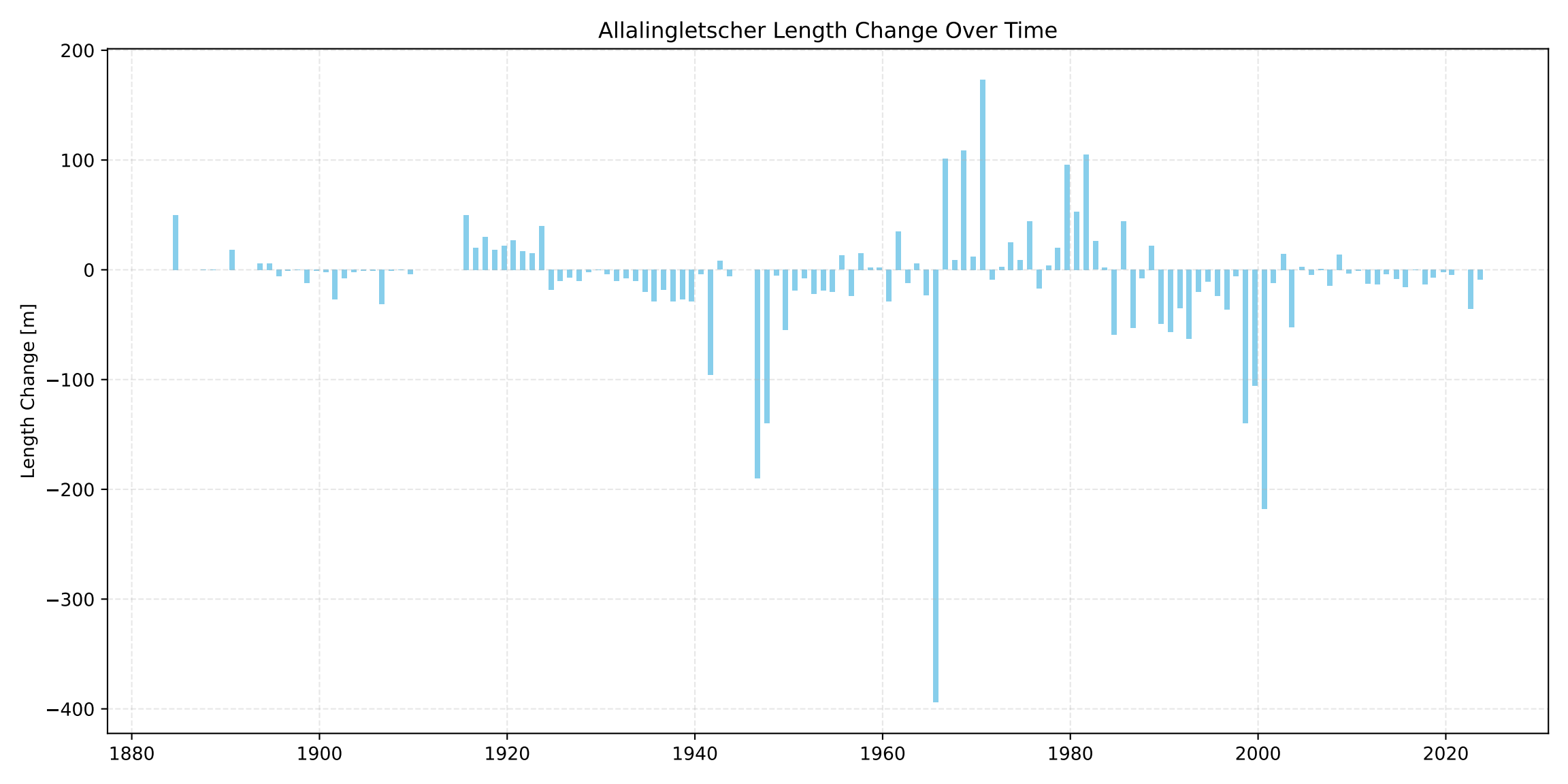
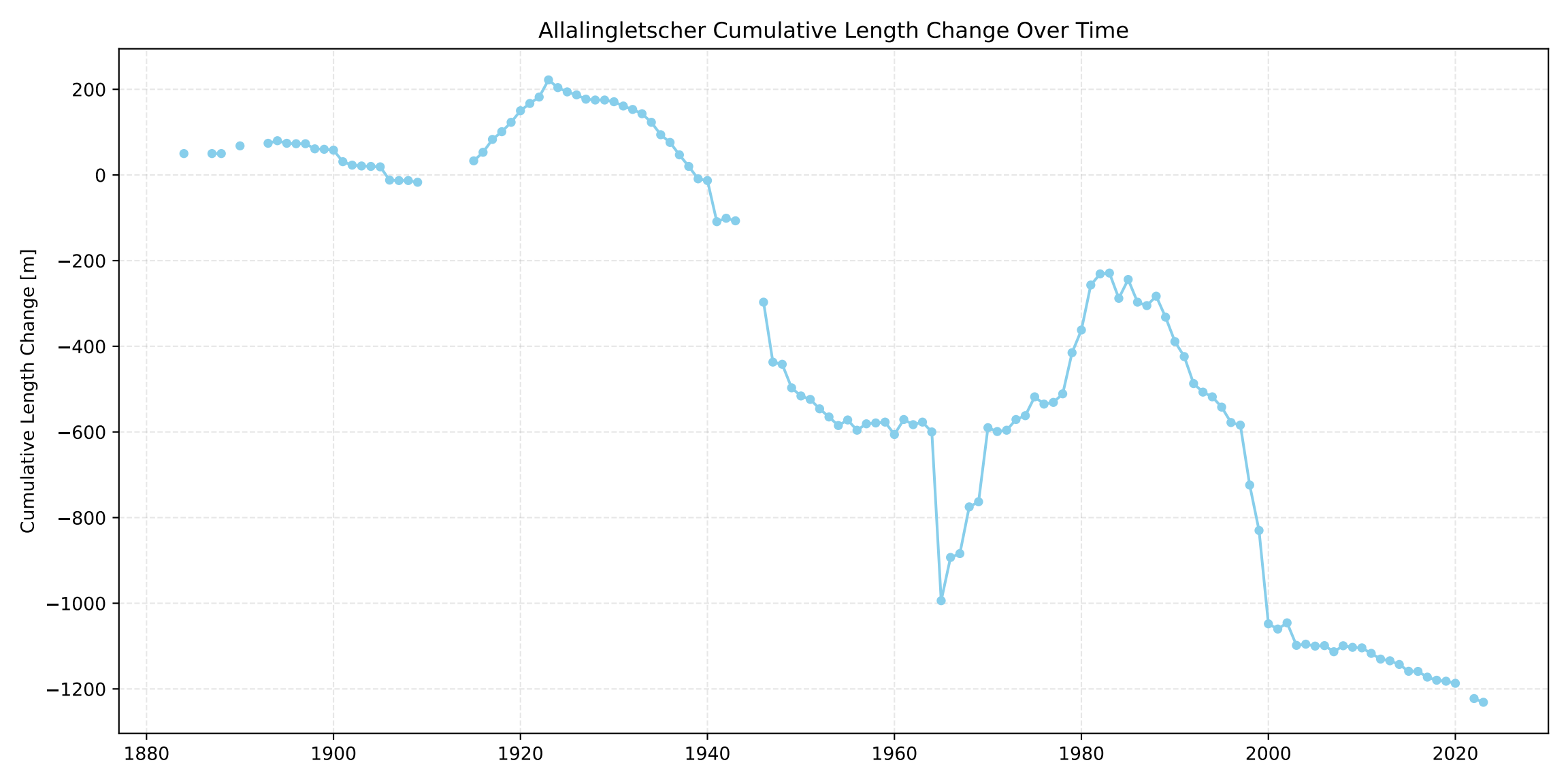
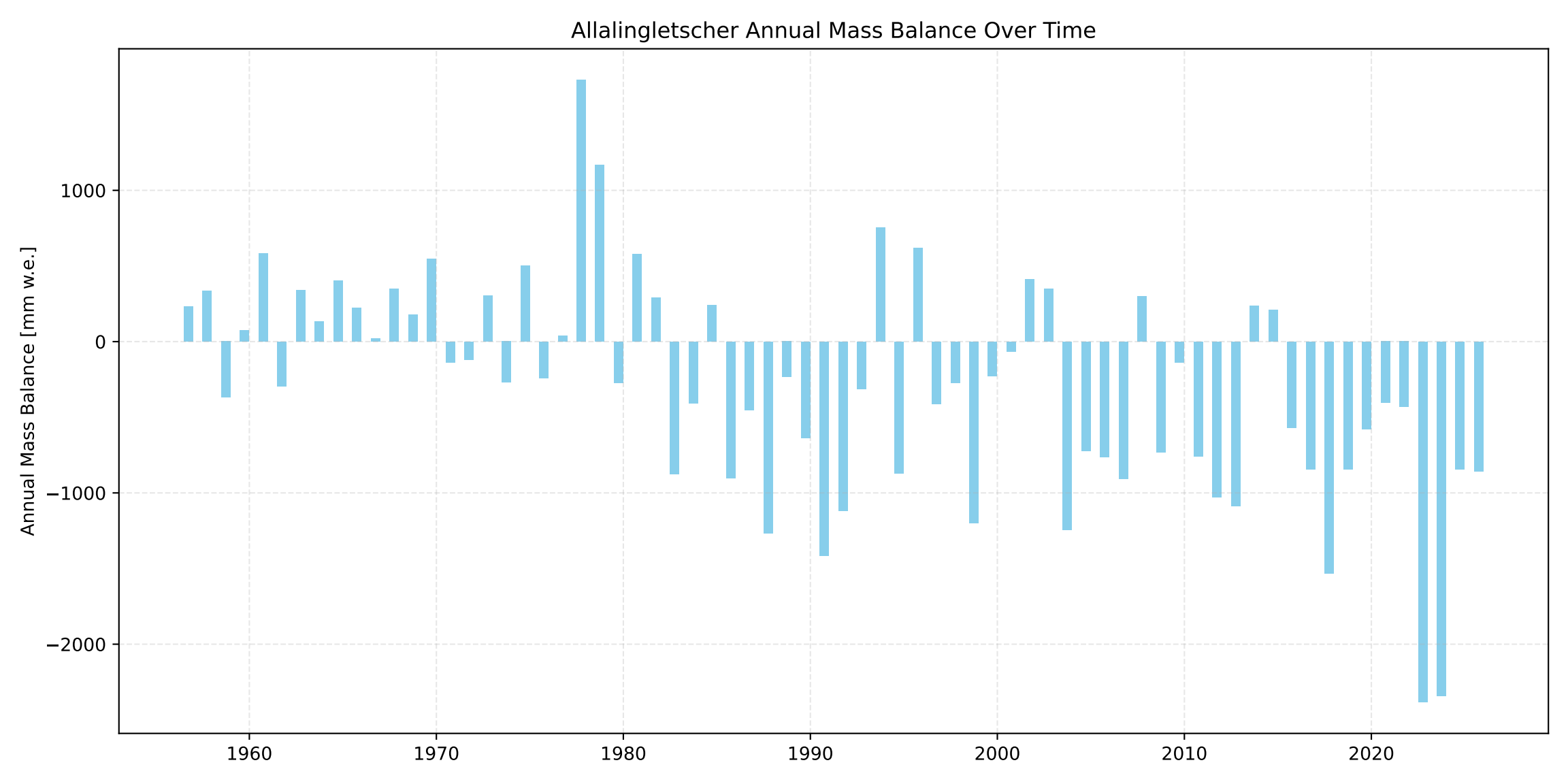
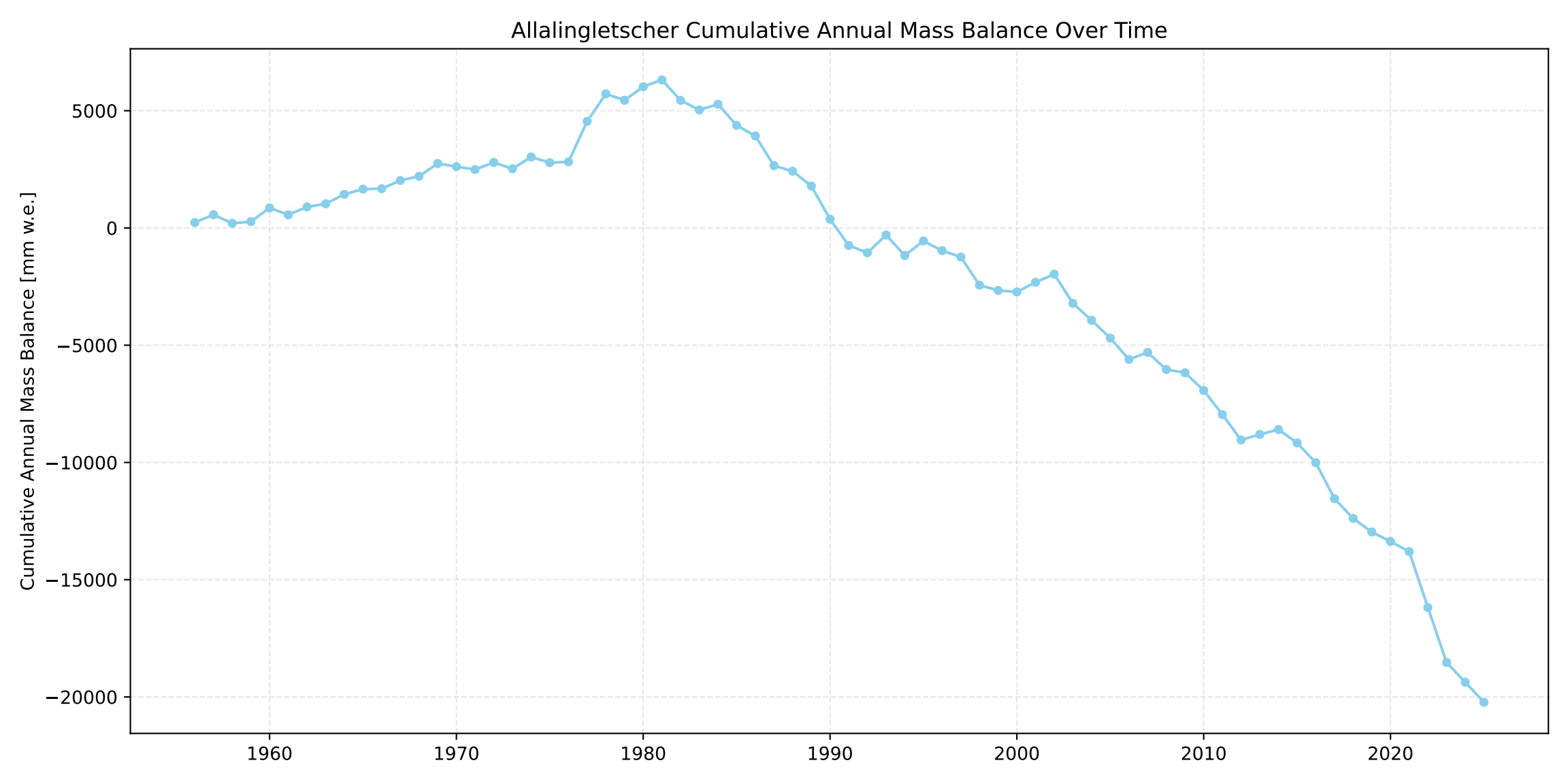
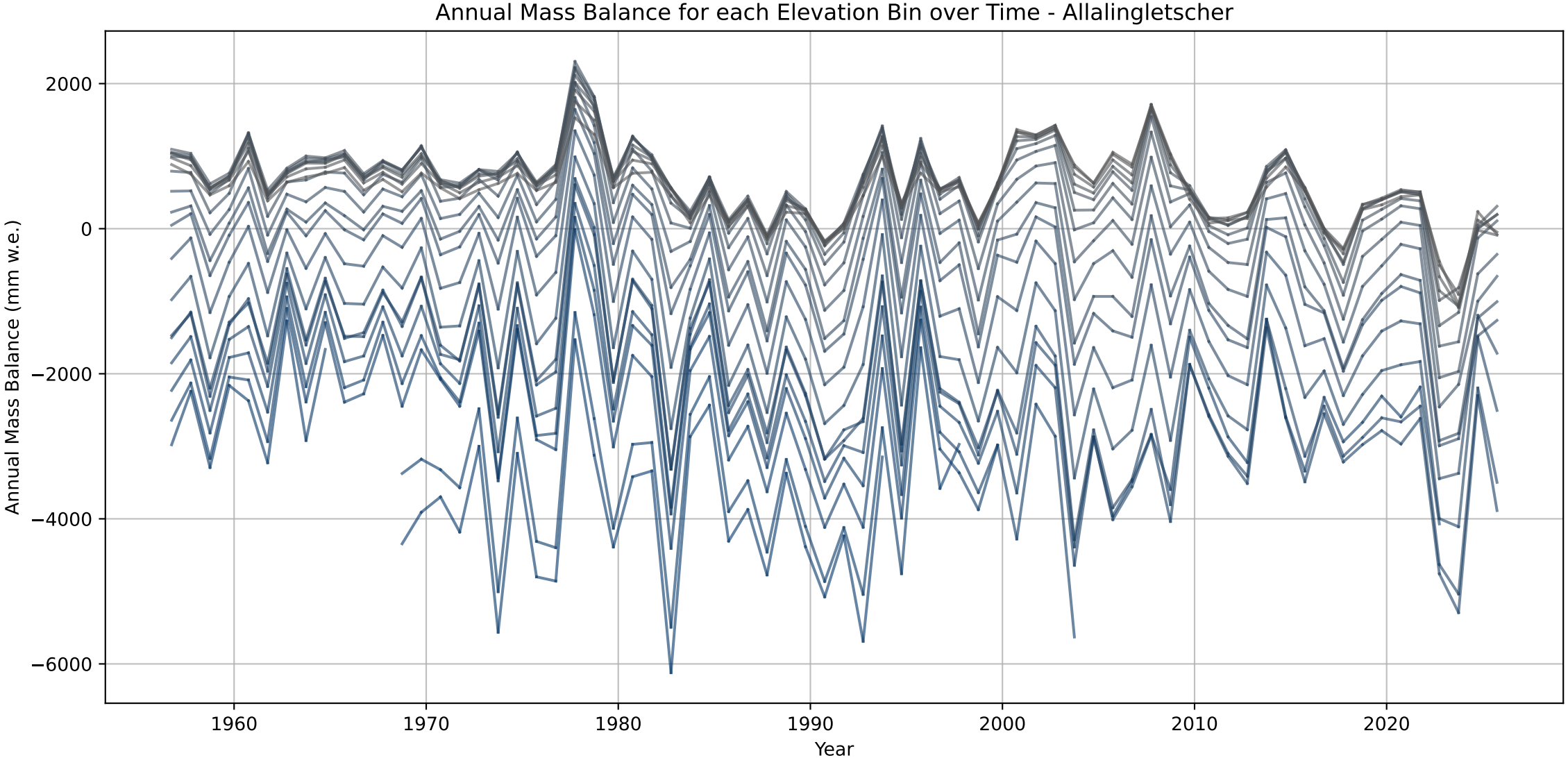
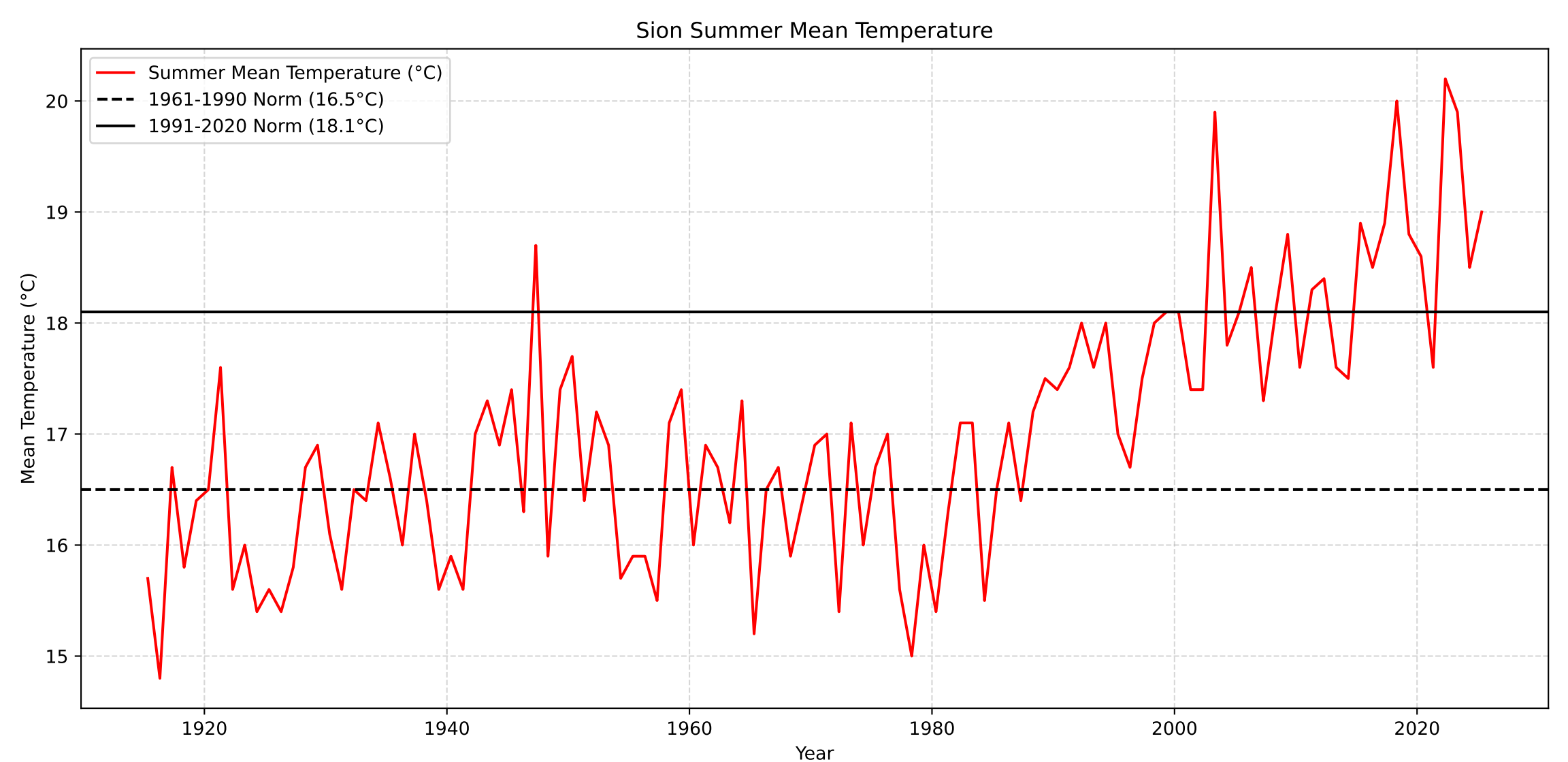

Allalingletscher Length Change Over Time
Length Change [m]
200
100
0
−100
−200
−300
−400
1880
1900
1920
1940
1960
1980
2000
2020

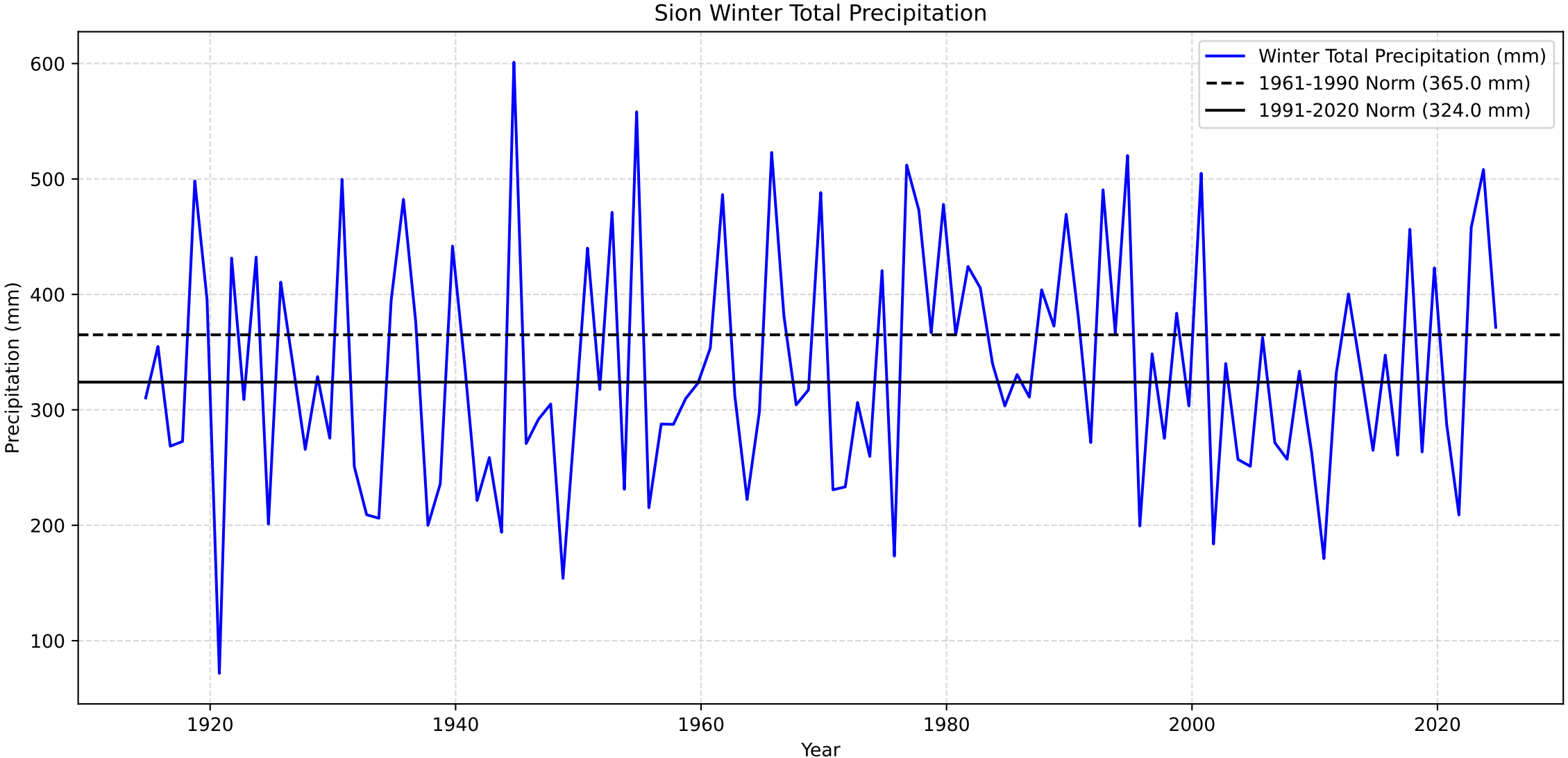

Allalingletscher Cumulative Length Change Over Time
Cumulative Length Change [m]
200
0
−200
−400
−600
−800
−1000
−1200
1880
1900
1920
1940
1960
1980
2000
2020

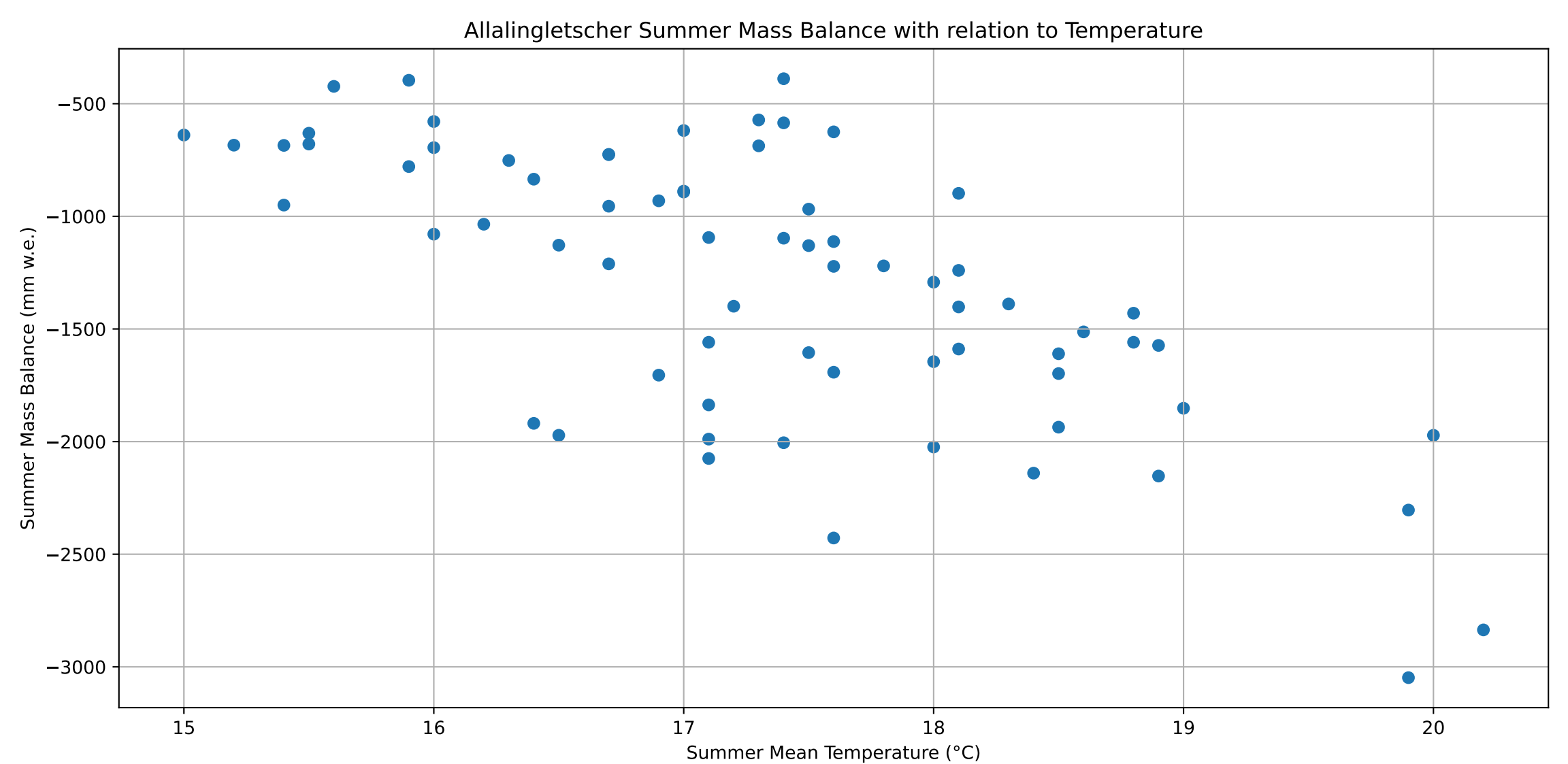

Allalingletscher Annual Mass Balance Over Time
Annual Mass Balance [mm w.e.]
1000
0
−1000
−2000
1960
1970
1980
1990
2000
2010
2020


Allalingletscher Cumulative Annual Mass Balance Over Time
Cumulative Annual Mass Balance [mm w.e.]
5000
0
−5000
−10000
−15000
−20000
1960
1970
1980
1990
2000
2010
2020


Annual Mass Balance for each Elevation Bin over Time - Allalingletscher
Annual Mass Balance (mm w.e.)
2000
0
−2000
−4000
−6000
1960
1970
1980
1990
2000
2010
2020
Year


Sion Summer Mean Temperature
Summer Mean Temperature (°C)
1961-1990 Norm (16.5°C)
1991-2020 Norm (18.1°C)
Mean Temperature (°C)
Year
15
16
17
18
19
20
1920
1940
1960
1980
2000
2020


Sion Winter Total Precipitation
Winter Total Precipitation (mm)
1961-1990 Norm (365.0 mm)
1991-2020 Norm (324.0 mm)
Precipitation (mm)
600
500
400
300
200
100
1920
1940
1960
1980
2000
2020
Year


Allalingletscher Summer Mass Balance with relation to Temperature
Summer Mass Balance (mm w.e.)
−500
−1000
−1500
−2000
−2500
−3000
15
16
17
18
19
20
Summer Mean Temperature (°C)

Regression: Monthly 1961-1990

```
================================================================================
MONTHLY DEVIATIONS ANALYSIS USING 1961-1990 CLIMATE NORMS
================================================================================

================================================================================
MONTHLY DEVIATIONS for Allalingletscher (1961-1990 norms)
================================================================================

Correlation Analysis with Significance Testing:
        Variable  Correlation Coefficient       P-value  Significant (p < 0.05)
10   february_pd                 0.191023  1.131806e-01                   False
7    november_pd                 0.139067  2.509042e-01                   False
11      march_pd                 0.078152  5.201751e-01                   False
6     october_pd                 0.049693  6.828859e-01                   False
9     january_pd                 0.026701  8.263267e-01                   False
12      april_pd                -0.033442  7.834401e-01                   False
8    december_pd                -0.056406  6.427920e-01                   False
1         may_td                -0.383095  1.062868e-03                    True
2        june_td                -0.507660  7.269171e-06                    True
5   september_td                -0.524591  3.138374e-06                    True
3        july_td                -0.569002  2.755457e-07                    True
4      august_td                -0.575838  1.834509e-07                    True
0          const                      NaN           NaN                   False

Number of observations: 70

Regression Summary:
                                OLS Regression Results
================================================================================================
Dep. Variable:     annual mass balance (mm w.e.)   R-squared:                       0.577
Model:                                       OLS   Adj. R-squared:                  0.488
Method:                            Least Squares   F-statistic:                     6.472
Date:                           Mon, 08 Dec 2025   Prob (F-statistic):           4.26e-07
Time:                                   12:08:35   Log-Likelihood:                -530.10
No. Observations:                             70   AIC:                             1086.
Df Residuals:                                 57   BIC:                             1115.
Df Model:                                     12
Covariance Type:                       nonrobust
================================================================================
                   coef    std err          t      P>|t|      [0.025      0.975]
--------------------------------------------------------------------------------
const         1.523e+04   1949.710      7.813      0.000    1.13e+04    1.91e+04
may_td         -35.6575     49.823     -0.716      0.477    -135.427      64.112
june_td        -43.8331     46.968     -0.933      0.355    -137.885      50.218
july_td       -107.0402     50.392     -2.124      0.038    -207.949      -6.132
august_td     -116.1017     59.460     -1.953      0.056    -235.168       2.965
september_td  -150.8187     47.312     -3.188      0.002    -245.560     -56.078
october_pd       1.3714      2.318      0.592      0.556      -3.269       6.012
november_pd      2.9680      1.722      1.723      0.090      -0.480       6.416
december_pd      1.1423      1.439      0.794      0.431      -1.740       4.024
january_pd       1.9309      1.751      1.102      0.275      -1.576       5.438
february_pd      0.8317      1.360      0.611      0.543      -1.892       3.555
march_pd         0.5088      2.002      0.254      0.800      -3.500       4.518
april_pd         2.4437      3.058      0.799      0.428      -3.680       8.568
==============================================================================
Omnibus:                        1.054   Durbin-Watson:                   1.687
Prob(Omnibus):                  0.590   Jarque-Bera (JB):                1.056
Skew:                          -0.164   Prob(JB):                        0.590
Kurtosis:                       2.496   Cond. No.                     2.44e+03
```

Regression: Optimal 1961-1990

```
================================================================================
OPTIMAL SEASONAL DEVIATIONS ANALYSIS USING 1961-1990 CLIMATE NORMS
================================================================================

================================================================================
OPTIMAL SEASONAL DEVIATIONS for Allalingletscher (1961-1990 norms)
================================================================================

Correlation Analysis with Significance Testing:
        Variable  Correlation Coefficient       P-value  Significant (p < 0.05)
2  opt_season_pd                 0.186076  1.230024e-01                   False
1  opt_season_td                -0.666348  3.054587e-10                    True
0          const                      NaN           NaN                   False

Number of observations: 70

Regression Summary:
                                OLS Regression Results
==============================================================================================
Dep. Variable:     annual mass balance (mm w.e.)   R-squared:                       0.458
Model:                                       OLS   Adj. R-squared:                  0.442
Method:                            Least Squares   F-statistic:                     28.28
Date:                           Mon, 08 Dec 2025   Prob (F-statistic):           1.25e-09
Time:                                   12:08:35   Log-Likelihood:                -538.77
No. Observations:                             70   AIC:                             1084.
Df Residuals:                                 67   BIC:                             1090.
Df Model:                                      2
Covariance Type:                       nonrobust
================================================================================================
                     coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------------------------
const          1.277e+04   1804.163      7.078      0.000    9168.463    1.64e+04
opt_season_td  -374.9944     51.866     -7.230      0.000    -478.520    -271.469
opt_season_pd     1.0495      0.807      1.301      0.198      -0.561       2.660
==============================================================================
Omnibus:                        2.365   Durbin-Watson:                   1.521
Prob(Omnibus):                  0.307   Jarque-Bera (JB):                1.614
Skew:                          -0.314   Prob(JB):                        0.446
Kurtosis:                       3.398   Cond. No.                     2.29e+03
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 2.29e+03. This might indicate that there are
strong multicollinearity or other numerical problems.

Coefficient Interpretation:
Intercept (normal mass balance): 12769.59 (p=0.0000)
opt_season_td: -374.99 (p=0.0000)
opt_season_pd: 1.05 (p=0.1978)

Variance Inflation Factors (VIF):
        Variable         VIF
0          const  768.775289
1  opt_season_td    1.011060
2  opt_season_pd    1.011060

R-squared: 0.4577
Adjusted R-squared: 0.4415
```

Regression: Seasonal 1961-1990

```
================================================================================
SUMMER/WINTER SEASONAL DEVIATIONS ANALYSIS USING 1961-1990 CLIMATE NORMS
================================================================================

================================================================================
SUMMER/WINTER SEASONAL DEVIATIONS for Allalingletscher (1961-1990 norms)
================================================================================

Correlation Analysis with Significance Testing:
    Variable  Correlation Coefficient       P-value  Significant (p < 0.05)
2  winter_pd                 0.183920  1.274798e-01                   False
1  summer_td                -0.712208  4.734166e-12                    True
0      const                      NaN           NaN                   False

Number of observations: 70

Regression Summary:
                                OLS Regression Results
==============================================================================================
Dep. Variable:     annual mass balance (mm w.e.)   R-squared:                       0.526
Model:                                       OLS   Adj. R-squared:                  0.512
Method:                            Least Squares   F-statistic:                     37.17
Date:                           Mon, 08 Dec 2025   Prob (F-statistic):           1.38e-11
Time:                                   12:08:35   Log-Likelihood:                -534.06
No. Observations:                             70   AIC:                             1074.
Df Residuals:                                 67   BIC:                             1081.
Df Model:                                      2
Covariance Type:                       nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const       1.442e+04   1760.778      8.189      0.000    1.09e+04    1.79e+04
summer_td   -434.3106     52.076     -8.340      0.000    -538.254    -330.367
winter_pd      1.0757      0.661      1.626      0.109      -0.244       2.396
==============================================================================
Omnibus:                        1.872   Durbin-Watson:                   1.553
Prob(Omnibus):                  0.392   Jarque-Bera (JB):                1.327
Skew:                          -0.326   Prob(JB):                        0.515
Kurtosis:                       3.175   Cond. No.                     2.76e+03
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 2.76e+03. This might indicate that there are
strong multicollinearity or other numerical problems.

Coefficient Interpretation:
Intercept (normal mass balance): 14419.81 (p=0.0000)
summer_td: -434.31 (p=0.0000)
winter_pd: 1.08 (p=0.1086)

Variance Inflation Factors (VIF):
    Variable         VIF
0      const  837.655805
1  summer_td    1.004453
2  winter_pd    1.004453

R-squared: 0.5260
Adjusted R-squared: 0.5118
```

Regression: Monthly 1991-2020

```
================================================================================
MONTHLY DEVIATIONS ANALYSIS USING 1991-2020 CLIMATE NORMS
================================================================================

================================================================================
MONTHLY DEVIATIONS for Allalingletscher (1991-2020 norms)
================================================================================

Correlation Analysis with Significance Testing:
        Variable  Correlation Coefficient       P-value  Significant (p < 0.05)
10   february_pd                 0.191023  1.131806e-01                   False
7    november_pd                 0.139067  2.509042e-01                   False
11      march_pd                 0.078152  5.201751e-01                   False
6     october_pd                 0.049693  6.828859e-01                   False
9     january_pd                 0.026701  8.263267e-01                   False
12      april_pd                -0.033442  7.834401e-01                   False
8    december_pd                -0.056406  6.427920e-01                   False
1         may_td                -0.383095  1.062868e-03                    True
2        june_td                -0.507660  7.269171e-06                    True
5   september_td                -0.524591  3.138374e-06                    True
3        july_td                -0.569002  2.755457e-07                    True
4      august_td                -0.575838  1.834509e-07                    True
0          const                      NaN           NaN                   False

Number of observations: 70

Regression Summary:
                            OLS Regression Results
================================================================================================
Dep. Variable:     annual mass balance (mm w.e.)   R-squared:                       0.577
Model:                                       OLS   Adj. R-squared:                  0.488
Method:                            Least Squares   F-statistic:                     6.472
Date:                           Mon, 08 Dec 2025   Prob (F-statistic):           4.26e-07
Time:                                   12:08:35   Log-Likelihood:                -530.10
No. Observations:                             70   AIC:                             1086.
Df Residuals:                                 57   BIC:                             1115.
Df Model:                                     12
Covariance Type:                       nonrobust
================================================================================
                   coef    std err          t      P>|t|      [0.025      0.975]
--------------------------------------------------------------------------------
const         -645.4679     76.214     -8.469      0.000    -798.084    -492.852
may_td         -35.6575     49.823     -0.716      0.477    -135.427      64.112
june_td        -43.8331     46.968     -0.933      0.355    -137.885      50.218
july_td       -107.0402     50.392     -2.124      0.038    -207.949      -6.132
august_td     -116.1017     59.460     -1.953      0.056    -235.168       2.965
september_td  -150.8187     47.312     -3.188      0.002    -245.560     -56.078
october_pd       1.3714      2.318      0.592      0.556      -3.269       6.012
november_pd      2.9680      1.722      1.723      0.090      -0.480       6.416
december_pd      1.1423      1.439      0.794      0.431      -1.740       4.024
january_pd       1.9309      1.751      1.102      0.275      -1.576       5.438
february_pd      0.8317      1.360      0.611      0.543      -1.892       3.555
march_pd         0.5088      2.002      0.254      0.800      -3.500       4.518
april_pd         2.4437      3.058      0.799      0.428      -3.680       8.568
==============================================================================
Omnibus:                        1.054   Durbin-Watson:                   1.687
Prob(Omnibus):                  0.590   Jarque-Bera (JB):                1.056
Skew:                          -0.164   Prob(JB):                        0.590
Kurtosis:                       2.496   Cond. No.                         65.8
```

Regression: Optimal 1991-2020

```
================================================================================
OPTIMAL SEASONAL DEVIATIONS ANALYSIS USING 1991-2020 CLIMATE NORMS
================================================================================

================================================================================
OPTIMAL SEASONAL DEVIATIONS for Allalingletscher (1991-2020 norms)
================================================================================

Correlation Analysis with Significance Testing:
        Variable  Correlation Coefficient       P-value  Significant (p < 0.05)
2  opt_season_pd                 0.186076  1.230024e-01                   False
1  opt_season_td                -0.665403  3.303086e-10                    True
0          const                      NaN           NaN                   False

Number of observations: 70

Regression Summary:
                                OLS Regression Results
==============================================================================================
Dep. Variable:     annual mass balance (mm w.e.)   R-squared:                       0.455
Model:                                       OLS   Adj. R-squared:                  0.439
Method:                            Least Squares   F-statistic:                     28.02
Date:                           Mon, 08 Dec 2025   Prob (F-statistic):           1.44e-09
Time:                                   12:08:35   Log-Likelihood:                -538.92
No. Observations:                             70   AIC:                             1084.
Df Residuals:                                 67   BIC:                             1091.
Df Model:                                      2
Covariance Type:                       nonrobust
================================================================================================
                     coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------------------------
const          -616.3370     78.515     -7.850      0.000    -773.054    -459.620
opt_season_td  -374.0837     51.987     -7.196      0.000    -477.850    -270.318
opt_season_pd     1.0113      0.809      1.250      0.216      -0.604       2.626
==============================================================================
Omnibus:                        2.208   Durbin-Watson:                   1.529
Prob(Omnibus):                  0.332   Jarque-Bera (JB):                1.476
Skew:                          -0.299   Prob(JB):                        0.478
Kurtosis:                       3.386   Cond. No.                         107.
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

Coefficient Interpretation:
Intercept (normal mass balance): -616.34 (p=0.0000)
opt_season_td: -374.08 (p=0.0000)
opt_season_pd: 1.01 (p=0.2157)

Variance Inflation Factors (VIF):
        Variable       VIF
0          const  1.449949
1  opt_season_td  1.012557
2  opt_season_pd  1.012557

R-squared: 0.4555
Adjusted R-squared: 0.4392
```

Regression: Seasonal 1991-2020

```
================================================================================
SUMMER/WINTER SEASONAL DEVIATIONS ANALYSIS USING 1991-2020 CLIMATE NORMS
================================================================================

================================================================================
SUMMER/WINTER SEASONAL DEVIATIONS for Allalingletscher (1991-2020 norms)
================================================================================

Correlation Analysis with Significance Testing:
    Variable  Correlation Coefficient       P-value  Significant (p < 0.05)
2  winter_pd                 0.183920  1.274798e-01                   False
1  summer_td                -0.711854  4.903874e-12                    True
0      const                      NaN           NaN                   False

Number of observations: 70

Regression Summary:
                                OLS Regression Results
==============================================================================================
Dep. Variable:     annual mass balance (mm w.e.)   R-squared:                       0.526
Model:                                       OLS   Adj. R-squared:                  0.512
Method:                            Least Squares   F-statistic:                     37.16
Date:                           Mon, 08 Dec 2025   Prob (F-statistic):           1.38e-11
Time:                                   12:08:35   Log-Likelihood:                -534.07
No. Observations:                             70   AIC:                             1074.
Df Residuals:                                 67   BIC:                             1081.
Df Model:                                      2
Covariance Type:                       nonrobust
================================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
--------------------------------------------------------------------------------
const       -639.4128     73.187     -8.737      0.000    -785.495    -493.330
summer_td   -433.6850     52.004     -8.339      0.000    -537.485    -329.885
winter_pd      1.0890      0.661      1.647      0.104      -0.231       2.409
==============================================================================
Omnibus:                        2.028   Durbin-Watson:                   1.553
Prob(Omnibus):                  0.363   Jarque-Bera (JB):                1.428
Skew:                          -0.333   Prob(JB):                        0.490
Kurtosis:                       3.217   Cond. No.                         124.
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

Coefficient Interpretation:
Intercept (normal mass balance): -639.41 (p=0.0000)
summer_td: -433.69 (p=0.0000)
winter_pd: 1.09 (p=0.1043)

Variance Inflation Factors (VIF):
    Variable       VIF
0      const  1.447098
1  summer_td  1.004137
2  winter_pd  1.004137

R-squared: 0.5259
Adjusted R-squared: 0.5118
```