Janicke Consulting
Environmental Physics

LASPORT

A program system for the calculation of airport-related pollutant emissions and concentrations in the lower atmosphere

Overview

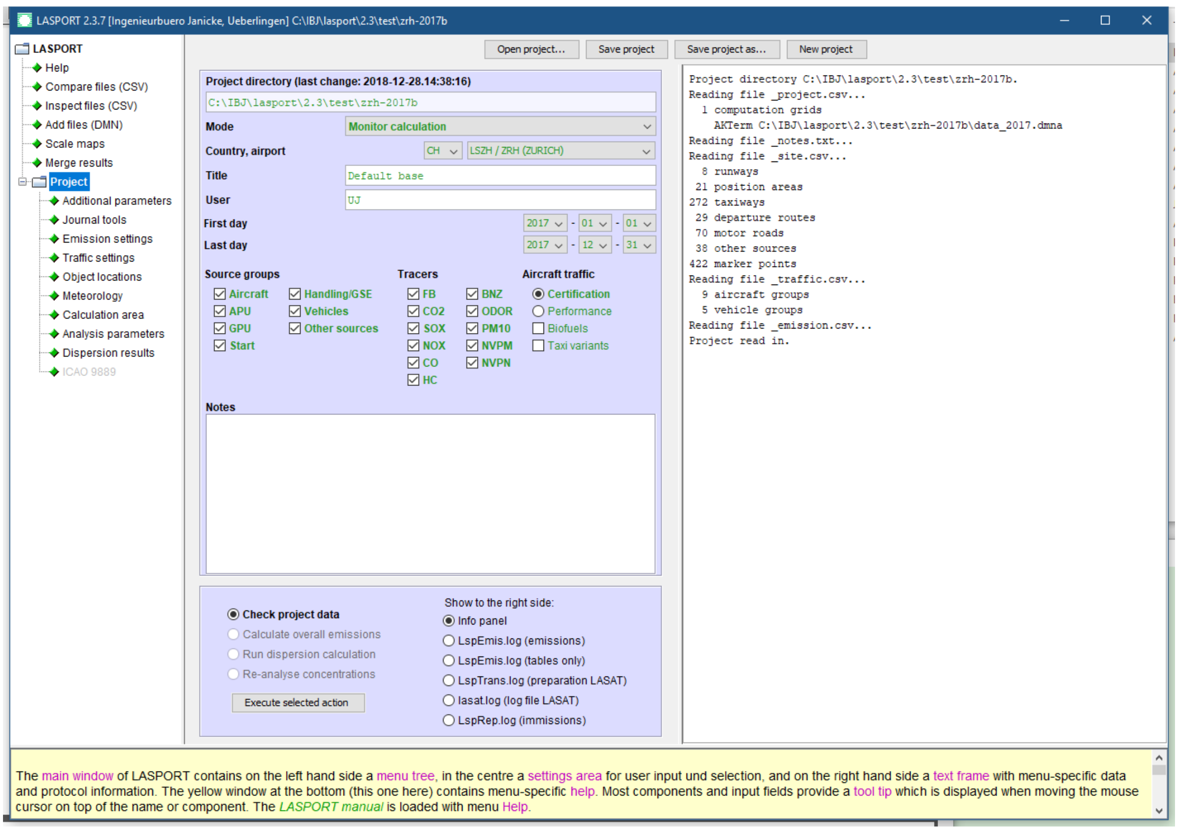
Based on experiences with the application of the Lagrangian dispersion model LASAT at airports in Germany and Switzerland, LASPORT (LASAT for Airports) was developed in 2002 on behalf of the Federal German Airports Association (ADV) as a standard tool for emission and dispersion calculations.

The program system is available as a commercial software package since 2003. It has been steadily adopted to the requirements of practice and current standards, among other based on projects with EC/FP7, EUROCONTROL, and ICAO/CAEP.

LASPORT has been approved for use by ICAO/CAEP (ICAO Environmental Report 2010).

LASPORT is supported by a graphical user interface that provides the following functionalities:

- Definition of source groups, emissions, and other parameters.
- Preparation and evaluation of journals with individual aircraft movements.
- Calculation of overall emissions for each source group and pollutant.
- Preparation, start, and control of the dispersion calculation with LASAT.
- Result analysis and graphical visualization.



The figure shows a screen dump with the main window of the graphical user interface. The left side contains the menu tree. In the centre panel, source groups, trace substances, and other project parameters are specified. The info panel to the right and the help panel at the bottom provide menu-specific information.

Features of LASPORT 2.3

The following source groups are explicitly accounted for:

- Aircraft traffic (LTO cycle divided into 6 phases)
- Auxiliary power units (APU), ground power units (GPU), engine startups
- Ground support equipment (GSE) and de-icing
- Motor traffic (airside and landside)

Other sources can be defined in form of point, line, and volume sources with individual emission strengths. All source specifications are set interactively in the graphical user interface or directly in form of formatted text files.

Aircraft traffic is defined either based on general traffic information (scenario calculation) or by means of a movement journal with individual aircraft movements (monitor calculation). Monitor calculations allow a detailed study of actual aircraft traffic. Scenario calculations are well suited for prognosis calculations for which no detailed traffic information is available.

In a monitor calculation, individual emission strengths per movement and LTO phase and individual profiles can be applied: user-defined values, certification values based on the ICAO engine emission databank and LASPORT default profiles, or performance-based values and profiles derived by the integrated performance model ADAECAM.

A data base provides engine emissions, aircraft types, airports (worldwide), and default emissions of fuel burn, CO_2, SO_x, NO_x, CO, HC, Benzene, Odorants, PM10, non-volatile PM mass, and non-volatile PM number.

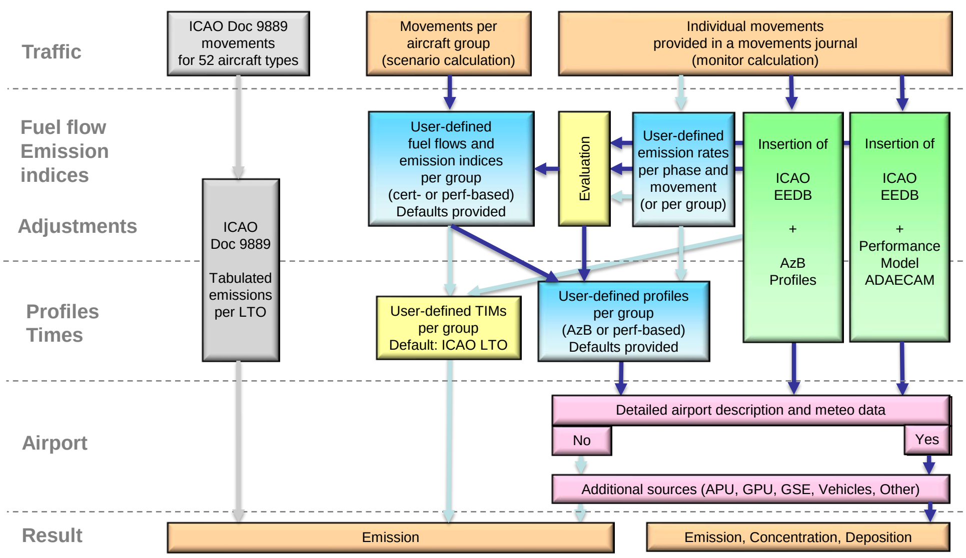
In the dispersion calculation, the dynamics of the engine exhaust from aircraft is accounted for by a directed exit velocity and turbulence characteristics which are a function of aircraft group and LTO phase. For other source groups, thermal plume rise is covered parametrically based on the German guideline VDI 3782 Part 3.

Chemical conversion of NO to NO_2 is modelled by means of linear conversion rates dependent on the atmospheric stability according to the German standard VDI 3782 Part 1. Dry and wet deposition are accounted for based on the German standard VDI 3782 Part 5.

An integrated diagnostic wind field model allows to carry out dispersion calculations in complex terrain and in the presence of buildings. Alternatively, three-dimensional fields provided by external models can be used.

The dispersion calculation is carried out on the basis of a meteorological time series with typically hourly means of wind speed, wind direction and a measure of the atmospheric stability (e.g. Obukhov length). The result is the three-dimensional concentration field of each trace substance averaged over successive time intervals of typically one hour. From these time series, long-time means and short-time values according to EU directives are derived. In addition, the long-time means of dry, wet, and total deposition are provided.

Selected pathways in LASPORT 2.3



Features of LASAT 3.4

The dispersion calculation is carried out with a subset of programs from the software package LASAT 3.4 which are integrated in the LASPORT software system.

The dispersion model LASAT (Lagrangian Simulation of Aerosol Transport) computes the transport of trace substances in the lower atmosphere (up to heights of about 2000 m) on a local and regional scale (up to distances of about 150 km).

The dispersion is simulated utilizing a random walk process on a computer (Markov process) for a group of representative simulation particles.

Advantages over other simulation methods are:

- In the near field of sources the Lagrangian technique allows for a more accurate description of the atmospheric dispersion as compared to models based on the classical equation of diffusion.
- The method is not restricted to quasi-stationary dispersion situations, in contrast to Gaussian plume models.
- The dispersion process is not subject to numerical artefacts that are inherent to finite difference methods. For example, a point source is truly modelled as a point source.
- Plume dynamics can be accounted for in detail.
- By adjusting the number of simulation particles the user can give preference either to short calculation time or to high statistical accuracy.

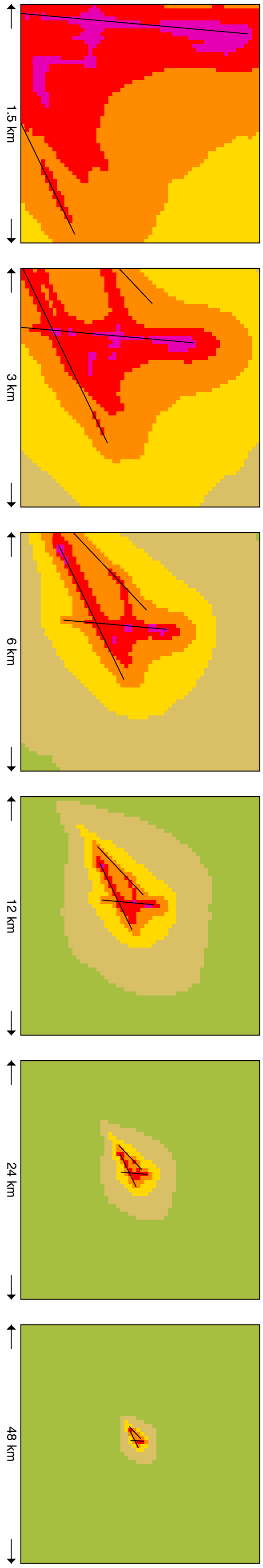
The roots of LASAT go back to research models developed and applied by the German company Dornier in the 80s. Since 1990 LASAT is a commercial program package maintained by Janicke Consulting. It is routinely applied by consultants, industry, research institutes, and public authorities.

The model type has been standardized 2000 in the German standard VDI 3945 Part 3. LASAT complies to this standard.

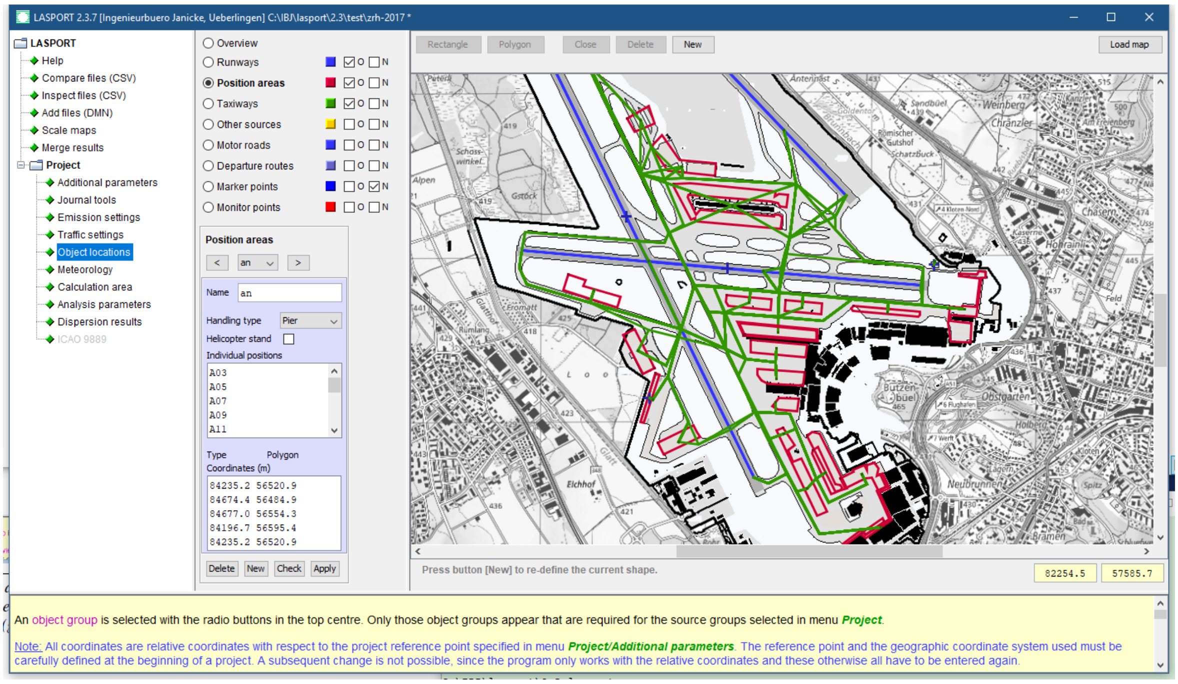
LASAT has been the basis for the development of the German regulatory model AUSTAL which is provided free of charge in the Internet (www.austal2000.de).

LASAT is verified according to the standard VDI 3945 Part 3. A variety of model validations have been carried out in course of its long standing application.

The program LASAT 3.4 utilizes all available processor cores (multithreading).



The sequence of figures to the right shows the result of a dispersion calculation with nested grids. The combination of nested grids allows to resolve the vicinity of the airport, where strong concentration gradients occur, with a high spatial resolution (top figure) and to calculate at the same time the dispersion up to large distances (bottom figure). The figures depict the NO_x concentration field near the ground (annual mean, aircraft only). The calculation area in the top figure covers the terminal area, the black lines denote the runway locations.



A screen dump with the menu for defining objects. Source outlines like the location of position areas are interactively defined in a site map. Depicted are the locations of runways (blue), position areas (red), and taxiways (green).

General information

The graphical user interface is bilingual (English and German), all other documentation is provided in English.

All input and output files of a project are of type ASCII (text files) with fully documented formats, providing easy access for pre- and post-processing.

Basic actions of the user interface can also be carried out in command line mode, allowing to automatize calculations.

The software package is provided as compressed archive or on DVD-ROM.

Installation is carried out with the help of an installation program. The installed package contains a program manual and documented example calculations.
The program system is written in the programming languages JAVA and ANSI-C.

The program package is provided for 64-bit Windows 10.

A demo version with limited functionality is available on demand.

Hardware requirements

Preferred platform is a PC with 64-bit Windows 10 and a free USB slot for the licence dongle.

At least 4 GB RAM and 20 GB free hard disk space are recommended.

Janicke Consulting
Environmental Physics
Germany

Hermann-Hoch-Weg 1
88662 Überlingen

Email: info@janicke.de
Internet: www.janicke.de

The data shown in the figures are part of a dispersion calculation at Zurich Airport and were kindly provided by E. Fleuti (Flughafen Zürich AG).