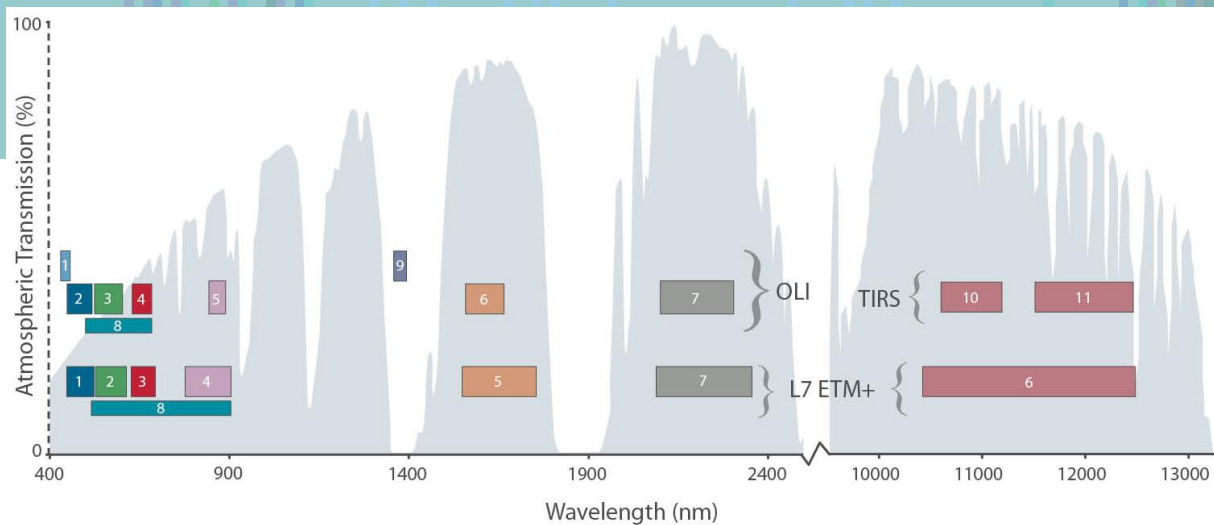


Práctico 5:
Corrección atmosférica en el espectro solar.
Estimación de la reflectividad TOA y de
superficie

Landsat-7 ETM+ Bands (μm)			Landsat-8 OLI and TIRS Bands (μm)		
			30 m Coastal/Aerosol	0.435 - 0.451	Band 1
Band 1	30 m Blue	0.441 - 0.514	30 m Blue	0.452 - 0.512	Band 2
Band 2	30 m Green	0.519 - 0.601	30 m Green	0.533 - 0.590	Band 3
Band 3	30 m Red	0.631 - 0.692	30 m Red	0.636 - 0.673	Band 4
Band 4	30 m NIR	0.772 - 0.898	30 m NIR	0.851 - 0.879	Band 5
Band 5	30 m SWIR-1	1.547 - 1.749	30 m SWIR-1	1.566 - 1.651	Band 6
Band 6	60 m TIR	10.31 - 12.36	100 m TIR-1	10.60 - 11.19	Band 10
			100 m TIR-2	11.50 - 12.51	Band 11
Band 7	30 m SWIR-2	2.064 - 2.345	30 m SWIR-2	2.107 - 2.294	Band 7
Band 8	15 m Pan	0.515 - 0.896	15 m Pan	0.503 - 0.676	Band 8
			30 m Cirrus	1.363 - 1.384	Band 9



Reflectividad TOA

Esquema general...ver específicamente para L8

SIN CORRECCIÓN

ND_{λ}

(1)

$$L_{\lambda sat} = G_{\lambda} ND + B_{\lambda}$$

$L_{\lambda sat}$

(2)

Reflectividad
TOA

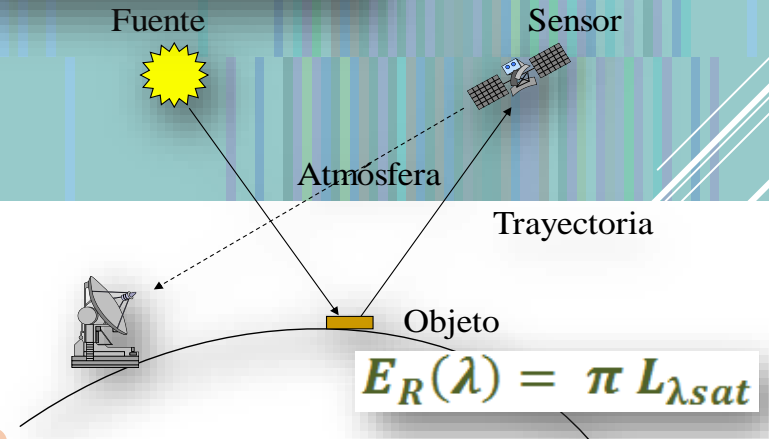
$$\rho_{\lambda TOA} = \frac{\pi L_{\lambda sat}}{E_{\lambda 0} d^{-2} \cos \theta_z}$$

$$\rho_{\lambda TOA} \neq \rho_{\lambda sup}$$

$$\rho = \frac{E_R(\lambda)}{E_I(\lambda)}$$

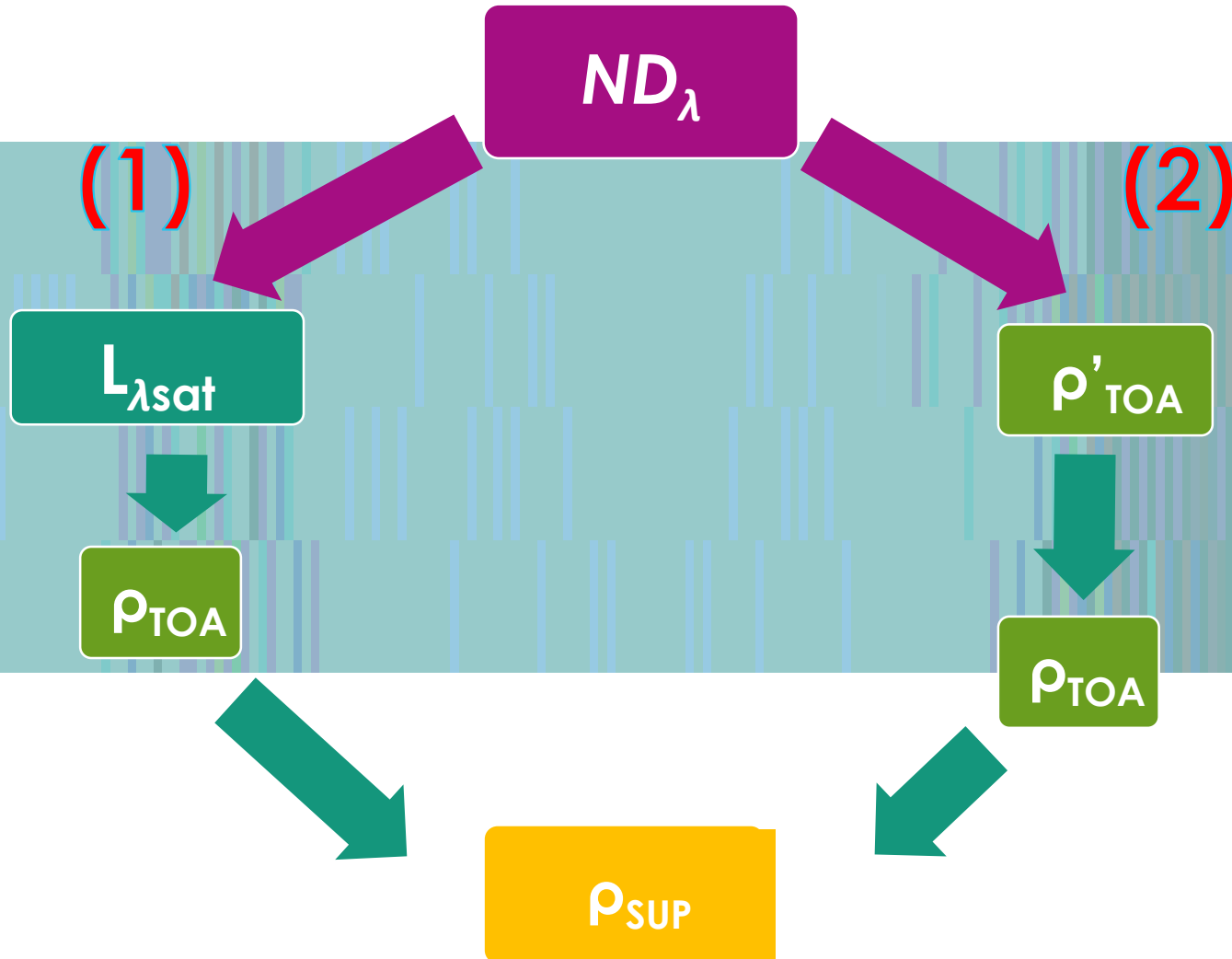
$$E_I(\lambda) = E_{\lambda 0} d^{-2} \cos \theta_z$$

SATÉLITE



Cómo hacerlo en Landsat 8

2 formas



(Ver parámetros en el header de la imagen)

(1)

ND_{λ}



$L_{\lambda sat}$

$$L_{\lambda sat} = G_{\lambda} ND_{\lambda} + B_{\lambda}$$

$[W m^{-2} \mu m^{-1} sr^{-1}]$

```
GROUP = RADIOMETRIC_RESCALING  
RADIANCE_MULT_BAND_1 = 1.2526E-02  
RADIANCE_MULT_BAND_2 = 1.2773E-02  
RADIANCE_MULT_BAND_3 = 1.1696E-02  
RADIANCE_MULT_BAND_4 = 9.9056E-03  
RADIANCE_MULT_BAND_5 = 6.0108E-03  
RADIANCE_MULT_BAND_6 = 1.5144E-03  
RADIANCE_MULT_BAND_7 = 4.9264E-04  
RADIANCE_MULT_BAND_8 = 1.1158E-02  
RADIANCE_MULT_BAND_9 = 2.4701E-03
```

G_{λ}

```
RADIANCE_ADD_BAND_1 = -62.62906  
RADIANCE_ADD_BAND_2 = -63.86516  
RADIANCE_ADD_BAND_3 = -58.47895  
RADIANCE_ADD_BAND_4 = -49.52809  
RADIANCE_ADD_BAND_5 = -30.05420  
RADIANCE_ADD_BAND_6 = -7.57216  
RADIANCE_ADD_BAND_7 = -2.46321  
RADIANCE_ADD_BAND_8 = -55.79026  
RADIANCE_ADD_BAND_9 = -12.35052  
RADIANCE_ADD_BAND_10 = 0.10000  
RADIANCE_ADD_BAND_11 = 0.10000
```

B_{λ}

(1)

$L_{\lambda sat}$



Reflectividad
TOA

$$\rho_{\lambda TOA} = \frac{\pi L_{\lambda sat}}{E_{\lambda 0} d^{-2} \cos \theta_z}$$

Angulo cenital solar (z) =
90 - SUN ELEVATION

$$d = 1 - 0.01673 \cos \left(2\pi \frac{\text{día Juliano} - 3}{365} \right)$$

Banda - L8	$E_{0\lambda}$ (W m ⁻² μm ⁻¹)
2	2067
3	1893
4	1603
5	972.6
6	245.0
7	79.72
9	399.7

Fuente: <http://www.gisagmaps.com/landsat-8-atco/>

$E_{\lambda 0}$ ó E_{sun} no es necesario para calcular reflectividad TOA , pues para Landsat 8 se puede obtener de una forma más sencilla, de la siguiente forma:

(2)

ND_{λ}



ρ'_{TOA}



ρ_{TOA}

$$\rho'_{\lambda TOA} = M_{\lambda} ND_{\lambda} + A_{\lambda}$$

M=Reflectance_Mult
A=Reflectance_Add

$$\rho_{\lambda TOA} = \frac{\pi L_{\lambda sat}}{E_{\lambda 0} d^{-2} \cos \theta_z} \approx \frac{\rho'_{\lambda TOA}}{\cos \theta_z}$$

Angulo cenital solar (z) =
90 - SUN ELEVATION

<i>banda</i>	<i>M (pendiente)</i>	<i>A (ordenada)</i>
Band 1 - Coastal aerosol	0,00002	-0,1
Band 2 - Blue	0,00002	-0,1
Band 3 - Green	0,00002	-0,1
Band 4 - Red	0,00002	-0,1
Band 5 - Near Infrared (NIR)	0,00002	-0,1
Band 6 - SWIR 1	0,00002	-0,1
Band 7 - SWIR 2	0,00002	-0,1
Band 8 - Panchromatic	0,00002	-0,1
Band 9 - Cirrus	0,00002	-0,1

Reflectividad de superficie

$$\rho_{\lambda sup} = \frac{\pi(L_{\lambda sat} - L_{\lambda p})}{T_{\lambda v}(E_{\lambda 0} d^{-2} \cos\theta_z T_{\lambda z} + E_{\lambda down})}$$



$$\rho_{\lambda SUP} = \left[\frac{\rho_{\lambda TOA} - \rho_{\lambda TOAmin}}{T_{\lambda v} T_{\lambda z}} \right]$$

Transmisividades...

$$T_{\lambda v} = \exp(-\tau_{\lambda r} / \cos\theta_v)$$

$$T_{\lambda z} = \exp(-\tau_{\lambda r} / \cos\theta_z)$$

$$\tau_r = 0.008569 * \lambda^{-4} (1 + 0.0113 * \lambda^{-2} + 0.00013 * \lambda^{-4})$$

Kaufman 1989

μm	μm	μm	$\tau_{\lambda r}$
0,43	0,45	0,440	0,242759907
0,45	0,51	0,480	0,169735243
0,53	0,59	0,560	0,090386893
0,64	0,67	0,655	0,047813931
0,85	0,88	0,865	0,015540855