

Default atmospheric correction algorithm on GEO Grid

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1 Conversion from AST_BETA product to TOA radiance/reflectance

The ASTER TOA reflectance can be calculated by the following equations:

$$L_{ASTER} = (DN_{ASTER} - 1) \times UCC \quad (1)$$

$$d = 1 - e \cos\left(0.9856(J - 4) \frac{\pi}{180}\right) \quad (2)$$

$$\rho_{ASTER} = \frac{\pi L_{ASTER} d^2}{F_0 \cos(\theta_{ASTER})} \quad (3)$$

where L_{ASTER} [W/m²/str/ μ m] is ASTER/MODIS observed radiance, DN_{ASTER} is the recorded digital number, and UCC means "Unit Conversion Coefficients", which is calibrated by onboard or recalibrated coefficients. ρ_{ASTER} is observed reflectance, and F_0 [W/m²/ μ m] is irradiance based on World Radiation Center (WRC), that ASTER science team adopts. θ_{ASTER} [rad] is ASTER solar zenith angle. This research uses WRC irradiance, however, we can exchange the other irradiance models for intercomparison of other satellite. d is Earth-Sun distance in astronomical units, which can be calculated by using the day number of the year (Julian Day), J , and elliptical eccentricity of earth's orbit, e (=0.01672).

2 Atmospheric correction

Firstly, we apply various re-calibration algorithms and coefficients based on vicarious calibration to the ortho-rectified radiance data. And then, the following atmospheric correction algorithm is applied to the radiometric re-calibrated ASTER TOA reflectances. ASTER TOA reflectance, ρ_{obs} (= ρ_{ASTER}) can be expressed by the following equations:

$$\rho_{obs}(\tau_{O_3}, \tau_R, \theta_s, \theta_\nu, \varphi_{s-\nu})$$

$$= T_{O_3}(\tau_{O_3}, \theta_s, \theta_\nu) \times (\rho_R(\tau_R, \theta_s, \theta_\nu, \varphi_{s-\nu}) + \frac{T_{R\downarrow}(\tau_R, \theta_s)\rho_s T_{R\uparrow}(\tau_R, \theta_\nu)}{1 - S_R(\tau_R)\rho_s} T_{H_2O}(\theta_s, \theta_\nu)) \quad (4)$$

T_{O_3} : Ozone transmittance
 ρ_R : Path radiance
 $T_{R\downarrow}$: Downward transmittance
 $T_{R\uparrow}$: Upward transmittance
 S_R : Spherical albedo
 ρ_s : Rayleigh/Ozone/Warer Vapor corrected
reflectance
 θ_s : Solar zenith angle
 θ_ν : Satellite zenith angle
 $\varphi_{s-\nu}$: Relative azimuth angle

where ρ_s is Rayleigh scattering, ozone and warer vapor absorption corrected reflectance, which is output of this algorithm. τ_R is calculated by ASTER DEM, and T_{O_3} can be derived from TOMS/Earth Probe (EP-TOMS,2000~2004) or OMI L3 daily global gridded products(2005~). T_{H_2O} is calculated by using MODIS atmospheric L3 daily global gridded product (MOD08_D3, 2000~).

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