

ENVIRONMENTAL MONITORING

Environmental Monitoring

Definition:

Environmental monitoring refers to the tools and techniques designed to observe an environment, characterize its quality, and establish environmental parameters, for the purpose of accurately quantifying the impact an activity has on an environment. Results are gathered, analyzed statistically, and then published in a risk assessment and environmental monitoring and impact assessment report.

What is Environmental Monitoring?

The main objective of environmental monitoring is to manage and minimize the impact an organization's activities have on an environment, either to ensure compliance with laws and regulations or to mitigate risks of

harmful effects on the natural environment and protect the health of human beings.

As human population, industrial activities, and energy consumption continues to grow, the continued development of advanced, automated monitoring applications and devices is crucial for enhancing the accuracy of environmental monitoring reports and the cost-effectiveness of the environmental monitoring process.

Monitoring programs are published outlines within an organization that detail precisely which elements are being monitored, overall objectives, specific strategies, proposed sampling methods, projects within each strategy, and time frames.

Environmental monitoring products and environmental monitoring software, such as Environmental Data Management Systems (EDMS), facilitate the implementation and monitoring of environmental monitoring and assessment programs, which includes a central data management hub, automated environmental monitoring alerts, compliance

checking, validation, quality control, and generation of reports on dataset comparisons.

Environmental Monitoring Types:

The three main types of environmental monitoring are soil, atmosphere, and water. Some techniques of environmental scanning and monitoring include filtration, sedimentation, electrostatic samples, impingers, absorption, condensation, grab sampling, and composite sampling.

Data collected from these methods of environmental monitoring can be input into a DBMS, where it can be categorized, analyzed, visualized, and create actionable insights that drive informed decision making.

- **Air Monitoring:** Environmental data gathered using specialized observation tools, such as sensor networks and [Geographic Information System](#) (GIS) models, from multiple different

environmental networks and institutes is integrated into air dispersion models, which combine emissions, meteorological, and topographic data to detect and predict concentration of air pollutants.

- **Soil Monitoring:** Grab sampling (individual samples) and composite sampling (multiple samples) are used to monitor soil, set baselines, and detect threats such as acidification, biodiversity loss, compaction, contamination, erosion, organic material loss, salinization, and slope instability.

- **Salinity Monitoring:** Remote sensing, GIS, and electromagnetic induction are used to monitor soil salinity, which, if imbalanced, can cause detrimental effects on water quality, infrastructure, and plant yield.

- **Contamination Monitoring:** Chemical techniques such as chromatography and spectrometry are used to measure toxic elements, such as nuclear waste, coal ash, microplastics, petrochemicals, and acid rain, which can lead to the

development of pollution-related diseases if consumed by humans or animals.

- **Erosion Monitoring:** Monitoring and modeling soil erosion is a complex process in which accurate predictions are nearly impossible for large areas. The Universal Soil Loss Equation (USLE) is most commonly used to try to predict soil loss due to water erosion. Erosion may be due to factors such as rainfall, surface runoff, rivers, streams, floods, wind, mass movement, climate, soil composition and structure, topography, and lack of [vegetation management](#).

- **Water Monitoring:** Environmental sampling techniques include judgmental, simple random, stratified, systematic and grid, adaptive cluster, grab, and passive; semi-continuous and continuous environmental monitoring; remote sensing and environmental monitoring; and bio-monitoring are used to measure and monitor ranges for biological, chemical, radiological, microbiological, and population parameters.

Environmental condition monitoring for water is managed by federal, state, and local agencies, universities, and volunteers, and is crucial in characterizing waters, determining the efficacy of existing pollution control programs, identifying trends and emerging problems, redirecting pollution control efforts as needed, and in emergency response efforts.

IOT Based Environmental Monitoring:

Environmental monitoring solutions have evolved over the years into Smart Environmental Monitoring (SEM) systems that now incorporate modern sensors, Machine Learning (ML) techniques, and the [Internet of Things](#) (IoT). Technologies such as IoT devices and wireless sensor networks have made advanced environmental monitoring using IoT a more streamlined and Artificial Intelligence-controlled process.

Data captured by IoT environmental monitoring sensors from a wide variety of environmental conditions can be integrated via the Wireless Sensor Network (WSN) into one, cloud-based environmental system, in which IoT devices embedded with ML can record, characterize, monitor, and analyze elements in a specific environment.

IoT for environmental monitoring facilitates the development of wireless, remote environmental monitoring systems, which enable operations to remove much of the human interaction in system function, which reduces human labor, increases the range and frequency of sampling and monitoring, facilitates sophisticated on-site testing, provides lower latency, and connects detection systems to response teams, ultimately resulting in higher rates of significant disaster and contamination prevention.

Reasons for Environmental Monitoring:

The advantages of environmental monitoring lie in its ability to improve the quality of life for society by highlighting the relationship between the environment and health.

Transforming environmental monitoring data into information and communicating actionable insights to the community in a timely manner is crucial for keeping citizens informed of the state of their environment.

Practical environmental monitoring applications include protection of public water supplies, management of hazardous and radioactive waste, identification and analyzation of pollution sources that affect urban air quality and its effects on human health, protection and management of natural resources like soil and water supplies, weather forecasting, resource allocation for land planning and economic development with [energy analytics](#) and energy [business intelligence](#), identifying population density

patterns in relation to natural resources and economic development, mapping of natural resources, protection of endangered species, and global climate change.

An Environmental Monitoring Solution?

Remote sensing data from environmental monitoring is a major source of spatial data used in Geographic Information Systems (GIS). Geospatial capabilities are a top feature of HEAVY.AI's accelerated [geospatial analytics platform](#). While the enormous volumes of data collected by modern environmental monitoring sensors and IoT devices easily overwhelm legacy GIS tools, HEAVY.AI's accelerated analytics platform allows analysts to cross-filter billions of location data records and polygons alongside other features in milliseconds.