Team Name: _____
Student Name(s): _____
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Remote Sensing (C)

Nebraska Science Olympiad
Nebraska State Competition
University of Nebraska-Lincoln
Saturday, April 21st 2012
100 points total

Show all mathematical operations using significant figures and proper units. Answer all questions with complete sentences unless noted.

1) What are some advantages/disadvantages to using a remote sensing based system (e.g. Figure 1a) verses a system of point measurements (e.g. Figure 1b). 8pts

2) The Gravity Recovery and Climate Experiment (GRACE) mission has provided a better estimation of the actually measured ocean currents (Figure 1) compared to the original models based on previous estimates of the Earth's geoid (Figure 2). Why are good estimates of geoids critical to predicting ocean currents? Identify at least one area that remains the same and one that differs between Figure 1a and Figure 2. Label the two points accordingly. 8pts

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3) The greenhouse gas CO_2 receives more press than other common greenhouse gases. Why? Compare CO_2 to these other greenhouse gases in your explanation. 8pts

4) What is the distribution of chlorophyll *a* (Chl) in Asov Sea on May 22nd 2009 (Figure 3)? What are some possible reasons the image does not have a smooth gradient outside of the north eastern portion of the map? 8pts

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5) Why do lakes, rivers, streams, etc. have near zero reflectance > 0.8 μm (Figure 4)? How does this lack of reflectance in the NIR range affect vegetation indices like the Normalized Difference Vegetation Index? 8pts

6) Using Figure 5, describe and compare the changes in glacial fields over time. What are some factors that may cause these changes? 8pts

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7) From Figure 6, calculate the % loss of mangrove cover in the image between 1985 and 2010. Which time period indicated had the greatest loss per year? (Part of this question will be used as a tie-breaker). 10pts

8) Figure 6 shows changes in a mangrove forest, specifically fragmentation of the original forest. How does fragmentation change the forest edge? What are the implications of changing the forest edge on other species? 8pts

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9) In Figure 7, which image was taken before the tsunami (Top/Bottom)? What are some of the clues used to come to this conclusion? The tsunami took place in March; however, the other image was collected in August. Can one accurately compare images taken on different dates? If not, why? If so, how much time must pass between the images that one cannot make a comparison? Why? 8pts

10) Many archeological remote sensing studies use vegetation indices (e.g. Figure 8). Why would these scientists be interested in looking at vegetation, when their target areas of interest are man-made structures? Also, why would are some vegetation indices used to identify water? 8pts

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11) Using Figure 9, when can you estimate that the leak from Horizon oil well was plugged? Why did you select this date? Did the oil plume expand in the same direction throughout the oil spill? Why or why not? 8pts

12) Estimate the percent change in area of the Aral Sea (Figure 10) between 1989 and 2003, and 1989 and 2009. Which time period is this rate of change faster? (Part of this question will be used as a tie-breaker). 10pts

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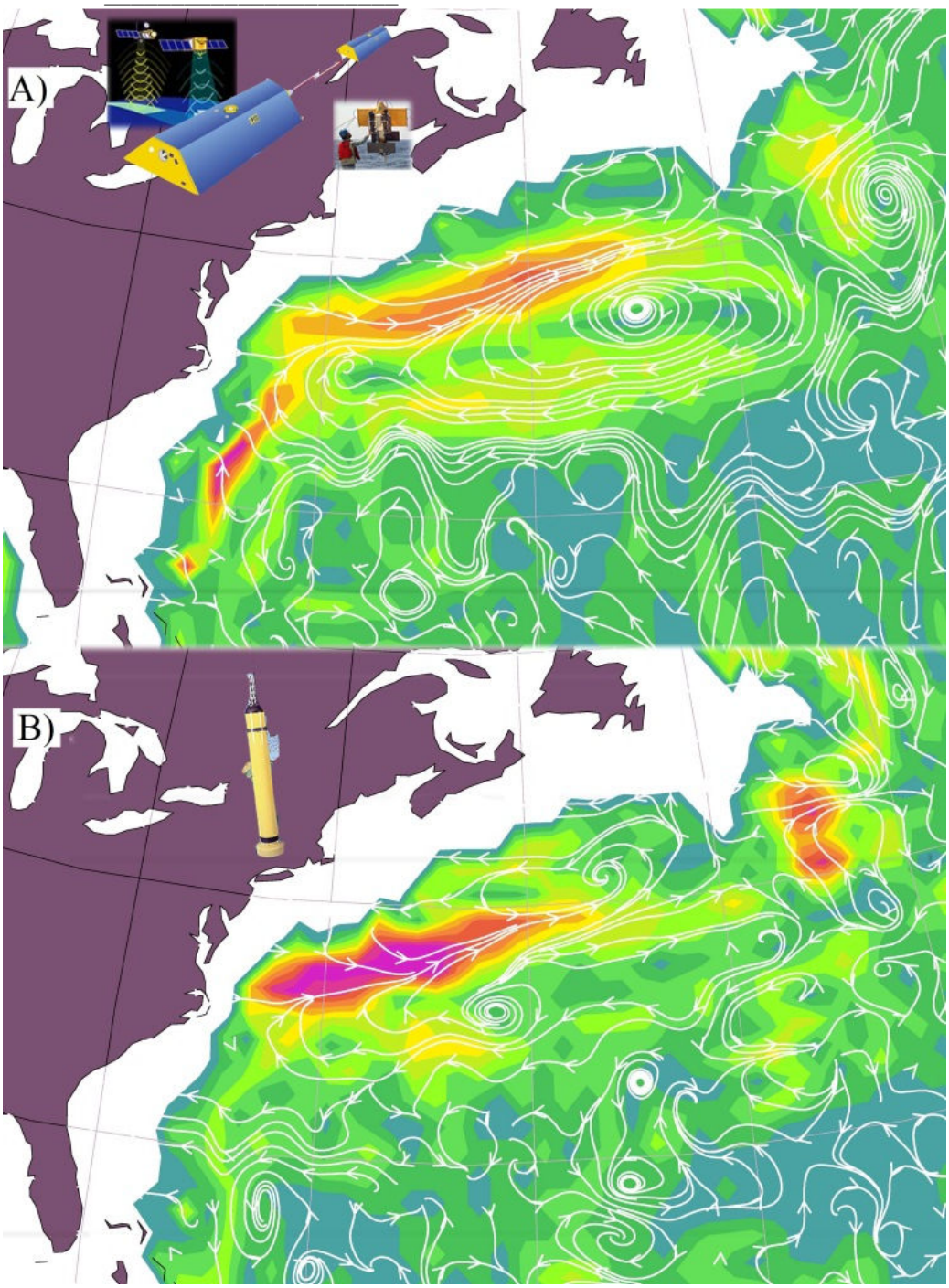

Figure 1: Ocean currents off the East coast of the USA 1,000 m beneath the surface where A) is the currents estimated from the Gravity Recovery and Climate Experiment (GRACE) based geoid, satellite altimetry, and ship measurements of temperature and salt and B) are those calculated from direct measurement of those currents by floats deployed from ships. Colors depict the speed of the current with red being the fastest and blue-green being the slowest. (Image modified from http://www.csr.utexas.edu/grace/gallery/gravity/03_07_Circulation.html, Courtesy of Steve Jayne at Woods Hole Institute of Oceanography and Victor Zlotnicki, JPL)

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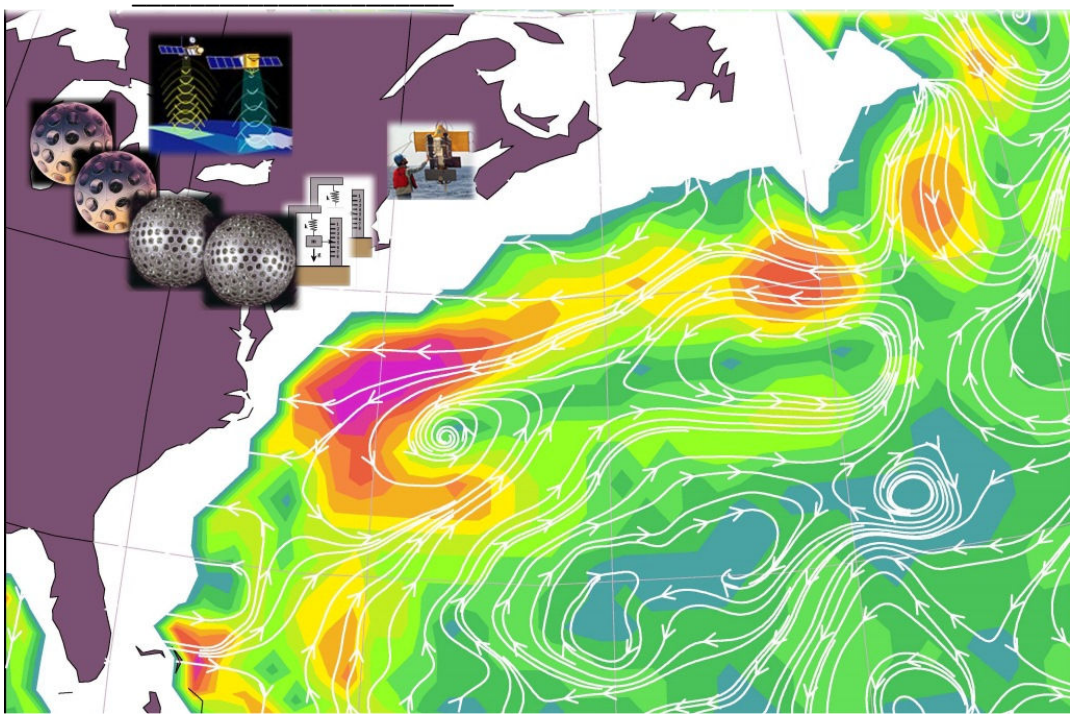

Figure 2: Ocean currents off the East coast of the USA 1,000 m beneath the surface where the currents are estimated from the a geoid prior to the launch of the Gravity Recovery and Climate Experiment (GRACE) satellite. Colors depict the speed of the current with red being the fastest and blue-green being the slowest. (Image modified from http://www.csr.utexas.edu/grace/gallery/gravity/03_07_Circulation.html, Courtesy of Steve Jayne at Woods Hole Institute of Oceanography and Victor Zlotnicki, JPL)

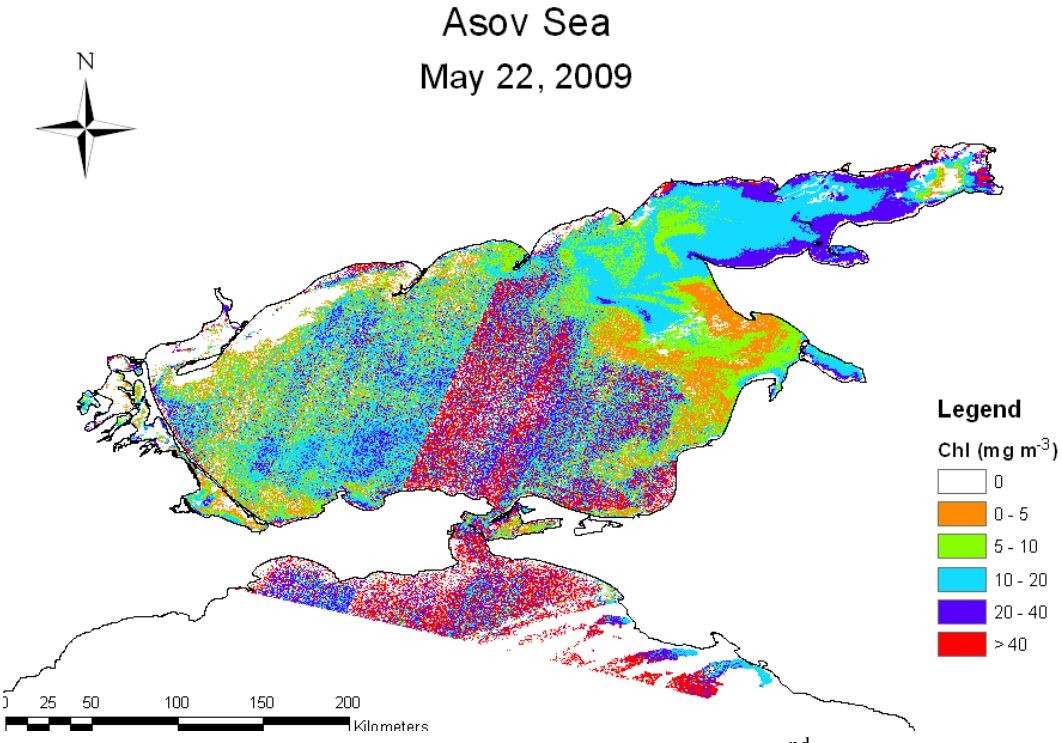

Figure 3: Chlorophyll *a* (Chl) distribution in the Asov Sea on May 22nd, 2009. Image produced from MERIS data by Anthony L. Nguy-Robertson.

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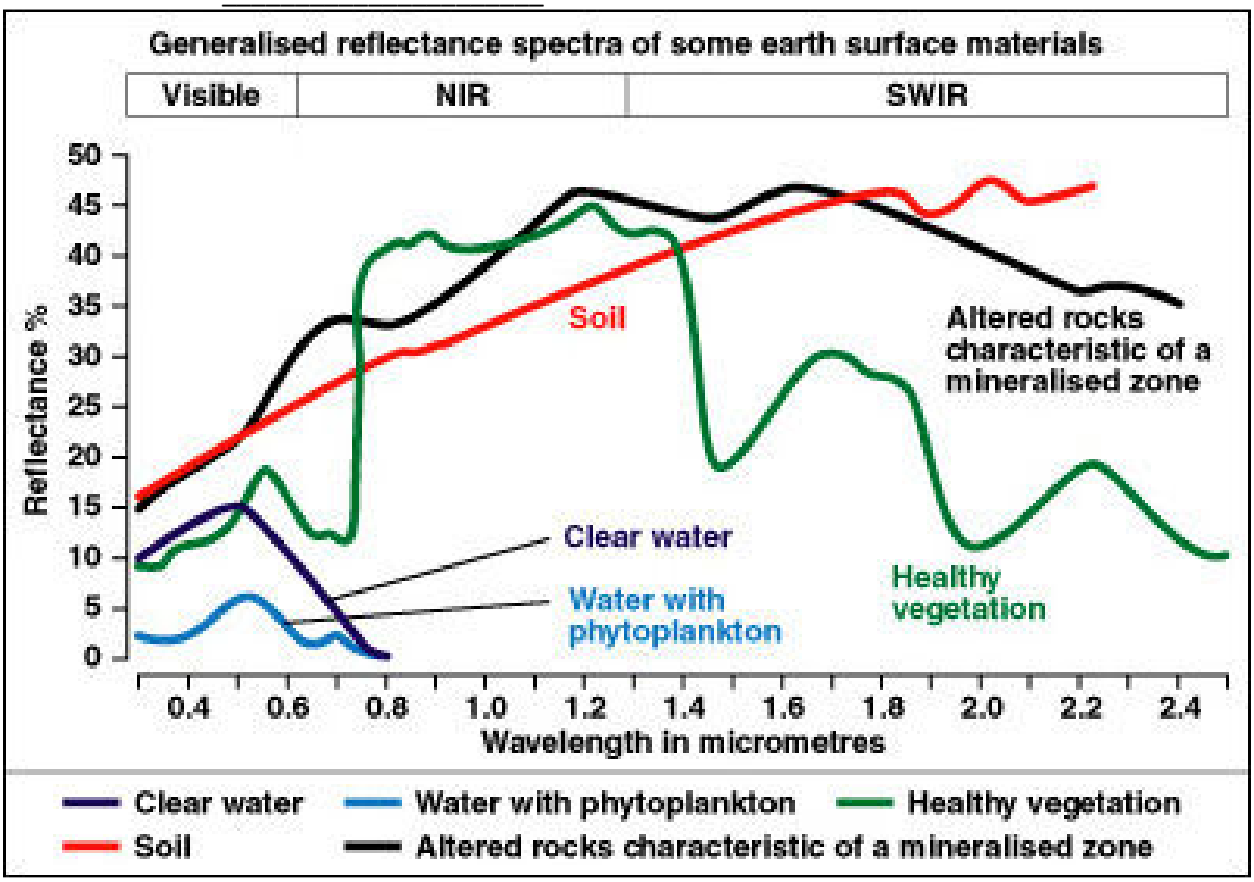

Figure 4: Generalized reflectance spectra of common earth surface materials. Image from the Remote Sensing Applications Consultants website: http://www.rsacl.co.uk/rs.html

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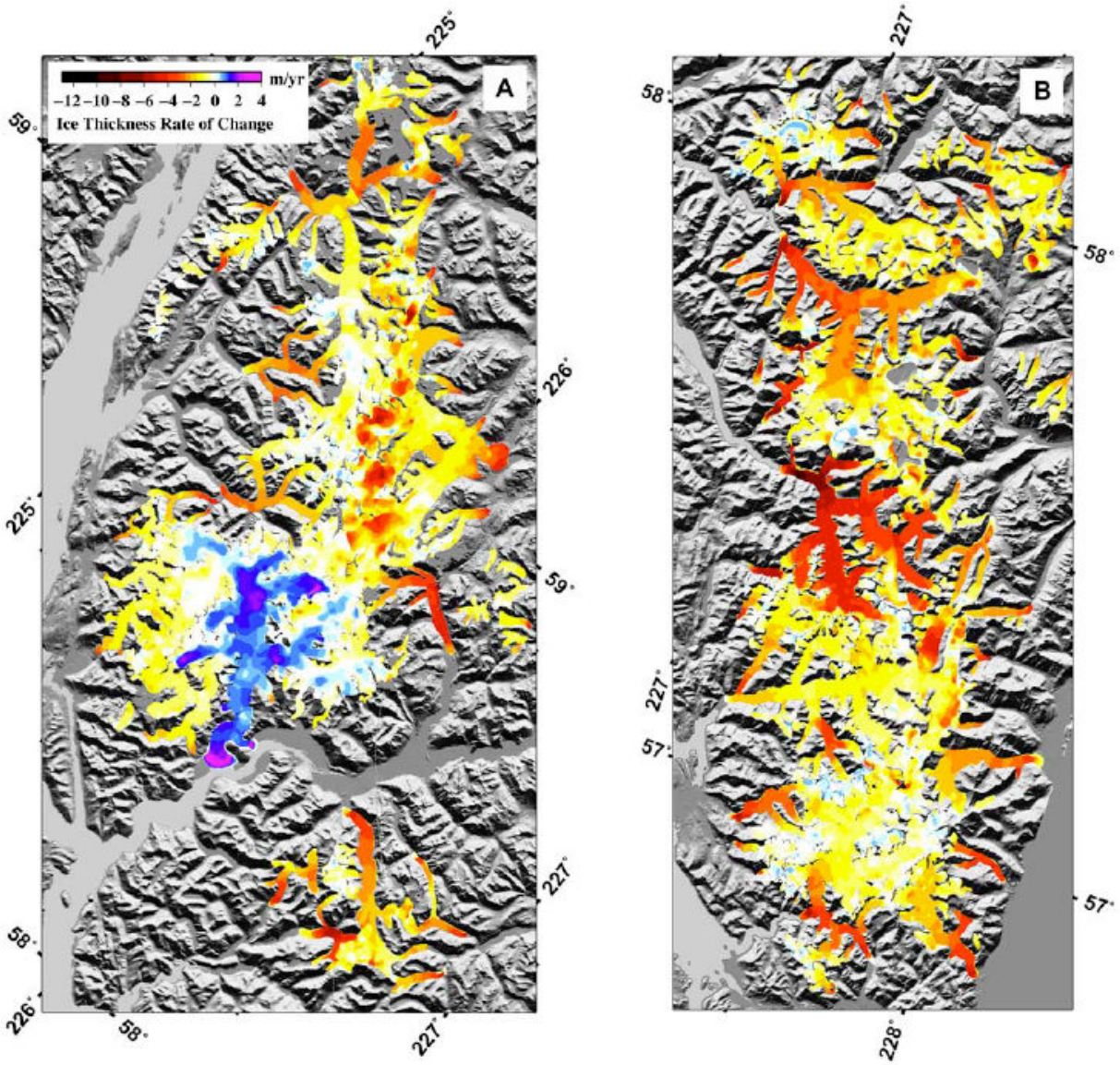

Figure 5: Glacier surface elevation changes, a) Juneau Ice Field and b) Stikine Ice Field. Image from Larsen, C. et al. (2007) Glacier changes in southeast Alaska and northwest British Columbia and contribution to sea level rise. http://dx.doi.org/10.1029/2006JF000586

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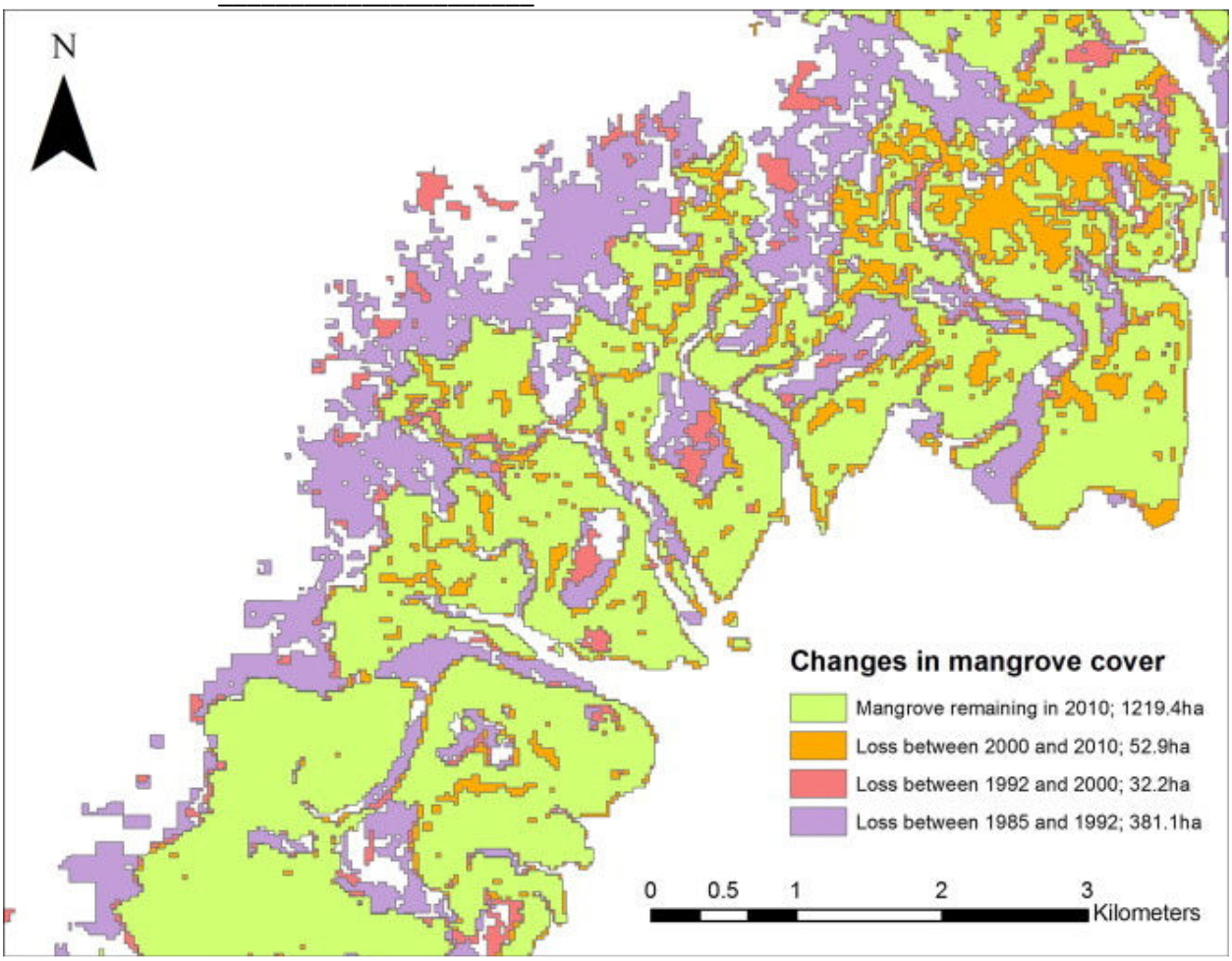

Figure 6: Changes in mangrove cover in Kenya. Kirui et al. (in press) Mapping of mangrove forest land cover change along the Kenya coastline using Landsat imagery. http://dx.doi.org/10.1016/j.ocecoaman.2011.12.004

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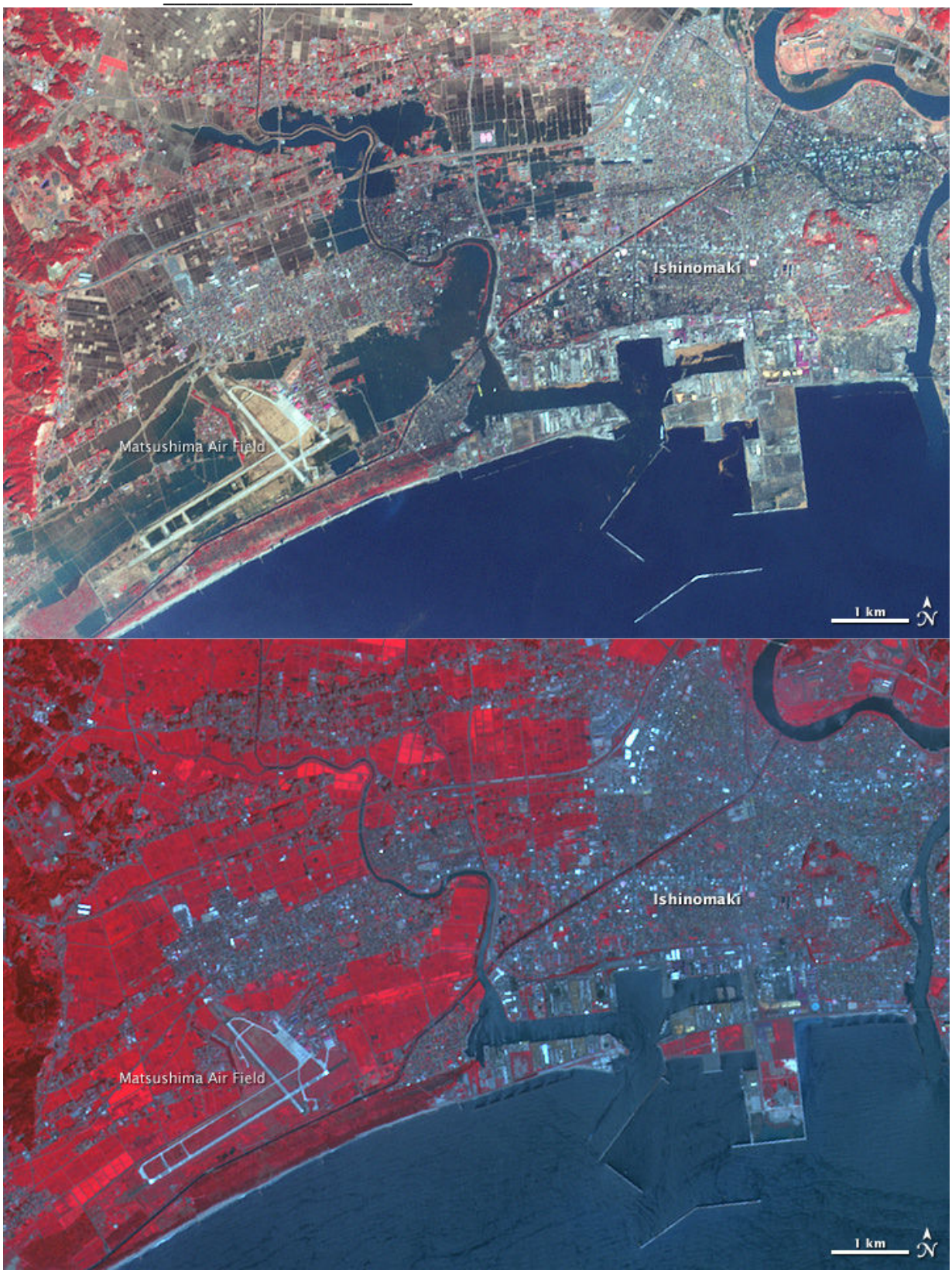

Figure 7: Aster Images of Ishiomaki taken either before or after the March 11, 2011 tsunami. Downloaded from http://earthobservatory.nasa.gov/IOTD/view.php?id=49648 3

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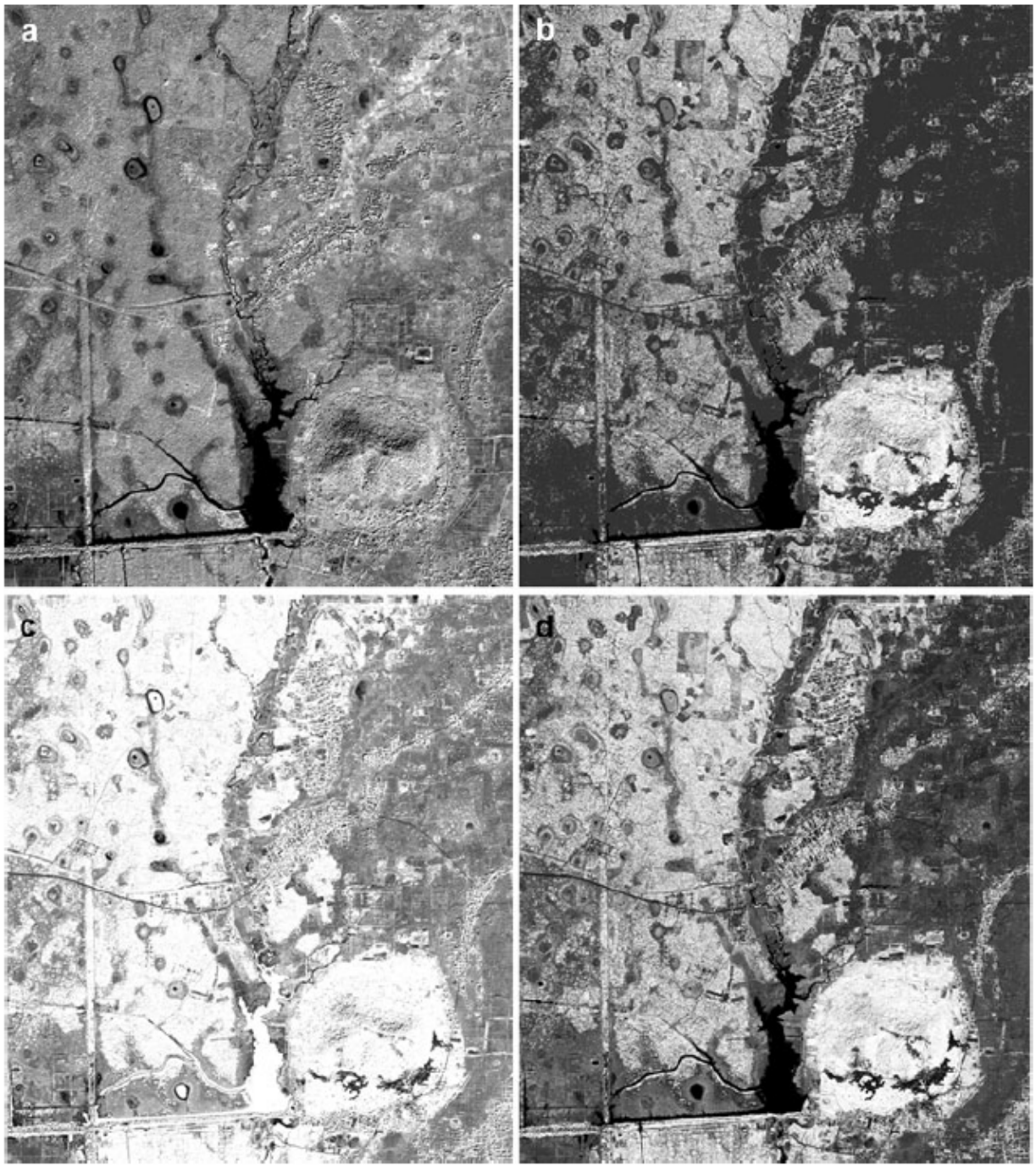

Figure 8: Comparison of four vegetation indices located near Angkor Wat a) Red Band, b) NIR – Red, c) NIR/Red, and d) (NIR-Red)/(NIR+Red). Data from Evans, D. (2012) Uncovering Angknor: Integrated Remote Sensing Applications in the Archaeology of Early Cambodia. *In*: Lasaponara, R & Masini, N. (Eds.) Satellite Remote Sensing: A new tool for archaeology. Springer, New York. 364 p. http://dx.doi.org/10.1007/978-90-481-8801-7

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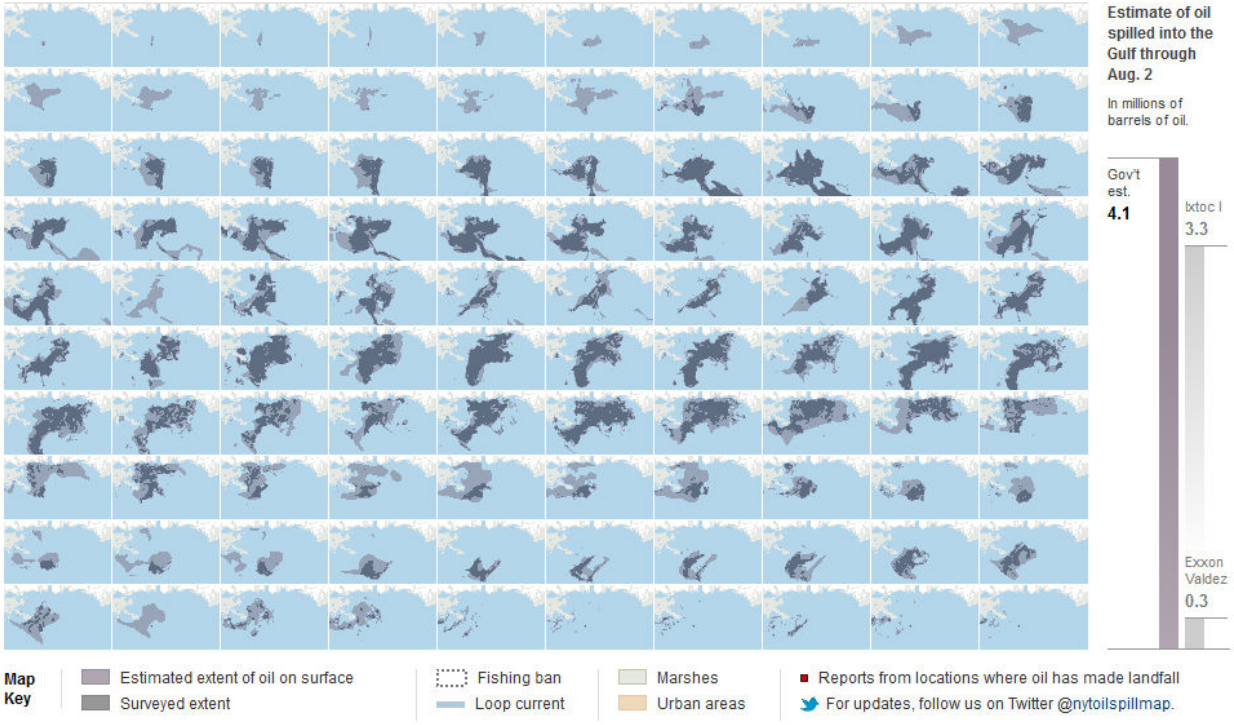

Figure 9: Temporal behavior of the 2011 Gulf Oil Spill between 4/22 and 7/30.New York Times
http://www.nytimes.com/interactive/2010/05/01/us/20100501-oil-spill-tracker.html#composite

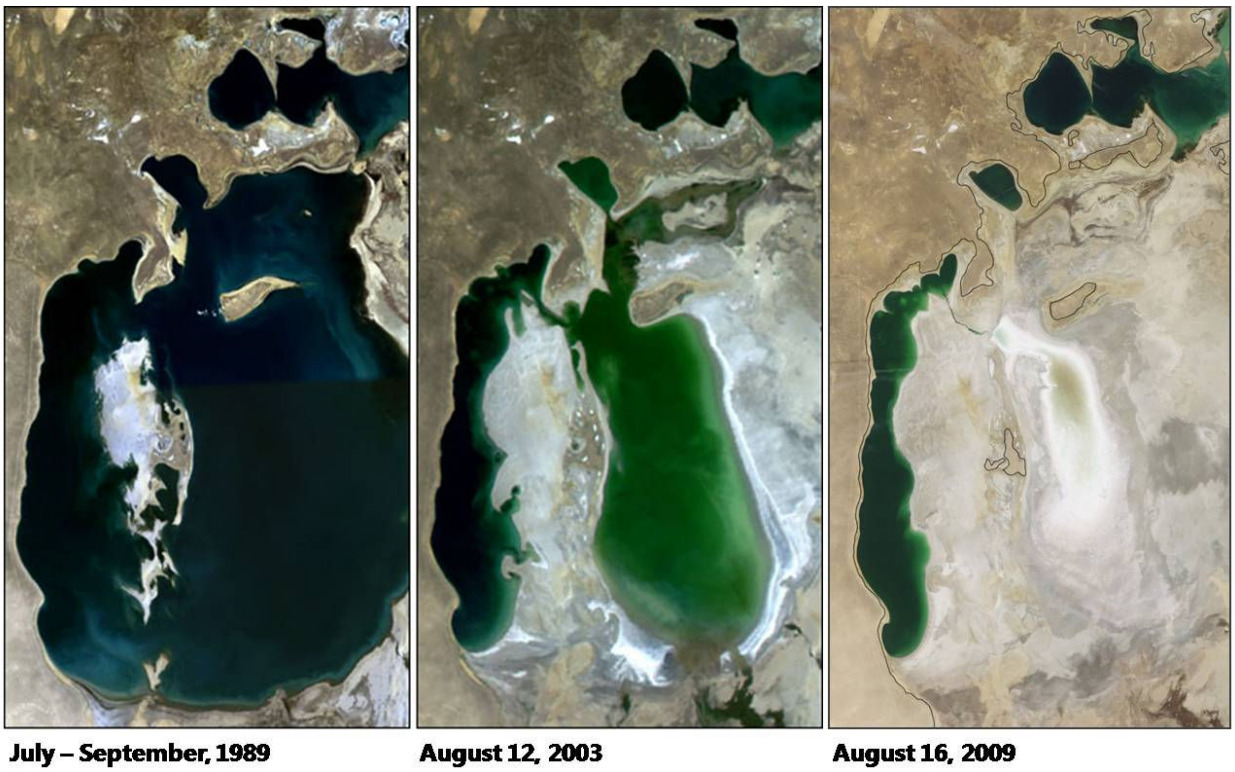

Figure 10: Changes in the Aral Sea over time. Downloaded from
http://geoserver.isciences.com/DataBlog/?p=1908&pid=119