Tree-ring reconstructions of past climate at the regional scale: extending back in time summer temperature variability in the Italian Alps and the central Mediterranean

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(3)- IGG-CNR, Institute of Geosciences and Earth Resources, National Research Council

Climate change in the Italian Mountains and the Mediterranean Region (NextData project)

Italian Society for Climate Sciences

Venice Mestre - 17-19 October 2018

SISC

Sixth Annual Conference

Recent trends in climate sciences, adaptation and mitigation

NextData

This research was developed within the framework of the project of interest **NextData** (CNR - Università Milano-Bicocca)

A national system for the retrieval, storage, access and diffusion of environmental and climate data from mountain and marine areas of Italy

http://www.nextdataproject.it

Ice cores, lacustrine and marine sediments, pollen, **tree rings**…

391 tree-ring sites from the Italian dendro community (mainly metadata) and from the NOAA's ITRDB (also data)

NextData Project - Dendrocronologia

Insieme dei siti italiani per i quali è disponibile una cronologia stazionale. I metadati sono stati raccolti unicamente a scopo scientifico entro il progetto NextData: in parte sono stati direttamente inviati dai vari gruppi operanti in Italia e in parte sono stati derivati da database internazionali aperti.

Nome Ente che ha fornito dati e/o metadati

NOAA
National Oceanic and Atmospheric Administration
International Tree-Ring Data Bank (ITRDB)

Museo Civico Rovereto
Museo Civico di Rovereto
Laboratorio di Dendrocronologia

Seconda Università degli Studi di Napoli
Dipartimento di Scienze e Tecnologie Ambientali, Biologiche e Farmaceutiche (DiSTABiF)

Universita degli Studi del Molise
Dipartimento Bioscienze e Territorio

Università degli Studi della Basilicata
Dipartimento di Scienze dei Sistemi Colturali, Forestali e dell'Ambiente

Università degli Studi di Pisa
Dipartimento di Scienze della Terra

Università degli Studi di Milano
Dipartimento di Scienze della Terra "Ardito Desio"

Università degli Studi di Pavia
Dipartimento di Ecologia del Territorio

Università degli Studi di Padova
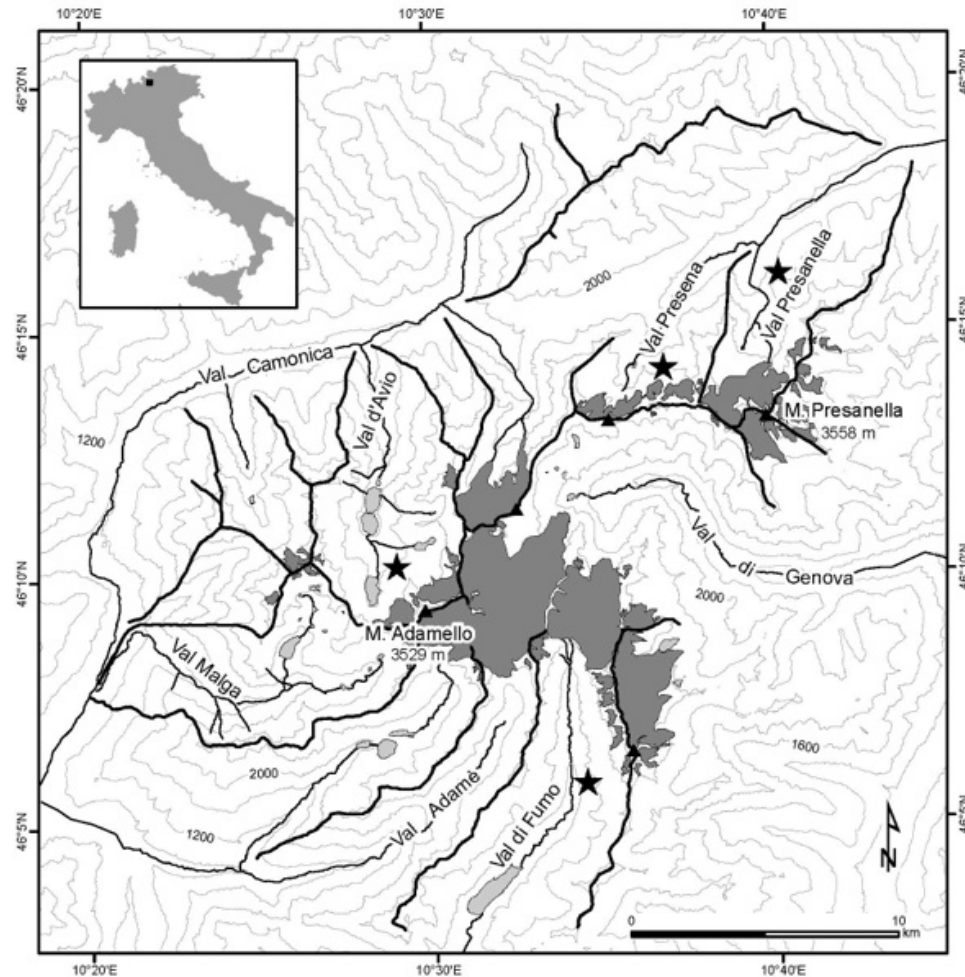Dipartimento Territorio e Sistemi Agro-Forestali

Nextdata project   Geomatic Laboratory DISAT Unimib

Lower abundance of data

Summer temperature reconstruction from a central sector fo the Alps and from the Apennines
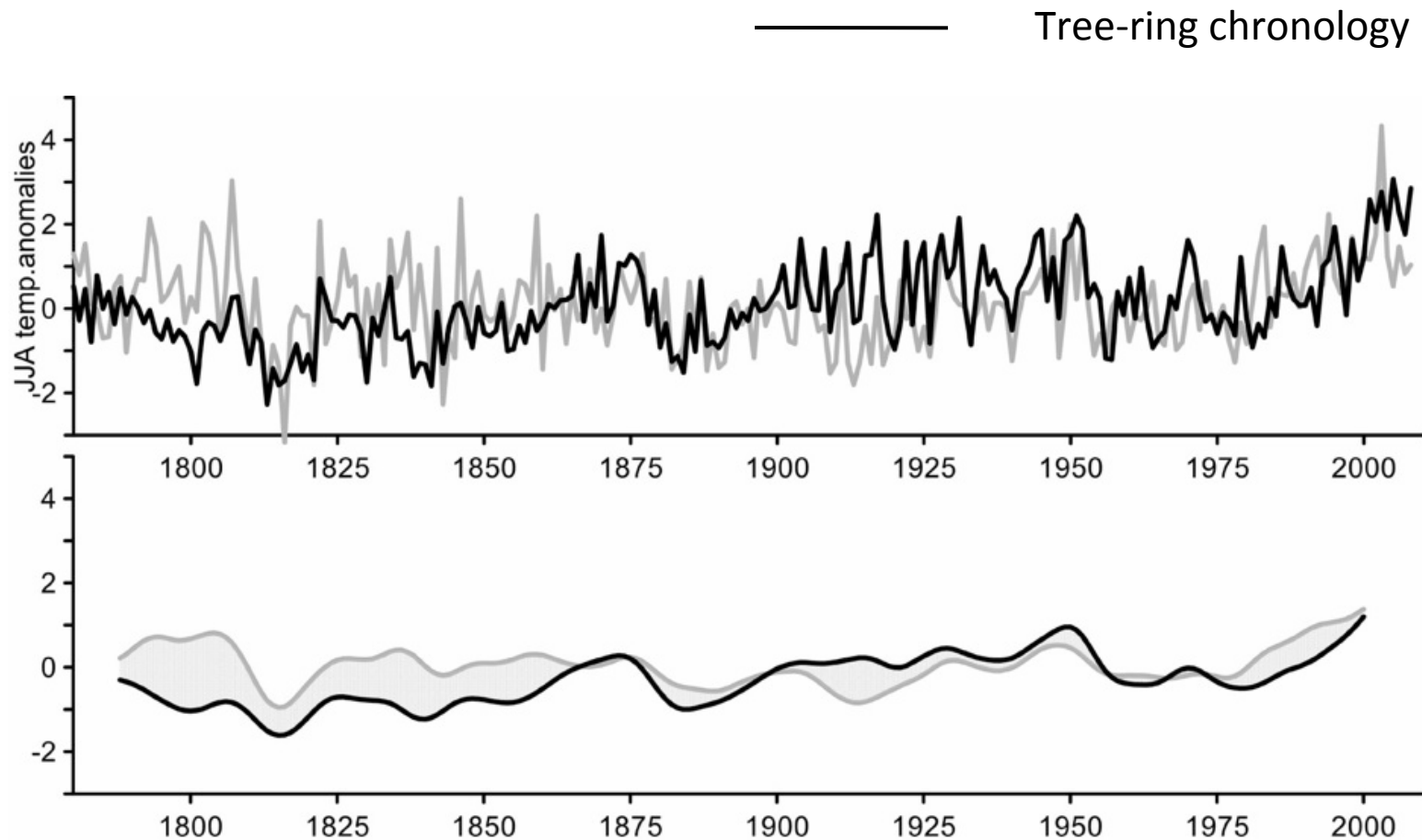
Temperature reconstructions - Alps

The Adamello-Presanella tree-ring network (*Larix decidua* Mill.)

Val Presena
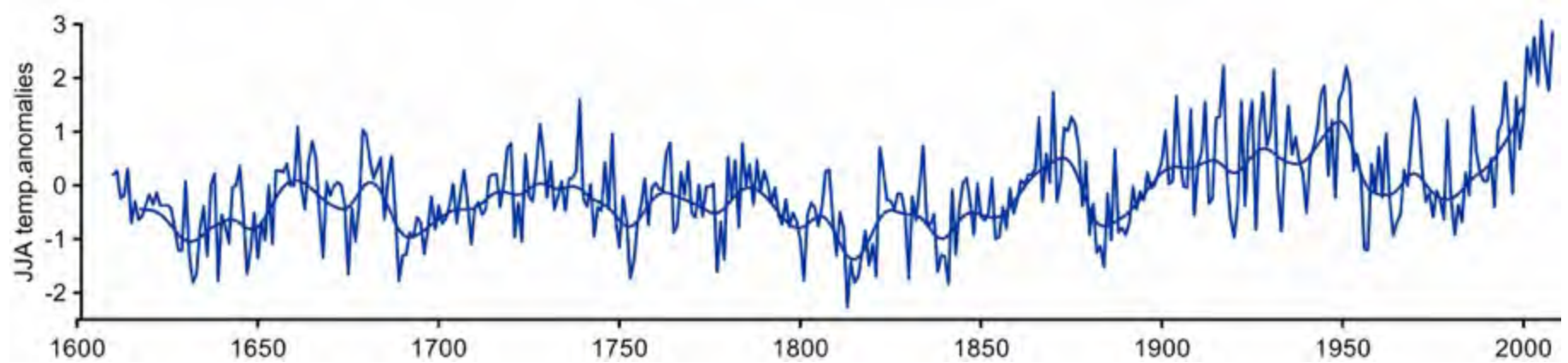Val Presanella
Val d'Avio
Val di Fumo

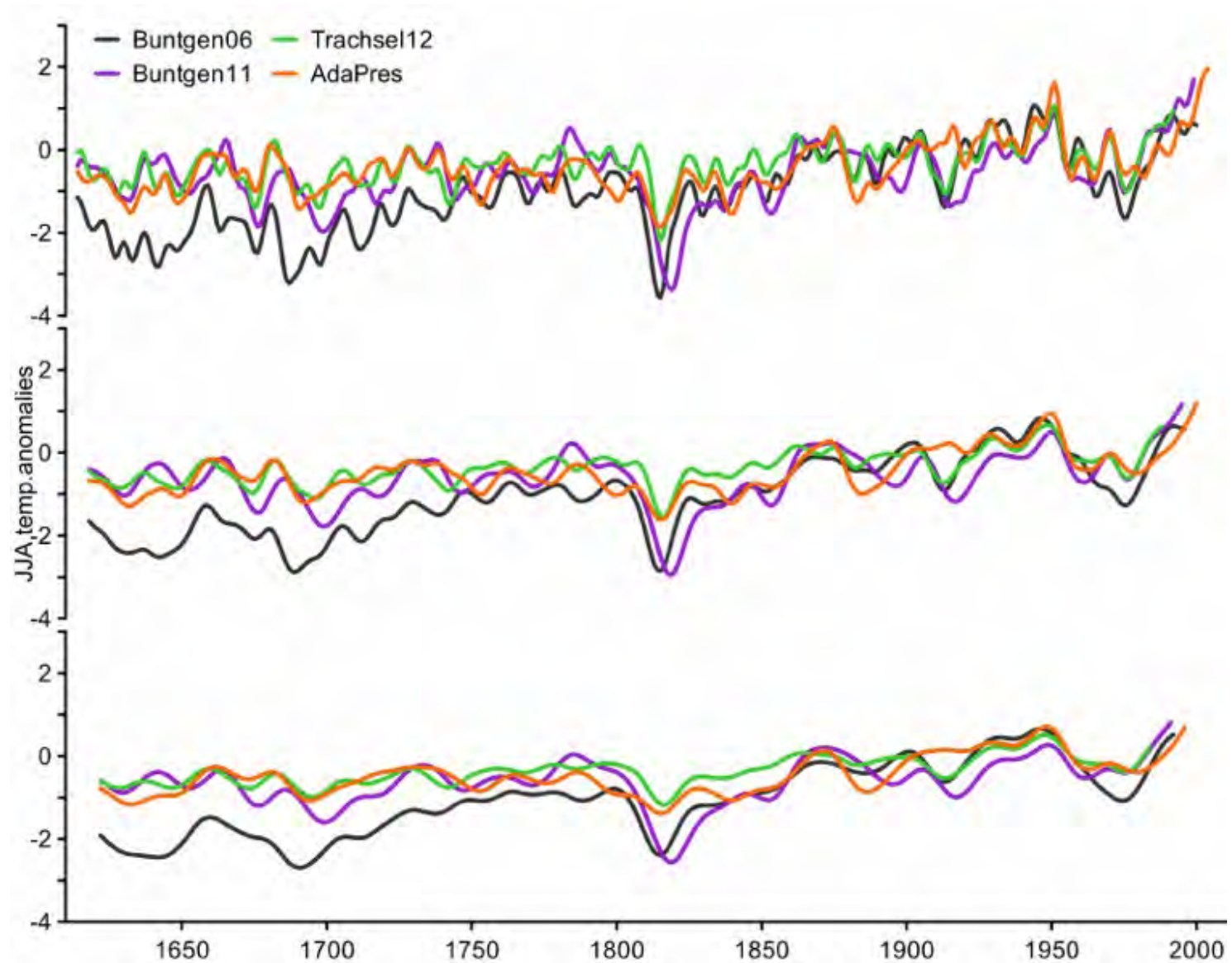Coppola et al., 2013 - Clim. Past

Temperature reconstructions - Alps

Tree-ring chronology

Coppola et al., 2013 - Clim. Past

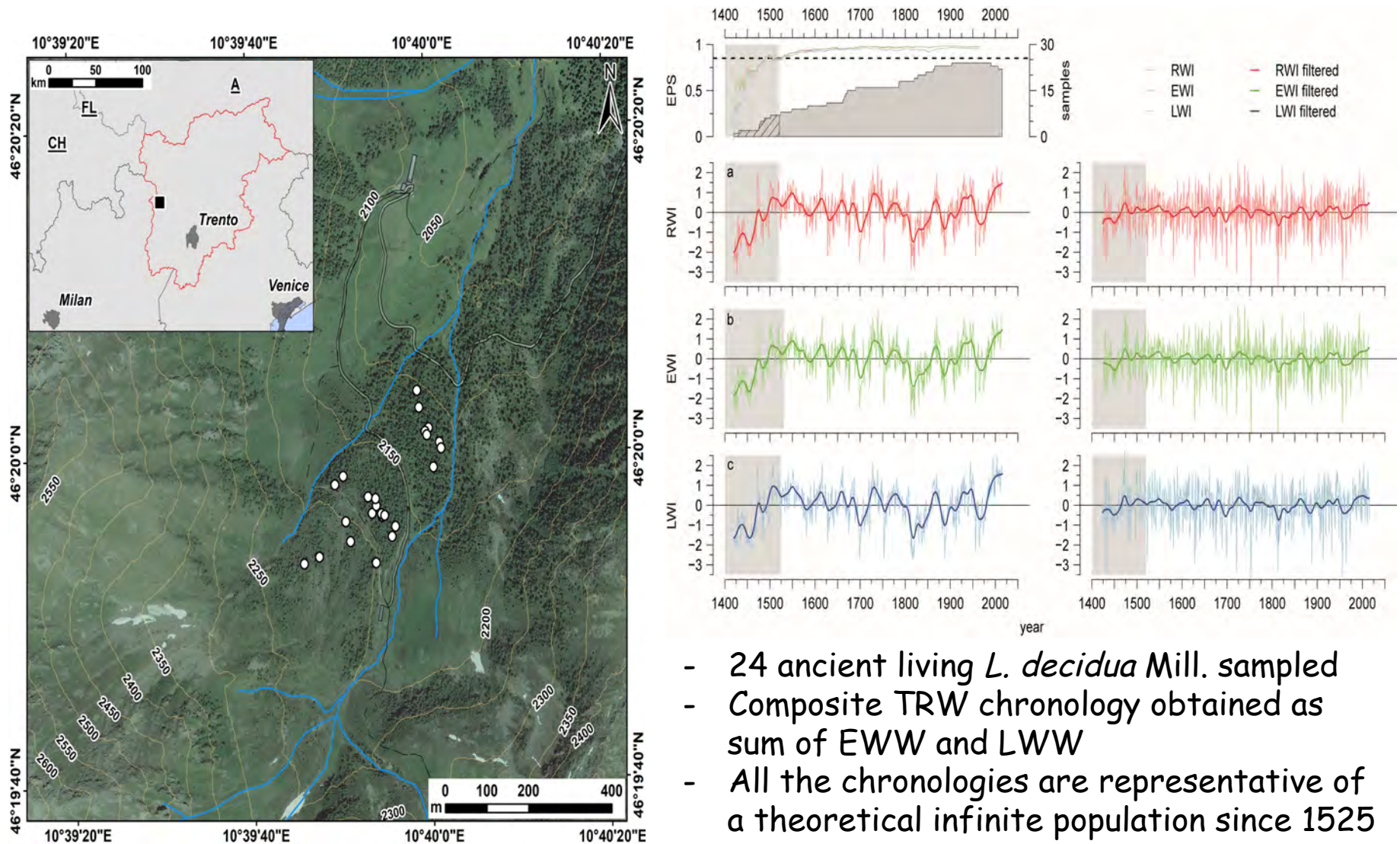Calibration over the JJA temperature HISTALP dataset. Auer et al., 2007 - Int. J. Climatolgoy
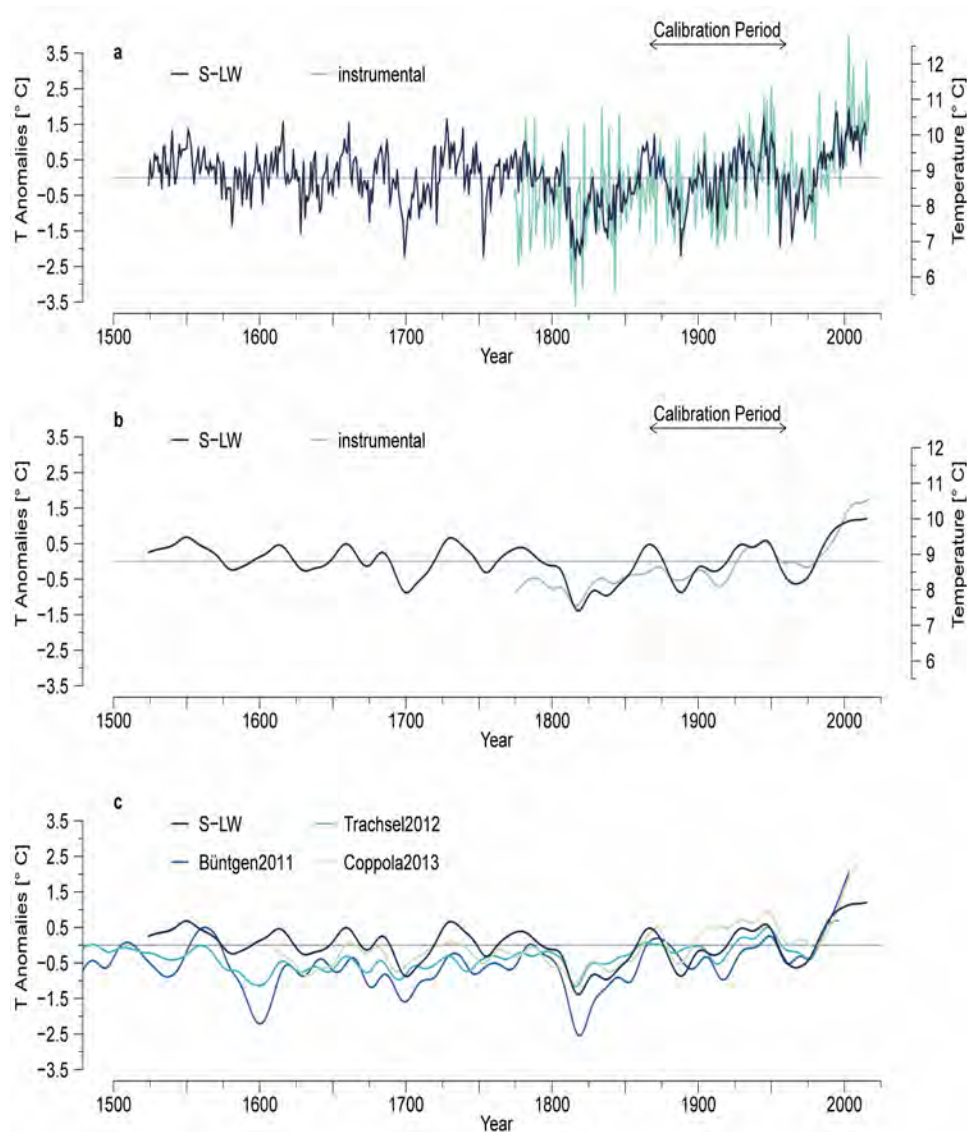
Temperature reconstructions - Alps

Coppola et al., 2013 - Clim. Past

Temperature reconstructions - Alps

Coppola et al., 2013 - Clim. Past

Bosco Antico, the most ancient living European larch wood in the Southern Rhaetian Alps

- 24 ancient living *L. decidua* Mill. sampled
- Composite TRW chronology obtained as sum of EWW and LWW
- All the chronologies are representative of a theoretical infinite population since 1525

CERRATO R., SALVATORE M.C., BRUNETTI M., COPPOLA A. & BARONI C. (2018) - *Dendroclimatic relevance of "Bosco Antico", the most ancient living European larch wood in the Southern Rhaetian Alps (Italy)*. Geografia Fisica e Dinamica Quaternaria, 41 (1).

- The new reconstruction well represents the climatic variations at both local (Coppola2013) and regional (Buntgen2011, Trachsel2016 [var. 6]) scales
- Perfectly represent the cool phase at the end of the LIA and the last cool phase occured during the 1970s that drew the last readvance of the glaciers in the area
- Lenghtening the previous local reconstruction of about 100 years

CERRATO R., SALVATORE M.C., BRUNETTI M., COPPOLA A. & BARONI C. (2018) - *Dendroclimatic relevance of "Bosco Antico", the most ancient living European larch wood in the Southern Rhaetian Alps (Italy)*. Geografia Fisica e Dinamica Quaternaria, 41 (1).

Poster PS02/06

Temperature reconstructions - Alps

- The 46°N 10°E tree-ring network (*multi species approach*)
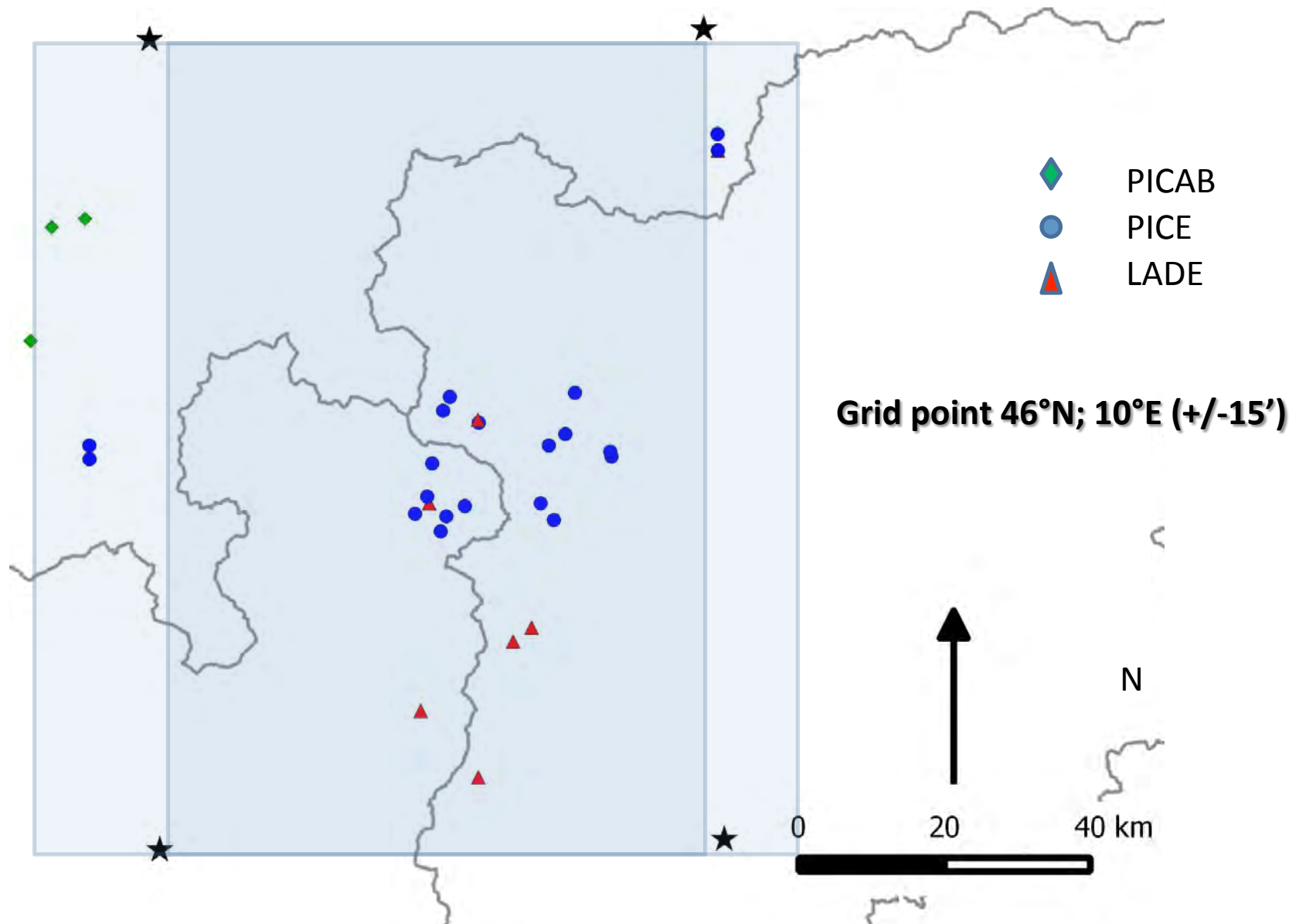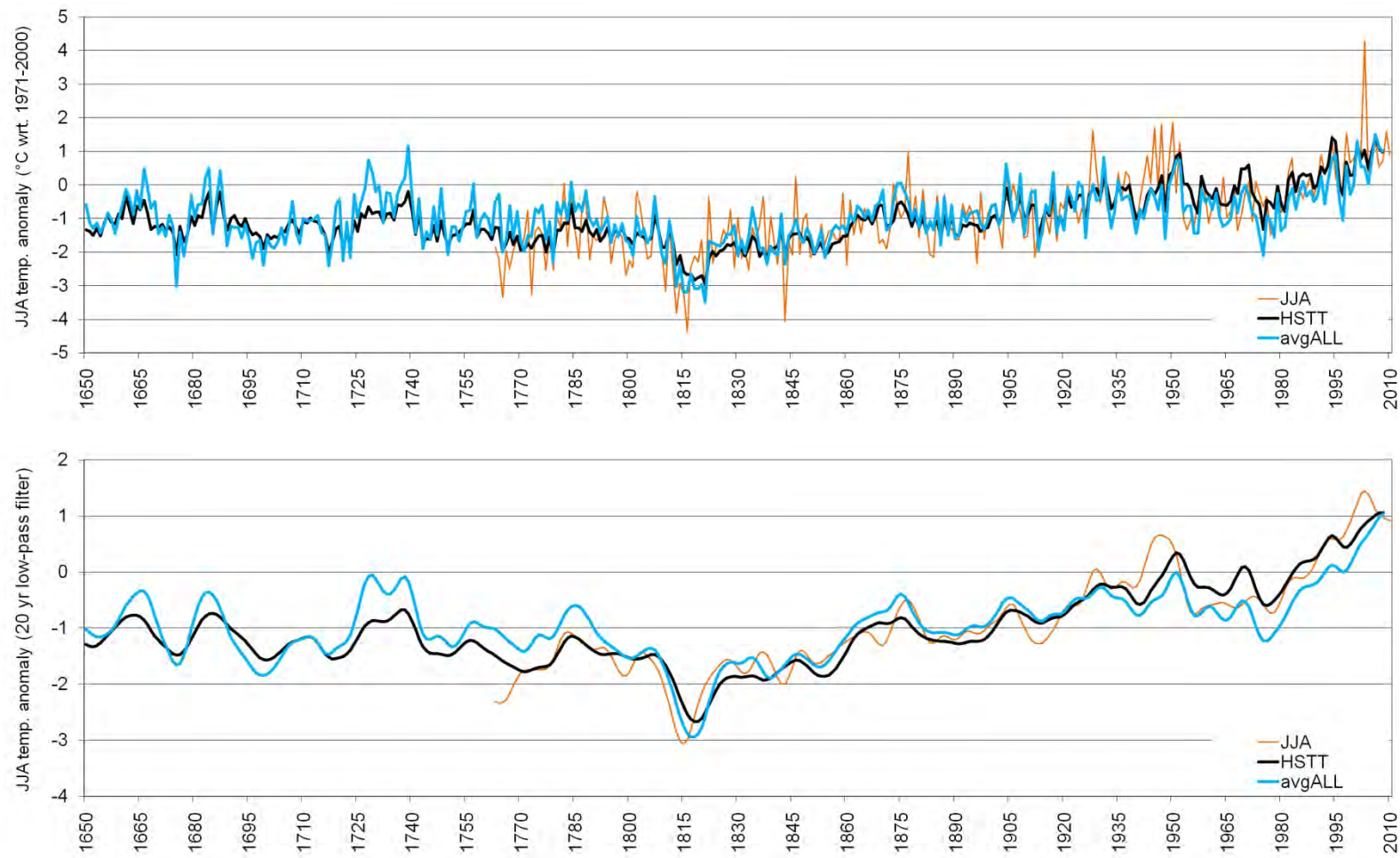
Temperature reconstructions - Alps
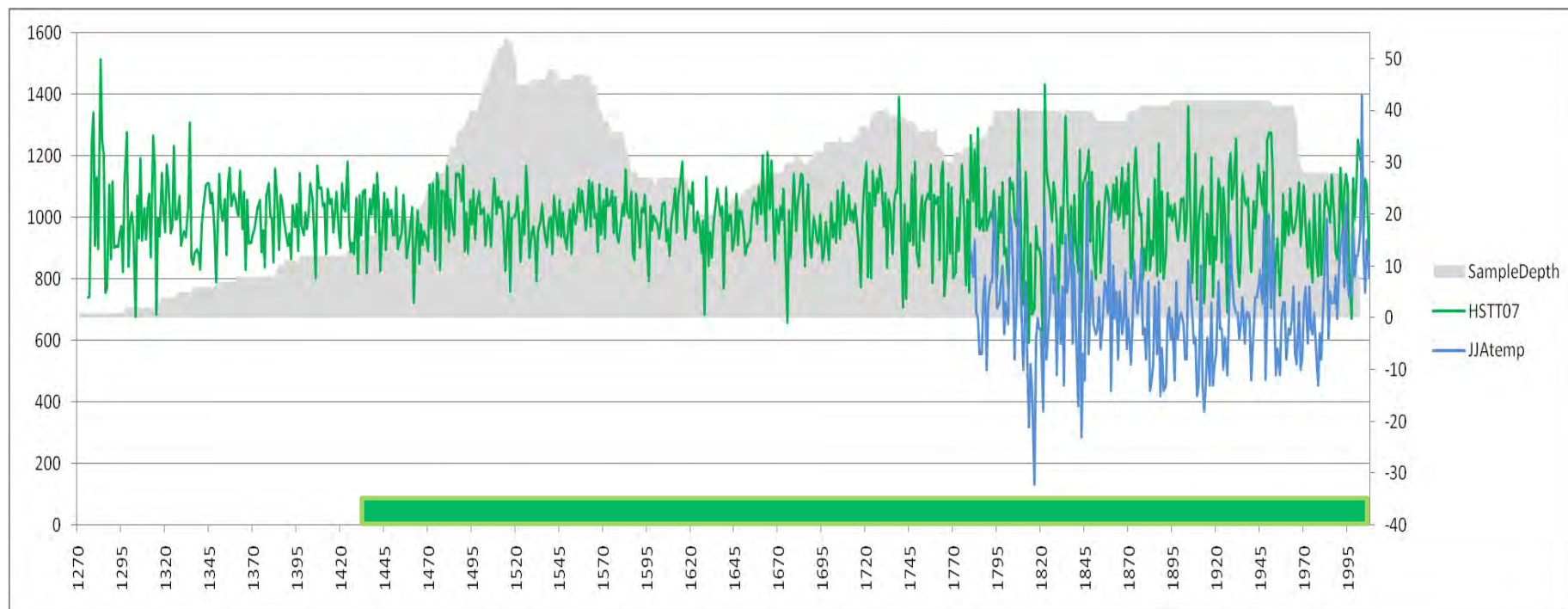
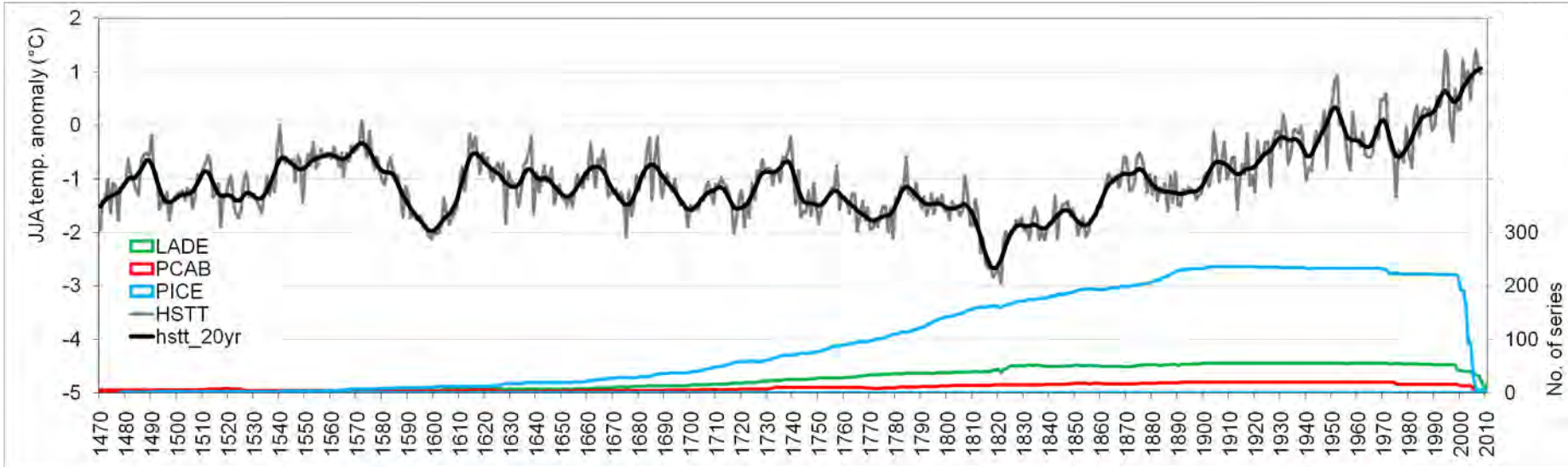Chronology time span 1276-2008 (732 yr)
Period with EPS>85% 1430-2005 (576 yr)

Summer temperature reconstruction for the pre-instrumental period

Modeling JJA temperature by scaling, using the HSTT and avgALL chronologies

Summer temperature reconstruction for the pre-instrumental period

The HSTT reconstruction and the contribution of the series from different species over time (c): the vertical line in 1566 delimits the older period where the number of series of *P.abies* exceeds the *L.decidua series*

(Leonelli et al., 2016 Climatic Change)

Comparisons with other reconstructions

The HSTT and avgALL JJA temperature reconstructions compared with Büntgen et al., 2011 (Büntgen11) and Trachsel et al. 2012 (Trachsel12). All series, comprising the instrumentally recorded JJA temperatures, were smoothed with a Gaussian 20-yr low-pass filter

(Leonelli et al., 2016 Climatic Change)

Temperature reconstruction from sites located in the Apennines
Site selection, tree selection — Site-specific climate data

- Application of a metholdology for reconstructing past climate based only on the most sensitive trees.

- RW: Ring-width sites
    - Conifer 11 sites (+5 sites only for some series)
    - Broadleaf 4 sites (+7 sites only for some series)

- MXD: Maximum latewood densitiy sites
    - Conifer 8 sites

- Mean precipitation 1433 mm

    Winter 34%
    Spring: 24
    Summer: 11%
    Autumn: 31%

Site-specific climate data available, also from historic series: 200-250 yr of data (Brunetti et al., 2006).

Variables used: monthly temperature, monthly precipitaztion and Standardized Precipitation Index at 3 months.
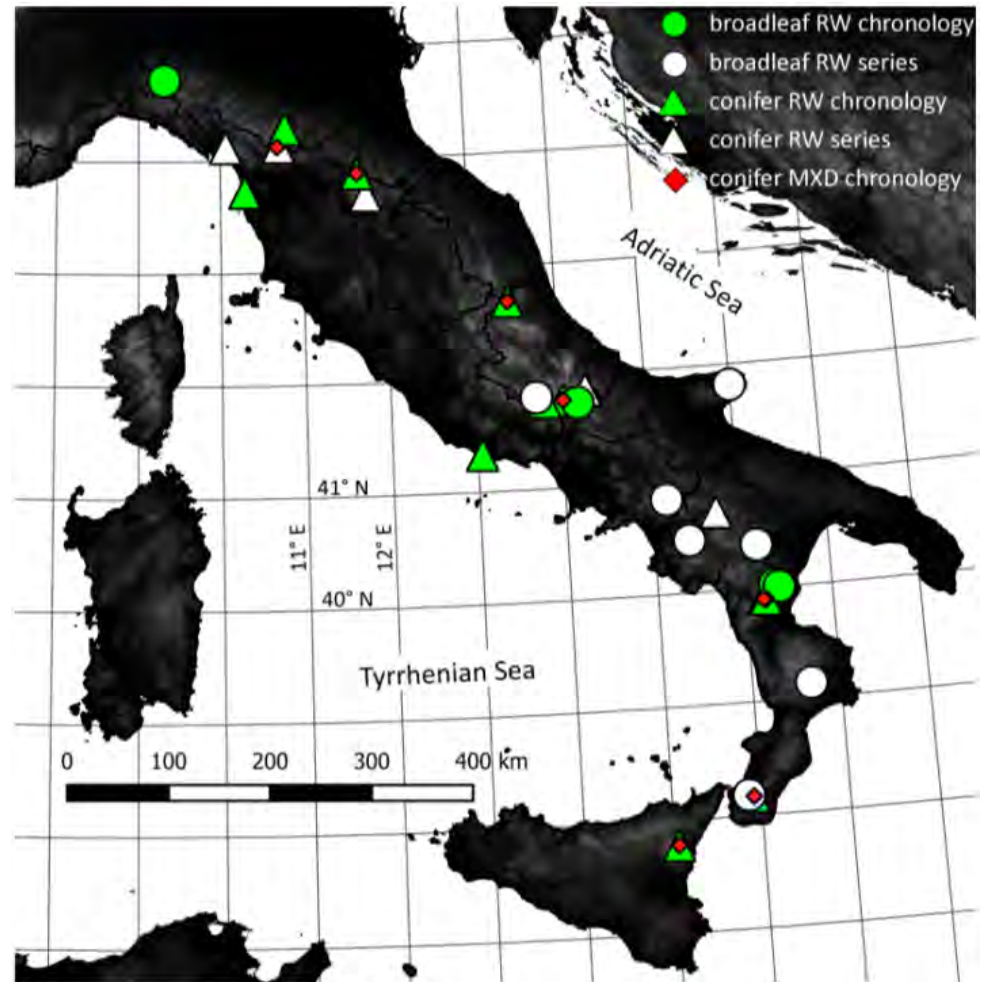
(Leonelli et al., 2017 Climate of the Past)

# Temperature reconstruction from sites located in the Apennines
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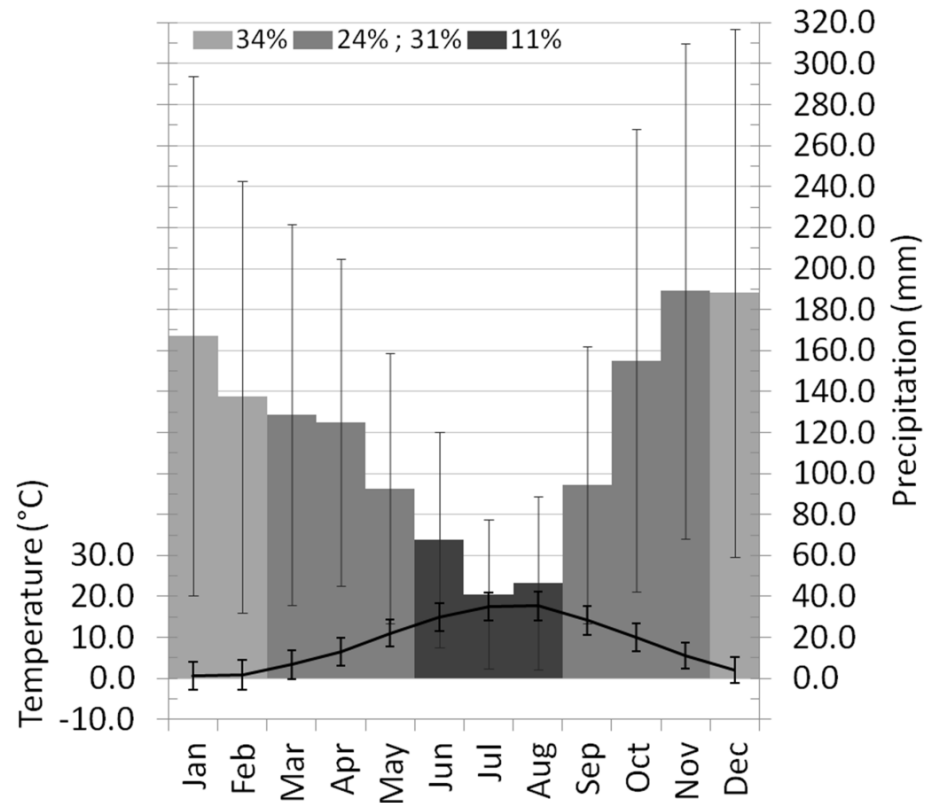
(Leonellit al., 2017 Climate of the Past)

Climate sensitivity of site chronologies — Conifer MXD (Max. Latewood Density); common period 1880–1980
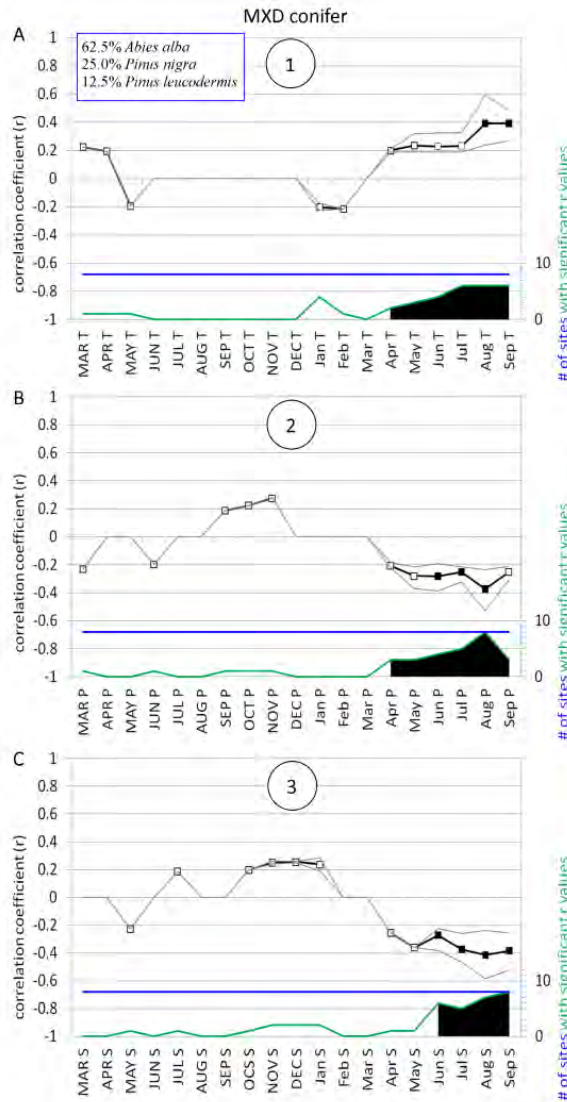
Temperature

Precipitation

SPI_3 months (drought)

Silver fir

Summer precipitation index

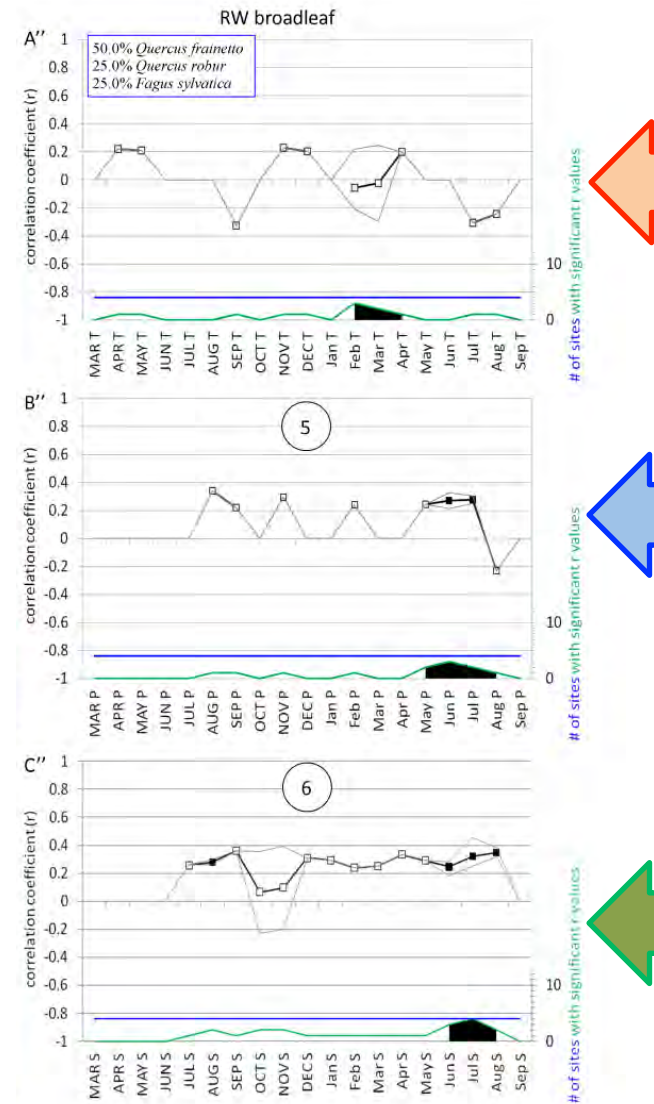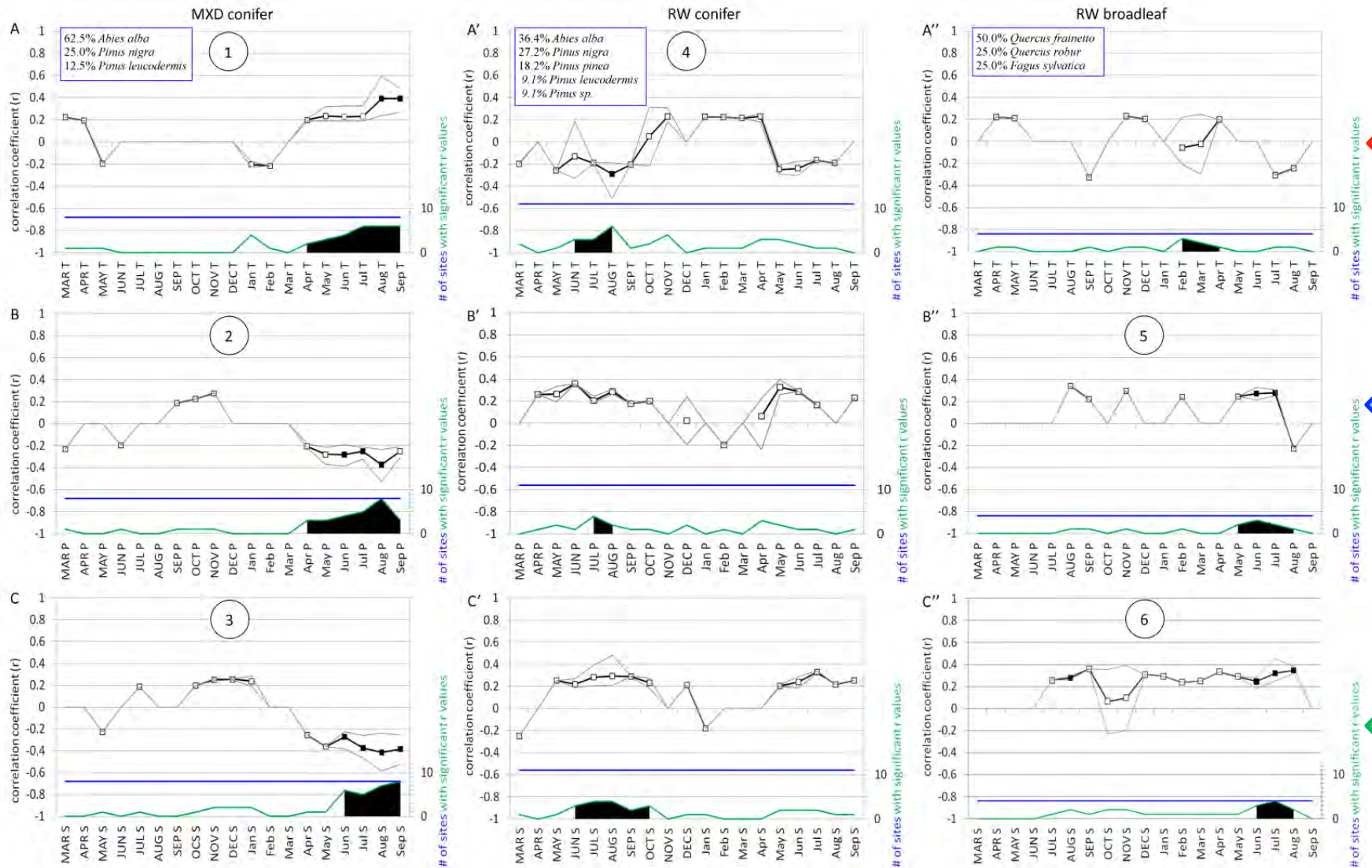# Climate sensitivity — Conifer RW; common period 1880–1980

Austrian (or black) pine

Climate sensitivity — Broadleaf RW; common period 1880–1980

Beech forest - southern Italy

Climate sensitivity — all tree-ring proxies

Climate sensitivity — 60-yr moving window

Bootstrapped moving correlation analysis with a 60-year time window, performed over the maximum period available for the HSTC chronologies and their respective climate variables (temperature, precipitation and SPI_3)

The statistically significant values (p < 0.05) of r are depicted by bold lines
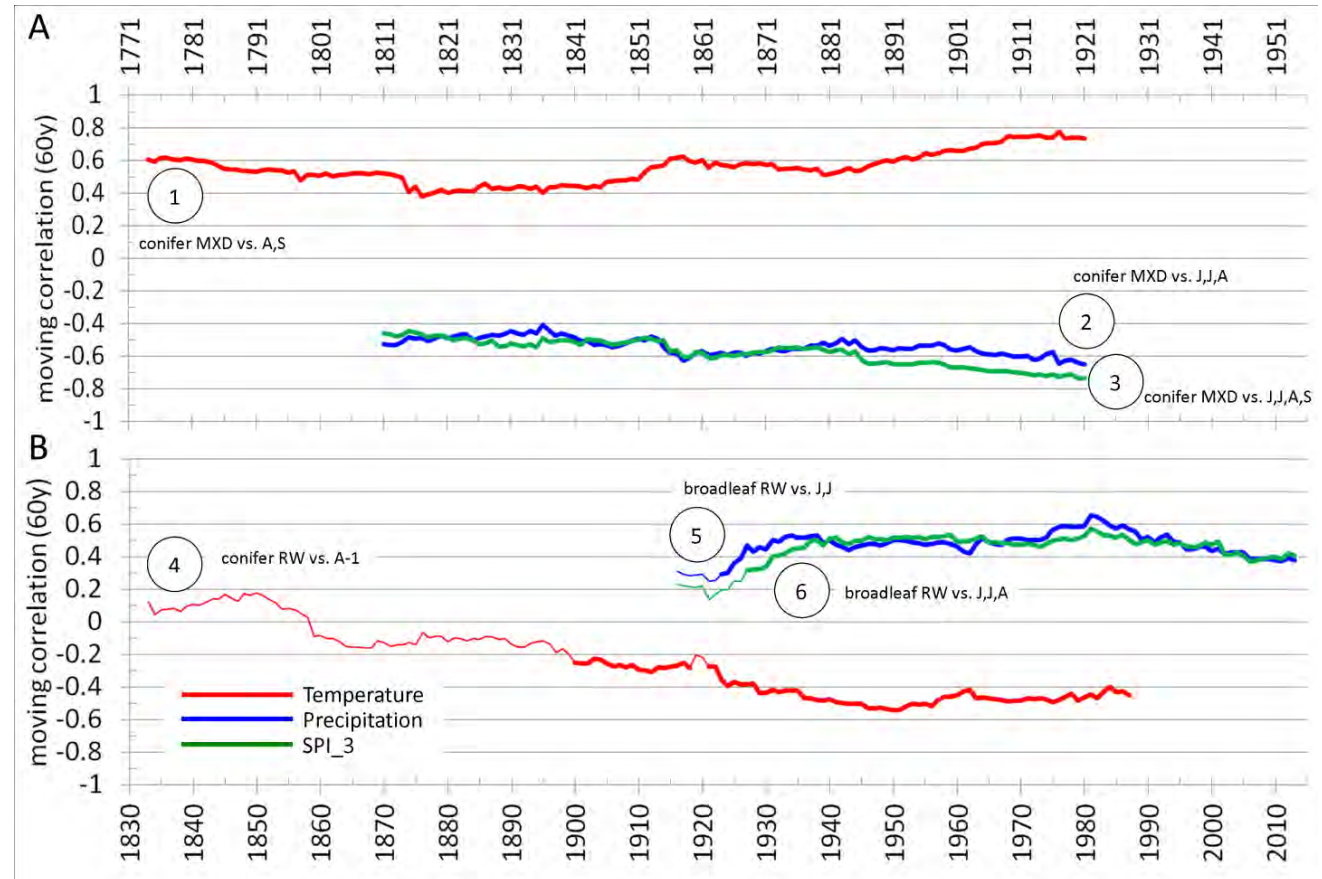
Climate reconstruction — scaling approach
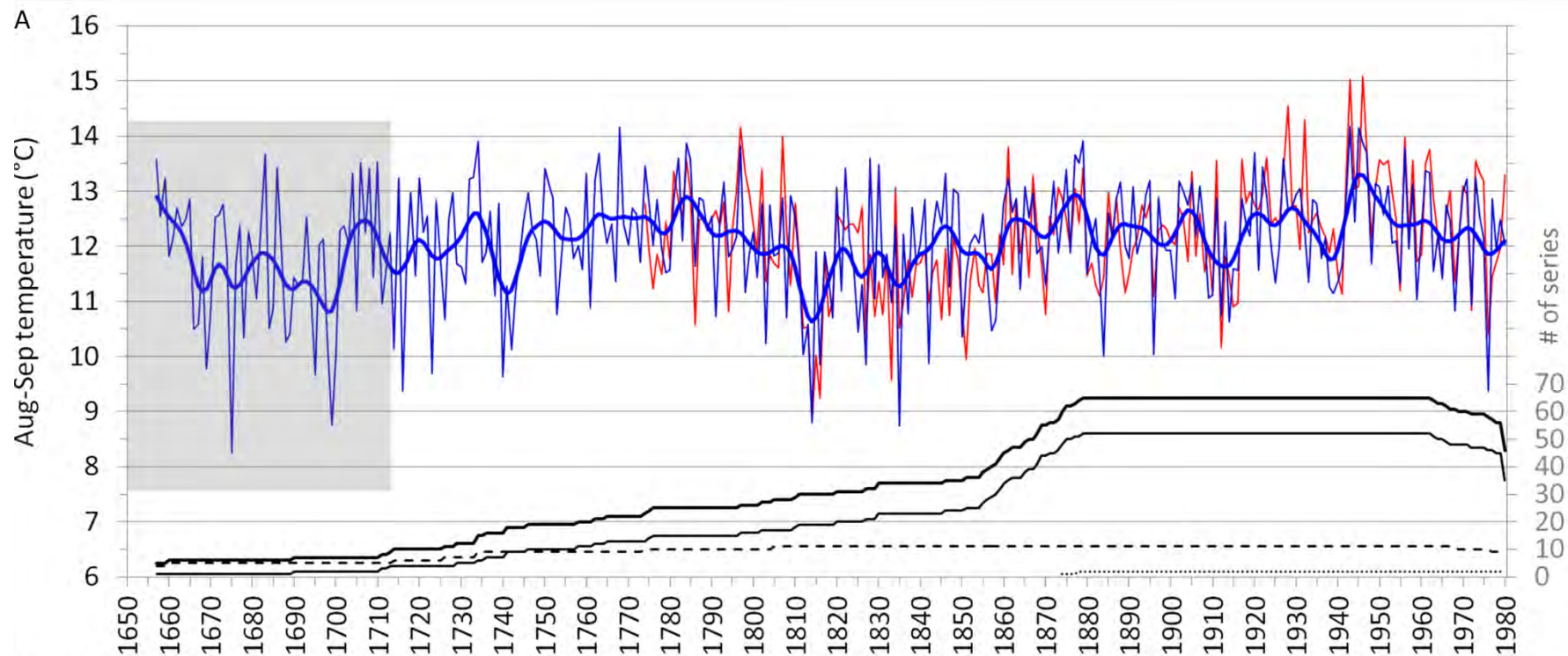
			Regression		Scaling		
		R^2	RE	CE	RE	CE	Full period R^2
Calib.	1781–1880	0.383					
Verif	1881–1980		0.484	0.305	0.533	0.371	
Calib.	1881–1980	0.506					0.435
Verif	1781–1880		0.409	0.223	0.278	0.060	

A,S actual temperature
A,S reconstr. scaling

Climate reconstruction — different transfer functions (scaling and regression)
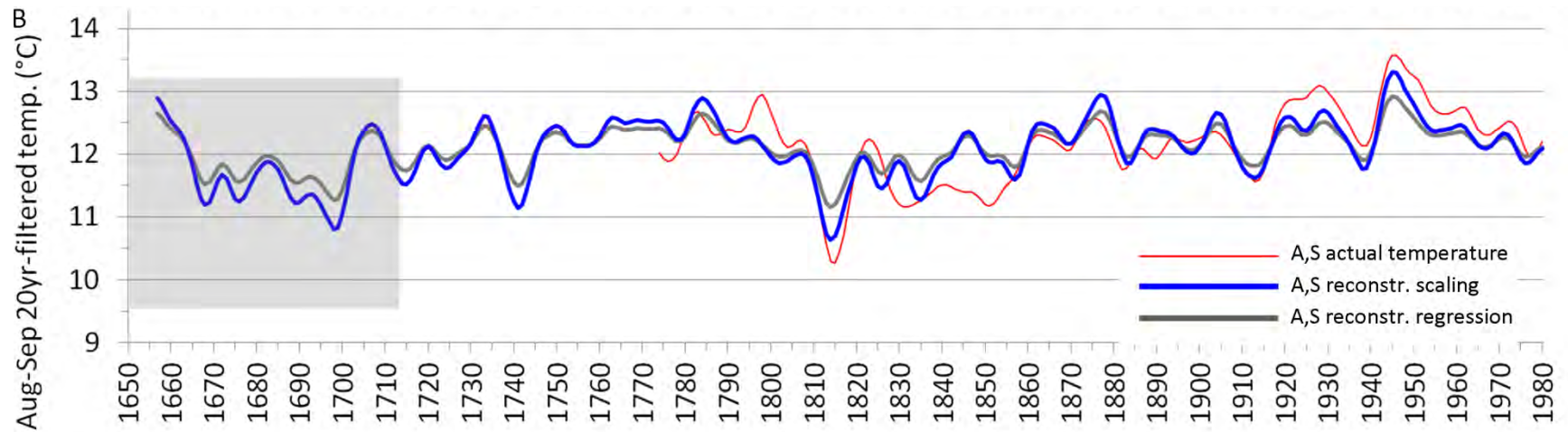
Climate reconstruction — comparisons with other reconstructions
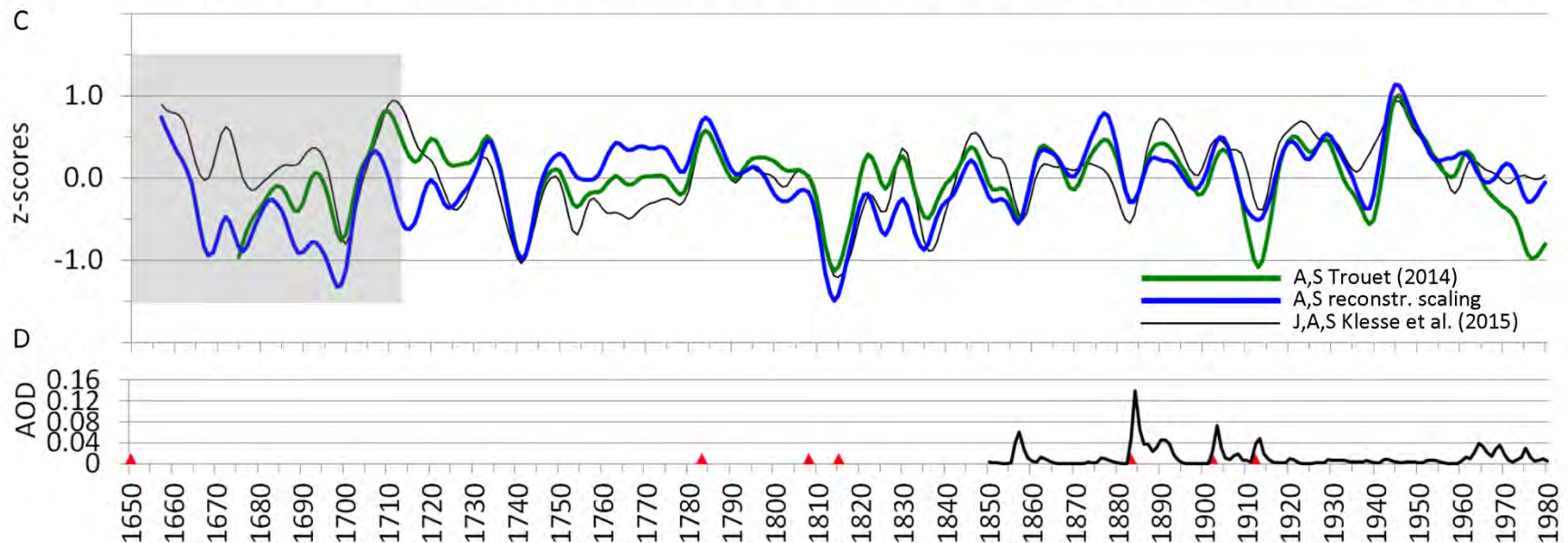
At the bottom the annual mean of stratospheric aerosol optical depth (AOD) at 550 nm for the Northern Hemisphere (https://data.giss.nasa.gov/modelforce/strataer/)
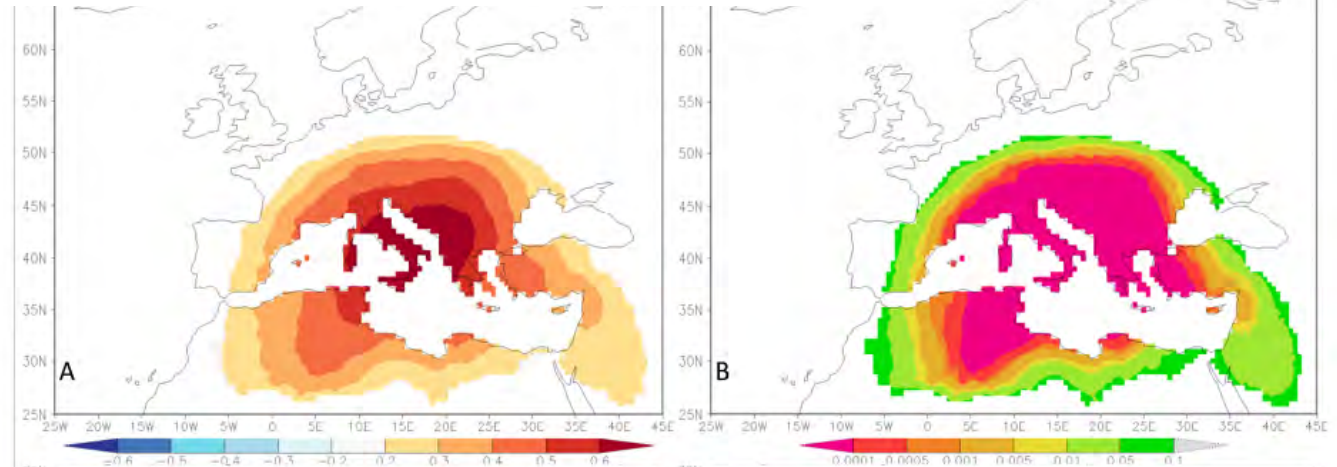
Red triangles mark major volcanic eruptions (volcanic explosivity index ≥ 6): in chronological order Kolumbo-Santorini, Grímsvötn, source unknown, Mount Tambora, Krakatau, Santa María and Novarupta

AS temperature reconstructed series vs. AS instrumental 0.5° CRU TS 4.0
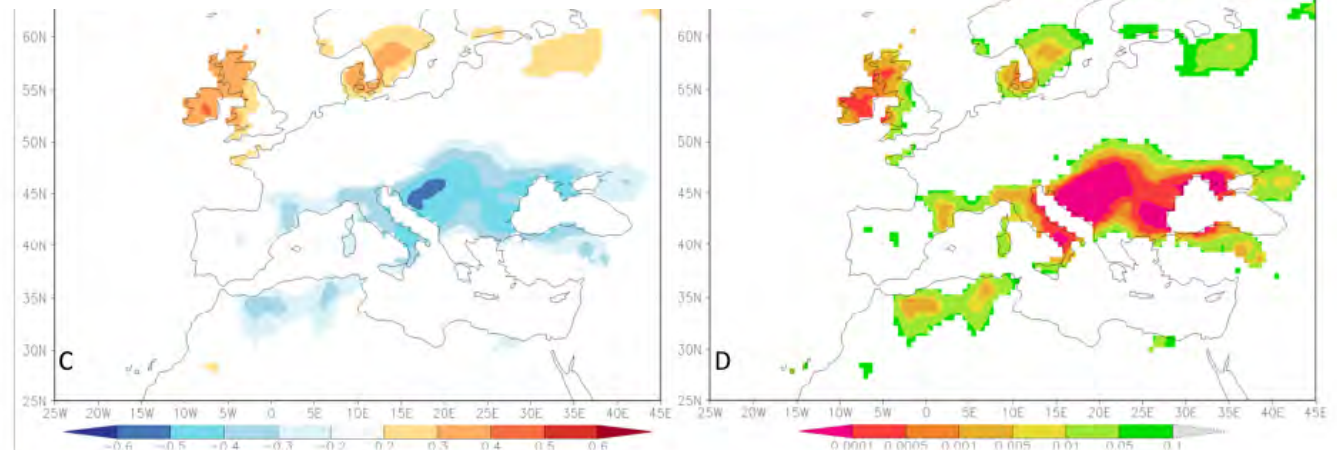
- Spatial correlation pattern of the reconstructed late summer temperature (using the MXD chronology from the Italian Peninsula)

  versus the 0.5° grid CRU TS 4.0 August–September mean temperature and mean precipitation, over the period of 1901–1980

r, August-September **temperature** — p value

r, August-September **precipitation** — p value

(Leonelli et al., 2017 Climate of the Past)

Online resources

http://geomatic.disat.unimib.it/dendro