# Remote Sensing (C)

Nebraska Science Olympiad
State Competition
University of Nebraska-Lincoln
Saturday, April 2nd 2011
100 points total

Show all mathematical operations and answer all questions with complete sentences unless noted. Always use significant figures. Use the separate sheet with tables/figures to answer any questions referencing them on this answer sheet.

1) Name at least three types of greenhouse gases and four sources of these gases. At least one example must be from a non-anthropogenic source. (10pts)

water vapor, carbon dioxide, methane, nitrous oxide, ozone, chlorofluorocarbons
sources: much more varied acceptable: fossil fuels, volcanic eruptions, agricultural byproduct etc.

2) Provide at least two causes for sea level rise when global temperatures rise. (6pts)

Thermal expansion of the ocean and glacial melting. Melting sea ice DOES NOT contribute to sea level rise.

3) Table 1 is a grid radiance values taken from a layer of a satellite image. Assuming the highest value is 100% reflectance and the lowest value is 0% reflectance, complete the table on your answer sheet. Provide the work solving for at least 1 number in the grid. You do not need to answer in complete sentences for this question (6pts: Part of this question will be used as a tie breaker).

| | |
|---|---|
| 0% | 47% |
| 7.9% | 17% |
| 74% | 100% |

(Number – Min)/(Max - Min)*100
Example: (123 – 34)/(223-34)*100 = 89/189*100 = 47%

4) What is the difference between active and passive sensors? Provide at least 1 example of each type (6pts).

Active – emits energy and collect reflectance, fluorescence or scattering off of subject of interest (e.g. Lidar)
Passive – uses energy either reflected, scattered or emitted from object of interest (e.g. LandSat, MODIS)

5) In a LandSat 7 image, which bands would be used for a true color and false color image? Indicate which band would represent which color for both images. (6pts)

In order of Red, Green, Blue
True: 3,2,1
False: Any combination except 3,2,1; however, the most common is 4,3,2

6) NDVI is defined in Eq. 1. Calculate NDVI from the spectral response of a pixel in Table 2. You do not need to answer in complete sentences for the question. Part of this question will be used as a tiebreaker (6pts)

Eq. 1: (NIR-Red)/(NIR+Red)

MODIS bands for NIR is 2 and Red is 1
(48.0-4.7)/(48.0+4.7) = 43.3/52.7 = 0.82

7) Using Fig. 1, near what other land cover type is agriculture typically found? Which land cover type has grown the most between 1973 and 1997? Second largest growth? Which land cover type has shrunk the most over this watershed? Between which images did the most change occur? (10pts)

Water or Riparian is acceptable
Mesquite Woodland
Urban
Desertscrub

8) Which satellite platform(s) is/are least sensitive to cloud cover? Why? (4pts)

Synthetic aperture radar (SAR) is the only type that can definitely penetrate heavy cloud cover. LiDAR has some bands that are less susceptible if the energy output is high enough; however, it is generally not a feasible approach.

9) Using Fig 2., as of 2004, where is most of the Hemlock Wooly Aphid infestations currently located? If we assume that this species needs the presence of Hemlock to spread within 5 counties, are any regions currently safe from infestation? Provide a scientifically sound reason why there are isolated infections of the Hemlock Wooly Aphid (e.g. infected county surrounded by uninfected Hemlock). (6pts)

Eastern USA, Eastern Application Mountains
No regions are safe using this criteria
Anthropogenic or animal-based transport of the aphids (although anthropogenic are more likely).

10) Using Fig 3., what process in the hydrologic cycle individually involves the largest volume of water? As global warming increases the surface temperature of the earth, it will increase evaporation and transpiration rates. What must happen to balance out this increase? (6pts)

Evaporation of ocean water
Increased precipitation rates

11) If global $CO_2$ increases but temperatures do not change, what will have to a plant's transpiration rate? If $CO_2$ is stable, but global temperature increases, what will have to a plant's transpiration rate? (4pts)

Transpiration rates will decrease with CO2 increase
Transpiration rates will increase with temperature increases

12) Using Fig 4., where in the USA is fire potential the highest on 8/6/08? Why does this area have a higher risk potential? Why might the USFS not provide a fire potential for agricultural areas (e.g. Most of IL, IN etc.) (6pts)

Nevada and the other western mountain states.
Without ancillary data is difficult to know for sure why; however, it is most likely due to reduced rainfail in mountain regions and warm summer temperatures.
a) Some of these areas are irrigated which reduces the accuracy of the models, b) these areas are heavily managed, thus reducing the likelihood of a fire.

13) Using Fig. 5, why is the reflectance of water essentially zero around 0.8 μm? At this same region healthy vegetation has high reflectance, what are some reasons that a healthy plant will reflect more in this region over the red region ~0.67 μm. (6pts)

Water absorbs most energy at wavebands > 0.8 μm.
Plants scatter light in the NIR to minimize heating the plant in regions that are not useful for photosynthesis
The red region is photosynthetically active; thus the plant absorbs light to produce sugars.

14) Using Fig. 6 and Fig 7, is Europe most likely experiencing a heat or cold wave in July of 2003? Approximately what is the difference between 2003 and the averaged 1982-1998. (Hint 273K = 0 °C). Are there any other areas with extreme differences between the two figures, if so, what are they and in which direction is the difference. Part of this question will be a tie breaker. (8 pts)

Averages 12-32°C
July 2003 15-45°C
So Europe is in a heat wave
3°C-13°C acceptable
Any area generally accepted as long as it was justified and the range matches

15) Subsidence is the process of which earth settles to a lower elevation. Fig. 8 and Fig. 9 demonstrate subsidence located near several mine shafts (indicated by the red and white lines). Why might managers of mining operations be interested in figures such as these? How many areas are affected on 8/14/07, 12/30/07? In units of area, how much as the largest subsidence grown from these two dates. You may approximate by estimating each area as a known polygon (please indicate which polygon utilized to ensure accurate grading). (8 pts)

    They are interested because this is an indication that mining shafts may collapse. The also cause structural damage to buildings, thus need to be mitigated
    8/14/07 2 areas; 12/30/07 3 areas. ~1.2km^2 = 1.2e10^6 (For the image printed it was ~2.75 cm^2; however, this could change a bit based on how the test document is printed, therefore the correct units should be that of the map [meters]).

16) Due to the devastation of natural disasters, such as the one in Japan on March 11$^{th}$, 2011, there is a rush to capture and develop before and after images, such as Fig. 10. While these images can be useful to indicate areas affected by the disaster, list and describe at least 3 potential problems associated with these types of images (e.g. how might someone misinterpret information from the before and after images, etc.) (6pts)

There may be seasonal differences March vs. September (vegetation more developing in September in Japan)
Anthropogenic changes not related to the disaster (e.g. building a road, etc.)
Non-anthropogenic changes not related to the disaster (Weather, tidal, effects of aftershocks etc.)

17) Fig. 11 shows an impervious land surface map. Why are city planners interested in such maps? What is the primary driver for increasing impervious surfaces? How much city planners mitigate some increases in impervious surfaces? (6pts)

Impervious surfaces increase run-off, thus stresses the sewage systems
Urban development (build roads, buildings, etc.)
Require developers to use materials that are less impervious, require buffer zones, etc.