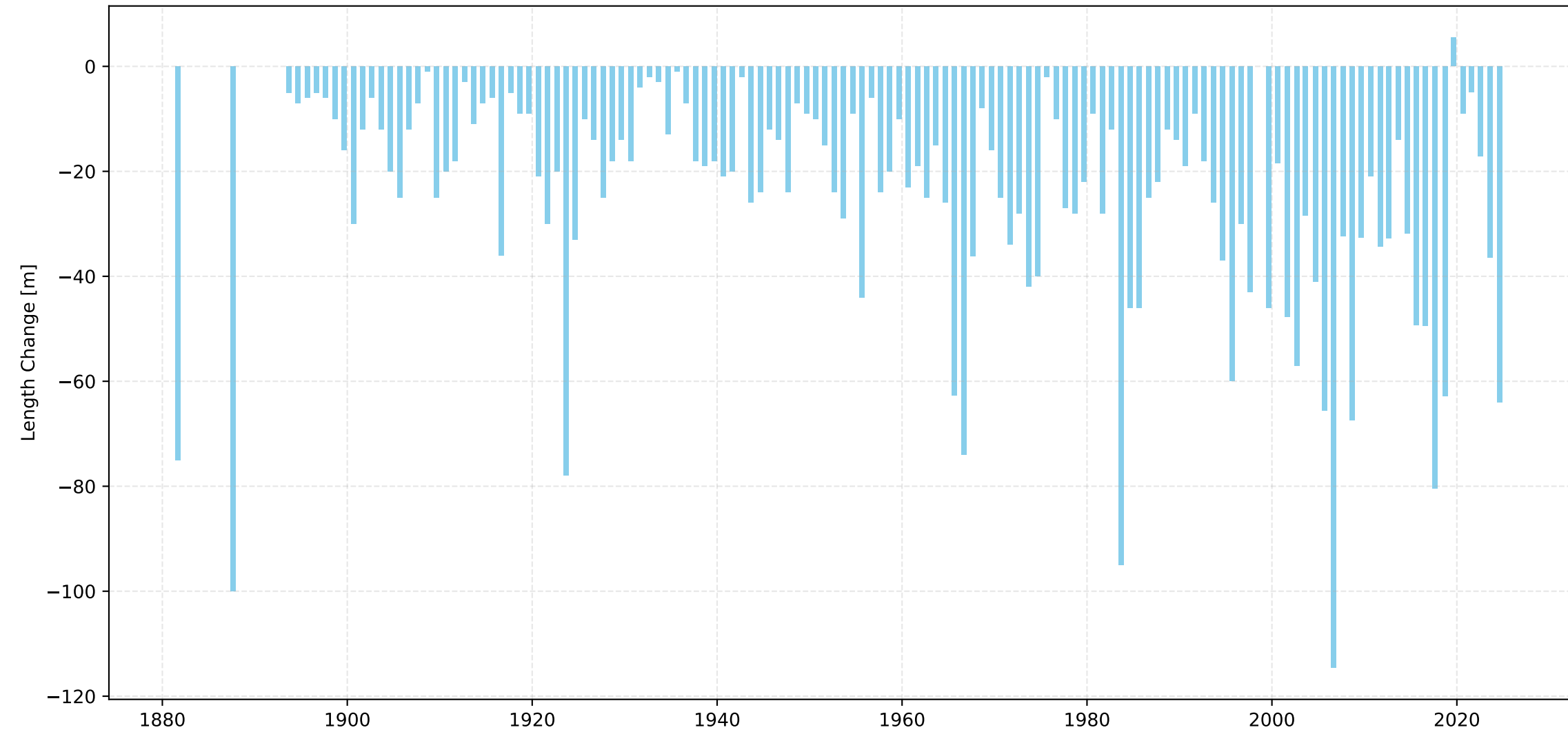
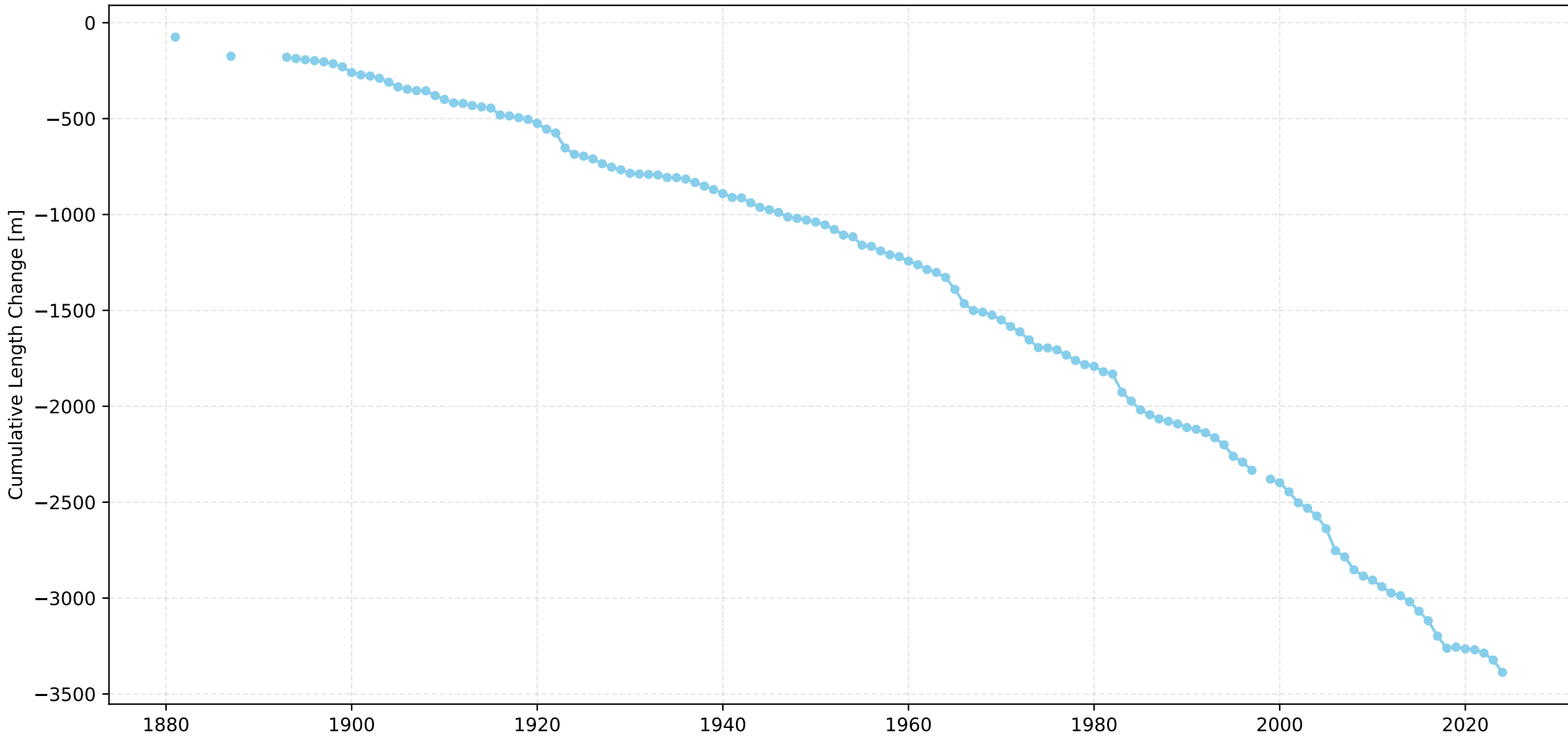


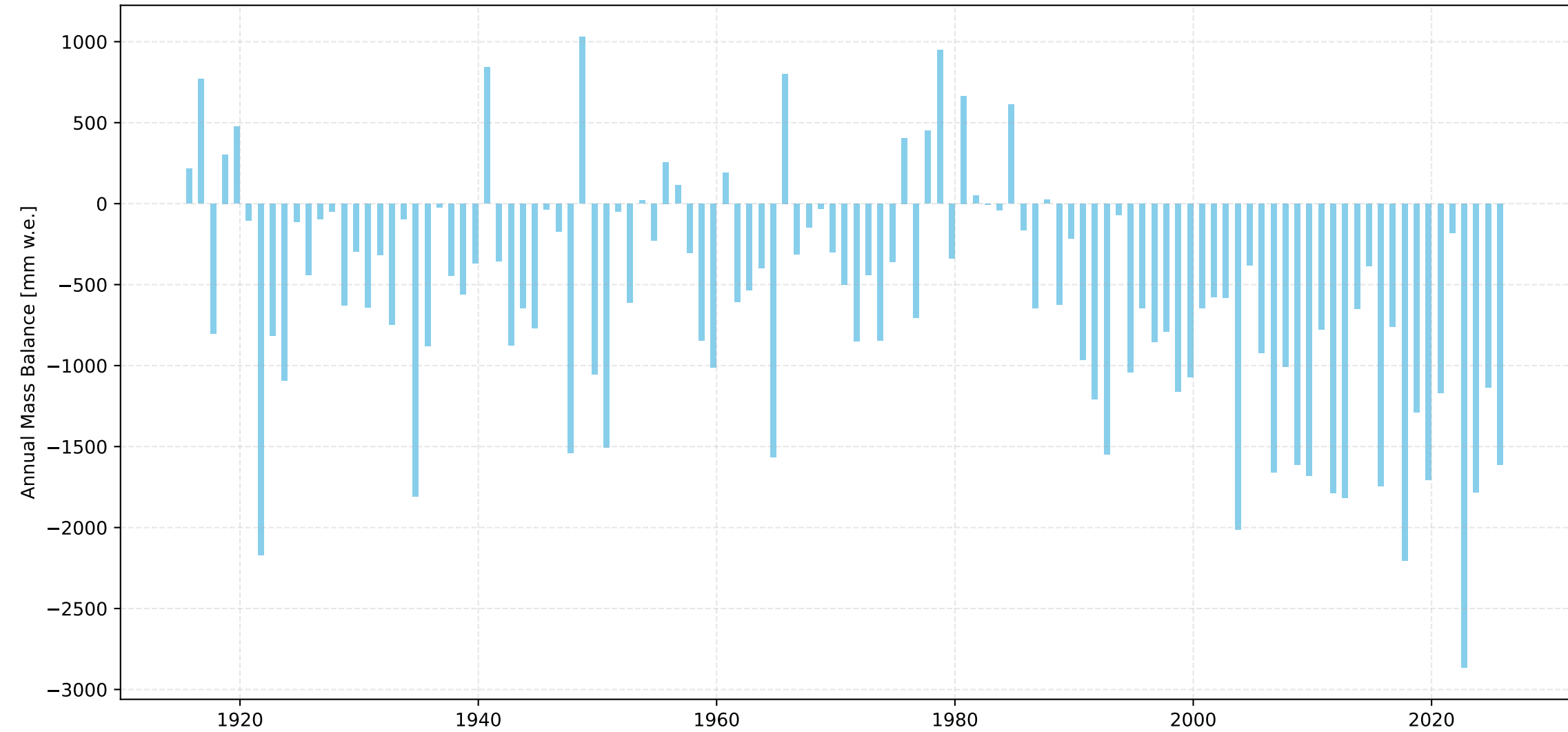
Grosser Aletschgletscher Length Change Over Time



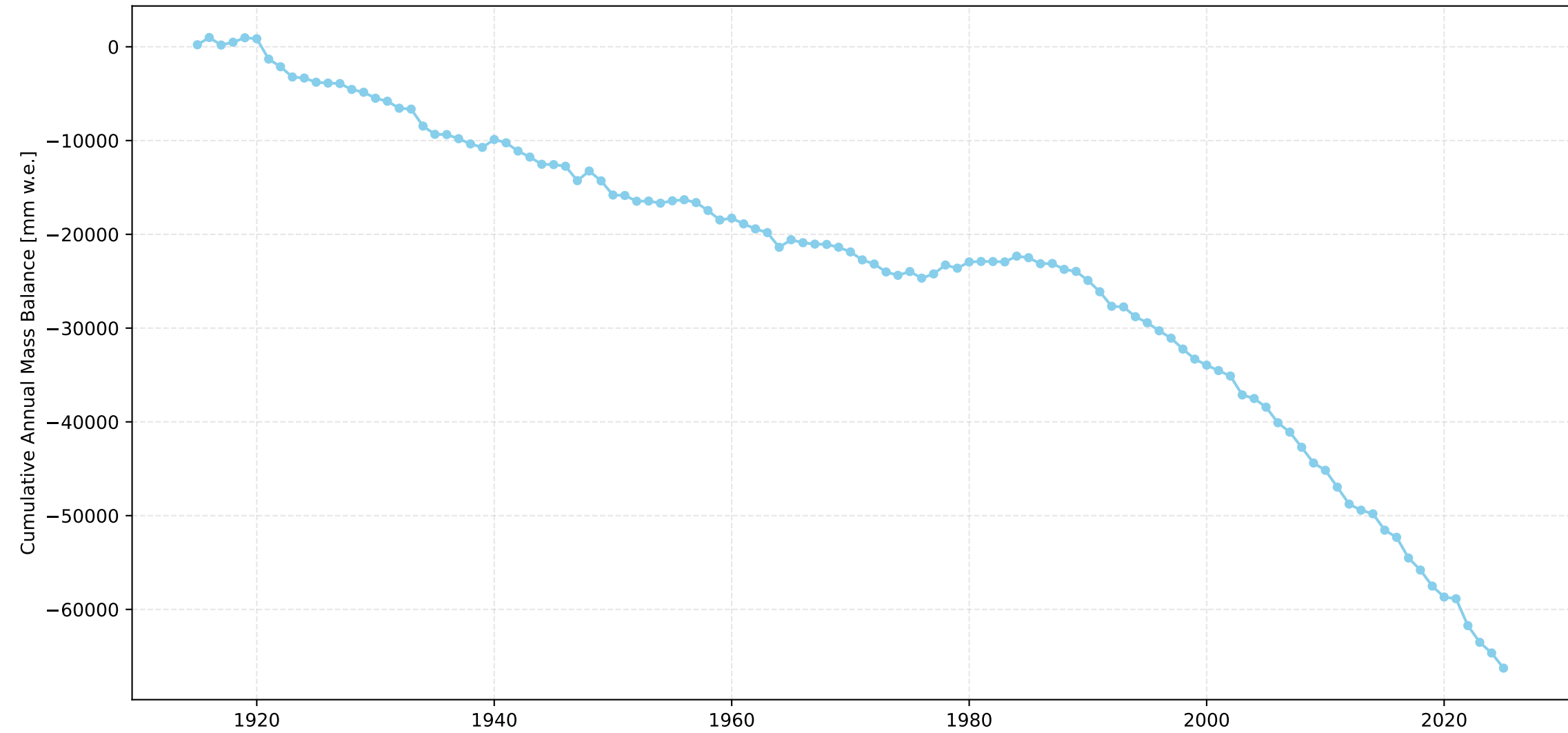
Grosser Aletschgletscher Cumulative Length Change Over Time



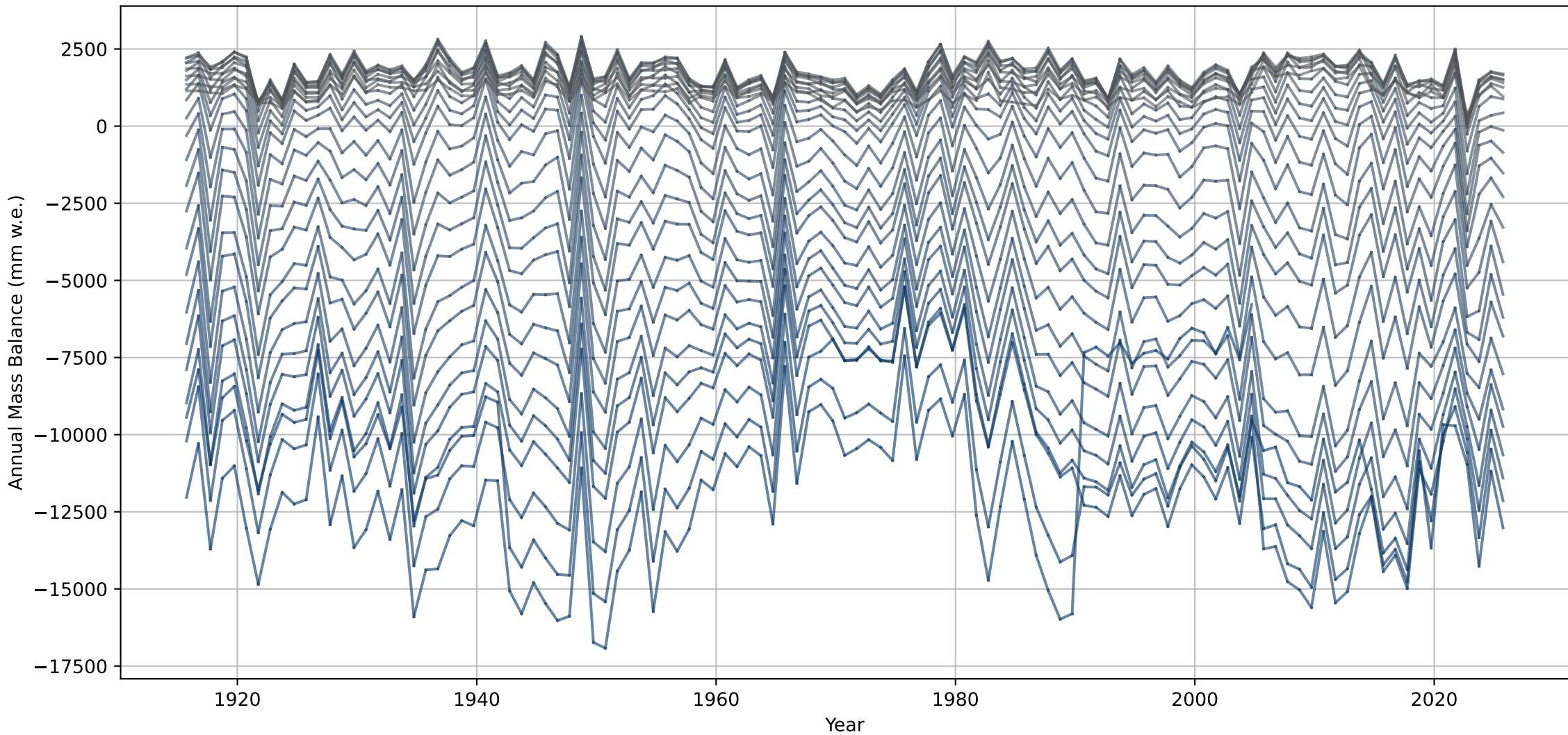
Grosser Aletschgletscher Annual Mass Balance Over Time



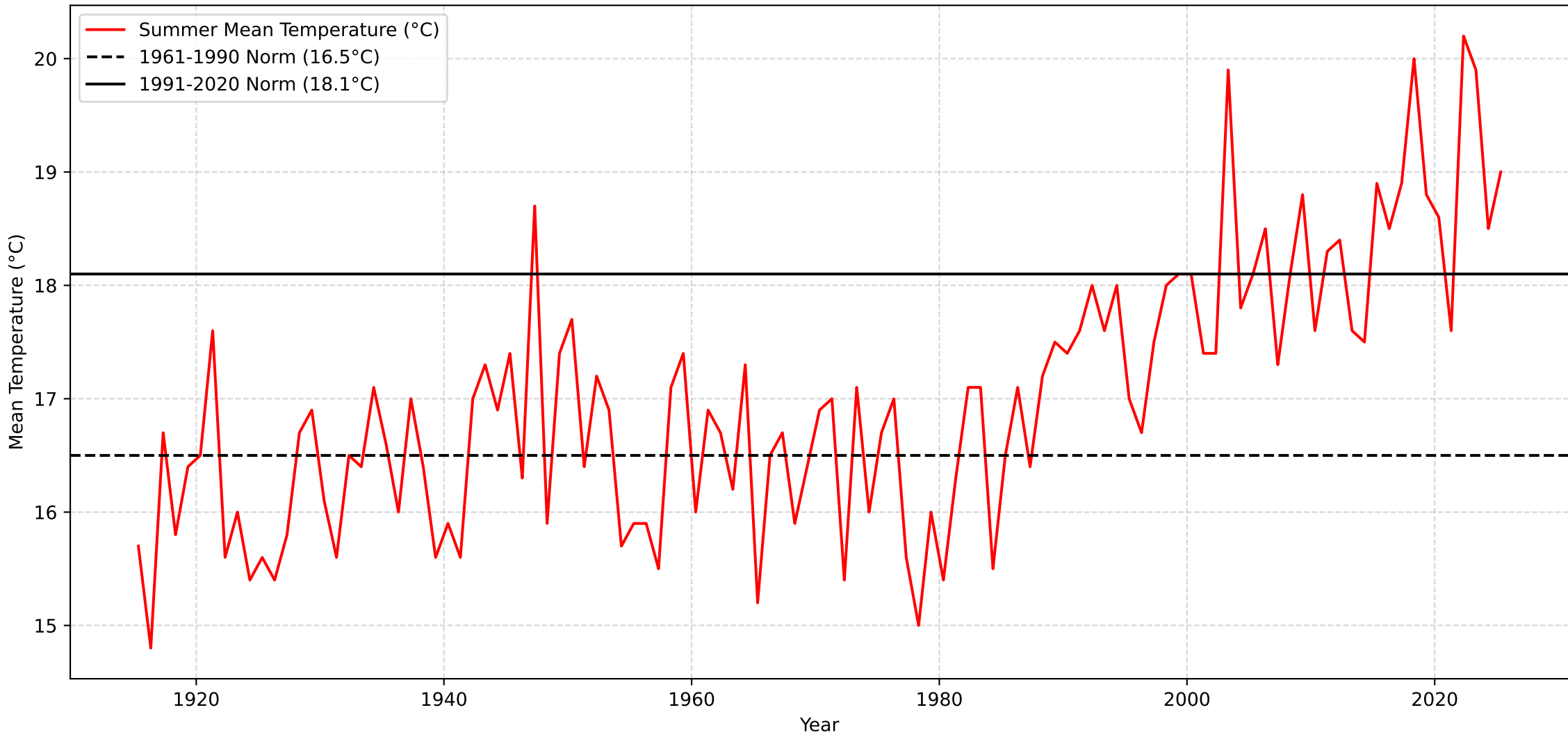
Grosser Aletschgletscher Cumulative Annual Mass Balance Over Time



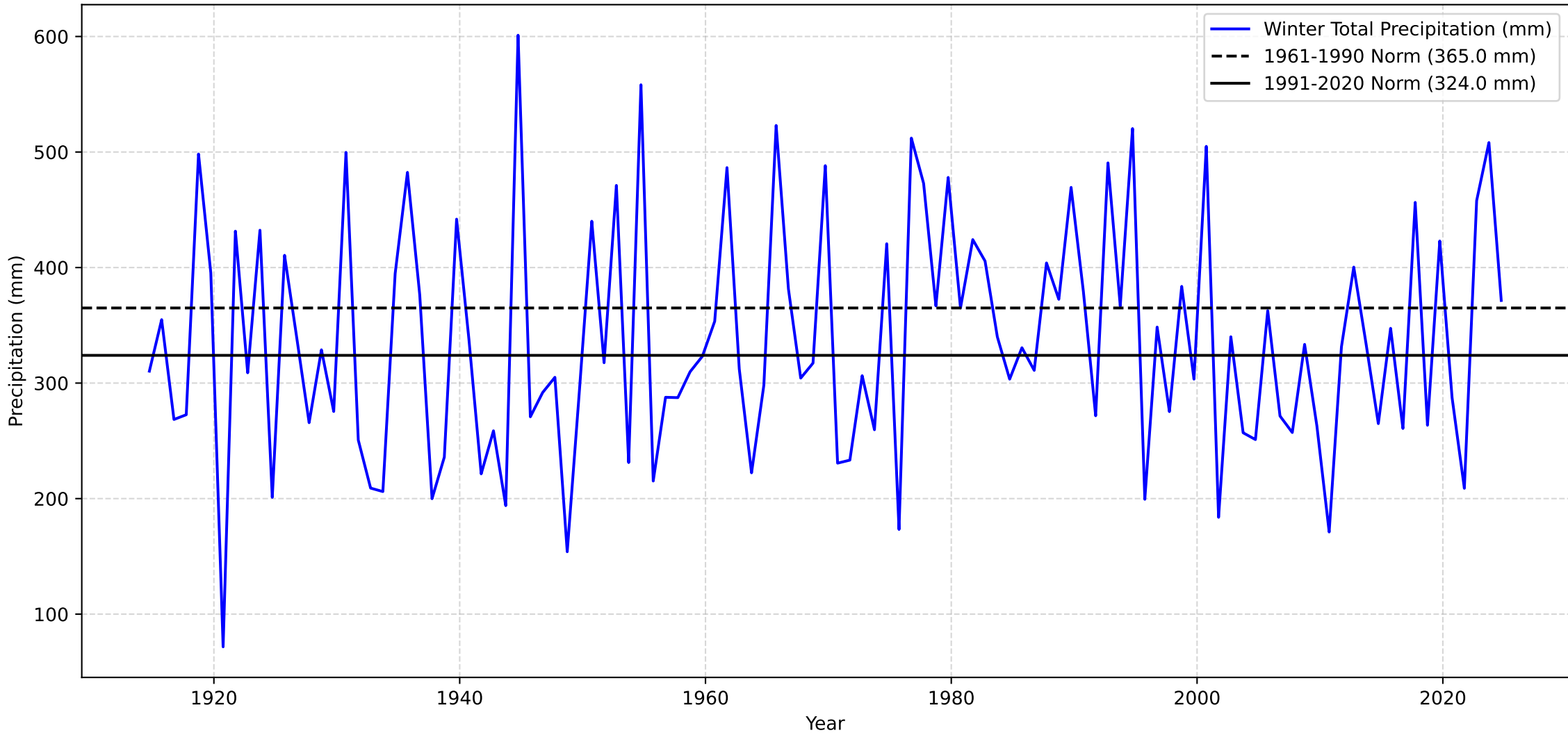
Annual Mass Balance for each Elevation Bin over Time - Grosser Aletschgletscher



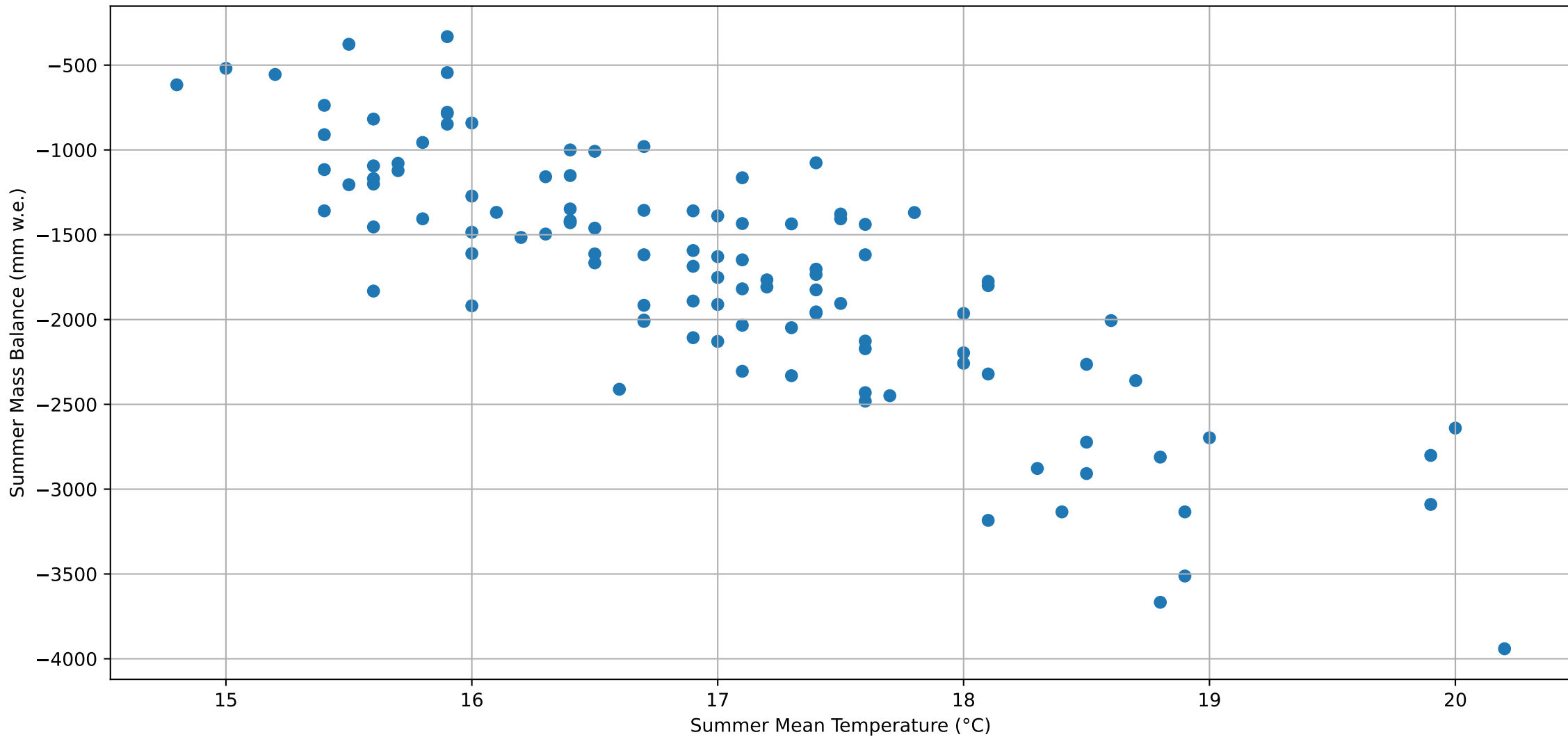
Sion Summer Mean Temperature



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 Aletschglletscher (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

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OPTIMAL SEASONAL DEVIATIONS ANALYSIS USING 1961-1990 CLIMATE NORMS
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OPTIMAL SEASONAL DEVIATIONS for Grosser Aletschgletscher (1961-1990 norms)
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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

Table with 7 columns: coef, std err, t, P>|t|, [0.025, 0.975]. Rows include const, opt\_season\_td, and opt\_season\_pd.

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

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SUMMER/WINTER SEASONAL DEVIATIONS ANALYSIS USING 1961-1990 CLIMATE NORMS
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SUMMER/WINTER SEASONAL DEVIATIONS for Grosser Aletschgletscher (1961-1990 norms)
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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

Table with 7 columns: , coef, std err, t, P>|t|, [0.025, 0.975]. Rows include const, summer\_td, and winter\_pd.

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 Aletschglletscher (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

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OPTIMAL SEASONAL DEVIATIONS ANALYSIS USING 1991-2020 CLIMATE NORMS
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OPTIMAL SEASONAL DEVIATIONS for Grosser Aletschgletscher (1991-2020 norms)
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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

Table with 7 columns: coef, std err, t, P>|t|, [0.025, 0.975]. Rows include const, opt\_season\_td, and opt\_season\_pd.

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

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SUMMER/WINTER SEASONAL DEVIATIONS ANALYSIS USING 1991-2020 CLIMATE NORMS
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SUMMER/WINTER SEASONAL DEVIATIONS for Grosser Aletschgletscher (1991-2020 norms)
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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

Table with 7 columns: , coef, std err, t, P>|t|, [0.025, 0.975]. Rows include const, summer\_td, winter\_pd, and diagnostic statistics (Omnibus, Prob(Omnibus), Skew, Kurtosis).

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