The primary goals of this course are to introduce students to the topic of macro-scale hydrology and to practice some of the fundamental elements of scientific research: manuscript reading and reviewing and the preparation of a scientific study. The course is organized as a mix of formal lectures by the instructor with open discussion during class. A team-based student project will be pursued during the course of the semester. Topics to be covered will feature the water cycle and water resources in the context of:

- **Planetary Boundaries**
  - Biogeochemistry & Pollution
  - Water Engineering
  - Water & Economic Development
  - Green-Grey Engineering

- **Global Climate Change**
  - Land Use and Cover Change
  - Land-Coastal Zone Links
  - Private Sector Innovation
  - Monitoring of the Water Cycle

The course is open to Graduate Students & Upper-Level Undergraduates.

**CONTACT:** Professor C. Vörösmarty <cvorosmarty@gmail.com>

**SUBJECT LINE** Macro-Hydrology: xxxxxx
GRADING AND ASSIGNMENTS

The primary goals of this course are to introduce students to the topic of macro-scale hydrology and to practice some of the fundamental elements of manuscript reading, reviewing and preparation, in a form that would be potentially publishable in the scientific literature. To this end, the course is organized to maximize a fruitful collaboration among students and the instructor. Students should come prepared to participate in this interactive effort, armed with a cooperative and creative spirit. Unfortunately, as egalitarian as we might wish to be, PGEOG 38304/PGEOG 70508 is a credit-bearing course that will ultimately require judgment on the part of the instructor as to the performance of each student.

Grading will be based on student contributions to the overall course goals and therefore students will be judged on:

- Knowledge of the assigned literature
- Meeting assigned deadlines
- Active participation in class, including formal presentations
- Any technical analyses performed
- Content of writing
- Demonstrating initiative

READINGS

Reading of the scientific literature will be an integral part of the course. Both the instructor and students will be presenting summaries of the current scientific literature. Some of the assigned readings are unavailable (e.g. manuscripts in review or in press) and will be posted on DropBox and made available to each student free of charge, as needed. Others are in the open literature and each student
is expected to locate and read relevant papers, and then make short reports on these during discussion within each class period.

The publications for a particular date deal with thematic material that will be covered in the upcoming lecture. These papers are representative of what in many cases are literally volumes upon volumes of material treating the subject. The papers in the reading list are thus only a beginner’s “library” on the subject of macro-scale hydrology. These papers, plus the references cited at the end of each, should form an excellent source of raw material that can be consulted throughout the duration of the course. Students are expected to locate, read and report upon papers not included in the initial lists that will be handed-out during the first lecture. Electronic copies should be made of student-selected papers to be shared with other members of the class, which might not otherwise be readily available.

Based on the readings, specific products will need to be prepared, submitted, and presented by each student, by small teams and by the class as a whole. The purpose of these assignments is to:

(a) facilitate the students’ ability to locate the relevant existing literature;
(b) establish a “habit” of assessing such work; and,
(c) offer practice in critical scientific writing and presentation.

These assignments will also allow the instructor to monitor the progress of the class and to fine-tune the format/content of the course. The specific due dates for the assignments are attached. For group-based assignments, all students on each team will jointly agree to and then document the specific contributions of each individual student.

Student Presentations: A research topic will be determined in late March. The research on this topic will evolve through a series of sub-group projects, which will contribute ultimately to a larger group project. The work will proceed as follows:

- Student teams (assuming 2-3 students each, depending on topic/size of class) will each prepare a first 250-word Sub-team Report (Draft 1.0), deliver a 15-20 minute presentation, and lead discussion on one or more aspects of the chosen topic. Each Report should clearly review the existing literature, provide the students’ assessment of the current state-of-the-art, and assess the readiness of a small team to work on such a topic. The Report should clearly highlight the connections to ongoing work and why the work would represent value-added over other existing research. Each sub-team will be expected to present and defend their collective submission, and answer questions from the rest of the class during an open discussion. Three questions should guide each student in this task:
(1) What is the main idea that is being worked on?
(2) How does this relate to the work so far by the scientific community?
(3) What are the time and personnel requirements for the particular sub-topic being considered, that is, in order to contribute analysis and writing to the larger team effort?

The instructor and remainder of the class (i.e., those not in a particular sub-group that is reporting) will give constructive criticism to improve the work.

• A revised Sub-team Report (Draft 2.0) will also need to be prepared and submitted. An oral presentation of similar scope and content to the first presentation will also be delivered, but improved by consideration of the earlier critique.

• In the mid-to-late April timeframe, an Overall Study Team, comprising all of the earlier Sub-Teams, will be formed. The new, larger team will consolidate the individual elements and bring them into a synthesis of the entire project. This is NOT simply “stapling” the individual elements together, but will require an integration and elaboration and interpretation of all findings. A 2000-word Overall Study Team Report, emulating a professional scientific paper, will be prepared and submitted by the end of the semester. There will be two versions that can be sequentially improved upon (1.0 and 2.0). A joint team presentation will be required as well.

This Report should constitute a succinct document, in the format of a Science report (http://www.sciencemag.org/authors/science-information-authors). The inclusion of graphics and tables is encouraged. A properly-prepared LITERATURE CITED section must be included. Use of a spell-checker is required. Depending on the merits of the topic and the Report content, instructor would be willing to work past the end of the semester for those wishing to develop their manuscript further. This could be arranged on a credit-bearing basis.

**SPECIFIC GRADING FORMULA**

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>QUIZZES</td>
<td>40%</td>
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<tr>
<td>CLASS PARTICIPATION, DISCUSSION OF</td>
<td></td>
</tr>
<tr>
<td>ASSIGNED AND “DISCOVERED” READINGS...........</td>
<td>15%</td>
</tr>
<tr>
<td>SUB-TEAM REPORTS AND PRESENTATIONS............</td>
<td>25%</td>
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<tr>
<td>FINAL MANUSCRIPT &amp; PRESENTATIONS ..............</td>
<td>20%</td>
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Note: +/- (e.g. B to B-) deducted from each assignment turned in late. Full grade deducted for any assignment one week late and each week thereafter.

1 Lowest quiz grade dropped  
2 Make-up quizzes by appointment (see below)
Students who have an unavoidable and serious emergency or severe illness that prevents them from attending a required class period, or submitting an assignment, exam, project, etc. on the day it was due, will not be penalized provided that they provide official documentation that excuses them. The documentation may be reviewed by the GSOE Dean, and must justify the student's absence for the required class period or their inability to submit work on the day it was due.

**ACADEMIC INTEGRITY**

This course seeks to promote scientific professionalism and professional integrity will be a central cornerstone of the effort. For students this means academic integrity. All students are therefore fully expected to read and understand the *CUNY Academic Integrity Policy*, which the instructor will make available at the start of each semester. The instructor is available if there are any questions or need for clarification. Violations (e.g., copying text verbatim, cheating on quizzes, etc.) will be grounds for immediate expulsion from this course, which unfortunately has occurred in the past. There is no reason or excuse for violations of the academic integrity policy and students will be rewarded for honest efforts and dedication to the work.

**COVID ADDENDUM**

This class will be held in person. Please consult information on University policies associated with COVID and the return to campus [https://www.ccny.cuny.edu/return-campus](https://www.ccny.cuny.edu/return-campus).

**OFFICE HOURS** for C. Vörösmarty (by appointment; evorosmarty@gmail.com)

**SUBJECT LINE:** Macro-Hydrology: xxxxxx
### MACRO-HYDROLOGY SCHEDULE & ASSIGNMENT TIMETABLE (Spring 2024)

<table>
<thead>
<tr>
<th><strong>DATE</strong></th>
<th><strong>TOPIC</strong></th>
<th><strong>ASSIGNMENT</strong></th>
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</thead>
<tbody>
<tr>
<td>Thurs 25 JANUARY</td>
<td>Introductions, Handouts of Syllabus, Reading/Reviewing Instructions, Grading Expectations</td>
<td>------------------</td>
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<tr>
<td>Thurs 1 FEBRUARY</td>
<td>Course Topical Framing, Some of the Basics, Planetary Boundaries</td>
<td>Read: Postel et al. 1996; Steffen et al. 2015; Rockström et al. 2009; Jaramillo and Destouni 2015; Fekete 2013</td>
</tr>
<tr>
<td>Thurs 15</td>
<td>Climate Change-2: A Focus on the Arctic Quiz on previous lecture/readings</td>
<td>Read: USARC 2010; Hinzman et al. 2013; Vörösmarty et al. 2018c (NSF Report); Rawlins et al. 2010</td>
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<tr>
<td>Thurs 22</td>
<td>NO CLASS (MONDAY SCHEDULE)</td>
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<tr>
<td>Thurs 29</td>
<td>Water Engineering Quiz on previous lecture/readings</td>
<td>Read: Vörösmarty et al. 1997; Nilsson et al. 2005; Vörösmarty et al. 2005b (<em>Section 7.3.2</em>); Hanasaki et al. 2007; WWF 2007; Zarfl et al. 2015</td>
</tr>
<tr>
<td>Thurs 7 MARCH</td>
<td>Land Use and Cover Change Quiz on previous lecture/readings</td>
<td>Read: Douglas et al. 2005; FAO 2005; D'Almeida et al. 2007</td>
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<tr>
<td>Thursday</td>
<td>Date</td>
<td>Topic</td>
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<tr>
<td>Thurs 21</td>
<td>21</td>
<td>Biogeochemistry/Constituent Fluxes-2</td>
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<td>Quiz on previous lecture/readings</td>
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<td></td>
<td>Instructor presents overall topic, sub-topics</td>
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<td></td>
<td>Form 2-3 person study sub-teams</td>
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<td>Quiz on previous lecture/readings</td>
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<tr>
<td>Thurs 4</td>
<td>APRIL</td>
<td>Global Water Resources and Their Assessment</td>
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<td></td>
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<td>Quiz on previous lecture/readings</td>
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<tr>
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<td></td>
<td>Initiate work as Sub-teams/make brief oral reports</td>
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<td>Discussion on sub-teams’ progress</td>
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<tr>
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<td>Quiz on previous lecture/readings&amp; Famiglietti et al. 2015, Palmer et al. and Muller et al. 2015; McKinsey 2009; Palmer</td>
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<tr>
<td></td>
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<td>Discussion on sub-teams’ progress</td>
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<td>Make brief oral reports</td>
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</table>
**SCHEDULE AND ASSIGNMENT TIMETABLE (cont.)**

<table>
<thead>
<tr>
<th>Date</th>
<th>Activity</th>
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<tbody>
<tr>
<td>Thurs 18</td>
<td><em>The Future, Natural Capital &amp; the SDGs</em>&lt;br&gt;250-word Sub-team Reports (Draft 1.0) due&lt;br&gt;Discussion on sub-teams’ progress&lt;br&gt;Consolidate sub-groups as single team&lt;br&gt;Make brief oral reports&lt;br&gt;Quiz on previous lecture/readings&lt;br&gt;Read: Green et al. 2015, Harrison et al. 2016, Hoekstra 2016, Poff et al. 2015, Dudley et al. 2003; Palmer 2010; Vörösmarty et al. 2018a,b</td>
</tr>
<tr>
<td>Thurs 25 APRIL</td>
<td>NO CLASS (SPRING BREAK)</td>
</tr>
<tr>
<td>Thurs 2 MAY</td>
<td>Discussion on full group progress&lt;br&gt;Discussion on sub-teams’ progress&lt;br&gt;Quiz on previous lecture/readings&lt;br&gt;250-word Sub-team Reports (Draft 2.0) due&lt;br&gt;Make brief oral reports</td>
</tr>
<tr>
<td>Thurs 9</td>
<td>Discussion on full group progress&lt;br&gt;Make brief oral reports&lt;br&gt;Read other students’ team writing and be ready to comment</td>
</tr>
<tr>
<td>Thurs 16</td>
<td>FINAL PRESENTATION <em>(final time period)</em>&lt;br&gt;2000-word Overall Team Report due (Draft 3.0)&lt;br&gt;Overall Team Oral Presentation</td>
</tr>
</tbody>
</table>

See list of assigned readings (handed-out on first day of class). This listing will indicate if (a) students will have access during customary digital access provided by the University or (b) the professor has uploaded a digital version, usually when these references are obscure or otherwise difficult to access.
**MACRO-HYDROLOGY ASSIGNED READING LIST**

**Signifies digital version that students can download from DROP-BOX, to which the instructor will invite students**


**FAO (UN Food and Agriculture Organization). 2005. Forests and floods: Drowning in fiction or thriving on facts? RAP Publication 2005/03. Forest Perspectives 2. FAO, Rome. 40 pp.**


**Stive et al. 2013. The Sand Engine: A solution for vulnerable deltas in the 21st Century?**

*Coastal Dynamics 2013*, pp. 1537-46.


**Vörösmarty et al and Hering et al. 2015. What scale for water governance? Science 349: 478-80**


TIPS ON READING SCIENTIFIC ARTICLES

GOOD PAPERS ANSWER THE FOLLOWING QUESTIONS:  
(ask yourself these 3 questions when reading)  
(also use these questions as guidelines when YOU write research papers)

(1) ASK YOURSELF: WHAT IS THIS PAPER ABOUT?

Should be found in the Abstract and Introduction and it lays-out for you the “foundation” for the paper:

-- Let’s you identify the specific knowledge gap that this paper will fill, typically based on a short review of the recent scientific literature
-- Presents the upcoming structure of the paper that you will be reading (typically this will be reflected directly by the headings and sub-headings)

(2) ASK YOURSELF: SO WHAT?

A good paper should connect facts and findings:

-- Linking them to the knowledge of the authors or contained in any published references that were cited within the paper
-- In other words......How are the facts related? And, Why does reading this paper make a difference in moving the particular field of science forward?

This question basically assesses the importance of the findings......so:

-- What are the most important findings?
-- Why are these important?
-- How does the study you have just read build on prior work to move it forward?
-- Does the research reported on solve some previous puzzle?

(3) ASK YOURSELF: SO WHAT NOW?

The paper should propose what should happen next:

-- Remember: Science builds on itself (that is why there is this whole peer-reviewed publication process!)
-- What do the authors suggest should be the next phase of study?

Now you come in:

-- Do you agree with the next steps? Do you have other ideas? (this is often where graduate students and professional researchers can discover opportunities for topics in their own future work)
FOLLOW THESE STEPS WHEN READING SCIENTIFIC ARTICLES especially when time is of the essence

• Preview what is to come
• Read and digest the title
  -- Ask yourself what is it that you expect will be presented?
• Read the Abstract
• Look at the Major/Minor headings
• Read the Conclusions
• Examine the graphics
• Re-read the Abstract
  -- Ask yourself if what you expected to be presented was indeed presented?
• Read relevant portions of the text
• Do you agree / disagree with the central findings
  -- Are they reasonable?
  -- Do they fit your world view?
  -- How do they relate to the work of other authors?
  -- What, if anything, did you learn from this work?
  -- What, if anything, did you learn from this work that you could use in your own research?
MANUSCRIPT REVIEWING (How to)

--Purpose of a review
  • Improve the writing you have been asked to review
  • Discourage publication of work that is poorly executed, inconsequential, or difficult to understand in its published form
  • Reviews that we receive – can encourage / educate us OR discourage / infuriate

--How to provide advice to the authors
  • Use the simplest, least contentious wording to convey your ideas
  • Understand & correctly represent the studies you cite, especially when refuting elements of the paper you are reviewing

--Assume a Non-confrontational Attitude
  • Write to convince author
    -- Avoid insults
    -- Be even-handed
    -- Be a detective, but give the authors the benefit of the doubt (i.e., assume they are not trying to do something purposefully incorrect or unethical)
    -- Avoid “absolutes”
    -- Pinpoint good/bad

--Some more specifics
  • Focus on what you know and give your opinion
  • Discuss w/ colleagues if necessary
  • Place into larger (coherent) context
  • Demand scholarship in citations
    -- Proper attribution of ideas
    -- Economy of space
  • Write to assist editor
  • Describe the contribution or benefit of the paper to the scientific literature and in particular to specific audiences (e.g., climate science paper to support carbon management policies)
  • Write the review w/ “economy, clarity, precision”
  • Be prompt