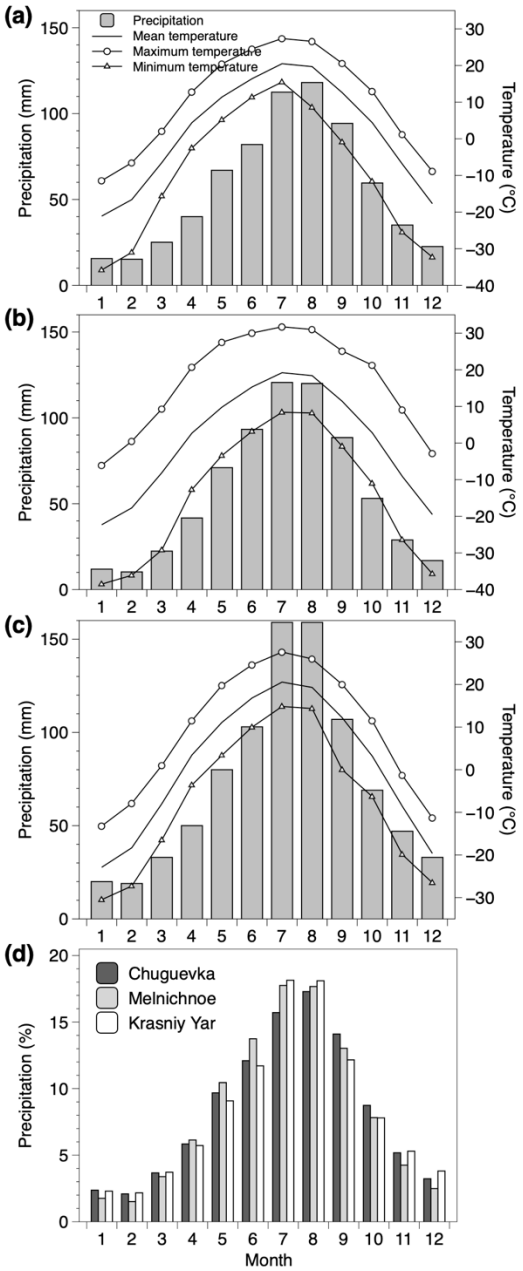

Figure S1: Monthly total precipitation and mean, minimum and maximum temperature at (a) Chuguevka (1936-2004), (b) Melnichnoe (1941-2009), and (c) Krasniy Yar (1940-2013) meteorological stations; (d) annual precipitation distribution in percent for all three meteorological stations.

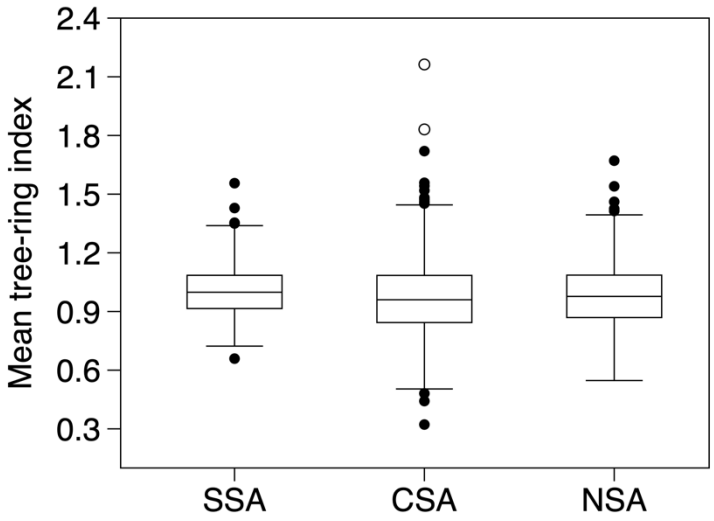

Figure S2: Mean tree-ring index for SSA, CSA and NSA chronologies. Boxes represent the interquartile range, and the horizontal line within the box shows the median. Whiskers extend to the 10th and 90th percentiles; the points show outliers and the circles show extremes beyond the 90th percentile.

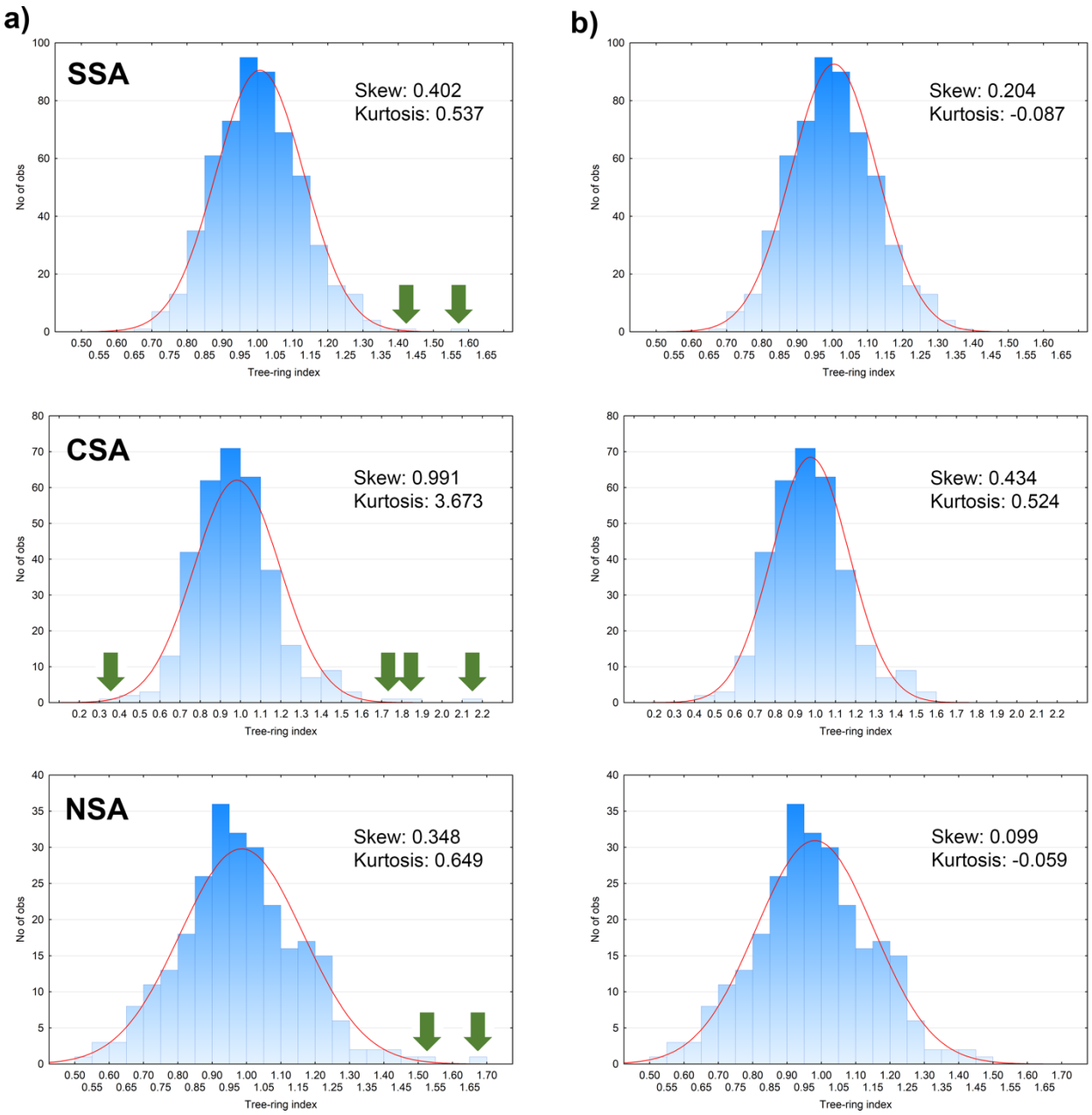

Figure S3: Distribution of the tree-ring indexes for SSA, CSA and NSA chronologies: before (a) and after (b) filtering outliers (using Z-score, with -3 and 3 as threshold values) in the beginning of the chronologies (where EPS < 0.85). Green arrows indicate outliers (the values are caused by the low sample depth); red lines are the fit with a normal curve.

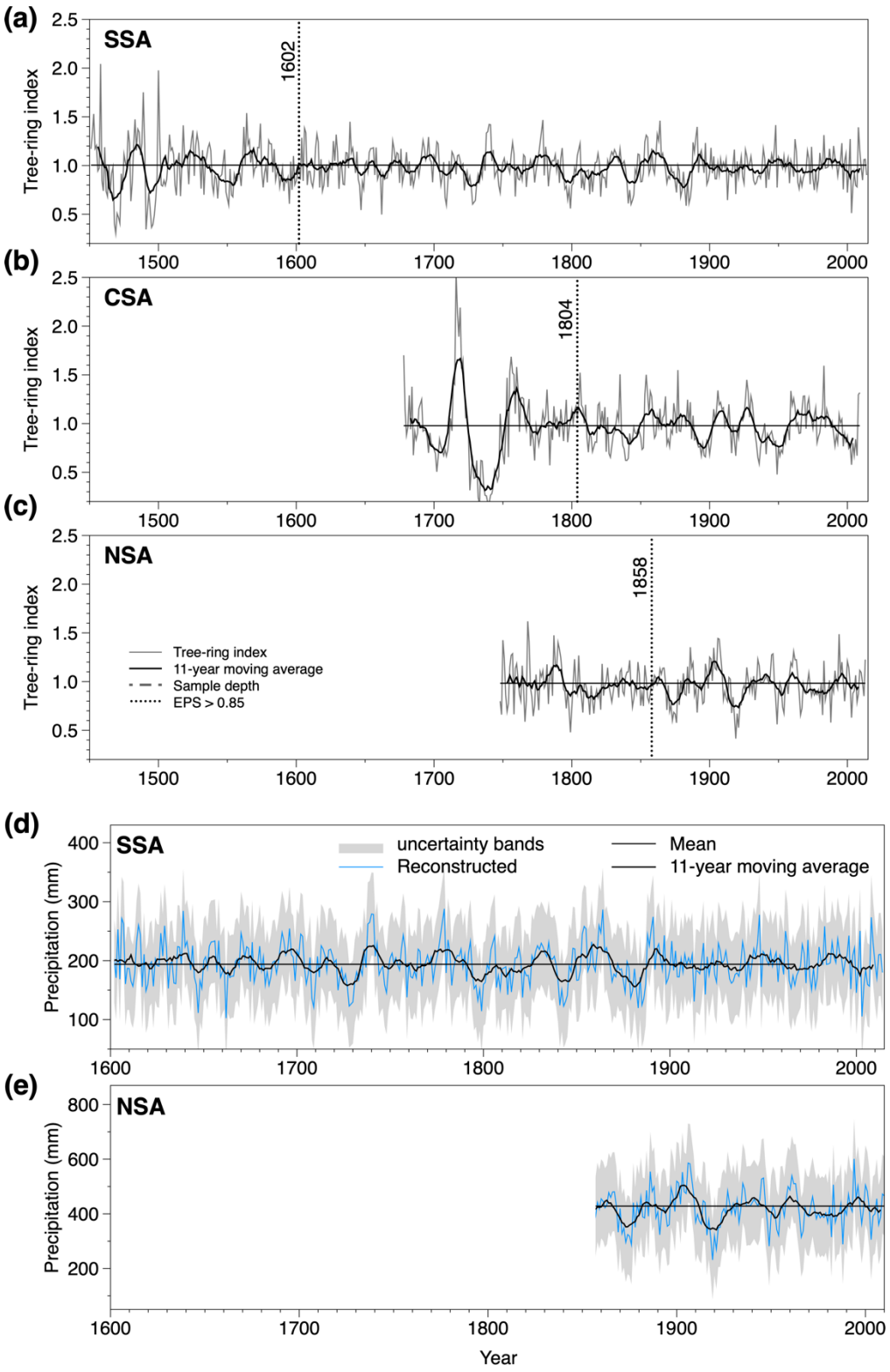

Figure S5: Standard chronologies (a-c) and corresponding precipitation reconstructions (d, e). Uncertainty bands estimated as twice the standard error of prediction (±2σ) (Wilks, 1995). CSA chronology was not used for reconstruction because as a result of evaluation the relationships between the ring-width index and observed monthly climate records in treeclim for RE and CE we obtained values 0.322 and -0.348, respectively. For SSA and NSA values of RE and CE were 0.298 and 0.297, 0.218 and 0.124, respectively.

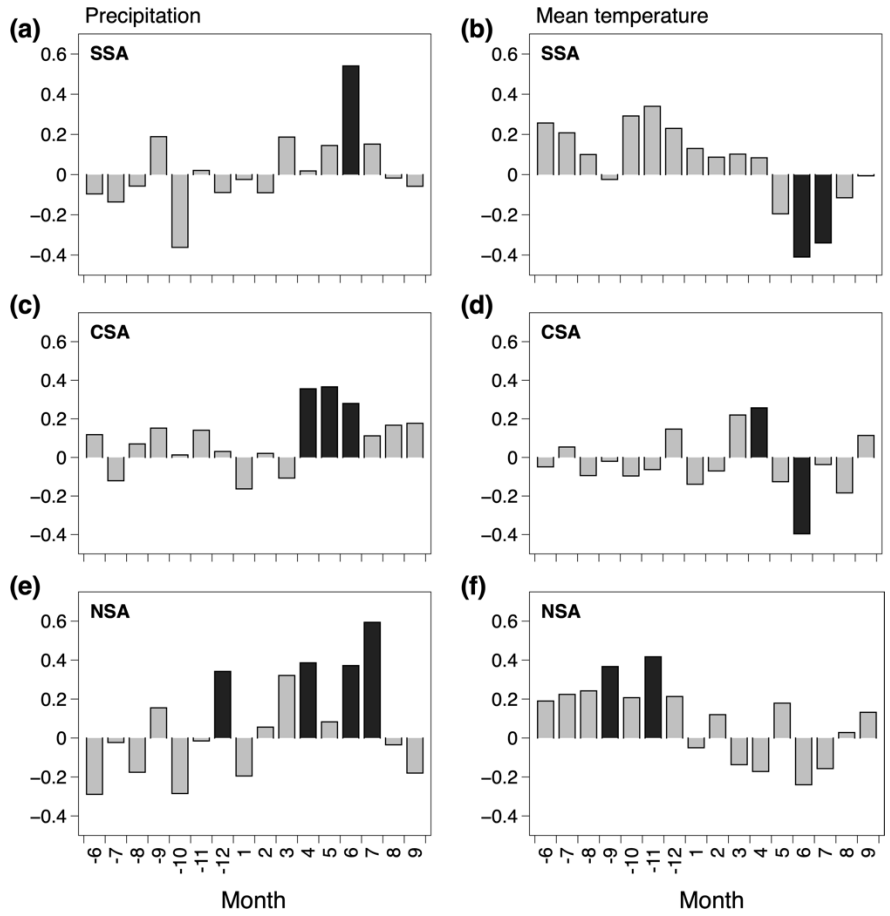

Figure S5: The correlation between the meteorological data (total precipitation and mean temperature) from Chuguevka meteorological station and SSA tree-ring width index (a, b), Melnichnoe meteorological station and CSA tree-ring width index (c, d), Krasniy Yar meteorological station and NSA tree-ring width index (e, f). Black bars denote significant values ($\alpha = 0.01$).

Table S1. Correlation between instrumental precipitation data and monthly climate indexes. April-June and July-September are the durations of the first and second stages of the summer monsoon, respectively; April-September is entire summer monsoon period. Significant correlations ($p < 0.05$) are marked in bold.

	Chuguevka			Melnichoye			Krasny Yar		
Index	Apr-Jun	Jul-Sep	Apr-Sep	Apr-Jun	Jul-Sep	Apr-Sep	Apr-Jun	Jul-Sep	Apr-Sep
SOI	0.151	0.199	**0.351**	0.037	0.107	0.140	-0.035	-0.072	-0.02
NINO3	0.021	-0.195	-0.194	0.080	0.033	0.030	0.130	-0.034	-0.012
NINO4	-0.055	-0.137	-0.185	-0.004	-0.013	-0.113	0.121	0.026	0.062
NINO3.4	-0.046	-0.184	**-0.399**	0.076	0.037	-0.034	0.130	0.030	0.043
PDO	-0.075	-0.158	**-0.331**	-0.037	-0.211	**-0.419**	-0.011	-0.188	-0.123
AO	0.188	-0.108	0.099	-0.009	0.002	0.062	0.175	0.114	**0.267**