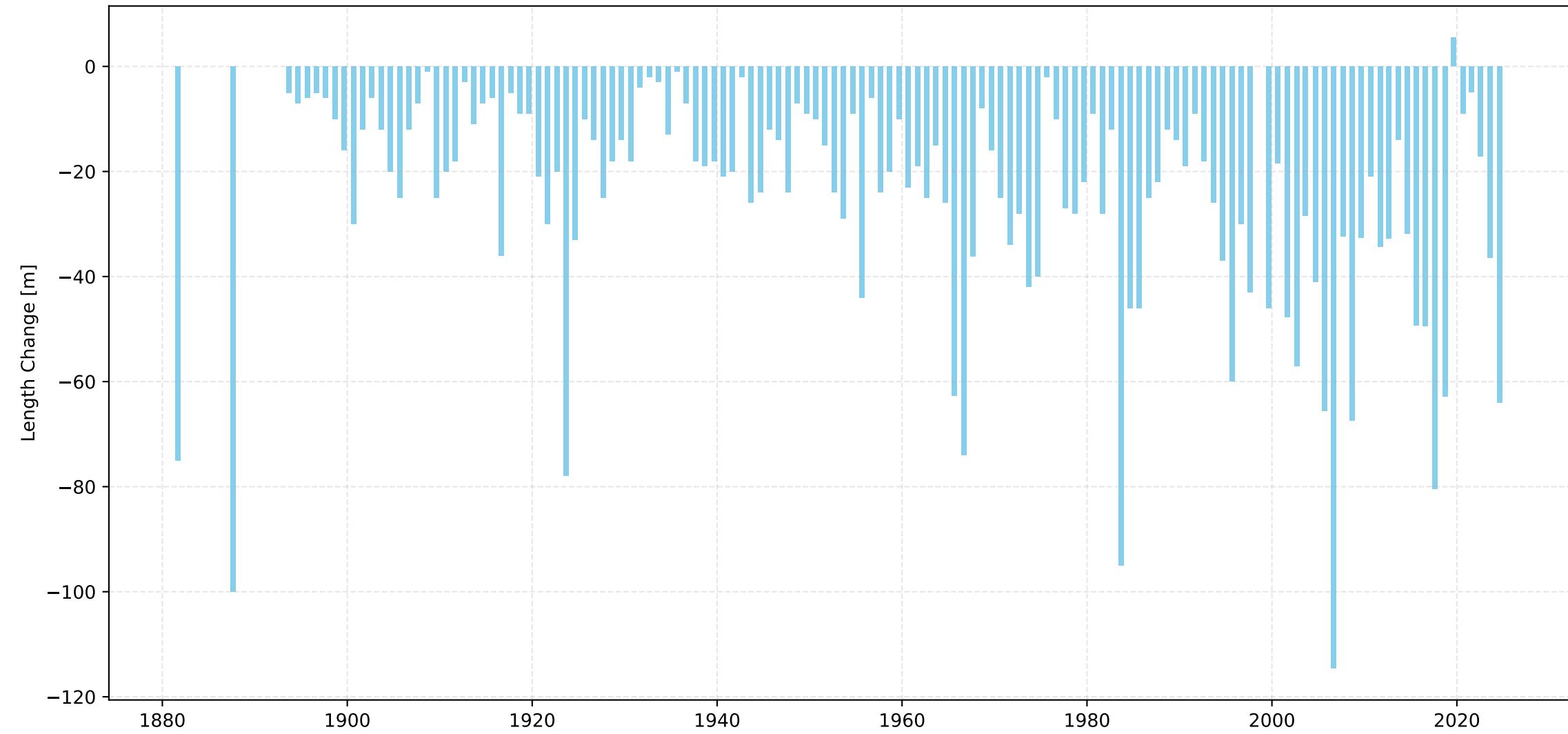
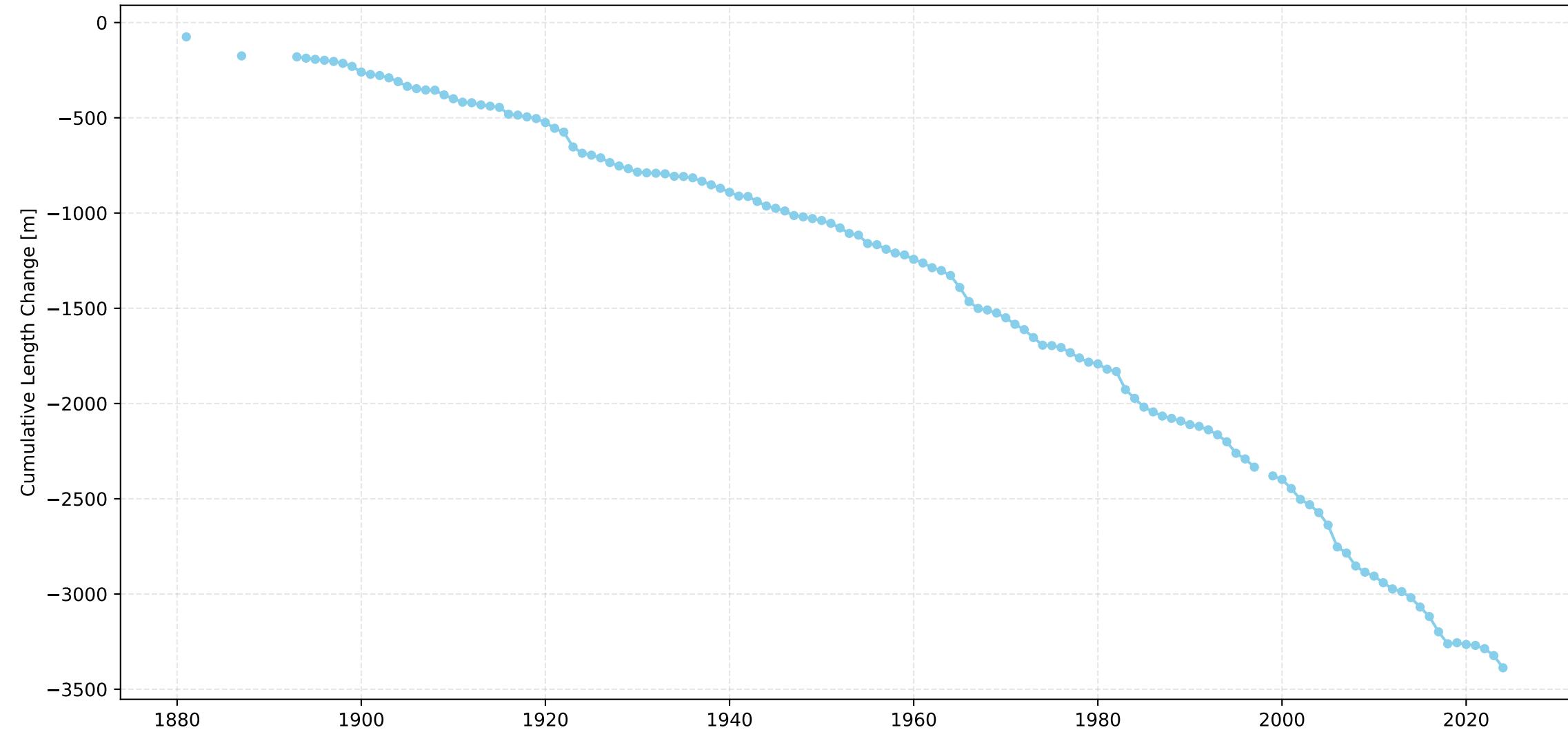


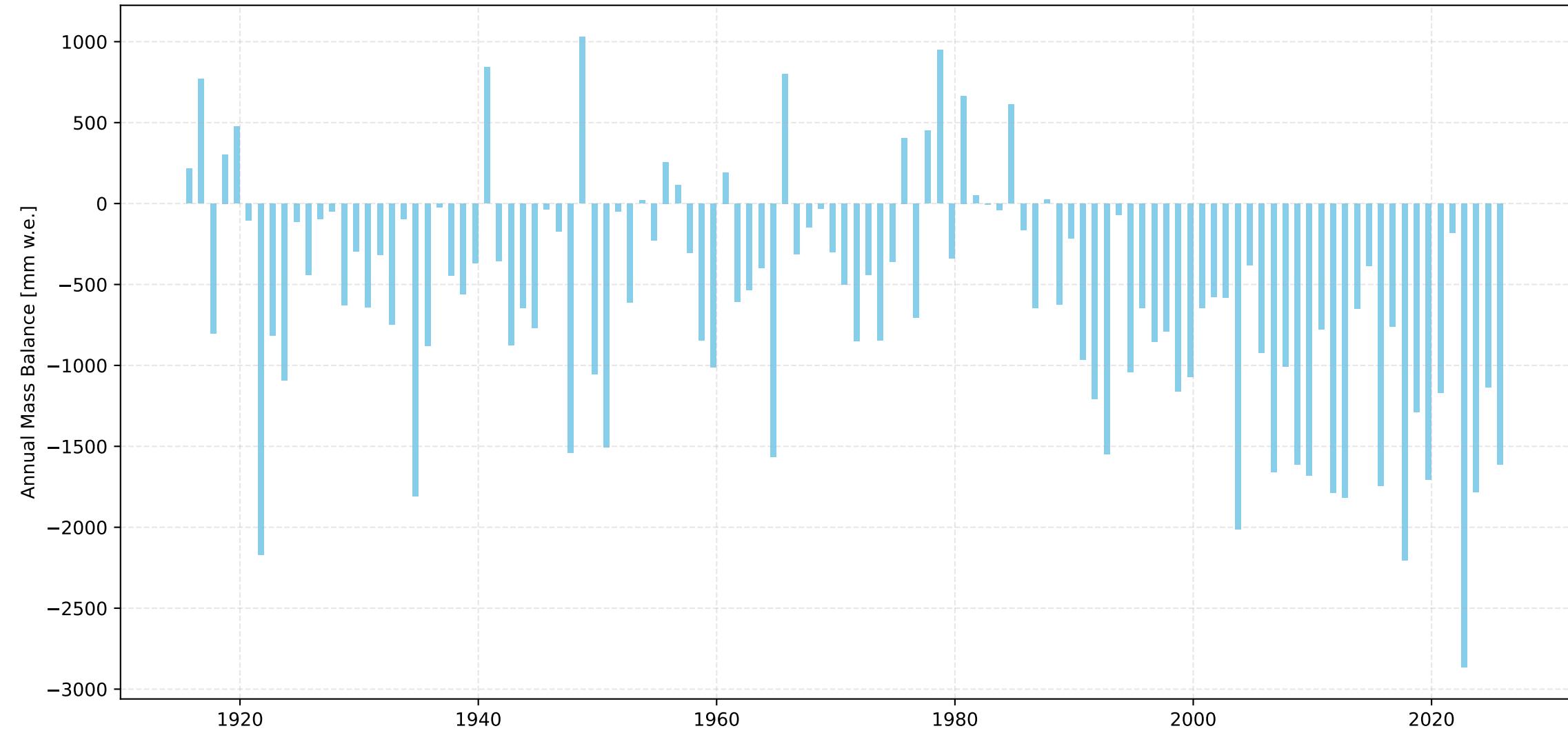
Grosser Aletschgletscher Length Change Over Time



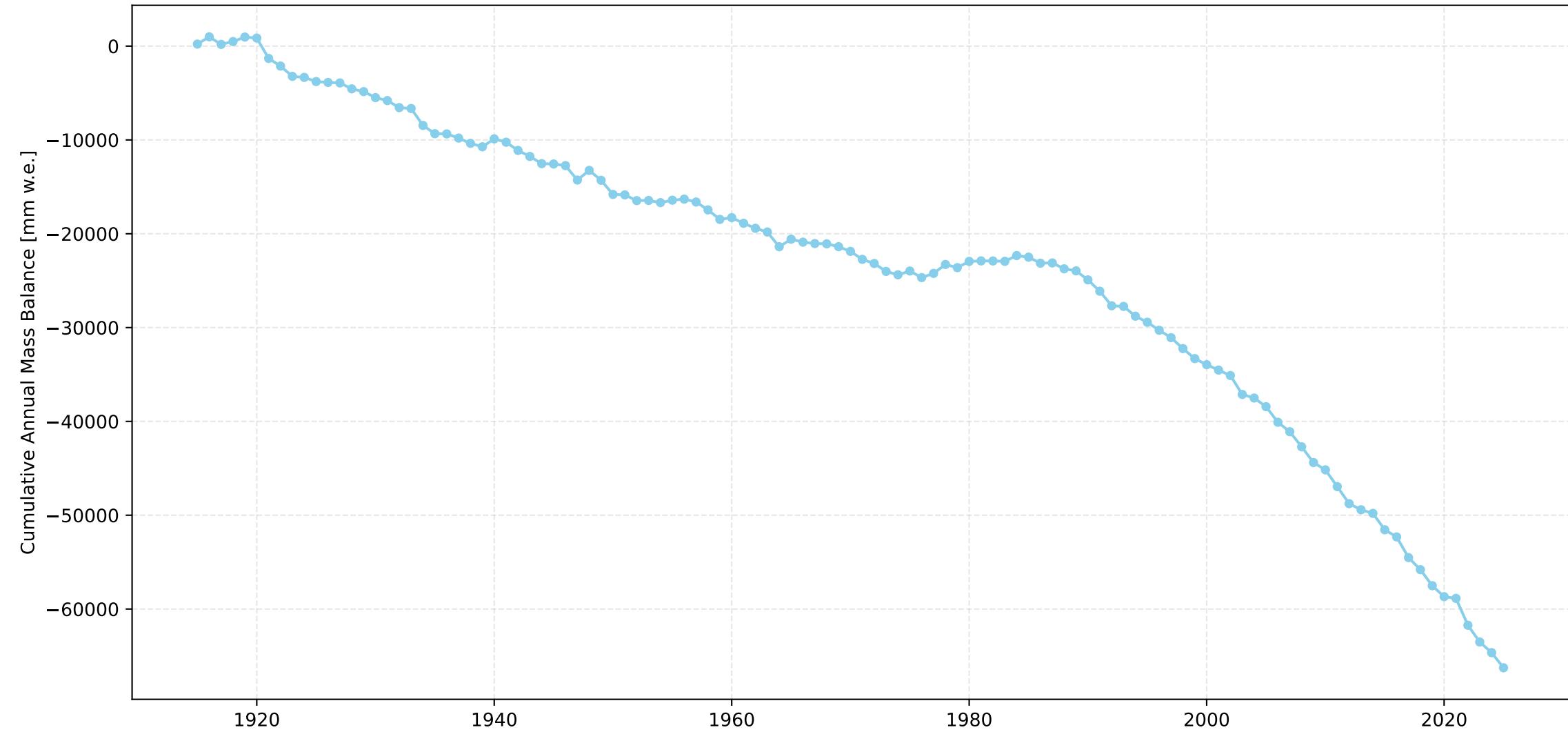
Grosser Aletschgletscher Cumulative Length Change Over Time



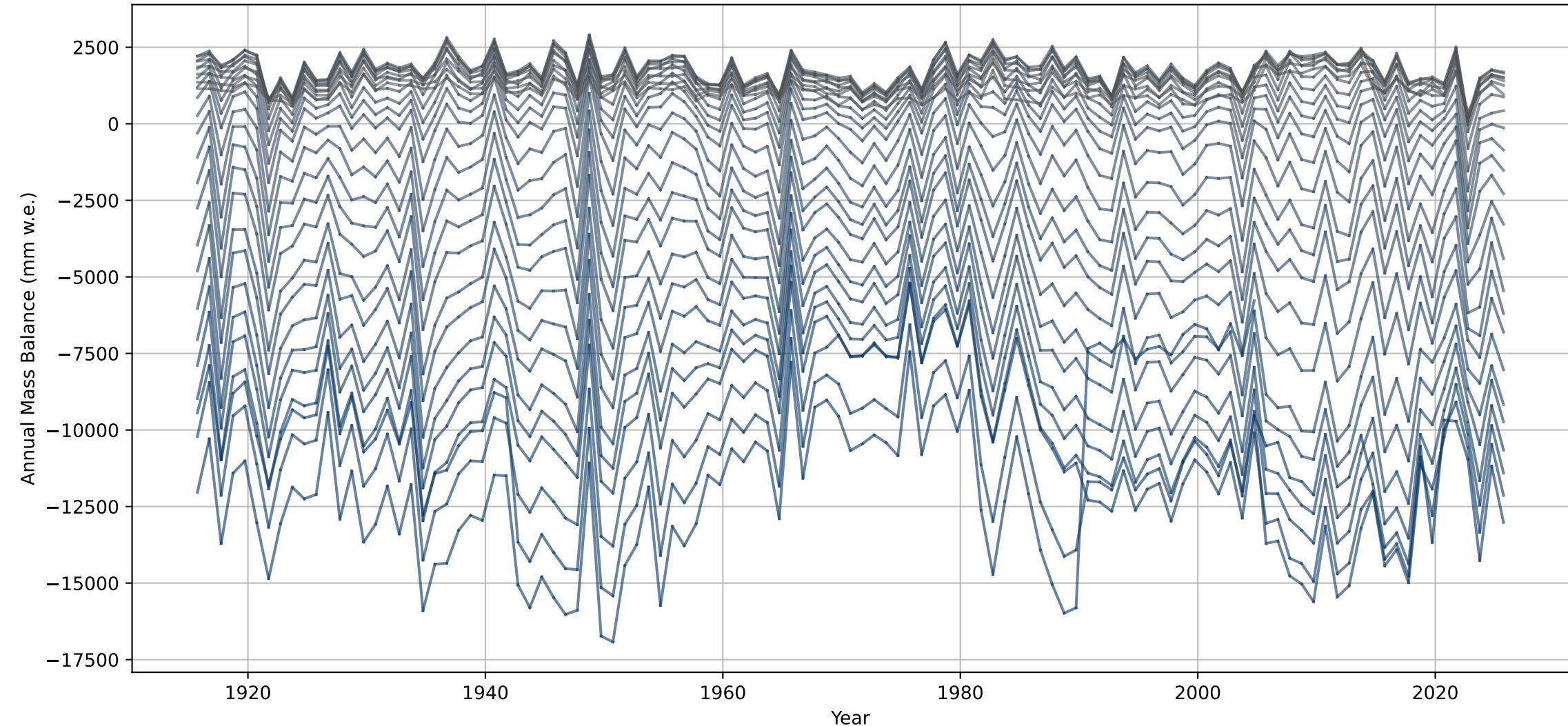
Grosser Aletschgletscher Annual Mass Balance Over Time



Grosser Aletschgletscher Cumulative Annual Mass Balance Over Time



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



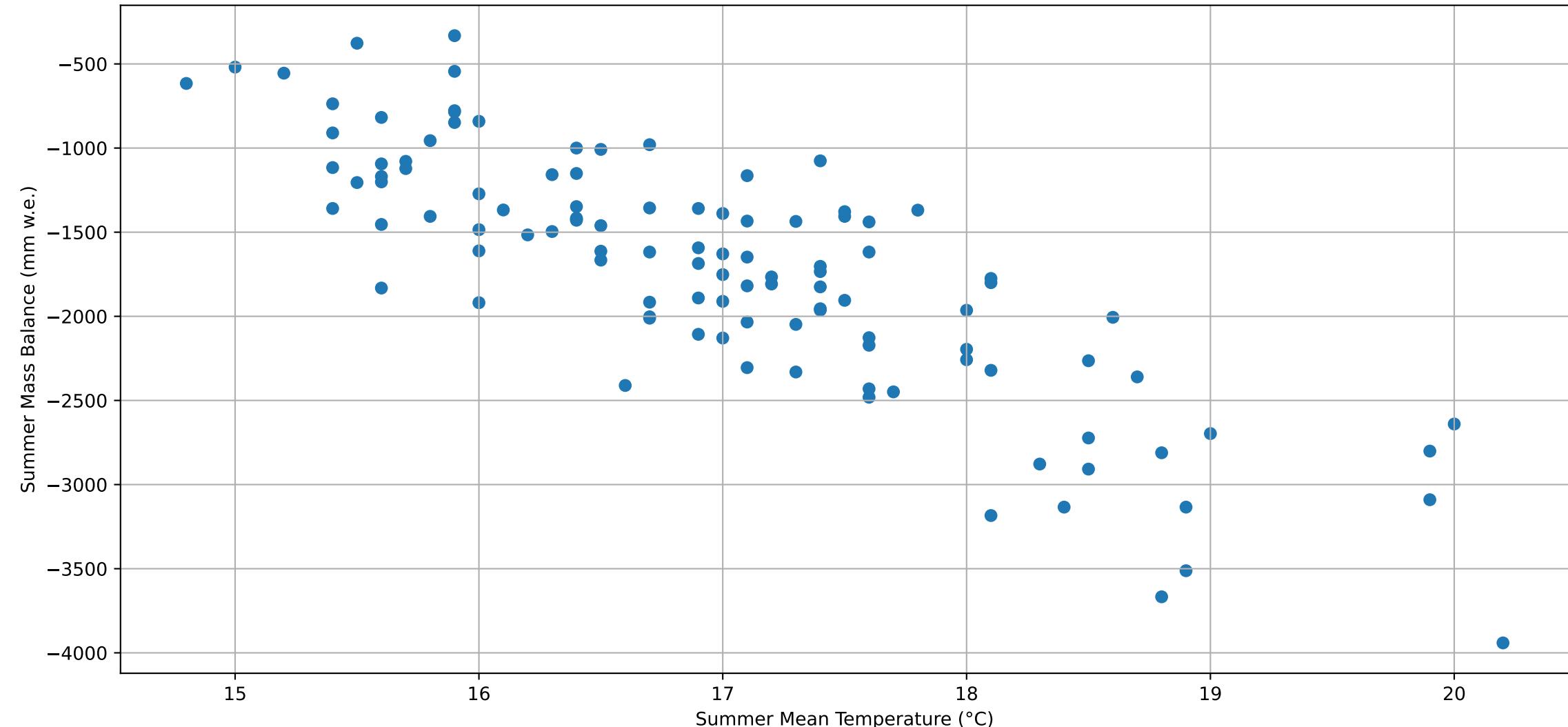
Sion Summer Mean Temperature



Sion Winter Total Precipitation



Grosser Aletschgletscher Summer Mass Balance with relation to Temperature



Regression: Monthly 1961-1990

MONTHLY DEVIATIONS ANALYSIS USING 1961-1990 CLIMATE NORMS

MONTHLY DEVIATIONS for Grosser Aletschgletscher (1961-1990 norms)

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:	Mon, 08 Dec 2025	Prob (F-statistic):	3.55e-25
Time:	00:57:34	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	1.615e+04	1101.005	14.665	0.000	1.4e+04	1.83e+04
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.	2.36e+03

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 2.36e+03. This might indicate that there are strong multicollinearity or other numerical problems.

Coefficient Interpretation:

Intercept (normal mass balance): 16145.83 (p=0.0000)

may_td: -112.02 (p=0.0001)

june_td: -98.17 (p=0.0002)

july_td: -140.95 (p=0.0000)

august_td: -94.18 (p=0.0018)

september_td: -43.30 (p=0.1035)

october_pd: 4.12 (p=0.0005)

november_pd: 2.51 (p=0.0045)

Regression: Optimal 1961-1990

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

=====
OPTIMAL SEASONAL DEVIATIONS for Grosser Aletschgletscher (1961-1990 norms)
=====

Number of observations: 111

Regression Summary:

OLS Regression Results

=====
Dep. Variable: annual mass balance (mm w.e.) R-squared: 0.729
Model: OLS Adj. R-squared: 0.724
Method: Least Squares F-statistic: 145.1
Date: Mon, 08 Dec 2025 Prob (F-statistic): 2.51e-31
Time: 00:57:34 Log-Likelihood: -817.27
No. Observations: 111 AIC: 1641.
Df Residuals: 108 BIC: 1649.
Df Model: 2
Covariance Type: nonrobust
=====

	coef	std err	t	P> t	[0.025	0.975]
const	1.552e+04	1047.094	14.826	0.000	1.34e+04	1.76e+04
opt_season_td	-466.8954	30.408	-15.355	0.000	-527.168	-406.622
opt_season_pd	2.4006	0.395	6.072	0.000	1.617	3.184

=====

Omnibus: 0.176 Durbin-Watson: 1.812
Prob(Omnibus): 0.916 Jarque-Bera (JB): 0.306
Skew: 0.082 Prob(JB): 0.858
Kurtosis: 2.802 Cond. No. 2.72e+03
=====

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 2.72e+03. This might indicate that there are strong multicollinearity or other numerical problems.

Coefficient Interpretation:

Intercept (normal mass balance): 15523.97 (p=0.0000)
opt_season_td: -466.90 (p=0.0000)
opt_season_pd: 2.40 (p=0.0000)

Variance Inflation Factors (VIF):

	Variable	VIF
0	const	814.025785
1	opt_season_td	1.007004
2	opt_season_pd	1.007004

R-squared: 0.7288

Adjusted R-squared: 0.7238

Regression: Seasonal 1961-1990

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

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

Number of observations: 111

Regression Summary:

OLS Regression Results

=====
Dep. Variable: annual mass balance (mm w.e.) R-squared: 0.713
Model: OLS Adj. R-squared: 0.707
Method: Least Squares F-statistic: 134.0
Date: Mon, 08 Dec 2025 Prob (F-statistic): 5.61e-30
Time: 00:57:34 Log-Likelihood: -820.46
No. Observations: 111 AIC: 1647.
Df Residuals: 108 BIC: 1655.
Df Model: 2
Covariance Type: nonrobust
=====

	coef	std err	t	P> t	[0.025	0.975]
const	1.596e+04	1111.970	14.355	0.000	1.38e+04	1.82e+04
summer_td	-493.1045	33.239	-14.835	0.000	-558.990	-427.219
winter_pd	2.1107	0.375	5.625	0.000	1.367	2.855

=====

Omnibus: 0.457 Durbin-Watson: 1.765
Prob(Omnibus): 0.796 Jarque-Bera (JB): 0.146
Skew: -0.042 Prob(JB): 0.930
Kurtosis: 3.157 Cond. No. 3.10e+03
=====

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 3.1e+03. This might indicate that there are strong multicollinearity or other numerical problems.

Coefficient Interpretation:

Intercept (normal mass balance): 15962.71 (p=0.0000)
summer_td: -493.10 (p=0.0000)
winter_pd: 2.11 (p=0.0000)

Variance Inflation Factors (VIF):

	Variable	VIF
0	const	866.702229
1	summer_td	1.007355
2	winter_pd	1.007355

R-squared: 0.7127

Adjusted R-squared: 0.7074

Regression: Monthly 1991-2020

=====

MONTHLY DEVIATIONS ANALYSIS USING 1991-2020 CLIMATE NORMS

=====

=====

MONTHLY DEVIATIONS for Grosser Aletschgletscher (1991-2020 norms)

=====

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:	Mon, 08 Dec 2025	Prob (F-statistic):	3.55e-25
Time:	00:57:34	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.

Coefficient Interpretation:

Intercept (normal mass balance): -1177.47 (p=0.0000)

may_td: -112.02 (p=0.0001)

june_td: -98.17 (p=0.0002)

july_td: -140.95 (p=0.0000)

august_td: -94.18 (p=0.0018)

september_td: -43.30 (p=0.1035)

october_pd: 4.12 (p=0.0005)

november_pd: 2.51 (p=0.0045)

december_pd: 1.93 (p=0.0150)

january_pd: 3.56 (p=0.0009)

Regression: Optimal 1991-2020

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

=====
OPTIMAL SEASONAL DEVIATIONS for Grosser Aletschgletscher (1991-2020 norms)
=====

Number of observations: 111

Regression Summary:

OLS Regression Results

=====
Dep. Variable: annual mass balance (mm w.e.) R-squared: 0.727
Model: OLS Adj. R-squared: 0.722
Method: Least Squares F-statistic: 143.8
Date: Mon, 08 Dec 2025 Prob (F-statistic): 3.55e-31
Time: 00:57:34 Log-Likelihood: -817.63
No. Observations: 111 AIC: 1641.
Df Residuals: 108 BIC: 1649.
Df Model: 2
Covariance Type: nonrobust
=====

	coef	std err	t	P> t	[0.025	0.975]
const	-1174.4716	51.607	-22.758	0.000	-1276.765	-1072.178
opt_season_td	-466.7401	30.540	-15.283	0.000	-527.276	-406.204
opt_season_pd	2.3835	0.397	6.008	0.000	1.597	3.170

=====

Omnibus: 0.086 Durbin-Watson: 1.805
Prob(Omnibus): 0.958 Jarque-Bera (JB): 0.082
Skew: 0.057 Prob(JB): 0.960
Kurtosis: 2.929 Cond. No. 144.
=====

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

Coefficient Interpretation:

Intercept (normal mass balance): -1174.47 (p=0.0000)
opt_season_td: -466.74 (p=0.0000)
opt_season_pd: 2.38 (p=0.0000)

Variance Inflation Factors (VIF):

	Variable	VIF
0	const	1.964658
1	opt_season_td	1.007507
2	opt_season_pd	1.007507

R-squared: 0.7270

Adjusted R-squared: 0.7220

Regression: Seasonal 1991-2020

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

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

Number of observations: 111

Regression Summary:

OLS Regression Results

=====
Dep. Variable: annual mass balance (mm w.e.) R-squared: 0.710
Model: OLS Adj. R-squared: 0.705
Method: Least Squares F-statistic: 132.3
Date: Mon, 08 Dec 2025 Prob (F-statistic): 9.16e-30
Time: 00:57:34 Log-Likelihood: -820.97
No. Observations: 111 AIC: 1648.
Df Residuals: 108 BIC: 1656.
Df Model: 2
Covariance Type: nonrobust
=====

	coef	std err	t	P> t	[0.025	0.975]
const	-1170.9339	53.040	-22.076	0.000	-1276.069	-1065.799
summer_td	-492.1145	33.399	-14.735	0.000	-558.316	-425.913
winter_pd	2.1197	0.377	5.624	0.000	1.373	2.867

=====

Omnibus: 0.462 Durbin-Watson: 1.778
Prob(Omnibus): 0.794 Jarque-Bera (JB): 0.137
Skew: -0.004 Prob(JB): 0.934
Kurtosis: 3.172 Cond. No. 158.
=====

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

Coefficient Interpretation:

Intercept (normal mass balance): -1170.93 (p=0.0000)
summer_td: -492.11 (p=0.0000)
winter_pd: 2.12 (p=0.0000)

Variance Inflation Factors (VIF):

Variable	VIF
0 const	1.954085
1 summer_td	1.007113
2 winter_pd	1.007113

R-squared: 0.7101

Adjusted R-squared: 0.7047