We thank the referee for constructive comments and comprehensive analyses of our manuscript. We have fully addressed the comments. For your convenience, we now provide our point-by-point responses to all the concerns as detailed below. Note that the referee's comments are in italic font (blue), whereas our reply is not italicized and some corrections (red) of the revised manuscript are attached. All figures are placed at the end of text.

Overall comments:

1. *This paper adopts the complex network method [Fan et al., 2017] to find the seasonal relation between the global sea surface temperature anomalies (SSTA) with the rainfall in southwest China (SWC). But comparing the governing equations used in this study to Fan et al. (2017), I feel some modification is done without explanation in the manuscript. In addition, similar (even more advanced) approach and extended application have been presented in quite some studies, e.g. [Liess et al., 2014; Lu et al., 2016]. The authors chose a small region and used a coarse resolution (2.5 X 2.5), which might not work for this approach and the research questions they intended to answer. My understanding is the such complex network needs a vast amount of data to feed, otherwise, the results learnt might be biased. I would suggest the study to extend to a large region to fully utilize that method. Also the authors might want to consider extend their literature reviews on the complex network.*

Response: We thank the referee very much for these useful and important comments. Based on referee #1's comments, we renamed the chosen area as Northwestern South Asia (NWSA) in the revised manuscript, since the chosen area is little larger than Southwest China. Indeed there are some differences between Fan's method and ours. Fan et al., 2017 mainly studied the networks for one variable. Here we constructed networks between two variables: the global SSTA and precipitation anomalies (PA) in NWSA. Moreover, networks for four seasons were considered in our paper. We claimed these in the revised manuscript. We read the useful refs (Liess et al., 2014; Lu et al., 2016) and cited them in the revised manuscript. Their methods are worth to learn. In our paper, the time series for each grid is enough length (39 years) to guarantee unbiased. Moreover, for the SSTA, we considered a large spatial size (global). Actually, Fan et al., 2017 also considered the networks between the El Niño region (small size) and global temperature anomalies (large size). Thus we believe that the network method is also fitting for our study. We carefully extended our literature reviews on the complex network in the revised manuscript.

Corrections:

(Line 47-48) In this paper, we use a multi-variable network method to analyze the relation between the global SSTA and precipitation anomalies (PA) in NWSA for different seasons.

(Line 66-72) We then construct the directionally multi-variable network. Network nodes i and j can be classified into two subsets by two different variables respectively; one subset includes the PA nodes over NWSA and the other includes the global SSTA nodes. We take 3 months for a season in each year, for example June, July and August were selected for summer. Thus for each grid i in SWC, we can obtain 117 months' daily data for 39 years as the PA time series for a season, $X_i(t)$, where t spans those selected days with 9 months gap for each year. Then the corresponding time series of SSTA can be obtained for as $Y_j(t + \tau)$, where τ is a time delay. Note that the corresponding time series of SSTA depends on the time delay and could be not in the same season as the time series of the PA. The cross-correlation function is written as (Fan et al., 2017; Zhang et al., 2019)

(Line 33-46) Some new approaches have been developed to better detect and understand teleconnections in climate (Liess et al., 2014). Such as a complex networks approach has been applied to a wide variety of disciplines in the past decade (Barabasi et al., 1999; Newman et al., 2010; Barrat et al., 2004), which also emerged as a powerful tool to study climate systems (Donges et al., 2009a, b). The geographic sites or grids are taken as network nodes, and linear or nonlinear interactions between the nodes are treated as network edges or links. The strength of the link used to be quantified by a cross-correlation or synchronization et al. (Donges et al., 2009a; Boers et al., 2013). The networks were used to study the teleconnection patterns of the El Niño and North Atlantic Oscillation (Tsonis et al., 2008; Yamasaki et al., 2008; Guez et al., 2013). Applications of complex networks in climate science have improved the understanding of many climate phenomena (Steinhaeuser et al., 2011, 2012; Barreiro et al., 2011; Gong et al., 2008; Fan et al., 2017). The El Niño phenomenon can be predicted one year ahead in advance by using the network method (Ludescher et al., 2013,2014). Some features of air pollution have also been detected by the networks (Zhang et al., 2018, 2019). Recently, the network method provided a great insight into the function of the Rossby waves in creating stable, global-scale dependencies of extreme-rainfall events, and into the potential predictability of associated natural hazards (Boers et al., 2019). Furthermore, extreme precipitation events can be predicted even in long-term scale in some cases by using the networks (Lu et al., 2016; Boers et al., 2014).

2. *The authors chose NHESS to publish their paper; however, I find the scope of the study does not fit well with the journal unless the authors improve their writing to emphasize that. Simply speaking, rainfall in SWC does not necessarily indicate hazards, unless it is extremely – dry or wet.*

Response: We thank the referee very much for this valuable comment. Extremely low and high precipitation is associated with droughts and floods respectively. The correlations between precipitation anomalies (PA) and SSTA may be mainly contributed by extremes. To answer this question, we replaced top and bottom 5% extreme precipitation with the random middle magnitude precipitation in data. Then we analyzed the data by using our method and compared the results with before replacing. Fig. 2 and Fig. 3 show the results. There are big differences between before and after replacing. Most of the correlation patterns disappear in Fig. 2 (b), (d), (f) and (h) after replacing. This indicates that top and bottom 5% extreme precipitation plays important roles to produce the correlation patterns in our study.

Corrections:

(Line 126-130) To further prove that extreme rainfall is significantly influenced by these important regions, top and bottom 5% extreme PA is replaced by the random middle magnitude PA in data. Then we employ the same analysis of the new time series. Fig. 2(b), (d), (f) and (h) shows the results after replacing. Comparing with Fig. 2(a) before replacing, some important nodes disappear in Fig. 2(b) after replacing. Similar results also can be found for other seasons. It implies that top and bottom 5% extreme precipitation plays important roles to contribute to the teleconnection patterns.

Response: We thank the referee for the helpful comment. We did our best to improve the revised manuscript. The figures, methods and discussions were revised based on the referees' comments.

Response: We thank the referee for this kind and valuable comment. We improved the introduction in the revised manuscript by a logical way. In the 1st paragraph, we introduced the importance of NWSA in research fields and explained why we need to study it. In the 2nd paragraph we introduced some research progress on precipitation in NWSA. Then we extended literature reviews on complex networks in the 3rd paragraph. We also removed the disputable statements in the revised manuscript.

Corrections:

(Line 12-19) In recent decades, natural hazards (such as droughts and floods) have occurred frequently in Northwestern South Asia (NWSA) due to climate change, causing a large number of casualties and property losses (Ha et al., 2019; Gao et al., 2017; Wei et al., 2018). In the summer of 2006 and 2011, NWSA suffered from record-breaking droughts events (Zhang et al., 2017). On the other hand, the portion of annual precipitation contributed by extremely heavy precipitation has been found an increasing trend from 1961–2010 in NWSA (Ma et al., 2013). Due to an increasing population and the high risk of natural hazards, NWSA has attracted lots of attention in meteorological research fields. According to CMIP5 multi-model projections, they found that severe and extreme droughts in NWSA increase dramatically in the future, and extremely wet events will also increase (Wang et al., 2014).

(Line 20-32) Droughts and floods can be attributed to precipitation anomalies. A better understanding of precipitation can further improve the underlying mechanisms of droughts and floods in NWSA. Annual precipitation over NWSA did not show a significant decreasing or increasing trend (Qin et al., 2010; Zhang et al., 2017). In fact, the trend of precipitation in NWSA has been found to strongly depend on seasons and locations (Shi et al., 2015; Huang et al., 2014; Ma et al., 2013). Precipitation in NWSA is very difficult to forecast, since it can be influenced by both the East Asian monsoon and Indian monsoon that carry moist air from the Indian Ocean and

Pacific Ocean to this region (Qian et al., 2002; Renhe et al., 2001). Wang et al. (2015) investigated the inter-annual variation of autumn precipitation in NWSA and found the teleconnection between tropical Northwest Pacific sea surface temperature and autumn precipitation in NWSA. Furthermore, autumn precipitation in NWSA experienced a notable wet-to-dry shift in 1994 that could be influenced by the tropical warm pool (Wang et al., 2018). During the drought in NWSA in 2006, the western Pacific subtropical high was abnormally high, which can inhibit the water vapor transport to NWSA resulting in extremely low precipitation (Li et al., 2011). Feng et al. (2014) studied the drought events in NWSA from 1951 to 2010 and found that most of these events were related to the tropical Pacific and North Atlantic sea temperature anomalies.

2. *Line 60: As this study discusses the relation between rainfall and SSTA for four seasons independently, why the authors still need removal of the seasonal cycle of rainfall and SSTA data? Also, in fact, I am not clear how the authors did the removal. Please clarify.*

Response: We thank the referee for the comments. Because we still saw a seasonal trend in the 3-months' time series for non-removal of the seasonal cycle as showed in below Fig. 10, especially for the SSTA. After we detrended it, this seasonal trend can be removed. We explained the details how we did the removal in the revised manuscript.

Corrections:

(Line 60-65) First, we remove the seasonal cycle to obtain the time series of the SSTA as (Fan et al., 2017; Meng et al., 2017),

$$Y^y(t) = \frac{\widetilde{Y}^y(t) - mean\left(\widetilde{Y}(t)\right)}{std\left(\widetilde{Y}(t)\right)}, \qquad (1)$$

where $\widetilde{Y}^y(t)$ is the time series of the daily SST; y stands year and t stands date within a year. "mean" and "std" denote the mean and standard deviation of the SST for all the years on a date t. We use the same way to obtain precipitation anomalies (PA).

3. *Line 75-80: Why should we separate the positive and negative degree? Since the authors only mention that they are different characteristics and display the corresponding regions for positive and negative degrees, but the explanation for the underlying mechanisms of these two degrees is lacking. For instance, in Line 100-110, the authors state that most of the clusters locating in the tropics are reasonable because of the important role of Hayley circulation in moisture transportation. But how does Hayley circulation involve in both positive and negative degrees? The authors need to provide clear explanation otherwise it is difficult for readers to follow. And how do the positive and negative degrees contribute to the rainfall in SWC?*

Response: We thank the referee for the helpful comment. Negative degrees can reflect the information about anti-correlation to be different with that of the positive degrees. Thus we considered them separately. Hayley circulation is a general circulation to connect the equator and non-equator. To be specific, we improved our explanation that the mechanisms are related to the East Asian monsoon and Indian monsoon which can carry moist air from the Indian Ocean and Pacific Ocean to NWSA resulting in extreme precipitation. Some of the clusters in the topics can directly influence on precipitation in NWSA. Other clusters are indirectly connected to NWSA. So the anti-correlation of the SSTA itself between two SSTA areas can result in positive and

negative degrees in the two different places. We improved the explanation in the revised manuscript.

Corrections:

(Line 126-130) Due to the special geographical location of NWSA, both the East Asian monsoon and Indian monsoon can carry moist air from the Indian Ocean and Pacific Ocean to NWSA resulting in extreme precipitation. Thus we suggest that these important out-degree areas and NWSA are connected by the East Asian monsoon and the Indian monsoon. Different features of the monsoon account for the changes of the degree patterns in different seasons.

(Line 135-137) In fact, there are correlations for the SSTA itself between two regions i.e. the SSTA in the east Equatorial Pacific is negative correlated with the SSTA in the west Equatorial Pacific. Such anti-correlations can lead to the positive and negative correlation patterns between the PA in NWSA and SSAT in the two different places.

4. *Lines 82-88: I suggest the authors to clearly state methodology in details in Section 2.2 instead of in the result section. In addition, the authors should pay attention to address the following questions in their revised manuscript: (1) how to obtain the shuffled data? (2) this sentence, "no correlation between the shuffled time series" (Lines 85-86), is quite confusing. Does it mean "no significant autocorrelation for one time series" or "no significant correlation between two different shuffled time series"? (3) it is also unclear why this threshold (i.e., 0.11) is appropriate. At least some sensitive test should be provided to see the effect of choosing 0.11 or close values. It seems that values around 0.1 are all reasonable guess based on Figure 1. Also, I suggest to reorganize the result section into several subsections in line with revised methodology part, in order to have a clearer structure.*

Response: We thank the referee for these valuable comments. We improved the method to obtain shuffled data as Fan et al., (2017) did. We randomly shuffled the order of years, keeping the variations within each year and then calculated the cross-correlation between the shuffled time series. In Fig. 1, we showed the PDF of correlations for the shuffle data comparing with real data. In this shuffling approach, the distribution of values and the autocorrelations in each year have been kept in each shuffled record, and the physical dependencies between nodes tend to be destroyed. If the correlations are significantly higher than the significant threshold, we regarded it as a true link; otherwise, it is suspected to be a spurious link. We obtained the threshold $\Delta = 0.1$ by using the 95% confidence significance test combined with a multiple testing correction (Benjamini-Hochberg). We improved and reorganized the result into three subsections in the revised manuscript: 1. Significance tests, 2. Links and degrees and 3. Important areas.

Corrections:

(Line 99-107) In order to verify the significance of the correlation, we compare the PDFs between the real data (red) and shuffled data (blue) in Fig. 1. We randomly shuffle the order of years for each node, keeping the variations within each year to get shuffle data (Fan et al., 2017). Then we calculate the cross-correlation for shuffled data as same as real data. In this shuffling process, the autocorrelations and common seasonality in each year have been kept in each shuffled time series, while the physical dependencies between the SSTA and PA nodes are destroyed. The PDF of real data in Fig. 1 shows a much slower decay than that of shuffle data with the increased absolute correlation |C| both in the positive and negative parts. If the correlations are significantly higher than the significant threshold Δ, we regard it as a true link; otherwise, it is suspected to be a spurious link as Eq. 3. We obtain the threshold $\Delta = 0.1$ by using

the 95% confidence significance test combining with a multiple testing correction (Benjamini-Hochberg) (Thissen et al., 2002).

5. *Line 88-90: the authors try to verify the significance of the correlation through comparing the PDFs for the real data and shuffled data. However, the difference is not that distinct, with the maximum correlation of the real data only reaching 0.2 compared to 0.1 for the shuffled data. Besides, how is the data being shuffled? Just randomize the whole original time series? Or as done in Fan et al. (2017), the time series is shuffled only in year level and the time ordering within a year is unchanged.*

Response: We thank the referee. Please see above response. The correlation C = 0.1 is already larger than most of the correlations (95%) for shuffle data. Thus the maximum correlation C = 0.2 is very significant.

6. *Figure 2: The maps are too small for the reader to interpret. The same problem is with Figure 3, Figure 6 - 8 (a, c) and Figure 9 (a). In addition, the caption of Figure 2 is not consistent with color bar.*

Response: Thank the referee. We corrected the errors in the revised manuscript.

7. *L99 – 100: Why is the regional size in spring greater than other seasons? I suggest some explanation should be provided. In fact there are many places that the authors only present the observation from figures without extended discussion or explanation. It is very important to provide insights rather than just purely stating patterns that can be seen from the figures.*

Response: We thank the referee for the helpful comment. We suggested that greater regional size in spring could be caused by the El Niño. Most of the influence areas were found in the Pacific. Seeing Fig. 7 (b), (d), the time delay between the west (east) Pacific and SWC is nearly 3 months, since El Niño events probably influence NWSA in MAM according to the monsoon as a mediator three months after the SSTA in the east Pacific reaches to the peak on the December of last year. We extended the discussion in the revised manuscript.

Corrections:

(Line 165-171) For MAM, there are most links between the SSTA and PA in NWSA. The largest cluster size is also larger than other seasons. Figs. 7(a) shows that the cluster C_1 in the western Pacific and C_2 in the Equatorial Atlantic are positively correlated with the nodes I_{11} in MAM. For the negative correlation, we find the clusters C_1 and C_2 in the east Pacific and Indian Ocean (see Figs. 7(c)). Thus most of the correlation patterns come from the Pacific. Moreover, the time delay of the strongest positive and negative link for C_1 are within 100 days shorter than that of DJF, but the strength of links is stronger seeing Figs. 7(b) and (d). Thus we suggest that El Niño events probably influence the PA of I_{11} in MAM three months after the SSTA in the east Pacific reaches to the peak on the December of last year during El Niño. Next winter PA of I_{11} is influenced by the El Nino with nearly one year delay.

8. *Figure 4 and 5: The legend of color bar is missing. The descriptions of these figures are quite confusing (Lines 110 - 119). For instance, C_3 is the grid with the largest value in the Figure 4 (c), then why it is chosen there? As in the manuscript, C_1 to C_4 are selected based on the largest in-degree value (C_1 is consistent with Figure 4, but I am not sure about C_4). The same problem is*

also found in Figure 5 (d) – inconsistent with the manuscript. Authors should clarify their statement carefully.

Response: We thank the referee for the helpful comment. We corrected these and redefined the grid with the largest in-degree as I_x in Figs. 4 and 5 for each season in the revised manuscript.

9. *Similar to Comment # 5: L113 – 115: What are the relationships between the identified nodes spatial patterns and the inhomogeneous spatial distribution of rainfall in SWC? The authors could elaborate more about the spatial distribution of rainfall in SWC.*

Response: Thank the referee very much. We tried to find the relationships between the identified nodes spatial patterns and the spatial distribution of rainfall in NWSA. Unfortunately, there no exits a sensible relation. So we removed this sentence in the revised manuscript. Instead, we suggested that the significant in-degree nodes are dependent on their geographical locations.

Corrections:

(Line 140-144) A lot of nodes within NWSA show a small in-degree value. Only several nodes have strong correlations with the SSTA as shown in Figs. 4 and 5. The distribution of in-degrees is localized and change with seasons. The important nodes with the large in-degree values are almost found in the left- and right- bottom corners of Figs. 4 and 5 which are close to the Indian and west Pacific Ocean respectively. Thus these nodes of NWSA are easier to be influenced by the different monsoons than other nodes in NWSA. Also seasonality of the in-degree could be attributed to the monsoons.

10. *L115 – 118: What are the possible mechanisms that induces the changes of the spatial distributions of identified nodes with seasons? E.g., the joint-effects of terrain and important SSTA nodes.*

Response: We thank the referee for the comment. The possible mechanisms are related to the East Asian monsoon and Indian monsoon. Due to the special geographical location of NWSA, both them can carry moist air from the Indian Ocean and Pacific Ocean to NWSA resulting in extreme precipitation. Different features of the monsoons account for the changes of the degree patterns in different seasons. Also please see above corrections.

Corrections:

(Line 121-125) Due to the special geographical location of NWSA, both the East Asian monsoon and Indian monsoon can carry moist air from the Indian Ocean and Pacific Ocean to NWAS resulting in extreme precipitation. Thus we suggest that these important out-degree areas and SWC are connected by the East Asian monsoon and Indian monsoon (Zhao et al., 2009; Gong et al., 2018; Zhang et al., 2017; Feng et al., 2014). Different features of the monsoons account for the changes of the degree patterns in different seasons.

11. *L118 – 119: The sentence may be inappropriate, please rewrite it. Since one node of SSTA may positively and negatively correlate with different nodes in SWC.*

Response: We thank the referee very much. We rewrote it as below.

(Line 144-146) Furthermore, the largest positive and negative weighted in-degree nodes are same for MAM (see Figs. 4(b) and 5(b)). This indicates that this node is positively (negatively) correlated with the most SSTA areas.

12. *Lines 121-125: A significant test for correlations much be done, as the absolute values of correlation in Figure 6 (b, d) is only around 0.1. With all these very weak correlation values, I cannot be convinced by the statement such as "a high daily SSTA in East Equatorial Pacific is probably observed ... in SWC". The same problem is also found in the discussion for different nodes (Lines 135-144). And the color bars of Figure 6, 7, 8 (a, c) and Figure 9 (a) are incomplete.*

Response: We thank the referee for the comment. We already did the significance tests as addressed in comment #4. We also replaced to show Figures 6-9 (b, d) by using the strongest links that are clear. The color bars were corrected.

13. *Figure 6 a&c: I think there are better ways to select critical SSTA regions, rather than just simply comparing Figure 2 and Figure 3. I think the authors could utilize more advanced method (e.g. in [Kawale, 2013; Lu et al., 2016])*

Response: We thank the referee for the helpful comment. We read and use the mentioned method [Kawale, 2013; Lu et al., 2016] to identity clusters. In section 3.3 of the revised manuscript, we identified the two largest cluster for the SSTA areas connected to the important node in NWSA.

Corrections:

(Line 149-153) We first select the nodes in NWSA with the largest weighted in-degree for each season as showed in Figs. 4 and 5. The largest cluster C_1 is identified by the largest successive area where all the inside SSTA nodes are connected to that important node in NWSA (Kawale, 2013; Lu et al., 2016). We can obtain the second largest cluster C_2 in a similar way. Figs. 6(a) shows the cluster C_1 (blue) and C_2 (green) which are connected to the nodes of I_{11} (as shown in Fig. 4(a)) for DJF.

14. *L141 – 144: Can the authors provide the links between nodes C_2, C_3 and the SSTA nodes for both MAM and JJA. Because both C_2 and C_3 are important nodes in spring and summer based on figures 4 and 5. The authors should explain more if the SSTA nodes affecting C_2 are different with the nodes affecting C_3 in spring or summer.*

Response: We thank the referee for the valuable comment. Note that we renamed the nodes C_2 as I_{11} and C_3 as I_{31} in the revised manuscript. In below Fig. 11, we provided the SSTA nodes which are connected to I_{11} and I_{31} for MAM and JJA respectively. Interestingly, we found that the connected SSTA areas of I_{11} and I_{31} are very different in MAM for the positive correlation. (see Fig. 11 (a) and Fig. (e)). I_{11} is linked to the west Pacific, but I_{31} is linked to the east Pacific and the Indian ocean. The big differences are also observed for the negative correlation (in Fig. 11(c), (g)) and in JJA (Fig. 11(b), (d), (f), (h)), although the distance between I_{11} and I_{31} is not long. We have not yet fully understood the mechanism. But we thought that the mechanism should be related to the special climate in NWSA. There are high mountains between the two places leading to the non-similarity. And the places could be controlled by the different monsoon systems.

15. *Conclusion part: This section is only a brief summary of the study. The authors are expected to provide an in-depth discussion from the physical perspective, like potential mechanism, instead of just listing some related results from previous studies. I do not see any contribution from this study from reading the conclusion part.*

Response: We thank the referee for the valuable comment. We improved our conclusion part as follows.

Corrections:

(Line 178-185) In summary, we employ a multi-variable complex network method to study the teleconnection between the SSTA and PA in NWSA. We show the most teleconnection links in spring, followed by winter. There are less links in summer and autumn. The El Niño could cause the stronger teleconnections in spring. According to the weighted out-degree of the network, we show that the positive and negative correlation patterns over the world are mainly contributed by the extreme PA in NWSA. Moreover, We find that most of the out-degree patterns emerge in the Equatorial Indian, Pacific and Atlantic Oceans. The mechanisms are related to the East Asian and Indian monsoons for the Equatorial Indian and Pacific Oceans. For the Atlantic, long-range planetary waves account for the teleconnections. Due to seasonality of the monsoons, we also find that the out-degree patterns significantly change with season.

(Line 186-192) According to the weighted in-degree in NWSA, we find that the teleconnections are dominated by the several specific nodes within NWSA. These nodes are closer to the oceans than other nodes. Thus we focus on the important nodes in NWSA to obtain the two largest clusters which are both connected to one of the important nodes in NWSA. The time delay between the cluster and the node in NWSA is given by the strongest link. We find that the largest cluster in the east Pacific for the node I_{11} in NWSA could be related to the El Niño with the time delays −230 and −79 days for DJF and MAM respectively. These results could be useful to improve the prediction of rainfall in NWSA. In future work, we will focus on the prediction based on these observed teleconnections.

16. *When I read the abstract (Lines 9-10), I got interested in the study because the authors claimed that "the time-lag of the teleconnection links ... prediction of rainfall in SWC". After I read this manuscript, I do not see how this study could achieve this, the authors should provide related analysis or discussion to support how this study can improve the rainfall prediction.*

Response: We thank the referee very much. Rainfall prediction in NWSA is a very difficult issue. It will be very important even for a small progress. In the present study, we cannot claim that we improved the prediction. But the time delays between important SSTA areas and NWSA could be helpful to improve the prediction. Previous studies for NWSA didn't show these. In further study, we will focus on the prediction based on these results.

Corrections:

Abstract: Droughts and floods have frequently occurred in Northwestern South Asia (NWSA) in this century. The mechanism of precipitation in NWSA is quite complicated, since the East Asian monsoon, Indian monsoon and et al. potentially influence the rainfall in this region. Prediction of precipitation in NWSA has become a difficult and critical topic in climatology study. Thus we here develop a novel multi-variable network method to delineate the relations between the global sea surface temperature anomalies (SSTA) and the precipitation anomalies (PA) in NWSA. Our results show the important out-degree patterns in the Pacific, Atlantic and Indian Ocean, which significantly influence the PA in NWSA. Particularly most of the patterns are caused by extreme

precipitation and change with the season. Furthermore, the in-degree patterns indicate that the teleconnections are dominated by several important nodes within NWSA. According to study these nodes in NWSA, we find that the SSTA areas influence the nodes in NWSA with some specific time delays (more than 50 days) that could be helpful to improve long-term prediction of precipitation in NWSA.

Some minor issues:
1. L128: I suggest removing ", which has been closed to the limit of the time lag" unless the authors can evaluate the significance of it.

Response: We thank the referee for the helpful comment. We did it and extended the range of the time lag (see Fig 6-9) in the revised manuscript.
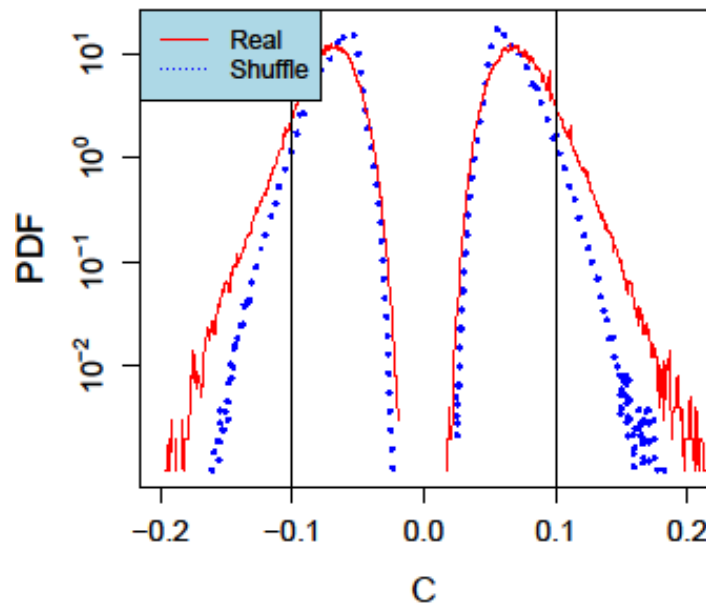
Figure 1. (Color online) PDFs of correlations C_{ij} for real data and shuffle data. Black vertical lines represent the location of the threshold $|\Delta| = 0.1$.
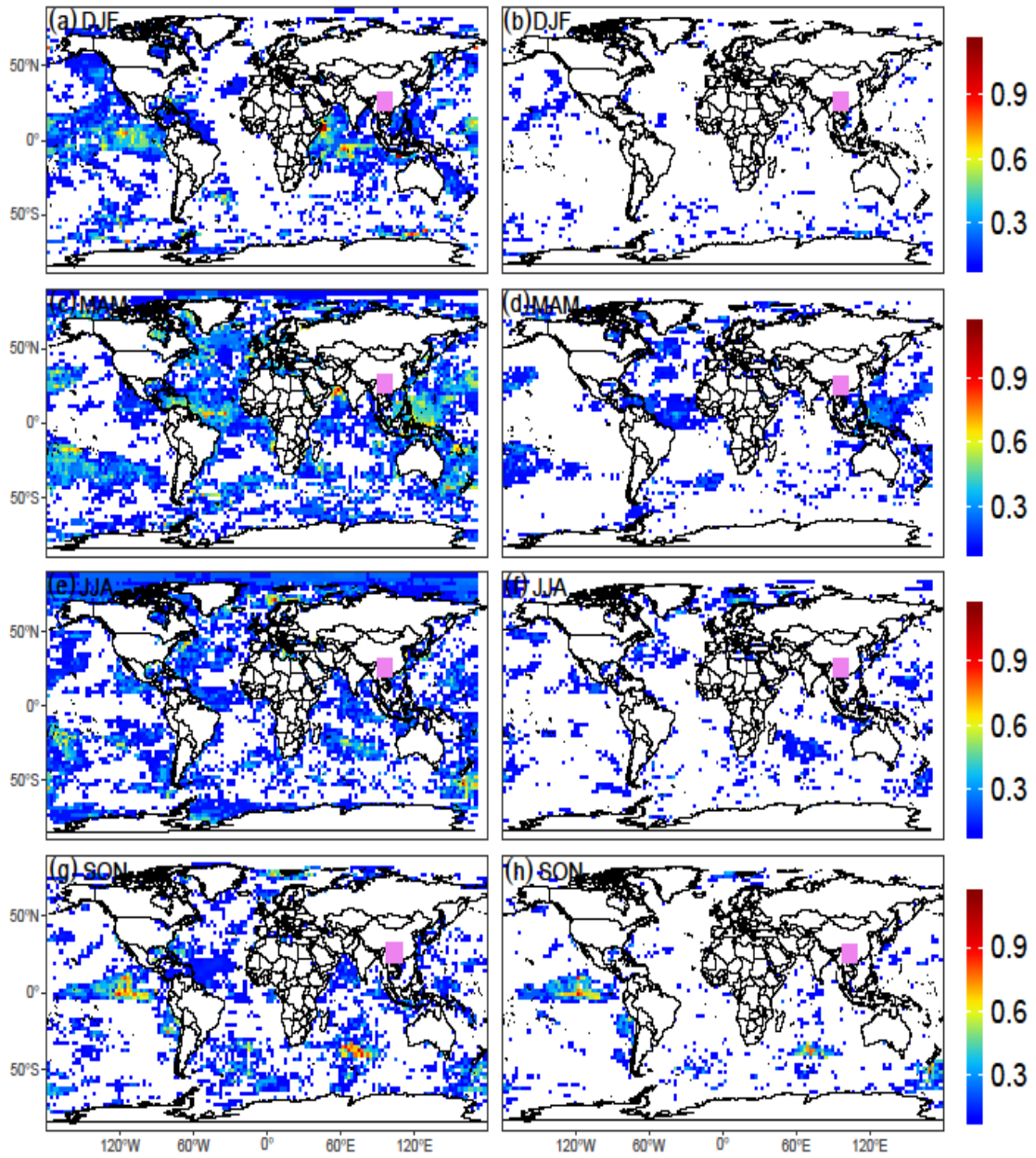
Figure 2. (Color online) Distributions of the positive weighted out-degree for (a) DJF, (c) MAM, (e) JJA and (h) SON. (b), (d), (f) and (h) Same as (a), (c), (e) and (h) but for replacing top and bottom 5% extreme precipitation with middle magnitude precipitation in data. White areas represent zero in maps. Purple rectangle area covers the region of NWSA.
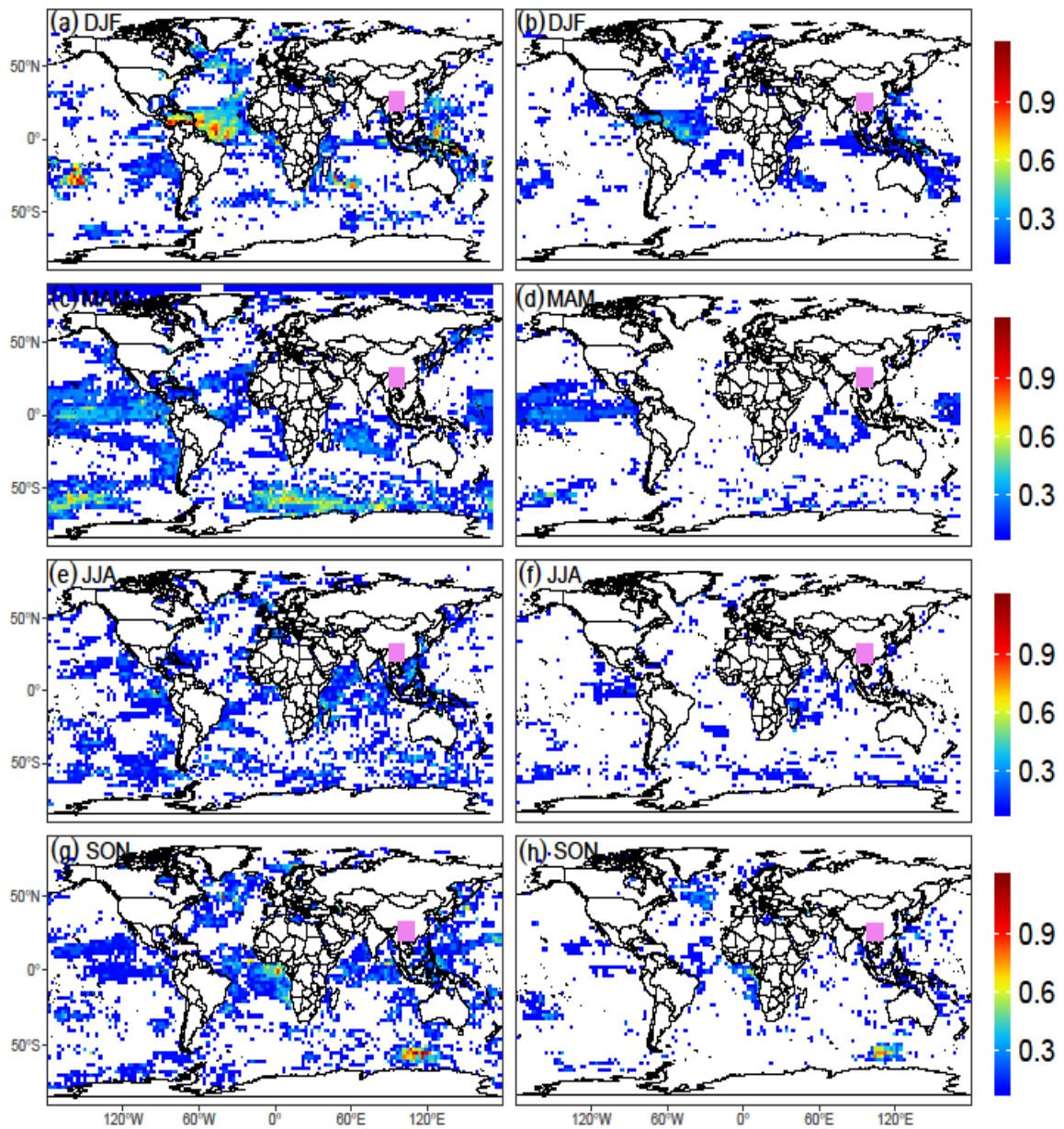
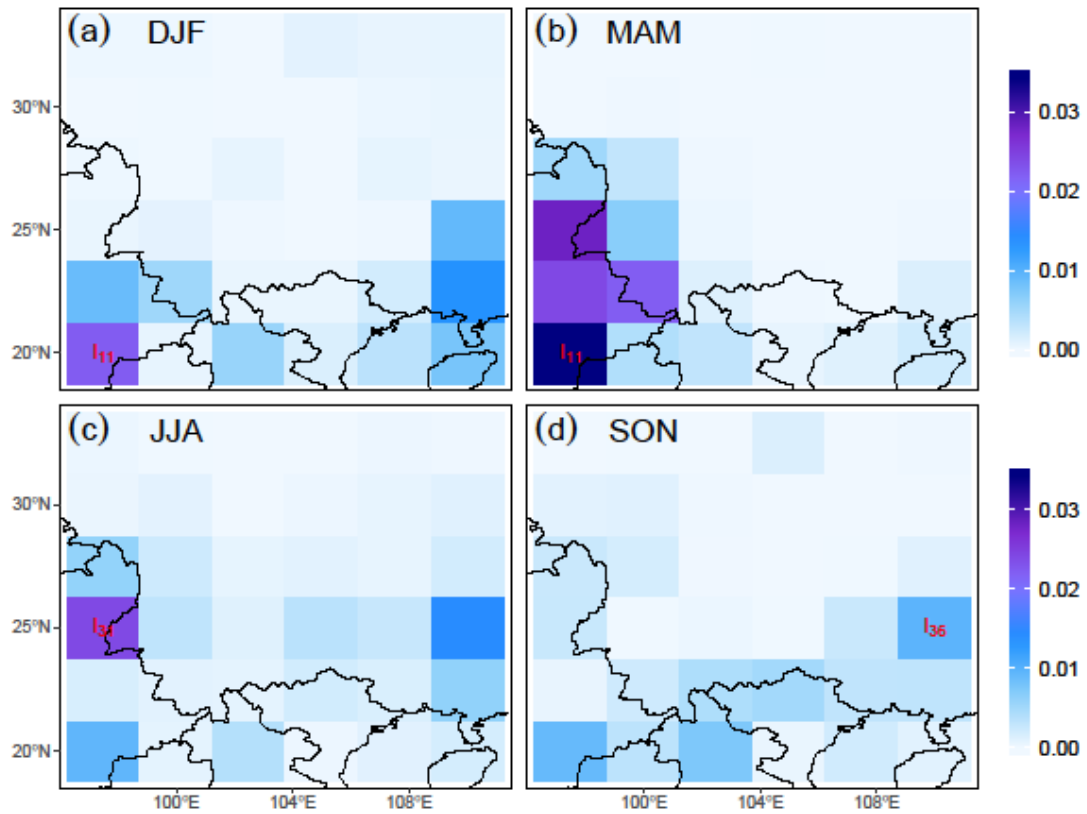**Figure 3.** Same as Fig. 2 but for the negative weighted out-degree.

Figure 4. (Color online) Distributions of the positive weighted in-degrees for (a) DJF, (b) MAM, (c) JJA and (d) SON in SWC. The location of NWSA in the world is shown as the purple rectangle area in Fig. 2. I_{11}, I_{31} and I_{36} are the important nodes in NWSA with the largest positive weighted in-degree in a season.
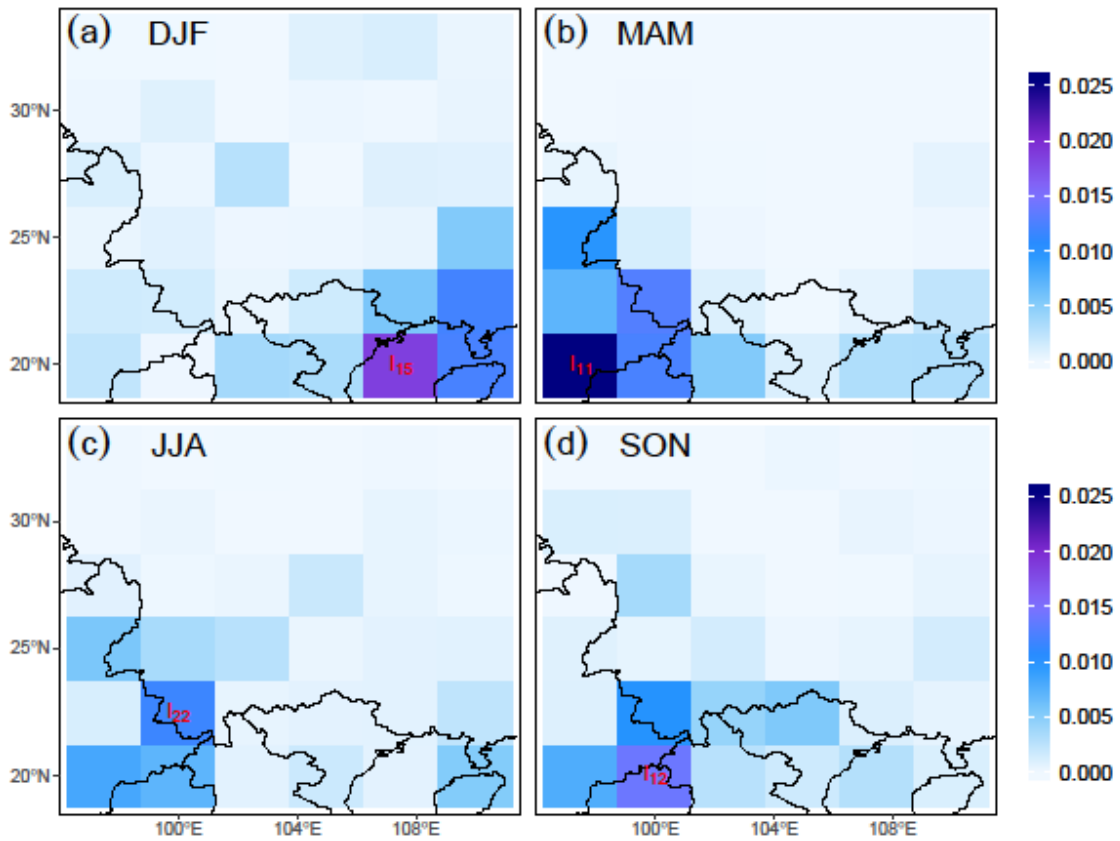
Figure 5. (Color online) Same as FIG. 4 but for the negative weighted out-degree. I_{15}, I_{11}, I_{22} and I_{12} are the important nodes in NWSA with the largest negative weighted in-degree in a season.
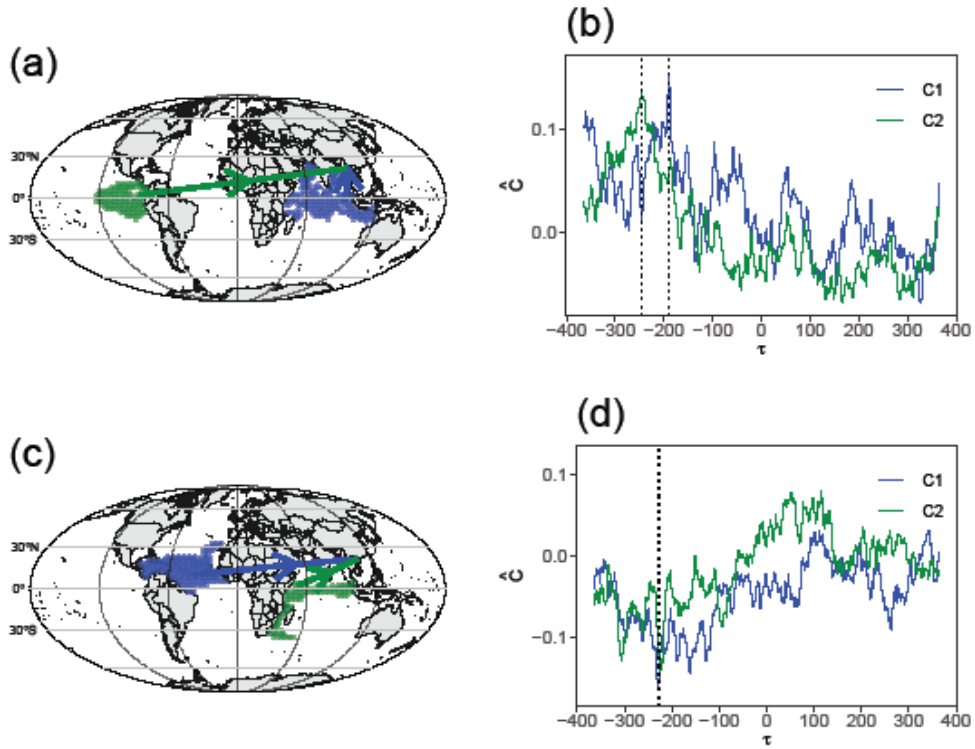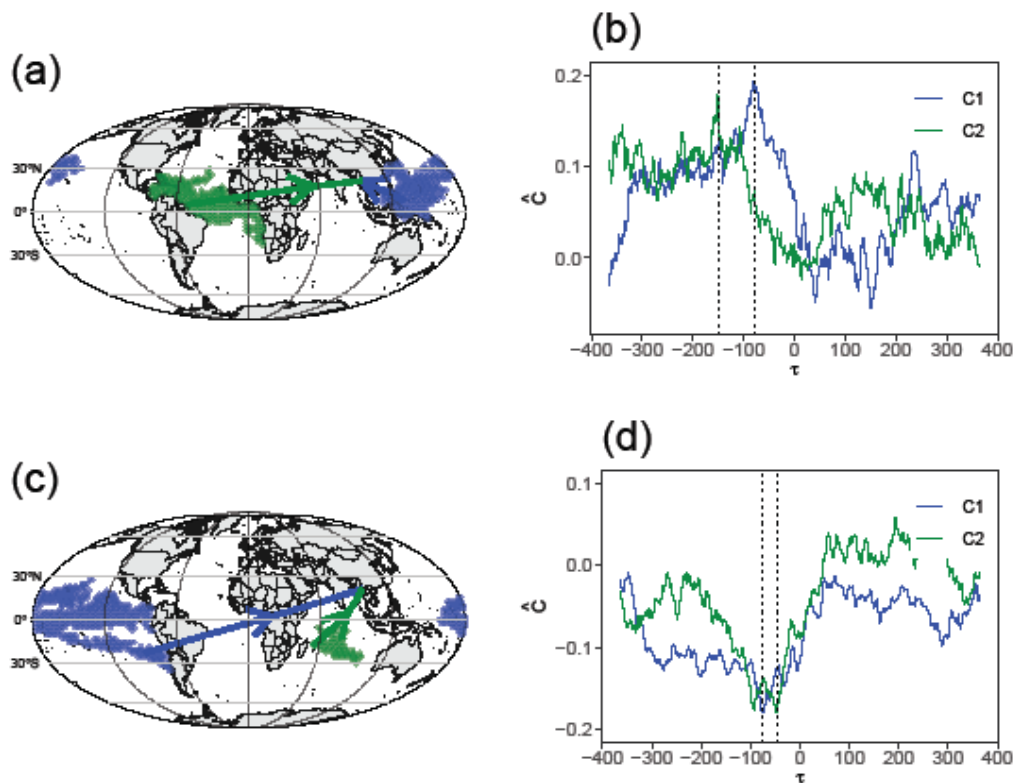
Figure 6. (Color online) Locations of the largest cluster C_1 (blue) and the second largest cluster C_2 (green) that are (a) positively ((c) negatively) correlated with the node $.I_{11}$, (I_{15}) in NWSA for DJF. The blue and green arrows represent the strongest links from C_1 and C_2 to that node in NWSA respectively. (b), (d) The correlation $\hat{C}$ as a function of the time lag τ corresponding to the strongest links in map (left) respectively. Dashed black line shows the absolute maximum of the correlation $\hat{C}$.

Figure 7. (Color online) Locations of the largest cluster C_1 (blue) and the second largest cluster C_2 (green) that are (a) positively ((c) negatively) correlated with the node I_{11} (I_{11}) in NWSA for MAM. Everything else is the same as Fig. 6.
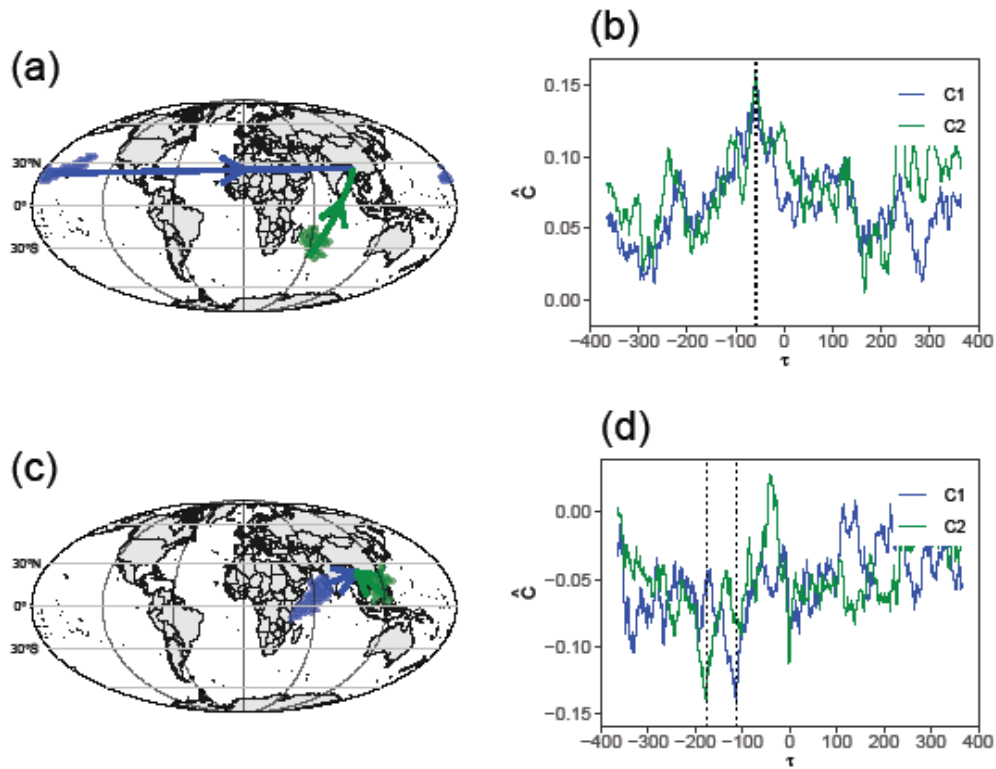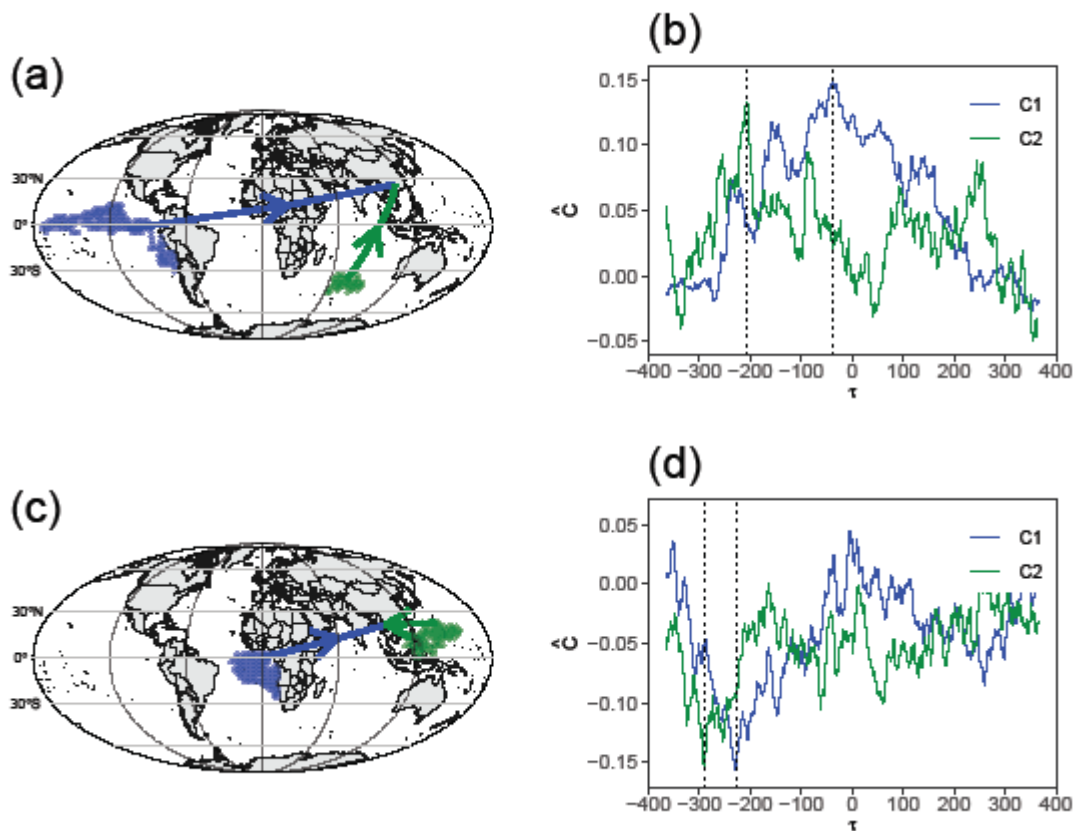
Figure 8. (Color online) Locations of the largest cluster C_1 (blue) and the second largest cluster C_2 (green) that are (a) positively ((c) negatively) correlated with the node I_{31} (I_{22}) in NWSA for JJA. Everything else is the same as Fig. 6.

Figure 9. (Color online) Locations of the largest cluster C_1 (blue) and the second largest cluster C_2 (green) that are (a) positively ((c) negatively) correlated with the node I_{36} (I_{12}) in NWSA for SON. Everything else is the same as Fig. 6.
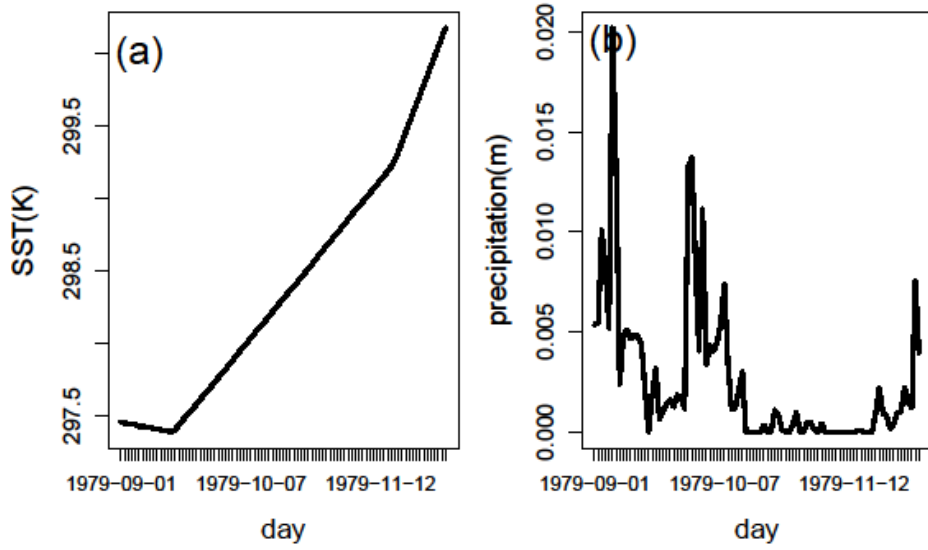
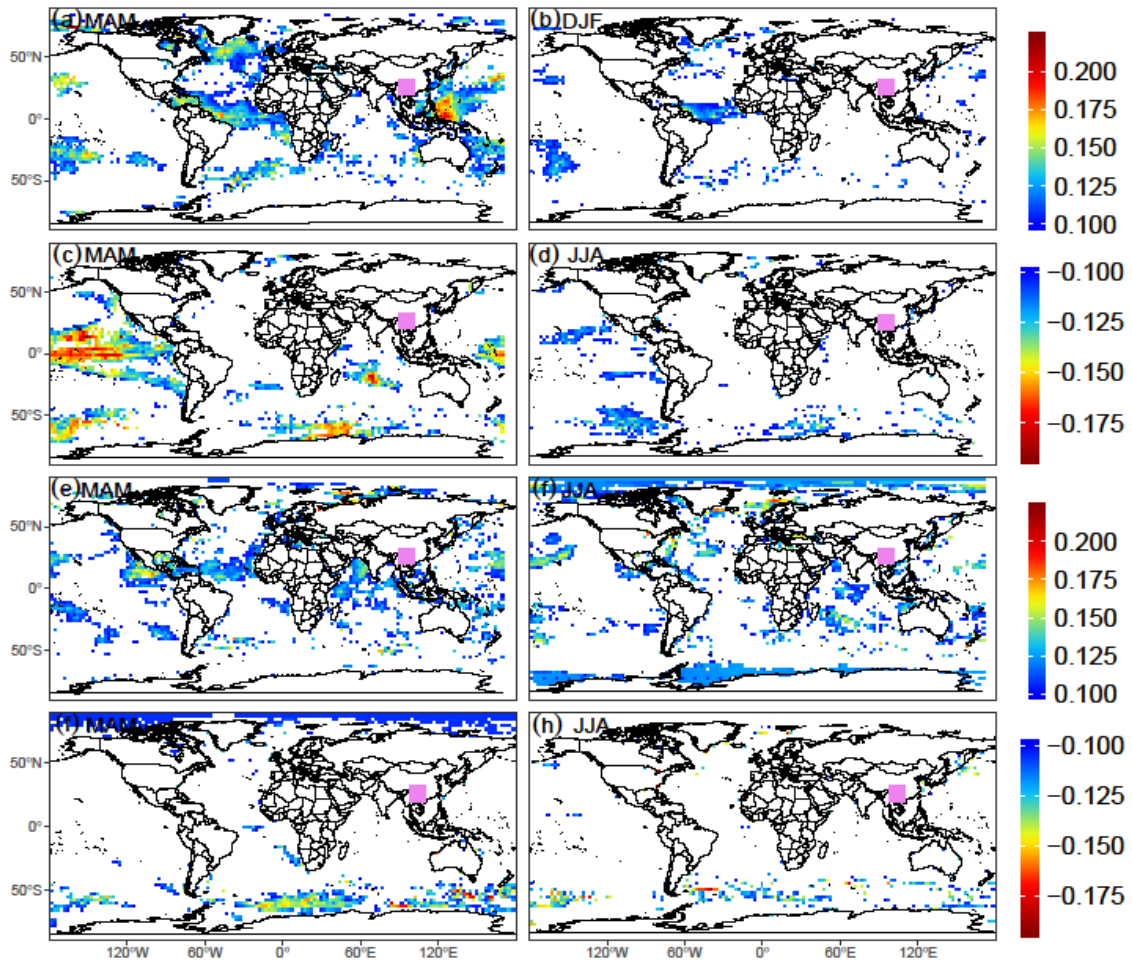**Figure 10.** The non-detrended time series of (a) the SSTA and (b) PA in 3 months.

Figure 11. (Color online) The SSTA areas which are connected to the nodes I_{11} (a-d) and I_{31} (e-f) in MAM and JJA respectively. Color bars represent the correlations of the links.