Reviewer #4
Thanks to this review, we added and clarified specific changes.

The paper by Joannin et al. on "Pollen-based reconstruction of Holocene vegetation and climate in Southern Italy: the case of Lago di Trifoglietti" is a very interesting work on the development of vegetation and climate at a high altitude site in Calabria. It is clearly written, well organized and informative.

In my view, the following points need reconsideration:
1. the Pann reconstructions of Fig. 9 for the present time (800 mm at year 0) show a very strong discrepancy with the modern annual precipitation values presented in Fig. 3 (1850 mm). Considering that the present time is the only control point allowing verification of the climate model, such a discrepancy invalidates the entire climate reconstruction. This problem needs to be fixed or discussed.
Please see the response in Laura Sadori's comment.

2. *"The climate reconstruction is quantified on the basis of terrestrial vegetation" (page 2241 – line 3), therefore it cannot be used back to explain the behaviour of terrestrial vegetation. Circular argumentations should be avoided especially at page 2247 – lines 7-8 (More arid conditions recorded in Pann (150 mm, Fig. 9f) may have reduced fir and beech woods), page 2248 – lines 24-26 (the regression of fir to the benefit of beech also suggests a dry episode, as supported by the ca. 100 mm annual precipitation decrease inferred by quantitative climate reconstruction (Fig. 9f)), and page 2250 - lines 4-6 (This more humid phase corresponds to peaks in annual precipitation (Fig. 9f; Peyron et al., 2012) that favoured beech/fir forest restoration).*
We corrected:
"More arid conditions recorded in Pann (Δ150 mm, Fig. 9F) and reduced fir and beech woods,…"
"….suggests a dry episode, this corresponds to a ca. 100 mm annual precipi..."
"This more humid phase favours beech/fir forest restoration (despite relative instability) and corresponds to peaks in annual precipitation (Fig. 9F; Peyron et al., this volume)"

3. T*he quasi-disappearance of Abies from the local forest is considered as due to selective exploitation beginning in Roman times (cf. page 2237 – lines 25-27, page 2252 – lines 3-4, and page 2253 – lines1-2). It would be important to support this interpretation with archaeological data. In central Italy, where Abies is currently almost completely absent, all botanists used to ascribe this lack to timber exploitation by the Romans, until various long pollen records in the region demonstrated that Abies quasidisappeared already 70 ka BP (Follieri et al., 1998; Quaternary International 47/48: 3-20). A regional reduction of Abies in southern Italy is also recorded at Lago Salso (Di Rita et al., 2011 Palaeogeogr. Palaeoclim. Palaeoecol. 310: 139-151) and Lago Grande di Monticchio (Allen et al., 2002, Quaternary International 88: 69-80). In the light of these results, can you exclude that the recent reduction of Abies in Calabria is the effect of a natural process?*
It is very difficult to test this hypothesis by archeological findings as they are extremely rare at site from mountains in the region of Calabria. Therefore can we assess that abies disappearance is due to specific timber as we suggest and/or to climate change. The strong

climate changes which occurred at the climate cycle-scale cannot be involved at the Holocene-scale.
Di Rita et al. (2011) wrote about the study of Lago Salso : “Human clearings may have only locally amplified the effects of a natural opening of the forest, which is recorded in many sites of the central Mediterranean (Di Rita and Magri, 2009)”. However, they did not really discuss the abies disappearance as the record stop at around 4ka BP.
Allen et al. (2002) wrote in the study of Lago Monticchio: “Abies no longer occurs in much of the Italian peninsula, but large stands may be found in mountainous areas of extreme southern Italy and in northern Italy. The extinction may be due to a prevention of regeneration through forest cutting and perhaps subsequent burning by people of the Etruscan or Greek culture whose pre-Roman presence is revealed by rich tomb finds now preserved at Melfi. The disappearance of Abies is followed by expansion of Corylus (hazel), Carpinus betulus (hornbeam) and Gramineae (grasses). The changes in vegetation may record forest exploitation and regeneration of different species, but may also be a record of climatic change and instability, or an interaction of exploitation and climate change.”
The first hypothesis discussed by Allen is that Abies disappearance is associated with other taxa development. It is not the case at Trifoglietti where this specie disappears together with Ostrya. Can it be explain by a dense beech forest development? Abies tree develops with Fagus since the early Holocene so this tree seems the more able to resist the competition for sun compared to Ostrya. Is the climate change responsible? At 2000 cal BP pollen-inferred Pann record a minimum, which is related to the Abies drop. However, this taxa did not completely disappeared and could have re-develop when Pann increases again but did not. Is the human responsible? At Monticchio, Abies tree disappears at around 3000-2500 cal. BP during the Etruscan and Greek civilizations and concomitantly with Juglans widespread (which is highly associated with human activity). At Trifoglietti, Juglans similarly starts when Abies disappeared.
If we cannot completely exclude the climate change, argues are weak for instance. However, we modified the sentences: 4.2.2 “…and/or to climate change” and 5.3: “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).”

Minor corrections:
1. *“Pollen grains of Castanea are produced by plants absent from around the lake” (Page 2234 – lines 20-21), but Fig. 2 shows that there are communities of Castanea sativa located less than 500 m from Lago Trifoglietti!*
We change to: Pollen grains of Quercus robur tp., Olea and Castanea are produced by plants absent <u>(almost absent in the case of Castanea)</u> from around the lake

2. *There is some confusion in quoting the interpretation of pollen sequences from southern Italy by Di Rita and Magri (2009), who reported “an aridity crisis combined with increasing human impact”, but did not describe it as “marked by 1) during the middle Bronze age, the use of fire to clear land for agricultures and grazing (Pteridium spores), 2) in Roman times, the exploitation of Abies for timber, and 3) since the Middle Ages, the cultivation of Castanea, Juglans and Olea” (page 2252 – lines 1-5).*
We correct this sentence: … with increasing human impact. At Trifoglietti, this is marked by 1) during the….

3. *The increases in cereals at 6800-6500 cal BP have been interpreted as effect of human activity (page 2248, lines 14-15). However, even higher increases are recorded around 11,000 cal BP, which are not considered as effect of human activity. One single line of interpretation should be followed throughout the work, in the absence of independent evidence.*
A single line of interpretation cannot be applied in a region where wild cereals grow. It may conduct the authors to say that there is no evidence for farming or that farming in Italy exists since the Paleolithic and even before. We won't solve this problem now, but it is necessary to try. We revised the part at the light of this comment and also of the comments of W. Fletcher and Reviewer3 (who asked for archeological findings that could corroborate our hypothesis):
From ca. 6800 to ca. 6500 cal. BP, the APwa record shows a decrease which cannot be explained by changes in annual rainfall characterised by an increase at that time. In Basilicata, Piccarreta et al. (2011) observed an increase in flood frequency from ca. 7200 to 6300 cal. BP (the strongest phase is up to ca. 6800 cal. BP) which is related to colder and moister climate. This correlates with indication of SST cooling inferred from foraminiferal assemblages in core AD91-17 (Sangiorgi et al., 2003) and MD90-917 (Siani et al., this volume) in the Adriatic Sea. At Trifoglietti, this decline of AP could reflect a locally more developed human impact as shown by slight increases in anthropogenic indicators and Cerealia (Fig. 8). At Santuario della Madonna Cave, periods of human activity are interspersed in deposits which characterised the record of rapid oscillations in the moisture regime during the Late Neolithic (since 5th millennia BC; Scarciglia et al., 2009). However, this hypothesis needs to be tested by further investigation in a region (Calabria) marked by the scarcity of archeological findings in the mountainous areas.

4. *In Italy there are many cases of woodstands able to withstand changes for more than 11,000 years (page 2224 – line 8; page 2252 – lines 18-19), for example deciduous oaks at Lago Grande di Monticchio, Lago dell'Accesa, Lagaccione, Lago di Martignano, Lago Albano, Prato Spilla, Core C106, and so on.*
Our conclusion focuses on a beech woodstand. We complete the word in the sentences by adding "beech woodstand".

5. *Fig. 9f: an arrow may be added to indicate the clear increase in Pann of the last 2000 years. Include also some comments in the text, for example modifying the sentence at page 2253, lines 10-11, indicating "a general trend towards drier climate conditions that prevail up to the present".*
We didn't added the requested arrow on the Pann as WAPLS Pann indicates low precipitation. Therefore, we did not change our conclusion which is based on the local and regional pollen record from Trifoglietti and on a comparison with other terrestrial and marine sites and proxies from southern Italy and Sicily (as discussed in parts 4.2.5, 5.1.5)

6. Page 2241 – line 12: early Holocene

7. If possible, add a time scale in calibrated years next to the depth scale of Fig. 7.

8. Quercus caduc. is not a proper scientific name. Use "deciduous Quercus" instead

9. Table 2: Pinus nigra subsp. laricio: subsp. not in italics

10. Table 3: the names of families should not be written in italics

11. Fig. 6: Ericaceae

12. Caption of Fig. 9: Lake Grande di Monticchio (di in small letters), or Lago Grande di Monticchio.