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The Johannesburg Lightning Laboratory (JLL)

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Abstract

Johannesburg is a unique city in the world, with a lightning flash density between 15 - 20 flashes/km²/year, making it one of the few cities to have its main economic and industrial centre in a high lightning density area. Johannesburg has shown itself to be an ideal location for lightning observations, as the thundercloud base is high allowing the researchers to observe the complete channel of lightning events, even to tall towers located at the city, which have a high incidence of both upward and downward natural flashes. Lightning is of particular concern to the renewable energy industry - namely wind energy. To produce this energy, tall wind turbines are installed. These wind turbines are susceptible to a type of lightning known as upward lightning, characterised by its slow initial current rise leading to severe heating and damage.

The Johannesburg Lightning Laboratory (JLL) project aims to turn Johannesburg into a laboratory where real lightning events can be measured and characterised through the use of high-speed cameras, direct current measurements to the tower, fast electric field measurements, field mill measurements and the South African Lightning Detection Network (SALDN). The research objectives for the project:

To characterise upward lightning currents to a 250m-tall tower using high-speed video footage as well as direct current measurements at the tower.

To measure propagated electric field changes of lightning events and develop an estimation model that allows the parameters characterised in 1. to be estimated from electric field measurements.

To apply deep learning techniques to the propagated electric field measurements and train a network to distinguish upward lightning events to the tower from intra-cloud events or downward lightning events in the region.

To compare the ground-truth measurements (video and current) and electric field measurements with SALDN reports.

The JLL project begins running for the summer thunderstorm season of 2019-2020 and will be run for many subsequent seasons. This paper will present the equipment and the project set up, as well as some of the preliminary results obtained during this first season.

Topic Areas

Lightning Physics, Characteristics and Measurements, Lightning Detection Systems
Technology and Performance

Submission Format

Poster