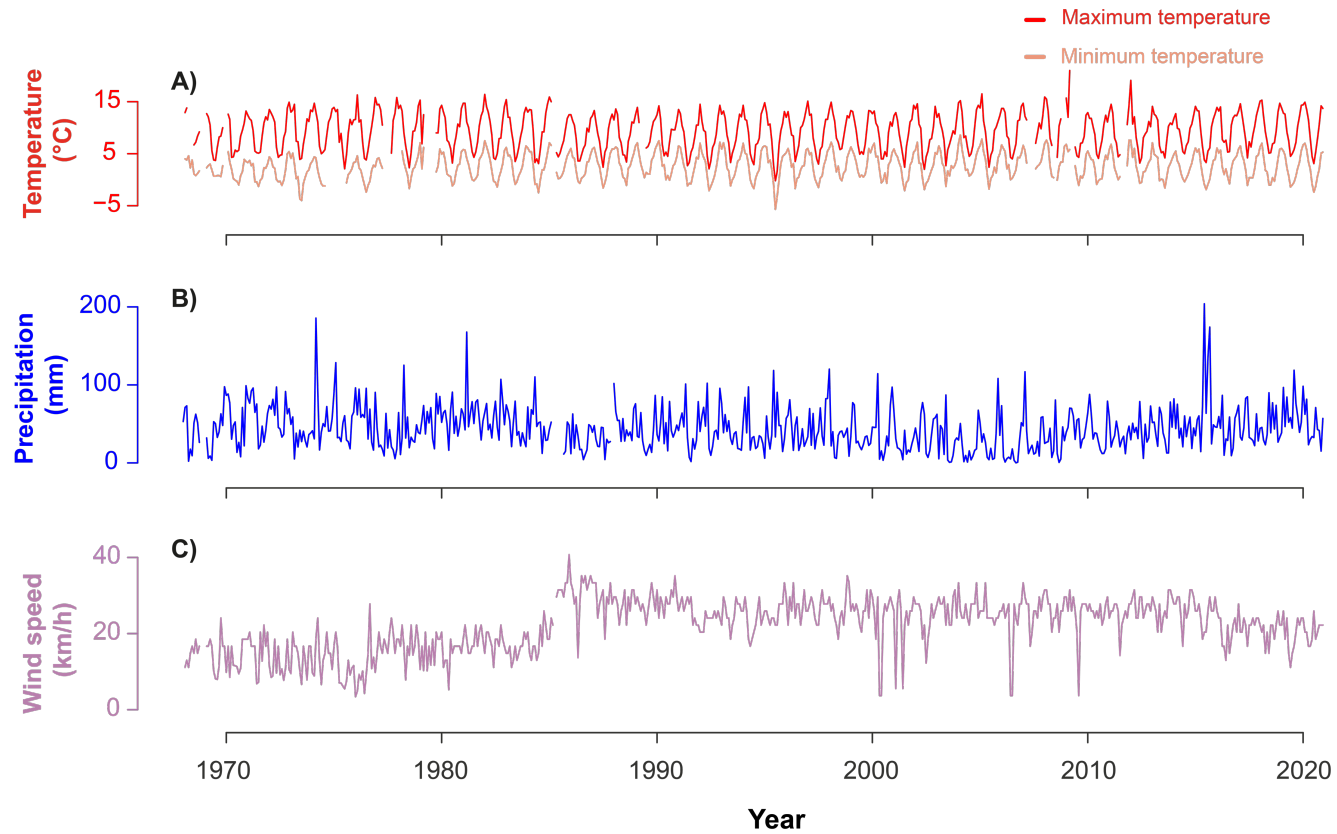


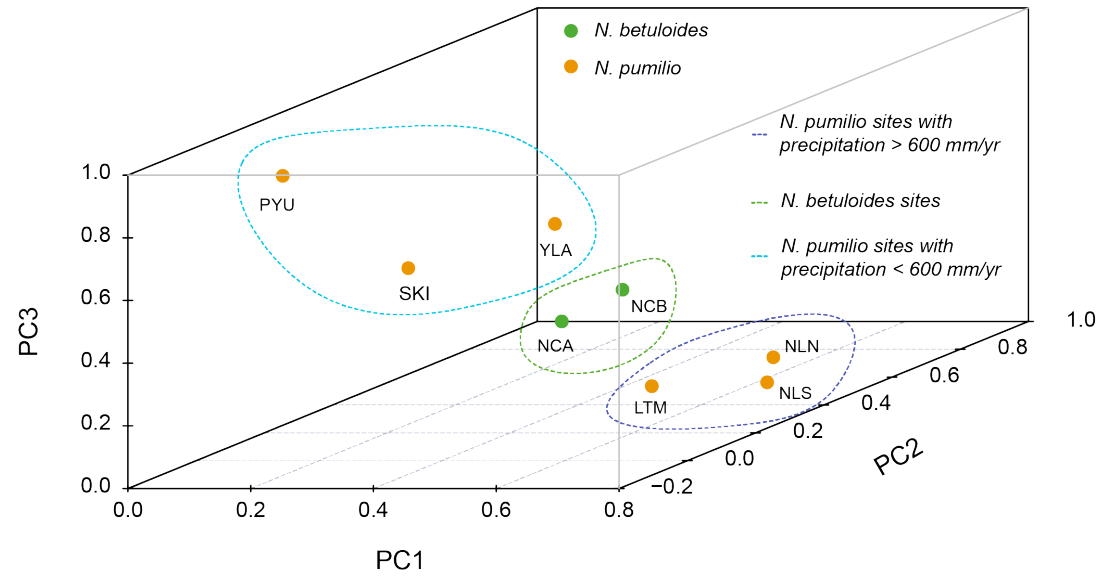
## SUPPLEMENTARY MATERIAL



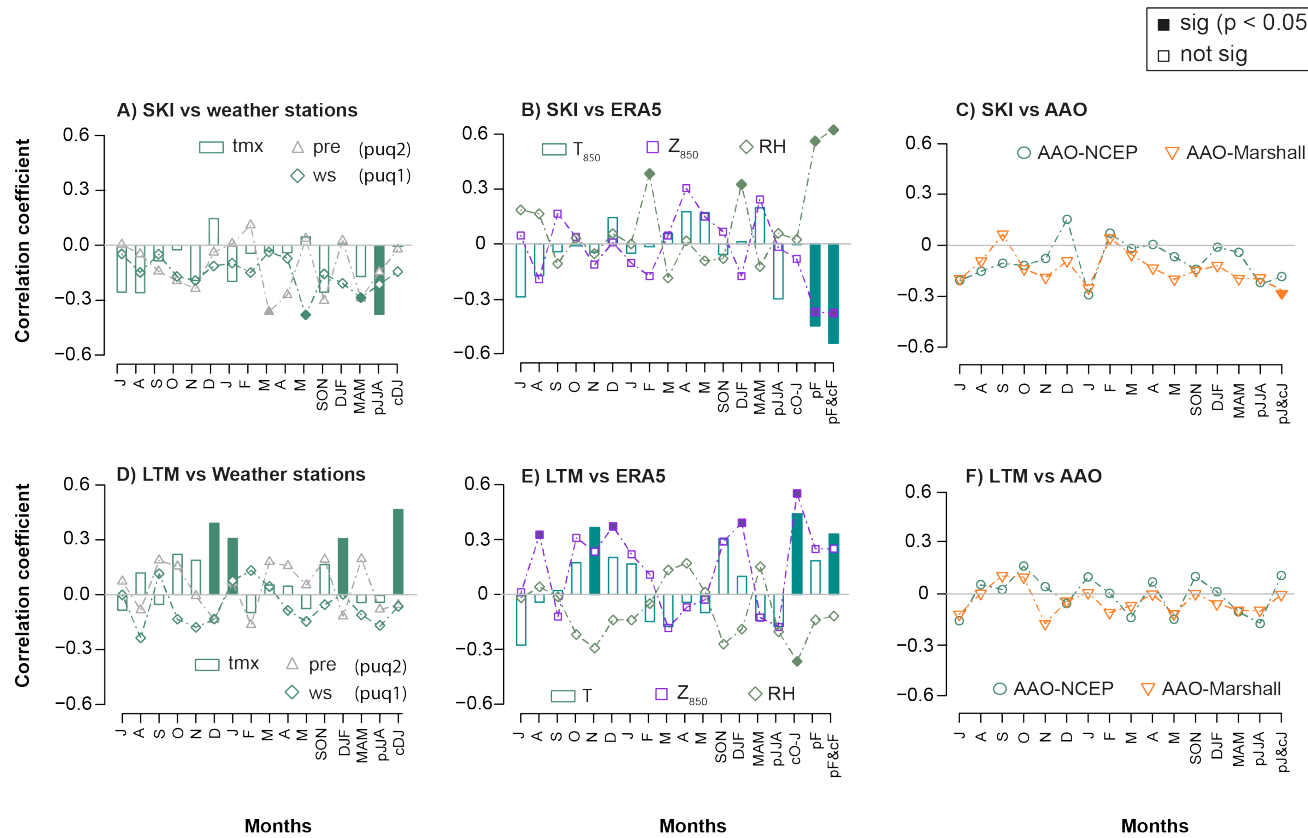
**Figure S1.** Monthly climate time series from Puerto Williams weather station between January 1968 and December 2020 for A) temperature (in  $^{\circ}\text{C}$ ); B) precipitation (in mm) and C) wind speed (in km/h).

Name site	specie	Collection sites	Mean (Std dev) series intercorrelation	Mean (Std dev) AR1
<b>SKI</b>	<i>N. pumilio</i>	<i>Ski field, Punta Arenas</i>	0.65 (0.086)	0.67 (0.132)
<b>LTM</b>	<i>N. pumilio</i>	<i>Tres Morros, Punta Arenas</i>	0.64 (0.082)	0.72 (0.112)
<b>YLA</b>	<i>N. pumilio</i>	<i>Yendegaia Chile-Argentina border</i>	0.67 (0.062)	0.69 (0.098)
<b>PYU</b>	<i>N. pumilio</i>	<i>Paso Lapataia, Yendegaia</i>	0.73 (0.059)	0.60 (0.083)
<b>NLN</b>	<i>N. pumilio</i>	<i>Ukika Valley, Navarino Island</i>	0.66 (0.060)	0.680 (0.11)
<b>NLS</b>	<i>N. pumilio</i>	<i>Ukika Valley, Navarino Island</i>	0.60 (0.073)	0.73 (0.086)
<b>NCA</b>	<i>N. betuloides</i>	<i>Ukika Valley, Navarino Island</i>	0.55 (0.072)	0.79 (0.095)
<b>NCB</b>	<i>N. betuloides</i>	<i>Ukika Valley, Navarino Island</i>	0.53 (0.071)	0.82 (0.087)

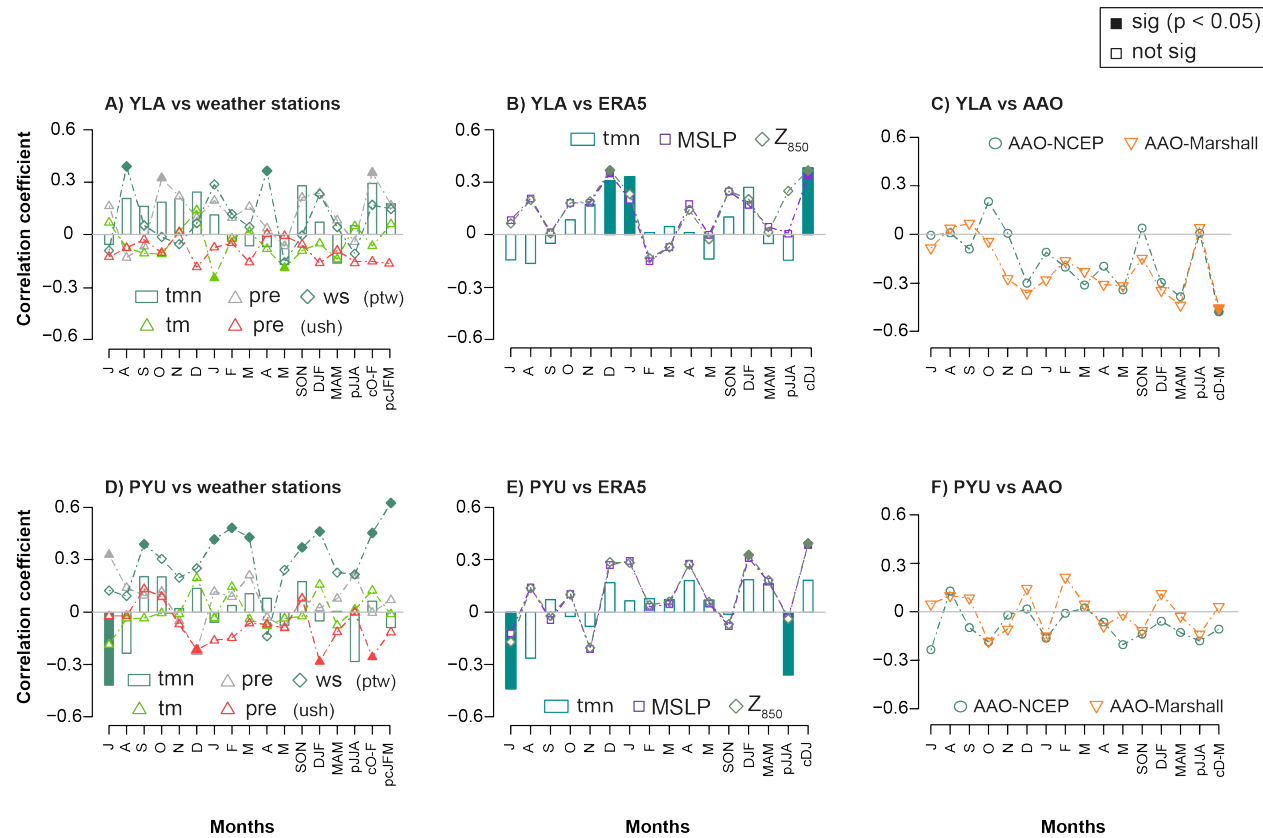
**Table S1.** Statistical characteristics of our tree-ring chronologies.



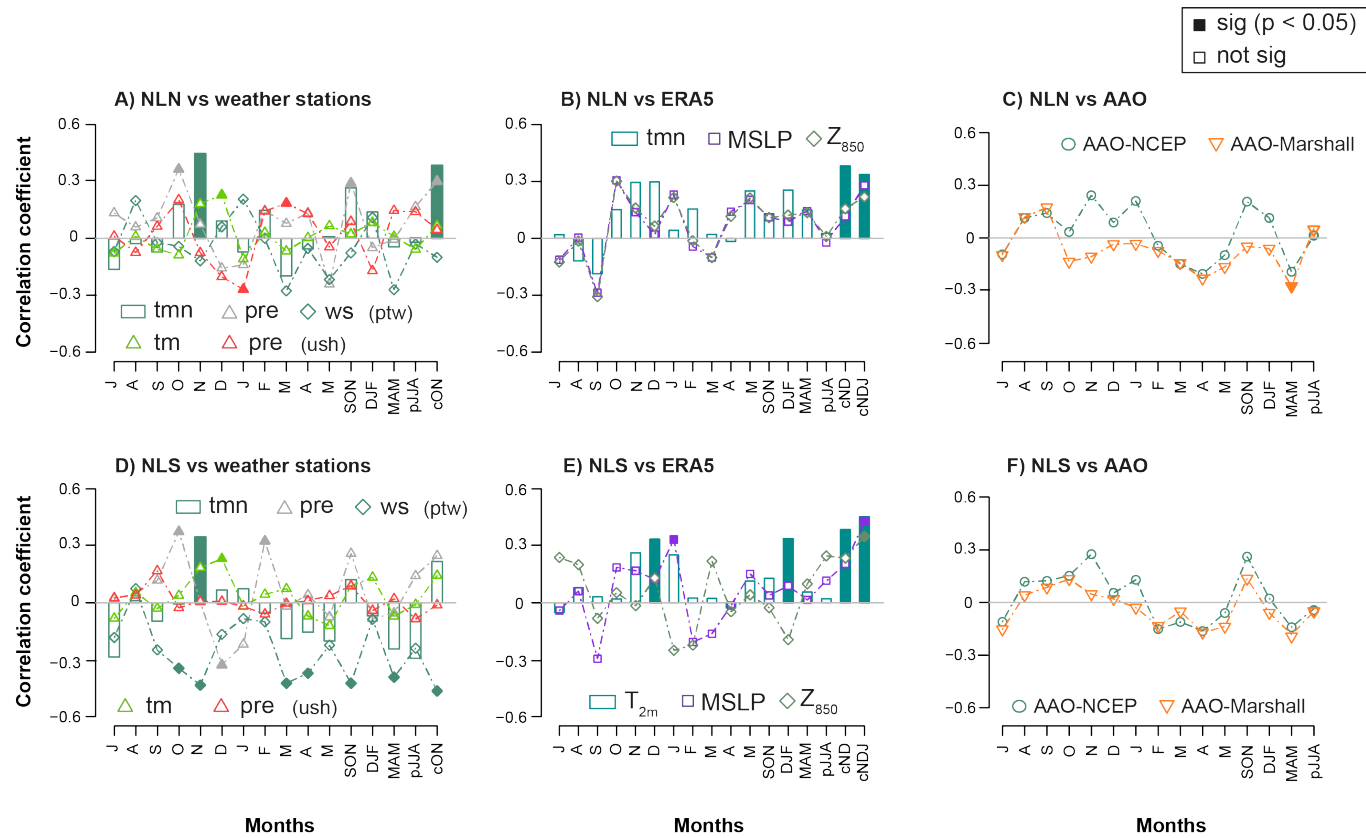
**Figure S2.** The 3D PCA plot for *Nothofagus* spp. tree growth chronologies. *N. pumilio* and *N. betuloides* chronologies are shown with orange and green colors, respectively



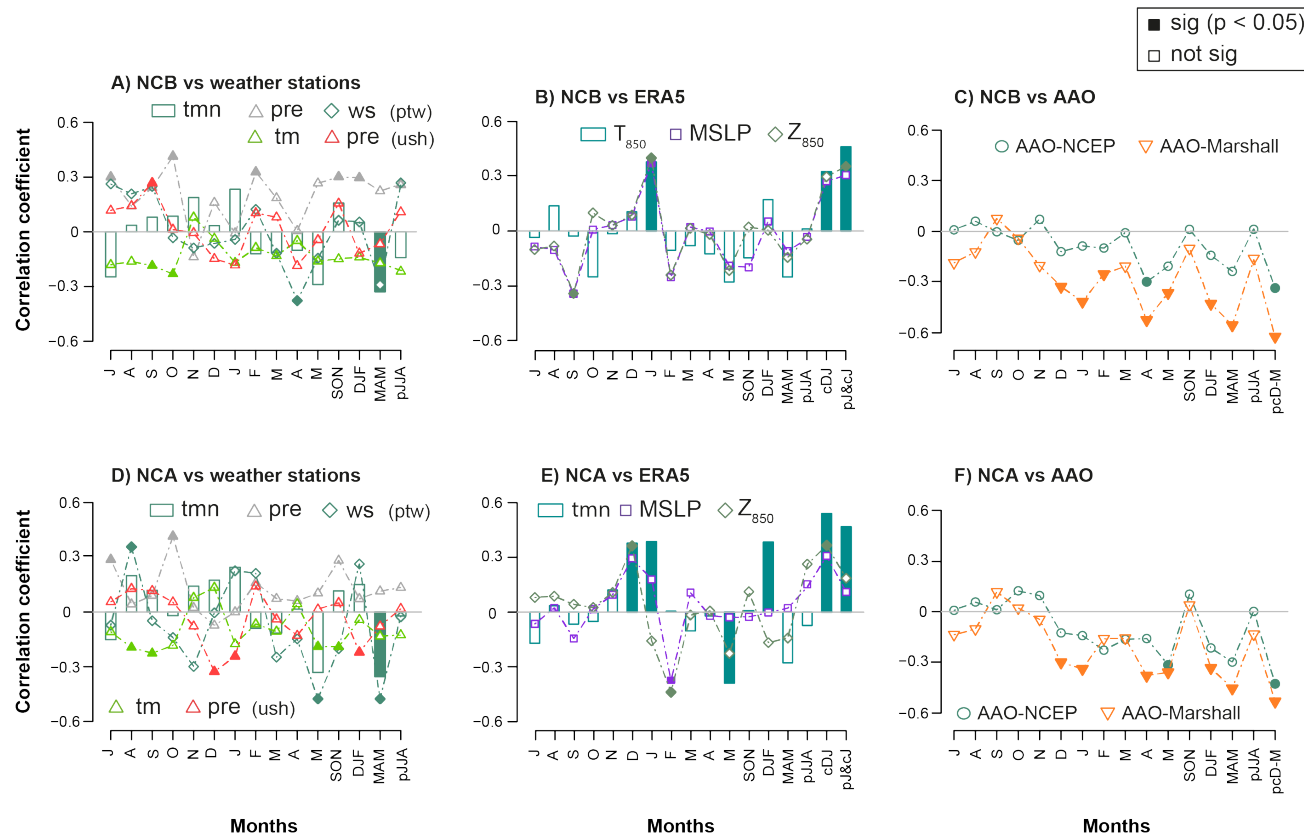
**Figure S3.** Monthly, season and the best combination of months of Pearson correlation coefficients between Punta Arenas study area tree-ring SKI/LTM chronologies (*N. pumilio*) and climate variables from the weather station, ERA5 data, and AAO indices. Significance is indicated for each case: ns= blank colour,  $p < 0.05$ = filled with colour. Austral seasons: SON= September-October-November (spring), DJF=December-January-February (summer), MAM=March-April-May (autumn), and pJJA=June-July-August (previous winter). The best combination of months for the climate-growth correlations were: cDJ=current December-January, cO-J=current October to through January, pF= previous February, July, pF&cF=previous and current February, pJ&pJ=previous and current January.



**Figure S4.** Monthly, season and the best combination of months of Pearson correlation coefficients between Yendegaia Valley study area tree-ring YLA/PYU chronologies (*N. pumilio*) and climate variables from the weather station, ERA5 data, and AAO indices. Significance is indicated for each case: ns= blank colour,  $p < 0.05$ = filled with colour. Austral seasons: SON= September-October-November (spring), DJF=December-January-February (summer), MAM=March-April-May (autumn), and pJJA=June-July-August (previous winter). The best combination of months for the climate-growth correlations were: cO-F=current October to through February, pcJFM=previous and current January to through March, cDJ=current December-January, cD-M=current December to through May, pcJFM=previous and current May to through July.



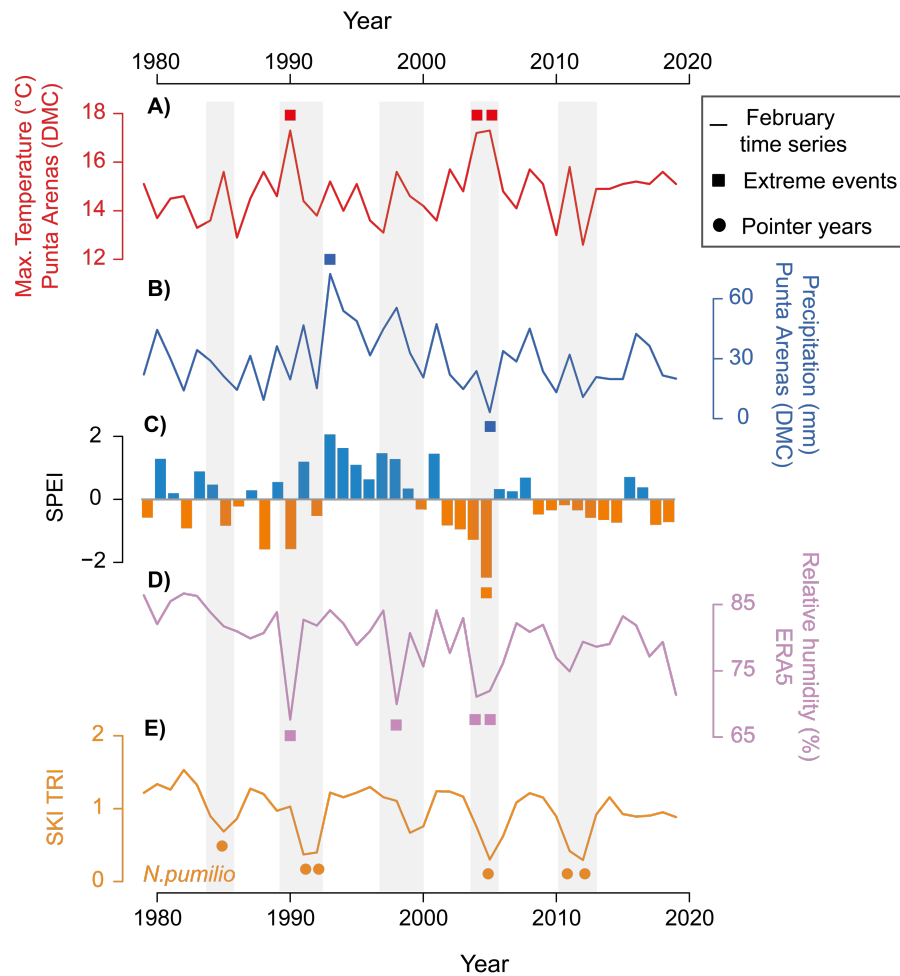
**Figure S5.** Monthly, season and the best combination of months of Pearson correlation coefficients between Navarino Island (Ukika Valley) study area tree-ring NLN/NLS chronologies (*N. pumilio*) and climate variables from the weather station, ERA5 data, and AAO indices. Significance is indicated for each case: ns= blank colour,  $p < 0.05$ = filled with colour. Austral seasons: SON= September-October-November (spring), DJF=December-January-February (summer), MAM=March-April-May (autumn), and pJJA=June-July-August (previous winter). The best combination of months for the climate-growth correlations were: cON=current October-November, cND=current November-December, cNDJ=current November to through January, pF=previous February, cJA=current July-August.



**Figure S6.** Monthly, season and the best combination of months of Pearson correlation coefficients between Navarino Island (Ukika Valley) study area tree-ring NCB/NCA chronologies (*N. betuloides*) and climate variables from the weather station, ERA5 data, and AAO indices. Significance is indicated for each case: ns= blank colour, p < 0.05= filled with colour. Austral season: SON= September-October-November (spring), DJF=December-January-February (summer), MAM=March-April-May (autumn) and pJJA=June-July-August (previous winter). The best combination of months for the climate-growth correlations were: cDJ=current December-January, pJ&pJ=previous and current January, pcD-M= previous and current December to through May.



**Figure S7.** Monthly, season and the best combination of months of Pearson correlation coefficients between principal components (PCs) and climate variables from the weather station, ERA5 data, and AAO indices. Significance is indicated for each case: ns= blank colour,  $p < 0.05$ = filled with colour. Austral season: SON= September-October-November (spring), DJF=December-January-February (summer), MAM=March-April-May (autumn), and pJJA=June-July-August (previous winter). The best combination of months for the climate-growth correlations were: pJ&pJ=previous and current January, pcD-M= previous and current December to through May.



**Figure S8.** Time-series: A) maximum temperature (in °C), B) precipitation (mm), C) standardized precipitation-evapotranspiration index (SPEI), D). Relative humidity (%) and E) SKI tree-ring index of *Nothofagus pumilio*. SPEI scale ranges from -2 (very dry) to +2 (very wet). Light grey shaded stripes indicate extreme events and pointer years.