Laura Sadori

Thanks to her review, we added and clarified specific changes.

GENERAL COMMENTS

Overview

The paper "Pollen-based reconstruction of Holocene vegetation and climate in Southern Italy: the case of Lago di Trifoglietti" by Joannin and colleagues is supported by new and consistent data from a region poorly investigated from a palynological point of view. Moreover, the Calabria region, in the heart of Mediterranean, has high mountains very close to the sea featuring its environment and climate. The Trifoglietti record fills a gap existing not only in southern Italy, but in the whole Mediterranean.

I liked the integration between present and past vegetation visible in the whole manuscript draft.

Pollen analysis is accurate and precise, and supplied with basic sediment data. I regret the fact that a concentration/influx diagram, at least for AP and main taxa was not included.

The radiocarbon dating was carried out properly too, and on a good number of terrestrial plant macroremains.

The bibliography is updated, even if some recent articles can be added and few ones are misquoted. I just wonder why most pollen records from Latium (Lagaccione, Vico, Stracciacappa, Mezzano, Albano and Nemi) are not considered, while you refer to northernmost Italian sites.

Albano and Nemi are cited, others are from lowlands and northern Italy. We decided to not extend the pollen comparison through northern sites and used sites shown on the map (Figure 1). Other sites from northern Italy are used in the discussion about climate and hydrological features (not on vegetation) for a bigger consideration.

There are some important mismatchings between palynological data (presence of high water demanding trees like fir and beech) and reconstructed P_{ann} (pollen-based annual precipitation).

Present-day mean annual precipitations do not fit with the reconstruction for pollen top-samples. I do suggest to check the climate reconstruction procedure you followed to check if there was something wrong.

Once the quantitative reconstruction of past precipitation is adjusted, some sentences in the discussion should be better addressed too.

Common answer to the reviewers #3 #4.

As proposed by the three reviewers, we have checked our reconstruction of the annual precipitation based on the MAT. The quality of the reconstruction is acceptable (see answer to the reviewer W. Fletcher), but we agree that the precipitations are underestimated. This is due to a lack of meteorogical stations close to Lake Trifoglietti and to a bad interpolation of the precipitation calculated for the Lake Trifoglietti surface samples (New et al., 2001). Values of precipitation calculated for the surface samples taken close to the Trifoglietti site are now corrected according to the ombrothermic diagram of the closest meteorological station (1850 mm instead of 1100 mm).

These new results are shown on Figure 9. We have also added the error bars (Fig. 9). Moreover, to test the MAT results and to obtain a more reliable climate reconstruction, we have added here the results provided by another method, the WAPLS, which is also usually applied to reconstruct Holocene climate changes in Mediterranean area (eg Finsinger et al.,

2010). Results are now included in the new figure 9. Please note that the results based on the WAPLS are consistent to those based on the MAT. The new precipitation values are 150-200 mm higher than the first version, the mean is around 900-1000 mm (1100 mm for the first part of the Holocene, when *Fagus* percentages are particularly high), the error bar is close to 1200 mm (and can reach 1800 mm, not shown in the figure). These new curves seem in better agreement with the fact that at present the natural populations of Mediterranean Abies live in areas where mean annual precipitations are above 1000 mm. Furthermore, these values are consistent with the estimates (MAT method) obtained for a marine core located in the Gulf of Salerno (Fig. 9) by Di Donato et al (2008).
These new values can still appear too low taking into account the extremely high modern values (1850 mm). We have however to keep in mind that this value of 1850 mm is based on only one climate station. Furthermore, such a difference may be influenced by the fact that this station is pouring the east (contrary to Trifoglietti which is pouring the west) and by the difference in altitude (516m asl). Despite these uncertainties, when the climatic parameters –temperature or precipitation- are very low or high, all the methods very often fail to reproduce such pattern (Combourieu-Nebout et al., 2009). Therefore, we prefer discuss in terms of trend instead of raw values. Here the climate trend reconstructed at Lake Trifoglietti during the Holocene is consistent with closest sites (for example, lake Preola see Peyron et al., same issue).
L. Sadori underlines that "present-day mean annual precipitations do not fit with the reconstruction for pollen top-samples" and Reviewer 4 states that "considering that the present time is the only control point allowing verification of the climate model, such a discrepancy invalidates the entire climate reconstruction". We don't agree with the reviewer 4 about the fact that such a discrepancy for the present time invalidates the entire climate reconstruction. Very often for the last 1000-2000 yrs cal BP, the pollen assemblages reflect vegetation with a strong human impact. This can induce a bias in climate reconstructions (more dry conditions), particularly for very recent periods but not for the entire sequence.

We change part 3.3.3 Pollen-based climate reconstruction
"To provide robust quantitative estimates of the Holocene climate, a multi-method approach of the Trifoglietti pollen sequence is applied in order to better assess reconstruction error. We have chosen two "standard" methods based on different ecological concepts: the Modern Analogues Technique (MAT, Guiot, 1990), and the Weighted Average Partial Least Squares regression (WAPLS, ter Braak and Juggins, 1993). These methods are usually applied to reconstruct climate changes in Mediterranean area during the Lateglacial or the Holocene (e.g. Davis and Brewer, 2009; Dormoy et al., 2009; Di Donato et al., 2008; Joannin et al., 2011; Peyron et al., 2011; Joannin et al., this volume; Combourieu Nebout et al., this volume). The WAPLS NMDS/GAM is a true transfer function based on a calibration between environmental variables and modern pollen assemblages whereas the MAT does not require real calibration. This method is based on a comparison of past assemblages to modern pollen assemblages and used a modern pollen dataset that contains more than 3500 modern spectra (Dormoy et al., 2009) and in which surface sample spectra from Lake Trifoglietti surroundings, from Mount Altesina (close to Lake Pergusa, Sicily) and Lake Preola (Sicily) have been included. Annual precipitations (MAT Pann, WAPLS Pann) have been reconstructed and represented in Figure 9F. Winter and summer precipitations are also reconstructed and discussed in the paper of Peyron et al. (this volume) which propose a climatic reconstruction based on a multi-method approach (MAT, WA, WAPLS, NMDS/GAM)

on four Italian pollen records (Lakes Ledro, Accesa, Trifoglietti, Pergusa). More details on the methods and their application to Trifoglietti's pollen record are given in this paper. Note that Alnus is excluded in the climate reconstructions performed with both the MAT and the WAPLS and that the values of precipitation calculated for the surface samples taken close to the Trifoglietti site have been corrected according to the ombrothermic diagram of the closest meteorological station (1850 mm)."

We added at the beginning of part 4.2.5 Pollen-based quantitative reconstruction of precipitation

The quality of the MAT reconstruction appears acceptable for all the Holocene: the adopted threshold is 61.99, and only 2 samples between 7950 and 7500 yrs cal BP have been removed because the number of analogues selected was too low. For all other samples, 8 modern analogues have been selected for the climate reconstruction. The modern analogs selected are located in Italy (samples close to Lake Trifoglietti), Alps, and Pyrenean areas, except for the period between ca. 11500 to ca. 11200 cal. BP. This strong precipitation anomaly is driven by a switch from regional to extra-regional analogues, from Italy to high-elevation East regions (Greece, Turkey). The dissimilarity coefficients are however acceptable in this part of the reconstruction, as for the entire sequence.

To test the MAT results and to obtain a more reliable climate reconstruction, results provided by the WAPLS have been added. These results are in accordance with the annual precipitation based on the MAT. Annual precipitations reconstructed at Trifoglietti are around 900-1000 mm (1100 mm for the first part of the Holocene, when Fagus percentages are particularly high) and the error bar is close to 1200 mm (it can reach 1800 mm, not shown in the Figure 9 for clarity). The quality of the reconstruction is acceptable, but the precipitations can appear underestimated taking into account the extremely high modern values (1850 mm). This underestimation may be related to the fact that this station is located at lower altitude (516m asl) and is pouring the east (while Trifoglietti is pouring the west). Despite these uncertainties, when the climatic parameters –temperature or precipitation– are very low or high, all the methods often fail to reproduce such pattern (Combourieu Nebout et al., 2009). Therefore, we prefer discuss in terms of trend instead of raw values. The climate trend reconstructed at Lake Trifoglietti during the Holocene is consistent with closest sites such as Lake Preola in Sicily (see Peyron et al., same issue) and with the estimates obtained for a marine core located in the Gulf of Salerno (Fig. 9C) by Di Donato et al (2008). These curves also seem in agreement with the fact that at present the natural populations of Mediterranean Abies live in areas where mean annual precipitations are above 1000 mm.

Paper organization

I wonder if the paragraphs 4.2.2 (Pollen sequence and terrestrial vegetation dynamics) and 4.2.3 (Pollen sequence and hygrophilous vegetation) could be joined. It's not easy to start again with the diagram description, even if I understand that the authors want to link water plant remains data and lake level oscillations.

Is Table 3 necessary? This information can be read in the pollen diagram. I wonder if it could be included as supplementary file.

L. Sadori exactly understood why we choose this way of separating the paragraphs. We know that it is difficult to start again the description. It was as asked in a previous version of this text, however, we decided to split the two parts as it is even harder to constantly go

from one description to the other one and as it results on a terribly long part. Furthermore, it is very useful in order to introduce the following part: 4.2.4 changes in water-depth.
Concerning table 3, we think it is useful when someone wants to go straightly on a more elaborated result file than the figures where the rare pollen grains are not represented.

SPECIFIC COMMENTS

2225 line 16

"… and the Neoglacial climate cooling at ca. 6000–5000 cal.BP (Magny et al., 2006b; Miller et al., 2010)."

Have also a look at the very recent paper by Zanchetta and colleagues (2012), Quaternary Research.

It is now done in the discussion part 5.2.2 "… At higher latitudes, it coincided with the beginning of the Neoglacial (Giraudi et al., 2011, Zanchetta et al., 2012), marked by a glacier readvance in the Gran Sasso massif in central Italy."

2226 line 20

"Lago di Monticchio (656m a.s.l.; Allen et al., 2002) and Lago di Pergusa in Sicily (667m a.s.l.; Sadori et al., 2011) are located in the collinean belt, but they are separated by 450 km and therefore provide a forest development asynchronism of ca. 4000 yr." **it's not the distance to make the difference, but the very different clmatic and geomorphological features of the sites. In my opinion it's not proper to speak of asynchronism.**

We corrected: "Only Lago Grande di Monticchio (656 m a.s.l.; Allen et al., 2002) and Lago di Pergusa in Sicily (667 m a.s.l.; Sadori et al., 2011) are located in the collinean belt, which are separated by 450 km, provide a forest development asynchronism of ca. 4000 yrs."

2227 line 8

"Lake Trifoglietti" ***Lago Trifoglietti. Can you call it properly at least when you describe its geographical features?***

We choose to keep talking about Lake Trifoglietti but used the proper name in the Title.

line 14

"… parallel along the Tyrrhenian coast for 70 km with altitudes ranging from 1060 and 1541m (Amici della Terra, 2004)". ***I wonder if there are other papers available!***

We found one: (Sperone et al., 2007).

2231 line 12-14

To emphasise the correlation between pollen rain and vegetation, we provide the corresponding phytosociological relevés of actual vegetation (Pignatti, 1953) (Table 2) along with the five surface samples, using the TILIA 1.12 programme. A semi-detailed pollen diagram of surface samples is provided in Fig. 6.

I do not understand the phrase, Was Tilia used to draw pollen diagrams? What do you mean with a semi-detailed diagram?

We change to "a pollen diagram of selected taxa is provided…"

2232 line 17

"*Cyperaceae****" Not Italic, also in the following for families and subfamilies.***

Corrected

2233 lines 13-24

4.1.1 Lithological and magnetic susceptibility changes

I think it would be better to have a table with this information.

Everything is shown in the various figures.

2238 lines 20-22

"From 11 000 to 8900 cal.BP (T-3), abundant Botryococcus ***(what, colonies?)*** *are recorded, typical of an open lake with deep water and gyttja sedimentation.*

Please correct and add a reference for this ecological feature.

We added colonies. We also give this reference: Testa et al., 2001.

Concerning the ecology, it is difficult to find clear information in the exact context of our site. According to Jankovska and Komarek (2000), Botryococcus spp. dominates in studied lakes where water was very cold, clear, oligotrophic, eventually dystrophic.

Ref: Jankovska, V. and Komarek, J.: Indicative value of *Pediastrum* and other coccal green algae in palaeoecology, Folia Geobotanica, 35, 59-82, 2000

2240 lines 20-21

"…induced paleohydrological changes as evidenced in Central Italy and in Sicily (Ariztegui et al., 2000; Giraudi et al., 2011; Magny et al., 2007a, 2011a, b)." ***Have also a look at Sadori et al. 2004, QI 113: 5-17.***

We added this reference.

2241 lines 19-20

"…(e.g. Lago Alimini Piccolo, Di Rita and Magri, 2009; Lago Grande di Monticchio, Allen et al., 2002; 2002; Lago di Pergusa, Sadori et al., 2008; Fig. 1), though most of these concern lowlands. Lake Trifoglietti, however, appears as a unique example of well-dated pollen sequences from the mountain belt of Southern Italy." ***Please add Lago Battaglia, Caroli and Caldara, 2007. If you quote 4 of them (and I wonder what could be added) lakes Monticchio and Pergusa are in the mountain belt and former lake Battaglia and lake Alimini Piccolo are by the coast? If yes, no problem, I agree that it is the best dated record. I think that these phrases should be changed.***

We corrected the sentence and added one reference: "(e.g. Lago Battaglia, Caroli and Caldara, 2007; Lago Alimini Piccolo, Di Rita and Magri, 2009; Lago Grande di Monticchio, Allen et al., 2002; Lago di Pergusa, Sadori et al., 2008; Tavoliere Plain, Di Rita et al., 2011; Fig. 1)"

2251 lines 24-25

"Clear disturbances in forest ecosystems are observed (drop in pollen percentages of Abies and Fagus…". ***You should mention the drop in Abies curve recorded at Monticchio (alle net al. 2002)***

We added: The exploitation of *Abies* for timber in Roman times is expected to caused the disappearance of *Abies*, however climate change (marked by a drought at ca. 2000 cal. BP) cannot be excluded (Allen et al., 2002).

TECHNICAL REMARKS corrected

2225 *though, nethertheless* through

2234 *Quercus caduc****., change to deciduous Quercus***
2235, *Thoughf, Cichorio¨****ı****deae*
2236, line 26
This is also ***(true for?)*** *the extremely rare Pistacia.* Erased
2246*, line 13* *change onland to* ***inland***
2251 ostrya, **use the common name or the Latin one**
palaeoenvironemental
2253 line 27
delete "are thanking"

Tables and figures
table 1
"Wood-Peat-Charcoal "
Why the distinction between the three was not carried out?
The 14C ages have been made on terrestrial organic material: wood and charcoal. We corrected the Table 2 and in the text.

Table 3
Deciduous not Italic
We didn't find this.

Fig. 1
I would prefer to see Calabria centered in the figure, and not at the southern border of Europe Caption: Location of study site and other sites considered in the text: Lago Albano and Nemi (Ariztegui et al., 2000), Lago Battaglia** and Lago Alimini Piccolo (Di Rita and Magri, 2009), Lago*** di Monticchio (Allen et al., 2002), C106 (Di Donato et al., 2008), Grotte di Latronico (Colonese et al., 2010), Canolo Nuovo (Schneider, 1984), Lago di Pergusa (Sadori and Narcissi****, 2001), Biviere di Gela (Noti et al., 2009), Grotte***** di Carburangeli (Frisia et al., 2006), Gorgo Basso (Tinner et al., 2009), Lago Preola (Magny et al., 2011b), AD91-17 (Sangiorgi et al., 2003), BS7938 (Sba et al., 2004), MD90-917 (Siani et al., 2012).*
** Please consider also Lowe et al. 1996 and Mercuri et al 2003. ** Caroli and Caldara, 2007*
**** Grande*
***** Narcisi*
****** Grotta*
**We added (and references therein) and corrected the other points.
The work focuses on southern Italy, so that it is centered on this area.

Fig. 3. Ombrothermic diagram of the meteorological station nearest to Fagnano Castello.
Which is the name of the station. Is it Fagnano Castello? In the case you should write nearest to Trifoglietti
We corrected.
Fig. 7
The curves are so thin that I wonder if it would be better having trees and herbs in two separate figures. The ages in the scale are not calendar, but radiocarbon!
Why don't you use the chronological scale of fig. 8? Please add it in fig. 7
We corrected figure 7 and added the chronological scale. When the paper will be published, the figures 7 and 8 will be placed on a complete page.