CHAPTER 3
SOURCES OF DATA AND CLASSIFICATION OF DATA

This chapter reveals the source of data, delimitations, classification of data, the present studies on the classifications and the location of the observatories used for the present research.

3.1 Sources of data:

This research work is based on the data of Indian geomagnetic observatories only. Data for hourly variations, annual variations and storm time range have been obtained from the volumes of Indian Magnetic data from 1971 to 2001. Data for one minute variations of geomagnetic storm on 29-31 October 2003, for the Alibag observatory are obtained from the Kyoto University, World Data Centre for Geomagnetism, Japan.

3.2 Classification of data and importance on each classification:

Each period range of natural geomagnetic field fluctuations can be identified with special utilization topics:

1. For the period range from 0.25 seconds to 1 minute the primary subjects of interest are Earth crust exploration, detection of hidden conductivity anomalies, electric power transformer failures, studies of hydro magnetic wave propagation and discovery of magnetospheric processes.

2. For the range from 1 minute to 24 hours, studies include the structure of magnetospheric deformation and currents, thermospheric heating and winds, ionospheric currents, mantle, and continental coastlines. Geomagnetic storms in this time scale affect a multitude of man-made systems such as satellites, communication systems, electric-power girds, and long pipelines.

3. From the range 1 day to 1 year will provide information about the fluid motions within the Earth’s core and at core-mantle boundary, solar activity and solar sector changes, tropospheric weather changes, and magnetospheric deformation. Our main field magnetic navigation charts are obtained from data in this period range.

4. For the range from 1 year to 100 years, geomagnetism reveals changes in the dipole-field moment generated in the Earth’s outer core, solar-cycle variability, and climatic variation in solar weather relationships.
5. From the range 100 years to 3000 years, archeomagnetic and lava-flow magnetic samples provide evidence that tells of the Earth's polar wandering, non dipole outer-core drift patterns, and historic climatic changes.

6. From the range 3000 years to 200 million years, paleomagnetic studies reveal information about main-field reversals and dipole-field disappearances, paleomagnetosphere, and continental drift.

3.3 Limitations of data

As pointed out in chapter 1, the magnetic observatories at Annamalainagar, Trivandrum and Ujjain were closed in 1995, 1998 and 2004 respectively. Therefore, continuous data on earth's magnetic field are not available for these stations. This caused a limitation for the present study.

3.4 Data used for the study

Depending on the availability of data at Indian magnetic observatories, data pertaining to different periods have been employed to illustrate the applications of the mathematical models selected for this research work.

3.5 The present studies on the classification

1. Geomagnetic storm time ranges are utilized to study the latitudinal variations.

2. Daily ranges of quiet day hourly values are utilized to study the geomagnetic coastal effects by Fuzzy clustering analysis.

3. Values of hourly variation of the horizontal H component during the quiet and disturbed days are studied through the technique of Fuzzy C-means clustering.

1. Annual mean variations of horizontal, vertical and declination (H, Z, D) components are utilized in Fractal analysis to study secular variations.

2. One minute variations of the sensitive horizontal (H) component of Alibag observatory is used to quantify the fractal dimension of the great geomagnetic storm of 29-31 October 2003.

3. Daily ranges of solar quiet day hourly mean values are utilized for studies on Gabriel graph.

4. Annual mean values of geomagnetic variations are utilized to study the stochastic nature by applying the technique of Hurst exponent.