Reviewer 1

Dear reviewer, thank you for your valued time dedicated to reviewing this paper. Your contributions certainly will improve it. Here you can find the response to your comments, questions, and suggestions. The paper will be submitted for a careful English editing.

Comment 1:

This is quite and unique region. It comprises the second largest rainforest in the world, and while there have been so many studies analyzing the Amazon, the recycling rates in the Amazon are not nearly as large as the ones reported here. I think it is important to point this out. There are few regions in the world that have such high terrestrial sources of moisture and can sustain a rainforest!

Response 1:

We are agreeing. We have improved in the introduction the section 1.1.

1.1 Region of Study

The Congo River Basin (CRB) is located in central-equatorial Africa, an important part of the continent containing major rivers and dense forest (Fig. 1). With an approximate area of 3,687,000 km2 (Alsdorf et al., 2016), the basin includes several African countries: the Democratic Republic of the Congo (DRC), the People's Republic of the Congo, the Central African Republic, and parts of Zambia, Angola, Cameroon, and Tanzania (Chishugi, 2008). The Congo River (also known as the Zaire during at one time) is over 4,375 km long, considered to be the fifth longest river in the world, and the second longest in Africa after the Nile River (IBP, 2015). Its discharge shows a composite variability, which is due to the sum of its tributaries (Laraque 2001). With an annual discharge of 5000 m3 s-1 at its mouth, the Oubangui River is the second most important tributary to the Congo River (mean flow 41 000 m3 s-1), after the Kasai River (8000 m3 s-1) (Briquet, 1995).

The CRB comprises the second largest continuous rainforest in the world; covering an area of approximately 1.8 Million km2 the high rate of evaporation is comparable to the oceans is one of the main features of the forests, being extremely important for storing carbon and having an impact on the continental and global climate system mainly through the water cycle (Haensler et al., 2013; Marquant et al., 2015; Wasseige et al. 2015). The basin is composed basically of a central area that contains an immense forest swamp best known as "Cuvette Centrale"; an immense depression at the centre of the basin where sediment accumulation since the Quaternary alluvial deposits rest on thick sediments of continental origin, consisting principally of sands and sandstones (Kadima et al., 2011; Gana and Herbert, 2014) (Fig. 1). Here the spatial distribution of forested wetland types is controlled by topography and also by the time and the intensity of the submersion, making it the most extensive peatland complex in the tropics (Dargie et al., 2017). From a rainfall point of view, because of the topographic barrier around the "Cuvette Centrale", the Congolese central basin functions to a large extent as a closed system of precipitation, on-site evaporation, and precipitation (Robert, 1946; Sorre, 1948). Located in the heart of the dense Congolese equatorial forest is the Lake Telé, an immense elliptical body of water (3 m deep for a surface of 23 km2 and a maximum water storage evaluated to 55x106m3) where hydrological exchanges are almost exclusively vertical with very little lateral contribution from the surrounding swamp (Lareque et al., 1998). Furthermore, the basin contains several large, permanent open water lakes including Lake Tanganyika, the largest of the African rift lakes and the world's second largest by volume and depth (Coulter, 1991; Cohen et al., 1993).

Around the central basin, there is mainly a humid evergreen dense forest and to the north and south mosaics of mixed forest; woody savannahs savannas and savannas (Marquant et al., 2015). The current distributions of different forest types correlate strongly with annual rainfall and particularly with the length and severity of dry seasons (CARPE, 2005). The CRB moist forests are the continent's main forest resource, containing an extraordinary biodiversity (Ilumbe, 2006; SCBD-CAFC, 2009) that brings important economic benefits to approximately 60 million people living in local communities (Hugues, 2011; Marquant et al., 2015). Unfortunately, in the CRB the rate of deforestation varies from one country to another. Overall, the basin had a net deforestation rate of 0.09% between 1990 and 2000, compared with 0.17% between 2000 and 2005 (Tchatchou et al., 2015). In fact, the satellite data show a widespread decline in greenness in the northern Congolese forest over the past decade, which is generally consistent with decreases in rainfall, terrestrial water storage, and other related aspects (Potapov et al., 2012; Zhou et al., 2014; Hua et al., 2016) like hydrological regimes (Laraque et al., 2001; Laraque et al., 2013; Wesselink, 1996).

The air masses originating from three permanent anticyclones located to the north-west (Azores), south-west (St. Helena), and south-east (Mascarene) of the CRB converge along the Intertropical Convergence Zone (ITCZ), which separates the southerly low-level winds from the northerly winds, and the Inter-Oceanic Confluence Zone (IOCZ), separating the westerly from the easterly winds in the southern part of Africa (Samba and Nganga, 2012). In general two modes of circulation: circulation of Hadley and the Walker circulation control the movement of air masses and the climate in Central Africa, leading to moisture convergence not being uniform in the atmospheric column (Tsalefac et al., 2015, Pokam et al., 2012). Areas which are positively correlated with Congo convection are areas of the ascending arm of the Hadley cell (Matari, 2002), while the east-west oscillation of the Walker circulation cell modulates the moisture advection from the Atlantic Ocean and the upward motion over the CRB (Matari, 2002; Lau and Yang, 2002) .
The rainfall-generating mechanisms are controlled by a zone of shallow depression systems in the CRB (Samba and Nganga, 2012) as well as north-south ITCZ migration (Samba and Nganga, 2012; Alsdorf et al., 2016) together with

Mesoscale Convective Systems (MCS) (Jackson et al., 2009) and the African Easterly Jet along with the typical circulation of the Hadley cell (Nicholson, 2009; Pokam et al., 2012; Haensler et al., 2013).

Comment 2.

Related to the above, you need to explain (in lay terms in the conclusions) how >80% of the moisture is of terrestrial origin. I am not saying this is wrong, but It is difficult to imagine the mechanism by which this is happening. The moisture initially has to come from the ocean: but how can it climatologically be of terrestrial origin? I am having a difficult time understanding the process.

Response 1 & 2.

Thank you. The next explanation has been introduced in the text to clarify the second part of the Comment 1 and the comment 2

"We analysed separately the percentage of moisture supplied from land-based and oceanic sources to the total moisture inflow to the CRB for the period 1980-2010. The results confirm that over the whole year near or more than the 80% of the total moisture contribution to the basin origins in land sources, highlighting that more than the 50% of the total comes from the CRB itself (Fig. 10). Evaporation as a source for precipitation over land depends on the availability of surface moisture, which in turn depends upon the disposition of precipitation once it hits the ground (Trenberth 1998). In fact, according to with Eltahir (1998) the soil moisture conditions over any large region should be associated with relatively large boundary layer moist static energy, which favours the occurrence of more rainfall. This hypothesis was also confirmed for West African monsoons by Zheng and Eltahir (1998). In this line van der Ent and Savenije (2011) quantified the spatial and temporal scale of moisture recycling, independent of the size and shape of the region; through this method they found that about the 70% of the precipitation in the center of the South American continent is of terrestrial origin like in many parts of Africa, but specifically in the CRB where occur a strong moisture feedback. For Central Equatorial Africa (CEA) Pokam et al. (2012) and Trenberth (1999) reported a recycling ratio (the fraction of rainfall coming from evapotranspiration and not from moisture advected to the target region) higher than obtained for the Amazon in studies of Eltahir and Bras (1994) and Burde et al., (2006). In the CRB, as already commented the role of forests is also fundamental as they sustain atmospheric moisture through evapotranspiration, which is of utmost importance for the region's water resources, specifically the evergreen forest region (Matsuyama et al., 1994; van der Ent and Savenije, 2011). The key role of continental moisture sources has been also documented for monsoonal wettest regions like the Western Mexico (Bosilovich et al., 2003; Domínguez et al., 2008), Sudamérica (Drumond et al., 2014; Keys et al., 2014) and the Indian region (Misra et al., 2012; Pathak et al., 2015)".

Comment 3.

The results for the extreme events are interesting. Again, this is the first time I see that periods of extreme rainfall are associated with higher recycling – I've never seen this in other regions of the world! I suggest the authors analyze another wet period to see if this result is reproducible. The results for extremes were not reported in the abstract – please include.

Response 3.

We apologize because we made an improper use of the word ''recycling''. To understand this mechanism and explain better we performed a backward experiment from CRB and calculated the anomalies of (E-P)>0 and the VIMF for the same years. Please consider the changes in section: ***3.4 Moisture sources during severe dry and wet periods in the CRB***. We hope it clarifies the explanation and your concern.

During the period 1980-2010, the years 1995 and 1996 were characterized by severe (SPEI12_December = -1.69) and extreme (SPEI12_December= -2.06) drought conditions respectively, while 1982 is characterized as severely wet (SPEI12_December = 1.68). Fig. 13 shows the mean annual contribution from all sources and the anomaly of |(E-P)i10<0| for each event. In 1982 (Fig.13a) the most important moisture contributions are from the basin itself (~120 mm day-1), O3 (~28 mm day-1), and C4 (~27 mm day-1). The anomalies of |(E-P)i10<0| from all the sources are positive, but it is particularly high for the basin itself (18 mm day-1). In 1995 and 1996 (Fig. 13b,c) the greatest moisture loss continues to be that from the air masses from the CRB itself, the oceanic source O3, and the continental C4. However, when the anomalies were analysed all the sources showed negative values, meaning that the moisture support was, in fact, less than the average conditions for the whole period. In 1995 the deficit in the contribution from the CRB and O4 is highlighted. Hua et al. (2016) described how an increase in subsidence across the western edge of Indian Ocean (O4) and a decrease in convection over the Congo Basin (CRB) led to a reduction in moisture transport and rainfall across Central Equatorial Africa. In 1996, a year characterized by extreme drought conditions, the negative anomaly in the moisture supply from all the sources remains, but that computed for the basin is higher than it was in 1995. These results explain a mechanism in which the CRB is more efficient providing moisture for precipitation over itself during wet (dry) periods increase (decrease).

To clarify these results, for the three years under study there was calculated the anomalies of |(E-P)i10<0| (moisture contribution) and (E-P)i10>0 (moisture uptake) in air masses tracked forward and backward in time, respectively, from the CRB. It worth noting that utilizing FLEXPART we obtained the budget of (E-P) but not exactly the recycling, which computes the amount of precipitation evaporated falling again within the same region. Besides, to support the results there was calculated the anomaly of the Vertically Integrated Moisture Flux (VIMF) to check the dynamical conditions favourable to the convergence/divergence of moisture flux.

In 1982 a severely wet year, higher positive anomalies of |(E-P)i10<0| are observed in the half north of the CRB, but mostly negative in the south part (Fig. 14a). This pattern is clearly opposite to that obtained for the same year but in the anomalies of (E-P)i10>0 for the backward experiment (Fig. 14d), which explains the strengthening role of the half south of the basin as moisture source; mainly favouring the moisture lose over the north part of the CRB, coinciding with the evergreen forest extends. The anomalies of the VIMF support this result, negative values identifying convergence are appreciated over the half north of the CRB, while positive anomalies indicating divergence in the half south (Fig. 15a). During a wet period is supposed that recycling decrease, however, for the Indian region Pathak et al. (2015) described that whereas the monsoon progresses the enhanced soil moisture and vegetation cover leads to increased evapotranspiration and recycled precipitation. Also for the North American Monsoon region, a positive feedback was previously described by Bosilovich et al. (2003), and Domínguez et al. (2008). In 1982 it may happen that in the half north of the CRB increase both the evaporation and precipitation, but the second much more; thus, affecting the budget of (E-P). It was also documented when the tropical rainbelt shifts northward during boreal summer months; then, the evergreen forest gets active rapidly due to the onset of the rainy season, resulting in the increase of evapotranspiration (Matsuyama et al., 1994).

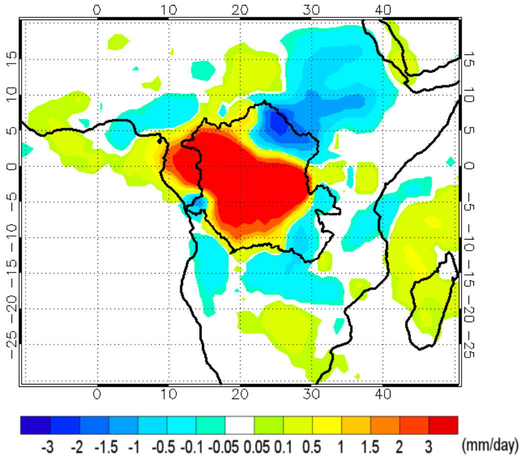
The Oubangui basin in the northeast of the CRB, should have benefited in 1982 due to positive anomalies of |(E-P)i10<0|, favouring the precipitation in the half north of the CRB. In the Oubangui basin, a decrease in runoff observed everywhere coincides with a decrease in rainfall with a time lag of 3 years, which can be explained by the sponge-like functioning of the drainage basin, where interannual variability is less important for runoff than for the rainfall series (Orange et al., 1997). An important finding of theses authors is that also the maxima and minima of annual rainfall do not completely coincide with the extreme flow events; as occurred in 1982, a severely wet year when positive anomalies of |(E-P)i10<0| over the half north of the basin including the Oubangui basin. According to the results of Orange et al. (1997), it was documented by Laraque et al. (2013) that from 1982 to 2010 the Oubangui remains in the drought phase, as the Congo returns to a phase of stability.

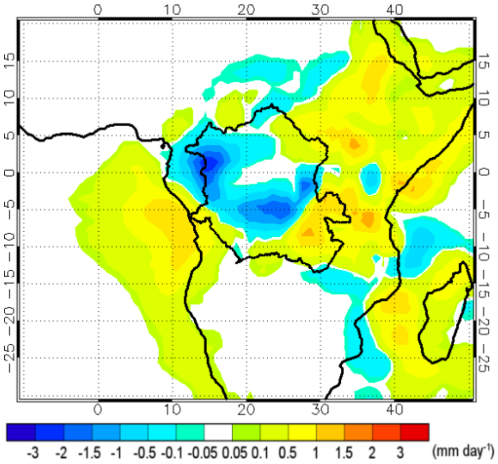
In 1995 a severely dry year, negative anomalies of |(E-P)i10<0| cover the major part of the basin (Fig. 14b) being more intense over the west and north. Over these areas in the backward analysis are observed positive anomalies of (E-P)i10>0 (Fig. 14e) and positive anomalies of the VIMF, indicating the prevalence of divergence (Fig. 15b). In 1996 an extremely dry year, the mechanism is the same like described for 1995 but negative anomalies of |(E-P)i10<0| occupy almost all the basin as well the positive anomalies of (E-P)i10>0 does. In the work of Trenberth and Guillemot (1996) are discussed the importance of land surface feedbacks in the 1988 drought and 1993 flood over the United Stated, while results of Dirmeyer and Brubaker, (1999); Bosilovich and Schubert (2001) and Domínguez, et al. (2006) agree that 1988 had a higher recycling ratio than 1993. To resume, in the CRB during dry years 1995 and 1996 prevail positive anomalies of (E-P)i10>0; indicating that moisture uptake by the atmosphere predominates. It surely occurs because the evapotranspiration is enhanced and precipitation decrease, but the prevalence of divergence of the VIMF (Fig. 15b,c) does not favour the moisture lose over the basin, which must be transported outside, suggesting the role of the CRB itself as a moisture source for remote regions. A more detailed analysis should be done in future works to determine the role of forests during drought conditions in the CRB. In Figure 12c it's possible to observe, that lowest SSI values obtained for the Kinshasa gauge station discharge data, occur after 1995 and 1996, as commented before due to the lag period from precipitation, runoff and underground water to feed rivers.

An important feature for 1982, 1995 and 1996 is that anomalies of moisture uptake and moisture contribution obtained in air masses tracked backward and forward in time, respectively from the CRB, are not homogenous over the CRB itself. In 1982 and 1995 is best appreciated a relocation of regions sources and sinks of moisture at the basin. This confirms that research on the hydrological cycle should not be developed for the entire basin as a whole, agreeing to Matsuyama et al. (1994). These authors argue that for the CRB the seasonal change of the water budget in the entire basin, can be recognized as the combination of those in the evergreen forest and southern deciduous forest regions, but regional characteristics of the water budget in the basin cannot be explained by studying the basin as a whole.

The results of extremes are now mentioned in the Abstract.

We made the same analysis for the second wettest year, 1988, and we found a similar result like in 1982. In the next figure is possible to observe positive anomalies of ***|(E-P)i10<0| (left)*** covering the center of the basin and extending southwest while the patter of *(E-P)i10>0 (right)* anomalies *is mostly opposite*.





Anomalies of |*(E-P)i10<0*| forward integrated from the CRB (left) and anomalies of *(E-P)i10>0* in a backward experiment. Moderate wet year (SPEI = 1.31) 1988.

<u>Comment 4.</u>

In the description of the method, it is important for the authors to clearly write what the forward trajectories are providing for the analysis and what the backward trajectories are providing. It is my understanding that figures 9, 10, 11 can ONLY be obtained with the forward trajectories – is this correct?

<u>Response 4:</u>

Thank you for your suggestion. In the following text, we believe is more clear the purpose of use for the backward and forward analysis. It has been included in the text. Yes, you are right, figures 9, 10 and 11 were obtained from the forward analysis. It is mentioned at the beginning of the section: ***3.4 Moisture contribution from the sources. Forward analysis.***

"The methodology implemented here is based on the Lagrangian model FLEXPART developed by Stohl and James (2004, 2005). The model allows us to track the parcels backward and forwards. The model outputs were used to compute the gain and loss of humidity along trajectories of air particles leaving and arriving in the CRB. The backward analysis was utilized for the identification of the moisture sources for the CRB and the forward to obtain their climatological moisture supply and the relationship to the precipitation in".

<u>Comment 5.</u>

In lines 15-27 of page 6, you need to understand the difference between streamflow and runoff. Streamflow includes baseflow (the contribution of groundwater) while runoff doesn't. It is not only the lag time because of the routing, but also the contribution of groundwater.

<u>Response 5.</u>

Thank you for clarifying the differences between these concepts. We have rewritten the paragraph like we reproduce below; in this, we changed the word streamflow by discharge and commented the groundwater influence:

"The mean annual discharge of the Congo River is 38617.4 m3 s-1, as calculated from the GRDC monthly discharge values registered at the Kinshasa gauging station in the period 1980-2010. In the secular chronic of the hydro-pluviometric data (1903-2010) recorded at Brazzaville gauge station, close to Kinshasa and analysed by Lareque et al. (2013), the average flow of the Congo River from 1982 to 1994 is below the annual mean, followed by a period of stability from

1995 to 2010. At long-term results of Mahe et al. (2013) pose that as for the equatorial rivers, the Congo river runoff time series (at the Brazzaville station) follows no long-term trend (here these author refers runoff as discharge) and that the minimum shows a lesser inter-annual variability than that of the average or of the maximum.

The annual cycle of discharge (which is very similar to the precipitation and runoff) shows climatological maxima during November-December (Fig. 3) with values above 48000 m3/s, while in July and August the minimum is less than 30000 m3/s. Despite this, a difference is seen during March when high precipitation and runoff occur, but the discharge is low. During the next few months the precipitation and runoff decrease while in contrast the discharge increases, reaching a maximum in May. This lag should reflects the time needed for the surface runoff to reach the river mouth but also the groundwater contribution (Dai and Trenberth, 2002, 2008; Marengo, 2005; Rwetabula et al., 2007; Sear et al., 1999), as documented by Materia et al. (2012) using data recorded at Brazzaville station, about 400 km upstream of the river mouth. The direct relationship between precipitation over the basin and the discharge has a correlation of 0.52, which increases to 0.66 for a one-month lag (both statistically significant at $p<0.05$), confirming the lagged response mentioned earlier. Briquet, (1993) pointed out that a translation of the stability of this hydrological regime is shown by a high (low) frequency of floods occurrence on close dates from one year to the other. Future climate projections (21st century) despite to be uncertain, show a basin average increase in both rainfall and evaporation, but the total increase in rainfall tends to be higher than the increase in evaporation and result in most scenarios the runoff is increasing (Beyene et al., 2013). Nevertheless, for the northern sub-basins of the Oubangui and Sangha Rivers Tshimanga and Hughes (2012) downscaled scenarios in which occur more than 10% decrease in total runoff as a consequence of relatively little increase in rainfall and a consistent increase in potential evapotranspiration".

<u>Comment 6:</u>

Line 15 of page 7: I think you mean east to west.

<u>Response 6:</u>

You are right, thank you. The VIMF is from the east to the west. It has been corrected it in the paper.

<u>Comment 7:</u>

The description of Figure 7 very poor. The analysis is not done in the order of the panels and it is very confusing, and I think including Figure 8 only makes it worse. The take-home message is that the contribution from each source can be completely different from the evaporation from each source. This highlights the importance of the atmospheric circulation in determining the contribution from a particular source. Please streamline this conclusion in the manuscript, make it much shorter, and I recommend deleting Fig 8.

<u>Response 7:</u>

Thank you for your recommendations for this section. We have rewritten completely this section following your suggestions and deleted Fig 8 and his explanation. You can check it in the section:

***3.3 Freshwater evaporation in the sources*.**

An analysis of the evaporation rate over the moisture sources may support our understanding of their role in the moisture uptake for the CRB over the year. It is most important to note that although the mean evaporation over a *region considered to be a moisture source, quantified here using GLEAM and OAFLUX, can be high, its contribution to precipitation over the CRB might not be because it could be providing moisture for precipitation in other target regions as well. The geographical location of the basin allows it to receive moisture from the Atlantic and Indian Oceans, as well from land regions around the basin, as Fig. 6 shows. Oceanic evaporation is highly important if we consider that evaporation from the ocean surface equates to roughly 84% of the total amount of water evaporated from the planet (Oki, 2005), and the role of the oceans is decisive in continental precipitation (Gimeno et al., 2010). The mean annual evaporation from the sources is given in Table 1 using data from OAFlux and GLEAM for the ocean and continental regions, respectively. On average, O4 and O1 are the most evaporative sources while O3 is the least evaporative. Among the continental sources, the most evaporative are C2, CRB and C3.*

Because the sources are located in two different hemispheres, they should have different annual evaporation cycles (Figure 7). From the FLEXPART backward experiment from the CRB, monthly positive values of (E-P)i10 were calculated over each source (hereafter E-FLEX) to compare over the year the average of evaporation over the sources with the moisture average uptake from each source to the CRB. (E-P)>0 can be discounted after (E-P) has been integrated without altering the general patterns of net precipitation, where (E-P)>0 is discounted using a monthly or longer time scale (Castillo et al., 2014). In Figure 7 it is possible to observe both series for comparison, E-GLEAM (evaporation data over continental sources) or E-OAF (for oceanic ones) and E-FLEX. On the African continent, in C1 from May to October (boreal summer) E-GLEAM is higher than E-FLEX, and the opposite takes place in the other months, indicating when this source becomes more efficient in providing moisture to the CRB (gray shaded areas in Fig. 7, C1). The next continental source is C2 which shows the higher land annual evaporative value (Table 1). In this source, the annual cycle of E-GLEAM and E-FLEX differs from C1. Over this region, the E-FLEX values are greater than the local evaporation calculated using the GLEAM dataset during February and from June to October (gray shaded areas in Fig. 7, C2). Despite the local evaporation E-GLEAM does not show any great variations over the year, varying from 2 to 3 mm day-1, the E-FLEX shows a bimodal cycle with a minimum in May (~2 mm day-1) when major local evaporation occurs, and a maximum in August (~4.2 mm day-1) when local evaporation is at its lowest. This behaviour illustrates that it is possible to have moisture available in the atmosphere (higher E-GLEAM values) but less humidity is taken up by air masses and then carried towards our target region (lower values of E-FLEX); in this mechanism the rainfall over the region must play a key role since the E-FLEX could be lowest than E-GLEAM as a result of high P values over the region. The gray shaded areas in Figure 7 indicate those months when the transport of moisture is favoured from the source to the CRB. Over the course of several days an air parcel may undergo multiple cycles of evaporation and precipitation (Sodeman, 2008) and in our case, after integrating monthly data over 10 days it is hardly surprising that the E-FLEX values could be greater than local evaporation. Nevertheless, C2 is a land region, where the recycling concept is most useful because moisture for evaporation is limited by precipitation, whereas over the oceans the surface is clearly wet regardless of whether it rains or not (Trenberth, 1999). The C3 source, separated from C2 by the Congo River mouth, follows a similar annual evaporation cycle to C2, but with lower values (<1 mm day-1) during June-October (Fig. 7, C3). In addition, the E-FLEX values are higher than E-GLEAM in February and July-September. In the months of March-May and November, C3 becomes less efficient at providing moisture to the CRB. For the continental source C4, the annual cycle of local evaporation (E-GLEAM) is similar to C2, C3 but the moisture uptake by air masses tracked backwards from the CRB (E-FLEX) over C4 is always greater than E-GLEAM (unless in February), indicating that this source is very efficient in terms of moisture uptake for the CRB, agreeing with results of van der Ent et al. (2014). For CRB the annual cycle of the E-GLEAM is characterized by maximum values during December-May and minimum in July-August (Fig. 7, CRB). In January-February, April-October, and December, E-FLEX is higher than E-GLEAM, in accordance with the decreasing precipitation over the basin (Fig. 3). This is understandable because the moisture uptake (E-FLEX) over the basin itself must be favoured when the precipitation over it decreases. Comparing the precipitation annual cycle in the CRB (Fig. 3) with E-GLEAM (Fig. 7), it can be seen that both show the same annual cycle, but they show opposite behaviour from E-FLEX (Fig. 7, CRB). This relationship describes a scheme in which the precipitation and evaporation are strongly lineally related; in fact, the evaporation as a source for precipitation over land depends on the availability of surface moisture, which in turn depends upon the disposition of precipitation once it hits the ground (Trenberth, 1999). But, the moisture uptake is the opposite, determining when the source is more effective in providing moisture for itself. This relationship is not strictly interdependent because it could be modulated by moisture income from the other sources or transported outside the boundaries of the target region (the basin).

Regarding the oceanic sources of moisture, in the source O1 the mean annual E-OAF is 4.60 mm day-1. This source is located on the Red Sea, where the oceanic evaporation rate is the highest in the world according to Abdulaziz (2012). After reviewing many studies Sofianos et al. (2002) confirmed several differences in the mean annual evaporation rate for the Red Sea, but it was estimated at around 2.06 m year-1 (~5.6 mm day-1). Figure 7 shows the annual cycle of evaporation (E-OAF) in this source, which is characterised by higher values during the boreal winter months and minimum values in summer, in accordance with Bower and Farrar (2015). Monthly E-FLEX values obtained over this source follow the same annual cycle as E-OAF but with lower values. This means that despite to be a high evaporative source, the moisture uptake from O1 to the air masses in transit to the CRB is less than that which it must provide itself to the atmosphere; converting it into a region that is not efficient in terms of the moisture supply to the CRB. In contrast, it seems an important moisture source during December-February over continental areas to its Northeast and during June-August to the remote area of the Indian Peninsula (Gimeno et al., 2010). Located in the Arabian Sea, the O2 source shows two evaporation peaks during December-January and June, and two minima in April and September (Fig. 7). This cycle was also noted by Sadhuram and Kumar (1987), who showed that the maxima are related to strong winds, and the minima are a result of low wind speeds together with weak vapour pressure across the Arabian Sea. The moisture uptake over this source between April-October is almost insignificant, but the evaporation from OAFlux is greater, which means that this source is not efficient in delivering moisture to the CRB, because during these months it instead contributes to the Indian monsoon (Levine and Turner, 2012). In the Atlantic (O3) has the smallest monthly average evaporation rate among all the oceanic sources throughout the year (<1 mm day-1), showing a negligible annual cycle. Materia et al. (2012) determined that the evaporation rate from the ocean surface is lower due to the fact that part of this oceanic region is affected by the huge freshwater discharge of the Congo River, contributing to a decrease in Sea Surface Salinity (SSS) and Sea Surface Temperature (SST). Despite this, E-FLEX is greater than E-OAF except for during April and May, when the moisture uptake over this source is less than 1 mm day-1. The moisture uptake has two peaks, one in February and the other in September-October. The last oceanic source is O4, the most evaporative and characterized by a maximum average E-OAF in May-July (>5.5 mm day-1) and a minimum at the *beginning and end of the year (Fig. 7, O4). This behaviour is in accordance with the results of Yu et al. (2007), who argued that the enhancement of evaporation occurs primarily during the hemispheric winter (defined as the mean of December–February for the northern hemisphere and June-August for the southern). The positive values of E-FLEX over this source (O4) are lower and quite different from the mean E-OAF during all months. This means that on average this source is not very efficient in supplying moisture to the CRB. The efficiency of a region, providing moisture for precipitation at a target area, depends on the amount of evaporated water that reaches it, and not just on the initial evaporation rate. In this mechanism, we must highlight the importance of the atmospheric circulation patterns in determining the water vapour transport, and also, that moisture uptake from each source can be completely different from the evaporation in it.*

Comment 8:

Figure 10: I would just have two bars, one terrestrial and one oceanic. Then denote the part of the terrestrial bar with the CRB contribution.

Response 8:

We are agreeing. The figure is now changed according to your suggestion.

Comment 9:

Please show statistical significance for Table 3. It is not clear to me that this figure is important for the conclusions in the manuscript.

Response 9.

Dear reviewer, this table shows the significant monthly correlation ($p<0.05$) between the precipitation from CRU, Runoff from ERA-Int, River discharge from the GRDC and evaporation from GLEAM or OAFLUX, and series of |*(E-P)i10<0*| forward-integrated using FLEXPART from the sources over the CRB, and with the total |(E-P)i10<0| amount (T).

In the paper, we represented the percentage of moisture supply from each source to the CRB respect the total *(E-P)<0* income. Besides, with this table, our purpose is to determine the linear relationship between the moisture contribution from the sources and some steps of the hydrological cycle in the CRB. The next paragraph has been improved in the article in order to clarify this analysis:

"In order to analyse the joint linear temporal variability, table 3 shows the significant correlation values obtained between monthly series of evaporation, precipitation, runoff in the CRB, river discharge at Kinshasa gauge station and |*(E-P)i10<0*| *from each source over the CRB and the total* |*(E-P)i10<0*| *from all the sources (T). All the correlation coefficients are positive and statistically significant at 95%, with the exception of that obtained between* |*(E-P)i10<0*| *over the CRB from C2 with the evaporation in the basin and the Congo River discharge at Kinshasa gauge station. As expected, the correlation is greater with precipitation than evaporation as* |*(E-P)i10<0*| *may be associated with rainfall process over the CRB. In most of the cases, the initial correlation values with evaporation and those followed obtained with the rest of variables decrease as a consequence of the lagged response of the hydrological system. This behaviour is best appreciated for the correlation with* |*(E-P)i10<0*| *over the CRB, obtained in the air masses tracked forward in time from the CRB itself and for the Total contribution. In the correlation values shown in Table 3,* |*(E-P)i10<0*| *are best correlated with discharge than with evaporation in the basin, unless for* |*(E-P)i10<0*| *obtained in air masses from O4".*

Comment 10:

Figure 13 doesn't work for me. What (E-P) are you analyzing, over the entire region? Over the CRB? I don't know what the point of this graph is.

Response 10:

In this figure, we use the total *(E-P)i10<0* over the CRB obtained in the forward track from all the sources. It represents the correlation between the total moisture loss over the CRB and the SPEI at different time scales. Also with the runoff and the river discharge at Kinshasa gauge station. This analysis was not done for evaporation and precipitation because they are involved in the calculation of SPEI.

With this analysis, we pretend to identify the months and time scale of the SPEI best correlated with moisture loss. Please consider the text below that we introduced to improve this explanation.

We calculated the monthly correlations between the anomalies of the total moisture influx to the basin |(E-P)i10<0| (summed from all the sources), runoff, and SSI for the 1- to 24- month SPEI time scales (Figure 12) in order to investigate any possible temporal relationships. The significance of the correlation threshold was set at $p<0.05$. The correlations between monthly values of |(E-P)i10<0| and SPEI show significant and high values for all months (Fig. 12a), recorded for short SPEI time scales. The relationship is positive and statistically significant from January to March within the 24 SPEI time scales. During low rainfall climatological months in the basin, especially in June, July and August the correlations become lowest even negative after the SPEI-4.-5 time scales, and generally remain until the last. It indicates a negative feedback that may reflect the increased evapotranspiration modulating the SPEI. As the months advance and the period of less rain ends, the correlations increase being positive and significant during October - December from first SPEI temporal scales until SPEI-10 approximately. In these months for major SPEI, temporal scales correlations become lowest, being also negative as can be appreciated in Figure 12a. However, it changes for January and February when as commented was found positive correlations at all SPEI time scales. This approximately shows a lag of one month needed for the SPEI to reflect wet condition recovery in the CRB.
In Figure 12b the surface runoff seems to be strongly dependent on precipitation deficit for both shorter and annual rainfall deficit. When the rainfall increases over the basin from July to December (Fig. 8), the correlations also increase. Here we observe the same relationship described before between |(E-P)i10<0| and SPEI; but higher correlations were obtained. Correlations between SSI obtained with Kinshasa gauge station discharge and the SPEI (1–24 months) show that the evolution of hydrological conditions is consistent with the meteorological rainfall deficit state over the basin (Figure 12c). In particular, the strongest and most significant correlations were found with SPEI-5 to -7 from January to May, being maximum in April; this suggests the most appropriate time scales to use when identifying the hydrological drought (according to the Congo River discharge at Kinshasa gauge station) in terms of its relationship with the SPEI computed for the whole CRB. From May to July when the precipitation and discharge are minima (Fig. 3) the correlation are negative at first SPEI temporal scales; suggesting a time response of two or three months to reflect SPEI changes at river discharge.