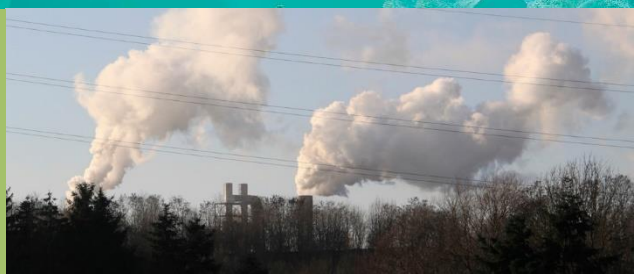
Air quality



Air quality comprises part of our research in the area of the sustainable use of natural resources. We measure concentrations of pollutants with a variety of tools and calculate the spatial distribution of different substances in the atmosphere. Stationary measurements are supplemented with mobile measurements of gases and airborne dust using an environmental measurement vehicle. The air quality is assessed according to spatial planning and health aspects based on valid EU guidelines and the latest research.

Our range of services

Measurements

^ Mobile measurements of nitrogen oxides, ozone, benzene, toluene, xylene and of selected natural and anthropogenic volatile organic compounds, pesticides.

^ Temporal high-resolution mobile particulate matter measurements of PM10, PM2.5 and PM1, as well as of the number of particles in 31 size categories between 0.25 µm and 32.0 µm, and nanoparticles.

^ Temperature measurement runs to map urban heat islands, record cold air corridors and for a human-bioclimatic evaluation.

^ Chemical analysis of particulate matter (e.g. heavy metals, nutrients, organic pollutants and mineralogical composition).

Modelling

^ Modelling of the air quality in cities and communes at the street and city quarter scale with the help of numeric models.

^ Malfunction analysis and malfunction prevention using modelling approaches.

Evaluation and advice

^ Evaluation of the regional and local air quality based on current laws and EU guidelines.

^ Preparation of reports on local pollution levels and advice on the development of air quality improvement concepts.

Measuring

The air quality describes the concentration of pollutants in the ground-level atmosphere and is evaluated by means of threshold values. Air quality monitoring and analysis is done through measurements and numerical modelling.

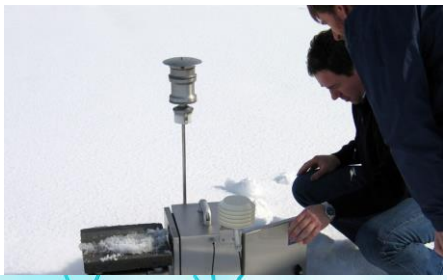
We use data from national monitoring networks, supplemented with our own monitoring stations and our measurement vehicle.

^ We used certified dust measuring instruments to measure PM10, PM2.5, PM1, and to record the number of particles between 0.25 µm and 32 µm, as well as nanoparticles. Our mobile measuring containers are equipped with nitrogen oxide and ammonia analysers and are supplemented with meteorological sensors.

^ To record coarse dust, Sigma-2 passive samplers and high and low-volume samplers complete the stationary measuring equipment.

^ Our environmental measurement vehicle can measure the following air pollutants continuously, both during a journey and when stationary: Nitrogen oxides, ozone, volatile organic compounds, pesticides, and particulate matter / nanoparticles.

^ In parallel, the vehicle records the wind vector up to a height of 7m, dry-bulb and wet-bulb temperatures at two variable heights and different radiation parameters.



Modelling

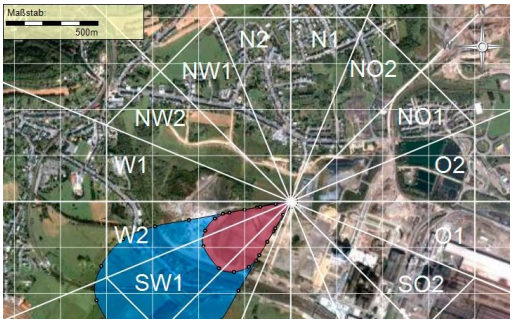
Taking into account the local terrain conditions, construction and meteorology, statements regarding the spatial distribution of pollutants can be made by means of dispersion calculation. Depending on the question, the VOMATEC SSA, SelmaGIS, Breeze (Aermod) or WRF models can be used.

^ The VOMATEC SSA serves to calculate the dispersion of toxic substances in the air in the event of fires, explosions or leaks. Depending on the substance and the dispersion conditions, possible areas of risk will be identified.

^ The SelmaGIS model is a dispersion model connected to a microscale climate model and used to calculate the air quality at street and neighbourhood levels.

^ The WRF mesoscale model serves as much for the operational weather forecast as for research purposes. It will be supplemented as a WRF/Chem version to simulate atmospheric chemistry.

SelmaGIS



VOMATEC SSA

Evaluation and advice

Meteorological evaluation

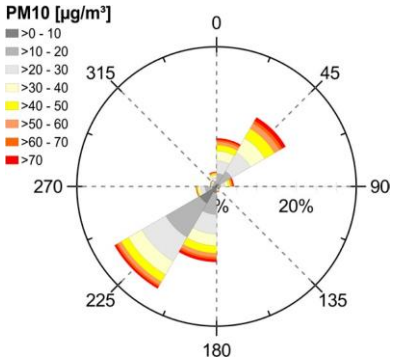
The air quality cannot be analysed and evaluated without taking meteorology into account. The local and regional dispersion conditions determine the immission concentrations that are active on the ground. In this way, for example, the dependency of the wind direction on immissions can be investigated with the help of pollution roses. Other determining factors are precipitation, air temperature, radiation and the relative air humidity.

Health evaluation

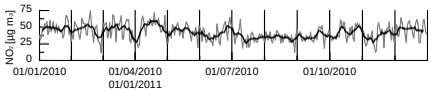
Air quality and bioclimate have a strong influence on human health. In this context, we investigate the link between current and future thermal stress (heat and cold stress), air pollutants and human health.

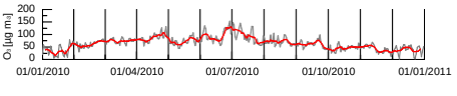
Solution strategies

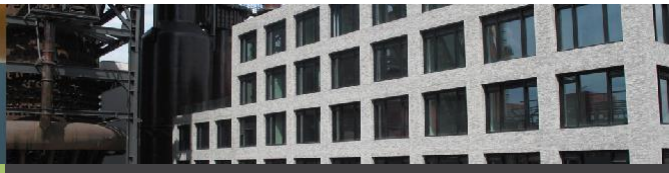
We evaluate the air quality with valid threshold values and formulate, where necessary, strategies for a long-term improvement in air quality.



Pollution rose - particulate matter







Contact

Jürgen Junk

juergen.junk@list.lu

Tel.: (+352) 275 888 - 5051

Andreas Krein

andreas.krein@list.lu

Tel.: (+352) 275 888 - 5010

Headquarters

Luxembourg Institute of Science and Technology (LIST) 5, avenue des Hauts-Fourneaux
L-4362 Esch/Alzette
Tel.: (+352) 275 888 - 1 | Fax: (+352) 275 885

info@list.lu

www.list.lu/social-

Environmental measurement vehicle

Air quality comprises part of our research in the area of the sustainable use of natural resources. We measure local concentrations of pollutants with a variety of tools and calculate the spatial distribution of different substances in the atmosphere. Stationary measurements are supplemented with mobile measurements of gases and airborne dust using an environmental measurement vehicle. The air quality is rated according to spatial planning and health aspects based on valid EU guidelines and the latest research.

Our range of services

Measurements

^ Mobile measurements of nitrogen oxides, ozone, benzene, toluene, xylene, pesticides and of selected natural and anthropogenic volatile organic compounds.

^ Temporal high-resolution mobile particulate matter measurements of PM10, PM2.5 and PM1, as well as of the number of particles in 31 size categories between 0.25 µm and 32.0 µm, nanoparticles.

^ Temperature measurement runs to map urban heat islands, record cold air corridors and for a human-bioclimatic evaluation.

^ Chemical analysis of particulate matter (e.g. heavy metals, organic pollutants and mineralogical composition).

Modelling

^ Modelling of the air quality in cities and communes at the street and neighbourhood level with the help of numeric models.

^ Malfunction analysis and malfunction prevention using modelling approaches.

Evaluation and advice

^ Evaluation of the regional and local air quality based on current laws and EU guidelines.

^ Preparation of reports on local pollution levels and advice on the development of air quality improvement concepts.

Gas measurements

Measurements can be taken both when stationary and during a journey. Air sampling to determine gases and particulate matter is carried out using extendable probes and suction pipes on the roof of the vehicle. All measurements are automatically localized via GPS.

The environmental measurement vehicle records the following gases:

^ Nitrogen oxides are measured with a chemiluminescence monitor tested for suitability (HORIBA, APNA-370).

^ A UV absorption monitor, tested for suitability, records ozone in the ambient air (HORIBA, APOA-370).

^ Volatile organic compounds are measured continuously with a gas-phase chromatograph with photoionization detector (AMA Instruments, GC 5000 BTX).

^ The analyser is used to measure benzene and can also record the concentrations of other aromatic hydrocarbons (e.g. toluene, ethylbenzene, xylene) at the same time.

^ The system is also used for the continuous measuring of ozone precursors from C4 to C12.

^ Pesticides are collected on absorber tubes.

Measuring of particulate matter

Particulate matter is measured in fractions of PM10, PM2.5 and PM1. The dust measuring device, made by Grimm (Model 180 D) has been tested for its suitability for PM10 (EN 12341) and PM2.5 (EN 14907).

Our mobile air quality laboratory contains a GRIMM SMPC+C Model 5420 to measure the particle fraction between 5 nm to 350 nm in 255 channels with a two-minute resolution.

The measuring principle is based on a laser spectrometer. This makes a parallel, continuous measurement of the three dust fractions with an extension to measure the number of particles in 31 size channels from 0.25 µm to 32.0 µm.

Measuring of meteorological data

The parameters measured are biometeorologically relevant indicators, which will be considered, in combination with the gases and particulate matter, when assessing the adverse health effects on the population.

^ At the top of the mast, which is extendable to 7m, the wind direction and wind speed are recorded with a 2D ultrasonic anemometer.

^ Furthermore, dry-bulb and wet-bulb temperatures are measured at two measurement levels on the front of the vehicle, and air temperature, global radiation, erythema-active radiation, and UVA and UVB radiation are measured on the roof of the vehicle. To give an example, erythema-active radiation can lead to damage to human skin.

Schematic overview

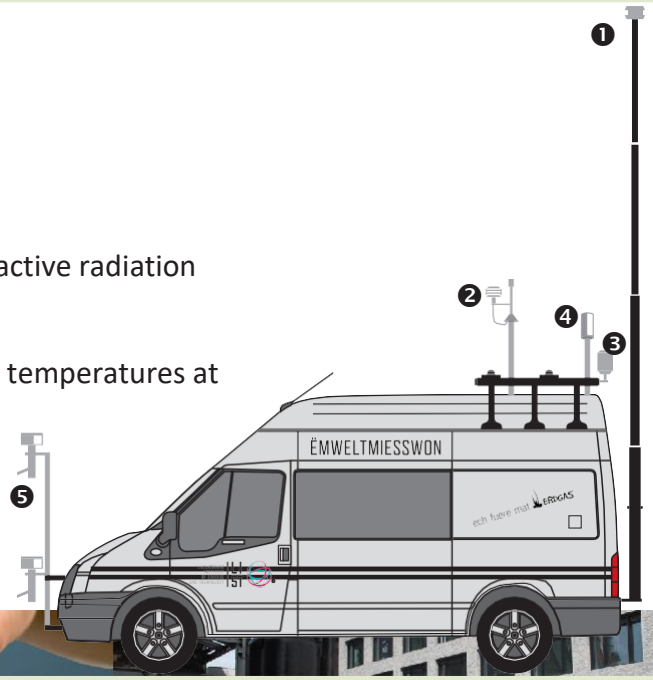
❶ 2D Ultrasonic anemometer

❷ Extendable gas collector (up to 1m above the roof)

❸ Sensors to measure global radiation and erythema-active radiation

❹ Dust sampling

❺ Detachable mast to measure dry-bulb and wet-bulb temperatures at two variable heights



Jürgen Junk
juergen.junk@list.lu
Tel.: (+352) 275 888 - 5051

Andreas Krein
andreas.krein@list.lu
Tel.: (+352) 275 888 - 5010

Headquarters

Luxembourg Institute of Science and Technology (LIST) 5, avenue des Hauts-Fourneaux
L-4362 Esch/Alzette
Tel.: (+352) 275 888 - 1 | Fax: (+352) 275 885

info@list.lu

www.list.lu/social-