Static Electric Fields and Lightning Over Land and Ocean in Florida Thunderstorms

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Abstract—Natural cloud-to-ground (CG) lightning and the charge structure of the associated clouds behave differently over land and ocean. Existing literature has raised questions over the years on the behavior of thunderstorms and lightning over oceans, and there are still open scientific questions. We expand on the observational datasets by obtaining identical electric field observations over coastal land, near-shore, and deep ocean regions during both clear air and thunderstorm periods. Oceanic observations were obtained using two 3-meter NOAA buoys that were instrumented with Campbell Scientific electric field mills to measure the static electric fields. These data were compared to selected electric field records from the existing on-shore electric field mill suite of 31 sensors at Kennedy Space Center (KSC). CG lightning occurrence times, locations and peak current values for both on-shore and ocean were provided by the U.S. National Lightning Detection Network. The buoy instruments were first evaluated on-shore at the Florida coast, to calibrate field enhancements and to confirm proper behavior of the system in elevated-field environments. The buoys were then moored 20NM and 120NM off the coast of KSC in February (20NM) and August (120NM) 2014. Statistically larger CG peak currents were reported over the deep ocean for first strokes and for subsequent strokes with new contacts points. Storm-related static fields were significantly larger at both oceanic sites, likely due to decreased screening by nearby space charge. Time-evolution of the static field during storm development and propagation indicated weak or missing lower positive charge regions in most storms that initiated over the deep ocean, supporting one mechanism for the observed high peak currents in negative first strokes over the deep ocean. This project also demonstrated the practicality of off-shore electric field measurements for safety-related decision making at KSC.