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ERS 186 Study Question Set # 3

Due Start of Class, Tuesday May 15, 2008

20 points

KEY

1. What is the difference between multispectral, hyperspectral, and hyperspatial data? What do you think hypertemporal data should be like? Give an example of a good application for each.

Multispectral remote sensor data is measured in multiple discrete wavelength regions (bands) of the electromagnetic spectrum. Multispectral data (such as data collected by the Landsat sensors) is often more informative than single broadband panchromatic type imagery because you can extract both biophysical and land-cover information from the imagery. Perhaps most commonly, satellite multispectral data is used for land cover change detection.

Hyperspectral remote sensing data is recorded in hundreds of bands sampled at close intervals to allow the construction of spectra that resemble those measured by laboratory spectrometers. Hyperspectral remote sensing data is most applicable when there is a need to resolve narrow spectral differences that are not resolvable with the relatively large bandwidths provided by multispectral data. Applications usually involve direct identification of specific materials based upon their reflectance characteristics, including minerals, atmospheric gases, vegetation, snow and ice, and water quality constituents.

Hyperspatial remote sensing data has very small pixels sizes (in the case of optical remote sensing), or more generally, very high spatial resolution. It is often defined as having a spatial resolution smaller than the object of interest. Quickbird and LiDAR data are commonly used in hyperspatial remote sensing applications that conduct tree and forest inventories, or study tree structure.

Hypertemporal remote sensor data should obtain many images of an object, at a high enough temporal resolution (e.g. very frequently) to be able to observe the phenomenon through time and investigate the underlying processes at work. Hypertemporal data should, therefore, be collected at a time scale that is equal to or more frequent than phenomenon under investigation. Currently the highest temporal resolution (~30 min.) data being collected is from weather satellites to monitor and track storm events globally.

2. You see a lineament (linear feature) across an image (along the inner coast range foothills). You notice that the geologic formations change at this boundary. What type of land form is this and what might be a reason for mapping it?

A lineament in imagery indicates a rock fracture. It may be a joint, which is a crack in rock along which there is no appreciable movement, or it could potentially be a fault, which involves the movement of rock bodies against one another, resulting in earthquakes. Mapping lineaments and measuring the displacement along faults are important for assessing earthquake risk.

3. Several types of river systems are described in your text and in the lecture. Describe two types of fluvial regimes and what their characteristics are?

Dendritic Drainage Pattern: the most common type, characterized by tree-like branches intersecting at primarily acute angles. Found on landforms composed of relatively homogenous, horizontally bedded sedimentary rock, glacial till, volcanic tuff, sandy coastal plains, tidal marshes, or glaciated outwash plains.
Pinnate Drainage: variation of dendritic patterns with featherlike branching. Indicative of high silt content landforms composed of loess, silty alluvium, or highly erodable sedimentary materials.
Trellis Drainage: Modified dendritic pattern with straight, parallel primary tributaries that join at right angles. Indicative of folded, faulted, or titled bedrock. Common in regions with differentiated bedrock resistance.
Rectangular Drainage: Treelike pattern with abrupt bends in the main channels. Develop in areas where there are joints or faults in the bedrock. Occurs on metamorphic rocks, and in hard, resistant arid sandstone regions.
Parallel Drainage: Tributaries flow nearly parallel to each other, and join main channel at approx. same angle. Indicative of gentle, uniform slope, following beds in less resistant rock.
Radial and Centripetal Drainage: Water flows down/outward from a hill or dome with circular network of parallel channels. Often found on slopes of volcanic cones or in steep mountainous terrain. When water flows into an enclosed central basin, this centripetal drainage.
Annular Drainage: Similar to radial, ringlike tributaries intercept radial streams at right angles, usually around resistant domes of granite, sedimentary rock, or meteorite craters.
Dichotomic Drainage: Water and suspended sediment enter a fan or delta in a single channel and are redistributed via distributaries. Can only form on deltas when suspended sediment is fine-grained and can undergo high transport distances.
Braided Drainage: Interwinding channels looks like braided hair due to deposition of suspended material from decreased flow velocity in floodplains.
Deranged Drainage: Streams that wander in disorder in swamps. Primarily found in young landscapes with level topography and high water table. Occur in glacial till plains, moraines, low coastal plains, or floodplains. Often occur alongside swamps, marshes, bogs, lakes, and ponds.
Anastomic Drainage: Meandering streams that, due to decreased flow velocity and homogenous sediment, deposit sediment loads and increase channel length. Often found on mature floodplains, with meander scars and oxbow lakes (e.g. Mississippi River).
Sinkhole (doline) Drainage: Isolated lakes or ponds that do not appear to be connected by surface drainage. Develops in karst (limestone) dominated topography.

4. You are asked by the UCD Director of the Natural Reserves to develop a habitat map for mountain lions in Stebbins Cold Canyon Reserve (it is just east of Berryessa dam, if you don't know). You are going to do this using a GIS but first you need some remote

sensing data to populate your database. Please explain what type of satellite and data (spectral, spatial, temporal resolution) is needed and why you think this will give you a good land cover map of the reserve. You can look the reserve up online if you need help to understand its plant communities.

Reasonable answers will select data that has moderate to high spatial resolution (since the site is local), and is at least multispectral in nature in order to provide information about different vegetation communities. A multi-temporal dataset that takes advantage of different phenological stages of the oak-woodlands and grasslands will improve vegetation community classification. If a single date image is selected, it should be recently acquired.

5. What are characteristics of sensors that are appropriate for doing global land cover classification of broad ecosystem types (e.g. rainforest, temperate forest, grassland, etc…)? Give an example of a sensor used for global land cover mapping.

Sensors appropriate for global land cover classifications should have a large enough swath width to effectively cover the globe in a short period of time (to account for cloud cover, and phenological changes that occur throughout a growing season). Examples include SPOT Vegetation, MODIS, Thematic Mapper, ASTER, and AVHRR.

6. Thermokarst formations are unique to what type of ecosystem? What is the dominant feature seen in remote sensing image data?

Unique to tundra: form pitted surfaces or hummocks

7. What is the difference between global maps of land cover properties that use "continuous variables" vs. ones that define discrete variables?

Global landcover maps that use discrete variables (i.e. single land cover categories, such as vegetation, soil, snow) are often concise, and in general have low data volume, but are abstractions of real landscapes. Land cover maps of continuous properties, such a biophysical variables (e.g. albedo, leaf reflectivity or transmission, green leaf fraction) provide continuous data that are going to vary in both space and time, at both seasonal and inter-annual time scales. These maps typically have much large data volume, and may or may not be easily interpreted in terms of land cover change detection.

8. A major wildfire occurred in the mountains of the Cleveland National Forest, inland from San Diego last September. As part of a risk reduction activity, you are asked to evaluate the risk of mudslides within the burned area. You have access to SRTM and AVIRIS data of the burned area. What information would you need to estimate the potential for mudslides?

SRTM: elevation, surface roughness, vegetation cover, presence of urban areas (impermeable surfaces)

AVIRIS: soil texture type and water content, vegetation type, burned vegetation fraction, urban areas, roads

9. Rivers change course many times through geologic time. You are analyzing a Landsat image for past river channels. What types of landforms do you expect to observe?

Stream-cut valleys, floodplains, terraces, deltas, alluvial fans, pediments, and playas.

10. You wish to identify clouds in an image that also contains a lake. Please name two spectral properties of clouds that will help you identify cloud pixels.

In the visible region, clouds have high albedo, and will appear white, or brighter than water surface. In the NIR and SWIR region, clouds absorb more than water, and have blue-shifted absorption features. In thermal IR (10-12.5 µm), clouds are usually colder than the surface of the earth, and have lower radiance than a lake.