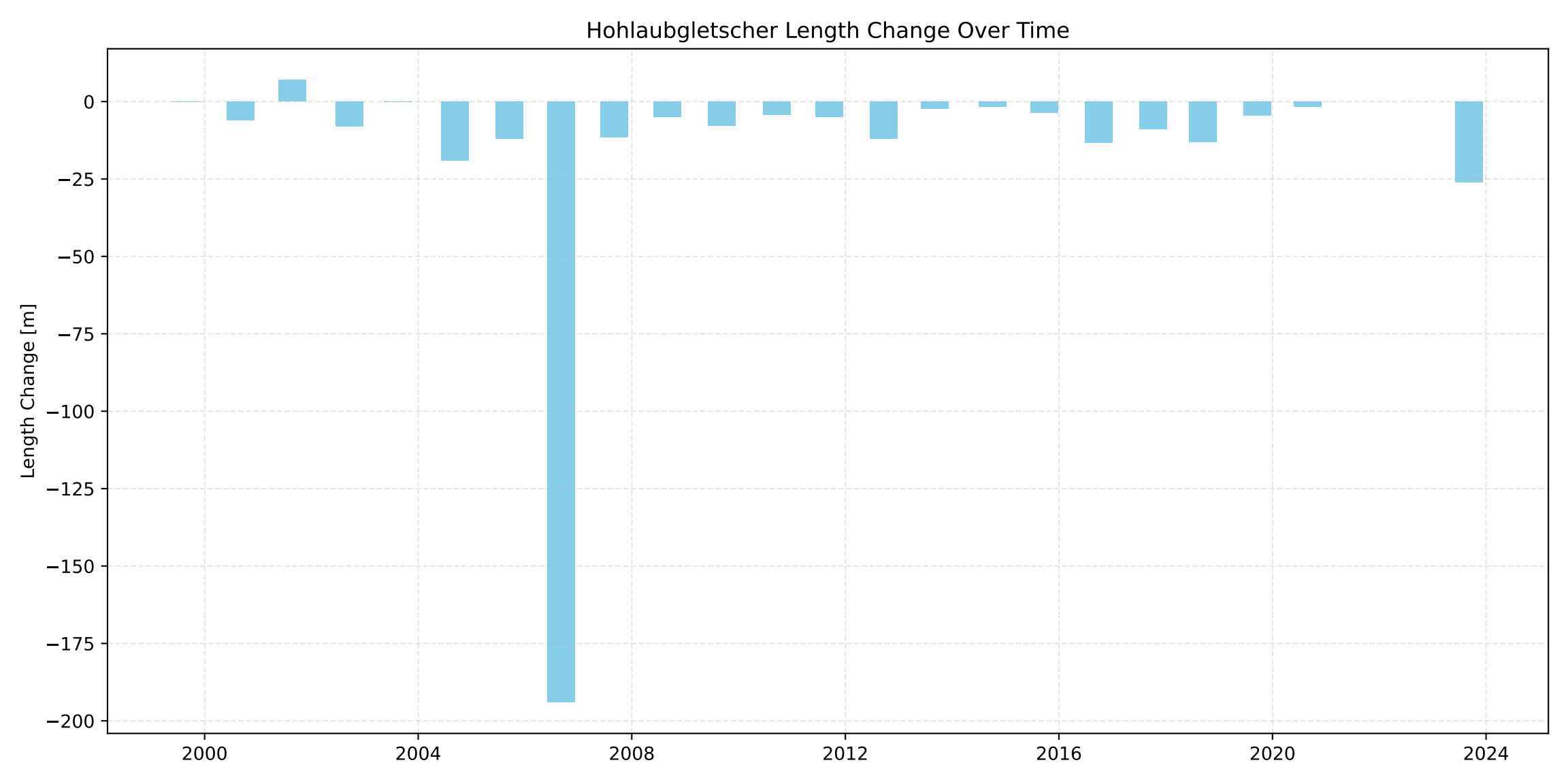
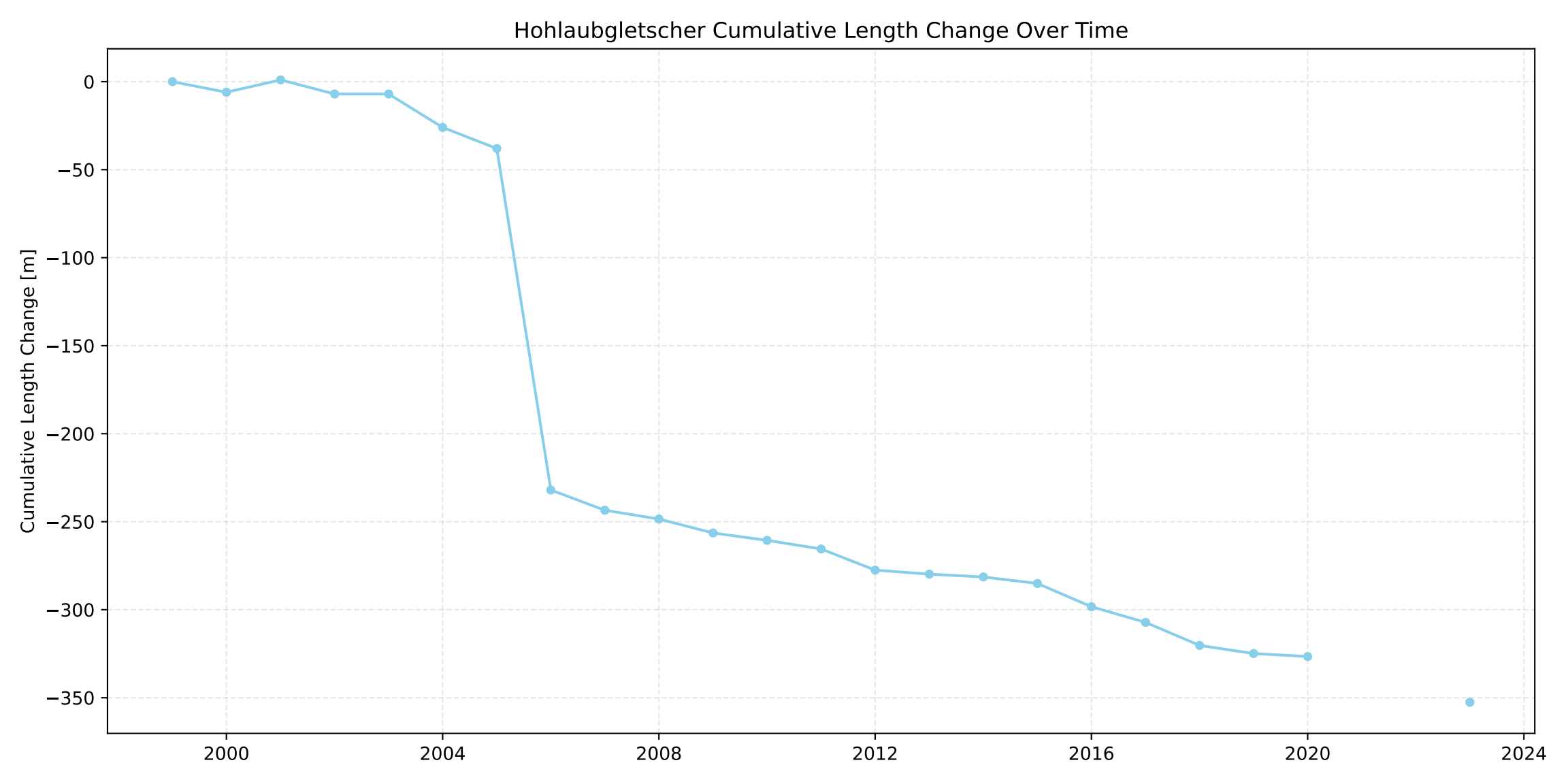
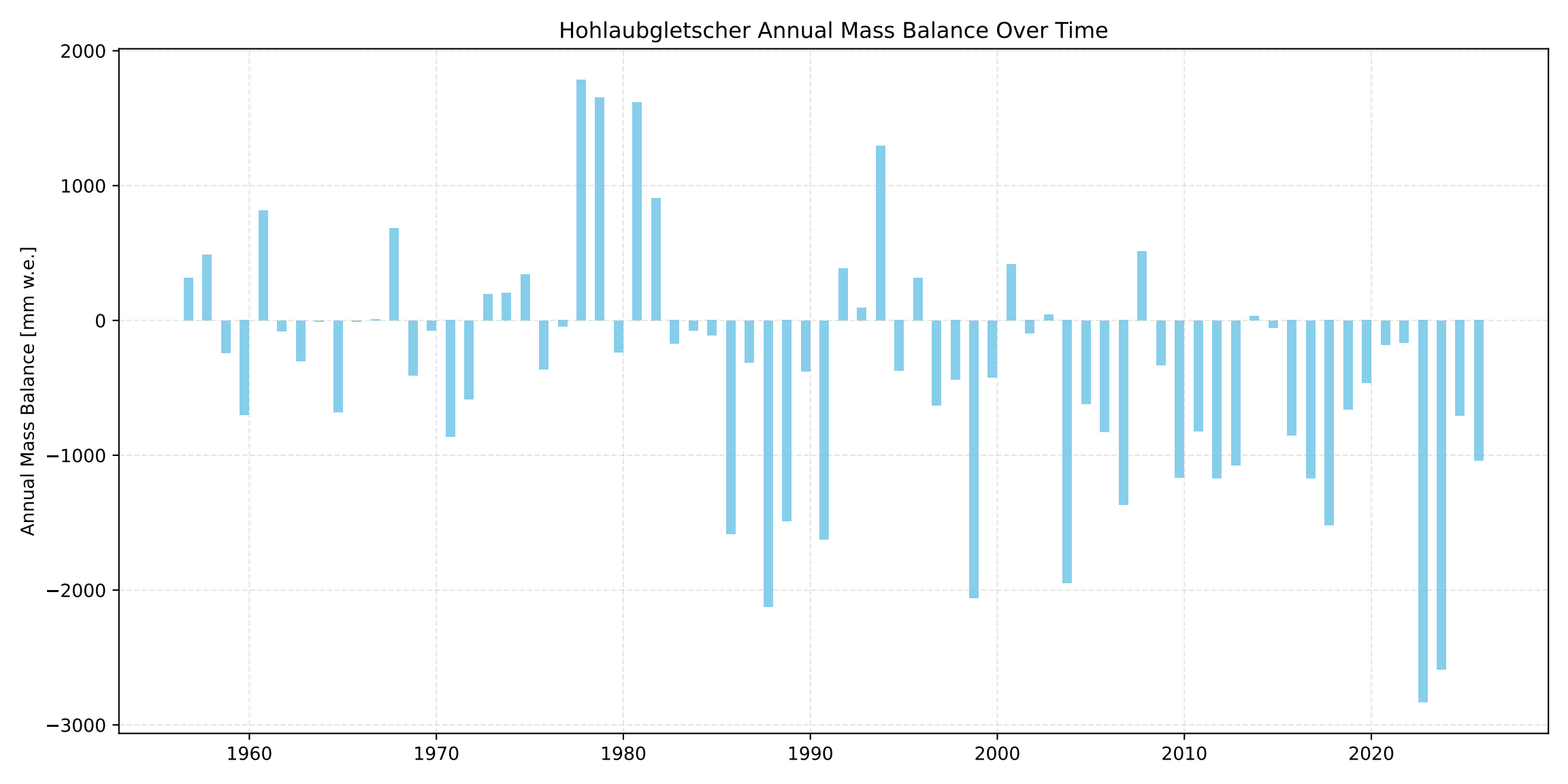
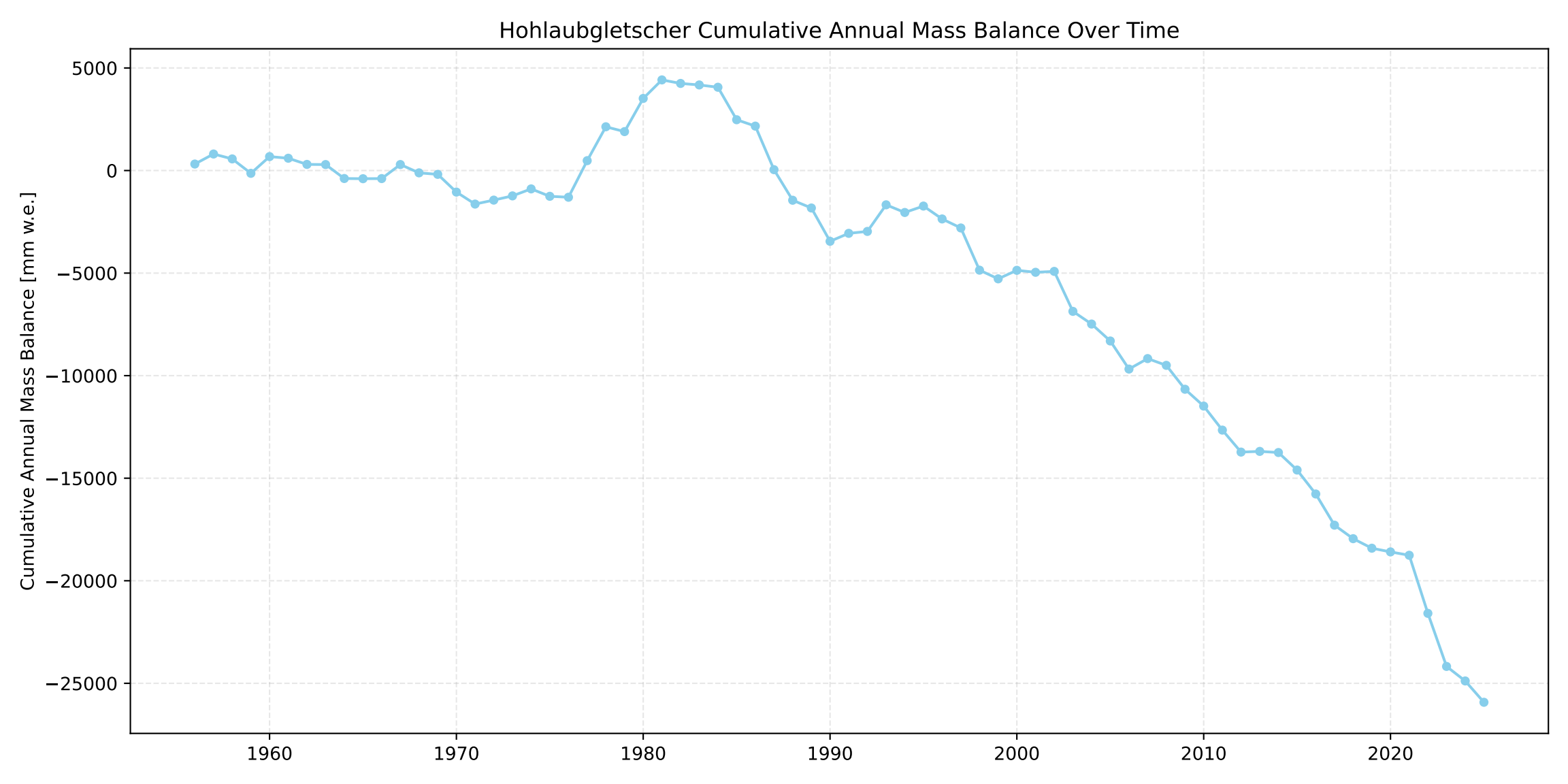
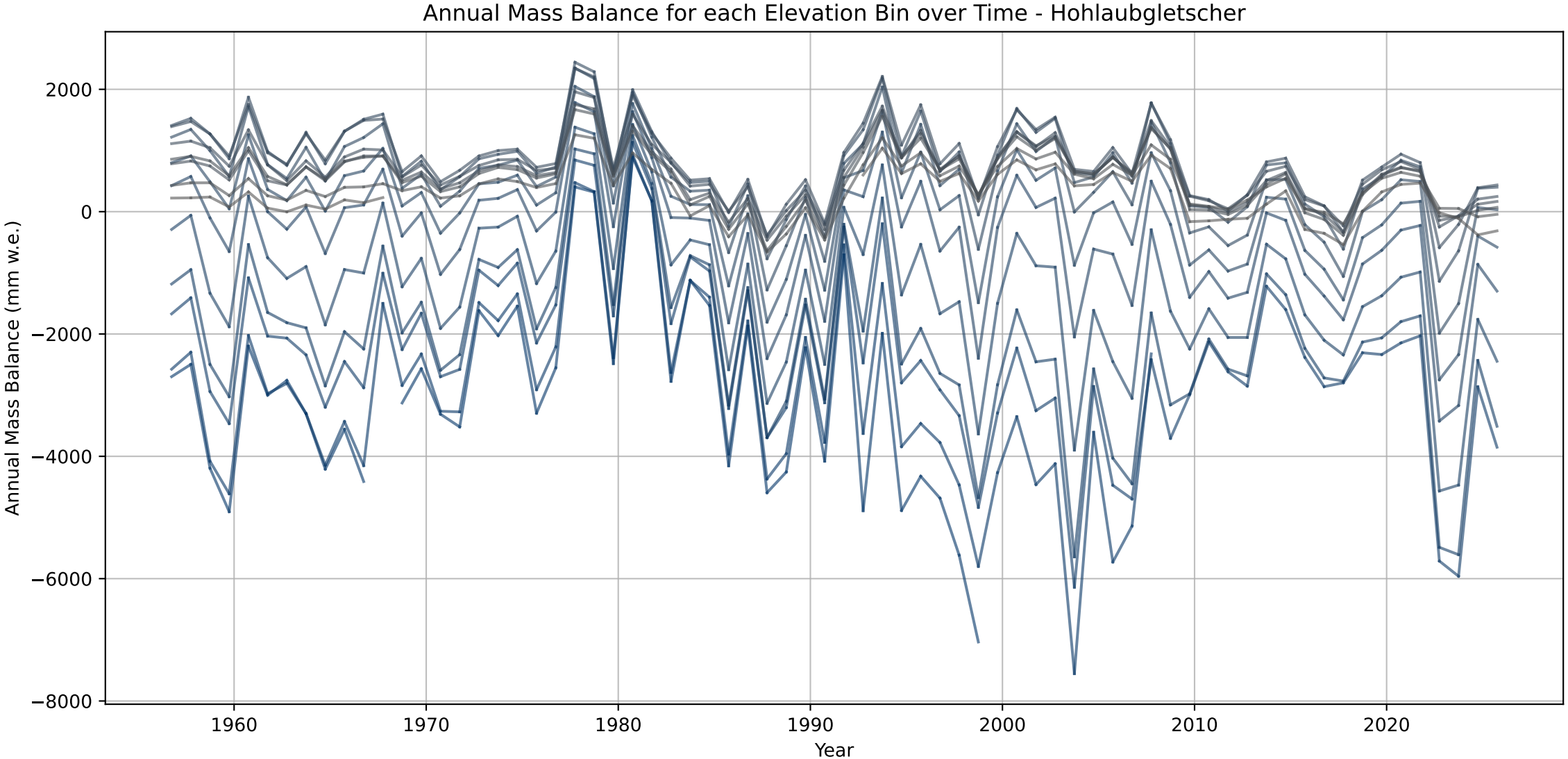
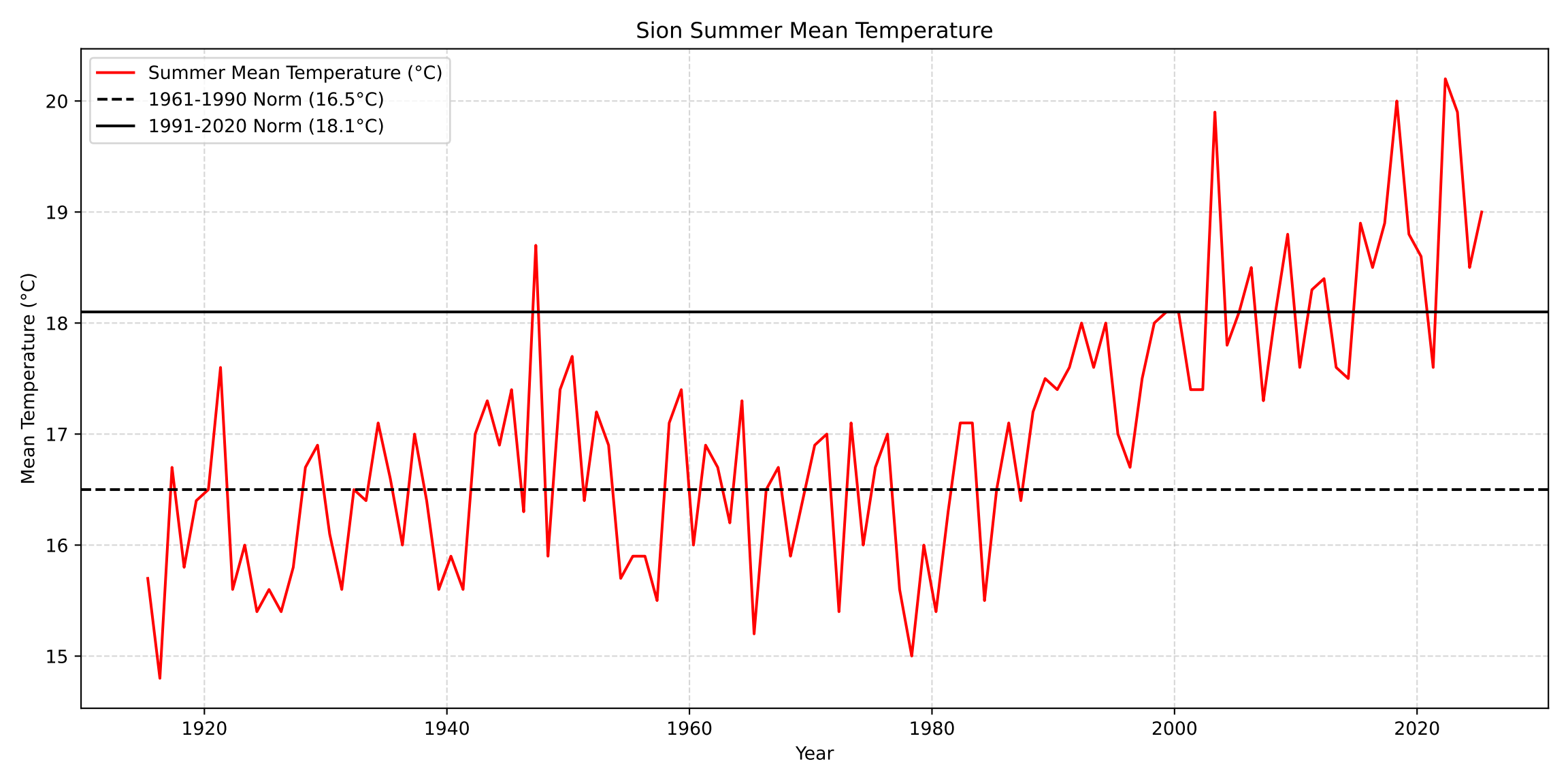

Hohlaubgletscher Length Change Over Time
Length Change [m]
0
−25
−50
−75
−100
−125
−150
−175
−200
2000
2004
2008
2012
2016
2020
2024

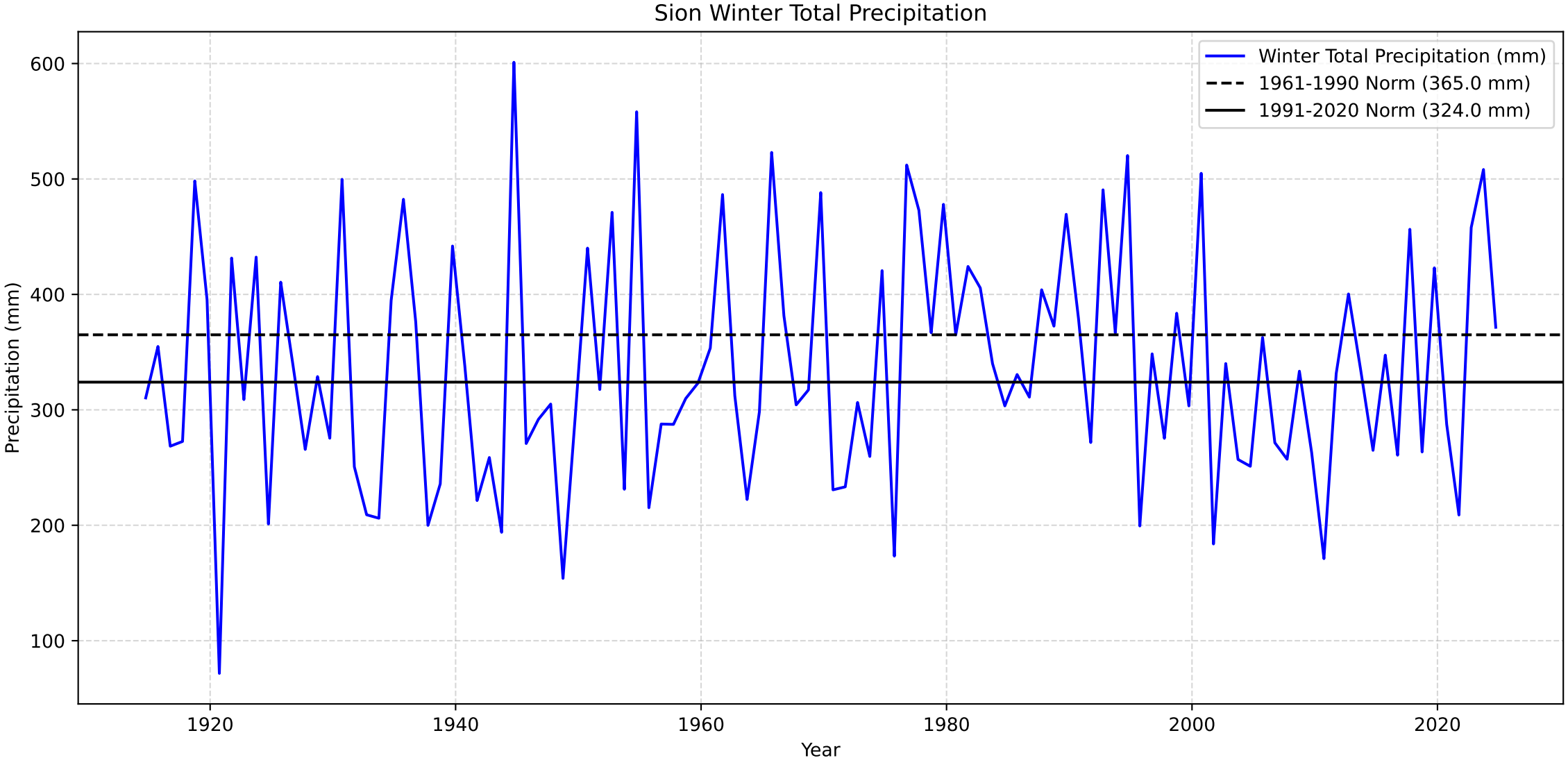

Hohlaubgletscher Cumulative Length Change Over Time
Cumulative Length Change [m]
0
−50
−100
−150
−200
−250
−300
−350
2000
2004
2008
2012
2016
2020
2024

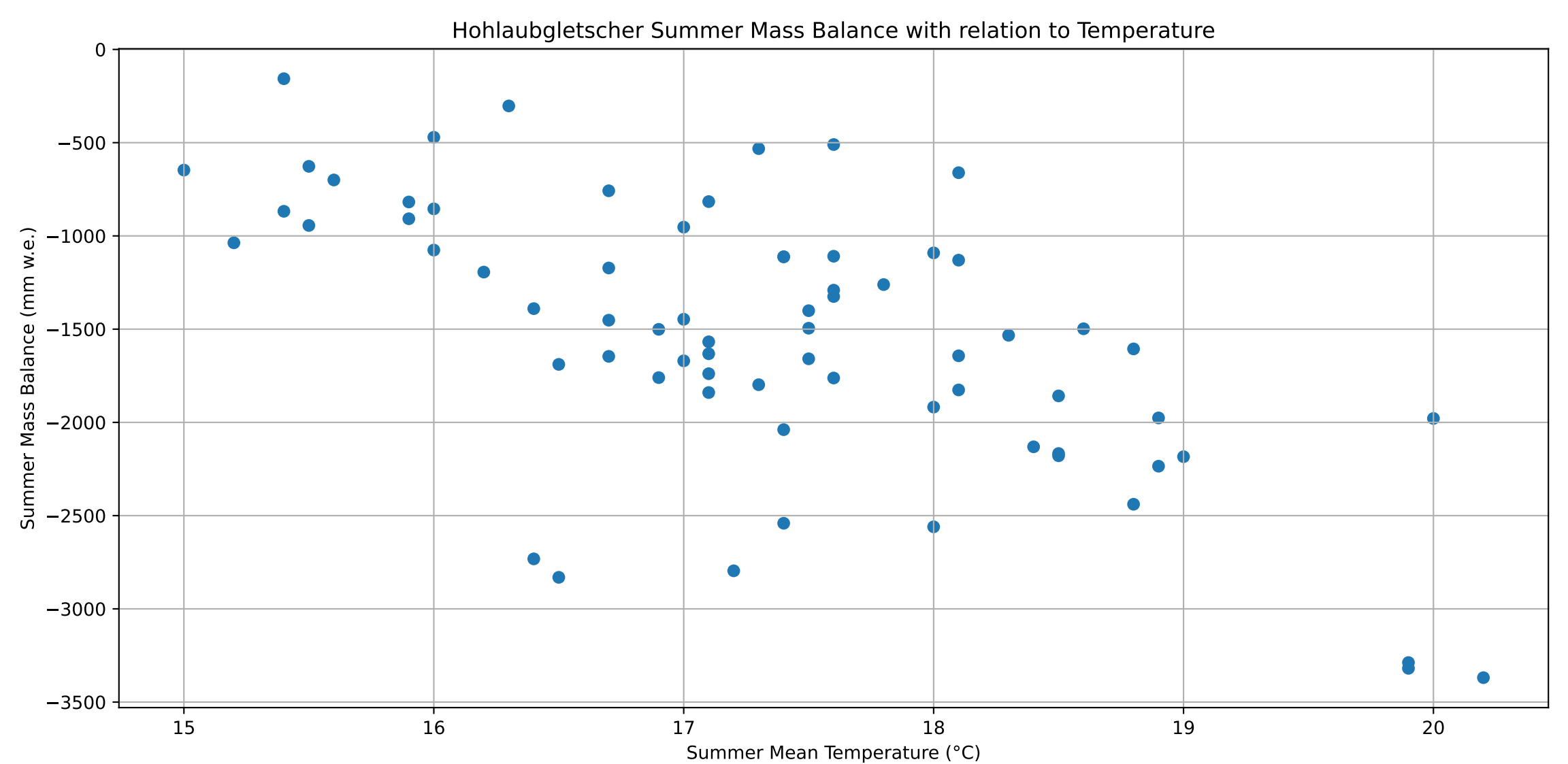

Hohlaubgletscher Annual Mass Balance Over Time
Annual Mass Balance [mm w.e.]
2000
1000
0
−1000
−2000
−3000
1960
1970
1980
1990
2000
2010
2020


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


Annual Mass Balance for each Elevation Bin over Time - Hohlaubgletscher
Annual Mass Balance (mm w.e.)
2000
0
−2000
−4000
−6000
−8000
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


Hohlaubgletscher Summer Mass Balance with relation to Temperature
Summer Mass Balance (mm w.e.)
0
−500
−1000
−1500
−2000
−2500
−3000
−3500
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 Hohlaubgletscher (1961-1990 norms)
================================================================================

Correlation Analysis with Significance Testing:
        Variable  Correlation Coefficient       P-value  Significant (p < 0.05)
6     october_pd                 0.192638  1.101076e-01                   False
10   february_pd                 0.154829  2.006150e-01                   False
7    november_pd                 0.101388  4.036308e-01                   False
8    december_pd                 0.082763  4.957804e-01                   False
11      march_pd                 0.064021  5.985187e-01                   False
9     january_pd                 0.014279  9.066076e-01                   False
12      april_pd                -0.141633  2.421798e-01                   False
1         may_td                -0.388732  8.821633e-04                    True
5   september_td                -0.414801  3.566138e-04                    True
2        june_td                -0.444657  1.150260e-04                    True
4      august_td                -0.467402  4.515425e-05                    True
3        july_td                -0.551877  7.340182e-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:                       0.518
Model:                                       OLS   Adj. R-squared:                  0.417
Method:                            Least Squares   F-statistic:                     5.105
Date:                           Mon, 08 Dec 2025   Prob (F-statistic):           1.05e-05
Time:                                   12:08:42   Log-Likelihood:                -549.81
No. Observations:                             70   AIC:                             1126.
Df Residuals:                                 57   BIC:                             1155.
Df Model:                                     12
Covariance Type:                       nonrobust
================================================================================
                   coef    std err          t      P>|t|      [0.025      0.975]
--------------------------------------------------------------------------------
const         1.652e+04   2583.727      6.393      0.000    1.13e+04    2.17e+04
may_td         -51.7296     66.025     -0.783      0.437    -183.942      80.483
june_td        -16.4373     62.241     -0.264      0.793    -141.073     108.198
july_td       -161.9487     66.779     -2.425      0.018    -295.671     -28.226
august_td     -132.5787     78.796     -1.683      0.098    -290.364      25.207
september_td  -121.8690     62.697     -1.944      0.057    -247.418       3.680
october_pd       7.0823      3.071      2.306      0.025       0.932      13.232
november_pd      2.8305      2.282      1.240      0.220      -1.739       7.400
december_pd      4.4549      1.907      2.336      0.023       0.636       8.274
january_pd       0.6375      2.321      0.275      0.785      -4.010       5.285
february_pd      1.2869      1.802      0.714      0.478      -2.322       4.896
march_pd        -0.7323      2.653     -0.276      0.784      -6.045       4.581
april_pd        -4.2385      4.053     -1.046      0.300     -12.354       3.877
==============================================================================
Omnibus:                        3.799   Durbin-Watson:                   1.573
Prob(Omnibus):                  0.150   Jarque-Bera (JB):                3.408
Skew:                          -0.540   Prob(JB):                        0.182
Kurtosis:                       3.006   Cond. No.                     2.44e+03
```

# Regression: Optimal 1961-1990

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

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

Correlation Analysis with Significance Testing:
        Variable  Correlation Coefficient       P-value  Significant (p < 0.05)
2  opt_season_pd                 0.272364  2.254596e-02                    True
1  opt_season_td                -0.604964  2.908402e-08                    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:                       0.410
Model:                                       OLS   Adj. R-squared:                  0.393
Method:                            Least Squares   F-statistic:                     23.30
Date:                           Mon, 08 Dec 2025   Prob (F-statistic):           2.08e-08
Time:                                   12:08:42   Log-Likelihood:                -556.88
No. Observations:                             70   AIC:                             1120.
Df Residuals:                                 67   BIC:                             1126.
Df Model:                                      2
Covariance Type:                       nonrobust
================================================================================================
                     coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------------------------
const           1.41e+04   2336.689      6.033      0.000    9434.146    1.88e+04
opt_season_td  -415.0115     67.175     -6.178      0.000    -549.094    -280.929
opt_season_pd     2.3416      1.045      2.241      0.028       0.256       4.427
==============================================================================
Omnibus:                        8.191   Durbin-Watson:                   1.533
Prob(Omnibus):                  0.017   Jarque-Bera (JB):                7.858
Skew:                          -0.655   Prob(JB):                       0.0197
Kurtosis:                       3.989   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): 14098.20 (p=0.0000)
opt_season_td: -415.01 (p=0.0000)
opt_season_pd: 2.34 (p=0.0284)

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

R-squared: 0.4102
Adjusted R-squared: 0.3926
```

# Regression: Seasonal 1961-1990

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

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

Correlation Analysis with Significance Testing:
    Variable  Correlation Coefficient       P-value  Significant (p < 0.05)
2  winter_pd                 0.227639  5.806108e-02                   False
1  summer_td                -0.630833  4.816630e-09                    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:                       0.433
Model:                                       OLS   Adj. R-squared:                  0.416
Method:                            Least Squares   F-statistic:                     25.54
Date:                           Mon, 08 Dec 2025   Prob (F-statistic):           5.70e-09
Time:                                   12:08:42   Log-Likelihood:                -555.52
No. Observations:                             70   AIC:                             1117.
Df Residuals:                                 67   BIC:                             1124.
Df Model:                                      2
Covariance Type:                       nonrobust
================================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
--------------------------------------------------------------------------------
const       1.571e+04   2392.403      6.567      0.000    1.09e+04    2.05e+04
summer_td   -474.4156     70.756     -6.705      0.000    -615.645    -333.186
winter_pd      1.8168      0.899      2.022      0.047       0.023       3.610
==============================================================================
Omnibus:                        6.203   Durbin-Watson:                   1.538
Prob(Omnibus):                  0.045   Jarque-Bera (JB):                5.375
Skew:                          -0.591   Prob(JB):                       0.0681
Kurtosis:                       3.668   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): 15711.42 (p=0.0000)
summer_td: -474.42 (p=0.0000)
winter_pd: 1.82 (p=0.0472)

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

R-squared: 0.4326
Adjusted R-squared: 0.4156
```

# Regression: Monthly 1991-2020

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

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

Correlation Analysis with Significance Testing:
        Variable  Correlation Coefficient       P-value  Significant (p < 0.05)
6     october_pd                 0.192638  1.101076e-01                   False
10   february_pd                 0.154829  2.006150e-01                   False
7    november_pd                 0.101388  4.036308e-01                   False
8    december_pd                 0.082763  4.957804e-01                   False
11      march_pd                 0.064021  5.985187e-01                   False
9     january_pd                 0.014279  9.066076e-01                   False
12      april_pd                -0.141633  2.421798e-01                   False
1         may_td                -0.388732  8.821633e-04                    True
5   september_td                -0.414801  3.566138e-04                    True
2        june_td                -0.444657  1.150260e-04                    True
4      august_td                -0.467402  4.515425e-05                    True
3        july_td                -0.551877  7.340182e-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:                       0.518
Model:                                       OLS   Adj. R-squared:                  0.417
Method:                            Least Squares   F-statistic:                     5.105
Date:                           Mon, 08 Dec 2025   Prob (F-statistic):           1.05e-05
Time:                                   12:08:42   Log-Likelihood:                -549.81
No. Observations:                             70   AIC:                             1126.
Df Residuals:                                 57   BIC:                             1155.
Df Model:                                     12
Covariance Type:                       nonrobust
================================================================================
                   coef    std err          t      P>|t|      [0.025      0.975]
--------------------------------------------------------------------------------
const         -761.0987    100.998     -7.536      0.000    -963.343    -558.854
may_td         -51.7296     66.025     -0.783      0.437    -183.942      80.483
june_td        -16.4373     62.241     -0.264      0.793    -141.073     108.198
july_td       -161.9487     66.779     -2.425      0.018    -295.671     -28.226
august_td     -132.5787     78.796     -1.683      0.098    -290.364      25.207
september_td  -121.8690     62.697     -1.944      0.057    -247.418       3.680
october_pd       7.0823      3.071      2.306      0.025       0.932      13.232
november_pd      2.8305      2.282      1.240      0.220      -1.739       7.400
december_pd      4.4549      1.907      2.336      0.023       0.636       8.274
january_pd       0.6375      2.321      0.275      0.785      -4.010       5.285
february_pd      1.2869      1.802      0.714      0.478      -2.322       4.896
march_pd        -0.7323      2.653     -0.276      0.784      -6.045       4.581
april_pd        -4.2385      4.053     -1.046      0.300     -12.354       3.877
==============================================================================
Omnibus:                        3.799   Durbin-Watson:                   1.573
Prob(Omnibus):                  0.150   Jarque-Bera (JB):                3.408
Skew:                          -0.540   Prob(JB):                        0.182
Kurtosis:                       3.006   Cond. No.                         65.8
```

# Regression: Optimal 1991-2020

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

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

Correlation Analysis with Significance Testing:
        Variable  Correlation Coefficient       P-value  Significant (p < 0.05)
2  opt_season_pd                 0.272364  2.254596e-02                    True
1  opt_season_td                -0.605611  2.786038e-08                    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:                       0.409
Model:                                       OLS   Adj. R-squared:                  0.392
Method:                            Least Squares   F-statistic:                     23.21
Date:                           Mon, 08 Dec 2025   Prob (F-statistic):           2.19e-08
Time:                                   12:08:42   Log-Likelihood:                -556.93
No. Observations:                             70   AIC:                             1120.
Df Residuals:                                 67   BIC:                             1127.
Df Model:                                      2
Covariance Type:                       nonrobust
================================================================================================
                     coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------------------------
const          -749.6822    101.557     -7.382      0.000    -952.390    -546.974
opt_season_td  -414.5566     67.243     -6.165      0.000    -548.774    -280.339
opt_season_pd     2.2984      1.047      2.196      0.032       0.209       4.387
==============================================================================
Omnibus:                        7.664   Durbin-Watson:                   1.534
Prob(Omnibus):                  0.022   Jarque-Bera (JB):                7.203
Skew:                          -0.628   Prob(JB):                       0.0273
Kurtosis:                       3.944   Cond. No.                         107.
==============================================================================

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

Coefficient Interpretation:
Intercept (normal mass balance): -749.68 (p=0.0000)
opt_season_td: -414.56 (p=0.0000)
opt_season_pd: 2.30 (p=0.0316)

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

R-squared: 0.4093
Adjusted R-squared: 0.3917
```

# Regression: Seasonal 1991-2020

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

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

Correlation Analysis with Significance Testing:
    Variable  Correlation Coefficient       P-value  Significant (p < 0.05)
2  winter_pd                 0.227639  5.806108e-02                   False
1  summer_td                -0.628791  5.584849e-09                    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:                       0.431
Model:                                       OLS   Adj. R-squared:                  0.414
Method:                            Least Squares   F-statistic:                     25.33
Date:                           Mon, 08 Dec 2025   Prob (F-statistic):           6.41e-09
Time:                                   12:08:42   Log-Likelihood:                -555.64
No. Observations:                             70   AIC:                             1117.
Df Residuals:                                 67   BIC:                             1124.
Df Model:                                      2
Covariance Type:                       nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const       -763.8050     99.610     -7.668      0.000    -962.627    -564.983
summer_td   -472.5222     70.779     -6.676      0.000    -613.797    -331.247
winter_pd      1.8323      0.900      2.036      0.046       0.036       3.629
==============================================================================
Omnibus:                        6.431   Durbin-Watson:                   1.533
Prob(Omnibus):                  0.040   Jarque-Bera (JB):                5.631
Skew:                          -0.599   Prob(JB):                       0.0599
Kurtosis:                       3.704   Cond. No.                         124.
==============================================================================

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

Coefficient Interpretation:
Intercept (normal mass balance): -763.81 (p=0.0000)
summer_td: -472.52 (p=0.0000)
winter_pd: 1.83 (p=0.0457)

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

R-squared: 0.4306
Adjusted R-squared: 0.4136
```