Lightning Warnings using a Logical AND (intersection) Combination between Intra-Cloud Discharge and electric field Data

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Abstract

The objective of this study is to identify the optimal warning trigger, and clear conditions of a stand-alone lightning warning system (SLWS) to protect the infrastructure of NMSC (National Meteorological Satellite Center) against cloud-to-ground strikes (CG).

In my prior study [Shim, 2019], it was already found that a logical OR (union) combination with intra-cloud discharges (IC) and CG is better than IC only data to increase in probability of detection (POD), whereas critical success index (CSI) as a function both POD and false alarm ratio (FAR) became worse relatively to 0.47 from 0.57.

To augment CSI, as an another warning condition, a logical AND (intersection) combination between IC and atmospheric electric field (EF) data is explored in this study.

Warning statistics with CG in the area of concern (CGAOC), successful prior warning (SUC), false alarm (FR), and failure to warn (FTW) have been collected to evaluate the warning condition during the last two summers.

The statistics are analyzed, and compared with other conditions, and prior literature[e.g., Murphy, and Said, 2016] by using POD, FAR, CSI, and total alarm duration (TAD).

The warning methods adopted in this paper are "two-region" for CG, "one-region" for IC, and "threshold warning" for EF data. Those are similar to the "lightning AND electric field rule" used by Murphy and Said (2016).

A one second is referred to as effective lead time (LT) because the time is enough to turn on/off power automatically in case of the NMSC.

Upon conclusion of this study, it was found that the combination was the best in CSI than those of my past studies in all the cases [e.g., Shim, 2019], while the penalty was that POD became somewhat lower than the IC OR CG, and IC only. Finally, the TAD including LT showed little difference among the assessed warning conditions.

Keywords lightning warning; critical success index; intra-cloud discharges; electrostatic field

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Topic Areas

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