



Product specification of the program package LASAT 3.1

Although some of the following specifications represent upper limits, like e.g. the number of possible sources, they may be exceeded in many cases depending on the computer configuration and the combination of specifications being used.

1. Hardware requirements

- (a) Preferred platform is a PC with a CD-ROM drive and a free USB slot for the licence key. At least 500 MB RAM and 1 GB free hard disk space are recommended.
- (b) The program system is available for Windows (XP/Vista/7) and Linux.
- (c) On a computer with multiple processor cores, the programs *Lasat*, *Lprwnd*, and *Lprprf* can make use of all cores (multithreading), the number of applied cores can be specified.

2. Language, formats, performance

- (a) Documentation, parameter names, and error messages are throughout in English.
- (b) All programs run in a shell window (DOS under Windows). In addition, interactive programs (English/German) with a graphical user interface are provided.
- (c) All input and output data is provided in form of text files with fully documented contents and formats (DEF and DMN) as described in the reference book.

3. Boundary layer model *Lprprf*

The boundary layer model (as module of *Lasat* and as stand-alone program) provides the meteorological profile functions on the vertical grid (wind speed and direction, fluctuations of the wind velocity, exchange coefficients).

- (a) In the simplest case specification of wind speed and direction at one anemometer height together with the atmospheric stability (Monin-Obukhov length or stability class according to Klug/Manier).
- (b) Specification of profile values for up to 20 anemometer heights. Linear interpolation between these heights, beyond extrapolation with the theoretical profile functions.
- (c) Definition of profile values, Monin-Obukhov length, stability class, mixing layer height, and friction velocity in form of a time series (at maximum 9999 successive intervals).
- (d) For complex terrain incorporation of a diagnostic wind field model (see *Lprwnd*).
- (e) Optionally meteorological profiles of the German regulation "TA Luft".

4. Wind field program *Lprwnd*

The diagnostic wind field model (as module of *Lprprf* and as stand-alone program) calculates a three-dimensional, divergence-free wind field on the basis of the given profiles and the specification of terrain and buildings.

- (a) Integration of complex terrain (terrain profile and/or buildings) in the boundary conditions of the flow field.
- (b) Modelling of the flow around buildings under consideration of recirculation and enhanced diffusion at the lee-side according to the model DMK as implemented in AUSTAL2000.
- (c) Collection of wind fields in a library, from where they are selected as required.
- (d) Import of wind fields from other program systems.

5. Dispersion program *Lasat*

- (a) Area of calculation
 - i. Extent: local to regional range (up to source distances of about 200 km), atmospheric boundary layer (up to a height of about 2000 m).
 - ii. Grid: Horizontally: equally spaced meshes with a uniform width of typically 5 m to 10 km. Maximum number of meshes in each direction 200. Maximum grid extend 400 times 400 km. Vertically: division into at most 90 arbitrary intervals. Absolute coordinate values (in metre) may not exceed 200 000.
 - iii. Nesting: Up to 6 nested grids. Change of mesh width from grid to grid by a factor of 2.
 - iv. Boundary conditions: Horizontally open or periodic, at the top open or closed.
- (b) Terrain
 - i. Characterisation by a roughness length and displacement height.
 - ii. Specification of a terrain profile.
- (c) Buildings
 - i. Definition in form of quaders, circular towers, polygons of constant height, or by a raster file (top parallel to the terrain surface). At most 200 buildings.
 - ii. Shapes internally resolved on the calculation grid.
 - iii. With nested grids, consideration only on the grid with the smallest mesh size.
- (d) Sources
 - i. Definition of point, line, area, volume, and 3-dimensional grid sources. At most 1000 sources.
 - ii. Parametric treatment of plume rise according to the German guideline VDI 3782 Part 3 (stacks) or VDI 3784 Part 2 (cooling towers).
 - iii. Explicit specification of a directed exit velocity and velocity fluctuations together with their decay time.
- (e) Trace substances
 - i. Bundling of trace substances (at most 60) into groups (at most 5).



- ii. Definition of a gravitational settling velocity for each group. For gravitational settling of dust, alternatively definition of a continuous size spectrum.
 - iii. Definition of emission rate, deposition velocity (dry deposition), washout rate (wet deposition), and chemical reactions (first order conversion) for every substance.
 - iv. Definition of odorants and rated components according to the German regulation GIRL.
- (f) Time series
Time-dependent specification of meteorological parameters and parameters describing source and substance properties in form of time series (at most 9999 successive intervals), optionally distributed over several independent files.
- i. Free choice of the averaging interval for input and output data, typically between a minute and a year.
- (g) Program control
- i. Control of calculation time and statistical error by the number of applied simulation particles.
 - ii. Program interruption and continuation at a later time.
 - iii. Output of information on the program run and the total emitted mass per substance into a log file.
- (h) Results
- i. Concentrations and dry and wet deposition fluxes averaged over each grid mesh for a series of successive time intervals (e.g. daily means). For odorants output of the odor hour frequency instead of the concentration.
 - ii. Time series of concentration (e.g. hourly means) at given monitor points.
 - iii. Maximum concentration values or concentration histograms for the calculation of quantiles.
 - iv. Estimation of the statistical error for every output value.
- 6. Utility programs**
- (a) *LASAT tools* for the extraction and evaluation of result files and for the creation of result reports.
 - (b) Interactive program for the setup of source and building shapes at hand of a site map.
 - (c) Interactive program for the result visualization.
 - i. Tabulated view of two-dimensional layers.
 - ii. Graphical view of horizontal layers of concentration and wind fields (e.g. isolines, superposition background maps, terrain profiles, source and building contours).
 - iii. Output as PNG and PDF files.
 - (d) Programs for converting data files with meteorological time series or dispersion class statistics to LASAT time series.
 - (e) Programs for the evaluation of concentration files: temporal averaging; re-formatting and smoothing; extraction of layers; addition of substances; integration of time series at monitor points.
 - (f) Program for the calculation of cloud radiation for radioactive substances.
- 7. Example calculations**
The program package includes over 20 example calculations covering typical applications from simple to complex.
- 8. Calculations in conformance with AUSTAL2000**
The reference book lists the parameter settings required for calculations in conformance with AUSTAL2000. The example package includes LASAT versions of various examples of the AUSTAL2000 package. Result files in conformance with AUSTAL2000 can be created with the *LASAT tools*.
- 9. Verification**
Fundamental parts of the model are verified according to the German guideline VDI 3945 Part 3. The verification tests can be re-run by the user.
- 10. Documentation**
The reference book (about 220 pages) describes the usage of the programs, the structure and format of input and output files, the implemented model approaches, and the verification tests.
The working book (about 50 pages) describes the installation of the program system and provides an introduction at hand of a step-by-step description of example applications.
- 11. Demo version**
Without valid licence, the programs operate in demo mode with the possibility to re-run the example calculations and verification tests. A demo version is available free of charge.
- 12. Order**

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