

The observation of Sporadic E using FT8 in Japan

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Abstract

Sporadic E has dramatic effects on communication in the HF and VHF bands. In this study, I observed Sporadic E using FT8 on 50MHz in Japan. A large number of reception reports were directly collected during Sporadic E events, and the locations of each transmitting station were determined. From the information collected, this study identified the horizontal structure and movement of Sporadic E. In conclusion, most of the observed structures exhibited an overall shape extending in the east–west direction, or slightly in the north–south direction, and no structures that purely elongated along the north–south axis of the Japanese archipelago were observed. This tendency is consistent with results obtained from GNSS and other techniques used in existing studies.

Introduction

Recently, Ionosonde and GNSS-TEC methods are mainly used to observe Sporadic E in Japan.

【Ionosonde】

National Institute of Information and Communications Technology (NICT) operate ionosonde systems. Ionosonde can observe ionosphere by the stable interval, so it can provide more accurate data. However, it cannot reveal the horizontal structure of Sporadic E. Also, Ionosondes which NICT has are only in 4 locations in Japan, so there would be areas that Ionosonde cannot observe sporadic E.

【GNSS TEC method】

GNSS-TEC is a method that uses the total number of electrons in high altitude atmosphere. It can reveal the horizontal structure and motion of Sporadic E very accurately. However, it cannot observe some Sporadic E whose critical frequency is below 17MHz.

Given these factors, this study argues that FT8 makes it possible to reveal horizontal structure of all sporadic E in Japan, even when its critical frequency is below 17MHz.

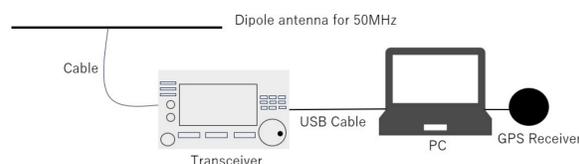
Purpose

- To observe horizontal structure of sporadic E in Japan by using FT8 on 50MHz.
- To compare the result with the conventional research.
- To reveal advantages and disadvantages of FT8 for researching ionospheric phenomena.

Method

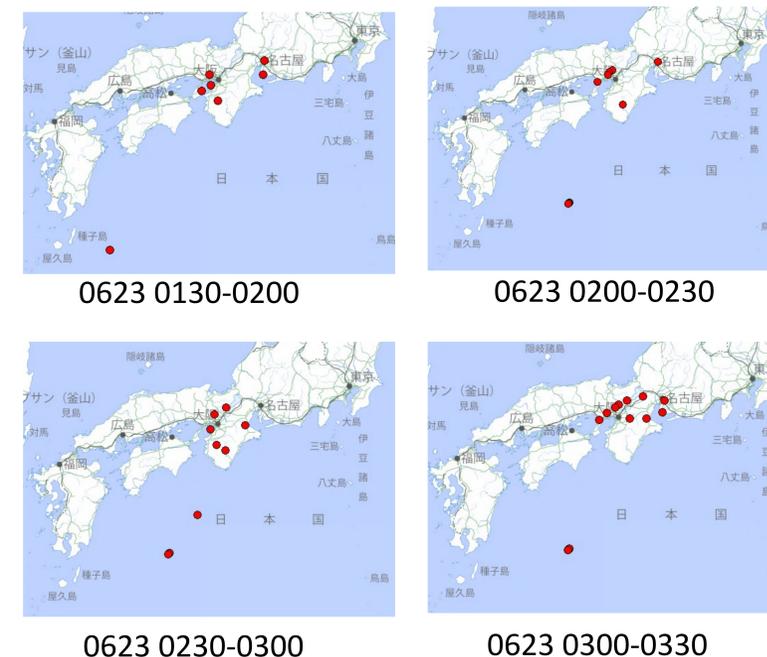
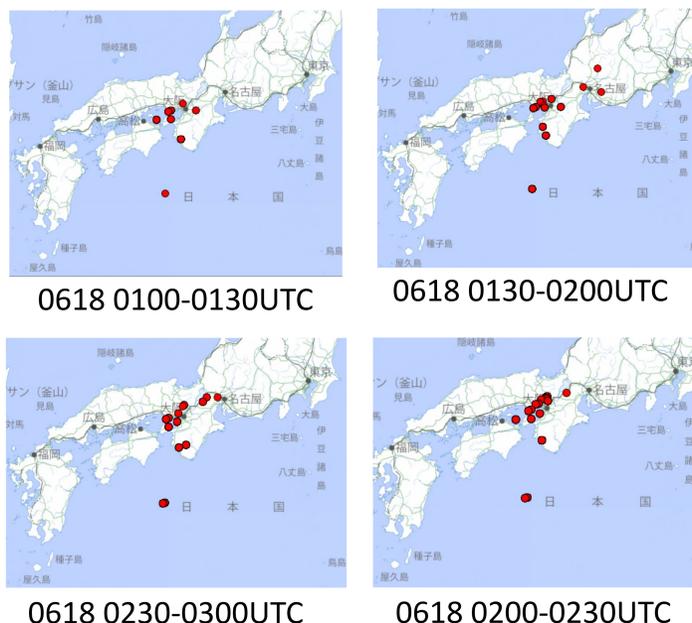
The research method is as follows:

- ① Receiving FT8 signal on 50.313MHz
- ② Installing reception data and analyzing to PC
- ③ Identifying locations of each transmitting station based on public database provided by Japanese government
- ④ Plotting midpoints between transmitting stations and an observing station. The gathering of the midpoints indicate the horizontal structure of Sporadic E.



Result

The clustering of the red dots indicates the presence of Sporadic-E. From positional changes of the red dots, we can observe the spatial distribution and movement of Sporadic-E. Most of the observed structures generally exhibited an overall shape extending in the east–west direction, or slightly in the north–south direction, and no structures purely elongated along the north–south axis of the Japanese archipelago were observed. This tendency is consistent with observations obtained from GNSS and related measurement techniques.



Discussion

<Advantage>

• This method enables observation of the horizontal structure of Sporadic E with a critical frequency under 17 MHz, which cannot be observed by GNSS.

<Limitations>

- Especially at night, the number of active amateur radio stations is limited, which may make observing Sporadic E difficult.
- Even when Sporadic E appears to be moving, the apparent motion may actually be caused by changes in the activity of amateur radio stations.
- Naturally, this method cannot be applied in regions where amateur radio stations are not present.

<Future works>

- Receive signals at multiple locations across Japan in order to increase the number of red plots, which would allow a more accurate observation of the horizontal structure of Sporadic E.
- Combining these observations with data from GNSS and ionosondes to provide real-time information on Sporadic-E layers across Japan.