19.10 EXTRATROPICAL CYCLONE AND ANTICYCLONE TRACKS AND TRENDS FOR THE SOUTHERN HEMISPHERE: POSSIBLE ENSO RELATED IMPACTS AND CLIMATE CHANGES

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1. INTRODUCTION

Over the decades, operational meteorologists have been drawing synoptic charts with a particular concern for the precise location of cyclones and anticyclones near the surface. In the past, the process of monitoring low and high pressure tracks on a climatic basis demanded a lot of operational time because of its manual nature. Nowadays, however, due to recent developments on automatic tracking schemes like the ones described in Murray and Simmonds (1991) and Sinclair (1994), it is easier to handle large amount of data sets.

Automatic procedures can be applied for finding and tracking highs and lows from operational numerical analyses. The most important advantages are the possibility of handling a large amount of information in a shorter time frame and generating results that can be easily compared between them, because most outputs obtained from any automatic scheme are reproducible.

In this work, it is presented a wintertime SH climatology of cyclone and anticyclone tracks using the NCEP Reanalysis data for the 1973 – 1996 period, applied to the Murray and Simmonds (MS henceforth) automatic scheme. The total amount of tracks and orphan systems were counted in order to analyze possible climatic trends and ENSO-related impacts.

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2. RESULTS AND DISCUSSION

Figure 1 shows the Southern Hemisphere winter (JJA) total number of cyclone and anticyclone tracks with no restriction to pressure ranges (figure 1a), for cyclones below 1010 hPa and anticyclones above 1020 hPa (figure 1b), and for cyclones below 980 hPa and anticyclones above 1035 hPa (figure 1c) according to the MS automatic scheme using data every 12 hours for the 1973 – 1996 period. The linear regression lines and the square linear correlation coefficients according to the least square method are shown in each case.

According to figure 1a, when no pressure restriction is applied the number of anticyclones is significantly higher than the number of cyclones. On the other hand, figure 1b shows that the counts for both systems are similar when a "synoptic" pressure criterion is used. Figure 1c is showing only the intense end of the spectrum, with anticyclones above 1035 hPa, which are usually seen over the continent in association with strong polar air masses, and cyclones below 980 hPa, which occur in mid and high latitudes and are usually associated with strong winds and precipitation.

The regression lines indicate a significant overall decline of cyclones and anticyclones when no pressure restriction is used (figure 1a). Nevertheless, the variability is high. The trends are less noticed in figure 1b, and figure 1c shows an overall increase of cyclones below 980 hPa, which indicates an opposite behavior at the intense end of the spectrum. This would suggest fewer but more intense systems, and hence, if one progressively eliminates the weaker systems, an apparent downward trend could even turn into an increase. Finally, no tendency has been observed for the anticyclones above 1035 hPa.

These considerations raise the question about how tracking schemes are sensitive to capturing low and high pressure centers when different restrictive pressure criteria are applied. As shown in the literature, different data sets and the use of automatic procedures based on vorticity or sea level pressure are important factors which might significantly impact the final results.

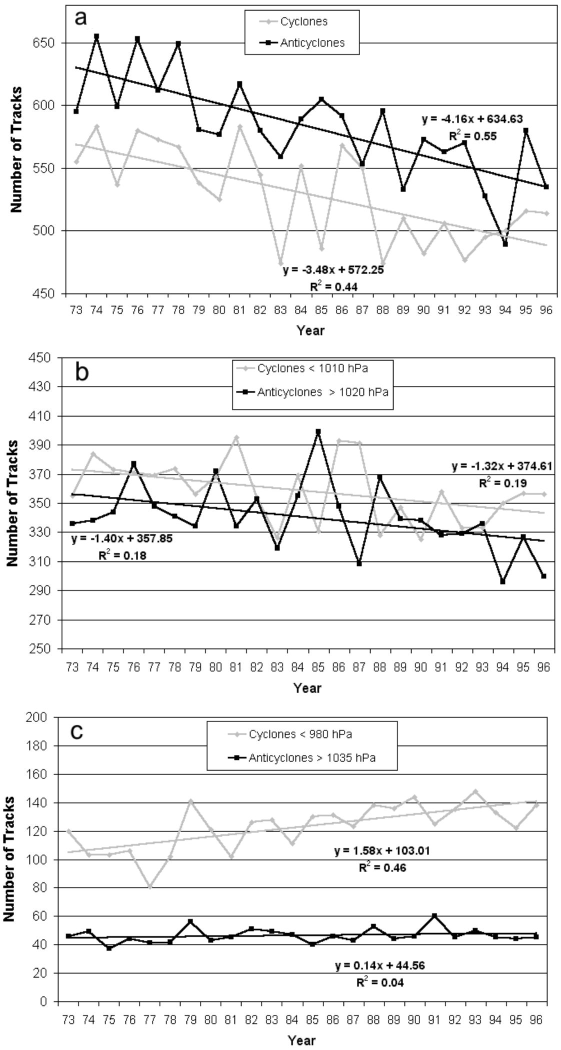

Figure 1: Number of cyclone and anticyclone tracks every 12 hours during JJA (1973 – 1996), according to the automatic scheme of MS for the Southern Hemisphere (a) without pressure restriction, (b) for cyclones below 1010 hPa and anticyclones above 1020 hPa and (c) for cyclones below 980 hPa and anticyclones above 1035 hPa.

Any physical mechanism that would reasonably explain an environment with fewer but more frequent intense cyclones and a static number of intense anticyclones is rather complex and difficult to address. This issue needs further analyses in light of the possible climate changes occurred in the SH.

One may wonder if ENSO events would impact the total hemispheric number of surface cyclones and anticyclones. If a plot similar to figure 1a is prepared having the tendencies removed (figure not shown), no significant relation with the ENSO phase is observed, indicating that the natural variability of the system is higher than the ENSO signal. Despite of that, Pezza and Ambrizzi (2003) showed a spatial pattern where one can see local areas of increase or decrease in the tracks concentration depending on the region, suggesting the existence of some preferential ENSO trajectories. As suggested in their work, the local contributions tend to be compensated when the total hemispheric count is made, what is physically consistent with the above results.

3. ACKNOWLEDGMENTS

This work is supported by FAPESP (Sao Paulo/Brazil). It has also been partially supported by the IAI-CRN-055 project. TA was also supported by CNPq.

4. REFERENCES

Murray, R.J., and I. Simmonds, 1991: A numerical scheme for tracking cyclone centres from digital data. Part I: Development and operation of the scheme. *Aust. Metero. Mag.*, **39**, 155-166.

Pezza, A. B., and Ambrizzi, T. 2003: Variability of Southern Hemisphere Cyclone and Anticyclone Behavior: Further Analysis. *Journal of Climate*, in press.

Sinclair, M.R., 1994: An objective cyclone climatology for the Southern Hemisphere. *Mon. Wea. Rev.*, **122**, 2239-2256