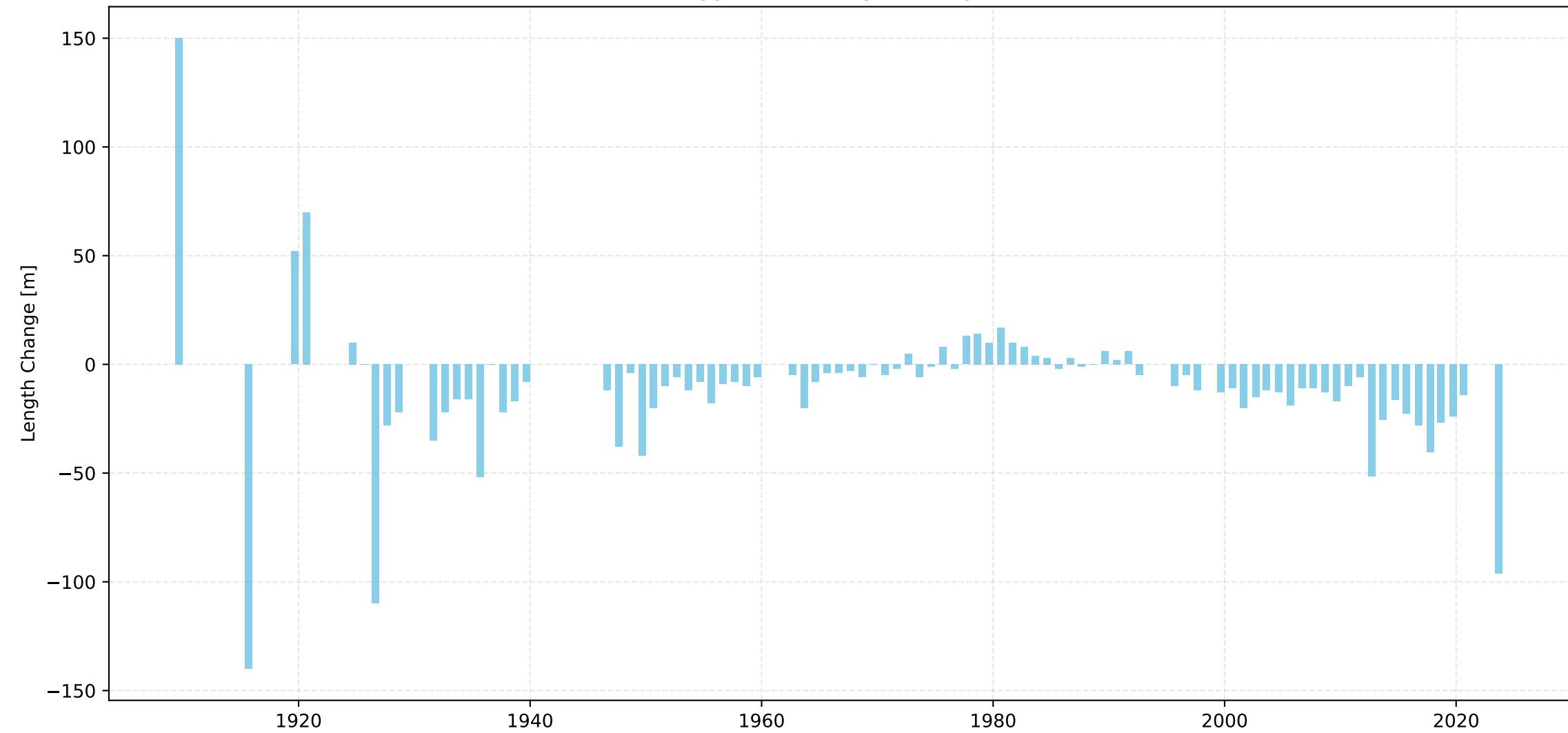
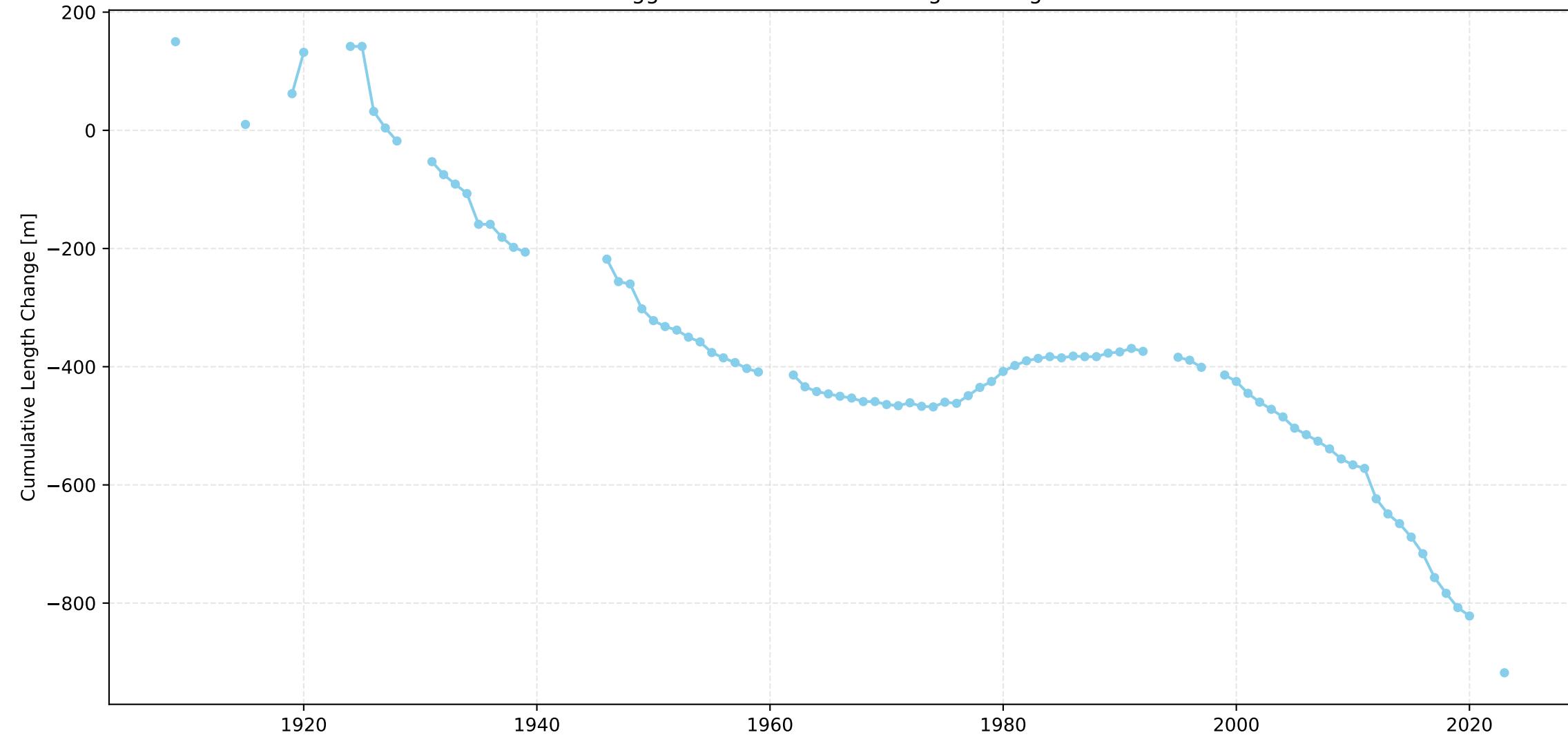


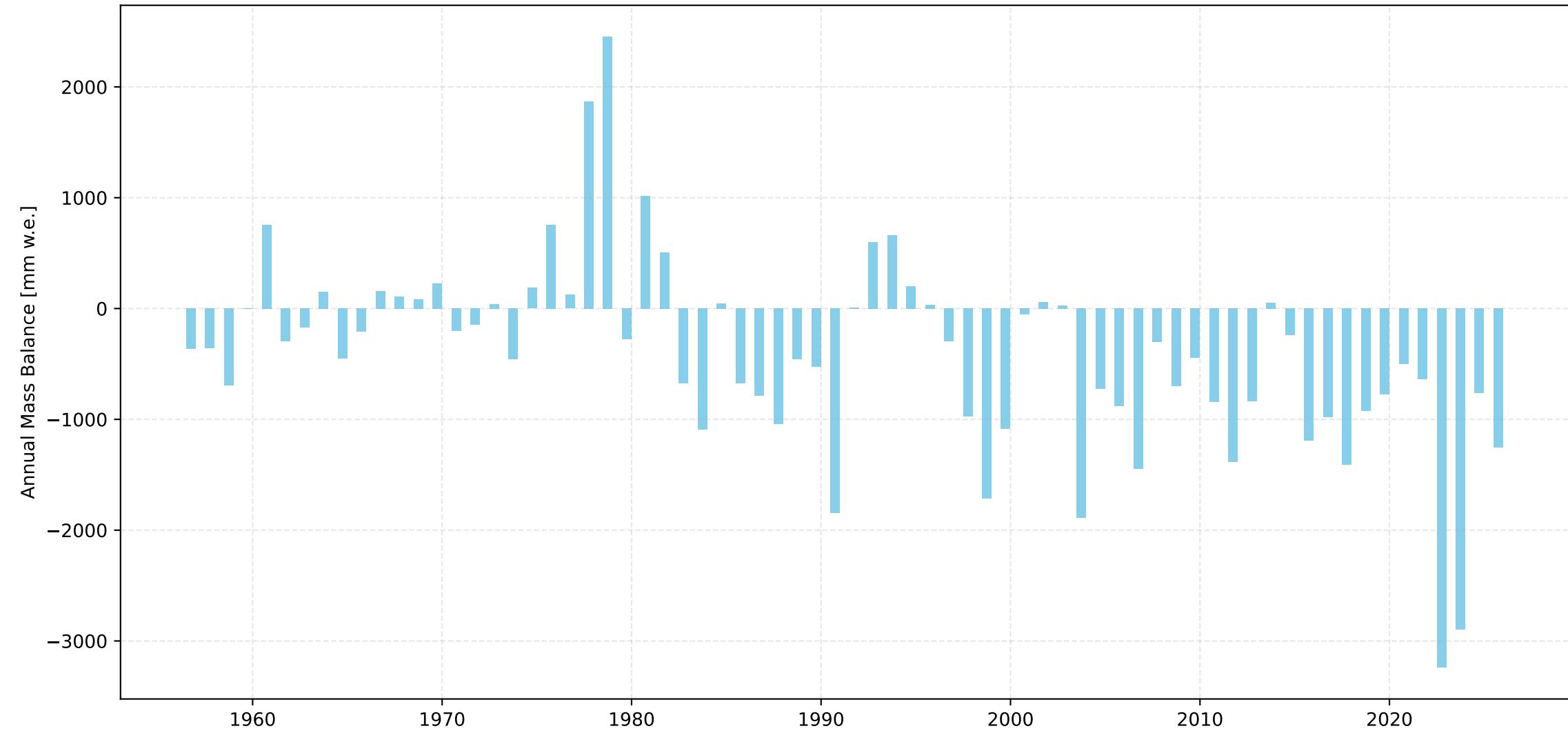
## Schwarzberggletscher Length Change Over Time



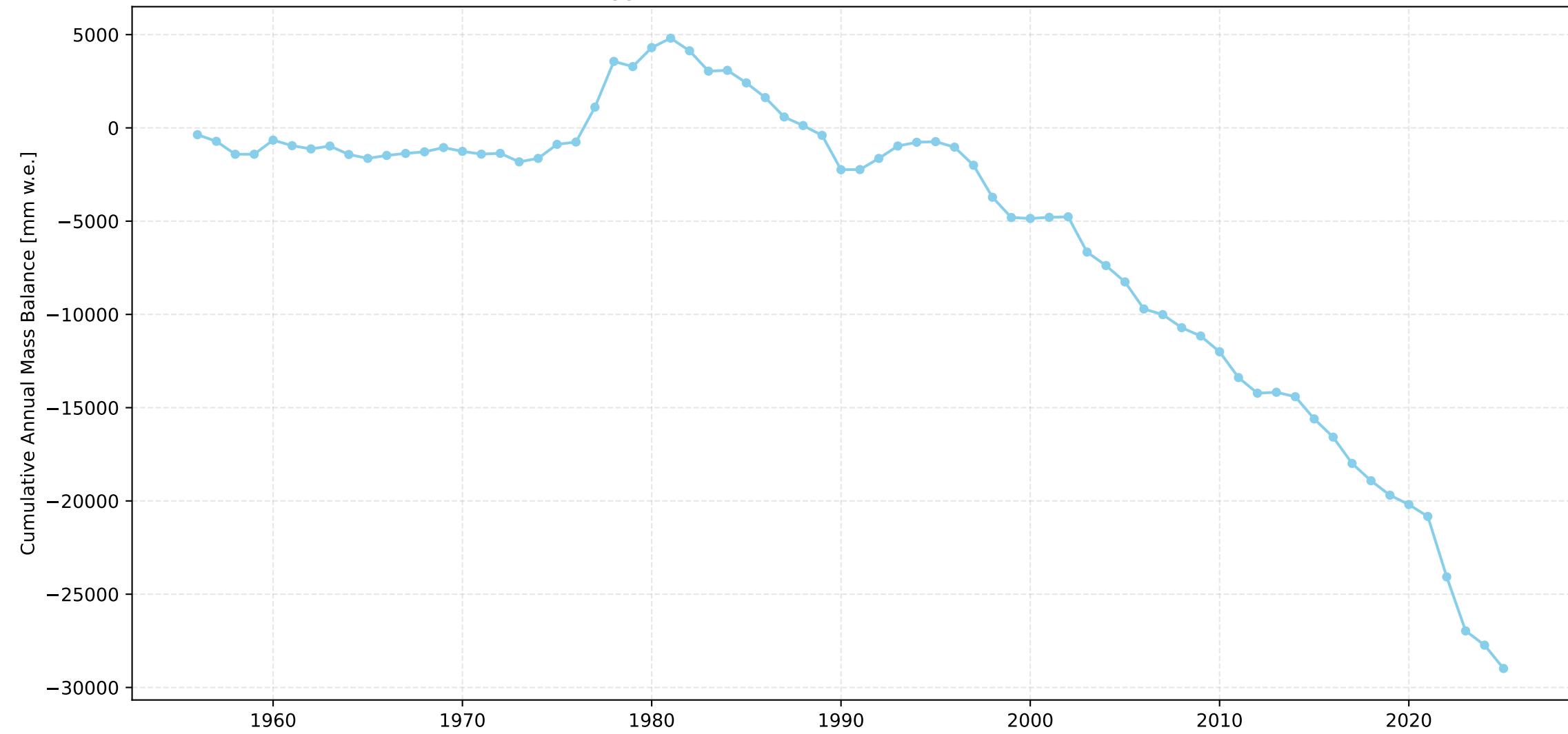
## Schwarzberggletscher Cumulative Length Change Over Time



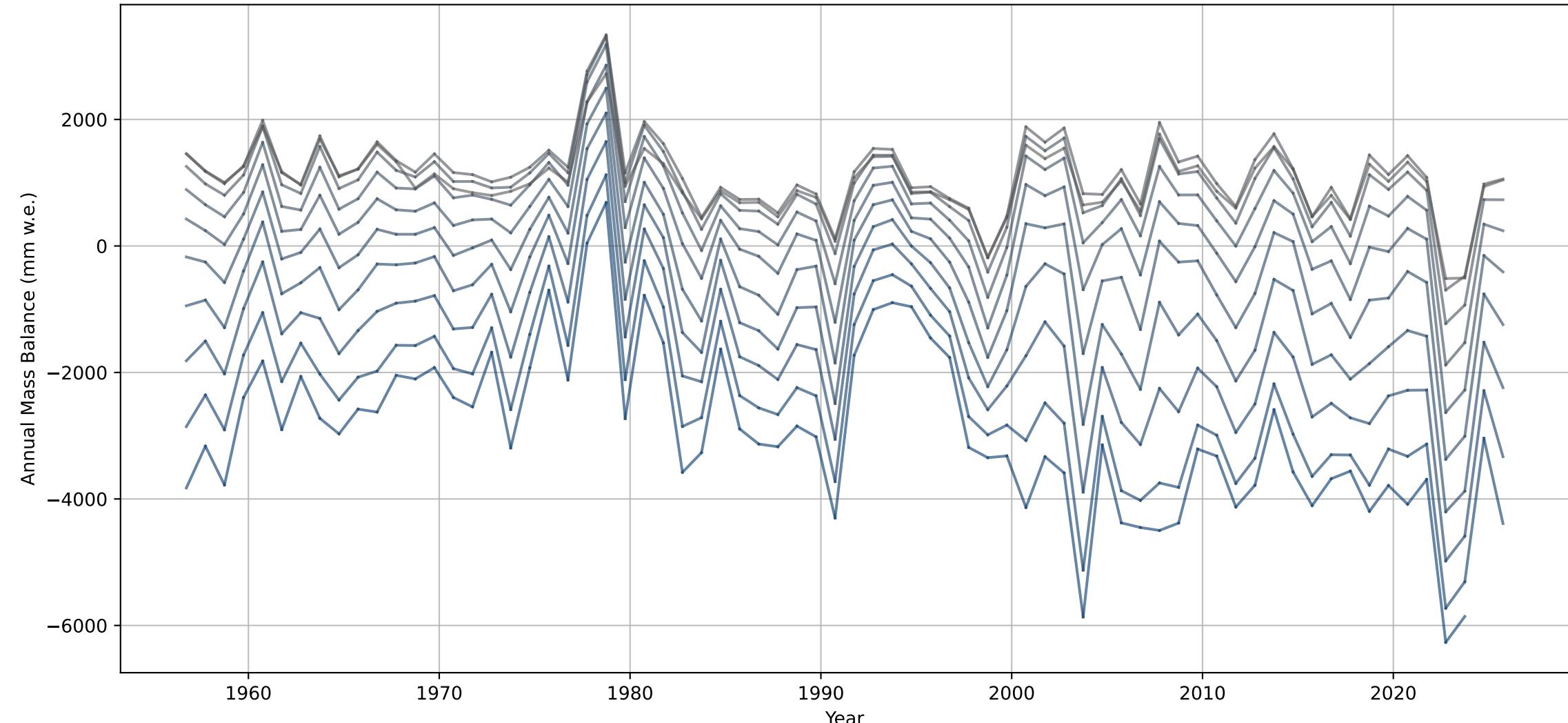
## Schwarzberggletscher Annual Mass Balance Over Time



## Schwarzberggletscher Cumulative Annual Mass Balance Over Time



# Annual Mass Balance for each Elevation Bin over Time - Schwarzberggletscher



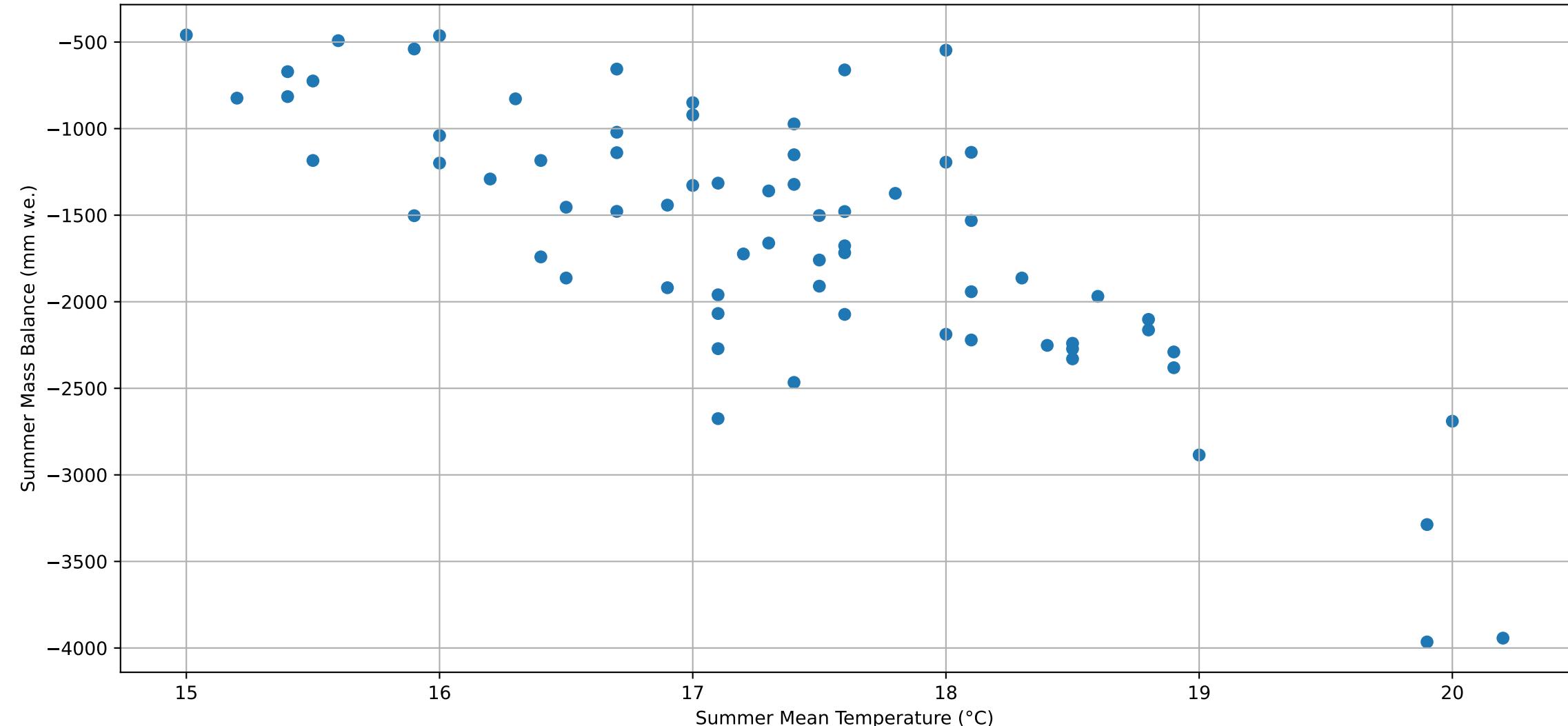
## Sion Summer Mean Temperature



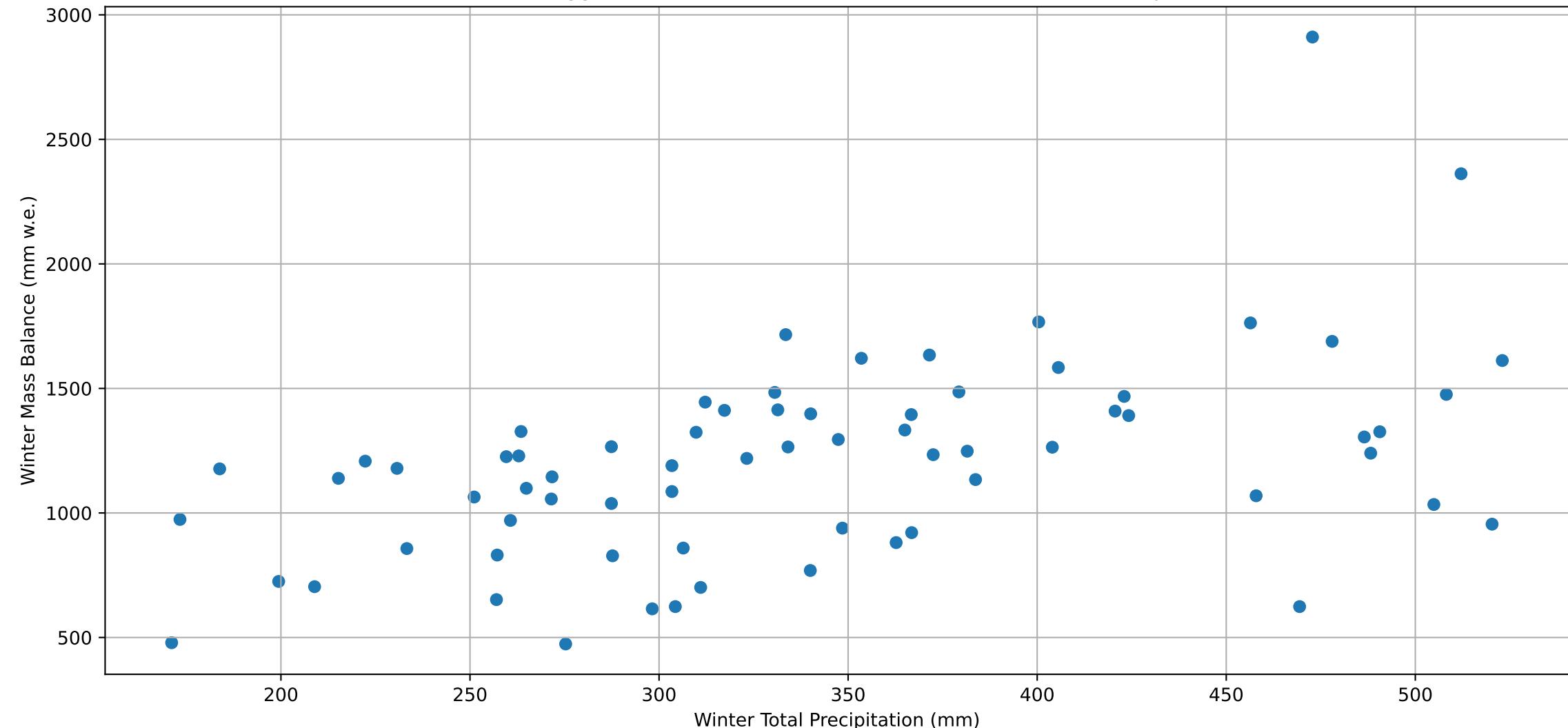
## Sion Winter Total Precipitation



### Schwarzberggletscher Summer Mass Balance with relation to Temperature



# Schwarzberggletscher Winter Mass Balance with relation to Precipitation



# Regression: Monthly 1961-1990

=====  
MONTHLY DEVIATIONS for Schwarzberggletscher using 1961-1990 climate norms  
=====

Correlation Analysis with Significance Testing:

Skipping constant column: const

|    | Variable     | Correlation Coefficient | P-value      | Significant (p < 0.05) |
|----|--------------|-------------------------|--------------|------------------------|
| 2  | july_td      | -0.570124               | 2.579128e-07 | True                   |
| 1  | june_td      | -0.544123               | 1.123852e-06 | True                   |
| 3  | august_td    | -0.517207               | 4.552076e-06 | True                   |
| 4  | september_td | -0.453572               | 8.035801e-05 | True                   |
| 0  | may_td       | -0.437913               | 1.499031e-04 | True                   |
| 5  | october_pd   | 0.136419                | 2.601277e-01 | False                  |
| 10 | march_pd     | 0.125403                | 3.009506e-01 | False                  |
| 6  | november_pd  | 0.122187                | 3.136170e-01 | False                  |
| 9  | february_pd  | 0.101011                | 4.053910e-01 | False                  |
| 7  | december_pd  | 0.070149                | 5.639044e-01 | False                  |
| 8  | january_pd   | 0.060120                | 6.210324e-01 | False                  |
| 11 | april_pd     | -0.053554               | 6.597125e-01 | False                  |

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:             | Thu, 11 Dec 2025              | Prob (F-statistic): | 3.05e-07 |
| Time:             | 23:54:17                      | 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.

# Regression: Optimal 1961-1990

```
=====
OPTIMAL SEASONAL DEVIATIONS for Schwarzberggletscher using 1961-1990 climate norms
=====
```

Correlation Analysis with Significance Testing:

Skipping constant column: const

|   | Variable      | Correlation Coefficient | P-value      | Significant (p < 0.05) |
|---|---------------|-------------------------|--------------|------------------------|
| 0 | opt_season_td | -0.673903               | 1.617824e-10 | True                   |
| 1 | opt_season_pd | 0.241944                | 4.360289e-02 | True                   |

Number of observations: 70

Regression Summary:

## OLS Regression Results

|                   |                               |                     |          |
|-------------------|-------------------------------|---------------------|----------|
| Dep. Variable:    | annual mass balance (mm w.e.) | R-squared:          | 0.484    |
| Model:            | OLS                           | Adj. R-squared:     | 0.469    |
| Method:           | Least Squares                 | F-statistic:        | 31.45    |
| Date:             | Thu, 11 Dec 2025              | Prob (F-statistic): | 2.34e-10 |
| Time:             | 23:54:17                      | Log-Likelihood:     | -550.54  |
| 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         | 37.4196   | 96.002  | 0.390  | 0.698 | -154.201 | 229.040  |
| opt_season_td | -452.9618 | 60.918  | -7.436 | 0.000 | -574.554 | -331.370 |
| opt_season_pd | 1.8855    | 0.954   | 1.975  | 0.052 | -0.020   | 3.791    |

|                |        |                   |       |
|----------------|--------|-------------------|-------|
| Omnibus:       | 0.847  | Durbin-Watson:    | 1.175 |
| Prob(Omnibus): | 0.655  | Jarque-Bera (JB): | 0.312 |
| Skew:          | -0.020 | Prob(JB):         | 0.856 |
| Kurtosis:      | 3.325  | Cond. No.         | 111.  |

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

# Regression: Seasonal 1961-1990

```
=====
SUMMER/WINTER SEASONAL DEVIATIONS for Schwarzberggletscher using 1961-1990 climate norms
=====
```

Correlation Analysis with Significance Testing:

Skipping constant column: const

| Variable    | Correlation Coefficient | P-value      | Significant (p < 0.05) |
|-------------|-------------------------|--------------|------------------------|
| 0 summer_td | -0.704085               | 1.048873e-11 | True                   |
| 1 winter_pd | 0.245330                | 4.065650e-02 | True                   |

Number of observations: 70

Regression Summary:

## OLS Regression Results

|                   |                               |                     |          |
|-------------------|-------------------------------|---------------------|----------|
| Dep. Variable:    | annual mass balance (mm w.e.) | R-squared:          | 0.537    |
| Model:            | OLS                           | Adj. R-squared:     | 0.523    |
| Method:           | Least Squares                 | F-statistic:        | 38.87    |
| Date:             | Thu, 11 Dec 2025              | Prob (F-statistic): | 6.23e-12 |
| Time:             | 23:54:17                      | Log-Likelihood:     | -546.76  |
| No. Observations: | 70                            | AIC:                | 1100.    |
| Df Residuals:     | 67                            | BIC:                | 1106.    |
| Df Model:         | 2                             |                     |          |
| Covariance Type:  | nonrobust                     |                     |          |

|           | coef      | std err | t      | P> t  | [0.025   | 0.975]   |
|-----------|-----------|---------|--------|-------|----------|----------|
| const     | 83.7591   | 92.237  | 0.908  | 0.367 | -100.347 | 267.865  |
| summer_td | -518.3643 | 62.394  | -8.308 | 0.000 | -642.904 | -393.825 |
| winter_pd | 1.9387    | 0.793   | 2.446  | 0.017 | 0.357    | 3.521    |

|                |        |                   |       |
|----------------|--------|-------------------|-------|
| Omnibus:       | 1.179  | Durbin-Watson:    | 1.253 |
| Prob(Omnibus): | 0.555  | Jarque-Bera (JB): | 0.579 |
| Skew:          | -0.128 | Prob(JB):         | 0.748 |
| Kurtosis:      | 3.364  | Cond. No.         | 132.  |

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

# Regression: Monthly 1991-2020

=====  
MONTHLY DEVIATIONS for Schwarzberggletscher using 1991-2020 climate norms  
=====

Correlation Analysis with Significance Testing:

Skipping constant column: const

|    | Variable     | Correlation Coefficient | P-value      | Significant (p < 0.05) |
|----|--------------|-------------------------|--------------|------------------------|
| 2  | july_td      | -0.570124               | 2.579128e-07 | True                   |
| 1  | june_td      | -0.544123               | 1.123852e-06 | True                   |
| 3  | august_td    | -0.517207               | 4.552076e-06 | True                   |
| 4  | september_td | -0.453572               | 8.035801e-05 | True                   |
| 0  | may_td       | -0.437913               | 1.499031e-04 | True                   |
| 5  | october_pd   | 0.136419                | 2.601277e-01 | False                  |
| 10 | march_pd     | 0.125403                | 3.009506e-01 | False                  |
| 6  | november_pd  | 0.122187                | 3.136170e-01 | False                  |
| 9  | february_pd  | 0.101011                | 4.053910e-01 | False                  |
| 7  | december_pd  | 0.070149                | 5.639044e-01 | False                  |
| 8  | january_pd   | 0.060120                | 6.210324e-01 | False                  |
| 11 | april_pd     | -0.053554               | 6.597125e-01 | False                  |

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:             | Thu, 11 Dec 2025              | Prob (F-statistic): | 3.05e-07 |
| Time:             | 23:54:17                      | 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.

# Regression: Optimal 1991-2020

```
=====
OPTIMAL SEASONAL DEVIATIONS for Schwarzberggletscher using 1991-2020 climate norms
=====
```

Correlation Analysis with Significance Testing:

Skipping constant column: const

|   | Variable      | Correlation Coefficient | P-value      | Significant (p < 0.05) |
|---|---------------|-------------------------|--------------|------------------------|
| 0 | opt_season_td | -0.676153               | 1.334027e-10 | True                   |
| 1 | opt_season_pd | 0.241944                | 4.360289e-02 | True                   |

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:        | 31.59    |
| Date:             | Thu, 11 Dec 2025              | Prob (F-statistic): | 2.17e-10 |
| Time:             | 23:54:17                      | 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         | -822.2518 | 92.603  | -8.879 | 0.000 | -1007.088 | -637.415 |
| opt_season_td | -457.0050 | 61.315  | -7.453 | 0.000 | -579.390  | -334.620 |
| opt_season_pd | 1.8258    | 0.954   | 1.913  | 0.060 | -0.079    | 3.731    |

|                |        |                   |       |
|----------------|--------|-------------------|-------|
| Omnibus:       | 0.687  | Durbin-Watson:    | 1.161 |
| Prob(Omnibus): | 0.709  | Jarque-Bera (JB): | 0.208 |
| Skew:          | -0.004 | Prob(JB):         | 0.901 |
| Kurtosis:      | 3.267  | Cond. No.         | 107.  |

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

# Regression: Seasonal 1991-2020

```
=====
SUMMER/WINTER SEASONAL DEVIATIONS for Schwarzberggletscher using 1991-2020 climate norms
=====
```

Correlation Analysis with Significance Testing:

Skipping constant column: const

| Variable    | Correlation Coefficient | P-value      | Significant (p < 0.05) |
|-------------|-------------------------|--------------|------------------------|
| 0 summer_td | -0.702701               | 1.198032e-11 | True                   |
| 1 winter_pd | 0.245330                | 4.065650e-02 | True                   |

Number of observations: 70

Regression Summary:

## OLS Regression Results

|                   |                               |                     |          |
|-------------------|-------------------------------|---------------------|----------|
| Dep. Variable:    | annual mass balance (mm w.e.) | R-squared:          | 0.534    |
| Model:            | OLS                           | Adj. R-squared:     | 0.520    |
| Method:           | Least Squares                 | F-statistic:        | 38.40    |
| Date:             | Thu, 11 Dec 2025              | Prob (F-statistic): | 7.75e-12 |
| Time:             | 23:54:17                      | Log-Likelihood:     | -546.99  |
| 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     | -842.3214 | 88.023  | -9.569 | 0.000 | -1018.016 | -666.627 |
| summer_td | -516.2801 | 62.546  | -8.254 | 0.000 | -641.122  | -391.439 |
| winter_pd | 1.9136    | 0.795   | 2.406  | 0.019 | 0.326     | 3.501    |

|                |        |                   |       |
|----------------|--------|-------------------|-------|
| Omnibus:       | 1.147  | Durbin-Watson:    | 1.229 |
| Prob(Omnibus): | 0.564  | Jarque-Bera (JB): | 0.548 |
| Skew:          | -0.105 | Prob(JB):         | 0.760 |
| Kurtosis:      | 3.379  | Cond. No.         | 124.  |

Notes:

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