Piedmont Project Statement
Jeremy Hess

I came to the Piedmont Project thinking that I would not have to stretch far to incorporate sustainability and ecological thinking into my public health course on Climate and Infectious Disease. In fact, the course had originally been developed by Christine Moe as through her prior work with the Piedmont Project, and we were just re-focusing the course to include more information on climate change.

Despite the easy entrée, integrating a focus on sustainability – particularly a focus on place – has been a challenge. The challenge came from the fact that much of the class focuses on the ecology of diseases in geographically distant, unfamiliar places; creating an educational exercise to help students experience how climate, infectious disease, and place interplay here in Georgia, where they're learning, was the question.

I've tackled the issue in two ways. First, by modifying an existing exercise in the class on water quality. The exercise originally was an introduction to water quality assessment by taking a water sample from near home, plating the sample in the lab, and looking for fecal coliforms. We have broadened the exercise both geographically and temporally. I've encouraged the students to get samples from a place that they feel connected to (or would like to develop a connection to), or a place that has particular importance in the water cycle of Atlanta (and thus in the city's sustainability). I've given them a list of parks and a general overview of the water intake and sewer discharge in Atlanta. We're also asking them to take samples over several weeks to look at how precipitation or the lack thereof affects the number of coliforms in the sample. This gives them a better sense of how weather – as a surrogate, in this instance, for climate – affects disease ecology. I will be very curious to see how they engage the exercise and what we find.

The second way I introduced the issue was by devoting an entire class to West Nile Virus and its changing epidemiology. West Nile was not an endemic disease in North America until recently, and season and climate have very strong effects on disease incidence. Moreover, West Nile is a vector-borne zoonotic infection, with reservoirs in wild birds, so the climate effects on the ecology of mosquitoes and birds is important, as well. We will be looking at the spread of West Nile across the country and considering why this year was a particularly bad year for West Nile, and then correlating the disease's emergence and inter-annual variability in North America with changes in climate and ecology.

Hopefully these two additions to the class will provide ample opportunities for students to relate a bit more deeply to place than they might have otherwise. I hope, too, that by grounding their inquiry in place, they will have opportunities to consider the connections between place and sustainability at a deeper level.

ROLLINS SCHOOL OF PUBLIC HEALTH
EMORY

DEPARTMENT: Global Health / Environmental and Occupational Health

COURSE NUMBER: IH582 / EOH582

CREDIT HOURS: 2

COURSE TITLE: Environment, Climate and Infectious Disease

INSTRUCTOR NAMES: Christine L. Moe, Ph.D.; Jeremy Hess, M.D., M.P.H.

INSTRUCTOR CONTACT INFORMATION: Dr. Moe
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INSTRUCTOR CONTACT INFORMATION: Dr. Hess
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TEACHING ASSISTANT CONTACT INFORMATION: Elizabeth Ailes, MPH
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COURSE DESCRIPTION (3-4 Sentences)

This course will explore the role of the environment and climate change in the ecology and transmission of infectious diseases and the emergence of new pathogens. The course format will be a combination of lectures and classroom discussions guided by a series of questions. Many specific waterborne, vector-borne, and zoonotic infections will be used throughout the lectures and discussions to illustrate general principles of environmental transmission as well as hallmark aspects of climate change.

EVALUATION

There will be two class exercises (team work) and one homework assignments (individual work). The first class exercise is diagramming disease transmission cycles and ecological variables affecting transmission rates and virulence; the second exercise is a field and laboratory exercise on measuring microbiological water quality; the third exercise is researching, preparing and possibly presenting a short PowerPoint assignment. The homework assignment is a case study on a specific disease that has an environmental transmission component. These studies include selected readings and questions provided by the instructors. The class exercises and homework provide practice in critical literature review and synthesis skills necessary for the final assignment.

Final assignment: Each student will be required to give a final oral presentation on a selected topic and submit a final paper (10-12 pages) on the same topic. The presentation/paper should provide background material on a specific infectious agent, how the agent is transmitted, the role of specific environmental factors in disease transmission, the ways in which the agent's range and/or virulence is expected to be affected by climate change, and an assessment of available control measures or specific interventions. Students will be evaluated on their understanding of the principles of environment transmission of infectious diseases and their ability to critically review and synthesize information from studies of their topic that are described in the literature.

COURSE GRADE: Three class exercises: 35%

- Class 1 - Mapping transmission cycles (0%)
- Class 5 - Monitoring urban water quality (20%) Final report due Nov 20, 2007
- Class 7 - Water and sanitation in megacities (15%) Due Oct 23, 2007

One homework assignment: Pfiesteria (15%) Due Sept 25, 2007
Oral Presentation: 25% - Due December 11, 2007
Final Paper: 25% - Due December 14, 2007

ACADEMIC HONOR CODE

The RSPH requires that all material submitted by a student in fulfilling his or her academic course of study must be the original work of the student.

LEARNING OBJECTIVES OR COMPETENCIES OF THE COURSE

The goal of the course is to provide the student with a clear understanding of the relationship between infectious agents, their hosts, and the environmental conditions that affect their interactions, to consider how climate change will affect these dynamics, and to discuss how this information can be used to design effective control measures. Topics include: basic principles of infectious disease transmission, the influence of climate variation and change on infectious diseases, the impact of deforestation, urbanization and other environmental changes on emergence or re-emergence of pathogens, the epidemiology and science of modeling and tracking climate-health relationships, and infectious disease outbreaks associated with natural disasters.

LEARNING OBJECTIVES OR COMPETENCIES FOR THE DEPARTMENT OR PROGRAM TO WHICH THE COURSE CONTRIBUTES

Learning Objectives for GH MPH students in the Infectious Disease Concentration

- Explain basic microbiology and ecology of groups of pathogenic organisms – including structure, replication strategy, survival in the host and survival in the environment.
- Review general aspects of climate change including projected ecological changes globally and by region, with consideration to effects on both endemic disease and emerging infections.
- Describe major transmission routes of infectious agents (including vector-borne pathogens) and the implications of these various routes for exposure and virulence.
- Explain basic principles of infectious disease epidemiology – including reservoirs, incubation period, transmission, infectivity, the distinction between infection and disease, etc.
- Explain the environmental, behavioral, ecological, and evolutionary factors that contribute to the emergence and re-emergence of infectious diseases.
- Consider how best to study the effect of climate change on the epidemiology of infectious disease, including time-series methodology, modeling, inter-disciplinary approaches, and vulnerability mapping.
- Describe and apply appropriate strategies to prevent and control infectious disease - including vaccines, antimicrobial therapy, behavior changes, environmental interventions and vector control.
- Evaluate effectiveness of interventions to control, prevent, eliminate or eradicate infectious disease.

"Environment, Climate and Infectious Disease" Lecture and Reading Schedule:
Tuesdays, 10 – 11:50 am; Location: GCR 103
NOTE: All readings will be posted on Blackboard as pdf files unless noted otherwise.

Class One – September 4, 2007	
Introduction to infectious disease ecology and to climate change **Class Exercise I: Mapping Transmission Cycles**	**Christine L. Moe** **Jeremy Hess**
Readings:	Wilson ML. "Ecology and Infectious Disease" In: Ecosystem Change and Public Health: A Global Perspective. JL Aron and JA Patz, Eds. Chapter 10. Baltimore: The Johns Hopkins University Press, 2001. pp. 283-324. McMichael, AJ. Global environmental change as "risk factor": Can epidemiology cope? (editorial) *Am J Pub Health* 2001 91(8):1172-1174. Chan NY, Smith F, Wilson TF, Ebi KL, Smith AE. An integrated assessment framework for climate change and infectious diseases. Environ Health Perspect 1999, 107: 329-337. Haines A and JA Patz. Health effects of climate change. JAMA 2004 291(1):99-103. Patz J. " Climate Change" in Environmental Health: From Global to Local. H Frumkin, ed. San Francisco, CA: Jossey-Bass, 2005, pp. 238-268. **(Hard copy distributed in class)**

Class Two – September 11, 2007	
Introduction to weather, seasonality and climate change modeling and prediction.	**Jeremy Hess**
Readings:	Rose et al. "Health, Climate and Infectious Disease: A Global Perspective". American Academy of Microbiology. 1999. 1-24 Dowell, SF. Seasonal variation in host susceptibility and cycles of certain infectious diseases. *Emerg Inf Dis* 7(3):369-374 Confalonieri, U., B. Menne, R. Akhtar, K.L. Ebi, M. Hauengue, R.S. Kovats, B. Revich and A. Woodward, 2007: Human health. *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, M.L. Parry, O.F. Canziani,

	J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 391-431. McMichael AJ, Campbell-Lendrum D, Corvalan CF, Ebi, KL, Githeko AK, Scheraga J, Woodward A, eds. Climate Change and Human Health: Risks and Responses. Geneva: World Health Organization, 2003, chapters 2, 6, 7 and 10. National Research Council. "Chapter 3. Linkages Between Climate, Ecosystems and Infectious Disease" In: Under the Weather: Climate, Ecosystems and Infectious Disease. Washington, DC: National Academy Press, 2001. pp. 20-44. **(Access book at http://books.nap.edu/openbook.php?record_id=10025&page=20)** National Research Council. "Chapter 4. Climate Influences on Specific Diseases" In: Under the Weather: Climate, Ecosystems and Infectious Disease. Washington, DC: National Academy Press, 2001. pp.45-58. **(Access book at http://books.nap.edu/openbook.php?record_id=10025&page=45)**

OPTIONAL CLASS – TBN	
"An Inconvenient Truth"	**Christine L. Moe**
Summary:	Documentary by former vice president Al Gore warns about the potential impacts of global warming within the next 10 years, including: could bring extreme weather, floods, droughts, epidemics and severe heat waves. Movie is 1 hour and 40 minutes, followed by discussion.

Class Three– September 18, 2007	
The link between seasonality, climate change and emerging and re-emerging pathogens: Cholera and Assessing Water Quality	**Christine L. Moe**
Readings:	Colwell RR. Global climate and infectious disease: the cholera paradigm. *Science* 1996 Dec 20;274(5295):2025-31. Speelmon EC et al. Cholera incidence and El Niño-related higher ambient temperature. *JAMA* 2000 Jun 21;283(23):3072-4. Pascual M and A Dobson. Seasonal patterns of infectious diseases. PLoS Medicine 2005 2(1):18-20 *Available online at www.plosmedicine.org*

	Lobitz B. et al. Climate and infectious disease: Use of remote sensing for detection of *Vibrio cholera* by indirect measurement. PNAS 2000 97(4):1438-1443. Sack RB. et al. A 4-year study of the epidemiology of *Vibrio cholerae* in four rural areas of Bangladesh. JID 2003 187:96-101. Huq A. et al. Critical factors influencing the occurrence of *Vibrio cholerae* in the environment of Bangladesh. App Environ Micro 2005 71(8):4645-4654.

Class Four – September 25, 2007	
Modeling climate - Can we predict the impact of climate change?	**Peter Webster School of Civil and Environmental Engineering, GA Tech**
Readings:	Webster, PJ, Holland, GJ, Curry JA and Chang, H-R. Changes in tropical cyclone number, duration and intensity in a warming environment. *Science* 2005 309:1844-1846. Using Climate to Predict Infectious Disease Outbreaks: A Review. WHO 2004 National Research Council. "Chapter 5. Analytical Approaches to Studying Climate/Disease Linkages" In: Under the Weather: Climate, Ecosystems and Infectious Disease. Washington, DC: National Academy Press, 2001. pp 59-79. **(Access book at http://books.nap.edu/openbook.php?record_id=10025&page=59)** Haines A and JA Patz. Health effects of climate change. JAMA 2004 291(1):99-103. **(REPEAT from Class 1)** Patz JA, Campbell-Lendrum D, Holloway T, Foley JA. Impact of Regional Climate Change on Human Health. Nature 438: 310-317. Campbell-Lendrum D, Woodruff R. Comparative Risk Assessment of The Burden of Disease from Climate Change. Env Health Persp 114: 1935-1941. Linthicum KJ et al. Climate and satellite indicators to forecast Rift Valley fever epidemics in Kenya. *Science* 1999 Jul 16;285(5426):397-400.

HOMEWORK ASSIGNMENT 1: PFIESTERIA CASE STUDY – Due September 25, 2007. Please leave your homework assignment in Dr. Moe's mailbox.

Class Five – October 2, 2007	
Monitoring urban water quality – Class Exercise II Students will be asked to select urban streams on campus or in their neighborhoods and collect a water sample to be analyzed in the laboratory.	**Christine L. Moe**
Readings:	A handout will be provided that explains the field assignment (how to collect water samples) and the laboratory exercise (how to analyze water samples for fecal coliform bacteria by membrane filtration). This exercise will continue through mid-November 2007. Class groups will be assigned specific water bodies to monitor to observe the effects of combined sewer overflows and heavy precipitation events on water quality or urban streams. We will also explore gathering historical precipitation data and weather data, etc. and then synthesizing all this information in class to see if there are any trends. Final group reports due November 20, 2007. Standard Methods for the Examination of Water and Wastewater. 20th Edition. Sections 9010 – 9060, 9222, 9223**(Will make book available for scanning or copying)**

**** There is no class on October 9, 2007 due to Fall Break at RSPH, Emory University. ****

Class Six – October 16, 2007	
Modeling the interaction between the environment and infectious diseases	**Lance Waller**
Readings:	Russell, CA, Smith DL, Waller, LA, Childs, JE, Real, LA. (2004) A priori prediction of disease invasion dynamics in a novel environment. PNAS 2004 Jan 7;271(1534):21-5.

Class Exercise III: Research and prepare megacity Powerpoint slides (student teams) for possible class presentations on October 23rd, 2007. All teams will turn in their

Powerpoint slides to Dr. Moe and Dr. Hess for evaluation. Teams will be chosen at random to present during class.

Class Seven – October 23, 2007	
Megacity PowerPoint Presentations **Discussion of Pfiesteria homework assignment**	**Christine Moe** **Jeremy Hess**
Readings:	Garrett L. The Coming Plague: Newly Emerging Diseases in a World Out of Balance. New York, NY: Penguin, 1993. Chapters 9, 14. **(Will scan and post as pdf)**

Class Eight – October 30, 2007	
Understanding the relationship between the urbanization of populations and infectious disease: West Nile	**Jeremy Hess**
Readings:	Hayes CG. West Nile Virus: Uganda, 1937, to New York City, 1999. Ann NY Acad Sci, 2001: 951: 25-37. Despoommier D. West Nile Story: A New Virus in the New World. New York, NY: Apple Trees Productions, 2001. Chapters 1 & 2. CDC. West Nile virus update--United States, January 1-July 24, 2007. MMWR - Morbidity & Mortality Weekly Report. 56(29):740-1, 2007 Jul. CDC. West Nile virus activity--United States, 2006. MMWR - Morbidity & Mortality Weekly Report. 56(22):556-9, 2007 Jun 8.

Class Nine – November 6, 2007	
Location and climate: Hantavirus	**Jeremy Hess**
Readings:	Garrett L. The Coming Plague: Newly Emerging Diseases in a World Out of Balance. New York, NY: Penguin, 1993. Chapter 15 – "Hantaviruses in America" . **(Will scan and post as pdf)**

	Busch M, Cavia R, Carbajo AE, Bellomo E, Gonzalez Capria S, Padula P. Spatial and temporal analysis of the distribution of hantavirus pulmonary syndrome in Buenos Aires Province, and its relation to rodent distribution, agricultural and demographic variables. Trop Med Int Health 2004, 9: 508-519. Hess J, Malilay J, Parkinson A. Climate Change: Places at Special Risk. Am J Prev Med, July 2008 (draft in process) **(still need pdf)**

Class Ten – November 13, 2007	
Schistosomiasis and the Environment	**Evan Secor** **Division of Parasitic Diseases** **CDC**
Readings:	Sturrock, RF, Diaw OT, Talla I, Niang M, Piau JP, Capron A. Seasonality in the transmission of schistosomiasis and in populations of its snail intermediate hosts in and around a sugar irrigation scheme at Richard Toll, Senegal. *Parasitology* 123 Suppl:S77-89, 2001. Kloos H, Fulford AJ, Butterworth, AE, Sturrock RF, Ouma JH, Kariuki HC, Thiongo FW, Dalton PR, Klumpp RK. Spatial patterns of human water contact and *Schistosoma mansoni* transmission and infection in four rural areas in Machakos District, Kenya. *Social Science and Medicine* 44(7):949-68, 1997. Karanja, DMS, AW Hightower, DG Colley, PNM Mwinzi, K Galil, J Andove and WE Secor. Resistance to reinfection with *Schistosoma mansoni* in occupationally exposed adults and effect of HIV-1 co-infection on susceptibility to schistosomiasis: a longitudinal study. Lancet 360 (Aug 24, 2002):592-596. Lerer LB, Scudder T. Health impacts of large dams. Environmental Impact Assessment Review. 1999;19:113-123. N'Goran EK, Diabate S, Utzinger J, Sellin B. Changes in human schistosomiasis levels after the construction of two large hydroelectric dams in central Cote d'Ivoire. Bull World Health Organ. 1997;75(6):541-545. Li Y-S, Raso G, Zhao Z-Y, He Y-K, Ellis MK, McManus DP. Large water management projects and schistosomiasis control, Dongting Lake Region, China. Emerg Infect Dis [serial on the Internet]. 2007 Jul.

	Available from http://www.cdc.gov/EID/content/13/7/973.htm **- will post pdf**

Class Eleven – November 20, 2007	
Malaria, Dengue and climate change	**Jeremy Hess**
Readings:	Reiter, P. From Shakespeare to Defoe: Malaria in England in the Little Ice age. *Emerging Infectious Diseases*, 2000;6:1-11 This reading is free online at the following URL: http://www.cdc.gov/ncidod/eid/vol6no1/pdf/reiter.pdf **(will post pdf)** Pascual M, Ahumada JA, Chaves LF, Rodo X, Bouma M. Malaria resurgence in the East African highlands: Temperature trends revisited. Proc Nat Acad Sci, 103: 5829-5834, 2006. Tanser FC, Sharp B, LeSueur D. Potential effect of climate change on malaria transmission in Africa. Lancet. 362:1792-8, 2003. Reiter P. Climate Change and Mosquite Borne Disease. Env Health Persp, 109: 141-161, 2001. Reiter, P. Climate Change and Highland Malaria in the Tropics. Proceedings of Symposium on "Avoiding Dangerous Climate Change", February 2005, Exeter, England. http://www.stabilisation2005.com/ Rua, G. et al. Laboratory estimation of the effects of increasing temperatures on the duration of gonotropic cycle of *Anopheles albimanus*. *Mem Inst Oswaldo Cruz*. 2005 100(5): 515-520.

Class Eleven – November 27th, 2007	
Onchocerciasis: Environmental controls vs. mass treatment **Video: Rx for Survival segment on River Blindness**	**Frank Richards, The Carter Center**
Readings:	Winnen, M. Can Ivermection mass treatments eliminate onchocerciasis in Africa? *Bull WHO*. 2002 80(5): 384-390. Hopkins, AD. Ivermectin and onchocerciasis: Is it all solved? *Eye*. 2005 19:1057-1066.

Class Twelve – December 4, 2007	
The health effects of extreme weather	**Jeremy Hess**

Readings:	Floret N, Viel J-F, Mauny, F, Hoen B, Piarroux R. Negligible risk for epidemics after geophysical disasters. *Emerg Inf Dis* 2006 12:543-548. Waring SC, Brown BJ. The threat of communicable diseases following natural disasters: a public health response. *Disaster Management and Response* 2005 3:41-47. Charron D, Thomas M, Waltner-Toews D, Aramini J, Edge, Kent R, Maarouf A, Wilson J. Vulnerability of waterborne diseases to climate change in Canada: a review. Journal of Toxicology & Environmental Health Part A. 67:1667-77, 2004. Hunter PR. Climate change and waterborne and vector-borne disease. J App Microbio. 94: 37S-46S, 2003. Morgan O. Infectious disease risks from dead bodies following natural disasters. *Rev Panam Salud Publica* 2004 15(5):307-12 *Available at*: http://www.scielosp.org/scielo.php?script=sci_issuetoc&pid=1020-498920040005&lng=en&nrm=iso

Classes Fourteen – December 11, 2007
Student Presentations Group A Presentations: Group B Presentations: All members of the group are required to attend both of their group sessions.

Final papers are due December 14, 2007 by 5 p.m. You must provide a hard copy of your paper in Dr. Moe's mailbox (7th floor of the Grace Crum Rollins building) before the deadline.

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