

<b>HYD 298 (4 units)</b> CRN: 29170	<b>Global Groundwater-Agriculture Nexus</b> Instructor: Thomas Harter	UC Davis, Winter Quarter 2022
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**Format**

This graduate course will be co-taught at UC Davis and University of Freiburg Germany. The course will be held within the University of Freiburg's block course format (3 weeks full-time, Jan 10-28). Video recordings of the lectures will be made available to UC Davis students at the beginning of the quarter. Students will form groups of 2 to develop their quarter project. In February and March, the course will meet at UC Davis once per week for a one hour discussion. Grades will be based on final presentation and a synthesis report, both due during winter quarter finals week.

**Content**

About one third of the earth's land surface is used for agricultural production including pastures for livestock. About 15 million square kilometers (10% of the earth's surface) is cropped land in annual or permanent crops. Agriculture, and especially irrigated agriculture, which generates about 40% of global agricultural products on about 20% of cropped land, is highly dependent on adequate water supplies. With its large global land use footprint, agriculture also has major impacts on water resources, which in turn affect ecosystems and human uses of water. Many of the most productive groundwater basins around the globe are closely linked with agricultural activities. Groundwater is an essential resource to manage droughts. Dependency of global food, feed, fiber, and (bio)fuel production on groundwater will increase with a warming climate and more extreme weather conditions. Groundwater is also a major source of drinking water, in many rural areas often the only source of drinking water. Understanding and sustainably managing groundwater resources in agricultural regions is therefore critical to global food security and human health. Assessment, monitoring, regulation, and management of groundwater resources is implemented locally and regionally, sometimes nationally. For graduate students, groundwater issues at the interface with agriculture provide ample work and research opportunities and challenges while collaborating and networking across disciplines (hydrology, environmental sciences, ecology, geography, social sciences, policy, engineering).

- Course Content (eleven daily topics for lecture and discussion, readings):
1. Global geography of agriculture and groundwater: groundwater regions of the world, agricultural regions of the world, challenges to global food security, role of irrigation in agriculture, role of groundwater in irrigation
  2. Groundwater dynamics in agricultural regions: groundwater systems and water budgets, regional groundwater flow in various aquifer systems, green water vs. blue water, rainfed agriculture, irrigation, groundwater recharge in agricultural regions, modeling
  3. Agricultural groundwater management: Quantity/Extraction: US law, EU law, challenges, Integrated Regional Water Management Planning in CA
  4. Groundwater quality issues in agricultural regions: sources, occurrence, fate and transport of contaminants: nitrate, pesticide, nitrogen assessment, salinization
  5. Groundwater quality focus: Animal farming, manure management, and groundwater: animal farming systems, pathogens, antibiotics / pharmaceuticals, hormones
  6. Assessment of nonpoint source pollution of groundwater: vulnerability assessments: overview, soil / unsaturated zone models, groundwater models, high resolution NPS modeling
  7. Agricultural groundwater quality: regulation, compliance, monitoring: Pesticides and Nutrients: BMPs, Regulations: US, EU Nitrate Directive, EU Groundwater Directive, EU Water Framework Directive, Enforcement and Monitoring
  8. Monitoring groundwater for assessment, enforcement, and trends: Classification, monitoring well construction, monitoring well network design, groundwater age-dating, isotopes for fingerprinting (forensics), trend analysis
  9. Groundwater-surface water nexus in agriculture: conjunctive use management, ASR, optimization of conjunctive use, groundwater dependent ecosystems, classification, hyporheic zone dynamics, Scott Valley example, EU examples

- Learning Outcomes**
- deepen understanding of groundwater hydrology by investigating issues specifically related to agriculture
  - understand and learn to apply key principles of physical groundwater hydrology
  - understand and learn key policy and regulatory approaches to managing groundwater, and apply appropriate technical-scientific tools to support groundwater management
  - gain familiarity with and apply a variety of modeling and field observation tools
  - refresh and apply fundamental knowledge from various modules already taken during graduate studies to date
  - learn basic principles of being a science advisor to policy processes
  - gain professional practice: implementing a mock consulting research project
  - explore / prepare for potential thesis topic

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<b>Grading</b>  NOTE: The mode of grading for HYD 298 will be other than that listed in the General Catalog. It will be graded rather than P/NP. Any student has the option of reinstating the original grading mode by taking a copy of the syllabus to the Office of the Registrar and filing a "Grading Variance Exception" petition by the 25th day of instruction.	
<b>Schedule</b>  The course will be held in a flipped classroom format: Lecture recordings will be made available at the beginning of the quarter. Weekly, 4 hours of lecture viewings will be assigned. Beginning the week of February 7, the class will meet weekly for one hour discussion, with time to be determined pending students' schedule. Students will engage with their group mates to perform their quarter project research.	