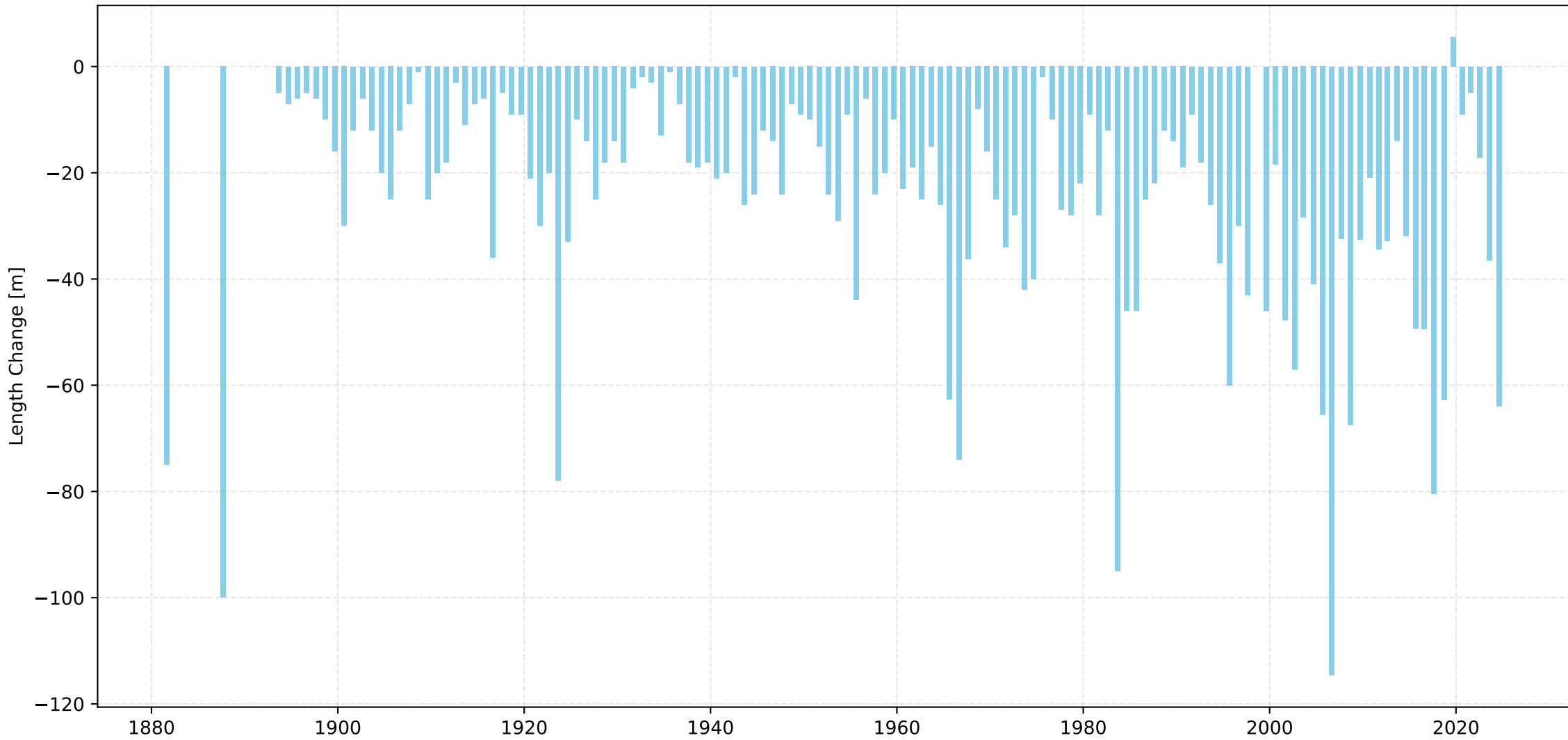
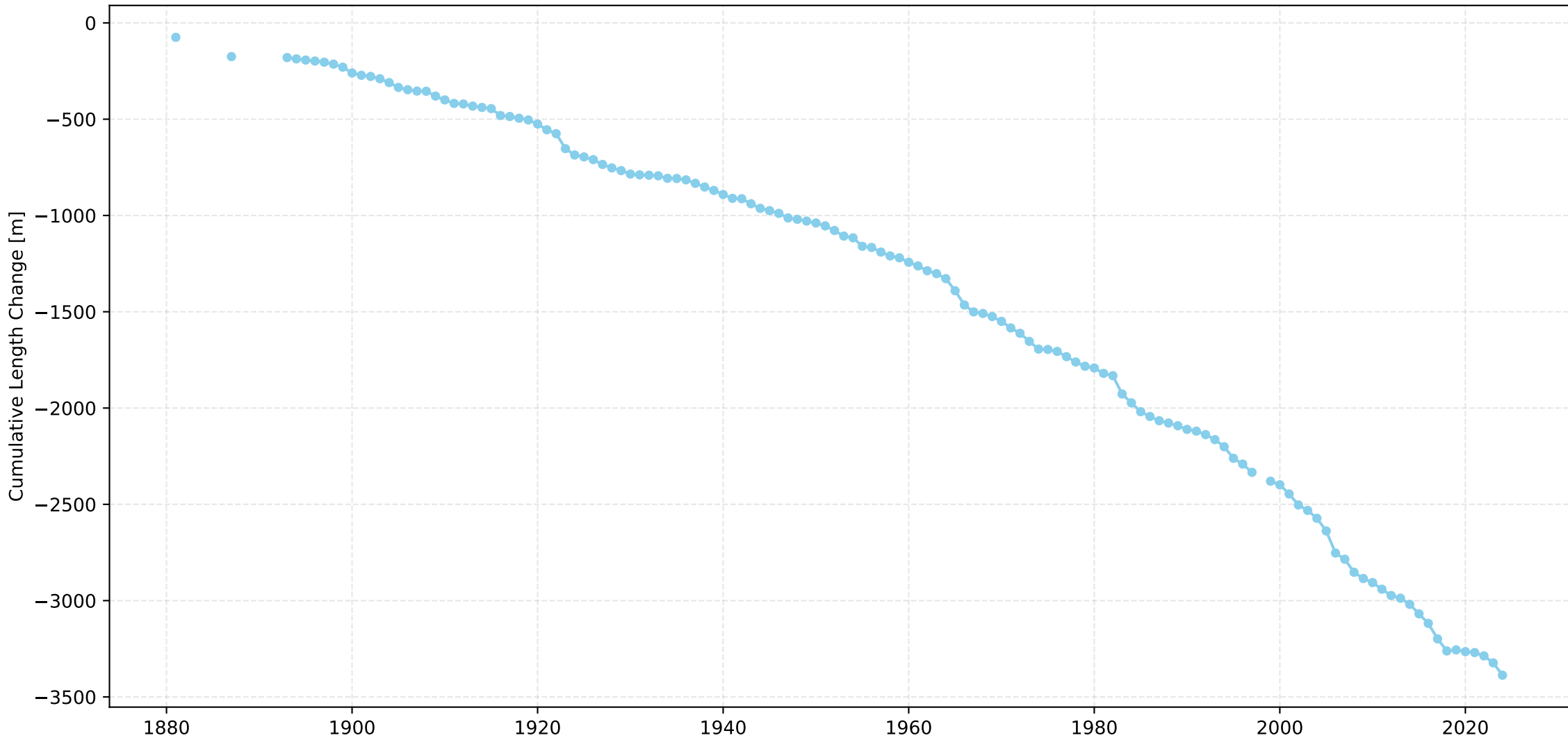


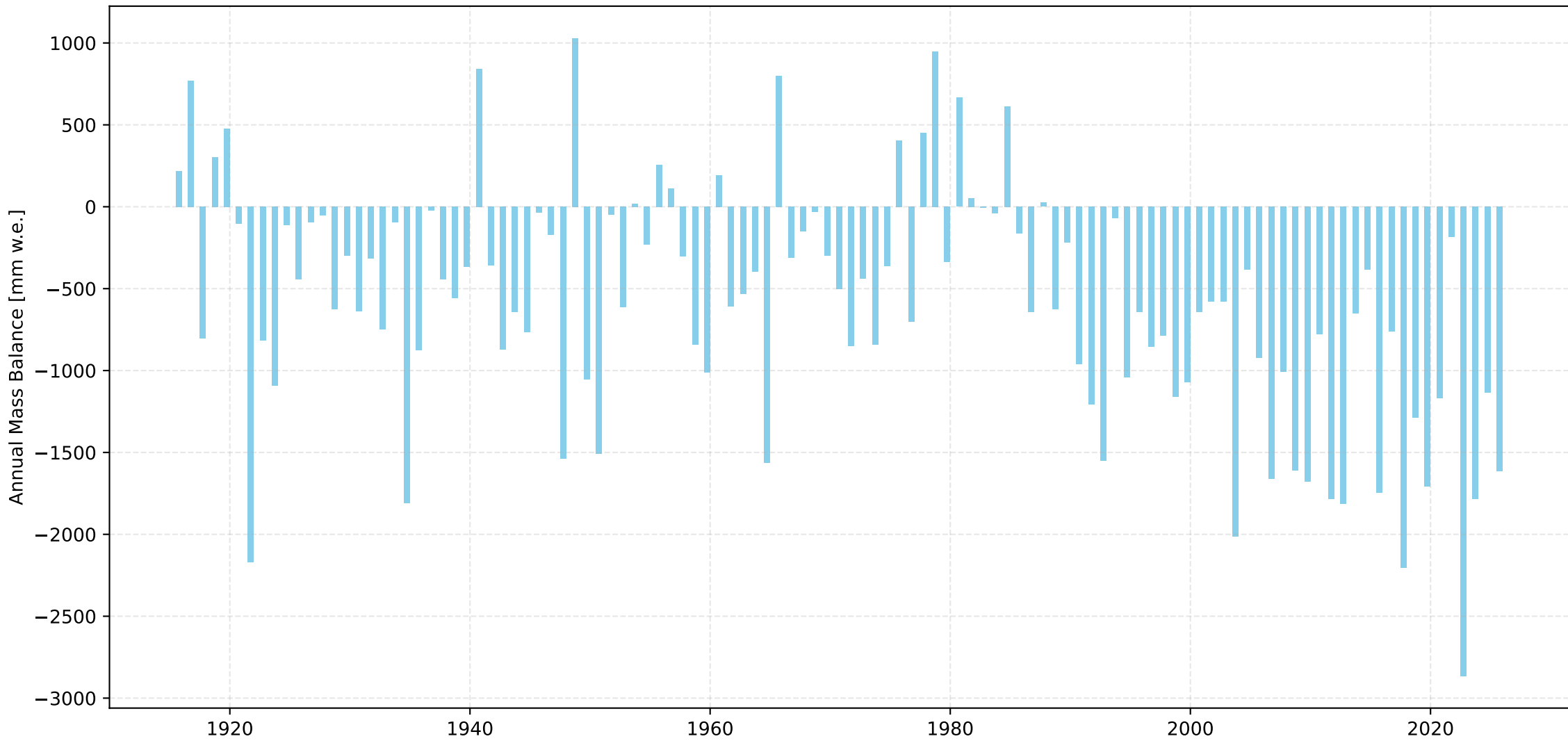
Grosser Aletschgletscher Length Change Over Time



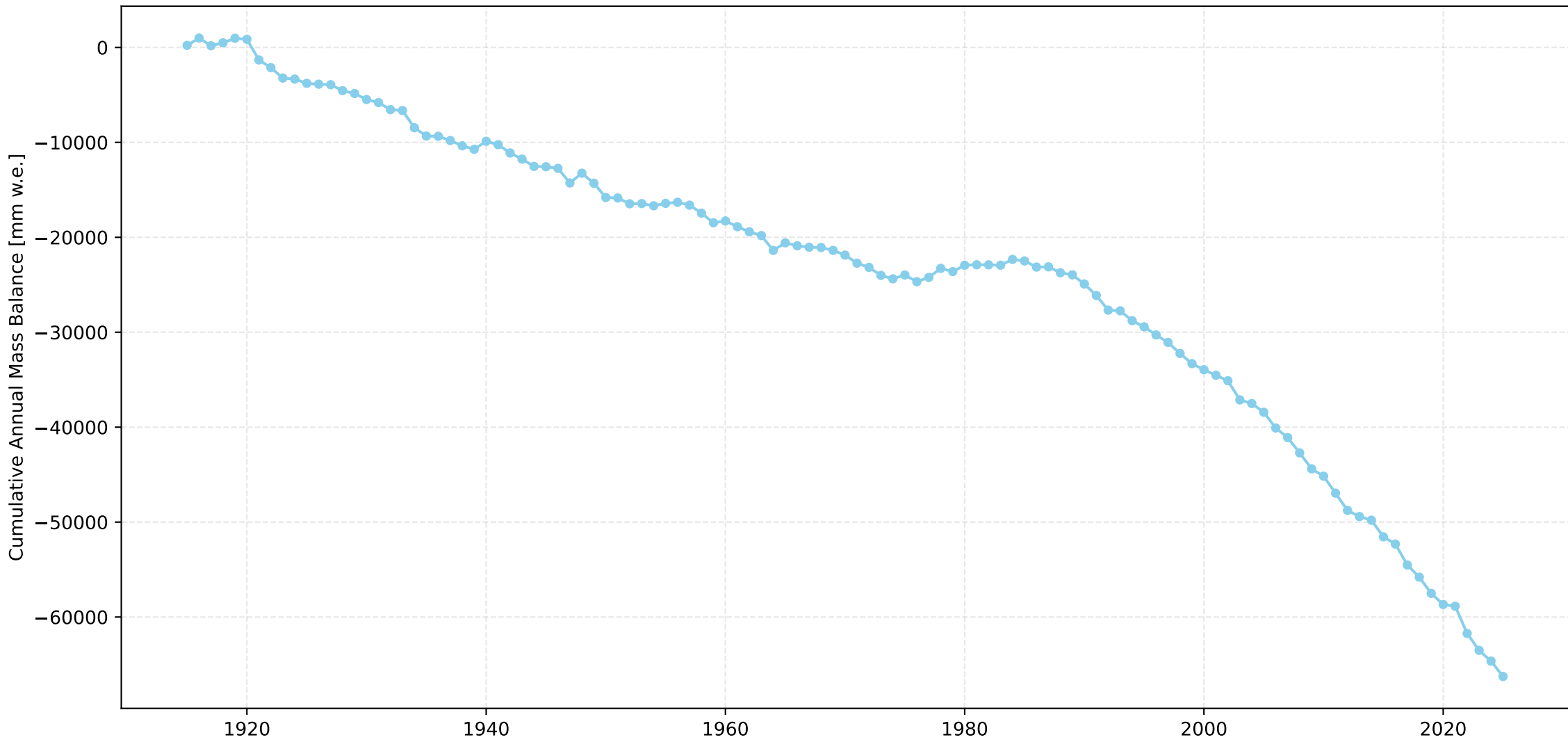
Grosser Aletschgletscher Cumulative Length Change Over Time



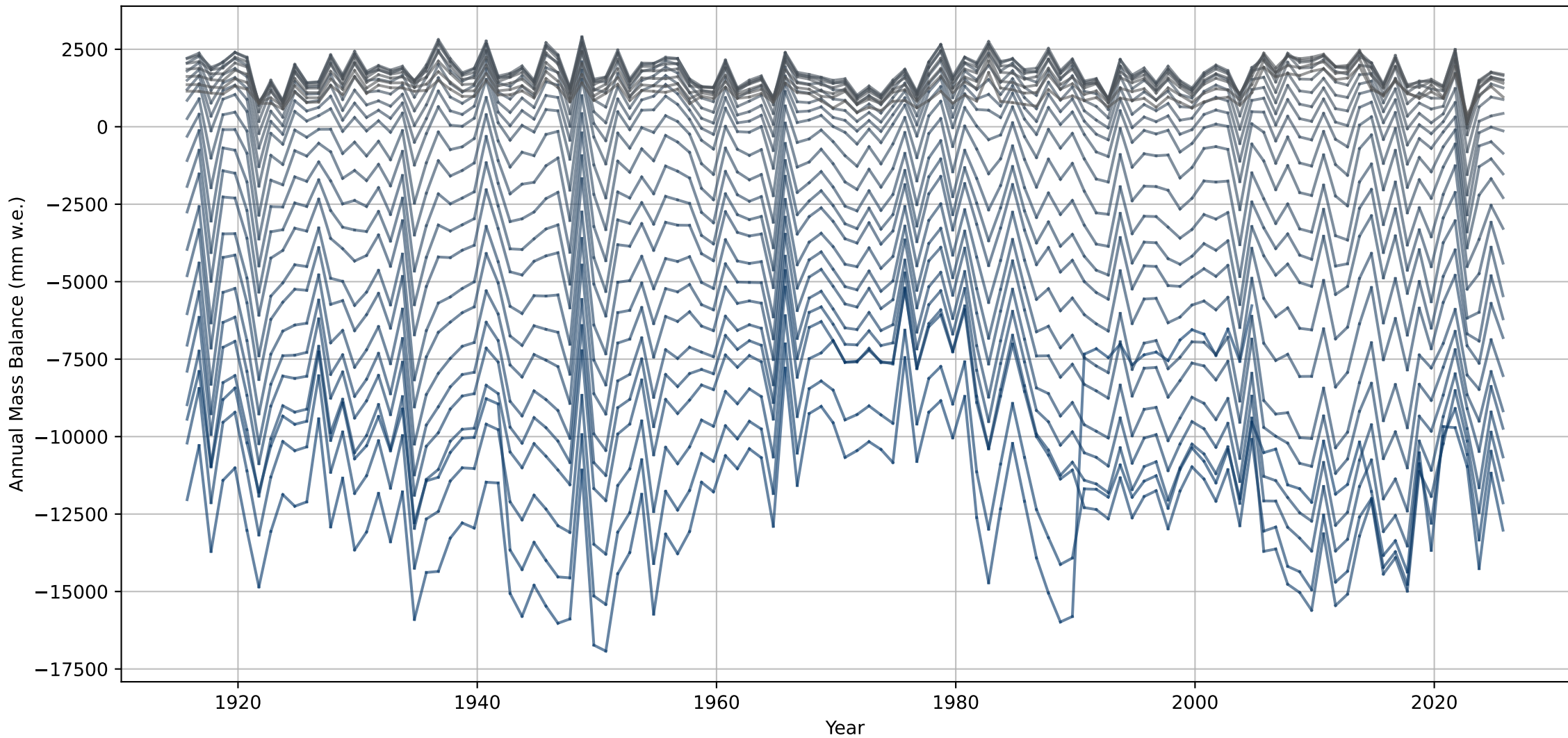
Grosser Aletschgletscher Annual Mass Balance Over Time



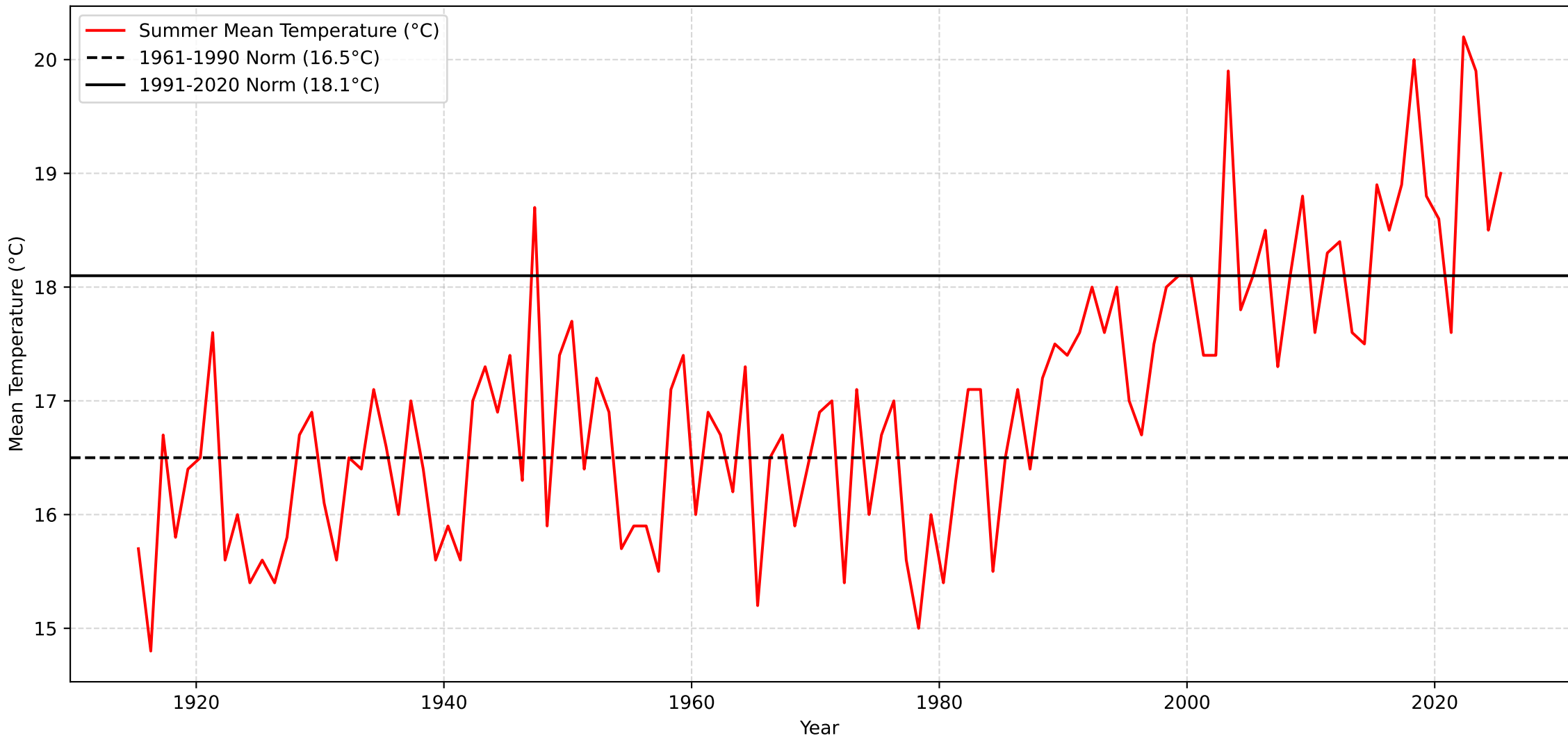
Grosser Aletschgletscher Cumulative Annual Mass Balance Over Time



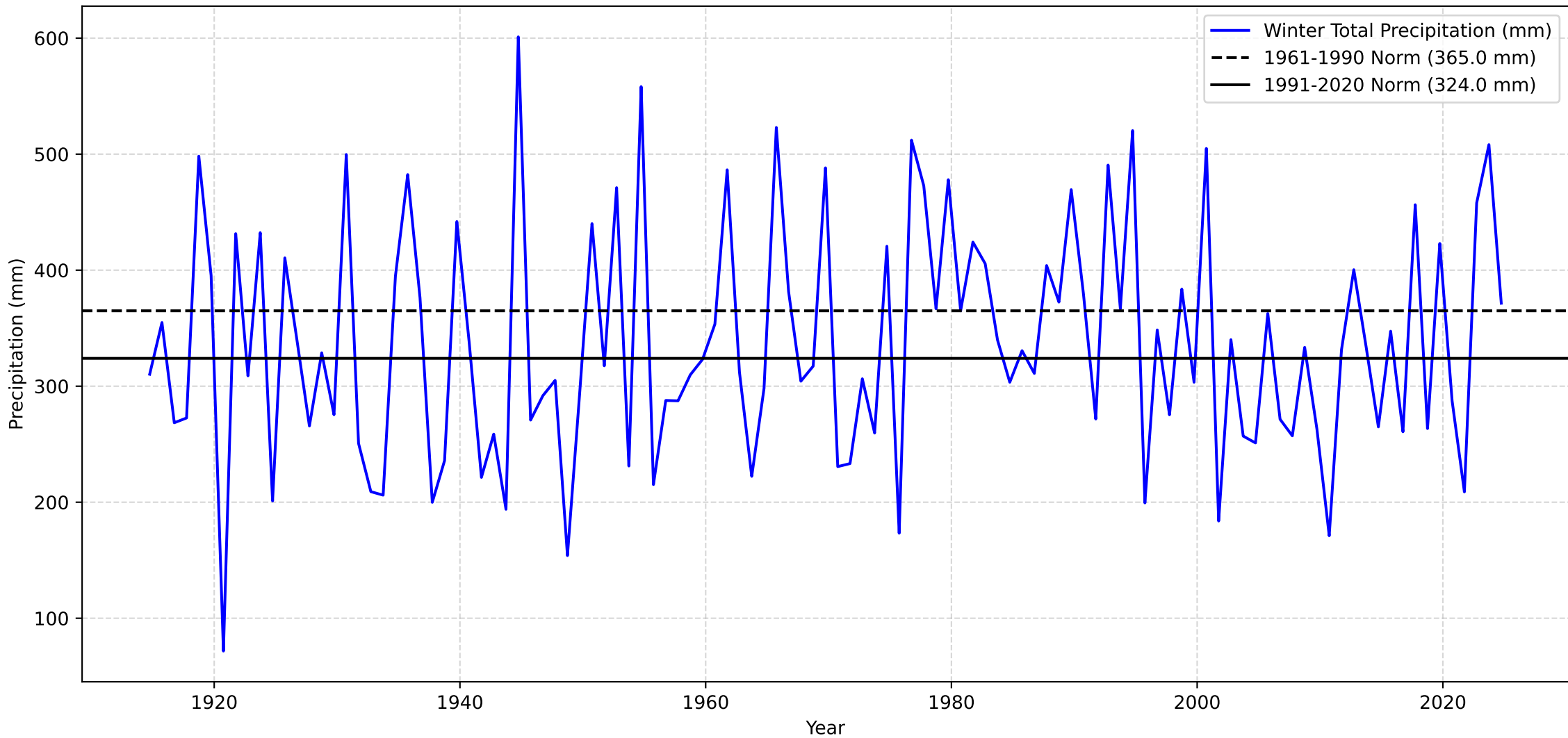
Annual Mass Balance for each Elevation Bin over Time - Grosser Aletschgletscher



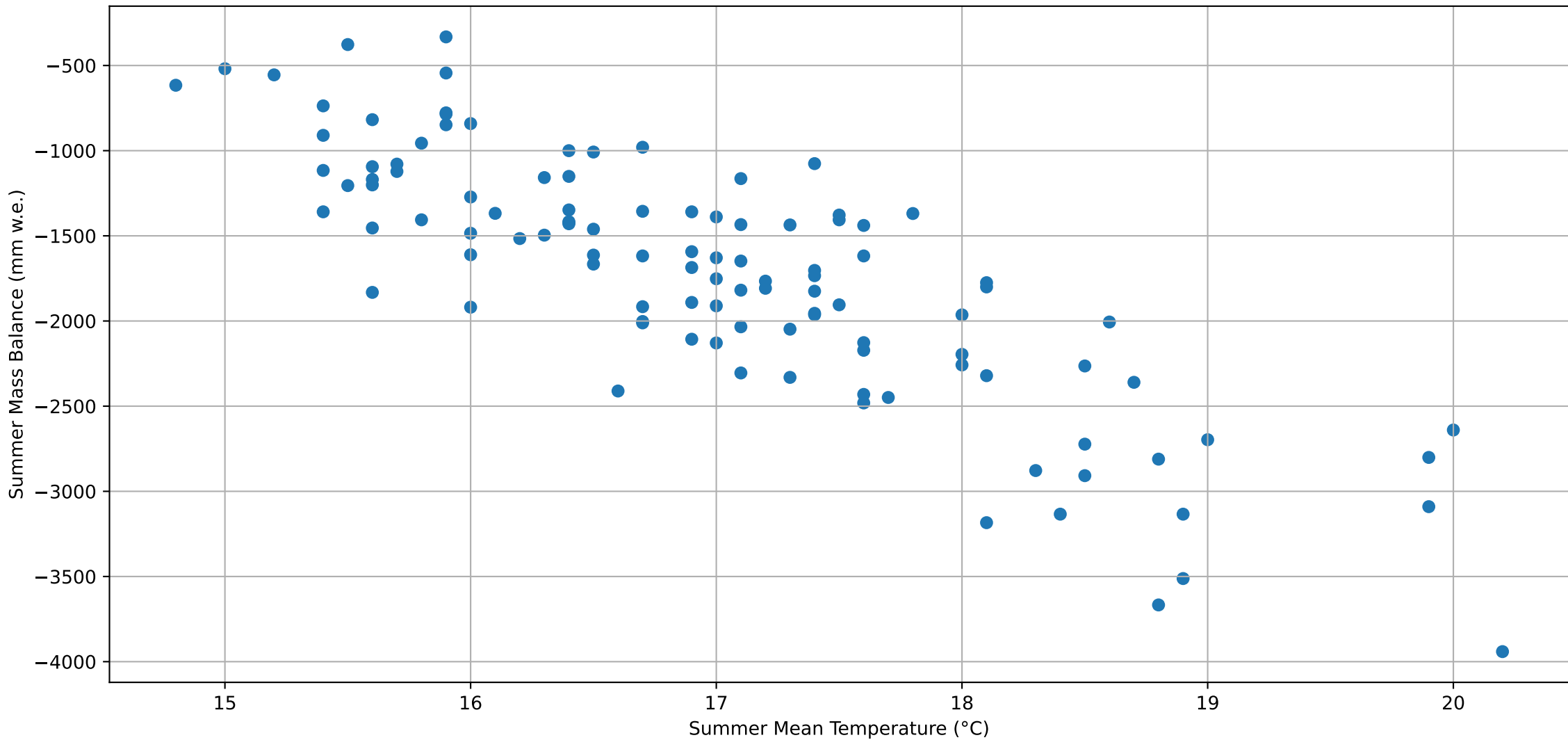
Sion Summer Mean Temperature



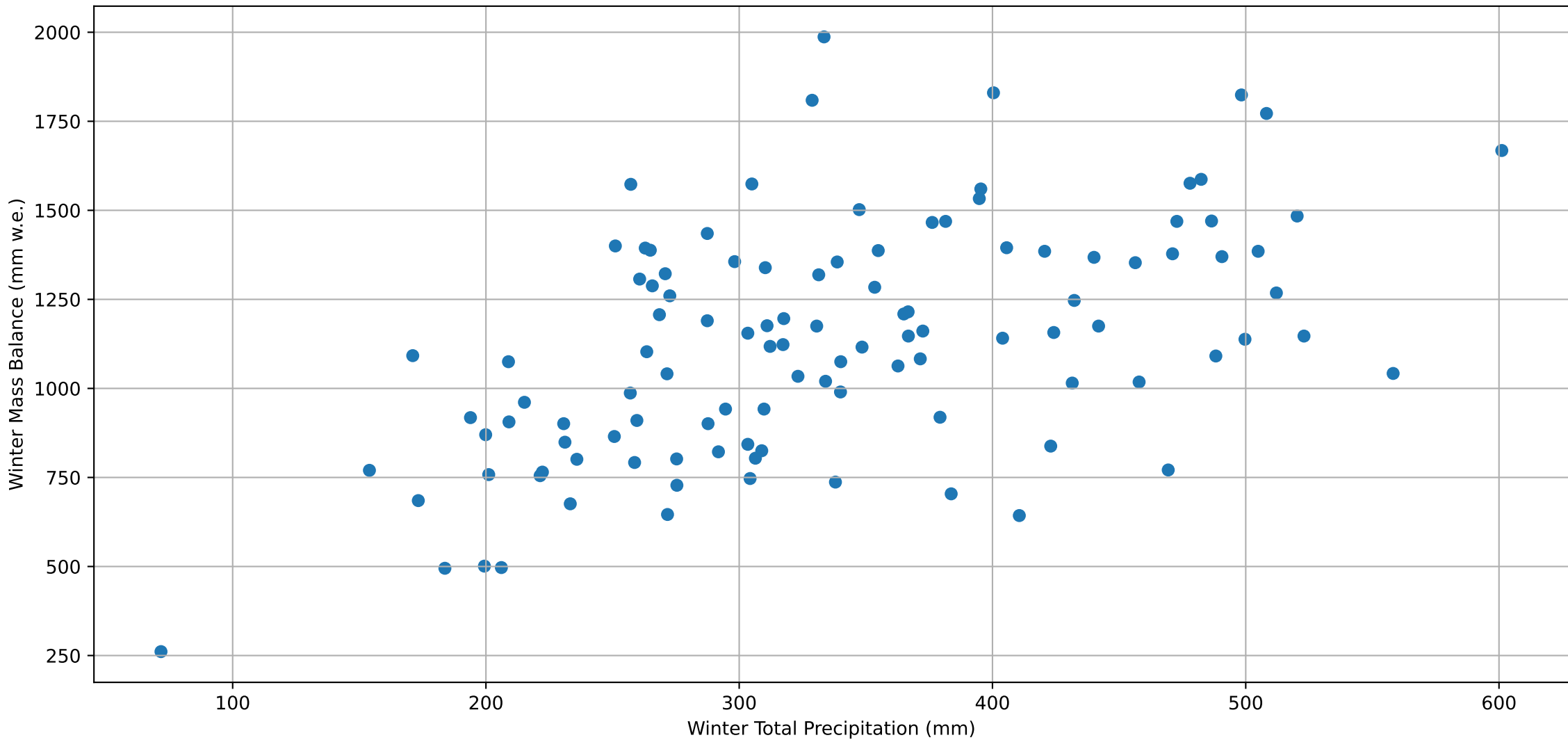
Sion Winter Total Precipitation



Grosser Aletschgletscher Summer Mass Balance with relation to Temperature



Grosser Aletschgletscher Winter Mass Balance with relation to Precipitation



# Regression: Monthly 1961-1990

MONTHLY DEVIATIONS for Grosser Aletschgletscher 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	-0.658611	3.951726e-15	True
3	august_td	-0.601941	2.795118e-12	True
1	june_td	-0.601370	2.966760e-12	True
0	may_td	-0.476302	1.264350e-07	True
4	september_td	-0.386431	2.800089e-05	True
5	october_pd	0.257259	6.415710e-03	True
9	february_pd	0.185586	5.116320e-02	False
8	january_pd	0.171998	7.106367e-02	False
6	november_pd	0.140863	1.403069e-01	False
7	december_pd	0.106127	2.676038e-01	False
10	march_pd	0.067017	4.846355e-01	False
11	april_pd	-0.018161	8.499417e-01	False

Number of observations: 111

Regression Summary:

## OLS Regression Results

```

=====
Dep. Variable:    annual mass balance (mm w.e.)    R-squared:                0.760
Model:                                OLS          Adj. R-squared:         0.731
Method:                                Least Squares    F-statistic:             25.86
Date:                Wed, 17 Dec 2025              Prob (F-statistic):       3.55e-25
Time:                21:49:22                      Log-Likelihood:          -810.49
No. Observations:                111                AIC:                     1647.
Df Residuals:                    98                  BIC:                     1682.
Df Model:                        12
Covariance Type:                nonrobust
=====

```

	coef	std err	t	P> t	[0.025	0.975]
const	-281.4766	44.125	-6.379	0.000	-369.042	-193.911
may_td	-112.0230	26.694	-4.197	0.000	-164.996	-59.050
june_td	-98.1723	25.746	-3.813	0.000	-149.264	-47.081
july_td	-140.9470	26.832	-5.253	0.000	-194.194	-87.700
august_td	-94.1784	29.398	-3.204	0.002	-152.519	-35.838
september_td	-43.2964	26.343	-1.644	0.103	-95.573	8.980
october_pd	4.1218	1.144	3.604	0.000	1.852	6.391
november_pd	2.5133	0.864	2.910	0.004	0.799	4.227
december_pd	1.9253	0.778	2.475	0.015	0.381	3.469
january_pd	3.5573	1.036	3.433	0.001	1.501	5.614
february_pd	1.2807	0.816	1.570	0.120	-0.338	2.899
march_pd	0.7875	1.203	0.654	0.514	-1.601	3.176
april_pd	-0.7447	1.477	-0.504	0.615	-3.675	2.186

```

=====
Omnibus:                0.127    Durbin-Watson:                1.760
Prob(Omnibus):          0.939    Jarque-Bera (JB):            0.216
Skew:                   -0.077    Prob(JB):                    0.898
Kurtosis:               2.848    Cond. No.                     60.9
=====

```

Notes:

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

Regression: Optimal 1961-1990

=====
OPTIMAL SEASONAL DEVIATIONS for Grosser Aletschgletscher 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 -0.798823 8.306912e-26 True
1 opt\_season\_pd 0.369735 6.502864e-05 True

Number of observations: 111

Regression Summary:

OLS Regression Results
Dep. Variable: annual mass balance (mm w.e.) R-squared: 0.730
Model: OLS Adj. R-squared: 0.725
Method: Least Squares F-statistic: 146.2
Date: Wed, 17 Dec 2025 Prob (F-statistic): 1.85e-31
Time: 21:49:22 Log-Likelihood: -816.96
No. Observations: 111 AIC: 1640.
Df Residuals: 108 BIC: 1648.
Df Model: 2
Covariance Type: nonrobust
coef std err t P>|t| [0.025 0.975]
const -279.1853 41.055 -6.800 0.000 -360.562 -197.808
opt\_season\_td -465.2580 30.177 -15.417 0.000 -525.075 -405.441
opt\_season\_pd 2.3955 0.394 6.075 0.000 1.614 3.177
Omnibus: 0.082 Durbin-Watson: 1.808
Prob(Omnibus): 0.960 Jarque-Bera (JB): 0.202
Skew: 0.055 Prob(JB): 0.904
Kurtosis: 2.823 Cond. No. 114.

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

Regression: Seasonal 1961-1990

=====
SUMMER/WINTER SEASONAL DEVIATIONS for Grosser Aletschgletscher 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 -0.789128 8.141774e-25 True
1 winter\_pd 0.356799 1.211095e-04 True

Number of observations: 111

Regression Summary:

OLS Regression Results
Dep. Variable: annual mass balance (mm w.e.) R-squared: 0.711
Model: OLS Adj. R-squared: 0.706
Method: Least Squares F-statistic: 133.2
Date: Wed, 17 Dec 2025 Prob (F-statistic): 7.05e-30
Time: 21:49:22 Log-Likelihood: -820.70
No. Observations: 111 AIC: 1647.
Df Residuals: 108 BIC: 1656.
Df Model: 2
Covariance Type: nonrobust
coef std err t P>|t| [0.025 0.975]
const -275.4478 42.750 -6.443 0.000 -360.186 -190.710
summer\_td -493.6561 33.382 -14.788 0.000 -559.825 -427.487
winter\_pd 2.1660 0.376 5.765 0.000 1.421 2.911
Omnibus: 0.638 Durbin-Watson: 1.749
Prob(Omnibus): 0.727 Jarque-Bera (JB): 0.258
Skew: -0.043 Prob(JB): 0.879
Kurtosis: 3.220 Cond. No. 128.

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

# Regression: Monthly 1991-2020

MONTHLY DEVIATIONS for Grosser Aletschgletscher 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	-0.658611	3.951726e-15	True
3	august_td	-0.601941	2.795118e-12	True
1	june_td	-0.601370	2.966760e-12	True
0	may_td	-0.476302	1.264350e-07	True
4	september_td	-0.386431	2.800089e-05	True
5	october_pd	0.257259	6.415710e-03	True
9	february_pd	0.185586	5.116320e-02	False
8	january_pd	0.171998	7.106367e-02	False
6	november_pd	0.140863	1.403069e-01	False
7	december_pd	0.106127	2.676038e-01	False
10	march_pd	0.067017	4.846355e-01	False
11	april_pd	-0.018161	8.499417e-01	False

Number of observations: 111

Regression Summary:

OLS Regression Results						
Dep. Variable:	annual mass balance (mm w.e.)			R-squared:	0.760	
Model:	OLS			Adj. R-squared:	0.731	
Method:	Least Squares			F-statistic:	25.86	
Date:	Wed, 17 Dec 2025			Prob (F-statistic):	3.55e-25	
Time:	21:49:22			Log-Likelihood:	-810.49	
No. Observations:	111			AIC:	1647.	
Df Residuals:	98			BIC:	1682.	
Df Model:	12					
Covariance Type:	nonrobust					
	coef	std err	t	P> t	[0.025	0.975]
const	-1177.4733	51.689	-22.780	0.000	-1280.048	-1074.899
may_td	-112.0230	26.694	-4.197	0.000	-164.996	-59.050
june_td	-98.1723	25.746	-3.813	0.000	-149.264	-47.081
july_td	-140.9470	26.832	-5.253	0.000	-194.194	-87.700
august_td	-94.1784	29.398	-3.204	0.002	-152.519	-35.838
september_td	-43.2964	26.343	-1.644	0.103	-95.573	8.980
october_pd	4.1218	1.144	3.604	0.000	1.852	6.391
november_pd	2.5133	0.864	2.910	0.004	0.799	4.227
december_pd	1.9253	0.778	2.475	0.015	0.381	3.469
january_pd	3.5573	1.036	3.433	0.001	1.501	5.614
february_pd	1.2807	0.816	1.570	0.120	-0.338	2.899
march_pd	0.7875	1.203	0.654	0.514	-1.601	3.176
april_pd	-0.7447	1.477	-0.504	0.615	-3.675	2.186
Omnibus:	0.127	Durbin-Watson:		1.760		
Prob(Omnibus):	0.939	Jarque-Bera (JB):		0.216		
Skew:	-0.077	Prob(JB):		0.898		
Kurtosis:	2.848	Cond. No.		70.6		

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

Regression: Optimal 1991-2020

=====
OPTIMAL SEASONAL DEVIATIONS for Grosser Aletschgletscher using 1991-2020 climate norms
=====

Correlation Analysis with Significance Testing:
Skipping constant column: const
Table with 5 columns: Variable, Correlation Coefficient, P-value, Significant (p < 0.05), and an unlabeled column. Rows include opt\_season\_td and opt\_season\_pd.

Number of observations: 111

Regression Summary:

OLS Regression Results
Table with 7 columns: Variable, coef, std err, t, P>|t|, [0.025, 0.975]. Rows include model statistics (R-squared, F-statistic, etc.), coefficients for const, opt\_season\_td, and opt\_season\_pd, and diagnostic statistics (Omnibus, Jarque-Bera, etc.).

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

Regression: Seasonal 1991-2020

=====
SUMMER/WINTER SEASONAL DEVIATIONS for Grosser Aletschglletscher using 1991-2020 climate norms
=====

Correlation Analysis with Significance Testing:
Skipping constant column: const
Table with 5 columns: Variable, Correlation Coefficient, P-value, Significant (p < 0.05), and a boolean result.

Number of observations: 111

Regression Summary:

OLS Regression Results
Table with 7 columns: Variable, coef, std err, t, P>|t|, [0.025, 0.975]. Rows include model statistics (R-squared, F-statistic, etc.) and coefficient estimates for const, summer\_td, and winter\_pd.

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