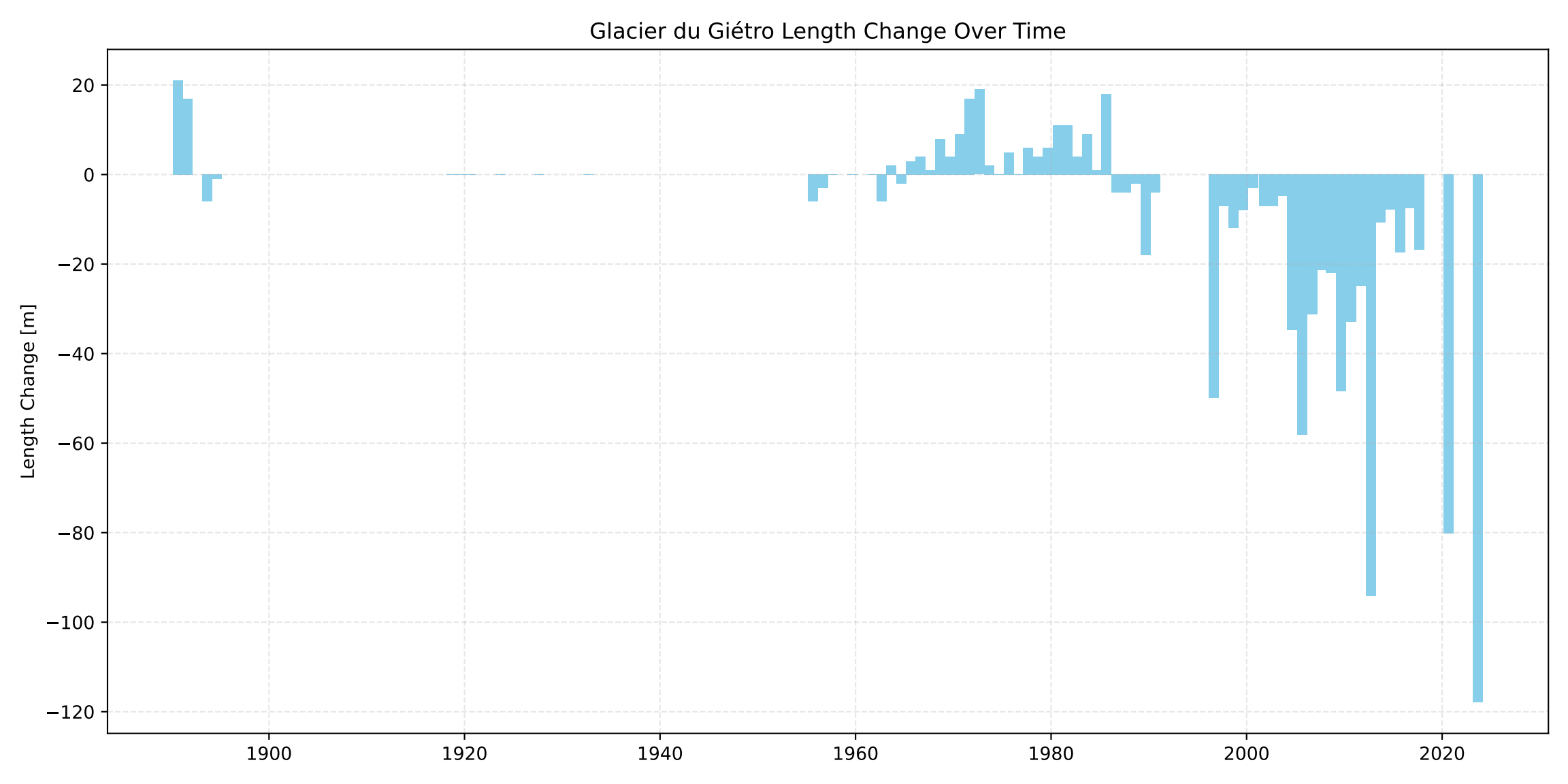
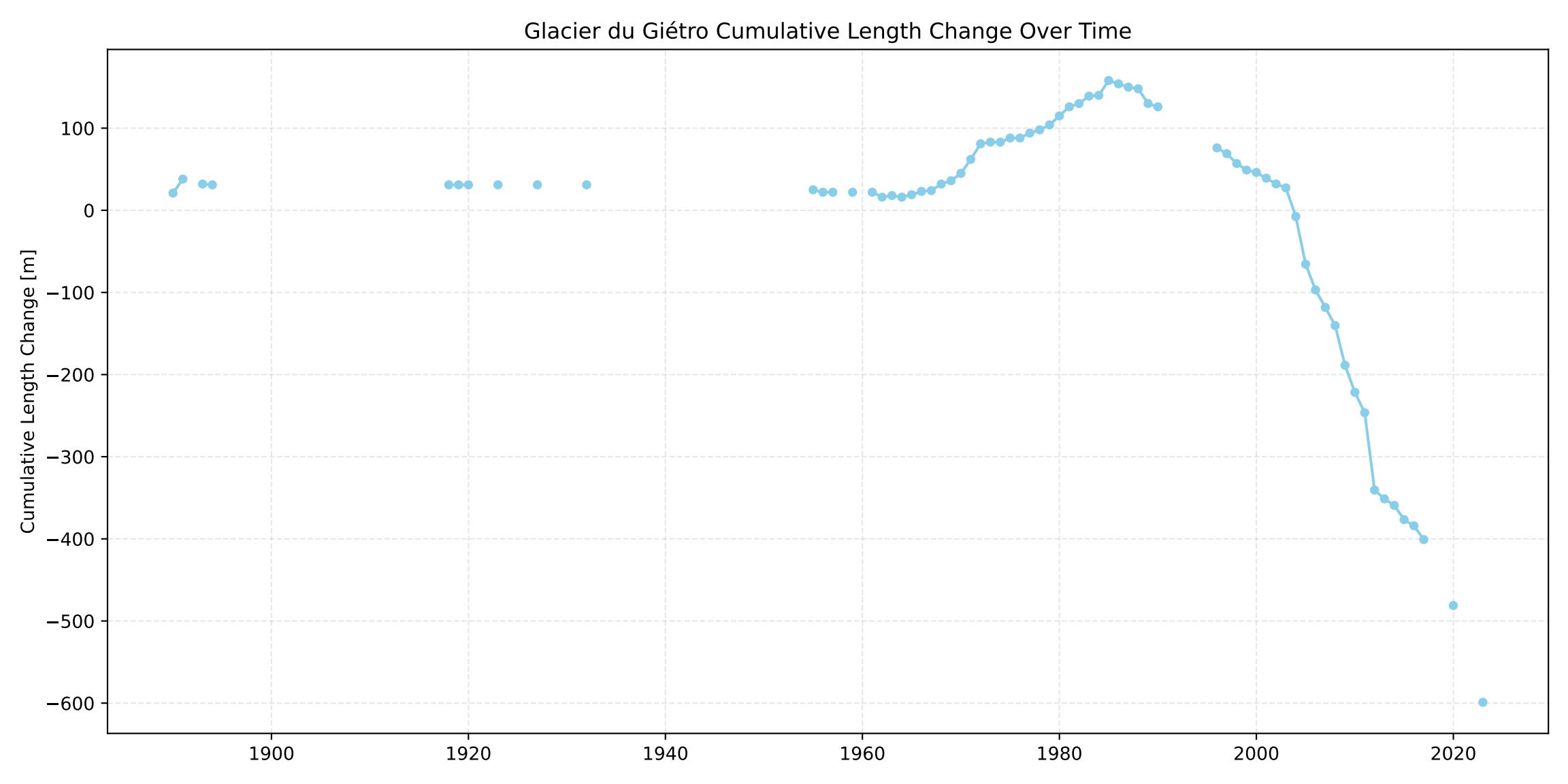
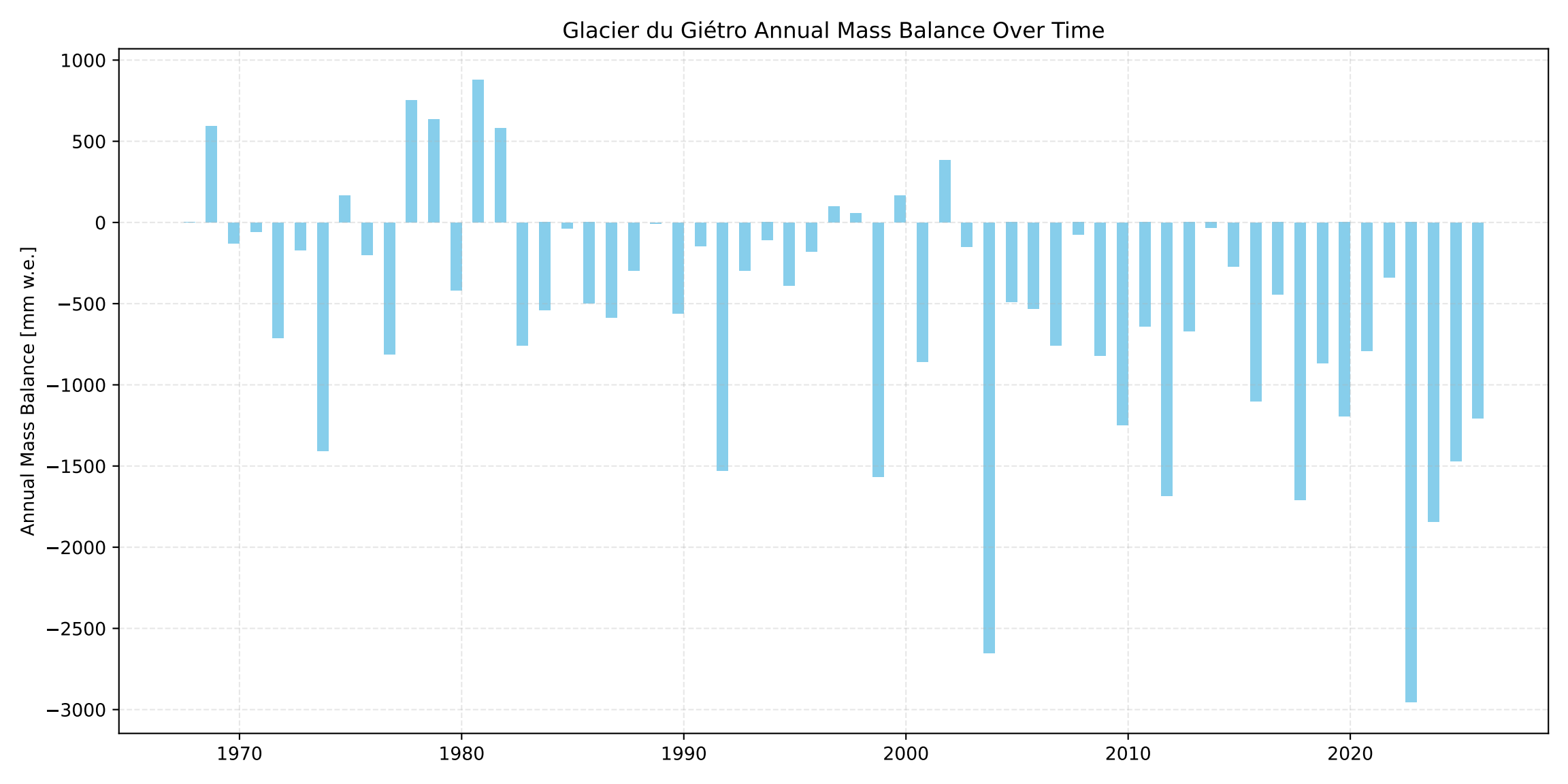
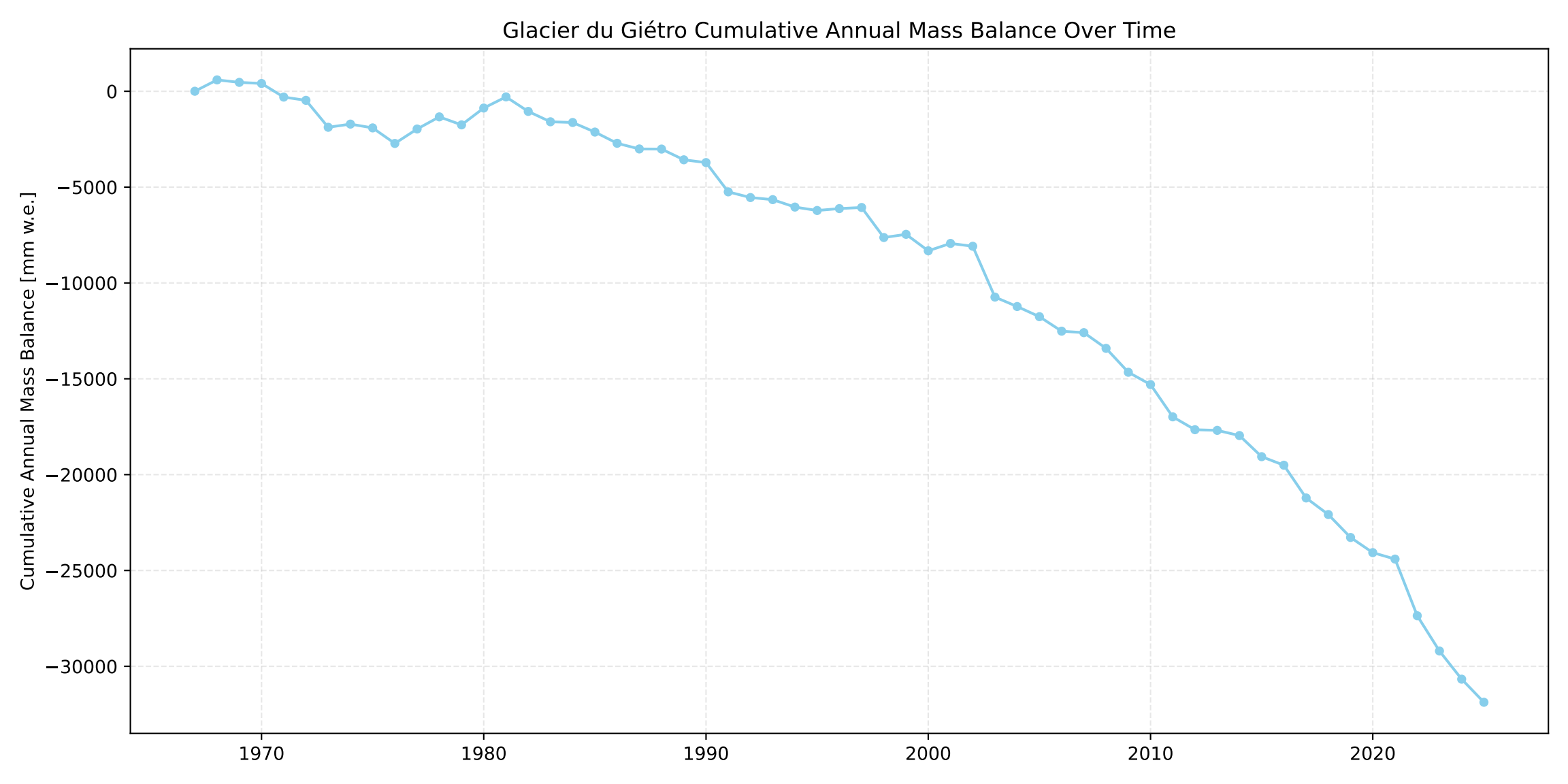
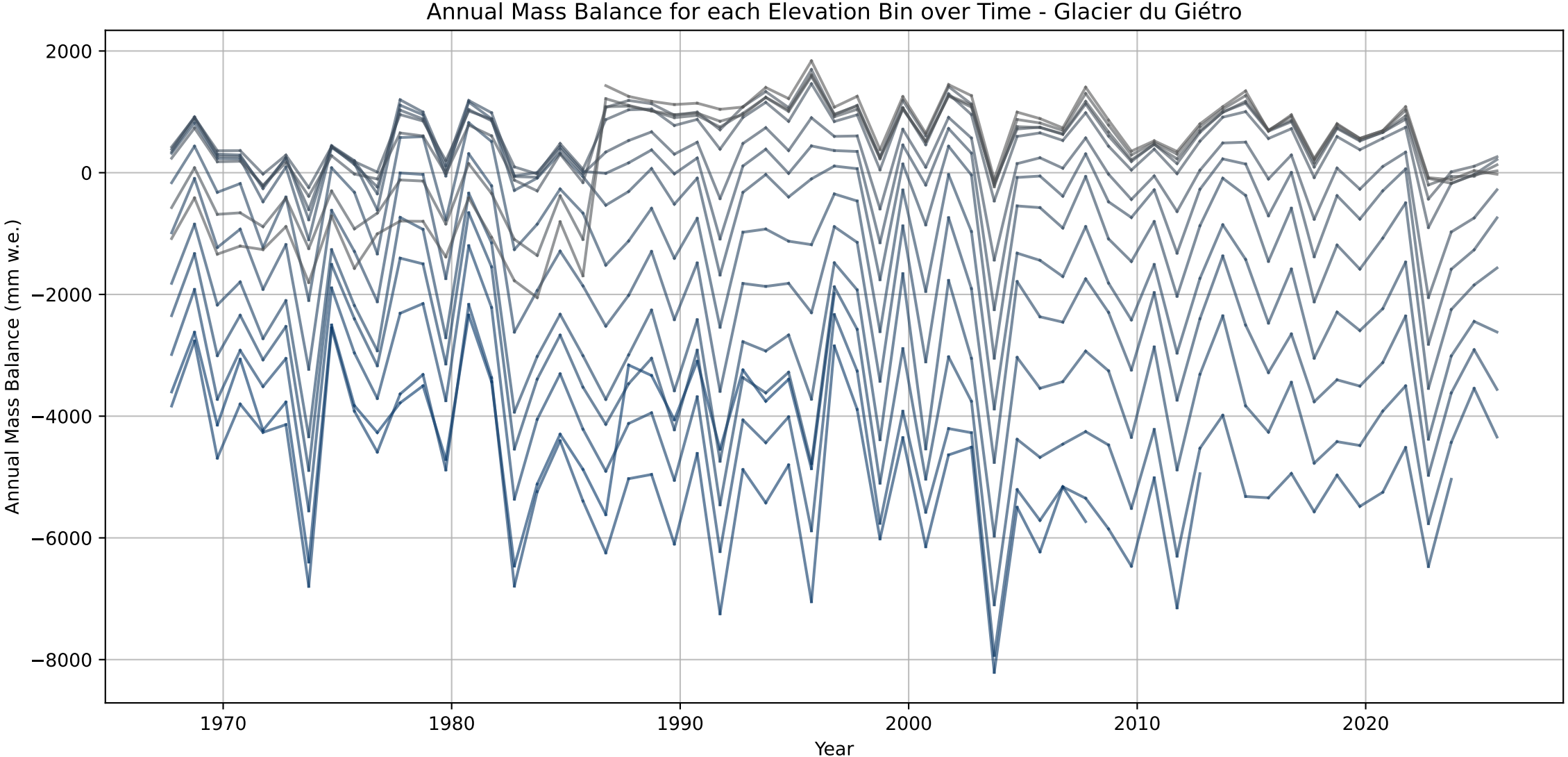
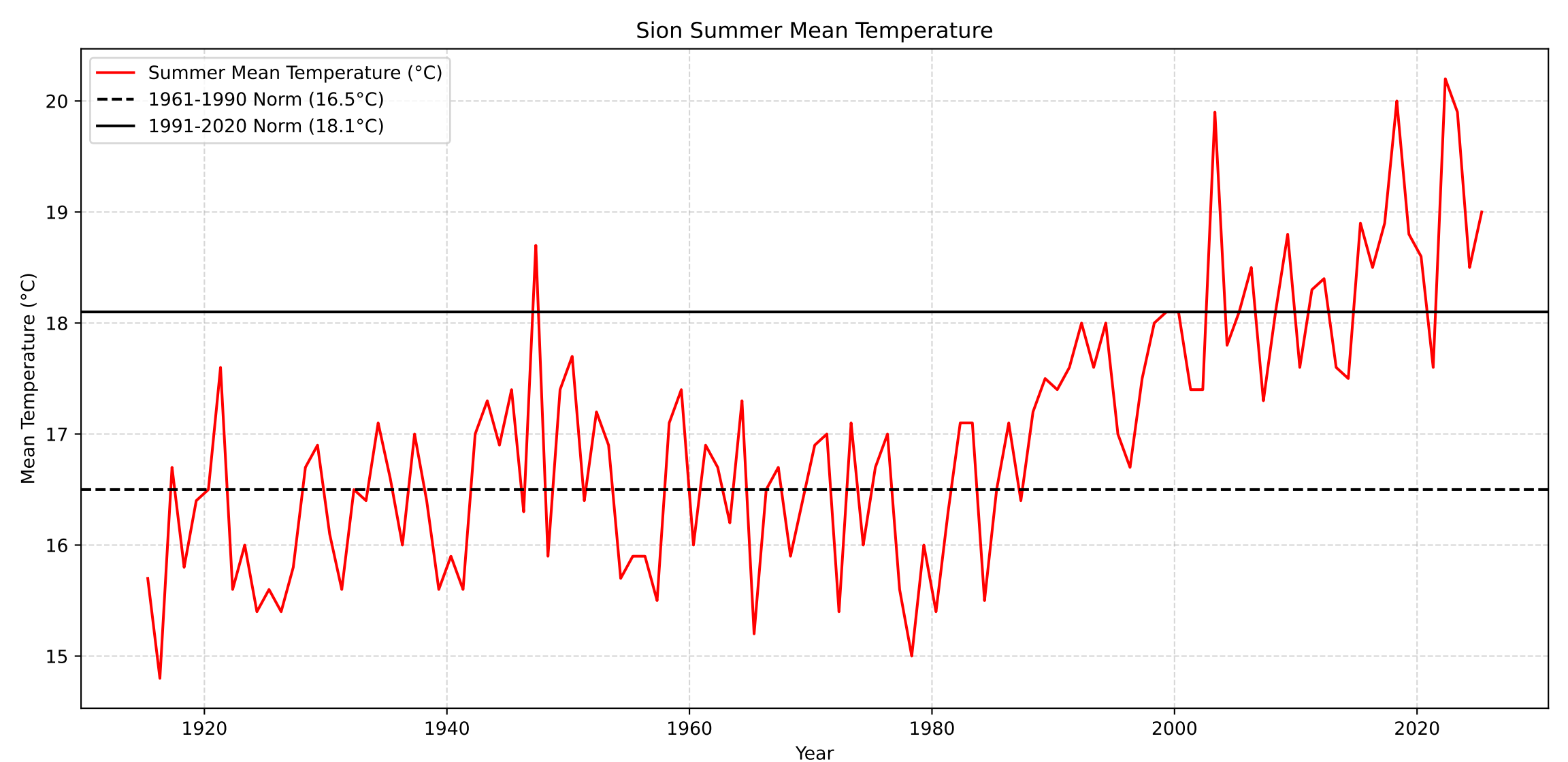

Glacier du Giétro Length Change Over Time
Length Change [m]
20
0
−20
−40
−60
−80
−100
−120
1900
1920
1940
1960
1980
2000
2020

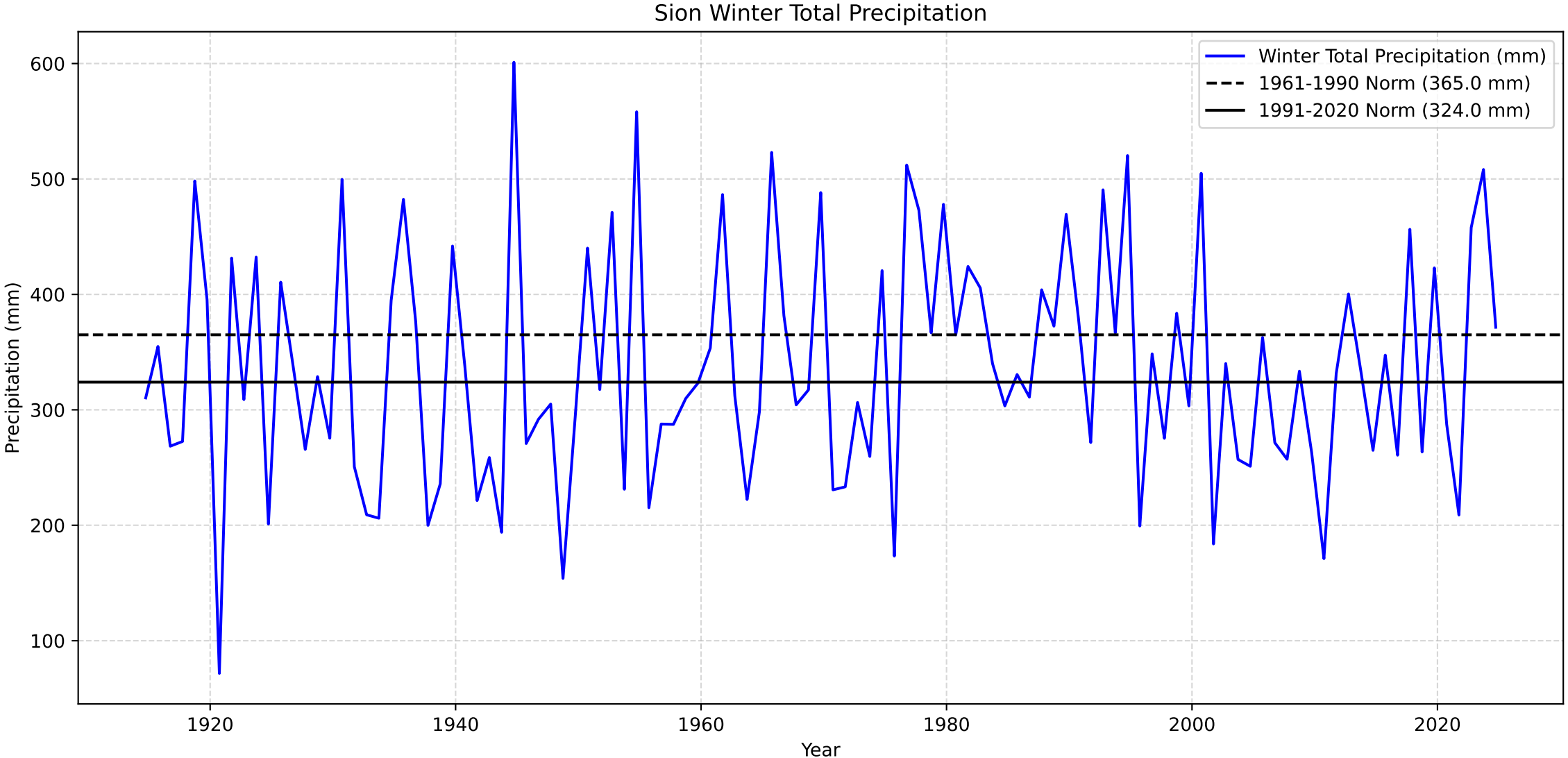

Glacier du Giétro Cumulative Length Change Over Time
Cumulative Length Change [m]
100
0
−100
−200
−300
−400
−500
−600
1900
1920
1940
1960
1980
2000
2020

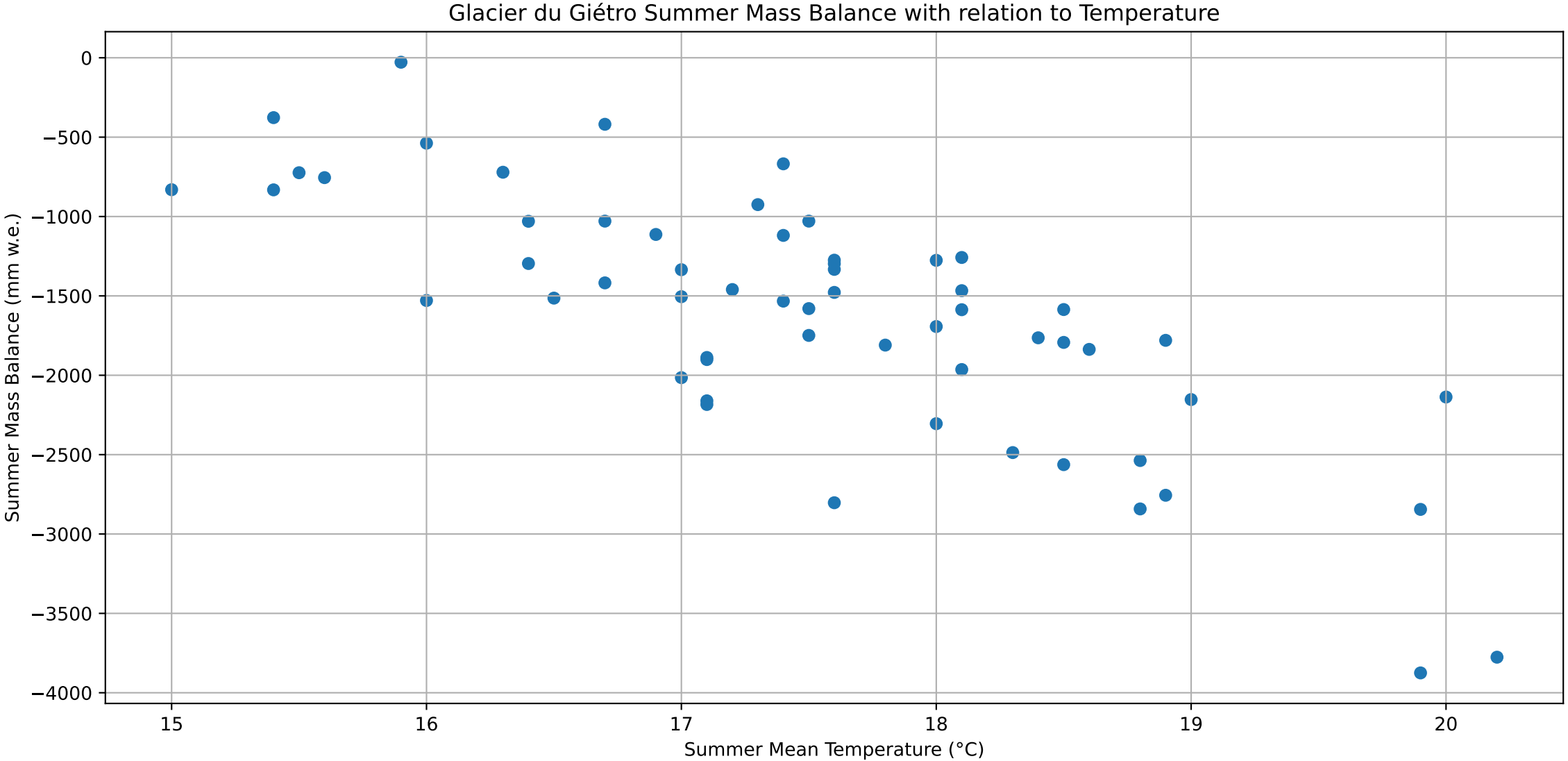

Glacier du Giétro Annual Mass Balance Over Time
Annual Mass Balance [mm w.e.]
1000
500
0
−500
−1000
−1500
−2000
−2500
−3000
1970
1980
1990
2000
2010
2020


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


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


Glacier du Giétro Summer Mass Balance with relation to Temperature
Summer Mass Balance (mm w.e.)
0
−500
−1000
−1500
−2000
−2500
−3000
−3500
−4000
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 Glacier du Giétro (1961-1990 norms)
================================================================================

Correlation Analysis with Significance Testing:
        Variable  Correlation Coefficient       P-value  Significant (p < 0.05)
10   february_pd                 0.344876  7.473511e-03                    True
11      march_pd                 0.185747  1.589784e-01                   False
9     january_pd                 0.175636  1.833241e-01                   False
6     october_pd                 0.153290  2.464077e-01                   False
12      april_pd                 0.014406  9.137634e-01                   False
8    december_pd                -0.079247  5.507605e-01                   False
7    november_pd                -0.079989  5.470221e-01                   False
5   september_td                -0.402591  1.571603e-03                    True
1         may_td                -0.474425  1.469830e-04                    True
3        july_td                -0.579919  1.483556e-06                    True
2        june_td                -0.644929  3.523408e-08                    True
4      august_td                -0.658178  1.470237e-08                    True
0          const                      NaN           NaN                   False

Number of observations: 59

Regression Summary:
                                OLS Regression Results
================================================================================================
Dep. Variable:     annual mass balance (mm w.e.)   R-squared:                       0.703
Model:                                       OLS   Adj. R-squared:                  0.625
Method:                            Least Squares   F-statistic:                     9.065
Date:                           Mon, 08 Dec 2025   Prob (F-statistic):           1.40e-08
Time:                                   12:08:45   Log-Likelihood:                -438.92
No. Observations:                             59   AIC:                             903.8
Df Residuals:                                 46   BIC:                             930.9
Df Model:                                     12
Covariance Type:                       nonrobust
================================================================================
                   coef    std err          t      P>|t|      [0.025      0.975]
--------------------------------------------------------------------------------
const         1.617e+04   1948.539      8.300      0.000    1.23e+04    2.01e+04
may_td         -38.2728     50.064     -0.764      0.448    -139.046      62.500
june_td        -89.3936     45.822     -1.951      0.057    -181.629       2.842
july_td       -145.8930     49.850     -2.927      0.005    -246.235     -45.551
august_td     -120.0130     61.355     -1.956      0.057    -243.515       3.489
september_td   -75.7921     47.156     -1.607      0.115    -170.713      19.129
october_pd       2.3180      2.186      1.060      0.295      -2.083       6.719
november_pd     -1.5704      1.698     -0.925      0.360      -4.988       1.847
december_pd      1.3308      1.522      0.874      0.386      -1.733       4.395
january_pd       3.3608      1.667      2.017      0.050       0.006       6.715
february_pd      2.8796      1.417      2.032      0.048       0.027       5.732
march_pd         1.7271      1.961      0.881      0.383      -2.219       5.674
april_pd         3.1540      2.942      1.072      0.289      -2.768       9.076
==============================================================================
Omnibus:                        1.577   Durbin-Watson:                   2.085
Prob(Omnibus):                  0.454   Jarque-Bera (JB):                1.584
Skew:                          -0.345   Prob(JB):                        0.453
Kurtosis:                       2.589   Cond. No.                     2.52e+03
```

Regression: Optimal 1961-1990

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

================================================================================
OPTIMAL SEASONAL DEVIATIONS for Glacier du Giétro (1961-1990 norms)
================================================================================

Correlation Analysis with Significance Testing:
        Variable  Correlation Coefficient       P-value  Significant (p < 0.05)
2  opt_season_pd                 0.265071  4.246513e-02                    True
1  opt_season_td                -0.770141  1.001176e-12                    True
0          const                      NaN           NaN                   False

Number of observations: 59

Regression Summary:
                                OLS Regression Results
==============================================================================================
Dep. Variable:     annual mass balance (mm w.e.)   R-squared:                       0.617
Model:                                       OLS   Adj. R-squared:                  0.604
Method:                            Least Squares   F-statistic:                     45.20
Date:                           Mon, 08 Dec 2025   Prob (F-statistic):           2.06e-12
Time:                                   12:08:45   Log-Likelihood:                -446.37
No. Observations:                             59   AIC:                             898.7
Df Residuals:                                 56   BIC:                             905.0
Df Model:                                      2
Covariance Type:                       nonrobust
================================================================================================
                     coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------------------------
const          1.524e+04   1760.086      8.656      0.000    1.17e+04    1.88e+04
opt_season_td  -450.4983     50.330     -8.951      0.000    -551.322    -349.675
opt_season_pd     1.4877      0.787      1.889      0.064      -0.090       3.065
==============================================================================
Omnibus:                        1.705   Durbin-Watson:                   2.018
Prob(Omnibus):                  0.426   Jarque-Bera (JB):                1.531
Skew:                          -0.387   Prob(JB):                        0.465
Kurtosis:                       2.844   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): 15235.01 (p=0.0000)
opt_season_td: -450.50 (p=0.0000)
opt_season_pd: 1.49 (p=0.0640)

Variance Inflation Factors (VIF):
        Variable         VIF
0          const  795.023059
1  opt_season_td    1.021034
2  opt_season_pd    1.021034

R-squared: 0.6175
Adjusted R-squared: 0.6038
```

Regression: Seasonal 1961-1990

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

================================================================================
SUMMER/WINTER SEASONAL DEVIATIONS for Glacier du Giétro (1961-1990 norms)
================================================================================

Correlation Analysis with Significance Testing:
    Variable  Correlation Coefficient       P-value  Significant (p < 0.05)
2  winter_pd                 0.303591  1.941328e-02                    True
1  summer_td                -0.767873  1.280460e-12                    True
0      const                      NaN           NaN                   False

Number of observations: 59

Regression Summary:
                                OLS Regression Results
==============================================================================================
Dep. Variable:     annual mass balance (mm w.e.)   R-squared:                       0.636
Model:                                       OLS   Adj. R-squared:                  0.623
Method:                            Least Squares   F-statistic:                     48.96
Date:                           Mon, 08 Dec 2025   Prob (F-statistic):           5.08e-13
Time:                                   12:08:45   Log-Likelihood:                -444.89
No. Observations:                             59   AIC:                             895.8
Df Residuals:                                 56   BIC:                             902.0
Df Model:                                      2
Covariance Type:                       nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const       1.586e+04   1788.122      8.871      0.000    1.23e+04    1.94e+04
summer_td   -481.6753     52.641     -9.150      0.000    -587.128    -376.223
winter_pd      1.7815      0.666      2.676      0.010       0.448       3.115
==============================================================================
Omnibus:                        2.465   Durbin-Watson:                   2.093
Prob(Omnibus):                  0.292   Jarque-Bera (JB):                2.370
Skew:                          -0.431   Prob(JB):                        0.306
Kurtosis:                       2.529   Cond. No.                     2.78e+03
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 2.78e+03. This might indicate that there are
strong multicollinearity or other numerical problems.

Coefficient Interpretation:
Intercept (normal mass balance): 15862.72 (p=0.0000)
summer_td: -481.68 (p=0.0000)
winter_pd: 1.78 (p=0.0098)

Variance Inflation Factors (VIF):
    Variable         VIF
0      const  862.630407
1  summer_td    1.013727
2  winter_pd    1.013727

R-squared: 0.6362
Adjusted R-squared: 0.6232
```

Regression: Monthly 1991-2020

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

================================================================================
MONTHLY DEVIATIONS for Glacier du Giétro (1991-2020 norms)
================================================================================

Correlation Analysis with Significance Testing:
        Variable  Correlation Coefficient       P-value  Significant (p < 0.05)
10   february_pd                 0.344876  7.473511e-03                    True
11      march_pd                 0.185747  1.589784e-01                   False
9     january_pd                 0.175636  1.833241e-01                   False
6     october_pd                 0.153290  2.464077e-01                   False
12      april_pd                 0.014406  9.137634e-01                   False
8    december_pd                -0.079247  5.507605e-01                   False
7    november_pd                -0.079989  5.470221e-01                   False
5   september_td                -0.402591  1.571603e-03                    True
1         may_td                -0.474425  1.469830e-04                    True
3        july_td                -0.579919  1.483556e-06                    True
2        june_td                -0.644929  3.523408e-08                    True
4      august_td                -0.658178  1.470237e-08                    True
0          const                      NaN           NaN                   False

Number of observations: 59

Regression Summary:
                                OLS Regression Results
================================================================================================
Dep. Variable:     annual mass balance (mm w.e.)   R-squared:                       0.703
Model:                                       OLS   Adj. R-squared:                  0.625
Method:                            Least Squares   F-statistic:                     9.065
Date:                           Mon, 08 Dec 2025   Prob (F-statistic):           1.40e-08
Time:                                   12:08:45   Log-Likelihood:                -438.92
No. Observations:                             59   AIC:                             903.8
Df Residuals:                                 46   BIC:                             930.9
Df Model:                                     12
Covariance Type:                       nonrobust
================================================================================
                   coef    std err          t      P>|t|      [0.025      0.975]
--------------------------------------------------------------------------------
const         -848.2916     69.883    -12.139      0.000    -988.959    -707.625
may_td         -38.2728     50.064     -0.764      0.448    -139.046      62.500
june_td        -89.3936     45.822     -1.951      0.057    -181.629       2.842
july_td       -145.8930     49.850     -2.927      0.005    -246.235     -45.551
august_td     -120.0130     61.355     -1.956      0.057    -243.515       3.489
september_td   -75.7921     47.156     -1.607      0.115    -170.713      19.129
october_pd       2.3180      2.186      1.060      0.295      -2.083       6.719
november_pd     -1.5704      1.698     -0.925      0.360      -4.988       1.847
december_pd      1.3308      1.522      0.874      0.386      -1.733       4.395
january_pd       3.3608      1.667      2.017      0.050       0.006       6.715
february_pd      2.8796      1.417      2.032      0.048       0.027       5.732
march_pd         1.7271      1.961      0.881      0.383      -2.219       5.674
april_pd         3.1540      2.942      1.072      0.289      -2.768       9.076
==============================================================================
Omnibus:                        1.577   Durbin-Watson:                   2.085
Prob(Omnibus):                  0.454   Jarque-Bera (JB):                1.584
Skew:                          -0.345   Prob(JB):                        0.453
Kurtosis:                       2.589   Cond. No.                         59.6
```

Regression: Optimal 1991-2020

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

================================================================================
OPTIMAL SEASONAL DEVIATIONS for Glacier du Giétro (1991-2020 norms)
================================================================================

Correlation Analysis with Significance Testing:
        Variable  Correlation Coefficient       P-value  Significant (p < 0.05)
2  opt_season_pd                 0.265071  4.246513e-02                    True
1  opt_season_td                -0.768057  1.255240e-12                    True
0          const                      NaN           NaN                   False

Number of observations: 59

Regression Summary:
                                OLS Regression Results
==============================================================================================
Dep. Variable:     annual mass balance (mm w.e.)   R-squared:                       0.613
Model:                                       OLS   Adj. R-squared:                  0.599
Method:                            Least Squares   F-statistic:                     44.30
Date:                           Mon, 08 Dec 2025   Prob (F-statistic):           2.91e-12
Time:                                   12:08:45   Log-Likelihood:                -446.73
No. Observations:                             59   AIC:                             899.5
Df Residuals:                                 56   BIC:                             905.7
Df Model:                                      2
Covariance Type:                       nonrobust
=====================================================================================
                    coef    std err          t      P>|t|      [0.025      0.975]
-------------------------------------------------------------------------------------
const          -852.7609     71.051    -12.002      0.000    -995.092    -710.429
opt_season_td  -448.0476     50.588     -8.857      0.000    -549.388    -346.707
opt_season_pd     1.4408      0.793      1.816      0.075      -0.148       3.030
==============================================================================
Omnibus:                        1.850   Durbin-Watson:                   2.024
Prob(Omnibus):                  0.396   Jarque-Bera (JB):                1.632
Skew:                          -0.402   Prob(JB):                        0.442
Kurtosis:                       2.871   Cond. No.                         99.0
==============================================================================

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

Coefficient Interpretation:
Intercept (normal mass balance): -852.76 (p=0.0000)
opt_season_td: -448.05 (p=0.0000)
opt_season_pd: 1.44 (p=0.0746)

Variance Inflation Factors (VIF):
        Variable       VIF
0          const  1.279578
1  opt_season_td  1.023234
2  opt_season_pd  1.023234

R-squared: 0.6127
Adjusted R-squared: 0.5989
```

Regression: Seasonal 1991-2020

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

================================================================================
SUMMER/WINTER SEASONAL DEVIATIONS for Glacier du Giétro (1991-2020 norms)
================================================================================

Correlation Analysis with Significance Testing:
    Variable  Correlation Coefficient       P-value  Significant (p < 0.05)
2  winter_pd                 0.303591  1.941328e-02                    True
1  summer_td                -0.769107  1.120325e-12                    True
0      const                      NaN           NaN                   False

Number of observations: 59

Regression Summary:
                                OLS Regression Results
==============================================================================================
Dep. Variable:     annual mass balance (mm w.e.)   R-squared:                       0.639
Model:                                       OLS   Adj. R-squared:                  0.626
Method:                            Least Squares   F-statistic:                     49.62
Date:                           Mon, 08 Dec 2025   Prob (F-statistic):           3.99e-13
Time:                                   12:08:45   Log-Likelihood:                -444.64
No. Observations:                             59   AIC:                             895.3
Df Residuals:                                 56   BIC:                             901.5
Df Model:                                      2
Covariance Type:                       nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const       -863.4615     68.764    -12.557      0.000   -1001.212    -725.711
summer_td   -482.6673     52.371     -9.216      0.000    -587.580    -377.755
winter_pd      1.8040      0.663      2.723      0.009       0.477       3.131
==============================================================================
Omnibus:                        2.461   Durbin-Watson:                   2.051
Prob(Omnibus):                  0.292   Jarque-Bera (JB):                2.309
Skew:                          -0.407   Prob(JB):                        0.315
Kurtosis:                       2.475   Cond. No.                         116.
==============================================================================

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

Coefficient Interpretation:
Intercept (normal mass balance): -863.46 (p=0.0000)
summer_td: -482.67 (p=0.0000)
winter_pd: 1.80 (p=0.0086)

Variance Inflation Factors (VIF):
    Variable       VIF
0      const  1.286778
1  summer_td  1.012792
2  winter_pd  1.012792

R-squared: 0.6393
Adjusted R-squared: 0.6264
```