RESPONSES TO REVIEWERS

Responses to the reviewers are in *italics*, and new or revised text that will be included is given in *red*.

Anonymous referee #1

Response:

In order to add a perspective of the impact of changes in shortwave albedo with other radiative forcing induce by fires, we will add the following paragraph in the conclusion section as follows in page 12 L2-15:

Changes in shortwave albedo are not the only source of radiative forcing when fires affect the land surface. According to the IPCC Fourth Assessment Report (REFERENCE), biomass burning accounts for the 75% of the direct radiative forcing from organic aerosols and it is estimated at -0.5 ± 0.5 Wm^{-2} for the period of 1750-2005 (Forster et al., 2007). In the tropics, where incident solar radiation is larger than at higher latitudes, it can enhance the radiative effect from aerosols (Holben et al., 2001). Ross et al., 1998 found a radiative forcing of about -15 ± 5 Wm^{-2} during the 1995 Amazon fire season. Total black carbon emissions from biomass burning (3.3 TgC yr^{-1}) represent 40% of the total black carbon emissions, with an additional 4.6 TgC yr^{-1} contributed by fossil fuel and biofuel combustion (Bond et al., 2004). Although the overall radiative forcing of smoke aerosol particles is negative, black carbon can produce positive radiative forcing. The global radiative forcing of total black carbon was estimated at +0.2 Wm^{-2} in the IPCC Third Assessment Report (Ramaswamy et al., 2001) and 0.55 Wm^{-2} in the IPCC Fourth Assessment Report (Forster et al., 2007).

References added:

Holben, B.N., Smirnov, A., Eck, T.F., Slutsker, I., Abuhassan, N., Newcomb, W.W., Schafer, J.S., Tanre, D., Chatenet, B., Lavenu, F.: An emerging ground-based aerosol climatology - Aerosol optical depth from AERONET. J. Geophys. Res. 106, 12067–12097, 2001.

Bond, T.C., Streets, D., Yarber, K.F., Nelson, S.M., Woo, J.-H., Klimont, Z:. A technology-based global inventory of black and organic carbon emissions from combustion. J. Geophys. Res. 109, 2004.

With regards to the evolution of burned are over some specific regions, we did not provide numbers about the evolution of burned area over time at local or regional scale. The main goal is to measure the impact of fires on the Earth system at global scale. However, we agree that some illustrative results showing the temporal evolution of burned areas over the two regions shown as examples, may be helpful. We therefore add two plots, one for Australia and another for northern hemisphere Africa, including burned area and radiative forcing over time as shown in figure 7.

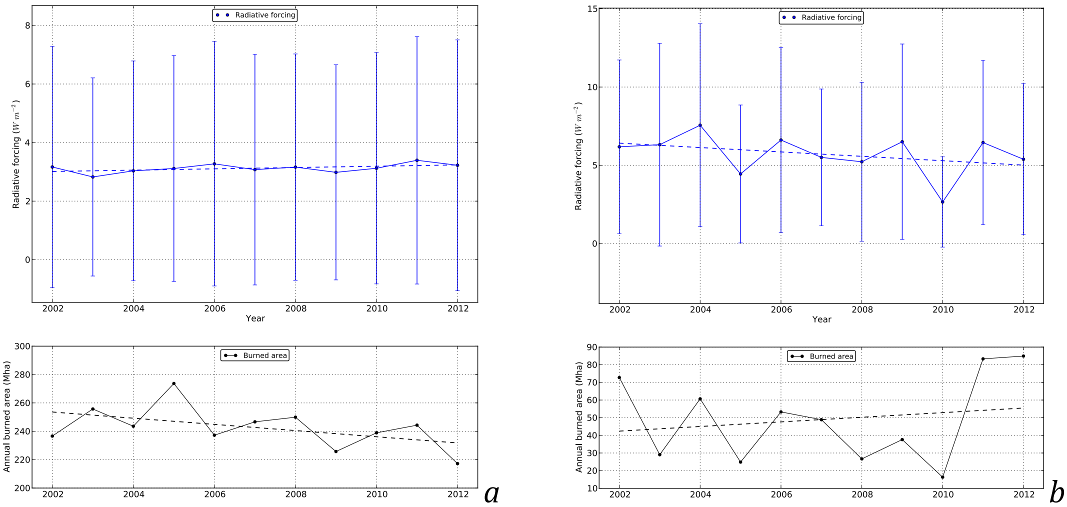

Figure 7. Temporal evolution of the radiative forcing and burned areas. Panel a) shows the profiles for Africa, panel b) for Australia.

Specific comments.
P7778-L25-26: "Using the three BRDF ..." is not clear and should be rephrased
The paragraph will be rephrased as follows in P4L6-15:

"The Global bi-hemispherical reflectance (α_{BHR}) under isotropic illumination, also designated white-sky albedo, for every 16-day time period was computed using:

$$\alpha_{BHR}(\lambda) = f_{iso}g_{iso} + f_{vol}g_{vol} + f_{geo}g_{geo} \qquad (1)$$

where f_{iso} , f_{vol} and f_{geo} are the three BRDF model parameters, isotropic, volumetric and geometric. The integrated coefficients have the following values: $g_{iso} = 1.0$, $g_{vol} = 0.189184$ and $g_{geo} = -1.377622$.

P7779-L15: "per year" → "each year" ?
In P4L24 the sentence will be changed to:
The areas affected by fire each year were derived using the MODIS...

P7780: What about peatlands? In which class are they included?
Response:
The MODIS land cover product we used for this study includes three different classification legends. We selected the IGBP (International Geoshpere-Biosphere Programme), which is the only one that includes peatlands in class 11: Permanent wetlands. Therefore, as part of the aggregation we performed, peatlands were aggregated into the "non-forest" class.

P7781L3: identify->identified
Correction as follows in P6L3:
For every pixel identified as affected by fire...

P7781L17: missing coma
Correction as follows in P6L15:

However, fire affects vegetated areas, which generally are very reflective in the near-infrared and after a burning event, show a decrease in reflectance due to vegetation loss and de- position of charcoal and ash.

P7781L24: uncertainties
Correction as follows in P6L22:
Second, there are uncertainties *in the day of burning.*

P7782L9-14: The phrase is too long and should be cut.
In P7L6-14 the phrase will be changed as follows:
Ramaswamy et al. (2001) define radiative forcing as 'the change in net (down minus up) irradiance (solar plus longwave; in W m^{-2}). In this study we do not consider longwave forcing. Once the change in albedo ΔA_{fire} was computed, the shortwave radiative forcing at the surface ΔF_0 exerted by changes in shortwave albedo due only to fire is estimated as: $\Delta F_0 = -dswrf_0^{\downarrow}\,\Delta A_{fire}$

P7782L15: DFsurface or DF0? Is it the same parameter? If so be consistent
It is the same parameter. $\Delta F_{surface}$ will be changed to ΔF_0 as in response to comment P7782L9-14.

P7782L10: It would be appreciable if the authors could justify why they neglect the longwave calculations. A quick computation could prove if a change in albedo has a significant influence or not on the amount of energy absorbed by the surface and re emitted as LW flux.

Land Surface Temperature (LST) and emissivity can indeed influence fire-induce longwave radiative forcing. However since the main goal of this study is to quantify the impact of instantaneous shortwave albedo changes in areas affected by fire and taking in to account the findings from in the scientific literature it was decided to omit the contribution of longwave fluxes. Previous studies for Africa by Govaerts et al. (2002), Northern Australia by Jin and Roy (2005), North America boreal forest by Jin et al. (2012), also ingnored the role of longwave radiation.

References added:
Jin, Y., Randerson, J. T., Goetz, S. J., Beck, P. S. a., Loranty, M. M. and Goulden, M. L.: The influence of burn severity on postfire vegetation recovery and albedo change during early succession in North American boreal forests, J. Geophys. Res., 117(G1), G01036, doi:10.1029/2011JG001886, 2012.

The sentence will be modify as follows in P7-6-7:
Ramaswamy et al. (2001) define radiative forcing as 'the change in net (down minus up) irradiance (solar plus longwave; in Wm^{-2}). In this <u>study we do not consider</u> longwave forcing.

P7782-L22: It's very hard to see any correlated trends between BA and RF with this Y-axis scale. Maybe try to change the Y-axis for the RF?
Plot will be changed as shown below in figure 2. Quantities in radiative forcing and albedo change are different due to introduction of burned area fraction requested

by reviewer #2. Since uncertainties are very large, they will be omitted, in order to show temporal variability.

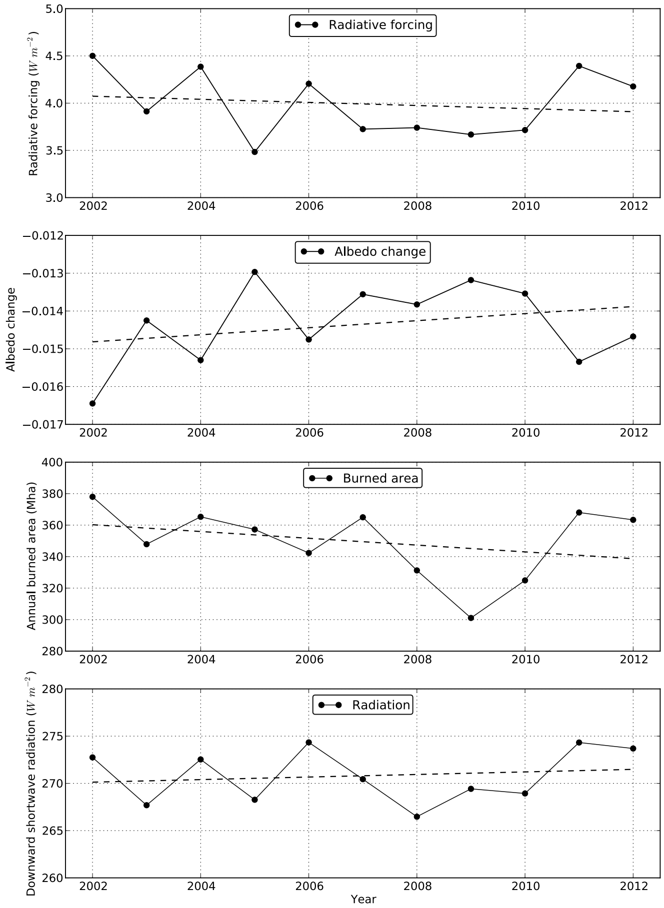

Figure 1. Temporal changes of the annual global radiative forcing induce by fires and albedo change spanning from 2002 to 2012. Bottom plots show the total annual burned area and the downward shortwave radiation fluxes at the surface. The dashed lines depict linear trends, where changes of rate per year are, for radiative forcing: -0.016Wm^{-2}, albedo change: 9.33e-05, burned area: -2.15Mha and downward shortwave incoming radiation: 0.14 Wm^{-2}.

P7782-L24: Figures should be introduced before referring to them. The authors should also explain the results from the figures instead of letting the reader decides what he should see in them.
The following text will be included before introducing figures 4 and 5 in P8L5:
Figs. 5 and 6 show for the Sahel and Australia correspondingly: in panel (a), the approximate day of burn (DoB), instantaneous shortwave albedo change in panel (b), the relative albedo change in panel (c). Panel (d) depicts the associated radiative forcing. Areas in red tones indicate a large change and areas in blue tones small change in the aforementioned variables.

P7783-L10: and – and
Quantities in radiative forcing are different due to an introduction of burned area fraction requested by reviewer #2. Correction as follows in P9L13-15:
… whereas the highest radiative forcing per unit area is located in forests of Australia in 2003 and 2006, Europe in 2010 and Asia in 2003, with mean

continental values of 15.43 Wm^{-2}, 15.26 Wm^{-2}, 13.98 Wm^{-2} and 8.55 Wm^{-2} respectively (Fig. 3).

P7784-L0-7: Rephrase (too long)
Quantities in radiative forcing are different due to an introduction of burned area fraction requested by reviewer #2. Paragraph will be rephrase as follows in P8L22-27:
Using again the mean radiative forcing in areas where fire occurred during 2002–2012 is 3.99Wm^{-2}, multiplying by the proportion of area affected by fire, the global mean radiative forcing is 0.0275Wm^{-2}. When performing the same calculation at regional scale, for instance, Australia, the mean radiative forcing is 5.71Wm^{-2}, and the mean area burned is 0.502 Mkm2, representing the 6.53% of the Australian territory. Therefore, the mean radiative forcing for Australia is 0.373 Wm^{-2}, an order of magnitude higher than the global number.

Table 1 not useful (only 3 parameter), better to state the number in full text.
Table 1 will be omitted and values in the equation will be shown as in response to comment P7778-L25-26.

Fig.1 not usefull. It would be more interesting if we had other information than the name of continents on it (i.e. global change in SW of albedo).
Figure 1 will be omitted.

Fig.2 not easy to read:
- Thicker lines + text
- Change to a/b/c/d instead of blue red lines
- What is the linear regression of the linear fit? /year

Plot will be modified as stated in comment P7782-L22. The rate of change will be part of the figure description as follows:
Figure 2. Temporal changes of the annual global radiative forcing induce by fires (blue line) and albedo change (in red) spanning from 2002 to 2012. Bottom plots show the total annual burned area and the downward shortwave radiation fluxes at the surface. The dashed lines depict linear trends, where changes of rate per year are, for radiative forcing: -0.016Wm^{-2}, albedo change: 9.33e-05, burned area: -2.15Mha and downward shortwave incoming radiation: 0.14 Wm^{-2}.

Fig 5-6: Add a-b-c-d) instead of top middle etc.
Background color white would be easier to read
Panels will have letters to be identified. Background colour will be change to white as in the following example from the approximate day of burn for Australia during 2003 in figure 3:

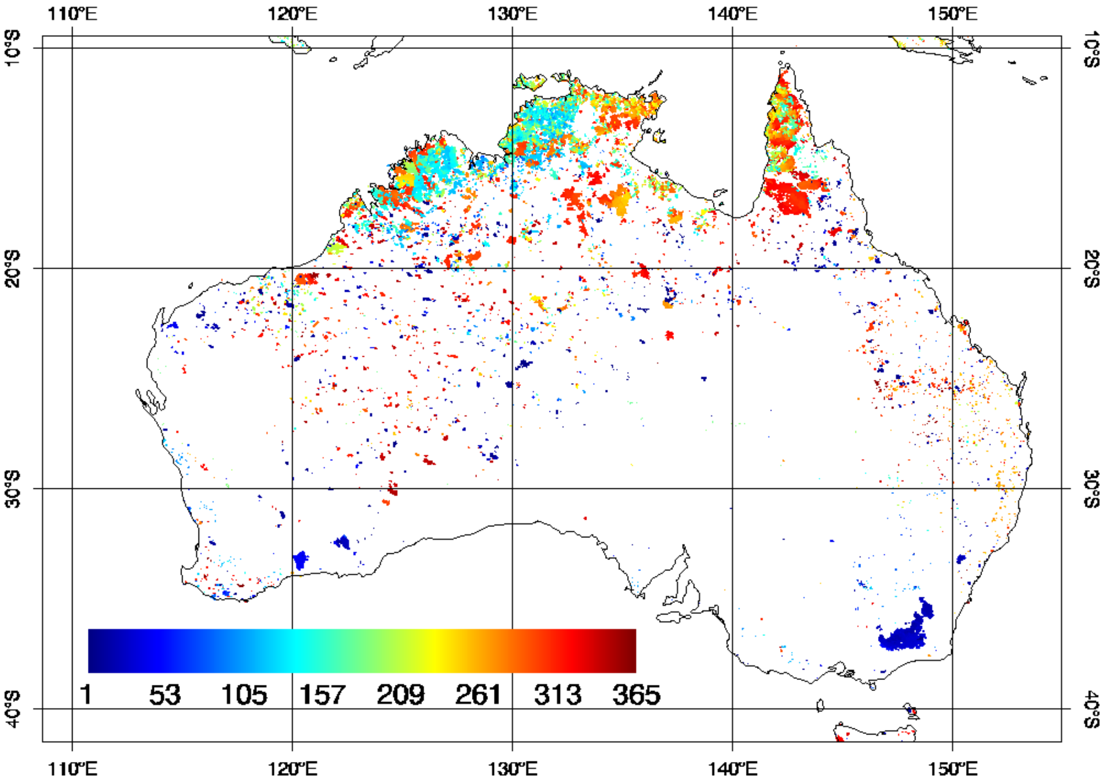

Figure 3. *DoB for Australia during 2003*

Anonymous referee #2

Response:

As the referee points out, this is the first attempt to study a large area, in this case the whole Earth's land surface and quantify the impact of fires on the energy balance system.

General comments

In general I found that it would be much easier for the audience to absorb the main findings if the results and discussions were better organized. for example, one paragraph for spatial distribution (e.g., a global map of 11 year long term mean would be very valuable), one for interannual variation and extreme fire impacts, one for land cover differences, and etc.

The results section will be modified to show findings in a top down approach, going from the global to the regional results. We will add the following paragraph and plot at the beginning of the results section:

Figure 1 illustrates the global spatial distribution of mean radiative forcing caused by "instantaneous" shortwave albedo changes on areas affected by fires. Most fires occur in the tropical and sub-tropical environments. High values of radiative forcing, e.g., greater that 5 Wm^{-2} in those areas, shown in dark red tones, might suggest frequent intense fire occurrence like in South Sudan, Angola and Northern Australia, whereas low forcing in dark blue tones, like the big cluster in Ukraine and the South West corner of the Russian Federation are related to frequent non intense fires.

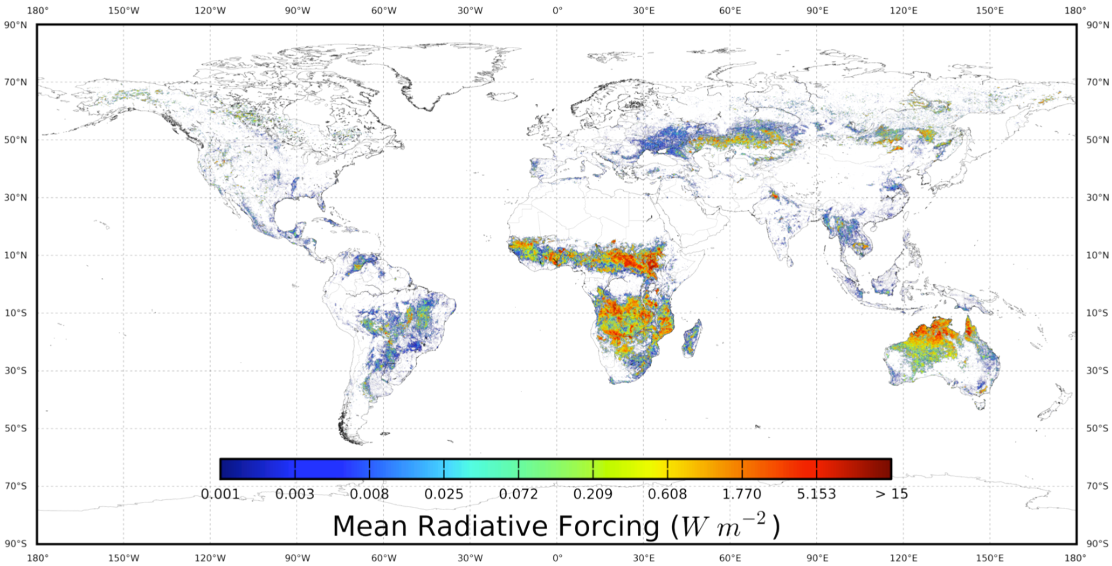

Figure 1. Global mean radiative forcing caused by "instantaneous" shortwave albedo changes on areas affected by fires. The values were normalized using a logarithmic scale.

A subsections to address the interannual variability and land cover affected will be included in the results section as follows in P8L29:

Interannual variability and land cover affected

The main discrepancies between area burned and radiative forcing occur in the period of 2005–2007, where intermediate-high area burned is associated with the lowest values of radiative forcing in 2005 and 2007, and a high abrupt peak in 2006.
The greatest drop in mean shortwave albedo change occurs in 2002, which corresponds to the highest total area burnt (3.78Mha) observed in the same year and produces the highest mean radiative forcing (4.5Wm^{-2}) (Fig. 2). The lowest short-wave albedo change values in 2005 and 2007 are not associated to low area burned and similarly the lowest and very abrupt drop of area burnt in 2009 does not produce the lowest albedo change and radiative forcing (Fig. 2).

Most fires occur in the Sahel (Fig. 5) and the Australian savanas (Fig. 6) corresponding to an average up to 89 % of the total global area burnt, whereas the highest radiative forcing per unit area is located in forests of Australia in 2003 and 2006, Europe in 2010 and Asia in 2003, with mean continental values of 15.435Wm^{-2}, 15.26 Wm^{-2}, 13.98 Wm^{-2} and 8.55 Wm^{-2} respectively (Fig. 3).

In croplands, Asia shows the greatest oscillations with a minimum of 2.11 W m−2 in 2004 and maximum of 6.1 W m−2 in 2008 (Fig. 3). The rest of the continents show a low variability in cropland areas, with the exception of Australia in 2003 showing a steep peak of 6.54 W m−2. In non-forests, the highest radiative forcing is in North America in 2004, in Europe in 2010 and in Asia in 2003 and 2010. High oscillations are also observed in Australia with an abrupt drop in 2010, contrasting with very stable inter-annual cycle of Africa.

The extreme events will be addressed in the "Discussion and conclusions" section as a subsection which in P10L22 includes a modified figure 3:

Extreme events

Continental Europe includes Russian territories and, has as eastern borders the Ural mountains, the Ural river and the Caucasus mountains, as well as the water line of Caspian lake. Therefore, the anomalous fire events in July 2010 around Moscow are included in European continent. On an annual basis, in Russia, 90–95 % of burnt areas are located in the Asian part of Russia with the majority (59.3 %) being forests, with the exception of the extreme event of 2010 (Shvidenko et al., 2011). The abrupt peak in 2010 in Fig. 3e corresponds to that event exactly with mean annual value for forests in continental Europe of 13.98 Wm^{-2}. The mean continental value is more realistic when compared to the massive maximum number of 167 Wm^{-2} for the same event including aerosols in smoky conditions found in the literature (Chubarova et al., 2012).
Similar extreme events can be observed in Fig. 2f in 2003 and 2006 in Australia, depicting the Eastern Victorian alpine fires, which burnt 1.3Mha in 2003, and the Grampians in Victoria in 2006 that burned 184 000 ha. A plausible explanation is that a weak to moderate El Niño event had a very strong impact in Australia causing the major 2002–2003 drought had rainfall deficiencies over the period March 2002 to January 2003 (Australian Government, 2014). Fires affected eastern New South Wales (NSW), Canberra, and the mountains areas of southeast NSW

and forested areas in eastern Victoria as show in Fig. 6 upper-left panel. A radiative forcing above 15 Wm^{-2} over northeast Victoria and the Great Dividing Range Mountains in the Kosciuszko National Park in southern NSW mainly to a large shortwave albedo decrease due to forest fires is shown in Fig. 6. Broadly, forest has a low shortwave albedo ~0.3 that varies with the viewing and illumination conditions (Liang, 2000). Given the extraordinary circumstances during the 2002–2003 drought in Australia, the forest fires dramatically altered the albedo, up to a 60 % relative change in some areas, during the Austral summer (pick of incoming radiation), nevertheless changes due to seasonality, e.g., vegetation senescence that affects surface reflectivity were not taking into account and a contribution of the decrease in albedo in the Australian summer might be due to these non-fire related changes.

In Fig. 2b, the highest value of radiative forcing occurs in 2003 when the massive boreal fires in western Siberia burning over 20 Mha and being one of the largest forest fires on record (Sheng et al., 2004). Croplands and non-forests are following the west Siberian event of 2003, showing the highest mean radiative forcing value of all cropland areas (Fig. 2b).

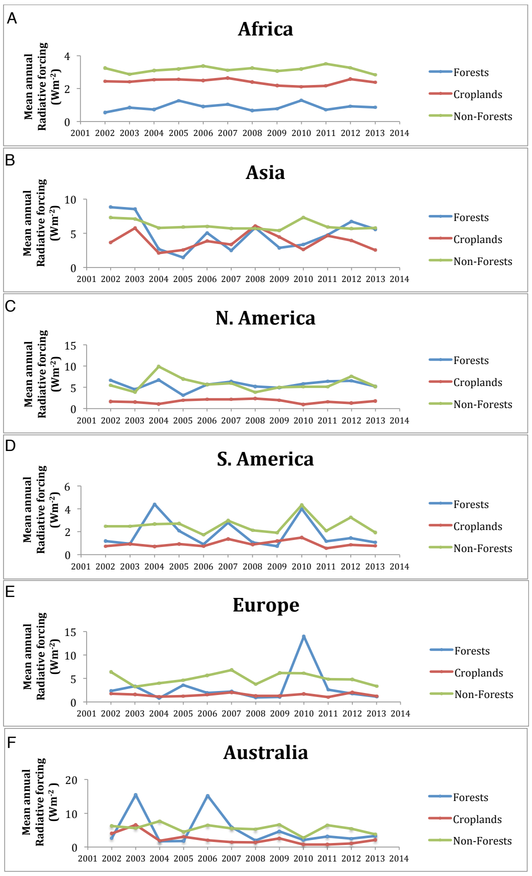

***Figure 2**. The mean annual radiative forcing per land cover and continent (A–F).*

Comment: My main concern is the potential implication of the much different spatial resolution of MODIS BRDF/albedo (0.05 deg) and burned area (500m) that were used in this study.

We fully understand the concern about the difference in spatial resolutions. The 500m MODIS BRDF/Albedo, which indeed will produce the most accurate results was not used mainly due to the amount of data required to perform the analysis. Additionally, the main goal of this study is to quantify the impact of fires on the Earth's balance energy system. When using a spatial resolution of 0.05° at global scale we are still capable to observe the main burned area patterns, for instance, a common spatial resolution for burned area long term data records is 0.25° for the Global Fire Emissions Database (GFED4).

Comment: Secondly, and most importantly, when aggregating the MODIS 500m burned area to the CMG 0.05 deg grid, did the authors apply any threshold to identify the CMG grids, burned or not burned? For example, if only 10% of 500m pixels within each CMG ~5km grid were burned, but the albedo change was calculated at ~5km resolution, which would include many unburned 500m pixels, and thus would lead to low bias of albedo change and forcing estimates. It wasn't clear whether and how this fractional burned area at the CMG resolution was considered.

In the first version of the analysis we used a nearest neighbour method when aggregating the MODIS 500m burned area to the 0.05Deg grid. The assumption was that we would keep only the core burned pixels that, at global scale contribute the most to the Albedo changes due to fire. Nevertheless using this assumption we were consistently, 1) overestimating the burn area, since we assumed that the whole pixel was affected by fire and 2) underestimating burned area, where coarse resolution pixels not mapped as burned due to the resampling technique applied, were not taken into account at all. The description of the resampling applied to address this issue will be added to the section 2.2 Burned area identification as follows in P5L1:
It was necessary to perform a spatial aggregation on the monthly datasets to 0.05Deg to match the CMG spatial resolution. The proportion of the CMG pixel that was affected by fire was calculated, thus giving a fractional burn area estimate. When more than one date was found inside a CMG pixel the mode of the day of burn was selected.

Using this new fractional burned area dataset the albedo change was calculated as discussed in section 3.1, subtracting the pre-fire from the post-fire albedo and then multiplying by the fraction of the area affected in each pixel. The associated radiative forcing was computed as before, however, when calculating spatial statistics, at global and continental scale in different land cover types, a weighted mean was computed using the fractional burned area as weights. The updated results did not change the trends or temporal behaviour, what changed was the magnitude of the albedo changes and the radiative forcing. The updated abstract reflects the new numbers as follows:
The analysis reveals a mean decrease in shortwave albedo of –0.0143 (1σ = 0.017) causing a mean positive radiative forcing of 3.99 Wm^{-2} (1σ = 4.89) over the 2002 - 2012 time period in areas affected by fire. The greatest drop in mean shortwave albedo change occurs in 2002, which corresponds to the highest total area burnt (3.78Mha) observed in the same year and produces the highest mean radiative forcing (4.5 Wm^{-2}).

Africa is the main contributor in terms of burned area but forests globally yield the highest radiative forcing per unit area, resulting in detectable shortwave albedo changes. The global mean radiative forcing for the whole analysis period ~0.0275Wm^{-2} shows that the contribution of fires into the Earth system is significant.

As a remark, the burned area extent is the same as before since no resampling was applied at all to calculate it. The original 500m was used to compute the global and regional extent.

Other specific comments

1. In both the title and “Abstract”, please make it clear the albedo change and forcing presented in this paper were indeed “instantaneous”. This is critical for understanding the numbers, as both quantities change significant as vegetation recovers after fire.
This paragraph in the abstract was modified:
The main goal of this study therefore, is to quantify the changes in instantaneous shortwave albedo produced by biomass burning activities and their associated radiative forcing.

2. In the “Introduction”, page 7777, Line 11, “The radiative forcing caused by CO2” , did you mean by CO2 change?

The sentence was modified as follows in P2L15-16:
The global mean concentration of CO_2 in 2005 was 379 ppm, leading to a radiative forcing of +1.66 Wm^{-2} (1σ = 0.17).

3. In page 7777, Line 18-24, again, when referring to other studies, please clearly state the time periods of the albedo change and forcing, e.g., did Govaerts et al. and Jin and Roy report the “instantaneous” change? Since this manuscript was for global analysis, please also cite some studies in other regions, such as in boreal regions.

Paragraph will be modified as follows in P2L22-32:
Earlier studies aimed to quantify the impact of fires on the land surface albedo. Govaerts et al. (2002) analysed a Meteosat albedo time series for 1996 in Northern Hemisphere Africa and using fire-induced albedo perturbation probabilities, estimated that fires are responsible for a relative albedo decrease as large as 25 %. Jin and Roy (2005) used MODIS data to estimate a mean 2003 instantaneous shortwave albedo change of −0.024 over all the burned areas in the Australian tropical savana, which exerted a shortwave surface radiative forcing of 6.23 Wm^{-2}. Several studies have been carried out in the boreal area, Jin et al. (2012a) analysed the sensitivity of spring albedo to the MODIS-derived difference Normalized Burn Ratio (dNBR) while Jin et al. (2012b) found a fire-induced surface shortwave forcing (SSF) integrated over an annual cycle of -4.1 Wm^{-2} between southern and northern boreal regions.

Citations to add:

Jin, Y., Randerson, J. T., Goetz, S. J., Beck, P. S. a., Loranty, M. M. and Goulden, M. L.: The influence of burn severity on postfire vegetation recovery and albedo change during early succession in North American boreal forests, J. Geophys. Res., 117(G1), G01036, doi:10.1029/2011JG001886, 2012.

Jin, Y., Randerson, J. T., Goulden, M. L. and Goetz, S. J.: Post-fire changes in net shortwave radiation along a latitudinal gradient in boreal North America, Geophys. Res. Lett., 39(13), doi:10.1029/2012GL051790, 2012.

4. In Page 7777, Lines 26 to 27, state clearly the uniqueness of "the main goal", e.g., continental and global estimate. Also I didn't get that it is for instantaneous estimate instead of longer term impact until I read the method and results?

The paragraph will be rephrase it as follows in P3L9-11:
No earlier studies have attempted to quantify the impact of fire on shortwave albedo at global scale; therefore, the main goal of this study is to quantify the "instantaneous" shortwave albedo change in areas affected by fire and the corresponding radiative forcing at the surface.

5. In Page 7779, Lines 6-13, with regards to linear temporal interpolation, any special considerations for the abrupt albedo change after fire, both for adjacent pre-fire and post-fire periods ? It makes sense to include only snow-free albedo after knowing that this study was to look at the instantaneous change after fire.

No considerations were taking into account to perform the linear interpolation related to the fire occurrence. Since only the best pixels were kept for processing, the gaps in the time series for some pixels indicates that those pixels were masked due to their quality flag value:

2. mixed, 75% or less full inversions and 25% or less fill values
3 all magnitude inversions or 50% or less fill values
4 50% or more fill values

Instead of using low quality pixels that could lead to spurious changes in the shortwave albedo, we considered that applying a linear interpolation between pixels with high quality data was the most adequate option to have a gapless time series. The interpolation was applied only to fill single 8-day gaps.

6. In Page 7779, Lines 20-22, when aggregating MCD64A1 500m burned area to CMG 0.05 degree resolution, did you record and keep track of the fraction of burned area? See the main comment on this. When the estimate was presented over the area burned, did you mean only over the areas burned identified by the 500m burned area product, or over the areas burned at the 0.05 deg resolution?

This issue was addressed in the general comments.

7. In Page 7781, Line 16: change near-infra-red to near-infrared
Will be change as follows in P6L15:

… which generally are very reflective in the <u>near-infrared</u> and…

8. In Page 7783, Line 25-29, it would be interesting to present numbers for global LAND area only.
Quantities in radiative forcing are different due to an introduction of burned area fraction requested in the general comments. The numbers for global LAND area only will be presented as follows in P8L15-20:

In order to quantify the global or regional impact, it is necessary to normalize the forcing by the proportion of the total area burned to the total surface. Given r = 6 371 007.181 m as the radius of the idealized sphere representing the Earth; the total global surface is ~510.07 Mkm2. Assuming a proportion of land in the planet of 30%, given the mean radiative forcing in areas where fire occurred during 2002–2012 is 3.99Wm^{-2}, the global mean forcing only in land is 1.197 Wm^{-2}

9. Page 7784, Line 10: change from "In here, we . . ." to "We here . . ."

Sentence will be change as follows in P10L17:
We here used the radiative forcing as measure…

10. For "Results" and "Discussions", see general comments on the organizations.

"Results" and "Discussion and conclusions" sections were modified. Please see response to general comments.

11. Table 1, not necessary, a reference is good enough.
Table 1 will be removed.

12. In "Results", Page 7782, Line 19-23, are all linear trends presented significant (Figure 2)? For the statement of "The mean albedo changes, considering the change between post-fire shortwave albedo minus the pre-fire value, have the opposite trend of the total annual area burnt.", is the magnitude of post-fire albedo reduction also decreasing, consistent with the trends of burned area and forcing?

The Mann-Kendall test for monotonic trend was applied to all annual global mean time series shown in figure 2. Only the burned area has a significant trend. Neither the albedo change nor the associated radiative forcing has a significant trend, therefore the finding will be rephrased as follows in P7L27-30:

Overall, the trend in burned area for the whole studied period is negative, however the albedo change and the radiative forcing show no significant trend (Fig 2). The mean albedo changes, considering the change between post-fire shortwave albedo minus the pre-fire value, have a slightly annual increase opposite trend of the total annual area burned.

13. In Figure 4, it would be easier to compare if all y-axis were in the same range; In Figure 5: please label image panels A to D; and refer each in the legend.

Figure 3 was modified to have the same scale in all y-axis as follows:

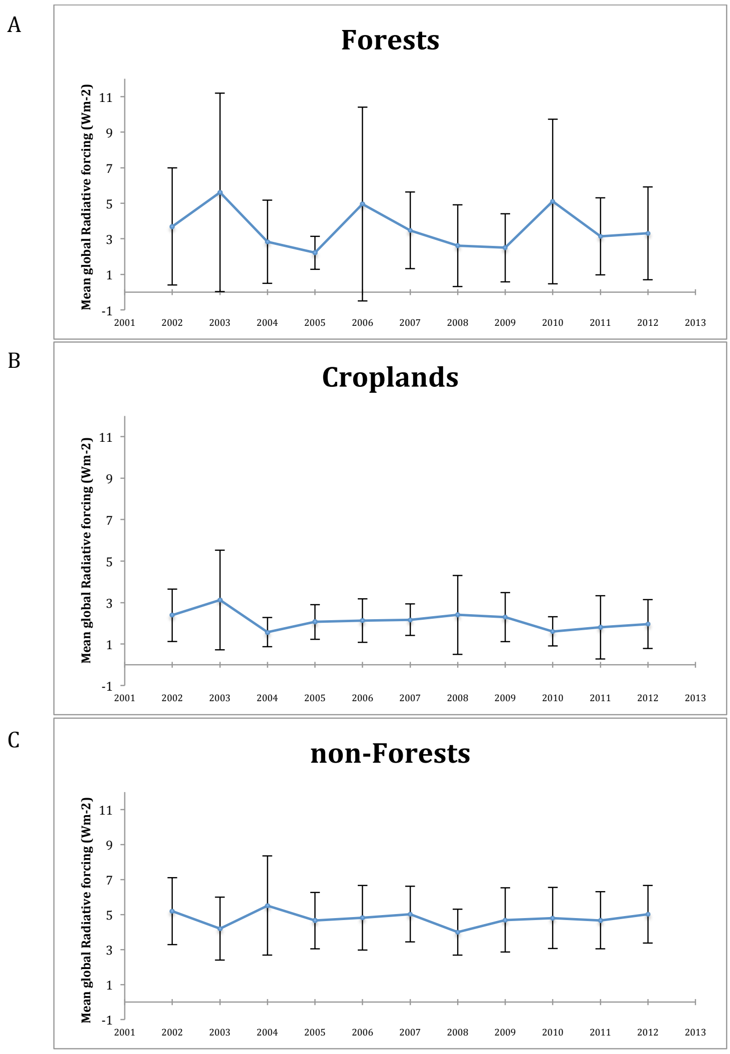

Figure 3. *The mean annual radiative forcing per land cover* ***(A–C)*** *in W m−2 .*

14. It would be more interesting to show a global map of mean albedo change and forcing averaged over the 11 years.

A map of the 11-year global mean radiative forcing will be shown as stated in the general comments.