December 2002

Observations on the Relationship Between October and Late-season Rainfall for Southern Africa

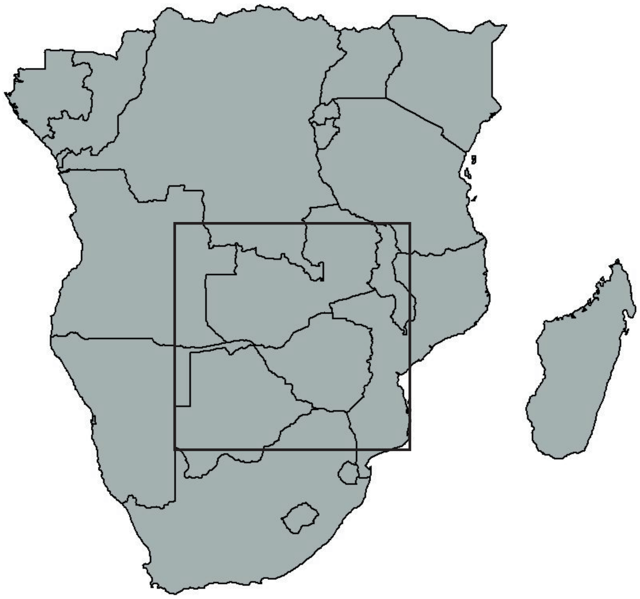

Figure 1. Approximate location of region for which rainfall data were averaged.

Introduction

El Nino years have typically delivered below-average rainfall for Southern Africa and led to low agricultural yields in these years. With an understanding that rainfall during these years has usually left the region in difficult circumstances, a further investigation into the timing of the rainfall seemed appropriate. By understanding the relationship between early and late season rains it would be possible to assess the end-of-season crop conditions based on the expected rainfall from early season rainfall totals.

For the purposes of this research, all rainfall data were averaged from the CHARM dataset for an area extending from 20°E to 35°E, and from 10°S to 25°S (Figure 1). Rainfall totals were extracted from the CHARM monthly data for the area of interest as an average amount for each month. The recorded value was then transformed to an anomaly by subtracting the mean for all years from the observation. El Nino years designated as "weak" or stronger, defined by the Climate Prediction Center (CPC) as sea surface temperature anomalies of 0.6 or greater, were considered in this analysis. Based on this, El Nino years were defined as those seasons which ended in March of 1966, 1969, 1970, 1973, 1978, 1980, 1983, 1987, 1988, 1991, 1992, 1993, and 1995. Unfortunately, because the CHARM data do not go past 1996, it is not possible to look at more recent El Nino events.

Analysis

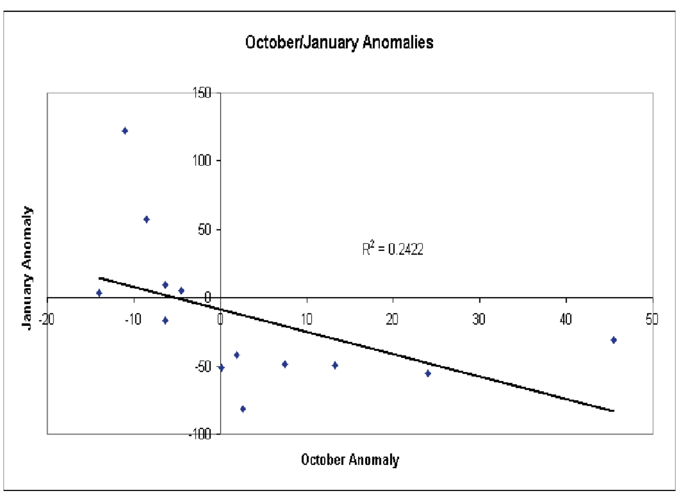

Figure 2. Plot of October anomaly versus January anomaly.

By plotting rainfall anomalies from October with those from other months it is possible to see if there is a trend in the relationship between early season rains and rain during the rest of the season. The relationship to November and December rainfall was rather poorly defined, and no clear trends were identified. However, when comparing October anomalies with those of later months, some interesting relationships became apparent.

These plots confirm what had been suspected, that January rainfall during El Nino years tends to be drier than average. To go one step further, January rainfall that follows wetter-than-average October rains is always drier than average (Figure 2). Understanding that there may be a relationship between early-season and late-season rains could prove to be a valuable tool when making decisions regarding agriculture.

The linear relationship between the anomalies for October and January is not particularly strong. What the data reveal is that as October rainfall is increasingly large, January rains do not necessarily become increasingly small. There does, however, appear to be a strong step-function in the data, such that positive October anomalies (right of

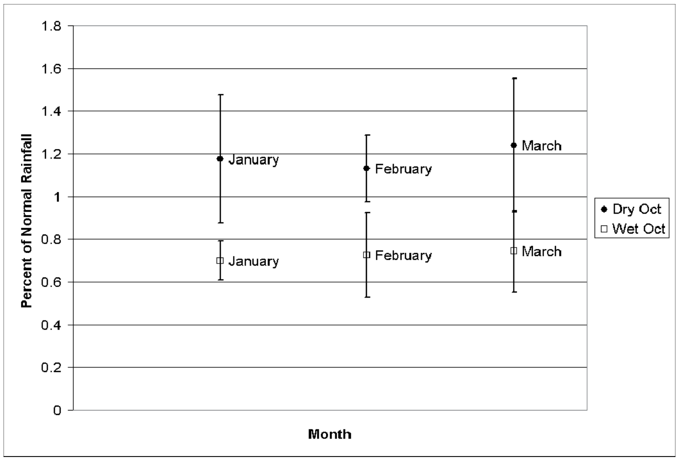

Figure 3. Plot of percent of normal rainfall by month for wet- and dry-October conditions with standard deviations shown.

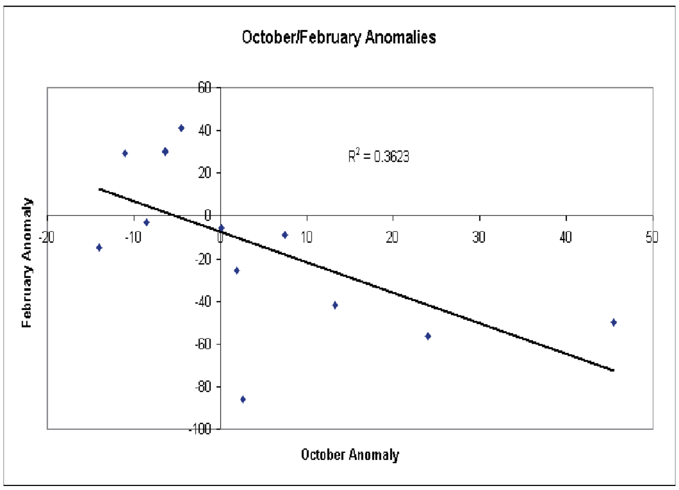

Figure 4. Plot of October anomaly versus February anomaly.

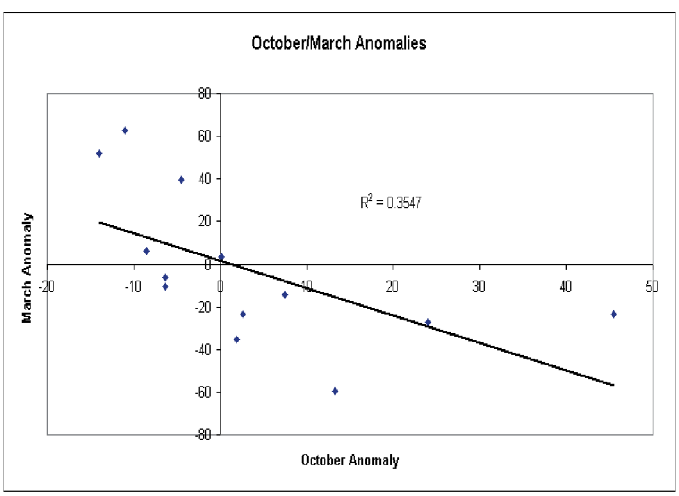

Figure 5. Plot of October anomaly versus March anomaly.

the y-axis) always correspond to particularly negative January anomalies (below the x-axis). A difference-of-means test supports the hypothesis that the rainfall for Januaries following wet Octobers is significantly drier than that for Januaries following dry Octobers. Furthermore, a two-way analysis-of-variance test to compare all (El Nino and non-El Nino) years shows that having a negative or positive October anomaly is actually a more significant predictor of January rainfall than the presence of El Nino conditions. Differences in late-season rainfall between wet-October and dry-October conditions are summarized in Figure 3. Analysis of this figure shows that January rains following wet Octobers tend to be about 70% of normal for that month.

With the relationship between wet Octobers and January dry-spells established, evaluation of the most recent October should give an indication of what is to follow later this season. Using satellite-derived rainfall estimates (RFE), it is possible to extract the mean rainfall for the same region used for the historical data. The mean value for the RFE shows a large positive anomaly, roughly corresponding to the second-wettest October for all El Nino years. This large anomaly indicates that the January rains should be drier than average for this region. Because there is not a linear effect, the rather large magnitude of the anomaly does not indicate a more severe January dry-spell than would a moderate anomaly. However, the large anomaly does add increased confidence that what is observed as a wet anomaly is truly an anomalously wet October.

Similar relationships exist for rainfall anomalies in October and February, and October and March (Figures 4 & 5). The relationship for January was identified as the most important because it is the first month for which the relationship exists, and thus the beginning of the dry-spell.

Summary

Understanding rainfall during El Nino years is critical for Southern Africa because of the drought that is traditionally associated with these years. With information on how early-season rains have historically related to late-season accumulations it is possible to evaluate what the end of this season holds for the region. Total rainfall for October 2002 was greater than average October accumulation, which has usually meant that late-season rains will be lighter than usual. *Finally, it should be noted that this analysis relates to regional trends, and that local trends might not follow what has been observed as a region-wide phenomenon.*

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