



On the potential use of lightning and total lightning information for nowcasting - a review

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Lightning and total lightning (TL) activity has been monitored for decades now, ranging from local field measurements, ground networks to space-borne observations. The term “lightning“ is usually understood as cloud-to-ground (CG) lightning, while “total lightning“ comprises CG and intra-cloud (IC) lightning. Lightning information is an important indicator for storms, severe weather and other related hazards like hail, turbulence, gusts or heavy rain.

Worldwide, all weather services use the locally and globally available lightning information, predominantly in a qualitative way by the forecaster as a diagnostic observational tool and for forecasting purposes, mainly for nowcasting. Furthermore, lightning data are of interest in many research fields and for many applications such as aviation safety, power plant operations, atmospheric chemistry, forest fire, flash flood or precipitation forecasting. However, the quantitative use of lightning and TL information is still in its advent.

The objective of this presentation is to review of how and to what extent and for what purposes lightning and TL data are used currently in a quantitative matter in the various forecasting schemes under development. This research originated from a project within the Priority Program “*Quantitative Precipitation Forecast (QPF)*“ of the German Research Foundation (DFG). One of its objectives is to improve the short-term QPF with help of all types of new data, among which lightning and TL are of primary interest. Lightning research in Hannover/Germany is based essentially on a university owned regional and operational SAFIR total lightning detection system (FINKE ET AL., 2004).

The main findings of the review may be summarized as follows:

- a) It is general consensus that lightning initiation and lightning characteristics are governed by many cloud characteristics which, in turn, may allow to conclude on the latter by analysis of lightning information. This potential use of lightning information is objective of many research programs and outside the scope of this study.
- b) With respect to forecasting purposes, lightning data are mainly used for now-casting.
- c) Only a few nowcasting systems for convective weather make use of lightning information quantitatively.
- d) Assimilation techniques of lightning and TL data in cloud-resolving numerical weather prediction models are under development.
- e) A new application of lightning data emerges from inclusion into Model Output Statistics (MOS).

Recent trends in use of lightning data focus on the potential superiority of total lightning over conventional CG lightning. That view is based on the following hypothetical advantages:

- Higher spatial and temporal coverage with TL data rather than with CG lightning data only. TL covers more than the main updraft region and corresponds closer with the radar coverage.
- Despite of the expected higher data rate of 5 to 10 there is no additional delay with TL data.
- Not yet fully explored but presumed correlation with storm characteristics, resulting in provision of precursor parameters of severe weather.
- As IC discharges generally precede CG lightning in the range of several minutes, the former may be used as indicators of newly developing cells.

Results will be discussed and examples will be presented.

References:

1. FINKE, U. AND O. KREYER, 2002: *Detect and Locate Lightning Events from Geostationary Satellite Observations. EUMETSAT Report Part 1, Review of existing lightning location systems, EUM/CO/02/1016/SAT, September 2002.*
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3. KREYER, O., 2004: <http://www.muk.uni-hannover.de/forschung/hauf/dfglight.doc>.