INTRO: References missing in entire section

0.1 Ice Core Data and Mapping Paleoclimate and -temperature

Isotopes, ECM, chemicals.

0.2 A Rare Gem of Knowledge

The study of ice cores has revealed much information and knowledge about the dynamics of the world's past climate, atmosphere and geology through measured proxies such as isotopic and chemical compositions, and conductivity among many other. Simultaneously, it has opened for the possibilities of modeling and predicting the future that lies ahead of us, based on the understanding of the past behaviors of the Earth system. Many analyses of ice cores have mainly focused on the large scale changes happening over hundreds, thousands and tens of thousands of years, [**??**] . When considering such large-scale changes, it is acceptable that the dating of the ice core is off by a year or two as the interest is mainly on the general trends over many years and not on individual annual changes. This is rather lucky, as it is rare to have exact and precise dating, especially in older and deeper cores where the annual layer cycles have been extinguished. The scope of this project though, has a different focus: When examining ice core data for volcanic eruptions through, for example, electrical conductivity measurements, it is sometimes possible to date the ice cores much more accurate and precise. Two aspects are in play here: Firstly, if volcanic eruptions are visible in more than one ice core it is possible to synchronize all measured quantities in these cores by matching their volcanic profiles. This enhances the accuracy of the dating and also presents the possibility to examine more local behaviors of the Earth system as, for example, cross-hemisphere data can be compared. Secondly, if the eruptions have been recorded in human history, the precision of the dating can be highly improved, as these historical records often contain both time, place, duration and other important parameters of the volcanic events. For this project both aspects are considered as the focus is on the volcanic eruptions of the Icelandic volcano Laki in 1783 and the Indonesian volcano Tambora in 1815, which are both very well historically recorded and documented and are both visible in a great number of ice cores. This reveals a rare gem of knowledge: as the two eruptions are relatively close in time, well documented and detectable in many cores, it is possible to say with high confidence that any data measured

INTRO: REFERENCES and examples

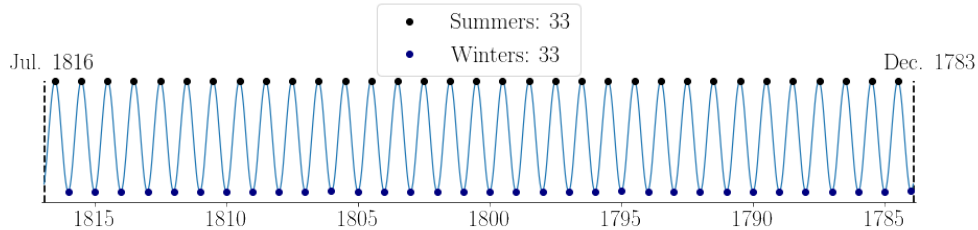

Figure 0.1: Theoretical summers and winters in the time span between the Laki and Tambora volcanic depositions in Greenland.

and analyzed, be it isotopic, conductivity, chemical ot otherwise, in the ice core section between these two visible eruptions, must in time represent the time span between the deposition of volcanic material at the ice core site. This allows for in depth analysis of the diffusion and densification processes the ice has been through and makes it possible to examine and develop new methods to restore diffused signals and otherwise lost information with high precision and accuracy. This is mainly due to the constraints raised based on the knowledge of deposition time: Since there are 33 years between the volcanic depositions, there must be detected exactly 33 winters and 33 summers in the isotopic signals. Thus, the restoration of the diffused data series can be optimized to fulfill these criteria. All of this presents a way to make more precise local temperature estimates over a shorter time period through the different temperature proxies present in the ice core data.

INTRO: Make Figure with 33 summer and winter cycles.

In this thesis an introduction to diffusion of water isotopes in ice cores is firstly presented along with methods for modeling densification and diffusion profiles. Following is a brief examination of different experimental methods for detection of volcanic deposited material and which methods has been used for the data under inspection. The chosen data are then presented along with an argumentation of why they were selected. Then a thorough presentation of data and signal analysis along with important computational methods are presented. These different tools are then combined in the method description, depicting a walk-through and testing of the final algorithm developed for estimating the diffusion length given the specific number of years. The final method is tested and further developed and fine tuned, and results given the last iteration of the method are presented. On the basis of these results, finally, a temperature reconstruction of the area of the drill sites is attempted.