsaber.html

The SABER instrument