

Interactive comment on “Climate changes since the mid-Holocene in the Middle Atlas, Morocco” by M. Nourelbait et al.

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Response to reviewer #2:

-The English needs to be checked and improved by a native English speaker – there are too many mistakes and the grammar could be better.

== Thank you for this comment. The English will be checked and improved by a native English speaker.

-There is a very interesting change observed in the pollen at ca. 3750 cal yr BP with the expansion of Cedrus but this vegetation change seems to start earlier on, around 4 ka, with a decrease in Pinus and decreasing estimations of temperature (Fig. 3). Could that also be related with the globally detected 4.2-4ka cold/arid event? This event

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has been previously identified in the western Mediterranean (i.e., Jiménez-Moreno & Anderson, 2012) so it would be worth adding some discussion about it.

== Actually, in many sites that we have studied in the Middle Atlas we observe an expansion of Atlas cedar populations after ca. 6 ka. The sustained expansion of Atlas cedar after ca. 4500 cal BP in this site is more probably related to its late spread at high altitudes. In other sites (lake Tigalmamine (Lamb et al., 1995), Ras El Ma (Nouvelbait et al., 2014); Ait Ichou (Tabel et al., JQS in press)) located at about 100 to 200 meters below lake Hachlaf (ca. 1700m asl), Atlas cedar occur much earlier. The strong expansion of Atlas cedar around lake Hachlaf is very probably related to an upslope migration rather than to an abrupt climatic event.

-It seems reasonable to suggest the hypothesis about an increase in seasonality triggering the Cedrus expansion since 3700 cal yr BP in the area but it looks like the authors are not very sure about it. . . This could be tested checking the environmental factors controlling Cedrus occurrences at Present, which I am sure has previously been done by ecologists in the area.

== Thank you for this remark. Indeed, Atlas cedar is one of the most resistant conifers to summer drought which should explain its expansion at the expense of Pinus. Here is some eco-physiological information that we have provided to reviewer 1 (apologies for the copy/paste). "A study of drought thresholds influencing the growth and photosynthesis was performed on different cedar stands and species (*C. atlantica*, *C. libani*, *C. brevifolia* & *C. deodora*) of different origins (Aussenac & Finkelstein, 1983). This study shows that among many conifers, cedar trees may keep a sustained photosynthesis activity even when drought is very high. Thus, strong precipitation contrast between summer and winter may not affect the cedar's overall growth as long as the total amount of rainfall is sufficient (higher than 600 mm/year) and the winter temperature is low enough for the bud burst (Larcher, 2000)." Aussenac, G., & Finkelstein, D. (1983). Influence de la sécheresse sur la croissance et la photosynthèse du cèdre. *Annales Des Sciences Forestières*, 40(1), 67–77. Larcher, W. (2000). Temperature stress and

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survival ability of Mediterranean sclerophyllous plants. *Plant Biosystems*, 134(3), 279–295.

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