CEE6440 Final Exam Fall 2009

GIS in Water Resources

There are three questions on this exam. Do all three questions. For the first two questions, prepare a 2-page typed theme paper. For the third question use ArcGIS (and Excel/Word) to prepare the map and answers requested. *Staple all three solutions together in the order of the questions*, and turn in the result to Dr Tarboton in ENGR 230 or the CEE secretary in EL211, by 5PM on Friday, December 11. This is a take-home exam. You are honor bound not to discuss this exam with your colleagues in the class. Your answers should be the result of your work and thought alone. Be assured that if essentially the same idea appears in answers from more than one person, it is fairly easy to recognize that when the grading is being done. If that happens, it is not clear from whom the idea originated and who is just using somebody else's knowledge. So, keep your ideas to yourself!

The term papers that you choose to describe in answering Questions 1 and 2 should be mutually exclusive, that is, if you focus on particular term papers in answering one of the questions, don't focus on the same papers when answering the other question. The term projects can be found at:

- Texas: http://www.ce.utexas.edu/prof/maidment/giswr2009/docs/termprojlist.htm.
- Utah: http://www.engineering.usu.edu/dtarb/giswr/2009/students.html.
- Nebraska: http://snr.unl.edu/airmak/giswr/2009/termproject.htm.

You are encouraged to look at term projects from all three locations in preparing your answers since this will give you a greater body of information to speak from.

What we are looking for in grading your answers to the first two questions is:

- **Knowledge of the facts.** Make sure you lay out the facts of what has actually been done before you start offering opinions about what could have or should have been done. This particularly applies to the discussion of term papers. Make sure you discuss what was actually done in the term paper not just about the general subject itself.
- **Thoughtful evaluation.** How do you evaluate the advantages and limitations of the principles, methods and data that have been used? How does the knowledge you've learned in this class relate to the world around us? I am looking for a sense of reflection here, of seeing you set individual situations and facts in a larger context in an intelligent way.

Questions

1. Compare and contrast two papers dealing with the same theme

Choose two term papers that deal with the same or similar themes or topics. Neither of these papers should be your own term paper. The papers that you choose may be from any of the three participating universities. Briefly summarize the contents of the papers (the problem examined, the method of analysis, the results achieved). Compare and contrast the approaches to the problem that the two papers took. Which technical approach do you think was more effective? Why? Which paper does a more effective job of communicating its results? Why? Suppose you were undertaking a study of this same subject. Having studied these two papers, what have you learned about how to go about your investigation effectively? What would you do differently from what the authors of these papers did?

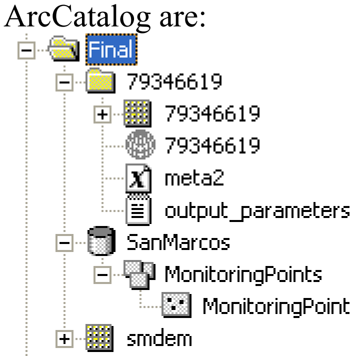
2. Write an assessment of the utility of GIS in a particular application area

Student term papers on a range of topics have been presented. Select four papers that fall within a similar subject area and present a critique of how effective GIS is in its application in this subject area. What is the scope of the application area? How has GIS been used? What types of problems have been solved effectively? What limitations exist that have yet to be overcome in the application of GIS in this area? *In your answer, you must refer specifically to work presented in term papers prepared in this course*. In other words, I am not looking here just for a general statement about your opinions in the field but rather a deduction based on the term papers presented in this class of what has been done and how you judge the effectiveness of that. The papers that you select for this question may be from any of the three participating universities. You are encouraged to look at and use papers across all the universities, where they address similar subject areas.

3. San Marcos Basin topography and land cover

Background and Context. Topography and land cover are important factors in hydrology and water resources. This problem requires you to use the ArcGIS tools to determine topographic, land cover and corresponding runoff properties for the San Marcos basin that you have analyzed in class exercises.

Question. The zip file final.zip (http://www.engineering.usu.edu/dtarb/giswr/2009/final.zip) contains the data you will need for this problem. The contents when unzipped and viewed using ArcCatalog are:

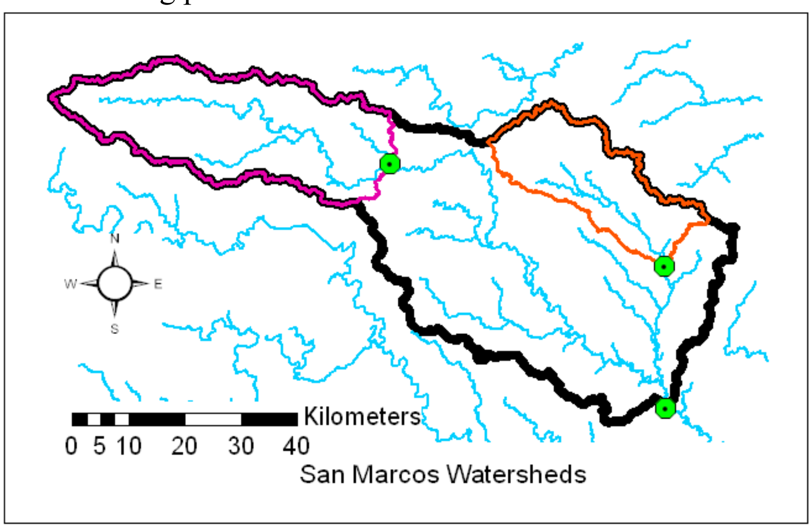


The geodatabase SanMarcos contains a MonitoringPoints feature class with **MonitoringPoint** feature giving the position of three watershed outlets. This is in a **Texas NAD_83_Albers** projection. The grid **smdem** is a 30 m resolution DEM similar to that used in the class, also in a **Texas NAD_83_Albers** projection. The folder 79346619 contains land cover data from the national land cover dataset obtained from http://www.mrlc.gov/ in a **USA_Contiguous_Albers_Equal_Area_Conic_USGS_version** projection. The land cover grid categorizes land cover according to the table following. The first two columns in this table are abstracted from more detailed information at http://www.epa.gov/mrlc/definitions.html. The third column gives broad land cover groups to use in this question to simplify the problem.

Table of NLCD 2001 Land Cover Classes

Value	Name	Group
11	Open Water	Water
21	Developed, Open Space	Developed
22	Developed, Low Intensity	Developed
23	Developed, Medium Intensity	Developed
24	Developed, High Intensity	Developed
31	Barren Land (Rock/Sand/Clay)	Range
41	Deciduous Forest	Forest
42	Evergreen Forest	Forest
43	Mixed Forest	Forest
52	Shrub/Scrub	Range
71	Grassland/Herbaceous	Range
81	Pasture/Hay	Agriculture
82	Cultivated Crops	Agriculture
90	Woody Wetlands	Water
95	Emergent Herbaceous Wetlands	Water

a) Use the ArcHydro tools to delineate the watersheds draining to each of the monitoring points in the provided MonitoringPoints feature class. Note that here watershed refers to the entire area draining to a monitoring point as illustrated.



You do not need to burn in existing streams for this exercise, rather streams should be delineated based on the DEM alone. Prepare a table that for each watershed reports the following:

- Name
- Drainage area (km^2)
- Mean slope
- Mean elevation (m)
- Elevation range (Max elevation – Min elevation in m)

- Relative relief (This is elevation range divided by the square root of the drainage area. Express this in dimensionless terms)

In summarizing this information over watersheds ensure that in the methods and functions that you use that you obtain results that pertain to each entire watershed recognizing the overlap, with the two smaller watersheds being contained within the larger one. The relative relief provides a dimensionless measure of the ruggedness of the topography. Prepare a layout where you depict the topography and watershed boundaries. Label the watershed with the highest and lowest relative relief and indicate whether these relative relief measures make sense given the topography.

b) Prepare a layout where you depict the watershed boundaries and land cover aggregated into the five groups (Water, Developed, Range, Forest and Agriculture). Include a legend for the land cover. Determine the percentage of each land cover group (Water, Developed, Range, Forest and Agriculture) in each watershed. Assume that runoff coefficient (the fraction of rainfall that becomes runoff) is related to land cover group according to the following table:

Group	**Runoff coefficient**
Water	1
Developed	0.6
Range	0.4
Forest	0.2
Agriculture	0.3

Prepare a table that for each watershed reports the percentage of land cover associated with each group and the runoff coefficient determined as an area weighted average based on these percentages. Again ensure that in the methods and functions that you use that you obtain results that pertain to each entire watershed recognizing the overlap, with the two smaller watersheds being contained within the larger one.

Hint: The following toolbox functions may be useful
Tabulate area, Reclassify.