

TITLE: LIGHTNING OBSERVATIONS ABOVE AND BELOW CLOUDS

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Significant Accomplishments to Date in FY-84:

1) A study of the quantitative optical characteristics of cloud-to-ground (CG) and intracloud (IC) lightning above clouds is nearing completion. A data base of a number of pulse parameters such as energy, rise times, pulse widths and pulse intervals has been compiled and categorized for first return strokes, subsequent strokes, the intracloud part of CG flashes and IC flashes. Major conclusions from this study are 1) single stroke CG's are more readily distinguishable from IC flashes than multiple stroke CG's; 2) there is no significant difference between the energy of first and subsequent return stroke pulses; and 3) the pulse rise times and pulse widths are time broadened.

2) An initial study of lightning activity in a mesoscale convective weather system (MCS) has been undertaken. CG flash rates average almost 50 per minute for 7 hours. U-2 observations of lightning above storms embedded within the MCS show that IC lightning activity can be much greater than CG activity at certain times in the MCS lifecycle.

Focus of Current Research Activities:

The quantitative analysis of the optical pulse characteristics of lightning measured from the U-2 is being completed with a few pulse discrimination techniques for distinguishing CG from IC flashes being tested. More emphasis will be given on studies relating the lightning observations to storm structure and evolution.

Plans for FY-84:

Doppler radar and lightning ground strike density data sets will be compared to evaluate the ground strike density technique for storm cell characterizations. Current research activities using U-2 observations will continue.

Recommendations for New Research:

Determine if there are more single stroke CG's during the early part of the storm life cycle since these flashes appear to be readily detectable from above clouds. This will require a thorough literature search and examination of ΔE data from NSSL.

List of Publications Prepared Since June 1983:

- Rust, W. David, W.L. Taylor, D.R. MacGorman, R.T. Arnold, S.J. Goodman, and V. Mazur, 1983: "Storm Electricity Research in Oklahoma: An Overview," Preprints, 8th International Aerospace and Ground Conference on Lightning and Static Electricity, DOT/FAA/CT-83/25, pp. 1.1 - 8.
- Goodman, Steven J., 1983: "Lightning Activity Associated with Severe Storms Embedded Within a Mesoscale Convective Storm Complex," Preprints, 13th Conf. on Severe Local Storms, Am. Meteor. Soc., pp. 29 - 32.
- Goodman, Steven J., and H.J. Christian, 1983: "Simultaneous Observations of Lightning from Above and Below Thunderstorms," EOS, Vol. 64, No. 45, p. 660.
- Rust, W.D., W.L. Taylor, D.R. MacGorman, E. Brandes, V. Mazur, R.T. Arnold T. Marshall, H. Christian and S.J. Goodman, 1984: " Lightning and Related Phenomena in Thunderstorms and Squall Lines," AIAA 22nd Aerospace Sciences Meeting, Reno, Nevada, 9 pp.
- Goodman, S.J., H.J. Christian, W.D. Rust, D.R. MacGorman, and R.T. Arnold, 1984: "Simultaneous Observations of Cloud-to-Ground Lightning Above and Below Cloud Tops," Preprints, VII International Conf. on Atmospheric Electricity, Am. Meteor. Soc., 7 pp.
- Christian, H.J., R.L. Frost and S.J. Goodman, 1984: "The Optical Characteristics of Lightning as Measured from Above Cloud Tops," Preprints, VII International Conf. on Atmospheric Electricity, Am. Meteor. Soc., 4 pp.
- Johnson, R.L. and S.J. Goodman, 1984: "Atmospheric Electrical Activity Associated With Hurricane Alicia," Preprints, VII International Conf. on Atmospheric Electricity, AM. Meteor. Soc., 4 pp.