Adaptation and Resilience in Water Resources Systems

GEOG 696O Seminar, Spring Semester 2011
Meets in Altschul Lab (Harvill Bldg. Room 402), Fridays 12:30 – 3:00

Instructor

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Seminar summary

[from course catalog] Climate change, urban growth, energy demand, and global food trade alter water in coupled human-natural systems. This seminar addresses adaptation and resilience using material on river basins, aquifers, infrastructure, policy, and institutions from Southwest U.S., transboundary U.S.-Mexico, and international cases.

As we enter an era of drastically heightened pressure on water resources combined with greater exposure to extremes (drought and floods), human societies and ecosystems adapt in unforeseen ways. Decision-making by water users, agencies, and global water initiatives must rethink conventional approaches that have assumed bounded variability in hydrologic, water demand, and institutional terms. The new conception of water resource systems – unbounded to allow for multiple future outcomes – seeks to better integrate scientific, engineering, social, and institutional perspectives. It requires new understanding of multiple factors that influence how water is used and managed and how innovation and adaptation arise and can be strengthened. Thresholds, system reorganization, multiple equilibria, and the societal and ecosystem implications of alternative water resource systems will be addressed.

What can students expect to gain from this seminar?

This is an opportunity to refine your interests related to adaptation and resilience of water resources systems in the context of global change, inter-sectoral water allocation, and progressive policy. I emphasize a geographical perspective on international and transboundary dimensions of adaptive water management, and promote inter-disciplinary scholarship. I strongly encourage you to use seminar discussions and the research paper (or research proposal) as the means to fine-tune your own research design and make headway on your thesis, dissertation, or research proposal. Please feel free to contact me if you need further information.

Seminar objectives

1. Place societal water use and dependence in the broader context of global change
2. Sample the literature on the theory and application of adaptation and resilience with particular emphasis on water resources
3. Identify and discuss the role of agriculture and irrigation in complex human-natural systems
4. Relate seminar content to your experience and provide insights that should be useful in your future
5. Write and present, as part of the seminar, a scholarly research paper or full research proposal
6. Build inter-disciplinary bridges among students and faculty across campus and beyond

Requirements

Students must actively participate in seminar discussions, and must write an original research paper (min. 20 pages, double-spaced) **or** research proposal (min. 15 pages, double-spaced plus 5 pages supporting documentation including fully developed budget with justification) that is conceptualized, researched, orally presented in seminar (with feedback from the instructor and fellow students), and finalized as part of the course.

There is no pre-requisite for this course.

Grading policy

Grades are based on regular participation in seminar discussions, in-class presentation of your research paper, and satisfactory revision and submission of your research paper or proposal. Using the rubrics below, regular grades (A, B, C, D, or E) will be awarded upon completion of the seminar.

Seminar participation (total 30%) based on:	*Expectation for A-grade*
20% - Lead min. one discussion of readings	*Clearly relate theory/ main argument to broader context, pose questions for discussion & conceptual development.*
10% - Join discussions led by others	*Insightful comments showing you have read the material.*
Research paper or proposal (total 70%) based on:	
5% - Abstract & prelim. lit review (due 2/4)	*Descriptive title, articulate research question, 10 annotated references (not including seminar readings).*
Presentation (during 4/22 and 4/29 seminars)	
5% - Assessment by fellow students	*Effective communication, topic with scientific merit and societal relevance.*
10% - Assessment by instructor	*Paper: summarize research questions and findings; or Proposal: integrate research questions, tasks, budget.*
50% - Final paper/ proposal due 5/6 (e-copy only)	*Review literature, identify theoretical/ conceptual gaps in which to situate your research. For paper, demonstrate analytical rigor, relate findings/ discussion to theory and concept, explore ways forward/ next steps. Or, for proposal, link objectives and tasks to methods and resources (including budget) required to achieve stated goals.*

Invited speakers

Lance Gunderson, Emory University
Diana Liverman, Institute of the Environment
Gregg Garfin, Institute of the Environment
Margaret Wilder, Latin American Studies, Geography & Development, and Udall Center
Sharon Megdal, Water Resources Research Center

Course materials

Gunderson, Lance H., Craig R. Allen and C.S. Holling (eds.). 2010. Foundations of Ecological Resilience. Washington, D.C.: Island Press.

Walker, Brian and David Salt. 2006. Resilience Thinking: Sustaining Ecosystems and People in a Changing World. Washington D.C.: Island Press.

Gunderson, Lance and C.S. Holling (eds.). 2002. Panarchy: Understanding Transformations in Human and Natural Systems. Washington D.C.: Island Press.

Journal articles and book chapters will be posted on the course D2L website or distributed in class.

Recommended (optional):

Hollnagel, Erik, David D. Woods, and Nancy Leveson (eds.). 2006. Resilience Engineering: Concepts and Precepts. Ashgate Publishing.

Seminar policies

All students should be familiar with the following University of Arizona policies:

- Student Code of Conduct: http://deanofstudents.arizona.edu/policiesandcodes/studentcodeofconduct
- Code of Academic Integrity: http://deanofstudents.arizona.edu/codeofacademicintegrity

Students with disabilities

Please register with the Disability Resource Center and see me in order to accommodate any special needs you may have.

SCHEDULE of TOPICS (subject to revision as agreed/ announced)

Date	Topic	Reading / *Notes*
1/14	Introductions by seminar participants; seminar overview.	Walker, B. and D. Salt. 2006. "Living in a Complex World: An Introduction to Resilience Thinking" (pp. 1-14) in Resilience Thinking. Univ. Arizona (Scott, C.A., D. Kang, K. Lansey, , G. Bayraksan, R. Arnold, C. Choi). 2011 draft. Water Resource Systems Planning: Sustainability, Resilience, and Robustness. Paper presented at NSF EFRI-RESIN Workshop on Infrastructure Sustainability, Resilience, and Robustness, Tucson, Arizona, Jan. 13-14, 2011.
1/21	Global change	O'Brien, K.L. and R.M. Leichenko. 2000. Double exposure: Assessing the impacts of climate change within the context of economic globalization. *Global Environmental Change* 10: 221-232. Milly, P.C.D., Julio Betancourt, Malin Falkenmark, Robert M. Hirsch, Zbigniew W. Kundzewicz, Dennis P. Lettenmaier, Ronald J. Stouffer. 2008. Stationarity is dead: Whither water management? *Science* 319: 573-574. doi 10.1126/science.1151915 Pahl-Wostl, Claudia. 2007. Transitions towards adaptive management of water facing climate and global change. *Journal Water Resources Management* 21(1): 49-62. DOI 10.1007/s11269-006-9040-4.
1/28	Resilience and decision-making	***Meet in Marshall Bldg. Rm. 531, observe a new NSF project inception meeting.*** Scott, C.A., H.R. Gimblett, T. Meixner, B.J. Morehouse, M. Pavao Zuckerman. 2009. Strengthening Resilience of Arid Region Riparian Corridors: Ecohydrology and Decision-Making in the Sonora and San Pedro Watersheds. Proposal approved for $1,400,000 by NSF, Dynamics of Coupled Natural and Human Systems. Young, O.R. 2010. Institutional dynamics: Resilience, vulnerability and adaptation in environmental and resource regimes. *Global Environmental Change* 20: 378–385.
2/4	Ecological resilience	***Abstract and preliminary literature review for paper or proposal due (e-submission only as .doc).*** Gunderson, L.H., C.R. Allen, C.S. Holling. 2010. Foundations of Ecological Resilience (pp. XIII – 18). Holling, C.S. 1973. "Resilience and Stability of Ecological Systems" (pp. 19-49) in Gunderson et al (eds). 2010. Foundations of Ecological Resilience. Gunderson, L.H., C.S. Holling, and C.R. Allen. 2010. "The Evolution of an Idea – the Past, Present and Future of Ecological Resilience" (pp. 423-444) in Gunderson et al (eds). 2010. Foundations of Ecological Resilience. Walker, B. and D. Salt. 2006. "Crossing the Threshold: Be Careful about the Path You Choose – You May Not be Able to Return" (pp. 53-63) in Resilience Thinking.

Date	Topic	Reading / *Notes*
2/11	Panarchy	Walker, B. and D. Salt. 2006. "In the Loop: Phases, Cycles, and Scales – Adaptive Cycles and How Systems Change" (pp. 74-95) in Resilience Thinking. Holling, C.S., L.H. Gunderson, D. Ludwig. 2002. "In Quest of a Theory of Adaptive Change" (Ch. 1, pp. 3-22) in Panarchy. Holling, C.S., L.H. Gunderson. 2002. "Resilience and Adaptive Cycles" (Ch. 2, pp. 25-62) in Panarchy. Westley, F., S.R. Carpenter, W.A. Brock, Holling, C.S., L.H. Gunderson. 2002. "Why Systems of People and Nature Are Not Just Social and Ecological Systems" (Ch. 4, pp. 103-119) in Panarchy. Jannssen, M.A. 2002. "A Future of Surprises" (Ch. 9, pp. 241-260) in Panarchy.
2/18	Social-ecological systems	*Diana Liverman (12:30 guest speaker) to present and discuss:* Liverman, D.M. and Billett S. 2010. Copenhagen and the Governance of Adaptation. *Environment* May/Jun 2010. 52(3): 28-36. New, M., D. Liverman, H. Schroeder, and K. Anderson. 2010. Four degrees and beyond: the potential for a global temperature increase of four degrees and its implications *Phil. Trans. R. Soc. A* January 13, 2011 369: 6-19. New, M., D. Liverman, and K. Anderson. 2009. Mind the gap. *Nature* (Reports Climate Change), 143-144. Rockström, J., W. Steffen, K. Noone, Å. Persson, F.S. Chapin, E.F. Lambin, T.M. Lenton, M. Scheffer, C. Folke, H.J. Schellnhuber, B. Nykvist, C.A. de Wit, T. Hughes, S. van der Leeuw, H. Rodhe, S. Sörlin, P.K. Snyder, R. Costanza, U. Svedin, M. Falkenmark, L. Karlberg, R.W. Corellm, V.J. Fabry, J. Hansen, B. Walker, D. Liverman, K. Richardson, P. Crutzen, and & J.A. Foley. 2009. A safe operating space for humanity. *Nature* 461, 472-475 (24 September 2009). Lemos, M.C., E. Boyd, E. Tompkins, H. Osbahr, and D. Liverman 2007. Developing adaptation and adapting development. *Ecology and Society*12(2): 26 [online] URL: http://www.ecologyandsociety.org/vol12/iss2/art26/ Biermann, F., M.M. Betsill, S. Camargo Vieira, J. Gupta, N. Kanie, L. Lebel, D. Liverman, H. Schroeder, B. Siebenhuner, P.Z. Yanda, R. Zondervan. 2010. Navigating the anthropocene: the Earth System Governance Project strategy paper, *Current Opinion in Environmental Sustainability*, In Press, Corrected Proof, Available online 30 May 2010, ISSN 1877-3435, DOI: 10.1016/j.cosust.2010.04.005. *Recommended:* Prichard, L. Jr., S.E. Sanderson. 2002. "The Dynamics of Political Discourse in Seeking Sustainability" (Ch. 6, pp. 147-169) in Panarchy.

Date	Topic	Reading / *Notes*
2/25	Adaptive systems	*Margaret Wilder (12:30 guest speaker) to present and discuss:* Wilder, M., C.A. Scott, N. Pineda Pablos, R.G. Varady, G.M. Garfin, J. McEvoy. 2010. Adapting across boundaries: climate change, social learning, and resilience in the U.S.-Mexico border region. *Annals of the Association of American Geographers* 100(4): 917-928. Ostrom, E. 2007. A diagnostic approach for going beyond panaceas. *Proceedings of the National Academy of Sciences* 104(39): 15181–15187. Walker, B. and D. Salt. 2006. "Making Sense of Resilience: How Do You Apply Resilience Thinking" (pp. 111-124) in Resilience Thinking. Westley, F. 2006. "The Devil in the Dynamics: Adaptive Management on the Front Lines" (Ch. 13, pp. 333-360) in Panarchy. *Recommended:* Wester, P. 2008. When the pumps run dry: Arresting groundwater depletion in Guanajuato. In Shedding the Waters (PhD dissertation, pp. 173-207 **and conclusions and references**). Wageningen University, The Netherlands. Chapters 14-16 and Appendices in Panarchy.
3/4	Research blitz	***Seminar research progress (each 5 min. presentation followed by 5 min. Q&A)***
3/11	Infrastructure resilience	Woods, David D. 2006. "Essential Characteristics of Resilience" (pp. 21-34) in Hollnagel, Erik, David D. Woods, and Nancy Leveson (eds.). 2006. Resilience Engineering: Concepts and Precepts. Ashgate Publishing. Holling, C.S. 1996. "Engineering Resilience versus Ecological Resilience" (pp. 51-66) in Gunderson et al (eds). 2010. Foundations of Ecological Resilience. Scott, C.A., M.J. Pasqualetti. In press. Energy and water resources scarcity: Critical infrastructure for growth and economic development in Arizona and Sonora. *Natural Resources Journal* 50.3: xx. *Recommended/optional* (in Hollnagel et al (eds.) 2006. Resilience Engineering): Westrum, Ron. 2006. "A Typology of Resilience Situations" (pp. 55-66); Hollnagel, E., D.D. Woods "Epilogue: Resilience Engineering Precepts" (pp. 347-358)
3/18	*No seminar*	***Spring Break***

Date	Topic	Reading / *Notes*
3/25	Agricultural AWM and urban AWM (adaptive water management)	Chapagain, Ashok K., Arjen Y. Hoekstra. 2008. The global component of freshwater demand and supply: an assessment of virtual water flows between nations as a result of trade in agricultural & industrial products. *Water International* 33(1):19-32. Molden, David, Theib Y. Oweis, Pasquale Steduto, Jacob. W. Kijne, Munir A. Hanjra, Prem S. Bindraban. 2007. Pathways for increasing agricultural water productivity (pp. 279-310). In David Molden (ed.) Water for Food, Water for Life. Earthscan, London; International Water Management Institute, Colombo. Scott, C.A., N. Pineda Pablos. In review. Innovating Resource Regimes: Water, Wastewater, and the Institutional Dynamics of Urban Hydraulic Reach in Northwest Mexico. Submitted to Geoforum. *Sharon Megdal (2:00 guest speaker) to present and discuss:* Megdal, Sharon B. 2006. Municipal water reuse in Tucson, Arizona, USA. Paper presented at NATO workshop on water security. Megdal, Sharon B. with K. Mott Lacroix. 2006. Water Resource Availability for the Tucson Metropolitan Area. Water Resources Research Center, The University of Arizona.
4/1	Field trip	*8:30 – 5:00 pm; meet at Water Resources Research Center (350 N. Campbell Ave.). Lunch will kindly be provided.*
4/8	Science-policy co-production	Morehouse, Barbara J., Daniel B. Ferguson, Gigi Owen, Anne Browning-Aiken, Pablo Wong-Gonzalez, Nicolás Pineda and Robert Varady. 2007. Science and socio-ecological resilience: Examples from the Arizona-Sonora Border. *Environmental Science & Policy* 11(3): 272-284. doi:10.1016/j.envsci.2007.07.007 Lemos, M. C. and B. J. Morehouse, 2005. The co-production of science and policy in integrated climate assessments. *Global Environmental Change* 15: 57-68. Walker, B. and D. Salt. 2006. "Scenarios on the Lakes: The Northern Highlands Lake District, Wisconsin" (pp. 96-110), "Building Resilience in the Wetlands: The Kristianstads Vattenrike, Sweden" (pp. 125-138), and "Creating Space in a Shrinking World: Resilience and Sustainability" (pp. 139-157) in Resilience Thinking. *Gregg Garfin (2:00 guest speaker):* "Collaborative Research for Water Resource Management Under a Changing Climate". Garfin, G., M.A. Crimmins, and K.L. Jacobs. 2007. Drought, climate variability, and implications for water supply and management. In B.G. Colby and K.L. Jacobs (eds.), Arizona Water Policy. Resources for the Future Press, Washington DC, pp. 61-78.

Date	Topic	Reading / *Notes*
4/15	*No seminar*	***Annual Meeting of the Association of American Geographers, Seattle, Washington***
4/22	Research presentations	***Seminar research presentations, discussion and feedback***
4/29	Research presentations (continued)	***Seminar research presentations, discussion and feedback***
5/6	*No seminar - classes end on 5/5*	***Final paper or proposal due (e-submission only as fully formatted, single-document .pdf emailed to cascott@email.arizona.edu).***

Final note

All information contained in this syllabus, except the grading policy, may be subject to change with reasonable advance notice, and considering seminar participants' input.