

# Environmental Hazard Monitoring

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**MAD-EM**

Mobile Application Development in Environment  
Monitoring – a New Program of Master Studies in English

# Presentation overview



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- Concept of environmental monitoring
- Monitoring impact area
- DPSIR model
- Environmental monitoring objective
- Blocks of environmental monitoring
- Monitoring methods

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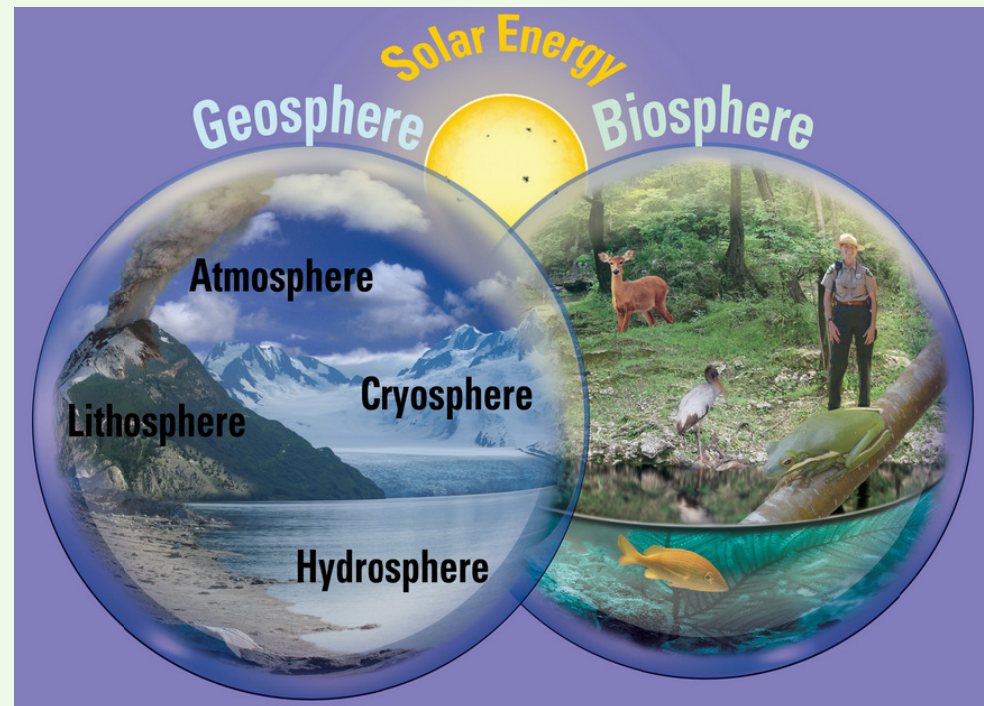


# Concept of environmental monitoring

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The natural environment includes a portion of geographical space, which consists of:

- lithosphere,
- atmosphere,
- hydrosphere,
- cryosphere,
- pedosphere,
- and biosphere.



<http://pubs.usgs.gov/pp/p1386a/images/gallery-1/full-res/pp1386a1-fig01.jpg>

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# Concept of environmental monitoring MAD EM

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- The environment is subject to degradation, therefore it must be observed in order to prevent unfavourable phenomena.  
This is achieved by environmental monitoring.
- Environmental monitoring is a system of measurements, assessments and forecasts of the state of the environment and the collection, processing and dissemination of environmental information.
- The subject of environmental monitoring are phenomena and processes that can be tracked in terms of quantity and quality.

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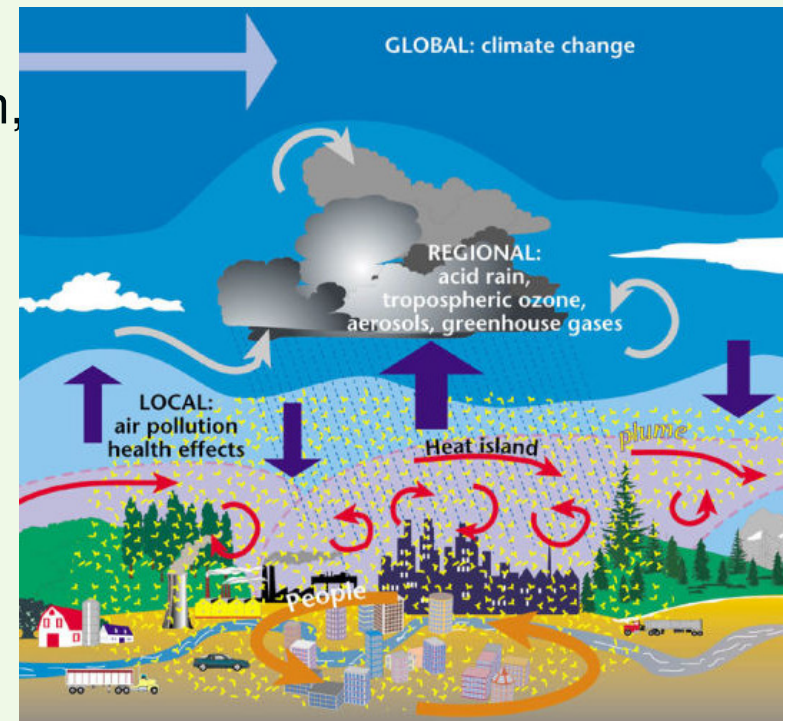
# Impact area



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The area of environmental monitoring impact can be:

- global, e.g. Global Atmosphere Watch,
- continental, e.g. El Niño Southern Oscillation (ENSO), offshore environmental monitoring on the Norwegian continental shelf,
- national,
- regional, e.g. voivodeship, province,
- local, in the areas of industrial plants, landfills, highways.



[http://imk-ifu.fzk.de/img/Urban\\_rural\\_interaction.jpg](http://imk-ifu.fzk.de/img/Urban_rural_interaction.jpg)

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# Global monitoring



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## Global atmosphere watch (GAW) stations



<https://www.wmo.int/pages/prog/arep/gaw/images/gaw-global-stations-2015-02-10-black-text.pdf>

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# DPSIR model

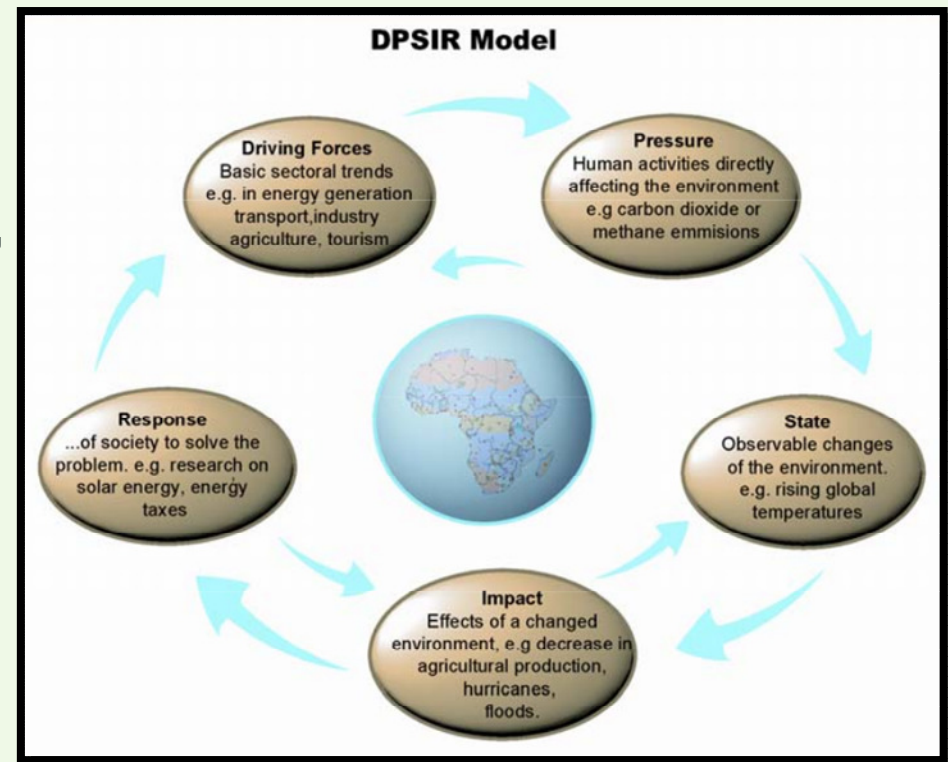


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Environmental monitoring is integrated into the environmental management system, based on the DPSIR model:

- D – driving forces/drivers,
- P – pressures,
- S – state,
- I – impacts,
- R – responses.

[http://www.unep.org/ieacp/\\_res/site/File/iea-training-manual/Africa/english/module-3.pdf](http://www.unep.org/ieacp/_res/site/File/iea-training-manual/Africa/english/module-3.pdf)



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# DPSIR model



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- **Driving forces** – the factors that are driving the process of degradation and transformation of the environment, e.g. economic development, population growth, the development of technology.
- **Pressures** – generated by sectors of the economy at every stage of the process from the extraction of raw materials, through their processing, production of the product, its distribution and sale all the way to the generation of waste, e.g. the volume of production and consumption, the production of municipal and industrial waste.

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# DPSIR model



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- **State** – the current state of the environment and environmental threats, sources of emission levels of pollutants, e.g. the frequency of floods and their size, soil quality, biodiversity of ecosystems, drinking water quality, air quality, climate change.
- **Impacts** – the impact of environmental hazards.
- **Responses** – measures to counter unfavourable developments, reduction and control of hazards, e.g. the implementation of secure technology, economic and social policy, environmental protection.

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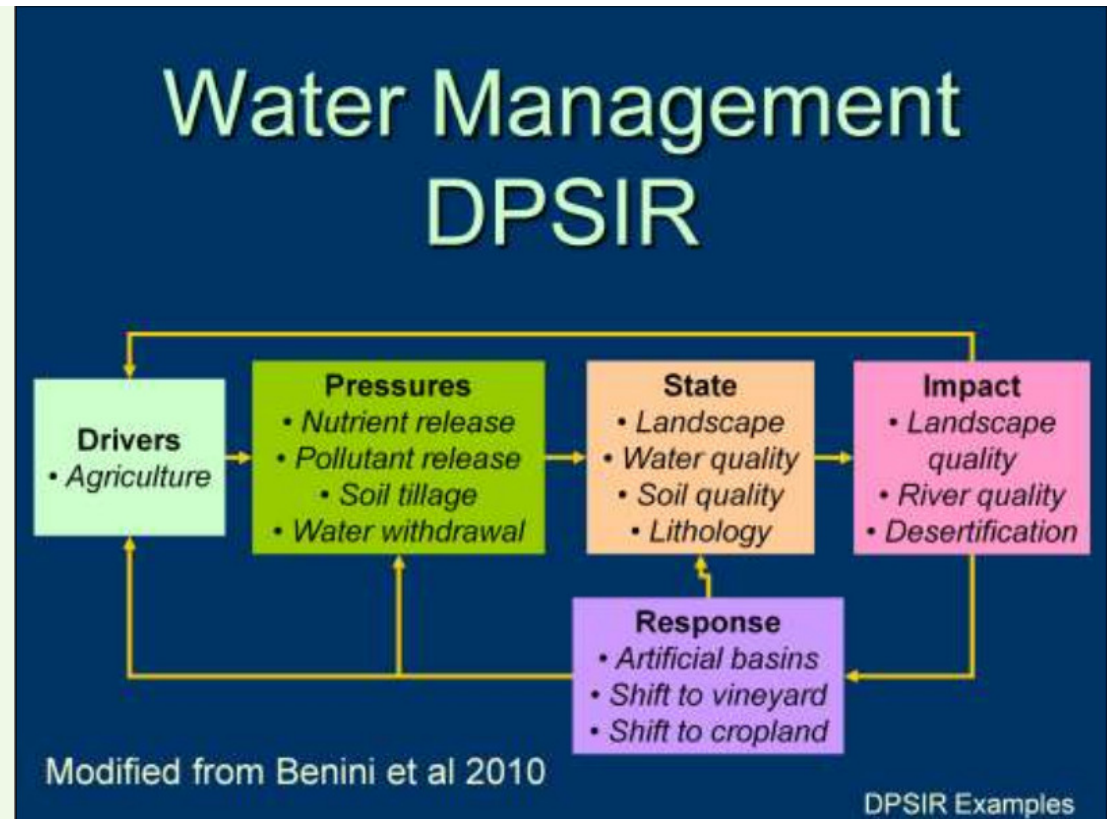


# DPSIR model



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- This model is commonly used by the European Commission (EC), Organisation for Economic Co-operation and Development (OECD) and the European Environment Agency (EEA).



[http://www.epa.gov/ged/tutorial/docs/DPSIR\\_Module\\_2.pdf](http://www.epa.gov/ged/tutorial/docs/DPSIR_Module_2.pdf)

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# Monitoring objective



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Monitoring studies are used to observe changes in the environment and enable one to take actions necessary to:

- minimise the effects of anthropogenic pressure,
- identify areas of occurrence of environmental pollution,
- develop plans for land use,
- prepare environmental impact assessments,
- develop working studies and forecasts.

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# Blocks of environmental monitoring

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Blocks of environmental monitoring:

- pressures/emissions (sub-systems such as air, water and waste),
- state of the environment/immissions (quality of the environment),
- assessment and evaluation.

Pressures imply obtaining information about sources and loads discharged into the environment, in particular information on emissions.

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# Blocks of environmental monitoring

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The size of emissions is related to:

- the type and quantities of substances or energy within a specified time, i.e. of solid, liquid and gas pollutants, heat, noise, vibration and radiation,
- the concentration or levels of substances or energy in the waste gases, effluents and waste produced.



<http://www.dailytimesgazette.com/wp-content/uploads/2015/06/AIR-POLLUTION1.jpg>



[http://217.218.67.233/photo/20141209/389496\\_Air%20pollution-public%20health%20crisis.jpg](http://217.218.67.233/photo/20141209/389496_Air%20pollution-public%20health%20crisis.jpg)



<http://geology.com/volcanoes/chaiten/>

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# Sources of monitoring data



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The monitoring of environmental hazards can be based on data from a wide variety of sources:

- emissions inventories (records of the permitted or actual level of emissions from specified sources),
- environmental data (measurements of the concentrations of pollutants in the environment),
- bio-monitoring data (measurements of specific agents or their metabolic products in biological samples),
- health data.

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# Data sources of emissions



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The data sources on emissions include:

- the system of official statistics,
- administrative systems,
- data on emissions coming from producers and traders,
- reports of entities covered by Regulation (EC) No 166/2006 concerning the establishment of a European Pollutant Release and Transfer Register and amending Council Directives 91/689/EEC and 96/61/EC,
- the results of emission measurements obtained through the control of subjects,
- information obtained from the system of trading carbon dioxide emissions.

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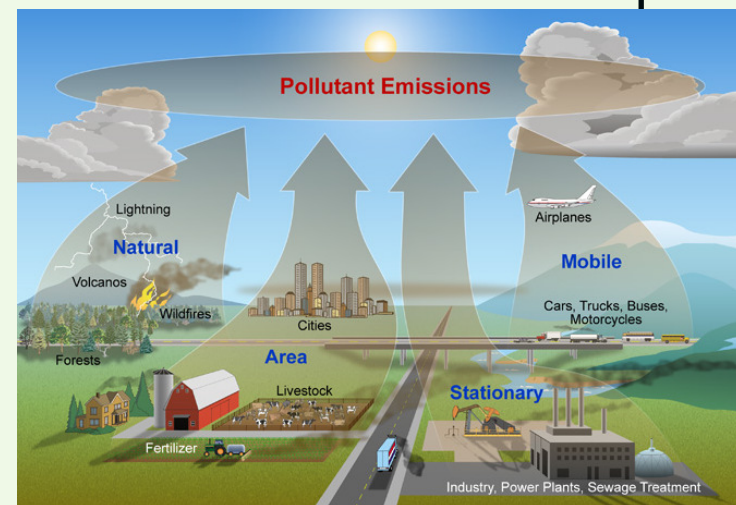


# Control of environmental hazards



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- The control of environmental hazards depends on defining acceptable levels of exposure and hence health risk and determining the levels of control needed to keep exposure below specified thresholds.
- Monitoring and control of environmental hazards require the identification of:
  - 1. critical agents,
  - 2. pathways of pollutants,
  - 3. population at risk.



[http://www.nature.nps.gov/air/AQBasics/images/types\\_of\\_sources\\_02-2012.jpg](http://www.nature.nps.gov/air/AQBasics/images/types_of_sources_02-2012.jpg)

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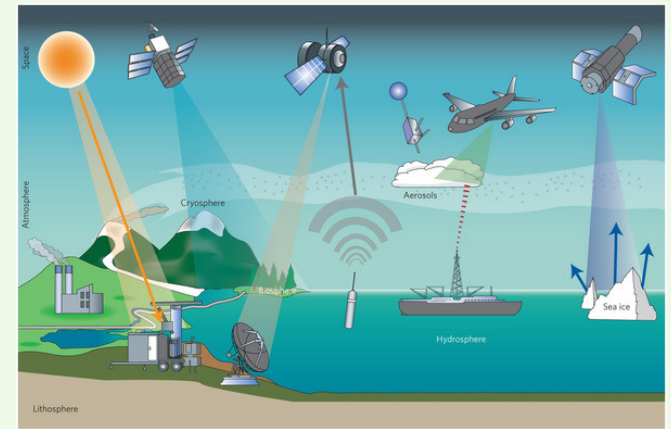
# Monitoring methods



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Environmental monitoring involves:

- spatial measurements,
- diffractograms,
- long- and short-wave spectra,
- thematic cartography and remote sensing,
- sensors and self-registering devices,
- Global Monitoring for Environment and Security techniques (GMES),
- mathematical modelling and Geographic Information System (GIS).



[http://www.nature.com/nclimate/journal/v3/n10/images\\_article/nclimate1908-f1.jpg](http://www.nature.com/nclimate/journal/v3/n10/images_article/nclimate1908-f1.jpg)

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# GMES



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- In 2002, the European Commission (EC) and the European Space Agency (ESA) established a program of the Global Monitoring for Environment and Security (GMES), which is used to coordinate global monitoring for environment.
- Coordination is carried out using artificial satellites and data collected on the surface of the earth.



<http://www.space-airbusds.com/media/image/programmes/GMES.jpg>

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# GMES



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Meteorological and water-level data come from:

- meteorological satellites (geostationary GETEOSAT 7, TERRA, FY, GOES, GOMS, GMS and polar-orbiting NOAA, METEOR),
- weather radars,
- balloon surveys,
- meteorological, synoptic (round-the-clock measurements) and climatological stations,
- meteorological, water-gauge and groundwater stations,
- lightning detection and localisation network,
- aerological measurement network (radio probes),
- sodars - sound detection and ranking.

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# GMES



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<http://www.metlink.org/wp-content/uploads/2013/06/satellites.jpg>

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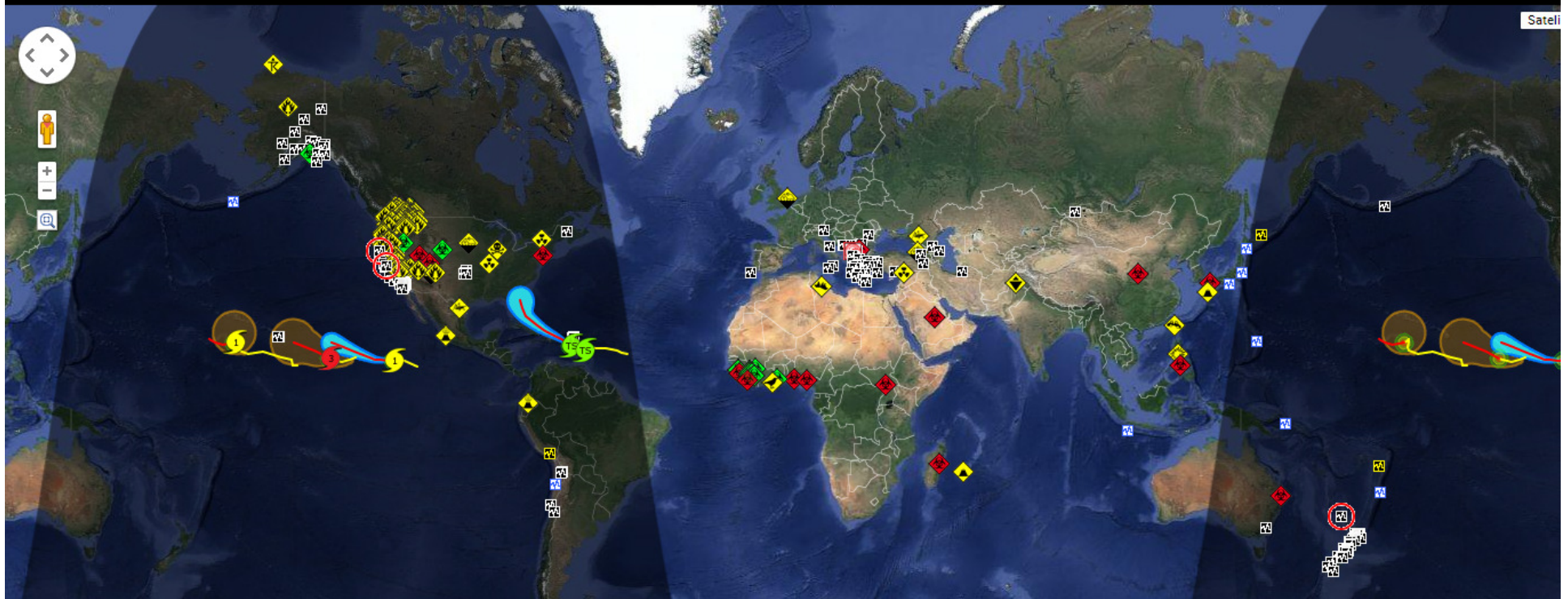
# RSOE EDIS - World wide hazard map



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RSOE EDIS - Emergency and Disaster Information Service

AREAS SERVICES LAYERS CONTACT ABOUT



<http://hisz.rsoe.hu/alertmap/index2.php>

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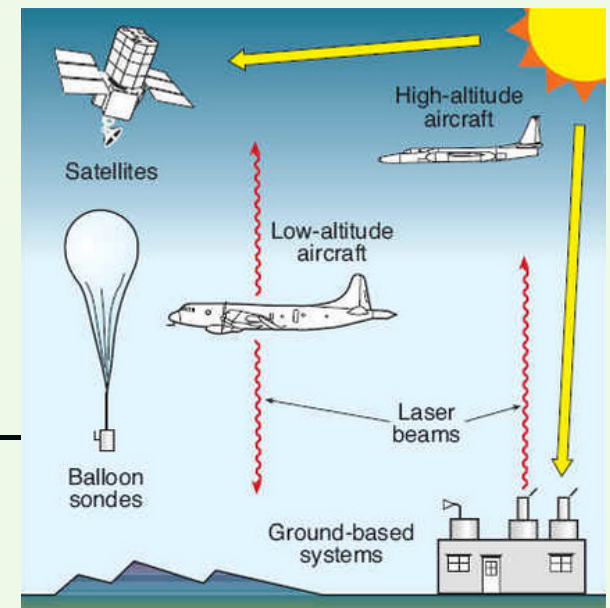
# Monitoring methods



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Methods of monitoring include:

- *in situ* measurements – sampling in threat location, analysis in field conditions or after transfer to a laboratory.
- remote pollution monitoring systems – equipped with sensitive sensors, allowing remote threat detection over the distance of several kilometers, measurement of pollutants' concentrations and rapid data transfer.



<http://www.theozonehole.com/images/twemeasurenty5.jpg>

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# Monitoring methods



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- monitoring through observation of the consequences of pollution in another environmental element, (examination of atmospheric precipitation indicates the state of air pollution),
- bioindication methods, biomonitoring.



[http://study.com/cimages/multimages/16/effects\\_of\\_acid\\_rain.jpg](http://study.com/cimages/multimages/16/effects_of_acid_rain.jpg)



<http://mason.gmu.edu/~jlawrey/CUE/F%20balt%20.jpg>

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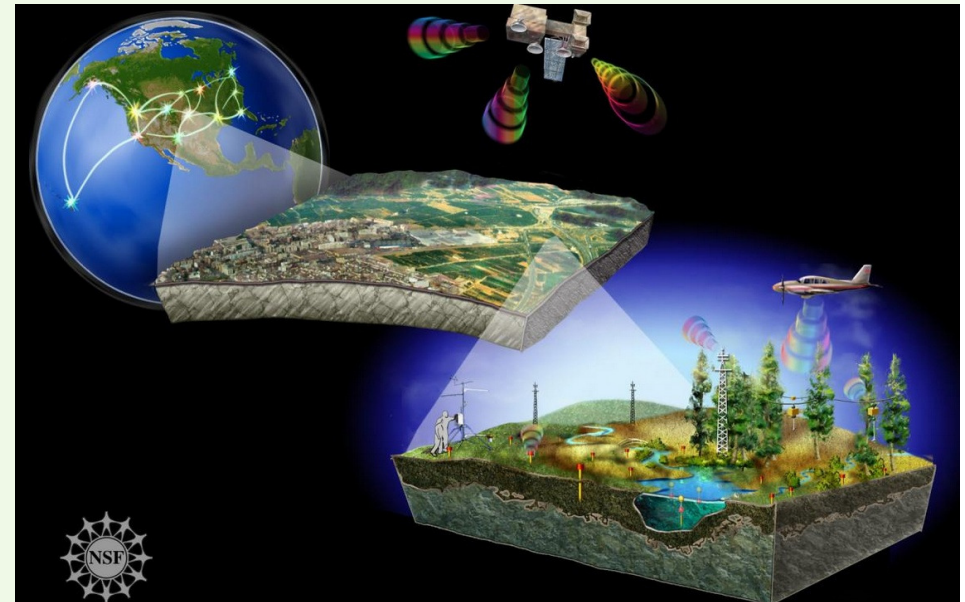
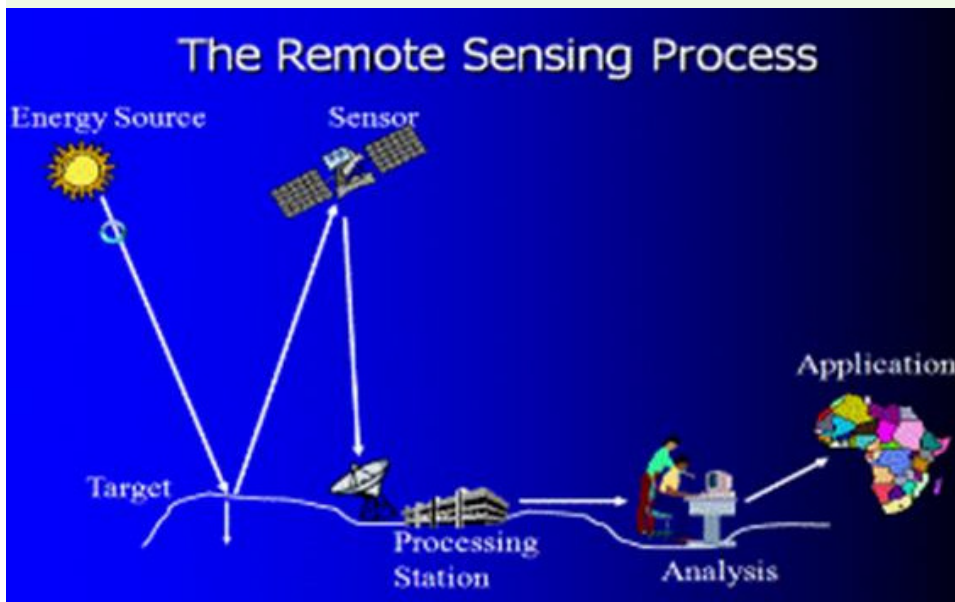


# Remote sensing



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Environmental remote sensing uses aircraft or satellites to monitor the environment using multi-channel sensors.



[http://dgl.salemstate.edu/geography/Profs/Young/Imaging%20Earth/Glacier-webpage/home\\_image3561.jpg](http://dgl.salemstate.edu/geography/Profs/Young/Imaging%20Earth/Glacier-webpage/home_image3561.jpg)

[http://larse.forestry.oregonstate.edu/sites/larse/files/project\\_images/NEON\\_Rager\\_h.jpg](http://larse.forestry.oregonstate.edu/sites/larse/files/project_images/NEON_Rager_h.jpg)

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# Remote sensing



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## Remote sensing of pollutants:

- makes it possible to collect data on dangerous or inaccessible areas, does not require entering the polluted area (e.g. inaccessible areas),
- ensures control of selected pollutants in a company, without entering its premises,
- enables examination of natural sources of pollution, e.g. volcanoes,
- allows for detection and identification of biological and chemical weapons.

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# Monitoring network



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The monitoring network consists of:

- automatic measurement and alarm networks,
- measuring network verification – to determine the accuracy of the models dispersion,
- a national network of stations and measurement stations (based on international agreements and conventions) – to monitor major environmental elements.

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# Environmental monitoring



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