Comments from reviewer #1:

In the paper, effects of plantation expansion on streamflows in Australia were analysed using the simple FCFC model, which was applied in 15 catchments with areas ranging from 0.6 up to 1135.7 km2. This model needs only a low amount of easy available data such as measured daily stream flow, daily mean rainfall and potential evapotranspiration as input. The results might be of interest to e.g. water resources managers and forest management agencies. The paper focuses on a very interesting topic and has an appropriate scientific basis. However, from my point of view, the paper is sometimes difficult to read as a standalone publication in the actual state and should be restructured especially in the model chapter. For many relevant informations about the model and data preprocessing, the authors refer to publications without any further or only insufficient description and explanation. Further comments will go more into details.

Chapter 2. Model description Obviously, the FCFC model consists of three parts such as the parameterization of the FDC-curve, calculation of mean annual water yield, and a simple bucket model to calculate the percentage of time the flow occurs in a given catchment. In the recent paper, only the parameterization of FDC-curve is described. I would like to recommend to add a short and concise description of the total FCFC-model. From my point of view, outstanding readers of the paper should be able to understand the basics and assumptions of the model applied in this study without reading some furthers papers or the model manual. Without such a description, the reader has no sufficient information e.g. how an increase of forest cover is incorporated in the FCFC-model. The quality of fit is described by the Nash-Sutcliffe Index (NSI). What are the ranges for the FCFC-model for a good or bad fit? In addition, as far as I know, NSI was mainly designed for discharge rates and is mainly sensitive to a good correspondence between observed and calculated peak flows. Is NSI really appropriate for a description of the fit of predicted and observed FDC-curves?

Response: Thanks for the comment. We have made major changes in the model description and it should now be clear how FCFC predicts FDC associated with a new forest cover in a catchment. The reviewer is right that the Nash and Sutcliffe efficiency is more sensitive to peak flows. In this study, we used logarithm of flows to give more weight to low flow values and a number of studies showed that the use of the Nash and Sutcliffe efficiency is appropriate for describing FDCs(Best et al., 2003; Brown et al., 2006; Brown, 2008).

The detailed descriptions for FCFC model are as follows.

2.2 Forest Cover Flow Change model (FCFC)

The Forest Cover Flow Change methodology (FCFC) was developed to predict changes in a daily flow duration curve (FDC) following a change in forest cover (Brown et al., 2006; Brown, 2008). The inputs to FCFC are daily values of rainfall, potential evaporation, and streamflow. FCFC also requires percentage forest cover during pre-treatment period and new percentage forest cover. The output from FCFC is a FDC associated with the new forest cover.

The FDC within FCFC is represented by a five parameter model as described by Best et al. (2003):

$$Q(x)=\begin{cases} Q_{50}\left(10^{\frac{s}{c_u}\left[\exp\left(F^{-1}\left(\frac{x}{CTF}\right)c_u\right)-1\right]}\right) & x\le \frac{CTF}{2} \\ Q_{50}\left(10^{\frac{s}{c_l}\left[\exp\left(F^{-1}\left(\frac{x}{CTF}\right)c_l\right)-1\right]}\right) & \frac{CTF}{2}<x<CTF \\ 0 & x\ge CTF \end{cases} \quad (1)$$

where $Q(x)$ is the predicted percentile flow, F^{-1} is the inverse of the standard normal cumulative distribution, Q_{50} is the median of the non-zero flow or conditional median, CTF is the cease-to-flow percentile, x is a percentile value (0-100%) and s, c_u, c_l are curve fitting parameters. The s, c_u and c_l parameters relate to different sections of the FDC, s being the slope at the origin of the normalised FDC (NFDC) and c_u and c_l being the exponents for the upper and lower sections of the NFDC, respectively.

The FCFC model normalizes the FDC so that Q_{50} = 1 and CTF = 0 and this facilitates the estimation of the remaining three parameters. Fig. 1 shows the method used to normalise the FDC of perennial and ephemeral streams. Firstly, the cease-to-flow (CTF) percentile is established (Fig. 1a). The CTF percentile is defined as the ratio of the number of non-zero flow days to the total number of days. A non-zero flow day is defined as any day on which flow is greater than or equal to a specified threshold value (adopted here as 0.001 mm/day). A FDC is then constructed using only the days on which flow is greater than the threshold value as streamflow measurements below this value are considered unreliable (Fig. 1b). The FDC is then normalised by dividing all flow values by the conditional median (Fig. 1c). Finally, the FDC is plotted in log-normal space (Fig. 1d) to produce a normalised FDC (NFDC). This normalisation procedure results in all of the NFDCs intersecting the origin.

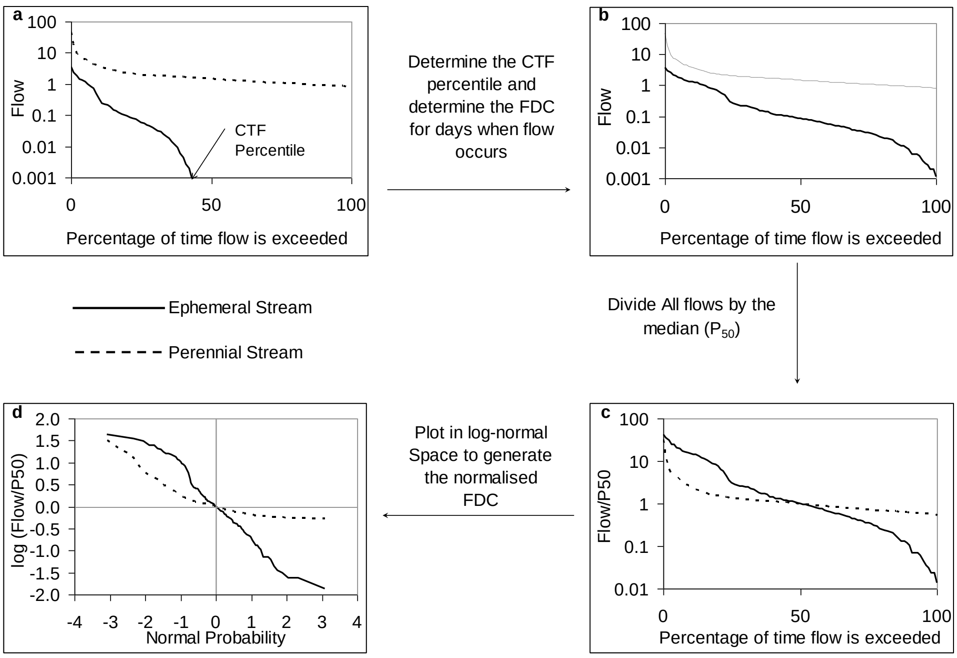

Figure 1. Normalising the FDC to achieve common parameter space.

The FCFC model optimizes the parameters by fitting equation (1) to measured daily FDC for each year of the flow record under pre-treatment conditions. The CTF and Q_{50} are determined directly from the measured daily streamflow data, while the three remaining parameters (s, c_u, c_l) are obtained by maximizing the Nash and Sutcliffe efficiency of percentile flows in the log domain (Nash and Sutcliffe, 1970):

$$E = 1 - \frac{\sum_{i=1}^{CTF} \left(\log(Q_o) - \log(Q_p)\right)^2}{\sum_{i=1}^{CTF} \left(\log(Q_o) - \log(\overline{Q_p})\right)^2} \qquad (2)$$

where Q_o is the observed percentile flow and Q_p is the estimated percentile flow. The closer the coefficient of efficiency is to one the better the fit. The logarithm of the values is used to give more weight to low flow values. As the CTF parameters is determined from the observed flow data, E is calculated only between the first percentile and the *CTF* percentile, thus zero flows are not considered.

The upper exponent is then adjusted to ensure the area under the FDC and equals the observed annual streamflow. Once the parameters for each annual FDC are determined, the representative values of s and c_u are estimated as the mean of each of the s and c_u values for all the pre-treatment years.

To predict the effect of a forest cover change on a FDC, the model parameters are linked to a predicted change in mean annual streamflow using the method of Zhang et al. (2001). The linkage between mean annual streamflow and the FDC comes from the knowledge that the area under the FDC is equal to the mean annual streamflow (Fig. 2).

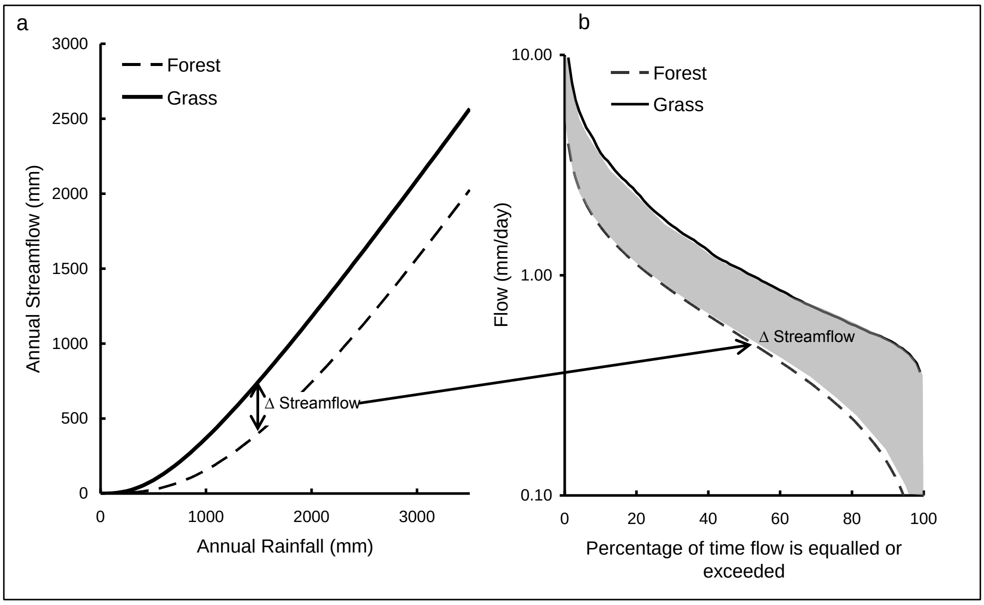

Figure 2. Linking mean annual streamflow estimated using the method of Zhang et al. (2001) to the FDC. The change in mean annual streamflow for a catchment from grass to forest can be predicted using the method of Zhang et al. (2001) (Δ streamflow) (a). The shaded area between the FDC for grass and FDC for forest is equal to Δ streamflow (b).

For a catchment with known forest cover change, the mean annual streamflow is predicted using the method of Zhang et al. (2001) and the information is then combined with the FDC parameterization to predict the changes in FDC associated with the forest cover change. This is done with the aid of a bucket model that simulates the relationship between rainfall, evapotranpsiration and streamflow as mediated by the soil water store. The bucket model is first calibrated against measured daily streamflow under pre-treatment conditions by adjusting the recession constant, maximum water storage capacity, and soil water storage threshold for evapotranspiration. The bucket model is then used to predict the CTF percentile and the 95th percentile flow under the new forest cover by changing soil water storage threshold. The lower exponent (c_l) is determined from the slope of the normalized FDC and the CTF percentile for ephemeral streams and the 95th percentile flow for perennial streams. The parameters s and c_u are assumed to be unchanged following a forest cover change as shown by Best et al. (2003). The procedure described above provides an initial estimate of the FDC under the new forest cover. To ensure that the area under the FDC is equal to the mean annual streamflow predicted by the method of Zhang et al. (2001), the conditional median streamflow and the lower exponent are adjusted accordingly. The detailed description of FCFC can be found in Brown (2008).

References

Best, A. E., Zhang, L., McMahon, T. A., and Western, A. W.: Development of a model for predicting the changes in flow duration curves due to altered land use conditions, MODSIM 2003, International Congress on Modelling and Simulation, Townsville, Queensland, Australia, Modelling and Simulation Society of Australia and New Zealand, 14-17 July 2003, pp. 861-866. http://www.mssanz.org.au/MODSIM03/Media/Articles/Vol%202%20Articles/861-866.pdf.

Brown, A. E., McMahon, T. A., Podger, G. M., and Zhang, L.: A methodology to predict the impact of changes in forest cover on flow duration curves. CSIRO Land and Water Science Report 8/06, 2006.

Brown, A. E.: Predicting the effect of forest cover changes on flow duration curves. PhD thesis, The University of Melbourne, Melbourne, Australia, 2008.

Zhang, L., Dawes, W. R., and Walker, G. R.: Response of mean annual evapotranspiration to vegetation changes at catchment scale, Water Resour. Res., 37(3), 701-708, 2001.

Chapter 3.2.1 I would like to recommend that information about the discharge regime (perennial of ephemeral), periods of pre-treatment and post-treatment and the prior land use before plantation should be included in Table 1. There is no mention in the paper of the land use prior to afforestation. Furthermore, which type of forest were used for afforestation, age of forest etc? These informations are essential for the analysis and discussion of results. This is illustrated e.g. by Fig.5.

Response: Changes have been made to include pre-treatment land use, plantation species, pre-treatment period, and post-treatment period. The reviewer suggested that we include information about the discharge regime (perennial or ephemeral) and age of forest in Table 1. In fact, information about the discharge is already shown in Figure 5. It is unnecessary to list the information again in Table 1. Most of the catchments used in this study are large and the plantation development took place over several years. It is not very meaningful to simply list the age of the plantation. More detailed descriptions of the plantation development in these catchments have been added in the revised manuscript (see as follows).

3.2.3 Plantation and land use data

In order to investigate the effects of plantation expansions on streamflow, plantation data including plantation area and age for each of the selected catchments were provided by the Bureau of Rural Science and State agencies. Plantation development began in 1935 in Adjungbilly Creek mostly on native forest sites. Since 1982, planting started on land previously occupied by pastures and cumulative plantation cover (%) over time for Adjungbilly Creek is shown in Fig. 4. The Batalling Creek catchment was 50% cleared for agriculture from 1940 to 1970 and plantations were established in the catchment in 1985 with eucalyptus covering 38% of the cleared area (Bari and Ruprecht, 2003). The Burnt Out Creek catchment is located in the western Mount Lofty Ranges, South Australia and around 40ha or 67% of the catchment was replanted with P. radiata in November 1978 after a bushfire destroyed most of plantation in the catchment (Greenwood and Cresswell, 2007). The Crawford River catchment has several main land uses including pastures, hardwood (blue gum: Eucalyptus globulus) and softwood (radiata pine: Pinus radiata) plantations, cropping and native forest. The area of plantations expanded significantly from less than 2000 ha in 1995 to 17,000 ha or 25% of the catchment area in 2005. The Darlot Creek catchment and Eumeralla River catchment experienced similar plantation expansions with most plantations established since 1995. The area of land under pine plantations in the Delegate and Bombala catchments expanded to 11% and 14% of the catchment area respectively (Tuteja et al., 2007). The Goobarragandra Creek catchment experienced plantation expansion in the period of 1965 to 1988 with about 8% of the catchment area planted. Plantation in the Jingellic Creek catchment did not start until 1965 and over 5000 ha of pasture land were converted to plantations in the period of 1982 to 1996, representing 14% of the catchment area. In 1986 and 1987 the entire Pine Creek catchment was converted from open grassland to Pinus radiata plantation (Linke et al., 1995, Lane et al., 2005). Red Hill is a small experimental catchment and over 70 % of the catchment was planted with Pinus radiata in 1988 and 1989 (Major et al., 1998). The Traralgon Creek catchment was 70% planted with Eucalyptus regnans from the late 1950s (Feikema et al., 2008). The Upper Denmark and Yate Flat Creek are sub-catchments of the Denmark River catchment. Clearing native forest for agricultural development in the catchments began in 1870 and 17% of the catchment had been cleared by 1957 (Bari et al., 2004). Tree planting in the catchments started in 1991 on previously pasture land (Bari et al., 2004) and by 2000 it had been almost completely replanted, mainly to E. globulus. Summary of the plantation data for the selected catchments is listed in Table 1. More detailed description of the plantation development in these catchments can be found in Zhang et al. (2010). Other information including land use history, farm dams, and water diversions was also obtained for the selected catchments. Over the period of streamflow records, these catchments had minimum impact from farm dams and water extractions, and plantation expansion represents the most significant land use change in these catchments.

References

Bari, M. A. and Ruprecht, J. K.: Water yield response to land use change in south-west Western Australia, Department of Environment, Salinity and Land Use Impacts Series Report No. SLUI 31. Perth, Western Australia, http://www.water.wa.gov.au/PublicationStore/first/43766.pdf, 2003.

Bari, M. A., Mauger, G. W., Dixon, R. N. M., Boniecka, L. H., Ward, B., Sparks, T. and Waterhouse, A. M.: Salinity situation statement: Deanmark River, Water Resource Technical Series No. WRT 30. 2004.

Feikema, P., Beverly, C., Morris, J., Collopy, J., Baker, T., and Lane, P. N. J.: Predicting and managing the impacts of commercial plantations on catchment water balances, Forest and Wood Products Australia. Project number: PN04.4009. pp. 64. ISBN: 978-1-920883-38-6, http://www.fwpa.com.au/sites/default/files/PN04_4009_impact_of_comm_plantations.pdf, 2008.

Greenwood, A. J. and Cresswell, D. J.: The impact of plantation forestry on runoff in the Mount Lofty Ranges, Case study: Burnt Out Creek, Department of Water, Land and Biodiversity Conservation Technical Note TN2007/11, 2007.

Lane, P. N. J., Best, A. E., Hickel, K., and Zhang. L.: The response of flow duration curves to afforestation, J. Hydrol., 310, 253-265, 2005.

Linke, G. K., Seker, M., and Livingston, M.: Effect of reafforestation stream flows, salinities and groundwater levels in the Pine Creek catchment, Murray Darling 1995 Wrokshop Extended Abstracts. Wagga Wagga, Australian, 11-13 September, 1995.

Major, E. J., Cornish, P. M., and Whiting, J. K.: Red Hill hydrology project establishment report including a preliminary water yield analysis, Research Paper No. 36, Forest Research and Development Division, State Forests of New South Wales, Sydney. pp. 24, 1998.

Tuteja, N. K., Vaze, J., Teng, J., and Mutendeudzi, M.: Partitioning the effects of pine plantations and climate variability on runoff from a large catchment in southeastern Australia, Water Resour. Res., 43, W08415, doi:10.1029/2006WR005016, 2007.

Zhang, L., Zhao, F. F., Brown, A. E., Chen, Y., Davidson, A., and Dixon, R. N. M.: Estimating impact of plantation expansions on streamflow regime and water allocation, Tech. Rep. 1835-095X, 84pp., CSIRO Water for a Healthy Country National Research Flagship, Canberra, ACT Australia, 2010.

Chapter 3.2.2 Climatic data Similar to the model description, the reader should understand how meteorological input data are preprocessed for the application of the FCFC-model. E.g., the processing from catchment averaged annual rainfall, the interpolation to monthly rainfall and the converting to daily rainfall is difficult to understand. In addition, was pan evaporation measured in each catchment or were these data interpolated and how?

Response: Changes have been made to include information on the rainfall and class A pan evaporation data used in the study. It should be noted the SILO rainfall is widely used in Australia and detailed information on the interpolation of the SILO rainfall data can be found in Jefferey et al. (2001).

The detailed information about climatic data is as follows.

3.2.2 Climatic data

Catchment averaged annual rainfall was estimated from gridded SILO daily rainfall (Jefferey et al., 2001). The spatial resolution of the gridded daily rainfall data is 0.05 degrees based on interpolation of point measurements from over 6000 rainfall stations across Australia. The spatial coverage of the rainfall stations is reasonably good, particularly in the southeast and along the east south coasts. The interpolation uses monthly rainfall data, ordinary kriging with zero nugget, and a variable range. The method takes into account rainfall variations with elevation. Monthly rainfall for each 5 × 5 km grid cell was converted to daily rainfall using daily rainfall distribution from the station closest to the grid cell (Jefferey et al., 2001). Catchment average rainfall was obtained by aggregating the SILO interpolated rainfall surfaces. Potential evaporation (E_0) was estimated using measurements of class A pan evaporation obtained from SILO with the pan coefficient set to 0.75 following van Dijk (1985). For large catchments, average potential evaporation was obtained by averaging measurements of the class A pan evaporation from the stations within the catchments. For small catchments, measurements of the class A pan evaporation station closet to the catchments were used.

References

Jeffrey, S. J., Carter, J. O., Moodie, K. M., and Beswick, A. R.: Using spatial interpolation to construct a comprehensive archive of Australian climate data, Environ. Modell. Softw, 16/4, 309-330, 2001.

van Dijk, M. H.: Reduction in evaporation due to the bird screen used in the Australian class A pan evaporation network, Aust. Meteorol. Mag., 33, 181-183, 1985.

Chapter 4.1 In Fig.5, there is no uniform relationship between forest cover and the different FDC-curves. High areal proportion of forest cover > 60% such as in the catchments Burnt out Ck, Pine Ck or Red Hill showed significant differences between the different FDC-curves. However, FDC-curves from Traralgon Ck showed only minor differences despite an areal forest cover proportion of 58 % (Fig.5). In contrast to that, FDC-curves from the Upper Denmark River with a forest cover 15 % showed higher differences between both FDC-curves. The FCFC model do not take into account the temporal dynamics of a forest cover with root water uptake changing with forest age and thinning. These aspects and the corresponding limitations of the model should be shortly discussed.

Response: Changes have been made to discuss in more detail the results shown in Figure 5. The changes in the FDCs were affected by extent of plantation development, climatic conditions (i.e. index of dryness), rainfall regime, and soil conditions. The FDCs shown in Figure 5 are not results of the FCFC and they are simply measured daily streamflow during the pre-treatment and post-treatment periods.

The detailed discussions about the results in Figure 5 are as follows.

The combined effect of these factors means the soil water store in these catchments drained more slowly, maintaining baseflow throughout the year. For example, Traralgon Creek has an index of dryness of 0.86, representing a wet and perennial catchment. The soil depth of the catchment is over 2 meters with soil water storage capacity of 270 mm as estimated by McKenzie et al. (2000). The flow from the catchment remained perennial despite of relatieve large proportional plantation expansion. On the other hand, the ephemeral catchments are relatively dry catchments with the index of dryness greater than unity. These catchments have winter dominated rainfall and are small in size. During the dry period (e.g. summer), soil water store of the catchments drained quickly, leading to zero flows. The presence of plantation in these catchments enhanced evapotranspiration and lowered soil water levels significantly. As a result, substantial proportional reductions occurred in the low flows with an increased number of zero-flow days. For example, the Upper Denmark River has an index of dryness of 1.36 with a strong winter-dominant rainfall. During summer, average monthly rainfall is about 25 mm, while potential evaporation exceeds 100 mm. The catchment has shallow (e.g. less than 1.0 m) duplex sandy gravel soil with a permeability of 28 mm/hour (Bari et al., 2004). After the plantation development, low flows in the catchment reduced considerably with greater number of zero-flow days (see Figure 5).

References

Bari, M. A. and Ruprecht, J. K.: Water yield response to land use change in south-west Western Australia, Department of Environment, Salinity and Land Use Impacts Series Report No. SLUI 31. Perth, Western Australia, http://www.water.wa.gov.au/PublicationStore/first/43766.pdf, 2003.

McKenzie, N. J., D. W. Jacquier, L. J. Ashton, and H. P. Cresswell. Estimation of soil properties using the Atlas of Australian Soils, Technical Report 11/00, 24 pp, CSIRO Land and Water, Canberra, ACT, 2000.

Chapter 4.2 In Fig.6, mean annual streamflow reductions calculated by the method of Zhang et al. (2001) as a part of the FCFC-model, which is not described in the paper, were compared with corresponding ones estimated by time-trend-analysis according to Zhang et al. (2011), which is also not described in the paper. Obviously, the latter ones were used as a quality measure for those simulated by the first method. Therefore from my point of view without no more information about both methods, the comparison of both estimated reduction rates in Fig.6 shows only a limited explanatory power for an outstanding reader.

Response: Thanks for the suggestion. Changes have been made to include description of Zhang et al. (2001) and time-trend analysis method (see 2.3).

2.3 Time-trend analysis method

One of the key componnent of the FCFC methodology is the method of Zhang et al. (2001) for estimating differences in mean annual streamflow for a catchment under different degrees of forest cover. The accuracy of Zhang et al. (2001) can be tested using time-trend analysis method, which is applicable to single catchment studies. Time-trend analysis method is primarily designed for estimating the differences in streamflow between pre-treatment and post-treatment periods (Bosch and Hewlett, 1982). In this method, rainfall and streamflow during the pre-treatment period are used to develop statistical relationship and this relationship is then used to estimate streamflow during the post-treatment period. The effect of forest cover change on streamflow is expressed as the difference between measured and predicted streamflow during the post-treatment period. Time-trend analysis method assuses that rainfall-streamflow relationship developed for pre-treatment period will remain unchanged unless there is a forest cover change. Time-trend analysis method can be expressed as (Lee, 1980):

During the pre-treatment period,

$$Q_1 = f\,(P_1) \tag{3}$$

During the post-treatment period,

$$Q_2' = f\,(P_2) \tag{4}$$

$$\Delta Q^{veg} = \overline{Q_2} - \overline{Q_2'}, \tag{5}$$

where *P* represents rainfall (mm), *Q* represents measured streamflow (mm), Q' is the predicted streamflow (mm) with equation (4) based data in the calibration period, and ΔQ^{veg} is the change in average annual streamflow (mm) due to forest cover changes; subscripts *1* and *2* indicate the pre-treatment and the post-treatment periods. The rainfall-streamflow relationship expressed by Equation (3) can be either linear or non-linear depending on data. In the case of non-linear relationship, the Tanh function is considered after Grayson *et al*. (1996).

References

Bosch, J. M. and Hewlett, J. D.: A review of catchment experiments to determine the effect of vegetation changes on water yield and evapotranspiration, J. Hydrol., 55, 3-23, 1982.

Grayson, R. B., Argent, R. M., Nathan, R. J., McMahon, T. A. and Mein, R. G.: Hydrological recipes: estimation techniques in Australian hydrology. Cooperative Research Centre for Catchment Hydrology, Melbourne, Victoria, 1996.

Lee, R.: Forest Hydrology, 349 pp., Columbia Univ. Press, New York, 1980.

Zhang, L., Dawes, W. R., and Walker, G. R.: Response of mean annual evapotranspiration to vegetation changes at catchment scale, Water Resour. Res., 37(3), 701-708, 2001.

Chapter 4.3 Comparison between predicted and observed FDCs. The authors state at page 388 that "all the catchments showed good agreement between the predictions and observations, except for one or two other catchments". These findings are mainly suggested by the NSI-data provided in Table 3 with only one catchment Traralgon Ck with an NSI < 0.8. However, the contents of Figure 5 indicated also some discrepancies between predicted and observed FDC-curves in catchments with NSI >0.8. Examples are the Bombala River catchment with an NSI of 0.86 and the Red Hill catchment with a NSI of 0.80. From my point of view, a more detailed explanation where and why the predictions were more or less accurate would improve the paper. This leads also to my hint in the review of chapter 2 with the question of the suitability of NSI for the analysis of the fit between predicted and observed FDC-curves. This should also be discussed by the authors.

Response: I assume the reviewer is referring to Figure 7 instead of Figure 5. As suggested, we have provided more detailed description in 4.3 and more discussion on the model performance and possible cause for less accurate results in some catchments.

4.3 Comparison between predicted and observed FDCs

Fig. 7 shows comparisons between FCFC predicted and observed FDCs for the selected catchments in the post-treatment period. Table 3 provides a summary of results for all the catchments. It is clear that most catchments showed good agreement between the predictions and observations. The model underpredicted the cease-to-flow (CTF) percentile or overestimated the number of zero-flow days in several catchments, for example, the predicted CTF is 48% for Yate Flat Creek, while observed value is 67%. However, the model overpredicted CTF in Red Hill. In 13 of the 15 the catchments the direction of change and the shape of the predicted FDC are consistent with the changes observed between the pre-treatment and post-treatment conditions. For the Bombala River and Traralgon Creek catchments, the predicted change in the FDC is not consistent with the observed change in shape between pre- and post-treatment condtions. Investigation into the causes showed that the bucket model of the FCFC methodology is not capturing the low flows well in the calibtation period. This results in an overestimation of the number of zero flow days or underestimated low flows. The impact of this is that the model overestimated the high flows to compensate for the lack of flow flows so that a mass balance can be achieved. This indicates the importance of assessing the bucket model fit during the calibration phase of FCFC to ensure the low flows are being adequately modelled. There is a strong correlation between predicted and observed median (see Table 3). The results in Fig. 7 and Table 3 show that the FCFC model works well with 13 of the 15 catchments having coefficient of efficiency greater than 0.8.

Chapter 5 Discussion The relevance of most of the statements in this chapter (examples: page 389, line 10-28, page 390, line 5-21) are difficult to judge without reading the cited references. Therefore, the authors should take into account to add some more information about the data, model and methods to enable the reading of this paper as a standalone publication.

Response: Changes have been made to provide more detailed information on the studies cited. We also presented more detailed description of the FCFC methodology and the data used. Now it should be easier to follow the discussion presented in the manuscript.

Technical remarks Please add the sources of Fig. 1 and 2 (FCFC-Manual?). Fig. 3: legend and descriptions are very small.

Response: Changes have been made as suggested. Section 2.2 has detailed described the FCFC model including the sources of Fig. 1 and Fig. 2. It should be noted that new Fig.2 is used in the revised manuscript. The detailed FCFC model description can be referred from the response to the first comment above.

We have also enlarged Fig. 3 to make it clear.

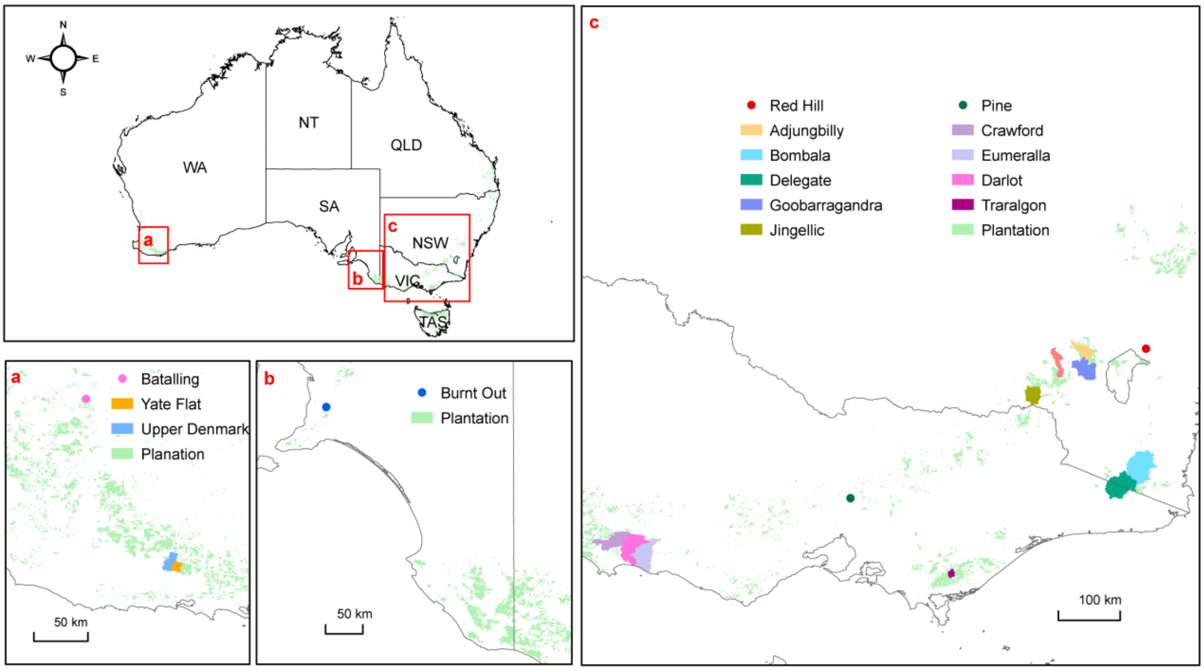

Figure 3. Location map of the catchments.