

Interactive comment on “Influence of regional precipitation patterns on stable isotopes in ice cores from the central Himalayas” by H. Pang et al.

Anonymous Referee #3

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With this study the authors addressed the question why the stable isotope records of two ice cores from nearby sites in the Central Himalaya are interpreted differently. Whereas the record from East Rongbuk (ER) Glacier is interpreted as precipitation sensitive, the record from Dasuopo (DSP) Glacier is thought to reflect temperature. The different behavior is explained by distinct precipitation patterns with a higher contribution of the Indian Summer Monsoon to the ER Glacier, resulting in an amount effect. In contrast, the Dasuopo Glacier also receives precipitation associated with winter West-erlies. These results were obtained from EOF and correlation analysis of the ice core data sets with regional instrumental summer monsoon rainfall data in India.

This is an important topic and answering this question would have strong implications for future interpretations of ice core stable isotope records as stated in the abstract.

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However, the study does not totally meet the expectations and does not succeed in resolving the contradiction. There is no clear evidence for a relation between ice core data and instrumental data as outlined below. The findings are in contrast to previous publications, which is not discussed. The information given for the ice core data is not sufficient and the data is not critically evaluated, see below. I therefore think the paper needs major revisions.

Neither the EOF analysis nor the Pearson correlation analysis shows a significant relation between the ice core data sets and the instrumental rainfall data. In the EOF analysis the 4 ice core records have high loadings only in 4 individual EOFs, respectively, and there is no relation with the rainfall data. The highest Pearson correlation coefficients between ice core and rainfall data were obtained for ER accumulation and North West India (NWI, $r=0.2$) and West Peninsula India (WPI, $r=0.2$) rainfall, and for DSP and North Central India (NCI, $r=-0.25$). This explains only 4% and 6% of the variance in the ice core data. The highest correlation coefficient $r=-0.39$ between ice core data is reported for DSP-accum and DSP- $\delta^{18}\text{O}$. This negative correlation points to amount effect, typical for monsoon contribution, in contrast to the interpretation that DSP- $\delta^{18}\text{O}$ is influenced by the temperature effect. The negative correlation between ER- $\delta^{18}\text{O}$ and precipitation amount along the southern slope of the central Himalayas, as stated in the abstract, is not supported by the correlation analysis with the rainfall data over India. There is just a weak anticorrelation with the GPCC dataset.

The manuscript gives a long discussion about the spatial pattern of the Indian Summer Monsoon, which reads like a review paper. It is not clear what is new. This could be condensed.

On the other hand, details of the ice core records are missing. What is the elevation of the sites? How was the accumulation corrected for thinning? Are the $\delta^{18}\text{O}$ -data annual data are how were they obtained, how many data points per year? What is the dating uncertainty? Can the dating uncertainty explain the low correlation with the instrumental data?

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The missing correlation with instrumental rain data suggests that they are not representative for the conditions at the ice core sites, which might be very local due to the topography. Local effects like wind erosion, melting, sublimation etc on the glacier are not considered at all. How does the local topography look like, show maps. Does this favor wind erosion? Is there any information about seasonality of precipitation at the sites?

The trend in accumulation is extremely strong for both sites (more than 100% change). This seems to be a much larger trend than in the precipitation data, given e.g. in Yao et al., NCC 2012. Is this a problem with thinning correction?

The interpretation that DSP receives significant contribution of precipitation associated with the Westerlies is in contradiction with previous studies, which is not sufficiently discussed in the manuscript. ER accumulation resembles most the accumulation reconstructions from Dundee, Guliya, and Puruogangri ice cores, and the Tibetan Plateau precipitation, as given in Kaspari et al., JGlac, 2008. DSP shows a very different trend. It seems unlikely that a glacier so far North as Dundee receives a significant Indian summer monsoon contribution, suggesting that the monsoon contribution is higher at DSP. This is consistent with the sulphate record from DSP, which shows the trend expected for southern Asia (Duan et al., GRL 2007). At ER, the excess sulphate concentration does not exhibit any trend or anthropogenic influence (Kaspari et al., JGR 2009). A strong influence of the monsoon at DSP was also reported by Vuille et al., JGR 2005, who detected a significant correlation between NCEP-NCAR JJAS monsoon index Mobs with annual $\delta^{18}\text{O}$ values from DSP ice core between 1950 and 1996.

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