In 2007 and 2008, we measured waveforms of vertical and horizontal electric fields from leaders and return strokes associated with lightning strikes to the 100-m tall Gaisberg tower in Austria. The Gaisberg Tower is a 100-m tall radio tower located 1287 m above sea level on the top of a mountain 5 km east of the city of Salzburg, Austria. On average, the tower is exposed to about 60 direct flashes per year [1]. The tower dimensions at ground level are 10.5 m × 10.5 m. The horizontal and vertical electric fields were measured at distances of 20 and 22 m from the tower centre, respectively. Simultaneously, the lightning return stroke current was measured using a sensor located near the top of the tower [2].

**Abstract**—We present measurements of very close vertical and horizontal electric fields from leaders and return strokes associated with lightning strikes to the 100-m tall Gaisberg tower in Austria obtained in 2007 and 2008. Simultaneously with the fields, return-stroke currents were also measured at the top of the tower. The vertical electric field waveforms appeared as asymmetrical V-shaped pulses. The initial negative electric field change is due to the downward leader and the following fast positive field change is due to the upward return stroke phase of the lightning discharge. The horizontal (radial) electric field due to the leader phase has a similar waveshape to the vertical electric field. However, the horizontal field due to the return stroke is characterized by a short negative pulse of the order of 1 microsecond or so, starting with a fast negative excursion followed by a positive one. Due to the shadowing effect of the tower, the return-stroke vertical electric field changes appear to be significantly smaller than similar measurements obtained using triggered lightning.

**Keywords**—Lightning, tall structures, electric fields, return stroke, leader

![Fig. 1. Representative waveforms of the data recorded on 2008-07-20, (a) tower top current, (b) horizontal electric field at \( r = 20 \) m, and (c) vertical electric field at \( r = 22 \) m (flash 682, stroke 1 of 3). The arrow represents the transition between the leader and the return stroke.](image-url)
Fig. 1 shows a representative set of simultaneously measured return-stroke current and associated fields. The vertical electric field waveforms appeared as asymmetrical V-shaped pulses [3]. The initial, relatively slow, negative electric field change is due to the downward leader and the following fast positive field change is due to the upward return stroke phase of the lightning discharge. The horizontal (radial) electric field due to the leader phase has a similar waveshape to the vertical electric field. However, the horizontal field due to the return stroke is characterized by a short negative pulse of the order of 1 microsecond or so, starting with a fast negative excursion followed by a positive one [2].

The return-stroke vertical electric field change at 20 m appears to be significantly smaller than similar measurements obtained using triggered lightning [4]. This is due to the shadowing effect of the tower which results in a significant decrease of the electric field at distances of about the height of the tower or less [5, 6].

ACKNOWLEDGMENT

This work has been financially supported by the Swiss State Secretariat for Education and Research (Grant No C05.0149), Armasuisse (Science and Technology), and the European COST Action P18 ‘The Physics of Lightning Flash and Its Effects’.

REFERENCES


