



# **LIGHTNING ACTIVITY AS A FUNCTION OF THE GEOGRAPHICAL CHARACTERISTICS AT RIO GRANDE DO SUL - BRAZIL**

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## **INTRODUCTION**

**The dependence of the total lightning activity in the State of Rio Grande do Sul, South of Brazil, on the altitude was investigated using data obtained from the Lightning Imaging Sensor (LIS) from 1998 to 2003, considering that some investigations have reported such a relationship.**



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## **BASIC CONSIDERATIONS**

- **The climatic and meteorological conditions in Rio Grande do Sul;**
- **In relation to the weather conditions.**
- **Relation to the geology and geomorphology at Rio Grande do Sul.**

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## BASIC CONSIDERATIONS



Some air masses in South America. Source: <http://satelites.cptec.inpe.br>.



Geological and geomorphological characteristics of Rio Grande do Sul. Source: Robaina, L. E. de S. *et al*



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## **METHODOLOGY**

The lightning data were obtained by LIS sensor. Thus we have a reasonable statistics about lightning and that were distributed in regions of  $1^\circ$  of latitude and longitude, considering the years of 1998 to 2003. Other point to be outstanding if it refers to the fact that the data generated by sensor LIS they do not discriminate the different types of lightning, being counted all the lightning that happen during registration time for seasonal and annual averages.



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## **METHODOLOGY**

**Maps about other variables were included, as precipitations temperature. Some small areas of Rio Grande do Sul were not included because it have little representative before a general area.**

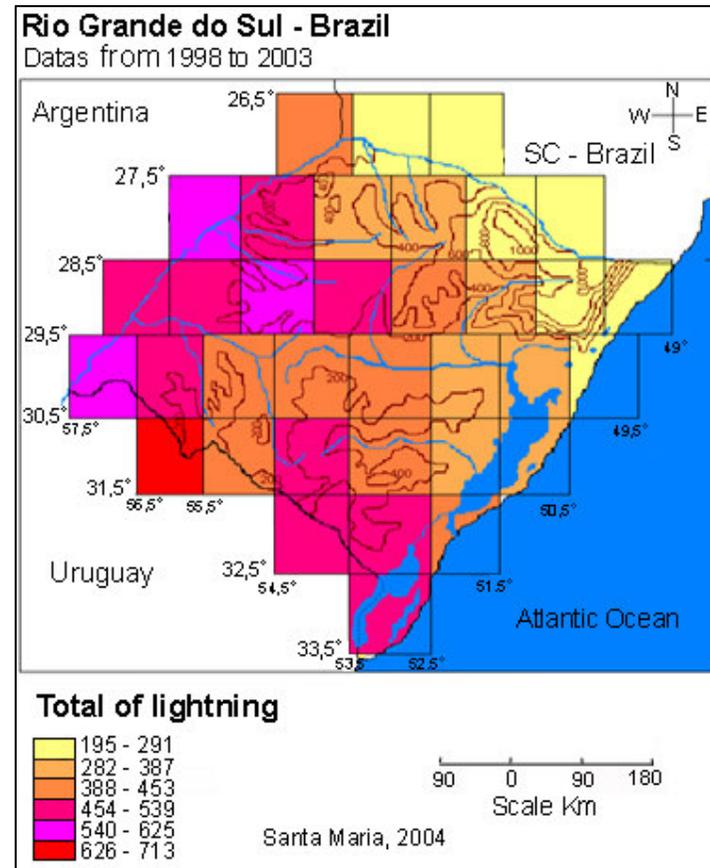


## LIGHTNING ACTIVITY AS A FUNCTION OF THE GEOGRAPHICAL CHARACTERISTICS AT RIO GRANDE DO SUL - BRAZIL

# RESULTS

### Lightning and altitude

### Annual lightning average.



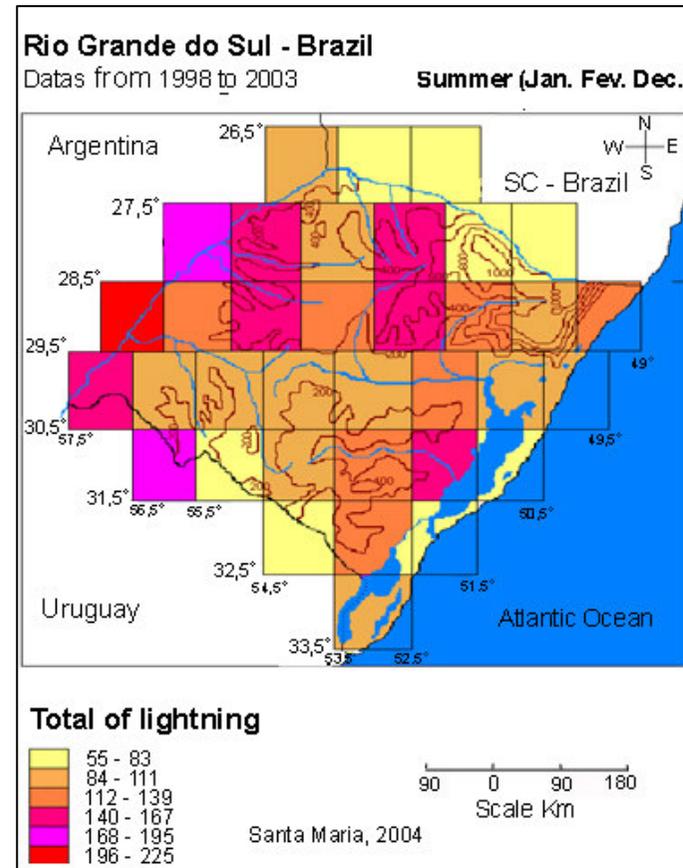


## LIGHTNING ACTIVITY AS A FUNCTION OF THE GEOGRAPHICAL CHARACTERISTICS AT RIO GRANDE DO SUL - BRAZIL

# RESULTS

### Lightning and altitude

## Summer



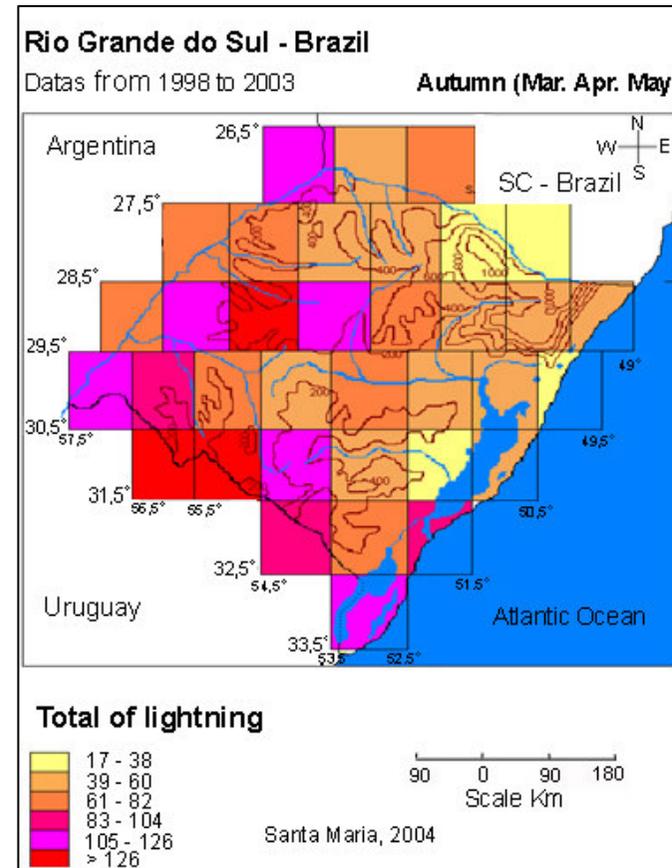


## LIGHTNING ACTIVITY AS A FUNCTION OF THE GEOGRAPHICAL CHARACTERISTICS AT RIO GRANDE DO SUL - BRAZIL

# RESULTS

### Lightning and altitude

## Autumn



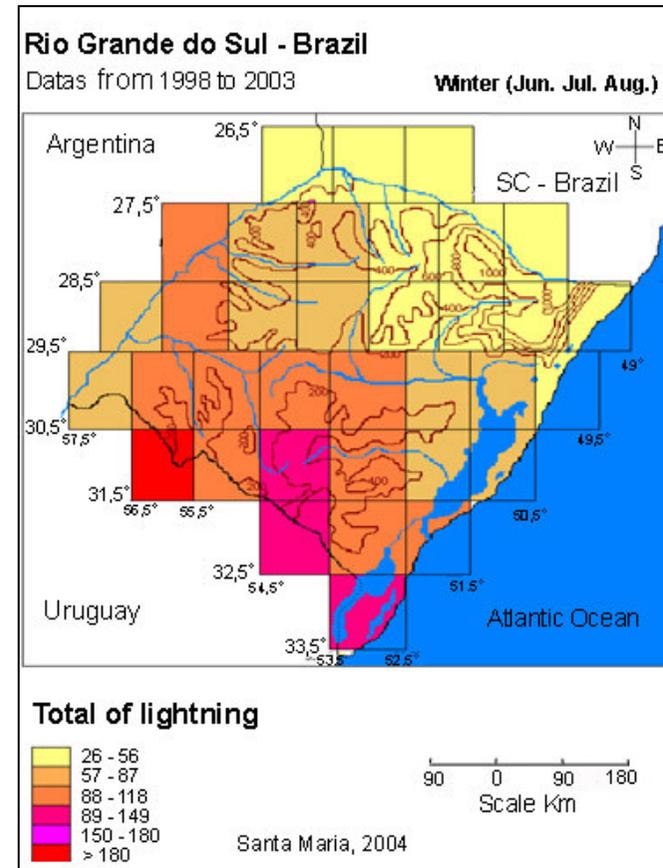


## LIGHTNING ACTIVITY AS A FUNCTION OF THE GEOGRAPHICAL CHARACTERISTICS AT RIO GRANDE DO SUL - BRAZIL

# RESULTS

## Lightning and altitude

# Winter



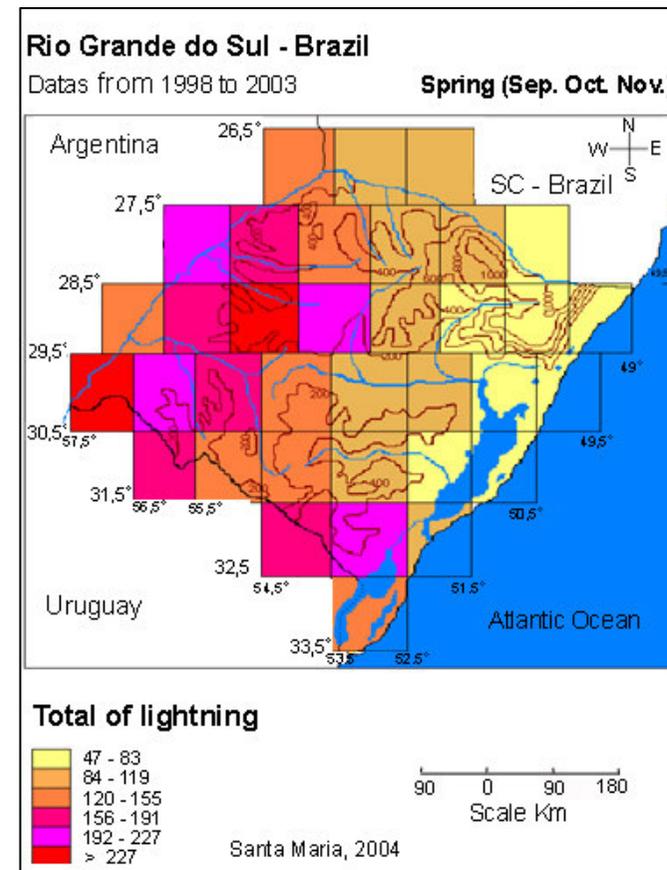


## LIGHTNING ACTIVITY AS A FUNCTION OF THE GEOGRAPHICAL CHARACTERISTICS AT RIO GRANDE DO SUL - BRAZIL

# RESULTS

### Lightning and altitude

## Spring





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## RESULTS

In the Northeast area was observed the smallest densities of lightning. The largest annual medium density was verified in the Southwest area. In general, in the West and in the South of Rio Grande do Sul the largest densities were observed, however, in these regions we verify altitudes under to 200 m. Thus, we do not found evidences that the land elevation increase the number of lightning, as suggested in other studies, according to Gomes, 2003, Diendorfer and Schulz, 1998 and 1999. However, this could be due to non discrimination among all lightning types, since in the studies above mentioned, only ground flashes were considered, or due the different spatial resolution that were used.



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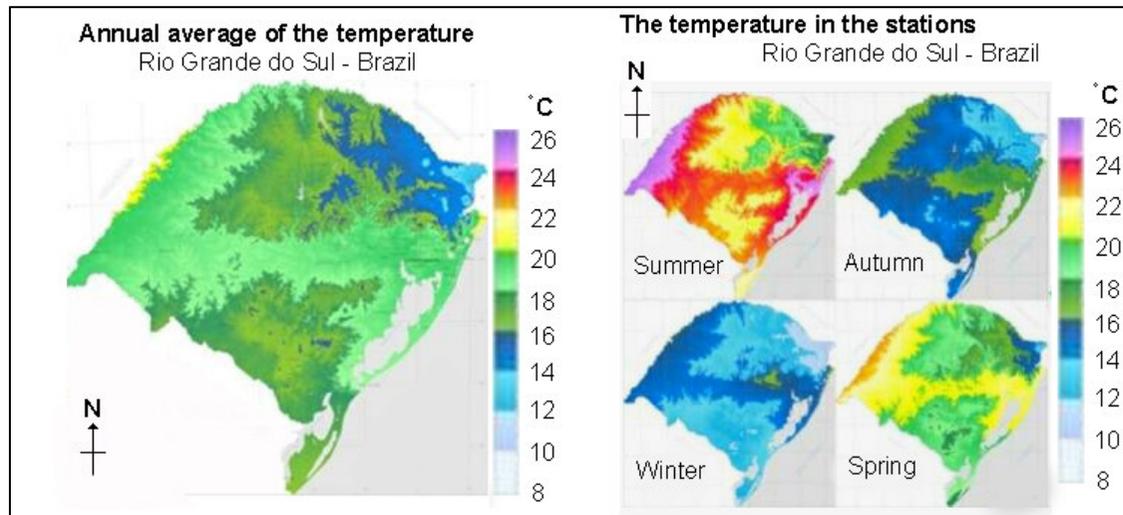
## RESULTS

Regarding the seasonal lightning distribution, in the summer, we verified the largest incidence in the Northwest quadrant, which can be associated to highest temperatures and precipitation. In this season a low activity of atmospheric discharges is also verified in the South of Rio Grande do Sul. In the autumn, lightning are more numerous in the West and Southwest. In this season a large lightning density is verified on South at the State. In the winter the electric activity of the atmosphere decreases plenty, and the distribution concentrates more in the South. A low density of lightning in the coast is verified in the spring, fact that may be associated with the temperature of the surface of the sea, that begin to heat. The West of the state has the largest densities, being this season that presents the largest density of lightning.

## RESULTS

### Lightning and temperature

The low number of lightning in the Northeast of the State coincides with the areas where the lowest temperatures. The high number of lightning is verified at the West and it coincides with higher temperatures.

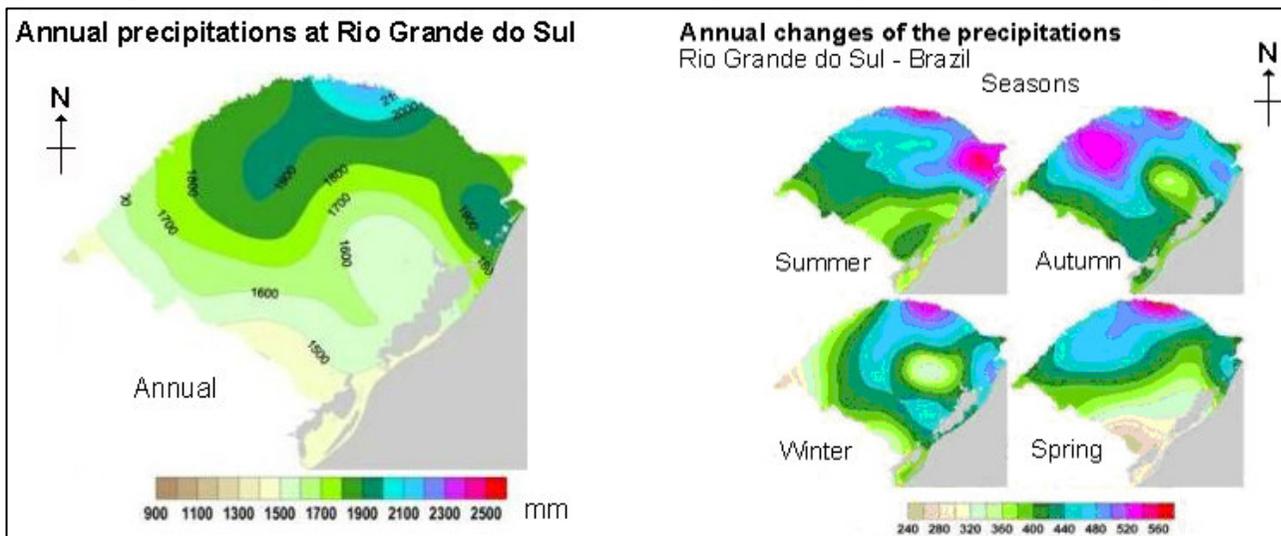


Annual and seasonal temperature of Rio Grande do Sul. Source: Available in: <http://www.semc.rs.gov.br/atlas/climat.htm>.

## RESULTS

### Lightning and precipitations

In relation to the precipitations we verified that the largest precipitation occur in the North of the State, however the number of lightning registered for this area is low. In the West and South, where low precipitation were observed, lightning is more frequent.





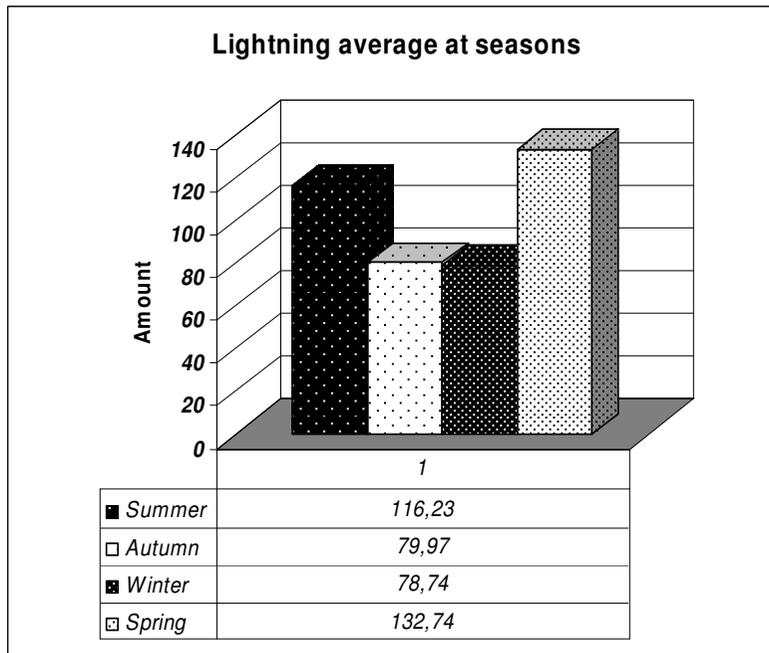
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## **RESULTS**

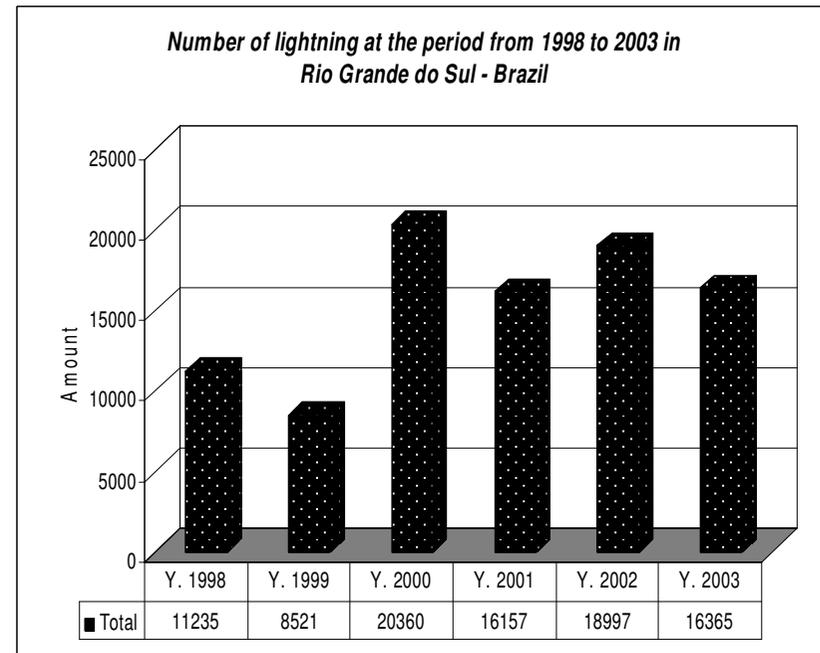
**In the 6 years of study, it was verified that in 1999 the LIS sensor registered less than 10.000 flashes and in 2000 more than 20.000 flashes. The average for these 6 years was 15272 flashes by year. Seasonal variation is presented and it can be seen that in the spring the lightning activity in Rio Grande do Sul is more intense, a fact that could be unexpected. In the winter we had the smallest densities of flashes, followed for the autumn. Thus, the meteorological conditions seem to be the largest conditioning of these variations, marked by the heating in the spring and associated to a larger convective activity and a larger presence of IT. In the autumn and winter we have a domain of MPA that causes a decrease of thunderstorms.**

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# RESULTS



**Seasonal variation of flashes in Rio Grande do Sul, 1998 to 2003**



**Annual variation of the number of flashes in Rio Grande do Sul in the period from 1998 to 2003**



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## **CONCLUSIONS**

**No evidence was found to an increase of lightning activity with altitude. However, this result might have been conditioned, for consider all the types of lightning, differently of the other researches that just considered ground flashes and/or for use low resolution data.**



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## **CONCLUSIONS**

**In general, the spatial distribution of the lightning is more intense in the West, Northwest and Southwest, suggesting a relationship with the convective systems. The areas with the largest precipitation indexes do not coincide with the areas with larger lightning activity, but coincide with the areas that presented the higher temperatures. In synthesis, considering the presented facts, it seems that the synoptic conditions are determining the distribution and the number of lightning in Rio Grande do Sul at the scale of this study.**



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## **CONCLUSIONS**

**Clearly, more studies starting from more reliable lightning data are necessary. Such studies will be possible in the near future, with the installation of a Lightning Detection network in Rio Grande do Sul. Anyway, this study gives the first conclusions about the density and distribution of the lightning in Rio Grande do Sul.**