UNIVERSITY
OF COLOGNE

Introdcution to LaTeX

For PhD-students of the GSGS

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University and City Library Cologne

Intro

Our agenda today

- Check-in, introductions (10 minutes)
- What is LaTeX and why would I want to use it? (10 minutes)
- Getting started with Overleaf (10 minutes)
- First steps with LaTeX(60 minutes)
- Further steps with LaTeX(60 minutes)
- Using templates (75 minutes)

Before we start: Preparing Overleaf

- You have been invited to Overleaf via mail.
- Follow the instructions in the email!
- Click on link to project in Ilias

Introductions

- Name?
- What is your thesis about? (for the others)
- What is your thesis about? (for us laypeople)
- Where are you in your PhD? Just starting – have to finish next week?
- Previous experience using LaTeX?

What is LaTeX and why should I use it?

What is LaTeX?

- A professional typesetting system
- Open-Source-Software
- Used for academic writing and publishing

Advantages of $\LaTeX$

- Professional documents
- Easy handling of formulas
- Really stable, especially for long texts with lots of cross-references etc.
- Collaboration via Overleaf

Advantages of $\LaTeX$

- Preferred writing tool in some fields
- Active user community
- Simple textfile, easy to use versioning-tools like git
- Many (not all) journals provide templates
- Removes barriers to look at and write *code*, gate-way drug?

Mathematical formulas

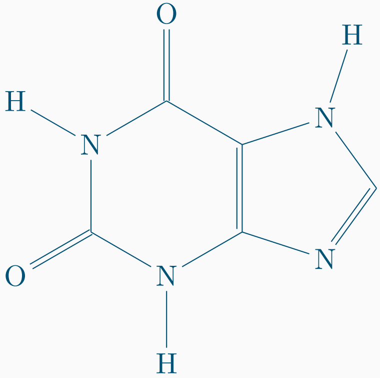
There are different ways to include formulas. This is how to include some important formula like this $A = \frac{\pi r^2}{2}$ inline. Within the text of the paragraph. But if you have lots of formulas/equations, you might want to do it a bit differently, as seen in 1 and 2 below:

$$\int_a^b x^2 \, dx \tag{1}$$

$$\sum_{i=0}^{\infty} a_i x^i \tag{2}$$

Packages

I need coffee...



Disadvantages of LaTeX

- You have to write *code* and troubleshoot errors
- Including graphics is a little bit more complicated compared to Word
- Tables are even more complicated
- You can spend a lot of procrastination time working on minor details in your LaTeX layout and typography instead of working on your actual thesis

When you should use LaTeX

- For longer academic texts
- When working with formulas
- When it is a standard in your field
- When you also produce your slides, posters etc. with LaTeX
- If you enjoy it!

Overleaf

What is Overleaf?

- Cloud-Editor for LaTeX
- No local installation needed
- Collaborative writing tool
- The commercial overleaf.com-instance has not been approved by the UoC (for data protection reasons)
- So: ITCC has its own overleaf-server

Overleaf in Cologne

- Free of charge for members of the university
- Unlimited collaboration (vs. only one collaborator for the free overleaf.com)
- Integrated in Sciebo
- Some features not available
  - no integration of dropbox and git
  - no integration of templates
  - no review-function

Now: Hands-on!

Using Templates

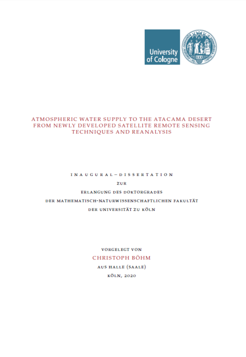
What are LaTeX-templates?

- where to find them?
  - overleaf
  - latextemplates
  - github, e.g. this
- how to use them?
- what parts are there?
- Some journals also provide -templates
- We will start with an easy example before we move on to the thesis template: CV

Now: Hands-on!

The Classic Thesis Template

- What does the thesis look like?
- Two examples in the Geosciences that we found that used it: Böhm, Christoph 2020 and Kizsler, Theresa 2024


University of Cologne

ATMOSPHERIC WATER SUPPLY TO THE ATACAMA DESERT FROM NEWLY DEVELOPED SATELLITE REMOTE SENSING TECHNIQUES AND REANALYSIS

INAUGURAL–DISSERTATION

ZUR

ERLANGUNG DES DOKTORGRADES

DER MATHEMATISCH-NATURWISSENSCHAFTLICHEN FAKULTÄT

DER UNIVERSITÄT ZU KÖLN

VORGELEGT VON

CHRISTOPH BÖHM

AUS HALLE (SAALE)

KÖLN, 2020

Classic Thesis Template

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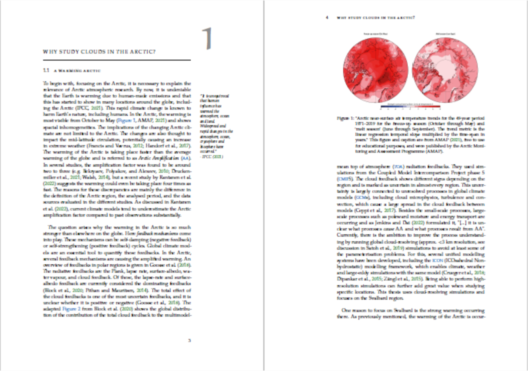

1

WHY STUDY CLOUDS IN THE ARCTIC?

1.1 A WARMING ARCTIC

To begin with, focusing on the Arctic, it is necessary to explain the relevance of Arctic atmospheric research. By now, it is undeniable that the Earth is warming due to human-made emissions and that this has started to show in many locations around the globe, including the Arctic (IPCC, 2021). This rapid climate change is known to harm Earth's nature, including humans. In the Arctic, the warming is most visible from October to May (Figure 1, AMAP, 2021) and shows spacial inhomogeneities. The implications of the changing Arctic climate are not limited to the Arctic. The changes are also thought to impact the mid-latitude circulation, potentially causing an increase in extreme weather (Francis and Vavrus, 2012; Handorf et al., 2017). The warming of the Arctic is taking place faster than the average warming of the globe and is referred to as *Arctic Amplification* (AA). In several studies, the amplification factor was found to be around two to three (e.g. Bekryaev, Polyakov, and Alexeev, 2010; Druckenmiller et al., 2021; Walsh, 2014), but a recent study by Rantanen et al. (2022) suggests the warming could even be taking place four times as fast. The reasons for these discrepancies are mainly the difference in the definition of the Arctic region, the analysed period, and the data sources evaluated in the different studies. As discussed in Rantanen et al. (2022), current climate models tend to underestimate the Arctic amplification factor compared to past observations substantially.

"It is unequivocal that human influence has warmed the atmosphere, ocean and land. Widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred."
- IPCC (2021)

The question arises why the warming in the Arctic is so much stronger than elsewhere on the globe. Here *feedback mechanisms* come into play. These mechanisms can be self-damping (negative feedback) or self-strengthening (positive feedback) cycles. Global climate models are an essential tool to quantify these feedbacks. In the Arctic, several feedback mechanisms are causing the amplified warming. An overview of feedbacks in polar regions is given in Goosse et al. (2018). The radiative feedbacks are the Plank, lapse rate, surface-albedo, water vapour, and cloud feedback. Of these, the lapse-rate and surface-albedo feedback are currently considered the dominating feedbacks (Block et al., 2020; Pithan and Mauritsen, 2014). The total effect of the cloud feedbacks is one of the most uncertain feedbacks, and it is unclear whether it is positive or negative (Goosse et al., 2018). The adapted Figure 2 from Block et al. (2020) shows the global distribution of the contribution of the total cloud feedback to the multimodel-

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4 WHY STUDY CLOUDS IN THE ARCTIC?

Figure 1: "Arctic near-surface air temperature trends for the 49-year period 1971–2019 for the freeze-up season (October through May) and 'melt season' (June through September). The trend metric is the linear regression temporal slope multiplied by the time-span in years." This figure and caption are from AMAP (2021), free to use for educational purposes, and were published by the Arctic Monitoring and Assessment Programme (AMAP).

mean top of atmosphere (TOA) radiation feedbacks. They used simulations from the Coupled Model Intercomparison Project phase 5 (CMIP5). The cloud feedback shows different signs depending on the region and is marked as uncertain in almost every region. This uncertainty is largely connected to unresolved processes in global climate models (GCMs), including cloud microphysics, turbulence and convection, which cause a large spread in the cloud feedback between models (Ceppi et al., 2017). Besides the small-scale processes, large-scale processes such as poleward moisture and energy transport are occurring and as Jenkins and Dai (2022) formulated it, "[...] it is unclear what processes cause AA and what processes *result* from AA". Currently, there is the ambition to improve the process understanding by running global cloud-resolving (approx. <3 km resolution, see discussion in Satoh et al., 2019) simulations to avoid at least some of the parameterisation problems. For this, several unified modelling systems have been developed, including the ICON (ICOsahedral Non-hydrostatic) modelling framework, which enables climate, weather and large-eddy simulations with the same model (Crueger et al., 2018; Dipankar et al., 2015; Zängl et al., 2015). Being able to perform high-resolution simulations can further add great value when studying specific locations. This thesis uses cloud-resolving simulations and focuses on the Svalbard region.

One reason to focus on Svalbard is the strong warming occurring there. As previously mentioned, the warming of the Arctic is occur-

Classic Thesis Template

given later.

Another reason one uses hectometer simulations is that the higher the resolution, the better the topography and surface types can be resolved. This is especially valuable in the Svalbard Archipelago as it is a complex environment with mountains, glaciers, fjords, open oceans, and decreasing sea ice. Fig. 1 in Dekhtyareva et al. (2018) demonstrates what happens when one uses a low-resolution model. The figure shows that in ERA-Interim, the "Ny-Ålesund cell" is centred ca. 19 km to the south of Ny-Ålesund on a glacier-covered mountain. This is obviously a disadvantage in an environment with heterogeneous surface types and pronounced orography. For the Arctic, the availability of highly resolved orography is more limited in ICON in comparison to the mid-latitudes. Currently, two different choices can be made for the orography in the Arctic, which are the GLOBE (1 km resolution; Hastings et al., 1999) and the recently added MERIT-DEM (90 m resolution; Yamazaki et al., 2017) data sets (Asensio et al., 2021).

Regular icosahedron

Now that the advantage of using different resolutions has been discussed, it is worth taking a moment to understand what "resolution" means in ICON. The "icosahedral" in the name ICON already hints towards a speciality of the grid. ICON uses a staggered C-grid, which is based on a regular, convex icosahedron which has 20 equilateral faces that are shaped as triangles (Wan et al., 2013; Zängl et al., 2015). These faces are refined systematically to create the grids with the desired resolution. These grids are termed as "RnBk"-grids, where n and k determine the degree of refinement and give the number of cells as $n_{cells} := 20n^2 4^k$ (details in Zängl et al., 2015). The term "resolution" can describe several features of a triangular cell, and in this work, generally, the edge length of a cell is meant. In other modelling contexts, the resolution can be given as the edge length of a square. This length is shorter than that of a triangle edge with the same area as the square. One can easily approximate the corresponding square edge length using the triangular edge length $\overline{\Delta x}$ as $\frac{2}{3}\,\overline{\Delta x}$. For any chosen resolution in ICON, one must parameterise the microphysical processes. As the results in this thesis include an analysis of these microphysical processes, the subsequent section will give an introduction to essential concepts in this regard.

3.2 MICROPHYSICAL MODELS

There are quite a few books in which cloud microphysical processes and their parameterisations are explained. Two of these are used in the following sections as general references: Khain and Pinsky (2018) and Lohmann, Lüönd, and Mahrt (2016). Further, in this work, the term "cloud microphysical parameterisation" is sometimes shortened

Disclaimer

- Do not know everything about this template
- This is not an official recommendation by the UoC
- Seems to have worked for others, looks good to me
- Check with your advisor if this looks ok to them

What we will try out today

- We will try to get some orientation as to what is where in the collection of files
- We will NOT be able to actually get your diss-setup finished, you will have to finish this on your own
- We *will* however try to get you started as far as possible
- We will get some things changed to UoC-settings and add some of your personal data

How to continue

Note:

- please read ClassicThesis.pdf before you start to actually work with this template on your own
- spend some time getting acquainted with it an cleaning it up so it works for you
- don't forget to send Andre Miede his postcard

Now: Hands-on!