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Interactive comment on "Simulating precipitation decline under a Mediterranean deciduous Oak forest: effects on isoprene seasonal emissions and predictions under climatic scenarios" *by* Anne-Cyrielle Genard-Zielinski et al.

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Responses to Referee #3

We do thank Referee #3 for her/his thorough reading and useful suggestions. We tried, in particular:

- to better explain how we tuned MEGAN2.1 model in order to assess its ability in reproducing the effect of drought on Q. Pub ER ;

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- to study the sensitivity of MEGAN2.1 to the wilting point value;

- to suggest some improvement in the formulation of the drought activity factor used in MEGAN2.1.

a. Main concerns:

- Bibliographical weakness:

Although many of the references cited in our manuscript were not all narrow in focus and scope, and that a large number of them did focus on the effects of drought onto photosynthesis/cellular processes/isoprene emissions (Chaves et al., 2002; Lichtenthaler et al., 1997; Funk et al., 2004, Simon et al., 2005; Tani et al., 2011; Guenther et al., 2013; Wiberley et al., 2005; Llusià et al., 2008, 2009; Owen et al., 1998; Loreto and Schnitzler, 2010; Pegoraro et al., 2004), we have added the works of Sharkey and Loreto (1993), and Brili et al. (2007).

In the original paper, we did refer twice to the Peñuelas and Staudt (2010) paper (in the Introduction p2 and in the Discussion p16 of the former version), which is a review, and inherently, cannot be considered as narrow in scope.

Our manuscript does not aim at reviewing all the isoprene modelling studies based on MEGAN; however the excellent work of Müller et al. (2008) is now cited in the revised manuscript, and their assessments of the sensitivity of isoprene emissions to soil moisture is now mentioned in the revised section 3.3.

As now clearly explained (in the revised introduction and discussion), the assessment of the wilting point in the Sindelarova et al. (2014) study was based on the Pegoraro et al. (2004) work.

- Measurements:

1. We have now made it clear in the revised manuscript (new section 2.5) that:

- we did not aim at extrapolating – using MEGAN or any another emission model –

isoprene fluxes from the whole canopy; our focus was to test MEGAN in assessing the impact of ND and AD on isoprene emission rates as observed from the sunlit branches of Q. pub; the effect of the canopy structure is thus not addressed in this paper (even if some measurements were made under the canopy during this study, see next paragraph).

- the shading effect was investigated, only for 2 trees in the ND plot, and only in June 2012; we observed that, although the shading effect can be strong (PAR lowered by a factor of 6 to 18), measured isoprene emission factors (Is) were not significantly different (P>0.05) at the top and below the canopy (77+/-3 and 59+/-12 μg gDM-1 h-1 respectively); these points have been detailed in another paper (Genard-Zielinski et al., 2015).

2. We give in the revised section 2.2 a full description on how the roof was operated in order to simulate an AD.

When this study was conducted we were well aware that the future climatic changes will affect not only the intensity of the precipitations but its seasonality too (see our discussion on that point). Since our study started just after the roof operation was available, we did focus, for this 1st year of measurements, only on the exclusion intensity aspect rather than its ‘timing’.

3. We don’t see any scientific basis for which Referee#3 could state that we do not relate the reality of our field work. Yes, a tremendous effort was made at the O3HP to conduct our field work and yes, we did sample Q. pub. over one week per month, as detailed in the table below:

Month / Sampling dates

June 2012 / 1 - 16

July 2012 / 15 - 20

August 2012 / 19 - 24

September 2012 / 18 - 24

October 2012 / 22 - 26

April 2013 / 22 - 27

June 2013 / 16 - 22

Note that we did not state that we sampled isoprene 'one week per month from June 2012 till June 2013'; we did precise that 'measurements were performed at least during one week, once a month, from June 2012 to June 2013, except from November 2012 to March 2013 when Q. pubescent is fully senescent with leaves remaining on the tree' (P7, L26-28).

All isoprene measurements presented here were sampled on cartridges except during April 2013 where only on-line PTRMS was used (and no cartridges). An intercomparison between Cartridge+GCMS and PTRMS was carried on parallel on another emitter present on the site (Acer monspessulanum); no significant difference was observed between both techniques. This information is now given in the revised section 2.3.

4. The COOPERATE data:

As now mentioned in the revised section 3.3, ANN training and validation were carried out using data measured at the O3HP (sampled ER, COOPERATE environmental data); we now explain in the revised manuscript that daily averaged values were used when regressors were cumulated over 7-21 days.

As mentioned in our response to referee#2, only a very few number (< 5 %) of precipitation data needed for assessing P integrated over 7, 14 or 21 days, was missing. As we spent quite a lot of time on the field site, we are well aware that precipitations can, locally, be highly variable in time and space; this is why we used the relative differences observed between the 2012 and 2013 Pcum curves in both sites (Forcalquier and O3HP) in order to 'fill the gap' of the missing data. Due to the fact that the P was integrated over 7, 14, 21 days, this bias remains negligible. These detailed are now

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given in the revised section 2.7.

Statistics

1. Being aware that MEGAN does include some 'historical' dependence of environmental conditions (as mentioned P15, L19-20 of the original manuscript) we did consider the PAR and T over the previous 24 and 240 hours before our measurements when we calculated isoprene emissions. This information is now clarified in the new section 2.5.

The other different points raised by Referee#3 concerning how we used MEGAN (canopy structure, canopy loss) are also detailed in the new section 2.5.

2. As mentioned earlier, no more 2100 projections are presented in the revised manuscript.

3. Indeed ANNs are often referred to as a 'grey' box, since such a statistical approach does not aim at providing new mechanistic understandings of the studied process. On the other hand, when a mechanistic approach is failing to do so, ANNs can provide some fruitful information. Note in particular that in MEGAN the isoprene dependency to PPFD over the previous 24 and 240h was deduced by a 'best statistical fit' (P3190, L28-32 Guenther et al., 2006), without providing any precise mechanistic insight on how and why it is working; the useful of MEGAN is, nevertheless, not challenged. In our case, by using G14 we showed that, for a drought adapted emitter, isoprene emission shall be much more sensitive to T than to P under future climatic changes; MEGAN2.1 was unable to do so, since not 'adapted' to account for drought effect of a drought adapted isoprene emitter.

ORCHIDEE

A better description of what data were obtained by ORCHIDEE and how these data were used in G14 is now given in the revised sections 2.7, and 3.4.

Our projections were not made specifically for the O3HP site, but for a Mediterranean site representative of the O3HP site conditions. Therefore, precipitations –or other parameters – were not downscaled to the O3HP site.

4b. Recommendations

We followed the final recommendations made by the referee#3:

- As it is now explained in the new section 2.5, site-specific data were used for MEGAN2.1 assessment;

- Site data were also used for G14 development (as explained in the revised section 3.3);

- Site data (COOPERATE) were also used in G14 to assess the present case in the sensitivity tests (see revised section 3.4);

- The sensitivity of MEGAN2.1 to the wilting point is now presented in the revised sections 3.3 and 4.2.

However, as explained in the original manuscript, and as it is now mentioned twice in the revised manuscript, physiological parameters such as sap flow, transpiration, . . . were not measured during this work since it was not the aim of this work. Rather than using such complex data, we favored the use of more 'integrative' environmental variable, 'easily' accessible than complex physiological data; we hypothesized that, in fine, sap flow, transpiration, . . . are more or less indirectly driven by L, T, SW, ST, especially if they are considered over a large of frequency range as in G14.

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