

# UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

College of Engineering

DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING

**CEE 598: Globalization of Water**

**Fall 2017**

**Professor**: Megan Konar

**Class Time:** MW 3.30-4.50

**Class Location:** 3350 Newmark

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# COURSE DESCRIPTION

This course will focus on global water resources, with a specific focus on the water footprint concept. Global food trade and associated embodied water resources will be evaluated as a complex system. The globalized food system has enormous implications for water resources, which will be explored in the course, drawing from hydrology, engineering, economics, causal inference, and complex systems analysis. This class will enable graduate students to understand and contribute to cutting edge water-food nexus literature.

The course is composed of the following primary modules: (1) global water resources, (2) water footprint accounting, (3) complex systems analysis, and (4) causal inference. The class is a combination of lectures and paper presentations/discussion. This enables the course to focus on the state of the art in the literature and enables students to develop scientific research comprehension and communication skills.

# GRADING

Class Presentations & Participation 40%

Homework (3 total) 30%

Final Project 30%

# PAPER PRESENTATIONS

The goal of the in-class presentations is to gain experience reading, understanding, and communicating dense scientific research. The main goal is to effectively communicate to your peers. For this reason, peer review will be used as part of your evaluation. Students in the class will be asked to grade each presentation along two dimensions: (1) clarity and (2) engagement.

# CLASS PROJECT

As part of this class you will work on a class project. The project should strive to be something novel and of publication quality, when possible. This should be a solo or a pair effort. I will solicit project proposals midway through the semester and meet with each student individually to provide personalized feedback. The last few classes will be dedicated for student presentations of their class project. The final written project will be due on the last day of exams.

# COURSE TOPICS

1. Global Water Resources

Global vs. local debate

Global freshwater resources

Planetary boundary concept

Water footprint framework

Sociohydrology

Water-food nexus

Water-energy nexus

Food-energy-water nexus

2. Water Footprints & Virtual Water Flows

Product water footprint

Water footprint of nations

Global water footprint

* humanity
* trade
* land grabbing
* aid

Commodity transfers

* modeled
* data

Global virtual water trade

Sub-national virtual water transfers

Water footprints of urban areas

Virtual water exports from aquifers

3. Complex Systems and Networks

Virtual water flows as a network

Networks as tools

Networks statistics

* degree
* strength
* centrality
* clustering

4. Causal Inference

Trying to establish causality in complex social systems

Random assignment as “gold standard”

Econometric methods try to instrument for randomness

Econometric methods

* triple differences
* instrumental variables
* regression discontinuity
* natural experiment

# READINGS

1. Global Water Resources

Freshwater goes global, Science, Vorosmarty et al 2015

Local perspectives on water, Science, Hering et al 2015

Global hydrologic cycles and world water resources, Oki and Kanae 2006

Global water resources: vulnerability from climate change and population growth, Science, Vorosmarty et al 2000

Global freshwater resources: soft-path solutions for the 21st century, Gleick 2003

A safe operating space for humanity, Nature, Rockstrom et al 2009

Urban growth, climate change, and freshwater availability, PNAS, McDonald et al 2011

Socio-hydrology: a new science of people and water, Hydrological Processes, Sivapalan, Savenije, Bloschl, 2011

The nature and causes of the global water crisis: syndromes from a meta-analysis of coupled human-water studies, WRR, Srinivasan et al, 2012

Water resources sustainability in a globalizing world: who uses the water? Hydrological Processes, Konar et al, 2016

Global impacts of energy demand on the freshwater resources of nations, Holland et al, 2015

Global water crisis and future food security in an era of climate change, Hanjra and Qreshi, 2010

Frontiers of the food–energy–water trilemma: Sri Lanka as a microcosm of tradeoffs, Perrone and Hornberger, 2016

The food-energy-water nexus: Transforming science for society, Scanlon et al, 2017

2. Water Footprint Accounting

TEXT: Globalization of Water: Sharing the Planet’s Freshwater Resources by Arjen Y. Hoekstra and Ashok K. Chapagain, 2008

An estimation of global virtual water flow and sources of water withdrawal for major crops and livestock products using a global hydrological model, Journal of Hydrology, Hanasaki, Inuzuka, Kanae, and Oki

The green, blue and grey water footprint of crops and derived crop products, HESS, Mekonnen and Hoekstra

A global assessment of the water footprint of farm animal products, Ecosystems, Mekonnen and Hoekstra

The water footprint of humanity, PNAS, Hoestra and Mekonnen

Global land and water grabbing, PNAS, Rulli, Saviori, and D’Odorico

The water footprint of land grabbing, GRL, Rulli and D’Odorico

The water footprint of food aid, Sustainability, Jackson, Konar, and Hoekstra

Virtual water trade flows and savings under climate change, HESS, Konar, Hussein, Hanasaki, Mauzerall, and Rodriguez-Iturbe

Virtual groundwater transfers from overexploited aquifers of the United States, Marston, Konar, Cai, and Troy

Drought impacts to water footprints and virtual water transfers of the Central Valley of California, Marston and Konar

High resolution production water footprints of the United States, Marston, Ao, Konar, Mekonnen, and Hoekstra

Direct and indirect water footprints of urban areas of the United States, Chini, Konar, and Stillwell

Groundwater depletion embedded in international trade, Dalin, Kastner, Wada, and Puma

The water footprint of wood for lumber, pulp, paper, fuel and firewood, Shyns, Booij, and Hoekstra, 2017

3. Complex Systems and Networks

TEXT: Social and Economic Networks by Matthew O. Jackson, 2008

Water for food: The global virtual water trade network, WRR, Konar, Dalin, Suweis, Hanasaki, Rinaldo, and Rodriguez-Iturbe

Evolution of the global virtual water trade network, PNAS, Dalin, Konar, Hanasaki, Rinaldo, and Rodriguez-Iturbe

On the temporal variability of the virtual water trade network, GRL, Carr, D’Odorico, Laio, and Ridolfi

Temporal dynamics of blue and green virtual water trade networks, WRR, Konar, Dalin, Hanasaki, Rinaldo, and Rodriguez-Iturbe

A network analysis of food flows within the United States of America, ES&T, Lin, Dang, and Konar

Agricultural virtual water flows within the United States, WRR, Dang, Lin, and Konar

Properties of commodity flow networks across spatial scales, Konar, Lin, Ruddell, and Sivapalan

4. Causal Inference

TEXT: Mostly Harmless Econometrics: An Empiricist’s Companion by Joshua D. Angrist and Jorn-Steffen Pischke, 2009

How does risk management influence production decisions? Evidence from a field experiment, Cole, Gine, and Vickery

U.S. food aid and civil conflict, AER, Nunn and Qian

Can openness mitigate the effects of weather shocks? Evidence from India’s famine era, Burgess and Donaldson

Impact of crop insurance on water withdrawals in agriculture, Deryugina and Konar

Trade openness and domestic water withdrawals, Dang and Konar

A natural experiment of social network formation and dynamics, Phan and Airoldi, 2015