Sprites over Africa during the AMMA with Multiple Electromagnetic Detections of Their Parent Lightning Flashes

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The MIT C-band Doppler radar was operated for four months during the 2006 AMMA (African Monsoon Multidisciplinary Analysis) campaign in Niamey, Niger, and documented a large number of energetic positive ground flashes in the trailing stratiform regions of squall lines. Concurrently, a low-light video camera was operated in a vacant control tower at Niamey International Airport for the months of August and September. Large squall line MCSs were frequently present in eastern Niger and Nigeria for anticipated detection of sprites, but the heavy loading of the atmosphere by mineral aerosol and the prevalence of upper tropospheric cirrus cloud streaming westward from the same MCSs often thwarted sprite observations. Nevertheless, sprites were successfully imaged on two nights (August 30 and September 21, 2006), with 14 total events. These events are believed to be the first cases detected from the ground over Africa. The MCS storm sources, at distances of ˜300 km and ˜500 km from the observation site for the two nights, were confirmed with Meteosat satellite imagery. The network of VLF receivers in the World Wide Lightning Location Network (WWLLN) located four of these parent lightning flashes, in good agreement with the satellite imagery. The majority of parent lightning flashes were detected by independently-operated, calibrated ELF receivers in Antarctica, Hungary, Israel, Japan and at two sites (North Carolina and Rhode Island) in the USA. Determinations of the vertical charge moment show excellent agreement among receiving sites, with values typically exceeding the threshold range for sprite occurrence (500-1000 C-km) in earlier studies. The availability of waveforms at multiple receivers for intense point sources such as these will enable further studies of the asymmetry of the Schumann cavity.