

Overview – Environmental Monitoring

Environmental monitoring refers to the deployment of instruments and the collection of data that characterize different aspects of environmental conditions. A common example is the reporting of weather conditions on a continuous basis, in radio, television, and other media outlets, as well as numerous web sites. We can look up the current air temperature, barometric pressure, cloud cover, and other information, and those data are provided through the deployment of sensors that record values at prescribed intervals (usually every 15 minutes for most National Weather Service stations). Other examples include temperature and other water quality conditions, as might be used to determine whether swimming safety at a particular beach. Monitoring can also refer to collection of data to represent ecosystem health, such as recording numbers of a given plant or animal species over a period of time, or evaluating changes in habitat.

At some level, monitoring of the environment has always been a part of human activities, if for no other reason than to follow game movements. In more recent times monitoring is used to gather data to support environmental management, and the level of sophistication has risen considerably. Remote sensing of data is common, including the use of satellite imagery, and advances in communication hardware and software have enabled the design of data collection strategies that include extending the time periods over which data can be collected, and developing sensor networks that can actively respond to real-time changes in the environment.

Although the word “monitoring” usually implies the sampling program is carried out in a more or less continuous manner in time and/or space, it can also mean occasional observation or sampling at relatively few discrete locations. In general, data can be sampled (recorded) at single or multiple locations, and with different sampling frequencies. Infrequent sampling is used either when budgets do not allow for more frequent readings, or the process being monitored does not vary quickly with time. More frequent (even continuous) monitoring is used when the process varies more rapidly, such as air temperature, and when higher resolution data are of interest for other purposes, such as model development, calibration, or validation.

Examples of environmental monitoring from the papers in the present catalogue focus primarily on topics associated with air or water quality. One paper, for instance, looks at combining real-time meteorological data with pollution discharge rates, along with regression analysis to develop an index that characterizes the potential for unhealthy air quality conditions.

Environmental monitoring is also highlighted as a means of documenting physical, chemical, and biological changes in a particular system in order to assess trajectories, cause-and-effect relationships, worsening or improving conditions as a result of pollution or restoration activities, and others. A composite of environmental conditions (an index) reflects the state of health of a given ecosystem and its ability to provide ecosystem services necessary to support human life. Degradation of the environment can directly affect human health, and it is important to know environmental conditions (chemical concentrations, for instance) to better assess health risks.

As suggested above, an important aspect of environmental monitoring is knowing where, and how often, a particular parameter should be measured. Monitoring choices are often made in conjunction with environmental modeling, where modeling or preliminary monitoring might identify locations (or times) in the system of interest where (when) the parameter of interest is varying significantly, or when interesting or potentially extreme behavior might be expected. Monitoring, in turn, aids in development of the models.