Vallombrosa 16/10/2010 CAMBIAMENTI CLIMATICI E OPINIONE PUBBLICA

"La risposta dell'abete bianco alle variazioni climatiche. Esperienze e lavori svolti all'interno della Riserva Naturale biogenetica di Vallombrosa, gestita dal Corpo Forestale dello Stato"

MONASH University
Arts

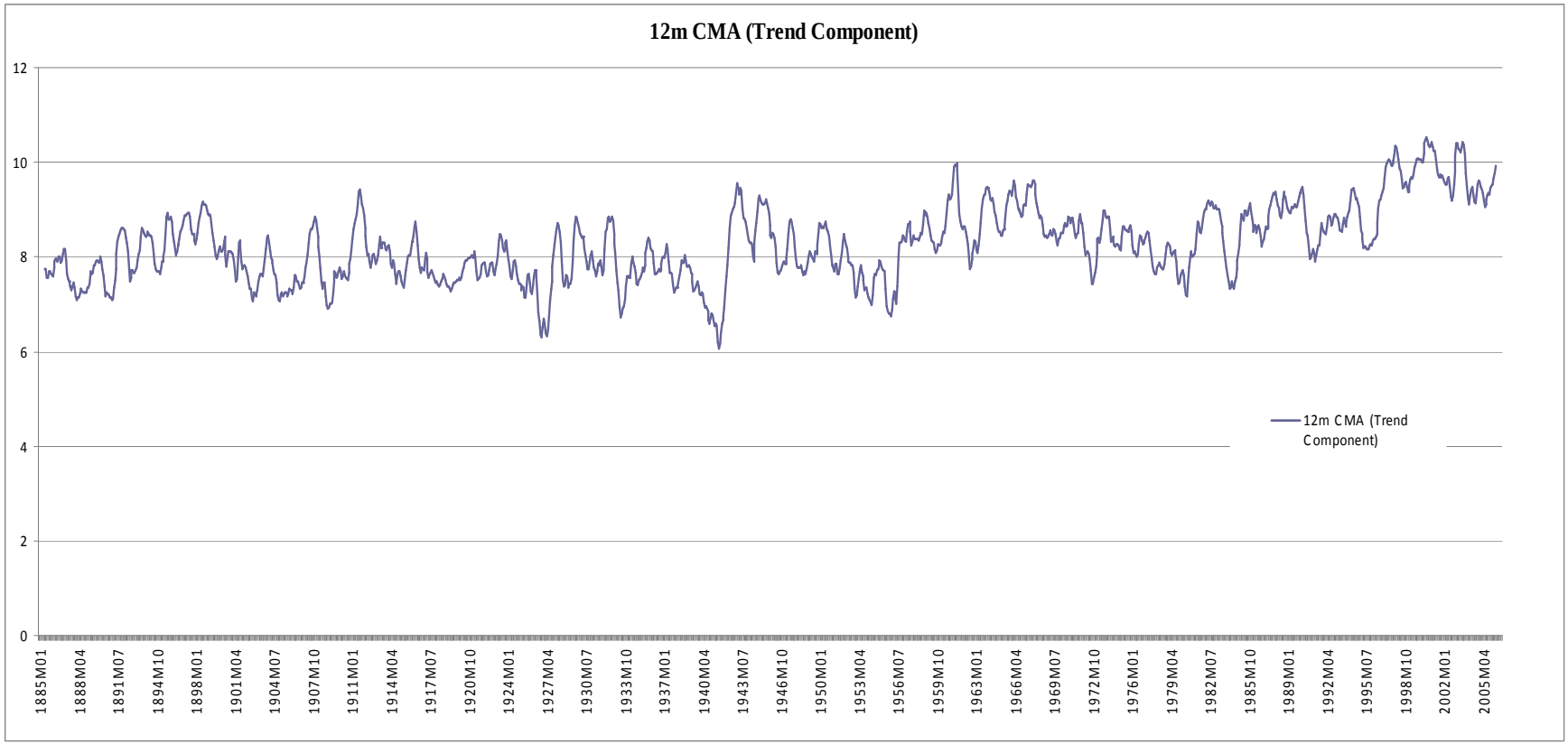
CORPO FORESTALE DELLO STATO

Ufficio Territoriale per la Biodiversità di Vallombrosa

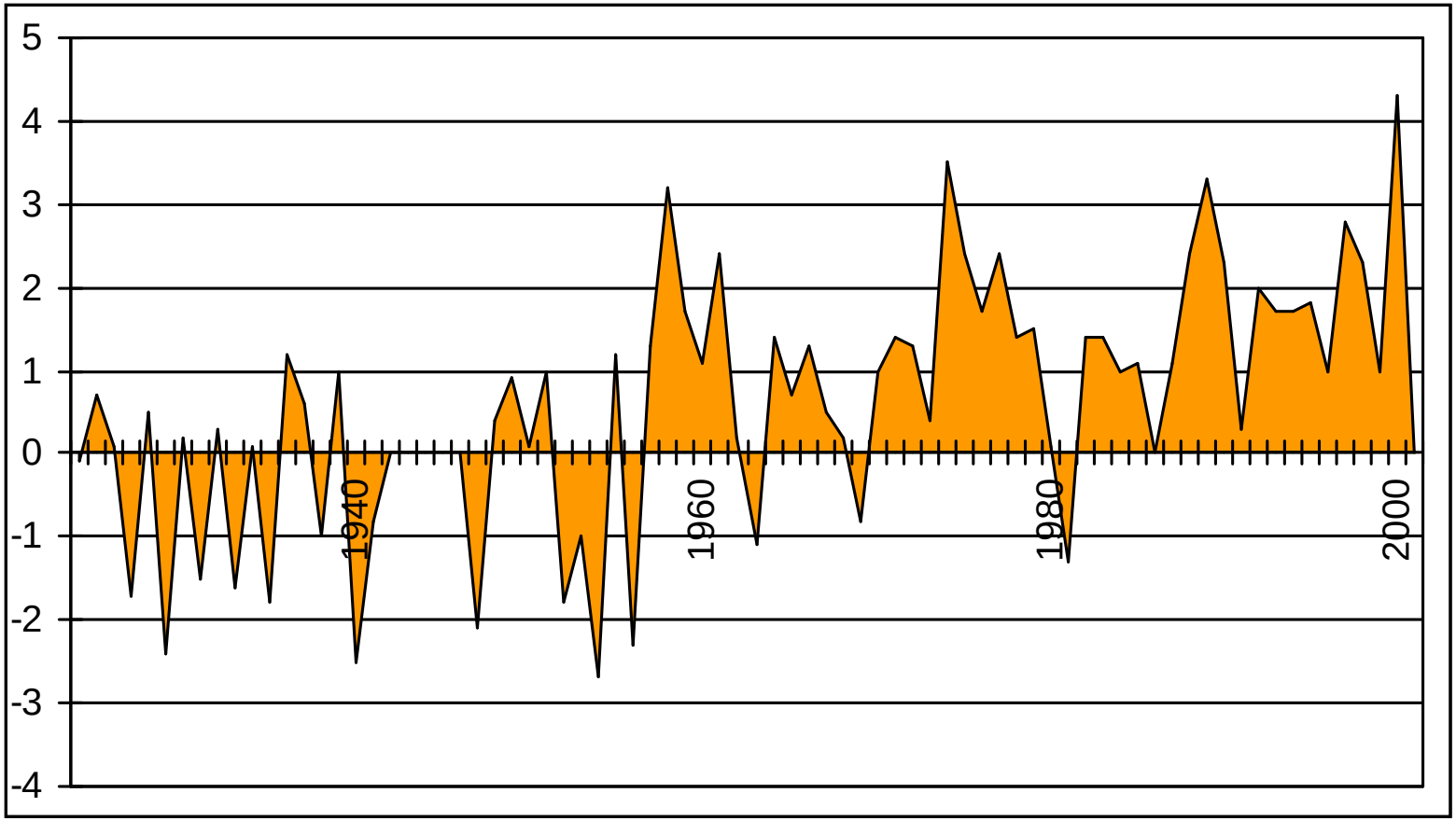
RISPOSTE DI ACCRESCIMENTO RADIALE DELL'ABETE BIANCO (*ABIES ALBA* MILL.) IN TOSCANA ED INFLUENZA DEL CLIMA: PRIME EMERGENZE

Fabrizio D'Aprile [(1)] , Nigel Tapper [(2)], Patrick Baker [(3)], Luigi Bartolozzi [(4)]

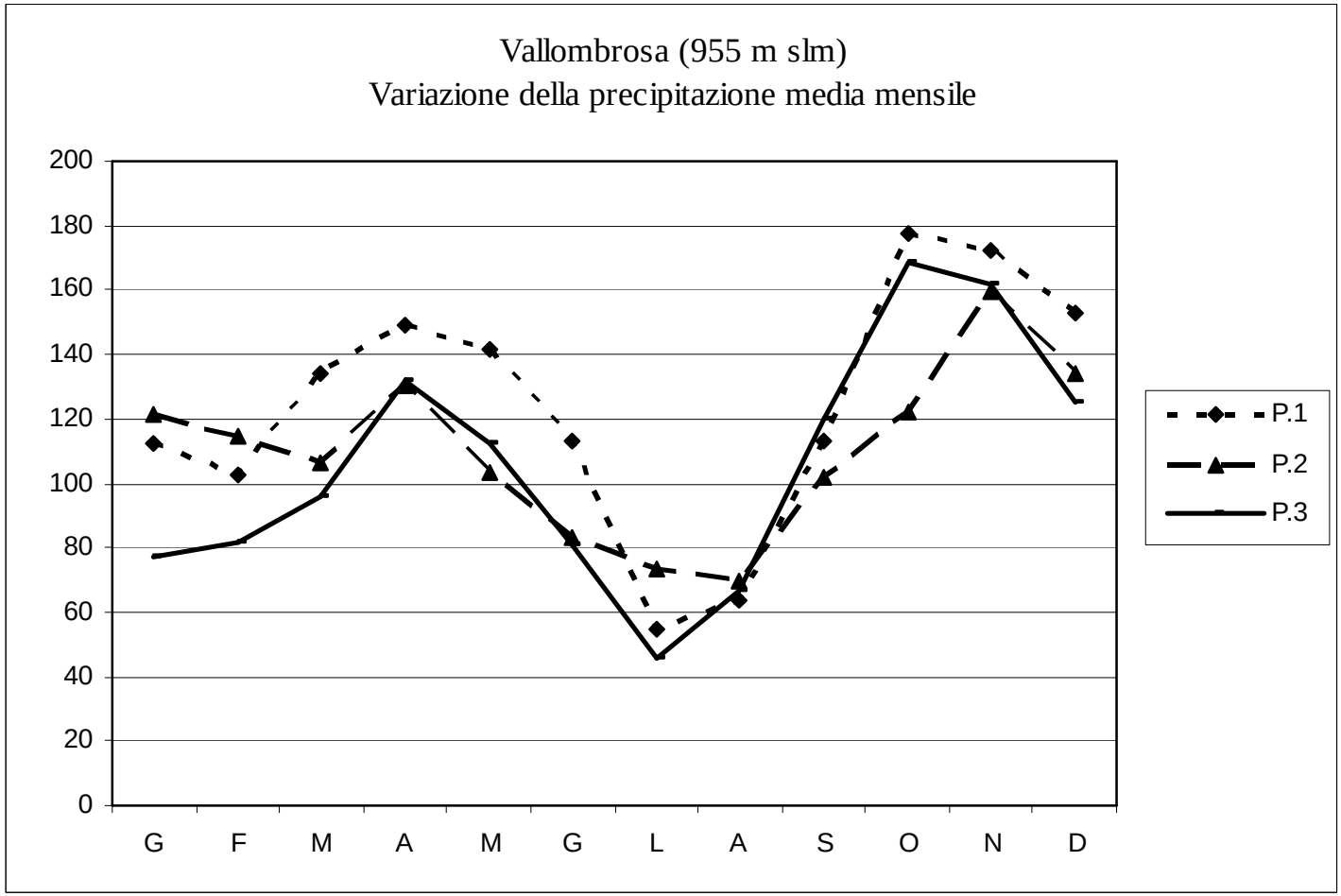
(1) Main and contact author,
School of Geography and Environmental Science, Monash University, Australia
(2) Head, School of Geography and Environmental Science, Monash University
(3) Faculty of Science, Monash University
(4) Corpo Forestale dello Stato, Ufficio Territoriale per la Biodiversità di Vallombrosa



Andamento della temperatura media mensile nelle quattro stazioni dalla fine del 1800 al 2006. La correlazione fra i siti è molto elevata, come mostrato sia dall'analisi delle reti neurali che dalle varie regressioni. Appare evidente un aumento medio di quasi 2°C, più rapido negli ultimi 20-25 anni.



Sequenza cronologica della temperatura media invernale (Dic, Gen, Feb) a Camaldoli dal 1924 al 2000. Prima del 1957 circa la media è -0,5°C, dopo è +1,4°C; nel periodo 1983-2000 è di +1,75°C, tra il 1990 ed il 2000 sale a +1,9°C. La frequenza di valori minori di zero cala fortemente e dopo il 1980 circa scompare.

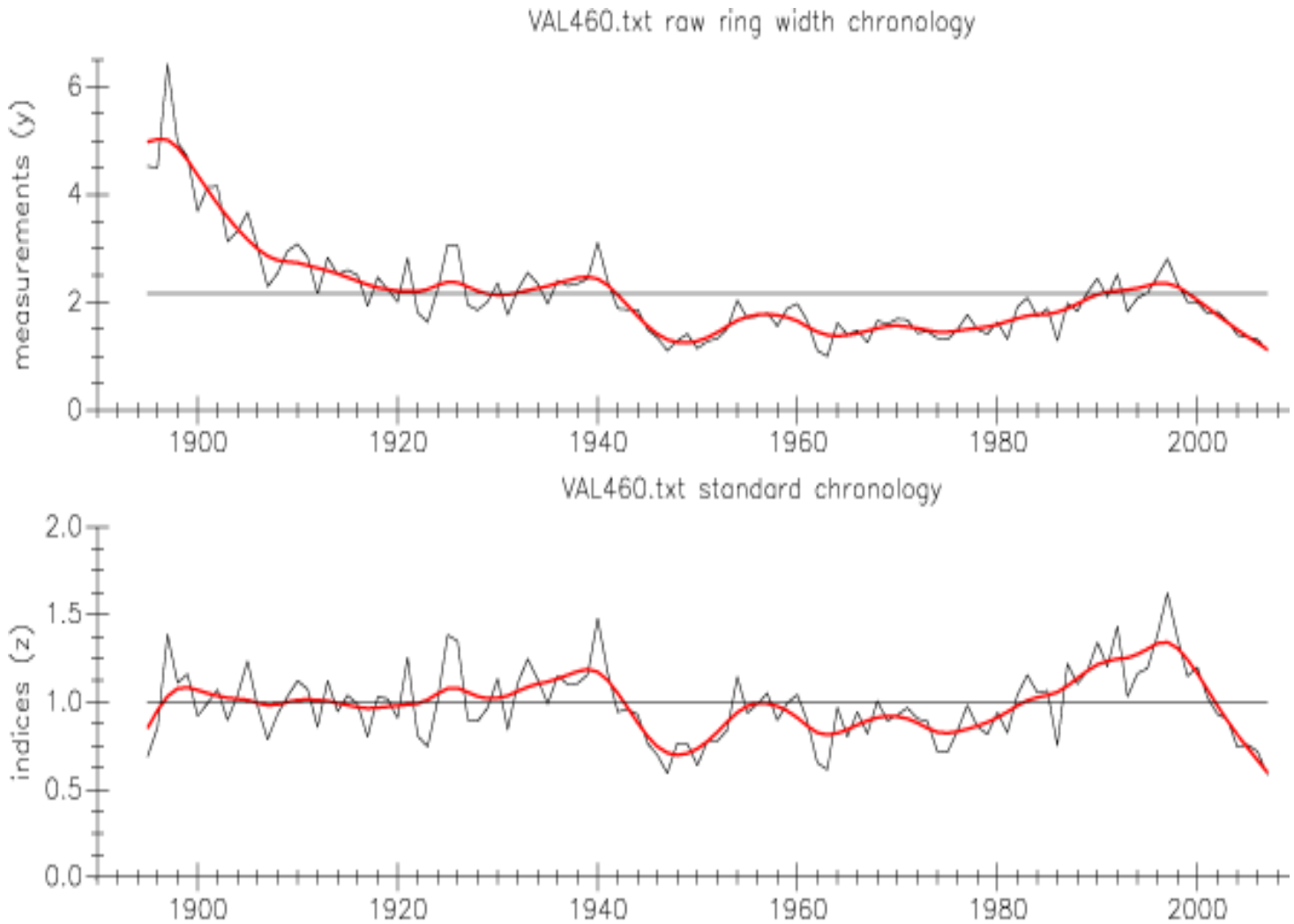


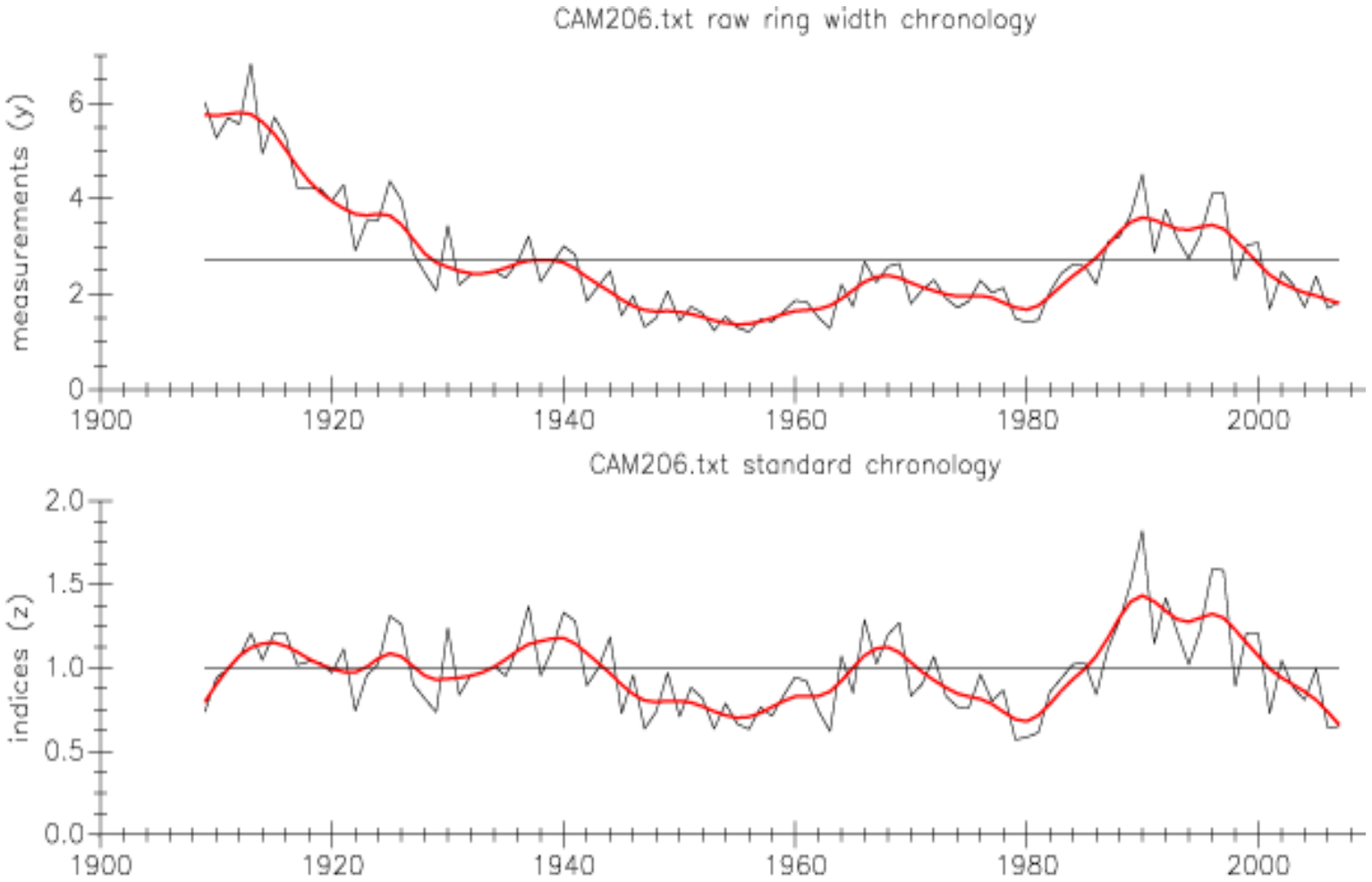
Variazione della precipitazione media mensile in mm a Vallombrosa. P.1: periodo 1872-1949; P.2: periodo 1950-1979; P.3: periodo 1980-2006. Il valore medio mensile è introduttivo, in quanto altri parametri sono più effettivi nel valutare tale cambiamenti. Ad esempio, la variabilità interannuale della precipitazione mensile, come intensità e frequenze relative, supera spesso ampiamente i valori medi mensili. A livello percentuale, le maggiori riduzioni della sola precipitazione acquosa non sono in estate ma nelle altre stagioni. La pioggia media annua nel periodo P.1 è circa 1487mm, ma scende in P.2 del -11,2%, e cala del -14,7% circa nei decenni recenti (26 anni) rispetto al lungo periodo.

Presenza di “cuore bagnato” (percentuale dei campioni) negli abeti e *Leaf Area Index* (LAI) dei transetti di alcune particelle ad Abetone, Camaldoli e La Verna.

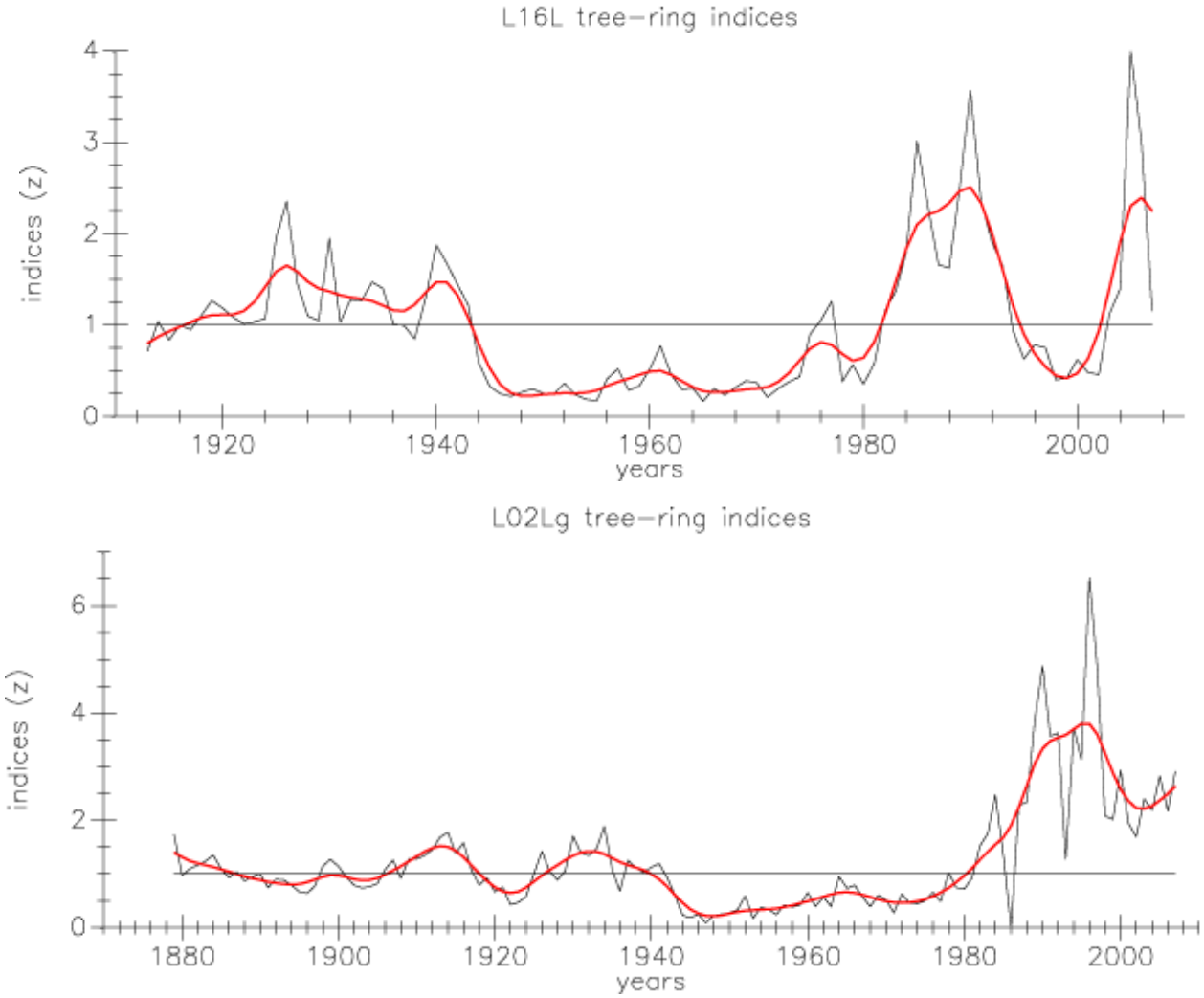
Particella	*Cuore bagnato %*	*LAI*
ABE38	85.7	2.83
CAM162	80.8	4.21
LAV19	85.7	5.55

Serie temporali (*master series*) delle ampiezze anulari (in alto nelle figure) della particella 460 a Vallombrosa e della 206 a Camaldoli, e relative curve standardizzate (grafici in basso nelle rispettive figure)




CAM206.txt raw ring width chronology
measurements (y)
0
2
4
6
1900
1920
1940
1960
1980
2000
CAM206.txt standard chronology
indices (z)
0.0
0.5
1.0
1.5
2.0
1900
1920
1940
1960
1980
2000

Serie cronologica delle ampiezze anulari standardizzate di due abeti a La Verna. E' importante notare che gli anni riportati non sono l'età delle piante, che è maggiore, per la presenza di porzioni consistenti di marciume che non consente la datazione.



Conclusioni

- **In ambienti come quelli dell'Appennino Toscano l'abete bianco costituisce una fascia ristretta e discontinua spesso prossima ai crinali, dove non esistono altre conifere autoctone sostituibili per biologia, ecologia e tassonomia. D'altronde, l'abete mostra di avere esigenze climatico-ambientali abbastanza specifiche che lo rendono suscettibile alle modificazioni del clima.**

- **Abetine diverse per altitudine, età, struttura, geologia, fase del ciclo ontogenetico, densità e condizioni delle chiome mostrano che nello stesso periodo, tra gli '80 ed i '90 circa, la crescita radiale annua era sostenuta, continuativa. Questo sembra contrastare con l'andamento dello sviluppo diametrale nel tempo secondo il noto modello esponenziale decrescente.**

- **Negli stessi anni, erano noti seri problemi di deperimento dell'abete bianco in Italia ed in Europa. Le varie concause delle sintomatologie di sofferenza e della "trasparenza delle chiome" non sembrano chiarire al momento il fenomeno riscontrato. La ricerca in corso esamina le variabili climatiche nelle tipologie ed interazioni, pur non escludendo il contributo degli effetti di composti quali gli ossidi di azoto (es. "fertilizzazione"), l'anidride carbonica (es. aumento efficienza assorbimento idrico), l'anidride solforosa, ed altri possibili fattori.**

- **Le variazioni climatiche appaiono come un fattore probabilmente importante nel determinare la risposta di accrescimento rilevata, mentre si cercano possibili ulteriori indicazioni e conoscenze mediante la verifica anche di relazioni tra stati patologici come il "cuore bagnato patologico", molto diffuso nelle abetine saggiate, la trasparenza delle chiome, ed altre variabili.**

European Geosciences Union
General Assembly 2010

Programme CL4.3
Regional Climate Modeling and Impacts

Vienna, Austria, 02 – 07 May 2010

VARIABILITY IN SIMILARITY OF TRENDS IN MONTHLY MEAN TEMPERATURE AMONGST SITES IN THE TUSCAN APENNINE ALPS

F. D'Aprile (1), N. Tapper (2), P. Baker (3), and L. Bartolozzi (4)

(1) Research fellow, School of Geography and Environmental Science, Monash University, Clayton Campus, Wellington Rd, Melbourne VIC 3800, Australia (**F.DAprile@arts.monash.edu.au**)
(2) Professor, School of Geography and Environmental Science, Monash University, Clayton Campus, Wellington Rd, Melbourne VIC 3800, Australia (Nigel.Tapper@arts.monash.edu.au)
(3) Senior Lecturer, Faculty of Science, Monash University, Clayton Campus, Wellington Rd, Melbourne VIC 3800, Australia (Patrick.Baker@sci.monash.edu.au)
(4) Superior Officer, Corpo Forestale dello Stato, Ufficio Territoriale per la Biodiversità di Vallombrosa (FI), Italy (l.bartolozzi@corpoforestale.it)

MONASH University Arts
School of Geography and Environmental Sciences

CORPO FORESTALE DELLO STATO
Ufficio Territoriale per la Biodiversità di Vallombrosa

The Object

In 2009, the School of Geography and Environmental Science of Monash University (Australia) signed a research protocol with the "Corpo Forestale dello Stato, Uffici per la Tutela della Biodiversità" at Pratovecchio (province of Arezzo, Tuscany) and Vallombrosa (province of Florence, Tuscany). The aim of the research program was to investigate the relationships between recent and historical variability of climate, soil and site factors in the Tuscan Alps on the diffusion and severity of the 'but rot' in silver fir (*Abies alba* Mill.). 'Rot but' severely affects silver fir forests at the study area (Fig. 1), and how climate alterations may impact on intensity and diffusion of the complex disease is very important for conservation and management of the species. Therefore, one of our primary objectives was to determine if temperature trends show alterations during the 20th century at the study area, the alterations are similar amongst sites (Tab.1), and master series of seasonal and/or monthly mean temperatures could be identified.

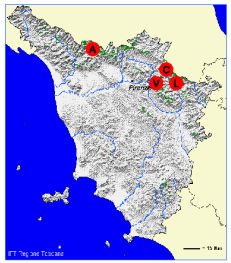


Fig. 1 – Location of the four meteorological stations on tops of the Tuscan Apennine Alps.

Table 1 – Elevation (m. asl), UTM coordinates, and period of data available for the four meteorological stations.

Site		Abetone (A)	Camaldoli (C)	La Verna (L)	Vallombrosa (V)
Elevation (m. asl)		1340	1111	1120	955
UTM Coordinates	N	4889150.00	4853040.00	4843695.00	4845450.00
	E	633615.00	727035.00	736295.00	706000.00
Period available	Temp. (°C)	1872-2006	1885-2003	1956-1990	1934-1996
	Prec. (mm)	1872-2006	1931-1996	1924-2006	1921-2003

Seasonal climate trends

Statistical analysis show different trends in seasonal mean temperature at the four sites (Fig. 2). For example, the 1960s at Abetone features a very warm period that does not occur at the other study sites; a change in winter mean temperature from <0.0°C to progressively >0.0°C at Camaldoli in the 1950s; low or moderate correlation of Abetone with the other study sites (Table 2); changes in level of similarity between seasonal mean temperature series with site and season (Fig. 3).

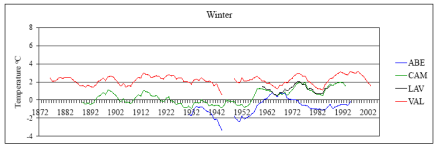


Fig. 2 – Seven-years moving averages of winter mean temperature at the four study sites. ABE is Abetone, CAM is Camaldoli, LAV is La Verna, and VAL is Vallombrosa.

Table 2 – Higher values of Pearson, Spearman, and Kendall coefficients of correlation of Abetone's seasonal mean temperatures when tested versus the seasonal mean temperatures at the other study sites (Camaldoli, La Verna, and Vallombrosa)

	Pearson r	Spearman ρ	Kendall τ
Winter	0.51	0.49	0.38
Spring	0.66	0.70	0.54
Summer	0.51	0.52	0.39
Autumn	0.71	0.73	0.32

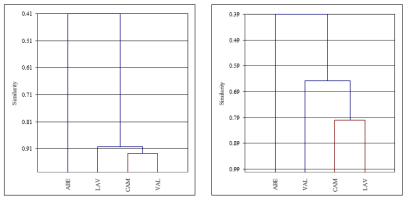


Fig. 3 – Dendrograms of winter (left) and summer (right) mean temperature series at ABE, CAM, LAV, and VAL produced by agglomerative hierarchical clustering. Level of similarity in seasonal mean temperature series and grouping of sites change with season.

Research Question

Does temperature change in similar ways in the Central Apennine Alps in Italy over the 20th century?

Variability in similarity of seasonal mean temperature trends

Similarity in trends of **seasonal** mean temperature over time amongst sites was tested by 7-yr moving averages of Pearson's r between paired sites. Results show that similarity in trends amongst sites is non-stationary and varies irregularly with season and period (Fig.4). For example, Pearson's r varies from >-0.8 to <1.0 in spring between CAM and VAL in the second half of the 1920s, and from >-0.4 to <0.9 in winter between ABE and CAM in the second half of the 1960s.

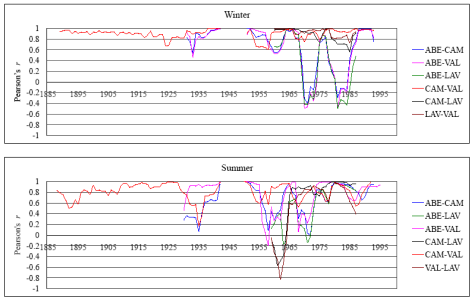


Fig. 4 – Seven-years moving averages of Pearson's r correlations of winter and summer mean temperature chronologies between paired sites. Similarity between sites appears to vary greatly and irregularly during the 20th century at the study area.

High variability in similarity between seasonal mean temperature series and changes in the level of association between sites with season would suggest that unlikely master series of seasonal temperature could be adopted to verify effects of climate alterations on forest trees' growth and health. In addition, the seasonal level in variability of mean temperature does not show if changes in similarity in site and season depend on one or more months, and this is very important in order to understand if and how potential impacts of alterations in temperature trends may differ at the local – but real – scale.
Therefore, monthly mean temperature trends at the study area were analysed with statistical methods similar to those that were applied to seasonal mean temperature trends.
Results show a complex scenario of differences in trends of monthly mean temperatures; high inter-annual variability is present in all months and sites at the study area. It is observed that
- although the prevailing tendency in monthly mean temperature is to increase at the regional scale, decrease in monthly mean temperature is noted in some months at different sites. For example, December mean temperature decreases at ABE from the 1960s but increases at VAL, and vice versa during the 1950s (Fig. 5);
- despite the short distance between CAM, LAV, and VAL, and similar elevation at CAM and LAV, the regime of mean temperature in winter months changes from <0.0°C to progressively >0.0°C in the 1950s only at CAM;
- the 1960s area very warm period only at ABE, the upper site (1340m asl);
- level of association of monthly mean temperatures amongst sites varies over time.

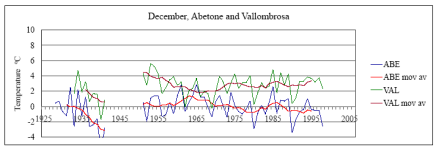


Fig. 5 – December mean temperature and respective seven-years moving averages at Abetone and Vallombrosa.

Variability in similarity of monthly mean temperature trends

Similarity in trends of **monthly** mean temperature over time amongst sites was tested by 7-yr moving averages of Pearson's r between paired sites. Results show that similarity in trends amongst sites is non-stationary and varies irregularly with month and period (Fig. 6).

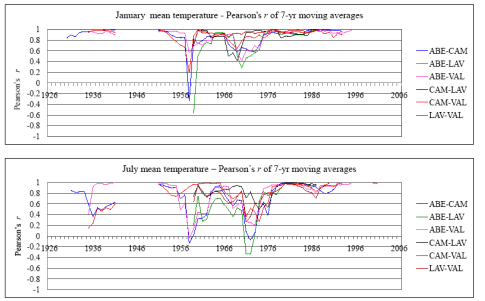


Fig. 6 – Seven-years moving averages of Pearson's r correlations of January and July mean temperature chronologies between paired sites at the study area. Similarity between sites appears to vary greatly and irregularly during the 20th century at the study area.

Conclusions

- This research highlights the importance of variability in trends of mean temperature at the local level when effects of climate variations are investigated. Although temperature alterations at the regional level may show a main tendency (i.e., warming), potential effects on forest species at the local level may vary greatly.

- In the Tuscan Apennine Alps, similarity in trends of seasonal and monthly mean temperatures amongst sites is non-stationary even between sites at short distance.

- Master series of seasonal mean temperature appear to fail in detecting alterations that occur at the monthly level, which are important to identify possible effects in tree growth and health.

- Despite a main tendency of temperature to increase over recent decades, there are months and sites where a slight cooling would occur. This may affect tree species in ways that unlikely could be generalized or predicted unless investigated at the local level.

- Regional or higher scale trends in temperature may smooth variability at the local level that may have relevant effects on tree growth and health instead.

CONTATTI:

Dott. LUIGI BARTOLOZZI, Vice Questore Agg. Forestale del Corpo Forestale dello Stato, Ufficio Territoriale per la Biodiversità di Vallombrosa (FI), Italy.
Tel. +39 055 862020. l.bartolozzi@corpoforestale.it