Preceding phenomena observed by Tree Bio-electric Potential prior to Noto Peninsula Off Earthquake

Japan Society of Ecology and Disaster Prevention (JSEDiP)
SAITO Yoshiharu
saito@jsedip.jp

1. Overview

Since 1977 Tree Bio-electric Potential (TBP) has been measured at Suginami Tokyo by Emeritus Professor TORIYAMA of Tokyo Woman's Christian University. Prior to EQs of magnitude 5 or above, anomalous potential changes were often observed. This paper reports abstract of the precursor which was observed at Miwa observation post in Aichi prefecture prior to 2007/3/25 Noto peninsula off EQ Magnitude 6.9.

2. Observation system

A silver electrode (diameter:0.5mm, length:50mm) is inserted into living tissue of the tree and another copper electrode is buried at a depth of 1m into the ground at a point 1.5m from the tree. The potential difference between 2 electrode is measured at sampling rate of 20 seconds. System Block Diagram is shown in Fig.1

Anomaly signal is expressed with dB as an S/N (Signal to Noise) ratio, S is obtained from Peak to peak (P-P) value of anomalies, and N is obtained from rms (Root mean square) value i.e., N=Noise(P-P)/2root2, then S/N can be obtained from 20logS/N.

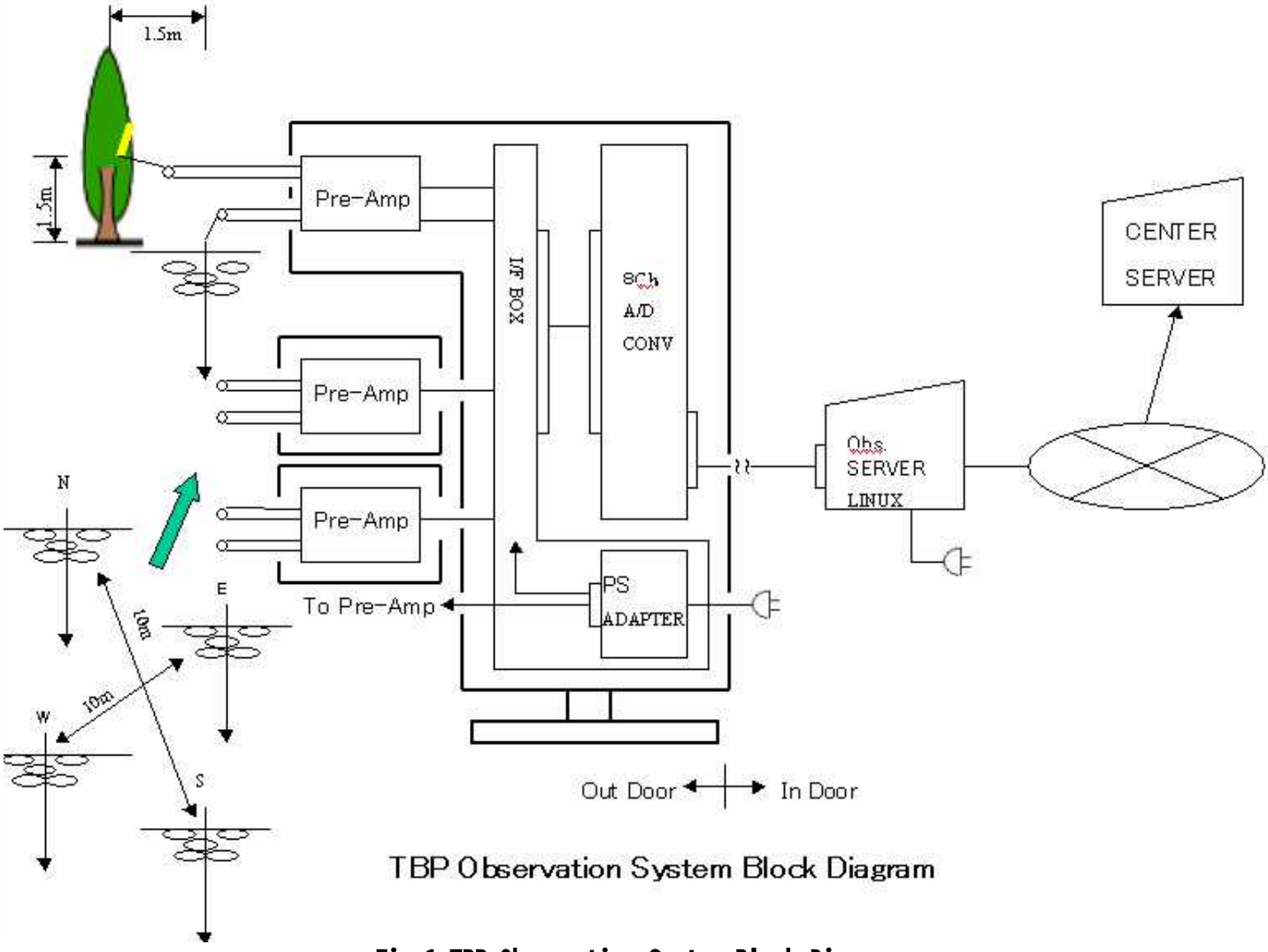

Fig.1 TBP Observation System Block Diagram

3. TBP Anomaly regarded as Precursor prior to Noto Peninsula EQ

As shown in Fig2, 35dB anomaly was observed 3 days and 51dB anomaly was observed 1 hour prior to the EQ. 51dB was the biggest anomaly at Miwa observation post in the past. Blue graph shows rain fall in 10mm/Div. Correlation between TBP anomaly and rain is not seen.

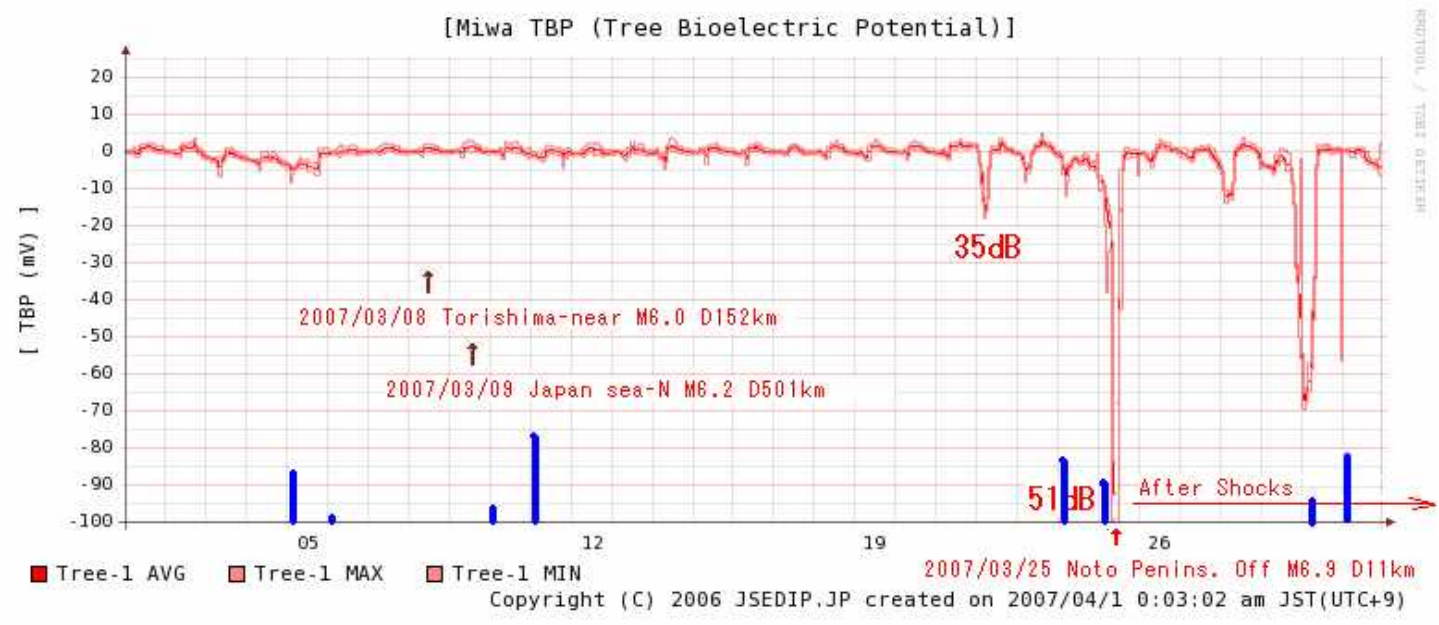

Fig.2 TBP Anomaly observer prior to Noto Peninsula Earthquake

4. Correlation between all past 1 year anomalies and all EQs of Magnitude 6 class

TBP preceding time and time interval between anomalies and between EQs are shown Fig.3 to Fig.17.

As vertical scale of each graph is automatically adjusted to peak to peak value of each month, vertical size of all of graph are reduced except Fig.5 and 17. Further more, dB value is not shown proportionally as Noise base line is different day by day.

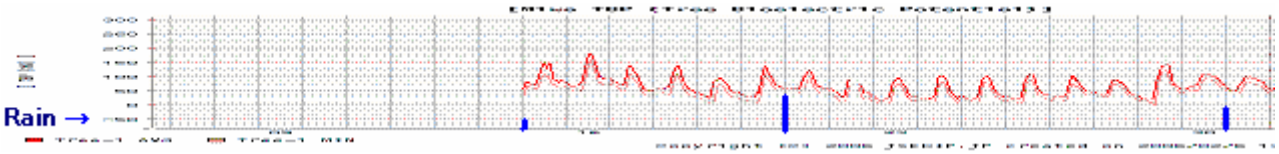

Fig.3 **2006/1/15 - 1/31**

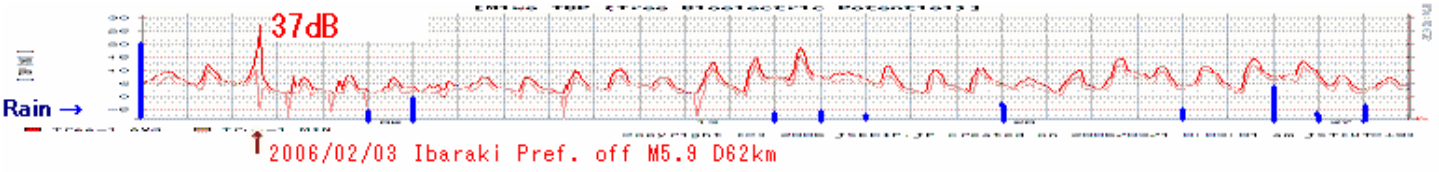

Fig.4 **2006/2/1 - 2/28**

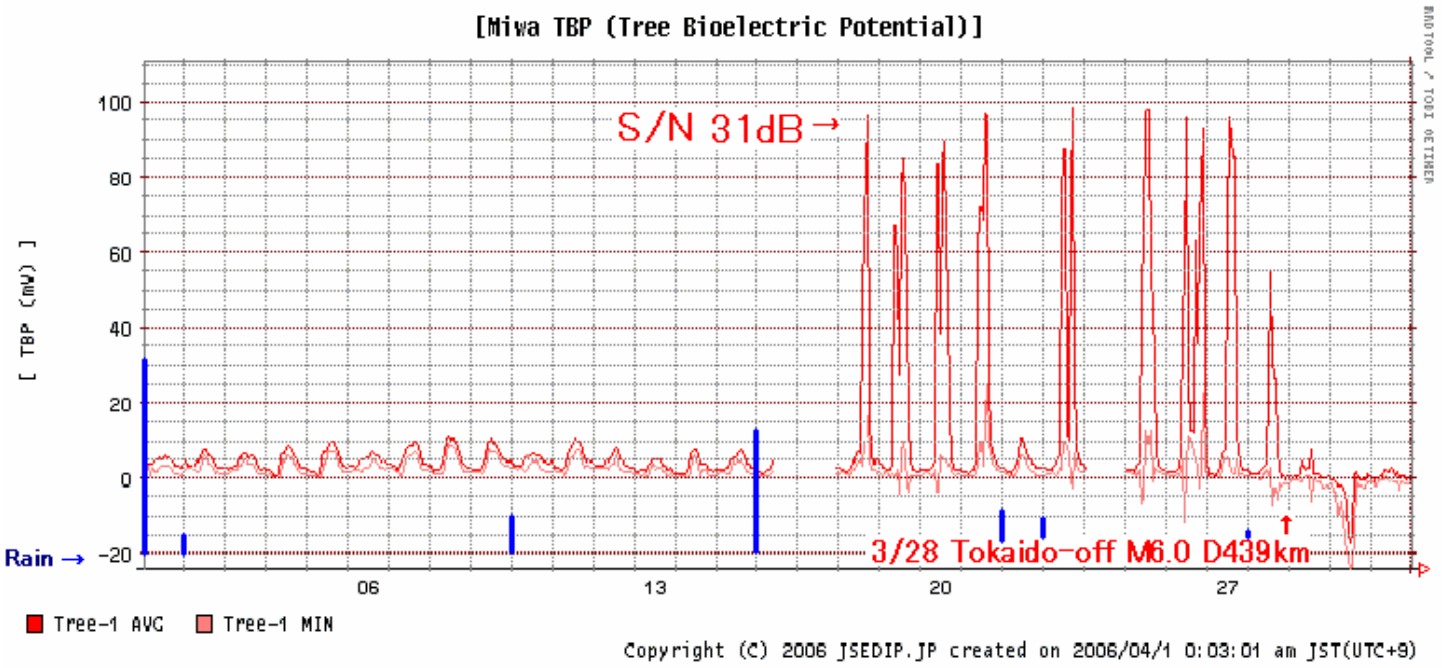

Fig.5 2006/3/1 - 3/31

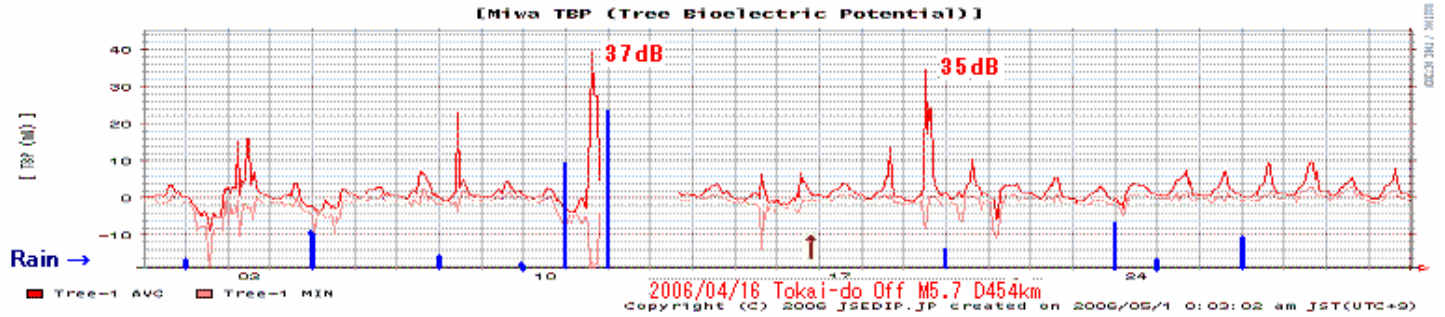

Fig.6 2006/4/1 - 4/31

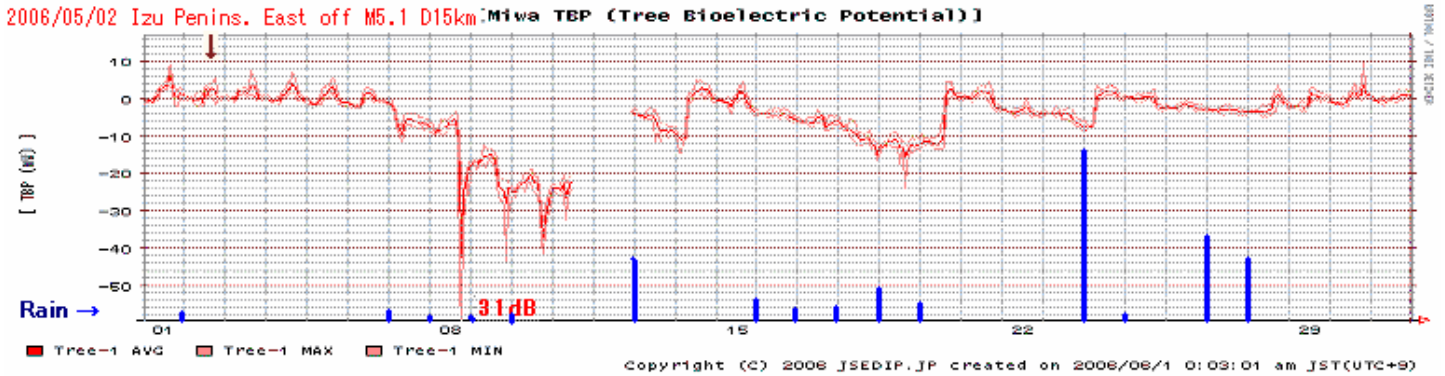

Fig.7 2006/5/1 - 5/31

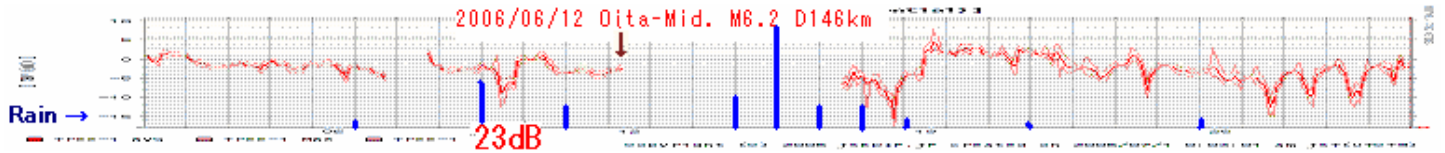

Fig.8 2006/6/1 - 6/30

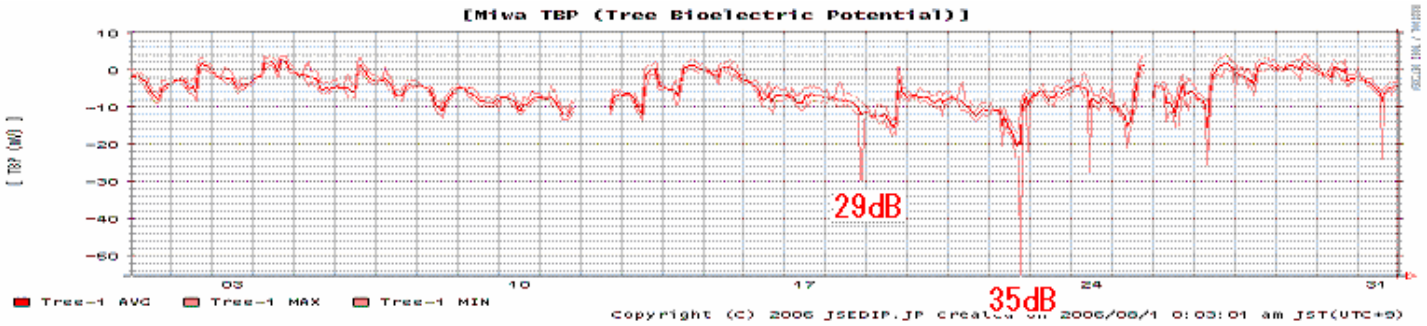

Fig.9A **2006/7/1 - 7/31**

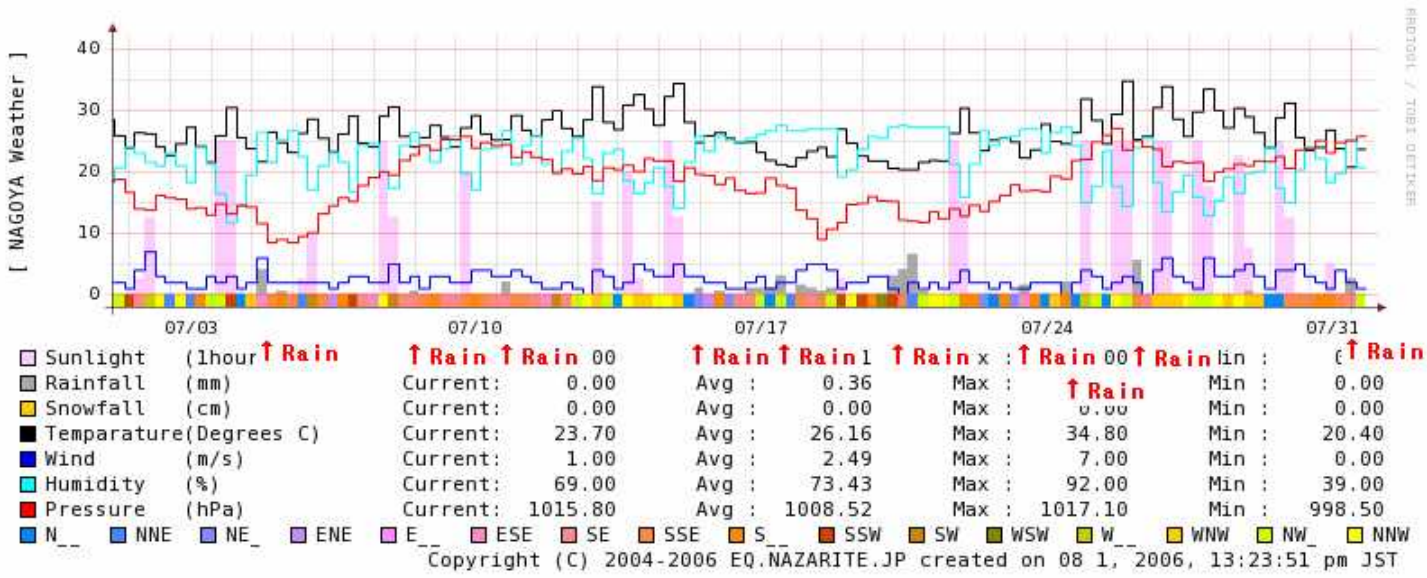

図 -9B 2006/7/1 - 7/31 AMeDAS

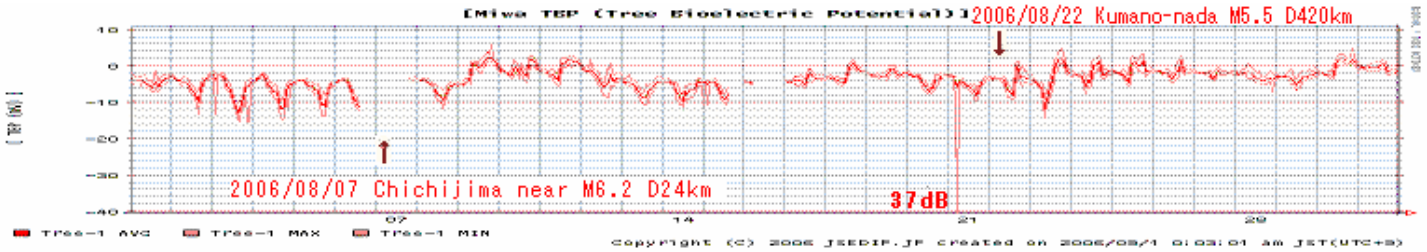

Fig.10A **2006/8/1 - 8/31**

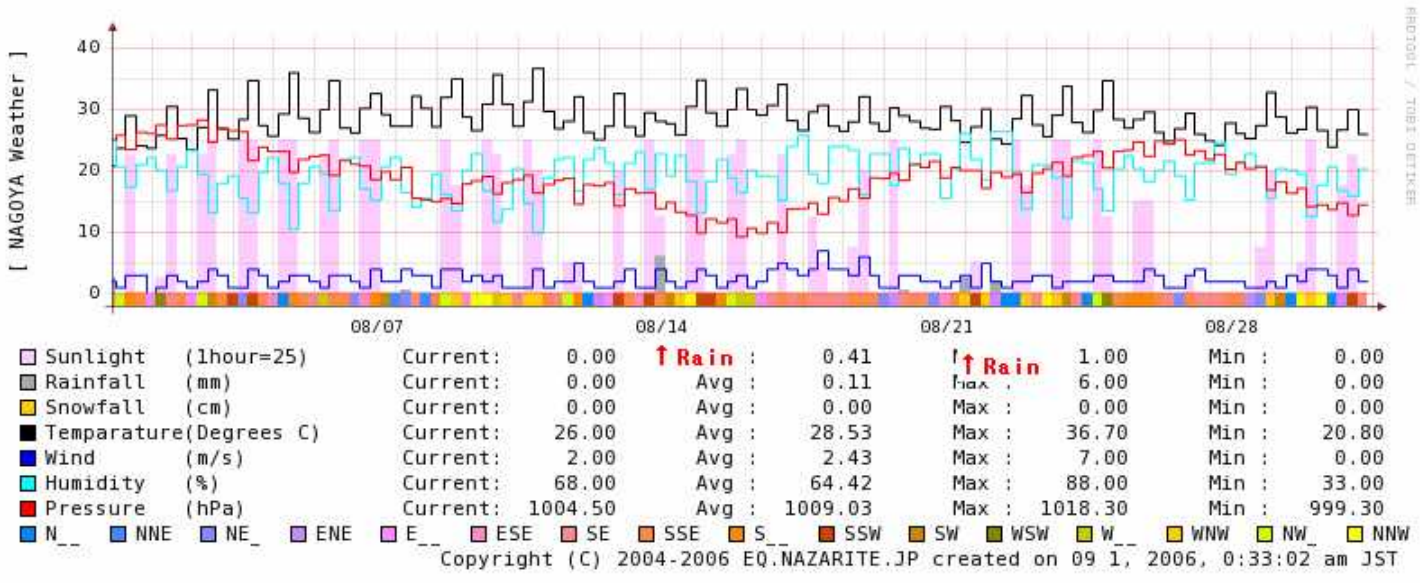

Fig.10B 2006/8/1 - 8/31 AMeDAS

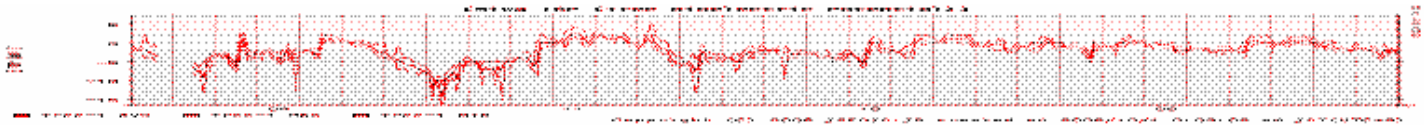

Fig.11A **2006/9/1 - 9/30**

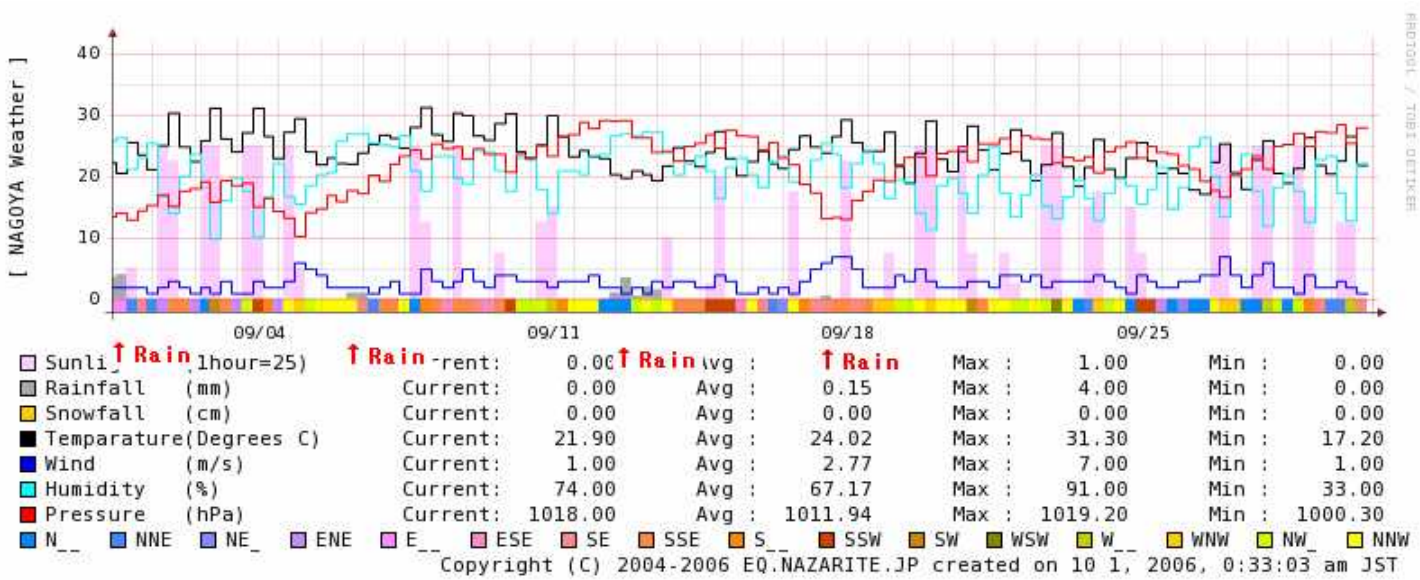

Fig.11B 2006/9/1 - 9/30 AMeDAS

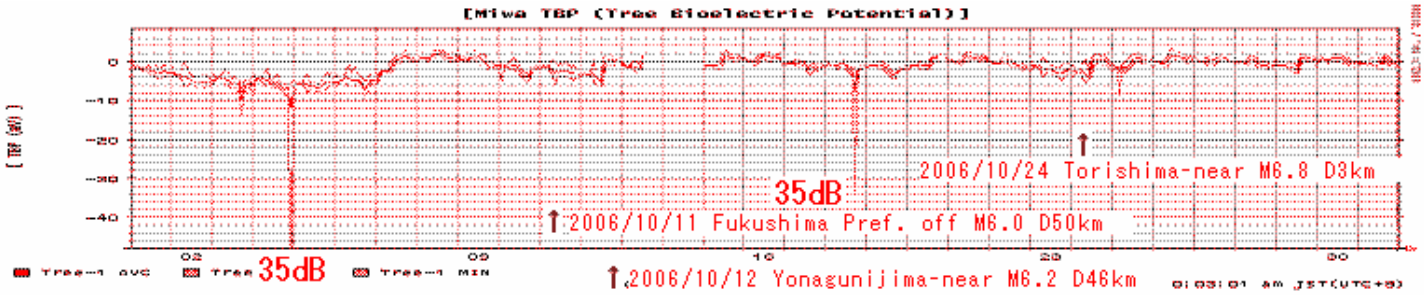

Fig.12A **2006/10/1 - 10/31**

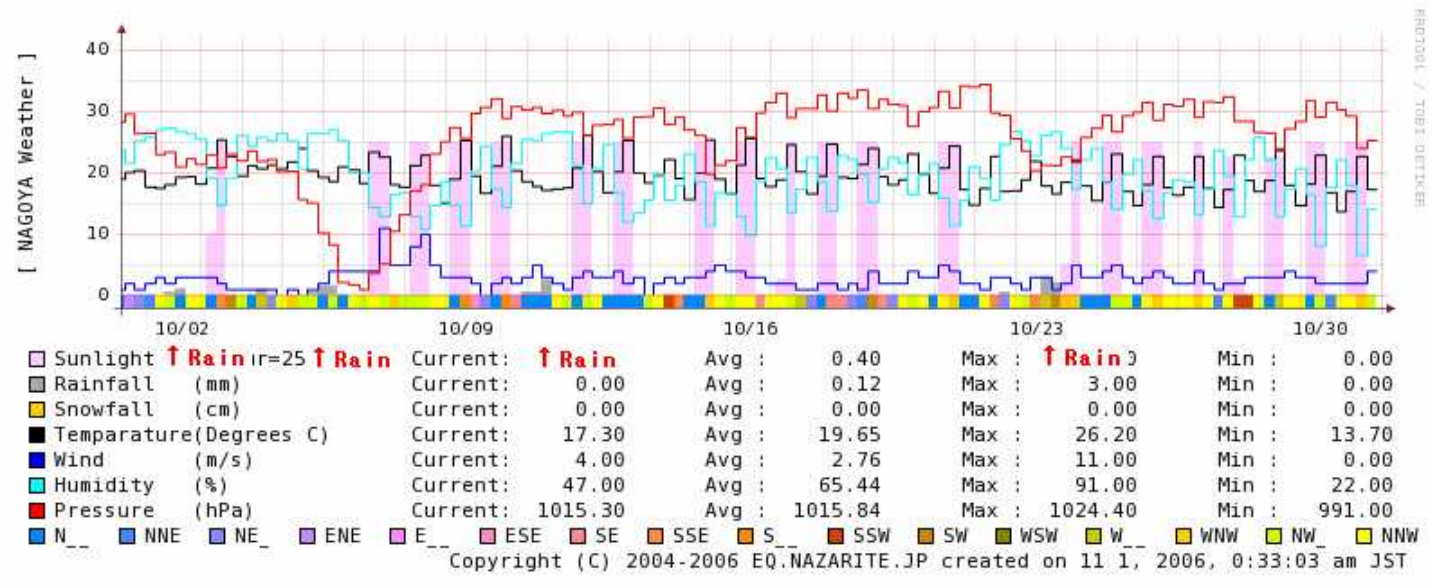

Fig.12B 2006/10/1 - 10/31 AMeDAS

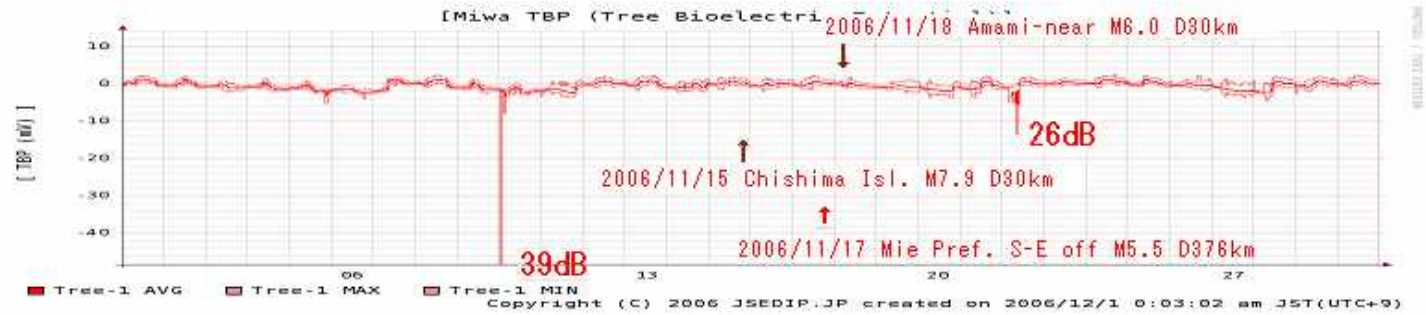

Fig.13A **2006/11/1 - 11/30**

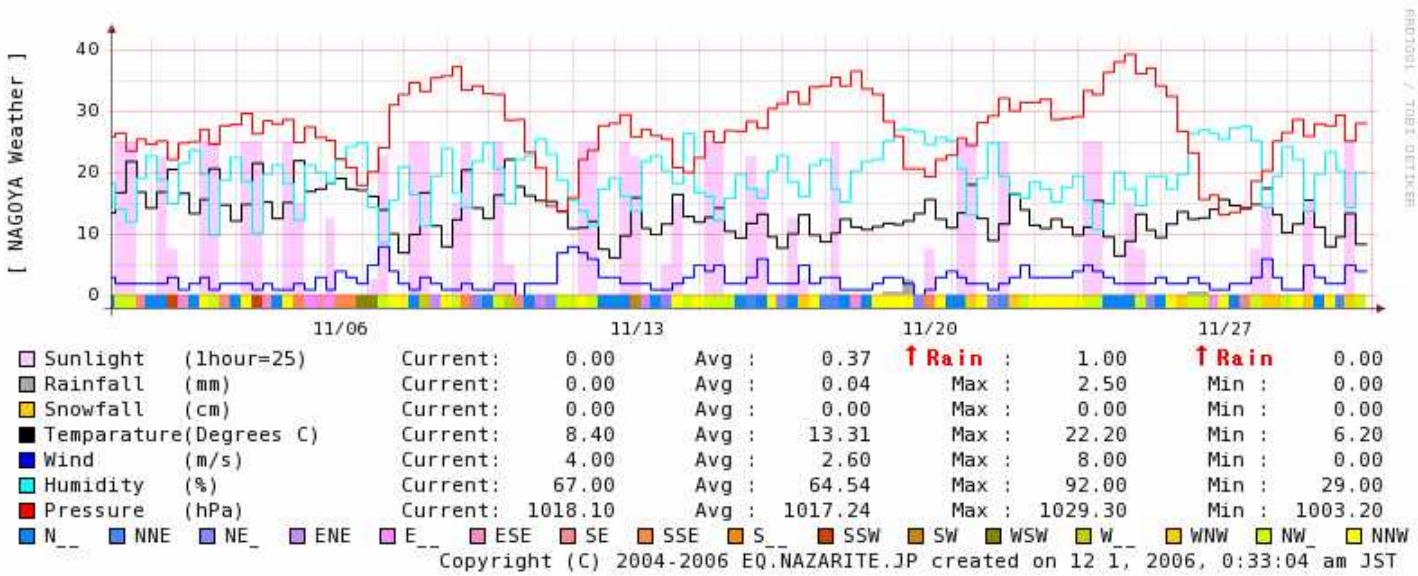

Fig.13B 2006/11/1 - 11/30 AMeDAS

Fig.14A **2006/12/1 - 12/31**

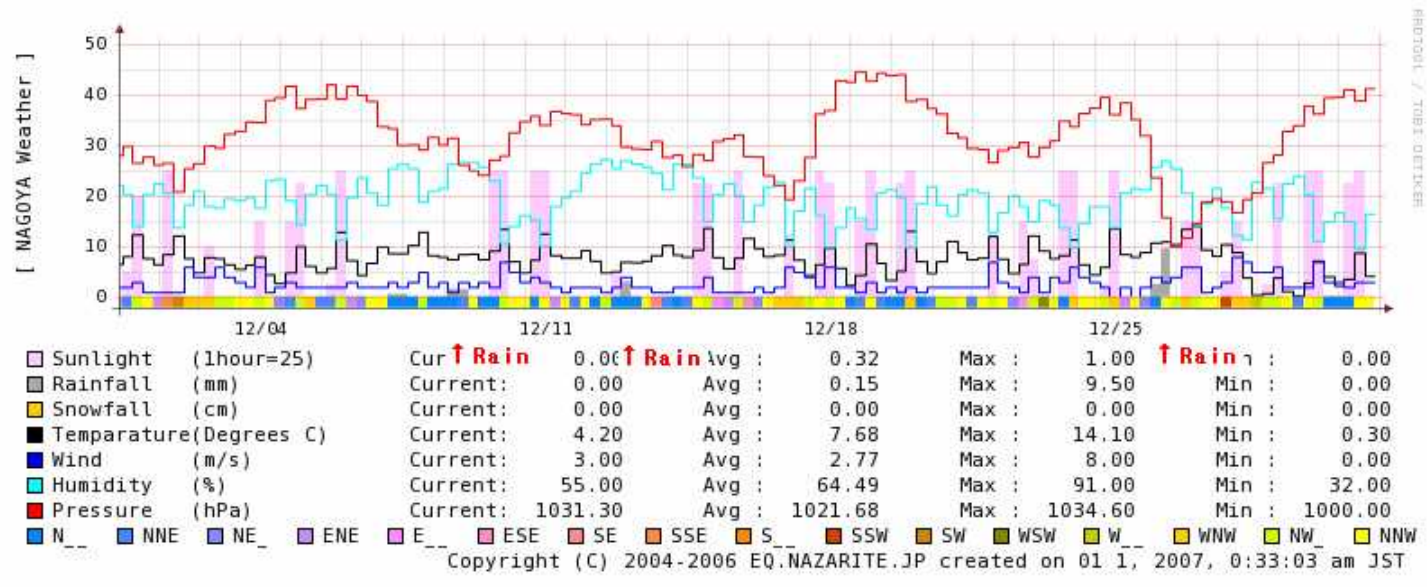

Fig.14B 2006/12/1 - 12/31 AMeDAS

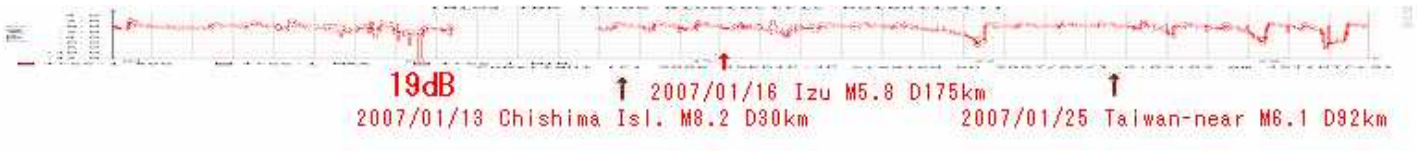

Fig.15A **2007/1/1 - 1/31**

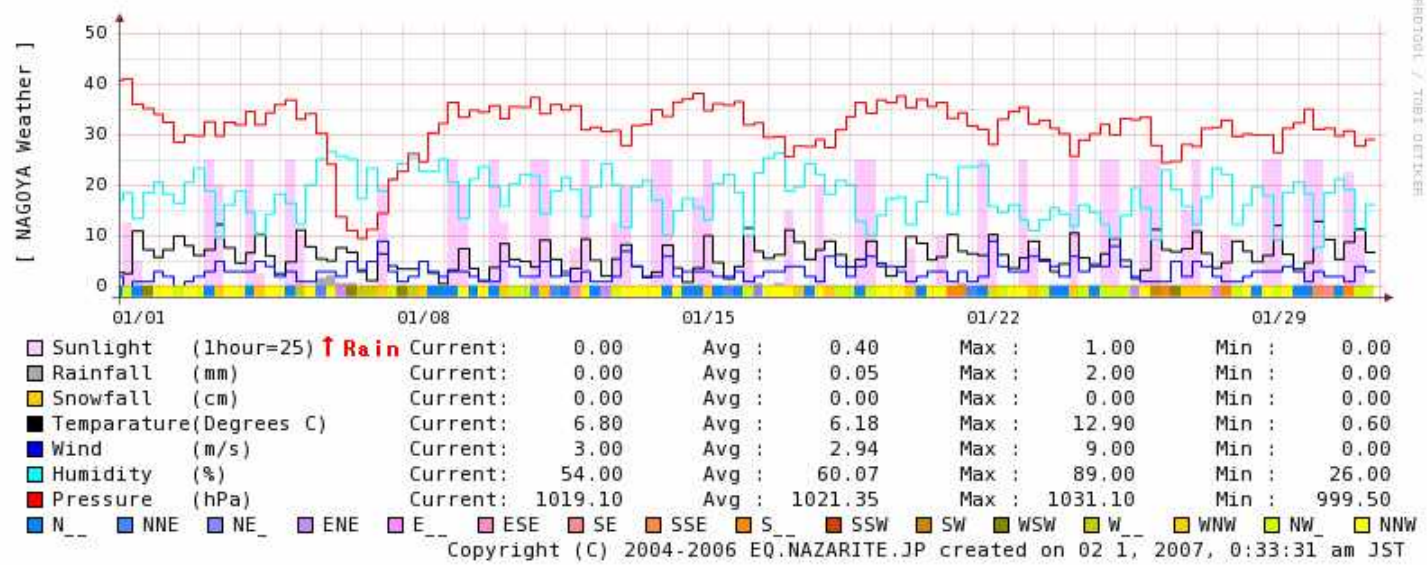

Fig.15B 2007/1/1 - 1/31 AMeDAS

Fig.16A **2007/2/1 - 2/28**

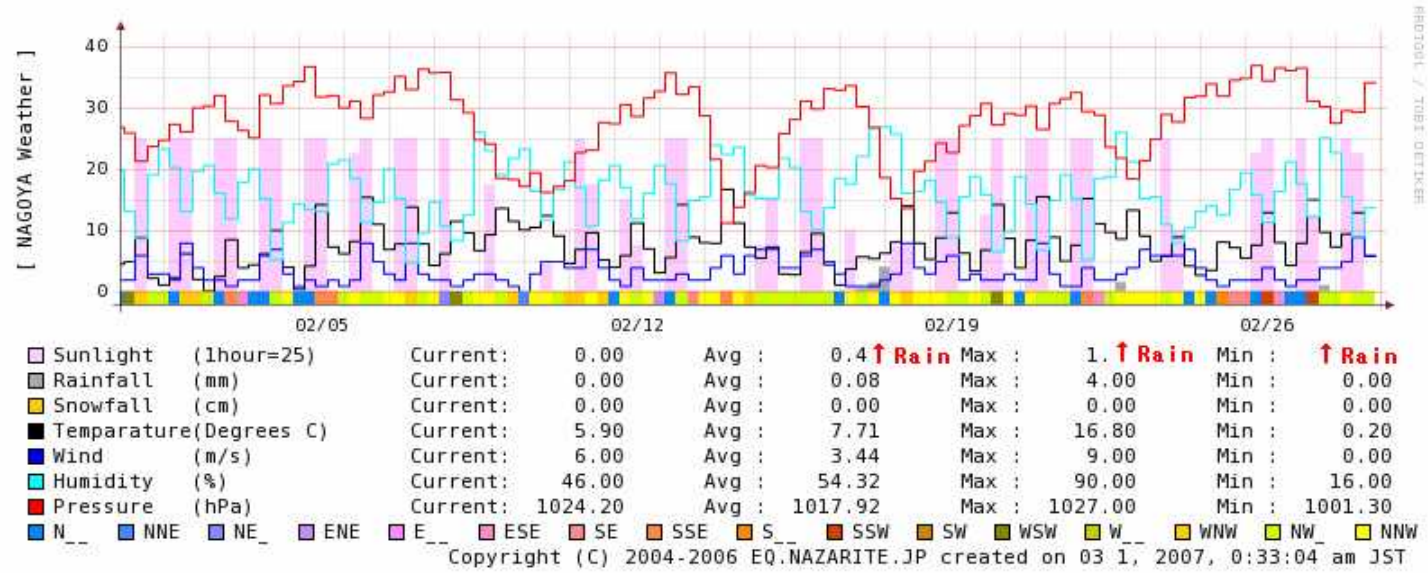

Fig.16B 2007/2/1 - 2/28 AMeDAS

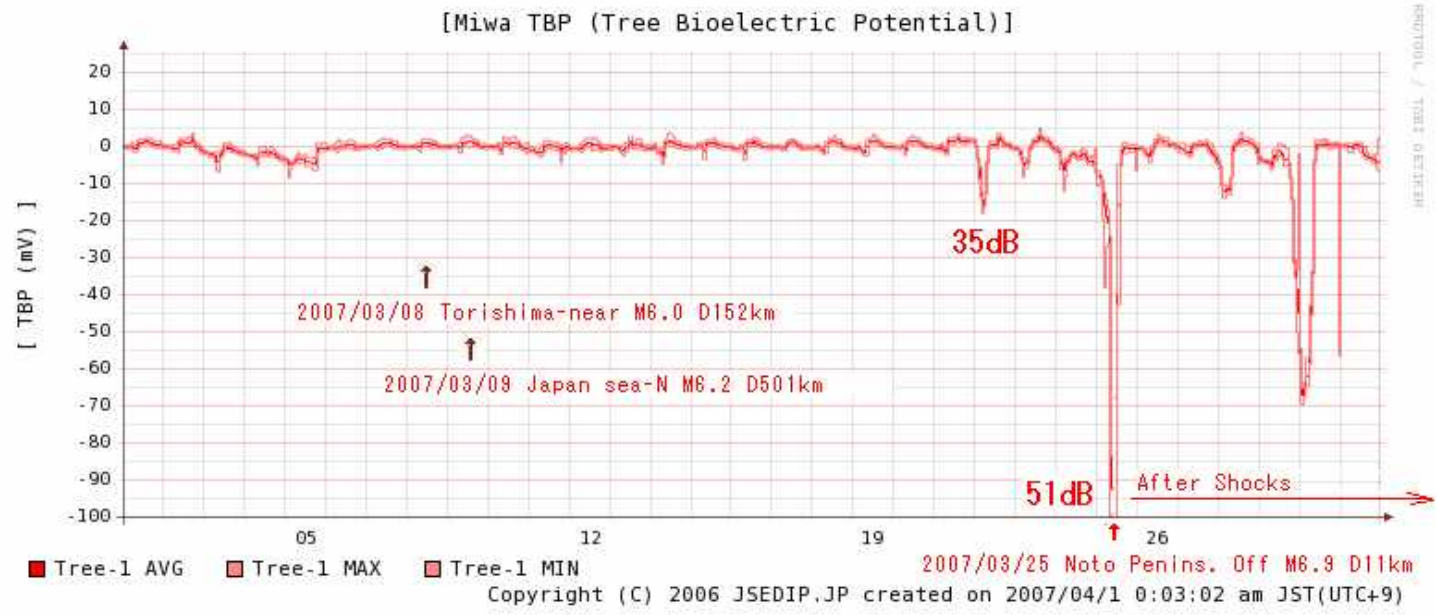

Fig.17A 2007/3/1 - 3/31

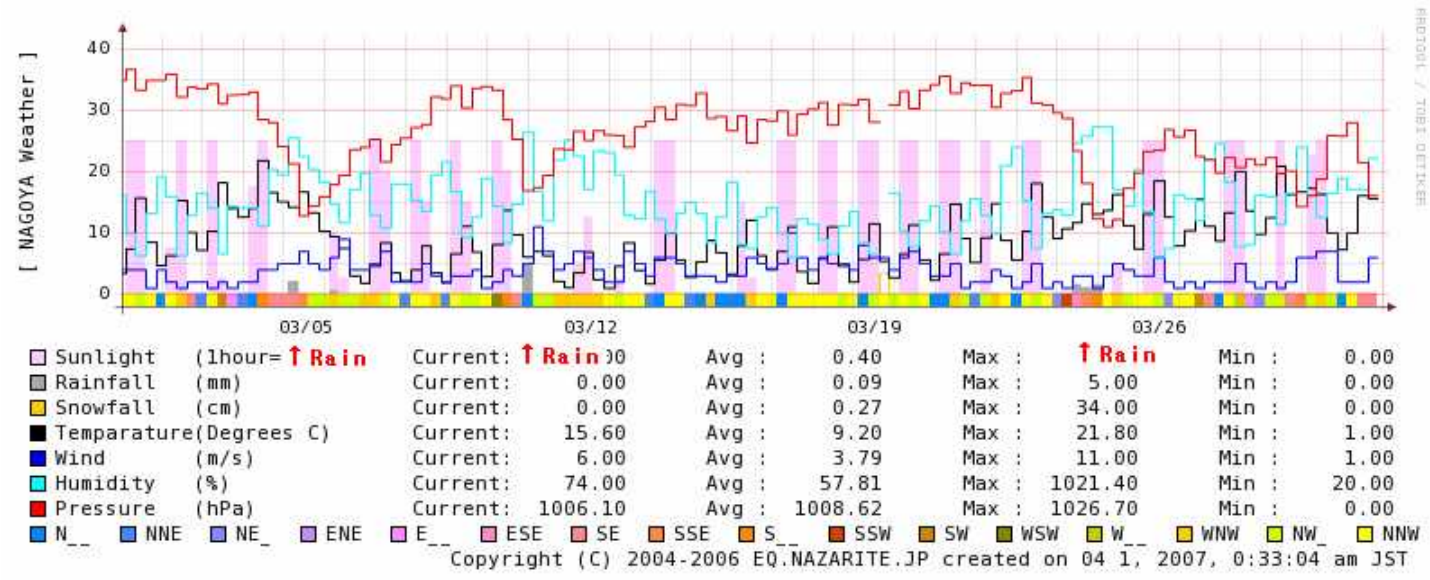

Fig.17B 2007/3/1 - 3/31 AMeDAS

5. Verification

TBP Anomaly and Occurred Earthquake Relation and Preceding Time is listed in List-1. Fig.18 shows Epi-center and anomalies, correlation between anomalies and occurred EQ are shown in Fig.19. Anomaly and EQ can be said as synchronized, since preceding time is almost several days, each interval is several 10 days. Correlation between TBP anomaly and actual EQ occurrence can be seen. No relation between anomalies and rain fall is not seen. Magnitude is displayed in 10 times due to graph scale.

異常現象 -発生地震の相関と先行期間

List -1 TBP(Tree Bio -electric Potential) Anomaly - Occurred Earthquake Relation and Preceding Time

First Anomaly		Related Earthquake				Preceding Time	Time Interval between	
Date	Signal Strength	Data	Place	Mag.	Depth	Days	Anomalies	Earthquakes
2006/2/3	37dB	2006/2/3	Ibaraki Pref. Off 茨城県沖	M5.9	62km	2 Hours (Co-seismic)	-	-
2006/3/18	31dB	2006/3/28	Tokaido-off 東海道沖	M6.0	439km	10 Days	43 Days	53 Days
2006/4/11	37dB	2006/4/16	Tokaido-off 東海道沖	M5.7	454km	6 Days	24 Days	19 Days
2006/4/20	35dB	2006/5/2	Izu Penins. East off 伊豆半島東方沖	M5.1	15km	13 Days	9 Days	16 Days
2006/5/8	31dB	?	?	?	?	?	-	-
2006/6/9	23dB	2006/6/12	Oita-Mid. 大分県中部	M6.2	146km	3 Days	32 Days	41 Days
2006/7/18	29dB	2006/8/7	Chichijima-near 父島近海	M6.2	24km	20 Days	39 Days	25 Days
2006/7/22	35dB					16 Days	43 Days	
2006/8/21	37dB	2006/8/22	Kumano-nada 熊野灘	M5.5	420km	1 Day	30 Days	15 Days
2006/10/4	35dB	2006/10/12	Yonagunijima-near 与那国島近海	M6.2	46km	8 Days	44 Days	51 Days
2006/10/18	35dB	2006/10/24	Torishima-near 鳥島近海	M6.8	3km	6 Days	14 Days	12 Days
2006/11/10	39dB	2006/11/17	Mie Pref. S-E Off 三重県南東沖	M5.5	376km	7 Days	23 Days	24 Days
2006/11/22	26dB	2006/12/8	Chishima Isl. 千島列島	M6.4	30km	16 Days	12 Days	21 Days
2007/1/8	19dB	2007/1/13	Chishima Isl. 千島列島	M8.2	30km	5 Days	48 Days	36 Days
2007/2/6	14dB	2007/2/17	Tokachi-off 十勝沖	M6.2	40km	11 Days	29 Days	35 Days
2007/2/27	20dB	2007/3/8	Torishima-near 鳥島近海	M6.0	152km	9 Days	21 Days	18 Days
2007/3/22	35dB	2007/3/25	Noto Penins. Off 能登半島沖	M6.9	11km	3 Days	23 Days	17 Days
2007/3/25	51dB					1 Hour (Co-seismic)	26 Days	

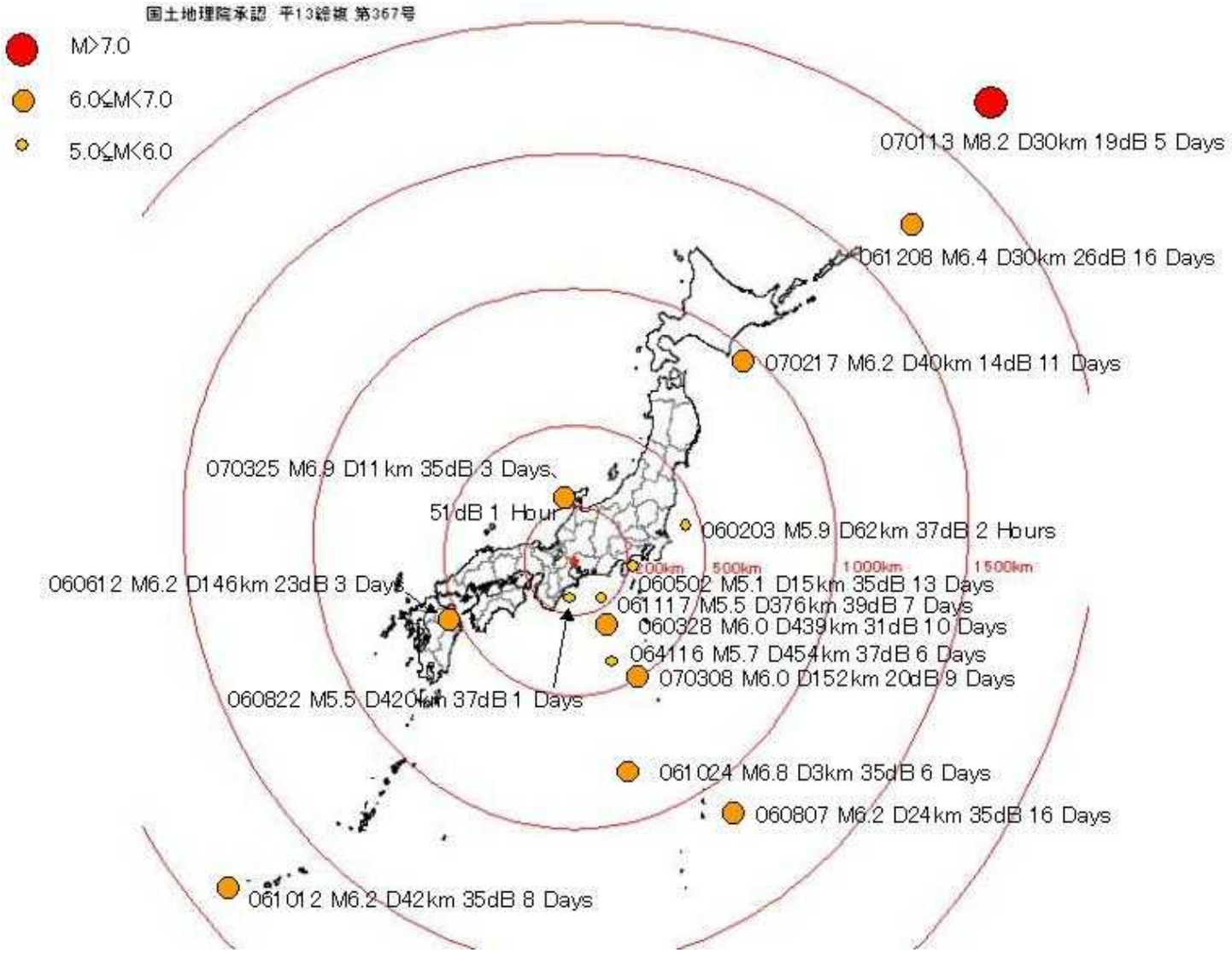

Fig.18 Earthquake occurrence and Anomalies

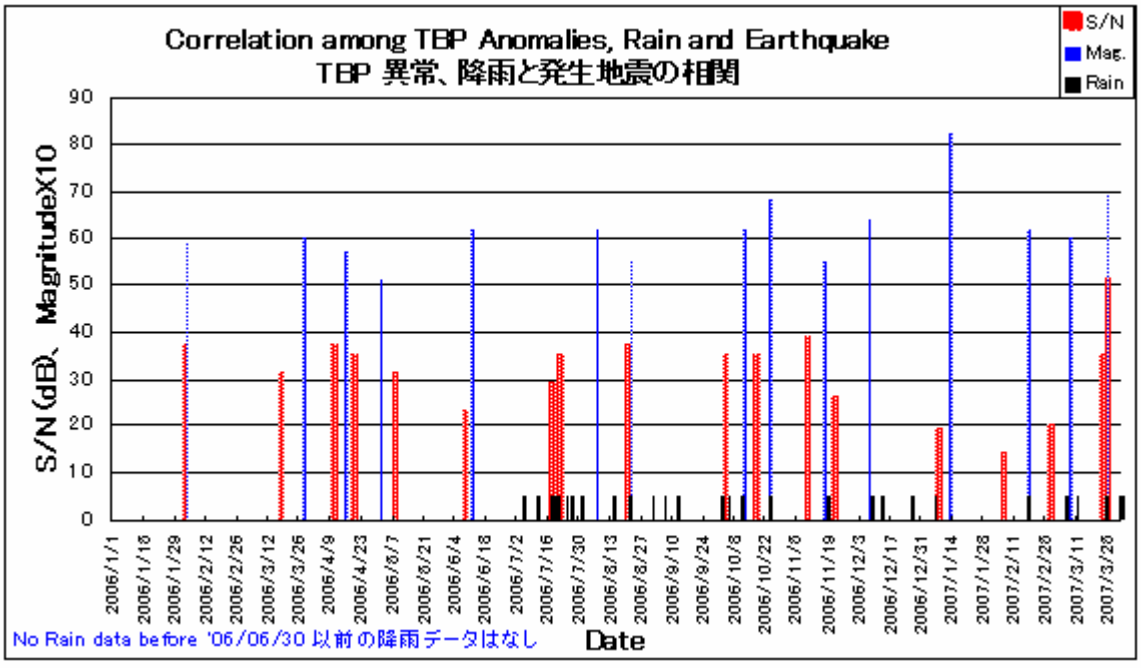

Fig.19 Correlation among TBP Anomalies, Rain and Earthquake occurrence

6. Hypothesis on prediction method of Earthquake occurrence place

Anomalous value in dB at Nagoya observation post and predicted epicentral distance is shown in Fig.19A -E.

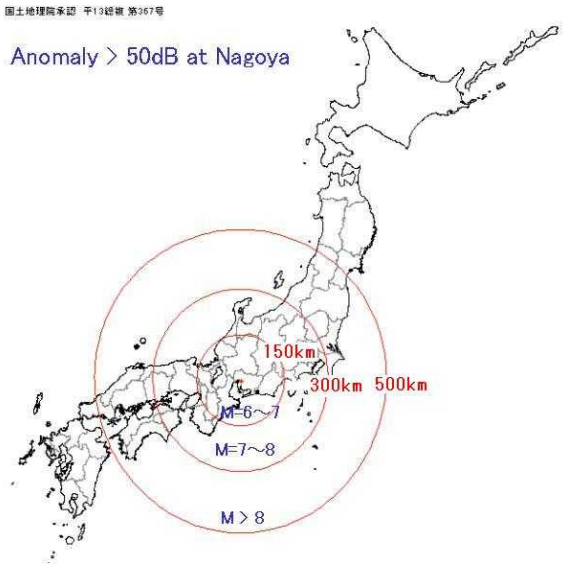

Fig.20A Anomaly of more than 50dB

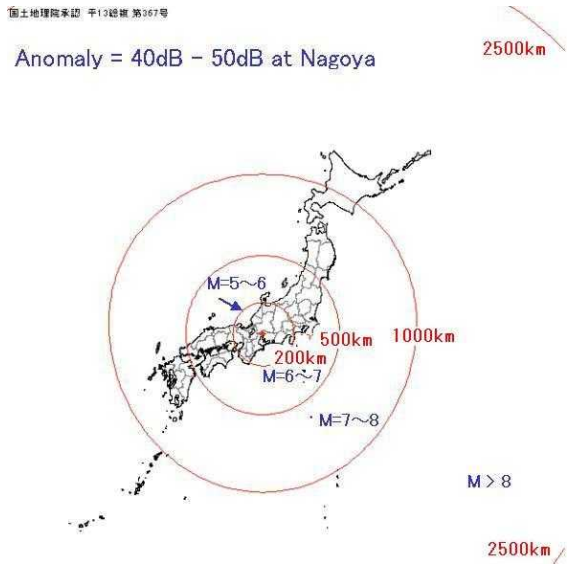

Fig.20B Anomaly of 40 -50dB

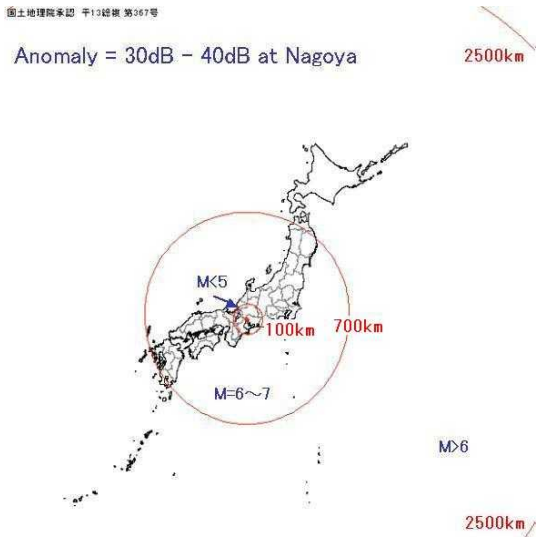

Fig.20C Anomaly of 30 -40dB

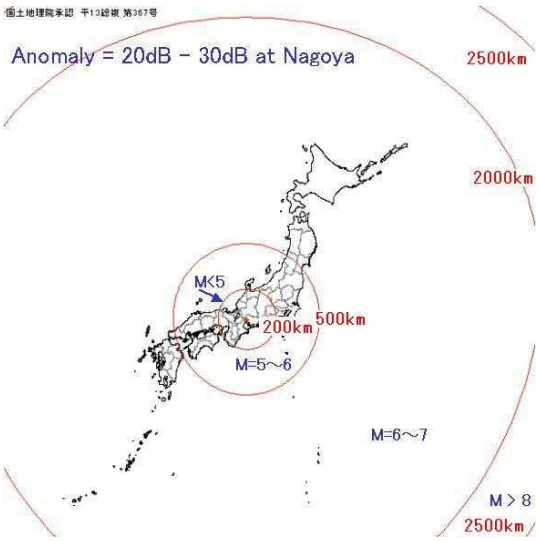

Fig.20D Anomaly of 20 -30dB

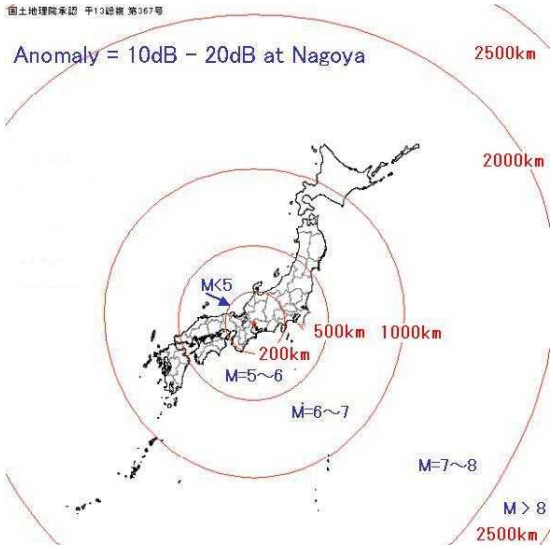

Fig.20E Anomaly of 10 -20dB

7. Hypothesis on obtaining of prediction distance between observation post and epicenter

The following formula is led from verification result.

$$D = \sqrt{\frac{10^{M}}{\frac{M}{k} \times 10^{\frac{dB}{20}}}}$$

D= Prediction distance between observation post and epicenter (km), M=Magnitude, dB= dB value of anomaly, k is Compensation coefficient which depends on Magnitude and led from Fig. 21

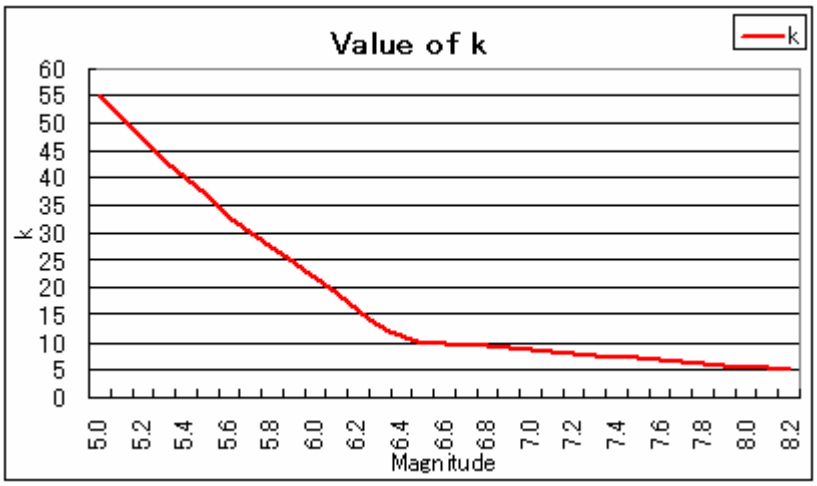

Fig. 21 Compensation coefficient

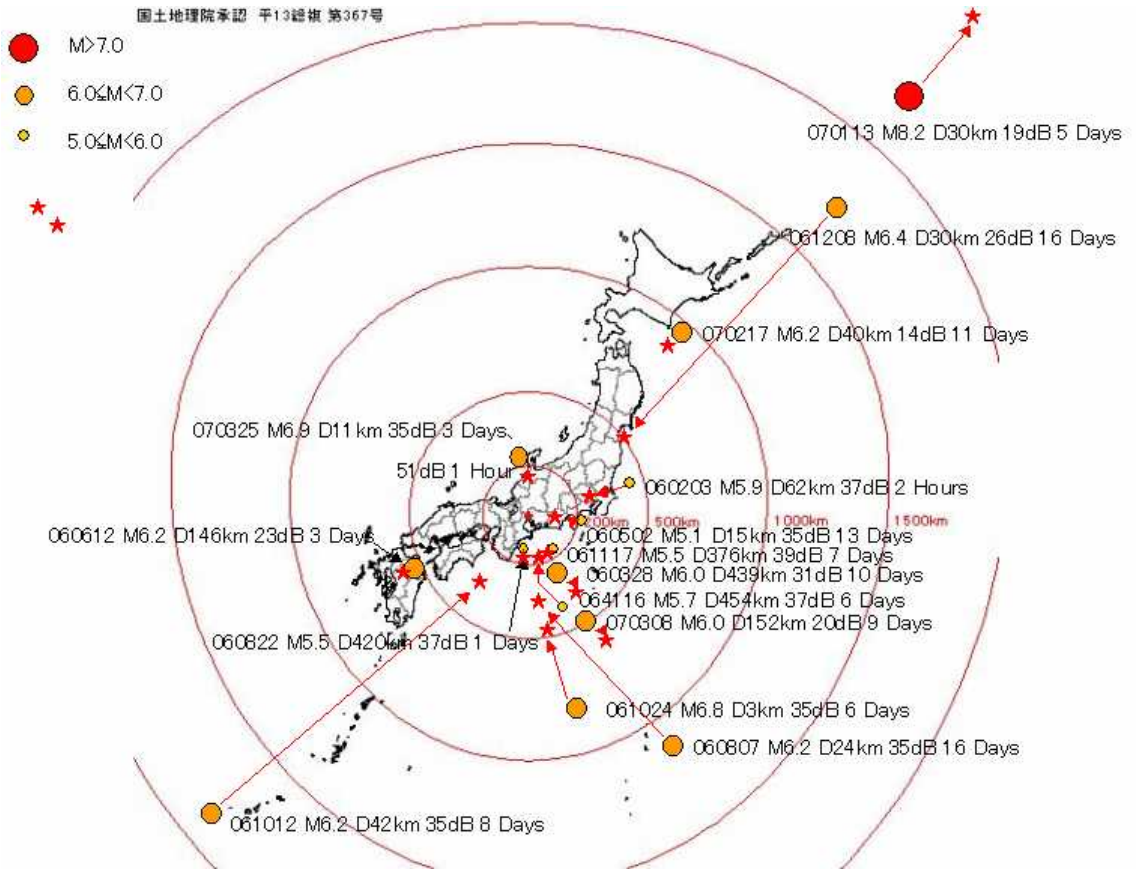

Fig.22 Error of the prediction distance

Error of the prediction distance is shown in Fig.22. Big error exists in 6 EQs of 18. Almost coincident for rest 12 EQs.

For future prediction, Magnitude is previously provided by atmospheric gravity wave observation. If Magnitude is provided, donuts like Epicenter prediction is obtained from Fig.20 by TBP anomaly in dB value.

8. Subject

The present subject is to proceed multiple points observation. Earthquake prediction will be possible by Direction inquiry.

5. Conclusions

Anomalies observed on 3/22 and 3/25 are regarded as correlated with Noto peninsula off EQ since most of past anomalies were correlated with actual EQs.

Therefore, TBP anomalous potential of 20dB or more can roughly say that the possibility is high to be a precursor of earthquake of M>6.0 occurred somewhere in Japan within three weeks from the day of an anomaly observation at Miwa observation post.

Although TBP detects also meteorological and artificial noise, noise elimination is not necessary as those noise level are much lower than seismic one. Especially large signal which exceeds 20dB can be regarded as seismic.

Mentioned above is a limit at the present science level, however, knowing of only earthquake occurrence place and time is much significant than sudden hitting by a large earthquake considering the meaning on practicable disaster prevention.

If the TBP and other significant electric and magnetic method from which specific in place is able to be obtained are observed in parallel at many points, this observation will contribute for future big earthquake prediction.

TBP real time data is shown at the following URL.

http://www.jsedip.jp/

References;

1)Hideo Toriyama; The Behaviour of the Sensitive Plant in a Typhoon