# Topics for BSc or MSc theses in Climatology, Spring Semester 2022

*Forest Fires*

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| Title | **The „Calanda Fire“** |
| Level | Preferably MSc |
| Prerequisites | R, programming, climatology, historical interest |
| Methods | Case study, statistical analyses, modeling |
| Description | In addition to statistical analyses (see topic above), rare events such as forest fires also require in-depth case studies. The arguably largest forest fire in recent Swiss history (in terms of area burnt) was the „Calanda fire“ in 1943, ignited by military shooting. The goal of this project is to study the meteorological and environmental conditions that led to this fire. In addition to historical reanalysis data meteorological data from Switzerland, it is envisaged, depending on the level and interest of the student, to use the numerical model „WRF-Fire“ to simulate this episode. This would contribute towards establishing WRF-Fire as a modeling tool in Switzerland. |
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| Advisor | |

*Climatology*

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| Title | **European Droughts** |
| Level | MSc |
| Prerequisites | R, programming, climatology, historical interest |
| Methods | Statistical analyeses |
| Description | There is a current scientific debate if the intensity of the recent 2003, 2015, and 2018 droughts is exceptional in the context of the last millennium. Based on tree-ring reconstructions, some authors find them to be within the range of natural variability (Ionita et al. 2021), while others describe them to be unprecedented (Büntgen et al. 2021). The goal of this thesis is the analysis of droughts in our new climate reconstruction, which combines various kinds of direct and indirect observations with model simulations since 1420 CE. This data set would allow to study drought intensity but also possible causes like Atlantic sea surface temperature variability or shifts in large scale atmospheric circulation.<br>References:<br>- Ionita, M., Dima, M., Nagavciuc, V. et al. Past megadroughts in central Europe were longer, more severe and less warm than modern droughts. Commun Earth Environ 2, 61 (2021). https://doi.org/10.1038/s43247-021-00130-w<br>- Büntgen, U., Urban, O., Krusic, P.J. et al. Recent European drought extremes beyond Common Era background variability. Nat. Geosci. 14, 190–196 (2021). https://doi.org/10.1038/s41561-021-00698-0 |
| Supervisor | Dr. Jörg Franke, joerg.franke@giub.unibe.ch |
| Advisor | |

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| Title | **Eurasian snow and ENSO influence on the Indian monsoon** |
| Level | MSc |
| Prerequisites | R, programming, climatology, historical interest |
| Methods | Statistical analyses, |
| Description | Two mechanisms have been proposed, how Eurasian snow cover in winter could influence the Indian monsoon in the following summer. First, Eurasian snow may directly affect monsoon by modulating large scale circulation. Second, El Niño-Southern Oscillation appears to be related with both, winter snow cover and summer monsoon rainfall. These direct in indirect relationships have been studied in satellite data and observations of the past decades as well as in simulations for the last century. Our new climate reconstruction, which combines various kinds of direct and indirect observations with model simulations since 1420 CE, offers a new possibility to study these causes of monsoon variability in India.<br>References:<br>- Amita Prabhu, Sujata K. Mandke, G. Pandithurai. Regional perspectives in Eurasian snow - Indian monsoon relationship: An observational study, Polar Science, Volume 30, 100718 (2021). https://doi.org/10.1016/j.polar.2021.100718.<br>- Peings, Y., Douville, H. Influence of the Eurasian snow cover on the Indian summer monsoon variability in observed climatologies and CMIP3 simulations. Clim Dyn 34, 643–660 (2010). https://doi.org/10.1007/s00382-009-0565-0 |
| Supervisor | Dr. Jörg Franke, joerg.franke@giub.unibe.ch |

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| Title | **Impact of volcanic eruptions on tropical teleconnections** |
| Level | MSc |
| Prerequisites | R, programming, climatology, historical interest |
| Methods | Statistical analyses |
| Description | Large tropical eruption lead to a reduction in incoming solar radiation. At least three possible consequences have been debated: 1) The land-ocean temperature gradient, due to the larger heat capacity of the ocean, can alter for instance the African monsoon and Walker circulation. 2) The so-called "ocean dynamical thermostat", refers to a dipole in the Pacific. Due to upwelling, the eastern Pacific could be less effected by radiation changes than the western Pacific. However, this upwelling may be altered itself by changes in wind stress. 3) Shifts of the Inter Tropical Convergence Zone. Enhanced Northern Hemisphere cooling after an eruption in the Northern Hemisphere may shift the ITCZ southward. This could weaken trade winds and result in an El Niño-like response.<br>Currently, there is some disagreement in the impact of eruptions on the tropical climate and ENSO in particular, depending on the proxy archive used in the climate reconstruction. Tree-ring based reconstructions suggest that ENSO will be in a positive phase after eruptions. On the other hand, coral data does not support this ENSO relationship. This thesis will focus on the tropical teleconnections of large eruptions in our new climate reconstruction, which makes fewer assumption about the stationarity of teleconnection throughout time than previous reconstructions efforts.<br>References:<br>- Zhu, F., Emile-Geay, J., Anchukaitis, K.J. et al. A re-appraisal of the ENSO response to volcanism with paleoclimate data assimilation. Nat Commun 13, 747 (2022). https://doi.org/10.1038/s41467-022-28210-1<br>- Dee, S. et al. No consistent ENSO response to volcanic forcing over the last millennium. Science, Vol 367, Issue 6485, 1477-1481 (2020). DOI: 10.1126/science.aax2000 |
| Supervisor | Dr. Jörg Franke, joerg.franke@giub.unibe.ch |

*Historical Climatology*

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| Title | **Historical Swiss meteorological series** |
| Level | BSc or MSc (several theses) |
| Prerequisites | Historical interest or background, statistics, R, climatology |
| Methods | Historical analysis, archive work, data processing, statistical analyses, |
| Description | Meteorological observations in Switzerland prior to the start of the „official“ network in December 1863 have never been systematically compiled until recently. Over the past four years we have imaged and digitised many of these. The task of these MSc or BSc theses (each thesis will cover one series) is to assess, quality check and evaluate the time series. This includes compiling metadata, such as descriptions and literature on these series, or comparisons to other series.<br>The choice is between Schaffhausen (1794-1845), Delémont (1801-1832), Vevey (1805-1840), Einsiedeln (1818-1864), Bellinzona (1826-1832), Luzern, (1826-1832/1844-1864), Fribourg (1829-1847) and Zug (1843-1873). |
| Supervisor | Prof. Dr. Stefan Brönnimann, room 506, stefan.broennimann@giub.unibe.ch |
| Advisor | Yuri Brugnara (yuri.brugnara@giub.unibe.ch) |

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| Title | **Historical Weather Diary from the late 17th/early 18th century** |
| Level | BSc/MSc (several) |
| Prerequisites | Historical interest or background, statistics, R, climatology |
| Methods | Historical analysis, archive work, data processing, statistical analyses, |
| Description | Weather diaries may contain categorisable or even quantifiable information that may be used for weather reconstruction. This thesis deals with one or several weather diaries: Grebner, Wroclaw (1692-1710, in collaboration with Univ. Torun, Poland), **Eimmart, Nürnberg (1695-1704)**, Fries, Zürich (1675-1715), Dietrich Einsiedeln (1670-1704, currently editted by Chr. Rohr, Institute of History), and Kirch, Guben (1677-1700, not imaged yet). These diaries should be described and contextualised. Quantifiable information (e.g. wind direction, rain/norain) has been or will be digitised, for others such as cloud cover a categorisation will be sought. The diary will then be compared to other sources of information (the data will be used in future project to produce daily weather type reconstructions using a machine learning approach). |
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| Title | **Weather reconstruction using machine learning** |
| Level | MSc |
| Prerequisites | Statistics, R, climatology |
| Methods | Data processing, statistical analyses, |
| Description | The goal of this work is to reconstruct day-to-day weather for severe winters and summers in the past such as the winter 1684/5 or the summer of 1695. Sparse instrumental measurements will be combined with weather diaries and wind observations from ships. This thesis will focus on training data sets towards that aim, i.e., generate the same data in a period in the more recent past for which daily weather fields are available. |
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| Title | **Evaluation of long climate series from observations and reconstructions** |
| Level | BSc (Deutsch oder Englisch) or MSc (several theses possible) |
| Prerequisites | Statistics, R, meteorology or climatology |
| Methods | R time series analysis |
| Description | The climatology group is currently producing a climate reconstruction based on data assimilation methods provides global monthly fields of temperature, precipitation and other parameters back to 1420. This is based on long measurement series, weather diaries and tree rings, which are combined with a climate model. The goal of this thesis is to evaluate the reconstruction using independent data and other reconstructions. Several theses are possible focusing on different variables, regions, time periods, etc. |
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*Urban Climate*

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| Title | **“Cool balcony”: Assessing the cooling potential of a novel urban gardening platform** |
| Level | MSc |
| Prerequisites | Solid skills in statistics (R or equivalent); background in meteorology/climatology and/or biology; interest in urban climatology and biosphere-atmosphere interactions |
| Methods | Environmental measurements and sensor intercomparisons; statistical analyses and modelling |
| Description | Greening of balconies and terraces is viewed as an important measure to help mitigate the increasing risk for heat-stress in urban environments. The urban gardening tech start-up “BOUM” aims at helping people to successfully grow plants on their balconies by developing an urban gardening platform that combines a novel irrigation system with sensor technology and big data. This system enhances plant growth success and at the same time delivers detailed information on local microclimatic conditions. Through local optimization, the platform will in the long run not only increase local plant production and biodiversity, but may also contribute to the cooling of local urban environments through combined effects of shadowing and evapotranspiration.<br>Situated within the fields of urban climatology and plant sciences, the goal of this interdisciplinary master thesis is to quantify the cooling potential of the new urban gardening platform. The project also seeks to evaluate the performance of built-in measurement sensors of the planting systems when compared to established measurement devices (e.g., the devices used for Urban Climate Bern project). By measuring and intercomparing different atmospheric variables (e.g., air temperature, surface temperature, solar irradiation, and relative humidity) in a quasi-experimental setting (balcony equipped with planting set vs. bare balcony) throughout spring and summer season 2022, this thesis offers a combination of field work and statistical analyses (e.g., regression modelling). The potential candidate should be interested in microclimatic measurement techniques, to be open and motivated for interdisciplinary challenges, and to have experience in statistical analyses of climatological/meteorological data at regional to sub-local scales. Love for plants is an advantage. |

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| Advisor | Dr. Moritz Gubler (Institute of Geography, Climatology group), moritz.gubler@giub.unibe.ch |

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|---|---|
| Title | Intercomparison of Low-Cost Measurement Equipment for UHI Assessments |
| Level | BSc or MSc |
| Prerequisites | Basics skills in statistics (R or equivalent); interest in urban climatology and meteorological measurement techniques |
| Methods | Environmental measurements and sensor intercomparisons; statistical analyses |
| Description | Since 2018, the Climatology group maintains an urban heat monitoring network consisting of 65 – 85 low-cost temperature sensors within and around the city of (more information: https://www.geography.unibe.ch/research/climatology_group/research_projects/urban_climate_bern/index_eng.html). Despite good performance during nocturnal conditions, daytime temperature data are subject to marked measurement bias due to the radiative heating and poor ventilation of the radiation shield used. To overcome these biases and reduce maintenance efforts for reading out the data manually, an improved type of measurement device has lately been developed including active ventilation, automated data transmission, solar energy supply, and relative humidity sensor. This thesis seeks to evaluate the performance of the new device under outdoor conditions by intercomparing it with automated, professional weather stations throughout summer season 2022. Thus, the project includes a substantial amount of field work at multiple measurement sites in an around the city of Bern and subsequent statistical analyses of the measurement data to depict the performance of the prototype. The potential candidate should bring a (basic) background in statistics, to have knowledge about meteorological processes at local scales, and to be interested in atmospheric measurement techniques. |
| Supervisors | Prof. Dr. Stefan Brönnimann (Institute of Geography, Climatology group), stefan.broennimann@giub.unibe.ch<br>Dr. Moritz Gubler (Institute of Geography, Climatology group), moritz.gubler@giub.unibe.ch |
| Advisor | Moritz Burger (Institute of Geography, Climatology group), moritz.burger@giub.unibe.ch |

*Historical*

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|---|---|
| Title | **Visueller Geographieunterricht anno 1900: Die Glasdiasammlung des GIUB** |
| Level | MSc |
| Prerequisites | Interesse an Disziplingeschichte und historischem Bildmaterial |
| Methods | Quellen- und Literaturarbeit |
| Description | Das GIUB verfügt über eine Sammlung von gegen 10'000 Glasdias aus der Zeit Ende 19. Jh./Anfang 20. Jh. Die Glasdias zeigen Landschaften, Städte, geomorphologische Formen und vieles mehr und wurden im Unterricht verwendet. Die Sammlung wird zur Zeit vollständig digitalisiert. Diese Masterarbeit (in Zusammenarbeit mit der Universitätsbibliothek) soll die Glasdiasammlung wissenschaftlich beschreiben und in einen disziplingeschichtlichen und institutsgeschichtlichen Kontext stellen. |
| Supervisor | Prof. Dr. Stefan Brönnimann, Raum 506, stefan.broennimann@giub.unibe.ch |
| Advisor | Universitätsbibliothek |

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| Title | **The Transcontinental Excurions 1912** |
| Level | BSc/MSc |
| Prerequisites | Interesse an Disziplingeschichte und historischem Bildmaterial |
| Methods | Quellen- und Literaturarbeit |
| Description | Eines der wissenschaftlichen Grossereignisse des Jahres 1912 war eine geographische Exkursion quer durch die USA. Die aufstrebende US-Geographie lud die führenden europäischen Geographen zur Teilnahme. Darunter war auch ein Berner (sowie ein Ex-Berner). Welche Bedeutung hatte dieses Ereignis für die Geographie in Europa, in der Schweiz, in Bern? Dazu hat es einige wenige Quellen sowie eine Postkartensammlung. |
| Supervisor | Prof. Dr. Stefan Brönnimann, Raum 506, stefan.broennimann@giub.unibe.ch |
| Advisor | |

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| Title | **Erwin Genge – ein Geologiestudium Anfang des 20. Jahrhunderts** |
| Level | BSc or MSc |
| Prerequisites | Geology |
| Methods | Science history |
| Description | Erwin Genge studierte an der Universität Bern Geologie im Sekundarlehramt von 1914 bis 1918, war danach Sekundarlehrer in Erlenbach. Seine Notizbücher zeigen, wie vor hundert Jahren in Bern Gelogie unterrichtet wurde. |
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