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EFFECTS OF ATMOSPHERE, TEMPERATURE AND EMITTANCE ON REMOTELY SENSED DATA

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The purpose of this work was to study the effects of temperature and emittance on the relative magnitudes of remotely sensed reflected and emitted energy from a natural target, taking into account atmospheric effects.

LOWTRAN 3 program was used to calculate the transmittance of the atmosphere. The LOWTRAN 3 program is strictly empirical and calculates the transmittance (averaged over a 0.014 µm interval) for a given atmospheric path from 0.25 to 28.5 µm for six model atmospheres and two aerosol models. In addition, radiosonde data, if available, can also be used instead of the model atmospheres.

To create illustrations of the energy reflected versus energy emitted from a natural target, the solar energy incident on the target was calculated for several values of the zenith angle of the sun, taking into account atmospheric transmittance. Assuming the target to be diffuse and the validity of Kirchhoff's law, the energy reflected and emitted from the target was calculated. The curves of relative magnitudes of solar energy reflected from a target over the energy emitted from it for several model atmospheres (midlatitude summer, tropical etc.) will be given at 3 µm, 3.5 µm, 4 µm, 4.6 µm, and 8 µm for ranges of emittance and temperature of 0.2 to 0.95 and 230°K respectively in the final manuscript.

The results indicate that the solar energy reflected from most natural targets cannot be neglected for wavelengths shorter than the 4.3 µm CO_2 band as compared to the energy emitted from them. In addition, the energy emitted by the model atmospheres incident on the natural target and reflected by it will be shown for typical values of their emittance. The results show that the incident atmospheric emission reflected from the target cannot be safely neglected for targets having low temperatures and low emittance.

Previously acquired field spectroradiometric data on soils and corn plants in the wavelength range 4 to 14 µm were available for comparing theoretical calculations with the experimental results, as was a software system. The solar energy incident on the soil was calculated and corrections for atmospheric effects applied. Calculations of energy reflected and emitted from the soil were compared with the experimental results and agreed closely. These calculations help in understanding the interaction of radiation with natural targets and give an estimate of the errors involved in neglecting other target reflectance.

A computer program has been developed at the Brazilian Institute of Space Research (INPE) to correct the aircraft and satellite multispectral scanner (MSS) data in 0.25 to 28.5 µm for atmospheric interference. The basic equation for radiance of radiation received by MSS is developed for a plane parallel atmosphere. It consists of radiance reflected by the target and the path radiance. This equation is simplified for a perfectly diffuse target, and assumptions are: diffuse reflectance of target, no absorption in region where scattering occurs, haze characterized by visibility, no clouds present, and single scattering.

The transmittance of the atmosphere is calculated by an empirical computer program averaged over 20 cm^{-1} interval. The atmosphere is assumed to have plane parallel layers of water vapor ozone, CO_2, N_2O, CH_4, CO, N_2O, CH_4, CO, N_2, and O_2. Aerosol models are based on measurements of continental aerosols under moderate visibility. Transmittance due to continuum absorption is assumed to follow a simple exponential law. An empirically determined function of 'equivalent absorber amount' is used to determine average transmittance due to molecular absorption.

In the final manuscript, the effect of many parameters--latitude, longitude, time, target reflectance, position of satellite, visibility, etc. on the radiance received by the satellite for several model atmospheres will be given. This computer program will be used to correct the MSS data of aircraft, LANDSAT, NOAA, Nimbus V, etc. Examples of the use of this program on real remote sensing data will be given in the final manuscript.