250 years of daily weather

a reconstruction of temperature and precipitation in Switzerland since the late 18th century

Noemi Imfeld[1,2], Lucas Pfister[1,2], Yuri Brugnara[1,2], and Stefan Brönnimann[1,2]

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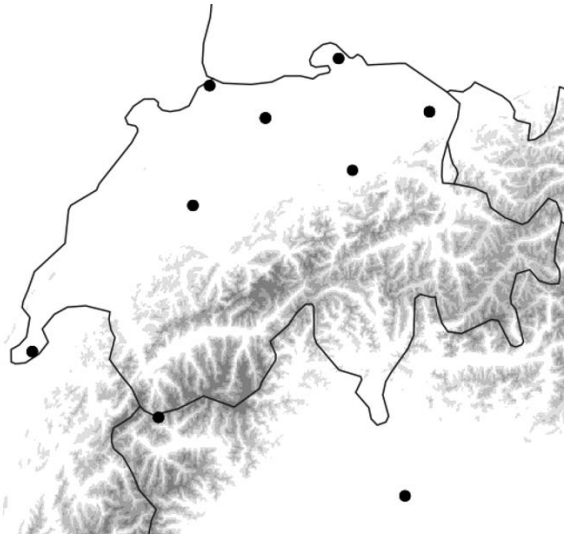
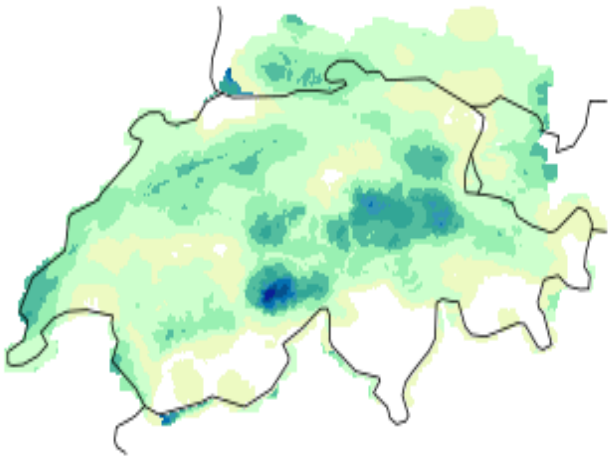
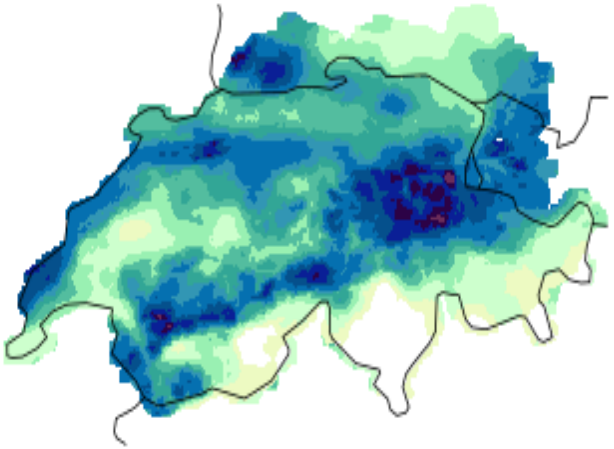




Updated from Pfister et al. (2019)



MeteoSwiss (2021)

1763 - 1863

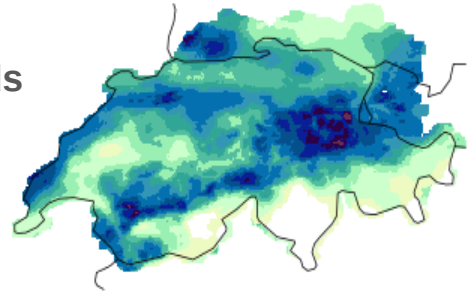
1864 - 1960

1961 - 2020

1. Daily temperature and precipitation fields

Covering the reference period 1961 - 2020

1km x 1km, Meteoswiss



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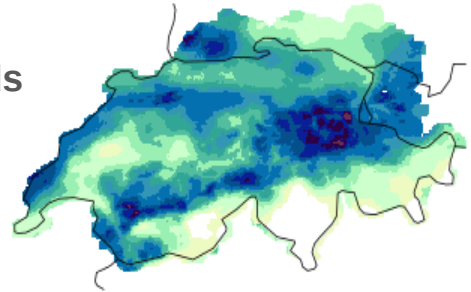
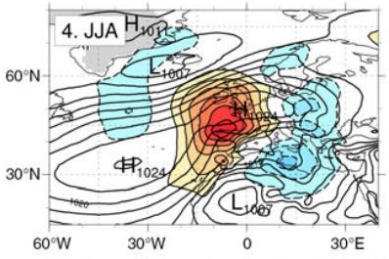


2. Daily weather types

1763 – 2009, Schwander et al. 2017



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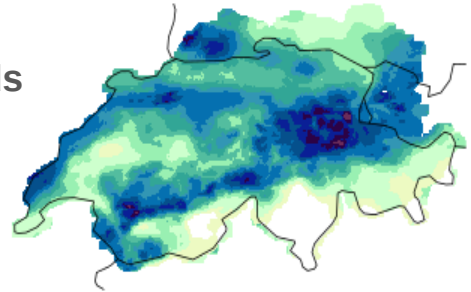

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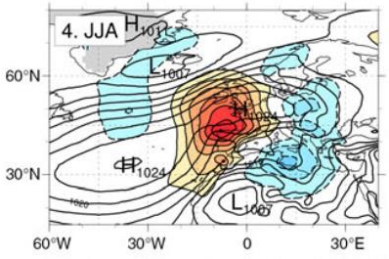
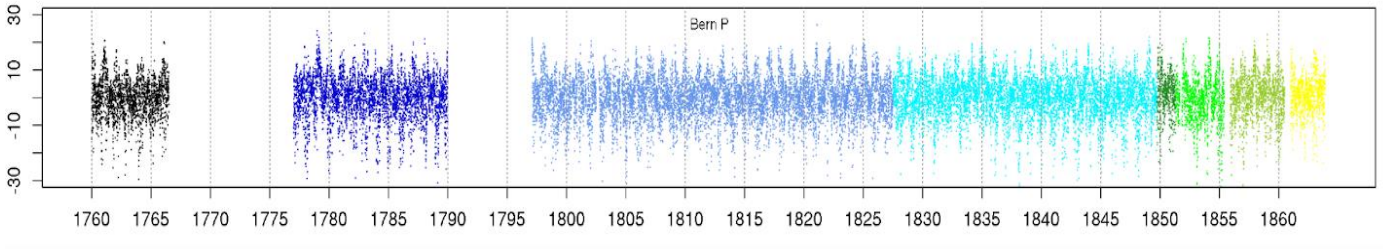
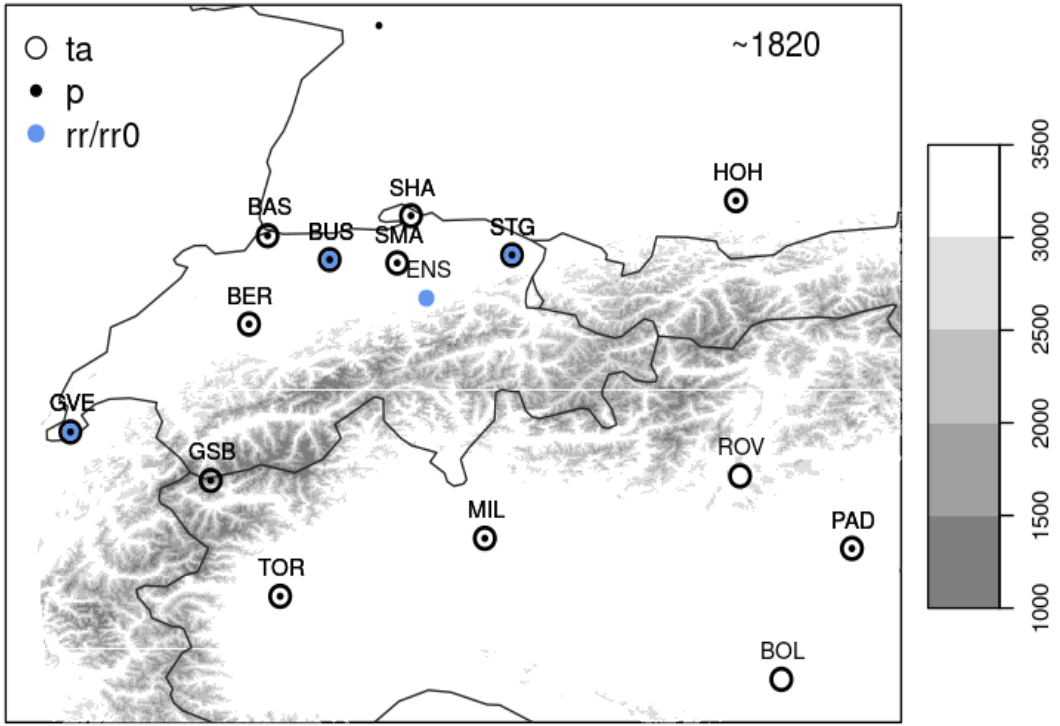


3. Station data

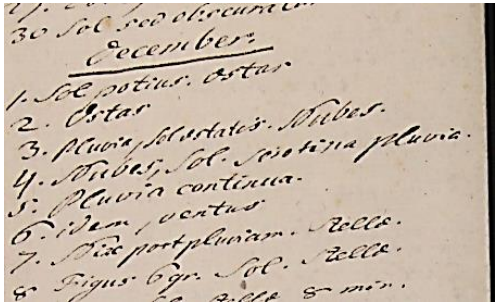
Reference: 1961 – 2020 ECAD, Meteoswiss
Historical: 1763 – 1863 CHIMES, PALAEO-RA, Improve



Station data around 1820



Measurements and weather notes, St. Gallen



Weather notes, Einsiedeln

1. Date preparation

2. Analog Resampling

3. Improvement

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Reference station data
- Gap filling
- Homogenization
- Detrending
- Climate offset

….

Historical station data
- Daily means estimation
- Homogenization

….

Temperature grids
- Climate offset
- Detrending

1. Date preparation

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Temperature grids
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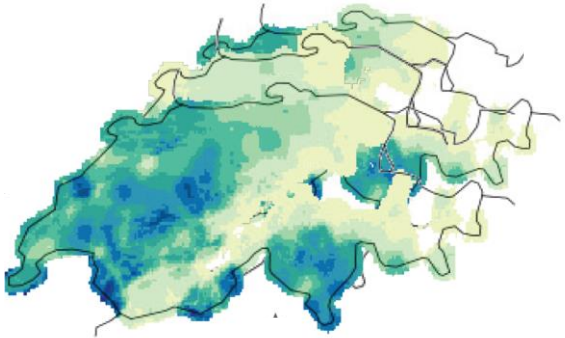
2. Analog Resampling

Best 50 analog days for a day in the past based on the smallest Gower distance

$$D_{Gower}(x_1, x_2) = 1 - \left(\frac{1}{p} \sum_{j=1}^{p} s_j(x_1, x_2) \right)$$



Preconditions:
same weather type | same season

3. Improvement

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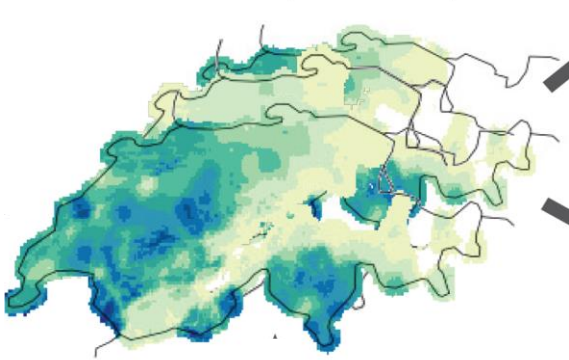

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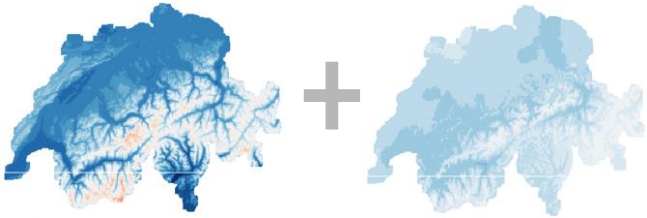
Temperature
Ensemble Kalman Fitting

$$\overline{x}^a = \overline{x}^b + \mathbf{K}(y - H\overline{x}^b)$$



Precipitation
Quantile mapping
> fitted in reference period and applied to historical period

$$\boldsymbol{P}_{\mathrm{o}} = h(\boldsymbol{P}_{\mathrm{m}})$$

Cross-validation for temperature anomalies

for station network ~1820

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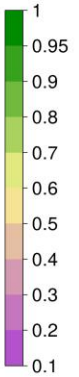
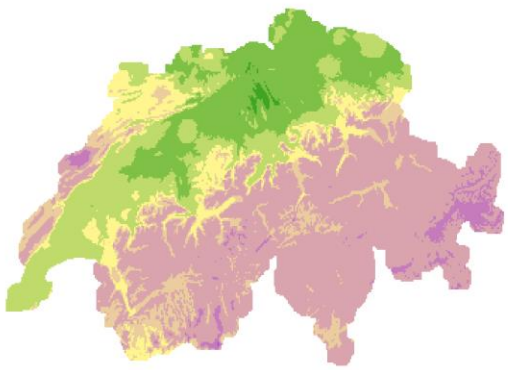
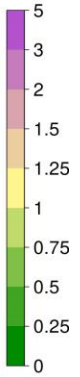
Pearson correlation

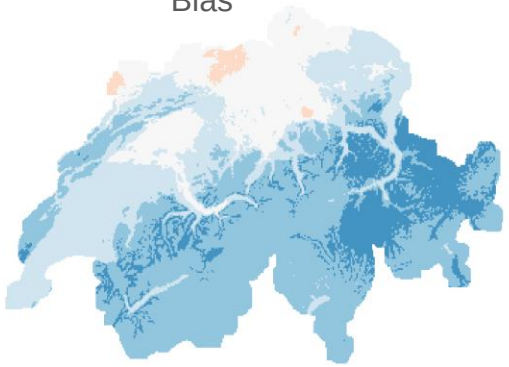


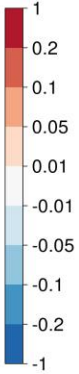
RMSE



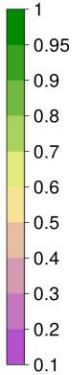


Bias





MSESS

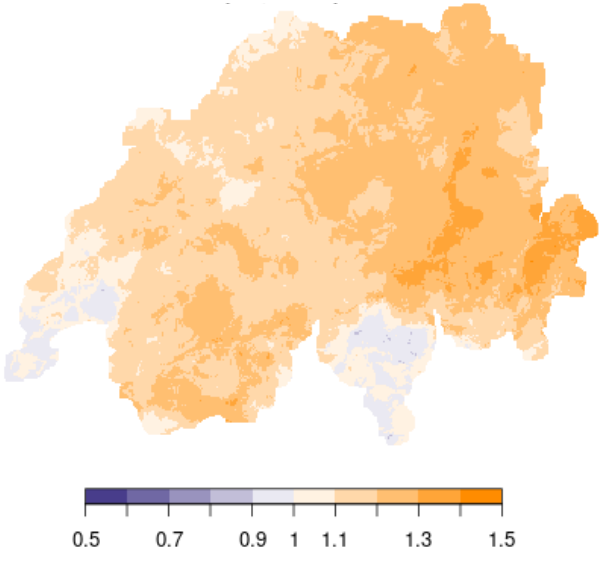


The double catastrophy 1769 - 1772

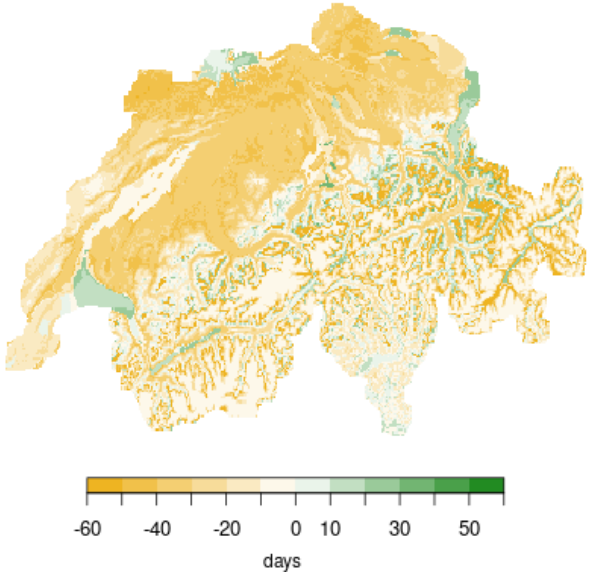
»dass sich hie und da Gletscher ansezen möchten«

…Lake Zurich reached a catastrophic level… (Collet, 2019)

Wetday frequency ratio Juli-August 1770



Growing season length anomaly 1770



Thank you for listening!

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