

# Generalized Mapping of Biophysical Properties

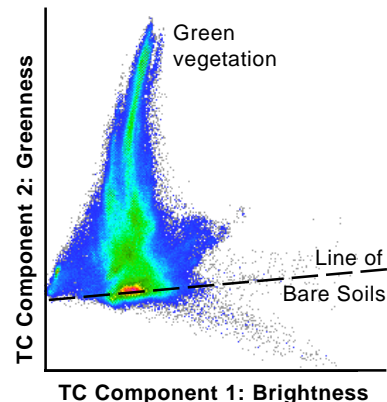
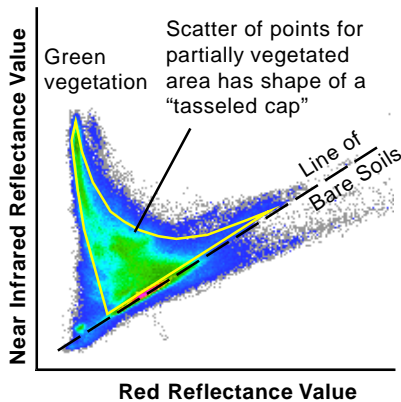
Multispectral satellite images of agricultural and range land can be used to map biophysical properties such as the surface color and moisture content of exposed and subcanopy soil, green and brown vegetation biomass, and others. Other applications include removal of the effects of unresolved intermittent grass and shrub cover to enhance the spectral mapping of exposed geological surfaces. The Tasseled Cap transformation simultaneously computes 2 or more biophysical indicators from a set of 3 or more multispectral image bands. It can therefore incorporate more information than ratio or modified ratio indices (like most vegetation indices), which use only a pair of spectral bands.



Color-infrared combination of Landsat 7 bands (corrected to calibrated surface reflectance using the SRFI script) for an agricultural area near Stockton, California. Bright red colors indicate fields with the highest green vegetation bio-mass; fields with bare soil are blue-green.



Tasseled Cap Component 2 (Greenness) for the same area computed from six bands of the SRFI-scaled Landsat 7 image. Bright tones indicate fields with the highest green vegetation biomass; fields with bare soil are dark.



2D scatterplots from the Raster Correlation tool for a Landsat 7 image of an agricultural area near Stockton, California (larger area surrounding the image excerpts shown above). Left, plot of near-infrared versus red reflectance calibrated with the SRFI script. Right, plot of Tasseled Cap component 2 (Greenness) versus component 1 (Brightness) computed using the default parameters in Method 2 of the TASCAP script. After this coordinate transformation, the line of bare soils is nearly parallel to the Brightness axis, and trajectories of increasing vegetation cover toward the peak are nearly parallel to the Greenness axis.

The set of spectral values for each cell in a multispectral image locate a point in a spectral space defined by an orthogonal coordinate axis for each image band. In the Tasseled Cap transformation, cell values are projected to a new spectral space with a rotated set of orthogonal coordinate axes (components) that are better aligned to trends in the data created by variations in biophysical properties. Most implementations apply the Tasseled Cap transformation to raw, uncalibrated multispectral images to automatically produce 4 new transformed images of soil Brightness, vegetation Greenness, soil surface Wetness, and Yellowness due to senescent vegetation and haze. The transformation coefficients used in these traditional Tas-

seled Cap applications are not dependent on the scene characteristics, but instead are determined solely by the imaging device.

Dr. Jack F. Paris has adapted the Tasseled Cap transformation to multispectral images previously calibrated to reflectance using the SRFI script (see the color plate entitled *Scripts by Jack: Calibrate Satellite Images to Surface Reflectance*). In this enhanced transformation, which is implemented in the TASCAP geospatial script, the transformation coefficients are independent of the imaging sensor. Applying the transformation to reflectance-calibrated multispectral images provides better, more consistent results than with raw image data. The script and the underlying concepts are documented in Part F of *FAQs by Jack™*.

Three methods of applying the Tasseled Cap transformation are provided in the TASCAP script. Method 1 uses coefficients developed by the U.S. Geological Survey and can be applied to six bands of Landsat Thematic Mapper (TM) or Enhanced Thematic Mapper (ETM+) images calibrated to top-of-atmosphere SRFI values. It produces the standard components described above.

Method 2 can be applied to scaled surface reflectance images from TM, ETM+, or any four-band imager (with blue, green, red, and near-infrared bands). This method uses default reflectance values to compute transformation coefficients, allows you to choose from 4 to 6 input bands, and produces the standard set of output components.

The third method provides the greatest flexibility. It can be applied to any SRFI-calibrated images from any sensor that has at least three spectral bands. Transformation coefficients are derived from the spectral values of specific biophysical materials that you identify by their line-column location in the image. You can therefore tailor the transformation to provide indices for the particular surface materials of interest to you.

Dr. Jack F. Paris, a private remote-sensing and geospatial consultant/coach, has developed a collection of advanced, model, geospatial **Scripts by Jack™** and associated documentation called **FAQs by Jack™**. These scripts are in the public domain and can be used and modified as desired. For access to the scripts and FAQs, more information, and contact with Jack, go to: [www.microimages.com/freestuf/ScriptsByJack.htm](http://www.microimages.com/freestuf/ScriptsByJack.htm)