Glossary of remote sensing and image processing terms

Version 1.0

A

affine transform: method of defining the relationship between pixels and a ground coordinate system

agility: ability of a remote sensing platform to change position, including positioning itself over a target, remaining in the target area, or slewing across the target area.

Anderson scheme: land cover/land use classification scheme developed the US Geological Survey particularly for use with remotely sensed imagery.

annulus: the area bounded by two concentric circles, often used to determine a neighborhood for statistical calculations.

anthropogenic: Caused by or resulting from human activity.

arcsecond (as “arc second”): The distance traversed on the Earth's surface while traveling 1/3600th of a degree of latitude or longitude.

aspect: the downslope direction of the maximum rate of change in value from each cell to its neighbors

B

band: The information stored in one raster, often recording a specific bandwidth of the electromagnetic spectrum. An image may be composed of one or more bands.

basemap: a collection of orthorectified imagery or vector data used as the background for a map.

bathymetry: The science of measuring and charting the depths of water bodies to determine the topography of a lake bed or seafloor.

bispectral plot: graph where two bands are plotted simultaneously, with one band on the x axis and the other on the y axis, used to evaluate the linkage between the variation in the image and the ground.

block adjustment: A technique used in photogrammetry to align and accurately georeference satellite images or aerial photographs of an area or a project (i.e. a block). The process produces the best statistical fit between images, for the whole contiguous block, minimizing errors with the ground control.

breakline: linear feature that defines and controls the smoothness and continuity of a surface.

C

classification scheme: A set of class categories to which image pixels or objects will be assigned. Appropriate classification schemes depend on the type of sensors utilized, their resolution, feature types of interest and the biome or landcover / land use imaged.

classification: The computational process of assigning pixels or objects into a set of categories, or classes, having common spectral, shape, elevation or other definable characteristics.

collection characteristics: Attributes describing how imagery was collected, including spectral, radiometric, spatial, and temporal resolutions, viewing angle, and extent.

color (image element): characteristic of an object of interest derived from combinations of the red, green, and blue spectral bands of imagery, used to help identify the object

color balancing: A technique used to adjust the color rendition between images to make transitions from one image to an adjoining image appear seamless.

compression: The process of reducing the size of a file or database. Compression can improve data handling, storage, and database performance. See also lossy compression, lossless compression.

context (image element): the neighbors of an object of interest, used to help identify the object

convolution filter: a function applied to the pixel values in an image used for sharpening, blurring, detecting edges, or other kernel-based image enhancements.

crosswalk: table illustrating equivalent categories in two or more classification schemes

D

date (image element): the date and time an image was acquired, used to help identify an object of interest

datum: defines the origin and orientation of lines of latitude and longitude, providing a frame of reference for measuring location on the earth's surface.

dendrogram: diagram with a tree-like structure representing hierarchical clustering

derivative bands: the result of processing imagery to create transformed bands containing information or characteristics different from the original bands

digital ortho quarter-quad (DOQQ): 1-meter resolution aerial photograph that has been orthorectified to remove image displacements, resulting in map-level accuracy; covers an area of 3.75 minutes longitude by 3.75 minutes latitude.

discrete cosine transform: Method of lossy compression; used by JPEG format, for example.

divergence analysis: statistical technique used to determine which bands to use for creating the best thematic map for a given mapping project

drone imagery: Still Images and video gathered from sensors mounted on remotely piloted vehicles. Drones are also known as unmanned aerial vehicles (UAV) or unmanned aerial systems (UAS).

dynamic image service: Provides access to a mosaic dataset or mosaic dataset layer through a web service. Among other advantages, a dynamic image service allows the user to dynamically create, serve, and analyze mosaics from the original imagery without precomputing them. See also image service.

E

electromagnetic energy: Energy (like that emitted from the sun) that moves through space at the speed of light at different wavelengths. Types of electromagnetic radiation include gamma, x, ultraviolet, visible, infrared, microwave, and radio.

ellipsoid height: distance above the reference ellipsoid used to approximate the earth's surface.

error matrix: table used to determine thematic map accuracy by comparing the map classification with reference data

extent: The minimum bounding area of a map or raster. All source data fall within this boundary.

F

fall off: the reduction of brightness at the edges of an image compared to its center.

feature space analysis: plot of an entire image dataset used to determine the degree of between-band correlation; similar to a bispectral plot

float: numerical data type that does not have a set number of digits before and after the decimal point

flow accumulation: The number of cells (weighted or not) flowing into each downslope cell in a raster. Can be used to identify stream channels and local topographic highs.

footprint: The extent of each image or raster dataset. A mosaic dataset or image service contains footprints of all the images comprising the mosaic dataset or service. The footprint can be limited to only valid raster data in some cases.

function chain: An ordered list of functions applied to a raster or mosaic dataset that are performed as the data is accessed.

G

Gamma: The degree of contrast between the midlevel gray values of a raster dataset (it does not affect the black or white values). By applying a gamma correction, you can control the overall brightness of a raster dataset, as well as the ratios of red to green to blue.

geoid: an approximation of the earth's surface using mean sea level

geoprocessing service: Geoprocessing services take data captured in a web application, process it, and return the resulting output in the form of features, maps, reports, and files.

georeferencing: Aligning geographic data to a known coordinate system so it can be viewed, queried, and analyzed with other geographic data. Georeferencing may involve shifting, rotating, scaling, skewing, and in some cases warping, rubber sheeting, or orthorectifying the data.

GeoTIFF: A Tagged Image File Format (TIFF) with spatial reference information.

Global Positioning System (GPS): A system of radio-emitting and -receiving satellites used for determining positions on the earth. The orbiting satellites transmit signals that allow a GPS receiver anywhere on earth to calculate its own location through trilateration. Developed and operated by the U.S. Department of Defense, the system is used in navigation, mapping, surveying, and other applications in which precise positioning is necessary.

H

height (image element): distance between the highest and lowest points of an object of interest, used to help identify the object

histogram: A graph showing the distribution of values in a set of data. Individual values are displayed along a horizontal axis, and the frequency of their occurrence is displayed along a vertical axis.

I

image elements: all the characteristics of an image, including its tone/color, shape, size, pattern, shadow, texture, location, context, height, and date

image filter: On a raster, an analysis boundary or processing window within which cell values affect calculations and outside which they do not. Filters are used mainly in cell-based analysis where the value of a center cell is changed to the mean, the sum, or some other function of all cell values inside the filter. A filter moves systematically across a raster until each cell has been processed. Filters can be of various shapes and sizes, but three-cell by three-cell squares are common.

image service: A service that provides access to a raster dataset or a raster dataset layer through the web. The data can be shared as part of a document, such as a map or globe document, or as part of other services, such as a geodata service. See also dynamic image service.

image statistics: Statistics that are calculated from the cell values of each band in a raster, including the minimum, maximum, mean, and standard deviation cell values, and if the dataset is thematic, the number of classes. Statistics are required for some rendering and geoprocessing operations.

image stretch: A display technique applied to the histogram of raster datasets, most often used to increase the visual contrast between cells.

imaging surface: A device that measures the electromagnetic energy captured by digital sensors. Often referred to as the focal plane.

index: a ratio of original bands, sometimes with other factors or coefficients included

inertial measurement unit: a device that measures the linear acceleration and angular velocity of a body, used in the precise navigation of airborne vehicles

insolation: the amount of solar radiation received by an area over a given period of time

J

JPEG: (1) file format for digital imagery, (2) method of lossy compression for digital imagery

K

Kappa technique: statistic representing map accuracy that can be used to test whether two error matrices (and therefore maps) have a statistically significant difference from one another

key: An attribute or set of attributes in a database that uniquely identifies each record.

L

Landsat: Multispectral, earth-orbiting satellites developed by NASA (National Aeronautics and Space Administration) that gather imagery for land-use inventory, geological and mineralogical exploration, crop and forestry assessment, and cartography.

LERC: Limited Error Raster Compression. An open-source image or raster compression method which supports rapid encoding and decoding. Users set the maximum compression error per pixel while encoding, so the precision of the original input image is preserved within user defined error bounds.

lidar: (light detection and ranging) an active optical remote-sensing technique that uses laser light to densely sample the surface of the earth, producing highly accurate x,y,z measurements

location (image element): the x, y, and z coordinates of an object of interest, used to help identify the object.

lossless compression: Data compression that has the ability to store data without changing any of the values, but is only able to compress the data at a low ratio (typically 2:1 or 3:1). In GIS, lossless compression is often used to compress raster data when the pixel values of the raster will be used for analysis or deriving other data products. See also lossy compression, LERC.

lossy compression: Data compression that provides high compression ratios (for example 10:1 to 100:1), but does not retain all the information in the data. In GIS, lossy compression is used to compress raster datasets that will be used as background images, but is not suitable for raster datasets used for analysis or deriving other data products. See also lossless compression, LERC.

lossy compression: type of data compression that provides much smaller file sizes than lossless compression, but results in some loss of image data.

M

map accuracy: The degree to which a value on the map conforms to true or accepted values measured on the ground. Accuracy is a measure of correctness. It is distinguished from precision, which measures exactness.

map precision: The closeness of a repeated set of observations of the same quantity to one another. Precision is a measure of the control over random error.

mapping key: see classification scheme

Margfit technique: method of analyzing an error matrix's accuracy that uses an iterative proportional fitting routine to normalize the error matrix so that it can be directly compared to another error matrix regardless of the number of samples used to create the matrix

mensuration: applying geometric rules to find the length of a line, area of a surface, or volume of an objectusing the information obtained from lines and angles

minimum mapping unit: the smallest item to be identified on the ground; determines the required spatial resolution for a mapping project

MIXED: common file format for cached tiles

mosaic dataset: In ArcGIS, a data model within a geodatabase used to manage collections of raster datasets stored as a catalog and viewed as a single mosaicked image or individual images.

multitemporal: characteristic of a collection of rasters or other features that have multiple time or date stamps

MXD: file extension for a map document used by ArcGIS

N

nadir: In aerial photography or satellite imagery, the point on the ground vertically beneath the perspective center of the camera lens or scanner's detectors.

near infrared: band of the electromagnetic spectrum from about 700 nm to 2500 nm

NoData: pixels without data, often represented by a value that is not valid elsewhere in the dataset

nonparametric: describing statistics that do not make assumptions about variables' probability distributions.

O

occlusion: The phenomenon in which, due to viewing angle, one object blocks another object from view in an image.

off-nadir angle: the angle between the nadir and the ray of light between the sensor and the vertical object.

off-nadir view: The view of any object not directly beneath a scanner's detectors or camera lens, but rather off at an angle; results in relief displacement.

on-demand caching: A feature that allows you to set up a tiling scheme and publish an image service, but only generate the cache when and where a user accesses the service. The tiles are drawn by the server when an initial user navigates to an un-cached area, then added to the service's cache folder (where they remain on until updated or deleted by the server administrator).

ordination: a type of multivariate statistical analysis used in community ecology that orders species along gradients.

ortho: see orthophotography

orthocorrected: see orthorectification

orthogonal: uncorrelated or independent

orthoimage: see orthophotography.

orthometric height: distance above an approximation of the earth's surface called a geoid.

ortho-mosaic: georeferenced image product mosaicked from an image collection, where the geometric distortion has been corrected and orthorectified

orthophotography: Aerial photography from which distortions owing to camera orientation and ground relief have been removed. An orthophoto has the same scale throughout and can be used as a map.

orthorectification: Process by which imagery is geometrically corrected so that coordinates in the imagery accurately represent coordinates on the ground.

overall accuracy: the most common measure of a map's accuracy; sums the major diagonal of the error matrix and divides by the total number of samples

P

pan sharpening (as "pan-sharpening"): A radiometric transformation in which a higher-resolution panchromatic image is fused with a lower-resolution multiband raster dataset. It is used to increase spatial resolution and better visualize a multiband image.

parallax: The apparent displacement of the position of an object relative to a reference point due to a change in the point of observation; used to create stereo imagery.

parallelepiped: an algorithm used to label unknown pixels in an image based on training statistics that uses minimum and maximum values as a surrogate for variance

pattern (image element): the spatial arrangement or configuration of objects, used to identify an object of interest.

phenology: the study of the seasonal cycles of plants, animals, and climate.

pixel value: Digital number (DN) representing information stored in one pixel (or cell) of a raster. The area summarized by one pixel value is determined by the spatial resolution of the imagery.

pixel: In remote sensing, the fundamental unit of data collection. A pixel is represented in a remotely sensed image as a cell in an array of data values.

platform: The vehicle that supports and transports sensors that gather remote sensing data.

PNG: Acronym for Portable Network Graphics. A bitmapped graphics format similar to GIF.

positional accuracy: whether objects on a map are in the correct place

principal component analysis: A data transformation method that rotates the axes of the input bands to a new multivariate attribute space in which the axes are uncorrelated. The main reason to transform the data in a principal component analysis is to compress data by eliminating redundancy.

processing template: A function chain in which the user uses a raster variable in place of a specific dataset so that it can be applied to similar datasets. Used to generate on-the-fly information layers.

pyramid: Reduced-resolution datasets stored with imagery that are used to read and display imagery at lower resolutions.

Q

quad: see digital ortho quarter-quad

R

radar: Acronym for radio detection and ranging. A device or system that detects surface features on the earth by bouncing radio waves off them and measuring the energy reflected back.

radiometric resolution: Describes the ability of a sensor to distinguish objects viewed in the same part of the electromagnetic spectrum. It is often represented by the bit depth, or sensitivity, of the sensor. Typical sensors have 8bit, 11bit 12bit or 16bit depth per band; the higher the bit depth the higher the sensitivity and radiometric resolution of the sensor.

raster function: Defines processing operations that can be applied to one or more rasters on the fly as the data is accessed and viewed, speeding up processing time. See also function chains.

raster: Matrix of cells (or pixels) organized into row and columns where each cell contains a value representing information.

ratio bands: a derivative band generated by dividing one original band by another

reference data: A baseline dataset used to compare to processed data to assess accuracy of results. It is primarily used to assess geopositional or feature classification accuracy, and is often verified with ground surveying.

reprojection: The mathematical conversion of a map or raster from one projected coordinate system to another, generally used to integrate maps from two or more projected coordinate systems into a GIS.

resolving power: the amount of detail the sensor can capture in each image, determined by the combination of the sensor's lens and the resolution of the imaging surface

REST API: An interface that simplifies interactions between GIS applications and ArcGIS for Server services. The REST API allows a user to consume ready-to-use ArcGIS Online services hosted by Esri; consume services published by you or by other organizations; publish your own web services; create and share items on ArcGIS Online or your own portal; and configure and automate parts of the ArcGIS system, such as ArcGIS for Server and Portal for ArcGIS.

S

sampling: (1) the spatial resolution of data gathered by a sensor, which determines pixel size. (2) the selection of a subset of data or pixels

satellite imagery: data collected by sensors on satellite platforms, often of the earth

scale: The ratio or relationship between a distance or area on a map and the corresponding distance or area on the ground, commonly expressed as a fraction or ratio. A map scale of 1/100,000 or 1:100,000 means that one unit of measure on the map equals 100,000 of the same unit on the earth.

seamline: A polygon or polyline that defines the mosaic boundary between adjoining rasters. Overlapping rasters can be blended along the seamline by a specified width.

sensor: An electronic device for detecting electromagnetic energy and converting it into a signal that can be recorded as numbers and displayed as an image.

shadow (image element): the consequence when the the sensor's ability to capture reflectance or radiance of a feature on the ground is hindered by another feature; used to help identify objects of interest

shape (image element): the form of the outline of an object of interest, used to help identify the object

size (image element): the extent of an object of interest, used to help identify the object

slope: The incline, or steepness, of a surface, measured in degrees from horizontal (0–90), or percent slope (the rise divided by the run, multiplied by 100). The slope of a TIN face is the steepest downhill slope of a plane defined by the face; the slope for a cell in a raster is the steepest slope of a plane defined by the cell and its eight surrounding neighbors.

solar insolation: Incoming radiation received from the sun—a driving force of many of the earth's physical and natural processes. Knowledge of the amount of insolation at specific geographic locations is helpful for application in many diverse fields such as agriculture, resource management, meteorology, civil engineering, and ecological research.

spatial pattern analysis: The identification and quantification of geographic patterns to better understand how geographic phenomena behave and to make it easier to compare patterns for different distributions or time periods.

spatial resolution: The dimensions of the area on the ground represented by a single cell in a raster. The spatial resolution (e.g. cell size) affects the level of detail represented in an image.

spectral resolution: The range of wavelengths that an imaging system can detect, including both the number of bands and the wavelength range detected by each band.

stability: the ability of a sensor to resist changes in position

T

Tasseled Cap Transformation: Also known as the Kauth-Thomas transformation; designed to analyze and map vegetation and urban development changes detected by various satellite sensor systems. It uses principle component analysis to yield transformed bands commonly defined as brightness, greenness and wetness.

temporal resolution: The frequency at which images are captured over the same location on the earth's surface.

texture (image element): the feel or appearance of the surface of an object of interest, used to help identify the object

thematic accuracy: whether an object has been given the correct label on a map

tile cache service: highly compressed, preprocessed imagery delivered from servers to applications and end users, used primarily for providing background imagery and unsuitable for analysis

tiling scheme: Describes how clients should reference the tiles in a cache. The tiling scheme maps between the spatial reference of the source map document and the tiling grid. It also defines the scale levels at which the cache has tiles, the size of the tiles in pixels, and the screen resolution for which the tiles are intended to be displayed.

tiling: The internal subsetting of a spatial dataset, especially a raster, typically used to process or analyze a large dataset without consuming vast quantities of computer memory.

tone (image element): characteristic of an object of interest derived from the intensity of spectral response in each band of an image, used to help identify the object

topography: The study and mapping of land surfaces, including relief (relative positions and elevations) and the position of natural and constructed features.

transform: A function that takes an image as input and generates an image as output.

transformed band: the result of applying a function to a band

U

UAS: Unmanned aerial system. Refers to the components of a remotely piloted image acquisition system. This include the airborne platform, imaging sensor, airborne GPS and inertial measurement unit, and communication method and protocols such as broadband transmission of commands and data.

UAV: Unmanned aerial vehicle; an airborne drone with sensor.

V

vegetation alliance: A lower-level unit in the National Vegetation Classification Standard that identifies ranges with similar species composition and abundance.

visualization imagery: imagery used in a map to help the user understand the context of a location

W

wavelet transform: Method of lossy compression; used by JPEG 2000, for example.

web map (as “webmap”): interactive, shareable display of geographic information accessed online.

web service: A software component accessible over the internet for use in other applications. Web services are built using industry standards such as XML and SOAP, and thus are not dependent on any particular operating system or programming language, allowing access to them through a wide range of applications.

X

xeric: needing very little moisture, as in drought-tolerant plants

Y

Z