Sprites and halos produced by positive and negative cloud-to-ground lightning over Argentina and Brazil: Overview of video images, ELF/VLF data, and meteorology

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To investigate sprite activity over Argentina and Brazil, a field campaign was conducted from the Brazilian Southern Space Observatory near Santa Maria, Rio Grande do Sul (29.4^o S, 53.8^o W). We observed more than 500 sprites and halos during two large thunderstorm systems on February 23 and March 4, 2006, which included the third most active sprite-producing storm ever reported. We present an overview of the campaign, which includes sprite video images and extremely low to very low frequency (ELF/VLF) electric and magnetic field data recorded at the observatory, along with coincident lightning location data from the World Wide Lightning Location Network (WWLLN). The optical observations were made using two intensified CCD cameras arranged to view the low elevation sky with overlapping fields of view to capture the sprites and halos above the extensive storm systems. We also present meteorological conditions inferred from GOES Infrared imagery, TRMM rainfall data, WWLLN lightning locations, local radar data, and the BRAMS mesoscale model. Within the high sprite activity, we identified several sprites driven by negative cloud-to-ground (CG) lightning. Downward directed electric fields should be absent following negative CG lightning, so the observation of negative CG sprites challenges runaway breakdown theories of sprite production. The negative CG sprites were not as vertically extensive compared with positive CG sprites from the same storm and appeared to be less bright. In examining over 220 halos, we found that they were overwhelmingly associated with positive CG discharges, however at least 5 were closely associated with negative CG strokes. This is in contrast with recent satellite measurements of halos over land-sea interfaces that suggest that they are mainly associated with negative CG discharges. Another finding is that these storms were large mesoscale convective systems with total cloud shields of 200,000 to 500,000 km^2 and that most sprites occurred in stratiform regions where cloud-top temperatures were about 15° C warmer than spriting regions of US High Plains storms.