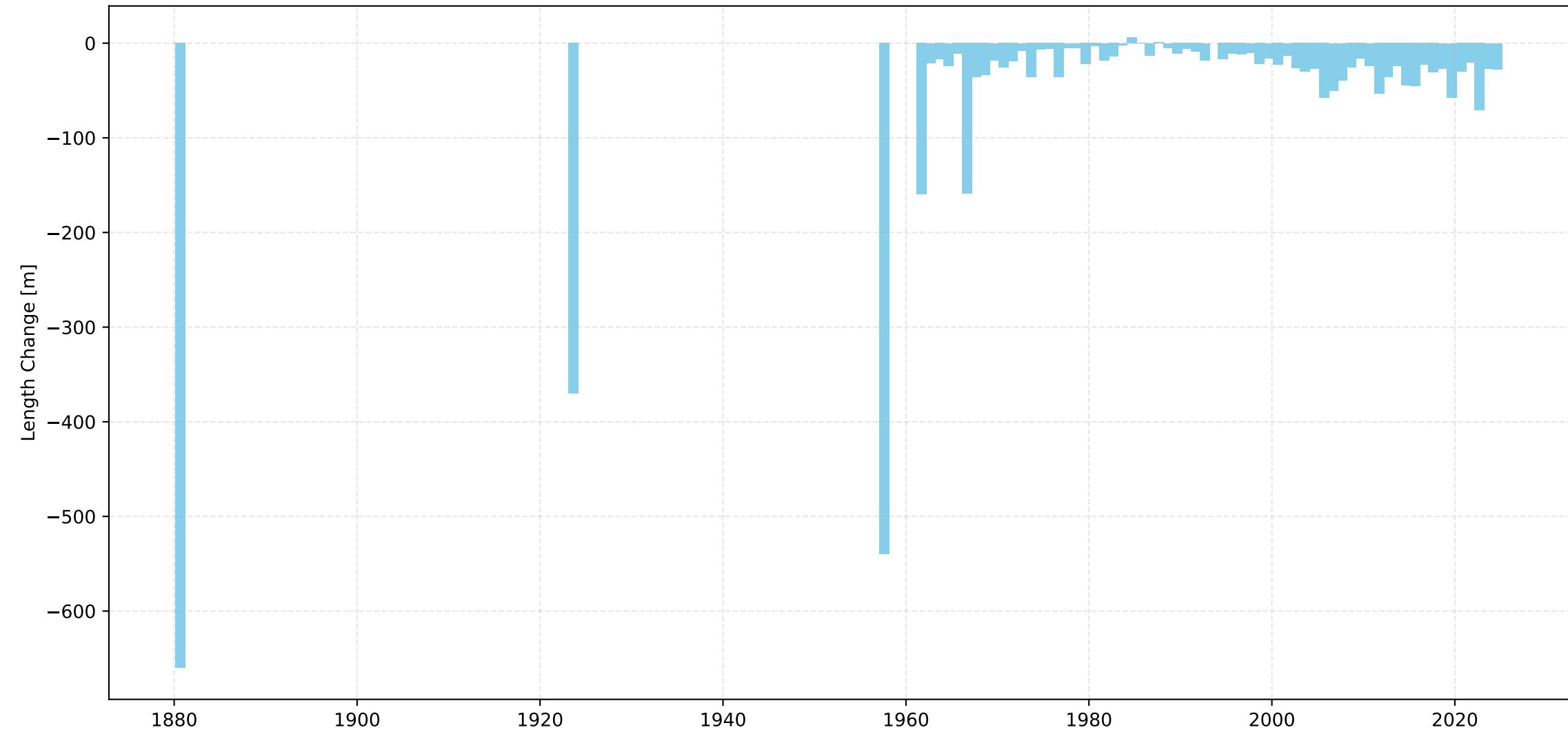
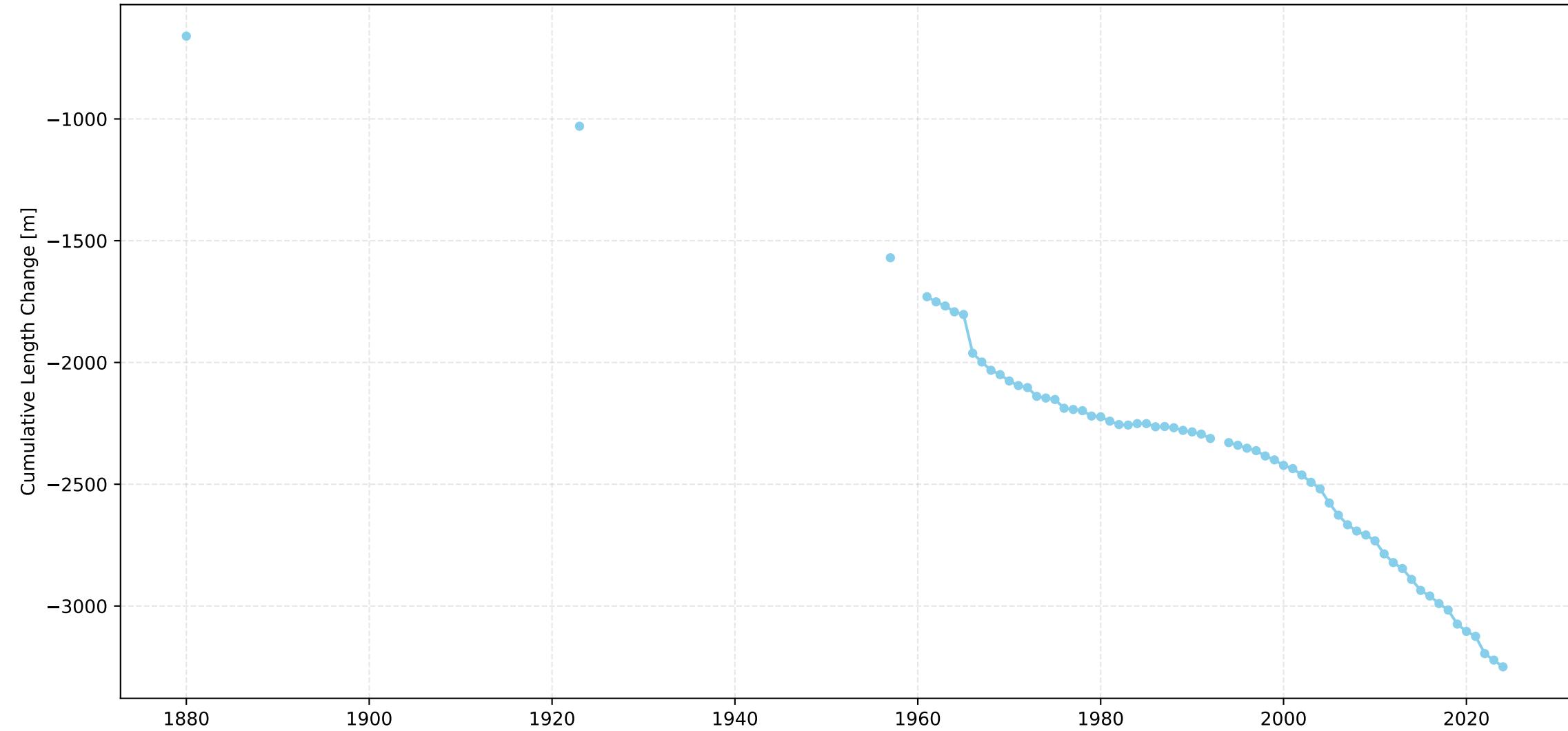


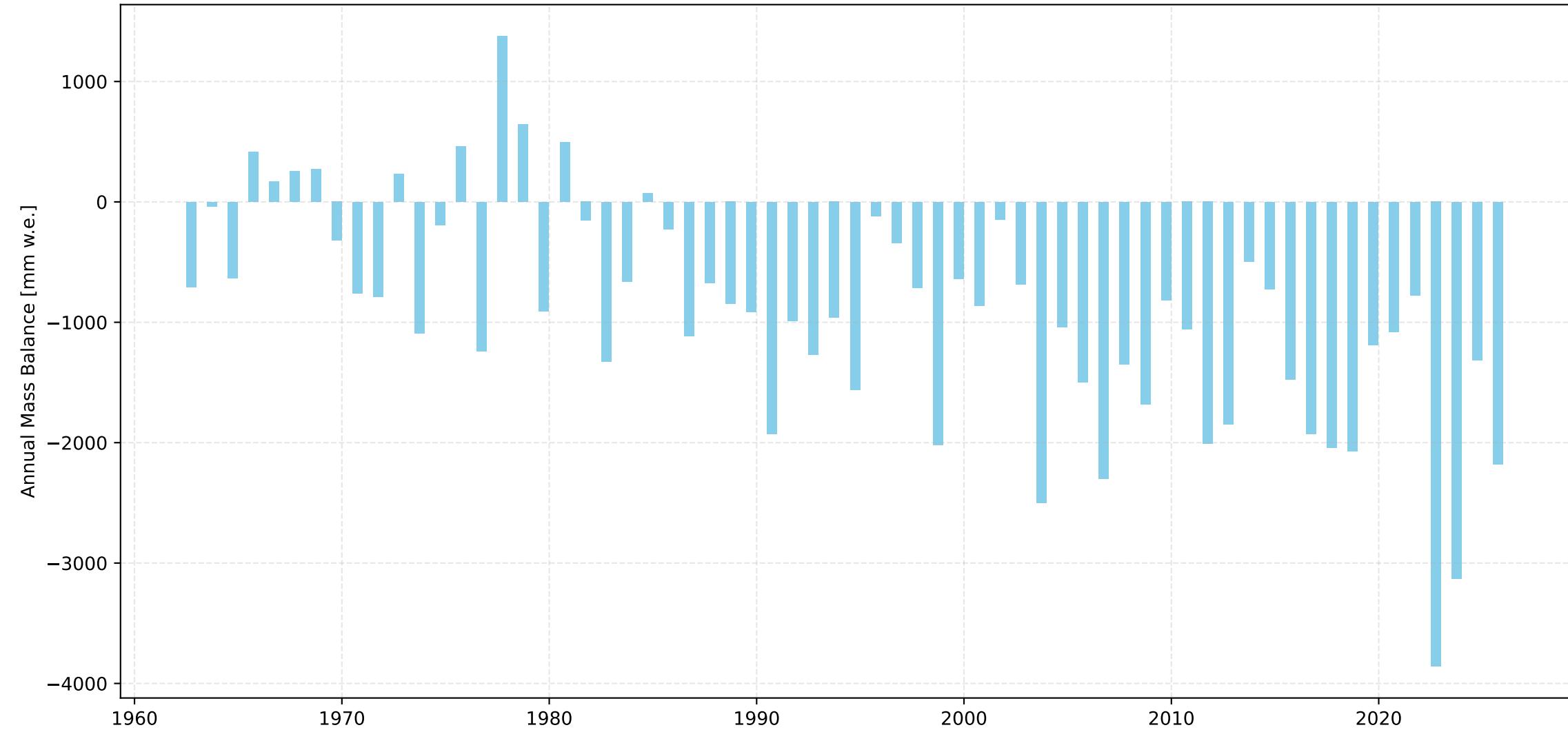
## Griesgletscher Length Change Over Time



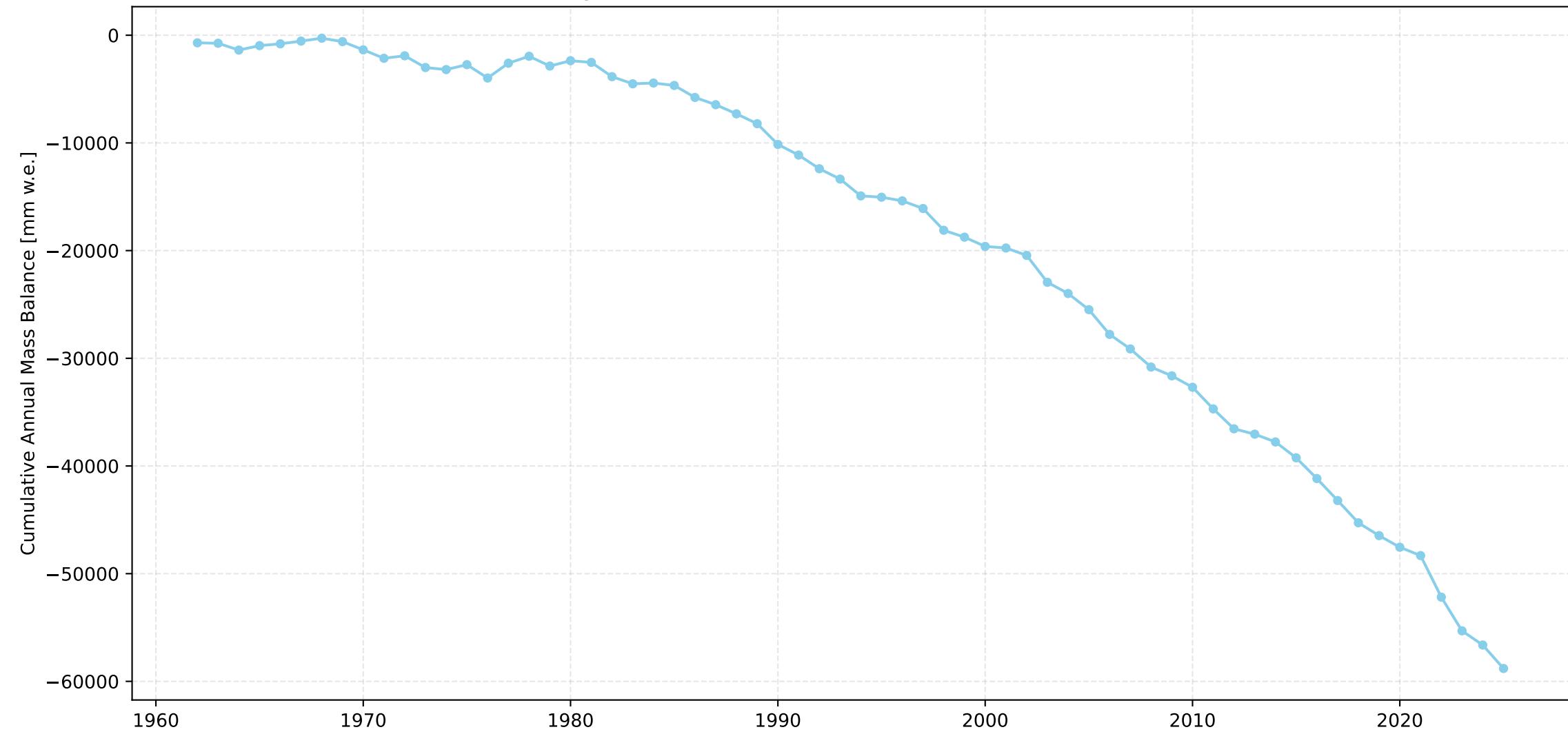
## Griesgletscher Cumulative Length Change Over Time



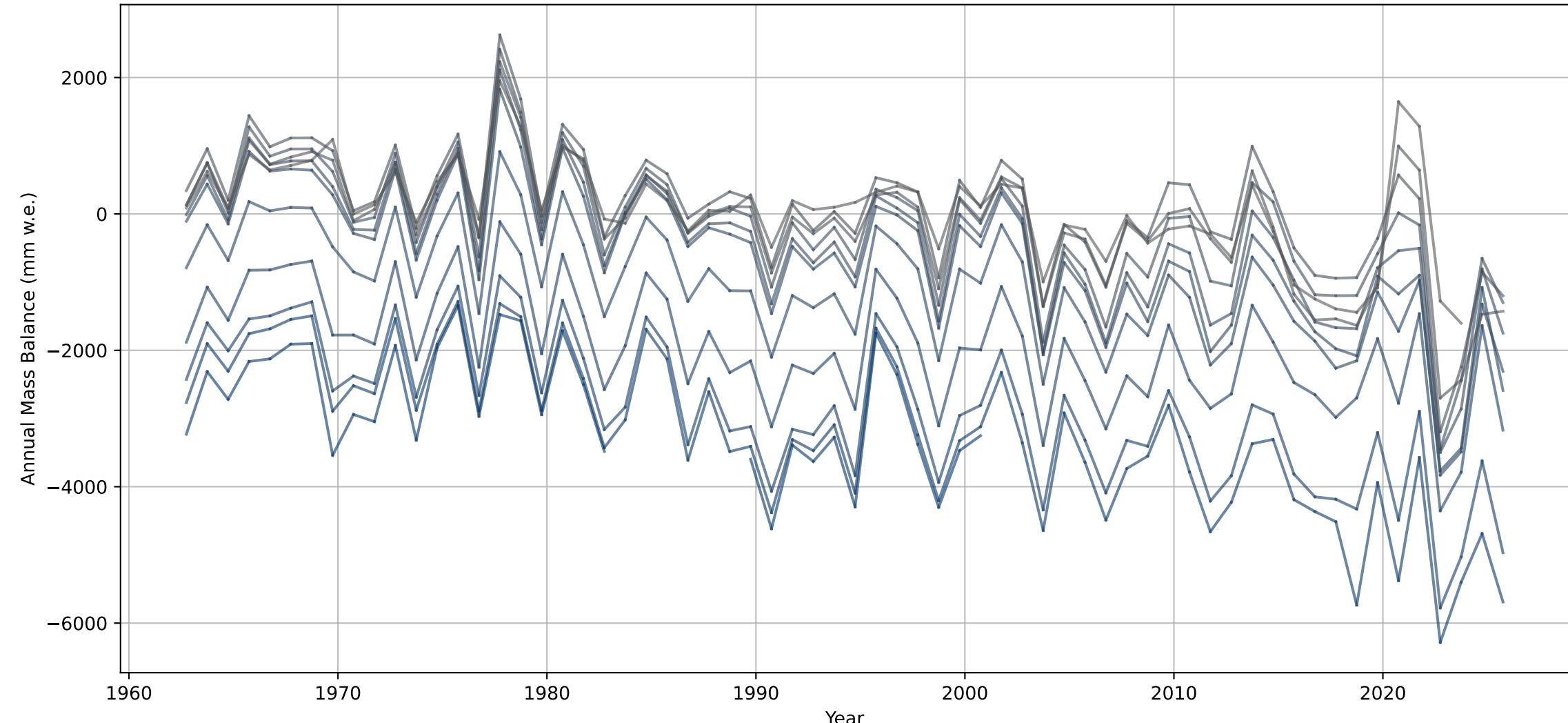
## Griesgletscher Annual Mass Balance Over Time



## Griesgletscher Cumulative Annual Mass Balance Over Time



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



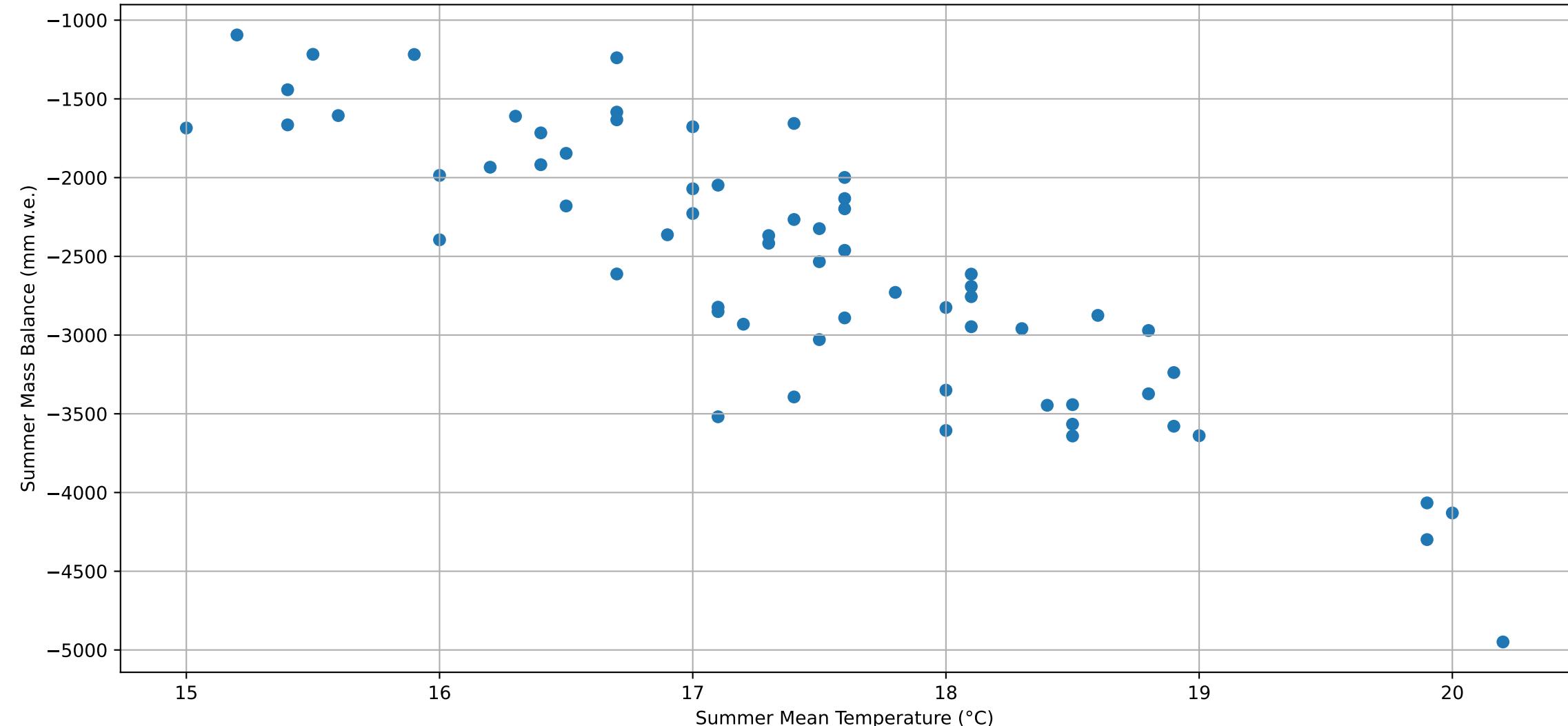
## Sion Summer Mean Temperature



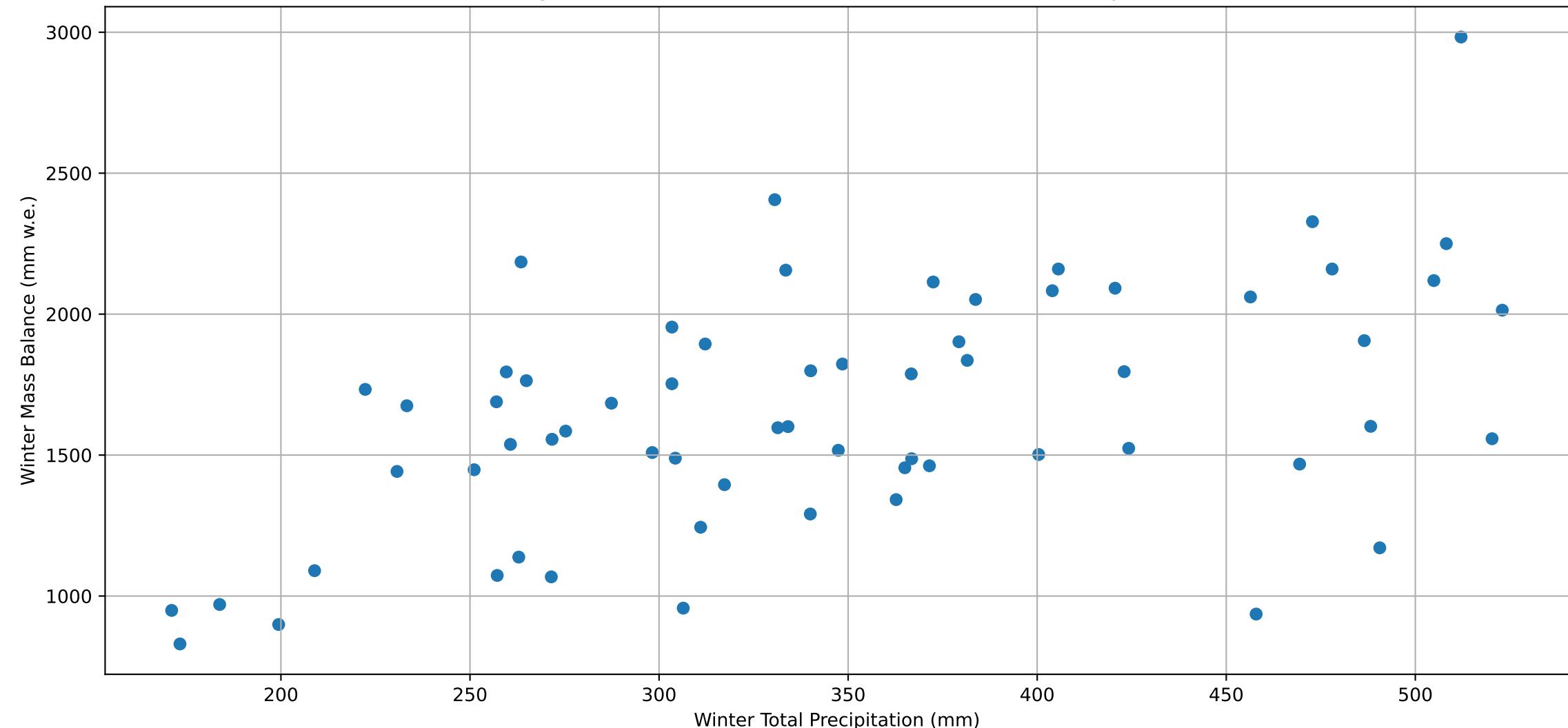
## Sion Winter Total Precipitation



### Griesgletscher Summer Mass Balance with relation to Temperature



### Griesgletscher Winter Mass Balance with relation to Precipitation



# Regression: Monthly 1961-1990

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

Correlation Analysis with Significance Testing:

Skipping constant column: const

	Variable	Correlation Coefficient	P-value	Significant (p < 0.05)
1	june_td	-0.698060	1.443175e-10	True
3	august_td	-0.655278	4.221977e-09	True
0	may_td	-0.625149	3.351914e-08	True
2	july_td	-0.616048	6.005828e-08	True
4	september_td	-0.508344	1.799456e-05	True
9	february_pd	0.192294	1.279396e-01	False
6	november_pd	0.156378	2.172118e-01	False
5	october_pd	0.140020	2.697968e-01	False
10	march_pd	0.131427	3.005778e-01	False
8	january_pd	0.085564	5.014223e-01	False
11	april_pd	-0.075242	5.545815e-01	False
7	december_pd	-0.068362	5.914439e-01	False

Number of observations: 64

Regression Summary:

## OLS Regression Results

Dep. Variable:	annual mass balance (mm w.e.)	R-squared:	0.773
Model:	OLS	Adj. R-squared:	0.719
Method:	Least Squares	F-statistic:	14.46
Date:	Wed, 17 Dec 2025	Prob (F-statistic):	1.74e-12
Time:	20:25:19	Log-Likelihood:	-480.43
No. Observations:	64	AIC:	986.9
Df Residuals:	51	BIC:	1015.
Df Model:	12		
Covariance Type:	nonrobust		

	coef	std err	t	P> t	[0.025	0.975]
const	-253.5128	80.999	-3.130	0.003	-416.125	-90.901
may_td	-152.9150	51.327	-2.979	0.004	-255.957	-49.873
june_td	-142.2344	47.185	-3.014	0.004	-236.963	-47.506
july_td	-106.0656	49.078	-2.161	0.035	-204.593	-7.538
august_td	-148.2455	58.751	-2.523	0.015	-266.194	-30.297
september_td	-119.6194	47.846	-2.500	0.016	-215.674	-23.565
october_pd	2.3939	2.245	1.066	0.291	-2.113	6.900
november_pd	3.3629	1.687	1.994	0.052	-0.023	6.749
december_pd	1.1490	1.424	0.807	0.424	-1.710	4.008
january_pd	2.1679	1.700	1.275	0.208	-1.245	5.581
february_pd	0.2412	1.452	0.166	0.869	-2.673	3.156
march_pd	-0.1632	1.979	-0.082	0.935	-4.137	3.811
april_pd	0.8314	3.074	0.270	0.788	-5.341	7.004

Omnibus:	0.563	Durbin-Watson:	1.566
Prob(Omnibus):	0.755	Jarque-Bera (JB):	0.705
Skew:	0.160	Prob(JB):	0.703
Kurtosis:	2.597	Cond. No.	65.0

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

# Regression: Optimal 1961-1990

```
=====
OPTIMAL SEASONAL DEVIATIONS for Griesgletscher 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	-0.842259	2.741200e-18	True
1	opt_season_pd	0.237420	5.888798e-02	False

Number of observations: 64

Regression Summary:

## OLS Regression Results

Dep. Variable:	annual mass balance (mm w.e.)	R-squared:	0.726
Model:	OLS	Adj. R-squared:	0.717
Method:	Least Squares	F-statistic:	80.84
Date:	Wed, 17 Dec 2025	Prob (F-statistic):	7.04e-18
Time:	20:25:19	Log-Likelihood:	-486.43
No. Observations:	64	AIC:	978.9
Df Residuals:	61	BIC:	985.3
Df Model:	2		
Covariance Type:	nonrobust		

	coef	std err	t	P> t	[0.025	0.975]
const	-274.3677	80.189	-3.422	0.001	-434.715	-114.020
opt_season_td	-602.0175	49.297	-12.212	0.000	-700.593	-503.442
opt_season_pd	1.4376	0.746	1.927	0.059	-0.054	2.930

Omnibus:	0.547	Durbin-Watson:	1.614
Prob(Omnibus):	0.761	Jarque-Bera (JB):	0.597
Skew:	-0.208	Prob(JB):	0.742
Kurtosis:	2.773	Cond. No.	119.

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

# Regression: Seasonal 1961-1990

```
=====
SUMMER/WINTER SEASONAL DEVIATIONS for Griesgletscher 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	-0.855394	2.273303e-19	True
1 winter_pd	0.240352	5.574003e-02	False

Number of observations: 64

Regression Summary:

## OLS Regression Results

Dep. Variable:	annual mass balance (mm w.e.)	R-squared:	0.753
Model:	OLS	Adj. R-squared:	0.745
Method:	Least Squares	F-statistic:	93.11
Date:	Wed, 17 Dec 2025	Prob (F-statistic):	2.91e-19
Time:	20:25:19	Log-Likelihood:	-483.09
No. Observations:	64	AIC:	972.2
Df Residuals:	61	BIC:	978.6
Df Model:	2		
Covariance Type:	nonrobust		

	coef	std err	t	P> t	[0.025	0.975]
const	-262.7624	75.959	-3.459	0.001	-414.651	-110.874
summer_td	-659.9391	50.330	-13.112	0.000	-760.580	-559.298
winter_pd	1.4463	0.627	2.308	0.024	0.193	2.699

Omnibus:	0.715	Durbin-Watson:	1.725
Prob(Omnibus):	0.699	Jarque-Bera (JB):	0.563
Skew:	-0.227	Prob(JB):	0.755
Kurtosis:	2.934	Cond. No.	137.

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

# Regression: Monthly 1991-2020

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

Correlation Analysis with Significance Testing:

Skipping constant column: const

	Variable	Correlation Coefficient	P-value	Significant (p < 0.05)
1	june_td	-0.698060	1.443175e-10	True
3	august_td	-0.655278	4.221977e-09	True
0	may_td	-0.625149	3.351914e-08	True
2	july_td	-0.616048	6.005828e-08	True
4	september_td	-0.508344	1.799456e-05	True
9	february_pd	0.192294	1.279396e-01	False
6	november_pd	0.156378	2.172118e-01	False
5	october_pd	0.140020	2.697968e-01	False
10	march_pd	0.131427	3.005778e-01	False
8	january_pd	0.085564	5.014223e-01	False
11	april_pd	-0.075242	5.545815e-01	False
7	december_pd	-0.068362	5.914439e-01	False

Number of observations: 64

Regression Summary:

## OLS Regression Results

Dep. Variable:	annual mass balance (mm w.e.)	R-squared:	0.773
Model:	OLS	Adj. R-squared:	0.719
Method:	Least Squares	F-statistic:	14.46
Date:	Wed, 17 Dec 2025	Prob (F-statistic):	1.74e-12
Time:	20:25:19	Log-Likelihood:	-480.43
No. Observations:	64	AIC:	986.9
Df Residuals:	51	BIC:	1015.
Df Model:	12		
Covariance Type:	nonrobust		

	coef	std err	t	P> t	[0.025	0.975]
const	-1418.2957	73.361	-19.333	0.000	-1565.574	-1271.017
may_td	-152.9150	51.327	-2.979	0.004	-255.957	-49.873
june_td	-142.2344	47.185	-3.014	0.004	-236.963	-47.506
july_td	-106.0656	49.078	-2.161	0.035	-204.593	-7.538
august_td	-148.2455	58.751	-2.523	0.015	-266.194	-30.297
september_td	-119.6194	47.846	-2.500	0.016	-215.674	-23.565
october_pd	2.3939	2.245	1.066	0.291	-2.113	6.900
november_pd	3.3629	1.687	1.994	0.052	-0.023	6.749
december_pd	1.1490	1.424	0.807	0.424	-1.710	4.008
january_pd	2.1679	1.700	1.275	0.208	-1.245	5.581
february_pd	0.2412	1.452	0.166	0.869	-2.673	3.156
march_pd	-0.1632	1.979	-0.082	0.935	-4.137	3.811
april_pd	0.8314	3.074	0.270	0.788	-5.341	7.004

Omnibus:	0.563	Durbin-Watson:	1.566
Prob(Omnibus):	0.755	Jarque-Bera (JB):	0.705
Skew:	0.160	Prob(JB):	0.703
Kurtosis:	2.597	Cond. No.	57.9

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

# Regression: Optimal 1991-2020

```
=====
OPTIMAL SEASONAL DEVIATIONS for Griesgletscher 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	-0.844729	1.747008e-18	True
1	opt_season_pd	0.237420	5.888798e-02	False

Number of observations: 64

Regression Summary:

OLS Regression Results

Dep. Variable:	annual mass balance (mm w.e.)	R-squared:	0.728
Model:	OLS	Adj. R-squared:	0.719
Method:	Least Squares	F-statistic:	81.73
Date:	Wed, 17 Dec 2025	Prob (F-statistic):	5.53e-18
Time:	20:25:19	Log-Likelihood:	-486.17
No. Observations:	64	AIC:	978.3
Df Residuals:	61	BIC:	984.8
Df Model:	2		
Covariance Type:	nonrobust		

	coef	std err	t	P> t	[0.025	0.975]
const	-1387.5375	71.772	-19.333	0.000	-1531.054	-1244.021
opt_season_td	-608.4661	49.547	-12.281	0.000	-707.542	-509.391
opt_season_pd	1.3504	0.744	1.815	0.074	-0.137	2.838

Omnibus:	0.389	Durbin-Watson:	1.612
Prob(Omnibus):	0.823	Jarque-Bera (JB):	0.461
Skew:	-0.175	Prob(JB):	0.794
Kurtosis:	2.774	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 Griesgletscher 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	-0.860874	7.474647e-20	True
1 winter_pd	0.240352	5.574003e-02	False

Number of observations: 64

Regression Summary:

## OLS Regression Results

```
=====
Dep. Variable: annual mass balance (mm w.e.) R-squared: 0.761
Model: OLS Adj. R-squared: 0.753
Method: Least Squares F-statistic: 97.21
Date: Wed, 17 Dec 2025 Prob (F-statistic): 1.07e-19
Time: 20:25:19 Log-Likelihood: -482.04
No. Observations: 64 AIC: 970.1
Df Residuals: 61 BIC: 976.6
Df Model: 2
Covariance Type: nonrobust
=====
```

	coef	std err	t	P> t	[0.025	0.975]
const	-1402.5838	67.574	-20.756	0.000	-1537.707	-1267.460
summer_td	-664.4016	49.568	-13.404	0.000	-763.518	-565.285
winter_pd	1.3968	0.617	2.264	0.027	0.163	2.630

```
=====
Omnibus: 0.605 Durbin-Watson: 1.692
Prob(Omnibus): 0.739 Jarque-Bera (JB): 0.494
Skew: -0.211 Prob(JB): 0.781
Kurtosis: 2.912 Cond. No. 124.
=====
```

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