Responses to the comments of referee 2

The comments from referee 2	Responses	Changes in the manuscript
1. Convincing evidences are required to support the authors' view.	Accepted	Some contents were added as the suggestion. **Pg9 lines 210-214:** 'We examined possible relationships between the first principal component and the Indian monsoon indices by calculating their lag correlation coefficient and corresponding 95% confidence level based on Monte Carlo Hypothesis testing (table 2). The lag correlation coefficient of the first principal component with the Indian monsoon indices is 0.828, much larger than the 95% confidence level of 0.223, and change of the first principal component lags that of India monsoon indices by one month. Obviously, there is significant correlation between them'. **Pg10 lines 237-241:** 'Similarly, we also examined possible relationships between the second principal component and El Niño by calculating their correlation coefficient and corresponding 95% confidence level based on Monte Carlo hypothesis testing (table 2). Their correlation coefficient is 0.302, nearly twice as large as the 95% confidence level of 0.167. Change of the second principal component lags that of El Niño by one month. The test result shows a strong correlation between them'. **Pg13 lines 303-305:** 'On the other hand, the inland Plateau, especially the western part of Qiangtang plateau and Kunlun mountains area, is also influenced by the westerlies and La Niña phenomenon (Figure 5a), which further create the meteorological conditions for rain and snow'. **Pg13 lines 310 - Pg14 line 350:** 'The trend of mass balance change from GRACE data shows that the most negative signal is along the Himalayas and northwestern India. The mass reduction rate of glaciers in the

		entire Himalaya mountain region is 14 Gt yr^{-1}, and the mass loss of glaciers in the eastern Himalayas was the most dramatic, with the rate of -4.6 Gt yr^{-1} in A area and -4.1 Gt yr^{-1} in B area. The mass reduction rate in northwestern India (H area) was −13.6 Gt yr^{-1}, whereas Rodell et al. (2009) and Yi et al. (2014) gave larger values of −17.7 Gt yr^{-1} and −20.2 Gt yr^{-1}, respectively. The reason for this discrepancy is that Rodell et al. (2009) used the data of the RL04 version. Yi and Sun (2014) stated that the RL04 solutions tend to overestimate the glacier melt rate in the Himalayas by as much as 17%. The difference between our results and those of Yi and Sun (2014) is because they used the mascon inverse method in a concise form. Moreover, the filtering method may somewhat attenuate the signal. Yao et al. (2012), after investigating the glacial change over the past 30 years, reported that the Himalayas shows the most extreme glacial shrinkage based on the reduction both of glacier length and area, the shrinkage is most significant in the southeastern QTP (A area), where the length decreased at a rate of 48.2 m yr^{-1} and the area was reduced at a rate of 0.57% yr^{-1} during the 1970s-2000s, and the most negative mass balances occurred along the Himalayas, ranging from -1100 to -760mm yr^{-1}. This trend of mass change along the Himalayas is consistent with our result. They attribute this change to the weakened Indian monsoon towards the interior of the plateau. Thakuri et al. (2014) examined glacier changes on the south slope of Mt. Everest from 1962 to 2011 (400 km^2) using optical satellite imagery and concluded that the observed glaciers shrinkage, upward shift of snowline altitudes, and the negative mass balance (Nuimura et al., 2012) is not only due to warming temperatures, but also as a result of weakened Asian monsoons registered over the last few decades. Bolch et al. (2011) examined the mass change of glaciers on Mt. Everest, Nepal using stereo Corona spy imagery (years 1962 and 1970), aerial images, and recent high resolution satellite data (Cartosat-1), founding that glaciers south of Mt. Everest had continuously lost mass from 1970 through 2007, with a possibly increasing rate in recent years. Wagnon et al. (2013) arrived at the same conclusion. They also indicated that glacier shrinkage south of Mt. Everest was less than that of others in the western and eastern Himalaya and southern and eastern Tibetan Plateau.

		Recently, Salerno et al. (2015) analyzed the precipitation time series during 1994-2013 reconstructed from seven stations located between 2660 and 5600 m a.s.l. They found that precipitation even decreased 47% during the monsoon period and the snowfall decreased 10% in the last 20 years. Salerno et al. (2016) extended this analysis to even the first 1960s and for all regions used, as proxy of the precipitation trend, the surface area variation of glacial lakes. These authors inferred an increase in precipitation occurred until the mid-1990s followed by a decrease until recent years in all Mt. Everest regions. Studies using different types of data arrived to the same results: i.e. negative mass balances and weakened Indian monsoon along Himalayas. Our results support this conclusion, the results of CPCA analysis indicate that mass change on the Himalayas and its southern portion are associated with the Indian monsoon climate, and the intensity of this monsoon is weakening. This result is also consistent with the conclusions of Wu (2005). A weakened Indian monsoon brings less humid air to the study region, causing interannual rainfall decreases, (Thakuri et al., 2014; Salerno et al., 2015, 2016). The GPCP rainfall data confirms this conclusion. The eastern Himalayas are also affected by El Niño (figure 4a) and East Asian monsoons, and no evidence supporting the role of westerlies (figure 5a) in driving local climate and glacier changes. Glaciers in this area are of a marine type, whose mass has large inputs and outputs and is strongly affected by changes of marine climate. The weakened Indian monsoon, strengthening El Niño and westerlies, combined with the huge topographic landform, exert climatic controls on the distribution of existing glaciers along all Himalayas regions and bring more less precipitation to there.'. **Pg14 line 352 - Pg 15 line 371:** 'Archer et al. (2004) indicated that the western Hindu-Kush Karakoram is largely exposed to the arrival of westerly midlatitude perturbations bringing precipitation during winter and early spring, whereas the eastern Himalaya is dominated by summer monsoon precipitation (Syed et al. 2006; Yadav et al. 2012). There is little difference between their results and ours. The results of CPCA indicate that the eastern Himalaya is under the influence of weakened Indian monsoon and El Niño, while the Hindu-Kush Karakoram

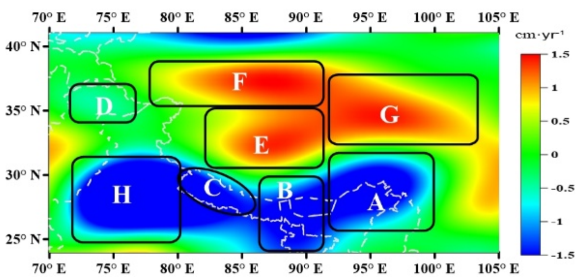
		area is under the influence of a weaken Indian monsoon, westerlies and La Niña. Thompson et al. (2000) examined the variability of the South Asian monsoon by analyzing ice core records of Dasuopu glacier on the QTP, finding evidence of drought conditions and a weakened monsoon from 1780 to 1810. Interestingly, according to historical recorders, at least 600,000 people died in 1972 in just one region of northern India from an epic drought associated with this event. The onset of this event in the Dasuopu cores is concurrent with a very strong El Niño–Southern Oscillation (ENSO) of 1790-1793, which was followed by a moderate ENSO event of 1794-1797 as documented. These data suggest an association between ENSO and weakened Asian monsoon. Studies have suggested that Arctic amplification may impact mid-latitude weather patterns and extremes (Francis et al., 2012; Screen et al., 2013), and mid-latitude westerlies may drive climate variation and glacier variability in monsoon affected areas of High Asia (Thomas et al., 2014). On large spatial scales, climate change over the QTP may also be teleconnected with hemispheric or global atmospheric circulations including North Atlantic Oscillation (NAO) and ENSO (Wang et al., 2003). Some literature suggests that ENSO influences climate over the southern QTP through a link with the Indian monsoon (Xu et al., 2010; Xu et al., 2011). The NAO is associated with climate fluctuations over the northern QTP through modulation of the westerlies (Wang et al., 2003; Xu et al., 2010), which is similar to climate change from the westerlies and La Niña in the third principal component'. **Pg15 line 378 – Pg16 line 396:** 'The two atmospheric circulation patterns, combined with the huge topographic landform, exert climatic controls on the distribution of existing glaciers. The East Asian monsoon only affects glaciers on the eastern margin, such as the Mingya Gongga and those in the eastern Qilian Mountains. They believed that the interior of the QTP is dominated more by continental climatic conditions, and the sparse glacier distribution and higher ELAs in the continental-climate-dominated interior are consequences of a limited water-vapor source from both those air masses. They divided glaciers of the Tibet Plateau into seven regions and categorized them

into three climatic transects: transect 1, southwest-northeast oriented (middle Himalaya-Qiangtang Plateau-eastern Qinghai Plateau), with the weakened Indian monsoon influence northward; transect 2, southeast-northwest oriented (eastern Himalayas-Qiangtang Plateau-Pamirs), with the weakened Indian monsoon toward the interior and strengthening westerlies toward the northwest; and transect 3, along the Himalayas, with stronger monsoon influence in the east and weaker monsoon influence in the west.

To some extent, we support this type of classification. From results of the CPCA, the first spatial mode clearly shows that the mass balance of the Himalayas-Pamirs-northwestern India (transect 3) was the most sensitive to climate change associated with the Indian monsoon, whereas the impact of that change on mass balance of the inland plateau was not very sensitive. The third spatial mode shows that mass balance of the northwest plateau, including all the Kunlun mountains (not only the Pamirs and its eastern portion), is also affected by climate change from the westerlies and La Niña. Another difference between the results of Yao et al. (2012) and ours is that climate change from El Niño rather than the weakened Indian monsoon toward the interior affected mass balance along transect 2, because we found that the time evolution of the second principal component and El Niño index had a stronger time-frequency correlation'.

Pg16 lines 401 - line 410:

'Recently, Ke et al.(2017) examined area and thickness change of glaciers in the Dongkemadi (DKMD) region of the central QTP using Landsat images from 1976 to 2013 and satellite altimetry data from 2003–2008. They then analyzed relationships between glacier variation and local and macroscale climate factors based on various remote sensing and reanalysis data. Their results suggest that glacier change in the DKMD region was dominated by the variation of mean annual temperature, and was influenced by the state of the NAO over the past 38 years. The mechanism linking climate variability over the central QTP and state of the NAO is most likely via changes in strength of the westerlies and Siberian High. In addition, ENSO may have been associated with extreme weather (snowstorms) in October 1986 and 2000 which might have led to substantial glacier expansion in the following years. It is noteworthy that the DKMD is located

		on the eastern Qiangtang Plateau (the center of transect 2), where area mass balance change is the most sensitive to El Niño in our results.’**.** **Pg17 lines 416 - 419:** ‘The Indian monsoon mainly affects mass balance change on southern and southwestern QTP, whereas El Niño mainly modifies that change over the eastern Himalayans, Qiangtang Plateau, Pamirs and eastern Qinghai Plateau area. Mass balance over the western and northwestern QTP is mainly affected by the westerlies and La Niña.’.
2. How was the mass balance obtained in Figure 2?	Accepted	We supplemented the relevant information in the revised manuscript and redrew Figure 2. **Revised on Pg8 line 180-185:** ‘A regional 1° × 1° gridded (24° - 45°N , 70°-105°E) surface mass change field (in units of equivalent water height) was calculated from each GRACE spherical harmonic solutions following Equations (1). Then, we filtered each surface mass change field using the smoothness priors method (Tarvainen et al., 2002; Zhan et al., 2015) and interpolated missing data using a spline function at each grid point. Finally, GRACE mass rate was estimated at each grid point using the least squares to fit a linear trend, plus annual and semiannual sinusoids to GRACE-derived mass change time series’. **The figure 2 was redrew and the trend scale was added.**  Figure 2 Trend of mass balance in and around Tibetan Plateau. (A)Eastern Himalaya,(B)central Himalaya, (C)western Himalaya, (D)Pamirs, (E) Qiangtang plateau,(F)Kunlun mountain,(G)Qinghai plateau, (H) northwestern India.

3. Why choose the smoothness priors method for filtering? The authors should explain more.	Accepted	Before applying the CPCA, we have filtered each surface mass change field using the smoothness priors method (Tarvainen et al.,2002) and interpolated missing data with a spline function at each grid point. We compared this filter with classical filters such as the Gaussian, Correlated-Error and combined filters (Gaussian with 300-km smoothing + Correlated-Error) in Zhan et al(2015). That work describes how the smoothness priors method works in removing noise in GRACE data, and compared the results of this filter with that of the Gaussian smoother, Correlated-Error filtering, and combined filter (Gaussian smoother + decorrelation filtering) with “actual signals”. The results show that the smoothness priors method has the advantages of less reduction of signal amplitude at high latitude, retention of greater detail of short-wavelength components in the result, and less signal distortion at low latitude. Moreover, grid statistical results of the filtered field show that results of that method are the most similar to the actual minimum, maximum and RMS values of the original field. Please refer to Figures 1 and 2 and Table 1 listed below. Figure 1a shows a numerical model simulation of mass change trend (as a ‘true’ signal), Figure 1b the simulation of a stripe noise model, and Figure 1c the synthesized signal of mass change trend from adding the data of Figure 1a and b. we then converted the field of Figure 1c into normalized spherical harmonic coefficients, to degree and order 60. Finally, we applied the smoothness priors method, Gaussian filter, correlated error filter, and combined filter to the synthesized signal. Figure 2 shows the results of different filters. From these results, we can see that the outcome of the smoothness priors method (Figure 2d) has the advantages of less reduction in signal amplitude at high latitude, preservation of greater detail of short-wavelength components in the result, and less signal distortion at low latitude. Table 1 lists grid statistical results of the numerical model of mass change (Figure 1a) and filtering results of mass change (Figure 2) from applying different filters in the synthetic mass change model. The grid statistical results of the filtered field show that the output of smoothness priors method is the most similar to the actual minimum, maximum and RMS

values of the original field (Figure 1a).

We supplemented this information on **P4 lines 105-Pg5 line110** and Zhan et al (2015) on **P22 lines 541-542** in the revised manuscript. Thank you for the suggestions.

Revised on Pg4 line 105- Pg5 line110:

'Compared with the Gaussian filter, Correlated-Error filter and the combined filter (Gaussian with 300 km smoothing + Correlated-Error), the smoothness priors method has advantages of less reduction in signal amplitude at high latitude, preservation of greater detail for short-wavelength components in the result and less signal distortion at low latitude. Moreover, grid statistical results of the filtered field show that the result of smoothness priors method is the most similar to the actual in the minimum, maximum and the RMS values of the original field (Zhan. et al.,2015).'

And the literature was supplemented:

Pg24 line 601-602:

'Zhan, J.G., Wang Y., Shi H.L., Chai H., Zhu C.D.: Removing correlative errors in GRACE data by the smoothness priors method, Chinese J. Geophysics, 58(4): 1135-1144, 2015.'

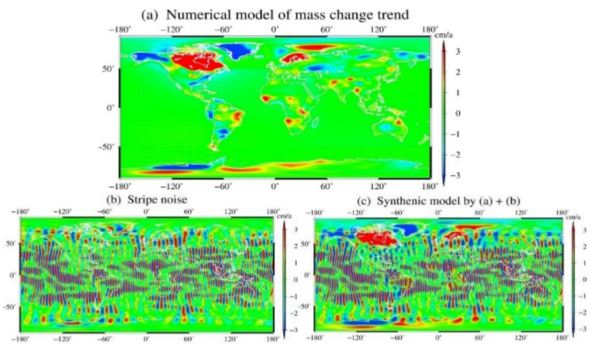


Figure 1. (a) The numerical model of mass change trend, (b) the stripe noise model; (c) synthetic model by (a) + (b).

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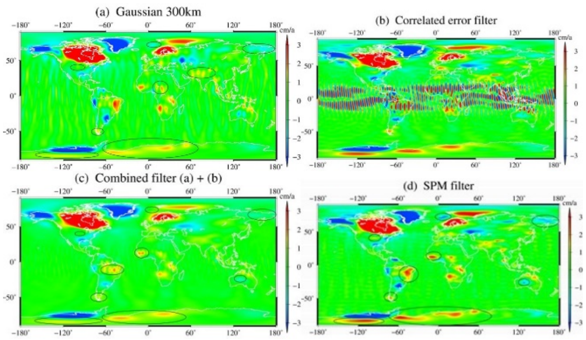

Figure 2. Results by applying different filters on the synthetic model. (a) The Gaussian filter with a smoothing radius of 300km; (b) the correlated error filter; (c) a 300km Gaussian smoothing after the correlated error filter; (d)the SPM filter.

Table 1.The grid statistics results of the numerical mass change trend model and the filtered mass change results by applying different filter on a synthetic mass change model. Unit: cm.

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<tr><th></th><th>minimum</th><th>maximun</th><th>mean</th><th>rms</th></tr>
<tr><td>original</td><td>-11.45</td><td>13.15</td><td>-0.0396</td><td>1.448</td></tr>
<tr><td>Gaussian</td><td>-6.78</td><td>11.06</td><td>-0.0349</td><td>1.231</td></tr>
<tr><td>De-correlation</td><td>-11.53</td><td>11.69</td><td>-0.0399</td><td>1.727</td></tr>
<tr><td>Combination</td><td>-6.53</td><td>11.10</td><td>-0.0349</td><td>1.196</td></tr>
<tr><td>SPM</td><td>-8.81</td><td>11.88</td><td>-0.0399</td><td>1.371</td></tr>
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<td>4. How to ensure reliable results with CPCA?</td>
<td>Accepted</td>
<td>Principal component analysis (PCA) was first formulated in statistics by Pearson (1901), who formulated the analysis to find “lines and planes of closest fit to systems of points in space”. PCA was briefly mentioned by Fisher and MacKenzie (1923) as more suitable than analysis of variance for the modeling of response data. Fisher and MacKenzie also outlined the NIPALS algorithm, and Hotelling (1932) further developed PCA to its present state. Since then, the utility of PCA has been rediscovered in many diverse scientific fields, resulting in, amongst other things, an abundance of redundant terminology. PCA now goes under many names, such as singular value decomposition (SVD) (Golub et al., 1983; Mandel, 1982) and empirical orthogonal function analysis (Lagerloef et al.,</td>
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1988; Kaihatu et al., 1998; Zhang et al., 2004). Eigenvector and characteristic vector analysis are often used in the physical sciences. In image analysis, the term Hotelling transformation is often used for a principal component projection.

PCA (Abdi et al., 2010) is a multivariate technique that analyzes a data table, in which observations are described by several inter-correlated quantitative dependent variables. Its goal is to extract the important information from the table, represent it as a set of new orthogonal variables called principal components, and display the pattern of similarity of the observations and variables as points on maps. Mathematically, PCA depends upon the eigen-decomposition of positive semi-definite matrices and (SVD) of rectangular matrices.

Compared with PCA, the CPCA method (Horel, 1984) introduces phase information and has been shown to be a useful for identifying traveling and standing waves (Pfeffer et al., 2010; Kichikawa et al., 2015). CPCA transforms original data and its Hilbert transform into a complex time sequence and conducts PCA by calculating the covariance or complex characteristics vector of the cross-correlation matrix.

Thus, CPCA has well-developed theory and is a reliable method.

K. Pearson, On lines and planes of closest fit to systems of points in space, Philosophical Magazine, (6) 2 (1901)559-572.

R. Fisher and W. MacKenzie, Studies in crop variation. II. The manurial response of different potato varieties, Journal of Agricultural Science, 13 (1923) 311-320.

H. Hotelling, Analysis of a complex of statistical variables into principal components, Journal of Educational Psychology, 24 (1933) 417-441 and 498-520.

G. Golub and C. VanLoan, Matrix Computations, The Johns Hopkins University Press, Oxford, 1983

J. Mandel, Use of the singular value decomposition in regression analysis, American Statistician, 36 (1982) 15-24.

Lagerloef G S E, Bernstein R L. Empirical Orthogonal Function Analysis of Advanced Very High Resolution

		Radiometer Surface Temperature Patterns in Santa Barbara Channel[J]. Journal of Geophysical Research, 1988, 93(93):6863-6873. Kaihatu J M, Handler R A, Marmorino G O, et al. Empirical Orthogonal Function Analysis of Ocean Surface Currents Using Complex and Real-Vector Methods[J]. Journal of Atmospheric & Oceanic Technology, 1998, 15(4):927-941. Zhang Y, Li T, Wang B. Decadal Change of the Spring Snow Depth over the Tibetan Plateau: The Associated Circulation and Influence on the East Asian Summer Monsoon. Journal of Climate, 2004, 17(14):2780-2793. Abdi, H. and Williams, L. J. (2010), Principal component analysis. WIREs Comp Stat, 2: 433–459. doi:10.1002/wics.101 Horel J D. Complex Principal Component Analysis: Theory and Examples.[J]. Journal of Climatology & Applied Meteorology, 1984, 23(12):1660-1673. Pfeffer R L, Ahlquist J, Kung R, et al. A study of baroclinic wave behavior over bottom topography using complex principal component analysis of experimental data[J]. Journal of the Atmospheric Sciences, 2010, 47(47):67-81. Kichikawa Y, Arai Y, Iyetomi H. Complex Principle Component Analysis on Dynamic Correlation Structure in Price Index Data ☆[J]. Procedia Computer Science, 2015, 60(1):1836-1845. We supplemented this information on **P5 line 120- Pg6 line134** in the revised manuscript. **Revised on Pg5 line 121-Pg6 line135:** ‘Principal component analysis (PCA) was first formulated in statistics by Pearson (1901), Hotelling (1932) further developed PCA to its present stage. Since then, the utility of PCA has been rediscovered in many diverse scientific fields, and it now goes under many names, such as singular value decomposition (SVD) (Golub et al., 1996; Mandel, 1982) and empirical orthogonal function (EOF) analysis (Lagerloef et al.,1988; Kaihatu et al.,1998; Zhang et al.,2004). Eigenvector analysis and characteristic vector analysis are

		often used in the physical sciences and other fields. PCA (Abdi et al.,2010; Helena et al., 2000; Wang et al.,2000) is a multivariate technique that analyzes a data table in which observations are described by several inter-correlated quantitative dependent variables. Its goal is to extract the important information from the table, represent it as a set of new orthogonal variables called principal components, and display patterns of similarity of the observations and variables as points in maps. Mathematically, PCA depends upon the eigen-decomposition of positive semi-definite matrices and SVD of rectangular matrices. Compared with PCA, the CPCA method (Horel, 1984) introduces phase information and was shown to be a useful method for identifying traveling and standing waves (Pfeffer et al., 2010; Kichikawa et al., 2015). CPCA transforms original data and its Hilbert transform into a complex time sequence and conducts principal component analysis by calculating the covariance or complex characteristics vector of the cross-correlation matrix.’. **literature was supplemented：** **Pg19 line 450-451** Abdi, H. and L. J. Williams: Principal component analysis, Wiley Interdisciplinary Reviews Computational Statistics, 2(4):433-459, 2010. **Pg20 line 489-492:** Golub G. and C. V. Loan: Matrix computations: John Hopkins University Press, 1996. Helena, B., Pardo, R., Vega, M., Barrado, E., Fernandez, J. M., and L. Fernandez: Temporal evolution of groundwater composition in an alluvial aquifer (Pisuerga River, Spain) by principal component analysis, Water Research, 34(3):807-816, 2000. **Pg20 line 495-496:** Hotelling H.: Analysis of a complex of statistical variables into principal components, Journal of Educational Psychology, 24(6):417-520, 1932. **Pg20 lines 499-501:** Kaihatu, J. M., Handler, R. A., Marmorino, G. O., and L. K.

		Shay: Empirical orthogonal function analysis of ocean surface currents using complex and real-vector methods, Journal of Atmospheric & Oceanic Technology, 15(4): 927-941, 1998. **Pg21 line 504-509:** Kichikawa Y, Arai Y. and H. Iyetomi: Complex Principle Component Analysis on Dynamic Correlation Structure in Price Index Data, Procedia Computer Science, 60(1):1836-1845, 2015. Lagerloef G., R. L. Bernstein: Empirical Orthogonal Function Analysis of Advanced Very High Resolution Radiometer Surface Temperature Patterns in Santa Barbara Channel, Journal of Geophysical Research, 93(93):6863-6873, 1988. Mandel J.: Use of the singular value decomposition in regression analysis, American Statistician, 36:15-24, 1982. **Pg21 line 525- Pg22 line 528:** Pearson K.: On lines and planes of closest fit to systems of points in space, Philosophical Magazine, (6) 2:559-572,1901. Pfeffer, R. L., Ahlquist, J., Kung, R., Chang, Y., and G. Li: A study of baroclinic wave behavior over bottom topography using complex principal component analysis of experimental data, Journal of the Atmospheric Sciences, 47(47):67-81, 2010. **Pg23 lines 570-571:** Wang F. K. and T. Du: Using principal component analysis in process performance for multivariate data, Omega, 28(2):185-194, 2000. **Pg24 line 597-598:** Zhang Y, Li T. and B. Wang: Decadal Change of the Spring Snow Depth over the Tibetan Plateau: The Associated Circulation and Influence on the East Asian Summer Monsoon, Journal of Climate, 17(14):2780-2793, 2004.
5. Is it suitable to only analyze the first three	Accepted	The reasons behind Tibetan Plateau glacier mass balance changes are very complicated. The CPCA showed its major components by calculating covariance of the cross-

major factors?		correlation matrix of mass balance. This paper only explains the first three major possible reasons for the mass change using the first three major components, which were responsible for 76.04% of that change. For more detailed information, one still needs to analyze the other principal components to explain the remaining 23.94% of mass balance.
6. "However, we believe that geologic structural processes are slow." Could the authors quantitatively describe the impact on mass balance change?	Accepted	Here, we just want to express that geologic tectonics is a long process, and the period of 153 months is only a very short period relative to the geological tectonic time scale (millions of years). We still lack sufficient observation data of mass balance states in the interior part of the earth across the study region. We have removed the above sentence to avoid ambiguity on **P12 Lines 291-292** in the revised manuscript **Revised on Pg12 Lines 291-292**： 'However, we still lack enough observation data of mass balance states in the interior part of the earth in the study region.'
7. The discussion and conclusions can be improved	Accepted	We have improved this content in the revised manuscript. Changes listed below: **Pg13 lines 303-305:** 'On the other hand, the inland Plateau, especially the western part of Qiangtang plateau and Kunlun mountains area, is also influenced by the westerlies and La Niña phenomenon (Figure 5a), which further create the meteorological conditions for rain and snow'. **Pg13 lines 310 - Pg14 line 350:** 'The trend of mass balance change from GRACE data shows that the most negative signal is along the Himalayas and northwestern India. The mass reduction rate of glaciers in the entire Himalaya mountain region is 14 Gt yr^{-1}, and the mass loss of glaciers in the eastern Himalayas was the most dramatic, with the rate of -4.6 Gt yr^{-1} in A area and -4.1 Gt yr^{-1} in B area. The mass reduction rate in northwestern India (H area) was −13.6 Gt yr^{-1}, whereas Rodell et al. (2009) and Yi et al. (2014) gave larger values of −17.7 Gt yr^{-1} and −20.2 Gt yr^{-1}, respectively. The reason for this discrepancy is that

		Rodell et al. (2009) used the data of the RL04 version. Yi and Sun (2014) stated that the RL04 solutions tend to overestimate the glacier melt rate in the Himalayas by as much as 17%. The difference between our results and those of Yi and Sun (2014) is because they used the mascon inverse method in a concise form. Moreover, the filtering method may somewhat attenuate the signal. Yao et al. (2012), after investigating the glacial change over the past 30 years, reported that the Himalayas shows the most extreme glacial shrinkage based on the reduction both of glacier length and area, the shrinkage is most significant in the southeastern QTP (A area), where the length decreased at a rate of 48.2 m yr^{-1} and the area was reduced at a rate of 0.57% yr^{-1} during the 1970s-2000s, and the most negative mass balances occurred along the Himalayas, ranging from -1100 to -760mm yr^{-1}. This trend of mass change along the Himalayas is consistent with our result. They attribute this change to the weakened Indian monsoon towards the interior of the plateau. Thakuri et al. (2014) examined glacier changes on the south slope of Mt. Everest from 1962 to 2011 (400 km^2) using optical satellite imagery and concluded that the observed glaciers shrinkage, upward shift of snowline altitudes, and the negative mass balance (Nuimura et al., 2012) is not only due to warming temperatures, but also as a result of weakened Asian monsoons registered over the last few decades. Bolch et al. (2011) examined the mass change of glaciers on Mt. Everest, Nepal using stereo Corona spy imagery (years 1962 and 1970), aerial images, and recent high resolution satellite data (Cartosat-1), founding that glaciers south of Mt. Everest had continuously lost mass from 1970 through 2007, with a possibly increasing rate in recent years. Wagnon et al. (2013) arrived at the same conclusion. They also indicated that glacier shrinkage south of Mt. Everest was less than that of others in the western and eastern Himalaya and southern and eastern Tibetan Plateau. Recently, Salerno et al. (2015) analyzed the precipitation time series during 1994-2013 reconstructed from seven stations located between 2660 and 5600 m a.s.l. They found that precipitation even decreased 47% during the monsoon period and the snowfall decreased 10% in the last 20 years. Salerno et al. (2016) extended this analysis to even the first 1960s and for all regions used, as proxy of the precipitation

		trend, the surface area variation of glacial lakes. These authors inferred an increase in precipitation occurred until the mid-1990s followed by a decrease until recent years in all Mt. Everest regions. Studies using different types of data arrived to the same results: i.e. negative mass balances and weakened Indian monsoon along Himalayas. Our results support this conclusion, the results of CPCA analysis indicate that mass change on the Himalayas and its southern portion are associated with the Indian monsoon climate, and the intensity of this monsoon is weakening. This result is also consistent with the conclusions of Wu (2005). A weakened Indian monsoon brings less humid air to the study region, causing interannual rainfall decreases, (Thakuri et al., 2014; Salerno et al., 2015, 2016). The GPCP rainfall data confirms this conclusion. The eastern Himalayas are also affected by El Niño (figure 4a) and East Asian monsoons, and no evidence supporting the role of westerlies (figure 5a) in driving local climate and glacier changes. Glaciers in this area are of a marine type, whose mass has large inputs and outputs and is strongly affected by changes of marine climate. The weakened Indian monsoon, strengthening El Niño and westerlies, combined with the huge topographic landform, exert climatic controls on the distribution of existing glaciers along all Himalayas regions and bring more less precipitation to there.'. **Pg14 line 352 - Pg 15 line 371:** 'Archer et al. (2004) indicated that the western Hindu-Kush Karakoram is largely exposed to the arrival of westerly midlatitude perturbations bringing precipitation during winter and early spring, whereas the eastern Himalaya is dominated by summer monsoon precipitation (Syed et al. 2006; Yadav et al. 2012). There is little difference between their results and ours. The results of CPCA indicate that the eastern Himalaya is under the influence of weakened Indian monsoon and El Niño, while the Hindu-Kush Karakoram area is under the influence of a weaken Indian monsoon, westerlies and La Niña. Thompson et al. (2000) examined the variability of the South Asian monsoon by analyzing ice core records of Dasuopu glacier on the QTP, finding evidence of drought conditions and a weakened monsoon from 1780 to 1810. Interestingly,

		according to historical recorders, at least 600,000 people died in 1972 in just one region of northern India from an epic drought associated with this event. The onset of this event in the Dasuopu cores is concurrent with a very strong El Niño–Southern Oscillation (ENSO) of 1790-1793, which was followed by a moderate ENSO event of 1794-1797 as documented. These data suggest an association between ENSO and weakened Asian monsoon. Studies have suggested that Arctic amplification may impact mid-latitude weather patterns and extremes (Francis et al., 2012; Screen et al., 2013), and mid-latitude westerlies may drive climate variation and glacier variability in monsoon affected areas of High Asia (Thomas et al., 2014). On large spatial scales, climate change over the QTP may also be teleconnected with hemispheric or global atmospheric circulations including North Atlantic Oscillation (NAO) and ENSO (Wang et al., 2003). Some literature suggests that ENSO influences climate over the southern QTP through a link with the Indian monsoon (Xu et al., 2010; Xu et al., 2011). The NAO is associated with climate fluctuations over the northern QTP through modulation of the westerlies (Wang et al., 2003; Xu et al., 2010), which is similar to climate change from the westerlies and La Niña in the third principal component'. **Pg15 line 378 – Pg16 line 396:** 'The two atmospheric circulation patterns, combined with the huge topographic landform, exert climatic controls on the distribution of existing glaciers. The East Asian monsoon only affects glaciers on the eastern margin, such as the Mingya Gongga and those in the eastern Qilian Mountains. They believed that the interior of the QTP is dominated more by continental climatic conditions, and the sparse glacier distribution and higher ELAs in the continental-climate-dominated interior are consequences of a limited water-vapor source from both those air masses. They divided glaciers of the Tibet Plateau into seven regions and categorized them into three climatic transects: transect 1, southwest-northeast oriented (middle Himalaya-Qiangtang Plateau-eastern Qinghai Plateau), with the weakened Indian monsoon influence northward; transect 2, southeast-northwest oriented (eastern Himalayas-Qiangtang Plateau-Pamirs), with the weakened Indian monsoon toward the interior and strengthening westerlies toward the northwest; and transect

		3, along the Himalayas, with stronger monsoon influence in the east and weaker monsoon influence in the west. To some extent, we support this type of classification. From results of the CPCA, the first spatial mode clearly shows that the mass balance of the Himalayas-Pamirs-northwestern India (transect 3) was the most sensitive to climate change associated with the Indian monsoon, whereas the impact of that change on mass balance of the inland plateau was not very sensitive. The third spatial mode shows that mass balance of the northwest plateau, including all the Kunlun mountains (not only the Pamirs and its eastern portion), is also affected by climate change from the westerlies and La Niña. Another difference between the results of Yao et al. (2012) and ours is that climate change from El Niño rather than the weakened Indian monsoon toward the interior affected mass balance along transect 2, because we found that the time evolution of the second principal component and El Niño index had a stronger time-frequency correlation'. **Pg16 lines 401 - line 410:** 'Recently, Ke et al.(2017) examined area and thickness change of glaciers in the Dongkemadi (DKMD) region of the central QTP using Landsat images from 1976 to 2013 and satellite altimetry data from 2003–2008. They then analyzed relationships between glacier variation and local and macroscale climate factors based on various remote sensing and reanalysis data. Their results suggest that glacier change in the DKMD region was dominated by the variation of mean annual temperature, and was influenced by the state of the NAO over the past 38 years. The mechanism linking climate variability over the central QTP and state of the NAO is most likely via changes in strength of the westerlies and Siberian High. In addition, ENSO may have been associated with extreme weather (snowstorms) in October 1986 and 2000 which might have led to substantial glacier expansion in the following years. It is noteworthy that the DKMD is located on the eastern Qiangtang Plateau (the center of transect 2), where area mass balance change is the most sensitive to El Niño in our results.'**.** **Pg17 lines 416 - 419:** 'The Indian monsoon mainly affects mass balance change on southern and southwestern QTP, whereas El Niño mainly

		modifies that change over the eastern Himalayans, Qiangtang Plateau, Pamirs and eastern Qinghai Plateau area. Mass balance over the western and northwestern QTP is mainly affected by the westerlies and La Niña.' **Pg17 lines 428 - Pg18 line 445:** 'Change of the Indian monsoon was the most important effect on mass balance variation over the QTP. The lag correlation coefficient of the first principal component with the Indian monsoon indices is 0.828, much larger than the 95% confidence level of 0.223, and the change of the first principal component lags that of the India monsoon indices by one month. Mass balance variation over the eastern Himalayan Mountains, Karakoram, Pamirs and northwestern India was the most sensitive to change of the Indian monsoon, and was responsible for 54.02% of that change. The weakened Indian monsoon, combined with the huge topographic landform, exerted climatic controls on the distribution of existing glaciers in these regions and caused less precipitation there. Because El Niño is strengthening, it has recently become the second major effect on mass balance change of QTP, and was responsible for 16.38% of that change. Their lag correlation coefficient is 0.302, almost twice the 95% confidence level of 0.167, and change of the second principal component lags that of El Niño by one month. Mass balance over the eastern Himalayas, Qiangtang Plateau, Pamirs and eastern Qinghai Plateau areas were the most sensitive to El Niño variation. Further research is needed to better understand the physical mechanisms linking El Niño and mass balance. The third principal component was climate change of the westerlies and La Niña. Mass balance on the western and northwestern QTP were the most sensitive to climate change from the westerlies and La Niña, which represented 5.64% of mass balance change. The strengthening westerlies and La Niña climate phenomenon created meteorological conditions for rain and snow to those regions, and there is no evidence in our results to support the role of westerlies in driving glacier changes across the southeastern QTP'.
8. There are no legends in some figures, such as Figure 2, Figure 3,	Accepted	We have added this information in the revised manuscript.

<table>
<tr>
<td>Figure 4a and Figure 5a.</td>
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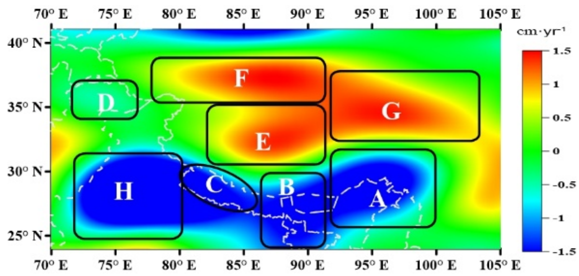

Figure 2 Trend of mass balance in and around Tibetan Plateau. (A)Eastern Himalaya,(B)central Himalaya, (C)western Himalaya, (D)Pamirs, (E) Qiangtang plateau,(F)Kunlun mountain,(G)Qinghai plateau, (H) northwestern India.

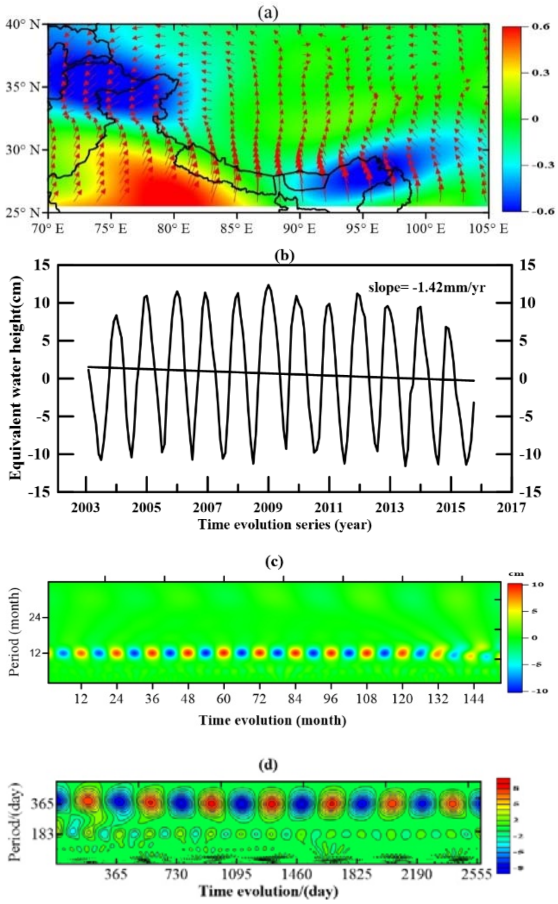

Figure 3 First spatial mode and phase (red arrows) (a), temporal patterns of first principal component (b), and its wavelet amplitude-period spectrum (c) of mass balance change, as well as wavelet amplitude-period spectrum of Indian monsoon indices in period 2003–2009 (d) .
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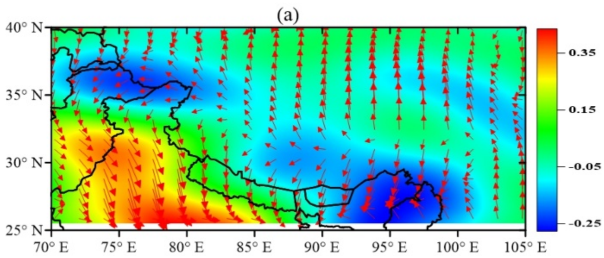
<tr><td></td><td></td><td>

Figure4 Second spatial mode and phase (red arrows) (a).

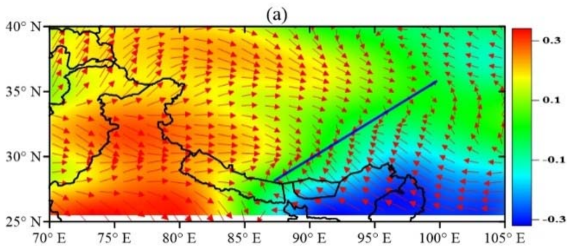


Figure 5 Third spatial mode and phase (red arrows) (a).</td></tr>
<tr><td>9. Line 22: the westerlies and of La Niña?</td><td>Accepted</td><td>We have revised this information on Pg1 Line 23 in the revised manuscript.
Revised on Pg1 line 23:
It was changed to ‘ climate change from westerlies and La Niña’.</td></tr>
<tr><td>10. Line 48: TBP should be explained when it first appears.</td><td>Accepted</td><td>We have revised this information on P2 Line35, and used the QTP instead of TBP and Qinghai-Tibet Plateau in the revised manuscript.

Revised on Pg2 line 35:

It was changed to ‘QTP’</td></tr>
<tr><td>11. Line 85: Qinghai Tibet Plateau?</td><td>Accepted</td><td>We have changed “Qinghai Tibet Plateau” to “QTP” on Pg4 Line 87 in the revised manuscript.

Revised on Pg4 line 87:

It was changed to ‘QTP’.</td></tr>
<tr><td>12. Line 118: the left side of Eq. (3)?</td><td>Accepted</td><td>We have revised this information on Pg6 Lines 139-140 in the revised manuscript, and the left side of Eq. (3) should show capital letter ‘U’.

Revised on Pg6 lines 139-140:

‘The constructed complex observation vector $U_j(t)$ can be expressed as $U_j(t) =$ ’.</td></tr>
</table>

13. Line 168: The number in Table 1 should be same as the number in line 168 and in the paper.	Accepted	We have revised this information on **P8 Lines 194-195** in the revised manuscript. **Revised on Pg9 lines 194-195:** '…respectively 82.6516, 25.0562 and 8.6290, and their contribution percentages are respectively 54.02%, 16.38% and 5.64%, which could explain 76.04% of the variation of…'.
14. Line 273: the bracket?	Accepted	We have removed the brackets on **Pg13 lines 312-313** in the revised manuscript. **Pg13 lines 312-313:** 'rate of -4.6 Gt yr^{-1} in A area and -4.1 Gt yr^{-1} in B area.'
15. Line 310: 74%?	Accepted	It should be 76.04%. We have revised this information **on P17 Line 427** in the revised manuscript. **Revised on Pg17 line 427:** '74%' was changed to ' 76.04% '.
		Language corrections are also revised in the revised manuscript : **Pg2 line 29:** 'In one hand, seawater absorbs' was changed to 'Seawater absorbs'; **Pg2 line 29:** 'In one hand, seawater absorbs' was changed to 'Seawater absorbs'; **Pg2 line 30:** 'On the other hand' was changed to 'Moreover '; **Pg2 line 32:** 'also **raising…** ' was changed to 'which can also lead to rising …'. **Pg2 line 35:**

		'the Qinghai-Tibet Plateau' was changed to 'the Qinghai-Tibet Plateau (QTP)'; **Pg2 line 39:** 'Indian monsoon and East Asian monsoon ' was changed to 'Indian and East Asian monsoon '; **Pg2 line 42:** 'The difference between their results is that Yi et al.' was changed to 'The difference between the results of those authors and that of Yi et al.(2014) is that the latter'; **Pg2 lines 43-44:** 'is so much stronger' was changed to 'is much stronger' ; 'and thus it can' was changed to 'and it can therefore' ; 'Pamirs precipitation' was changed to 'precipitation in the Pamirs'; **Pg3 line 56:** 'high' was changed to 'highly' ; **Pg3 lines 60-61:** 'GRACE' was changed to 'Gravity Recovery and Climate Experiment (GRACE) observation data '; 'signals from ' was changed to 'signals of'; **Pg3 line 62:** 'and the terrestrial water storage (TWS) model from the GRACE observation data, the residual gravity change can be totally attributed…' was changed to 'and terrestrial water storage model from GRACE data, residual gravity change can be fully attributed'; **Pg3 line 66:** 'time scales' was changed to 'temporal scales'; **Pg3 line 67:** 'The most advantage' was changed to 'The greatest advantage'; **Pg3 line 69:** 'standing wave' was changed to 'a standing wave';

		Pg4 line 82: 'from the GRACE' was changed to 'from GRACE'; 'have been' was changed to 'are'; **Pg4 line 83:** 'and its corresponding' was changed to 'and corresponding'; **Pg4 line 84:** 'by using' was changed to ' using ' **Pg4 line 85:** 'studied by ' was changed to ' examined' ; **Pg4 line 86:** 'to explore the possible reasons' was changed to 'to explore possible reasons'; **Pg4 line 87:** '… in the QTP, It is very helpful for us to understand the respond relationship ' was changed to '… over the QTP. This is very helpful to understand the response…'; **Pg4 line 88:** 'of great significance' was changed to 'very important' ; 'melting' was changed to 'melt'; **Pg4 line 92:** 'the America ' was changed to 'the U.S. ; **Pg4 line 93:** 'the changes' was changed to 'changes' ; 'in 300-km' was changed to ' at 300-km'; **Pg4 line 94:** 'the change of hydrology and cryosphere' was changed to 'changes in hydrology and the cryosphere'; **Pg5 line 113:** 'Wahr et al. [1998],' was changed to 'Wahr et al. (1998)'. 'equal ' was changed to 'equivalent '. **Pg5 line 117:**

		‘λ is colatitude, θ is latitude,’ was changed to ‘λ is longitude, θ is colatitude,’. **Pg5 line 118:** ‘the normalized’ was changed to ‘ normalized’; **Pg6 line 139:** ‘Its complex form is’ was changed to ‘The constructed complex observation vector $U_j(t)$ can be expressed as’; **Pg6 line 146:** ‘is the principal’ was changed ‘is principal’; ‘the CPCA’ was changed to ‘ CPCA ’; **Pg6 line 147:** ‘the principal component’ was changed to ‘ such’; ‘the complex vector constructed’ was changed to ‘the constructed complex vector’; ‘After the normalization’ was changed to ‘After normalization’; **Pg7 line 167:** **‘**After the temporal change series of principal components in the area being obtained’ was changed to ‘After obtaining the temporal change series of principal components in the area’; **Pg7 line 169**: ‘choosing’ was changed to ‘ choose ’; **Pg7 lines 168-169**: ‘(Liu L., 1999; Liu L., and Hsu H., 2012; Zhan et al., 2003)’ was added in the revised manuscript;; **Pg8 line 178**: ‘C_ψ is a constant, a and *b* are scale factors of period and time’ was added in the revised manuscript; **Pg8 line 186**: ‘period 2003 to 2015’ was changed to ‘period 2003-2015’; ‘From figure 2, we can see that mass balance’ was changed

		to ‘Figure 2 shows that this mass balance ’; **Pg8 line 188**: ‘in’ was changed to ‘ over’; **Pg8 line 190:** ‘Before the CPCA analysis, data of mass change were filtered, and missing data were interpolated at each grid point’ was added in the revised manuscript. **Pg8 line 191**: ‘shows the corresponding’ was changed to ‘shows corresponding’ **Pg8 line 192**: ‘in this area’ was changed as ‘in the area’; **Pg8 line 194**: ‘CPCA analysis of the mass variation in’ was changed to ‘CPCA of mass variation over the’; **Pg8 line 194-P9 line 195:** ‘are respectively 82.65, 25.05 and 8.62, and their contribution percentages 54%, 16.37% and 5.64%,’ was changed to ‘ are respectively 82.6516, 25.0562 and 8.6290, and their contribution percentages are respectively 54.02%, 16.38% and 5.64%’; **Pg8 line 195:** ‘could’ was changed to ‘can’; **Pg9 line 197:** ‘is’ was changed to’ shows’; **Pg9 line 199:** ‘eastern part of the Himalayas’ was changed to ‘eastern Himalayas’; **Pg9 line 200:** ‘signal of the northwestern part of India’ was changed to ‘signal in the northwestern India’; **P9 line 203:** ‘are the time evolution’ was changed to ‘ depict the temporal

		evolution';
		'Pg9 line 204:
		'It can be seen in the figure 3c' was changed to 'It is seen in figure 3c';
		'affect' was changed to 'affected';
		'Pg9 line 205:
		'its period' was changed to ' whose period ';
		Pg9 line 215:
		'mass variation' was changed to 'mass variation and the correlation analysis';
		Pg10 line 225:
		'oriented' was changed to 'orientation' ;
		Pg10 line 230:
		'are respectively the time evolution' was changed to 'respectively show the temporal evolution' ;
		Pg10 line 232:
		'we can see that ' was changed to 'we see that ';
		Pg10 line 234:
		' of ' was changed to 'in' ;
		Pg10 line 235:
		'of the El Niño' was changed to 'of El Niño' ;
		Pg10 line 241:
		'the wavelet' was changed to ' wavelet';
		'we conclude' was changed to 'the data suggest';
		Pg10 line 242:
		'by East Asian' was changed to 'by climate change related to East Asian';
		Pg10 line 243:
		'one of the branches enters into the Qinghai plateau by through…' was changed to 'one enters the Qinghai Plateau through… ' ;

		Pg10 line 244: ‘ another branch enters ‘ was changed to ‘ and the other enters ’ ; ‘by through the eastern part of Himalayas ’ was changed to ‘ through the eastern Himalayas’ ; **Pg10 line 245:** ‘until reaches’ was changed to ‘until reaching ‘; ‘turn to’ was changed to ‘ turns ‘ ; **Pg10 line 246:** ‘From the figure, we can see’ was changed to ‘The figure shows … ’ ; **Pg11 line 250:** ‘ has obvious character from west-to-east’ was changed to ‘had an obvious west-to-east configuration ’ ; **Pg11 line 252:** ‘come’ was changed to ‘ came’ ; **Pg11 line 252:** ‘Figure 5b and 5c show’ was changed to ‘Figure 5b and c shows’; **Pg11 line 254:** ‘In contrast with from…’ was changed to ‘In contrast with the results of ’; **Pg11 line 260:** ‘moves to north ’ was changed to ‘moves to the north’; **Pg11 line 261:** ‘enters Tarim ‘ was changed to ‘enters the Tarim ‘; ‘reaches to the eastern ‘ was changed to ‘reaches the eastern ‘; **Pg11 line 262:** ‘moves to east beyond the west Himalayas and enters into the’ was changed to ‘moves east beyond the western Himalayas and enters the ‘;

		Pg11 line 263: 'at 90°E area' was changed to 'around 90°E '; **Pg11 line 267:** 'Mass Change of Mass in Inland Qinghai-Tibet Plateau' was changed to 'Mass Change in Inland QTP'; **Pg11 line 270:** ' Yi et al.(2014)' was changed to 'Yi and Sun (2014)' ; **Pg11 line 274:** 'Jacob (2012) deduced the glacier' was changed to 'Jacob et al. (2012) deduced glacier'; **Pg12 line 276:** 'Qinghai-Tibet Plateau that area' was changed to ' that area' ; 'shows' was changed to ' have shown' ; **Pg12 line 278:** ' 48.2m/ yr and the area was reduced' was changed to ' 48.2m yr^{-1} and the area declined'; **P12 line 279:** '0.57% /yr' was changed to '0.57% yr^{-1}'; 'decreases from ' was changed to 'decreased from' ; **Pg12 line 284:** 'melted water' was changed to 'meltwater '; **Pg12 line 286:** 'Yi et al. (2014)' was changed to 'Yi and Sun (2014) '; **Pg12 line 291:** 'However, we believe that geologic structural processes are slow. Further, we still lack enough…' was changed to 'However, we still lack enough…' ; **Pg12 line 298:** 'believe' was changed to 'support the point '; **Pg12 line 299:** ' on the ITP over the past…' was changed to ' over the inland

		QTP during the past…'; **Pg12 line 301:** 'influenced by El Niño ' was changed to 'On one hand, influenced by El Niño'; **Pg12 line 302- Pg13 line 303:** 'inland ' was changed to 'inland area' ; **Pg13 line 306:** 'melting water' was changed to ' meltwater'; **Pg16 line 397:** ' Yi et al. (2014)' was changed to 'Yi and Sun (2014)'; **Pg16 line 398:** 'the correlation of mass' was changed to 'correlation between mass' ; **Pg16 line 399:** 'Arctic Oscillation (AO), and found' was changed to 'the Arctic Oscillation (AO), founding'; **Pg16 line 400:** 'both the ENSO and AO ' was changed to 'both the ENSO and AO ' ; **Pg17 line 412:** 'which is …' was changed to 'which was …' ; '16.3%' was changed to '16.38%'; 'Yi et al. (2014)' was changed to 'Yi and Sun (2014)'; **Pg17 line 414:** 'in QTP' was changed to 'in the QTP'; **Pg17 line 415:** 'phenomenon in the inland' was changed to ' on the inland' ; **Pg17 line 420:** 'Conclusion' was changed to 'Conclusions'; **Pg17 line 421:** 'Mass change on' was changed to 'During 2003-2015, mass

		change on'; 'varies' was changed to 'varied' ; **Pg17 line 427:** '74%' was changed to '76.04%'; **literature was supplemented：** **Pg19 lines 450-451:** Abdi, H. and L. J. Williams: Principal component analysis, Wiley Interdisciplinary Reviews Computational Statistics, 2(4):433-459, 2010. **Pg19 lines 460-461:** Bolch, T., Pieczonka, T., and D.I. Benn: Multi-decadal mass loss of glaciers in the Everest area (Nepal Himalaya) derived from stereo imagery, The Cryosphere, 5(2): 349-358, 2011. **Pg20 lines 478-479:** Francis, J. A., and S. J. Vavrus: Evidence linking Arctic amplification to extreme weather in mid-latitudes, Geophysical Research Letters, 39(6): L06801, 2012. **Pg20 lines 487-490:** Golub G. and C. V. Loan: Matrix computations: John Hopkins University Press, 1996. Helena, B., Pardo, R., Vega, M., Barrado, E., Fernandez, J. M., and L. Fernandez: Temporal evolution of groundwater composition in an alluvial aquifer (Pisuerga River, Spain) by principal component analysis, Water Research, 34(3):807-816, 2000. **Pg20 lines 493-494:** Hotelling H.: Analysis of a complex of statistical variables into principal components, Journal of Educational Psychology, 24(6):417-520, 1932. **Pg20 lines 497-510:** Kaihatu, J. M., Handler, R. A., Marmorino, G. O., and L. K. Shay: Empirical orthogonal function analysis of ocean surface currents using complex and real-vector methods, Journal of Atmospheric & Oceanic Technology, 15(4): 927-

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