

LAB EXERCISE NO. 04**DUE DATE: 9/29/2015****Total Points: 5****TOPIC: Thermal Remote Sensing**

Instructions: In the previous lab exercises, you have computed per-pixel TOA reflectance values from an L5 image and then performed atmospheric correction via Dark object subtraction, as well as radiative transfer-based methods such as 5S and 6S. Now we turn the thermal band, i.e., band 6 with digital numbers (DN) values to at-sensor radiance and then to effective at-sensor brightness temperature (Kelvin).

Methods – Conversion to at-sensor spectral radiance

1. Here, follow the same procedure you used to convert DN to Radiance as in Lab 2 using information listed in the .MTL file and the Landsat review paper (Chander et al. 2009), specific to Band 6 for Landsat 5, Thematic Mapper (TM).
2. The formula to convert at-sensor radiance to at-sensor brightness temperature is:

$$\frac{K2}{LN\left(\frac{K1 * \epsilon}{L_{\lambda}} + 1\right)}$$

Where, T= Effective at-sensor brightness temperature [K]

K2= Calibration constant 2 [K] = 1260.56 for L5

K1= Calibration constant 1 [W/(m² sr μm)] 607.76

L_λ= Spectral radiance at the sensor's aperture [W/(m² sr μm)]

Ln= Natural logarithm

ε is emissivity (typically 0.95)

Note: The calibration values specified here are for only for Landsat 5. For L7, look up Chander et al, 2009 or look up Landsat 8 handbook.

3. Convert Kelvin to Celsius by subtracting 273.15
°C= K-273.15
4. Create representative AOI's for different Land cover/land use (LCLU) like forest, wetland, agriculture, and urban and save them with appropriate file names. Use same AOIs and extract statistics from TOA or Surface reflectance image (using DOS or 5S/6S) and compare with statistics from thermal image °C values after entering them in to an excel worksheet.
5. You could also using use the 'inquire cursor', and geo-link two viewers with reflectance image in one and thermal in the other. Use the cross-hairs to pick out the values of reflectance data for aforesaid LCLU's vs thermal band °C values.

Reference:

Chander G, Markham BL, Helder DL (2009) Summary of current radiometric calibration coefficients for Landsat MSS, TM, ETM+, and EO-1 ALI sensors. *Remote Sens Environ* 113(5):893-903.