

# Chapter 1

## The Fundamentals and Applications of Geo-Spatial Research

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### ABSTRACT

*This chapter is about the fundamentals of geo-spatial research. The Earth's make-up and position in the entirety of the universe and its systems thereof is revealed. It also categorizes the Earth movements into types, causative effects, and their measurable, predictable time beat. It resonates together with Chapter 2 to form a bigger picture. The scenario draws out whole complete discussions of geoscience study on the origins of matter, space, time and energy entities. The revelations of what is known about the Cosmos today and therefore the Universe is the painstaking work of several scientists. This knowledge is fundamental to all Geo-spatial science research. For one to successfully carry out the research of this nature, it is imperative that one is fully conversant with how the Universe and therefore the Earth and its systems function. The discussions also include a map as a reporting platform for processes of the geospatial science research.*

### INTRODUCTION

The book and the study is about the fundamentals of *geo-spatial research*. To understand it one has to first comprehend the three key words of *Geo*, *Spatial*, and *Research*. First, essentially *Geo* is a prefix word. It is associated with all words meaning *Earth*. It is borrowed from a Greek word *Yaia* meaning *land*. In Southern Africa, the literal interpretation of the Setswana word *lehatshe* implies the environment

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at large with everything in it. It covers the people, land, rivers, vegetation, animals and their habitats, so covering the entire ecosystem (Maphanyane, 2012). The word *lehatsho* in English is translated not only just as land, but it must be understood as having the broad connotation, not just merely the physical land or ground but the world at large (Maphanyane, 2012). Also, in reiteration, when the history of ecology was considered, the concept '*land*' was often used in the sense of complete ecosystem (Leopold, 1949). Geo-examples are found in *geodesy* - in the science of *geomatics*, meaning the use of coordinates reference system for *Earth's surface point* location and measurement of its size, shape, and gravitational field; in *geodynamics*, in Geology, meaning the study of forces and processes pertaining to the *Earth's interior*; and in *Geophysics*, also a Geology sector, meaning the *Earth, air, and Space*. So, in this book *Geo* should be understood to mean land; the Earth and its systems in its entirety; the atmosphere, geosphere, hydrosphere and biosphere (See Figure 3 of Chapter 2). These include all matter, space, time, energy; and processes that occur within Earth's boundary.

Second, the word *spatial* is defined here as anything or a phenomenon whose position can be pinpointed at a specific point anywhere in space at any given time using some form of referencing system of coordinates; a certain place defined by some space whose size is dependent upon the scale of measurement applied.

Third, *Research* is understood here as any form of scientific investigation. It is described in many dictionaries as the enquiry or testing aimed at the discovery and explanation of facts, review of accepted theories or laws in the light of new facts, or practical application of such new or revised theories or laws. It incorporates the collection of information about a particular subject. In addition to that; Howard et al. (1983) eloquently defined research as "seeking through methodical processes to add to bodies of knowledge by the discovery or elucidation of non-trivial facts, insights and improved understanding of situations, processes, and mechanisms." (Howard & Sharp, 1983).

In this book, the *geospatial research* is therefore defined as the scientific investigation of the Earth and its systems. It will base itself in studies within the fields of the geology, geography, geomorphology, hydrology, vegetation and soils. The applications of study considered is the use of the core sciences of mathematics, statistics, physics, electromagnetic waves, and computer software. These core sciences are applied indirectly as underlying principles upon which, the tools and methods of measurements in geospatial science application techniques hinges upon. These tools and methods of measurements are geomatics, cartography, information computer technology (ICT), geographical information systems (GIS), photogrammetry and remote sensing hinges - upon. The results from such studies always have a map component: be it, the base maps such as topographical maps and nautical charts, that emanate from primary surveying in geomatics science; or the resultant thematic maps such as geological maps, geomorphological maps, soil maps, hydrological maps and vegetation maps that are topographical data based maps overlain with a particular theme such geology, geomorphology, soils, hydrology, vegetation respectively. Also, included to that are data captured from space such as the image maps in the form of orthophoto maps and space maps. These include georeferenced and rectified aerial photo mosaics and satellite images overlain with the topographical details.

## **IMPORTANCE AND PROCEDURES IN GEOSPATIAL SCIENCE RESEARCH**

The geospatial research is needed because the Earth is our home as human beings, its functions, and its systems is what life as a whole is all about. All life depends on the Earth's natural resources. Our

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