nhess-2017-101-RC1 Author Comments

Major Comments

A.1 VOD and NDVI: The application of stepwise regression on Equation 4 has excluded VOD as predictor (eq. 10). Please provide in the main text a possible explanation for that feature. If NDVI is also excluded by stepwise regression is expected that the obtained model performance will decrease significantly. How much? NDVI and VOD are assumed to be (anti-) correlated. When the predictors are correlated, some of them may be insignificant in regression and their inclusion may lead to overfitting. The difference in R2 coefficient between calibration and evaluation may be also a signal of overfitting. Did the authors aware of this feature? Please consider using a cross validation technique to evaluate model performance.

Author Response: At every selected observed DOC sites (excluding the forest areas) from July 2002 to June 2011, the r^2 of VOD and NDVI is 0.5217 with an RMSE of 0.1117. VOD was excluded as a predictor in the final model, as expressed in Eq. (10), because during the stepwise regression, when the NDVI and (VOD)(NDVI) terms are included as the first and second predictors, the VOD term does not contribute in improving the final model prediction (i.e. p-value exceeds the acceptance threshold, preventing overfitting). When NDVI term is excluded, (VOD)(NDVI) term is included first, followed by VOD term. The summary of calibration and evaluation results with additional evaluation with independent sites only (excludes 5 sites that were used in calibration) are as listed in Table RC1-1.

Table RC1-1

Model	Calibration (5/23 sites; 112/238 observations)		Original Evaluation (23/23 sites; 238/238 observations)		Total Independent Evaluation (18/23 sites; 126/238 observations)	
	r^2	RMSE	r^2	RMSE	r^2	RMSE
C=145.565-260.817(NDVI)+137.194(VOD)(NDVI) [Eq. (10)]	0.6724	13.3960	0.5510	15.2540	0.4430	16.7600
C=48.699+147.603(VOD)-259.947(VOD)(NDVI) [Not shown in original paper]	0.5355	15.9504	0.5034	15.9522	0.5423	15.5269
C=91.637-125.219(VOD)(NDVI) [Not shown in original paper]	0.4252	17.6304	0.3587	18.4265	0.4391	18.0763
Method B [Eq. (5)]	N/A	N/A	0.6110	14.4380	0.6320	11.9240
MapVic [Eq. (6)]	N/A	N/A	0.4350	19.8010	0.5620	14.6820

Changes in Manuscript: Additional explanations as stated in author response above will be added to section 4.1 (page 7). Table 1 will be updated with the results from the model with VOD and (VOD)(NDVI) due to its better cross validation performance (shown in Table RC1-1). Though the

model with only (VOD)(NDVI) term will not be included in the updated paper, since it is outperformed by other models. Texts and conclusions will be updated to reflect the added cross validation results, which show that Method B and MapVic outperformed DOC model with VOD.

A.2 Spatial and Temporal Standard Deviation (SD): A seasonal behaviour of Spatial SD seems to be present. Further analysis of the seasons/months with higher values of SD should give additional and important information. The same analysis could be performed for each land cover type.

Author Response: Forest areas are now excluded from the analysis and Fig. 4 in the original manuscript will be replaced with Fig. RC1-1. The continental mean spatial DOC standard deviation is updated from 21.70 % to 20.39 % (page 7, line 28). Further analysis on DOC spatial standard deviation are as shown in Table RC1-2. This includes seasonal, monthly, and land cover type spatial standard deviation of DOC. From both seasonal and monthly spatial standard deviation of DOC, it is shown that DOC has the highest spatial variation during winter, which is especially true for northern Australia (Anderson et al., 2011).

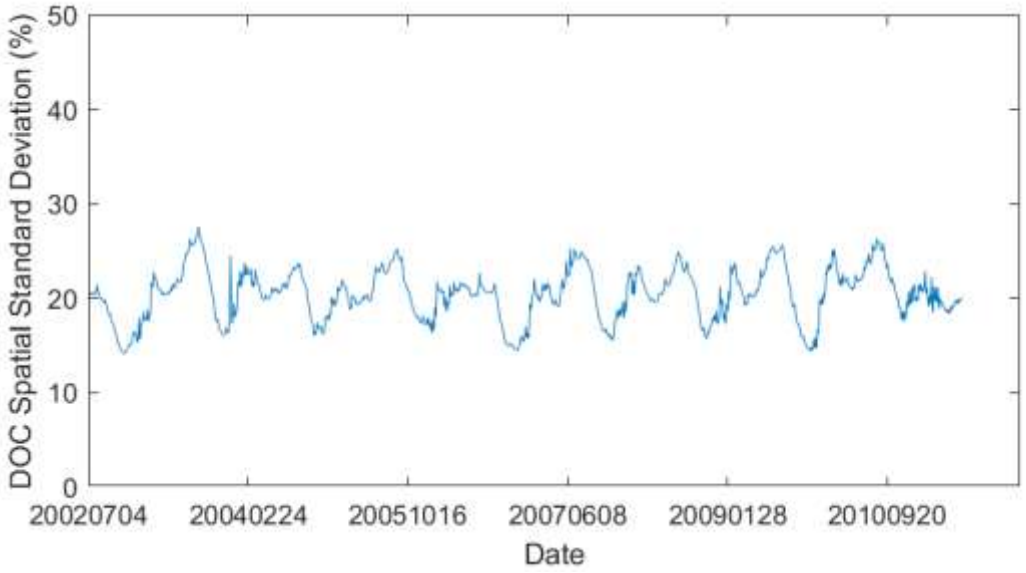

Figure RC1-1

Table RC1-2

DOC Spatial Standard Deviation					
Season	**Spatial SD (%)**	**Month**	**Spatial SD (%)**	**Land Cover Type**	**Spatial SD (%)**
Autumn (MAM)	20.6355	January	19.0502	Closed Shrublands	11.4843
Winter (JJA)	22.8947	February	21.3538	Open Shrublands	13.9821
Spring (SON)	18.8605	March	21.1669	Woody Savannas	17.9117
Summer (DJF)	19.1613	April	20.2281	Savannas	13.4322
		May	20.4982	Grasslands	19.1051
		June	21.7699	Croplands	20.9953

July	23.2311
August	23.6343
September	21.9705
October	18.3045
November	16.3252
December	17.2764

Changes in Manuscript: Add the information stated in the above author response and Table RC1-2 to the results in section 4.1 (page 7).

A.3 Spatial and Temporal Standard Deviation (SD): Burned area maps were used as true baseline. However, the burned area map may include fires that are lit in low–moderate conditions, such as prescribed burns and fire. The less good quality of the proposed model could be associated with such type of fires that are included in low and moderate classes. Please consider using Fire Radiative Power (hotspots) as obtained by MODIS, in order to categorize burned areas according to the power (energy) released and consequently with fire intensity and severity. This will allow to eliminate low and moderate fires from your analysis and increase model accuracy, namely in case of severe fires.

Author Response: It is true that burned area maps are not perfect for a true baseline, since it includes prescribed burns. Following your suggestion, we use fire radiative power (FRP, unit: MW) provided in MCD14ML to mask out burned area (MCD64A1) that have low FRP. We assume any burned area with FRP lower than 100 MW to be low and moderate fire. The changes in the GFDI and burned area analysis results (Fig. 9, Table 3, and 4 in the original manuscript) are as shown in Fig. RC1-2, Table RC1-3, and RC1-4. Note that while the true positive rate for every model significantly increases, the accuracy slightly decreases. Nevertheless, the overall results are still similar with the previous finding in the original manuscript (Method B has the highest accuracy, but worst true positive rate, MapVic has the highest true positive rate, but worst accuracy, and our proposed model sit in the middle among the three DOC models).

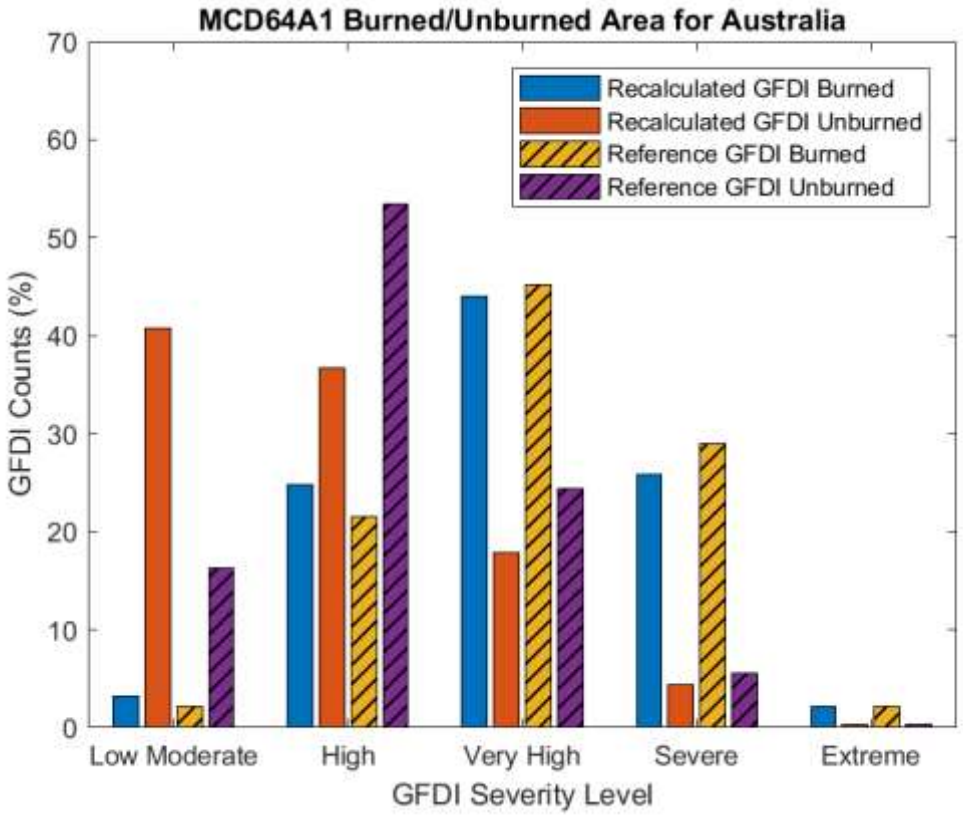

Figure RC1-2

Table RC1-3

		Reference GFDI		Recalculated GFDI	
		MCD64A1 No. of Pixels			
		Burned	**Unburned**	**Burned**	**Unburned**
GFDI Severity	**High or above**	88	446894217	80	319386462
	Low Moderate	5	395703734	13	523211489

	Reference GFDI	Recalculated GFDI
True Positive Rate	0.9462	0.8602
False Positive Rate	0.5304	0.3790
Accuracy	0.4696	0.6210

Table RC1-4

	Method B GFDI	MapVic GFDI

		MCD64A1 No. of Pixels			
		Burned	**Unburned**	**Burned**	**Unburned**
GFDI Severity	**High or above**	9	131413937	83	334095499
	Low Moderate	84	693718749	10	488464724

	Method B GFDI	**MapVix GFDI**
True Positive Rate	0.0968	0.8925
False Positive Rate	0.1593	0.4061
Accuracy	0.8407	0.5938

Changes in Manuscript: Add the description of MCD14ML to the end of section 2.1 (page 3, line 42). Add the above explanation in the author response regarding the application of MCD14ML on the burned area map (MCD64A1) to section 4.2 (page 8, line 16). Fig. 9, Table 2 and 3 will be replaced with Fig. RC1-2, Table RC1-3 and RC1-4.

Minor Suggestions

B.1 Why MODIS AQUA was not included in the analysis. The authors will have higher amount of available data and better opportunities to have valid data and to avoid clouds.

Author Response: We tested both MODIS Terra and Aqua correlation with both VOD and NDVI during the initial stage of the study and found that MODIS Terra (during our study period of 4 July 2002 to 26 June 2011) have better correlation than Aqua dataset. For consistency, we decided to use only Terra dataset.

Changes in Manuscript: No changes needed.

B.2 Several sites are referred by name; e.g., Darnum, Simcocks, and Neerim South, Durran Durra, Monaro, and Parry Lagoons. The authors should provide more details about the location of the sites. Non-Australian readers will get lost without those additional informations.

Author Response: Apart from the site name, Australian states will also be provided. Grass type at each site will also be labelled for additional information.

Changes in Manuscript: All site names in the paper will be accompany with state and grass type. For instance, “Darnum”, will become “Darnum, VIC (mixed grass).” The name of the selected sites for calibration will also be stated in section 2.2 (page 4). The selected sites are: Majura, ACT (improved pasture), Tidbinbilla, ACT (mixed grass), Ballan, VIC (improved pasture), Murrayville 1, VIC (native grass), and Murrayville 2, VIC (improved pasture).

B.3 The sites showed in Figure 2 are the 23 sites retained from the original pool? Please clarify and introduce this information in the main text.

Author Response: No, it included all 37 sites. New figure (shown as Fig. RC1-1 below) with only 23 valid sites will replace the original Fig. 2 in the paper.

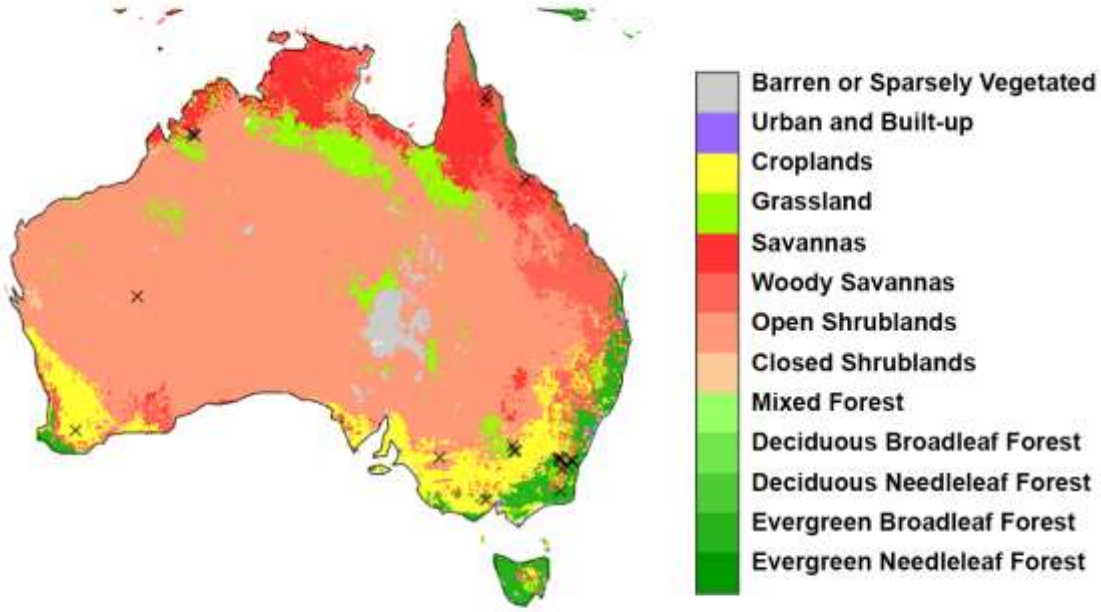

Figure RC1-1

Changes in Manuscript: Updated Fig. 2 (shown as Fig. RC1-1 here) will replace original Fig. 2. (page 15). Original caption will also be updated to “Figure 2: MCD12C1 land cover type map for Australia (Hansen et al., 2000). The locations of 23 valid observed degree of curing (DOC) sites are marked with crosses.”

B.4 Page 10, line 12: Use a dot before ‘With’

Author Response: Thank you for pointing out the missing period.

Changes in Manuscript: Text on page 10, line 12 will be updated as noted.