ELSEVIER

Atmospheric Research 76 (2005) 386–401

ATMOSPHERIC RESEARCH

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# Lightning optical pulse statistics from storm overflights during the Altus Cumulus Electrification Study

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Received 31 October 2003; accepted 16 November 2004

**Abstract**

The Altus Cumulus Electrification Study (ACES) was conducted during the month of August 2002 in an area near Key West, Florida. One of the goals of this uninhabited aerial vehicle (UAV) study was to collect time resolved optical pulse data from thunderstorms. During the month long campaign, we acquired 5256 lightning generated optical pulses. Most of these observations were made while quite close to the top of the storms. We divided our data into two amplitude groups based on prior NASA U2 aircraft optical data and the pulse characteristics. The group of strong pulses with radiance greater than 2.1 mW $m^{-2}$ $sr^{-1}$ had mean and median 10–10% optical pulse widths of 770 and 740 μs, respectively, 50–50% pulse widths of 399 and 355 μs, respectively, and 10–90% risetimes of 292 and 260 μs. These values are very similar to the previous U2 based optical results The other group of pulses consisting of slightly more than a quarter of the total pulses observed had radiances less than the minimum values detected in the U2 study. These weak pulses were narrower than the strong pulses with 50–50% mean and median values of 199 and 160 μs, respectively. Only 12% of the flashes observed contained only weak pulses. The source of these

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0169-8095/$ - see front matter 
doi:10.1016/j.atmosres.2004.11.039

weak pulses is unknown, but we suspect that some are artifacts of the close proximity of the aircraft to cloud top.


*Keywords:* Lightning; Unmanned aerial vehicle; Optical pulse; Thunderstorms

## 1. Introduction

In August 2003, the Altus Cumulus Electrification Study (ACES) (Blakeslee et al., 2003) investigated thunderstorms in the vicinity of the Florida Everglades using a high altitude Altus II unmanned aerial vehicle in a science/technology demonstration. Fig. 1 shows the Altus II aircraft, which flew between 15 and 17 km altitude to provide a cloud-top perspective for the storm observations. The aircraft carried a complement of optical, electrical and magnetic sensors to characterize the lightning transients and the thunderstorm electrical environment. The aircraft directly overflew most of the studied thunderstorms. For the few passes where it was unable to overfly the storm, the aircraft was directed to fly around the target thunderstorm. An example of an ACES flight track that included passes both around and then over a thunderstorm complex is shown in Fig. 2.

One objective for the optical measurements collected during ACES was to confirm and expand the cloud-top optical observations acquired by NASA U2 aircraft in the early

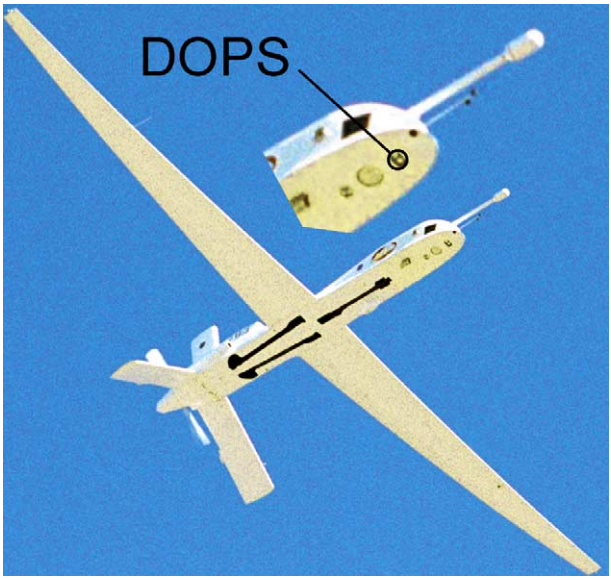


Fig. 1. Photo of Altus aircraft. The DOPS is mounted looking downward near the nose of the aircraft (the marked rectangular hole on the bottom of the aircraft).