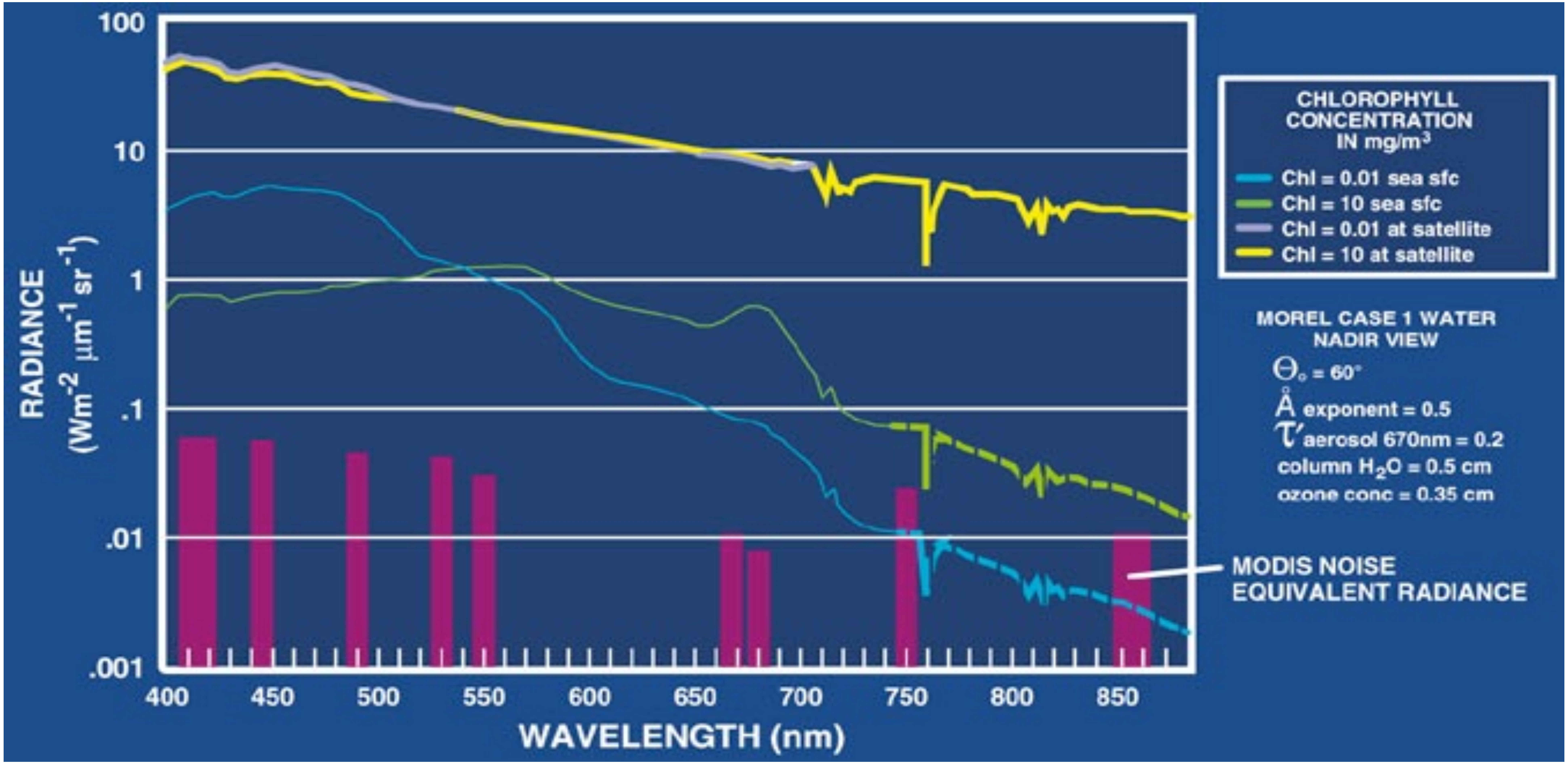
Atmospheric Correction

Top-of-the-Atmosphere Radiance versus Water Leaving Radiance



Sources of Radiance Detected by a Satellite Sensor

L_w = Water Leaving Radiance

L_r = Rayleigh Scattering (air molecules)

L_a = Aerosol Scattering

L_{ra} = Rayleigh-Aerosol Scattering Interactions

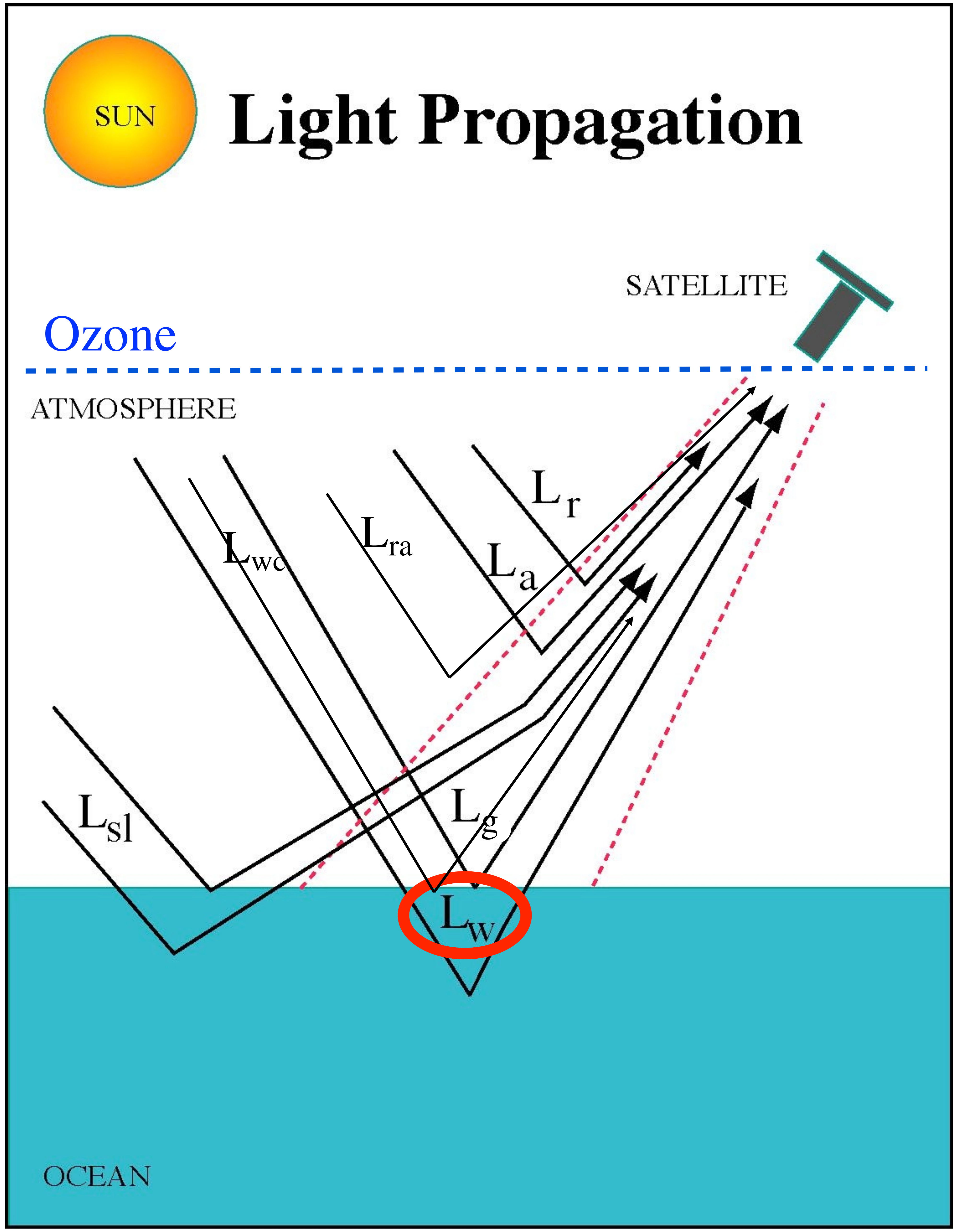
L_g = Direct Specular Reflection & Glitter (Sun Glint)

L_{wc} = White Caps

L_{sl} = Stray Light

Ozone Absorption

Blue = *variable quantities*
Black = *Known Quantities*



Atmospheric Correction in a Nutshell

measured | variable aerosol contribution | variable L_w contribution

$$Knowns = L_r(\lambda) + t(\lambda)L_{wc}(\lambda) + T(\lambda)L_g(\lambda)$$

$$\underline{L_t(\lambda)} = \underline{\left[L_a(\lambda) + L_{ra}(\lambda)\right]} + \underline{t(\lambda)L_w(\lambda)} + \underline{Knowns}$$

In the Near Infrared Region (*SeaWiFS Bands 7 & 8 = 765 nm and 865nm*) **L_w is traditionally *assumed* to be zero so that the above equation for these wavelengths can be written as:**

measured

$$L_t(\lambda_{765,865}) = L_a(\lambda_{765,865}) + L_{ra}(\lambda_{765,865}) \quad + \quad knowns$$

Measured by Satellite

$$\left[L_a(\lambda_{765,865}) + L_{ra}(\lambda_{765,865})\right] = \underline{L_t(\lambda_{765,865})} - \underline{Knowns}$$

Once $[L_a + L_{ra}]$ are determined ***for Bands 7 and 8 (near IR)*** from L_t, Look-Up Tables are used to determined the Relative Amount of Atmospheric Contribution by L_a+L_{ra} ***at the other Visible Wavelengths***

NIR Correction

It turns out that **turbid coastal waters** have a measurable level of water leaving radiance in bands 7 & 8 (748-nm & 869-nm) which make it seem like there was more aerosol present and so when the atmosphere was removed **it gave *negative water leaving radiances* in some of the visible bands**. A new iterative approach was introduced (see Siegel et al. 2000, Stumpf et al. 2003 and Bailey et al. 2010) to account for Lw (7,8) not being strictly zero in turbid water..

1. regular atmospheric correction is made and an ***initial chlorophyll estimate is made***
2. magnitude that L_w contributed to overall NIR signal is estimated from initial chlorophyll estimate
3. The estimate of L_w contribution is then subtracted from initial raw NIR signal and second atmospheric correction is made and ***second chlorophyll estimate is made***
4. **Steps 2 and 3 repeated until no change in chlorophyll concentration occurs upon further iteration**

SWIR Correction

By using the ***shortwave infrared (SWIR)*** bands (500m resolution bands at 1240-, 1640-, 2130-nm) on MODIS (that were originally intended for MODIS-Land use), an enhanced atmospheric correction method for “highly” turbid waters has been made available for use within the SeaDAS environment (see Wang et al. 2008)

Because of the low signal to noise ratio of the SWIR bands, it is recommended by Wang et al. (2008) that the standard NIR method be used in the open ocean and the combined NIR-SWIR method be used only in highly turbid coastal waters.