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A CLIMATOLOGY OF CONVECTIVE ACTIVITY IN THE WESTERN END OF THE ISTHMUS OF TEHUANTEPEC

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1. INTRODUCTION

Convective activity in the Gulf of Tehuantepec can be very intense and frequently is linked to the development of tropical depressions and storms that may results in hurricanes once they move westward. Nevertheless, there are other phenomena that lead to convective activity in the area, that are more local and or regional in nature. The objective of this study is to characterize the spatial extent, the diurnal variability and the intensity of the convection that develops in the western end of the Isthmus of Tehuantepec. In particular, we are interested in assessing the role of the mesoscale circulations, such as the land-sea breeze and mountain-valley breeze in the spatial organization and temporal evolution of the convective activity. It is also of interest to identify the events of low level jets through the isthmus, associated with synoptic scale features that are frequent during the winter months.

We present here preliminary results obtained from 2 years of satellite data for the region. The analysis is ongoing and the results for a period of 7 years will be presented at the conference.

2. DATA AND METHODOLOGY

In this preliminary study, the data from GOES 8 satellite for the months of February and September 2001 and 2002 were analyzed. The hourly images were utilized to determine the diurnal variability in the region of interest. Figure 1 presents a sample image, where Mexico is shown as well as the adjacent oceanic areas.

The 2 months selected correspond to very distinct climatological situations in the region of Tehuantepec: February corresponds to the winter, dry season while September is in the middle of the wet season. During February, there is a large probability of incidence of mid-latitude frontal systems reaching very low latitudes (around 14N). The pressure difference between the Gulf of Mexico and the Gulf of Tehuantepec (see Fig. 1) after the passage of such a system leads to acceleration of the winds through the Isthmus of Tehuantepec. In the climatology of satellite images we have separated the days that were influenced by the presence of such fronts. For example, during February 2001, there were 5 days identified as influenced by frontal systems. These days were subjectively identified from reports by the Mexican Weather Service.

During the month of September the region is frequently influenced by the passage of easterly waves and by the early development of tropical depressions and storms, as well as some early mid-latitude frontal systems.

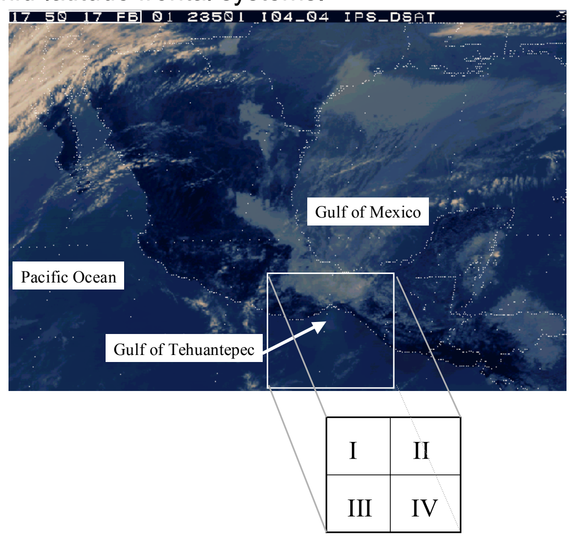

Figure 1. Infrared image corresponding to 17:50 GMT on 17 February 2001. The inset shows the 4 regions that were selected for this study.

It was necessary once again to identify these days in the database and single them out to obtain a clear separation of the spatial scale of the phenomena affecting the convective activity in the region. For example, during September of 2001 there were 14 days identified as either easterly waves and/or tropical depressions. This classification was carried out on the basis of reports by the Mexican Weather Service. The methodology utilized clearly separated the cases with and without large scale influence. The software utilized was developed in house, in C++ language (Oropeza, 2001). During the first phase of the analysis, the GOES images were clipped and centered in the region of the Isthmus and four sub-sections were selected, to characterize the convection over land and over the sea in the Gulf of Tehuantepec (see Fig. 1). The software was then used to characterize convection in terms of: i) the number of convective cores present (based on the description by Adler and Negri, 1988), ii) the number of convective cores surrounded by cirriform anvils, iii) the horizontal extent of the convective cores, iv) the minimum temperatures of the convective cores, v) the regions of the cores/

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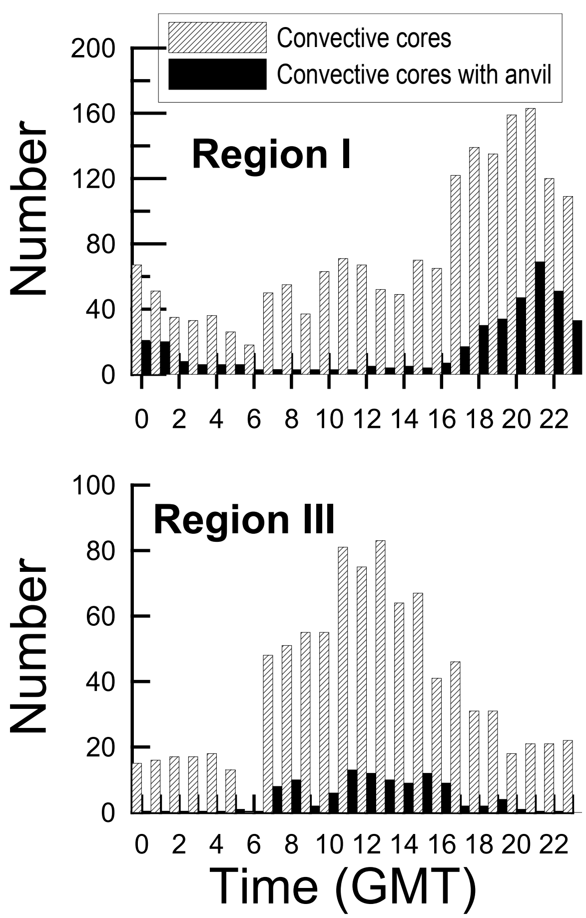
anvils with temperatures between –30 and –40 C, between –40 and –50 C and with temperatures lower than –50C. These parameters also allow the characterization of convection in terms of type, e.g. isolated vs. organized, by comparing the number of convective cores and those with cirrus anvils, together with their minimum temperatures.

3. RESULTS

Figure 2 presents the results of the number of convective cores observed in the February 2001 dataset, as a function of time of the day, for the four regions shown in Figure 1. The results indicate that the land and the adjacent region areas have very distinct diurnal variability, as was expected. The results are shown for only the days in February that were not influenced by the large scale systems. Both regions over land show maximum frequency of convective cores during the local afternoon, but with significant difference in the total number of convective cores present, showing more than 50% more in region I compared to region II.



Convective cores with anvils are always only a small fraction of the total, at most 50%. A secondary maximum is observed during the local early morning, with approximately half the number of convective cores observed. IN contrast, regions III and IV, completely over the ocean, present a more complex diurnal variability. Region III presents only one maximum between 6 and 8 am local time, with very few cores observed for about 11 hours out of the day. Region IV has fewer convective cores and a bimodal distribution with maxima at 8am and 12-1pm local time. Convective cores associated with anvils are very infrequent over the ocean, at most only 10% of the total number (in Region III)

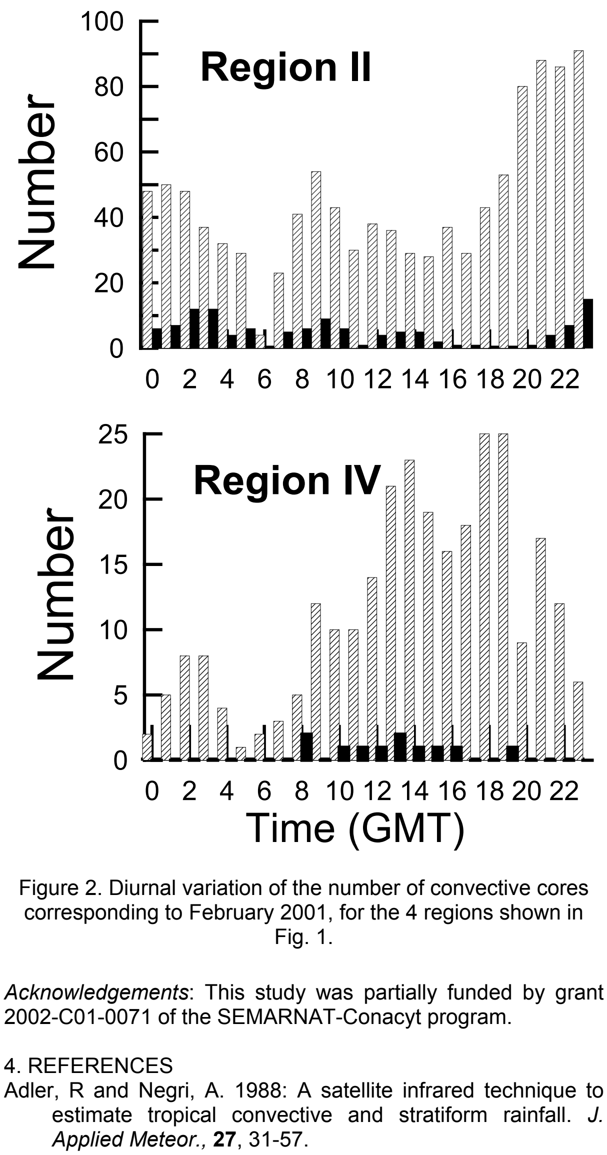


Figure 2. Diurnal variation of the number of convective cores corresponding to February 2001, for the 4 regions shown in Fig. 1.

Acknowledgements: This study was partially funded by grant 2002-C01-0071 of the SEMARNAT-Conacyt program.

4. REFERENCES

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