<1 line>

**Charge distribution in thunderstorm clouds** <boldface, 12pt>

<1 lines>

First Author1, Second Author2, Third Author3, and Forth Author2

<1 line>

1 First University, 1-2-3 XXX, YYY City, Tokyo zzz-zzz, Japan <9pt>

E-mail: xyz@xyz.xyz.ac.jp <option>

2 Second University, 1-1-1 XXX, YYY City, Osaka zzz-zzz, Japan

3 Third Research Institute, 3-2 XXX, YYY City, Hokkaido zzz-zzzz, Japan.

<1 line>

(Received xxxx, 2018; revised xxxx; accepted xxxx)

<2 lines>

**Abstract**. Charge distribution in thunderstorm clouds has been studied by the simultaneous electric field measurements ------------------------ . This paper describes ------------------------ . Charge distribution in thunderstorm clouds has been studied by the simultaneous electric field measurements ------------------------ . This paper describes ------------------------ . Charge distribution in thunderstorm clouds has been studied by the simultaneous electric field measurements ------------------------ . This paper describes ------------------------ . <hereafter single space, 11pt>

<1 line>

**Keywords:** keyword 1, keyword 2, keyword 3, keyword 4

<1 line>

**1. Introduction**

One of the most fundamental problems in thunderstorm electricity is to determine charge quantities and their positions in the storm clouds. Tanaka (1985) have shown that ------------------------------------------------------------------------------------------------------------------------------------------------------------.

One of the most fundamental problems in thunderstorm electricity is to determine charge quantities and their positions in the storm clouds. --------------------------------------------------------------------------------------------------------.



Figure 1. Model of charge distribution in thunderstorm clouds.

<1 line>

**2. Measurements and data analysis**

**2.1. Measurements**

The electric fields have been measured at eight stations in Tokyo for active thunderstorms which appeared during the five summer seasons 2015-2018 -----------------------------------------------------------------------------------------. The measurements equipment consists of -----------------------------------------------------------------------------------------.

The electric fields have been measured at eight stations in Tokyo for active thunderstorms which appeared during the five summer seasons 2015-2018 -----------------------------------------------------------------------------------------. The measurements equipment consists of -----------------------------------------------------------------------------------------.

<1 line>

**3. Results and discussion**

Obtained observation data are shown in Tab. 1. ----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------.

Table 1. Observation data.

|  |  |
| --- | --- |
| Data 1 | 123 |
| Data 2 | 456 |
| Data 3 | 789 |
| -------------------------------------- | -------------------------------------- |
| -------------------------------------- | -------------------------------------- |
| -------------------------------------- | -------------------------------------- |
| -------------------------------------- | -------------------------------------- |
| -------------------------------------- | -------------------------------------- |
| -------------------------------------- | -------------------------------------- |
| -------------------------------------- | -------------------------------------- |
| -------------------------------------- | -------------------------------------- |
| -------------------------------------- | -------------------------------------- |
| -------------------------------------- | -------------------------------------- |
| -------------------------------------- | -------------------------------------- |

Figure 2 represents the estimated charge quantities and their positions in clouds. The quantities of charge is estimated by Suzuki et al. (2010) as

…………………. (1)

Here, and are aaa and bbb values, respectively (Tanaka 1985; Yamada and Yamakawa 2016). The bbb value is given by

…………………………. (2)

Substituting the permittivity of free space into the Eq. (2), can be approximated as --------.

---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------.



Figure 2. Estimated charge quantities and their positions in clouds.

<1 line>

**4. Conclusion**

It is concluded that the charge distribution in thunderclouds is -------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------.

<1 line>

**Acknowledgement.** The authors thank J. Matsushita for his assistance in the measurements of -------------------------------. ABC model data were obtained from the DEF Center, NASA. This work was supported by JSPS KAKENHI Grant Numbers JPxxxxxxxx,JPyyyyyyyy,JPzzzzzzzz.

<2 lines>

**References**

<1 line>

Sato A., B Sato, C. Sato and D Sato (2012), Regional difference in tropical cyclone distributions, *J. Applied Meteorology*, xx, pp. yyy-zzz

Suzuki A., B. Suzuki, C. Suzuki and D. Suzuki (2010), A new model of charge generation in winter thunderclouds. *xx th International Kaminari Congress (IKC)*, IAC-yy. zzzz, Osaka, Japan

Tanaka A. (1985), Lightning physics. *in Cloud physics*, ed. by T. Okuda, Iwanami, Tokyo, pp. 256-280

Yamada A. and B. Yamakawa (2016) Global frequency and distribution of lightning, *J. Geophysical Research*, xxx, yy, 4005, doi:10.1029/2015JDzzzzzz

< in alphabetical order of the first author’s name without numbering.>