9.2 THE NOWCASTING POTENTIAL OF LIGHTNING-JUMPS IN CONVECTIVE CELLS TRACKED BY RADAR IN COMPLEX OROGRAPHY

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The developing phase of intense convective storms is often correlated with a sudden increase in the total lightning rate within thunderstorm cells. This abrupt increase, a so-called lightning jump, can occur from few minutes to some tenth of minutes before the onset of severe convective weather characterized by hail, wind gusts and heavy rainfall. Several studies suggest that lightning jumps can be used as predictors of severe weather, with the potential to increase the lead-time of real-time thunderstorm warnings, in combination with other parameters.

In recent years, a few algorithms have been developed to exploit the lightning jump potential for nowcasting severe thunderstorms. Ground-based total lightning detection networks and space-based detectors have been used. These algorithms were first applied on ground-based data over flat or hilly terrain, and later on the data measured by the new GOES-R Geostationary Lightning Mapper. A study on how lightning jumps behave in storms over the complex orography of the Alps was until now missing. A robust, 5-year statistical analysis of thunderstorm cells and total lightning data was performed to fill this gap. About 8400 hail storms were automatically detected and tracked by the Thunderstorms Radar Tracking (TRT) algorithm based on volumetric radar data from the MeteoSwiss network, and compared to more than 50,000 non-severe convective storms. The total lightning rate (CG and IC) from an operational ground-based lightning detector network was used. Results show an average lead-time of the lightning jumps to hail initiation inside the storm cells of about 20 minutes. However, only approximately 32% of hail storms produce a lightning jump before hail initiation.

Based on these findings, for nowcasting and warning purposes, MeteoSwiss has developed a real-time prototype algorithm for the automatic lightning jump identification and display. It uses the total lightning rate from the operational network to identify the occurrence of lightning jumps based on the classical 2-sigma threshold. In addition for each cell the continuous value of the sigma-level, a metric of lightning jump strength, is also computed automatically and visualized for the forecasters in real-time. To this purpose the total lightning rate is computed inside each convective cell identified automatically by the tracking algorithm of the TRT nowcasting system. To fully exploit the high temporal availability of the lightning data, the temporal resolution has been increased to 2.5 minutes. The new algorithm is going to be integrated in the convection nowcasting and warning systems already in use at MeteoSwiss such as TRT, COALITION, NowPAL and INCA.

In this paper the nowcasting potential of lightning jumps is analyzed and discussed based on a 5-year statistical study, and a first real-time prototype for the use in the complex Alpine orography is presented. An outlook on future operational applications is also provided.