Response to Short Comment #1

The authors gratefully thank to the Referee for the constructive comments and recommendations which definitely help to improve the readability and quality of the paper. All the comments are addressed accordingly and have been incorporated to the revised manuscript. Detailed responses to the comments and recommendations are as follows. Please note that all the comments are italic and authors reply follow immediately below the comments.

This manuscript assesses impacts of climate variability on catchment water balance and vegetation cover, which is an interesting topic of ecohydrology. It is well written and organized. The data and analysis are solid, and fully support the conclusions. Following comments may help you improve the manuscript:

(1)Figure 1 and 2 are switched. That is, Figure 1 should be Figure 2, and verse versa.

Yes, the order of Fig.1 and Fig. 2 was wrong. We have changed this order.

(2)Provide one reference or more to support your statement in Lines 21-22 on page 6298.

Thanks for this comment. This statement is not too strict. In this study, the number of samples is 193. It is significant when the absolute value of linear correlation coefficient is greater than 0.236 at the 99.9% confidence level. Therefore, we modified this sentence as “The larger the absolute value of the linear correlation coefficient, the stronger the linear correlation relationship. It is significant when the absolute value of correlation coefficient is greater than 0.236 at the 99.9% confidence level”.

(3)It seems that the statement in Lines 6-8 ("Woody vegetation ... E0/P <2.0.") is reversed.

Thank you for this comment. We think the Lines 6-8 are in Page 6309. Yes, the statement is reversed in wet and dry catchment for *E0/P <2.0* and *E0/P >=2.0*. The revised one should be “Woody vegetation is the dominant type in wet catchments with $E_0/P < 2.0$, and non-woody vegetation is the dominant type in relatively dry catchments with $E_0/P \geq 2.0$.”

(4)What is "litter" in Line 19 on page 6309?

Thanks. This is misspelling of “little”.

(5) What is "tot" in Line 7 on page 6311?

There are some words missing in the Line 7, Page 6311 in editing. These two sentences should be “The temperature elasticity of total runoff is -0.05 on average (ranges from -0.8 to 1.1), which means that a 1 °C increase of the annual temperature results in a -0.05% change in annual runoff. This means evapotranspiration will increase with temperature and contributing to a decrease in runoff.”

(6) In sections 4 and 5, the methods (e.g., equations) and results are mingled. They should be separated and documented in different sections.

Thanks for this suggestion. The paper structure could be improved by combing the methods into the same section.

(7) "This might be caused by the error introduced by the baseflow separation" (Line 19 on page 6303). Is it possible to quantify the accuracy of your baseflow separation? Does the separation have acceptable accuracy?

There must be some errors introduced from the baseflow separation. The accuracy of the baseflow separation could not be assessed directly from the measurement. However, the sensitivity of the separation method has been discussed by many researchers.

A key assumption in the baseflow separation is that the outflow from the aquifer is linearly proportional to its storage. The linear storage model has been questioned, however, Chapman (1999) showed that ‘for the commonly occurring case of recession of duration up to about 10 days, the linear model remains a very good approximation’.

(8) "...from the error introduced in Fp and Fr separation" (Line 12 on page 6308). Is it possible to quantify the accuracy of the separation? Does the separation have acceptable accuracy?

The fPAR data (*Ft, Fp* and *Fr*) used in this paper was obtained from Donohue et al. (2008, 2009, 2010). Total fPAR (*Ft*) was separated into persistent fPAR (*Fp*) and recurrent fPAR (*Fr*) performed by Gill et al. (2006). Gill et al. (2006) compared the separating results with field-based measurements in woody cover from across a range of vegetation types in north-eastern Australia and found a good correlation between them. They also pointed out there were still some other errors, such as the complex composition of F_r from grass and deciduous forest.

In this study, we used fPAR data to represent the spatial and temporal variability of vegetation and focused on the correlation between vegetation and catchment water balance components. Separation of *Ft* into *Fp* and *Fr* could introduce systemic error, which might have no significant impact on the results of regression analysis.

(9) It feels misleading by negative correlations between Fr and precipitation and E, and positive correlation between Fr and E/P (Table 1 and 2, and texts). It sounds that the more precipitation, the worse the non-woody vegetation. Same is true for E and E/P.

Table 1 (together with Figure 3) is used to describe the spatial characteristics of long-term catchment water balance with respect to both vegetation cover and climate. Among the 193 study catchments, most of them are woody vegetation dominated. Therefore, there are positive correlations between *Ft* (*Fp*) and *R* (*E*, *R/P*) and negative correlation between *Ft* (*Fp*) and *E/P*. Increase of woody vegetation cover causes decrease of non-woody vegetation cover among the 193 study catchments. The negative correlations between *Fr* and *R* (*E*, *R/P*) and positive correlation between *Fr* and *E/P* come from the negative relationship between *Fp* and *Fr*.

The contents in Table 2 were wrong. The corrected one is as follows:

Table 2 Correlation coefficients between vegetation coverage and runoff components, including surface runoff, subsurface runoff and their ratios to the total runoff over the 193 study catchments.

	$R_g\,(mm)$	$R_s\,(mm)$	R_g/R	R_s/R
Total fPAR(F_t)	0.637	0.549	0.354	-0.354
Persistent fPAR (F_p)	0.655	0.572	0.277	-0.277
Recurrent fPAR (F_r)	-0.470	-0.420	-0.090	0.090

Why don't you use LAI? You could use LAIt, LAIp, and LAIf, respectively, to describe total vegetation, woody vegetation, and non-woody vegetation. By doing this, the relations with the three climate variables will be consistent with common knowledge.

This is a good suggestion. However, we have no LAI data in the datasets of Australian AVHRR-derived monthly fPAR dataset.

(10) There are too many symbols. Is it possible to define them in a summary table?

Good suggestion, the summary table of all symbols is given as follows.

Summary Table Variables and parameters in this paper.

Symbol	Description
P ($\overline{P}$)	Annual precipitation (mean annual precipitation), mm
R ($\overline{R}$)	Annual runoff (mean annual runoff), mm
E	Annual evapotranspiration, mm
E_0	Annual potential evapotranspiration, mm
E_0/P	Aridity index, ratio of mean annual potential evapotranspiration to precipitation
T ($\overline{T}$)	Annual temperature (mean annual temperature), ℃
F_t ($\overline{F_t}$)	Annual recurrent fPAR (Mean annual recurrent fPAR)
F_p ($\overline{F_p}$)	Annual persistent fPAR (Mean annual persistent fPAR)
F_r ($\overline{F_r}$)	Annual total fPAR (Mean annual total fPAR)
R/P	Runoff coefficient, the ratio of annual runoff to precipitation
E/P	Evapotranspiration coefficient, ratio of annual evapotranspiration to precipitation
R_g	Annual subsurface runoff, mm
R_s	Annual surface runoff, mm
R_g/R	The ratio of annual subsurface runoff to total runoff
R_s/R	The ratio of surface runoff to total runoff
k	The time step number
a	The single filter parameter in eqn. (1), the value is 0.925 for all catchments
ρ	The linear correlation coefficient
F_p/F_t	The proportion of woody vegetation
F_r/F_t	The proportion of non-woody vegetation
ΔP_i	The annual departures from mean annual values for precipitation

ΔT_i	The annual change in temperature compared to the long-term mean temperature
ΔR_i	The annual departures from mean annual values for total runoff
ε_R^P	Elasticity of total runoff to precipitation
$\varepsilon_R^{P_{-1}}, \cdots, \varepsilon_R^{P_{-n}}$	Elasticity of total runoff to previous precipitation
ε_R^T	Elasticity of total runoff to temperature
$\Delta R_{s,i}$	The annual departures from mean annual values for surface runoff
$\varepsilon_{R_s}^P$	Elasticity of surface runoff to precipitation
$\varepsilon_{R_s}^{P_{-1}}, \cdots, \varepsilon_{R_s}^{P_{-n}}$	Elasticity of surface runoff to previous precipitation
$\varepsilon_{R_s}^T$	Elasticity of surface runoff to temperature
$\Delta R_{g,i}$	The annual departures from mean annual values for subsurface runoff
$\varepsilon_{R_g}^P$	Elasticity of subsurface runoff to precipitation
$\varepsilon_{R_g}^{P_{-1}}, \cdots, \varepsilon_{R_g}^{P_{-n}}$	Elasticity of surface runoff to previous precipitation
$\varepsilon_{R_g}^T$	Elasticity of subsurface runoff to temperature
R^2	The coefficient of determinant
F_{test}	F statistic
σ^2	Error variance
P_{grow}	Growing season precipitation
T_{grow}	Growing season temperature
$R_{sd,grow}$	Growing season shortwave coming radiation
$P_{nongrow}$	Precipitation during non-growing season
$\Delta F_{t,i}$	The annual departures from mean annual values for total fPAR
$\varepsilon_{F_t}^{P_{grow}}$	Elasticity of total fPAR to precipitation during growing season
$\varepsilon_{F_t}^{P_{nongrow}}$	Elasticity of total fPAR to precipitation during non-growing season
$\varepsilon_{F_t}^{T_{grow}}$	Elasticity of total fPAR to temperature during growing season

$\varepsilon_{F_t}^{R_{sd,grow}}$	Elasticity of total fPAR to shortwave radiation during growing season
$\Delta F_{p,i}$	The annual departures from mean annual values for persistent fPAR
$\varepsilon_{F_p}^{P_{grow}}$	Elasticity of persistent fPAR to precipitation during growing season
$\varepsilon_{F_p}^{P_{nongrow}}$	Elasticity of persistent fPAR to precipitation during non-growing season
$\varepsilon_{F_p}^{T_{grow}}$	Elasticity of persistent fPAR to temperature during growing season
$\varepsilon_{F_p}^{R_{sd,grow}}$	Elasticity of persistent fPAR to shortwave radiation during growing season
$\Delta F_{r,i}$	The annual departures from mean annual values for recurrent fPAR
$\varepsilon_{F_r}^{P_{grow}}$	Elasticity of recurrent fPAR to precipitation during growing season
$\varepsilon_{F_r}^{P_{nongrow}}$	Elasticity of recurrent fPAR to precipitation during non-growing season
$\varepsilon_{F_r}^{T_{grow}}$	Elasticity of recurrent fPAR to temperature during growing season
$\varepsilon_{F_r}^{R_{sd,grow}}$	Elasticity of recurrent fPAR to shortwave radiation during growing season

(11) The section of "Conclusions" is too long. It should be re-written and concisely summarize your study and taken-home findings. The last paragraph in this section (Lines 8-19 on page 6313) is very speculative. Do you really think that this study could "provide guidance and motivation for detailed ecohydrologic modeling studies?"

Thanks for this suggestion, we have revised the conclusions.

The revised conclusion section is given as follows.

“In this paper, we analyzed the effects of climate variability on catchment water balance and vegetation cover for 193 study catchments in Australia. Climate elasticities of runoff and vegetation cover were estimated. From all the results obtained through these analyses, we can conclude that:

1. Annual runoff, evapotranspiration and runoff coefficient increase with vegetation cover for catchments in which woody vegetation is dominant and annual

precipitation is relatively high. Control of water available on annual evapotranspiration becomes stronger in non-woody dominant catchments compared to woody dominant ones. The ratio of subsurface runoff to total runoff (R_g/R) increases with woody vegetation cover.

2. The current year's precipitation is the most important factor affecting the change in annual total, surface and subsurface runoff. The significance of other controlling factors is in the order of the annual previous precipitation (carry-over of soil moisture storage) and current year's temperature. Change in current year's precipitation by a +1% could produce about an average of a +3.35% change of R, a +3.47% change of R_s and a +2.89% change of R_g.
3. Regarding the climate elasticity of vegetation cover (represented by the maximum monthly F_t, F_p and F_r), the incoming shortwave radiation in the growing season ($R_{sd,grow}$) is the most important factor affecting the change in vegetation cover: A change of $R_{sd,grow}$ by +1% could produce a -1.08% change of total vegetation cover (F_t), on average. The growing season precipitation has a more significant effect on non-woody vegetation cover than the non-growing season precipitation, but precipitations in both growing and non-growing seasons have almost equally important effects on woody vegetation cover.

It should be noted, however, that catchment water balance is closely linked with vegetation cover. Change of vegetation cover can affect catchment water balance by influencing soil moisture through canopy interception and transpiration (Eagleson, 2002). Change of water balance can also have an effect on the vegetation cover. This interaction and feedback between water balance and vegetation cover is difficult to diagnose and quantify, which therefore calls for the development and use of catchment ecohydrological models that couple hydrologic processes and vegetation dynamics."