Environmental Data Analysis – More Spatial Analysis
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I. Reflection on week prior
1. Beware news stats!
2. Operations on spatial vs. non-spatial data.
3. GIS lab reflection.
4. Mid-term reports look very good, still working on them.
5. Discussion of the final
   a. Review session will be held in late April/early May.
   b. 20 MCQs (50%) and 2 (out of 3 options) essays (50%).
   c. No calculators (not allowed and not necessary).

II. Raster Analysis
1. Overlays and other functions in rasters operate differently from vectors.
2. Map algebra = unary (one layer) vs. binary (multiple layers).
3. Recall Boolean algebra from last week.
4. Cell sizes and frames must be consistent, otherwise solutions must be sought for accurate map algebra.
5. As in basic spatial analysis, raster functions can be defined as local, neighborhood or global.
6. Raster operations
   a. Reclassification and the use of reclassification tables can take raster information and produce an output of interest (e.g. lux levels).
   b. Logical operations (e.g. CON or ISNULL).
   c. Raster extraction (e.g. clipping)
   d. Algebra and addition, but be careful of ambiguities.
   e. Put all these things together and you can do all sorts of cool things such as Dengue vulnerability in Malaysia.
7. Neighborhood operations are among the most common in raster analysis
   a. Can be thought of as a “moving window”
   b. A variety of operations can be done according to the neighboring cells including mean, median, min, max, range, majority, slope and aspect (the latter of the two involve more complex algorithms).
   c. Majority, for example, identifies the majority of the cells surrounding and classifies the cell of interest based on that value.
   d. A kernel is a set of constants that defines the moving window operation taking place.
   e. Different kernels are required for corners and margins.
   f. Edge detection operations.
   g. High pass filters accentuate differences between neighboring cells (and can help identify outliers).
8. Some raster operations can cause an increase in spatial covariance (serial correlation).
9. Cost functions
   a. Similar in principle to buffer/distance functions (and even the multivariate lecture!)
b. Can be used to compute ease and difficulty of passing distances through a landscape.

III. Miscellaneous Spatial Stuff
1. GIS in R!
   b. Pretty straightforward for making simple maps (and is sometimes very useful for publications even!).
   c. More complicated things, such as raster/ vector overlays, are more complicated... but getting easier!
2. DEMs – Digital Elevation Models represent elevation and provide for 3D analysis of spatial data.
3. Terrain Analysis – The use of rasters (usually) with slope and aspect to determine elements of the landscape such as available sunlight and water accumulation.
4. Spatio-temporal modeling (e.g. LANDIS) takes process based models with climate, DEM etc. information and models change through time.
5. Important to recognize the level of accuracy and precision in your GIS.
   a. Accuracy – how close is an observation to its true value?
   b. Precision – how repeatable is the observation?
6. Data standards and metadata (i.e. data about the data)

IV. Preview of next week’s lab – Hong Kong’s forests
1. Lots of places to get data
   a. GADM – global administrative areas
   c. World Protected Areas - http://www.protectedplanet.net/
2. Having all of these sources is great – but remember, they need to be in the same coordinate space to be useful – what a headache!!
3. ArcCatalog can help you with this, it shows you metadata.
4. We can do all sorts of spatial and raster analyses as we’ve discussed today
5. Unfortunately YOU won’t be able to do some (e.g. zonal statistics) because the GIS lab doesn’t have a license for Spatial Analyst (GIS is EXPENSIVE and inferior to R in this way).