Aquatic Ecosystem and Water Resource Systems Modeling
WATS 6050, 2 - 4 units

Dr. Sarah Null

Course Meeting Time: Tuesdays and Thursdays, 2:00-4:00 pm
Classroom: Quinney Library 222
Course Duration: Sep 5 – Oct 14, 2015 (6 weeks)

Instructor: Dr. Sarah Null
Office: 354 Natural Resources
Phone: 435-797-1338
Email: sarah.null@usu.edu
Office hours: Mon and Wed 9:30 – 10:30 am or by appointment

Course webpage: All course materials, readings, announcements, and assignments are posted on canvas (https://canvas.usu.edu/).

Course Description: This course focuses on water resources systems modeling to improve river management and restoration of aquatic and riparian ecosystems. Historically, water resources systems modeling targeted economic water uses (water supply, hydropower, flood protection). However, maintaining and prioritizing aquatic and riparian ecosystems, habitats, and species are increasingly incorporated into water resources systems modeling. Including both economic and environmental water uses in systems modeling is beneficial to:

- understand potential water management or regulation changes from new dams, effects of removing dams, hydropower operation changes following relicensing, etc.,
- anticipate and mitigate for likely hydroclimatic changes, and
- highlight promising alternatives for river restoration.

Students will learn theory and techniques to incorporate economic and environmental water uses in systems analyses (primarily simulation and optimization modeling). Modeling applications include reservoir re-operation, environmental flows, hydroclimate modeling, evaluating tradeoffs between water uses, prioritizing barriers removal, and decision-making with uncertainty.

Students will learn through lectures, reading journal articles, hands-on modeling exercises, and a final modeling project. Excel or R knowledge is required. Programming experience is helpful, but not required.

Course Objectives:
1. Understand fundamental hydrologic modeling principles, generalizations, and theories through reading and lecture.

2. Apply hydrologic modeling theory, analysis, and critical evaluation through hands-on modeling exercises and projects to improve problem conceptualization, problem solving, and decision making.

3. Develop the technical skills and viewpoints needed by watershed sciences professionals.
Course Grading and Assignments:
20% - Participate in all class sessions, including discussing and/or leading journal article discussions
50% - Modeling exercises (see due dates on pg. 3)
30% - Final modeling project (due October 14)

Class Participation, Readings, and Discussions
Students are evaluated on class interaction and preparation in both lecture and journal article discussions. We will discuss one or two journal articles most days. One student will be chosen each class session to lead the discussion or each article. All students will be graded on participation in paper discussions, regardless of whether they are the discussion leader.

Modeling Exercises
Modeling exercises are assigned and explained on Thursdays. Students may have time to work on the modeling exercise in class on Thursday. The write up of the modeling exercise, including interpretation of modeled results, are due the following week.

Final Modeling Project
The final modeling project will use each student’s graduate research data to create a conceptual model or simple mathematical or process-based hydrologic simulation or optimization model. Students should speak to me to obtain a dataset if they do not have suitable data from their own research.

Late assignment policy
Your grade is reduced by 5% for each day an assignment is late and will not be accepted after a week has passed from the original due date unless prior arrangements have been made.
#### Rough Schedule

<table>
<thead>
<tr>
<th>Date</th>
<th>Topics</th>
<th>Reading/Assignment</th>
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<tbody>
<tr>
<td>Sep 6</td>
<td>Introduction to hydrologic modeling, systems analysis, and water resources management</td>
<td>n/a</td>
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<tr>
<td>Sep 8</td>
<td>WEAP hydrologic modeling (simulation)</td>
<td>Thompson et al. 2012; Yates et al. 2005</td>
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<td>Sep 13</td>
<td>River management</td>
<td>Nilsson et al. 2005; Richter et al. 1997; <strong>HW 1 due</strong></td>
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<td>Sep 15</td>
<td>Modeling environmental flows</td>
<td>Petts 2009; Mount &amp; Moyle 2007</td>
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<tr>
<td>Sep 20</td>
<td>Evaluating model fit: validation and calibration</td>
<td>Moriasi et al. 2007; Saito et al. 2001; <strong>HW 2 due</strong></td>
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<tr>
<td>Sep 22</td>
<td>Introduction to optimization</td>
<td>Geoffrion 1976; Harou et al. 2009</td>
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<tr>
<td>Sep 27</td>
<td>Role of modeling in large river management</td>
<td>Haight et al. 2000; Horne et al. 2016; <strong>HW 3 due</strong></td>
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<tr>
<td>Sep 29</td>
<td>Barrier removal optimization</td>
<td>Null et al. 2014; Jager et al. 2015</td>
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<td>Oct 4</td>
<td>Optimizing species, ecosystems, and habitats Evaluating tradeoffs between competing objectives</td>
<td>Poff et al. 2015; Kareiva 2012</td>
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<tr>
<td>Oct 6</td>
<td>Hydroclimate modeling</td>
<td>Milly et al. 2008; Barnett et al. 2008</td>
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<td>Oct 11</td>
<td>Water resources management in an uncertain world</td>
<td>Brown et al. 2015; TBD; <strong>HW 5 due</strong></td>
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<tr>
<td>Oct 13</td>
<td><strong>Final project class presentations</strong></td>
<td>Final project due Oct 14</td>
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*Students taking 4 unit course, continue directed research after October 14.*
Course Policies:

Cell phones and laptops
Please silence phones in class. It is disrespectful to take calls or text during class. Many students find it helpful to bring laptops or tablets to class, but please refrain from checking email or using other social media during class.

Plagiarism
Plagiarism includes knowingly "representing, by paraphrase or direct quotation, the published or unpublished work of another person as one's own in any academic exercise or activity without full and clear acknowledgment. It also includes the unacknowledged use of materials prepared by another person or agency engaged in the selling of term papers or other academic materials." In accordance with USU’s policy “the penalties for plagiarism are severe and include warning or reprimand, grade adjustment, probation, suspension, expulsion, withholding of transcripts, denial or revocation of degrees, and referral to psychological counseling”([http://www.usu.edu/aa/faculty/syllabus_resources.cfm](http://www.usu.edu/aa/faculty/syllabus_resources.cfm)).

Students may work together on modeling exercises, but all turned in material should represent the work of individual students. Copying models, model output, or results analysis is plagiarism.

Classroom environment
Treat each other with respect. Discriminatory behavior related to someone’s age, sex, gender identity, sexual orientation, race, ethnicity, national origin, creed, religion, or disability is unacceptable and will not be tolerated.

Sexual Harassment
Sexual harassment is defined by the Affirmative Action/Equal Employment Opportunity Commission as any "unwelcome sexual advances, requests for sexual favors, and other verbal or physical conduct of a sexual nature." If you feel you are a victim of sexual harassment, you may talk to or file a complaint with the Affirmative Action/Equal Employment Opportunity Office located in Old Main, Room 161, or call the AA/EEO Office at 797-1266.

Students with Disabilities
Students with ADA-documented physical, sensory, emotional or medical impairments may be eligible for reasonable accommodations. Veterans may also be eligible for services. All accommodations are coordinated through the Disability Resource Center (DRC) in the University Inn, (435) 797-2444. Please discuss privately with me and contact the DRC as early in the semester as possible for assistance. Alternate format materials (Braille, large print, digital, or audio) are available with advance notice.
**Reading Reference List**


