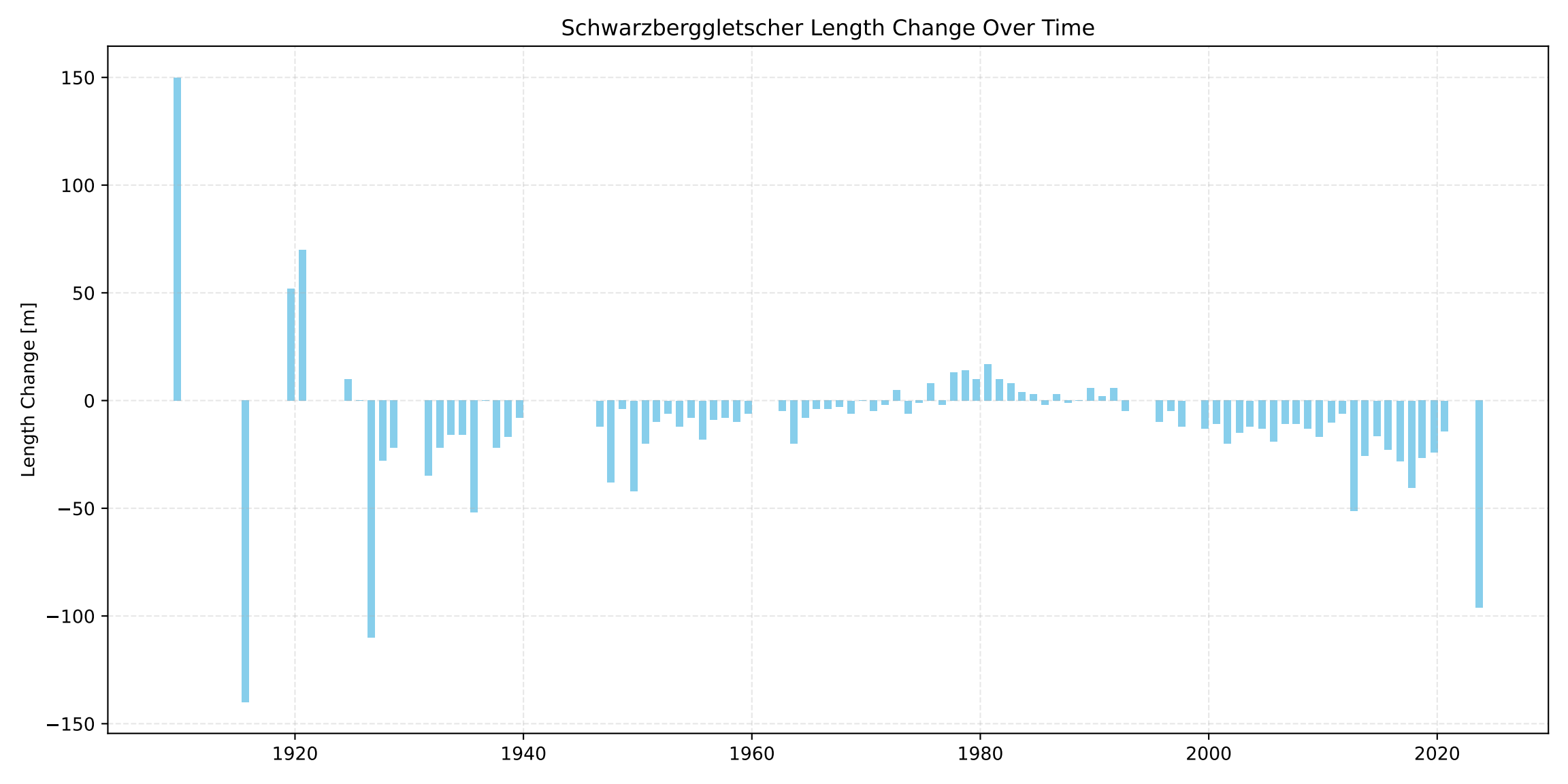
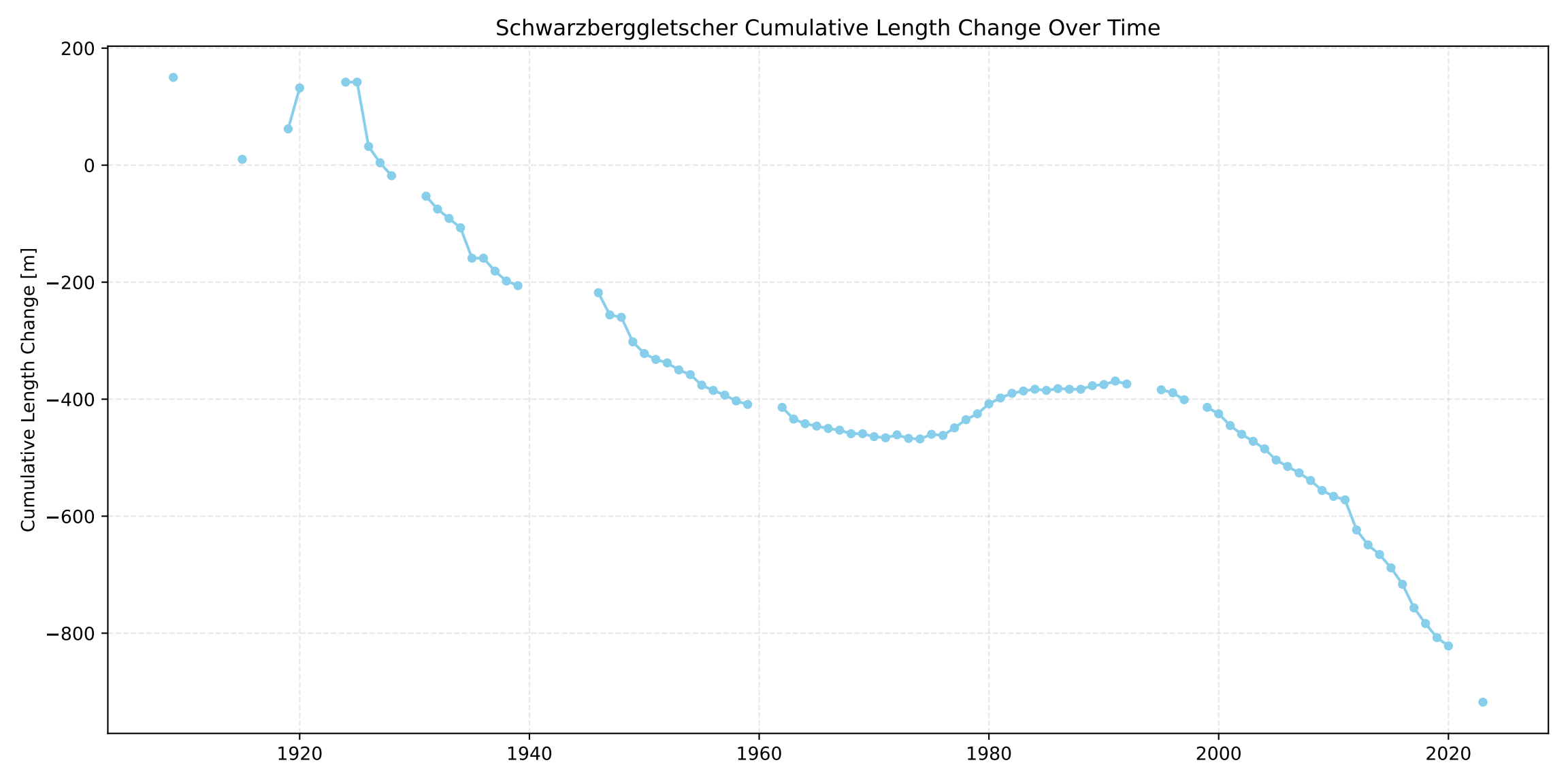
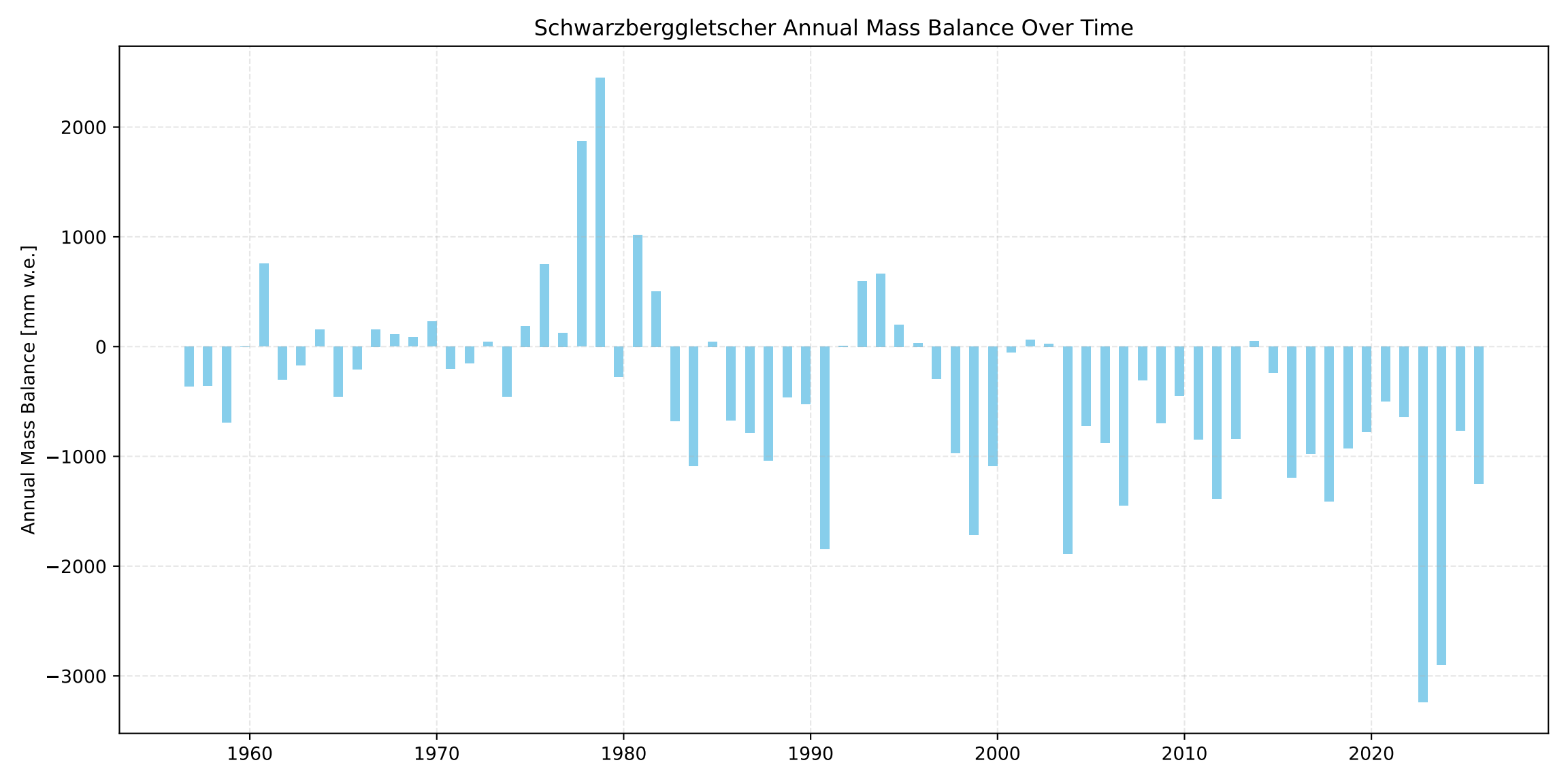
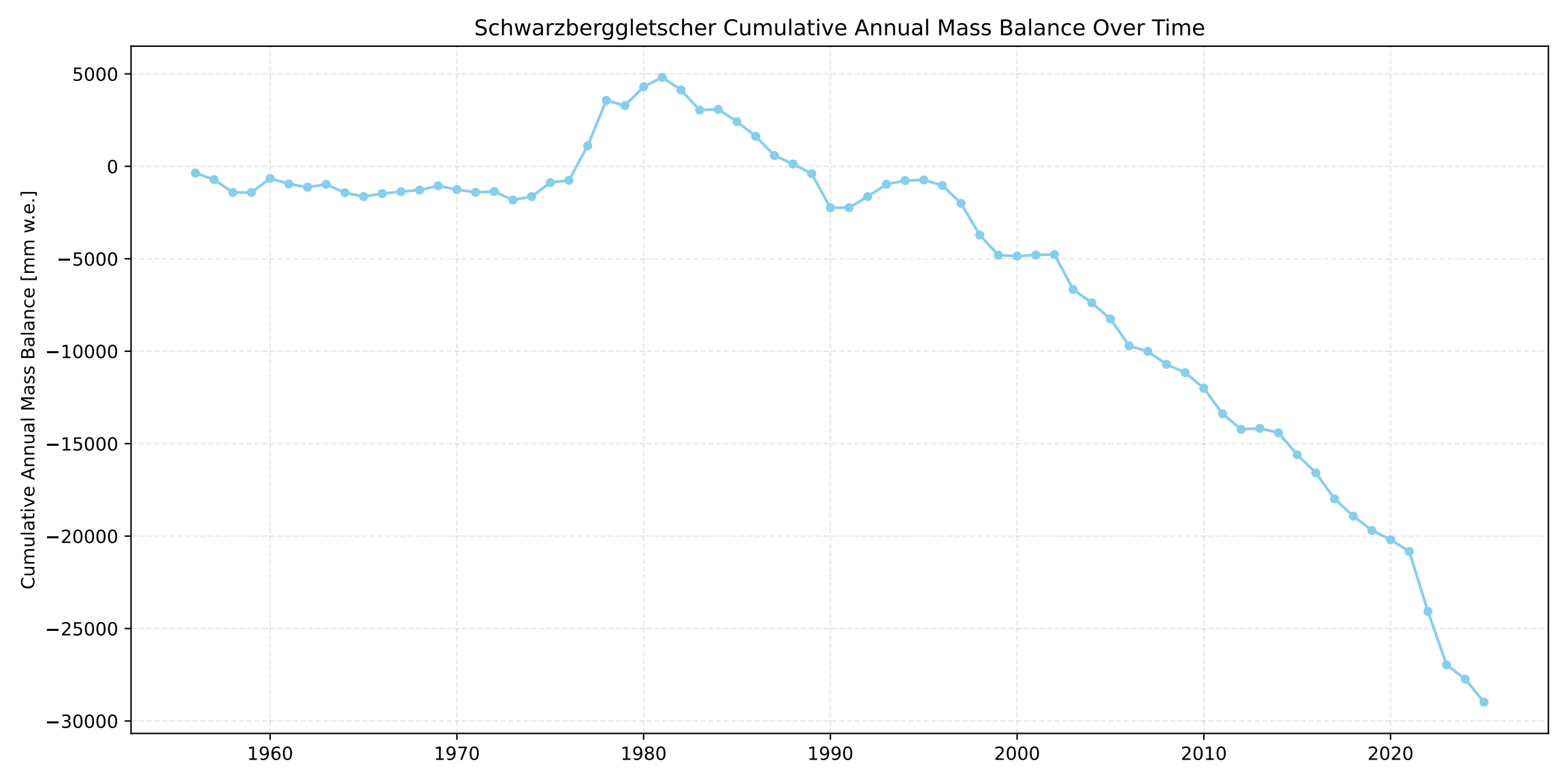
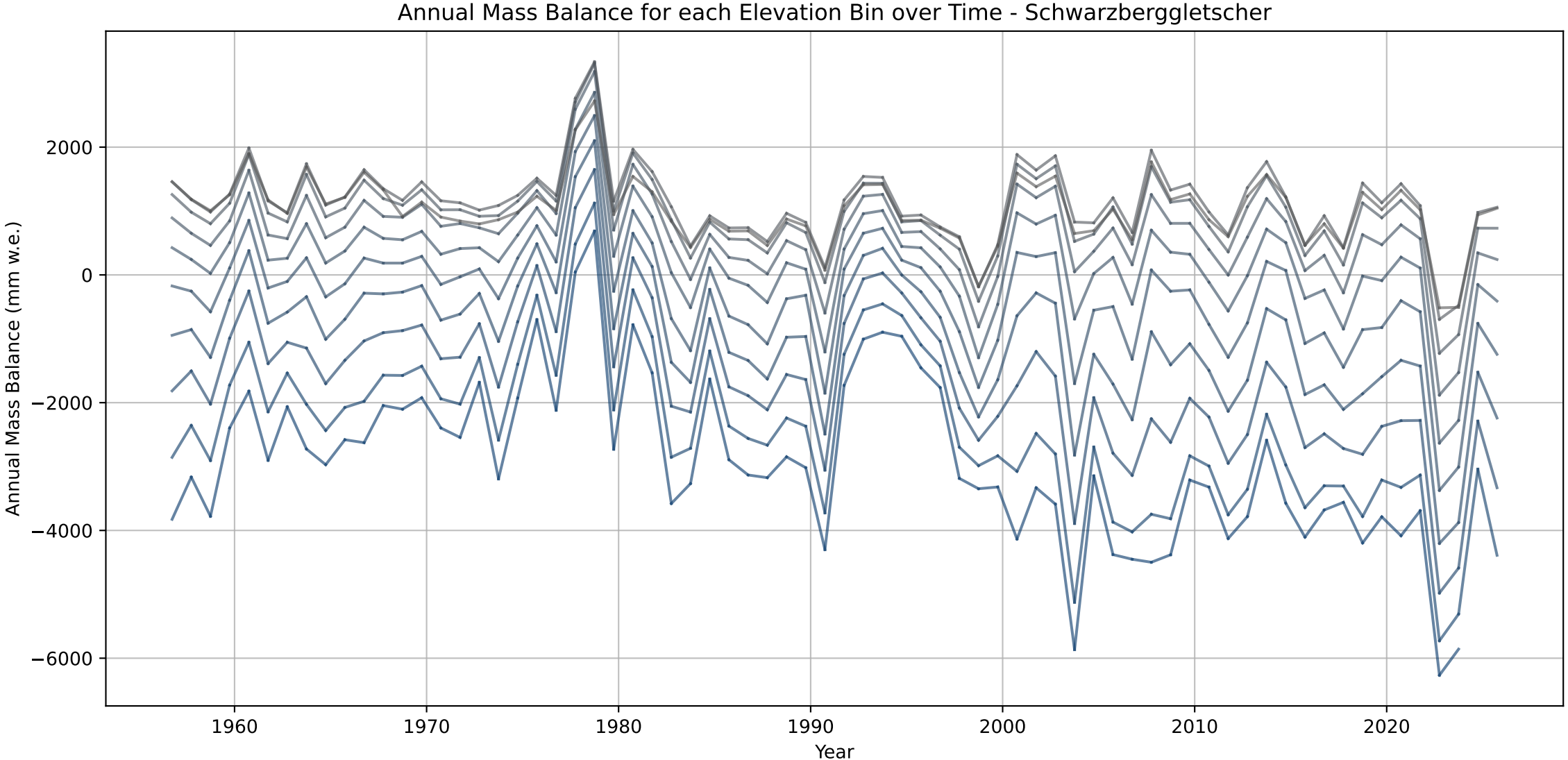
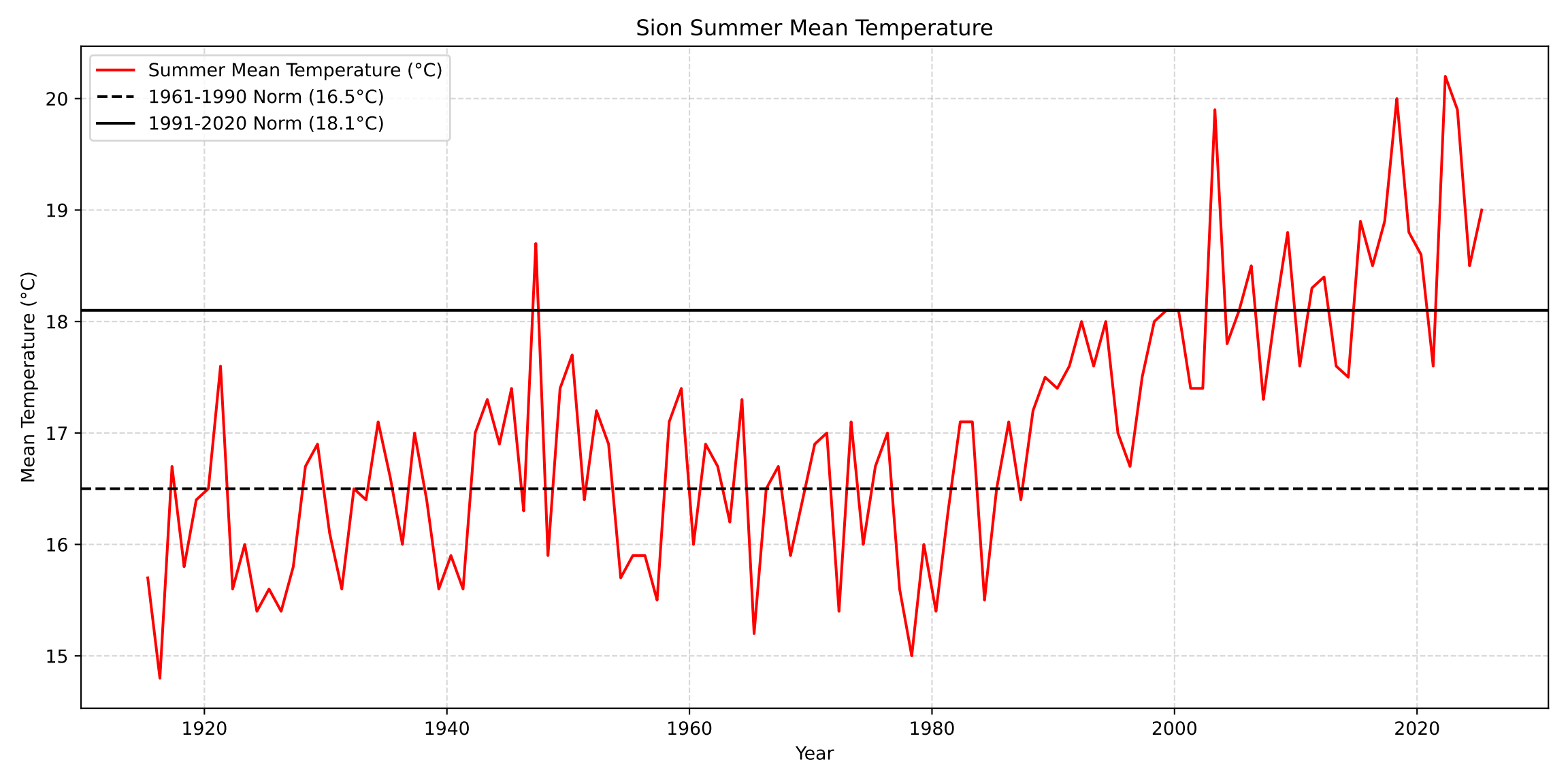

Schwarzberggletscher Length Change Over Time
Length Change [m]
150
100
50
0
−50
−100
−150
1920
1940
1960
1980
2000
2020

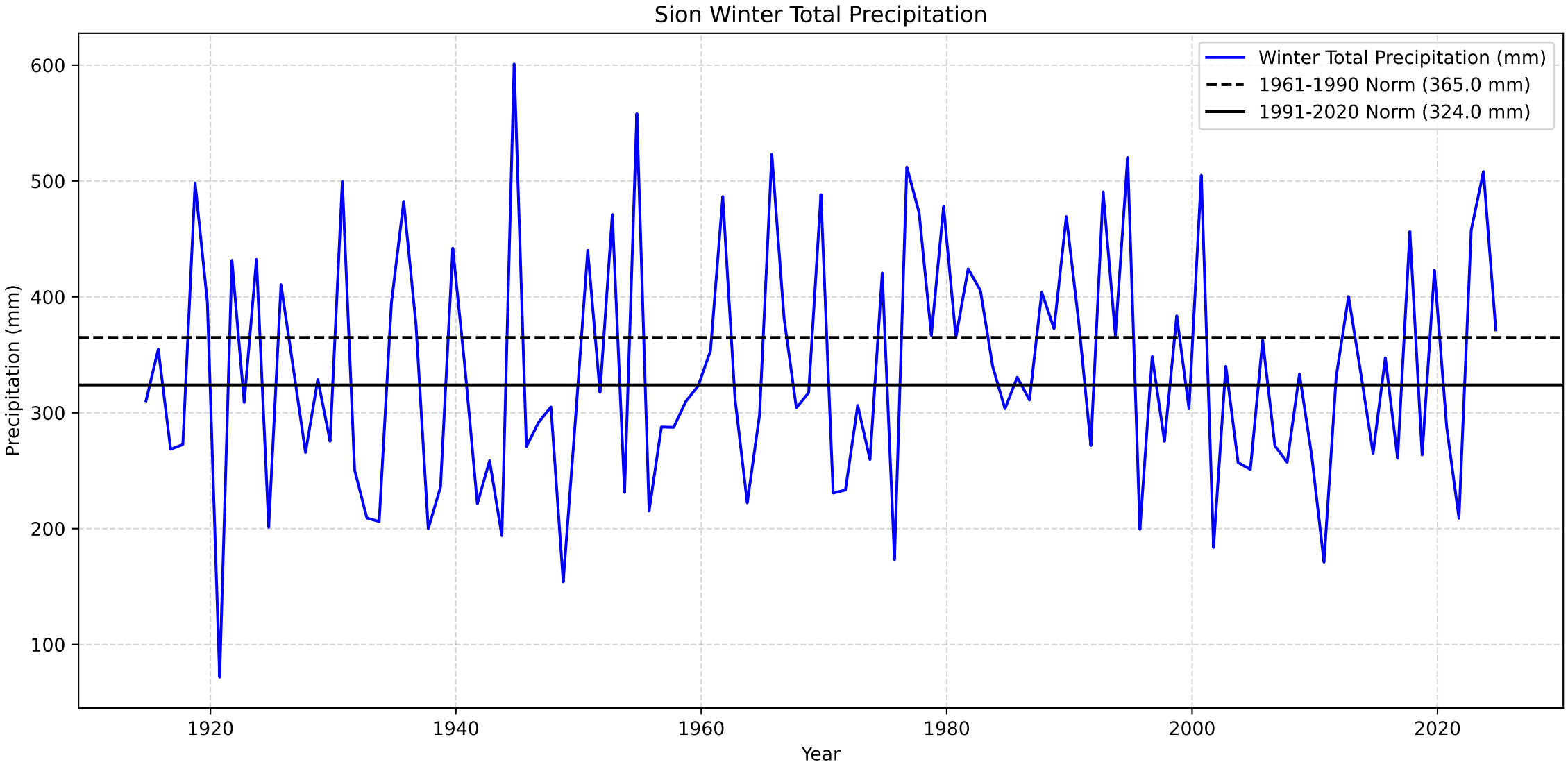

Schwarzberggletscher Cumulative Length Change Over Time
Cumulative Length Change [m]
200
0
−200
−400
−600
−800
1920
1940
1960
1980
2000
2020

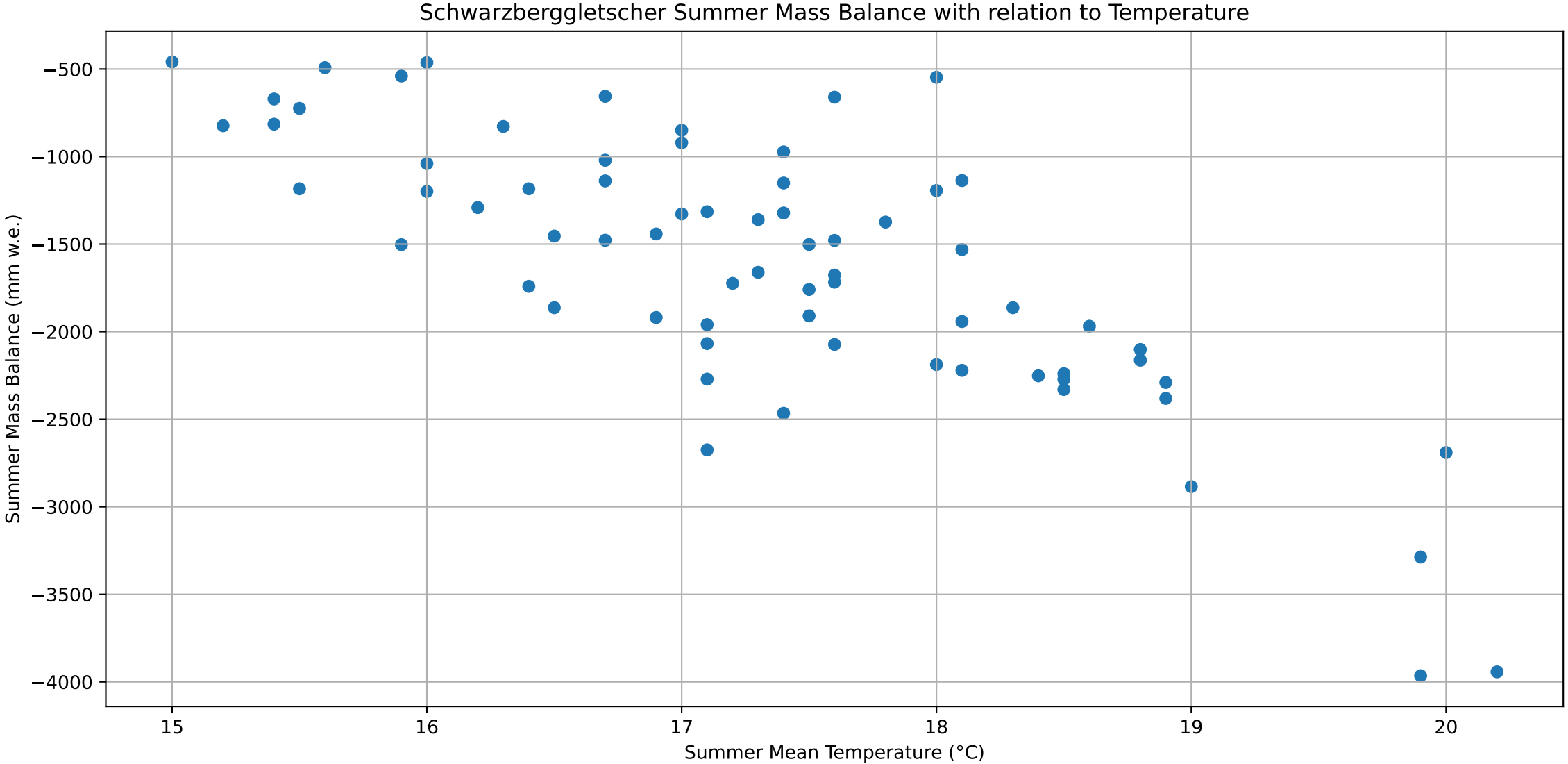

Schwarzberggletscher Annual Mass Balance Over Time
Annual Mass Balance [mm w.e.]
2000
1000
0
−1000
−2000
−3000
1960
1970
1980
1990
2000
2010
2020

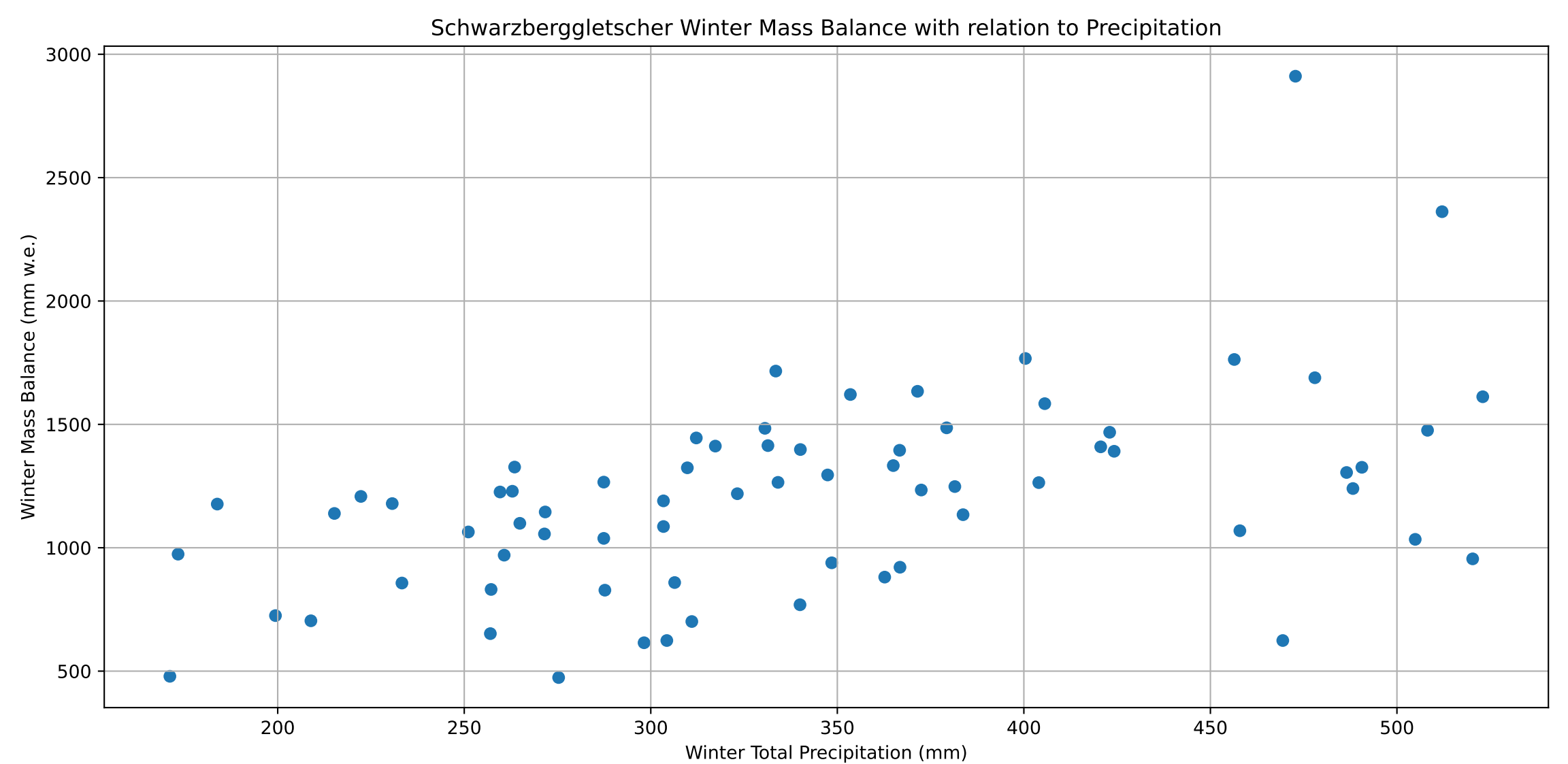

Schwarzberggletscher Cumulative Annual Mass Balance Over Time
Cumulative Annual Mass Balance [mm w.e.]
5000
0
−5000
−10000
−15000
−20000
−25000
−30000
1960
1970
1980
1990
2000
2010
2020


Annual Mass Balance for each Elevation Bin over Time - Schwarzberggletscher
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


Schwarzberggletscher Summer Mass Balance with relation to Temperature
Summer Mass Balance (mm w.e.)
−500
−1000
−1500
−2000
−2500
−3000
−3500
−4000
15
16
17
18
19
20
Summer Mean Temperature (°C)


Schwarzberggletscher Winter Mass Balance with relation to Precipitation
Winter Mass Balance (mm w.e.)
3000
2500
2000
1500
1000
500
200
250
300
350
400
450
500
Winter Total Precipitation (mm)

Regression: Monthly 1961-1990

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

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

Number of observations: 70

Regression Summary:
                                OLS Regression Results
==============================================================================================
Dep. Variable:     annual mass balance (mm w.e.)   R-squared:                       0.582
Model:                                       OLS   Adj. R-squared:                  0.494
Method:                            Least Squares   F-statistic:                     6.623
Date:                           Fri, 05 Dec 2025   Prob (F-statistic):           3.05e-07
Time:                                   00:05:32   Log-Likelihood:                -543.16
No. Observations:                             70   AIC:                             1112.
Df Residuals:                                 57   BIC:                             1142.
Df Model:                                     12
Covariance Type:                       nonrobust
================================================================================
                   coef    std err          t      P>|t|      [0.025      0.975]
--------------------------------------------------------------------------------
const           81.2746     97.680      0.832      0.409    -114.327     276.876
may_td         -93.5242     60.040     -1.558      0.125    -213.752      26.704
june_td        -87.6040     56.599     -1.548      0.127    -200.941      25.733
july_td       -161.3010     60.725     -2.656      0.010    -282.901     -39.701
august_td      -83.2476     71.653     -1.162      0.250    -226.730      60.234
september_td  -141.9432     57.014     -2.490      0.016    -256.111     -27.775
october_pd       2.2736      2.793      0.814      0.419      -3.319       7.866
november_pd      3.1229      2.075      1.505      0.138      -1.033       7.278
december_pd      3.7424      1.734      2.158      0.035       0.269       7.215
january_pd       2.0974      2.111      0.994      0.325      -2.129       6.324
february_pd     -0.6711      1.639     -0.409      0.684      -3.953       2.611
march_pd         1.7394      2.413      0.721      0.474      -3.092       6.571
april_pd         2.0444      3.685      0.555      0.581      -5.335       9.424
==============================================================================
Omnibus:                        0.273   Durbin-Watson:                   1.180
Prob(Omnibus):                  0.872   Jarque-Bera (JB):                0.042
Skew:                          -0.051   Prob(JB):                        0.979
Kurtosis:                       3.063   Cond. No.                         68.7
==============================================================================

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

Coefficient Interpretation:
Intercept (normal mass balance): 81.27 (p=0.4089)
may_td: -93.52 (p=0.1248)
june_td: -87.60 (p=0.1272)
july_td: -161.30 (p=0.0102)
august_td: -83.25 (p=0.2502)
september_td: -141.94 (p=0.0157)
october_pd: 2.27 (p=0.4190)
november_pd: 3.12 (p=0.1379)
december_pd: 3.74 (p=0.0352)
january_pd: 2.10 (p=0.3245)
```

Regression: Optimal 1961-1990

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

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

Number of observations: 70

Regression Summary:
                            OLS Regression Results
==============================================================================================
Dep. Variable:     annual mass balance (mm w.e.)   R-squared:                       0.485
Model:                                       OLS   Adj. R-squared:                  0.470
Method:                            Least Squares   F-statistic:                     31.58
Date:                           Fri, 05 Dec 2025   Prob (F-statistic):           2.18e-10
Time:                                   00:05:32   Log-Likelihood:                -550.47
No. Observations:                             70   AIC:                             1107.
Df Residuals:                                 67   BIC:                             1114.
Df Model:                                      2
Covariance Type:                        nonrobust
================================================================================================
                   coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------------------------
const           38.2340     95.929      0.399      0.691    -153.242     229.710
opt_season_td  -455.2302     61.087     -7.452      0.000    -577.160    -333.300
opt_season_pd     1.8667      0.954      1.957      0.054      -0.037       3.770
==============================================================================
Omnibus:                        0.795   Durbin-Watson:                   1.161
Prob(Omnibus):                  0.672   Jarque-Bera (JB):                0.277
Skew:                          -0.009   Prob(JB):                        0.871
Kurtosis:                       3.308   Cond. No.                         111.
==============================================================================

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

Coefficient Interpretation:
Intercept (normal mass balance): 38.23 (p=0.6915)
opt_season_td: -455.23 (p=0.0000)
opt_season_pd: 1.87 (p=0.0545)

Variance Inflation Factors (VIF):
        Variable       VIF
0          const  1.555743
1  opt_season_td  1.011296
2  opt_season_pd  1.011296

R-squared: 0.4852
Adjusted R-squared: 0.4699
```

Regression: Seasonal 1961-1990

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

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

Number of observations: 70

Regression Summary:
                                OLS Regression Results
==============================================================================================
Dep. Variable:     annual mass balance (mm w.e.)   R-squared:                       0.535
Model:                                       OLS   Adj. R-squared:                  0.521
Method:                            Least Squares   F-statistic:                     38.53
Date:                           Fri, 05 Dec 2025   Prob (F-statistic):           7.29e-12
Time:                                   00:05:32   Log-Likelihood:                -546.92
No. Observations:                             70   AIC:                             1100.
Df Residuals:                                 67   BIC:                             1107.
Df Model:                                      2
Covariance Type:                       nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const         82.7039     92.449      0.895      0.374    -101.826     267.234
summer_td   -517.4811     62.576     -8.270      0.000    -642.383    -392.580
winter_pd      1.9209      0.795      2.418      0.018       0.335       3.507
==============================================================================
Omnibus:                        1.103   Durbin-Watson:                   1.239
Prob(Omnibus):                  0.576   Jarque-Bera (JB):                0.518
Skew:                          -0.114   Prob(JB):                        0.772
Kurtosis:                       3.355   Cond. No.                         132.
==============================================================================

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

Coefficient Interpretation:
Intercept (normal mass balance): 82.70 (p=0.3742)
summer_td: -517.48 (p=0.0000)
winter_pd: 1.92 (p=0.0184)

Variance Inflation Factors (VIF):
    Variable       VIF
0      const  1.599275
1  summer_td  1.003988
2  winter_pd  1.003988

R-squared: 0.5349
Adjusted R-squared: 0.5210
```

Regression: Monthly 1991-2020

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

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

Number of observations: 70

Regression Summary:
                                OLS Regression Results
==============================================================================================
Dep. Variable:     annual mass balance (mm w.e.)   R-squared:                       0.582
Model:                                       OLS   Adj. R-squared:                  0.494
Method:                            Least Squares   F-statistic:                     6.623
Date:                           Fri, 05 Dec 2025   Prob (F-statistic):           3.05e-07
Time:                                   00:05:32   Log-Likelihood:                -543.16
No. Observations:                              70   AIC:                             1112.
Df Residuals:                                  57   BIC:                             1142.
Df Model:                                      12
Covariance Type:                        nonrobust
==============================================================================
                   coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const         -843.0152     91.842     -9.179      0.000   -1026.926    -659.104
may_td         -93.5242     60.040     -1.558      0.125    -213.752      26.704
june_td        -87.6040     56.599     -1.548      0.127    -200.941      25.733
july_td       -161.3010     60.725     -2.656      0.010    -282.901     -39.701
august_td      -83.2476     71.653     -1.162      0.250    -226.730      60.234
september_td  -141.9432     57.014     -2.490      0.016    -256.111     -27.775
october_pd       2.2736      2.793      0.814      0.419      -3.319       7.866
november_pd      3.1229      2.075      1.505      0.138      -1.033       7.278
december_pd      3.7424      1.734      2.158      0.035       0.269       7.215
january_pd       2.0974      2.111      0.994      0.325      -2.129       6.324
february_pd     -0.6711      1.639     -0.409      0.684      -3.953       2.611
march_pd         1.7394      2.413      0.721      0.474      -3.092       6.571
april_pd         2.0444      3.685      0.555      0.581      -5.335       9.424
==============================================================================
Omnibus:                        0.273   Durbin-Watson:                   1.180
Prob(Omnibus):                  0.872   Jarque-Bera (JB):                0.042
Skew:                          -0.051   Prob(JB):                        0.979
Kurtosis:                       3.063   Cond. No.                         65.8
==============================================================================

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

Coefficient Interpretation:
Intercept (normal mass balance): -843.02 (p=0.0000)
may_td: -93.52 (p=0.1248)
june_td: -87.60 (p=0.1272)
july_td: -161.30 (p=0.0102)
august_td: -83.25 (p=0.2502)
september_td: -141.94 (p=0.0157)
october_pd: 2.27 (p=0.4190)
november_pd: 3.12 (p=0.1379)
december_pd: 3.74 (p=0.0352)
january_pd: 2.10 (p=0.3245)
```

Regression: Optimal 1991-2020

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

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

Number of observations: 70

Regression Summary:
                                OLS Regression Results
==============================================================================================
Dep. Variable:     annual mass balance (mm w.e.)   R-squared:                       0.485
Model:                                       OLS   Adj. R-squared:                  0.470
Method:                            Least Squares   F-statistic:                     31.58
Date:                           Fri, 05 Dec 2025   Prob (F-statistic):           2.18e-10
Time:                                   00:05:32   Log-Likelihood:                -550.47
No. Observations:                             70   AIC:                             1107.
Df Residuals:                                 67   BIC:                             1114.
Df Model:                                      2
Covariance Type:                        nonrobust
================================================================================================
                     coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------------------------
const          -821.2349     92.539     -8.874      0.000   -1005.944    -636.525
opt_season_td  -455.2302     61.087     -7.452      0.000    -577.160    -333.300
opt_season_pd     1.8667      0.954      1.957      0.054      -0.037       3.770
==============================================================================
Omnibus:                        0.795   Durbin-Watson:                   1.161
Prob(Omnibus):                  0.672   Jarque-Bera (JB):                0.277
Skew:                          -0.009   Prob(JB):                        0.871
Kurtosis:                       3.308   Cond. No.                         107.
==============================================================================

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

Coefficient Interpretation:
Intercept (normal mass balance): -821.23 (p=0.0000)
opt_season_td: -455.23 (p=0.0000)
opt_season_pd: 1.87 (p=0.0545)

Variance Inflation Factors (VIF):
        Variable       VIF
0          const  1.447730
1  opt_season_td  1.011296
2  opt_season_pd  1.011296

R-squared: 0.4852
Adjusted R-squared: 0.4699
```

Regression: Seasonal 1991-2020

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

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

Number of observations: 70

Regression Summary:
                                OLS Regression Results
==============================================================================================
Dep. Variable:     annual mass balance (mm w.e.)   R-squared:                       0.535
Model:                                       OLS   Adj. R-squared:                  0.521
Method:                            Least Squares   F-statistic:                     38.53
Date:                           Fri, 05 Dec 2025   Prob (F-statistic):           7.29e-12
Time:                                   00:05:32   Log-Likelihood:                -546.92
No. Observations:                             70   AIC:                             1100.
Df Residuals:                                 67   BIC:                             1107.
Df Model:                                      2
Covariance Type:                       nonrobust
================================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
--------------------------------------------------------------------------------
const       -845.3304     88.112     -9.594      0.000   -1021.203    -669.458
summer_td   -517.4811     62.576     -8.270      0.000    -642.383    -392.580
winter_pd      1.9209      0.795      2.418      0.018       0.335       3.507
==============================================================================
Omnibus:                        1.103   Durbin-Watson:                   1.239
Prob(Omnibus):                  0.576   Jarque-Bera (JB):                0.518
Skew:                          -0.114   Prob(JB):                        0.772
Kurtosis:                       3.355   Cond. No.                         124.
==============================================================================

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

Coefficient Interpretation:
Intercept (normal mass balance): -845.33 (p=0.0000)
summer_td: -517.48 (p=0.0000)
winter_pd: 1.92 (p=0.0184)

Variance Inflation Factors (VIF):
    Variable       VIF
0      const  1.452737
1  summer_td  1.003988
2  winter_pd  1.003988

R-squared: 0.5349
Adjusted R-squared: 0.5210
```