# What's New in ADMS-Urban 5.1?

**July 2025**

ADMS-Urban 5.1 is the latest general release of CERC's state of the art model for the dispersion of pollutants in urban areas. ADMS-Urban 5.1 contains a number of major new features and options, most notably:

- A new tool within the Mapper for calculating the inputs for the Urban Canopy Flow and Advanced Street Canyons modules from buildings and road data
- The latest emission factors from Defra's Emission Factor Toolkit, EFT 13.1
- A verification mode for checking correctness of model inputs and generating information about the model run

This document contains details of the new features, scientific improvements and model corrections implemented since the previous version of ADMS-Urban (version 5.0.1, February 2022). Also contained in this document are instructions for installing ADMS-Urban 5.1 and upgrading from previous model versions.

## IMPORTANT NOTE FOR THE UPGRADE OF MODEL RUNS

Any additional input files (*.uai*) need to be upgraded before they can be used with ADMS-Urban 5.1. Full details of how to upgrade these files are given in this document.

# Installation

## Before installing ADMS-Urban 5.1

In this release, ADMS-Urban, ADMS-Roads and ADMS-Airport are installed using a single installation process. Therefore, if you have previous versions of any of these models installed on your computer, they will need to be uninstalled before installing any of the new versions.

Log on to your computer as Administrator, and uninstall any previous versions of ADMS-Urban, ADMS-Roads and ADMS-Airport. To do this, right click on the Windows **Start** button and select **System**. Then click **Apps** in the left-hand menu, select **Installed apps** and remove the currently installed version of the models.

## Installing ADMS-Urban 5.1

If you have not already done so, log on to your computer as Administrator.

ADMS-Urban will have been supplied by download link. Extract the downloaded *.zip* file to a local directory. In Explorer, browse to this directory, right click on the file '*setup.exe*' and select **Run as administrator**.

Follow the instructions on the screen. Further details are given in Section 2.2 of the User Guide, a copy of which can be found in the ADMS-Urban installation files in *.pdf* format.

You should also have been provided with a new licence file, which is required in order to run the model. To install the ADMS-Urban licence, copy the file (*ADMS-Urban.lic*) to the directory in which ADMS-Urban is installed.

The first time that you launch ADMS-Urban after installation, it is important that you are connected to the internet so that your licence can be registered.

Note that the installation procedure automatically puts a generic shortcut to ADMS-Urban, ADMS-Roads and ADMS-Airport on your desktop. The first time you double-click on this shortcut, a screen similar to that shown in Figure 1 will be displayed unless the **Launch the program** option was checked at the end of the installation process.

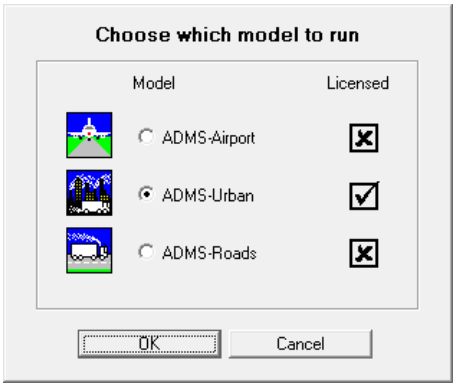


Figure 1 – Model selection screen

Select ADMS-Urban and click **OK**. (Subsequently, if you are using more than one of ADMS-Urban, ADMS-Roads and ADMS-Airport on your computer, then this generic shortcut will launch the most recently used model.)

You can also set up a specific shortcut to ADMS-Urban by browsing to the *\Support\Shortcuts* sub-directory under the ADMS-Urban install directory in Explorer, copying the ADMS-Urban shortcut and pasting it, for example, on to your desktop.

# Upgrading your input files

## Additional input (*.uai*) files

Any additional input (*.uai*) files must also be updated so that they are in file version 7 format. To do this:

1. If you wish, make a backup copy of the original *.uai* file in Explorer.
2. Open the **Additional Input file editor**, which can be accessed via the **Edit** button on the **Setup** screen of the ADMS-Urban interface.
3. **Open** the *.uai* file via the **File** menu.
4. Click **Yes** to the automatic upgrade message that appears to allow the editor to upgrade the file.
5. **Save** the *.uai* file via the **File** menu.
6. Reference the new *.uai* file in the **Setup** screen of the ADMS-Urban interface.

# New Features and Major Changes

## New features

1. A new tool has been added to the Mapper to calculate the input files required for the Urban canopy flow and Advanced street canyons modules. The required parameters are calculated from buildings and roads data supplied by the user. Refer to Section 6.4 of the Mapper User Guide for more details. This tool replaces the previous tools which required ArcGIS.

2. A new tool has been added to the Mapper to allow for the merging of shapefiles (*.shp*). This tool may be particularly useful for combining buildings files for use in the new Canyon and Canopy tool (see point 1), or for combining roads shapefiles for export to *.spt* format.

3. The interface now includes an option to run the model in 'Verification' mode. The verification mode carries out checks on all model input data, runs the met pre-processor, and produces a log file, but stops before concentrations are calculated. It is therefore quick to run, providing a useful check of the modelling input data before carrying out the main run. In verification mode, the model does not generally stop if a fatal error occurs, as it would do in normal run mode. Select **File**, **Verify**... to run the model in verification mode. Under **File**, **Preferences**, **UPL Verification** you can change the default options for running the verification mode.

4. There is now an option to apply a single (i.e. horizontally uniform) vertical profile for urban canopy flow to the dispersion. This option applies the same modifications to the flow and turbulence profiles as the existing spatially varying urban canopy flow option but takes as input only one set of urban parameters. Refer to Section 4.18.2 of the ADMS-Urban User Guide for more details on this option.

5. Users can now directly input a 3D flow-field, for example from CFD modelling, to be used in place of the standard ADMS-Urban flow-fields. When using this option only one meteorological data line can be modelled at a time. Refer to Section 4.17 of the ADMS-Urban User Guide for more details on this option.

6. It is now possible to output accumulated horizontal concentration flux per 10° or 30° wind sector at each specified point via a new *.uai* file option. For more details regarding this new option, please refer to Section 4.27 of the ADMS-Urban User Guide.

7. There is a new option to generate an additional specified points (*.asp*) file containing output points at a fixed distance from the edges of each road. Output points are generated for each road source and are labelled based on the source name and side of the road they are on. Refer to Section 4.28 of the ADMS-Urban User Guide for more details on this option.

8. It is now possible to specify individual sources which will not be disaggregated from the grid source when source disaggregation is undertaken. This option can be useful when modelling scenarios where the proposed new sources are not already present in

the grid source. Previously the emissions from these sources would have had to be added onto the existing grid source totals to ensure they were correctly disaggregated. More details on using this option are given in Section 4.8 of the ADMS-Urban User Guide.

## Sources

9. The UK EFT v13.1 emission dataset has been added for the calculation of road traffic emissions. For details relating to the new emission factors themselves, including differences between the current and previous datasets, please refer to the Defra website[1].

10. For the advanced street canyons module, the porosity of a canyon can now be defined in place of the length of the road with adjacent buildings. Specifying porosity directly may be useful when using the advanced street canyons module to represent something other than buildings, e.g. green infrastructure. Comment lines can now also be included within the advanced street canyons file, allowing for information such as when the file was created to be stored in the file to improve traceability. For more details on the format of the advanced street canyons file refer to Section 4.2.1 of the ADMS-Urban User Guide.

11. The advanced street canyons and road tunnels options can now be modelled when using statistical meteorological data with a wind sector size greater than $15^{o}$.

12. When using the advanced street canyons option, the modelling of very wide canyons has been improved to limit the downwind extent of the recirculation region.

13. When modelling advanced street canyons in network mode, the end canyon source is now limited to be no longer than the road length; this will only make a difference for very short road lengths.

14. Several changes have been made to the way matching is done between road sources:

    a. A road is now allowed to join itself. This removes an inconsistency between modelling a roundabout as several separate roads vs one multi-segment road.

    b. When matching between tunnels and outflow roads, the road widths are now taken into account. This allows for better matching in cases where a two-way tunnel is being matched to a one-way outflow road, e.g. due to the inflow and outflow roads being slip roads to a roundabout.

    c. A warning will now be issued if there is an inconsistency between the source height of an outflow road and the height of the corresponding tunnel.

15. A new option has been added to the 'Switch off stack downwash' option in the additional input file to allow for stack downwash to be switched off for all point sources.

[1] https://laqm.defra.gov.uk/review-and-assessment/tools/emissions-factors-toolkit.html

16. When using a 3D grid source, the grid cells can now have a rectangular footprint rather than being forced to be square. This allows for better matching to grid cells from regional models which are originally defined in latitude-longitude coordinates.

17. The daylight saving time option in the additional input file now contains the ability to apply the time shift due to British Summer Time directly without needing to specify the dates of the clock change.

18. The behaviour when plumes which are considered significantly dense hit the ground has been harmonised with ADMS 6. By default, if the model encounters such a plume it will stop with an error message. An option exists to change this to a warning and for the model to continue.

## Buildings

19. There have been several enhancements to the way the effects of buildings are modelled, particularly in the case of sources which are upwind of the building. To allow consistency with previous modelling, when required, a new *.uai* file option has been added which allows these new developments to be switched off, see Section 4.15.5 of the ADMS-Urban User Guide for more details about this option.

    a. When a plume upwind of the building impacts onto the face of the building, the plume will now split into up-to three parts going around and over the building. These plumes will then be used for the calculation of entrainment into the cavity region and for the dispersion of the non-entrained material in the main wake. Previously a single plume was modelled for this case.

    b. The secondary plume emanating from the cavity region is now modelled as a line source element. Previously this was modelled as a virtual point source. The use of a line source better represents the distribution of concentration emanating from the well-mixed recirculation region, in particular immediately downwind of the recirculation region.

    c. Changes have been made to ensure consistency when the model selects an alternative main building. In all cases the closest eligible building will now be selected. Previously different behaviour would be seen depending on whether the nearest alternative building within the region of influence was too low compared with the source.

    d. A building is now considered for inclusion in the effective building if any of its vertices are within $\sigma_y(|x|)$ of the plume centreline in the crosswind direction, where $x$ is the distance from the source in the along-wind direction and $\sigma_y(x)$ is the horizontal plume spread (not including buildings effects) at distance $x$ downwind of the source. Previously, $0.5\sigma_y(|x|)$ was used.

20. There is now an option to specify that the model should always automatically select a main building for a particular source. This option is specified by selecting "(Auto)" as the 'Main building' for this source in the Source screen. When using this option,

the closest building which is tall enough (met. line independent) and within the region of influence of the source (met. line dependent) will be selected.

21. When running in verification mode, see point 3, a *.bef* file will be output showing the effective building for each source for neutral conditions for a range of wind directions. The wind directions used for this can be altered in the additional input file. When carrying out the full model run the *.bef* file will be created based on the modelled meteorological data as before.

22. The format of the *.bef* file has been altered to allow it to easily be plotted as a series of polygons within the Mapper, see also point 21. The effective building heights have also been added to this file.

23. Output points within input buildings will now have their output concentration set to zero in the comprehensive output file for consistency with the output given in all other files.

24. When buildings are modelled in conjunction with the complex terrain module, a minimum plume wind speed is now applied to limit the magnitude of concentrations very close to reverse flow regions.

25. For consistency with non-buildings calculations, concentrations are no longer output within 1 m of the centre of the source for the primary plume component.

26. Information about all output pollutants emitted by a source will now be written to the *.bld* file, this includes indicating where no dispersion is calculated due to the emission rate for that hour being zero.

## Complex terrain

27. When modelling complex terrain, passive plumes will no longer penetrate the boundary layer due to the vertical velocity in the flow field.

28. When modelling with variable terrain height, the minimum turbulence value is now set based on the size of variation in terrain height. As this variation reduces, the minimum turbulence used will return to the value used for flat terrain. The **Specified minimum turbulence** section of the additional input file has also been altered to allow the user to choose which of the different minimum turbulence limits are applied.

29. Changes have been made to ensure consistency when modelling variable roughness with a nearly flat terrain file and with no terrain file.

    a. The blending function applied to the turbulence calculations is now only applied to the terrain component. Previously this blending function would also be applied to the roughness component if variable terrain was being modelled.

    b. The constraints on the variation of velocity in variable roughness are now always applied to the change in velocity due to the variable roughness, previously they would not be applied if variable terrain was also being modelled.

30. A minimum source height of 1.5 times the surface roughness is imposed within the calculations. Improvements have been made to the way this is applied with spatially varying roughness to ensure no part of the source is below the local roughness height.

31. When road, line, area and volume sources are modelled within complex terrain, extra elements are added outside of the region of influence to ensure all parts of the source are accounted for in strong crosswind or reverse flow conditions. Changes have been made to the positioning of these elements to remove spurious concentration patterns in strong crosswind flow.

32. The maximum dimension of a source, used in the calculation of the minimum extent of the region required to be covered by the terrain data, has been altered for line and road sources to be the maximum distance over all pairs of *adjacent* vertices (rather than over all pairs of vertices). The maximum dimension of an area or volume source remains the maximum distance over all pairs of vertices.

## Meteorology

33. There have been several changes to the format of the vertical profiles file, *.prf*. For full details on this new format refer to Section 4.21 of the ADMS-Urban User Guide.

    a. Year/Day/Hour can now be used in place of Met. Line number. This helps with matching to the meteorological data file, especially in the case where a meteorological subset is being used.

    b. A vertical profile of pressure can now be entered, this is used in the plume rise module to calculate potential temperature and density.

    c. It is no longer necessary to specify data for every variable in the *.prf* file. Now only columns for which a profile is to be supplied need to be entered. Only the height column and one of Year/Day/Hour or Met line number must always be specified.

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*Old format vertical profile files can still be used with the model, but cannot contain any of the new information.*

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34. For ADMS-Urban 5.0 the time used in the calculation of solar elevation, and hence the solar radiation, was altered to the middle of the hour rather than at the end of the hour. In certain circumstances it may be desirable to still calculate the solar elevation exactly at the times given in the meteorological data (i.e. end of the hour, given ADMS-Urban uses an hour-ending convention). A new **Solar elevation** section in the *.uai* file provides an option to determine when the solar elevation is calculated, see Section 4.22 of the ADMS-Urban User Guide.

## Background & Chemistry

35. If a background file is used together with the **Use a subset of met. data** option, checks for missing data within the background file will now only be applied to the period of time covered by the met. data subset. Previously the whole background file would be checked even if it was not going to be used.

36. When chemistry is modelled, it is now ensured that background $NO_2$ values are lower than background $NO_X$ values. Additionally, an error message will now be given if background values of NO are specified directly in a background file, as the model calculates background NO itself from $NO_X$ and $NO_2$ background values to ensure consistency.

37. Warnings will now be issued if an explicitly modelled pollutant matches the name of one of the internal pollutants used within the chemistry calculations. During modelling, the two pollutants will be treated as separate.

38. An option has been added to the additional input file to allow the user to determine whether the photolysis reaction rate is calculated directly from solar radiation or back-calculated from the background concentrations that are assumed to be in equilibrium. Previously the photolysis rate would always have been back-calculated from the background concentrations. If the photolysis rate is calculated directly from solar radiation, the background concentrations will then be put into equilibrium (if they are not already). Refer to Section 4.13.4 of the ADMS-Urban User Guide for more details on this option.

39. When chemistry is modelled, by default concentrations are split into near and far field age groups for the application of chemistry. A new additional input file option has been added to allow the user to alter both the number and size of these chemistry age groups. Refer to Section 4.13.7 of the ADMS-Urban User Guide for more details. Additionally, a smoothing has been applied to the way the concentrations are added to the age groups to help remove a discontinuity in calculated concentrations which could occur under certain circumstances.

40. The default primary $NO_2$ values for road and grid sources have been updated. Refer to Section 4.13.2 of the ADMS-Urban User Guide for details on how these values have been determined.

41. Several modifications have been made to the calculation of sulphate chemistry:

    a. Previously sulphate chemistry would not have been calculated if the contributions from all sources was classified as being in the near field (travel time of less than 150 s), this has now been changed,

    b. Changes to the reaction time and avoidance of negative $SO_2$ values,

    c. Sulphate chemistry is no longer applied to the background concentrations.

## Output

42. The Vertical slice creator has been replaced by a new **Create ASP grid** utility. This option allows *.asp* files to be created or appended to with grids of points representing rectangular grids aligned with the coordinate system, polar grids, or rectangular grids aligned with a specific line. For each of these cases, regular or variable grids can be specified and output can be requested for a series of heights. See Section 7.7 of the ADMS-Urban User Guide for more details on the Create ASP grid utility.

43. Improvements have been made to the way concentrations are stored when calculating different percentile levels for multiple output pollutants. Previously, when calculating output for multiple pollutants with some having a relatively low percentile an insufficient memory error may have been issued.

### Mapper

44. The menus within the Mapper have been rearranged to provide easier access to the available options.

45. A toggle has been added to determine whether the scalebar is displayed in the Mapper or not.

46. If the coastline module is being used, the line representing the coastline and the point on land are now displayed and editable in the Mapper.

47. When adding a layer to the Mapper from a comma separated variable file, polylines and polygons can now be imported in addition to points and single-segment lines. See Section 5.5.3 of the Mapper User Guide for details on the format of the header to use for each of these options.

48. An option to 'Use Map coordinate system' has been added to the ADMS-Urban interface. This option can be used when using a custom coordinate system for the input data.

49. Terrain (*.ter*), roughness (*.ruf*) and road geometry (*.rds*) files loaded in to the mapper will now be configured to be displayed automatically.

# Other Changes

50. The shape factor applied when modelling dry deposition for particulates with strong gravitational settling has been altered to account for the whole plume settling. Previously the shape factor was the same as that used for gaseous pollutants and primarily represented removal at the surface.

51. 3D grid emissions data files can now be in netCDF 4 format, previously they were required to be in netCDF 3 format.

52. Efficiency improvements have been made to the 'Spatial and temporal variation of deposition parameters' option. When using a spatially-varying deposition parameter (*.din*) file that contains a large number of data points, this improvement can lead to significantly faster model run times, particularly for model runs that include multiple sources and/or span multiple met lines.

53. Concentration calculations for road sources now use four reflection terms for the vertical profile calculations to bring consistency with the vertical profile calculations for other source types.

54. A memory leak issue has been fixed that could cause the model to reach its RAM limit (2GB) and stop before completing the run. This typically only affected runs with short-term output that used multiple years of met data.

55. The Grids screen now allows for the specified points in the interface and from a file to be enabled independently of each other.

56. The emission factors used when traffic induced turbulence is calculated from emission rates has been updated to more recent factors.

57. An issue has been fixed where the short-term plume centreline output may have been incorrect if both short-term and long-term outputs were selected in the same run.

58. ADMS 6 *.apl* files can now be opened in the interface.

59. A new option to plot a contour of the wind speed, i.e. horizontal magnitude of the wind vector, has been added to the Flow Field plotter.

60. The ArcGIS and MapInfo links are no longer included on the install. These links can still be downloaded from the User Area of the CERC website.