

Team Name: _____

Student Name(s): _____

Remote Sensing (C)

Nebraska Science Olympiad

Regional Competition

Henry Doorly Zoo

Saturday, February 19th 2011

100 points total

Show all mathematical operations and answer all questions with complete sentences unless noted.

KEY

- 1) Synthetic-aperture radar (SAR), Light Detection And Ranging (LIDAR), and multi-spectral Radiometers (e.g. LandSat) are all different types of remote sensing platforms used in monitoring earth processes. Please compare and contrast these platform types. Provide situations where one platform may be more advantageous over another. (6pts)

SAR-Active Sensor, uses microwave or radio waves.

Adv: Can penetrate clouds, effective both day and night

LIDAR-Active Sensor, uses lasers in UV, Vis, NIR

Adv: Effective both day and night, effective for estimating aerosols

Multi-spectral Radiometers-Passive sensor

Adv: Cheaper, uses less energy, larger data sets to compare

- 2) Many remote sensing studies create land use maps (as in Figure 1). How might a researcher/scientist create such a map without physically visiting all the locations on the map? (4pts)

Supervised or unsupervised classification

- 3) In Figure 2, what is the predominant land cover in 1900? 1992? What are the likely cause(s) of this change? (6pts)

1900: Predominantly evergreen needle leaf trees.

1992: Predominantly cops/mixed farming

Caused by anthropogenic changes, clearing forest for agriculture, etc.

- 4) What is the difference(s) between the two images in Figure 3 (Use Remote Sensing terminology)? How might a remote sensing scientist produce these images? (4pts)

a) is a False Color Image, b) is a True Color Image. These are produced by assigning a layer to each color 'gun' RGB. True color images use layers that correspond to Red, Green, Blue. False Color images use bands that do not correspond to these colors. Typically NIR is substituted for Red, Red for Green, and Green for Blue; however, it does NOT have to be this assignment.

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- 5) Find the CHL concentration using this relationship for the reflectance spectral in Table 1.

1st Solve for the index

$$(R_{705} - R_{670})/R_{670} = (1.2\% - 1.1\%)/1.1 = 0.1/1.1 = 0.091$$

2nd Solve for CHL

$$y = 275.39x + 21.43 = 275.39(0.091) + 21.43 = 25.06 + 21.43 = 46.49 \mu\text{g/L} = 46 \mu\text{g/L} \text{ (correct significant figures)}$$

- 6) Using GIS methods, scientists/researchers can create maps that can assist in determining areas of interest for management decision. Using Figure 4, determine areas where forestry management teams may wish to focus their energy to prevent future fires (You may indicate on the map by circling). Why did you choose these areas? (4pts)

Primarily the NE section of the map, few areas burnt twice acceptable. Areas burnt only once are NOT acceptable.

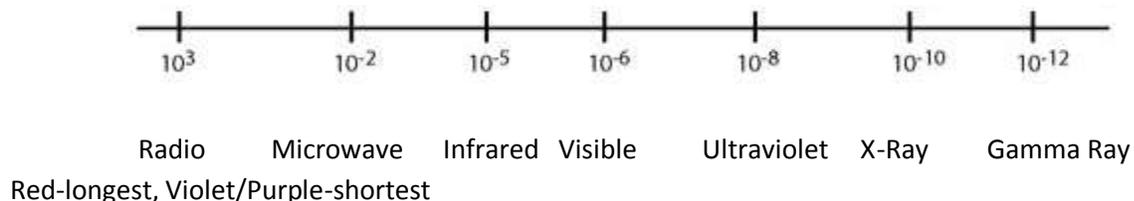
- 7) Scientists use remote sensing data to indicate areas heavily impacted by anthropogenic disturbances (Figure 5). On the global map, what areas are the most and least impacted, why? Using the regional panels, which area is the least impacted. (6pts)

Most: North Sea, Japanese Waters, Caribbean waters, Will accept areas off of India, Waters near Singapore, Vietnam, and Indonesia. Why: Most heavily fished areas or areas of high development

Least: Torres Strait, Arctic and Antarctic waters. Why: These areas are the least accessible to people

- 8) Indicated where in Figure 6 following are located (You do not have to write in complete sentences for the first part of the question): Gamma Ray, Infrared, Microwave, Radio, Ultraviolet, Visible, X-ray. What visible color has the longest waveband, shortest? (6pts)

Figure 6: Electromagnetic Spectrum: Wavelength (meters)



- 9) Referencing the electromagnetic spectrum, why are plants green? (4pts)

They are green because they reflect more green light than any other wavelength in the visible spectrum

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- 10) Compare/contrast the LandSat TM and MODIS satellite platforms. What are the advantages/disadvantages for each platform? (6pts)

Landsat TM, 7 bands all 30 m x 30 m except for band 6 (120 m x 30 m). Bands include Blue, Green, Red, 3 NIR bands, and a thermal infrared band.

MODIS, 36 bands from ~400-14,000 nm. Bands 1-2 250 m, 3-7 500m, 8-36 1000m.

Landsat has much higher spatial resolution, but lower spectral and temporal resolution. MODIS has much higher spectral and temporal resolution, but lower spatial resolution

MODIS Adv. Daily images, more useful for atmosphere and ocean researchers

Landsat Adv. Higher spatial resolution is useful for looking at features on land.

- 11) Using Figure 7, where did the Zebra mussel outbreak most likely occur? Zebra mussel DNA was recently confirmed in Electric Lake in Utah. What is the most likely method for the invasion of Electric Lake? (4pts)

Most likely occurred in the Midwest (Michigan also acceptable). Electric Lake was mostly likely infected by a boater who transported the mussels between an infected water and Electric Lake.

- 12) Explain the differences between the two maps. Why do scientists use NDVI? Pick a region on both maps and explain in detail from an ecological standpoint why an area might have a low or high NDVI (e.g. Why is Northern Africa nearly white in Figure 8b). (6pts: Part of this question will be used as a tiebreaker)

Jan image shows that the S. Hemisphere has the highest vegetation growth, while in September the N. Hemisphere has the highest vegetation growth. The second part is rather open-ended. For example N. Africa is nearly white in 8b because there is little rainfall during that time so that most vegetation is dead or in a dormant state.

- 13) Use Figure 9 to answer the following questions. You do not have to write complete sentences; however show all work and create a legible figure. If anthropogenic activity disturbs the carbon stored in the soils and 500 GtC is released into the atmosphere, calculate the final values for atmosphere, vegetation and ocean sediments if 30% is absorbed by the atmosphere, 27% by vegetation, and the remainder by ocean sediments. Draw the pathway that includes all steps for the carbon released from the soils to reach the ocean sediments (6pts).

$$\text{Atm} = (500 \text{ GtC} * .30) + 750 \text{ GtC} = 150 \text{ GtC} + 750 \text{ GtC} = 900 \text{ GtC}$$

$$\text{Veg} = (500 \text{ GtC} * .27) + 610 \text{ GtC} = 135 \text{ GtC} + 610 = 745 \text{ GtC}$$

$$\text{O. Sed.} = (500 \text{ GtC} * (1-.30-.27)) + 150 \text{ GtC} = (500 \text{ GtC} * 0.43) + 150 \text{ GtC} = 215 \text{ GtC} + 150 \text{ GtC} = 365 \text{ GtC}$$

Soils -> Atmosphere -> Surface Ocean -> Deep Ocean -> Sediments

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- 14) Explain how remote sensing data can be used to monitor human activity. Provide at least three examples. (6pts)

Pretty open-ended, acceptable to have the following: Urban Sprawl, Land Use Changes, Forest Fires, Temperatures Changes, etc.

- 15) Ignoring multipath and other errors in remote sensing data, what kind of information is gathered by passive remote sensing platforms? How is this information manipulated to provide a value comparable to data collected at a different date or by a different sensor? (6pts)

Information gathered: Radiance value from object usually in the form of a digital number. Typically this information is converted into reflectance. There are several methods on how to do this.

- 16) Using Figure 10 indicate which of the components contains unaltered data from the location of interest (black square below sensor). What are the effects of each of the other components on the raw radiance value collected by the sensor? (6pts)

Only 2 contain unaltered data from the location of interest. It does include error from light reflecting off of another surface (4). 1 provides unaltered light which can give an artificially high reading. 3 provides information from an object not of interest. 4 provides additional light, also with a signature of an object not of interest.

- 17) Calculate the total area where reflectance is greater than 80% from Table 2. You do not need to use complete sentences for this question. (4 pts)

Landsat TM pixels are 30m x 30 m

Total # of pixels >80 = 4

$4 \times 30 \text{ m} \times 30 \text{ m} = 120 \text{ m} \times 30 \text{ m} = 3600 \text{ m}^2$

- 18) Using Figure 11: High yield tends to correspond to what values for NDVI, Soil Depth? (4pts).

This question was tossed. It was realized that the figures are of poor quality and multiple interpretations could occur depending on how the students analyzed the figures.

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- 19) During the two events indicated in Figure 12, what is roughly the ocean temperature to the north of Australia? Is this temperature a departure for both graphs? If so, roughly how much? Does this correspond to the temperature along the equator in the central Pacific Ocean? (6pts)

Temperature N. of Australia is $\sim 30^{\circ}\text{C}$

Either no departure or a departure of $0.5\text{-}1^{\circ}\text{C}$ is acceptable.

No this does not correspond.