What's New in ADMS-Roads 2.3?

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USERS OF EMIT should note that ADMS-Roads 2.3 must be used with EMIT 2.3.

Since ADMS-Roads 2.2 (version 2.2.0.0) was released in January 2006, a number of model improvements and corrections have been made. These are described below.

This version of ADMS-Roads 2.3 includes an updated user interface, model and GIS links. The ADMS-Roads User Guide, which has not been updated, and guides to using the GIS links can be found in the 'Documents' sub-directory of the ADMS-Roads 2.3 install directory.

Results for all runs will have changed slightly in comparison with ADMS-Roads 2.2. This is in part due to two model improvements, both of which **reduce model run time**:

1. Dispersion calculations are now independent of the user-defined grid.
2. Previously, in convective conditions, the concentration was a weighted sum of a 'neutral' contribution and a 'convective' contribution for smoothness between different stability regimes. This smoothing did not significantly affect results, so the neutral contribution in convective conditions has been removed.

Other model improvements, new model features and bug fixes are listed on pages 3 to 7 of this document.

Before installing ADMS-Roads 2.3

If you use ADMS-Roads inventory files to store emissions data (as opposed to using CERC's emissions inventory tool EMIT), you should **import all source data stored in your inventory files into one or more ADMS-Roads 2.2 *.upl* files**. This will enable you to upgrade these data, as described below.

Once this has been done, log onto your computer as Administrator, and uninstall ADMS-Roads 2.2 by selecting **Add/Remove Programs** from Windows Control Panel.

Installing ADMS-Roads 2.3

If you have not already done so, log onto your computer as Administrator. Insert the ADMS-Roads 2.3 installation CD, and the install program should automatically start. If it does not, browse to locate the CD in Explorer and double-click on the file '*setup.exe*'. Follow the instructions on the screen. Further details are given in Section 2.4 of the User Guide, a copy of which is included on the installation CD in *.pdf* format.

New versions of any required GIS links can be installed by following the instructions in the User Guide.

Upgrading your input files

Model input (*.upl*) files that were set up using ADMS-Roads 2.2 will not automatically run with ADMS-Roads 2.3. To run an ADMS-Roads 2.2 file with ADMS-Roads 2.3, the file must first be saved in ADMS-Roads 2.3 format, as follows.

- In Explorer, make a backup copy of the file.
- Load the file into the ADMS-Roads 2.3 interface. A warning message will be issued indicating that the file will be updated to ADMS-Roads 2.3 format. Click 'Yes' to continue.
- Save the file, with a new name.

Upgrading ADMS-Roads inventory files

ADMS-Roads inventory files used with ADMS-Roads 2.2 cannot be used with ADMS-Roads 2.3. These files cannot be directly upgraded. It is recommended that EMIT users make a new version of their ADMS-Roads inventory file using EMIT version 2.3. Users without EMIT can update the source data held in an inventory file by the following steps.

- Before uninstalling ADMS-Roads 2.2, import the source data from the ADMS-Roads inventory files into one or more ADMS-Roads 2.2 *.upl* files.
- Load these ADMS-Roads 2.2 *.upl* files into ADMS-Roads 2.3 following the steps described in the above section.
- Export the source data to a new inventory file from ADMS-Roads 2.3.

New Features

1. As well as entering diurnally and monthly varying emissions profiles using a *.fac* file, hourly varying emissions factors can now be entered using an *.hfc* file. Details of how to use the *.hfc* file (including file format) are given in Appendix A. Table 1 below summarises the time-varying emissions options available in ADMS-Roads 2.3, for different source types

Source Type	Time-varying emissions data entered via the:		
	***.fac* file**	***.hfc* file**	**Interface**
Road	✓	✓	✓
Industrial	✓	✓	✗

Table 1 – Time-varying emissions options for different source types

2. Area and volume sources can now be convex polygons with up to 50 vertices. Previously they were restricted to 4 vertices.
3. Users now have the option of calculating weekly averages. The highest averaging time in previous versions was 72 hours.
4. Users can access the ADMS-Roads User Guide by selecting **Help, User Guide**.

Main changes

Dispersion calculations

5. Dispersion calculations are now independent of the user-defined output grid. This change reduces model run time as well as removing output grid dependency of results.
6. Previously, in convective conditions, the concentration was a weighted sum of a ‘neutral’ contribution and a ‘convective’ contribution. The neutral contribution in convective conditions has been removed.
7. For line, area, volume and road sources with complex terrain, the downstream distance from a source element beyond which non-zero output is given has decreased from 1m to 0.001m. This makes it consistent with the corresponding limit applied in flat terrain. This affects concentrations within the source, which may increase significantly.

Deposition

8. Where the deposition velocity v_d is user-defined, the expression for the dry deposition shape factor has been modified to ensure some dependence on the friction velocity u* and to remove dependence on the conditions at the top of the boundary layer.

Other

9. Improvements have been made to the 'intelligent gridding' feature in ADMS-Roads 2.3:

    - Previously 5000 additional intelligent gridding output points were available, to be placed along road and line sources to improve resolution of contoured results. Now, locations of intelligent grid points for road and line sources are evaluated separately, with 5000 points available for road sources and 1000 available for line sources.

    - The maximum number of intelligent gridding output points available to model road and line sources can now be entered using the *.igp* file for each source type. Note, previously although a figure may have been entered using the *.igp* file, it would not have been used.

This change means a change to the format of the *.igp* file; an example of the new format is shown in Figure 1. The parameter *LimitPoints* has been replaced by two parameters: LimitPointsRoads and LimitPointsLines. For more details, please refer to the file *Example.igp* that can be found in the 'data' subdirectory of the ADMS-Roads 2.3 installation directory.

```
&INTELLI_PARAMS
LimitPointsRoads     = 5000
LimitPointsLines     = 1000
PercentageSpacing    = 0.5
ActualSpacing        = 0.0
InterpolatePoints    = 1
/
```

Figure 1 – An example *.igp* file

Minor changes

Dispersion calculations

10. The calculation of the lateral plume spread σ_y above the boundary layer when there is no inversion (for stable and some neutral meteorological conditions) has been corrected to be the same as in the Technical Specification. For sources where the plume height goes above the boundary layer in such conditions, this correction reduces σ_y, resulting in increased ground level concentrations.

11. For a typical buoyant source, in stable meteorological conditions, the plume tends to rise initially and then the plume height oscillates about an equilibrium height. When the oscillation stage is reached, the amount of drag in the plume rise calculations is increased in order to damp the oscillations. This application of increased drag has been modified so that the drag is *not* modified for any release that is denser than the ambient air at release, or if gravitational settling is modelled.

12. For point sources, if the wind speed is large compared to the source exit velocity, the source height is now adjusted to account for 'stack downwash'. This is the same stack downwash as used in ADMS 4. Please refer to Appendix B for further details.
13. The lateral plume spread parameter σ_y is calculated as a combination of two terms σ_{yt} and σ_{yw}. The σ_{yt} term is due to turbulence and σ_{yw} is due to plume meandering. The stable calculation of σ_{yt} has been changed to be the same as the neutral calculation; the effect of this change is a small increase in concentrations in stable conditions.

Complex terrain

14. Previously the model may have crashed if the terrain resolution was not high enough. Now, if the terrain is not correctly resolved the model stops with an error message that offers the user helpful advice.
15. Previously the model may have crashed if the **Model Hills** option was used with line, area, volume or road sources, and an output point was found by the model to be outside the region of influence of a source. This has been corrected.
16. Previously the model may have crashed if a surface roughness file was modelled with stable met conditions. This has been corrected.
17. Previously the model may have crashed if the **Model Hills** option was used with line, area or volume sources under convective conditions that caused the plume to loft. This was because the model calculated the mean plume height for the part of the plume within the boundary layer using a value for the plume centerline height that was not restricted to being within the boundary layer. This has been corrected, and in cases where the model did not previously crash, will give a small increase in ground level concentration.
18. In ADMS-Roads 2.2 there may have been a crash due to problems with the way in which the local roughness length was calculated; this has now been corrected.
19. Previously if complex terrain was being modelled with non-point sources, the lateral plume spread, σ_y, was incorrectly held constant in the far field whereas it is only σ_z that should be held constant. This has been corrected.
20. The message in the log file when a surface roughness file is used now correctly says "Minimum Surface Roughness" rather than "Mean Surface Roughness".

Chemistry

21. The NO_X chemistry calculations involved in the **Chemical Reaction Scheme** have been improved, so that calculations are now done in two stages: near field and far field.

    In ADMS-Roads, at a particular receptor, the time scale over which chemical reactions are assumed to have occurred is estimated using a 'pollutant age'. In previous versions of the model, a weighted average pollutant age was calculated as:

$$\frac{\sum_{\text{All sources}} \text{Concentration} \times \text{Time}}{\sum_{\text{All sources}} \text{Concentration}},$$

    where the 'Concentration' is the concentration at the receptor due to a particular source, and 'Time' is the corresponding source-receptor travel time.

    In a typical urban scenario, this method had the disadvantage that although the concentration at a receptor is likely to be dominated by the nearest sources, the pollutant age was still slightly weighted towards sources further away, leading to an overestimation of the reaction time.

    In the new version of ADMS-Roads, two weighted average pollutant ages are calculated, one for near field sources, and one for far field sources. The difference between the two pollutant ages is used to model the chemical reactions that occur in the far field, and the near field pollutant age is used to model reactions that take place close to the receptor in question.

    When modelling a typical urban scenario, the consequence of this change is that very close to, and within road sources, NO_2 concentrations generally decrease and Ozone concentrations increase.

22. Previously, in scenarios where chemistry was modelled, the run may have crashed if not all of the pollutants involved in chemistry were selected for output. This has now been fixed.

Other

23. When noise barriers were modelled on both sides of a road, the concentrations downwind of the second noise barrier were incorrect (too low). This has been corrected.

24. An initialisation problem that may have caused model runs to crash has been fixed (this was most likely to occur if chemical reactions were modelled).

25. An error message will now be issued if a source is listed twice in the *.fac* file.

26. The batch file creator will now correctly identify whether the run uses the **Model Hills** option or not.
27. The model may have crashed if a point source was modelled at ground level. This has now been fixed.
28. The model may have crashed if ground level road sources were modelled over very large modelling domains (greater than 50km). This has now been fixed.
29. The method for calculating the effective source height has been updated.
30. A message is now output to the *.log* file if noise barriers are modelled. This message includes the path of the noise barrier file.
31. If intelligent gridding was selected with short-term output and more than 24 hours of met data, the run may have crashed; this will now no longer be the case. Note that gridded output is only given for the first 24 hours with short-term output.

Appendix A – *.hfc* files

An *.hfc* file provides a way of entering a profile of emissions factors for each hour to be applied to a source. The *.hfc* file should be in comma separated format and be contained in the same directory as the *.upl* file and have the same name as the *.upl* file but with an '*.hfc'* file extension. For example, for '*Example.upl'* the *.hfc* file should be called '*Example.hfc*'.

Format of the .hfc file

The *.hfc* file is split into two sections with a blank line between them. The first section lists profiles of emission factors for each met line and the second section identifies which profile is to be used for each source. An example *.hfc* file is shown in Figure 2.

The first line of the *.hfc* file should contain 'year, day, hour,' and then a list of each of the profile names. The following lines then contain the the profile data, which is listed in the format:

Year, day, hour, EmissionFactor1, EmissionsFactor2,…

Where *EmissionFactor1* is the emission factor for "Profile1" for that met line, etc. This is then repeated for each met line in the met file.

There should then be a blank line, and the source information should be listed in the format:

source name, -999, profile name

with this line then repeated for each source to which a profile should be applied. The profile names must match those listed in the top of the *.hfc* file

```
Year,Day,Hour,Profile1,Profile2,Profile3
1991,247,0,0,0,0.5
…
1991,247,23,2,2,1.5

Source1,-999,Profile1
Source2,-999,Profile2
Source3,-999,Profile3
```

Figure 2 – An example *.hfc* file

Further notes

- Up to 500 profiles can be listed in the *.hfc* file.
- A source must not be listed in both the *.hfc* and *.fac* files

- If a default road profile is used in the *.fac* file then this default profile is applied to any road sources that are not explicitly listed in either the *.fac* or *.hfc* files. A default road profile cannot be used in the *.hfc* file.

Appendix B Stack downwash

If the wind speed at the source height is large compared to the source exit velocity, the source height is adjusted to account for 'stack downwash', i.e. the effect of the stack structure itself on the release.

The adjustment (Hanna *et al* 1982) is described as follows:

$$\Delta z_s = 2D_s\left(\frac{W_s}{U(z_s)} - 1.5\right) \qquad \text{if } \frac{W_s}{U(z_s)} < 1.5$$

$$\Delta z_s = 0 \qquad \text{otherwise}$$

where D_s is the source diameter, W_s is the vertical component of the exit velocity, $U(z_s)$ is the wind speed at the source height and Δz_s is the adjustment to the source height (i.e. the final source height will be $z_s + \Delta z_s$).

This adjustment only applies to point sources.

Reference

Hanna, S.R., Briggs, G.A. and Hosker, R.P., 1982. 'Handbook on Atmospheric Diffusion'. US Dept. of Energy Office of Scientific and Technical Information, DOE/TIC-22800.