Comparisons of USDA UV-MFRSR UV irradiance measurements with TOMS satellite retrievals and DISORT under various cloud and aerosol conditions

J. R. Slusser¹ (slussr@nrel.colostate.edu), J. R. Herman², W. Gao¹, N. Krotkov³, G. Labow³

Program Objectives
The USDA UV-B Radiation Monitoring Program is a program of the US Department of Agriculture’s Cooperative State Research, Education and Extension Service (CSREES). The program was initiated in 1992, through a grant to Colorado State University, to provide information on the geographical distribution and temporal trends of UVB (ultraviolet-B) radiation in the United States. The information is critical to the assessment of the potential impacts of increasing UVB radiation on the population, agriculture, and other aspects of the environment. Specifically the program monitors:

- Provides information to the environmental community and others about the climatological and geographical distribution of UVB radiation.
- Furnishes the basic information necessary to support evaluations of the potential damage effects of UV radiation to agriculture and forests.
- Supplies ground truth for satellite measurements and basic information or radiation transfer model calculations.

The Climatological Network
The climatological network of the USDA UV-B Monitoring Program is designed to provide an adequate density of measurement sites to establish the spatial and temporal characteristics of UVB radiation. The network follows a grid-based design, which covers 29 regions of approximately equal-area. Sites are located primarily in rural areas, with particular consideration given to agricultural and forested regions. Initial site locations were also chosen to evaluate their suitability as research sites which will use high-resolution spectroradiometers. All sites have been established in cooperation with the National Oceanic and Atmospheric Administration (NOAA) and the Environmental Protection Agency (EPA), and all sites follow a standardized measurement protocol. For more information about the climatological network please check:

http://uvbr.nrel.colostate.edu/

Research Activities
Focused towards challenging our current understanding of factors that control UV-B and other environmental stress factors such as high temperature, drought, etc., and developing the genetic resources to identify crop varieties resistant to these stresses; Provide key opportunities for collaborative research and provide calculation benchmarks for the US Geothermal and other US Global Change agencies involved in UV-B research.

USB-UV-B Radiation Monitoring Network

Figure 1 Typical climatological site

Figure 2 Repeat spectral response function by CUCF

Figure 3 Langley time series for NM

Figure 4-7 from top to bottom

4. Ratio of DISORT to measurements, NM
5. Ratio of DISORT to measurements, OK
6. Ratio of TOMS to measurements, NM
7. Ratio of TOMS to measurements, OK

ABSTRACT
An array of widely spaced ground-based radiometers gives frequent, accurate point measurements of UV-B irradiances but lack the broad spatial coverage necessary for UVB monitoring. Results of single-platform satellite retrievals from NASA TOMS (Herman et al., 1992) have suggested that the TOMS algorithm overestimates UV-B irradiances under various sky conditions from the 7 channel UV Multi-Filter Rotating Shadowband Radiometer (UV-MFRSR) and are compared with UVB irradiances from CUCF as well as those using a radiative transfer model (DISORT).

Conclusions
By including aerosols in the RT model the measured clear sky irradiances agree to within 2% of the measured USDA irradiances, but a large range of 5% for TOMS irradiances agrees well with measured USDA irradiances averaged from 1 hour of the TOMS overpass, but overestimate the UV at OK. Since NM is generally located than OK, it is likely that at least some of the TOMS overestimate is due to aerosols. The effect of broken clouds on TOMS UV retrievals is improved by time averaging ground based radiometric data. More work is planned using 3 minute cloud optical depths to characterize the cloud field that TOMS "sees".

References

Acknowledgments
This study was supported by the USGS CSRES (Agreements 98-34263-888 and 98-34263-856), NASA (Contract number NCC2-241).

USDA UV-B Radiation Monitoring Network

Figure 1 Typical climatological site

Figure 2 Repeat spectral response function by CUCF

Figure 3 Langley time series for NM

Figure 4-7 from top to bottom

4. Ratio of DISORT to measurements, NM
5. Ratio of DISORT to measurements, OK
6. Ratio of TOMS to measurements, NM
7. Ratio of TOMS to measurements, OK

Author Information
This study was supported by the USGS CSRES (Agreements 98-34263-888 and 98-34263-856), NASA (Contract number NCC2-241).