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Interactive comment on "Foliar photochemical processes and carbon metabolism under favourable and adverse winter conditions in a Mediterranean mixed forest, Catalonia (Spain)" *by* D. Sperlich et al.

D. Sperlich et al.

dominik@creaf.uab.es

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We would like to thank Reviewer 1 for the profound review and for the constructive comments on this paper. It will certainly help to improve this paper. Our responses (AC) to the specific comments of the Anonymous Referee 1 (Ref1) are given below each point. Moreover, we attached a pdf with the incooperated changes in our manuscript.

Ref 1: GENERAL COMMENTS This paper reports measurements of several parameters related to photochemistry and C metabolism in leaves of three co-occurring

Mediterranean woody species during winter. Results are compared between (i) three species (Quercus ilex, Pinus halepensis and Arbutus unedo), (ii) two sampling periods ("mild" and "frost"), and (iii) two positions in the tree crown (sunlit and shaded). All measurements were made in the laboratory, on twigs recently collected from the field. This paper adds important data to the available information on winter performance of Mediterranean evergreen species. However, it presents some significant flaws:

Answer (AC): Thank you for the positive feedback concerning the importance of our work. Regarding the asserted flaws, we have endeavored to solve all criticized points. Find kindly our responses point by point in the following text.

Ref 1: 1. The two periods are not well defined: the authors are apparently comparing a "mild winter period" with a "frost/cold period" when it seems to me (from their own description) that they sampled a "frost period" and a "post-frost cold period". As a consequence, no real "mild period" was assessed. This compromises interpretations based on the comparison between "mild winter" and "cold winter".

Answer (AC): Thank you for pointing out the error which was introduced by wrongly defining the dates for the first field campaign taking place in the mild period. Here we clarify: Sampling field campaign 1 9.1- 19.1. (DOY 9-19) Frost/chilly phase 19.1.-4.2 (DOY 21-35) Sampling field campaign 2 14.2.-24.2. (DOY 45-55) After this correction the definition of the field campaigns and also the choice of the title became certainly clearer.

Ref 1: 2. Most of the Introduction focuses on the importance of different adaptive strategies and interspecific competition as determinants of plant community trends, particularly under climate and land use changes. However, the Discussion does not satisfactorily address these issues!

Answer (AC): Referee 1 points out that there are several arguments in the introduction being unaddressed in the discussion concerning different adaptive strategies and interspecific competition as determinants of plant community trends. We have revised now

our introduction and we have tried to foster our arguments so that they are better related to the observed eco-physiological behaviour presented in the results. We rewrote the section from L. 27 Pg.9699 to L. 19 Pg. 9700 when discussing adaptive strategies, phenotypic plasticity, and genotypic evolution. We have focused more on the physiological mechanism which explains frost induced changes in the foliar photosynthetic apparatus and tied it stronger to our objectives.

Ref 1: 3. The paper is burdened with theoretical details concerning the measured parameters, which were many. In fact, only those parameters with the most relevant (and not redundant) results should be presented, and discussed in view of the primary aims of the study. I get the impression the authors lose themselves in a "forest" of parameters and data and miss the purpose of the whole study.

Answer (AC): We agree that we provide an ample set of parameters, but those parameters provide valuable information to fulfill our objectives (introduction) by combining two independent methods, namely gas exchange (GE) and chlorophyll fluorescence (CF). The two methods inform on the photosynthetic machinery from different angles and together define much better stress effects in the carbon and light reactions. They provide valuable new information when combined (e.g. gm, Cc or Jamb – Anet relationship). In many gas exchange studies, interesting CF-parameters such as NPQ, Fv/Fm or others are neglected despite its ease to measure and the potential information they contain. However, we have accepted the suggestion to do some "thinning" in our "forest of parameters" and we have tried to find a compromise between reducing the amount of parameters and not losing interesting information. We have removed Fig 7 A, Fig. 7 B, and Fig. 9 B. Furthermore, we have restructured figures 10, 12 and 14 and also 11,13 and 15, so that they are now merged in one figure each (10 A,B,C and 11 A,B,C), reducing thus the space utilized.

Ref 1: SPECIFIC COMMENTS The TITLE reflects the core contents of the work, but the word "favourable" should be checked/corrected (cf. item 1, in General Comments).

Answer (AC): We have corrected the wrong labelling of the measurement dates in Material and Methods (see answer above) and the title should make sense now.

Ref 1: The ABSTRACT should indicate that measurements were made in the laboratory (on twigs collected from the field). The reference to the spring values should be removed since they were not obtained from the present study; the sentence in line 24-25 should also be removed because no results are presented for the weeks "after" the cold period (the cold period corresponding to 14-24 Feb, as described in section 2.3).

Answer (AC): We have included in the abstract the information that measurements were conducted on excised leaves in the laboratory, have deleted the reference to the spring values and also the sentence in line 24-25.

Ref 1: Line 6-8: how does this relate (or not) with the outcompetition of P. halepensis by Quercus spp. you describe in section 2.2?

Answer (AC): Thanks for this question helping to clarify this sentence. We had flipped unintentionally the order of "photoinhibition-avoiding (P. halepensis) and photoinhibition-tolerant (Q. ilex)" in line 6-8, p.9699. It should be reverse as described in line 11-14, p.9728. We have now corrected the sentence: "photoinhibition-avoiding (Q. ilex) and photoinhibition-tolerant (P. halepensis)". Now it should make sense in respect to the early-successional behavior of P. halepensis described in section 2.2 and its photoinhibition-tolerance in sunny environments after occupying disturbed areas, and the late-successional strategy of Q. ilex which induces much earlier a photoprotective mechanism and "stand-by" mode, therefore being photoinhibition-avoiding.

Ref 1: How does this competitive disadvantage of A. unedo relate with the current forest trends and/or the predicted trends?

Answer (AC): Thanks for pointing this out. We have now added information to clarify this point. The scattered occurrence of A. unedo in the closed forest reflects its com-

petitive disadvantage. Generally, A.unedo is abundant in open macchia ecosystems as a shrub sharing the habitat with other semi-deciduous or deciduous shrubs. However, under specific circumstances, A. unedo appears as a mature tree in the forest canopy. In the long-run of forest succession and canopy closure it would depend on disturbances to regenerate.

Ref 1: The INTRODUCTION is too long and/or not adequate for the kind of measurements and results presented afterwards (or vice versa. . .).

Answer (AC): As already outlined above in our answer after general comment Nr. 2, in our introduction we tried to link general aspects of global climate changes effects on species distribution in the Mediterranean to the specific topic of this work. We think that our way facilitates to enter such a physiological topic and to create awareness for a broader scientific community for which this special issue was designed. However, we do agree that the introduction is long and we have worked on it to make it shorter and more concise as already explained above after the general comment. The introduction counts now 777 words (previously: 958).

Ref 1: MATERIALS AND METHODS is an excessively long (but incomplete!) section. Examples of missing information: 1. Although the reasons for studying P. halepensis and Q. ilex can be deduced from the description of stand history (2.2), the choice of A. unedo is not explained.

Answer (AC): We pointed out that A. unedo enriches the tree species diversity despite being rather characterised as a shrubby species abundant in the macchia ecosystems (Beyschlag et al., 1986; Reichstein et al., 2002). (L. 12-15 pg. 9703). However, we included some supporting information why we included A. unedo in our study in section 2.3 pointing out the ecological value and the unusual occurrence as a mature tree in the forest canopy.

Ref 1: 2. How many trees/species were sampled on each occasion? How many leaves or sets of needles were measured for each parameter (e.g., the means presented in the

Figures correspond to how many leaves?). In other words, provide some information about the representativeness of your samples and measurements.

Answer (AC): Generally, we sampled 5 twigs of the sunlit and shaded crown for every tree species. Thus, the parameters were obtained on maximum 5 leaves except in those cases when we had to delete the data because of noisy responses and/or patchy stomatal openness. We have now clarified this point and we have provided more data about the sample size.

Ref 1: 3. Why was 25 _C the selected temperature for measurements?

Answer (AC): 25 C is the standard temperature for gas exchange measurements as it is assumed to be optimal for photosynthesis (Taz and Zeiger, 2010). Moreover, carbon or light response curves are always conducted on this reference temperature also because of the Rubisco enzyme kinetic parameters (Table 3) used in the Farquhar equations are provided for 25 C (Bernacchi et al., 2002).

Ref 1: Sections 2.4-2.11 are unacceptably long in this sort of paper. Although most of the laboratory details could be important for the correct interpretation of the results, the degree of such detail is excessive in comparison with the little or no information provided about other aspects of the methodology (cf. paragraphs above). Formulae that are of general knowledge or have been proposed by other authors (e.g. Fv/Fm, gm) could be avoided. In fact, most of these sections could be presented as an appendix to the main paper.

Answer (AC): We agree that in total these sections are quiet long. In the previous version we had considered it important to depict a complete and reproducible set of the equations for the parameters we used. This is because despite having chlorophyll fluorescence (CF) tools ready available in most of the gas exchange systems, these CF-derived parameters are often neglected in gas exchange studies. In any case, we have now followed the referee's suggestion and have reduced the length of M&M accordingly by moving several sections to the appendix including the equations and

explanations of Fv/Fm, PhiPSII, NPQ, qP and the section 2.9.

Ref 1: RESULTS about shoot growth (pg 9715, ln 21-22) refer to the 3 studied species?

Answer (AC): Yes, the shoot growth refers to all species (see L.21 p. 9715).

Ref 1: Where and how was this radiation measured (pg 9715, ln 25), and what was its value during the mild period?

Answer (AC): Thank you to help to clarify this point. We have provided now this information in our text as follows: "Sensors for measuring air temperature (HMP45C, Vaisala Oyj, Finland) and solar radiation (SP1110 Skye Instruments Ltd., Powys, UK) were installed at a height of 3 m, in a clearing ca. 1 km from the plot. The average radiation in the mild winter period (9-19.01.12 or DOY 9-19) was 46 W m-2."

Ref 1: Where is Fig. 5 mentioned, in the text?

Answer (AC): Thank you for pointing this out. We had referred to the wrong figure in the text in l.23 p.9716. Instead of Fig.4a and b, it should be Fig.5a and b. We have now corrected it.

Ref 1: In 3.4, please rephrase "representing the health of a leaf" when referring to Fv/Fm.

Answer (AC): We have corrected the wording and we have replaced it by "stress indicator".

Ref 1: Why are values from shaded leaves during the "mild period" not shown for P. halepensis and A. unedo?

Answer (AC): We did not want to include more information which is only of marginal relevance, as we are comparing primarily the difference between the two winter periods and no information for the shaded leaves of P. halepensis and A. unedo is available for the second winter campaign. Information in both winter periods is only available for the shaded leaves of Q. ilex (see Material and Methods, section 2.3, pg. 9704).

Nonetheless, we have tried to clarify this point in section 2.3.

Ref 1: The paper contains too many tables and figures; table 3 should certainly be removed.

Answer (AC): We have removed this table.

Ref 1: The mild and frost winter periods should be clearly indicated in Figs. 1-9 (and the indication of the sampling periods would also be welcome in Fig. 1).

Answer (AC): We have indicated now the two periods and have added in Figure 1 the sampling periods.

Ref 1: DISCUSSION needs shortening and focusing.

Answer (AC): Thanks for helping to improve our discussion. We shortened the discussion counting now 2693 words (previously: 3564).

Ref 1: Since no actual field measurements were performed (as far as I can understand from the present manuscript), it is not correct to imply that the present study combined both field and laboratory measurements (Pg 9719, ln 23-25). Moreover, the contents of most of this same paragraph should be moved to Materials and Methods!

Answer (AC): We have removed now this section from the discussion and moved the relevant information to Material and Methods.

Ref 1: Section 4.2 does not discuss the presented results.

Answer (AC):We have removed this section.

Ref 1: You did not show that leaf position has species-specific effects because you only showed the results for one species (Pg. 9726, ln 15-18).

Answer (AC): We have corrected this section and refer now only to Q.ilex.

Ref 1: What is an investment in life cycles (Pg. 9727, ln 17)?

Answer (AC): We meant that leaves of A. unedo have a shorter life cycle meaning they are shed and replaced earlier (1-2 years) in comparison to, for instance, Q. ilex which keeps its leaves intact for 2 to 3 years or even longer. We have clarified this point now.

Ref 1: The REFERENCE list is too long.

Answer (AC): The references list was reduced and counts now 3480 words (previously: 4042).

Ref 1: TECHNICAL CORRECTIONS Replace Treitach et al. by Tetriach et al.

Answer (AC): We replaced this citation. Note that the correct citation is Tretiach et al.

Ref 1: Pg. 9702, ln 23 – indicate which century

Answer (AC): We indicated now the century in the text.

Ref 1: Pg 9716, lns 19 and 22 – please check the grammar Pg 9718, ln 9 – "most strongly pronounced" is awkward.

Answer (AC): We have corrected the wording: "mostly pronounced".

Ref 1: Pg 9719, ln 21 – "though" is not appropriate (therefore?)

Answer (AC):Corrected.

Ref 1: Figs. 10, 13, 14 and 15 - μmol and not μmols

Answer (AC): Corrected.

Ref 1: The whole text should be revised for minor corrections (grammar, missing words?, punctuation)

Answer (AC): We have reviewed the text for minor corrections.

References: Bernacchi, C. J., Portis, A. R., Nakano, H., Caemmerer, S. Von and Long, S. P.: Temperature Response of Mesophyll Conductance . Implications for the Determination of Rubisco Enzyme Kinetics and for Limitations to Photosynthesis in Vivo, Plant

Physiol., 130, 1992–1998, doi:10.1104/pp.008250.water, 2002. Beyschlag, W., Lange, O. L. and Tenhunen, J. D.: Photosynthesis und Wasserhaushalt der immergrünen mediterranen Hartlaubpflanze Arbutus unedo L. im Jahresverlauf am Freilandstandort in Portugal I. Tagesläufe von CO2-Gaswechsel und Transpiration unter natürlichen Bedingungen, Flora, 178, 409–444, 1986. Reichstein, M., Tenhunen, J. D., Roupsard, O., Ourcival, J.-M., Rambal, S., Dore, S. and Valentini, R.: Ecosystem respiration in two Mediterranean evergreen Holm Oak forests: drought effects and decomposition dynamics, Funct. Ecol., 16(1), 27–39, doi:10.1046/j.0269-8463.2001.00597.x, 2002. Taz, L. and Zeiger, E.: Plant Physiology - 5th Edition, edited by L. Taz and E. Zeiger, Sinauer Associates, Inc., Sunderland., 2010.

Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/11/C3555/2014/bgd-11-C3555-2014-supplement.pdf

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