Scripts by Jack™

Calibrate Satellite Images to Surface Reflectance

Several of the geospatial *Scripts by Jack™* deal with calibration of multispectral satellite images (see the color plate entitled *Scripts by Jack: Calibrating Multispectral Satellite Images*). The SRFI script processes each spectral band of a multispectral image to produce a new, calibrated set of image bands with Standardized Reflectance Factor Index (SRFI) values. SRFI values are scaled integer reflectance values equal to the Standardized Reflectance Factor (in %) times 100. On this scale, 100% reflectance is equivalent to a SRFI value of 10,000. The script can adjust image bands from various sensors (currently including QuickBird2, IKONOS 2, ASTER, Landsat 7 ETM+, and Landsat 4-5 TM) to a consistent, calibrated reflectance scale that represents a consistent biophysical property of the surface. These adjustments are important in producing accurate band ratio indices (such as a vegetation index) for a single scene and in comparing scenes from multiple dates and sensors.

Three options in the SRFI script provide progressive, cumulative adjustments. **Option 1** applies sensor gain and offset values to convert raw image values to calibrated radiance, then uses the solar elevation angle to compute reflectance at the top of the atmosphere. **Option 2** corrects the top-of-atmosphere values for the additive, band-dependent effects of atmospheric path reflectance (haze). Path reflectance values are computed empirically from band histograms and a power-law model of the dependence of haze on wavelength. **Option 3** corrects for band-dependent atmospheric attenuation (absorption) effects to compute the scaled reflectance of the surface materials. This option also computes Perpendicular Vegetation Index (PVI) and Perpendicular Brightness Index (PBI) raster objects that can be used in diagnostic analysis of the image (such as with the DIAG script described in the color plate entitled *Scripts by Jack: Mapping Dense Vegetation and Bare Soils*).

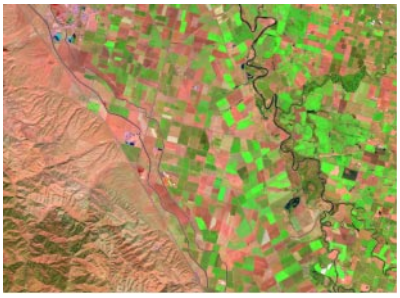
The SRFI script is amply documented with over 60 pages in two sections of *FAQs by Jack™*. The conceptual background for the SRFI adjustments is provided in Part A, and the application of these concepts in the script is covered in Part B.

Sample SRFI script results with Landsat 7 data

"Natural Color" Display RGB = Band 3, Band 2, Band 1	False Color Display RGB = Band 7, Band 4, Band 2
	

SRFI Option 1: Scaled reflectance at top of atmosphere. Atmospheric haze and attenuation remain and affect the overall image brightness. Band-by-band differences in these effects also alter the color-balance of these RGB images.


SRFI Option 2: Scaled reflectance corrected for atmospheric path reflectance. Haze is removed, but remaining atmospheric attenuation effects make images too dark and too red.

SRFI Option 3: Scaled reflectance of Earth surface materials with all atmospheric effects (path reflectance and atmospheric attenuation) removed. Remaining brightness variations due to varying slope angles and directions in hilly areas can be corrected using the TERCOR geospatial script (see the color plate entitled *Scripts by Jack: Correct for Terrain Induced Radiance Effects*).

Cell values in SRFI-calibrated bands are scaled integers equal to reflectance factor (in %) times 100. The DataTip to the left for a cell in a field with a full crop canopy shows a reflectance value of 48.1% in the Red color component (near-infrared image band), 1.15% in the Green component (red image band) and 3.44% in the Blue component (green image band).

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**

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