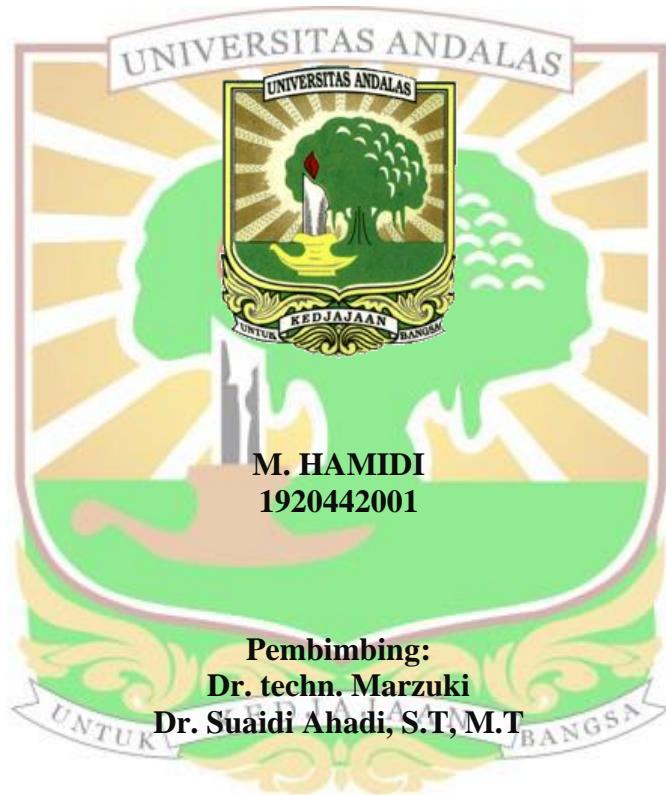


**ANALISIS EMISI *ULTRA LOW FREQUENCY* (ULF)
DAN ANOMALI *TOTAL ELECTRON CONTENT* (TEC)
SEBAGAI PREKURSOR GEMPA BUMI DI SUMATERA
PERIODE 2019 – 2020**

TESIS



**PROGRAM PASCASARJANA
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ABSTRAK

Pengamatan prekursor gempa bumi sangat penting untuk prediksi jangka pendek gempa. Dalam tugas akhir ini telah dilakukan analisis prekursor gempa bumi di Sumatera periode 2019 – 2020 berdasarkan emisi ULF (*Ultra Low Frequency*) dan anomali TEC (*Total Electron Content*). Keterkaitan emisi ULF dan anomali TEC sebagai prekursor gempa bumi di Sumatera diteliti menggunakan data geomagnetik yang terekam oleh MAGDAS (*Magnetik Acquisition Data System*) dan data GPS dari stasiun SuGAr (*Sumatran GPS Array*). Data gempa diseleksi berdasarkan persamaan zona persiapan gempa $\rho = 10^{0.43M}\text{km}$. Anomali ULF diidentifikasi menggunakan nilai polarisasi power ratio komponen Z dan komponen H yang melewati batas standar deviasi ($p+z$, $p-z$) dan teknik *Singgle Station Function Transfer* (STTF) berdasarkan *azimuth* anomali ULF yang mengarah ke episenter gempa. Anomali TEC diidentifikasi menggunakan teknik auto korelasi berdasarkan nilai simpangan koefisien korelasi (skk) terhadap deviasi simpangan koefisien korelasi (dskk). Anomali TEC yang diduga memiliki korelasi dengan anomali ULF ditandai oleh nilai skk/dskk < -1 yang terjadi bertepatan dengan terjadinya anomali ULF prekursor. Indeks *Disturbance Time Indeks* (Dst) digunakan untuk memastikan emisi ULF dan anomali TEC bukan disebabkan oleh aktivitasbadai geomagnet. Dari 29 gempa yang diteliti terdapat 15 (lima belas) gempa yang hanya didahului oleh emisi ULF prekursor, 10 (sepuluh) gempa yang memiliki emisi ULF dan TEC prekursor, dan 4 (empat) gempa yang tidak terdeteksi kemunculan prekursor. *Lead time* emisi ULF memiliki korelasi positif (+) terhadap *lead time* anomali TEC dengan nilai koefisien korelasi ($0,60 < R < 0,79$). Selain itu, frekuensi kemunculan emisi ULF dan anomali TEC memiliki tren korelasi positif (+) dengan magnitudo gempa. Semakin sering kemunculan emisi ULF dan anomali TEC prekursor maka semakin besar kemungkinan magnitudo gempa yang akan terjadi. Namun, hubungan antara magnitudo terhadap frekuensi kemunculan anomali ULF dan TEC prekursor bervariasi dari koefisien korelasi lemah hingga kuat ($0,00 < R < 0,79$).

Kata Kunci: sumatera, *ultra low frequency*, *total electron content*, prekursor gempa

ANALYSIS OF ULTRA LOW FREQUENCY (ULF) AND TOTAL ELECTRON CONTENT (TEC) ANOMALIES ASSOCIATED WITH SUMATRA EARTHQUAKES DURING 2019 – 2020

ABSTRACT

Observation of earthquake precursors is crucial for the short-term prediction of earthquakes. In this final project, an analysis of earthquake precursors in Sumatra during 2019 – 2020 has been carried out based on ULF (Ultra Low Frequency) emissions and TEC (Total Electron Content) anomalies. The correlation between ULF emissions and TEC anomalies as earthquake precursors in Sumatra was investigated using geomagnetic data recorded by MAGDAS (Magnetic Acquisition Data System) and GPS data from SuGAr station (Sumatran GPS Array). The earthquake data was selected by the earthquake preparation zone equation $\rho = 10^{0.43}M\text{km}$. The ULF anomaly was identified using the polarization power ratio of the Z and H component were passed the standard deviation limit ($p+z$, $p-z$). Furthermore, the Single Station Function Transfer (STTF) technique based on the azimuth of the ULF anomaly leading to the earthquake epicenter was also used. TEC anomalies were identified using the autocorrelation technique based on the correlation coefficient deviation (skk) to the correlation coefficient standard deviation (dkk). The TEC anomaly that is thought to correlate with the ULF anomaly is indicated by the value of $skk/dkk < -1$, which coincides with the occurrence of the precursor ULF anomaly. The Disturbance Time Index (Dst) was used to ensure that ULF emissions and TEC anomalies were not caused by geomagnetic storm activity. Of the 29 earthquakes was studied, there were 15 (fifteen) earthquakes that were only preceded by precursor ULF emissions, 10 (ten) earthquakes had precursor ULF and TEC emissions, and 4 (four) earthquakes where no precursors were detected. ULF emission lead time has a positive correlation (+) to TEC anomaly lead time with correlation coefficient value ($0.60 < R < 0.79$). In addition, the frequency of occurrence of ULF emissions and TEC anomalies has a positive correlation trend (+) with the earthquake magnitude. The more frequent the occurrence of ULF emissions and precursor TEC anomalies, the greater the probability that the earthquake's magnitude will occur. However, the relationship between magnitude and frequency of ULF anomalies and precursor TECs varies from weak to strong correlation coefficient ($0.00 < R < 0.79$).

Keyword: sumatra, ultra low frequency, total electron content, Earthquake precursor