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ATMOSPHERIC EFFECTS ON BAND-RATIOING IN VEGETATION MONITORING FROM SATELLITES

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An approximate, explicit expression has been previously developed for the Earth-atmosphere system nadir beam reflectivity a_s:

$$a_s = r[1 - (\frac{1}{\mu_0} + 1)(B + W) + 2ab] + (a - r)F + \frac{g(\mu_0)}{2\mu_0} B \qquad (1)$$

where r is the object pixel reflectivity, a the effective reflectivity of the surrounding terrain, μ_0 the cosine of the solar zenith angle, and $g(\mu_0)$ is the anisotropy of atmospheric scattering to zenith from the direct beam. B, F and W respectively are the backward scattering, forward scattering and absorption optical thickness.

Equation (1) is accurate only for the limiting cases of low optical thickness, $(Q/\mu_0) << 1$, and should not generally be used for quantitative correction of atmospheric effects. This expression affords good insight into atmospheric effects on reflective infrared to red band ratioing for monitoring and mapping vegetation. The Landsat bands applicable for this purpose are MSS-7 (0.8-1.1μm) and MSS-5 (0.6-0.7μm). The ratio of MSS-7 to MSS-5 increases with canopy thickness and plant vigor.

Under good visibility conditions (aerosol vertical optical thickness 0.05 to 0.15, less than 30mm water vapor, and zenith angle of 30^0) the atmosphere reduces an inherent MSS-7 to MSS-5 reflectivity ratio of 7 (representative of corn or winter wheat) to a range of 5.4 to 3.9. If the field is surrounded by sandy bare soil, the ratio is further reduced to a range of 4.2 to 2.4. An inherent band ratio of 10 (representative of deciduous forest or dense crops such as soybeans) is reduced to a range of 7.0 to 5.0 for uniform fields and to a range of 5.0 to 2.7 for a field surrounded by bare soil. A significant improvement will occur with the Thematic Mapper where water vapor effects are reduced.