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Land Surface Temperature Measurements from EOS MODIS Data

MODIS Team Member
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Abstract

A substantive progress has been made in the development of the new MODIS day/night land-surface temperature (LST) algorithm which retrieves surface emissivity and temperature simultaneously for land covers with variable emissivities. The assumptions of surface BRDF and reflectance in the 3-14μm range which we made in the LST algorithm have been validated by our spectral BRDF measurements in the thermal infrared. The physical principle of this day/night LST algorithm has been validated by ground-based measurements with the sun/shadow method. Comprehensive sensitivity and error analysis shows that the day/night LST algorithm is not very sensitive to uncertainties in the instrument noise and calibration accuracy and that the standard deviations of errors in retrieved surface daytime and nighttime temperatures are better than 0.8 °K, and the standard deviations of errors in retrieved emissivities in MODIS bands 31 and 32 (located at 11 μm and 12 μm) are better than ().01 over wide ranges of atmospheric and surface conditions.

The version 1 of the MODIS LST software is being prepared for its delivery scheduled in the early second half of this year.

1. Recent Progress in TIR Instrumentation

A substantive progress has been made in the development of the new MODIS day/night land-surface temperature (LST) algorithm which retrieves surface emissivity and temperature simultaneously for land covers with variable emissivities. Comprehensive sensitivity and error analysis shows that the day/night LST algorithm is not very sensitive to uncertainties in the instrument noise and calibration accuracy and that the standard deviations of errors in retrieved surface daytime and nighttime temperatures are better than 0.8 °K, and the standard deviations of errors in retrieved emissivities in MODIS bands 31 and 32 (located at 11μm and 12μm) are better than 0.01 over wide ranges of atmospheric and surface conditions. A paper on this new LST algorithm has been submitted to the peer review journal IEEE Trans. Geoscience and Remote Sensing, and the manuscript has been revised according to peer reviewer's comments. We included this revised manuscript in Appendix I.

The assumptions of surface BRDF and reflectance in the 3-14μm range which we made in the day/night LST algorithm have been validated by our spectral BRDF measurements in the thermal infrared. A paper on TIR BRDF measurements of sands and soils has been submitted to the peer review journal Remote Sensing of Environment, and the manuscript has been revised and resubmitted to the editor. We include this revised manuscript in Appendix II.

The physical principle of this day/night LST algorithm has been validated by ground-based measurements with the sun/shadow method. A paper on this sun/shadow method has been submitted to the peer review journal IEEE Trans. Geoscience and Remote Sensing in March 1996.

Two field campaigns were conducted in order to validated the LST algorithms. The first field campaign was conducted in a snow cover test site in Mammoth Lake area in April 2, 1996. The second field campaign was conducted jointly with other groups in Railroad Valley, Nevada in June 4, 1996. MODIS Airborne Simulator flights and ground-based TIR spectral measurements were accomplished in these two field campaigns.

2. V 1 Delivery of the MODIS LST Code

Two MODIS LST algorithms have been developed. Toolkit software packages of Product Generation System (PGS) and MODIS Application Program Interface (M-API) have been implemented on local SCF (Science Computing Facility) DEC Alpha workstations. The V1 version of the MODIS LST code is being prepared for its delivery scheduled in the early second half of this year.

3. Anticipated Future Actions

The MODIS LST ATBD (Algorithm Theoretical Base Document) will be revised before August 16th. MAS data and field measurement data collected in the last two field campaigns will be used to validate the MODIS LST algorithms. V1 version of the MODIS LST code will be delivered. The work to establish TIR BRDF/emissivity knowledge base and the development of MODIS LST algorithm will be continued.

4. Publications

1. Z. Wan and J. Dozier, "A generalized split-window algorithm for retrieving land-surface temperature from space", IEEE Trans. Geosci. Remote Sens., vol. 34, no. 4, pp. 892-905, 1996.
2. W. Snyder and Z. Wan, "Surface temperature correction for active infrared reflectance measurements of natural materials", Appli. Optics, vol. 35, no. 13, pp. 2216-2220, 1996.
3. Z. Wan, W. Snyder and Y. Zhang, "Validation of land-surface temperature retrieval from space", Proc. IGARSS '96, pp. 2095-2097, 1996.
4. Z. Wan and Z.-L. Li, "A physics-based algorithm for retrieving land-surface emissivity and temperature from EOS/MODIS data", IEEE Trans. Geosci. Remote Sens., revised 1996.
5. W. Snyder, Z. Wan, Y. Zhang and Y.-Z. Feng, "Thermal infrared (3- 14 pm) bidirectional reflectance measurements of sands and soils", Remote Sens. Environ., revised 1996.
6. Z. Wan, W. Snyder, Z.-L. Li, Y. Zhang and Y.-Z. Feng, "A sun-shadow method for in-situ measurements of land-surface temperature and emissivity", IEEE Trans. Geosci. Remote Sens., submitted 1996.