Converting Pléiades 1A Digital Numbers to Physical Units

Bio-physical applications require conversion of raw digital count number (DN) to physical units. Current physical units include radiance (at-Ground or at-Top Of Atmosphere), reflectance, or albedo.

A.1 Pléiades spectral bands

Pléiades acquires images in 5 spectral ranges. Following spectral ranges are based on a rejection at 1%:

Spectral ranges	λmin	λmax
PAN	0.47 µm	0.83 µm
B0	0.43 µm	0.55 µm
B1	0.50 µm	0.62 µm
B2	0.59 µm	0.71 µm
B3	0.74 µm	0.94 µm

TABLE 1: PLÉIADES SPECTRAL BANDS.

A.2 Converting Digital Count to TOA radiance

For a respective band (b), the conversion of the Digital Count of a pixel DC(p) to Top Of Atmosphere (TOA) radiance $L_b(p)$ (in $W{\cdot}sr^{-1}{\cdot}m^{-2}{\cdot}\mu m^{-1}$) is done by the absolute radiometric calibration coefficients GAIN and BIAS:

$$L_b(p) = \frac{DC(p)}{GAIN(b)} + BIAS(b)$$

Absolute radiometric calibration coefficients are updated periodically, typically 4 times per year, asset on the sensor native radiometric range of 12 bit-depth.

The values are recomputed for product ranged to 8 bit-depth with a linear adjustment, meaning a non-zero BIAS value.

These values have no sense when other radiometric adjustment like seamless (Mosaic) has been applied on data.

A.3 TOA Spectral Reflectance

The Top Of Atmosphere (TOA) spectral reflectance is the ratio of the TOA radiance normalized by the incoming solar irradiance:

$$\rho_b(p) = \frac{\pi . L_b(p)}{E_0(b) . \cos(\theta_s)}$$

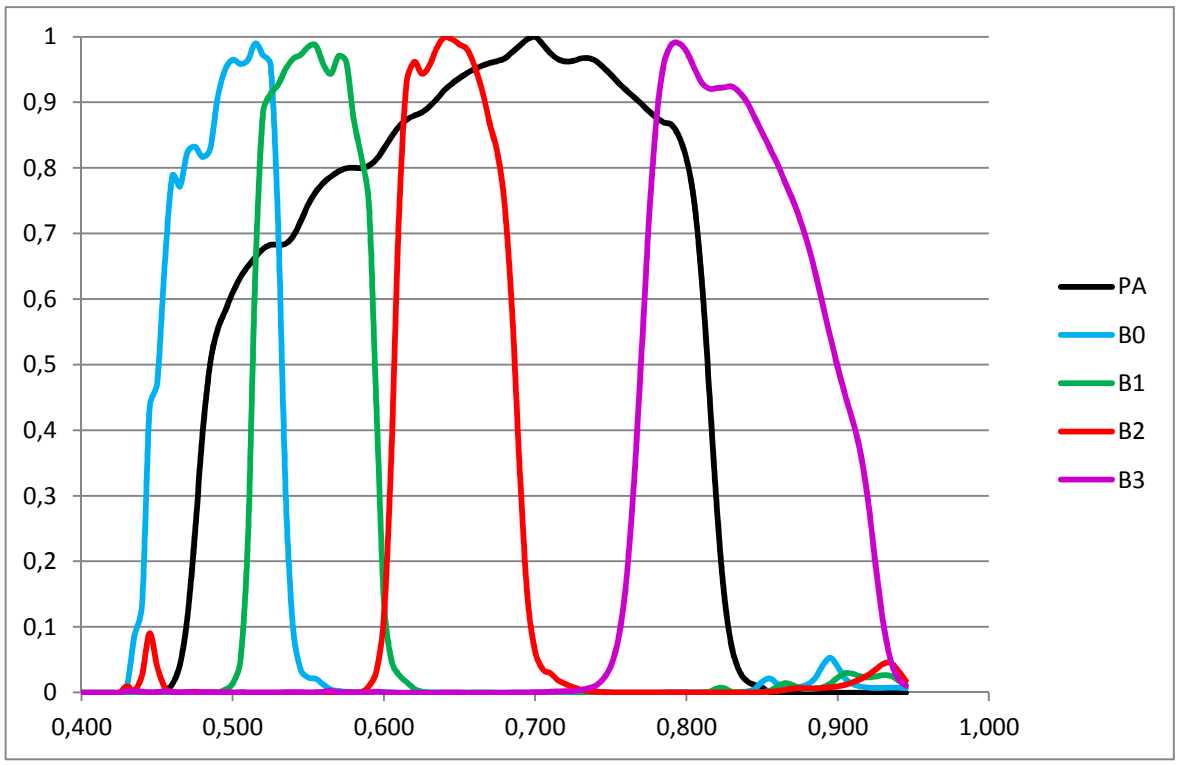
To take into account the spectral sensitivity of the sensors (see next paragraph), an “equivalent” spectral radiance will be computed:

$$L_{eq}(b) = \frac{\int L_b . S_b(\lambda) . d\lambda}{\int S_b(\lambda) . d\lambda}$$

A.4 Spectral sensitivity of the Pléiades sensors

Any sensor is sensitive to all wavelengths of the electromagnetic spectrum. For each band, the sensor has a characteristic response curve as a function of wavelength.

The spectral normalized sensitivities of the Pléiades sensors are represented on the following figure:



SPECTRAL NORMALIZED SENSITIVITIES OF THE PLÉIADES SENSORS.

The min and max sensitivities given for spectral band range are asset with a rejection at 1/100.

The updated radiometric calibration coefficients are located with the DIM metadata file delivered with all Pléiades 1A imagery. They are located here: Dimap_Document > Radiometric_Data > Radiometric_Calibration > Instrument_Calibration >Band_Measurement > Band_Radiance > Gain.