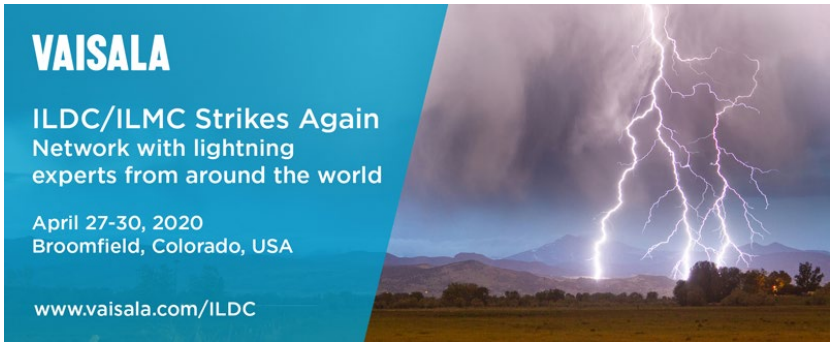


# Using Elves Recorded by the Pierre Auger Observatory to Study Argentinian Superbolts

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## Abstract

The Pierre Auger Cosmic-Ray Observatory, located in Malargüe, Argentina, has been observing transient luminous events, caused by the most intense lightning in the tallest thunderstorms on Earth. The combined field-of-view of the 24 telescopes of the UV Fluorescence Detector (Auger FD) spans 3x106 sq. km when it is projected to the base of the ionosphere. With a 100 ns time resolution, a data acquisition window up to 900 μs long, and a dedicated trigger since 2013, the FD can resolve the sub-structure of Emissions of Light from Very low frequency perturbations due to Electromagnetic pulse Sources, or elve(s).

From the high-quality transients observed in the Auger FD, we are able to reconstruct the location of the elve-inducing lightning strikes with an accuracy equivalent to ground-based detectors, but we can also provide information not typically obtainable from sferics observed at the ground. For example, with the help of a correlation with the Vaisala Global Lightning Dataset GLD360, we can test current models for the production of elves from intra-cloud (IC) or cloud-to-ground lightning activity, and provide an average variation of the height of the ionosphere during our total observation period on moonless nights from 2016 to mid-2019. A reconstruction of the lightning strike height, obtained from the multi-peaked photo-traces of elves created by IC lightning, can provide insights on the internal charge structure of these atypical Argentinian thunderstorm cells.

In addition, Northern Argentina and Chile have been flagged as the only regions over land with a high density of Superbolts. With the peak current values of elve-inducing lightning, provided by GLD360, we are able to select and study the largest transient luminous events on Earth and their complex internal structure. We have simulated IC superbolts with the specific lightning parameters of provided by Vaisala, in a well-accepted EMP simulation, to try to understand some of the emission profiles observed in the multi-peaked photo-traces of the Auger FD.

## Topic Areas

Lightning Physics, Characteristics and Measurements, Lightning Interactions with the Upper Atmosphere

## Submission Format

Oral