Paper Writing

Paper writing is essential for M.S. and Ph.D students as well as postdocs. While it is less so for undergrads, M.Eng., and M.P.S. students, turning your project into a paper could have benefits down the road.

Process Guidelines

1. Start with an outline and paper contract. This will help lay out the goals of the research and make sure all projected authors know their expected contributions and how key terms are being used (as vocabularies can vary across disciplines or even sub-disciplines).

2. In our group, the first author (usually the junior researcher leading the research) has the final say on scope, wording, and figure design. These decisions should be made in consultation with the entire team, however.

3. Don't expect immediate turnaround when submitting drafts for feedback, either to Vivek or to the other authors! Depending on how busy Vivek is, he might take up to a week to provide feedback, though doing so in a timely fashion will always be a top priority. Other authors may take a longer time depending on their constraints. This is especially important to bear in mind when revising a paper.

4. Our group's best practice is to do internal peer review before submitting a paper. After focusing on a piece of research, it is easy to believe that certain concepts can be taken as given or are implicit, which may limit the accessibility of the writing and complicate peer review. To reduce this risk, we will ask two or three group members who were not involved in the project to read the manuscript and provide feedback. If appropriate group members are not available, we will seek out external collaborators for this role. *Anyone who provides feedback should be listed in the Acknowledgements section.*

5. Similarly, our group's best practice is to do an internal code review before submitting a paper. We want our work to be reproducible and to ensure that there are no bugs driving the results, so code should be accessible, well-documented, and presented with a clear workflow. We will ask one member of the group to reproduce the workflow to make sure that the results and figures are reproducible. *Anyone who helps with code reviewing should be listed in the Acknowledgements section.*

Other Guidelines

Aim to always follow the American Geophysical Union's author guidelines when writing, whether or not submitting to an AGU journal:

1. Present a precise and accurate account of the research performed and a clear, objective discussion of its significance.

2. Include sufficient detail and reference to sources of information in a manuscript to permit the author's peers to repeat the work.[1]

3. Identify sources of all information and cite those publications that have been influential in determining the nature of the reported work and that guide the reader quickly to the primary and other earlier work essential for understanding the present investigation. Information obtained privately, as in conversation or correspondence, should not be used or reported without explicit permission from the source.

4. Carefully document methodology, assumptions, and uncertainty.[2]

5. Follow the appropriate procedures in force in their countries that govern the ethics of work done with human or animal subjects.[3]

6. Never plagiarize the work or ideas of others or your own work. Always provide appropriate citation. [The AGU provides additional guidelines on plagiarism at the same link.]

7. Avoid unnecessary fragmentation or redundant publication of research reports to artificially increase the number of publications.[4]

8. Never include personal criticism in a written piece of work.[5]

9. Report to the editor any changes made to the manuscript after acceptance.

10. Include as coauthors only those persons who have made significant scientific contributions to the work and determine order of authorship in a manner appropriate to the contribution. All coauthors share responsibility for the quality and integrity of the submitted and published manuscript.

11. Reveal to the editor any potential conflict of interest for any author that might be affected by publication of the results contained in a manuscript or in the development of the research.

12. List all funding sources and sources of data or other in-kind support for all authors in the acknowledgments.

13. In the role of corresponding author, ensure that all coauthors are fully cognizant of the steps and changes in the manuscript during the peer review process.

Selecting Journals

Selecting journals for submission is a key part of the paper writing process. This should be done early on, as different journals have difference emphases and audiences, which can greatly impact writing style.

You should select 4-5 journals that you would like to submit to. These can range in terms of ambition and technical emphases --- for example, *Nature* is highly prestigious but more general, while the *Journal of Flood Risk Management* is a solid journal with a more specific and technical focus. Ask yourself the following questions (Vivek will help!):

- What is the key question and hypothesized point of the paper? Is it a question that might get the attention of a more general audience, or is it addressing a more technical issue that specialists would be more interested in?

- How well does the scope of the journal align with your key question? Have they published related work?

- What are the word and figure limits of the journal and anticipated submission type? Tighter word limits can be difficult for more complex or technical analyses.

- How much time do you want to invest in revisions and (if the paper is rejected) in reformatting/reframing the paper for a different journal? More selective journals can have a higher career payoff (though some of the more technical journals publish work that is at least as good and will generate citations over time) but have a higher probability of rejection.

- How often have you published a paper in the journal? Over-publishing in the same journal can look strange, particularly if it isn't one of the top journals.

Based on these considerations, come up with your journal submission sequence. You can sort these journals along various lines, including impact factor (as a proxy for ambition) or similarity of formatting (for example, going from *Nature* to *Nature Climate Change* instead of going from *Nature* to *PNAS* and then *Nature Climate Change*).

Paper Contract

Writing a paper contract early in the research design facilitates conversations about authorship, author contributions, research scope, and submission plans. This document should include:

1. Author line
2. Expected author contributions

3. Key research questions

4. Research hypotheses

5. Key prior work to address

6. Methods (broadly speaking)

7. Submission plan

Outline

Papers should be organized using an outline. How you incorporate this outline into the writing process is up to you: Vivek prefers to expand the outline to full detail, then convert items to sentences and paragraphs, but you might prefer to switch to sentences earlier. However, an outline provides an organized way to facilitate feedback, and we should converge on it before advancing in the writing process.

Outlines are dynamic documents and will evolve over the course of the research, as key questions and findings and methods change. They should be broadly organized as follows (though some of the sections may be in a different order depending on the targeted journal's requirements):

1. Projected title

2. Projected author line

3. Targeted journal

4. Key research questions

5. Hypothesized key points (which will be replaced by key findings once these are available)

6. Abstract

7. Introduction (including literature review)

8. Methods

9. Results

10. Caveats

11. Discussion & Conclusions

12. Acknowledgements

13. Author contribution statements

Useful Resources

Here are some writing and formatting tips from Michael White, a climate science editor for *Nature*.

1. Make sure that you also provide links to the code and data repositories. ■

2. Documenting and characterizing uncertainty is difficult, but it is a key part of all of our analyses. We should be transparent about assumptions and honest about limitations. Good practice is to examine the impact of assumptions when possible, but they and how they might limit the generalizability of the analysis must be made clear in the paper. ■

3. We do not often work with human subjects, but be familiar with these procedures before beginning any project that involves them. ■

4. This is along the idea of "minimal publishable units." Papers should clearly and thoroughly address 1-3 key questions and contain the same number of key points. ■

5. Always be constructive when reviewing or engaging with other people's work. Other papers aren't "flawed" or "contain gaps," but they might leave open questions due to the assumptions or methods that you are now addressing. Science builds off other work, and we all have to make choices when designing a particular piece of research. ■

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