

# Guidelines for bachelor and master thesis

Lukas Brunner

April 20, 2024

## **General remarks**

### **Structure and length of a thesis**

A typical bachelor thesis is no longer than 20 pages and can be written in English or German. A typical master thesis is not longer than 50 pages and written in English. Either thesis contains the following chapters in this order: Introduction, Data and Methods, Results, Conclusions, References. The chapters can be divided using subheadings. A table of contents should be placed before the introduction and link to the individual (sub-)sections. A list of figures and a list of tables are not necessary and supplementary material can be placed in an appendix.

### **Developing a research question**

The research question reflects the topic of the thesis. While the overarching question is usually (but not necessarily) provided by the advisor, the student is expected to develop their own concrete question to be answered in the thesis.

A good research question addresses a specific (unsolved) scientific problem and can be answered in the scope of the thesis. Having a precise research question early in the thesis process can help finding the right reading material, developing appropriate analysis scripts or arguments, and focusing the work in general.

### **On the use of AI tools**

AI tools can be very helpful for spellchecking, improving grammar, and even formulating whole sentences. Please use them – responsibly.

## 1 Abstract

The abstract should summarise the motivation for the work, the main findings, and their impacts in a broader context. A good guide for the structure of an abstract can be found here: <https://www.nature.com/documents/nature-summary-paragraph.pdf>

## 2 Introduction

The introduction provides an interesting entry point into the thesis and introduces the topic. It can begin with a motivation that goes beyond the specific topic and highlights the broader relevance of the work. It should cover the current state of research in the field(s) relevant to the topic of the thesis, citing key literature. Ultimately, it guides the reader towards the research question, which is usually presented at the end of the introduction.

## 3 Data and Methods

A description of all data and methods used in the thesis. As short and concise as possible without omitting important details. It does not have to read exciting.

## 4 Results

This chapter is the main part of the thesis, it presents and describes the results of the work and their implications. If results are based on figures, they should go beyond a simple description of the figure. Avoid sentences like: “Figure ??a shows a large bias in the North Atlantic in blue colors.” This can already be seen in the figure, rather try to write something like: “The large bias in the North Atlantic shown in figure ??a provides evidence for.../is a result of.../develops due to...” (see also section on figures below).

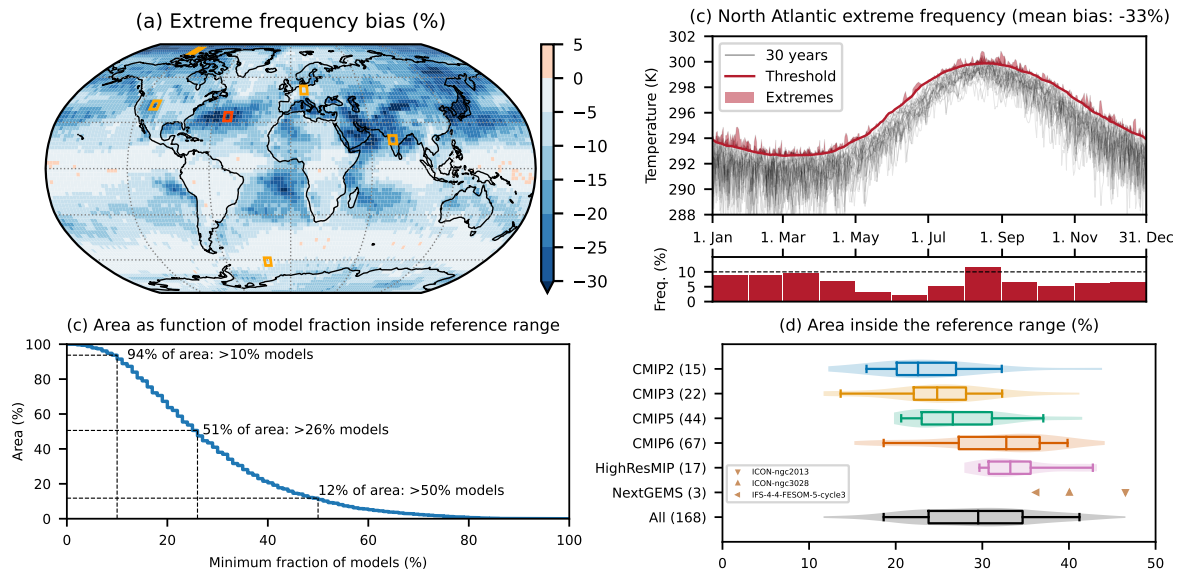
If there is previous work on the topic you can also compare and contextualise your results.

### 4.1 Figures

Well-designed figures are often the most effective of presenting information. It is, therefore, worth thinking about how to best visualise a given result and investing some time in polishing the figures at the end.

Here are some points to consider:

- What is the best way to visualise a result? (lineplot, barplot, boxplot, map with shading, etc.)
- Is all the information needed to interpret the figure included? (title, axis labels, units, legend, etc.)



**Figure 1: (a) Bias in the frequency of temperature extremes in ERA5.** Spatial bias distribution in the frequency of daily maximum temperature extremes based on exceedances of the 90th percentile using a 31 day running window in the period 1961-1990. (b)-(d) other examples of figures. (a) and (b): reprinted from Brunner2024.

- Could the figure be misleading to a reader? (e.g.: multiple sub-figures beside each other showing similar metrics should use the same colorbar range, except for rare exceptions; blue is often associated with negative temperature anomalies but positive precipitation anomalies)
- For figures using shading, the use of discrete color levels is often preferable to a continuous color gradient as, values and colors are easier to match.
- Does the figure have a precise figure caption (introducing any acronyms or technical terms used in the figure even when they have already been introduced in the text; do not describe results in the figure caption!)
- Does the figure use colorblind and perceptually uniform colormaps where possible? (see, e.g., here: [https://seaborn.pydata.org/tutorial/color\\_palettes.html](https://seaborn.pydata.org/tutorial/color_palettes.html))
- Is the font size of the labels and other text in the figure large enough? (ideally, it should have a similar font size to the rest of the text)
- Is the resolution high enough (and not so high that file size becomes a problem)? (ideally figures are included as vector graphics such as PDF)

**Table 1:** Area inside the reference range (see also figure ??d). Note that the caption of a table is typically placed above it, while it is placed below for figures.

Generation	Median (%)	Min-Max (%)
CMIP2	24	12-44
CMIP3	25	12-41
CMIP5	27	20-42
CMIP6	31	15-44

## 4.2 Tables

Tables are less exciting than figures but can help to structure results (see table ??) – consider using them.

## 4.3 Acknowledging the work of others

### 4.3.1 General remarks

If you build on the work of others, you should always acknowledge them. For information from scientific papers, this typically means citing them (see below). If you build on data or code provided by others, you should also disclose this, for example in the Data and Methods section: “The pre-processed data were provided by...”.

You can also reuse figures from existing work (particularly in the introduction), then you should state this at the end of the figure caption like: “Figure reprinted/adapted from...”. Note that some journals have a copyright that prohibits the reprinting of figures.

### 4.3.2 Citing scientific literature

Please cite using the author-year style only and link citations to their respective entry in the references chapter. If the citation is part of the sentence only the year should be in parentheses. For example: The abstract guide above is based on a paper by **Kapitein2005** published in Nature. If you are giving more general information, you can also place a citation at the end of a sentence or paragraph. It is then often not necessary to cite the same study in consecutive sentences. For example: The abstract guide above is based on a paper from a difference field. Its not necessary to cite it in the sentence before this one as this and the next sentence are still about the same topic. The abstract is used because it is a good example also for other fields (**Kapitein2005**).

When working with L<sup>A</sup>T<sub>E</sub>X you should make use of bibtex and .bib files (see, for example, here: [https://www.overleaf.com/learn/latex/Bibliography\\_management\\_with\\_bibtex](https://www.overleaf.com/learn/latex/Bibliography_management_with_bibtex)). To create an in-sentence citation you can use `\textcite`, for the end of the sentence `\parencite`.

#### 4.4 Some more general (English) writing remarks

- Write the important information first. It does not matter on which level, in a bullet point list, sentence, paragraph or chapter. First the main thing, then additional information, and at the end technical details.
- In scientific writing its normally better to always use the same word for the same thing. Switching between hot day, hot extreme, temperature extreme, and heatwave when referring to the same phenomenon might make the text more exciting but also harder to follow and less precise. Settle on one term and stick with it.
- Use the word “significant” only in the context of statistical significance. A good alternative otherwise is “considerable”
- People who originally come from countries where the majority of the population speaks the native language of German, such as Germany or Austria, tend to write very long – and complicated – sentences, that are hard to follow because the use many connecting words instead of just putting a full stop somewhere every now and then. Write short sentences. They are easier to read.
- An interesting take on scientific writing and Chekhov’s gun copied from Twitter:
  - *The great American novelist F. Scott Fitzgerald said: “You don’t write because you want to say something, you write because you have something to say.” So think about the story you want to tell before you start writing before you start typing.*
  - *Chekhov’s gun is fundamental because it provides a method to question every sentence in your text: how does that sentence contribute to your final goal? If it doesn’t, it must go. Pointless writing can be dismembered easily using this single technique. Use Chekhov’s gun to interrogate every sentence. Of course, all writers like to sometimes indulge in a poetic detour. But do that to often and you will lose your reader. There is a reason why there is another principle called “kill your darlings.” Cutting out a bad and pointless sentence is easy. Cutting out a beautiful but pointless sentences separates the kids from the adults. So try to write only relevant things and write them exactly once (although nothing is absolute and sometimes repetitions can be helpful to underline an important point).*
  - *Of course, some writing—and a lot of rewriting—takes place at the keyboard. But the point is that writing is something that we must do first inside our heads: when cycling to work, walking with your partner, or cooling off after a heated argument. At some point you will need to sit down and transcribe those ideas. But the chances that the idea will hit you the moment you sit in front of a keyboard is naive. Having ideas and writing them down are two difficult activities. Trying to do them at the same time is an overkill.*

## 5 Conclusions

May also be called “Summary and Conclusions” or “Conclusions and Outlook” or any other combination, depending on the focus. Here, the conclusions that can be drawn from the results are presented and contextualised. You can also provide your own interpretation, but always make a clear distinction between conclusions objectively based on the results and subjective opinions.

The conclusions chapter often opens with a short summary of the results, written in the past tense. This summary should be broadly understandable to someone who has not read the rest of the thesis in detail. It should, therefore, contain no acronyms and only make very limited use of references to other parts of the thesis.

Questions that remained open and could not be answered in the thesis can also be briefly discussed here. As well as possible new questions that arose in the course of the study. Suggestions for further studies or how the results might be applied in the future can be given in a short outlook at the end.

## 6 References