

TIPS ON PAPER WRITING FOR EEPS1520

B. FOX-KEMPER

Brown University Department of Earth, Environmental, and Planetary Sciences,
324 Brook St., Providence, RI 02912, USA
baylor@brown.edu

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Before you get worried about writing four papers for one class, let me explain the goals of the paper writing. These are *not* supposed to be polished, ready to submit papers detailing years of research. Instead, they are supposed to be practice in writing drafts for your real research. The idea is to get used to pounding out a working draft in only a couple of hours, so that when the time comes for you to do it for real, that part will be easy.

Key Words: Ocean Circulation, Climate, Research Papers.

1. Getting Help!

I am usually available by email. You can make an appointment other times. Just check my calendar at <http://fox-kemper.com/contact> and suggest a time that works for you.

If you are having trouble with the writing, there are lots of places to find help! You can make an appointment at the writing center (http://www.brown.edu/Student_Services/Writing_Center/) You also might ask older students for tips. I can show you past student papers from related courses if you'd like. I've put my favorite writing style guides in the bibliography (Turabian 2013; Strunk et al. 2005; Montgomery 2003; Gopen and Swan 1990).

2. General Comments on Papers

Many students think that they have to use fancy words or complex syntax for their writing to be “scientific”. The opposite is the case, since this writing just confuses. As Orwell (1946) nicely puts it:

If you simplify your English, you are freed from the worst follies of orthodoxy. You cannot speak any of the necessary dialects, and when you make a stupid remark its stupidity will be obvious, even to yourself.

Or, if you prefer Vonnegut (1981):

I find that I trust my own writing most, and others seem to trust it most, too, when I sound most like a person from Indianapolis, which is what I am.

2.1. AGU formats and templates

We will be writing all of the papers according to the style, page length, and guidelines of the American Geophysical Union (AGU) journal: *Geophysical Research Letters* (GRL). GRL is geophysics' own version of *Nature* or *Science*, and it contains only very short

focused articles (4 single-spaced, small-type pages, usually 4 figures or fewer). I chose this journal because it has very clear guidelines for formatting and reviews, as well as an online article length checker that we can borrow! Regardless of your specialization, you will probably have an opportunity to write a GRL paper in the near future, so this will be good practice.

The GRL article length is now measured as being 12 or fewer “publication units.” One publication unit is either 500 words, one figure, or one table. By “words” the abstract, main article, and captions are counted, not author lists, bibliography, and other filler. So, if you use only words, you could have a 6000-word article, which is about 10 pages of single-spaced, 10pt Times. Or, if you have 10 figures or tables, then you have only 1000 words left to use... Figures can have related subpanels, but each new “thought” means a new figure. So, you will need to economize.

I love L^AT_EX, and it is the BEST for writing scientific papers with lots of equations. However, I understand that many of you don’t want to learn it and are happy with something you have to spend money on that doesn’t look as good (L^AT_EX is free for download: <http://www.tug.org>). There are AGU L^AT_EX templates at <http://www.latextemplates.com/template/american-geophysical-union>.

2.2. *You will submit your paper in pdf format.*

You will submit your paper in pdf format. It should be ready to print, and line numbers are super handy for the version to be reviewed! We will be adding inline reviews using Crocodoc through canvas, as well as a written statement summarizing the main points of your review. Only a pdf can be marked up in this manner.

2.3. *Abstracts: What are they and do you need them?*

You need to have an abstract on every paper. It is a summary of what you’ve done, with enough detail that a reader can decide whether your paper has what they need or not in it, and they can quickly refresh their memory as to which paper of yours it is, too! It’s the first thing after the title and authors’ names.

Imagine doing a google scholar search for a keyword when you are working on one of these papers. For example, “North Atlantic Deep Water” input to scholar.google.com just got 6,590 hits, so how do you sort through them? 1) The number of citations generally tells you if it is a useful and/or a controversial treatment. 2) You read the titles, 3) You skim the abstract, 4) you skim the figures, reading the captions only. You should write your title, abstract, and captions for this audience: someone skimming a mess of papers on a related topic trying to find the particular treatment or fact that they need without reading all of the papers.

The *Nature* family of journals have created a template for the “Nature Summary Paragraph” which is their equivalent of an abstract. It is shown in Figure 1.

2.4. *The Theory &/or Methods Section: A new requirement*

In response to students’ feedback from previous versions of this class, I now require a theory and/or methods section *for every paper in this class*. After the abstract and introduction, each paper will be required to have a Theory and/or Methods section. In some of the papers, this may seem a little pedantic, but I have had complaints that the way the math in the class is presented doesn’t have enough opportunities to “get the equations under your fingers.” Hence, the theory section requirement.

In each paper’s theory section you will derive the equations you will be using in every subsequent calculation and every figure beginning from a collection of equations directly

How to construct a *Nature* summary paragraph

Annotated example taken from *Nature* 435, 114–118 (5 May 2005).

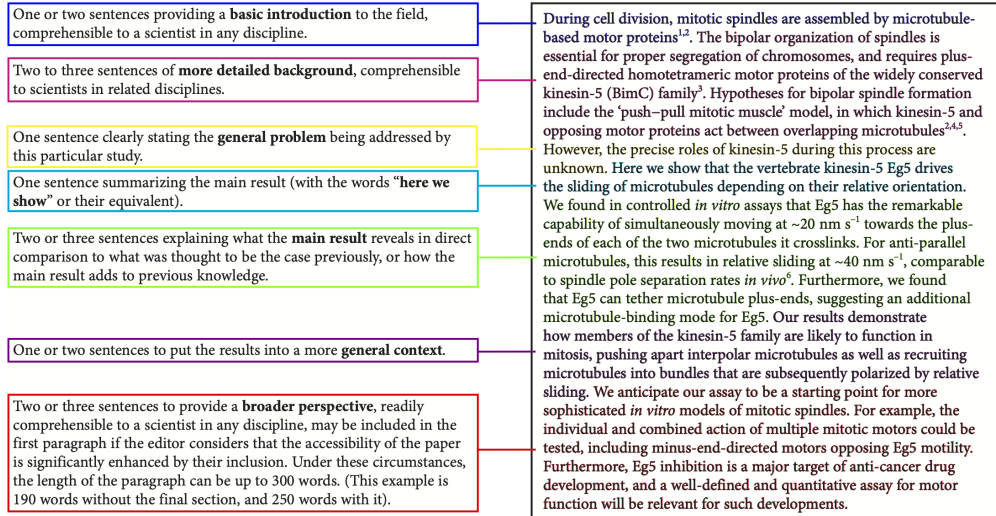


FIGURE 1. The *Nature* format for a summary paragraph, which is their version of an abstract.

transcribed from Vallis or other textbook. So, for example, if you are calculating a budget using ECCO data, you might say:

In Vallis (2006), equation (1.42), the tracer conservation equation is given

$$\frac{D\varphi}{Dt} = \dot{\varphi} \quad (2.1)$$

In our application, we will be considering the volume integral of this equation over a region of 243 finite volume elements of the ECCO dataset. Thus, the volume integrals are. . .

2.5. Graphics

A figure should be included inside the text just after the figure is mentioned in the text. It makes for easier reading with figures on same page as discussion.† (Note: every figure deserves at least one sentence of explanation in the text!) Every figure should have a caption, which should be short but detailed enough to understand the figure without digging in the text. Just like writing the title and abstract for the skimmer, write the figure caption so that by reading just the title, abstract, and figure captions gains an outline of the work.

2.6. Acknowledgements: Pay and Friends

Over time, the acknowledgements has become a place to state who paid for the research (you’ll notice journal articles with acknowledgments that begin ‘This research was funded under NSF...’). So, you can begin with this if you like, e.g., “This research was funded under a G.R.A. sponsored by (insert advisor/dept. here).” More importantly, if you talked to classmates or other teachers, and they gave you a good idea it is good to mention them

† In L^AT_EX, use preprint rather than draft.

here for two reasons: 1) It is a nice way to recognize their help, and 2) it closes the door on plagiarism. What I mean by 2) is, if you state that someone helped you in some regard, then they can't say that you 'stole' the idea from them. Instead, you just borrowed it, with adequate acknowledgement.

2.7. Ten Simple Rules for Structuring Papers

Mensh and Kording (2017) have written a beautiful set of guidelines to making a readable paper. They propose 10 simple rules, which are

- (a) Focus your paper on a central contribution, which you communicate in the title.
- (b) Write for flesh-and-blood human beings who do not know your work.
- (c) Stick to the context-content-conclusion (C-C-C) scheme.
- (d) Optimize your logical flow by avoiding zig-zag and using parallelism.
- (e) Tell a complete story in the abstract.
- (f) Communicate why the paper matters in the introduction.
- (g) Deliver the results as a sequence of statements, supported by figures, that connect logically to support the central contribution.
- (h) Discuss how the gap was filled, the limitations of the interpretation, and the relevance to the field.
- (i) Allocate time where it matters: Title, abstract, figures, and outlining.
- (j) Get feedback to reduce, reuse, and recycle the story.

2.8. A Special Role for Facts

Because of the special role for facts in the scientific method, scientific papers must be very careful when dealing with statements of fact. There are three ways to make a factual statement in a paper. You can:

- (a) Prove it (in data or analysis)
- (b) Cite it (and pass the buck to another source)
- (c) Speculate it (and clearly indicate you're doing so)

If you aren't sure which one you're doing, *you aren't allowed to make the statement*, at least not in a scientific paper.

For example, if you are trying to make a point like, "The oxygen content of NADW is anomalously high." You can 1) make a figure, 2) cite a source, or 3) hypothesize that it should be high because the NADW was recently near the surface (where it equilibrated with the atmosphere) and then sunk quickly below the depths of important biological activity. Or, if it is an important point, you can do all three!

2.9. Citations: When and Why?

Citations are a bit like the acknowledgements in that they shield you from plagiarism, but they also serve another equally important role: they allow you to pass the buck to another author/work who has proven it elsewhere.

2.9.1. How to do citations in L^AT_EX with BibT_EX

L^AT_EX has a sister program called BiB_TE_X, which processes a database of *.bib files to extract and label the citations you use within a particular paper. In the atocsample.tex file that I provided, there is also an atocbibliography.bib file that has some useful references for the class. If you want to add another one, just cut and paste one of the existing ones, and edit it. For example, the first reference in the database *.bib file is:

```
@BOOK{Pedlosky87,
AUTHOR      ="Pedlosky, J.",
TITLE       ="Geophysical Fluid Dynamics",
```

```
PUBLISHER  ="Springer",
ADDRESS    ="Berlin",
YEAR       ="1987",
EDITION    ="2nd",
PAGES      ="710"}

```

Most of the listings are obvious, but perhaps the most important is not. It is the reference name (Pedlosky87). If you want to cite this book anywhere in a \LaTeX file, you can use

```
\citet{Pedlosky87}
```

When \LaTeX sees that, it will automatically pull the reference and put it in the bibliography. The `citet` command gives you an in sentence form, e.g., “As we can see from Pedlosky (1987).” Another useful command is

```
\citep
```

It gives you a parenthetical reference, e.g., “The ocean is big (Pedlosky, 1987).” There are other examples in the `atocsample.tex` file.

Depending on the kind of \LaTeX program you are using, you might have to do the following to get this to work (e.g., Mac TeXShop). Run \LaTeX , run BiBTeX , run \LaTeX , run \LaTeX again. The first call sets up the reference, the second one gets the info from the `*.bib` file, the third one completes the reference, and the last call gets the numbering/labelling right.

2.10. *Acronyms*

Define upon first use, e.g., The Gulf of Mexico (GOM) is warm. The surface of the GOM is even warmer. If you want to get fancy, use the LaTeX acronym package.

2.11. *First Person*

No first person. (or at least very infrequently) So, instead of “I downloaded ODV”, “ODV was downloaded.”

2.12. *Dataset versus Plotting Program*

This may be due to the nature of the first assignment, but be careful about where the data comes from. For example, the data is not from Matlab or ODV. It was from Reid and Mantyla. Matlab was just used to plot it. Often you will not need to say how you plot something, but you will *always* need to say which dataset it is (usually including a citation), so that someone else can understand what you’re showing or look it up.

2.13. *Where in the World?*

On a similar note, where are your figures located in the world? Any figure you show should be labeled or captioned telling the geographic location. Latitude and Longitude may be quickest but including a map of the section/data point may be nicer (depending on the point you’re making). To say that a CTD cast is located in the Atlantic is not really specific enough.

2.14. *Piggy-back off of reading or lectures!*

Many of you already realize that starting from a statement made in one of the readings makes for an easy start to the paper. This is generally true, because all of the references you need and all of the terminology is probably right there.

However, you may end up with less exciting conclusions, e.g., “Just as Pickard and Emery said it would be, NADW was there.” Many of you will take the bolder route of

just plotting something up and trying to make sense of it. This is harder, because it's not easy to figure out where to find help. You can ask me, or use google scholar, and that may help, but more importantly, be circumspect about what you say. If you say, the temperature is warmer at the top than the bottom, and that is what your figure shows, then great. If you say, the temperature is warmer at the top because of solar heating, you either need a citation or need to be obviously speculative, e.g., "Presumably, the temperature is warmer at the top due to solar heating."

It is best to be both interesting and correct. If one must choose, it is better to be correct and boring rather than interesting and wrong (at least for the purposes of this class!)

2.15. *Where can you make a paper more interesting?*

The introduction and conclusion are a good place to stimulate broader interest. In the introduction, you can *motivate the research* with whatever you like (including appropriate citations, of course). In the conclusion, you can often speculate as to the importance of what you've done or directions for potential future investigations. In the middle, don't try to push too hard, just state what's in front of you, and add more figures if you want to show something else.

2.16. *Use Google Scholar and Web of Science!*

You will learn quickly the importance of writing a good abstract, because you can scan the abstracts of the papers that you find to see if they will answer the question you've got in mind. Also, a good citation will save you pages of discussion and hours of fiddling with figures!

2.17. *Who is your audience?*

Think about how to make the classroom assignment extend beyond the classroom: Can you address the underlying questions in the assignment, but do so in a way that reads like an article for the general oceanographic community? Or, at the very least, will any student taking any version of an Intro. to Physical Oceanography class get something out of it?

2.18. *Cut off debate when you're out of time/room/ideas*

It is not necessary or possible to address everything in one short paper (or even one very long paper)! So, zealously assert your right to stop somewhere, and try to choose that somewhere on a logical basis (e.g., the dataset doesn't extend there or this paper focuses on oxygen not nitrate, or we don't yet know how to calculate the velocity fields from the data we have, etc.) It is O.K. to stop anywhere that is convenient, but be clear about why you stop there. The reader may be interested in following up on your work, and it helps to state what you'd need to go further in that direction.

REFERENCES

- Gopen, G. and J. Swan: 1990, The science of scientific writing: If the reader is to grasp what the writer means, the writer must understand what the reader needs. *American Scientist*, **78**, 550–558.
 URL <http://www.americanscientist.org/issues/pub/the-science-of-scientific-writing/>
 1
- Mensh, B. and K. Kording: 2017, Ten simple rules for structuring papers. *PLOS Computational Biology*, **13**, e1005619.
 URL <http://dx.doi.org/10.1371/journal.pcbi.1005619.t001>

- Montgomery, S. L.: 2003, *The Chicago guide to communicating science*. University of Chicago Press, Chicago.
 URL <http://www.loc.gov/catdir/description/uchi052/2002072627.html>
- Orwell, G.: 1946, Politics and the english language. *Horizon*.
 URL <http://bit.ly/2jV4jee>
- Strunk, W., E. B. White, and M. Kalman: 2005, *The elements of style*. Penguin Press, New York.
 URL <http://www.loc.gov/catdir/enhancements/fy0721/2005048913-b.html>
- Turabian, K. L.: 2013, *A manual for writers of research papers, theses, and dissertations: Chicago style for students and researchers*. University of Chicago Press, Chicago, 8 edition.
 URL <https://josiah.brown.edu/record=b7338626~S7>
- Vallis, G. K.: 2006, *Atmospheric and Oceanic Fluid Dynamics : Fundamentals and Large-Scale Circulation*. Cambridge University Press, Cambridge.
 URL <http://bit.ly/SDSMSK>
- Vonnegut, K.: 1981, How to write with style. *IEEE Transactions on Professional Communication*, **PC-24**.