Peru installation report on December in 2015

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We developed new MAGDAS site in Peru on December in 2015 under the support by Dr. Jose K. Ishitsuka, the director of Huancayo observatory of IGP, and local committees. The purpose of this installation is to investigate and monitor detailed structure of Equatorial Electro-Jet (hereafter, it is called EEJ) or structural change of EEJ caused by ionosphere disturbances. Other participants for this installation are Dr. Shuji Abe from International Center for Space Weather Science and Education (ICSWSE), and two under graduate students from Kyushu University. The section of "Introduction" explains brief introduction of EEJ and our purpose of this installation. The sections of "Work report at Tingo Maria" and "Work report at Tarapoto" explain our contact person at each sites, how we installed magnetometer there, and shows derived data. The section of "Future work" explains our future plan in terms of both scientific and capacity building.

Introduction

Motivation

MAGDAS/CPMN network [Yumoto et al., 2006 and 2007], which is the largest network of magnetic field observation on the ground, has developed to all over the world by ICSWSE and local collaborators. MAGDAS in Peru, where installed at ANC, ICA and HUA, are applied as EE index (c.f. [Uozumi et al., 2008], [Fujimoto et al., 2016]), and it monitors Equatorial Electro Jet (EEJ) activity. It is well known that long-term variation of EEJ activity well correlates with solar activity (e.g. [Rastogi and Iyer, 1976], [Fujimoto et al., 2016]). On the other hand, disturbance of EEJ also correlates with Interplanetary Electric Field (IEF), for example, Dp2 variation (e.g. [Nishida, 1965], [Kikuchi et al., 1996]). Thus, it can be said that we can monitor space environment system from the sun to the earth thorough the EEJ activity. Although EE index can monitor of EEJ in almost every time because of its wide range of longitude, it is difficult to monitor detailed structure of EEJ along meridional line, in other words, is difficult to

identify if weaken amplitude of EE-index is caused by weaken intensity of EEJ or structural change of EEJ. In order to solve this problem, we decided to install magnetometers at Tingo Maria (TMA) and Tarapoto (TPT).

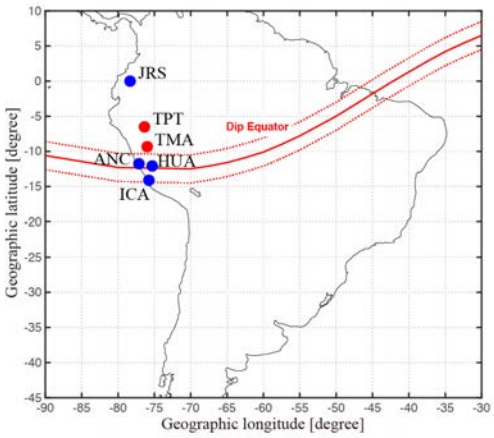

Figure1. Map of MAGDAS in Peru

Location of site and instrument

Location of new MAGDAS stations, TMA and TPT, is indicated by red dots in Figure1, and their latitude and longitude are described in Table1. MAGDAS9, which mainly consists of Data logger, Pre-amplifier and sensor, was installed in these new MAGDAS station.

Site	GG lat.	GG lon.	GM lat.	GM lon.	Dip lat.
Tingo Maria (TMA)	-9.12	-76.04	0.61	356.63	2.83
Tarapoto (TPT)	-6.51	-76.33	3.20	356.31	5.44

Table1. Information of new MAGDAS sites in Peru

Work report at Tingo Maria

The installation work in Tingo Maria was operated with Universidad Nacional Agraria de la Selva (UNAS). Ing. Victor Beteta Alvarado (Photo1), who belongs to UNAS, is our contact person and could help a lot for our installation work. We constructed pre-amplifier hut and sensor house according to the design described in Figure2. At first, we make a hole whose size is 120cm x 120cm x 50cm and poured cement into the hole in order to make the basement of the sensor house. Next, we constructed the wall for sensor house and pre-amp hut by piling up cement blocks. After that, we installed cables with pipes 1.5m above the ground, which connects between data logger and pre-amplifier. We also installed GPS antenna and Internet facility there. However, no real time data has been available here yet due to low signal

Photo1. Group photo with Ing. Beteta (center)

of mobile network, and will supposed to be maintained soon.

A daily data and successive data during 2015/12/17~2016/01/03 in TMA are shown in figure3 and 4. The blue, green and red lines in these figures correspond to the H, D and Z-component, respectively. The small amplitude of diff data for daily data indicates that there is little artificial noise like electricity. We fortunately observed two magnetic storms during this period as shown in figure3. Ing. Beteta took MAGDAS lecture, and he learned how to operate the MAGDAS briefly. Now, we continue contacting with him and discussing about possible research idea that can be use for their research.

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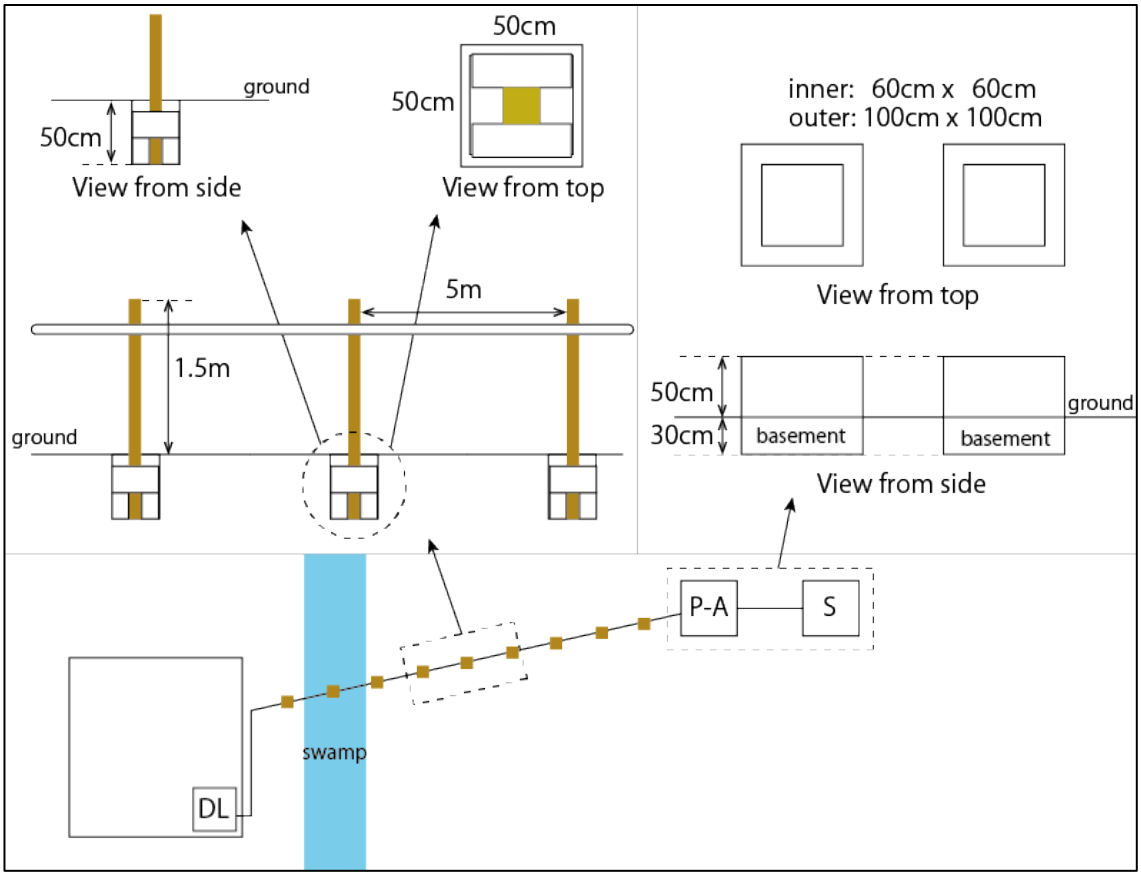


Figure2. Design of MAGDAS instruments in TMA

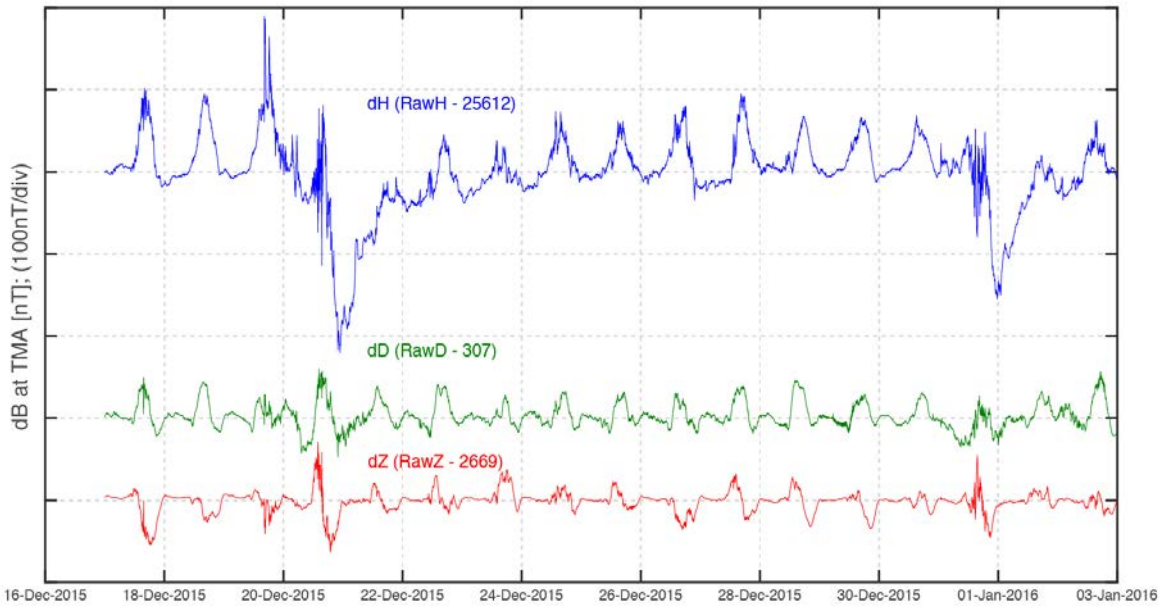
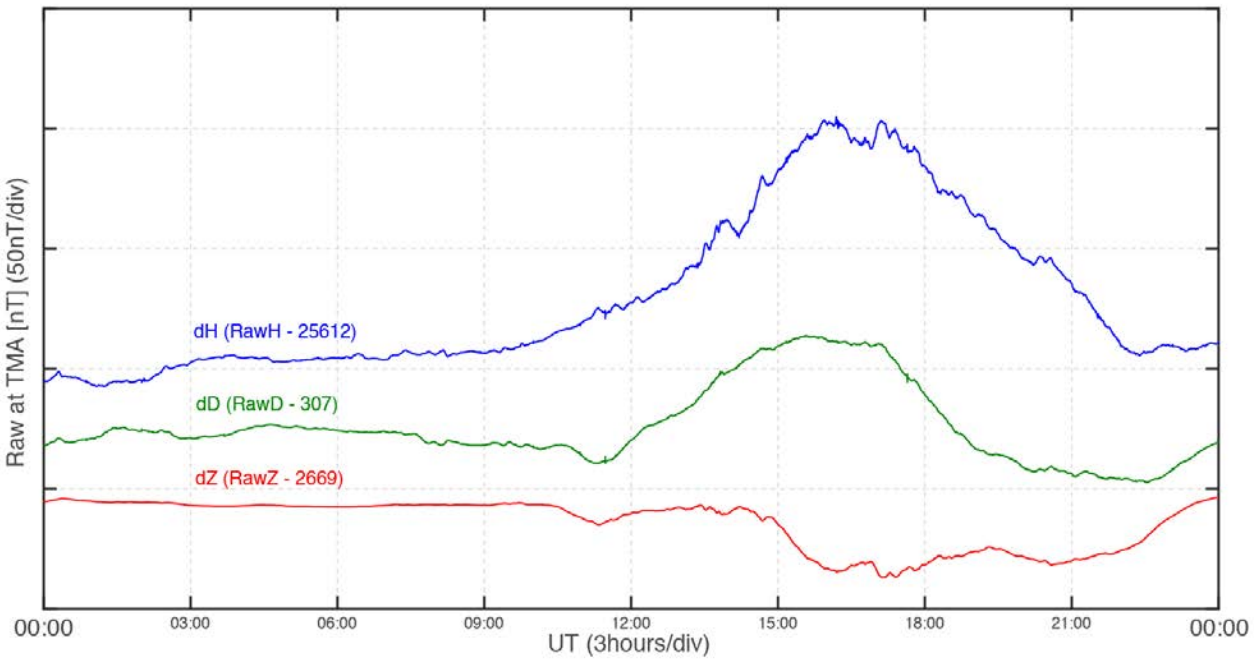


Figure3. Successive plot of magnetic field variation at TMA

a)



b)

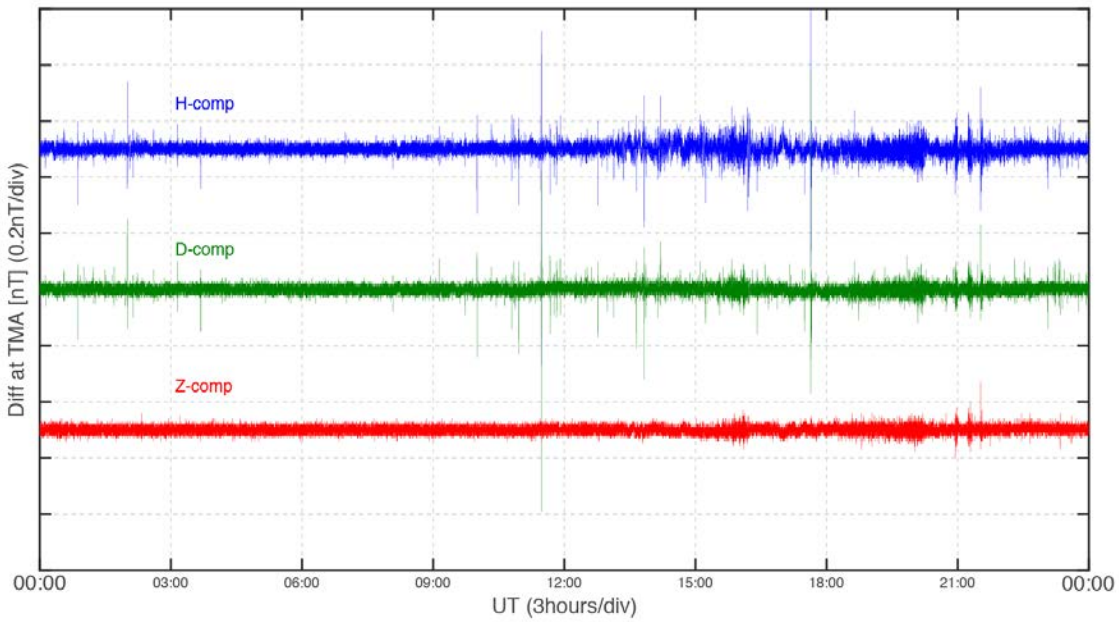


Figure4.

a) Daily plot on 18/12 of diff data at TMA, b) Same format as a) but is diff data

Work report at Tarapoto

The installation work in Tarapoto was operated with San Martin University. Ing. Giancarlo Maldonado Cárdenas, who belongs to San Martin University, is our contact person in TPT and could help a lot for the installation work. We constructed pre-amplifier hut and sensor house here (Photo2), which is according to the design described in Figure4. Almost same procedures as TMA case had taken, excepting that the cables, which is covered with pipes, installed under the ground. The data logger is installed in a room (Photo3). Daily data and successive data during 2015/12/17~2016/01/03 in TPT are shown in Figure6 and 7. The data at TPT is also seemed to be good, and the small amplitude of diff data for daily data is seen. From successive data, two magnetic storms are observed just like TMA case.

We could meet with the vice president of San Martin University and explained to him our purpose of the installation, what we need and so on. Thanks to Dr. Jose Ishitsuka, we got positive comment and support from the vice president, and then we could proceed the installation smoothly. Ing. Maldonado took MAGDAS lecture, and he learned how to operate the MAGDAS at TPT briefly. Now, we continue contacting with him and try to construct Internet facility for the MAGDAS and get real time data at TPT.

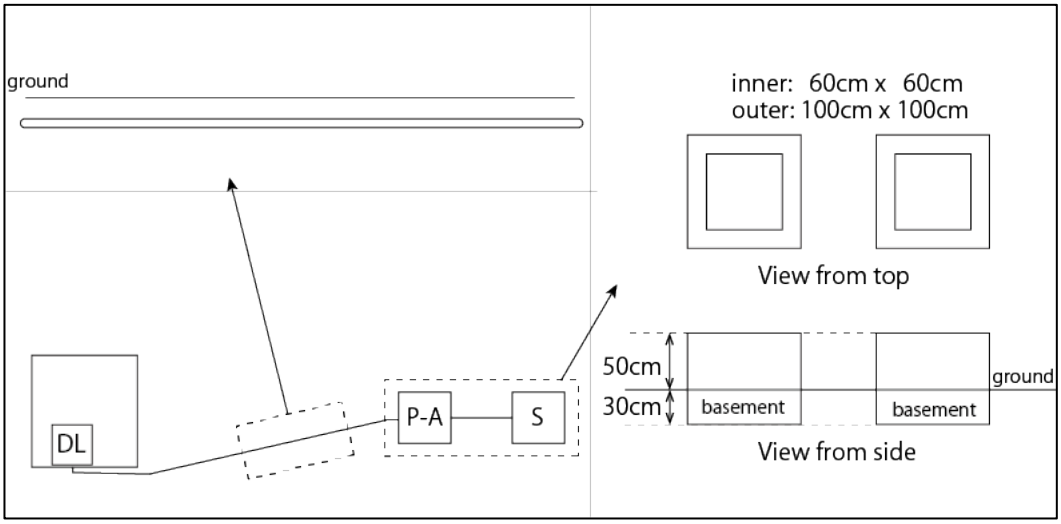


Figure5. Design of MAGDAS instruments in TPT

Photo2.

Sensor house and Pre-amp hut

Photo3. Data logger in a room

Photo4.

Snapshot of MAGDAS training

Photo5. Group photo with Ing. Maldonado (center-left)

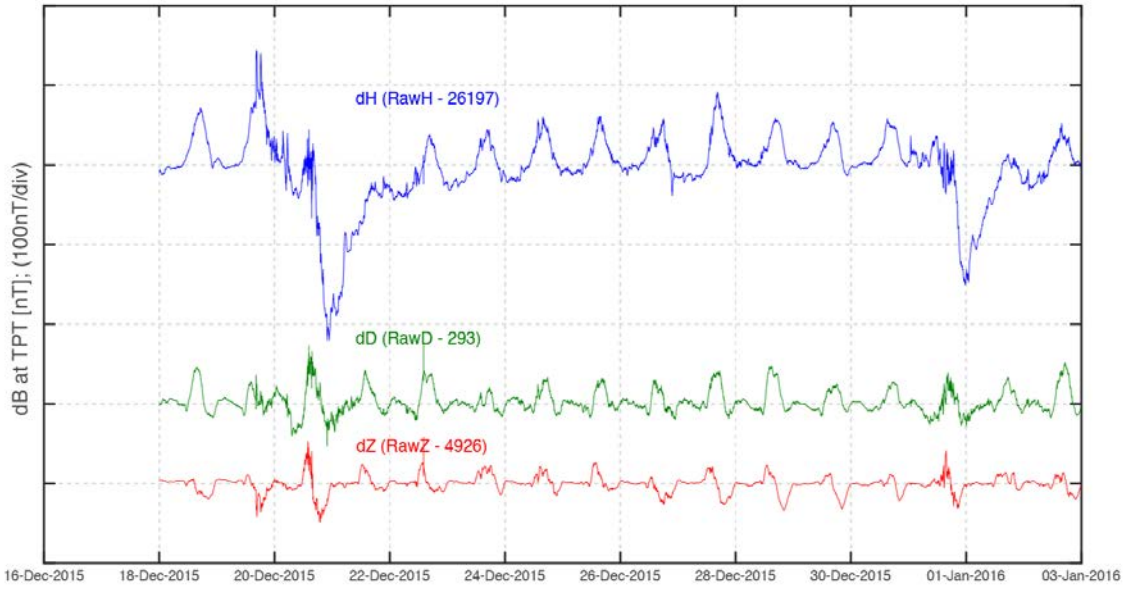
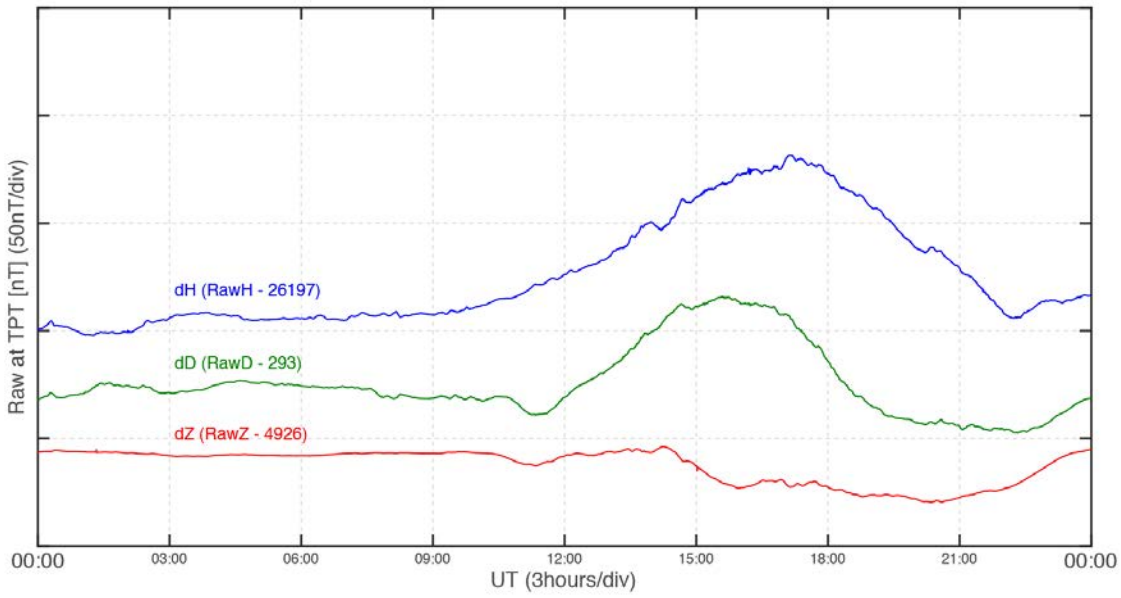


Figure6. Successive plot of magnetic field variation at TPT

a)



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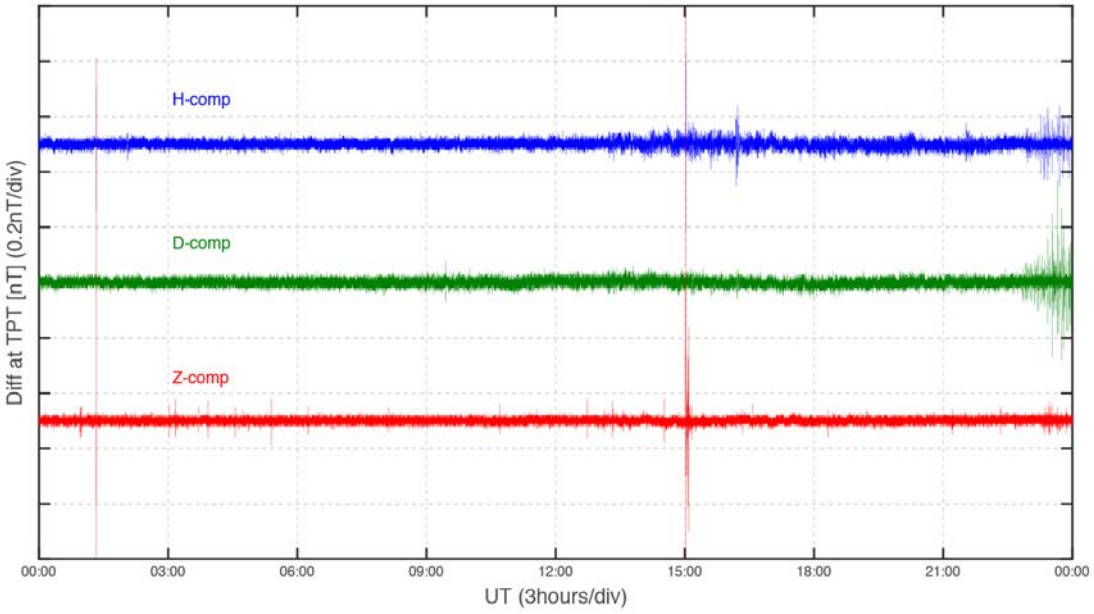

Figure7.

a) Daily plot on 18/12 of diff data at TPT, b) Same as (a) but is diff data

Future work

Now, we are contacting with Dr. Marco Milla and planning about some collaborative work between MAGDAS and LISN.

As for the capacity building, we try to get local people at TMA and TPT involved space weather study using the MAGDAS data. However, they are not familiar with space physics, so we would like to start at introduction of space weather and what is important for our lives.

Our original purpose is to produce new space weather index for EEJ. Using this index, we plan to estimate detailed structure of EEJ and monitor it in real time as two-dimensional map with the local time for x-axis and geographic latitude for y-axis as shown in Figure8. In order to archive this objective, we have to make both of new sites in Peru online. After getting real time data at both sites, we will publish this EEJ map via our website.

I am really grateful for Dr. Jose K. Ishitsuka's great effort and support. This work was supported by MEXT/JSPS KAKENHI Grant Number 15H05815.