Sessions 1a, 1b, 1c

Lightning Discharge

Moderator's Report

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A total of 22 papers have been accepted for presentation in three oral sessions (1a, 1b, and 1c) allotted to ICLP Topic 1, Lightning Discharge in 2004. This is more than 16 and 17 papers in 2002 (Cracow) and 2000 (Rhodes), respectively, but less than 26 papers in 1998 (Birmingham). The 22 accepted papers have been assigned to the three sessions as follows:

Session 1a, **Experimental data on lightning**, 7 papers (see Table 1)
Session 1b, **Lightning modeling**, 8 papers (see Table 2)
Session 1c, **Miscellaneous**, 7 papers (see Table 3)

Table 1. **Session 1a, Experimental Data on Lightning**

Paper Number	Author(s)	Country	Paper Content
1a.1 (158)	Wada et al.	Japan	Four types of lightning flashes initiated by an upward positive leader
1a.2 (95)	Miki et al.	Japan	Bipolar lightning discharges initiated from the 200-m Fukui chimney in winter in Japan
1a.3 (67)	Mesquita et al.	Brazil	Characterization of positive lightning in Brazil
1a.4 (175)	Baran and Berger	Romania, France	Characterization of negative and positive lightning in France
1a.5 (191)	Sharma et al.	Sri Lanka, Sweden	Frequency spectrum of electromagnetic fields produced by positive lightning strikes to the sea
1a.6 (195)	Sonnadara et al.	Sri Lanka, Sweden	Frequency spectra of electromagnetic fields produced by cloud flashes
1a.7 (180)	Liyanage et al.	Sri Lanka, Sweden	Comparison of optical and current waveforms of laboratory discharges

Table 2. **Session 1b, Lightning Modeling**

Paper Number	Author(s)	Country	Paper Content
1b.1 (60)	Visacro and Silveira	Brazil	The use of a hybrid electromagnetic/circuit model for studying lightning return stroke processes
1b.2 (251)	Bonyadi-ram et al.	Iran	An electromagnetic model of the return stroke with additional distributed inductance along the channel
1b.3 (81)	Maslowski	Poland	The use of an electromagnetic model to examine the role of corona sheath in the return-stroke process
1b.4 (94)	Theethayi and Cooray	Sweden	Return stroke as a lossy, non-uniform transmission line
1b.5 (204)	Cooray et al.	Sweden, USA, Italy, Switzerland	Waveshape of the equivalent corona current in engineering models
1b.6 (44)	Miyazaki and Ishii	Japan	The use of an electromagnetic model for studying lightning strikes to tall objects
1b.7 (168)	Pavanello et al.	Switzerland, USA, Italy	The use of engineering models for studying lightning strikes to a tall object
1b.8 (137)	Beroual et al.	France, Canada	A distributed-circuit model of negative long sparks

Table 3. **Session 1c, Miscellaneous**

Paper Number	Author(s)	Country	Paper Content
1c.1 (189)	Rakov	USA	A review of experimental data on lightning return-stroke speed
1c.2 (100)	Cooray et al.	Sweden, USA	The relationship between leader charge and return-stroke peak current
1c.3 (234)	Visacro et al.	Brazil	Lightning currents at the top and bottom of a relatively short strike object
1c.4 (114)	Bermudez et al.	Switzerland, Germany, USA	Approximation of measured lightning current waveforms by analytical functions
1c.5 (231)	Baran and Bouquegneau	Romania, Belgium	Statistical description of lightning current waveshape parameters
1c.6 (92)	Miki et al.	Japan	Laboratory studies of upward leaders in laser-triggered discharges
1c.7 (199)	Vasa et al.	Japan	A new technique for measuring lightning electric fields

The following are common themes in the 2004 edition of Topic 1, Lightning Discharge.

I. Interaction of lightning with tall structures

This area of lightning research continues to be very active. Both experimental (papers **1a.1**, **1a.2**, and **1c.6**) and modeling (**1b.6**, **1b.7**, **1c.3**, and **1c.4**) studies will be covered. There are two main directions in the modeling studies: (a) quantification of the effects of the strike object on measured currents that are to be applied to the case of lightning strikes to flat ground and (b) the effects of tall strike objects on remote electric and magnetic fields (with implications for detection and characterization of strikes to tall objects by lightning locating systems). Papers on lightning interaction with tall structures will be also presented in sessions for other ICLP topics (e.g., papers **3a.1**, **3a.5**, and **9b.7**).

II. Electromagnetic models of the lightning return stroke

The number of papers concerned with the development and application of such models increased from 2 at ICLP 2000 (Rhodes) to 4 at ICLP 2002 (Cracow) to 7 at ICLP 2004 (papers **1b.1**, **1b.2**, **1b.3**, **1b.6**, **1c.3**, **3a.5**, and **9b.2**). In electromagnetic models, Maxwell's equations are used to find the distribution of current along the lightning channel (papers **1b.2**, **1b.3**, **1b.6** and **9b.2**), although the model utilized in papers **1b.1**, **1c.3**, and **3a.5**) is based on a hybrid electromagnetic field/circuit theory approach. A major challenge in electromagnetic models is to find and implement physically reasonable means that would allow propagation of current waves at a speed that is lower than the speed of light, in accordance with optical observations.

III. Positive and bipolar lightning discharges

Positive lightning discharges are defined as those effectively transporting a positive charge from a cloud to the earth. It is thought that less than 10% of global cloud-to-ground lightning is positive, although positive lightning can be the dominant type during the cold season, during the dissipating stage of a thunderstorm, and in some other situations. Positive lightning discharges are studied in papers **1a.3**, **1a.4**, **1a.5**, and **1c.1**.

Lightning discharges that transfer to ground both positive and negative charges are termed bipolar lightning discharges. Bipolar lightning is usually not included in the traditional lightning classification, although it appears to be not less frequent than positive lightning. Bipolar lightning discharges are noted or discussed in papers **1a.1**, **1a.2**, and **1a.4**.