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# HAIR2014 Software Manual

R. Kruijne, J. Vlaming, J. Deneer, R. Nousiainen and K. Räsänen



ALTERRA  
WAGENINGEN UR

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R. Kruijne<sup>1</sup>, J. Vlaming<sup>2</sup>, J. Deneer<sup>1</sup>, R. Nousiainen<sup>3</sup> and K. Räsänen<sup>3</sup>

1 Alterra Wageningen University and Research Centre

2 Envista Consultancy, Arnhem

3 Agrifood Research Finland MTT

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The Hair instrument calculates risk indicators related to the agricultural use of pesticides in European countries. This manual describes the new features and the use of the HAIR2014 software package. The manual replaces the HAIR2010 Software Manual and, in part, adds to the HAIR2010 Documentation. All changes relate to the underlying input databases, the software user interface and the processing of the output files. No modifications were made to the methodology behind the risk indicators. The manual explains the concepts and functionality of the software tools Hair2014 and HairOutputViewer. Hands-on examples for using the software are provided.

Keywords: risk indicator, pesticide, protection goal, policy evaluation, EU, HAIR, SUD, Sustainable Use Directive, EU 2009 128, software.

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# Preface

The HAIR (HARmonised environmental Indicators for pesticide Risk) instrument can calculate risk indicators related to the agricultural use of pesticides in European countries. The methodology of the risk indicators was delivered by the original HAIR consortium within the framework of the 6<sup>th</sup> Environmental Action Programme (Contract No. SSP-CT-2003-501997). The HAIR2010 software package was released by Alterra, Wageningen UR.

The list of known issues in the HAIR2010 software version 1.0 was extended with the feedback from participants of the HAIR2010 Risk Indicators workshop in Wageningen, January 12-13, 2012 and from other users. We want to thank Jörn Strassemeyer, Julius Kühn-Institut (JKI), Federal Research Centre for Cultivated Plants, Institute for Strategies and Technology Assessment, Germany, for reviewing this updated list of known issues.

This new version HAIR2014 was released by Alterra, Wageningen UR in cooperation with Agrifood Research Finland MTT. The project was funded by the Dutch Ministry of Economic Affairs (project number BO-20-002-015).





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# Summary

The Hair instrument calculates risk indicators related to the agricultural use of pesticides in European countries. This manual describes the new features and the use of the HAIR2014 software package. The manual replaces the HAIR2010 Software Manual and, in part, adds to the HAIR2010 Documentation. Both the new HAIR2014 and the HAIR2010 software package can be retrieved from the website [www.pesticidemodels.eu/hair](http://www.pesticidemodels.eu/hair).

Based on the feedback given by participants of the HAIR2010 Risk indicators workshop in Wageningen and other users, the major part of a list of known issues was solved in this new release. All changes relate to the underlying input databases, the software user interface and the processing of the output files. No modifications were made to the methodology behind the risk indicators.

The manual explains the concepts and functionality of the software tools Hair2014 and HairOutputViewer. Hands-on examples for using the software are provided in a 'quick start guide' and two example cases;

- With the European geographical data at 10x10 km<sup>2</sup> map resolution and NUTS1 administrative units originally provided with HAIR2010, and fictitious usage data and compounds.
- With example databases from Finland demonstrating the use of HAIR2014 at the national scale level, with 1 km<sup>2</sup> map resolution and with usage data for ELY Centre regions in Finland.

The new software version can handle any regionalisation of pesticide usage data and map resolution. The risk indicators for calculation are now selectable, and the program logs compounds with out-of-range properties. Additional regional output and summary output can be generated within the software package.



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# 1 Introduction

## 1.1 Description and objectives

The Hair instrument calculates risk indicators related to the agricultural use of pesticides in European countries. This manual describes the new features and the use of the HAIR2014 software package. The manual replaces the HAIR2010 Software Manual and, in part, adds to the HAIR2010 Documentation. The HAIR2010 software package can still be retrieved from the website ([www.pesticidemodels.eu/hair](http://www.pesticidemodels.eu/hair)).

This manual explains the concepts and functionality of the software tools Hair2014 and HairOutputViewer. Hands-on examples for using the software are provided in the 'quick start guide' (Chapter 2) and the 'Example case' in Section 5.1. The preparation of usage data and spatial input data is described in detail using a case from Finland (Section 5.2).

The HAIR2014 software requirements are provided in Annex 1 and the installation procedure is described in Annex 2. Annex 3 includes the update of the HAIR2010 documentation. The list of known issues (established at the version HAIR2010 release) is updated in Annex 4. Tables and maps with input data of the Example case from Finland are included in Annex 5. Finally, the use of regions in HAIR2014 is explained in Annex 6.

## 1.2 What's new in HAIR2014?

Based on the feedback given by participants of the HAIR2010 Risk indicators workshop in Wageningen and other users a list of known issues was maintained since the HAIR2010 release in June 2011. Most of these issues were solved in this new release.

All changes relate to the underlying input databases, the software user interface and the processing of the output files, and no modifications were made to the methodology behind the risk indicators.

The following major changes were made in version HAIR2014;

- Geographical data has been separated from the original Hair Database and placed in a separate Geographical database; the new software version can handle any regionalisation of usage data and map resolution.
- Risk indicators for calculation are now selectable.
- Checking and logging of compounds with out-of-range properties are performed before the calculations start.
- HairOutputViewer now auto generates a regional output file and a summary output file based on the detailed output file.
- Hair2014 now has an option to specify the data folder from where it accesses its data.

### 1.2.1 Compatibility

The description of the risk indicator algorithms in the HAIR2010 Documentation (Kruijne *et al.*, 2011) complies with this new version HAIR2014. The HAIR2010 Documentation Section 1.5.3 on the Hair database and spatial input is replaced by Annex 3.

Usage and Compound databases of the version HAIR2010 are compatible with the current version HAIR2014. The Hair database provided with the previous software package HAIR2010 is not compatible with the current version HAIR2014.

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## 1.3 HAIR2014 software tools

The HAIR2014 software package consists of two tools that are used together:

1. Hair2014: The main software module that allows the definition and selection of cases, performs the calculations and saves the results to an output file.
2. HairOutputViewer: Reads the Hair output file, displays it in table format for viewing, generates two additional files with aggregated output, and creates summary reports.

The HairStudio tool, part of the HAIR2010 software package, is no longer supported in the new version HAIR2014.

## 1.4 Databases

The HAIR2014 software requires four databases to function. These four databases, from which the input data is read, are briefly described in Table 1. A more detailed description of the Geographical Database can be found in Section 5.2 and in Annex 3. The original HAIR2010 Documentation (Chapter 1) contains a detailed description of the Compound Database and the Usage Database.

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**Table 1**

*Description of the four databases required.*

Name	Description
<b>Hair Database</b> dbHair_{version}.mdb	Contains <ul style="list-style-type: none"><li>• Crop definitions</li><li>• Miscellaneous definitions</li><li>• Model parameter values</li><li>• Configuration</li></ul> Maintained by: Alterra (recommended). Part of software package release HAIR2014
<b>Geographical Database</b> dbGEO_{version}.mdb	Contains <ul style="list-style-type: none"><li>• GIS data (country, regions, crop, soil and climate maps)</li></ul> Maintained by: user Initial demonstration databases provided by Alterra.
<b>Compound Database</b> dbCOMPOUND_{version}.mdb	Contains <ul style="list-style-type: none"><li>• Compounds (names, properties)</li></ul> Maintained by: user Initial demonstration databases provided by Alterra.
<b>Usage Database</b> dbUSE_{region}_{version}.mdb	Contains <ul style="list-style-type: none"><li>• Application records (crop, compound, application rate, area treated, date of application, frequency, interval, ...)</li></ul> Maintained by: user Initial demonstration databases provided by Alterra.

With the input split into four parts, the user has more possibilities to adapt the input to the available information, such as the regionalisation of usage data and the resolution of the maps required by the risk indicators of concern. It also makes the information easier to maintain.

All four databases have the Microsoft Access format with .mdb extension (version 2003 or later).

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## 1.5 Geographical scope and regionalisation

The geographical scope of the risk indicators in Hair covers all climates and agricultural crop calendars of the European continent.

The European geographical data and NUTS1 administrative units provided with the original version HAIR2010 are still available in the new version HAIR2014. In addition, example databases from Finland are provided to demonstrate the use of HAIR2014 at the national scale level, with higher map resolution and with usage data for ELY Centre<sup>1</sup> regions in Finland.

The geographical area of interest, e.g. EU or Finland, can be selected in the graphical user interface.

## 1.6 Projects and cases

In Hair, a set of choices made by the user is generally referred to as a 'case'. A case is defined by a geographical area of interest, the year (range), compounds, crops, and risk indicators for which calculations should be performed.

A 'project' is simply a collection of 'cases', each with its own selection of databases, areas, compounds, crops and risk indicators. It is up to the user to decide whether to add a new case to an already existing project, containing one or more existing cases, or to define a new project which will then initially only contain the new case. Cases cannot be moved or copied from one project to another.

Project definitions, with the cases that are part of them, are saved to file in XML (.xml) format, by default in a subfolder named '\projects and cases'.

## 1.7 Output

The results of calculations are available in three different output files (Section 3.6);

1. detailed results with one row per application and per gridcell,
3. regional average results with one row per application, and
4. summarized results with one row per compound.

Summarized results can be presented in a report with the trends calculated for a compound and the period selected in the graphical user interface.

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<sup>1</sup> Centre for Economic Development, Transport and the Environment

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## 2 Quick start guide

Follow the instructions in Annex 2 to install the software on your PC.

Start the Hair software from the Windows Start Menu, group HAIR2014, item Hair 2014.

### **Define a project:**

- Create a new project (menu | Project | New) and enter at least the project name, [Ok].

### **Define a case:**

- Create a new case within the newly created project (menu | Case | New case). Enter a name for this new case.
- Based on the name of the project a folder for the calculation results will be suggested. Next select the four required databases (by default located in subfolder "\\database"). The databases are selected in the following order; Hair database, Geodatabase, Compound database and Usage database. A message will pop up if the wrong type of database was selected.
- Next, select the shapefile folder containing the COUNTRY and REGION shapefiles. Only the location (i.e. the folder) needs to be selected; not these two shapefiles.
- Finally, select the year range for which you want to calculate and wait for the program to load the Area selection page, the Compound and Crop selection page and the Risk indicator selection page.
- Proceed to the Area Selection page; the map shown at this page corresponds with your selection (see the previous step).
- Select the scale level from which you want to select (either country or region) and use the buttons below the map to make the desired selection. Move the mouse pointer over the buttons to see the function of each button.
- Proceed to the Compound and Crop Selection page and make a selection. By default, nothing is selected for new cases.
- Proceed to the Risk indicator Selection page and make a selection. By default none of the available risk indicators are selected for new cases.
- FOR TESTING PURPOSES: limit the selection of Areas, Compounds and Crops as the calculations may take a considerable amount of time!
- Save the Case (menu | Case | Save) and save the project as well (menu | Project | Save).

### **Run calculations:**

- Proceed to the calculation screen (menu | Case | Calculation screen | or calculator icon).
- Click the [Start] button; the calculations will start and progress is shown a) in the map, b) above the map, and c) to the right of the map.
- Calculations can be aborted anytime but that means that the results are lost.
- The Log page will appear once the calculations are completed. This page shows the number of cells and applications processed and will refer to the Messages page if any issues occurred.
- The Messages page lists problems encountered during calculation.

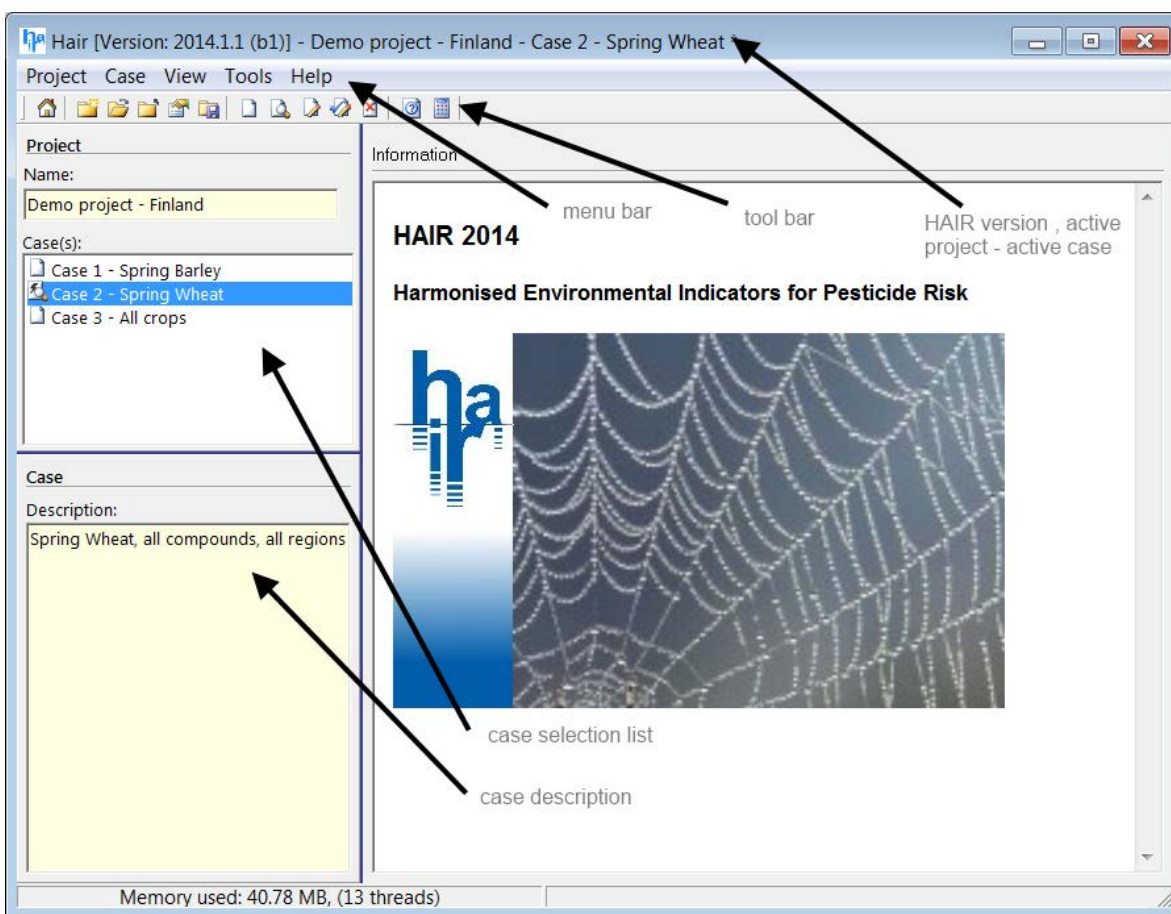
### **View the results:**

- Click the [View Hair Output] button at the bottom of the calculation page and HairOutputViewer will start.
- Click the [Open Last Output] button in the toolbar and the Hair results will load in the table. Upon loading the detailed output, the program generates an additional output file with regional average results.
- You can now browse through the results.

# 3 HAIR2014

## 3.1 Introduction

Hair2014 is the main software tool in the HAIR2014 package and is responsible for the calculation of risk indicator values based on user-defined cases. Users can define any number of cases in terms of underlying databases, period of analysis, area selection, compound selection, crop selection and risk indicator selection. Hair2014 then performs the risk indicator value calculations for the selected case and saves the results to an output file in csv format.



**Figure 1** HAIR2014 start page.

Additionally, Hair2014 provides insight in the relation between compound properties, replacement of missing values by the missing value routine for compound properties, and the risk indicators that can be calculated based on the availability of compound properties.

The Hair2014 tool does not facilitate viewing and analysis of the results (HairOutputViewer is used for that purpose) nor does it facilitate the maintenance of its databases.

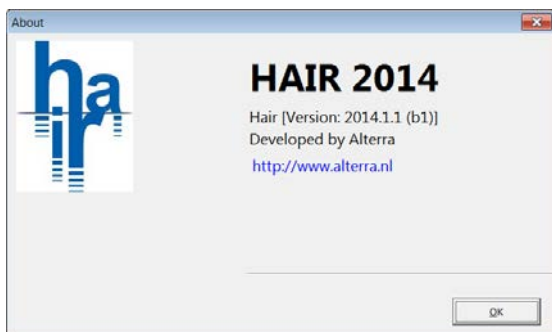


Figure 2 HAIR2014 About box.

## 3.2 Main menu

The options and functionality of the items in the Hair2014 main menu are listed and explained in this Chapter. Most of the menu functions are also present in the toolbar below the menu and they share the same name and icons (Table 2).

Table 2

HAIR2014 menu items.

Menu	Project	
	Home	Go to main page
	New ...	Create a new project
	Open ...	Open an existing project
	Save	Save current project
	Save As ...	Save current project with different name
	Close	Close current project
	Properties	Show project properties
	Exit	Exit application
Menu	Case	
	Select Case ..	Opens the case selector (same as project information pane)
	New Case ...	Create a new case within the current project
	View Case ...	View selected case
	Edit Case ...	Edit selected case
	Save Case	Save selected case
	Delete Case	Remove the case from the current project
	Evaluate Case	Evaluate case definition
	Calculation screen	Show calculation screen
Menu	View	
<input checked="" type="checkbox"/>	Project Info	Shows project information pane on left side of main screen (default=yes)
<input checked="" type="checkbox"/>	Case Description	Shows case description box at bottom of project information pane (default=yes)
Menu	Tools	
	View Compound Status	
	View Hair Output	Starts HairOutputViewer
	Open Hair Data Folder	Opens folder containing the Hair data files
	Documentation ...	Opens the folder containing the (pdf) documentation.
	About ...	Shows the About box (Figure 2)



## 3.3 Projects

A Project is a collection of cases, each with its own selection of databases, shapefile location, year range, areas, compounds, crops and risk indicators.

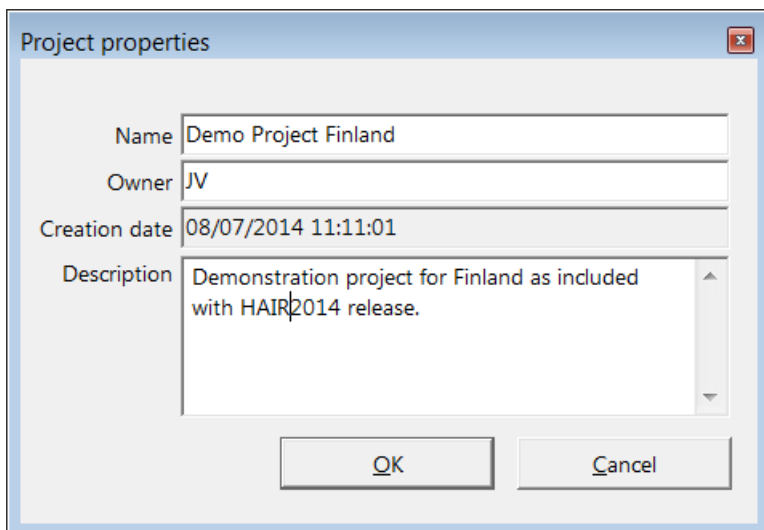
The configuration of a project, including its cases, is stored as a single file with extension '.xml' to a location given by the user when saving the project.

The software will remember the last project used whenever it is started. No projects will be present directly after installation so the user will have to define a new project when starting the software for the very first time.

The cases in a project are only really saved whenever the project in which they reside is saved. A message will appear if the user tries to close Hair2014 while there are unsaved changes to cases or project.


### 3.3.1 New project

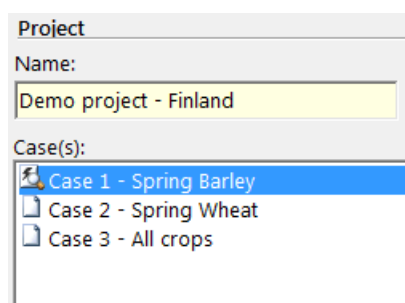
A new project is created using the Create a New Project button  through the main menu (Project | New ...)






**Figure 3** Project properties dialog.

### 3.3.2 Opening a project

An existing project can be opened using the Open Existing Project button  or through the main menu (Project | Open ...)




The case list on the left of the window will display a list of all cases contained in the open project file.

-  Currently selected case
-  Case with incomplete database information
-  Any other case

**Figure 4** Project information pane and case selection list.

### 3.3.3 Editing a project

An open project is saved using the Save Current Project button  through the menu (Project | Save) or (Project | Save as ...).

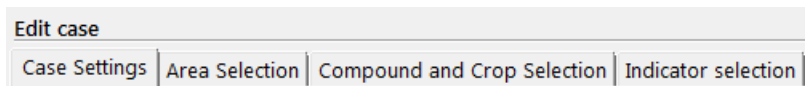
Hair will report unsaved project changes when closing.

Note that a project can only be deleted by removing the Project xml file from disk.

## 3.4 Cases

In Hair, a set of choices made by the user is referred to as a 'case'. A case is defined by a selection of databases, shapefile location, countries or regions, compounds, crops, risk indicators, and a range of years for which calculations should be performed.

Double clicking a case from the case list will open the case in read-only mode.



**Figure 5** Pages for definition of a case.

Note that existing cases can only be renamed, edited or deleted and cannot be copied.


### 3.4.1 Case settings

The first step in the definition of a new case is to fill out the fields in the page 'Case settings'. An overview of these fields is given in Table 3.

**Table 3**

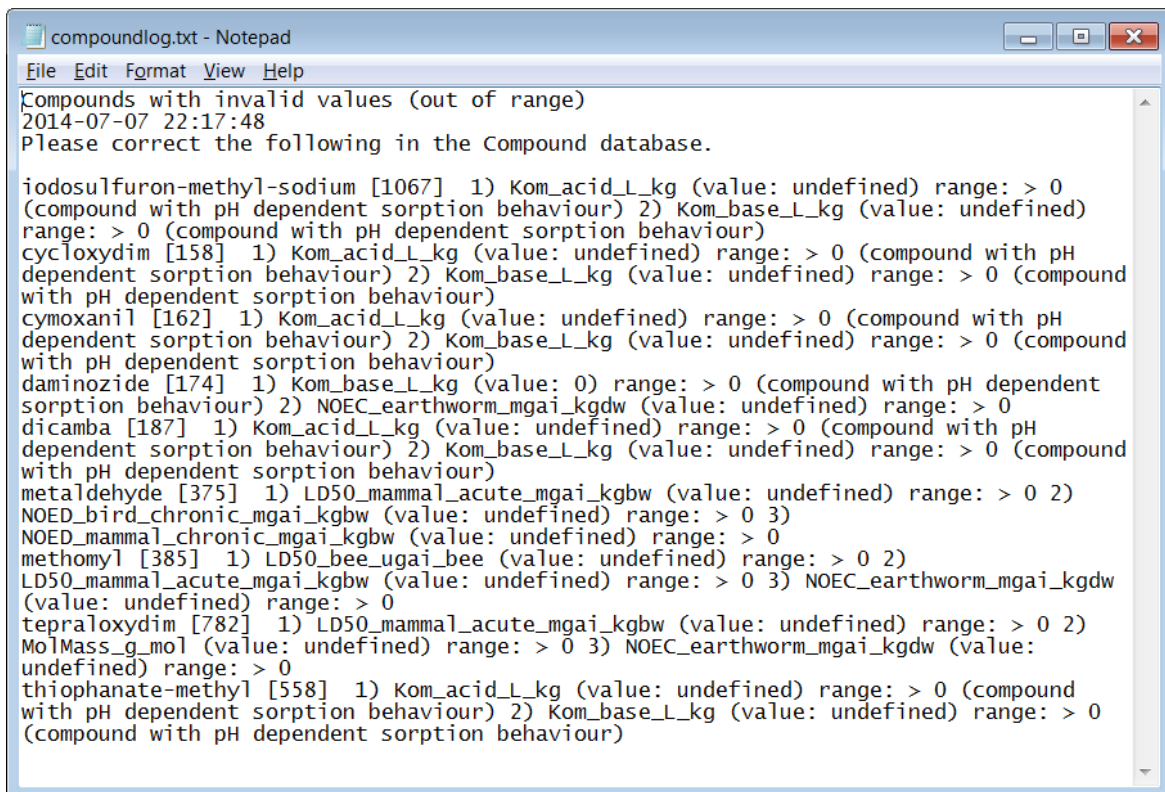
*Fields in Case settings.*

Field name	Required	Description
Case name	X	Unique name for case Default: blank
Owner	-	Person who created this case Default: same as project
Output folder *	X	Folder in which to place output for this case. Default: [Hair Data Folder]\output\<>project name>
Hair database *	X	Name and location of Hair database Default: File [Hair Data Folder]\databases\dbHair*.mdb
Geographical database *	X	Name and location of Hair database Default: File [Hair Data Folder]\databases\dbGEO*.mdb
Compound database *	X	Name and location of Hair database Default: File [Hair Data Folder]\databases\dbCOMPOUND*.mdb
Usage database *	X	Name and location of Hair database Default: File [Hair Data Folder]\databases\dbUSAGE*.mdb
Shapefile folder *	X	Location of the ESRI® shapefiles COUNTRY and REGION. Both shapefiles need to be present in all cases.
Evaluation period *	X	Year range of data to be evaluated from Usage database. Default: Minimum year as in Usage database
From		Default: Minimum year as in Usage database
Until		Default: Minimum year as in Usage database
Description		Additional description for case Default: blank

Fields marked \* are automatically pre-entered to their defaults. Database names can only be pre-entered if there is only one file in the \database folder that matches the naming requirements. In case there are more than one database of the same kind, use the  button, navigate to the \database folder and select a database.

### Compound database errors

HAIR will check the Compound database that is connected to a case when an existing case is loaded for viewing or editing. A message will be displayed whenever it finds that the Compound database contains compounds that have properties that are outside the acceptable ranges. Compounds that have out-of-range properties are logged to a text file named "compoundlog.txt" that can be found in the HAIR log folder (\logs).



**Figure 6** Compound database warning dialog.

The compound database error log specifies which compounds and properties are out of range.

### 3.4.2 Area selection

The tab "Area Selection" displays the map present in the shapefile location selected. The software package HAIR2014 includes two examples; Finland (Figure 7) and EU27. See Annex 6 for more details about the regionalisation and ESRI® shapefiles. Either Country or Region level is visible, depending on the "Selected scale level".



**Figure 7** Finland map; either visible at Country scale or at Region scale. Selection at Region scale shown at the right hand side.








The selection of countries or regions can only be changed while the case is in Edit Mode. The buttons directly below the map are used to make selections.

Hold the Ctrl-key while selecting a map unit with the mouse if more than one unit has to be added to or removed from an existing selection. A single mouse click without Ctrl-key will result in selecting only the chosen unit while deselecting all other map units.

An explanation of the function of each of the buttons below the map is given in Table 4.

**Table 4**

*Buttons for area selection.*

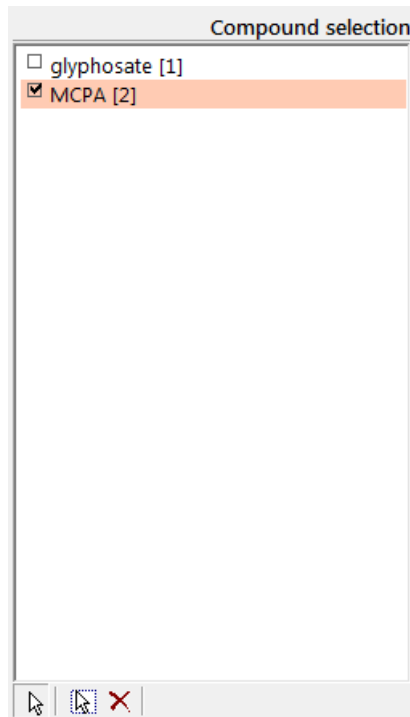
	Select area	Marks the selected area or unmarks it when it is already selected
	Select all areas	Marks all areas on map
	Unselect everything	Clear selection
	Zoom in	Zooms in on click or can be used to drag a rectangle around the area to zoom into
	Zoom out	Zooms out on click
	Pan map	Drag and move the map (only when zoomed in)
	Show entire map	Zooms out to whole map.

Note that a region has to be completely within one country. In some European countries regional usage data are not collected and only national usage data are available. Although there is no need to use a regionalisation in this case, both the REGION and COUNTRY shapefiles need to be present in the \shape folder. A single region covering the entire country needs to be defined with the shape of the country. Note that the attribute tables of both shapefiles are not the same (See Annex 6).

Selection of a country will result in the selection of all the underlying regions. Selection of part of the regions in a country is only possible at Region scale level.

### 3.4.3 Compound and crop selection

Page 'Compound and Crop Selections' consists of two lists from which the user can make a selection as shown in Figure 8 and Figure 9.

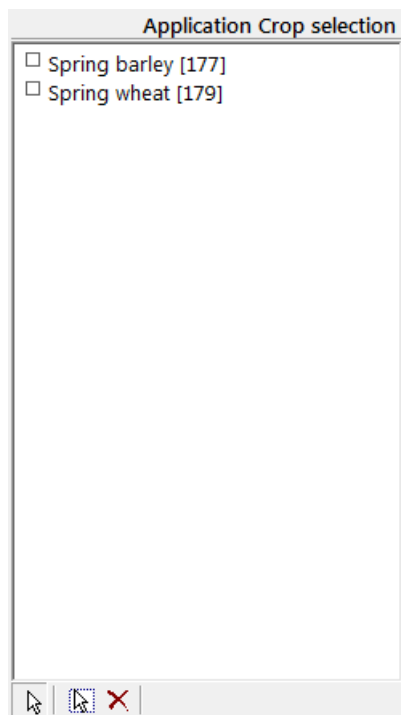


#### **Compound selection:**

This list contains the names of compounds that are found in the Usage Database (not necessarily all the compounds in the Compound Database).

Compounds are listed alphabetically and their ID (as used in Compound and Usage Database) is listed behind the name in square brackets for reference.

**Figure 8** Case compound selection.



#### **Application Crop selection:**

This list contains the names of application crops that are found in the Usage Database (not necessarily all the Application crops in the Hair Database).

Application crops are listed alphabetically and their ID (as used in the Hair Database and Usage Database) is listed behind the name in square brackets for reference.

**Figure 9** Case application crop selection.

Selection of crops and compounds is done using the buttons below the two lists. The three buttons have the same meaning as those for Area selection as explained in Table 4.

Hold the Ctrl-key while selecting an item with the mouse to select more than one item or remove an item from an existing selection. A single mouse click without Ctrl-key will result in selecting only the chosen items while deselecting all other items in the list.

### 3.4.4 Risk indicator selection

Page "Indicator selection" consists of one list from which the user can make any selection of risk indicator groups and/or risk indicators as shown in Figure 10.

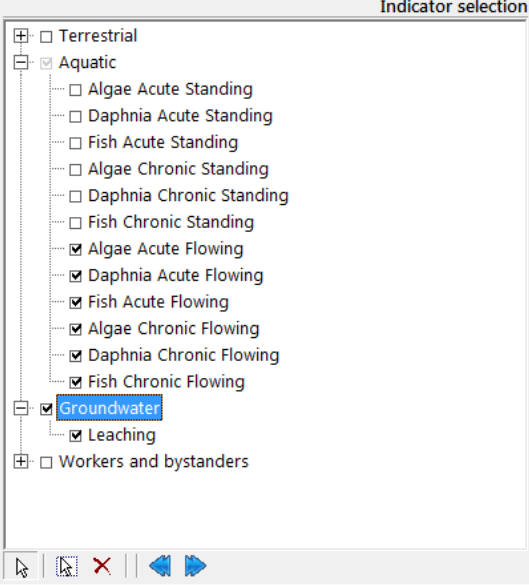

	<p><b>Indicator selection:</b></p> <p>This list contains the names of the risk indicators that can be selected.</p> <p>Selection can be made at two levels;</p> <ol style="list-style-type: none"><li>1. Grouped risk indicators for particular protection goals</li><li>2. Individual risk indicators within;<ol style="list-style-type: none"><li>a. Terrestrial (not expanded here)</li><li>b. Aquatic (with 6 out of 12 risk indicators selected here)</li><li>c. Groundwater (with the only one indicator selected here)</li><li>d. Workers and bystanders (not expanded here)</li></ol></li></ol>
--	---

Figure 10 Case indicator selection.


### 3.4.5 Creating a new case

Use the  button or menu (Case | New case) to create a new case. New cases are automatically created in Edit mode and can be adjusted right away. At least the information in tab 'Case settings' needs to be completed. The new case will automatically save once the case information minimally required has been entered. Saving the case will reveal three additional tabs for [Area Selection], [Compound and Crop Selection], and [Indicator selection], with the information based on the database selection.


### 3.4.6 Opening an existing case

An existing case in the active project is opened by double-clicking the case name in the case selection list on the left of the main page. The case will be opened in read-only mode.


### 3.4.7 Editing a case

A selected case can be modified by clicking the  button from the toolbar or from below the 'Review case' view.

### 3.4.8 Saving a case


The case is saved using the  button or from the menu (Case | Save Case). Cases are saved to the project file.

### 3.4.9 Deleting a case

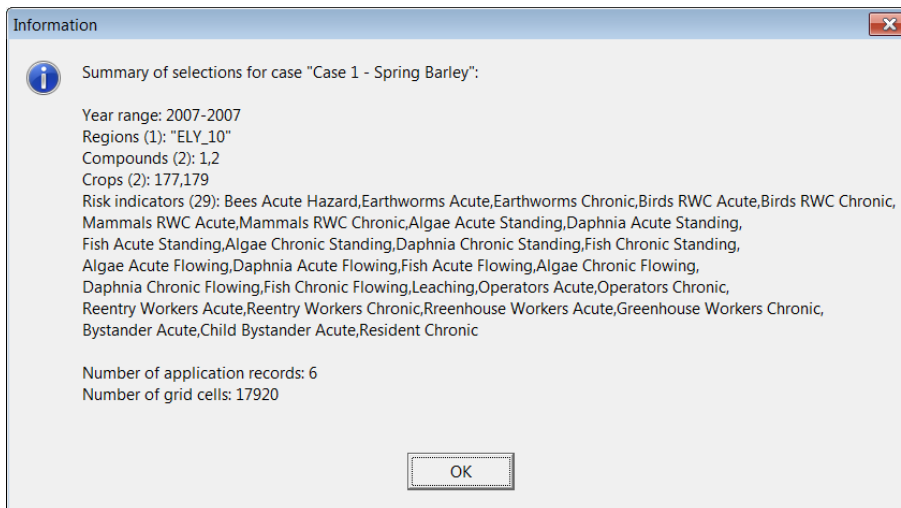
Cases are deleted by selecting a case in the case list and then selecting the  button from the toolbar or from the menu (Case | Delete Case). Deletion of a case is only permanent once the project to which the case belongs is explicitly saved.

When deleting a case from the case selection list, its output is not removed from disk automatically.

### 3.4.10 Evaluating a case


Selecting the  button will pop up a window summarizing the current case selection in terms of selected Year range, selected regions, compounds and crops and the resulting number of selected gridcells and applications. The resulting number of gridcells and applications is a measure for the amount of calculations that need to be performed and the amount of output that will be produced.

A number of zero selected application records mean that the combination of selected years, regions, compounds and crops did not result in any records from the Usage database being selected.



**Figure 11** Case evaluation message.

## 3.5 Calculations






Calculations are initiated from the calculation Screen which is opened using the  button or menu (Case |, Calculation Screen). A case has to be selected to be able to view the Calculation Screen.

An information dialog will inform you of the number of gridcells and applications in your case selection.

The calculation screen consists of three pages; 1) Progress, 2) Log and 3) Messages and has a single row of buttons at the bottom of the page.

Table 5

Buttons on calculation page.

 Start		Start calculations
 Stop!		Stop current calculation
 View HAIR Output		View results of calculations
 Copy to Clipboard		Copy the Log or Message text to clipboard
 Save to File		Save the Log or Message text to text file (.txt)

### 3.5.1 Calculating progress

The actual calculations are started using the [Start] button and can be interrupted at any time with the [Stop] button. However, results are lost when the calculations are stopped.

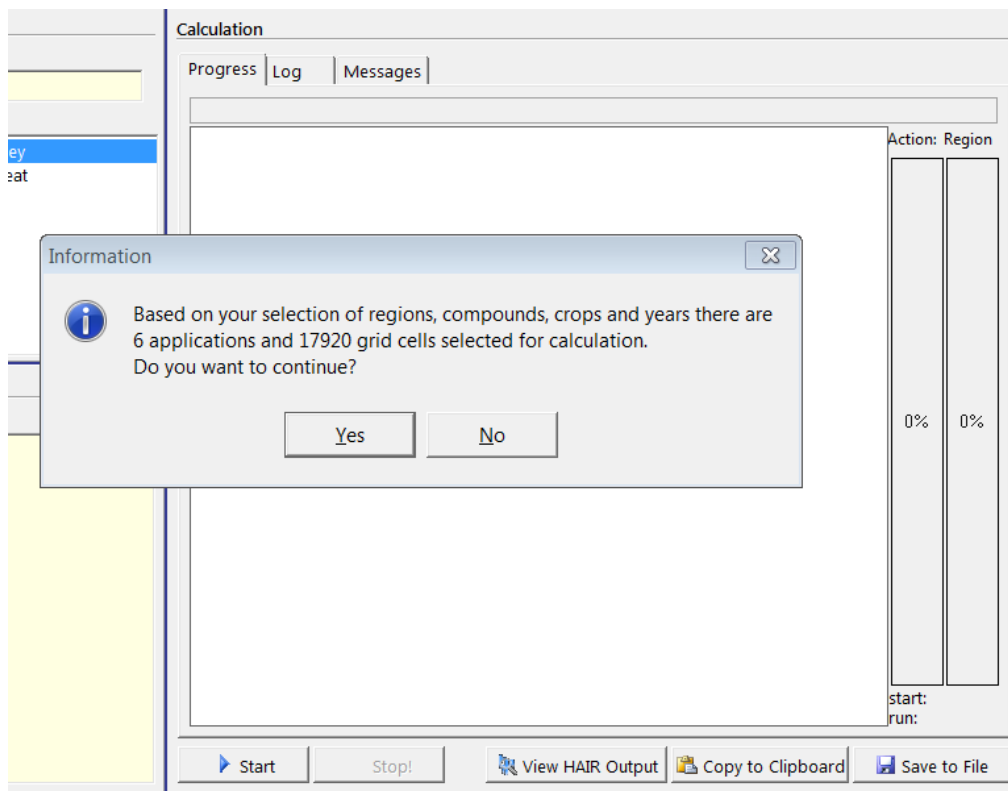
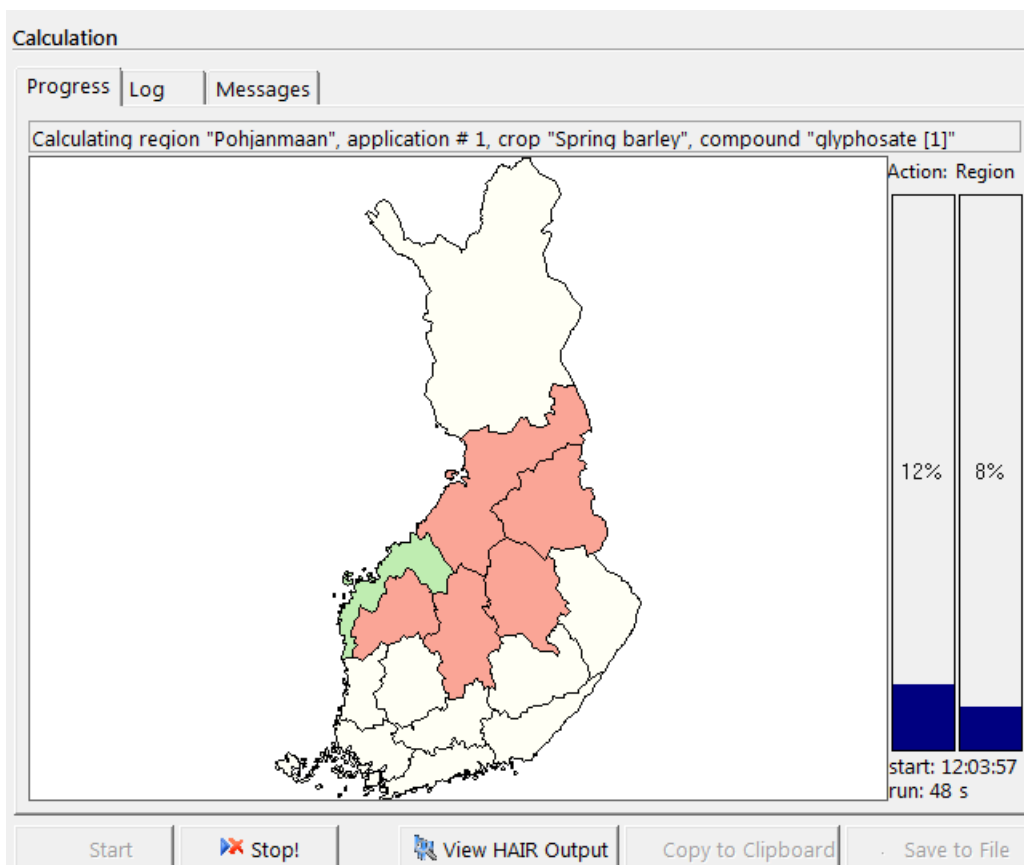


Figure 12 Case evaluation message before calculation.

Progress of the calculations can be followed from the progress text above the main progress window, the progress map and the two progress bars to the right of the map.





**Figure 13** Calculation progress in progress text, map and progress bars.

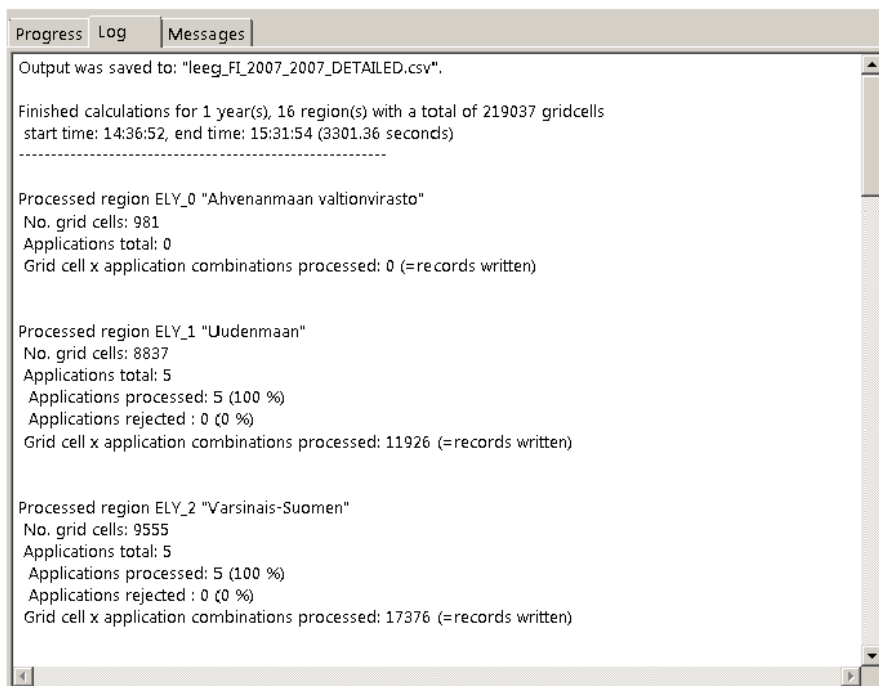
### 3.5.2 Log and messages

A log page is displayed once the calculations are completed. This page contains information about the calculation job and has a section for each region that was analysed, see Figure 14. The Log and messages can be copied to clipboard or saved to file.

The software reports whether any issues occurred during calculation. If so, the messages will be shown on the Messages page.

Currently the following issues are being reported:

- **Rejected application records:**
  - Application records that were skipped from analysis because of missing, invalid or inconsistent data. See the HAIR2010 Documentation, Section 1.5.1 for application data requirements.
  - It is the responsibility of the user to provide valid application data.
- **Occupational indicators not calculated because of failed lookup:**
  - Some occupational indicators depend on the lookup of additional information (e.g. POEM data, Recovery values). A message is printed if an application record - even though valid and in scope - has a combination of values that does not result in a valid lookup for the additional data. This issue cannot be solved directly by the user because these lookup values are stored in the HAIR2014 database.



**Figure 14** Log and messages after calculation.

## 3.6 Hair output files

Hair2014 writes a record with results to file once the calculations have been completed for all risk indicators selected and for each relevant combination of one application record and one gridcell. The size of an output file can easily exceed a hundred thousand records, depending on the number of gridcells and the number of applications resulting from the selections.

### Location and naming

Output files are saved to the folder that is entered during the definition of a case under Case Settings, Output folder (Section 3.4.1). The files are automatically named according to the following format:

*<project name>\_<case name>\_<start year>\_<end year>\_DETAILED.csv*

### Format

Output is saved as a text file in comma delimited format (.csv), i.e. values are delimited by a separator character. The separator character used depends on the Windows regional settings; for English language systems that use a decimal dot (".") the separator character is usually a comma (","). Languages that use a comma as decimal symbol might use a semicolon (";") for separator. The value of this separator character can be verified and checked under the Local settings of the Windows configuration (Windows start menu, Control panel, Region and Language, Formats page, [Additional Settings] button → List Separator).

String values are enclosed in double quotes (" ").

The first line of the file contains the column header names, separated by the separator character. Each subsequent line is a result record and contains all risk indicator results, plus additional information, separated by the separator character, for a combination of one application and grid cell.

This kind of file can be read in any text editor and can also be opened in a spread sheet application for further analysis.

HAIR uses the same separator character as Microsoft Excel on the same PC. If Microsoft Excel does not open the csv files correctly (showing all values as a single string per record) then this is probably due to different regional settings on the PC that created the csv file and that of the target PC that does not recognize the same separator character. Excel has a function called 'Text to columns' that correctly places the values in separate cells.

Upon loading the detailed output file, the HairOutputViewer generates additional output files with regional average results and with total results per compound. The structure of these three output files is described in the next sections. The aggregation steps are described in Annex 3.

### 3.6.1 Detailed output file content

The number of columns in the detailed output file depends on the risk indicators selected and reaches 93 columns when all 29 risk indicators are selected. Each of the risk indicators is represented by two columns, e.g. bees\_acute\_hazard and STATUS\_ bees\_acute\_hazard. The first of the two columns contains the actual calculated indicator value; the second column contains a status value for the indicator calculation. The status value, as explained in Table 6, is based on how -if at all- the risk indicator was calculated in relation to the information from the gridcell and application for which it was calculated.

**Table 6**

*Meaning of indicator status values.*

Status value	Meaning
0	<b>Success, original data</b> An indicator value was calculated and based on original compound data.
1	<b>Success, replacement based on chemical class</b> An indicator value was calculated but <i>at least one compound property</i> was generated by the missing value routine based on the compound's chemical class
2	<b>Success, replacement based on chemical use</b> An indicator was value calculated but <i>at least one compound property</i> was generated by the missing value routine based on the compound's chemical use
3	<b>Failure, missing compound data</b> An indicator value could not be calculated because of missing compound data that could not be solved by the missing value routine. The indicator value is set to zero.
4	<b>Failure, other unspecified</b> An indicator value could not be calculated because of any other missing data or calculation problem which is not specified. The indicator value is set to zero.
5	<b>Not applicable, out of scope</b> An indicator value was not calculated because the application was out of scope for the indicator. The indicator value is set to zero.

In addition to the pair of columns for each risk indicator selected, the detailed output file contains columns that identify the gridcell and application for which the calculations were performed. This includes references to the country, region, timing of the application, the application rate, the compound used, the crop treated, the area treated in the gridcell, some fields relating to mitigation, and some intermediate results.

Table 7 lists all non-indicator fields of the detailed output file.

Note that the results in the detailed output file are expressed per unit area of agricultural land. The loads towards surface water are expressed in kg per ha.

**Table 7**

*List of non-indicator fields in the detailed output file.*

Field name	Description
GridCell	Gridcell ID
X_map	X-coordinate of gridcell (m)
Y_map	Y-coordinate of gridcell (m)
Country	Country ID of gridcell
Region	Region ID of gridcell
ApplicationID	Application ID
Year	Application year <sup>1</sup>
Month	Month of application date
DayNr	Julian day number of application date
CompoundID	Unique compound ID
Compound	Compound name
ChemicalClass	Compound chemical class
ChemicalUse	Compound chemical use
ApplicationCrop	Application crop name
HairCrop	Hair crop name <sup>2</sup>
ApplicationRate_kgai_ha	Application rate (kg a.i./ha)
NrOfApplicationEvents	Number of application events
ApplicationInterval_d	Application interval (days)
AreaTreatedPerGridcell_ha	Calculated area treated per gridcell (ha)
MethodOfApplication	Method of application
Formulation	Formulation of compound
BufferStripWidth_m	Buffer strip width (meter)
DriftMitigationFactor	Mitigation factor for spray drift (-)
FieldMarginWidth_m	Field margin width (meter)
FloweringWeedsInCrop	Presence of flowering weeds in crop (true/false)
TERRESTRIAL	< separator field; start of terrestrial indicators>
.. Terrestrial indicator fields (2 per indicator)	
CIF	Crop Interception Factor (-)
NSDF	Net Soil Deposition Factor (-)
AQUATIC	< separator field; start of aquatic indicators>
.. Aquatic indicator fields (2 per indicator)	
Load_drift_aqua_kg_ha	Load of compound by spray drift (kg/ha)
Load_runoff_aqua_kg_ha	Load of compound by run-off (kg/ha)
Load_erosion_aqua_kg_ha	Load of compound by erosion (kg/ha)
Load_total_aqua_kg_ha	Total load of compound (kg/ha)
GROUNDWATER	< separator field; start of groundwater indicator>
.. Groundwater indicator fields (2 per indicator)	
WORKERS_AND_BYSTANDERS	< separator field; start of occupational indicators>
.. Occupational indicators fields (2 per indicator)	

<sup>1</sup> not necessarily year of application date (e.g. winter cereals, winter rapeseed))

<sup>2</sup> assigned by the program based on the application crop

### 3.6.2 Regional output file content

The regional output file contains regional average results. In addition to the pair of columns for each risk indicator selected, the regional output file contains columns that identify the application. This includes the country, region, timing of the application, the volume applied in the region, the compound used, the crop treated, the regional area treated, some fields related to mitigation, and some intermediate results. The number of rows in the regional output file equals the number of applications processed in one case. Table 8 lists all non-indicator fields of the regional output file.

Note that the risk indicator fields in the regional output file contain area weighted, average values. The volume applied and the loads towards surface water in the regional output file are expressed in kg. The aggregation procedure is described in Annex 3.

The prefix "Avg\_" is used in the field headers of the risk indicators (not shown in Table 8).

**Table 8**

*List of non-indicator fields in the regional output file.*

Field name	Description
N_GridCells	Number of gridcells processed
Country	Country ID
Region	Region ID
ApplicationID	Application ID
Year	Application year
Month	Month of application date
DayNr	Julian day number of application date
CompoundID	Compound ID
Compound	Compound name
ChemicalClass	Compound chemical class
ChemicalUse	Compound chemical use
ApplicationCrop	Application crop name
HairCrop	Hair crop name
Volume_Applied_kg	Volume applied in the region (kg)
NrOfApplicationEvents	Number of application events
ApplicationInterval_d	Application interval (days)
AreaTreatedPerRegion_ha	Calculated area treated in the region (ha)
MethodOfApplication	Method of application
Formulation	Formulation of compound
BufferStripWidth_m	Buffer strip width (meter)
DriftMitigationFactor	Mitigation factor for spray drift (-)
FieldMarginWidth_m	Field margin width (meter)
FloweringWeedsInCrop	Presence of flowering weeds in crop (true/false)
TERRESTRIAL	< separator field; start of terrestrial indicators>
.. Terrestrial indicator fields (2 per indicator)	
Avg_CIF	Crop Interception Factor (-)
Avg_NSDF	Net Soil Deposition Factor (-)
AQUATIC	< separator field; start of aquatic indicators>
.. Aquatic indicator fields (2 per indicator)	
Load_drift_aqua_kg	Load of compound by spray drift (kg)
Load_runoff_aqua_kg	Load of compound by run-off (kg)
Load_erosion_aqua_kg	Load of compound by erosion (kg)
Load_total_aqua_kg	Total load of compound (kg)
GROUNDWATER	< separator field; start of groundwater indicator>
.. Groundwater indicator fields (2 per indicator)	
WORKERS_AND_BYSTANDERS	< separator field; start of occupational indicators>
.. Occupational indicators fields (2 per indicator)	

---

### 3.6.3 Summary output file content

The summary output file contains one row with total results per year-compound combination. In addition to the pair of columns for each risk indicator selected, the summary output file contains columns that identify the year, the compound, and the total volume applied. Table 9 lists the non-indicator fields of the summary output file.

Similar to the regional output file, the volume applied and the loads towards surface water in the summary output file are expressed in kg. The risk indicator fields in the summary output file contains the sum of the regional average values ( $n = N_{\text{Applications}}$ ). The aggregation procedure is described in Annex 3.

The prefix "Total\_" is used in the field headers with volume and loads. The prefix "Sum\_" is used in the field headers with risk indicators (not shown in Table 9).

The number of rows in the summary output file equals the number of year-compound combinations in one case.

---

**Table 9**

*List of non-indicator fields in the summary output file.*

Field name	Description
N_Applications	Number of applications summed
Year	Application year
CompoundID	Compound ID
Compound	Compound name
ChemicalClass	Compound chemical class
ChemicalUse	Compound chemical use
Total_Volume_Applied_kg	Total volume applied (kg)
TERRESTRIAL	< separator field; start of terrestrial indicators>
.. Terrestrial indicator fields (2 per indicator)	
AQUATIC	< separator field; start of aquatic indicators>
.. Aquatic indicator fields (2 per indicator)	
Total_Load_drift_aqua_kg	Load of compound by spray drift (kg)
Total_Load_runoff_aqua_kg	Load of compound by run-off (kg)
Total_Load_erosion_aqua_kg	Load of compound by erosion (kg)
Total_Load_total_aqua_kg	Total load of compound (kg)
GROUNDWATER	< separator field; start of groundwater indicator>
.. Groundwater indicator fields (2 per indicator)	
WORKERS_AND_BYSTANDERS	< separator field; start of occupational indicators>
.. Occupational indicators fields (2 per indicator)	

### 3.6.4 Other files in the output folder

Hair2014 produces two more files to the same folder and together with the output file;

1. <case name>.csv  
Case description and definition in csv format.
2. <project name>\_<case name>\_<start year>\_<end year>\_DETAILED\_meta.txt  
Case description and definition in txt format as used by HairOutputViewer.

## 3.7 Compound status

Hair2014 includes a 'Compound Status' function that provides insight into a) compound property values that were used for the calculations, and b) the indicators that can be calculated for each compound. This function is accessed through the menu (Tools | View Compound Status) and can only be accessed when a case is selected.

The Compound Status Form contains three pages and is opened at the Compound (Property) Status page. An explanation of the functionality and legend is provided on the third page, 'Explanation'.

### 3.7.1 Compound (Property) Status page

The Compound (Property) Status table, as shown in Figure 15, lists the compounds present in the selected Usage Database and the values replaced by the missing values routine for compound properties.

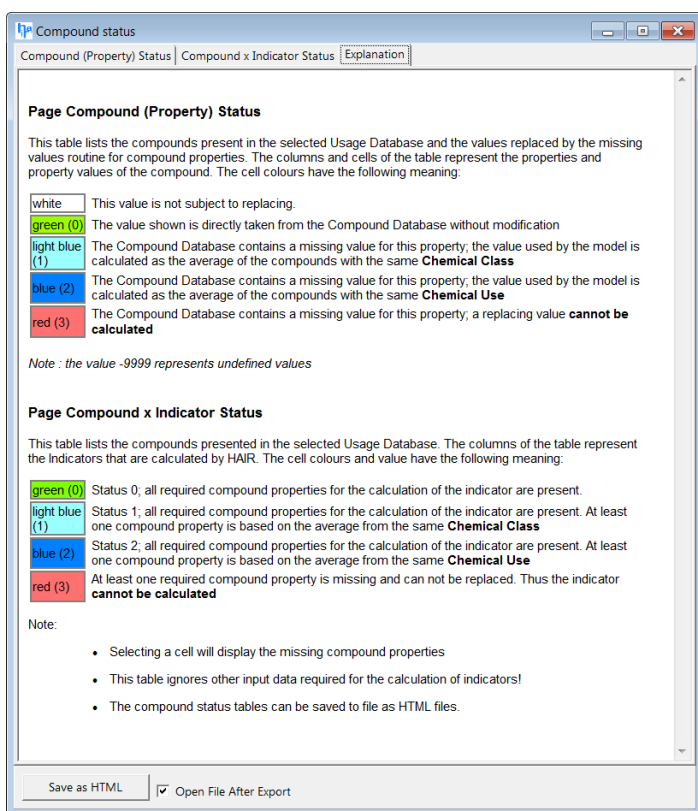


Figure 15 Compound Status, page Compound (Property) Status.

The columns and cells of the table represent the properties and property values of the compound. The cell colours are related to the indicator status values 0, 1, 2 and 3 as explained in Table 6. The value -9999 represents undefined and missing values (as soon as the databases selected by the user are evaluated and the -missing value routine is run).

### 3.7.2 Compound x Indicator Status page

The Compound x Indicator Status table lists the compounds present in the selected Usage Database. The columns of the table represent the HAIR risk indicators. The cell colours and value are related to the indicator status values 0, 1, 2 and 3 as explained in Table 6.

Compound (Property) Status | Compound x Indicator Status | Explanation

EARTHWORMS\_ACUTE - "abamectin [23]"  
Kom\_L\_kg (2), LC50\_earthworm\_mgai\_kgdw (2)

ID	Name	bees_acute	earthworms	earthworms	birds_rwc_a	birds_rwc_c	mammals_r	mammals_r	algae_acut
1067	iodosulfuron-methyl-sodium [1067]	0	2	2	0	0	2	0	2
11	2 4-D [11]	0	0	0	0	0	0	0	0
23	abamectin [23]	0	2	2	2	2	2	2	2
24	acephate [24]	1	0	1	0	0	0	0	0
26	aldicarb [26]	0	0	0	0	0	1	0	0
38	amitraz [38]	0	0	0	0	0	2	0	0
58	azaconazole [58]	1	1	1	1	0	0	0	1
71	benomyl [71]	0	0	0	0	0	1	0	0
80	bitertanol [80]	0	0	0	0	0	0	0	0

Save as HTML  Open File After Export Close

**Figure 16** Compound x Indicator Status page.

A single click on a coloured cell will show the indicator name, the compound and the "problem" properties (with status value between brackets) in the area above the table as show in Figure 16.



---

# 4 HairOutputViewer

## 4.1 Introduction



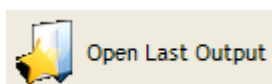
The HairOutputViewer provides quick access to the results from the Hair calculations which are stored as comma delimited file (.csv). It allows the user to browse a table with detailed results, create regional average output and summary output files, and create summary reports with trends in terms of risk reduction percentages for each compound in the data set.

HairOutputViewer is started either from within Hair2014 - using the menu (Tools | View Hair Output) or the [View Hair Output ] button at the bottom of the calculation page - or separately from the short cut in the Windows Start Menu.

## 4.2 Viewing HAIR output

### 4.2.1 Loading HAIR output files

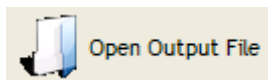
Initially, HairOutputViewer will display an empty window with the message 'no data to display'. The user has two options to load and display a Hair output file:



#### **Open Last Output**

Menu: File / Open Last Output

This will open the most recent Hair Detailed Output file.



#### **Open Output File**

Menu: File / Open Output File

This will show a File Open dialog for the user to select any previously created Hair Detailed Output File (\*.csv) for display.

After opening, HairOutputViewer will show the data contained in the output file as well as the meta information related to this file. The meta information includes;

- CSV file name, creation date and size.
- Number of records and columns contained.
- Databases on which the case was based.
- Year range, area, compound and crop selection on which the case was based.

The meta information can be hidden using the [Hide Meta Information] button

The contents of the output table are identical to those of the Hair output file and has a number of columns depending on the risk indicators selected;

- Detailed output file: A single record in the table contains the output for a combination of an application and a gridcell.
- Regional output file: A single record in the table contains the regional averages (risk indicators) and totals (loadings towards surface water) for each selected application.

### 4.2.2 Viewing an output table

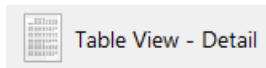
HairOutputViewer allows the user to browse two different output files. The first one is the Detailed Output File which is produced by HAIR2014. The second is the Regional Output File which is automatically created when a Detailed Output File is loaded into HairOutputViewer. The Regional

Output File is a summary of the Detailed Output File and aggregates each application to the regional level (instead of per grid cell) thus greatly reducing the number of records in the file.

The Regional Output File is located in the same folder as the Detailed Output File and is named

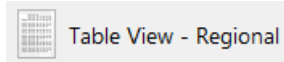
*<project name>\_<case name>\_<start year>\_<end year>\_REGIONAL.csv*

The Detailed Output File is shown by default when loading an output file but the user can switch between detailed and regional output using the buttons in the top bar.



**Table View Detail**

Menu: File / View / Table View – Detail  
Switch to the detailed output view



**Table View Regional**

Menu: File / View / Table View – Regional  
Switch to the regional output view

In addition, HairOutputViewer will automatically generate a third output file when loading a Detailed Output File. This file is called the Summary Output File and cannot be viewed inside HairOutputViewer directly but is used for the generation of the Report (See Section 4.3) and can still be opened directly in a text editor or in MS Excel from the HAIR output folder.

The Summary Output File summarizes the total use of a compound to year level and is also located in the same folder as the Detailed Output File and is named

*<project name>\_<case name>\_<start year>\_<end year>\_SUMMARY.csv*

GridCell	X_map	Y_map	Country	Region	Application	Year	Month	DayNr	Compound
26527	4989500	4362500	FI	ELY_3	13	2007	2007-09	259	1 glyphosate
26015	4988500	4276500	FI	ELY_3	13	2007	2007-09	259	1 glyphosate
26014	4988500	4275500	FI	ELY_3	13	2007	2007-09	259	1 glyphosate
26012	4988500	4273500	FI	ELY_3	13	2007	2007-09	259	1 glyphosate
25690	4987500	4372500	FI	ELY_3	13	2007	2007-09	259	1 glyphosate
25689	4987500	4371500	FI	ELY_3	13	2007	2007-09	259	1 glyphosate
25687	4987500	4369500	FI	ELY_3	13	2007	2007-09	259	1 glyphosate
26013	4988500	4274500	FI	ELY_3	13	2007	2007-09	259	1 glyphosate
26054	4988500	4315500	FI	ELY_3	13	2007	2007-09	259	1 glyphosate

Figure 17 HairOutputViewer displaying a Detailed Output File.

N_GridCel	Country	Region	Application	Year	Month	DayNr	Compound	Compound
1245	FI	ELY_10	8	2007	2007-05	135	1	glyphosate
1245	FI	ELY_10	20	2007	2007-09	264	1	glyphosate
1245	FI	ELY_10	34	2007	2007-06	167	2	MCPA
337	FI	ELY_10	46	2007	2007-05	135	1	glyphosate
337	FI	ELY_10	57	2007	2007-09	264	1	glyphosate
337	FI	ELY_10	70	2007	2007-06	167	2	MCPA
1601	FI	ELY_3	13	2007	2007-09	259	1	glyphosate
1601	FI	ELY_3	27	2007	2007-06	159	2	MCPA
810	FI	ELY_3	41	2007	2007-05	129	1	glyphosate
810	FI	ELY_3	51	2007	2007-09	259	1	glyphosate
810	FI	ELY_3	64	2007	2007-06	159	2	MCPA
2300	FI	ELY_5	5	2007	2007-07	195	1	glyphosate
2300	FI	ELY_5	15	2007	2007-09	265	1	glyphosate
2300	FI	ELY_5	29	2007	2007-06	162	2	MCPA
1804	FI	ELY_5	43	2007	2007-07	195	1	glyphosate
1804	FI	ELY_5	53	2007	2007-09	265	1	glyphosate
1804	FI	ELY_5	66	2007	2007-06	162	2	MCPA

**Figure 18** HairOutputViewer displaying a Regional Output File.

### 4.2.3 Browsing an output table

The Hair detailed output tables may contain up to 93 columns and many thousands of records. HairOutputViewer provides a number of options, as listed in Table 10, to easily navigate through the vast table data. Note that browsing the table becomes slower as the number of records in the table increases.

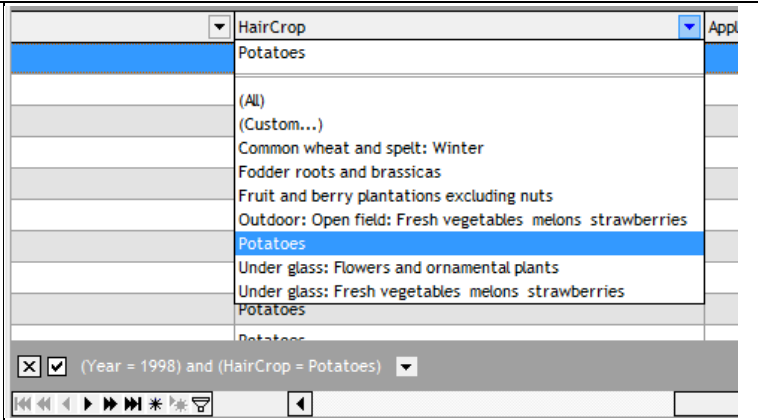
**Table 10**

Functions for browsing output tables, for Detailed Output Files and Regional Output Files.

Function	Example																																				
<p><b>Jump to field</b></p> <p>Select a Hair variable /indicator name from the 'Jump to field' list and the table will jump to that column.</p>	 <table border="1"> <thead> <tr> <th>NUTS1</th> <th>Applicati</th> <th>Year</th> <th>Month</th> <th>DayNr</th> <th>Compour</th> </tr> </thead> <tbody> <tr><td>NL1</td><td>86888</td><td>2004</td><td>2004-06</td><td>166</td><td>26</td></tr> <tr><td>NL1</td><td>86888</td><td>2004</td><td>2004-06</td><td>166</td><td>26</td></tr> <tr><td>NL1</td><td>86888</td><td>2004</td><td>2004-06</td><td>166</td><td>26</td></tr> <tr><td>NL1</td><td>86888</td><td>2004</td><td>2004-06</td><td>166</td><td>26</td></tr> <tr><td>NL1</td><td>86888</td><td>2004</td><td>2004-06</td><td>166</td><td>26</td></tr> </tbody> </table>	NUTS1	Applicati	Year	Month	DayNr	Compour	NL1	86888	2004	2004-06	166	26	NL1	86888	2004	2004-06	166	26	NL1	86888	2004	2004-06	166	26	NL1	86888	2004	2004-06	166	26	NL1	86888	2004	2004-06	166	26
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NL1	86888	2004	2004-06	166	26																																
<p><b>Filter on column</b></p> <p>Click on the downwards pointed arrow at the right side of the column name to open a list of items on which to filter. The same arrow will turn blue when a filter is active. Multiple columns can be filtered simultaneously.</p>																																					

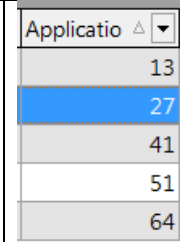
Any active filter is displayed in the grey band directly below the table and can be removed from there.

The '(Custom...)' option will start a filter builder with which more complicated filter conditions can be constructed.



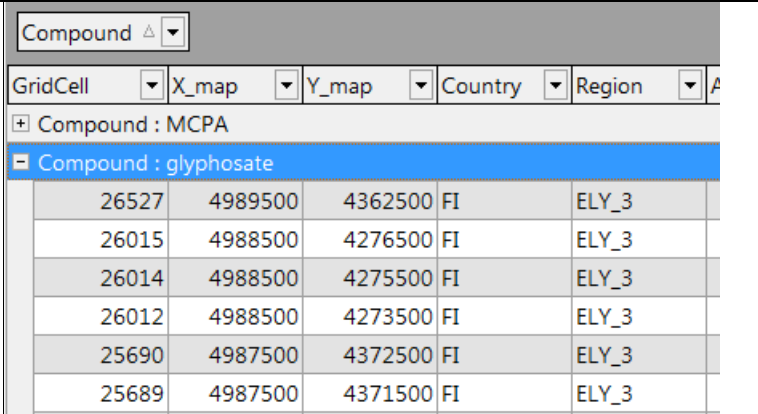
**Sort on column**

A single click on the column header/name will sort the selected column in one direction. Another click will sort in the opposite direction. The sorting direction (ascending, descending) is indicated by the small grey arrow left from the filter button. A sort on multiple columns is achieved by holding the [Shift] button while clicking on the second and following column headers.



**Grouping on column**

Data can be grouped on one or more columns by dragging the column header to the grey area directly above the column names. This will initially collapse all related records into a single line which will unfold when the [+] sign on the left side is clicked.



**Navigator**

A table navigator is located directly left below the table. It contains buttons for (left to right):

- Got to first record
- Go one page up
- Go to previous record
- Go to next record
- Go one page up
- Go to last record
- Bookmark a record
- Go back to bookmarked record
- Start the custom filter builder

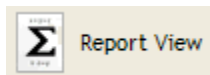


## 4.3 Hair Reports

### 4.3.1 Creating a report

HairOutputViewer has functionality to create a summary report of the information contained in the output file.

A report contains the risk reduction percentages based on the summed risk indicator values at the start year and the end year (as in the case definition) for a single compound.



The user has to select and load an output file before being able to produce a report. The reports are accessed using the [Report View] button or the menu (View | Report View)

Selecting a compound from the "Report for compound" list will immediately display the requested report.

The report consists of a meta information part that lists the compound for which the report is compiled and the relevant case information.

The lower part of the report has a line for each risk indicator containing the following information:

- Indicator : Name of indicator.
- Status : Maximum status value for that compound indicator combination (when the status is less than three).

The screenshot shows a software window titled 'Report for Compound: HAIR\_TEST\_B'. It features a dropdown menu with 'HAIR\_TEST\_B' selected, and two buttons: 'Save Report' and 'Save Report for All Compounds'. Below the header is a table with the following data:

Indicator	Status	Start year	End year	Reduction	Reduction %	
Total volume applied (kg)		2.02E+005	4.04E+004	1.62E+005	80	
>> Terrestrial Indicators						
1) bees_acute_hazard		0	4.41E+002	8.81E+001	3.53E+002	80
2) earthworms_acute		0	1.90E-001	3.81E-002	1.52E-001	80
3) earthworms_chronic		0	4.44E-001	8.88E-002	3.55E-001	80
4) birds_rwc_acute		0	1.96E+001	3.91E+000	1.57E+001	80
5) birds_rwc_chronic		0	5.06E+002	1.01E+002	4.05E+002	80
6) mammals_rwc_acute		0	1.54E+002	3.08E+001	1.23E+002	80
7) mammals_rwc_chronic		0	1.59E+003	3.19E+002	1.28E+003	80

Figure 19 Example page of HAIR report.

---

### 4.3.2 Exporting reports

The visible report can be saved to MS Excel format using the [Save Report] function. The [Save Report for All Compounds] will create a MS Excel file that contains one report sheet per compound.

### 4.3.3 Appending (summary) output files

#### **Append Output Files**

The "Append Output Files" function is started from the menu (Tools | Append Output Files ..). This will open a new page that allows the user to select two or more output files and then append them into a single destination file.

This is useful when applications are processed in separate cases and output is fragmented (because of processing time) and needs to be joined before further processing.

Note the following:

- Only files of the same type and with identical header information should (and can) be appended. In other words, the files should be created using cases with exactly the same risk indicators. If this is not the case the file will be skipped.
- It is the responsibility of the user to make sure that joining of files makes sense. This function only "glues" together the files and does not process any logic or check for redundant data.
- It is *not* possible to load the resulting (appended) output file into HairOutputViewer, nor make a report based on appended output.

### 4.3.4 Other functionality

#### **Open CSV file**

The "Open CSV File in Associated Application" function is started from the menu (Tools | Open CSV File in Associated Application) and will load the selected csv file into the application that is linked to the csv file format on the user's PC. Depending on the configuration of the user's PC this will usually result in MS Excel opening the CSV file. If MS Excel is not installed or not linked to csv files then the file will usually be opened in a text editor.

#### **Open CSV folder**

The "Open CSV Folder" function is started from the menu (Tools | Open CSV Folder) and will open the Windows File Explorer on the folder where the currently selected output file is stored.

---

# 5 Example Cases

In this chapter the use of HAIR2014 is demonstrated by two example cases;

- A case covering 25 European countries and with fictitious usage data (Section 5.1).
- A national case with regional usage data from Finland (Section 5.2).

The purpose of the first example case is to demonstrate the use of HAIR2014 with the input data originating from the previous version HAIR2010 at the European scale. The purpose of the second example case from Finland is to demonstrate how the user may prepare the spatial input data to suit a particular situation.

## 5.1 Example Case 1: EU, 10K

The purpose of this example case is to demonstrate the use of HAIR2014 with the input data originating from the previous version HAIR2010, i.e. with the NUTS1 administrative units used as regionalisation and with 10K resolution maps covering EU27 excluding Malta and Cyprus. Both the NUTS1 regions and the spatial data were delivered by the original Hair consortium.

The spatial data was taken from the HAIR database of the version HAIR2010 and put in a separate geographical database dbGEO\_EU\_10K<sup>2</sup> (Annex 3).

### 5.1.1 Case description

This case is based on the following selections:

- Databases
  - dbHAIR\_V13-1
  - dbGEO\_EU\_10K
  - dbCOMPOUND\_EU\_DEMO
  - dbUSAGE\_EU\_DEMO
- Shapefile location HAIR2014/shapes/EU\_10K
- Evaluation period: 2001-2007
- Area selection: All NUTS1 regions (211 regions; 28 countries).
- Compound selection
  - 1 out of 3 test compounds (id: 1 "HAIR\_TEST\_A")
- Crop selection
  - 1 out of 1 application crops (id: 148 "Permanent grassland")

---

<sup>2</sup> The soil pH map was modified to meet the requirements of the groundwater indicator:  $pH_{water}$  was converted into  $pH_{KCl}$  according to  $pH_{KCl} = 1.163 pH_{water} - 1.723$  (Boesten *et al.*, 2012).

## Steps

- 1 Start Hair, create a new project (or open an existing project) and add a new case.
- 2 Case settings: Name the case "Demo Case EU" and select the databases as above.
- 3 Select the location of the shapefiles: HAIR2014/bin/data/shape/EU\_10K/ (see Section 3.4.1).
- 4 Area selection: Select all countries.
- 5 Calculation period: Select the year 2011 as the start year and 2007 as the end year.
- 6 Compound and crop selection: select the compound and crop as listed above.
- 7 Risk indicator selection: select the groundwater indicator, any other risk indicator(s).
- 8 Save the case, proceed to Calculation, start the calculations and select [View Hair Output] when the calculations are finished.
- 9 Select [Open Last Output] in the HairOutputViewer, wait for the file to load

### 5.1.2 Results

When calculations are finished, a message can be seen at the bottom of the Log tab;

```
>> Some issues occurred during calculation; Please see Messages tab for details <<
```

Note that the selection of all countries includes Cyprus, Malta and Switzerland. For these three countries no crop maps and soil maps were available in HAIR2010. A message can be seen at the Message tab indicating these regions were no part of the calculations;

```
Warning: Region CH01 "Switzerland CH01" has no grid cells defined and was skipped.
Warning: Region CH02 "Switzerland CH02" has no grid cells defined and was skipped.
Warning: Region CH03 "Switzerland CH03" has no grid cells defined and was skipped.
Warning: Region CH04 "Switzerland CH04" has no grid cells defined and was skipped.
Warning: Region CH05 "Switzerland CH05" has no grid cells defined and was skipped.
Warning: Region CH06 "Switzerland CH06" has no grid cells defined and was skipped.
Warning: Region CH07 "Switzerland CH07" has no grid cells defined and was skipped.
Warning: Region CY "Cyprus" has no grid cells defined and was skipped.
Warning: Region MT "Malta" has no grid cells defined and was skipped.
```

### Detailed output

As can be seen in the Meta information section of the HairOutputViewer, the detailed output file contains 76090 records.

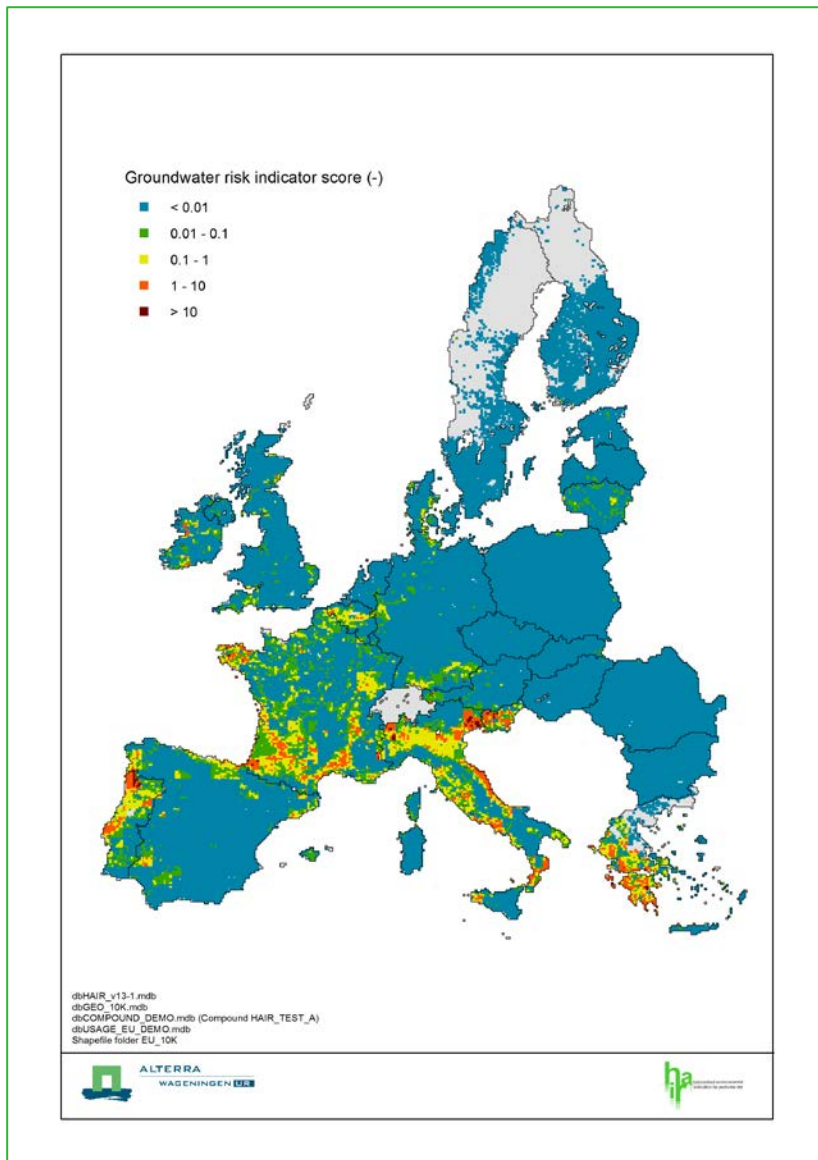
Figure 22 shows a map with the groundwater indicator calculated for HAIR test compound A (Table 11) resulting from one hypothetical, single application in 2001. The application crop is Permanent grassland. The application date is October 1<sup>st</sup>, and the application rate = 1 kg ha<sup>-1</sup>. Figure 22 is made in ArcMAP (ESRI®) based on the detailed output file produced by HAIR2014.

Table 11

*Physico-chemical properties for 3 hypothetical compounds (Example database dbCOMPOUND\_DEMO).*

Property	Dimensions	HAIR test compound		
		A	B	D
Molar mass	g mol <sup>-1</sup>	300	300	300
Vapour pressure	mPa	1000	1000	1000
Solubility	mg L <sup>-1</sup>	90	90	90
DegT50 in soil	D	60	20	20
Sorption coefficient	L kg <sup>-1</sup>	60	10	35
pH dependent sorption	-	N	N	N

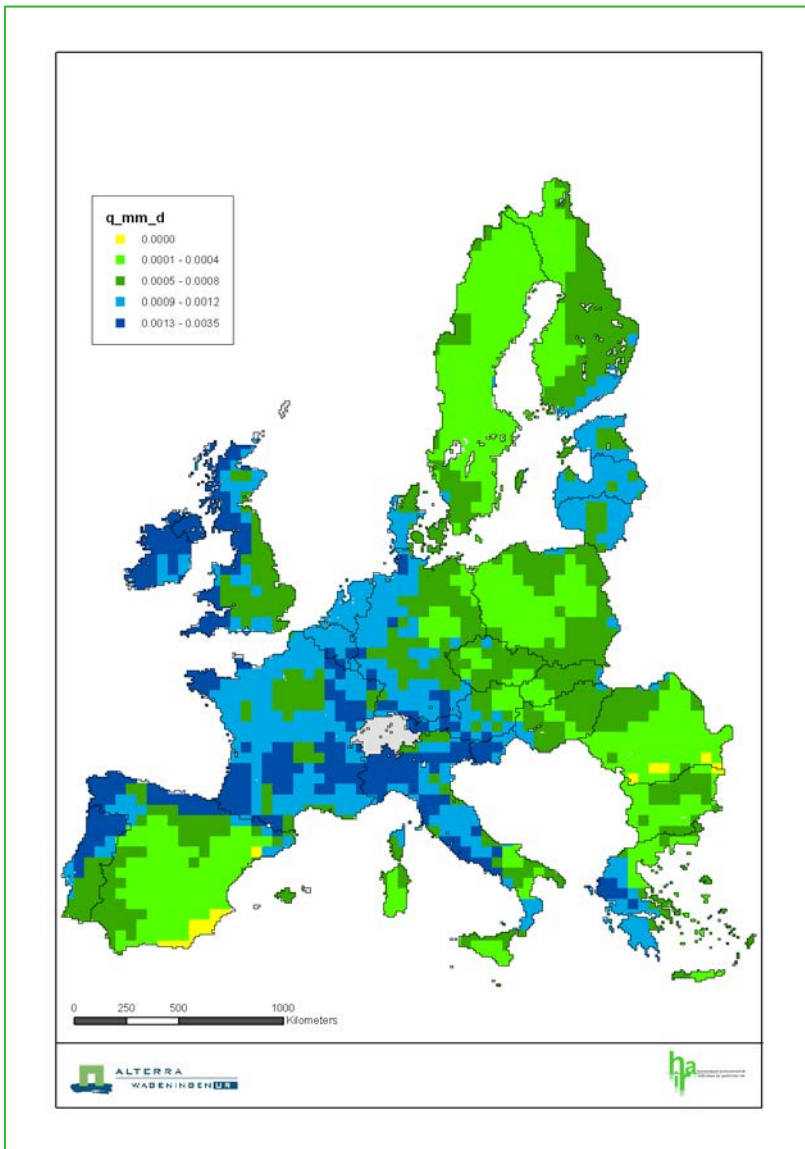




**Figure 20** Map showing the groundwater risk indicator for leaching towards deeper groundwater. Hypothetical compound HAIR\_TEST\_A, Example Case EU\_10K.

Depending on the crop calendar region, the crop interception fraction ranges from 0.40 to 0.75. The calculated cumulative volatilisation from the soil surface ( $CV_{soil}$ ) ranges from 33 to 55%. These percentages can be explained by the high vapour pressure of the test compound (Table 11). The model multiplies the application rate with the calculated net soil deposition fraction ( $0.11 < NSDF < 0.40$ ) and with the nominal leaching concentration  $C_L$  ( $\mu\text{g L}^{-1}$ ). The resulting exposure is divided by the drinking water criterion ( $\mu\text{g L}^{-1}$ ) to obtain the risk indicator for leaching towards deeper groundwater (HAIR2010 documentation, Chapters 2 and 4).

It can be seen in Figure 22 that relatively high leaching risk is calculated in regions of high precipitation surplus (Figure 23). The precipitation surplus map shown in this figure is obtained from the annual precipitation amount ( $q$  in  $\text{mm d}^{-1}$ ; HAIR2010 documentation, Equation 81).



**Figure 20** The precipitation surplus map ( $q$  in  $\text{mm d}^{-1}$ ) obtained from the annual precipitation amount (HAIR2010 documentation, Equation 81).

### Regional output

Open the regional output file in the HairOutputViewer. The regional output file contains 404 records; one hypothetical application in 202 regions in the years 2001 and 2007.

### Summary output

The summary output file cannot be opened in the HairOutputViewer. Open the summary output file in Excel. The summary output file contains 2 records; one for each compound year combination.

### Report view

Open the report view in the HairOutputViewer and select the compound "Test\_Compound\_A". The reduction percentage calculated in this example case is equal to the reduction of the application rate in the year 2007 (base year 2001). Note that all other parameters of these fictitious applications are the same.

---

## 5.2 Example Case 2: Finland

The purpose of the example case from Finland is to demonstrate how the user may prepare the spatial input data to suit a particular situation.

### 5.2.1 Case description

Usage data from Finland;

- Regional average usage data provided by MTT, Finland.
- Compounds: glyphosate and MCPA.
- Crops: feed barley, spring wheat and oats (in HAIR: spring barley).
- Year 2007

Spatial data;

- Map resolution: 1 sqkm.
- Annual crops, soil and climate data from EFSA Spatial Data Version 1.1.
- Slope map provided by MTT, Finland.

Compound data

- Physico-chemical properties and fate properties from Dutch registration dossiers (Van der Linden *et al.*, 2012).
- Ecotoxicity and AOEL from FootPrint (version received august 2013.)

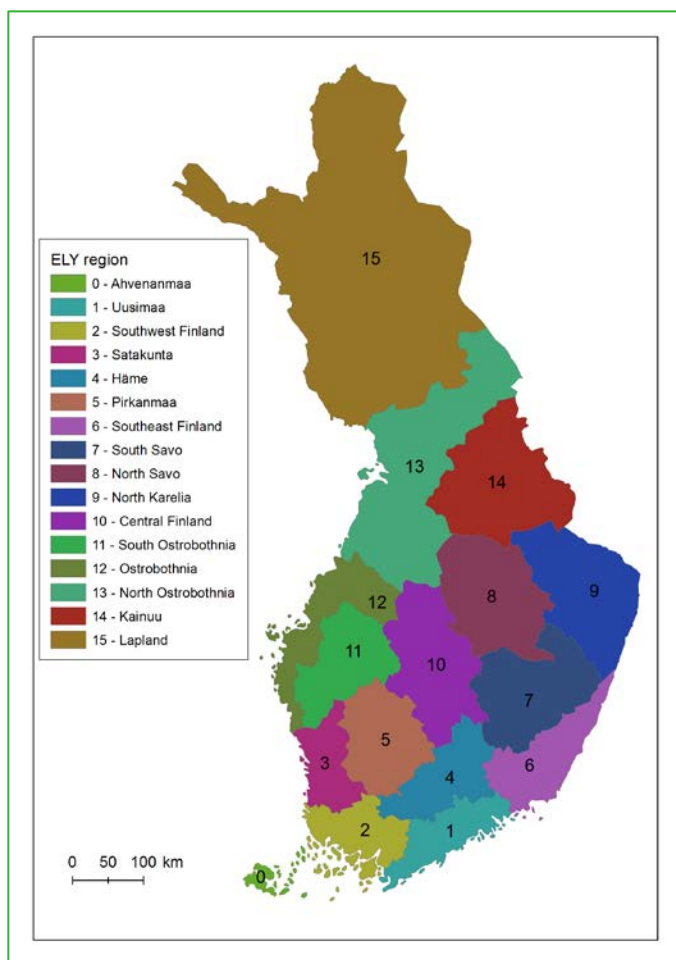
The shapefiles are available at location HAIR2014/shapes/FI/ (see Section 3.4.1).

### 5.2.2 Usage data

The usage data for this example case was kindly provided by Agrifood Research Finland MTT. The field scale pesticide usage data (kg of active ingredient per hectare) was originally obtained from a case study carried out by the Finnish Information Centre of the Ministry of Agriculture and Forestry (TIKE, the decision number of the agreement 567/720/2013, obtained in 14.01.2014), covering data from crop farms in Finland in 2007. The sampling of the case data by TIKE was conducted in a pilot study for the collection of pesticide usage data on a regular basis by Finnish authorities (EU Regulation 1185/2009).

The regional median application rate and application date for MCPA (14 spring applications) and glyphosate (10 spring applications and 14 autumn applications) are stored in dbUsage Table APPLICATION. The median values according to Tables 5 and 6 in (Räsänen *et al.*, 2013) were calculated for spring wheat, feed barley and oats together, because there were not enough data to calculate the median for each crop separately. The application crops spring barley and oats are input, and the area treated (in %, for 38 single applications according to Räsänen *et al.*, 2013) was converted into area treated in the region (in ha) using the regional area grown according to (Hiederer, 2012). The input is included in Annex 5, Tables 5.1 (glyphosate) and 5.2 (MCPA).

The regional division was done using ELY Centre regions (Centres of Economic Development, Transport and the Environment) in Finland. There are 15 ELY Centres which are tasked with promoting regional competitiveness, well-being and sustainable development, as well as curbing climate change. In addition, Ahvenanmaa is a part of Finland but it has no ELY Centre as it is an autonomous region. The regional centres are also responsible for organizing the environmental monitoring and control measures of the use of plant protection products on their areas (Figure 22). The ELY Centre regions were created using municipality data from National Land Survey of Finland (National Land Survey of Finland, 2013a). In this study, average pesticide usage data from 14 ELY Centres were used, named as ELY\_1 - ELY\_14. Because region Lapland, named as ELY\_15 contributes less than 1% to the agricultural area grown in Finland, this region was excluded from the survey. In addition, Ahvenanmaa was not used in this survey because there was no data available from that region (named as ELY\_0) either.



**Figure 21** The Finnish ELY Centre regions 1-15 and Anvenanmaa (region 0) with average usage data (shapes based on National Land Survey of Finland; provided by Agrifood Research Finland MTT; Räsänen et al., 2013).

### 5.2.3 Spatial data

The geographical database dbGEO contains the gridcell definitions, crop maps, soil data and climate data in four separate tables (Annex 3). The EFSA Spatial Dataset Version 1.1 covering the EU27 (Hiederer, 2012) was used to prepare the geographical database for this example case.

#### Gridcell definition

A gridcell is the smallest spatial unit for calculating the risk indicators. Each gridcell in dbGEO is defined by;

- A unique gridcell ID,
- meteorological region ID,
- country code,
- region code,
- x-coordinate (m), and
- y-coordinate (m).

The region codes according to Figure 20 were assigned to the 1 sqkm gridcells covering Finland. The region codes and the country code correspond with the attribute table of the REGION and COUNTRY shapefiles (see also Annex 6). The projection of the shapefile with ELY regions provided by Agrifood Research Finland MTT was modified into ETRS\_1989\_LAEA. The entire country is covered with approximately 335 thousand cells. In order to reduce computation times, gridcells covering Lapland (ELY\_15) were discarded. A unique ID was added to the remaining 219037 cells. This gridcell ID is also present in the dbGEO Tables SOIL and CROP\_MAPS (Annex 3, Table 1). The meteorological region ID in Table BASE refers to a row of data in dbGEO Table CLIMATE (see below). Table BASE is completed with the central coordinates of the gridcell.

## Climate data

In this example case, meteorological regions are defined by unique combinations of two climate properties;

1. the mean annual temperature (accuracy 0,1 degrees C), and
2. the total mean precipitation (mm).

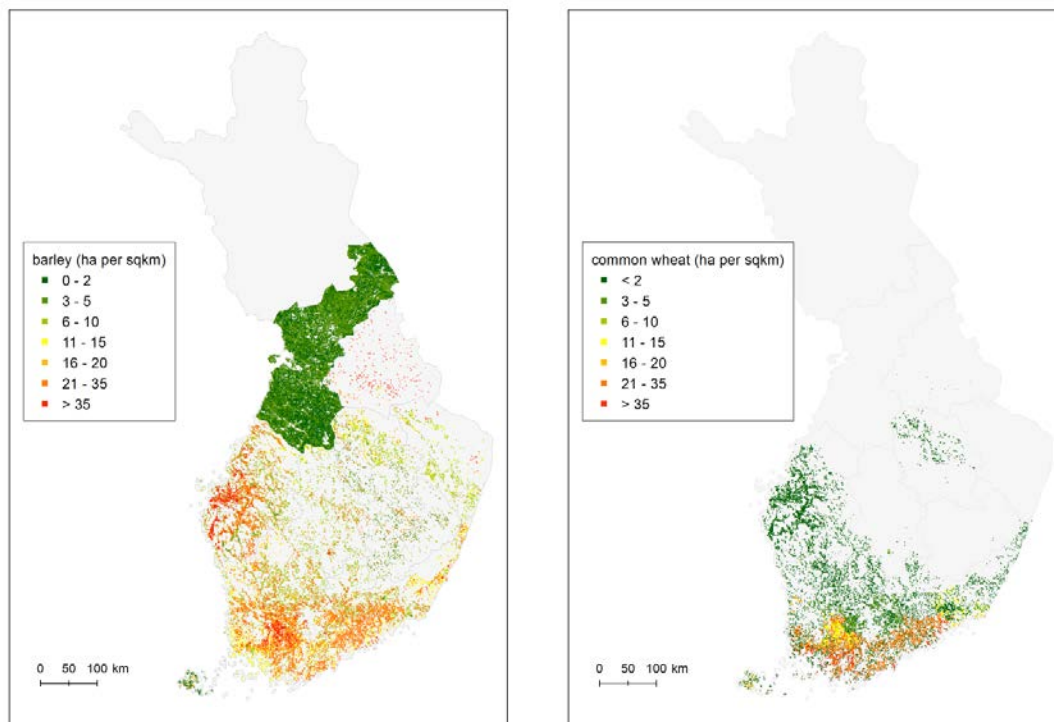
Relatively small variations in the mean monthly temperatures and mean monthly precipitation in the gridcells were ignored when creating these meteorological regions. The monthly values were calculated as the mean value of the group of cells in a meteorological region. The cells covering Finland excluding Lapland belong to 7582 different meteorological regions. A unique ID was added to each meteorological region. The crop calendar region was assigned to the meteorological regions according to the temperature and precipitation classes in HAIR (HAIR2010 Documentation, Table 8).

dbGEO Table CLIMATE contains 7582 records (one for each meteorological region) with a unique METEO\_ID, the CROP\_CALENDAR\_REGION\_ID, the mean annual and monthly temperatures, and annual and monthly precipitation amounts.

## Crop maps

dbGEO Table CROP\_MAP contains the area per sqkm for 17 annual crops. Similar to (Hiederer, 2012) and the crop map definition in HAIR2010, the sum of the area "Other fresh vegetable crops" and "Fresh tomatoes" was calculated and stored as a single crop "Other fresh vegetable crops and tomatoes". Dummy values (0 ha) were used to fill the gaps for the other 13 crop maps in HAIR (i.e. per-annual crops, greenhouse crops) and for replacement of No data values present in the source data. The total area grown per region is shown in Table 5.3 in Annex 5.

The application crop spring barley is connected to the HAIR crop map Barley and the application crop common wheat is connected to the HAIR crop map Common wheat. These two crop maps are shown in Figure 21.



**Figure 22** HAIR Crop maps of Barley<sup>3</sup> and Common wheat in Finland, according to the EFSA Spatial Dataset Version 1.1 (Hiederer, 2012).

<sup>3</sup> As can be seen in Figure 21, the distribution of the crop area for barley within ELY Centre region 13 is not realistic. The same pattern was observed for some other annual crops within this region.

---

### Soil data

dbGEO Table SOIL contains five soil properties and the average slope. The EFSA Spatial data version 1.1 (Hiederer, 2012) were prepared and imported as follows;

- The topsoil organic matter content was converted into organic carbon content using a conversion factor ( $OC = OM/1.72$ ).
- Organic carbon in the soil layer 0-1 m-ss. was calculated from the organic carbon content in the topsoil according to Hair2010 Documentation, Equation 1.
- The  $pH_{water}$  was converted into  $pH_{KCl}$  according to  $pH_{KCl} = 1.163 pH_{water} - 1.723$  (Boesten *et al.*, 2012).
- The soil moisture content was replaced with the hydrological soil group number 1, ..., 4 (these numerical values correspond with Soil map units A, .., B in Hair2010 Documentation Table 13). See Annex 5, Table 5.4.
- Soil texture class 9 (peat soils) was replaced with the value 8 (Hair2010 Documentation Table 18). See Annex 5, Table 5.5.

The EFSA Spatial Database version 1.1 contains no slope data. The slope map was kindly provided by the MTT, calculated using a 25 x 25 m DEM produced by National Land Survey of Finland (National Land Survey of Finland, 2013b). Although a more realistic value for the slope could be derived for the area within the gridcell covered with agricultural land, we decided to calculate the average slope for the entire gridcell area.

Annex 5 includes maps with the soil - and climate properties in the example database dbGEO\_FI\_JRC\_MTT (Figure 5.1).

#### 5.2.4 Compound data

The compound database for this example contains two herbicides glyphosate and MCPA. The physico-chemical properties and fate properties are taken from Dutch registration dossiers (Van der Linden *et al.*, 2011). Ecotoxicity and the AOEL were taken from the FootPrint database, version date August 2013.

#### 5.2.5 Results

The different types of output produced by HAIR2014 are described in Section 3.5.

---

# References

- Räsänen K., Nousiainen R., Kurppa S., Autio S., Junnila S., Tiilikkala K., Kaseva J. and Laitinen P. 2013. How to measure the environmental risks from uses of plant protection products for achieving the IPM requirements and risk communication – A case study on the production chain of cereal farming in Finland. 65 p. MTT - Agrifood Research Finland 105. Finland. Available at <http://www.mtt.fi/mttraportti/pdf/mttraportti105.pdf>.
- Hiederer, 2012. EFSA Spatial Data version 1.1 - Data Properties and Processing. JRC Technical reports, EUR 25546 EN. 50 pp.
- National Land Survey of Finland, 2013a. Municipal Division in Finland 2013. Licence: [http://www.maanmittauslaitos.fi/en/NLS\\_open\\_data\\_licence\\_version1\\_20120501](http://www.maanmittauslaitos.fi/en/NLS_open_data_licence_version1_20120501)
- National Land Survey of Finland, 2013b. Elevation model 25 x 25 m. Licence: [http://www.maanmittauslaitos.fi/en/NLS\\_open\\_data\\_licence\\_version1\\_20120501](http://www.maanmittauslaitos.fi/en/NLS_open_data_licence_version1_20120501)
- Kruijne, R., J.W. Deneer, J. Lahr and J. Vlaming, 2011. HAIR2010 Documentation - Calculating risk indicators related to agricultural use of pesticides within the European Union. Alterra, Wageningen UR, Report 2113.1, 202 p.
- Van der Linden, A.M.A., Kruijne, R., Tiktak, A., Vijver, M.G. 2012. Evaluatie Nota duurzame gewasbescherming 2010, Milieu. RIVM Rapport 60705900, 87 p.
- Vlaming, J., R. Kruijne and J.G. Groenwold, 2011. HAIR2010 Software manual. Alterra, Wageningen UR, Report 2113.2, 60 p.

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# Annex 1 Hardware and software requirements

## Windows

The HAIR2014 package will function only on Microsoft (MS) Windows PCs and has been tested with Windows 7 and Windows 8.1. Older versions of Windows, including Windows Vista and Windows XP, are not tested and not supported.

## Office

HAIR2014 does not require a version of MS Office to run but MS Excel is required for the creation of Hair summary reports from the HairOutputViewer.

MS Access is used for storage of input data and as temporary storage of results for HairOutputViewer. The databases are stored in MS Access format (version 2003) with .mdb extension.

## Pdf

Documentation is provided in pdf format for which the free Adobe Reader can be downloaded (<http://get.adobe.com/reader/>)

## Hardware

HAIR2014 will run on most recent and up to date hardware that runs the above mentioned versions on MS Windows.

## Platform test

HAIR2014 has explicitly been tested for the following combinations of MS Windows, MS Office and regional settings.

---

**Table 9**

*Platforms tested with HAIR2014.*

OS	bit	Office	Regional
W7	64		UK
W7	32		UK
W8.1	64		UK
W7	64		FRENCH
W7	64	2013	UK

## MapObjects

HAIR2014 requires the ESRI MapObjects LT™ software to display maps for area selection and results in Hair2014.

MapObjects is installed as part of the HAIR2014 setup. See Annex 2: Installation.



---

# Annex 2 Installation

## Installation

The HAIR2014 setup requires that the user has **administrator rights** on Windows during installation. HAIR2014 does **not** require administrator rights during normal use.

Windows does not allow standard users to install new software (see: <http://support.microsoft.com/kb/308116>). Administrator rights are not required to run the software after installation.

In case an administrator user is installing HAIR2014 for another user with standard privileges: make sure that the Hair data folder is not installed to the user folder (My documents) of the administrator user. This will make the HAIR data files inaccessible for the standard user when running the software with standard privileges.

1. Start the HAIR2014 installation by double-clicking the HAIR2014-setup.exe file.
2. On the "Welcome page", click [Next >]
3. On the "Select Destination Location" page select where the HAIR2014 data should be placed. Optionally, use [Browse...] to select an alternative location. Click [Next >].
4. Select "Full installation" on the "Select Components" page unless you are re-installing part of the software. Click [Next >].
5. Provide a name for the HAIR2014 folder in the Windows Start Menu.
6. Select Additional Tasks. Check the option if you want a copy of the Start Menu HAIR2014 folder on your desktop for quick access. Click [Next >].
7. The "Ready to Install" page lists the options selected. The [< Back] can be used if these options need to be changed. Otherwise click [Install].
8. The setup will now copy files to your PC.
9. A pop-up will appear with the message that the MapObjects installation was successful. Close this dialog.

Try the following if the installation of MapObjects is **not successful**:

- Run the MapObjects installer that is provided on CD-ROM.
- Restart your PC

If all fails; contact the author of the HAIR2014 Documentation with a copy of file C:\Program Files\ESRI\MapObjectsLT2\MapObjectInstallation.log and details on your version of MS Windows and Office.

10. The last page asks whether HAIR should be launched and [Finish] will close the installation and, optionally, start Hair2014

HAIR2014 installs software and data files to different locations on your PC.

- **HAIR2014 Program files:**

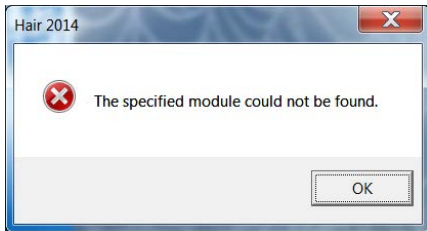
The main program files are installed to "C:\Program Files\Alterra\ HAIR2014" (or "C:\Program Files (x86)\Alterra\HAIR2014" on 64-bit versions of Windows).

- **HAIR2014 Data Folder:**

HAIR (user) data (i.e. databases, shape files, project definitions and output files) are installed to a user selectable folder. If the user does not change the default option then this will default to the "My documents\HAIR2014" folder on the PC (C:\Users\\Documents\HAIR2014).

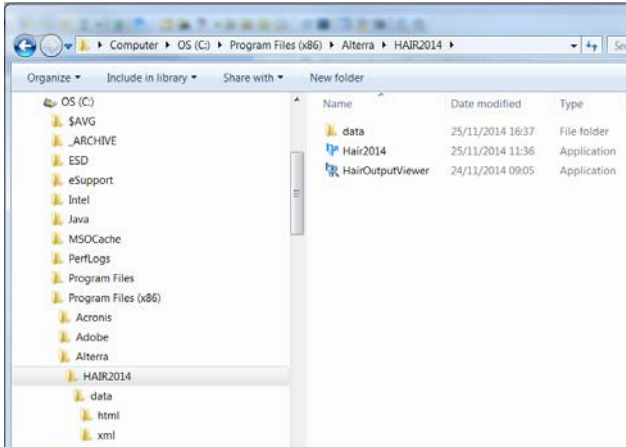
- **MapObjects LT2**

ESRI MapObjects is an external piece of software that is required for the display of maps in Hair2014 and HairStudio. HAIR will display an error message when Hair2014 is started without MapObjects being properly installed.

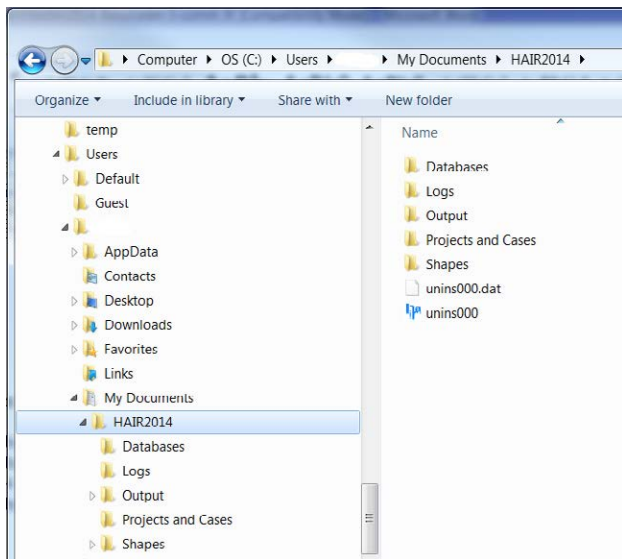


MapObjects LT2 is installed to the program files folder  
"C:\Program Files (x86)\ESRI\MapObjectsLT2"

**Figure 2.1** Error message when starting Hair2014 without MapObjects being installed.



**Figure 2.2** HAIR2014 Program Files folder (this example: on Windows 7 64-bit).

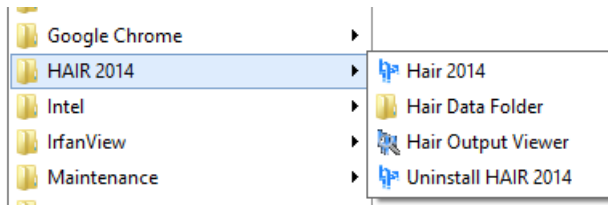


**Figure 2.3** HAIR2014 Data Folder.

### Folder structure HAIR 2014 after default installation

HAIR2014 will not be able to find default folder and file locations if the data folder is moved to a different location after installation. In this case the user will have to reset the data folder using the option in the Hair2014 software. This option is accessed through the menu (Tools | Manage Hair Data Folder) which lets the user select another folder from which to access the files required by Hair.

Hair will install a HAIR2014 group in the Windows Start Menu and the software can be started from there.



**Figure 2.4** HAIR 2014 group in the Windows Start Menu.

Note: When persistent problems occur with navigating to the default folders located in My Documents, we recommend to re-install the programme with an alternative location for the HAIR2014 data folders. Uninstall the programme first, then re-install. At installation Step 3, browse to an alternative location. Click [Next >]. Etc.

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# Annex 3 Update HAIR2010 Documentation

This annex describes the two major new features of HAIR2014; the separate geographical database (Section 1a) and the aggregation of detailed output (Section 1b). Moreover, some equations in the HAIR2010 Documentation were found to be incorrect, and the corrected version of these equations is given in Section 2.

## 1a Spatial input data

In HAIR2010 the spatial input data were part of the HAIR database (HAIR2010 documentation, Section 1.3). In HAIR2014 the input data are stored in four databases, with the spatial input data separated from the HAIR database

1. HAIR database with crop data and all the other input required for calculating risk indicators (dbHAIR).
2. Geographical database with spatial data (dbGEO).
3. Compound database with physico-chemical properties, fate properties and toxicity of active ingredients (dbCompound).
4. Usage database with pesticide applications (dbUsage).

The spatial input data are stored in the geographical database in four tables;

1. Table BASE with the definition of the gridcells,
2. Table CLIMATE with the crop calendar region ID, temperature and precipitation amounts per meteorological region,
3. Table CROP\_MAP with crop areas per cell, and
4. Table SOIL with soil data and slope per cell.

The field names of these four tables of the geographical database are listed in Table 1. Each record in Table BASE represents a gridcell which is defined by a unique ID, the meteorological region ID, country code, region code, and x- and y-coordinate (in m). The map resolution is no input but can be derived from the distance between the coordinates of adjacent cells in a regular grid consisting of square elements.

The gridcell ID is also present in the dbGEO Tables SOIL and CROP\_MAPS. These three tables must have the same number of records. Each gridcell ID present in Table BASE must also be present in Table CROP\_MAP and Table SOIL. Each meteorological region present in Table BASE must also be present in Table CLIMATE. A meteorological region ID present in Table CLIMATE may appear in one or more records in Table BASE.

In order to enable interactive selection of a country or region via the GUI, the country code in Table BASE must be equal to the code in the attribute table of shapefile COUNTRY, and the region code must be equal to the code in the attribute table of the of shapefile REGION.

Table 3.1

Field names in geographical database tables BASE, SOIL, CLIMATE and CROP\_MAP with key fields in grey fill.

BASE		SOIL		CLIMATE		CROP_MAP	
1	exclude	1	GRIDCELL_ID	1	METEO_ID	1	GRIDCELL_ID
2	TAG	2	OC_TOPSOIL_PCT	2	CROP_CALENDAR_REGION_ID	2	CM_BARL_HA
3	GRIDCELL_ID	3	OC_TOPM_SOIL_PCT	3	TEMP_ANN_C	3	CM_CITR_HA
4	METEO_ID	4	SOIL_PH	4	TEMP_JAN_C	4	CM_DWHE_HA
5	COUNTRY	5	HYDROSOILGROUP	5	TEMP_FEB_C	5	CM_FLOW_HA
6	REGION	6	SOILTEXTURECLASS	6	TEMP_MAR_C	6	CM_GRAS_HA
7	X_MAP	7	SLOPE_PCT	7	TEMP_APR_C	7	CM_LFALL_HA
8	Y_MAP			8	TEMP_MAY_C	8	CM_LFRUI_HA
				9	TEMP_JUN_C	9	CM_LMAIZ_HA
				10	TEMP_JUL_C	10	CM_LOLIV_HA
				11	TEMP_AUG_C	11	CM_LRAPE_HA
				12	TEMP_SEP_C	12	CM_LTEXT_HA
				13	TEMP_OCT_C	13	CM_LTWIN_HA
				14	TEMP_NOV_C	14	CM_NURS_HA
				15	TEMP_DEC_C	15	CM_OATS_HA
				16	PRECIP_ANN_mm	16	CM_OCER_HA
				17	PRECIP_JAN_mm	17	CM_OCRO_HA
				18	PRECIP_FEB_mm	18	CM_OFAR_HA
				19	PRECIP_MAR_mm	19	CM_OIND_HA
				20	PRECIP_APR_mm	20	CM_OVTO_HA
				21	PRECIP_MAY_mm	21	CM_PARI_HA
				22	PRECIP_JUN_mm	22	CM_POTA_HA
				23	PRECIP_JUL_mm	23	CM_PULS_HA
				24	PRECIP_AUG_mm	24	CM_ROOF_HA
				25	PRECIP_SEP_mm	25	CM_RYEM_HA
				26	PRECIP_OCT_mm	26	CM_SOYA_HA
				27	PRECIP_NOV_mm	27	CM_SUGB_HA
				28	PRECIP_DEC_mm	28	CM_SUNF_HA
						29	CM_SWHE_HA
						30	CM_TOBA_HA
						31	CM_GHCR_HA

### 1b Output aggregation

The way in which output is treated has been revised. The HairStudio program that was provided with HAIR2010 has been replaced with the HairOutputViewer in the 2014 version of HAIR. The HairStudio program is no longer supported and is not compatible with output generated by HAIR2014.

In this section the aggregation procedure for the calculated risk indicators and the loads to surface water is described as an example. Upon loading the detailed output file, the HairOutputViewer takes two aggregation steps;

1. From detailed results per application gridcell combination to one row with regional average results per application.
2. From the average results per application to one row with overall results per compound per year.

Step 1 involves the aggregation over space within the region and is automatically executed when the user opens the detailed output file with the HairOutputViewer. The results are written to an additional, regional output file. The regional output file contains one row with results for each application processed. The procedure is described here for the loads towards surface water and for the risk indicators.

#### Step 1 – From detailed results per gridcell to results per application

The load in the region resulting from one application equals the sum of the loads per gridcell;

$$RL_{drift} = \sum_{j=1}^N (L_j) A_j \tag{Eq. A}$$

- RL<sub>drift</sub> load in the region (kg)
- N the number of gridcells with results in the detailed output file (-)
- L<sub>j</sub> load in the gridcell resulting from one application (kg ha<sup>-1</sup>)
- A<sub>j</sub> area treated in the gridcell (ha)

j index for the gridcell

The loads in the region are written to the new regional output file. These loads are expressed in kg. Equation A applies to the load by spray drift, the load by run-off, the load by erosion, and the total load towards surface water.

The application rate is read from the detailed output file and converted into the volume applied per region. In addition, the area treated in the gridcell is read from the detailed output file and the area treated in the region is written to the regional output file.

The area-weighted, average risk indicator in the region resulting from the application is calculated according to;

$$RRI = \frac{\sum_{j=1}^N RI_j A_j}{A_{region}} \quad \text{Eq. B}$$

RRI average risk indicator in the region, per unit area of agricultural land (-)  
RI<sub>j</sub> risk indicator in the gridcell, per unit area of agricultural land (-)  
A<sub>j</sub> area treated in the gridcell (ha)  
A<sub>region</sub> area treated in the region (ha)  
N number of gridcells with results  
j index for the gridcell

The area treated in the region is part of the application definition and is stored in the Usage database.

### **Step 2 – From results per application to results per compound per year**

In Step 2 the sum is calculated for all applications of a compound within one year;

- the volume applied,
- the loadings towards surface water, and
- the average risk indicator outcomes.

The results of this step are summarized into one row per compound.

$$TL = \sum_{k=1}^N RL_k \quad \text{Eq. C}$$

TL total load (kg)  
RL regional load for one application (kg)  
N the number of applications of a compound in one year (-)  
k index for the application

$$TRI = \sum_{k=1}^N RRI_k \quad \text{Eq. D}$$

TRI overall risk indicator (-)  
RRI<sub>k</sub> average risk indicator, per unit area of agricultural land (-)  
N the number of applications of a compound in one year (-)  
k index for the application

The results of this second step are suitable for deriving trends; the Summary report function in the HairOutputViewer (Section 4.3.1) shows the trend based on all applications of a compound in the first year and in the last year of the calculation period.

The user can select summary output files from different cases and append these into one file (Section 4.3.3).

The user may decide to develop alternative procedures for aggregating results; either starting with the results in the detailed output or with the results in the regional output file.

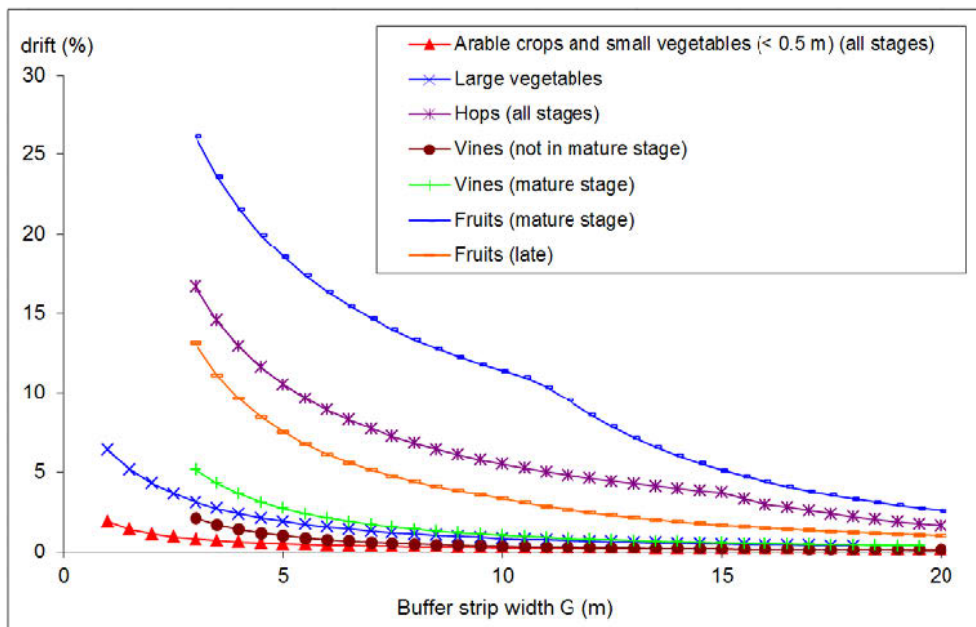
## 2 Errata

Errors were found in some of the equations in the HAIR2010 documentation. The equations given below are intended to repair and replace these equations in the HARI201 documentation. The Equation numbers in this section refer to the HAIR2010 Documentation (Kruijne *et al.*, 2011a)

$$C_{sw,i}(t) = \left( L_{drift}(t_i) + L_{runoff}(t_{i+\Delta t}) + L_{erosion}(t_{i+\Delta t}) \right) e^{-\frac{\ln(2)}{DegT50_{ws}}(t-t_i)} \frac{W}{Wd - d^2} 0.1 \quad \text{Equation 29}$$

$C_{sw,i}(t)$	concentration in the surface water at day t, caused by application event i at $t_i$ ( $\text{mg L}^{-1}$ )
$L_{drift}(t_i)$	spray drift load function ( $\text{kg ha}^{-1}$ )
$L_{run-off}(t_{i+\Delta t})$	run-off load function ( $\text{kg a.i. ha}^{-1}$ )
$L_{erosion}(t_{i+\Delta t})$	erosion load function ( $\text{kg a.i. ha}^{-1}$ )
$DegT50_{ws}$	degradation half-life of the compound in water sediment (d)
t	time (d)
$\Delta t$	time interval between the application event and the erosion event (= 3 d)
d	standard depth of the surface water body (m)
W	standard width of the surface water body (m)
0.1	conversion factor from ( $\text{kg ha}^{-1} \text{ m}^{-1}$ ) to ( $\text{mg L}^{-1}$ )
i	index denoting the application event number (-)

$$C_{sw,i}(t) = \left( L_{drift}(t) + L_{runoff}(t) + L_{erosion}(t) \right) \frac{W}{Wd - d^2} 0.1 \quad \text{Equation 30}$$



**Figure 9** Drift percentage as a function of buffer strip width  $G$ ; for the combinations of FOCUS drift crop groups and crop development stages in Table 11.

The week number correlates to the day number ( $dn$ );

$$wn = \left| \text{INTEGER} \left( \frac{dn}{7} + 1 \right) - 26 \right| \quad \text{Equation 54}$$

Equation 118 and 120 are not incorrect, but the area treated ( $A$ ) in these equations is not the actual size of the treated area, but assumed to be equal to 1 ha; i.e.  $A = 1$  ha.

$$IE_{operator,acute} = (IE_{mix/load} + IE_{applic}) * \frac{AR * A}{BW_{worker}} \quad \text{Equation 118}$$

- $IE_{operator,acute}$  Internal, acute exposure for operator (mg a.i. person<sup>-1</sup> d<sup>-1</sup>)
- $IE_{mix/load}$  Internal exposure mixer/loader (mg a.i. person<sup>-1</sup> d<sup>-1</sup>)
- $IE_{applic}$  Internal exposure applicator (mg a.i. person<sup>-1</sup> d<sup>-1</sup>)
- $AR$  Application rate (kg a.i. ha<sup>-1</sup>)
- $A$  Area treated (= 1 ha)
- $BW_{worker}$  Body weight worker (kg)

$$IE_{operator,chronic} = \frac{n}{DaysPerYear} * (IE_{mix/load} + IE_{applic}) * \frac{AR * A}{BW_{worker}} \quad \text{Equation 120}$$

- $IE_{operator,chronic}$  Internal, chronic exposure for operator (mg a.i. person<sup>-1</sup> d<sup>-1</sup>)
- $n$  number of application events (-)
- $DaysPerYear$  number of days in a year (= 365)
- $IE_{mix/load}$  Internal exposure mixer/loader (mg a.i. person<sup>-1</sup> d<sup>-1</sup>)
- $IE_{applic}$  Internal exposure applicator (mg a.i. person<sup>-1</sup> d<sup>-1</sup>)
- $AR$  Application rate (kg a.i. ha<sup>-1</sup>)
- $A$  Area treated (= 1 ha)
- $BW_{worker}$  Body weight worker (kg)



## Annex 4 Known issues

The list of known issues in the HAIR2010 software version 1.0, published in the HAIR2010 software manual Annex 3 (Vlaming *et al.*, 2011) was extended with the feedback from participants of the HAIR2010 Risk Indicators workshop in Wageningen, January 12-13, 2012 and from other users. The known issues were also reviewed by Jörn Strassemeier, Julius Kühn-Institut (JKI), Federal Research Centre for Cultivated Plants, Institute for Strategies and Technology Assessment, Germany.

This list with known issues was used to prioritize activities related to maintenance and new developments towards the new release HAIR2014.

**Table 4.1**

*Solved issues in HAIR2014 release (HD = HAIR2010 Documentation).*

Item Nr.	Date	Component	Type	Description
2	07/01/2012	HAIR	Issue	Selection of start and end year.
4	10/01/2012	HAIR	Issue	All risk indicators are calculated per unit area of agricultural land (HD, Section 7.2). However, both the acute and chronic operator indicator are multiplied with the area treated.
5	13/01/2012	HAIR	Issue	The drift curves in HAIR are valid at distance $G > G_{min}$ (with $G_{min} = 1$ or $3$ m). The procedure described in the HD Section 3.2.2 is not correctly implemented. If the Usage db contains a data row with the buffer strip width $G = 0$ m, the load by spray drift in the output file = $0$ kg. The input $G = 0$ m is out of range. So, the HAIR programme should replace this input value with $G_{min}$ .
9	13/01/2012	HAIR	Issue	At some laptop computers the layout /content is not fully displayed within a dialog box (Case definition, Save case). Screen resolution settings?
13	13/01/2012	HAIR	Issue	Compound x status: Legend title (HTML) not correct
23	04/11/2012	HAIR	Issue	Do range check on compound properties to avoid e.g. division by zero.
25	08/01/2013	HAIR	Issue	Aquatic indicators, load by drift: Replace the term $d/(Wd-d^2)$ in HD Eq. 29/30 with $W/(Wd-d^2)$ .
26	08/01/2013	HAIR	Issue	Aquatic indicators, load by run-off: Correct the $wn$ calculation (Eq. 54).
32	08/01/2013	HAIR	Issue	Resident chronic indicator (HD Eq. 174). Check for small differences between 2 gridcells.
33	08/01/2013	HAIR	Issue	Correct implementation of rules for sorption parameters in the Compound db. E.g. when $pH\_dependent\_soption = .True.$ , a missing values for $pKa$ should not be accepted. See also Annex 4.
36	09/01/2013	HAIR	Issue	In the detailed output file header the unit specification " $\_ha$ " is not correct. This should be " $\_kg\_ha$ ".
37	23/01/2013	HAIR	Issue	Load_runoff_kg should not contain negative output. The minimum value = $0.0$ . The same for Load_erosion, if relevant.
7	13/01/2012	HAIR	Request	All indicators: Make the risk indicators selectable in order to decrease the runtime and the amount of output.
8	12/01/2012	HAIR	Request	Post-processing (Aggregation): Copy the area treated in the region (part of the Usage db) to the detailed output file (CSV) in order to facilitate post-processing aggregation procedures based on the treated area fraction.
31	08/01/2013	HAIR	Request	Prepare for additional loads to surface water (entry routes drainpipe, greenhouses, losses from farm yards)
45	24/01/2013	HAIR	Request	Place output by default in folder named after project
30	08/01/2013	HAIR/DB	Request	Move map related data to separate Geo db.
16	12/01/2012	HOV	Issue	Display of result values (e.g. $5.0E18$ ) corrected
17	12/01/2012	HOV	Issue	Drift Mitigation Factor should show decimals.
22	05/02/2012	HOV	Issue	Selected record count over estimated by 1
41	24/01/2013	HOV	Issue	HOV access violation (when a 2 <sup>nd</sup> file is opened)
29	08/01/2013	HOV	Request	Aggregation procedure for output. (Regional, Summary)
11	10/01/2012	HD	Issue	HD, Figure 9, the symbol W must be replaced with G

**Table 4.2**

*Open issues in HAIR2014 and feature request for a next release.*

Item Nr.	Date	Component	Type	Description
15	12/01/2012	HAIR	Issue	Sometimes crop and compound lists are empty during case definition. Workaround; save and restart. Cannot yet duplicate.
19	05/02/2012	HAIR	Issue	Can sometimes not close HAIR in normal way. Cannot duplicate.
24	07/01/2013	HAIR	Request	Move the Ganzelmeier function parameters and some other data tables from the source code to the dbHAIR. Aquatic: HD Table 11 (A,B,C,D,H), T12 (CN), T14 (usleLS), T17 (usleK).
6	13/01/2012	HAIR	Request	Aquatic indicators: Make the emission pathways selectable in order to make a better agreement between the relevant emission pathways in a MS and the processes considered in the model.
18	12/01/2012	HAIR	Request	Speeding up of calculation by optimization and profiling
27	08/01/2013	HAIR	Request	Aquatic indicators, load by run-off: $P_{event} = 30$ mm is now a fixed value. Jörn: It might be better to relate $P_{event}$ to the monthly precipitation. In SYNOPS e.g. $P_{event} = P_{month}/3$ . This was suggested by the HAIR consortium but not reported in the original HAIR 2007 documentation.
28	08/01/2013	HAIR	Request	Aquatic indicators, load by erosion: Jörn: In SYNOPS the user can switch off the factor $f_2$ (HD Eq. 50) for the buffer zone. Maybe it makes sense to include this option in HAIR (e.g. no densely covered buffer zone, but distance for drift function).
38	24/01/2013	HAIR	Request	Implement range check for the Usage db
34	08/01/2013	HAIR/DB	Request	Replace map for the SCS hydrological soil group according to procedure described at the end of the document. This map is ready and could be easily implemented in HAIR. The map is available as 1*1 km or 10 *10 km grid.
35	09/01/2013	HAIR/DB	Request	Move function parameters and some other data tables from the source code to the HAIR db. Workers and bystanders: T28 (Recovery values), T33 (drift?).
43	24/01/2013	HAIR/DB	Request	Booleans in Compound db according to the HD (replaces the Y/N and 0/1)
12	12/01/2012	HOV	Issue	I/O Error in HOV due to the output file open in Excel. Catch this situation.
44	24/01/2013	HOV	Request	Aggregation Step 2: Use the regional output in the Summary report function.

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# Annex 5 Input Example case Finland

## **Contents**

- Table 5.1 regional applications for glyphosate
- Table 5.2 regional applications for MCPA
- Table 5.3 crop area per region
- Table 5.4 soil texture class
- Table 5.5 hydrological soil group
- Figure 5.1 Soil and climate property maps
- Table 5.6 compound data

## **Usage Database**

The Usage database dbUSAGE\_FI\_2007 contains applications for two herbicides and two spring cereals (Tables 5.1 and 5.2).

The area grown per region is shown in Table 5.3, for seventeen annual crops according to (Hiederer 2012).

## **Geographical Database**

The Geographical database dbGEO\_FI\_JRC\_MTT contains crop maps and soil- and climate data based on the EFSA Spatial dataset version 1.1 (Hiederer, 2012). The slope map was provided by MTT Finland.

The conversion of the soil texture class is shown in Table 5.4 and the conversion of the hydrological soil group is shown in Table 5.5.

Soil property maps are included for topsoil organic carbon (%), soil organic carbon in the layer 0-1 m (%), soil pH, the hydrological soil group, the soil texture class, and the average slope (%) (Figure 5.1).

Climate property maps are included for the mean annual temperature (°C) and the mean annual precipitation (mm) (Figure 5.1).

## **Compound Database**

The Compound database dbCOMPOUND\_FP2013\_NMI3 contains a record for glyphosate and for MCPA, with physico-chemical properties and fate parameters based on Dutch registration dossiers (ref. NMI 3 / EDG2010) and most toxicity from FootPrint database (version received at July 2013).

Table 5.1

Regional use data: applications of glyphosate in Application crops spring barley and spring wheat (based on Table 6 in Räsänen et al., 2013). The area grown is based on spatial data from JRC (Hiederer, 2012). The volume applied is added for reference (no input).

Region ID	Compound name	Application rate (kg ai/ha)	Application date	Treated area (%)	Application ID	Area grown (ha)	spring barley			spring wheat		
							Area treated (ha)	Volume applied (tonnes)	Application ID	Area grown (ha)	Area treated (ha)	Volume applied (tonnes)
ELY_1	glyphosate	0.68	2-5-2007	6.6	1	50731	3348	2.3	39	48455	3198	2.17
ELY_2	glyphosate	0.97	12-5-2007	3.8	2	85215	3238	3.1	40	72483	2754	2.67
ELY_3	glyphosate	0.83	9-5-2007	7.7	3	39015	3004	2.5	41	2667	205	0.17
ELY_4	glyphosate	1.01	27-4-2007	2.1	4	56014	1176	1.2	42	4665	98	0.10
ELY_5	glyphosate	1.08	14-7-2007	2.7	5	37985	1026	1.1	43	3174	86	0.09
ELY_6	glyphosate	0.18	10-5-2007	7.9	6	35623	2814	0.5	44	6978	551	0.10
ELY_7	glyphosate	1.01	26-5-2007	13	7	6907	898	0.9	45	4	1	< 0.01
ELY_10	glyphosate	1.1	15-5-2007	9.9	8	15372	1522	1.7	46	283	28	0.03
ELY_11	glyphosate	0.96	29-5-2007	1.9	9	61365	1166	1.1	47	2150	41	0.04
ELY_13	glyphosate	0.66	31-5-2007	7.7	10	54366	4186	2.8	48	129	10	0.01
ELY_1	glyphosate	1.21	26-9-2007	7.6	11	50731	3856	4.7	49	48455	3683	4.46
ELY_2	glyphosate	1.19	17-9-2007	6.6	12	85215	5624	6.7	50	72483	4784	5.69
ELY_3	glyphosate	1.2	16-9-2007	18	13	39015	7023	8.4	51	2667	480	0.58
ELY_4	glyphosate	1.26	8-9-2007	12	14	56014	6722	8.5	52	4665	560	0.71
ELY_5	glyphosate	1.11	22-9-2007	16	15	37985	6078	6.7	53	3174	508	0.56
ELY_6	glyphosate	1.02	22-9-2007	7.9	16	35623	2814	2.9	54	6978	551	0.56
ELY_7	glyphosate	1.44	25-9-2007	3.3	17	6907	228	0.3	55	4	0	< 0.01
ELY_8	glyphosate	0.98	5-9-2007	7.8	18	15536	1212	1.2	56	680	53	0.05
ELY_9	glyphosate	1.31	23-9-2007	4.1	19	11307	464	0.6	-	0	-	-
ELY_10	glyphosate	1.63	21-9-2007	10	20	15372	1537	2.5	57	283	28	0.05
ELY_11	glyphosate	1.07	16-9-2007	4.9	21	61365	3007	3.2	58	2150	105	0.11
ELY_12	glyphosate	1.34	16-9-2007	4.9	22	62092	3042	4.1	59	3313	162	0.22
ELY_13	glyphosate	1.21	26-9-2007	12	23	54366	6524	7.9	60	129	15	0.02
ELY_14	glyphosate	1.8	28-9-2007	5.2	24	17863	929	1.7	61	243	13	0.02

**Table 5.2**

*Regional use data: applications of MCPA in Application crops spring barley and spring wheat (based on Table 6 in Räsänen et al., 2013). The area grown is based on spatial data from JRC (Hiederer, 2012). The volume applied is added for reference (no input).*

Region ID	Compound name	Application rate (kg ai/ha)	Application date	Treated area (%)	Application ID	Area grown (ha)	spring barley			spring wheat		
							Area treated (ha)	Volume applied (tonnes)	Application ID	Area grown (ha)	Area treated (ha)	Volume applied (tonnes)
ELY_1	MCPA	0.38	11-6-2007	50	25	50731	25365	9.6	62	48455	24227	9.21
ELY_2	MCPA	0.32	7-6-2007	56	26	85215	47720	15.3	63	72483	40591	12.99
ELY_3	MCPA	0.6	8-6-2007	60	27	39015	23409	14.0	64	2667	1600	0.96
ELY_4	MCPA	0.54	8-6-2007	35	28	56014	19605	10.6	65	4665	1633	0.88
ELY_5	MCPA	0.77	11-6-2007	47	29	37985	17853	13.7	66	3174	1492	1.15
ELY_6	MCPA	0.46	14-6-2007	52	30	35623	18524	8.5	67	6978	3629	1.67
ELY_7	MCPA	0.7	18-6-2007	34	31	6907	2349	1.6	68	4	1	< 0.01
ELY_8	MCPA	0.7	22-6-2007	32	32	15536	4972	3.5	69	680	218	0.15
ELY_9	MCPA	0.62	24-6-2007	36	33	11307	4071	2.5	-	0	-	-
ELY_10	MCPA	0.66	16-6-2007	37	34	15372	5687	3.8	70	283	105	0.07
ELY_11	MCPA	0.73	13-6-2007	55	35	61365	33751	24.6	71	2150	1182	0.86
ELY_12	MCPA	0.71	20-6-2007	30	36	62092	18627	13.2	72	3313	994	0.71
ELY_13	MCPA	0.6	25-6-2007	51	37	54366	27727	16.6	73	129	66	0.04
ELY_14	MCPA	0.47	30-6-2007	5.7	38	17863	1018	0.5	74	243	14	0.01

Table 5.3

The area grown (ha) per region in Finland except Lapland. Seventeen annual crops according to (Hiederer 2012). Crop map codes according to HAIR2014 (HAIR2010 Documentation, Annex 4)

Region code	BARL	FLOW	LFALL	LMAIZ	LRAPE	LTEXT	OATS	OCER	OFAR	OIND	OVTO	POTA	PULS	RYEM	SUGB	SUNF	SWHE
ELY_0	1363	0	917	0	26	0	2071	82	3780	0	612	735	46	232	1056	0	1450
ELY_1	50731	19	22074	19	8322	389	26554	241	30499	296	1190	738	2271	8715	2720	98	48455
ELY_2	85215	30	27897	9	8701	417	29568	1234	23434	242	3011	2249	2718	10314	12351	74	72483
ELY_3	39015	0	12232	0	2387	40	39845	306	19957	67	2230	4078	601	3382	5956	7	2667
ELY_4	56014	10	15374	0.1	5541	182	33581	273	31419	356	1149	1817	500	4140	5763	1	4665
ELY_5	37985	10	13857	0	5413	79	46706	209	44313	153	767	1236	968	4585	1098	11	3174
ELY_6	35623	10	14407	0.08	3736	132	32903	81	36004	53	605	801	839	3876	609	20	6978
ELY_7	6907	1	3709	0	103	90	6208	0	37912	149	326	186	132	323	139	0	4
ELY_8	15536	6	8358	0	479	152	19481	0	75742	325	1497	854	223	1460	301	0	680
ELY_9	11307	4	4596	0	335	95	19060	0	48298	212	1052	599	140	1025	196	0	0
ELY_10	15372	20	7499	0	1336	20	15798	11	42943	200	330	393	94	1253	1	0.03	283
ELY_11	61365	0	21075	0	8823	569	60032	79	67997	99	443	7938	445	1950	405	0	2150
ELY_12	62092	0	10781	0	4643	280	31936	27	60490	199	702	5993	1133	1127	1023	0	3313
ELY_13	54366	0.03	12228	0	1869	319	27934	30	94312	69	455	3939	251	1348	1	0	129
ELY_14	17863	1	664	0	43	43	3854	0	13111	70	134	79	63	130	65	0	243
Total	550754	112	175669	28	51757	2805	395529	2573	630211	2491	14503	31634	10424	43860	31686	211	146674

**Table 5.4**

Soil texture class in dbGEO Table SOIL with the number of 1 sqkm gridcells covering Finland excluding Lapland (according to Hiederer, 2012)

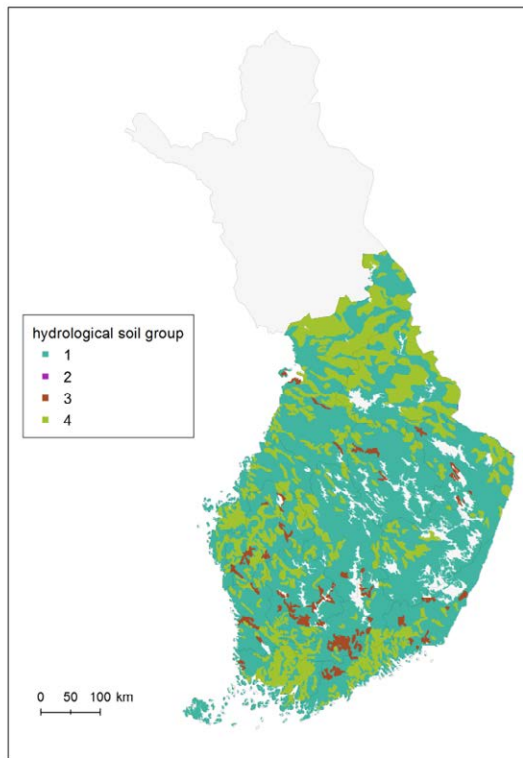
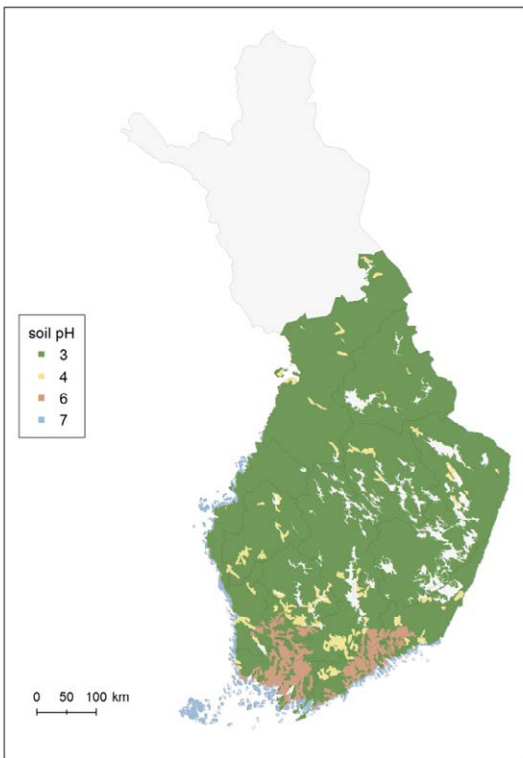
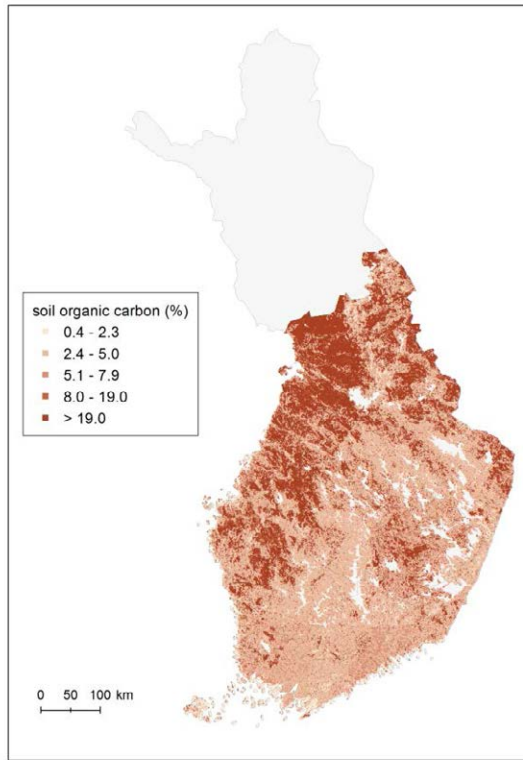
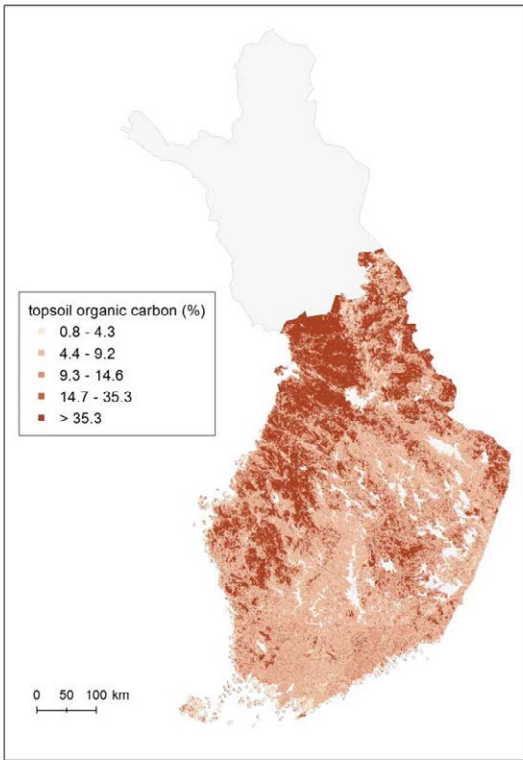
Soil texture class	Number of cells	Texture	
1	156282	Coarse	< 18% clay and > 65% sand
2	19	Medium	18% < clay < 35% and ≥ 15% sand
			< 18% clay and 15% < sand < 65%
3	6053	Medium fine	35% < clay < 60%
4	13328	Fine	clay > 60%
8*	43355	No mineral texture	Peat soils
Total	219037		

\* replaces 9

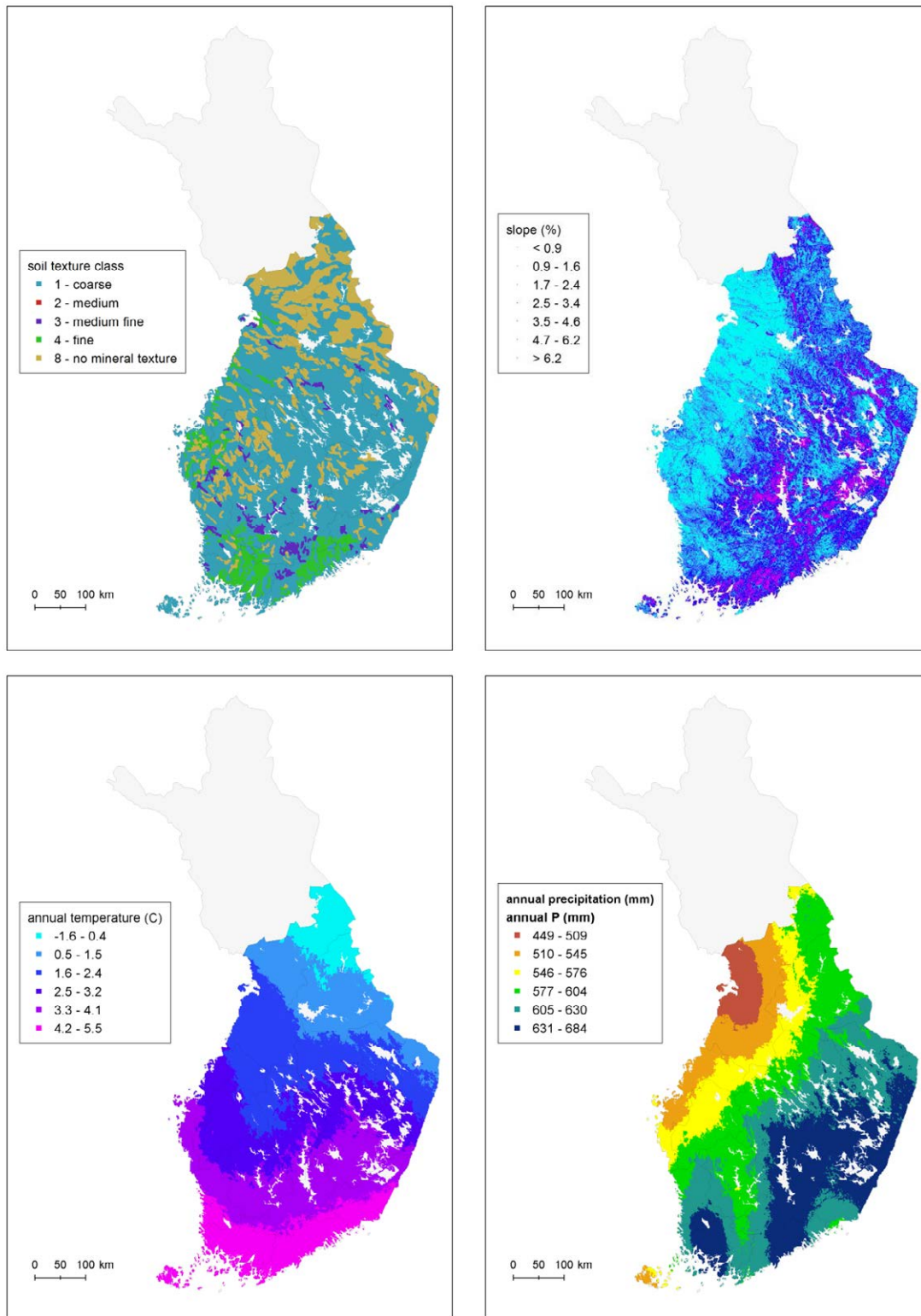
**Table 5.5**

Soil moisture content at field capacity and the Hydrological soil group (dbGEO Table SOIL) with the number of 1 sqkm gridcells excluding Lapland (according to Hiederer, 2012).

Theta_fc	HYDROSOILGROUP	Number of cells	(%)
0.24	1	156282	71.3
0.35	2	19	0.0
0.38	3	6053	2.8
0.45	4	56683	25.9
0.67		219037	100.0







**Figure 5.1** Soil and climate property maps: Topsoil organic carbon (%), soil organic carbon in the layer 0-1 m (%), soil pH, hydrological soil group, soil texture class, average slope (%), mean annual temperature (°C) and mean annual precipitation (mm).

**Table 5.6**

Compound properties (see the Hair2010 Documentation Table 5 for explanation of field names). -9999 denotes "not applicable".

Field name	glyphosate	MCPA
Compound nr	1	2
Compound ID	1	2
Compound name	glyphosate	MCPA
CAS nr	1071-83-6	94-76-6
Chemical class	glycine derivat	aryloxyalkanoic acid
Chemical use	herbicides	herbicides
DegT50 soil (d)	17	21.7
DegT50 water sediment (d)	23	20.6
pH dependent sorption	0	1
Kom base (L/kg)	-9999	14.5
Kom acid (L/kg)	-9999	91.1
Kom (L/kg)	13050	-9999
LogKow (-)	-2.8	-0.71
MolMass (g/mol)	169.07	200.62
pKa (-)	7	3.73
Pvap (mPa)	0.00681	0.12
Solubility (mg/L)	10.2	462380
AOEL (mg ai/kg bw)	0.2	0.04
LC50 algae (mg ai/L)	4.4	79.8
LC50 daphnia (mg ai/L)	40	190
LC50 earthworm (mg ai/kg dw)	480	325
LC50 fish (mg ai/L)	38	50
LD50 bee (ug ai/bee)	100	200
LD50 bird acute (mg ai/kg bw)	2000	234
LD50 mammal acute (mg ai/kg bw)	2000	962
NOEC algae (mg ai/L)	2	60
NOEC daphnia (mg ai/L)	30	50
NOEC earthworm (mg ai/kg dw)	28.8	84.9 <sup>a</sup>
NOEC fish (mg ai/L)	25	15
NOED bird chronic (mg ai/kg bw)	4640	983
NOED mammal chronic (mg ai/kg bw)	150	60
Insect Growth Regulator	0	0
Systemic Effect	0	0

\*) median value (NMI 3 / EDG2010)

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## Annex 6 Regionalisation and shapefiles

The regionalization in HAIR2014 may be adapted to the pesticide usage data available. Two separate shapefiles with regions and countries need to be present in the \shape folder, at least covering the geographical area of interest. The specifications of these ESRI® shapefiles are given in this annex. The Hair2014 software package includes an example at European scale level and one at national scale level.

Note that the shape of a region has to be completely inside the shape of a single country. The number of regions within a country is equal to, or larger than one. The attribute table of the shapefiles must contain the fields listed in Tables 6.1 and 6.2; additional fields (e.g. surface area) may be present too. The attribute table of the REGION shapefile contains one row for each region and the attribute table of the COUNTRY shapefile contains one row for each country.

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**Table 6.1**

*Mandatory fields in the attribute table of shapefile REGION*

Field name	Data type
FID	Object ID
Shape	Geometry
REGION	Text
NAME	Text

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**Table 6.2**

*Mandatory fields in the attribute table of shapefile COUNTRY*

Field name	Data type
FID	Object ID
Shape	Geometry
COUNTRY	Text
NAME	Text

When a region is selected, the program will select all rows in dbGEO Table BASE with the REGION code equal to the text in the REGION field of the shapefile. When a country is selected, the same applies to all regions inside that country. Note that a match of these text fields is case sensitive.

When the REGION code is not present in Table BASE, the program writes a message to the log. Data rows in Table BASE with a REGION code that is not present in the attribute table of the REGION shapefile can't be selected for calculations.

In case only national average usage data are available, no regionalisation needs to be used in HAIR2014. Nevertheless, both the REGION and COUNTRY shapefiles need to be present in the \shape folder. A single region covering the entire country needs to be defined with the shape of the country. Although the shapes in this case are equal, the attribute tables of both shapefiles are not the same.

It is recommended to store the shapefiles of additional regionalisations in a new subfolder of the \shape folder. The HAIR2014 software package includes a \EU\_10K subfolder with the shapefiles of Example Case 1 (Section 5.1) and a \FI subfolder with the shapefiles from Example Case 2 (Section 5.2).

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Alterra Wageningen UR  
P.O. Box 47  
6700 AA Wageningen  
The Netherlands  
T +31 (0)317 48 07 00  
[www.wageningenUR.nl/en/alterra](http://www.wageningenUR.nl/en/alterra)

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Alterra Wageningen UR  
P.O. Box 47  
6700 AB Wageningen  
The Netherlands  
T +31 (0) 317 48 07 00  
[www.wageningenUR.nl/en/alterra](http://www.wageningenUR.nl/en/alterra)

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