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The impact of El Nino-Southern Oscillation on Cloud-to-Ground Lightning along the Gulf Coast of the United States

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This study investigates the response of lightning over the United States Gulf Coast region to the El Niño Southern Oscillation (ENSO) for the years 1995-2002. The Gulf Coast region was selected for this study because of its high flash density and because it is an area where the ENSO fingerprint is very clearly demonstrated on both temperature and precipitation patterns.

A Geographic Information System (GIS) was used to construct flash density maps for the complete period of record, individual months, and all the winter and summer seasons. These maps were compared with past lightning climatologies and the one known study linking ENSO with the number of thunderstorm days. Following the qualitative review, Pearson's correlations were computed between concurrent monthly pairings of sea-surface temperatures in the equatorial Pacific NINO 3.4 and lightning flash deviation. The correlation results were visualized in ArcMap GIS, and analyzed both qualitatively and quantitatively.

Monthly mean flash density findings were, overall, consistent with previous United States climatologies. Winter season lightning flash densities are strongly influenced by the ENSO cycle. This was especially evident for the El Nino winter of 1997-1998 when a marked increase in both frequency and spatial extent of flashes occurred. Overall flash densities decreased during La Nina winters. During January and February areas of high correlation between NINO 3.4 SST anomaly and CG lightning flash deviation were spatially coincident with areas of enhanced flash density. Both the enhanced CG flash regions and high correlation values and patterns are indicative of a

southerly shift in the mid-latitude storm track known to occur during warm ENSO events. The summer months did not have as great a response to SST anomalies as the winter months. August was outstanding for having a large area of negative correlation perhaps indicating a decrease in convective activity during El Nino summers. Our study demonstrates the usefulness of GIS as a tool for climate analysis and, more importantly, the results have implications for long-term seasonal planning and public safety.