MESOSCALE CONVECTIVE SYSTEMS RELATED TO THE OCCURRENCE OF SEVERE WEATHER EVENTS IN RIO GRANDE DO SUL-BRAZIL, IN JFM AND JAS FROM 2004 TO 2008

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(Dated: 26 August 2011)

I. INTRODUCTION

Socio-economic losses associated with weather events are constantly reported by the media. As Kobiyama (2003), Brazil is the South American country with the largest number of people affected by natural disasters. In that, being the state of Rio Grande do Sul (RS), the impacts of excessive rainfall in summer is indicated by Marques et al. (2006) and Gruppelli et al. (2006) as a factor in productivity of soybeans, rice and grape quality, the main crops in the state. Likewise, according to Velasco and Fritsch (1987), severe weather situations, such as the presence of strong winds, floods and hail at times, are also present in the winter.

Despite the fact that Mesoscale Convective Systems (MCS) are common phenomena that cause damage to the RS, there is still little documentation related to its intensity and duration. Campos et al. (2010) concluded that the number of MCS is more frequent in the northern half of RS, compared to the southern half, which makes for a difference in the probability of occurrence of extreme events in the state between the two regions.

In this light, this study aims to relate the occurrence of MCS in hot season and cold season of 2008 (January, February and March – JFM, and July, August and September - JAS), with the number of affected cities in Rio Grande do Sul, in extreme events considered by the Brazilian Civil Defense.

II. PRESENTATION OF RESEARCH

In order to detect the MCS that occurred between 2004 and 2008 were used the MCS elected by Eichhloz (2011) , using raw images of GOES-12 satellite with a spatial resolution of 4 x 4 km and timescale of 30 minutes, of infrared channel, provided by CPTEC / INPE. It was possible with the application ForTraCC (Vila et al., 2008), through temperature thresholds, counting the number of MCS in the hot season (JAS) and also in the cold season (JAS). In this research, 626 MCS were detected between 2004 and 2008, of which 179 occurred in JFM and 142 in JAS.

In addition to MCS data, it was also used severe weather data reported by Brazilian civil defense, in the period of JFM and JAS form 2004 to 2008, that were needed for the selection of the occurrences of events of severe weather conditions (hail, flood, windstorm, flood, hurricane and made).

Meanwhile, there was made a relationship between the occurrences of all events of MCS for each of the years under study. Then were selected the days when events occurred, that because an event may have covered more than one city and, therefore, current competition in general, several events may correspond to a day of occurrence. After selecting the day of occurrence of events, they were separated by years, depending on the seasons: hot (JFM) and cold (JAS).

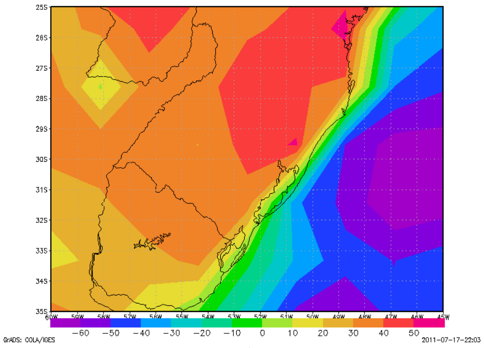
II. RESULTS AND CONCLUSIONS

Considering the 496 cities that make up the state of RS, the Table 1 was made counting the number of cities that have declared an emergency in the period under study, and MCS occurred within the limits of the state. The largest number of extreme events associated with MCS was observed in the cold phase of 2005, since 46.07% of the cities were hit in this period by the nine MCS that were detected. According to Climanálise (INPE/CPTEC), in 2005 the surface temperature of the ocean off the coast of RS, would have favored the formation of convective complexes, due to increased release of moisture from the ocean to the atmosphere, a combined with a time period when the Higher Levels Jet was in a intense phase, with wind speed of 50 to 30m/s. The MCS which caused more emergency situation in the cities had the life cyle during 29 and 30 August, where 23 of the 41 municipalities reported the alert. In the city of Bagé were recorded 57.1 mm of rain in two days, including hail. However, in the 2005 cold season had occurred a deficit in rainfall, with a precipitation anomaly of up to 100 mm negative in some cities in the state.

Overall, 22.9% of MCS occurred in the hot season caused warning in the municipalities of RS, and turn in the winter 19.71% caused emergencies. While 85.71% of the warnings issued in the hot season are caused by MCS, only 66.46% are in cold season.

	JFM			JAS		
	MCS	MCS Extremes	Cities Warning	MCS	MCS Extremes	Cities Warning
2004	30	6	7 (of 15)	26	5	25 (of 28)
2005	11	1	1 (of 2)	29	9	41 (of 44)
2006	38	9	17 (of 16)	19	3	6 (of 7)
2007	63	24	27 (of 28)	43	5	17 (of 63)
2008	37	2	2 (of 2)	25	6	22 (of 25)
Total	179	42	54 (of 63)	142	28	111 (of 167)

TABLE 1: Numbers of Mesoscale Convective Complexes (MCS) associated with cities that have declared Severe Weather Warning for the period 2004 to 2008.



a)

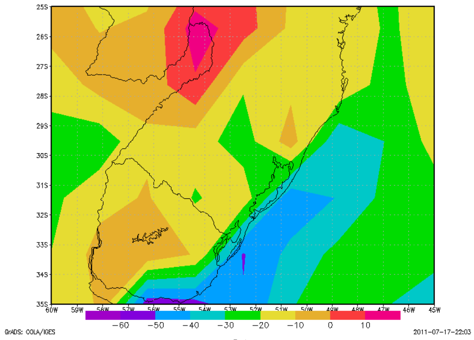


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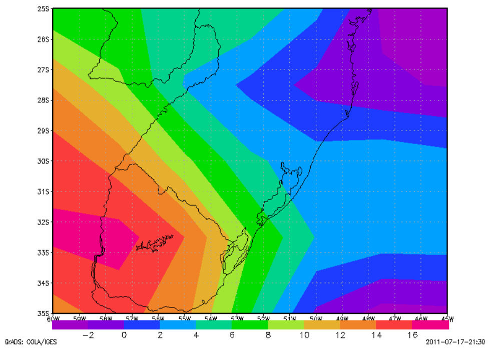
FIGURE 1: a) Summer b) Winter; Anomaly of Heat Latent Flux on Surface

Figure 1 shows that during the hot season there is a latent heat anomaly in the Pacific Ocean off the coast of the RS and the anomaly is positive over the continent in the northern part of the state. This may have favored the formation of MCS on the state, since even during the maturation phase the latent heat is necessary for the formation of convective cells. It is important to note that there is a positive anomaly of latent heat in the same region of low level jets, often necessary for the formation of convective systems.

In the field of relative humidity, Figure 2, it is possible to notice that during the hot season severe weather events, there was a positive anomaly relative humidity on the south-western state that has been decreasing to the north. In winter, the positive anomaly was present on the state in the Southeast, and also decreasing toward the north. It can be assumed that the formation of MCS have been favored over the continent during the cold season because there would be greater humidity 850hPa for the formation of convective systems



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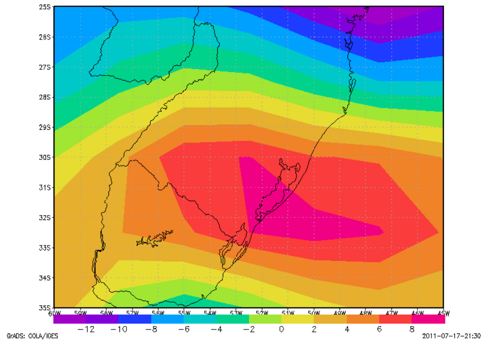

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FIGURE 2: a) Summer b) Winter; Anomaly of Relative Humity in 850hPa.

III. REFERENCES

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