

Seminar Course

Spring 2021

Metacoupling Science: Interdisciplinary Frontiers and Global Applications

Course Number: FW893 (Section 731)

Number of Credits: 1

Instructor:

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Class Time:

Thursdays: 9:00-9:50 am EST (Zoom)

Office Hour:

Thursdays: 10:00-11:00 am EST (Zoom)

(Please sign up if you would like to meet:

<https://docs.google.com/spreadsheets/d/1Adw1Uxj7Ygdp2AClRtdG0Yk2rpkQff6CrFjwnk3r92w/edit?usp=sharing>). If you are not available during this time or need additional time, please email us for appointments)

Course Description:

This course will examine key issues and exciting frontiers in the new science of metacoupling (human-nature interactions within as well as between adjacent and distant [coupled human and natural systems](#), e.g., social-ecological systems, human-environment systems). Metacoupling science has emerged as a hot topic as it helps guide innovative scientific discoveries and create integrated solutions to global challenges in sustainability, conservation, management, policy, and governance. Besides discussing important metacoupling concepts and methods as well as applications to a variety of important scientific, socioeconomic, and environmental issues (e.g., biodiversity, climate change, ecosystem services, energy, environment, fisheries, food, forest, species invasion, land, trade, water, and wildlife), students will have opportunities to learn how to write high-impacts papers and communicate with global news and social media.

Grading System:

Pass or Fail (for all items below and overall)

Expectations:

- Read the reading materials before class
- Attend every class (unless beyond control and received approval)
- Ask and answer questions
- Lead discussion
- Turn off or silence phones
- Do nothing unrelated during class
- Have fun☺

Optional Term Project

(For those students who would be interested in doing a term project and write a term paper, we would be happy to help. Please email or talk with either of us if you would like to discuss.)

Objective: Practice writing a paper (e.g., empirical analysis, literature review, synthesis, or perspectives)

Topic: Issues related to metacoupling (telecoupling, pericoupling, and/or intracoupling)

Project Type: Individual or group project.

Suggested Timeline:

Project proposal (topic and outline):	February 15
Draft paper:	April 10
Final paper:	April 30

A project proposal may consist of the following aspects:

- Background and motivation for the proposed research
- Research goal and objectives
- Research questions and/or hypotheses
- Methods (e.g., conceptual diagram(s) to illustrate relationships among different research components, data, analysis methods)
- Feasibility (e.g., data availability, possible data gaps)
- Expected outcomes (e.g., expected research findings)
- Significance

Course Schedule

Date	Topic (Guest Speaker if Any)
1/21	Introduction, Course Overview, Global Issues and UN Sustainable Development Goals
1/28	Coupled Human and Natural Systems
2/4	Telecoupling
2/11	Metacoupling
2/18	Critiques and Clarifications
2/25	How to Write High-impact Papers (Dr. Zhenci Xu , The University of Hong Kong)
3/4	Telecoupled Agent-based Modeling (Dr. Yue Dou , Vrije Universiteit Amsterdam, The Netherlands)
3/11	Opportunities for Metacoupling Research on Protected Areas (Dr. Vanessa Hull , University of Florida)
3/18	Human-Wildlife Interactions (Coexistence) (Dr. Neil Carter , University of Michigan)
3/25	Fisheries as metacoupled human and natural systems (Dr. Andrew Carlson , Princeton University)
4/1	Amplify Metacoupling Research Impact through Global News and Social Media (Sue Nichols , Assistant Director of Strategic Communication, CSIS)
4/8	Systems Integration and Governance
4/15	Europe's PhD Program in Telecoupling (Dr. Jonas Ø. Nielsen , Humboldt-Universität zu Berlin, Germany)
4/22	No Class (study day)
4/29	Reflections and Perspectives (and potential short presentations by those students who choose to do research projects, if any)

Reading Materials

(PDF of each paper can be downloaded from the GitHub folder at
<https://github.com/MetaCHANS/Metacoupling-Science-Course/tree/main/readings>)

1/21

UN Sustainable Development Goals (SDGs) <https://sdgs.un.org/goals> (click on the SDG icons to learn more)

1/28

Liu, Jianguo, Thomas Dietz, Stephen R. Carpenter, Carl Folke, Marina Alberti, Charles L. Redman, Stephen H. Schneider, Elinor Ostrom, Alice N. Pell, Jane Lubchenco, William W. Taylor, Zhiyun Ouyang, Peter Deadman, Timothy Kratz, William Provencher. 2007. Coupled human and natural systems. *Ambio* 36:639-649.

Liu, Jianguo, Thomas Dietz, Stephen Carpenter, Marina Alberti, Carl Folke, Emilio Moran, Alice Pell, Peter Deadman, Timothy Kratz, Jane Lubchenco, Elinor Ostrom, Zhiyun Ouyang, William Provencher, Charles Redman, Stephen Schneider, and William Taylor. 2007. Complexity of Coupled Human and Natural Systems. *Science* 317:1513 – 1516

Ostrom, E. 2009. A general framework for analyzing sustainability of social-ecological systems. *Science*, 325(5939), 419-422.

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Liu, Jianguo, Vanessa Hull, Mateus Batistella, Ruth DeFries, Thomas Dietz, Feng Fu, Thomas W. Hertel, Roberto César Izaurralde, Eric F. Lambin, Shuxin Li, Luiz Antonio Martinelli, William McConnell, Emilio F. Moran, Rosamond Naylor, Zhiyun Ouyang, Karen R. Polenske, Anette Reenberg, Gilberto de Miranda Rocha, Cynthia S. Simmons, Peter H. Verburg, Peter M. Vitousek, Fusuo Zhang, Chunquan Zhu. 2013. Framing sustainability in a telecoupled world. *Ecology and Society* 18 (2): 26.

Liu, Jianguo, Yue Dou, Mateus Batistella, Edward Challies, Thomas Connor, Cecilie Friis, James D.A. Millington, Esther Parish, Chelsie Romulo, Ramon Felipe Bicudo da Silva, Heather Triezenberg, Hongbo Yang, Zhiqiang Zhao, Karl Zimmerer, Falk Huettmann, Michael L. Treglia, Zeenatul Basher, Min Gon Chung, Anna Herzberger, Andrea Lenschow, Altaaf Mechiche-Alami, Jens Newi, James Roche, and Jing Sun. 2018. Spillover systems in a telecoupled Anthropocene: Typology, methods, and governance for global sustainability. *Current Opinion in Environmental Sustainability* 33:58–69.

Schrötera, Matthias, Thomas Koellner, Rob Alkemade, Sebastian Arnhold, Kenneth J. Bagstad, Karlheinz Erb, Karin Frank, Thomas Kastner, Meidad Kissinger, Jianguo Liu, Laura López-Hoffman, Joachim Maes, Alexandra Marques, Berta Martín-López, Carsten Meyer,

Catharina J.E. Schulp, Jule Thober, Sarah Wolff, Aletta Bonna. 2018. Interregional flows of ecosystem services: Concepts, typology and four cases. *Ecosystem Services* 31, Part B, pp 231-241

2/11

Liu, Jianguo. 2017. Integration across a metacoupled world. *Ecology and Society*, 22(4).

Zhao, Zhiqiang, Meng Cai, Fang Wang, Julie A. Winkler, Thomas Connor, Min Gon Chung, Jindong Zhang, Hongbo Yang, Zhenci Xu, Ying Tang, Zhiyun Ouyang, Hemin Zhang, and Jianguo Liu. 2021. Synergies and Tradeoffs among Sustainable Development Goals across Boundaries in a Metacoupled World. *Science of the Total Environment* 751: 141749

2/18

Friis, C., Nielsen, J. Ø., Otero, I., Haberl, H., Niewöhner, J., & Hostert, P. 2016. From teleconnection to telecoupling: taking stock of an emerging framework in land system science. *Journal of Land Use Science*, 11(2), 131-153.

Liu, Jianguo, Anna Herzberger, Kelly Kapsar, Andrew Carlson, Thomas Connor. 2019. What is telecoupling? Pp. 19-48. In: *Telecoupling: Exploring land-use change in a globalised world*. (Eds. Cecilie Friis and Jonas Østergaard Nielsen). Palgrave Macmillan Publishers Ltd.

2/25

Xu, Zhenci, Sophia N. Chau, Jian Zhang, Yingjie Li, Thomas Dietz, Jinyan Wang, Xiuzhi Chen, Shaohua Wu, Julie A. Winkler, Fan Fan, Shuxin Li, Anna Herzberger, Ying Tang, Yunkai Li, Jianguo Liu. 2020. Assessing progress towards sustainable development over space and time. *Nature* 577: 74-78.

Xu, Zhenci, Yingjie Li, Sophia N. Chau, Thomas Dietz, Canbing Li, Luwen Wan, Jindong Zhang, Liwei Zhang, Yunkai Li, Min Gon Chung, and Jianguo Liu 2020 Impacts of international trade on global sustainable development. *Nature Sustainability* 3:964–971

Xu, Zhenci, Xiuzhi Chen, Jianguo Liu, Yu Zhang, Sophia Chau, Nishan Bhattarai, Ye Wang, Yingjie Li, Thomas Connor, Yunkai Li 2020 Impacts of irrigated agriculture on food-energy-water-CO₂ nexus across metacoupled systems. *Nature Communications*. 11: 5837.

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Dou, Yue, James D.A. Millington, Ramon Felipe Bicudo Da Silva, Paul McCord, Andrés Viña, Qian Song, Qiangyi Yu, Wenbin Wu, Mateus Batistella, Emilio Moran & Jianguo Liu. 2019 Land-use changes in distant places: Design of a telecoupled agent-based model. *Journal of Land Use Science*. 14:119-209

Dou, Yue, Guolin Yao, Anna Herzberger, Ramon Felipe Bicudo da Silva, Qian Song, Ciara Hovis, Mateus Batistella, Emilio Moran, Wenbin Wu and Jianguo Liu. 2020. Land-use changes in distant places: Implementation of a telecoupled agent-based model. *Journal of Artificial Societies and Social Simulation* 23 (1) 11. DOI: 10.18564/jasss.4211.

3/11

Hull, V., Rivera, C. J., & Wong, C. 2019. A Synthesis of Opportunities for Applying the Telecoupling Framework to Marine Protected Areas. *Sustainability*, 11(16), 4450.

Hull, V., & Liu, J. 2018. Telecoupling: A new frontier for global sustainability. *Ecology and Society*, 23(4).

Zhang, J., Connor, T., Yang, H., Ouyang, Z., Li, S., & Liu, J. 2018. Complex effects of natural disasters on protected areas through altering telecouplings. *Ecology and Society*, 23(3).

3/18

Carter, Neil, Binoj K. Shrestha, Jhamak B. Karki, Narendra Man Babu Pradhan, Jianguo Liu 2012 Coexistence between wildlife and humans at fine spatial scales. *PNAS* 109: 15360-15365

Carter, N.H., Killion, A., Easter, T., Brandt, J., and Ford, A. 2020. [Road development in Asia: range-wide risks to tigers](#). *Science Advances* 6, eaaz9619

3/25

Carlson, Andrew K., William W. Taylor, Daniel I. Rubenstein, Simon A. Levin and Jianguo Liu 2020. Global marine fishing across space and time. *Sustainability* 12, 4714; doi:10.3390/su12114714.

Carlson, Andrew K., Daniel I. Rubenstein, and Simon A. Levin. 2020. Linking multiscale fisheries using metacoupling models." *Frontiers in Marine Science* 7 (2020): 614.

Carlson, A. K., D. I. Rubenstein, S. A. Levin. 2021. Modeling Atlantic herring fisheries as multiscale human-natural systems. *Fisheries Research* 236:105855.

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Walsh, Bryan 2011. The New Science of Telecoupling Shows Just How Connected the World Is—For Better and For Worse. <https://science.time.com/2011/02/23/the-new-science-of-telecoupling-shows-just-how-connected-the-world-is%E2%80%94for-better-and-for-worse/>

Thiaw, Ibrahim and Achim Steine. 2019 'Tele-coupling' and why your choice matters for the planet <https://news.trust.org/item/20190617080047-bv0jq>

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Liu, Jianguo, Harold Mooney, Vanessa Hull, Steven J. Davis, Joanne Gaskell, Thomas Hertel, Jane Lubchenco, Karen C. Seto, Peter Gleick, Claire Kremen, Shuxin Li. 2015. Systems integration for global sustainability. *Science* 347:1258832. DOI: 10.1126/science.1258832.

Munroe, Darla K., Mateus Batistella, Cecilie Friis, Nestor Ignacio Gasparri, Eric F. Lambin, Jianguo Liu, Patrick Meyfroidt, Emilio Moran, Jonas Østergaard Nielsen, 2019 Governing flows in telecoupled land systems. *Current Opinion in Environmental Sustainability*, 38:53-59.

Liu, Jianguo 2018 An integrated framework for achieving sustainable development goals around the world. *Ecology, Economy and Society—the INSEE Journal*; 1 (2): 11 –17.

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Europe's PhD Program in Telecoupling: Operationalising Telecouplings for Solving Sustainability Challenges for Land Use <http://coupled-itn.eu/>

Optional readings

(PDF of each paper can be downloaded from the GitHub folder at
<https://github.com/MetaCHANS/Metacoupling-Science-Course/tree/main/readings>)

Websites

Telecoupling: www.telecoupling.org

Telecoupling Toolbox: <https://telecouplingtoolbox.org/>

Global Land Programme's Telecoupling Working Group: <https://glp.earth/how-we-work/working-groups/telecoupling-research-towards-sustainable-transformation-land-systems>

CHANS-Net: International Network of Research on Coupled Human and Natural Systems
(<http://chans-net.org/>)

<https://sdgs.un.org/2030agenda>

Progress and Perspectives

Kapsar, Kelly E., Ciara L. Hovis, Ramon Felipe Bicudo da Silva, Erin K. Buchholtz, Andrew K. Carlson, Yue Dou, Yueyue Du, Paul R. Furumo, Yingjie Li, Aurora Torres, Di Yang, Ho Yi Wan, Julie G. Zaehring and Jianguo Liu 2019. Telecoupling research: The first five years. *Sustainability* 11, 1033; doi:10.3390/su11041033

Kramer, D. B., Hartter, J., Boag, A. E., Jain, M., Stevens, K., Nicholas, K. A., ... & Liu, A. J. (2017). Top 40 questions in coupled human and natural systems (CHANS) research. *Ecology and Society*, 22(2).

Applications

Deines, J. M., Liu, X., & Liu, J. (2016). Telecoupling in urban water systems: an examination of Beijing's imported water supply. *Water International*, 41(2), 251-270.

Liu, J. (2014). Forest Sustainability in China and Implications for a Telecoupled World. *Asia & the Pacific Policy Studies*, 1(1), 230-250.

Herzberger, Anna, Min Gon Chung, Kelly Kapsar, Kenneth Frank, Jianguo Liu 2019
Telecoupled food trade affects pericoupled trade and intracoupled production. *Sustainability* 11(10), 2908 <https://www.mdpi.com/2071-1050/11/10/2908>

Friis, C., & Nielsen, J. (2017). Land-use change in a telecoupled world: the relevance and applicability of the telecoupling framework in the case of banana plantation expansion in Laos. *Ecology and Society*, 22(4).

Zhao, Zhiqiang, Meng Cai, Thomas Connor, Min Gon Chung, and Jianguo Liu. "Metacoupled Tourism and Wildlife Translocations Affect Synergies and Trade-Offs among Sustainable Development Goals across Spillover Systems." *Sustainability* 12, no. 18 (2020): 7677.

Martín-López, Berta, Patricia Balvanera, Robert Manson, Tuyeni Heita Mwampamba, and Albert Norström. "Contributions of place-based social-ecological research to address global sustainability challenges." *Global Sustainability* 3 (2020).

López-Hoffman, L., Diffendorfer, J., Wiederholt, R., Bagstad, K. J., Thogmartin, W. E., McCracken, G., ... & Semmens, D. J. (2017). Operationalizing the telecoupling framework for migratory species using the spatial subsidies approach to examine ecosystem services provided by Mexican free-tailed bats. *Ecology and Society*, 22(4).

Coenen, Johanna, Simon Bager, Patrick Meyfroidt, Jens Newig, and Edward Challies. "Environmental Governance of China's Belt and Road Initiative." *Environmental Policy and Governance* (2020).

Wu, Changyan, Xianjin Huang, and Bowen Chen. "Telecoupling mechanism of urban land expansion based on transportation accessibility: A case study of transitional Yangtze River economic Belt, China." *Land Use Policy* 96 (2020): 104687.

Marola, Elena, Judith Schöpfner, Caleb Gallemore, and Kristjan Jespersen. "The bandwidth problem in telecoupled systems governance: Certifying sustainable winemaking in Australia and Chile." *Ecological Economics* 171 (2020): 106592.

Ibarrola-Rivas, Maria-Jose, Antonio J. Castro, Thomas Kastner, Sanderine Nonhebel, and Francis Turkelboom. "Telecoupling through tomato trade: what consumers do not know about the tomato on their plate." *Global Sustainability* 3 (2020).

Fang, Baling, Yi Tan, Canbing Li, Yijia Cao, Jianguo Liu, Pia-Johanna Schweizer, Haiqing Shi, Bin Zhou, Hao Chen, Zhuangli Hu 2016. Energy sustainability under the framework of telecoupling. *Energy*. 106: 253–259

Carlson, A. K., W. W. Taylor, J. Liu, I. Orlic. 2018. Peruvian anchoveta as a telecoupled fisheries system. *Ecology and Society* 23(1):35.

Methods

McConnell WJ, *et al.* (2011) Research on Coupled Human and Natural Systems (CHANS): Approach, Challenges, and Strategies. *Bull Ecol Soc Am* 92(2):218-228.

Tonini, F. and J. Liu. 2017. Telecoupling Toolbox: Spatially explicit tools for studying telecoupled human and natural systems. *Ecology and Society* 22 (4):11.

McCord, Paul, Francesco Tonini, and Jianguo Liu. 2018 The Telecoupling GeoApp: A Web-GIS Application to Systematically Analyze Telecouplings and Sustainable Development. *Applied Geography* 96:16–28.

Sonderegger, Gabi, Christoph Oberlack, Jorge Llopis, Peter Verburg, and Andreas Heinemann. "Telecoupling visualizations through a network lens: a systematic review." *Ecology and Society* 25, no. 4 (2020).

Carlson, A. K., Zaehring, J. G., Garrett, R. D., Felipe Bicudo Silva, R., Furumo, P. R., Raya Rey, A. N., ... & Liu, J. (2018). Toward rigorous telecoupling causal attribution: A systematic review and typology. *Sustainability*, 10(12), 4426.

Millington, J. D., Xiong, H., Peterson, S., & Woods, J. (2017). Integrating modelling approaches for understanding telecoupling: Global food trade and local land use. *Land*, 6(3), 56.

Koellner, T., Bonn, A., Arnhold, S., Bagstad, K. J., Fridman, D., Guerra, C. A., ... & Liu, J. (2019). Guidance for assessing interregional ecosystem service flows. *Ecological Indicators*, 105, 92-106.

Kleemann, Janina, Matthias Schröter, Kenneth J. Bagstad, Christian Kuhlicke, Thomas Kastner, Dor Fridman, Catharina J. E. Schulp, et al. Quantifying Interregional Flows of Multiple Ecosystem Services – A Case Study for Germany. *Global Environmental Change* 61: 102051.

Liu, Jianguo, Vanessa Hull, H. Charles J. Godfray, David Tilman, Peter Gleick, Holger Hoff, Claudia Pahl-Wostl, Zhenci Xu, Min Gon Chung, Jing Sun, Shuxin Li 2018 Nexus approaches to global sustainable development. *Nature Sustainability* 1: 466–476.

Tukker, Arnold, and Erik Dietzenbacher. "Global multiregional input–output frameworks: an introduction and outlook." *Economic Systems Research* 25, no. 1 (2013): 1-19.

Wiedmann, Thomas, and Manfred Lenzen. "Environmental and social footprints of international trade." *Nature Geoscience* 11, no. 5 (2018): 314-321.

Lenzen, Manfred, Daniel Moran, Keiichiro Kanemoto, Barney Foran, Leonarda Lobefaro, and Arne Geschke. "International trade drives biodiversity threats in developing nations." *Nature* 486, no. 7401 (2012): 109-112.

Fath, B., and U. Scharler. "Systems Ecology: Ecological Network Analysis☆." (2018): 1083-1088.

Barnes, Michele L., Örjan Bodin, Angela M. Guerrero, Ryan RJ McAllister, Steven M. Alexander, and Garry Robins. "The social structural foundations of adaptation and transformation in social–ecological systems." *Ecology and Society* 22, no. 4 (2017).

Sayles, J. S., M. Mancilla Garcia, M. Hamilton, S. M. Alexander, J. A. Baggio, A. P. Fischer, K. Ingold, G. R. Meredith, and J. Pittman. "Social-ecological network analysis for sustainability sciences: a systematic review and innovative research agenda for the future." *Environmental Research Letters* 14, no. 9 (2019): 093003.

Sayles, Jesse S., and Jacopo A. Baggio. "Social–ecological network analysis of scale mismatches in estuary watershed restoration." *Proceedings of the National Academy of Sciences* 114, no. 10 (2017): E1776-E1785.

Schaffer-Smith, Danica, Stephanie Tomscha, Karl Jarvis, Dorothy Maguire, Michael Treglia, Jianguo Liu 2018 Network analysis as a tool for quantifying the dynamics of metacoupled systems: an example using global soybean trade. *Ecology and Society* 23 (4):3