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Identifying climatic drivers of glacier mass balance variability of Lewis glacier, Mt. Kenya

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Lewis Glacier (Kenya, 0°09' S; 37°18' E) has a 20 year historical annual mass balance record, spanning 1979-1996 and 2010-2012. This offers an opportunity to investigate the glacier-climate interactions at ∼4800m a.s.l. in the equatorial zone, which in turn allows investigation of the possible tropical mid-tropospheric conditions that must have prevailed in order to permit formerly larger glacier extents on the mountain.

Here we use field data of glacier annual mass balance, seasonal glacier surface height changes and monthly precipitation records to test the impact of potential drivers on the glacier variability. We examine relationships between these glaciological data and ERA-interim atmospheric fields, satellite measurements of outgoing long wave radiation and sea surface temperatures.

In all years except the mass balance year of 1989 Lewis glacier experiences a negative mass balance. Strongly negative annual mass balances occur only if one or both of the wet seasons fail to bring snowfall to the summit and both annual mass balance and rainy season surface change is well correlated with measured precipitation and enhanced convection within the equatorial rain belt in East Africa and the western Indian Ocean. Seasonal glacier surface height change is correlated with air temperature throughout the whole tropical African zone during the dry months of January and February, but the only positive mass balance year experienced seasonal cold temperature anomalies over equatorial Africa in all seasons.

No single season emerges as the dominant driver of the inter-annual mass balance variability, and the climate sensitivity of the glacier surface change differs between seasons. However Lewis Glacier mass balance over the study period can be explained by moisture variability as the primary driver and temperature variability as an additional driver of glacier mass change.