



Visual Analytics approach for Lightning data analysis and cell nowcasting

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Thunderstorms and their ground effects, such as flash floods, hail, lightning, strong wind and tornadoes, are responsible for most weather damages (Bonelli & Marcacci 2008). Thus to understand, identify, track and predict lightning cells is essential. An important aspect for decision makers is an appropriate visualization of weather analysis results including the representation of dynamic lightning cells. This work focuses on the visual analysis of lightning data and lightning cell nowcasting which aim to detect and understand spatial-temporal patterns of moving thunderstorms.

Lightnings are described by 3D coordinates and the exact occurrence time of lightnings. The three-dimensionally resolved total lightning data used in our experiment are provided by the European lightning detection network LINET (Betz et al. 2009). In all previous works, lightning point data, detected lightning cells and derived cell tracks are visualized in 2D. Lightning cells are either displayed as 2D convex hulls with or without the underlying lightning point data. Due to recent improvements of lightning data detection and accuracy, there is a growing demand on multidimensional and interactive visualization in particular for decision makers.

In a first step lightning cells are identified and tracked. Then an interactive graphic user interface (GUI) is developed to investigate the dynamics of the lightning cells: e.g. changes of cell density, location, extension as well as merging and splitting behavior in 3D over time. In particular a space time cube approach is highlighted along with statistical analysis. Furthermore a lightning cell nowcasting is conducted and visualized. The idea thereby is to predict the following cell features for the next 10-60 minutes including location, centre, extension, density, area, volume, lifetime and cell feature probabilities. The main focus will be set to a suitable interactive visualization of the predicted features within the GUI. The developed visual exploring tool for the purpose of supporting decision making is investigated for two determined user groups: lightning experts and interested lay public.

Betz HD, Schmidt K, Oettinger WP (2009) LINET – An International VLF/LF Lightning Detection Network in Europe. In: Betz HD, Schumann U, Laroche P (eds) Lightning: Principles, Instruments and Applications. Springer Netherlands, Dordrecht, pp 115-140

Bonelli P, Marcacci P (2008) Thunderstorm nowcasting by means of lightning and radar data: algorithms and applications in northern Italy. *Nat. Hazards Earth Syst. Sci.* 8(5):1187-1198