Preface

For millennia, human communities have wondered about the possibility of observing phenomena in their surroundings, and in particular those affecting the Earth on which they live.

More generally, it can be conceptually defined as Earth observation (EO) and is the collection of information about the biological, chemical and physical systems of planet Earth. It can be undertaken through sensors in direct contact with the ground or airborne platforms (such as weather balloons and stations) or remote-sensing technologies. However, the definition of EO has only become significant in the last 50 years, since it has been possible to send artificial satellites out of Earth's orbit.

Referring strictly to civil applications, satellites of this type were initially designed to provide satellite images; later, their purpose expanded to include the study of information on land characteristics, growing vegetation, crops, and environmental pollution. The data collected are used for several purposes, including the identification of natural resources and the production of accurate cartography. Satellite observations can cover the land, the atmosphere, and the oceans.

Remote-sensing satellites may be equipped with passive instrumentation such as infrared or cameras for imaging the visible or active instrumentation such as radar. Generally, such satellites are non-geostationary satellites, i.e., they move at a certain speed along orbits inclined with respect to the Earth's equatorial plane, often in polar orbit, at low or medium altitude, Low Earth Orbit (LEO) and Medium Earth Orbit (MEO), thus covering the entire Earth's surface in a certain scan time (properly called 'temporal resolution'), i.e., in a certain number of orbits around the Earth.

The first remote-sensing satellites were the American NASA/USGS Landsat Program; subsequently, the European: ENVISAT (ENVironmental SATellite), ERS (European Remote-Sensing satellite), RapidEye, the French SPOT (Satellite Pour l'Observation de laTerre), and the Canadian RADARSAT satellites were launched. The IKONOS, QuickBird, and GeoEye-1 satellites were dedicated to cartography. The WorldView-1 and WorldView-2 satellites and the COSMO-SkyMed system are more recent. The latest generation are the low payloads called Small Satellites, e.g., the Chinese BuFeng-1 and Fengyun-3 series.

Also, Global Navigation Satellite Systems (GNSSs) have captured the attention of researchers worldwide for a multitude of Earth monitoring and exploration applications. On the other hand, over the past 40 years, GNSSs have become an essential part of many human activities. As is widely noted, there are currently four fully operational GNSSs; two of these were developed for military purposes (American NAVstar GPS and Russian GLONASS), whilst two others were developed for civil purposes such as the Chinese BeiDou satellite navigation system (BDS) and the European Galileo. In addition, many other regional GNSSs, such as the South Korean Regional Positioning System (KPS), the Japanese quasi-zenital satellite system (QZSS), and the Indian Regional Navigation Satellite System (IRNSS/NavIC), will become available in the next few years, which will have enormous potential for scientific applications and geomatics professionals.

In addition to their traditional role of providing global positioning, navigation, and timing (PNT) information, GNSS navigation signals are now being used in new and innovative ways. Across the globe, new fields of scientific study are opening up to examine how signals can provide information about the characteristics of the atmosphere and even the surfaces from which they are reflected before being collected by a receiver.

EO researchers monitor global environmental systems using in situ and remote monitoring tools. Their findings provide tools to support decision makers in various areas of interest, from security to the natural environment. GNSS signals are considered an important new source of information because they are a free, real-time, and globally available resource for the EO community.

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