We would like to thank all reviewers for taking the time to read the manuscript and make many useful suggestions that we will use to make this a strongly improved version of the manuscript. We are grateful for the overall positive assessment and will incorporate the advice to improve the narrative, increase the quantitative nature of the text and improve figures.

Response to Anonymous Referee #3

In the Results and Discussion sections there is a reliance on Figure data rather than Tabular data and from this the presentation of the argument in the text is generally of a qualitative nature – this could be strengthened by putting some numbers in appropriate places.
We have tried to keep a balance between figures and tables. It is an excellent suggestion to weave numbers into the text to make the manuscript more quantitative– we will follow this suggestion in across the the Results and Discussion sections.

Another area where things fall a little short is in the Discussion section where there is little pulling together of the Australian results with related studies from Europe, North America, China to generate a more holistic view of the impacts of these extreme heat events.
We will expand the discussion to compare and contrast to heat waves in Europe, North America and China.

Comments, suggestions for changes and areas that re-quire some clarification: 1) As a comment: the number of sites in forested systems was n = 1. The behavior of this system AU-Tum, was somewhat different to the rest and was also different to the behavior of the European forest systems under this sort of extreme heat event. This wet site may be buffered from the sort of behavior that is usually seen until the soil moisture reserve that the forest can tap into has been reduced. This apparently did not happen during this heat wave until right at the end. The conclusion tells the story as it was for this site but not much can be generalized from this result unless this forest type remains in a wet environment in the future climate or if other temperature forests in southern Australia also have similar soil moisture reserves.
Unfortunately there was no data available from another wet sclerophyll forest in Australia. We do think that our results are characteristic for wet sclerophyll forests but this may need to be confirmed when further sites become available. We will address these concerns in the site description of the revised manuscript.

2) For explanation: The background period of hourly measurements that was used as a baseline comparison point for the study was quite short BGH (2/1/2014 – 6/1/2014) when compared with the period of the heat wave 1/1/2013 – 18/1/2013. It was quite understandable that more data was not used from 2014 if there was another event during January but what about January 2015 as this paper was submitted 9th May 2016?
At the time of writing BIOS2 data was only available until end of 2013.

The results may not be altered but it would have been much more robust if a mean over 2 years was used or a longer period in 2015 was used rather than a 5 day window that was relatively warm (some sites z-score +1) and where the soil moisture was relatively low (some sites z-score -2) in 2014. 3)
It was a tradeoff between increased time and number of sites. Including the 2015 period would have meant an overall reduction in sites as in 2015 some sites had gaps in the relevant period.

3) Climatology is used rather loosely in the text. Generally it refers to the computed climatology from BIOS2.
We will make changes in the manuscript to refer to climatology only when talking about the computed climatology from BIOS2.

If we go to the CSIRO website that describes BIOS2 (http://carbonwaterobservatory.csiro.au/bios2.html) we get: A library of programs for the download and treatment of inputs (gridded vegetation cover, meteorological data and parameters). A weather generator for downscaling of meteorological data from daily to hourly. The BIOS2 modelling system computes the current and historical state of the major components of the carbon and water cycles for Australia at a spatial resolution of 0.05◦ latitude and longitude (~5 km), This could have been built into the paper more explicitly so that we understand what we are getting – current and historical climate surfaces that are presumably calculated using Australian Bureau of Meteorology field data as primary data.
We refer to the 2 papers in *Biogeosciences* led by Haverd in 2013 which give full detail of BIOS2. BIOS2 is doing much more than providing historical climate surfaces, which we will clarify in the model description of the methods.

In other places in the tables Climatology refers to the measured data from the flux towers. This needs to be specified more clearly.
We will make changes in the manuscript to refer to climatology only when talking about the computed climatology from BIOS2.

4) Figure 2 I find confusing with the precipitation spread over the 3 panels. This would be better on its own as a 4th panel.
We will do so

5) More needs to be put into the text on how close the various ecosystems were to switching from carbon sinks to sources. There were no numbers for sites to explain which sites switched to sources in Fig. 8 but what was provided indicated some MW site(s) (assuming the color code is brown) were sources in both HW1 and HW2 and some TW site(s) were sources in HW1. If this is correct then it is odd that this story was not developed as this would indicate some of these systems can be pushed over the edge by extreme heat events.
We would like to thank the reviewer for this valuable comment. We will extend the results section and discussion to include the point that we found a change in the

number of hours during which the ecosystems acted as sources and sinks during the heat waves.

Listed details:
P1/L33: BIOS2 to replace CABLE (throughout the text BIOS2 is used, CABLE is a part of this it would appear)
Will do, thanks

P2/L9 : not be sustainable
Will do, thanks

P3/L6: While green- house gas emissions generally (NOT climate change)
thank you, we will change this paragraph

P4/L4: Not really clear at this point how BGC and BGH differ. Spelling out that BGC is Modelled climate/fluxes and BGH are measured climate/fluxes would make it clearer.
will do, thanks

P4/L4: 2/1/2014 – 6/1/2014 Why was this reference chosen and not the mean from Jan 2014 and Jan 2015?
We defined the reference period such that data would be available from all the sites. Unfortunately, 2015 did not have the same sites available.

P5/L1: the drier interior
Will do, thanks

P5/L2: >30m as forests.
Will do, thanks

P5/L2: Not sure what is intended here - None of this sites are montane?
We think it is worth pointing out the range of elevation. While 1260 m asl may not seem montane on other continents it puts the site into the temperate cool climate range.

P5/L20: Is there a reference to ACCESS?
Will do, thanks

P6/L6: Jupyter Notebooks. (otherwise it sounds like a type of hardware)
Will do, thanks

P7/L28: Available energy – suggest providing a definition, this is not as well known as Bowen ratio
Will do, thanks

P7/L29: at MW and TW sites during HW1 but was about the same for HW2 and the TF site. does this mean about the same for MW, TW and TF sites during HW2
we will clarify in the text

P8/L16: to below background conditions in HW2 across the MW sites (?)
Will add across the MW sites to the sentence, thanks

P8/L18: For the TF site beta increased…
Will change, thanks

P9/L10: pattern for associated
Will change

P9/L15: heat wave in California..
Will change

P10/L4: or that there was little stomatal control of the latent heat flux at this site, This conflicts somewhat with what is written below: (L16) We observed a diurnal asymmetry in GPP at all sites and in all measurement periods. This is expected in ecosystems that exert some degree of stomatal control. (L30) With temperatures clearly above an optimum C3 temperature for carbon uptake and VPD exceeding values where stomatal closure can be expected at this site
That this could be due to limited stomatal control is a possibility, but we go on to exclude it.

P10/L9: threshold of 0.4 Where does this threshold come from for the site?
Will add (S. Zegelin, pers. comm.)

P10/L31: increased incoming shortwave Suggest using the z-scores for Fsd to indicate the difference to BGH and BGC
We give absolute values on how Fsd differs between the heat wave periods and the background in table 2 but will add a reference to the table in the text.

P10/L32: increased photosynthetically active leaf area likely Is there an indication from MODIS that LAI has changed? You have reported MODIS LAI in Table 1.
MODIS data cannot be used to track changes over short time frames. Because this analysis relies on consistency of meteorological statistics over the analysis periods (thus we cannot choose longer analysis periods), we will remove this reference. We do not know if LAI has changed due to the heat wave but the fact that the temperate woodlands recovered after rain and in cooler temperatures indicates that there may not have been permanent damage to the leafs.

P11/L7: Figure 8 does not do this justice – what is needed is a Table at the site level.
We will change fig.8 to provide the necessary numerical values and statistical inference of the comparison between background and heat wave values.

P11/L9: remained carbon sinks during both heat waves periods. This is why a table is needed - need to see that some sites are only just carbon sinks and some are sources.
We will change fig.8 following the previous comment, which will identify and illustrate differences in sink/source strength (as positive/negative NEP).

P11/L21: energy balance and therefore in con- cert with the current environmental conditions this may either mitigate.. (is this what was intended?)
Will change to "dampen"

P11/L22: In the 'Angry Summer' event the woodland...
Will change to "during this event"

P11/L28-30: Which of the sites in MW or TW are more at risk?
While TW has restored its carbon sink function after the rain and under cooler temperatures MW has not. We will change text to address this point.

P12/L16: HW1 the latent heat flux at the MW and TW sites was reduced even further. sense here is odd. We jump from the previous paragraph on carbon to this one on LE. ie. reduced even further means ?
thanks, will clarify

P12/L17:observed during BGH for the woodland sites.
added, thanks

P16/L20: CO2
thanks, will change

P18/L30: CO2
thanks, will change

P21: F2 Would be better with a 4 panel that shows precipitation. It is confusing seeing rainfall for a TF site on a plot of MW etc.
thanks, will add a fourth panel.

P22:L6 F3 stars denote soil water
We agree that this was confusing. A legend will be added to the figure to clarify the symbols.

P23:L5 F4 energy imbalance is presented here and in the table and not discussed in the text.
Energy imbalance is a long-standing issue in eddy covariance research. However, the analysis presented in this study will not resolve the energy imbalance problem.

P25:L7 F7 dark green) heat at
Will change.

P26: F8 What does the color coding mean here?
Will add a reference to Figure 1 in the legend (i.e. "colours as in Fig. 1), thanks

P27: FA1 What does the color coding mean here? to the BIOS2 climatology
In the legend, colour coding will be defined relative to Fig. 1 and reference to BIOS2 climatology will be added, thanks

P28: T1 oC
thanks, will change

P29: T2 N.B. Here climatology means both observed and modelled.
thanks, will clarify