MapEIre – User manual

User manual for the MapEIre model system

Academic report from the Department of Environmental Science

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Summary	This report describes the MapEIre model, which is a prepared by Department of Environmental Science (ENVS) at Aarhus University (AU), Denmark as part of the project National mapping of GHG and non-GHG emissions sources (MapEIre), which is funded by the Irish EPA and is part of the Environmental Protection Agency Research Call 2015 on Climate - Air Science under the EPA Research Programme 2014-2020. The report documents the methods behind the model and the specifications for the model, and serves as a guide for users of the model
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Contents

Introduction

This report describes the MapEIre model, which is a prepared by Department of Environmental Science (ENVS) at Aarhus University (AU), Denmark as part of the project National mapping of GHG and non-GHG emissions sources (MapEIre), which is funded by the Irish EPA and is part of the Environmental Protection Agency Research Call 2015 on Climate - Air Science under the EPA Research Programme 2014-2020. The report documents the methods behind the model and the specifications for the model, and serves as a guide for users of the model.

The MapEIre model provides a high spatial resolution of Irish emissions, including all sectors and pollutants in the national inventories of GHG and non-GHG emissions due to Ireland's legal agreements under the CAFÉ Directive, the Convention on Long Range Transboundary Air Pollution (CLRTAP) and the UN Framework Convention on Climate Change (UNFCCC). Reporting of spatial emissions is a requirement under CLRTAP, and the output of the MapEIre model is consistency with the national emission inventory and meets the requirements for reporting of to CLRTAP. But the MapEIre model takes the emission mapping at step further through a higher spatial resolution (1 km x 1 km vs. 0.1 degree x 0.1 degree) and a more disaggregated sectoral level (nomenclature for reporting, NRF vs. gridded nomenclature for reporting, GNFR), than the CLRTAP requirements. Further, the MapEIre model include a module for temporal distribution of emissions. The temporal model follow the methodology in the EMEP model, and the temporal profiles follow the format corresponds to EMEP's temporal profiles.

The MapEIre model is an integrated database system, and the different modules and their specifications and interrelationships are described in this report. The spatial distribution of emissions is based on a number of geographical distribution keys (GeoKeys), which are sector specific tables that holds information on the share of the total sectoral emission to be allocated to the individual grid cells. Most GeoKeys are prepared in a Geographical Information System (GIS) using overlay analysis and data management functionality, while GeoKeys for sectors only covering point sources are created from emission inventory data in spreadsheets or databases. The temporal distribution of emissions is based on temporal profiles (TKeys), which are sectoral tables that holds information on the share of the sectoral emission to be allocated by time intervals. The model include three temporal resolutions, i.e. monthly, daily and hourly, and following, three separate TKeys are prepared for each sector. TKeys are based on temporal production and consumption statistics, and on assumptions for sectors where temporal data are not available.

This report guides the user through the model system in four parts;

- Chapter one describes the system requirements for hosting, setting up, and running the MapEIre model
- Chapter two describes the workflow for mapping of emissions; import of emissions from the inventory, managing GeoKeys, running calculations, and generating outputs
- Chapter three describes spatial definitions and development of GeoKeys
- Chapter four describes the temporal model and the TKeys

1 System requirements

To be able to install and use the MapEIre model, the following requirements needs to be fulfilled;

- MS Excel and MS Access must be installed on the PC
- The user needs basic understanding of MS Access 2013, MS Excel 2013
- The user must have access to a file share with the MapEIre files
- The user must have access to the database *MapEIre* on an MS SQL server version 2016 or newer

The individual parts of the setup of the MapEIre system is described in detail in the following chapters.

1.1 Setup of the MapEIre system

The system can be setup in different ways; for demo or for production, and for one user or for more than one user. The choice of setup depends on the environment that is going to use the model. This user guide describes a system as setup for one person on one PC. See the Annex 1 for further information on other installation and setup options.

1.1.1 Database system

The *MapEire* database is installed on a MS SQL Server 2016 or newer.

1.1.2 Files

All files of the MapEIre model is stored in the folder *MapEIre*, covering documentation files, data files, and program files.

The user access the model from programs made in MS Access and the programs updates the database backend on MS SQL Server.

The MapEIre system include the following program files with the listed functions:

- ***NFR_Importer;*** a MS Access database used for import of data from the NFR reporting tables
- ***CRF_Importer***, a MS Access database used for import of data from the CRF reporting tables
- ***GeoKeys_Final_To_model***, a MS database that stores all GeoKeys used for calculation of spatial emissions
- ***GKey_Manager;*** a MS Access database used to manage GeoKeys and for calculation of spatial emissions

- ***QC;*** a MS Access database for data quality control
- ***MapEIre_Reporting;*** a MS Access database used for calculation of emissions for reporting to the UNECE LRTAP convention
- ***MapDatebasesMake;*** a MS Access database for making map data to be used in GIS like ESRI ArcMap
- ***TempMapEIre***; a MS Access database for calculation temporal emission for a user defined subset of the spatial emissions
- *Ireland_Dimensions_dw;* a MS Access database containing definitions of Sectors, Pollutants, Grid cells and Years
- *GeoKeys_Final_To_model*; a MS Access database containing GeoKeys
-

The table below shows the interactions between programs and the databases.

Access frontends/ SQL Server backend tables	**MapEIre.Dbo.- FactEmission**	**MapEIre.Dbo.- FactGEmission**
CRF_Importer.accdb	link, delete, insert into	
NFR_Importer.accdb	link, delete, insert into	
Gey_Key_manager.accdb	Link, select	link, delete, insert into
QC.accdb	Link, select	Link, select
MapEIre_Reporting.accdb		Link, select
MapDatabasesMake.accdb		Link, select
TempMapEIre.accdb		Link, select
GeoKeys_Final_To_model.mdb	no	No
Ireland_Dimensions_dw.accdb	no	no

2 Workflow for the spatial model

The spatial model in the MapEIre system covers the following steps;

- Import of emissions data from the CRF reporting tables and from the NFR reporting tables have to be done every year
- Update of the GeoKeys if new data become available that allow for improvement of the spatial distribution
- Calculation of spatial emissions
- Export of the resulting spatial emissions as different reports and datasets

The workflow in the spatial model is described in detail in the following chapters, covering the individual steps in the model run.

2.1 Importing emission data

The spatial model uses emissions data from the official Irish national emissions inventories for air pollution and for greenhouse gases, in agreement with the reporting's to the LRTAP convention in the NFR format and to the UNFCCC in the CRF format. The emission inventories are updated annually for the time series, and following the emissions data used in the MapEIre model should be imported every year to ensure consistency between the national total emissions and the spatial emissions.

2.1.1 Importing the CRF data

MapEIre uses emission data from the CRF tables. The import is done in the Access database *CRF_Importer*. If there have been changes to the CRF reporting variables, e.g. new variables, since the last import, refer to Chapter New CRF Variables2.1.1.2 for further information before running the import procedure described below.

It is possible to add only a new year, or to delete the old data and import all years in the time series. The latter is relevant if there have been changes in emissions time series in CRF tables.

2.1.1.1 Import of data

For each year that shall be imported to the model, the following procedures must be carried out:

1. Copy the CRF reporting table Excel spreadsheets to the folder *…MapEIre/ModelSystem/Inputdata/CRF* with the filename format *IRL_xxxx_yyyy*, where xxxx is the submission year and yyyy is the emission year
2. Open the file *CRF_macro.xlsm* in the folder *…MapEIre/ModelSystem/Inputdata/CRF*

3. Open the CRF reporting table in Excel
4. Select the Developer tab in the Excel Menu
5. To display the Developer tab, click on the File menu and select Options from the drop down menu. When the Excel Options window appears, click on the Customize Ribbon option on the left. Click on the Developer checkbox under the list of Main Tabs on the right. Then click on the OK button
6. Select Macros and run the macro named *Traverse_GetValues*
7. Click OK to save a .csv file in the same folder as the CRF Reporting table.
8. Repeat from Step 3 for every year you want to import.

Start MS Access

Open *CRF_Importer.mdb* from the folder *…\\MapEIre\ModelSystem\Program-Files*

Before an import of CRF data for all years in the time series, the old data in table *dbo_FactEmissions* in the database have to be deleted. The procedure to delete all data from CRF in the table *dbo_FactEmissions* is as follows;

- Run the query *qdbo_FactEmission_DeleteDataFromCRF*

Adding the data from Excel

1. For every year to import
   a. If the table *Cel_values* exist, then delete it
   b. Select External data, select Text file, browse to the folder *…MapEIre/ModelSystem/Inputdata/CRF*, and import the file *IRL_xxxx_yyyy.xlsx.cel_values.csv*. Make sure that the settings are correct for the field separator (,) and the decimal separator (.) in the file. A primary key is not needed in the import wizard. *Field2* holds both text and numeric values
   c. Rename the imported table to *Cel_values*
   d. Run the query *dbo_FactEmission_AppendCRF*. Enter the submission year of the import when inquired
2. Repeat the procedure above for all years in the time series

Note: Some text strings from CRF category names exceed the 255 character limitation of the shot text datatype, but as only the numeric values are used in the system, this does not cause any problems.

2.1.1.2 New CRF Variables

If new CRF variables has been added into the CRF Reporter since the last MapEIre model run, these have to be added to MapEIre.

If a new CRF variable, e.g. "Goats", or a new f-gas has been included in the CRF reporting tables, some changes have to be made in the MapEIre model before importing of the CRF data.

The following information is needed for each CRF variable in the excel spreadsheet, which should be imported to MapEIre:

- Sheet name
- Cell reference
- Pollutant name

Important: The user has to select all the emissions sources in table *Table2(II)B-Hs2* ("From manufacturing", "From stocks", and "From disposal") in the *CRF_Variable* table. The import function sum up the three sources to one emission value. It is the user's responsibility not to mix aggregated emissions in *Table2(I)* with disaggregated emissions in *Table2(II)*, and thereby import the emissions more than one time, leading to double counting.

For each new CRF variable, the following procedure must be performed;

- Enter sheet name, cell reference and pollutant name to the table *CRF_Variables* in the *CRF_Importer* database
- Select a sector in the *SectorID* Field

Detailed description on how to find sheet name and cell reference in the CRF tables, and how to import new CRF variables are included in the following chapters.

2.1.1.3 Finding sheet name and cell references

The procedure for finding sheet name and cell reference is described as an example, where a new CRF category named "Goats" has been included in the CRF reporting tables in "Table 3.1 A. Enteric fermentation". Adding this new category will cause creation of (a lot of) variables in CRF reporting tables, even though only the CH_4 and the N_2O variables are relevant to include in MapEIre. You need access to the CRF Reporter for doing this. The workflow below should be followed;

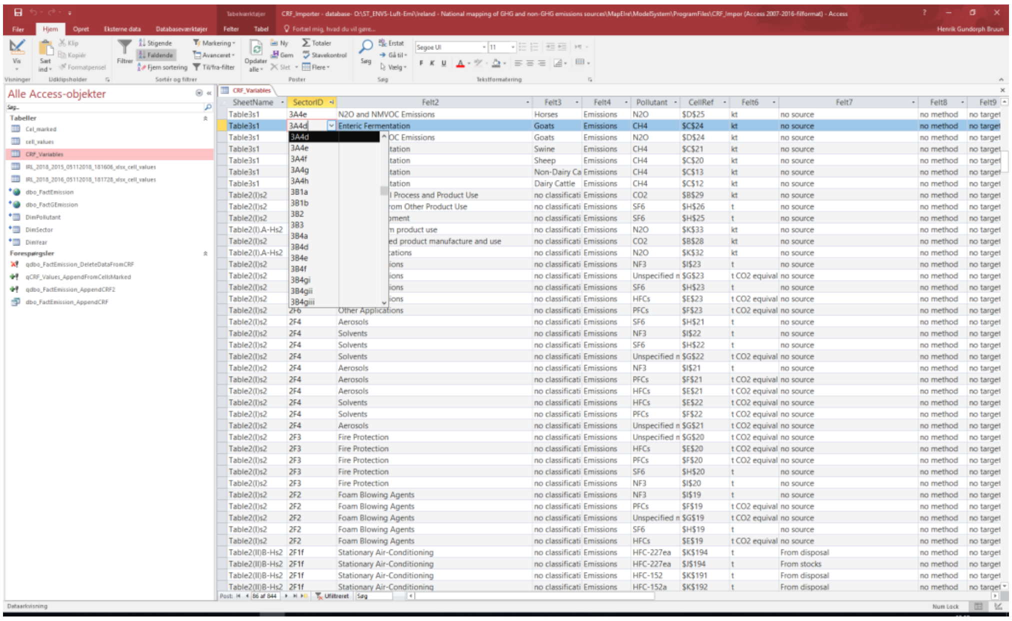
- Download the CRF reporting tables with new variables in CRF Reporter
- On the CRF Reporter website, click on Import/Export, click on Export Reporting tables, and select the variable
- Open the exported excel file, go to the sheet "Table3s1", and find the row "Goats"
- Mark the CH_4 cell and copy the value, e.g.:
  [Enteric Fermentation][Goats][Emissions][CH4][kt][no source][no method][no target][no option][no type] : 7565BBD7-9C8B-4240-AB37-E8974D0FFAE1

- The name of the variable is: [Enteric Fermentation][Goats][Emissions]
- The pollutant is: [CH4]
- The cell reference is: C26
- The Sheet ref is: Table3s1
- Copy the variable name to the field *CRF_Name*
- Copy the pollutant name to the field *Pollutant*
- Copy the cell reference to the field *CelRef*
- Copy the sheet reference to the field *Sheetname*
- Remove all brackets
- Select a sector in the field *SectorID, see Figure 1*

Repeat the workflow for the N_2O variable.

For importing many CRF variables in one process, see Appendix 11

Figure 1 Example of the table *CRF_Variable*



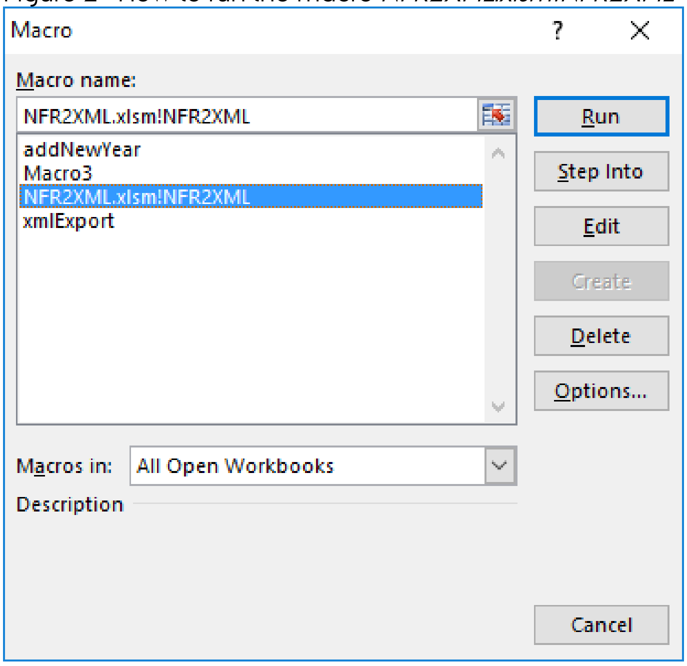
2.1.2 Importing the NFR data

MapElre uses emission data from the NFR reporting tables, which can be imported performing the following steps;

- Copy the NFR table Excel sheet to the folder *...MapElre\Modelsystem\Input\NFR*
- Open the NFR excel worksheet
- Open the excel sheet *NFR2XML*
- Select the NFR Excel sheet

- Select the developer Panel (if not present; select Files>Options>Customize Ribbon, click on Developer in the list to the right. Click OK)
- Select Macros
- Run the *NFR2XML.xlsm!NFR2XML* macro, see Figure 2. It will save the file *NFR.XML* in the same folder as the excel sheet. (It can take some time; > 1o min.)

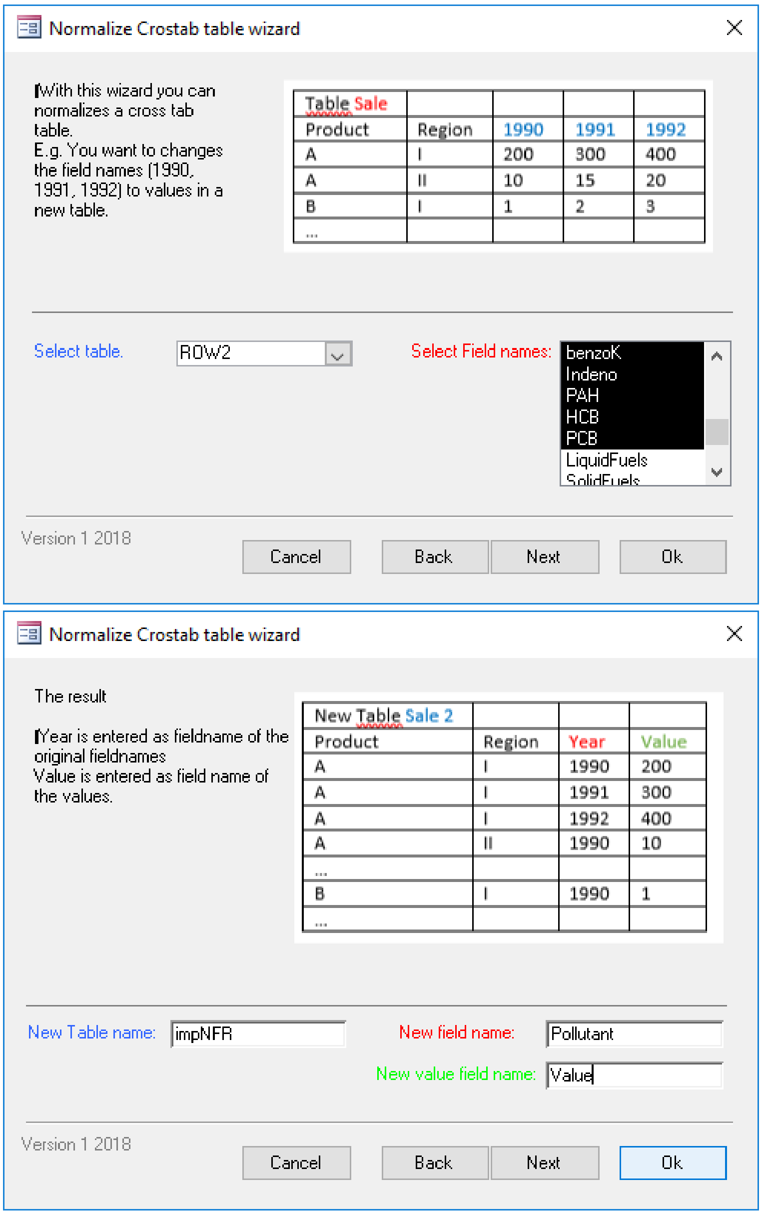
Figure 2 How to run the macro *NFR2XML.xlsm!NFR2XML*



- Open MapEIre/Inputdata/NFR/NFR_Importer.accdb
- Run the macro mcrDelete Old NFR in dbo_FactEmission
- Import the xml file *NFR.xml*
- Select the panel External Data, select the button XML File, browse to the *NFR.xml* file, click OK, select Structure and Data, and click OK
- Open the form *frmCCT*, which is a wizard to make a Converted Crosstab table
- Select the imported table. Select all the pollutants in the list. Click Next, Type "impNFR" as Table, "Pollutant" as New Field name, "Value" as New Value field name, and click OK
- The Normalize Crosstab table wizard normalizes a crosstab table, i.e. convert selected field names to values in a new table, see Figure 3

In the example below, the field names 1990, 1991, 1992 are converted to values in a new field. "Year" is entered as fieldname of the original fieldnames, and "Value" is entered as field name of the values.

Figure 3 Example of using the Normalize Crosstab table wizard; a) input and b) output



a) b)

- Double-click on the query *qFactNFR_Apppend* to run the query and append the records to the table *FactNFR*
- Double-click on the query *qdbo_FactEmission_Append* to run the query, which loads the data into *dbo_FactEmission* in the backend sql database MapEIre.

Now the NFR data is imported to the MS SQL Server database MapEIre into the table *dbo_FactEmission*.

2.2 GeoKeys management

This part is of the system is managed with a GIS tools and the MS Access database file *GKey_Manage* in *...MapEIre\ModelSystem\ProgramFiles*

A GeoKey is a normalized table holding shares of a national total emission, e.g. NO_x from road transport in 2016, which should be allocated to the individual cells in a predefined grid. The sum of all share values of all cells in a grid is 1. The GeoKeys have to be assigned to one or more NFR/CRF sector(s) and pollutant(s).

Beside the 1 km x 1 km grid, the model also use a grid with a spatial resolution of 0.1 degree x 0.1 degree for reporting of gridded emissions to the LRTAP convention. Aggregation to the 0.1 x 0.1 degree grid are made from the 1 km x 1 km emissions.

2.2.1 Creating GeoKeys

GeoKeys are prepared in a GIS or in Excel from various data sources including a spatial component, and the requisite information is exported and stored in GeoKey tables in the *GeoKeys_Final_to_model* database. The GeoKey tables include reference to the grid cells, year(s), and the emission shares. The methodology for preparing GeoKeys depends on the characteristics of the emission source; if it is a point source with a known geographical location, or if is an area source where emissions occur from an area or from small point sources that cannot be treated individually. Further information on GeoKey development is included in Annex 8 – Preparing a GeoKey for a point source and Annex 9 – Preparing a GeoKey for a line source, and in "MapEIre – Technical documentation report".

The working step for creating a GeoKey are;

- Create a table for the GeoKey
- Add data to the table or import the table from a GIS
- Register the GeoKey table and assign it to one or more CRF/NFR sectors and pollutants

2.2.2 Create table

All final GeoKey tables must be stored in the database *GeoKeys_Final_to_model*. To ensure that the tables follow the parameter and format definitions, data can with advantage be appended to an empty GeoKey table instead of being imported. If GeoKeys are prepared in a GIS it is most suitable to save the data as a shape file or in a personal geodatabase. If data are stored in a file geodatabases, it is necessary to export data to another format compatible with MS Access.

The GeoKey tables based on the 1 km x 1 km grid must have these fields:

- ***ID1kmIE*** (long int) (pk). The value has to exist in the *DimGrid1km* table.
- Grid1kmIE (Text)

- ***Year*** (Text) (pk). If the GeoKey is valid for all year, then year = "9999". The value has to exist in the *DimYear* table
- ***Share*** (Decimal) Setting: Precision=19, Scale=18
- The combination of the *ID1kmIE* and *Year* value has to be unique in the table. To ensure this, *ID1kmIE* and *Year* should be defined as primary key.

2.2.3 Register

All GeoKeys must be registered in the *GeoKeys_Final_to_model* table to be able to be assigned to a NFR/CRF sector.

- Name the GeoKey table, e.g. "1A1a_NOx" or "HeatDemand_Industrial" (case does not matter)
- Register new GeoKeys in the *GKey* table
- Open the table and create a new record with the name of the GeoKey table, like "1A1a_NOx". Note that it is crucial to use the same name in this table as the table name of the GeoKey

2.2.4 Assigning the GeoKey to Sectors and pollutants

All NFR/CRF sectors must be assigned a GeoKey in the MapEIre model. If the GeoKey is applicable for all pollutants:

- Open the form *frmGKey_Sector_AllPol_Add*
- Select the GeoKey
- Select the sector
- Press the Create button.
- The system tells you how many assignment you are doing

If the GeoKey is applicable for only selected pollutants:

- Open the form *frmGKey_Sector_Pol_Add*
- Select the GeoKey
- Select the sector
- Select the pollutants in the list box. You can use Shift and Ctrl for selection of multiple pollutants
- Press the Create button.
- The system tells you how many assignment you are doing

If anything goes wrong in the assigning process, e.g. a segment have been added more than once, open the table *GKey_Sector_Pollutant*, delete the lines for the specific sector and pollutant(s) (see Chapter 2.2.6), and repeat the process if necessary.

2.2.5 Checking for missing GeoKey assignments

It is important that all sector-pollutant combinations have been assigned one and only one GeoKey. This can be checked by evaluating the results of the following queries;

- Sectors without GeoKey: *qSectorNoGKey*
- Sector-Pollutant combinations without GeoKey: *qSector_PolNoGKey*

2.2.6 Change GeoKey assignment

Before changing a GeoKey assignment, the previous assignment must be deleted in the table *GKey_Sector_Pollutant*.

- Select the lines for the sector(s) and pollutant(s) in the table *GKey_Sector_Pollutant* that should be changed
- Delete the selected lines
- Assign the new GeoKey by running the steps described in Chapter 2.2.4

2.2.7 Update GeoKeys

When a GeoKey has been updated, the previous values in the GeoKey table must be deleted and the new values must be appended. Using append instead of import ensures that the GeoKey table definitions are maintained.

- Delete all data in the GeoKey
- Append the new updated data to the empty GeoKey table

To update a year-dependent GeoKey by adding a new year and without changing the existing values, the data for the new year can be appended to the existing GeoKey. If data for the previous years should be updated as well, the steps described above for updating a GeoKey must be followed.

2.3 Running the model

2.3.1 Introduction

When the GeoKeys, the NFR data and the CRF data is imported/updated, the model is ready to be run. The result of the model is stored in the MS SQL database *MapEIre* in the table *dbo.FactGEmission*. After calculation, MS SQL database holds more than 49 billion records for each year. The calculation process can take from hours to days, depending on the PC, network and size of the data set. The table *dbo.FactGEmission* has to be emptied before a new model run is started.

2.3.2 Emptying the table

Important: This process will empty the table dbo_FactGEmission. All existing model results in the table will be deleted without any warning and without any possibility to cancel or undo the process.

- The following step **will delete all existing model results** in the table *dbo_FactGEmission*
- Double-click *qdbo_FactGEmission_Truncate* to delete all data from *dbo_FactGEmission*

2.3.3 Calculation of spatial emissions

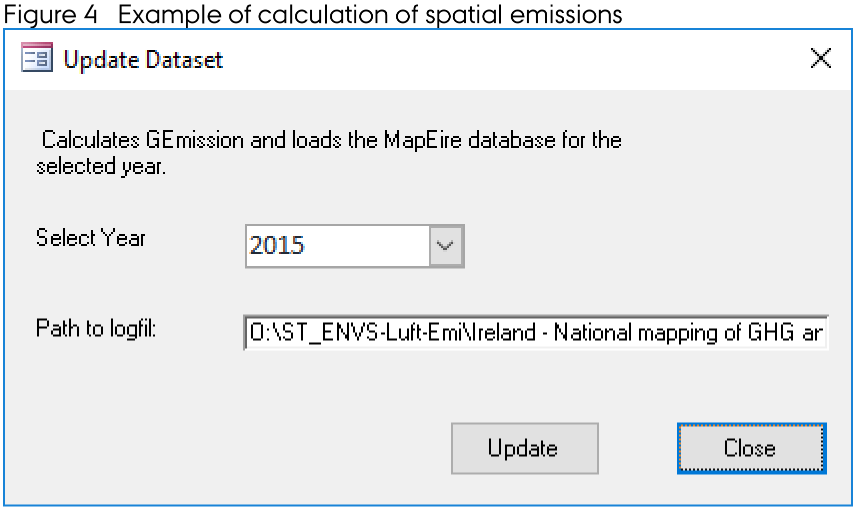
The calculation process can take from hours to days, depending on the PC, network and size of the data set.

Open the form *frmLoadMapEIre* in the database *GeoKey_Manager*. Select year, click update, and wait, see Figure 4. When the calculation is finished, MS Access shows a messages.

You can change the path to the log file and you can open the log file to control the progress of calculation.

Repeat for every year that should be imported

Figure 4 Example of calculation of spatial emissions



2.4 Quality check

Use the MS Access database *...MapEIre\ModelSystem\ProgramFiles\QC.accdb* for quality control of the data import and distribution.

The query *qQC* is used to test the sums of emissions against the NRF totals and CRF totals. The run time is some minutes and the result of the query include the following field:

- ***YearName***;; year
- ***GNFR_Code****; the GNFR sector*
- ***NFR_Code***, *the NFR/CRF sector*
- ***Pollutant***
- ***SumOfGEmission***, sum of spatial emissions in the table *dbo_FactGEmission*
- ***SumOfEmission***, sum of national total emission imported from the NFR tables and the CRF tables in the table *dbo_FactEmission*
- ***Pct_Diff***, difference between the sum of national total emission and the sum of spatial emissions in percentages

2.5 Generating outputs

The MapEIre model is set up to generate different output formats. It is possible to aggregate the results on the 0.1 degree x 0.1 degree grid and by GNFR categories for reporting to the LRTAP convention. Further it is possible to generate output databases for easy use in a GIS. The various output formats are generated in the MS Access database *MapEIre_Reporting* and *MapDatabasesMake* in the folder *...MapEIre/ModelSystem/Programfiles*.

2.5.1 UNECE reporting (0.1x0.1 & GNFR)

The database *MapEire_Reporting* include the following steps to generate output for reporting to the LRTAP convention;

- Run the query *qGNFR_Report_Crosstab*
- Export the result to Excel

2.5.2 Ad hoc User queries

It is possible to add user defined queries. The easiest procedure is as follows;

- Make a copy of e.g. *qMap_1km_Rail_1A3c_2015* and change it to reflect the new user defined output
- Save the adapted version of the query using a new name, e.g. *qMap_1km_Rail_1A3c_2016*
- To generate a crosstab result, also copy the query *qMap_1km_Rail_1A3c_2015_Crosstab* and change the data source table to the adapted version of the query from the previous step, e.g. *qMap_1km_Rail_1A3c_2016*

2.5.3 Generate output for maps and modelling

Output data for making maps are generated in the database *MapDatabasesMake.accdb*. Output including emissions aggregated by GNFR sector, for CRF totals and for NFR totals can be generated using this procedure;

- Run the form *frmMakeMapDatabasesGNFR*
- Run the form *frmMakeMapDatabasesTotals*

The results are stored as tables in separate databases, e.g.:

- *2015_A_PublicPower.mdb/2015_A*
- *2015_B_Industry.mdb/2015_B*
- ..

The result have columns for all pollutants. Some columns may be empty if emissions does not occur. You can delete unwanted columns in table design mode.

2.6 Creating maps

Maps are very useful to present spatial emissions both for validation of emission pattern and for providing information to stakeholders and the public. The MapEIre model returns calculated spatial emissions as data tables, which are easily joined to the 1 km x 1 km grid for Ireland in a GIS, using the grid cell ID field *ID_1kmIE* as join field. The joined data can be exported and stored for future use e.g. in a geodatabase or as a shape file. Visualization of the spatial emission data can be modified in a GIS to make it informative and easy to understand e.g. by changing colours and ranges of quantities, and by adding background layers, legends and scale bars. The resulting maps can be exported as e.g. jpeg or tiff files.

The workflow for creating a map from the spatial emissions calculated with the MapEIre model is described in details in Annex 7 - Guide to create maps. The data referred to in the description is examples of output from MapEIre and the GIS workflow shown is based on use of ArcMAP. Similar functionality can be found in other geographical information systems, e.g. QGIS (open source).

3 GeoKey development

A GeoKey is a table holding shares of a national total emission, e.g. NO_x from road transport in 2016, which should be allocated to the individual cells in a grid. The GeoKeys are normalised tables where the sum of shares for each table is one. Pollutant and/or year specific GeoKeys can be prepared for a sector if detailed emissions or activity data is available. If detailed data are not available, sectoral GeoKeys are used for all pollutants and for all years, causing similar spatial emission patterns for the sector for all pollutants and years included in the model. This is most likely not the case, but a necessary assumption in the spatial emission model.

The overall methodology for the GIS processing of digital spatial data is to intersect a feature data set (e.g. grassland area or road network) with a grid (e.g. the 1 km x 1 km grid used in MapEIre, *WL_1kmIE*), and calculate the share of the total feature layer located in each grid cell (e.g. share of total grassland area or share or total road length). In some cases the GeoKey is based on both spatial data and statistics (e.g. agricultural areas and number of agricultural machinery by county). In such cases, the spatial data are intersected with the grid, and shares are calculated by grid cell and by spatial aggregation level in the statistics (e.g. county level), and the GeoKey is calculated by grid cell as the sum of the share of the spatial feature multiplied by the share of the total statistics (e.g. share of agricultural area by grid cell and by county multiplied by share of total agricultural machinery by county). In this example the emissions are spatially distributed between the counties by the share of the total number of agricultural machinery, and inside the counties by the share of the agricultural area in the county by grid cell. A detailed guidance to generating GeoKeys using the geographical information system ArcGIS and the database program MS Access is included in Annex 8 – Preparing a GeoKey for a point source and in Annex 9 – Preparing a GeoKey for a line source.

Table 1 to Table 4 give examples on GeoKeys for industrial waste incineration (5C1bi), lime production (2A2), other metal production (2C7c), and public electricity and heat production (1A1a). These GeoKeys are all based on point source data with different level of details, and the resulting GeoKeys exemplifies the different types of GeoKeys;

- The GeoKey for 5C1bi is based on activity data for the latest reporting year to PRTR, and the same GeoKey is used for all years and all pollutants
- The GeoKey for 2A2 is based on annual plant specific activity data, and enabling the creation of year specific GeoKeys
- The GeoKey for 2C7c is based on PRTR data from the latest reporting year, which are available for selected pollutants. For this sector pollutant specific

GeoKeys are prepared for Cd, Pb, and Zn, plus a GeoKey for all remaining pollutants

- The GeoKey for 1A1a is based on emissions and fuel consumption data from ETS reportings. Year and pollutant specific GeoKeys are prepared for SO_2 and NO_x, plus a year dependent GeoKey for all remaining pollutants

Table 1 Example of GeoKey for Industrial waste incineration (NFR sector 5C1bi)

5C1bi			
ID_1kmIE	**Grid1kmIE**	**Year**	**Share**
312044	*	9999	0.4133
319400	*	9999	0.2686
320143	*	9999	0.0220
444769	*	9999	0.0388
444772	*	9999	0.2571
449545	*	9999	0.0002
SUM			*1*

*Removed due to confidentiality

Table 2 Example of year specific GeoKey for lime production (NFR sector 2A2)

2A2			
ID_1kmIE	**Grid1kmIE**	**Year**	**Share**
479066	*	*2014*	*0.5177*
405895	*	*2014*	*0.2582*
401438	*	*2014*	*0.2242*
479066	*	**2015**	**0.4375**
405895	*	**2015**	**0.3020**
401438	*	**2015**	**0.2605**
SUM			*2*

*Removed due to confidentiality

Table 3 Example of pollutant specific GeoKey for lead (Pb) for other metal production (NFR sector 2C7c)

2C7c_Pb			
ID_1kmIE	**Grid1kmIE**	**Year**	**Share**
324905	*	9999	0.2439
324906	*	9999	0.2683
353337	*	9999	0.2439
430786	*	9999	0.2439
SUM			*1*

*Removed due to confidentiality

Table 4 Example of year and pollutant specific GeoKey for pollutants other than SO_2 and NO_x for public electricity and heat production (NFR sector 1A1a)

1A1a_rest			
ID_1kmIE	**Grid1kmIE**	**Year**	**Share**
441859	*	*2014*	*0.1115*
320849	*	*2014*	*0.0531*
327315	*	*2014*	*0.0001*
357859	*	*2014*	*0.0051*
383901	*	*2014*	*0.0011*
385914	*	*2014*	*0.3582*
430786	*	*2014*	*0.0423*
320150	*	*2014*	*0.0618*
433804	*	*2014*	*0.0663*
444775	*	*2014*	*0.0457*
446896	*	*2014*	*0.1037*
447964	*	*2014*	*0.0008*
446897	*	*2014*	*0.0752*
516580	*	*2014*	*0.0001*
447897	*	*2014*	*0.0001*
473103	*	*2014*	*0.0747*
320150	*	**2015**	**0.0677**
320849	*	**2015**	**0.0324**
473103	*	**2015**	**0.0767**
327315	*	**2015**	**0.00001**
357859	*	**2015**	**0.0492**
447964	*	**2015**	**0.0003**
433804	*	**2015**	**0.0615**
385914	*	**2015**	**0.4075**
446896	*	**2015**	**0.1023**
447897	*	**2015**	**0.0003**
430786	*	**2015**	**0.0196**
446897	*	**2015**	**0.0094**
516580	*	**2015**	**0.0002**
441859	*	**2015**	**0.0995**
444775	*	**2015**	**0.0716**
383901	*	**2015**	**0.0016**
SUM			*2*

*Removed due to confidentiality

Other GeoKeys are based on area data (lines or polygons), e.g. emissions from road transport, which are allocated to the road network, and emissions from cultivated crops, which are allocated to the cropland areas.

A number of GeoKeys are a combination of two or more sub-sector keys. This is the case when a sector has both point sources and area sources, as for non-ferrous metals (NFR category 1A2b) where 85 % of the emissions are allocated to point sources and the remaining 15 % are allocated in accordance with the heat demand in the industrial sector.

3.1 Projection

The Irish grid TM65 (EPSG 29902) is used in the emission mapping model. Some geodata used to prepare the GeoKeys are provided in other projections, e.g. TM75 (EPSG 29903) and IRENET95 (EPSG 2157). In these cases the built-in projection transformations in ArcMAP are used to reproject the geodata, e.g. "TM65_To_WGS_1984_2" and "TM75_To_WGS_1984_2". An overview table of the Irish projections is included in Annex 10 – Working with coordinates and projections. Reprojection of coordinates for point sources is made in the program Franson CoordTrans.

3.2 Borders

The geographical scope of the spatial emission model is the Irish territory, and the exclusive economic zone (EEZ) is used as line of demarcation of the sea area. The coastline provided by EPA is used as line of demarcation of the land area.

3.3 EEZ

The shape of the Irish EEZ is based on data from MarineRegions.org. The data has been manually edited to complete the geometry and extent the EEZ line to the meet the coastline. The resulting layer is a polygon covering the Irish land and sea area.

3.4 Coastline

The coastline shapefile provided by the Irish EPA (*ADMIN_Coast.shp*) is used.

3.5 National border

Different spatial data are available that include the national border between the Republic of Ireland and Northern Ireland (*Census2011_Small_Areas_generalised20m* (data source: CSO), *Census2011_Garda_Districts_Nov2013* (data source: CSO), *Census2011_Constituencies_2013* (data source: CSO), *Agri* (data source: latest gridded emission inventory), and *northern_ireland_counties* (data source: ShareGeo Open, http://www.sharegeo.ac.uk/).

Analysis of the spatial data shows only smaller differences between the country border between the Republic of Ireland and Northern Ireland. In most cases the difference is below 25 meters, and of minor importance for gridding of emissions on a grid with a resolution of 1 km x 1 km.

Based on the analysis, the data set *Census2011_Garda_Districts_Nov2013* provided by the CSO is used as line of demarcation for the Republic of Ireland, as this layer corresponds well with maps including regions in Northern Ireland, and as this layer follows the coastline rather than the administrative boundaries along water bodies.

3.6 Border files

The files defining the borders in the MapEIre model are listed in Table 5.

Table 5 Files defining the land and sea area borders

File	**File location**
EEZ	...MapEIre\DataLibrary\Borders\Borders.mdb\EEZ
Coastline	...MapEIre\DataLibrary\Borders\Borders.mdb\Coastline
National border	...MapEIre\DataLibrary\Borders\Borders.mdb\NationalBorder

3.7 Grids

3.7.1 Grid 1km x 1km

A grid with a resolution of 1 km x 1 km is developed for the spatial emission model, using the standard tool Create Fishnet in ArcMap. The fishnet is created so that the corners of the grid cells follow the 1 000 meter x-axis and y-axis in the TM65 projection (EPSG 29902). The grid covers a square around the Exclusive Economic Zone (EEZ). The extent and resolution are defined by the parameters listed in Table 6.

Table 6 Parameters used to prepare the MapEIre 1 km x 1 km grid

Extent	Bottom	-365 000
	Top	630 000
	Left:	-360 000
	Right	385 000
Resolution	Width, m	1 000
	Height, m	1 000
Size	Number of rows	995
	Number of columns	745

Using the Calculate geometry tool in ArcMAP, each grid cell is applied X and Y coordinates for the centroid (Xc and Yc). The grid cells are named according to the location of the lower left corner and the grid resolution;

IE_1km_±Y_±X

where ±Y and ±X are the Y and X coordinates for the lower left corner rounded down to nearest full kilometre (e.g. the point *(-296 713.384 , 158 922.683)* will be given the grid ID 1km_158_-297).

By using a name convention based on the X and Y coordinates, it is easy to apply grid cell name to point sources, which are defined by their exact location (X,Y), and following to summarise emissions from point sources and area sources per grid cell, without using a GIS. Grid cell names are applied using the standard tool Calculate Field in ArcMAP with the following script;

```
Grid1kmIE: CStr("1km_" & (IIf([Yc_TM65]<0 And [Yc_TM65]>-1000;-1;(IIf([Yc_TM65]<1000 And [Yc_TM65]>=0;0;Left((IIf([Yc_TM65]<0;([Yc_TM65]-1000);[Yc_TM65]));( IIf((Len((CStr((Round((IIf([Yc_TM65]<0;([Yc_TM65]-1000);[Yc_TM65]));0))))))>2;( Len((CStr((Round((IIf([Yc_TM65]<0;([Yc_TM65]-1000);[Yc_TM65]));0))))))-3;0))))))) & "_" & (IIf([Xc_TM65]<0 And [Xc_TM65]>-1000;-1;(IIf([Xc_TM65]<1000 And [Xc_TM65]>=0;0;Left((IIf([Xc_TM65]<0;([Xc_TM65]-1000);[Xc_TM65]));( IIf((Len((CStr((Round((IIf([Xc_TM65]<0;([Xc_TM65]-1000);[Xc_TM65]));0))))))>2;( Len((CStr((Round((IIf([Xc_TM65]<0;([Xc_TM65]-1000);[Xc_TM65]));0))))))-3;0))))))))
```

Correspondingly Grid ID can be applied in Access using the query:

```
Grid1kmIE: CStr("1km_" & (IIf([Northing]<0 And [Northing]>-1000;-1;(IIf([Northing]<1000 And [Northing]>=0;0;Left((IIf([Northing]<0;([Northing]-1000);[Northing]));(IIf((Len((CStr((Round((IIf([Northing]<0;([Northing]-1000);[Northing]));0))))))>2;(Len((CStr((Round((IIf([Northing]<0;([Northing]-1000);[Northing]));0))))))-3;0))))))) & "_" & (IIf([Easting]<0 And [Easting]>-1000;-1;(IIf([Easting]<1000 And [Easting]>=0;0;Left((IIf([Easting]<0;([Easting]-1000);[Easting]));(IIf((Len((CStr((Round((IIf([Easting]<0;([Easting]-1000);[Easting]));0))))))>2;(Len((CStr((Round((IIf([Easting]<0;([Easting]-1000);[Easting]));0))))))-3;0))))))))
```

Four separate grids are prepared;

- **G_1kmIE**, covering the area (square) defined by the parameters in Table 6
- **WL_1kmIE**, covering the area defined by the Irish EEZ including both land and sea area
- **W_1kmIE**, covering the sea area defined by the EEZ and the coastline
- **L_1kmIE**, covering the land area defined by the coastline

3.7.2 Grid 0.1° x 0.1°

A grid with a spatial resolution of 0.1 degree x 0.1 degree in the projection WGS84 (EPSG 4326), following the definitions for the EMEP grid, is developed for reporting of spatial emission to LRTAP convention, using the standard tool Create Fishnet in ArcMap. The fishnet is created so that the corners of the grid cells follow the 0.1 degree x-axis and y-axis. The grid covers a square around the Exclusive Economic Zone (EEZ). The extent and resolution are defined by the parameters listed in Table 7

Table 7 Parameters used to prepare the MapEIre 0.1 degree x 0.1 degree grid

Extent	Bottom	47.0
	Top	57.0
	Left:	-17.0
	Right	-4.0
Resolution	Width, m	0.1

Size	Height, m	0.1
	Number of rows	100
	Number of columns	130

Using the Calculate geometry tool in ArcMAP, each grid cell is applied X and Y coordinates for the centroid (Xc and Yc). The grid cells are named according to the location of the centroid and the grid resolution;

01g_±Yc_±Xc

where ±Y and ±X are Yc and Xc coordinates rounded to two decimals.

By using a name convention based on the X and Y coordinates, it is easy to apply grid cell name to point sources, which are defined by their exact location (X,Y), and following to summarise emissions from point sources and area sources per grid cell, without using GIS. Grid cell names are applied using the standard tool "Calculate Field" in ArcMAP with the script:

Grid01glE: CStr("01g_" & Round([Yc_WGS84],2) & "_" & Round([Xc_WGS84],2))

Two separate grids are prepared;

- **G_01glE**, covering the area corresponding to *G_1kmIE*
- **WL_01glE**, covering the area corresponding to *WL_1kmIE*

3.7.3 Conversion from the 1 km x1 km grid to the 0.1 degree x0.1 degree grid

A conversion table is created for reallocation of emissions from the 1 km x 1 km grid to the 0.1 degree x 0.1 degree grid, including the share of each 1 km x 1 km grid cell to be allocated to the intersecting 0.1 degree x 0.1 degree grid cells. The list is based on an intersection of the 1 km x 1 km grid and the 0.1 degree x 0.1 degree grids covering the Irish territory (land and sea area).

3.7.4 Grid files

The files defining the grids in the MapEIre model are listed in Table 8.

Table 8 Files defining the land and sea area borders

File	**File location**
G_1kmIE	...MapEIre\DataLibrary\Grids.mdb\G_1kmIE
WL_1kmIE	...MapEIre\DataLibrary\Grids.mdb\WL_1kmIE
W_1kmIE	...MapEIre\DataLibrary\Grids.mdb\W_1kmIE
L_1kmIE	...MapEIre\DataLibrary\Grids.mdb\L_1kmIE
G_01glE	...MapEIre\DataLibrary\Grids.mdb\G_01glE
WL_01glE	...MapEIre\DataLibrary\Grids.mdb\WL_01glE
Conversion from the 1 km x 1 km grid to 0the .1 degree x 0.1 degree grid	...MapEIre\DataLibrary\Grids.mdb\-Share_of_1km_to_01g

4 Temporal model

4.1 Temporal profiles and TKey development

A temporal key (TKey) is a table holding shares of an emission e.g. NO_x from road transport with passenger cars in 2016, which should be allocated to the individual time intervals, i.e. months, days and hours. The TKeys are normalised tables where the sum of shares for each table is one. Three temporal profiles are prepared for each emission source category in the spatial model describing the monthly, the daily and the hourly distributions. For selected emission sources, separate hourly TKeys are prepared for different days of the week. An example is road transport, where separate hourly TKeys are prepared for Monday, Tuesday-Thursday, Friday, Saturday and Sunday, respectively. In other cases, separate TKeys are prepared for different pollutants for a source, as the emissions are related to different activities or processes within the emission category. This is e.g. the case for domestic wastewater handling, where two TKeys are prepared for N_2O and remaining pollutants, respectively.

TKeys are stored as tables in MS Excel and imported to the temporal model in MS Access database. The TKeys include the parameters;

- Monthly TKeys:
  - GNFR: GNFR category name
  - NFR: NFR category name
  - PollD: pollutant. If a specific pollutant name is applied, the TKey will be used for that pollutant only, e.g. N_2O. If the value "All" is applied, the TKey will be used for all pollutants that does not have a specific TKey
  - Month: share of emission sum up to 1
-
- Daily TKeys:
  - GNFR: GNFR category name
  - NFR: NFR category name
  - PollD: pollutant. If a specific pollutant name is applied, the TKey will be used for that pollutant only, e.g. N_2O. If the value "All" is applied, the TKey will be used for all pollutants that does not have a specific TKey
  - Day: share of emission sum up to 1
-
- Hourly TKeys:
  - GNFR: GNFR category name
  - NFR: NFR category name
  - Weekday: share of emission sum up to 1

In Access the TKeys are converted into a new table, holding hourly shares for real time years, taking into account the actual weekdays and leap years. These shares are stored in the table *MonthDayHour,* and the hourly shares *TimeFrac* are calculated as;

TimeFrac: [inMonth].[Value]*[inWeekDay].[Value]*[inHour].[Value]

This is done by the query qMonthDayHour_Add

4.1.1 Importing temporal profiles (TKeys)

The temporal profiles, which are stored in a spreadsheet, are imported to the temporal model using the following procedure;

1. Open *TempMapEire* in *...MapEire/Modelsystem/Programfiles/*
2. Create links to the sheets *Month*, *Day*, and *Hour* in the spreadsheet *TemporalProfiles*
3. Use the ConvertCrostab wizard to make the tables InMonth, InDay, InHour. The *Month*, *Day*, and *Hour* fields have to be integer
4. Delete posts with empty values in GNFR code and value field
5. Carefully control the data
6. Run the query *qMonthDayHour_Add*

4.2 Calculation of temporal emissions for use in maps and videos

Temporal emission tables can be generated for use in GIS (ArcMAP) to show hourly emissions maps or for making videos showing a sequence of hourly emissions maps.

The procedure is listed here and further described in the following chapters.

1. Decisions
2. Prepare the data in the database
3. Setup a project in ArcMap
4. Exports images for video production
5. Assemble a video

4.2.1 Decisions

The user have to decide which emissions should be visualised, defined by sector, year and pollutant (e.g. road transport, 2015, NO_x).

Further the user have to decide which time series to visualised; time start, time end, time steps (e.g. “1 Jan 2015 00:00 AM” to “7 Jan 2015 11:00 PM” as 1 hour steps).

Later in process the user has to decide video formats

4.2.2 Prepare data in the database

The MS Access database *TempMapEire.accdb* is used for calculating the temporal emission for the user defined data to be used in ArcMap. The database contain temporal profiles for the NFR sectors and some help/lookup tables. The database is also linked to the main database *MapEire*, which contain all the spatially distributed emissions.

The output of the database is a table *TimeEmission* with the following structure:

- **GridCell_ID**; the ID for the 1 km x 1 km grid cells
- **TimeInstant**; e.g. 01/01/2015 00:00:00
- **NFR_Code**; e.g. 1A1a
- **Pollutant**; e.g. NO_x
- **TEmission**; temporal emission value

4.2.3 Making the output

Output of the temporal emissions is made using the following procedure;

- Open the database *TimeEmission*
- Run the query *qTimeEmission_Add*
- Enter Start Date (format: dd-mm-yyyy), End date, NFR Code, Pollutant, and Year when asked

4.2.4 Export the table TimeEmission

It is possible to use data in the sql server in ArcMap. It is necessary to make the data table accessible from ArcMap.

The table can be exported to an ESRI personal file geodatabase, an ESRI file geodatabase, or to an ESRI Enterprise geodatabase server, e.g. SQL server. The personal file geodatabase is very convenient, but not supported in Arc GIS Pro.

Use the following steps to export data to a personal geodatabase;

- Create a personal geodatabase in ArcMap or in ArcCatalog
- Close the created geodatabase and open it from MS Access
- Import the table *TimeEmission* from the database *TempMapEire.accdb*

4.3 Set up a project in ArcMap

The following procedure is used to generate the hourly emissions maps, which can be used to create a video;

- Make a new project in ArcMap
- Add a basemap if desired

Regarding data, the best option is to have the 1kmgrid and the *TimeEmission* in the same personal geodatabase and save it on the local drive. The user defined output is called the sector feature in the following procedure description.

- Add the 1 km grid feature layer from the catalog tree
- Add the sector feature table from the catalog tree
- Join sector feature to the grid using the field *ID_1kmIE* as join field

  - Select keep only matching records
- Setup time properties for the sector feature
  - Enable time on this layer
  - Each feature has a single time field
  - Time field = *TheTimeInstant*
  - Time step = e.g. 1 hour
- Setup the symbology for the sector feature
  - Select quantities/graduated colours: value =<Pollutant field>
  - Colour ramp = e.g. "Green2Red" or "Spectrum-full bright"
  - Classification: Classes = e.g. 12 or 20
  - Classification: Method = e.g. Geometrical interval
  - Classification: Data exclusion: Sampling = >1.000.000
    - **Important**; check that the maximum pollutant value is in the resulting range
- Open the Time Slider Window
  - Select Options (button #2 from left), and select Time Display
    - Time Step = e.g. 1
    - Time window = 0 (normally)
    - Select Show Time on map display
    - Optionally select the button "Appearance"
- Setting up the page layout
  - The goal is to set the visual appearance of the ArcMap layout as it should appear in the video
  - Select the map extent for your layer in the data view
  - Click the layout view, optionally adjust the extent by panning
  - Insert the legend
  - Insert time stamp using Insert/Dynamic text/Data Frame Time, optionally adjust properties
  - Save the project
  - When the appearance is satisfactory, the images for the video can be made

4.4 Export images for making a video

It is possibly to make a video from the Time Slide Windows, button #3, but it is difficult to control and to get it right at first. It is also time consuming. It is more convenient to use an arcpy (python) script, which can be run in the background.

Below is an example of an arcpy script. The file locations for input and output should be changed to reflect the path chosen by the user. The file format and the resolution can be changed in the script, and the user can define if the data frame or the page layout should be exported.

```
import arcpy
import os
```

```
mxd = arcpy.mapping.MapDocument("C:/MapEireTemporal/Temp-
MapEire_3.mxd")
df = arcpy.mapping.ListDataFrames(mxd)[0]
df.time.currentTime = df.time.startTime
counter = 1
while df.time.currentTime <= df.time.endTime:
  while df.time.currentTime <= df.time.endTime:
  fileName = "img" + str(counter) + ".png"
  path = "C:/Gisprojekter/MapEireTemporal/movie/images3/"
  pathfilename = path + fileName
  arcpy.mapping.ExportToPNG(mxd, pathfilename)
  df.time.currentTime = df.time.currentTime + df.time.timeStepInterval
  counter = counter + 1
del mxd
```

Further information about the settings can be found here: http://desktop.arcgis.com/en/arcmap/10.5/analyze/arcpy-mapping/exporttopng.htm

Further information about running arcpy scripts can be found here: http://desktop.arcgis.com/en/arcmap/10.3/analyze/executing-tools/writing-python-scripts.htm

4.5 Assemble Video

Videos can be made in a lot of formats and resolution and with a lot of different programs.

The videos prepared in the MapEIre project have been made using the FFmeg program, which is a command line program.

The program is available for download here: https://www.ffmpeg.org/.

The following video show how to install FFmpeg on Windows 10:
https://www.youtube.com/watch?v=pHR3ttH5t-w

An example on a command line, including description of the commands, are described here:

Command line:

```
ffmpeg -y -framerate 3 -i  img%d.png   -vf scale=1588:1124  -c:v libx264 -pix_fmt yuv420p  H.264_codec.mp4
```

Explanation:

-y = overwrite
-framerate 3 = 3 frames per second, i.e. 56 seconds for 168 frames

-i tmp%d.png   input png files
-vf scale=1588:1124   = "upscale" of the original png file made in arcpy from 1587x1123 pixels (ffmpeg does not like odd pixel values)
-c:v libx264 = H.264 codec
-pix_fmt yuv420p = maybe not necessary

Annex 1

Installing MS SQL Server 2016 SP1 and SSMS 17 on a laptop

MS SQL Server 2016 Developer Edition is free for testing and development when the user have signed up as a member of Visual Studio Dev Essentials. Install the SQL server using the following procedure;

- Download MS SQL Server Developer edition from Visual Studio Developer
- Run setup basic installation
- Select Install SSMS in the setup finished window
- Download SSMS 17
- Restart
- Install SSMS 17

Network enabling of MS SQL Server

If the database has to be accessible from other devices than the local pc, the database server has to be network enabled. For further information on the relevant settings, see https://docs.microsoft.com/en-us/sql/relational-databases/lesson-2-connecting-from-another-computer

Creating the MapEIre database

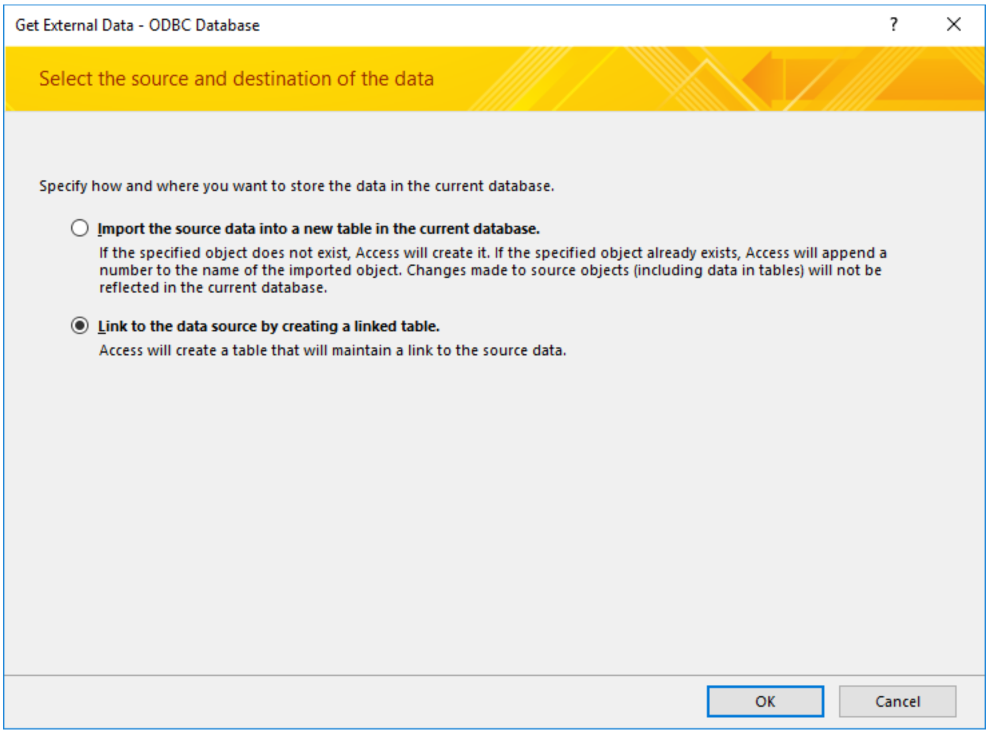
Run the scripts in the folder *.../MapEIre/Indata/SQL_scripts* from SSMS to create an empty database:

- *Create_MapEIreDatabase*
- *Create_FactEmission*
- *Create_FactGEmission*
- *Create_FactGemission_ColumnStoreIndex*

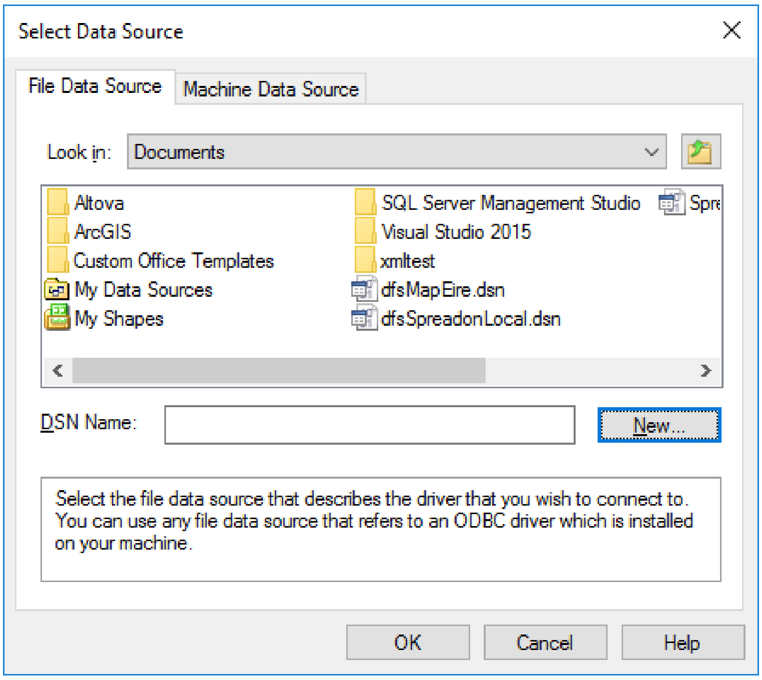
Make a connection from MS Access to the MapEIre database

In MS Access you have to make a connection to the MS SQL MapEIre database and save the information in a file. You can also use this step if you have lost the connection for some reason. Use the following steps to connect to the MapEIre database;

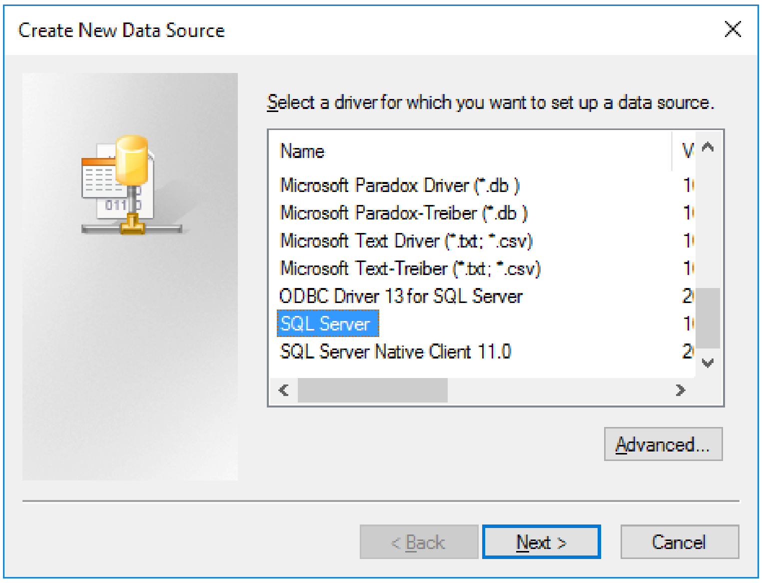
- Select External data, and select ODBC
- Select Link and click OK


Get External Data - ODBC Database
Select the source and destination of the data
Specify how and where you want to store the data in the current database.
Import the source data into a new table in the current database.
If the specified object does not exist, Access will create it. If the specified object already exists, Access will append a number to the name of the imported object. Changes made to source objects (including data in tables) will not be reflected in the current database.
Link to the data source by creating a linked table.
Access will create a table that will maintain a link to the source data.
OK
Cancel

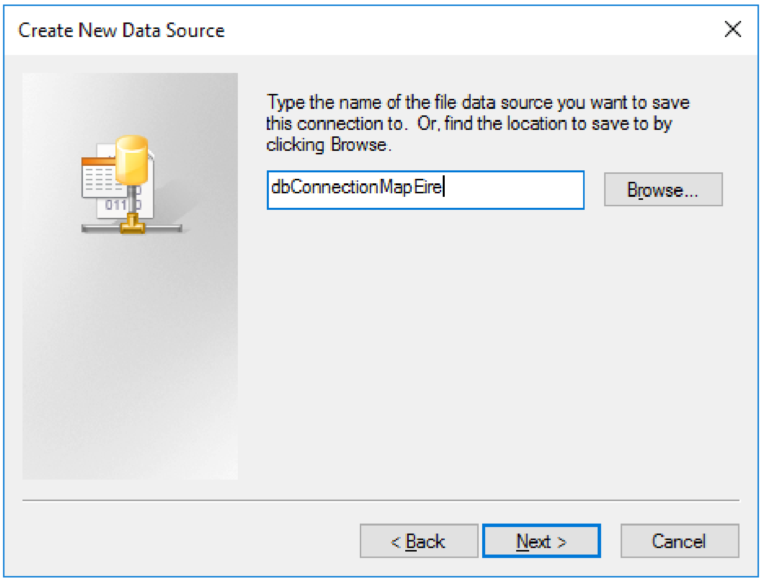
- Click New


Select Data Source
File Data Source
Machine Data Source
Look in:
Documents
Altova
ArcGIS
Custom Office Templates
My Data Sources
My Shapes
SQL Server Management Studio
Visual Studio 2015
xmltest
dfsMapEire.dsn
dfsSpreadonLocal.dsn
DSN Name:
New...
Select the file data source that describes the driver that you wish to connect to. You can use any file data source that refers to an ODBC driver which is installed on your machine.
OK
Cancel
Help

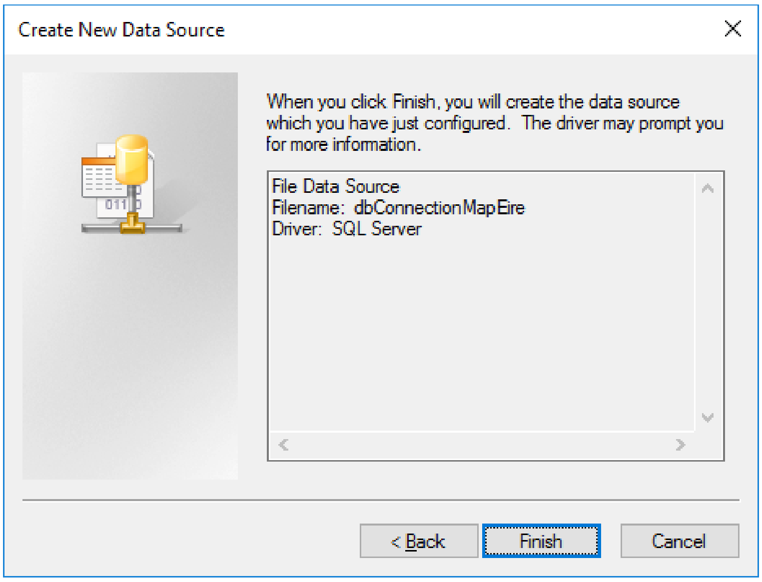
- Select SQL Server and click Next



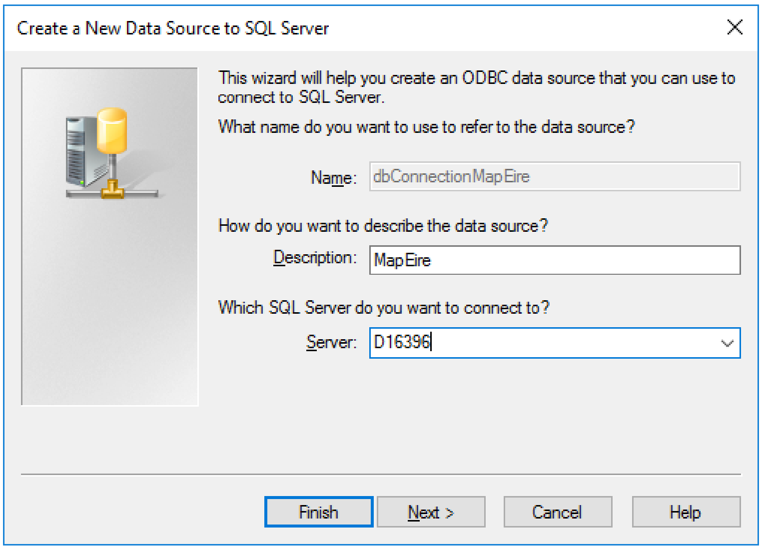
- Type a name for the connection file or browse to save the connection file at an appropriate path. Click Next



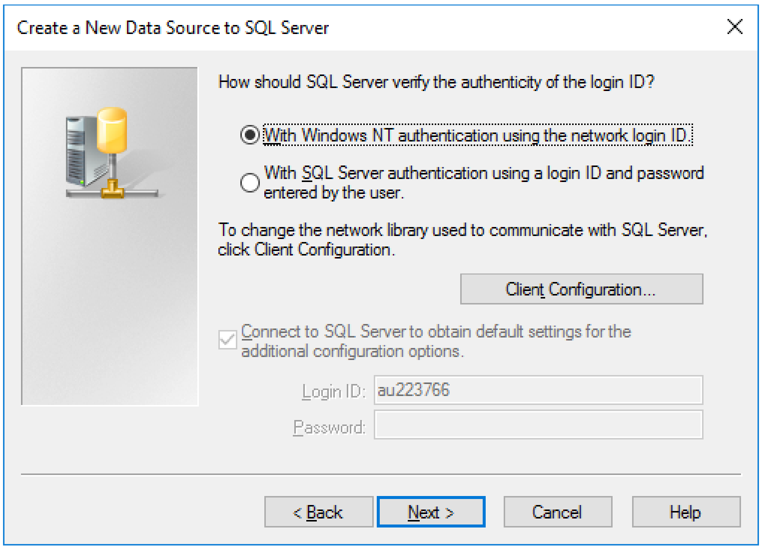
- Click finish



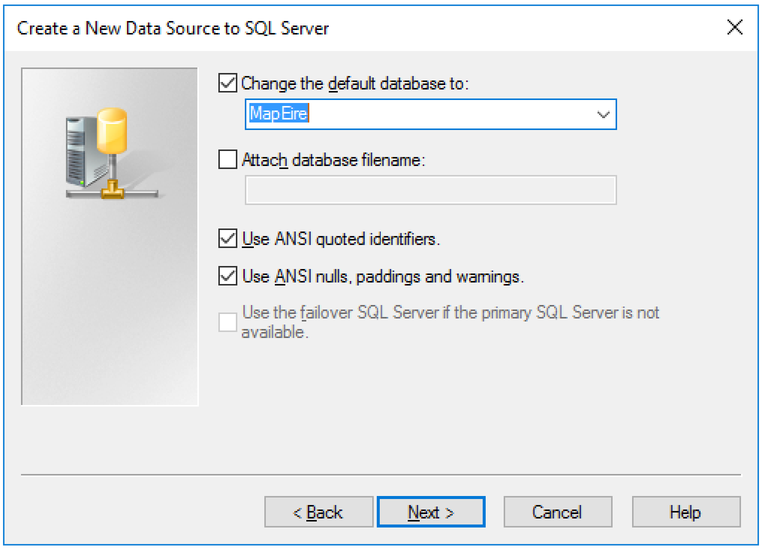
- Fill in the description and the name of the SQL server. Click Next



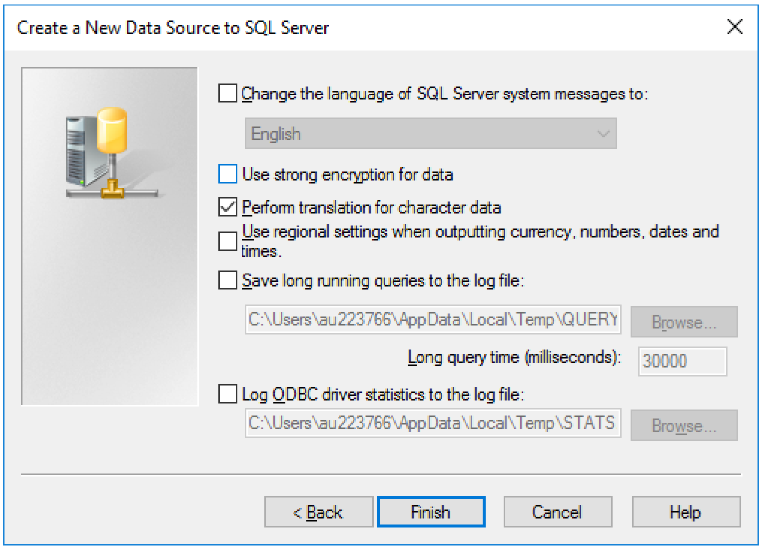
- Click Next



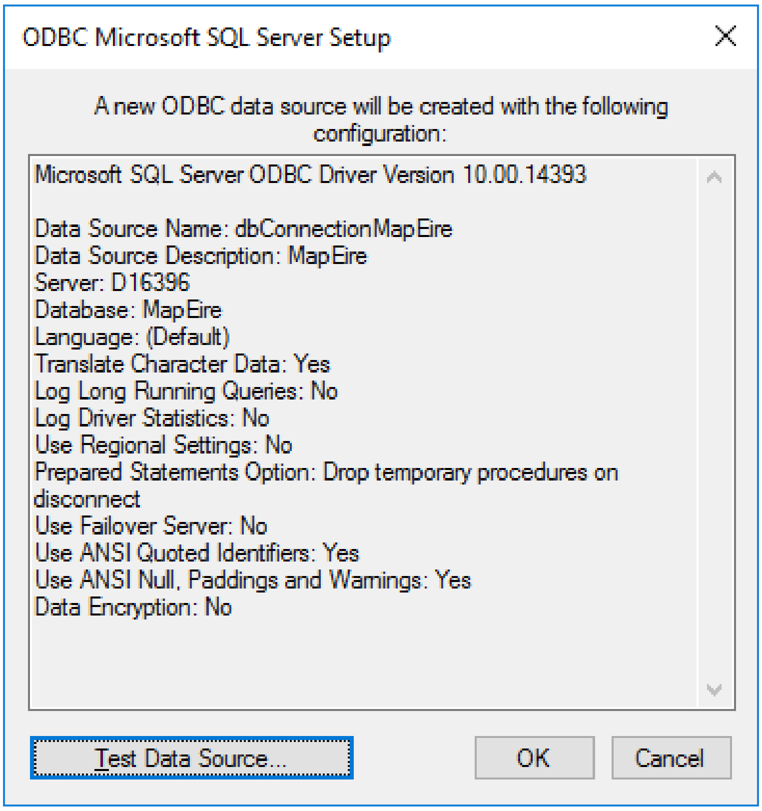
- Change the default database to MapEIre and click Next

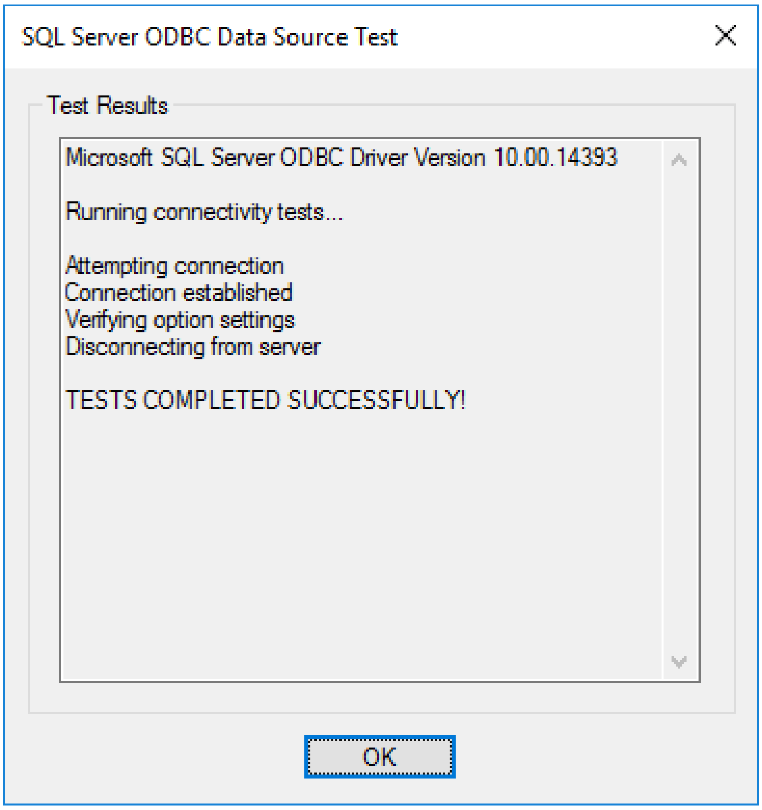


- Click Finish

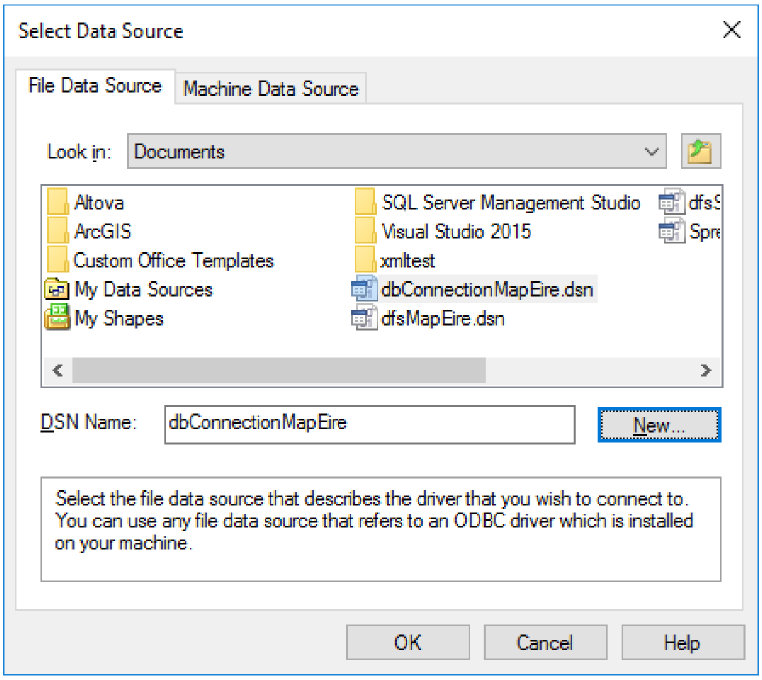


- Test the data source or click OK
  Note: Server name in the test setup at AU is D16396

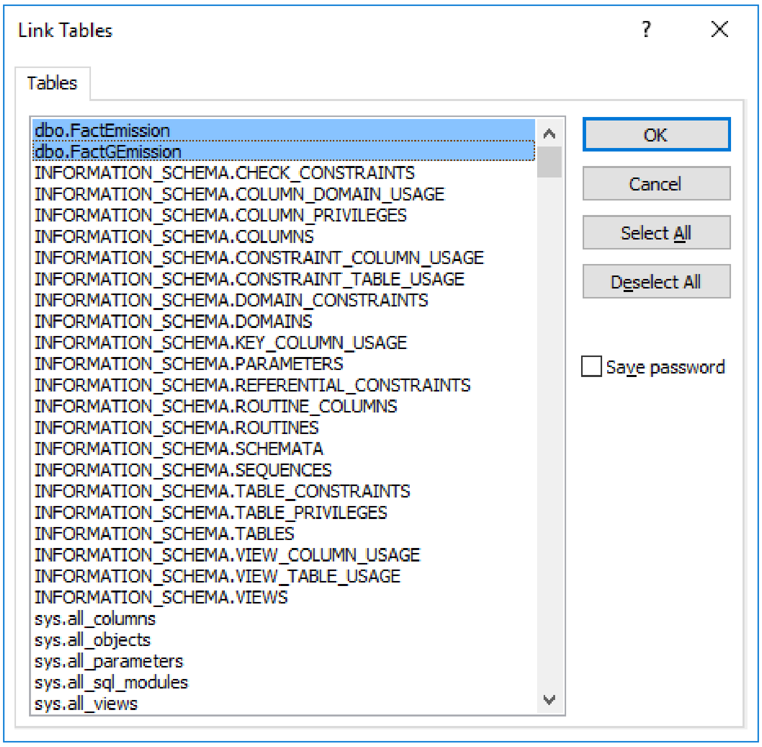



SQL Server ODBC Data Source Test
Test Results
Microsoft SQL Server ODBC Driver Version 10.00.14393
Running connectivity tests...
Attempting connection
Connection established
Verifying option settings
Disconnecting from server
TESTS COMPLETED SUCCESSFULLY!
OK

- Click OK

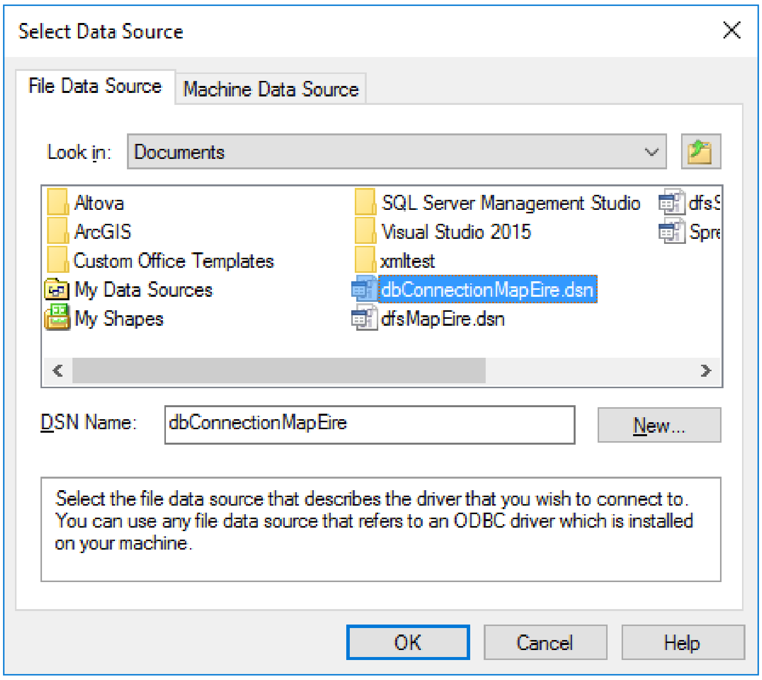


- Select dbo.FactEmission and dbo.FactGEmission and click OK



When the connection file is created, it can be used to connect to the MapEIre database if the connection has been lost or from another database using the following procedure;

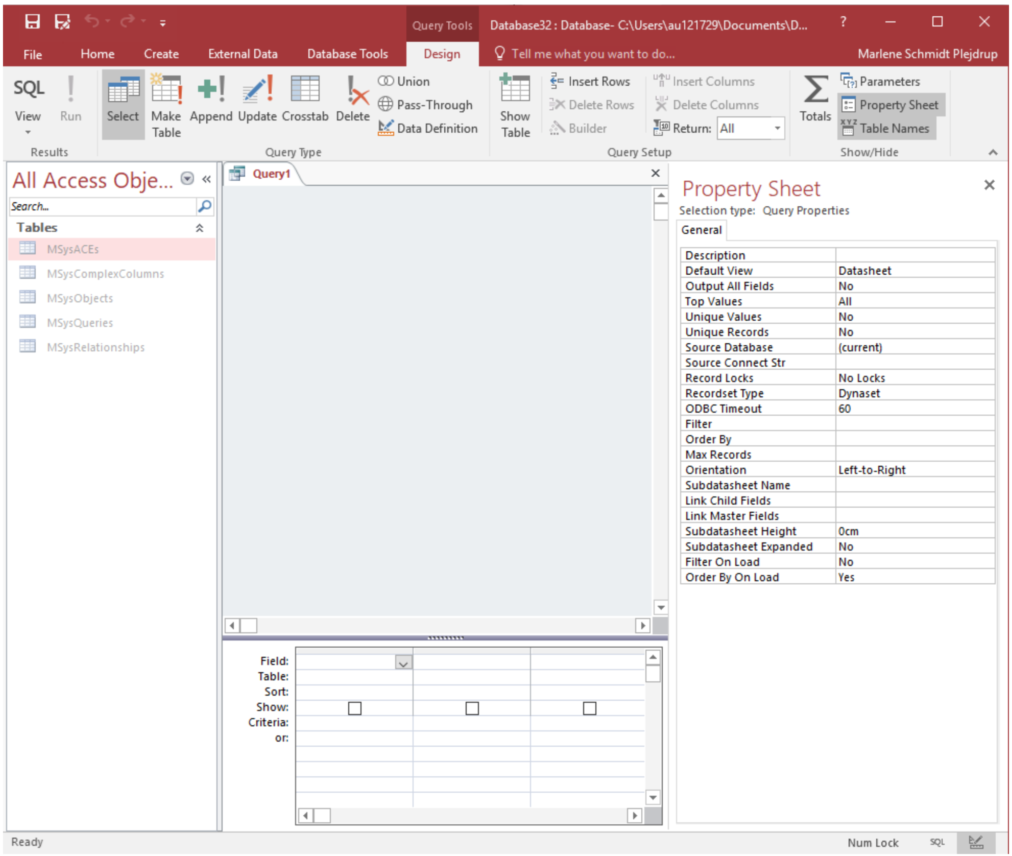
- Select ODBC and select link
- Select the connection file (data source file) generated in the previous chapter and click OK.



Changing the ODBC time out for queries in MS Access

If MS Access return an ODBC timeout error, it is advisory to try to solve the problem by changing the value in the query properties; Set it to 1800 sec

- By default, time is set to 60 sec
- Change it to 1800 sec (30 min)


Query Tools
Database32 : Database- C:\Users\au121729\Documents\D...
File
Home
Create
External Data
Database Tools
Design
Tell me what you want to do...
Marlene Schmidt Plejdrup
SQL View
Run
Select
Make Table
Append
Update
Crosstab
Delete
Union
Pass-Through
Data Definition
Show Table
Insert Rows
Delete Rows
Builder
Insert Columns
Delete Columns
Return: All
Totals
Parameters
Property Sheet
Table Names
Results
Query Type
Query Setup
Show/Hide
All Access Obje...
Search...
Tables
MSysACEs
MSysComplexColumns
MSysObjects
MSysQueries
MSysRelationships
Query1
Field:
Table:
Sort:
Show:
Criteria:
or:
Property Sheet
Selection type: Query Properties
General
Description
Default View Datasheet
Output All Fields No
Top Values All
Unique Values No
Unique Records No
Source Database (current)
Source Connect Str
Record Locks No Locks
Recordset Type Dynaset
ODBC Timeout 60
Filter
Order By
Max Records
Orientation Left-to-Right
Subdatasheet Name
Link Child Fields
Link Master Fields
Subdatasheet Height 0cm
Subdatasheet Expanded No
Filter On Load No
Order By On Load Yes
Ready
Num Lock

Annex 2 – List of GeoKeys

GeoKey
1A1a_NOx
1A1a_rest
1A1a_SO2
1A1b
1A1c
1A2b
1A2c
1A2e
1A2f
1A2gvi
1A2gviii
1A3ai(i)
1A3aii(i)
1A3aii(ii)
1A3c
1A3d
1A3e
1A4b_CO
1A4b_CO2
1A4b_NMVOC
1A4b_NOx
1A4b_PM25
1A4b_SO2
1A4cii
1A4ciii
1B1a_Handling
1B1a_Mining
1B2av
1B2bii
1B2c
2A1
2A2
2A4b
2A4d
2A5a
2B1
2B2
2C1

GeoKey (*continued*)
2C2_PM
2C3
2C7c_Cd
2C7c_Pb
2C7c_rest
2C7c_Zn
2D3f
2E1
2G3_NMVOC
2G3_rest
3B1a
3B1b
3B2
3B3
3B4d
3B4e
3B4f
3B4gi
3B4gii
3B4giv
3B4h
3D1a6
3D1b2
3Da2a
5A
5B1
5C1bi
5C1biii
5C1bv
5D_N2O
AreaLand
AreaLandSea
AreaSea
Buildings_All
Buildings_C_nonUrban
Buildings_R
Buildings_R_nonSewered
Buildings_R_nonUrban

GeoKey (*continued*)
CORINEcropland
CORINEgrassland
CORINEotherland
CORINEsettlement
CORINEwetland
HeatDemand_CommercialPublic
HeatDemand_Industrial
LPIScropImpGrass
LPIScropland
LPISfarmyard
LPISgrassland
Population
Road_HV
Road_PC
Road_PCHV

Annex 3 – Correspondence between GNFR, NFR and GeoKey

GNFR	NFR	NFR name	GeoKey
A	1A1a	Public electricity and heat production	1A1a_NOx
A	1A1a	Public electricity and heat production	1A1a_rest
A	1A1a	Public electricity and heat production	1A1a_SO2
B	1A1b	Petroleum refining	1A1b
B	1A1c	Manufacture of solid fuels and other energy industries	1A1c
B	1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	HeatDemand_Industrial
B	1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	1A2b
B	1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	1A2c
B	1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	HeatDemand_Industrial
B	1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	1A2e
B	1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	1A2f
B	1A2gviii	Stationary combustion in manufacturing industries and construction: Other (please specify in the IIR)	1A2gviii
B	2A1	Cement production	2A1
B	2A2	Lime production	2A2
B	2A4a	Ceramics	HeatDemand_Industrial
B	2A4b	Other uses of soda ash	2A4b
B	2A4d	Other uses of carbonates	2A4d
B	2A5a	Quarrying and mining of minerals other than coal	2A5a
B	2A5b	Construction and demolition	Buildings_All
B	2A6	Other mineral products (please specify in the IIR)	HeatDemand_Industrial
B	2B1	Ammonia production	2B1
B	2B10b	Storage, handling and transport of chemical products (please specify in the IIR)	LPISfarmyard
B	2B2	Nitric acid production	2B2
B	2C1	Iron and steel production	2C1
B	2C2	Ferroalloys production	2C2_Cd
B	2C2	Ferroalloys production	2C2_Pb
B	2C2	Ferroalloys production	2C2_PM
B	2C3	Aluminium production	2C3
B	2C7c	Other metal production (please specify in the IIR)	2C7c_Cd
B	2C7c	Other metal production (please specify in the IIR)	2C7c_Pb
B	2C7c	Other metal production (please specify in the IIR)	2C7c_rest

B	2C7c	Other metal production (please specify in the IIR)	2C7c_Zn
B	2D1	Lubricant use	Road_PCHV
B	2D2	Paraffin wax use	Population
B	2D3b	Road paving with asphalt	Road_PCHV
B	2D3c	Asphalt roofing	Buildings_All
B	2E	Electronics industry	2E1
B	2F1a	Commercial refrigeration	Population
B	2F1e	Mobile air-conditioning	Road_PCHV
B	2F1f	Stationary air-conditioning	Buildings_All
B	2F3	Fire protection	HeatDemand_Industrial
B	2F4	Aerosols	Population
B	2F6	Other applications	Population
B	2H2	Food and beverages industry	1A2e
B	2I	Wood processing	Buildings_C_nonUrban
B	2L	Other production, consumption, storage, transportation or handling of bulk products (please specify in the IIR)	AreaLand
C	1A4ai	Commercial/institutional: Stationary	HeatDemand_CommercialPublic
C	1A4bi	Residential: Stationary	1A4b_CO
C	1A4bi	Residential: Stationary	1A4b_CO2
C	1A4bi	Residential: Stationary	1A4b_NMVOC
C	1A4bi	Residential: Stationary	1A4b_NOx
C	1A4bi	Residential: Stationary	1A4b_PM25
C	1A4bi	Residential: Stationary	1A4b_SO2
C	1A4ci	Agriculture/Forestry/Fishing: Stationary	LPISfarmyard
D	1B1a	Fugitive emission from solid fuels: Coal mining and handling	1B1a_Handling
D	1B1a	Fugitive emission from solid fuels: Coal mining and handling	1B1a_Mining
D	1B2aiv	Fugitive emissions oil: Refining / storage	1A1b
D	1B2av	Distribution of oil products	1B2av
D	1B2b	Fugitive emissions from natural gas (exploration, production, processing, transmission, storage, distribution and other)	1B2bii
D	1B2c	Venting and flaring (oil, gas, combined oil and gas)	1B2c
E	2D3a	Domestic solvent use including fungicides	Population
E	2D3d	Coating applications	Population
E	2D3e	Degreasing	2C7c_rest
E	2D3f	Dry cleaning	2D3f
E	2D3g	Chemical products	HeatDemand_Industrial
E	2D3h	Printing	HeatDemand_Industrial
E	2D3i	Other solvent use (please specify in the IIR)	Population
E	2G	Other product use (please specify in the IIR)	2G3_NMVOC
E	2G	Other product use (please specify in the IIR)	2G3_rest
F	1A3bi	Road transport: Passenger cars	Road_PC
F	1A3bii	Road transport: Light duty vehicles	Road_PC
F	1A3biii	Road transport: Heavy duty vehicles and buses	Road_HV
F	1A3biv	Road transport: Mopeds & motorcycles	Road_PC
F	1A3bv	Road transport: Gasoline evaporation	Road_PC

F	1A3bvi	Road transport: Automobile tyre and brake wear	Road_PCHV
F	1A3bvii	Road transport: Automobile road abrasion	Road_PCHV
G	1A3di(ii)	International inland waterways	AreaSea
G	1A3dii	National navigation (shipping)	1A3d
H	1A3ai(i)	International aviation LTO (civil)	1A3ai(i)
H	1A3aii(i)	Domestic aviation LTO (civil)	1A3aii(i)
I	1A2gvii	Mobile Combustion in manufacturing industries and construction: (please specify in the IIR)	1A2gvi
I	1A3c	Railways	1A3c
I	1A3ei	Pipeline transport	1A3e
I	1A4aii	Commercial/institutional: Mobile	HeatDemand_Commer-cialPublic
I	1A4bii	Residential: Household and gardening (mobile)	Buildings_R
I	1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	1A4cii
I	1A4ciii	Agriculture/Forestry/Fishing: National fishing	1A4ciii
J	5A	Biological treatment of waste - Solid waste disposal on land	5A
J	5B1	Biological treatment of waste - Composting	5B1
J	5C1bi	Industrial waste incineration	5C1bi
J	5C1biii	Clinical waste incineration	5C1biii
J	5C1bv	Cremation	5C1bv
J	5C2	Open burning of waste	Buildings_R_nonUrban
J	5D1	Domestic wastewater handling	5D_N2O
J	5D1	Domestic wastewater handling	Buildings_R_nonSew-ered
J	5D2	Industrial wastewater handling	5D_N2O
J	5D2	Industrial wastewater handling	Buildings_R_nonSew-ered
J	5D3	Other wastewater handling	5D_N2O
J	5D3	Other wastewater handling	Buildings_R_nonSew-ered
J	5E	Other waste (please specify in IIR)	Population
K	3A1a	Dairy cattle	3B1a
K	3A1b	Non-dairy cattle	3B1b
K	3A2	Sheep	3B2
K	3A3	Swine	3B3
K	3A4d	Goats	3B4d
K	3A4e	Horses	3B4e
K	3A4f	Mules and asses	3B4f
K	3A4g	Poultry	3B4gii
K	3A4h	Other animals	3B4h
K	3B1a	Manure management - Dairy cattle	3B1a
K	3B1b	Manure management - Non-dairy cattle	3B1b
K	3B2	Manure management - Sheep	3B2
K	3B3	Manure management - Swine	3B3
K	3B4d	Manure management - Goats	3B4d
K	3B4e	Manure management - Horses	3B4e

K	3B4f	Manure management - Mules and asses	3B4f
K	3B4gi	Manure management - Laying hens	3B4gi
K	3B4gii	Manure management - Broilers	3B4gii
K	3B4giii	Manure management - Turkeys	3B4giv
K	3B4giv	Manure management - Other poultry	3B4giv
K	3B4h	Manure management - Other animals (please specify in IIR)	3B4h
L	3Da1	Inorganic N-fertilizers (includes also urea application)	LPIScropland
L	3Da2a	Animal manure applied to soils	3Da2a
L	3Da2b	Sewage sludge applied to soils	LPIScropland
L	3Da2c	Other organic fertilisers applied to soils (including compost)	LPIScropland
L	3Da3	Urine and dung deposited by grazing animals	LPISgrassland
L	3Da4	Crop residues applied to soils	LPIScropland
L	3Da5	Mineralization	LPIScropland
L	3Da6	Cultivation of organic soils	3D1a6
L	3Db	Indirect emissions from managed soils	LPIScropland
L	3Db1	Atmospheric deposition	AreaLand
L	3Db2	Nitrogen leaching and run-off	3D1b2
L	3Dc	Farm-level agricultural operations including storage, handling and transport of agricultural products	LPIScropImpGrass
L	3Dd	Off-farm storage, handling and transport of bulk agricultural products	HeatDemand_Industrial
L	3De	Cultivated crops	LPIScropland
L	3Df	Use of pesticides	LPIScropland
L	3F	Field burning of agricultural residues	LPIScropland
L	3G	Liming	LPIScropImpGrass
L	3H	Urea application	LPIScropland
O	1A3ai(ii)	International aviation cruise (civil)	AreaLandSea
O	1A3aii(ii)	Domestic aviation cruise (civil)	1A3aii(ii)
P	1A3di(i)	International maritime navigation	AreaSea
q	4A	LULUCF Forest land	CORINEforestland
q	4B	LULUCF Cropland	CORINEcropland
q	4C	LULUCF Grassland	CORINEgrassland
q	4D	LULUCF Wetlands	CORINEwetland
q	4E	LULUCF Settlements	CORINEsettlement
q	4F	LULUCF Other land	CORINEotherland
q	4G	LULUCF Harvested wood product	Population

Annex 4 - Correspondence list of IPCC categories and assigned land-use category

IPCC category	**Assigned land-use category**
Cropland Annual	Cropland Annual
Cropland Annual, Forestry	Complex Landscape
Cropland Annual, Forestry, Grassland Improved	Complex Landscape
Cropland Annual, Forestry, Grassland Temporary	Complex Landscape
Cropland Annual, Grassland Improved	Multiple Agriculture
Cropland Annual, Grassland Improved, Grassland Temporary	Multiple Agriculture
Cropland Annual, Grassland Improved, Grassland Unimproved	Multiple Agriculture
Cropland Annual, Grassland Improved, Settlement	Complex Landscape
Cropland Annual, Grassland Natural	Multiple Agriculture
Cropland Annual, Grassland Temporary	Multiple Agriculture
Cropland Annual, Grassland Temporary, Grassland Improved	Multiple Agriculture
Cropland Annual, Grassland Unimproved	Multiple Agriculture
Cropland Annual, Grassland Unimproved, Grassland Improved	Multiple Agriculture
Cropland Annual, Other	Complex Landscape
Cropland Annual, Settlement	Complex Landscape
Cropland Annual, Wetland	Complex Landscape
Cropland Perennial	Cropland Perennial
Cropland Perennial, Cropland Annual	Multiple Agriculture
Cropland Perennial, Grassland Improved	Multiple Agriculture
Cropland Perennial, Grassland Temporary	Multiple Agriculture
Cropland Perennial, Settlement	Complex Landscape
Forestry	Forestry
Forestry, Cropland Annual	Complex Landscape
Forestry, Grassland Improved	Complex Landscape
Forestry, Grassland Natural	Complex Landscape
Forestry, Grassland Unimproved	Complex Landscape
Forestry, Settlement	Complex Landscape
Forestry, Wetland	Complex Landscape
Grassland Improved	Grassland Improved
Grassland Improved, Cropland Annual	Multiple Agriculture
Grassland Improved, Cropland Annual, Forestry	Complex Landscape
Grassland Improved, Cropland Annual, Grassland Temporary	Multiple Agriculture
Grassland Improved, Cropland Annual, Grassland Unimproved	Multiple Agriculture
Grassland Improved, Cropland Perennial	Multiple Agriculture
Grassland Improved, Forestry	Complex Landscape
Grassland Improved, Grassland Natural	Grassland Improved
Grassland Improved, Grassland Natural, Grassland Unimproved	Grassland Improved
Grassland Improved, Grassland Natural, Other	Grassland Improved
Grassland Improved, Grassland Temporary	Grassland Improved

Grassland Improved, Grassland Temporary, Cropland Annual	Multiple Agriculture
Grassland Improved, Grassland Unimproved	Grassland Improved
Grassland Improved, Grassland Unimproved, Wetland	Grassland Improved
Grassland Improved, Other	Complex Landscape
Grassland Improved, Other, Grassland Unimproved	Grassland Improved
Grassland Improved, Settlement	Complex Landscape
Grassland Improved, Settlement, Cropland Annual	Complex Landscape
Grassland Improved, Settlement, Grassland Natural	Complex Landscape
Grassland Improved, Wetland	Complex Landscape
Grassland Improved, Wetland, Grassland Natural	Grassland Improved
Grassland Improved, Wetland, Grassland Temporary	Complex Landscape
Grassland Natural	Grassland Natural
Grassland Natural, Cropland Annual	Multiple Agriculture
Grassland Natural, Cropland Annual, Grassland Improved	Multiple Agriculture
Grassland Natural, Forestry	Complex Landscape
Grassland Natural, Forestry, Wetland, Grassland Improved	Complex Landscape
Grassland Natural, Grassland Improved	Grassland Improved
Grassland Natural, Grassland Improved, Grassland Unimproved	Grassland Improved
Grassland Natural, Grassland Temporary	Grassland Natural
Grassland Natural, Grassland Unimproved	Grassland Unimproved
Grassland Natural, Other	Other
Grassland Natural, Settlement, Other, Grassland Improved	Complex Landscape
Grassland Natural, Wetland	Complex Landscape
Grassland Temporary	Grassland Temporary
Grassland Temporary, Cropland Annual	Multiple Agriculture
Grassland Temporary, Cropland Annual, Grassland Improved	Multiple Agriculture
Grassland Temporary, Cropland Annual, Grassland Natural	Multiple Agriculture
Grassland Temporary, Cropland Perennial	Multiple Agriculture
Grassland Temporary, Forestry	Complex Landscape
Grassland Temporary, Grassland Improved	Grassland Improved
Grassland Temporary, Grassland Improved, Cropland Annual	Multiple Agriculture
Grassland Temporary, Grassland Natural	Grassland Natural
Grassland Temporary, Grassland Unimproved	Grassland Unimproved
Grassland Temporary, Settlement	Complex Landscape
Grassland Temporary, Settlement, Cropland Annual	Complex Landscape
Grassland Unimproved	Grassland Unimproved
Grassland Unimproved, Cropland Annual	Multiple Agriculture
Grassland Unimproved, Cropland Annual, Grassland Improved	Multiple Agriculture
Grassland Unimproved, Forestry	Complex Landscape
Grassland Unimproved, Grassland Improved	Grassland Improved
Grassland Unimproved, Grassland Improved, Cropland Annual	Multiple Agriculture
Grassland Unimproved, Grassland Improved, Grassland Temporary	Grassland Improved
Grassland Unimproved, Grassland Improved, Wetland	Grassland Improved
Grassland Unimproved, Grassland Natural	Grassland Unimproved
Grassland Unimproved, Grassland Temporary	Grassland Unimproved
Grassland Unimproved, Other	Other
Grassland Unimproved, Settlement	Complex Landscape
Grassland Unimproved, Wetland	Complex Landscape

Other	Other
Other, Grassland Improved	Grassland Improved
Other, Grassland Natural	Grassland Unimproved
Other, Grassland Unimproved, Grassland Natural, Grassland Improve	Complex Landscape
Other, Settlement, Grassland Improved	Complex Landscape
Other, Wetland, Grassland Improved, Grassland Natural	Complex Landscape
Settlement	Settlement
Settlement, Cropland Annual	Complex Landscape
Settlement, Grassland Improved	Complex Landscape
Settlement, Grassland Improved, Other	Complex Landscape
Settlement, Grassland Natural	Complex Landscape
Settlement, Grassland Temporary	Complex Landscape
Settlement, Wetland	Complex Landscape
Settlement, Wetland, Grassland Improved	Complex Landscape
Wetland	Wetland
Wetland, Forestry	Complex Landscape
Wetland, Grassland Improved	Complex Landscape
Wetland, Grassland Improved, Grassland Natural	Complex Landscape
Wetland, Grassland Improved, Grassland Unimproved	Complex Landscape
Wetland, Grassland Natural	Complex Landscape
Wetland, Grassland Natural, Grassland Improved	Complex Landscape
Wetland, Grassland Temporary	Complex Landscape
Wetland, Grassland Temporary, Grassland Natural	Complex Landscape
Wetland, Grassland Unimproved	Complex Landscape

Annex 5 - Irish projections

TM65_Irish_Grid **WKID: 29902 Authority: EPSG**	**TM75_Irish_Grid** **WKID: 29903 Authority: EPSG**	**IRENET95_Irish_Transverse_Mercator** **WKID: 2157 Authority: EPSG**
Projection: Transverse_Mercator False_Easting: 200000,0 False_Northing: 250000,0 Central_Meridian: -8,0 Scale_Factor: 1,000035 Latitude_Of_Origin: 53,5 Linear Unit: Meter (1,0) Geographic Coordinate System: GCS_TM65 Angular Unit: Degree (0,0174532925199433) Prime Meridian: Greenwich (0,0) Datum: D_TM65 Spheroid: Airy_Modified Semimajor Axis: 6377340,189 Semiminor Axis: 6356034,447938534 Inverse Flattening: 299,3249646	Projection: Transverse_Mercator False_Easting: 200000,0 False_Northing: 250000,0 Central_Meridian: -8,0 Scale_Factor: 1,000035 Latitude_Of_Origin: 53,5 Linear Unit: Meter (1,0) Geographic Coordinate System: GCS_TM75 Angular Unit: Degree (0,0174532925199433) Prime Meridian: Greenwich (0,0) Datum: D_TM75 Spheroid: Airy_Modified Semimajor Axis: 6377340,189 Semiminor Axis: 6356034,447938534 Inverse Flattening: 299,3249646	Projection: Transverse_Mercator False_Easting: 600000,0 False_Northing: 750000,0 Central_Meridian: -8,0 Scale_Factor: 0,99982 Latitude_Of_Origin: 53,5 Linear Unit: Meter (1,0) Geographic Coordinate System: GCS_IRENET95 Angular Unit: Degree (0,0174532925199433) Prime Meridian: Greenwich (0,0) Datum: D_IRENET95 Spheroid: GRS_1980 Semimajor Axis: 6378137,0 Semiminor Axis: 6356752,314140356 Inverse Flattening: 298,257222101

Annex 6 - List of TKeys

Monthly (GNFR_NFR/CRF_Pollutant)
A_1A1a_All
B_1A1b_All
B_1A1c_All
B_1A2a_All
B_1A2b_All
B_1A2c_All
B_1A2d_All
B_1A2e_All
B_1A2f_All
B_1A2gviii_All
B_2A1_All
B_2A2_All
B_2A4a_All
B_2A4b_All
B_2A4d_All
B_2A5a_All
B_2A5b_All
B_2A5c_All
B_2A6_All
B_2B10b_All
B_2C2_All
B_2D3b_All
B_2D3c_All
B_2H2_All
B_2I_All
C_1A4ai_All
C_1A4bi_All
C_1A4ci_All
D_1B1a_All
D_1B2aiv_All
D_1B2av_All
D_1B2b_All
D_1B2c_All
E_2D3a_All
E_2D3d_All
E_2D3e_All
E_2D3f_All
E_2D3g_All
E_2D3h_All

Daily (GNFR_NFR/CRF_Pollutant)
A_1A1a_All
B_1A1b_All
B_1A1c_All
B_1A2a_All
B_1A2b_All
B_1A2c_All
B_1A2d_All
B_1A2e_All
B_1A2f_All
B_1A2gviii_All
B_2A1_All
B_2A2_All
B_2A4a_All
B_2A4b_All
B_2A4d_All
B_2A5a_All
B_2A5b_All
B_2A5c_All
B_2A6_All
B_2B10b_All
B_2C2_All
B_2D3b_All
B_2D3c_All
B_2H2_All
B_2I_All
C_1A4ai_All
C_1A4bi_All
C_1A4ci_All
D_1B1a_All
D_1B2aiv_All
D_1B2av_All
D_1B2b_All
D_1B2c_All
E_2D3a_All
E_2D3d_All
E_2D3e_All
E_2D3f_All
E_2D3g_All
E_2D3h_All

Hourly (GNFR_NFR/CRF_Day)
A_1A1a_1-6
A_1A1a_7
B_1A1b_1-7
B_1A1c_1-7
B_1A2a_1-7
B_1A2b_1-7
B_1A2c_1-7
B_1A2d_1-7
B_1A2e_1-7
B_1A2f_1-7
B_1A2gviii_1-7
B_2A1_1-7
B_2A2_1-7
B_2A4a_1-7
B_2A4b_1-7
B_2A4d_1-7
B_2A5a_1-7
B_2A5b_1-7
B_2A5c_1-7
B_2A6_1-7
B_2B10b_1-7
B_2C2_1-7
B_2D3b_1-7
B_2D3c_1-7
B_2H2_1-7
B_2I_1-7
C_1A4ai_1-5
C_1A4ai_6-7
C_1A4bi_1-5
C_1A4bi_6-7
C_1A4ci_1-7
D_1B1a_1-7
D_1B2aiv_1-7
D_1B2av_1-7
D_1B2b_1-6
D_1B2b_7
D_1B2c_1-7
E_2D3a_1-5
E_2D3a_6-7

E_2D3i_All
E_2G1_All
E_2G2_All
F_1A3bi_All
F_1A3bii_All
F_1A3biii_All
F_1A3biv_All
F_1A3bv_All
F_1A3bvi_All
F_1A3bvii_All
G_1A3dii_All
H_1A3ai(i)_All
H_1A3aii(i)_All
I_1A2gvii_All
I_1A3c_All
I_1A3ei_All
I_1A4aii_All
I_1A4bii_All
I_1A4cii_All
I_1A4ciii_All
J_5A_All
J_5B1_All
J_5C1bi_All
J_5C1bv_All
J_5C2_All
J_5D1_All
J_5D1_N2O
J_5E_All
K_3B1a_All
K_3B1b_All
K_3B2_All
K_3B3_All
K_3B4d_All
K_3B4e_All
K_3B4f_All
K_3B4gi_All
K_3B4gii_All
K_3B4giii_All
K_3B4giv_All
K_3B4h_All
K_3B5_All
L_3Da1_All
L_3Da2a_All
L_3Da2b_All
L_3Da2c_All
L_3Da3_All
L_3Da4_All
L_3Db_All
L_3Dc_All
L_3Dd_All

E_2D3i_All
E_2G1_All
E_2G2_All
F_1A3bi_All
F_1A3bii_All
F_1A3biii_All
F_1A3biv_All
F_1A3bv_All
F_1A3bvi_All
F_1A3bvii_All
G_1A3dii_All
H_1A3ai(i)_All
H_1A3aii(i)_All
I_1A2gvii_All
I_1A3c_All
I_1A3ei_All
I_1A4aii_All
I_1A4bii_All
I_1A4cii_All
I_1A4ciii_All
J_5A_All
J_5B1_All
J_5C1bi_All
J_5C1bv_All
J_5C2_All
J_5D1_All
J_5D1_N2O
J_5E_All
K_3B1a_All
K_3B1b_All
K_3B2_All
K_3B3_All
K_3B4d_All
K_3B4e_All
K_3B4f_All
K_3B4gi_All
K_3B4gii_All
K_3B4giii_All
K_3B4giv_All
K_3B4h_All
K_3B5_All
L_3Da1_All
L_3Da2a_All
L_3Da2b_All
L_3Da2c_All
L_3Da3_All
L_3Da4_All
L_3Db_All
L_3Dc_All
L_3Dd_All

E_2D3d_1-7
E_2D3e_1-7
E_2D3f_1-7
E_2D3g_1-7
E_2D3h_1-7
E_2D3i_1-7
E_2G1_1-7
E_2G2_1-7
F_1A3bi_1
F_1A3bi_2-4
F_1A3bi_5
F_1A3bi_6
F_1A3bi_7
F_1A3bii_1
F_1A3bii_2-4
F_1A3bii_5
F_1A3bii_6
F_1A3bii_7
F_1A3biii_1
F_1A3biii_2-4
F_1A3biii_5
F_1A3biii_6
F_1A3biii_7
F_1A3biv_1
F_1A3biv_2-4
F_1A3biv_5
F_1A3biv_6
F_1A3biv_7
F_1A3bv_1-7
F_1A3bvi_1
F_1A3bvi_2-4
F_1A3bvi_5
F_1A3bvi_6
F_1A3bvi_7
F_1A3bvii_1
F_1A3bvii_2-4
F_1A3bvii_5
F_1A3bvii_6
F_1A3bvii_7
G_1A3dii_1-7
H_1A3ai(i)_1-7
H_1A3aii(i)_1-7
I_1A2gvii_1-7
I_1A3c_1-5
I_1A3c_6
I_1A3c_7
I_1A3ei_1-7
I_1A4aii_1-5
I_1A4aii_6-7
I_1A4bii_1-5

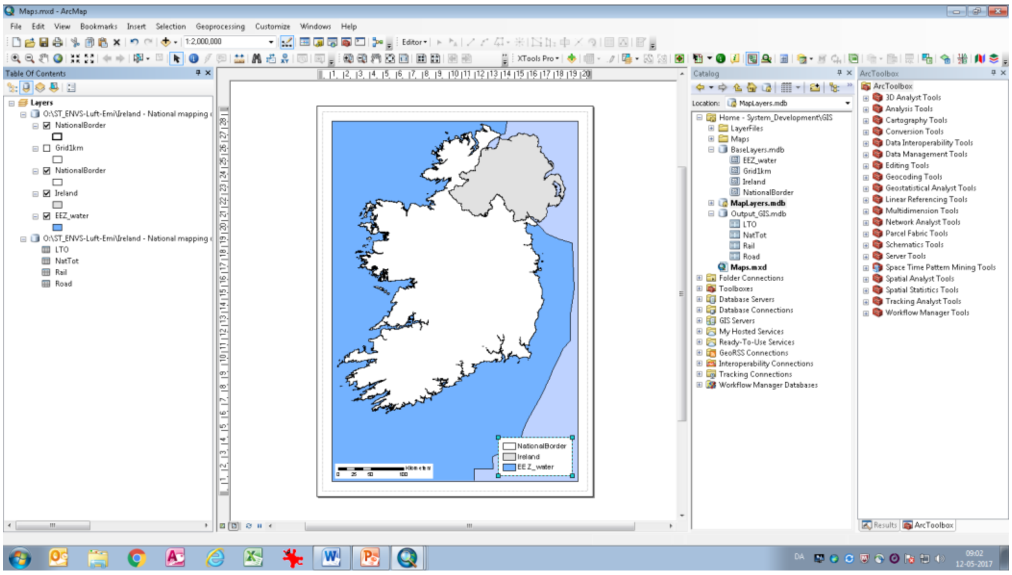
L_3Dd_PM2_5
L_3Dd_PM10
L_3Dd_TSP
L_3De_PM2_5
L_3De_PM10
L_3De_All
L_3Df_All
L_3F_All
O_1A3ai(ii)_All
O_1A3aii(ii)_All
P_1A3di(i)_All
q_4A_All
q_4B_All
q_4C_All
q_4D_All
q_4E_All
q_4F_All
q_4G_All

L_3Dd_PM2_5
L_3Dd_PM10
L_3Dd_TSP
L_3De_PM2_5
L_3De_PM10
L_3De_All
L_3Df_All
L_3F_All
O_1A3ai(ii)_All
O_1A3aii(ii)_All
P_1A3di(i)_All
q_4A_All
q_4B_All
q_4C_All
q_4D_All
q_4E_All
q_4F_All
q_4G_All

I_1A4bii_6-7
I_1A4cii_1-6
I_1A4cii_7
I_1A4ciii_1-7
J_5A_1-7
J_5B1_1-7
J_5C1bi_1-7
J_5C1bv_1-7
J_5C2_1-7
J_5D1_1-7
J_5E_1-7
K_3B1a_1-7
K_3B1b_1-7
K_3B2_1-7
K_3B3_1-7
K_3B4d_1-7
K_3B4e_1-7
K_3B4f_1-7
K_3B4gi_1-7
K_3B4gii_1-7
K_3B4giii_1-7
K_3B4giv_1-7
K_3B4h_1-7
K_3B5_1-7
L_3Da1_1-7
L_3Da2a_1-7
L_3Da2b_1-7
L_3Da2c_1-7
L_3Da3_1-7
L_3Da4_1-7
L_3Db_1-7
L_3Dc_1-7
L_3Dd_1-7
L_3De_1-7
L_3Df_1-6
L_3Df_7
L_3F_1-7
O_1A3ai(ii)_1-7
O_1A3aii(ii)_1-7
P_1A3di(i)_1-7
q_4A_1-7
q_4B_1-7
q_4C_1-7
q_4D_1-7
q_4E_1-7
q_4F_1-7
q_4G_1-7

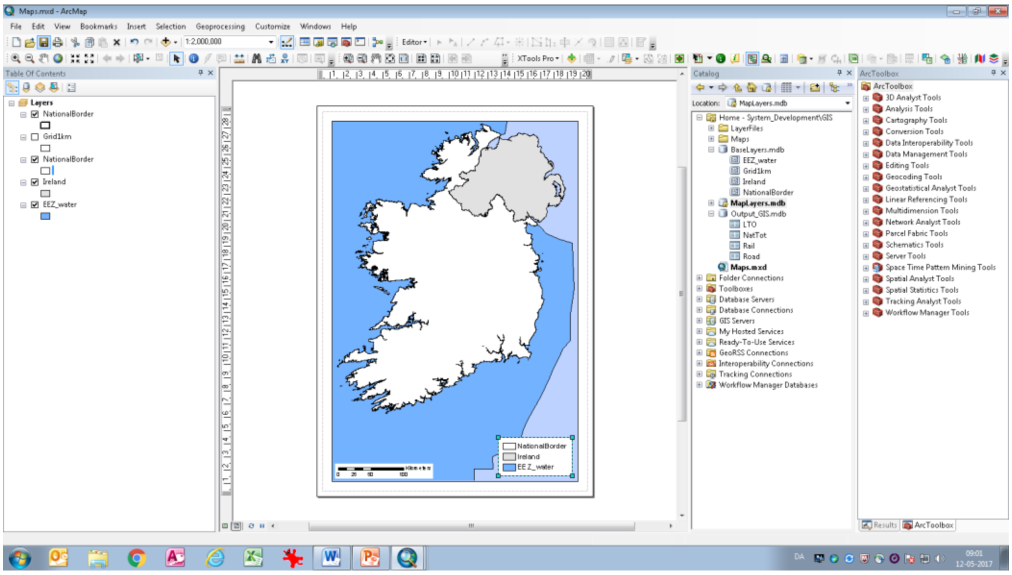
Annex 7 - Guide to create maps

- Open ...\\MapEIre\ModelSystem\GIS\Maps.mxd
- The mxd document contains the following base layers stored in the geodatabase ...\\MapEIre\ModelSystem\GIS\BaseLayers.mdb:
  - EEZ_water: The exclusive economic zone for the Republic of Ireland
  - Grid1km: grid with a resolution of 1 km x 1 km in the TM65 projection covering the national territory (land and water areas)
  - Ireland: coastline for Ireland (Republic of Ireland and Northern Ireland)
  - NationalBorder: national border for the Republic of Ireland
- Generate the output tables that should be included in the maps in ...\\MapEIre\ModelSystem\Output\MapEIre_Reporting.accdb
- Import the output tables to ...\\MapEIre\ModelSystem\GIS\Output_GIS.mdb. Use short table names (max 8 characters), avoid using reserved symbols and words (e.g. ln), and use letters as first character. All to avoid problems later in the workflow



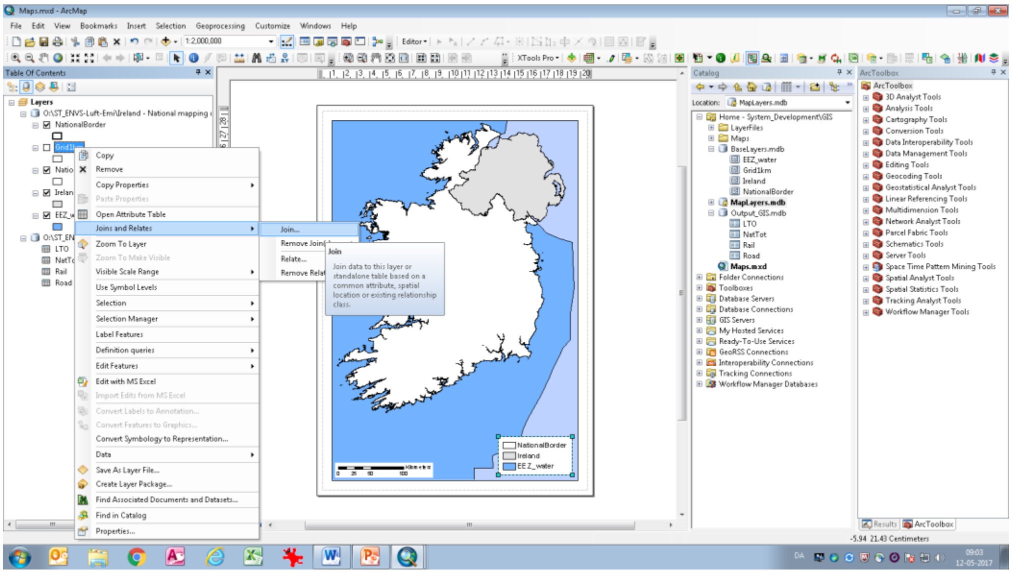
- Add the tables from Output_GIS.mdb to Maps.mxd

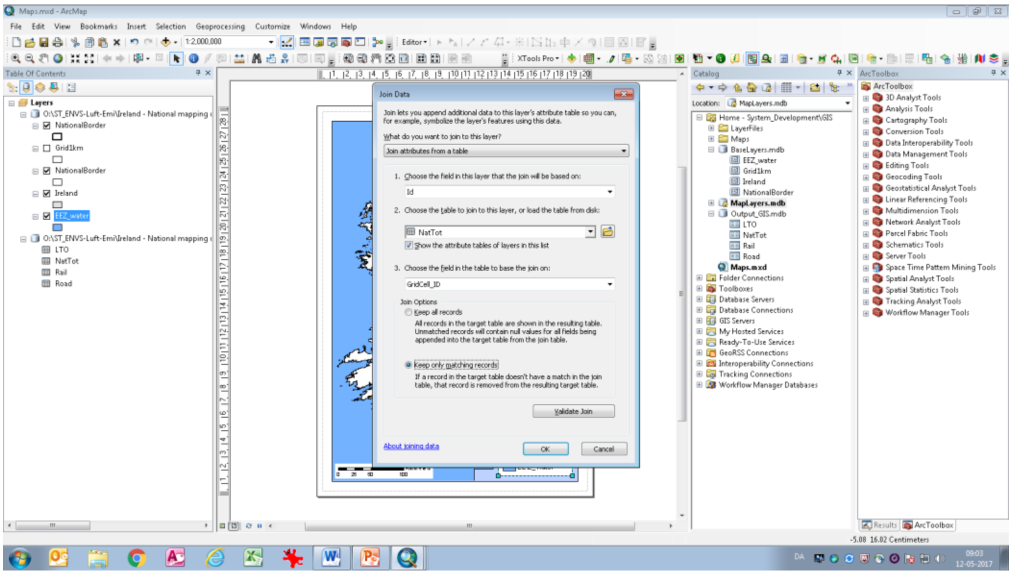
- The mxd document contains the following output tables:
  - LTO: emissions from national LTO (1A3aii_i) (…\\MapEIre_Reporting.accdb\qMap_1km_LTO_1A3aii_i_2015_Crosstab_MakeTable)
  - NatTot: National total emissions (…\\MapEIre_Reporting.accdb\qMap_1km_Nat_Tot_2015_Crosstab_MakeTable)
  - Rail: emissions from rail transport (1A3c) (…\\MapEIre_Reporting.accdb\qMap_1km_Rail_1A3c_2015_Crosstab_MakeTable)
  - Road: emissions from road transport (1A3b) (…\\MapEIre_Reporting.accdb\qMap_1km_Road_1A3b_2015_Crosstab_MakeTable)

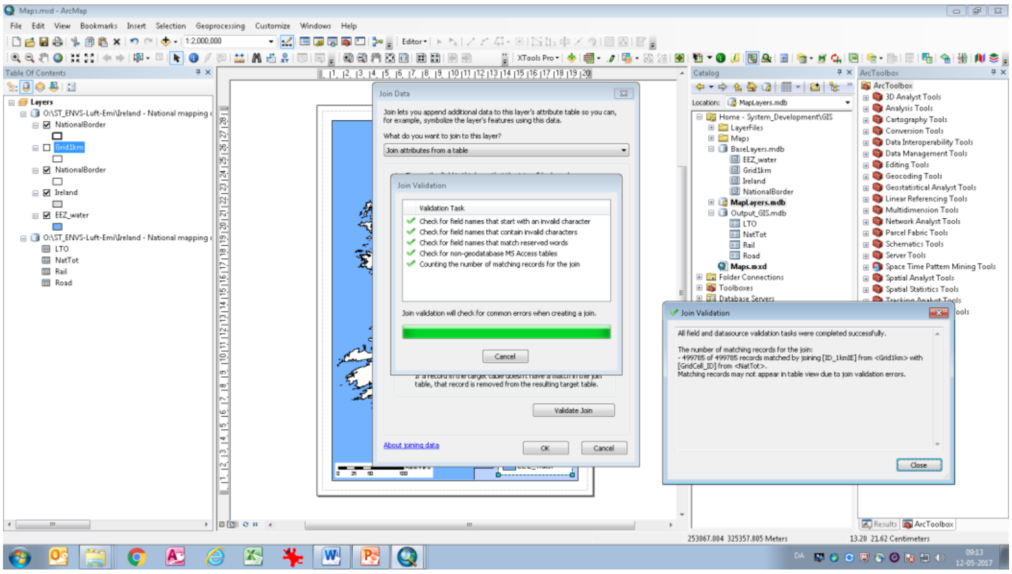


- Use Join by attribute to join an output table to the grid. Use ID_1kmIE as join field and select Keep only matching records

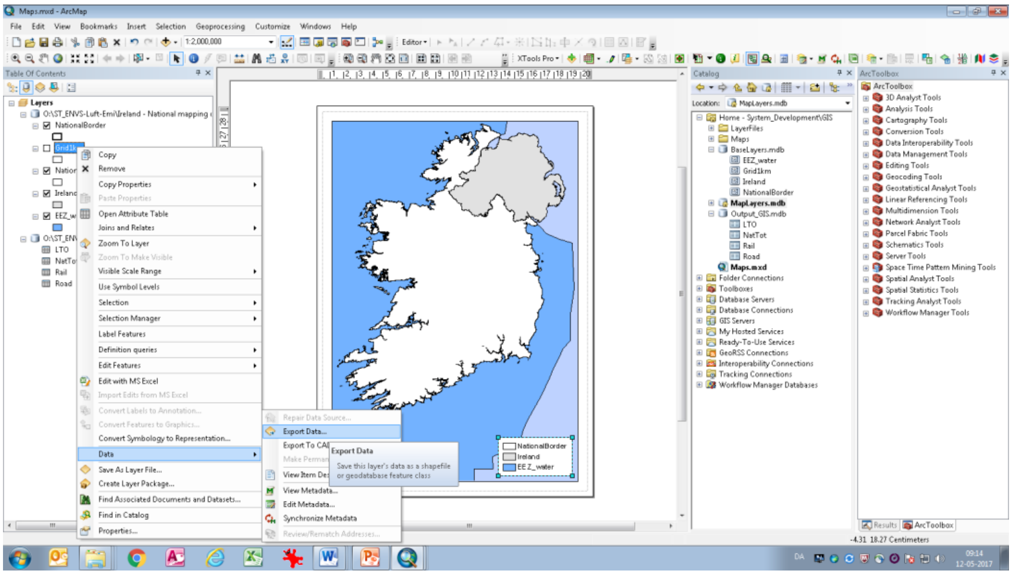
Hint: Use Validate join to check for common join errors, e.g. use of reserved words as field headings, and the number of joined records

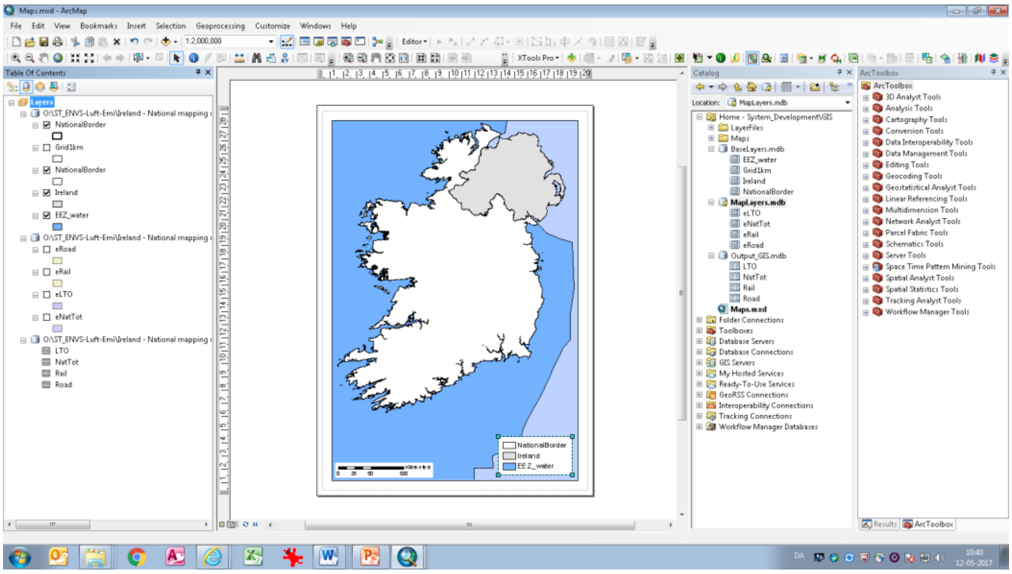




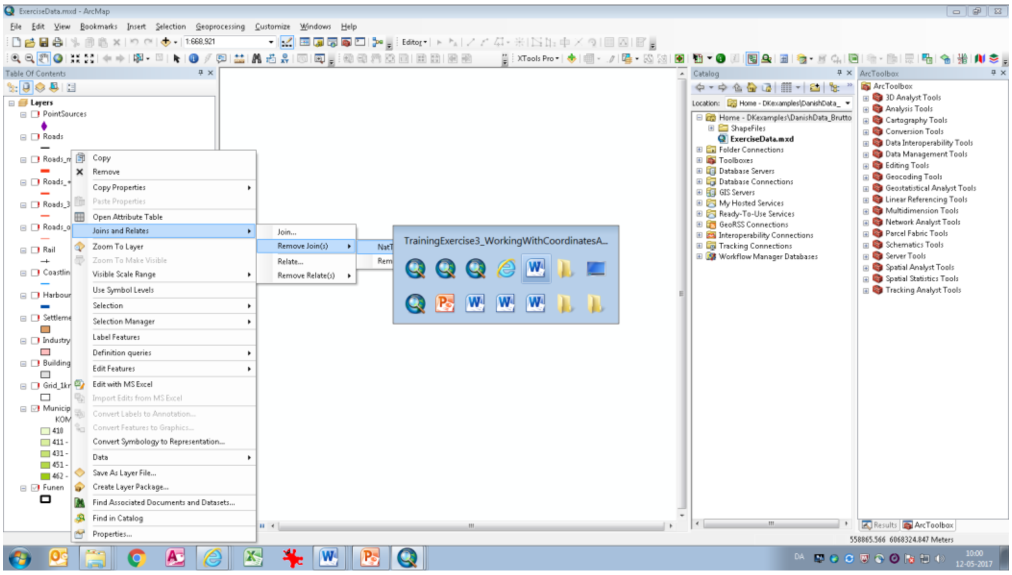


- Export the joined layer as feature layer to the personal geodatabase ...\\MapElre\ModelSystem\GIS\MapLayers.mdb
- Add the new layer to the map



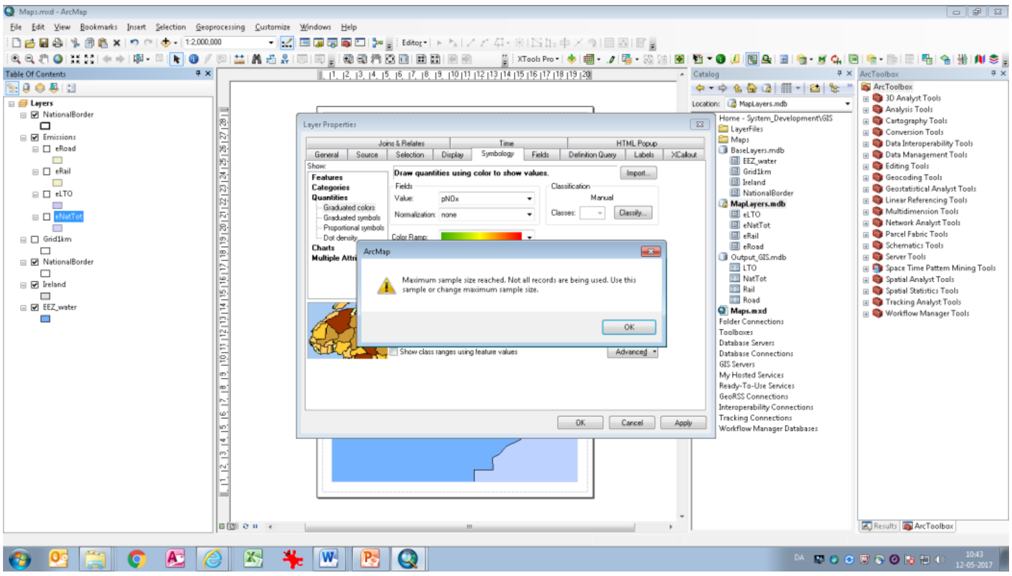


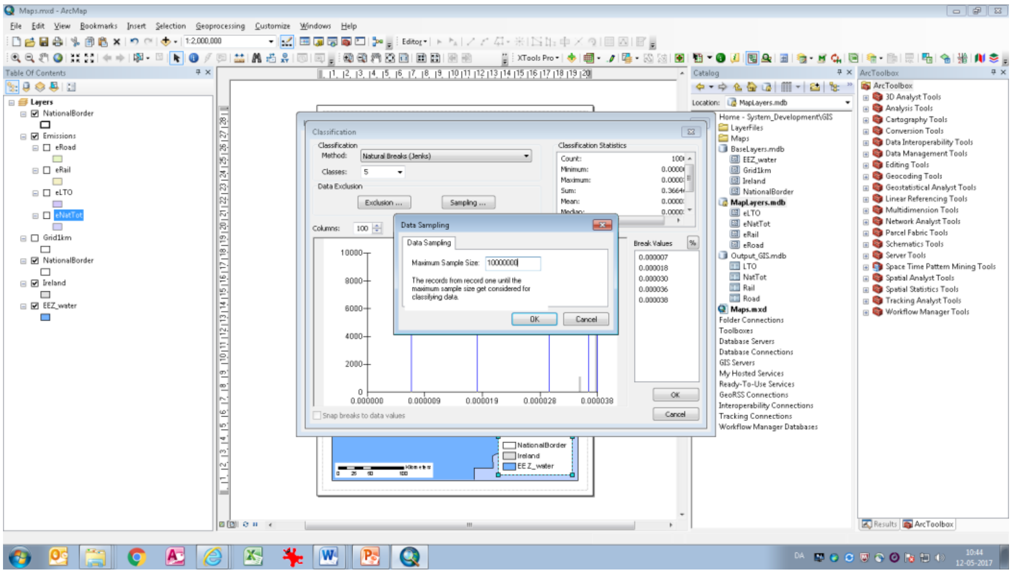
- Remove joins from the grid

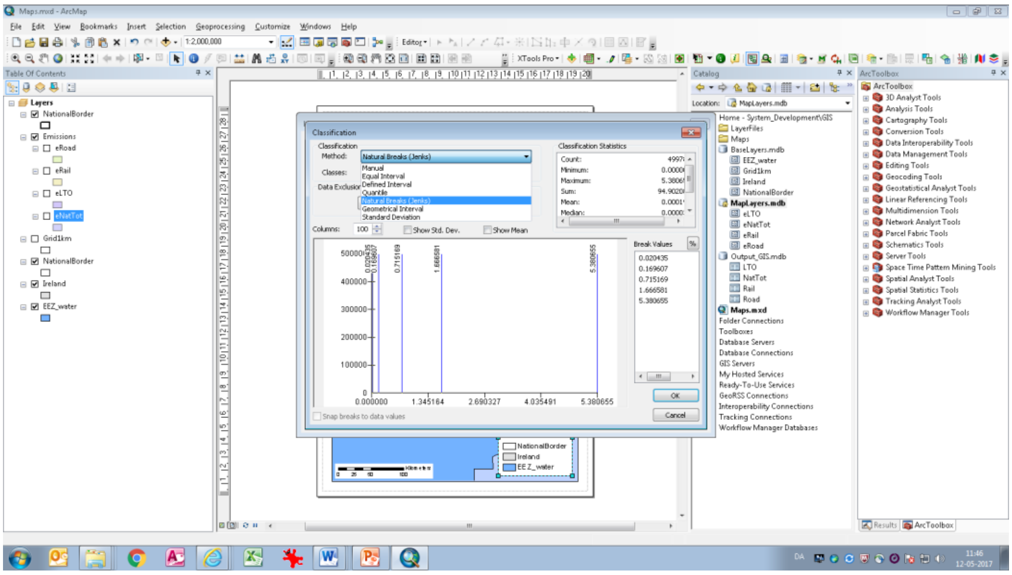


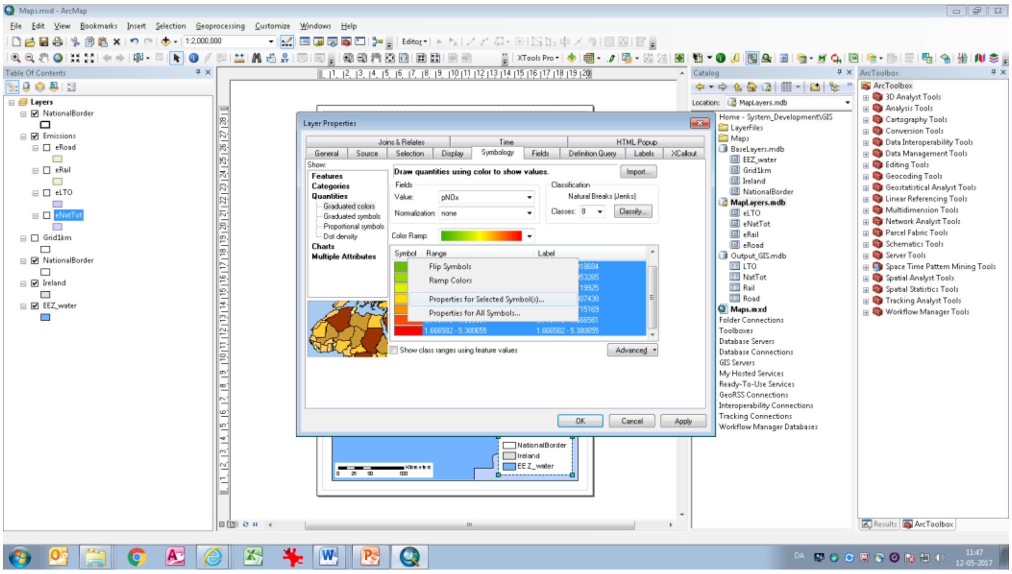
- Change the layer properties to adjust the visual settings
  - Symbology
    - How to draw layer (Quantities as Graduated colours or Graduated symbols are useful for displaying emissions and shares)
    - Field to show

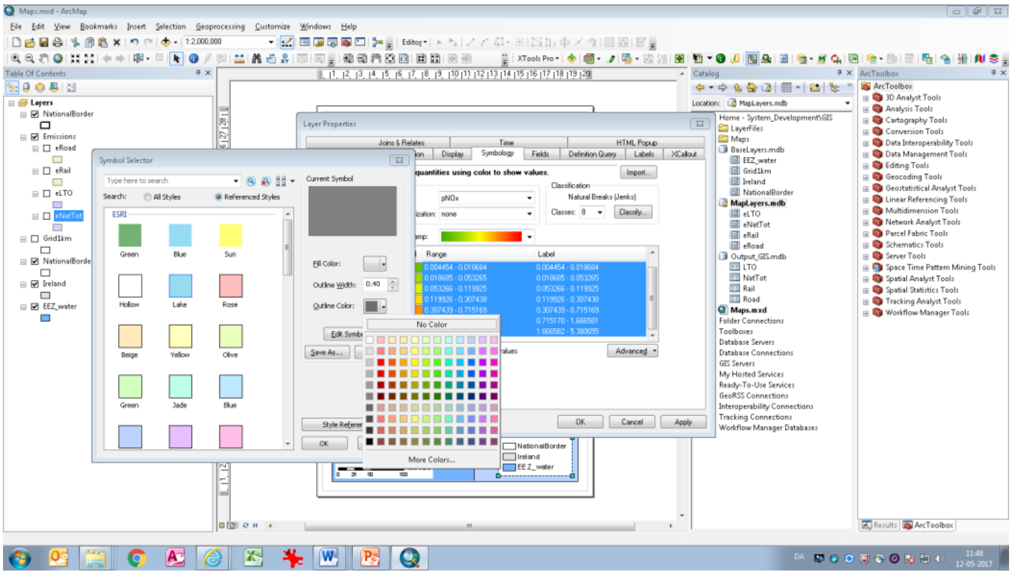
    - Colour ramp (be aware how the reader construes the colours; green→red=good→bad, light→dark = little→much)
    - Symbol settings (when using graduated colours for high resolution gridded data it is useful to set the outline colour to No colour)
    - Number of classes
    - Classification
        - Method (Natural breaks (jenks) are default)
        - Exclusion
        - Sample size (adjust so that all records are used to calculate ranges)
    - Ranges (when edited the classification method are changed to Manual)
    - Labels (will be shown in the legend on the map)
- Display
    - Transparent (colours are difficult to match to the legend when layers are partly transparent)

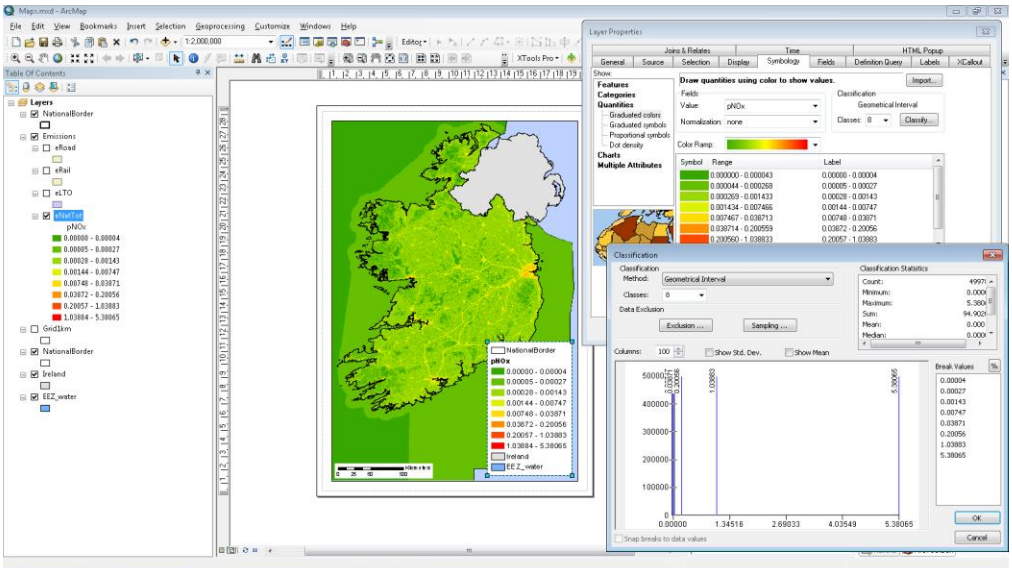


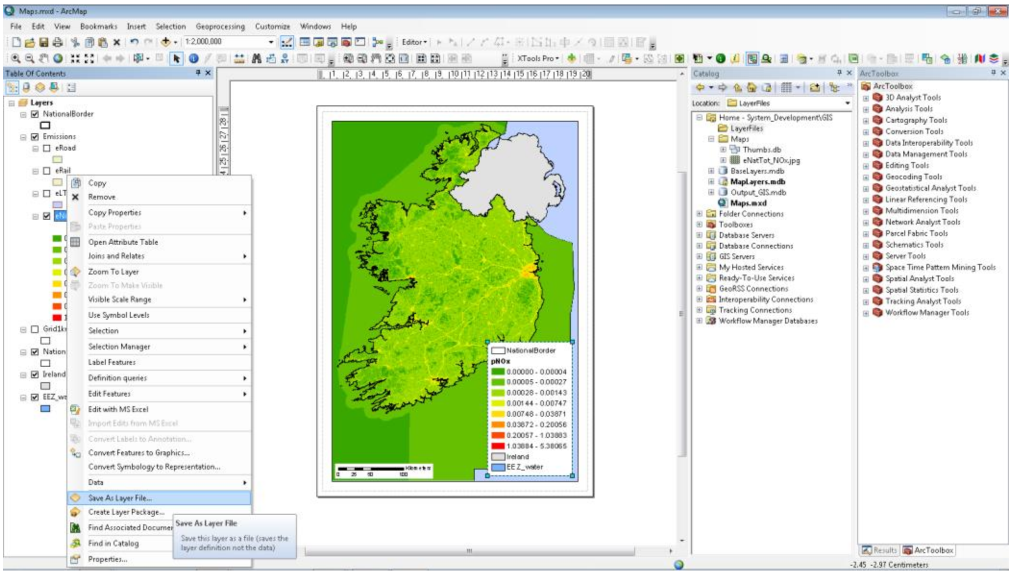


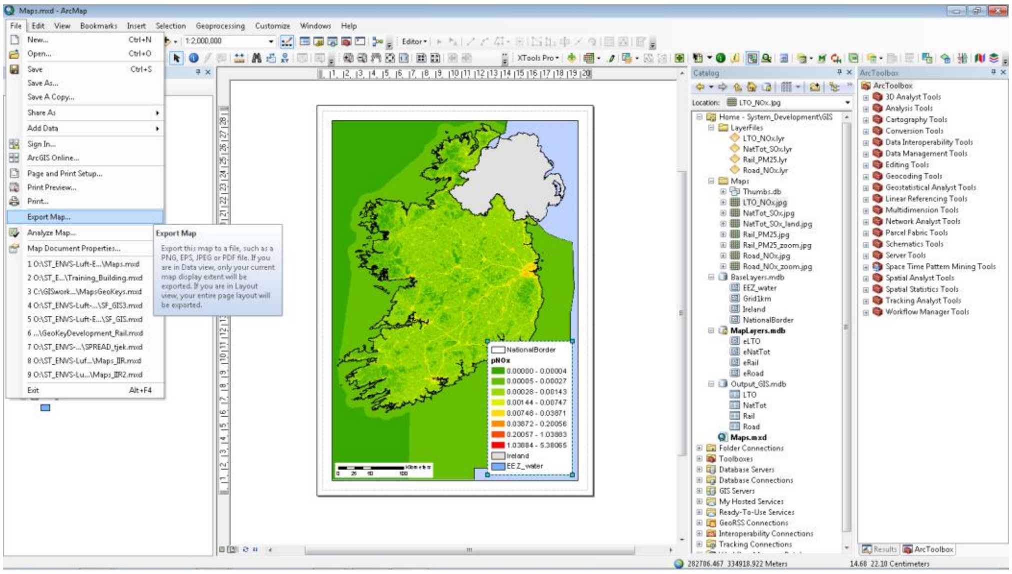


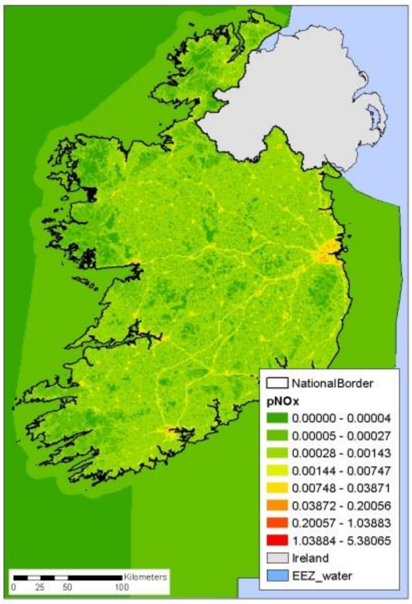
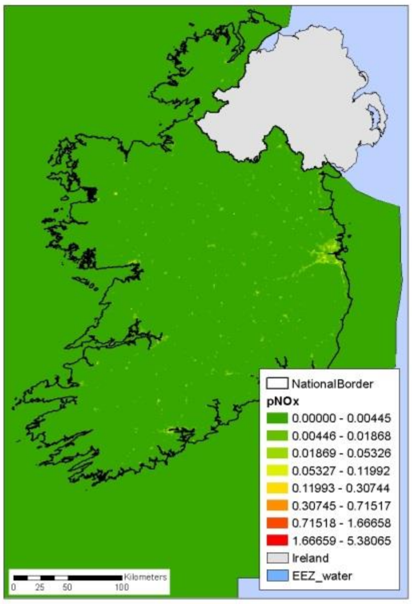




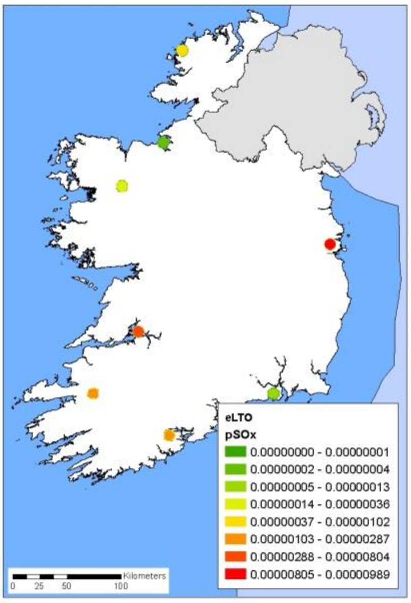




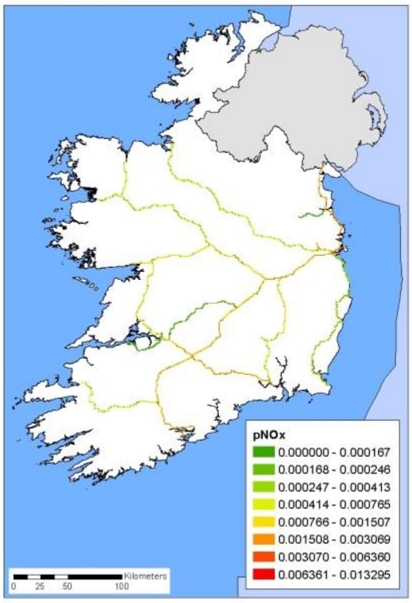


<table>
<tr>
<td>National total, NO_x
Classification: Geometrical intervals

</td>
<td>National total, NO_x
Classification: Natural breaks

</td>
</tr>
</table>

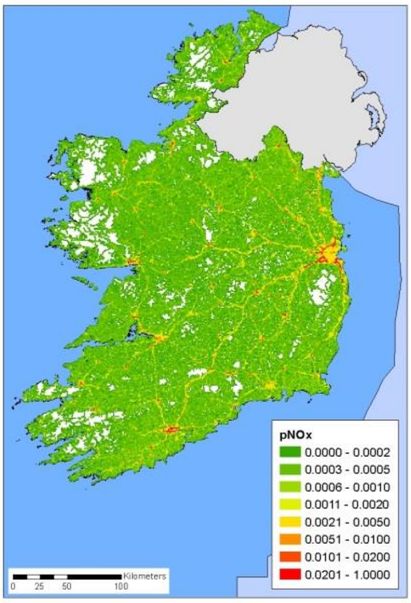
Domestic LTO, SO_x



Rail transport, NO_x

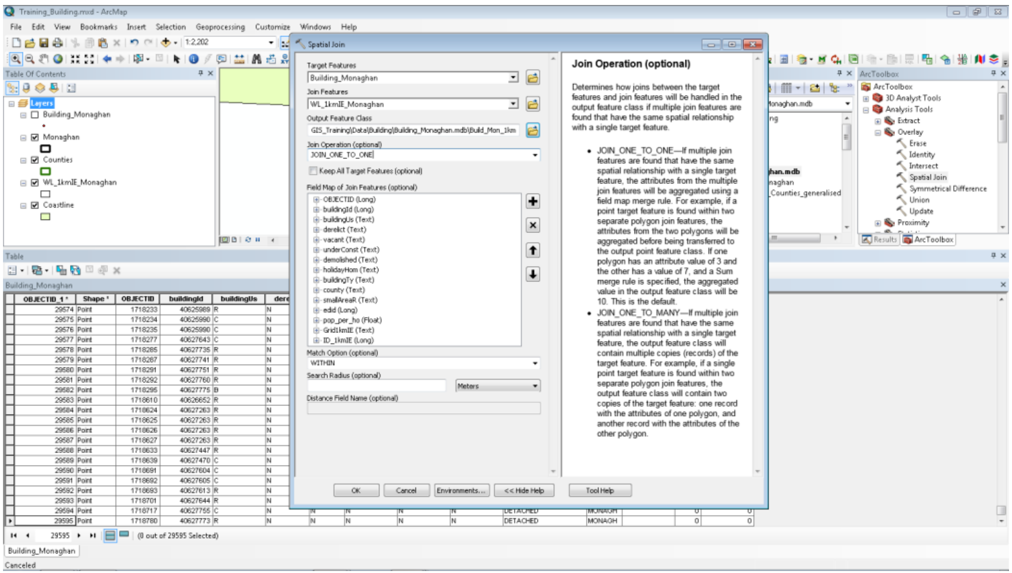


Road transport, NOx



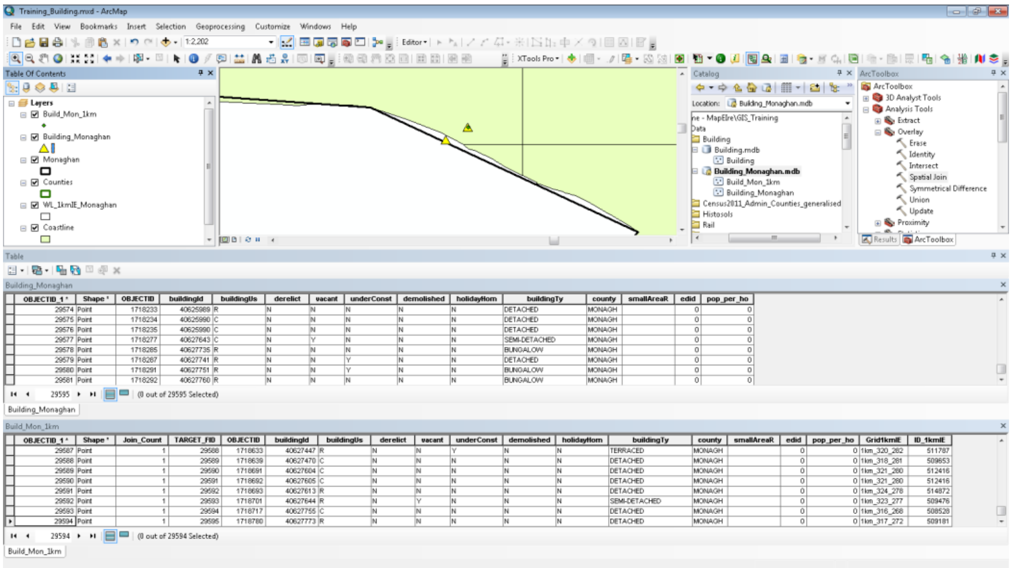
Annex 8 – Preparing a GeoKey for a point source

- Open ArcMAP and create a new mxd file (…\\MapEIre\GIS_Training\Training_Building.mxd)
- Add the following layers from …\\MapEIre\GIS_Training\Data\
    - \Borders.mdb\Coastline
    - \Borders.mdb\Counties
    - \Borders.mdb\Monaghan
    - \Grids.mdb\WL_1kmIE_Monaghan
    - \Building\Building_Monaghan.mdb\Building_Monaghan
- Use the Spatial join tool in ArcToolbox (ArcToolbox\AnalysisTools\Overlay\SpatialJoin) to join attribute data from “WL_1kmIE” to “Building_Monaghan”. Set JOIN OPERATION to JOIN ONE TO ONE and set the MATCH OPTION to WITHIN. Save layer as Building_Monaghan.mdb\Build_Mon_1km

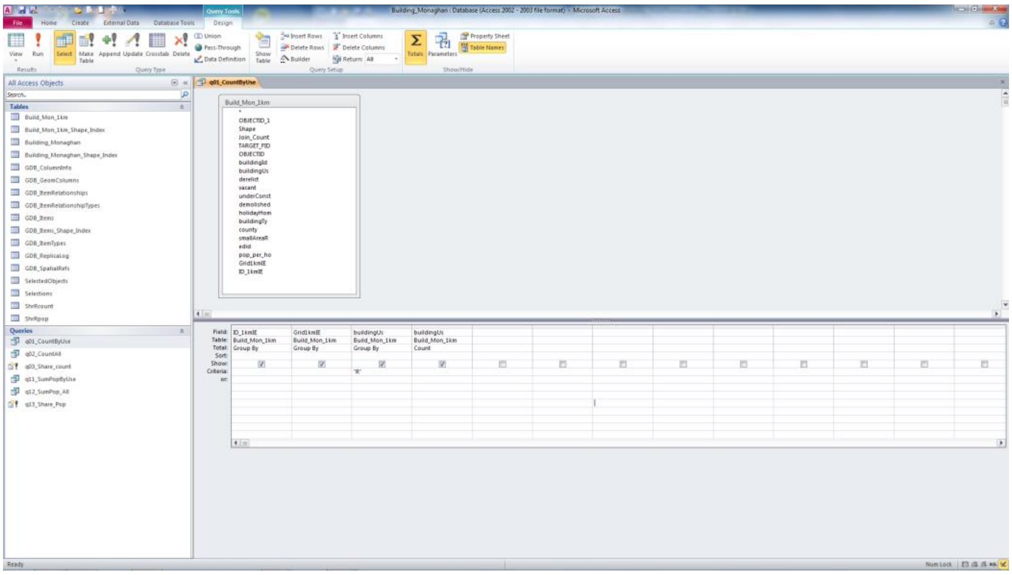


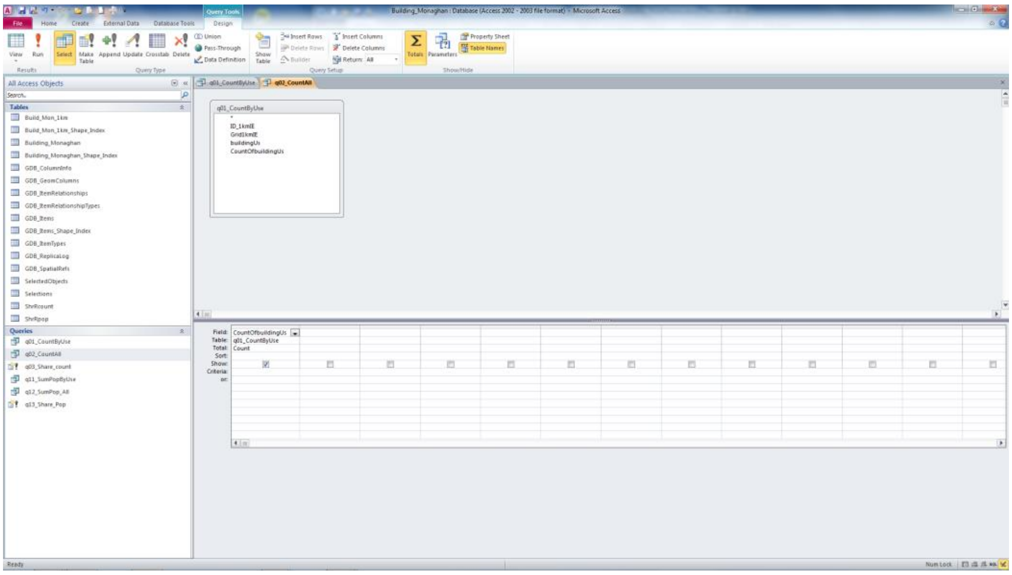
- Open the attribute tables of Building_Monaghan and Build_Mon_1km (right click the layers in table of content, TOC) and verify that the number of rows are equal, and that all rows in “Build_Mon_1km” have data in the 1km grid columns, e.g. “ID_1kmIE” (use Sort ascending)

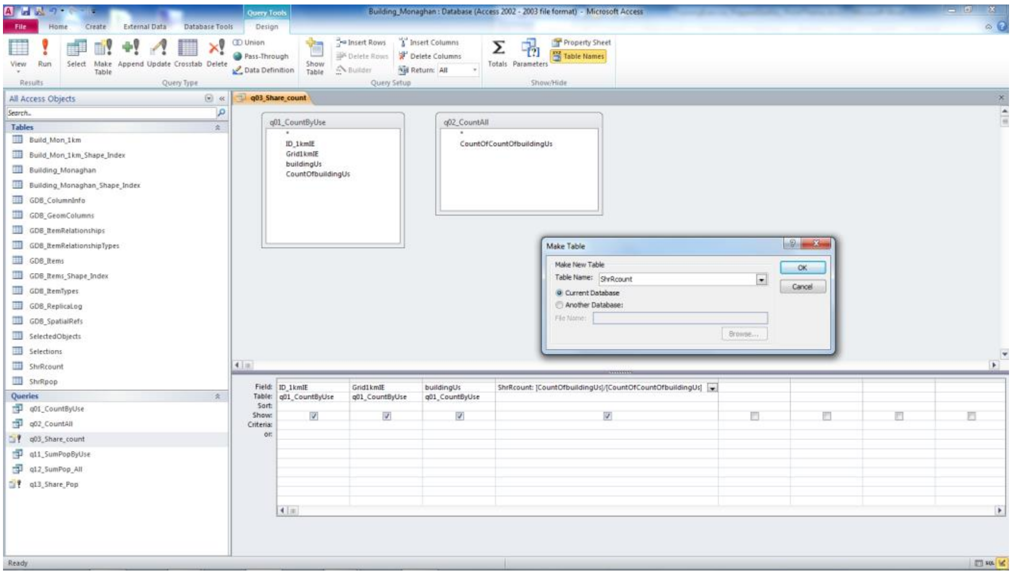
Hint: In this case one point cannot be spatially joined with the grid, as it is located inside the border of Co. Monaghan but outside the national border used in the model. The reason is that the county map is generalized and thereby less spatial accurate than the layer used for the national border



- Close ArcMAP
- Open Build_Mon_1km.mdb in Access
- Create a GeoKey based on count of residential buildings; “ShrRcount”:
- Create a select query (“q01_CountByUse”) that counts buildings in Build_Mon_1km by grid cell and by building use, and set the criteria for building use to “R” (residential). Group by “ID_1kmIE” and “Grid1kmIE”, and count by “buildingUs” where the Criteria is set to “R”
- Create a select query (“q02_Count All”) that counts buildings in “q01_CountByUse” by building use, and set the criteria for building use to “R” (Count by for “buildingUs”)
- Create a Make table query (“q03_Share_count”) that calculates the share of R-buildings by grid cell (“ShrRcount”:[CountOfbuildingUs]/[CountOfCountOfbuildingUs]). Set the new Table name to “ShrRcount”

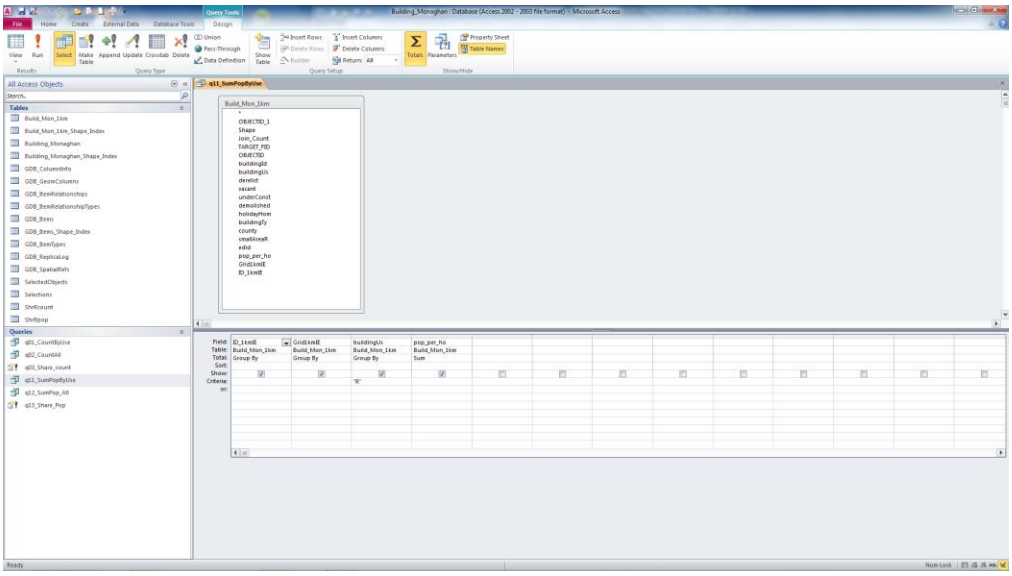


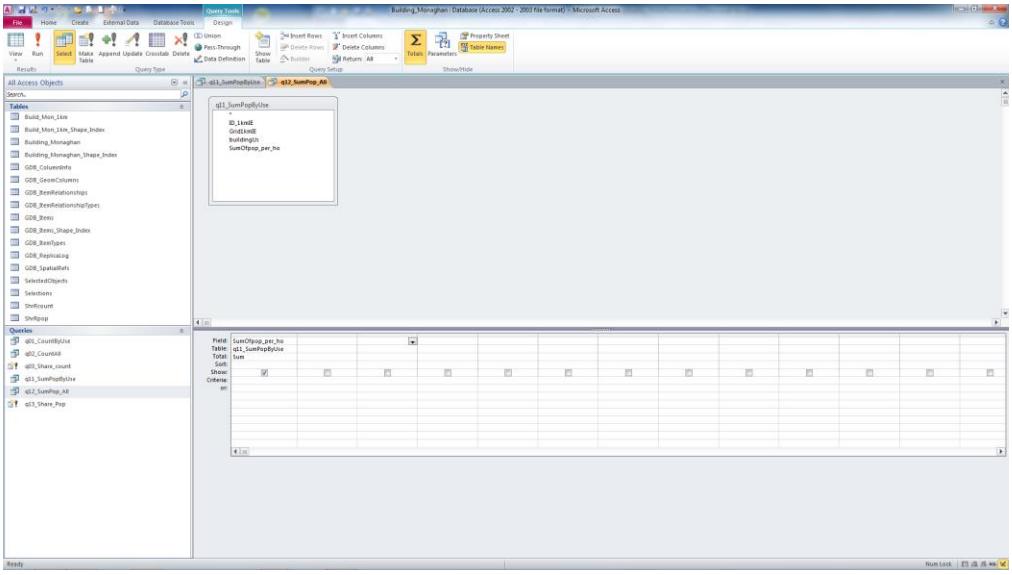


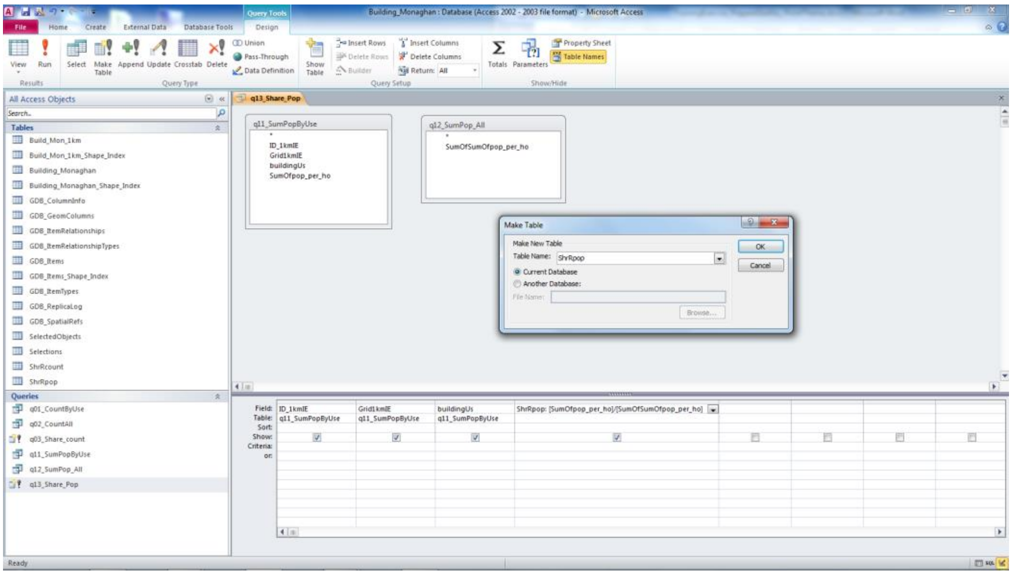


Create a GeoKey based on population in residential buildings; "ShrRpop":

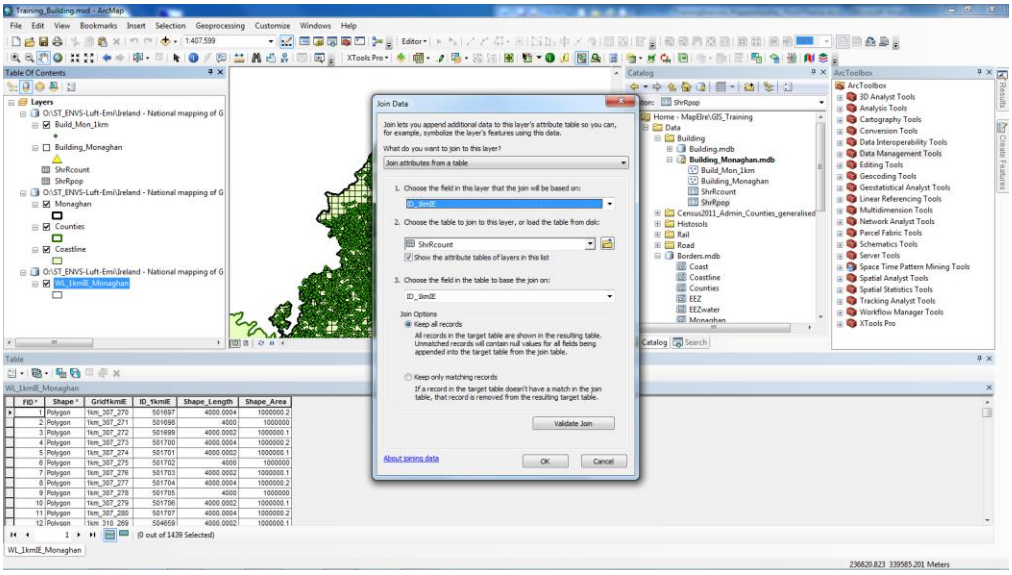
- Create a select query ("q11_SumPopByUse") that sum the population in "Build_Mon_1km" by grid cell and by building use, and set the criteria for building use to "R" (residential)
- Create a select query ("q12_SumPopAll") that sum the population in "q11_SumPopByUse" by building use, and set the criteria for building use to "R"
- Create a make table query ("q13_Share_pop") that calculates the share of population in R-buildings by grid cell. Set the new Table name to "ShrRpop"

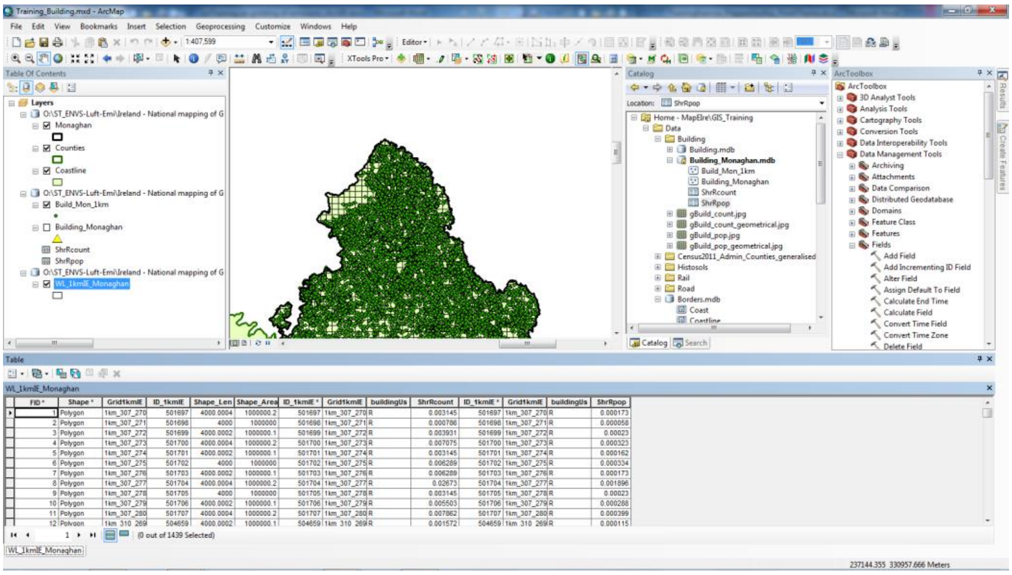






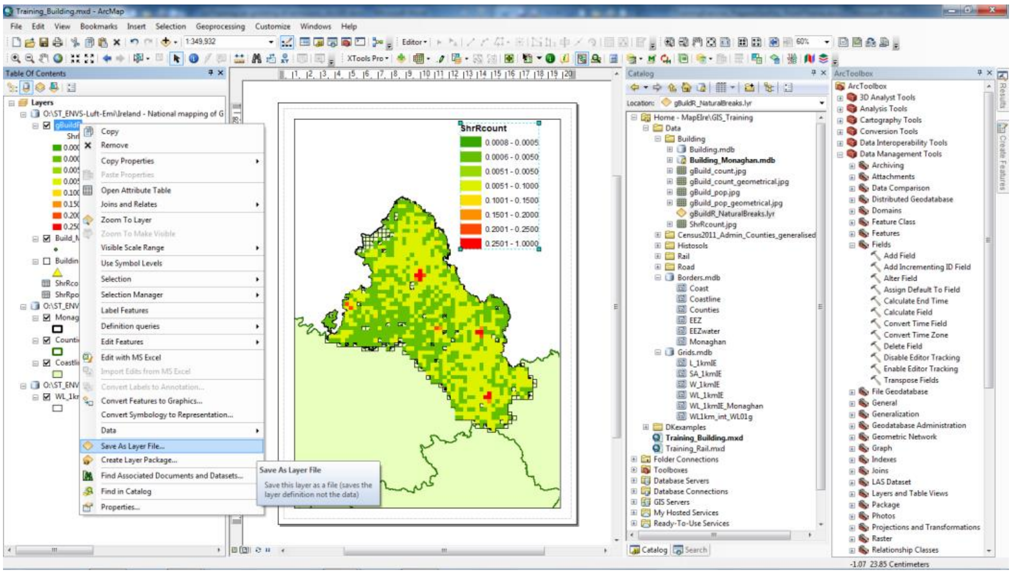
- Close Access
- Open Training_Building.mxd
- Add the tables “ShrRcount” and “ShrRpop”
- Join “ShrRcount” and “ShrRpop” to “WL_1kmIE_Monaghan” (right click “WL_1kmIE_Monaghan” and select Joins and Relates, Join). Use “ID_1kmIE” as join field and select the join option Keep all records
- Open the attribute table and verify that columns from both tables appear

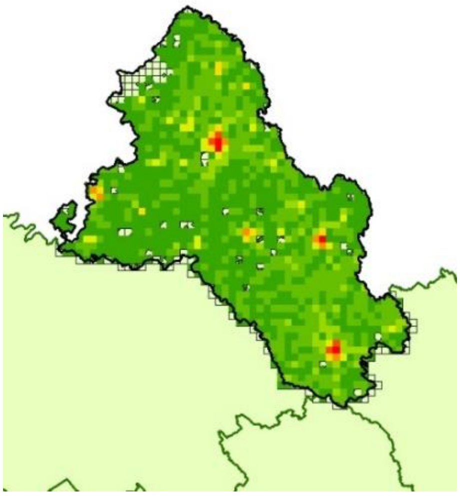




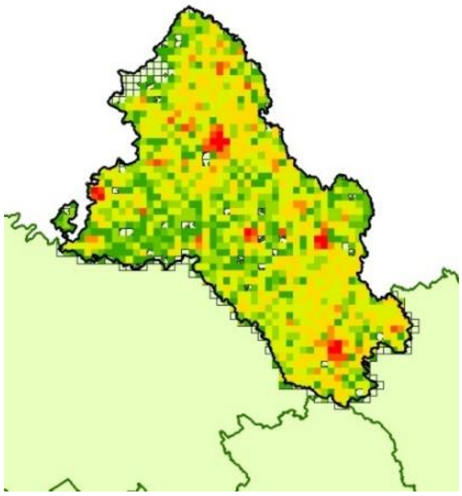
- Export the joined data to a new layer named "gBuilding" and add it to the map
- Remove all joins from "WL_1kmIE_Monaghan" (right click the layer in table of content, select Joins and relates and Remove all joins)
- Create maps for the two GeoKeys, using different classifications, and compare the maps

Hint: Saving symbology in layer files can be helpful for comparing maps of different parameters, using the same symbology. But be aware that values outside the ranges set in a layer file will not be displayed. E.g. if the maximum value in the value field that the layer file is based on ("ValueField1") is exceeded in the value field to which the layer file is applied ("ValueField2"), the values in "ValueField2" that exceed the maximum of "ValueField1" will be excluded from the map. The same can be the case for minimum values

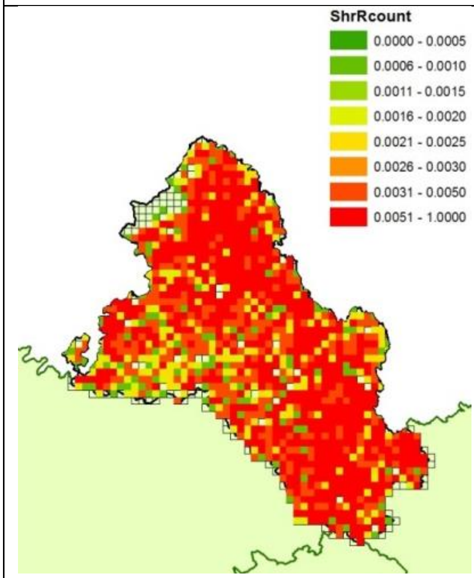




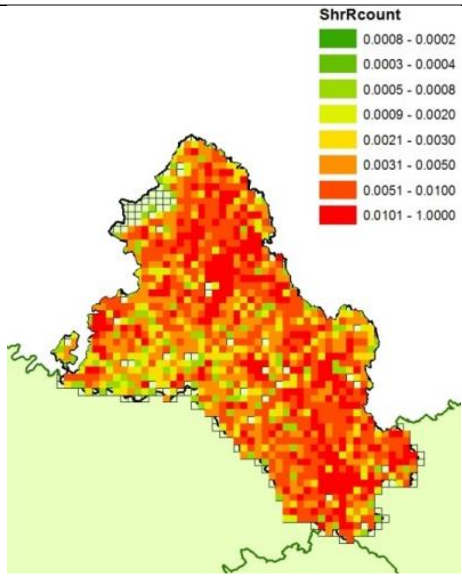
ShrRcount, natural breaks
Unadjusted ranges



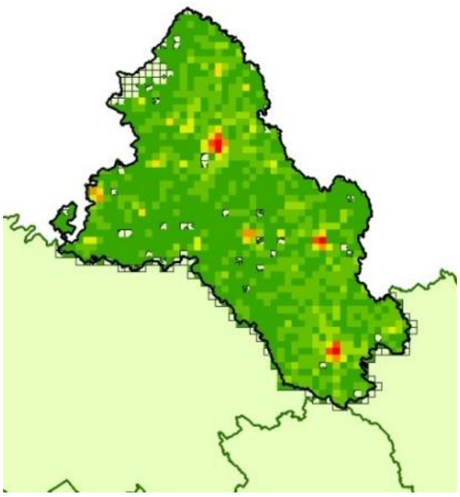
ShrRcount, geometrical intervals
Unadjusted ranges



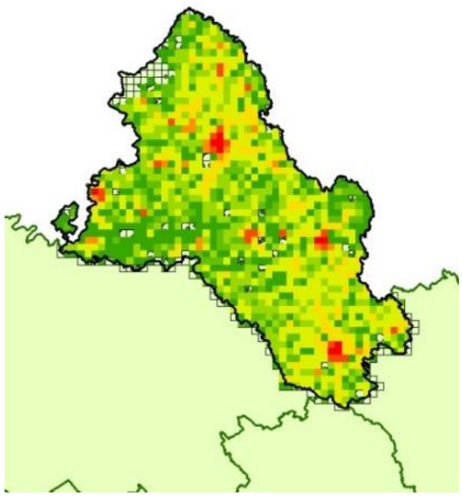
ShrRcount, natural breaks
Adjusted ranges



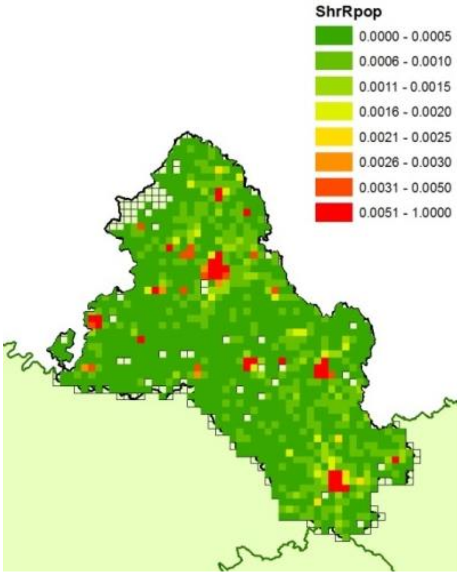
ShrRcount, geometrical intervals
Adjusted ranges



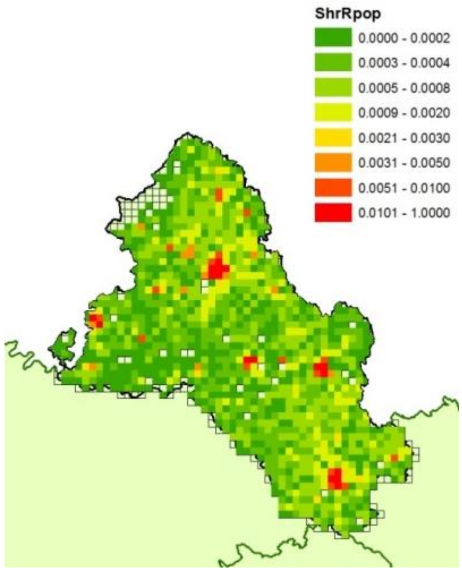
ShrRpop, natural breaks
Unadjusted ranges



ShrRpop, geometrical intervals
Unadjusted ranges



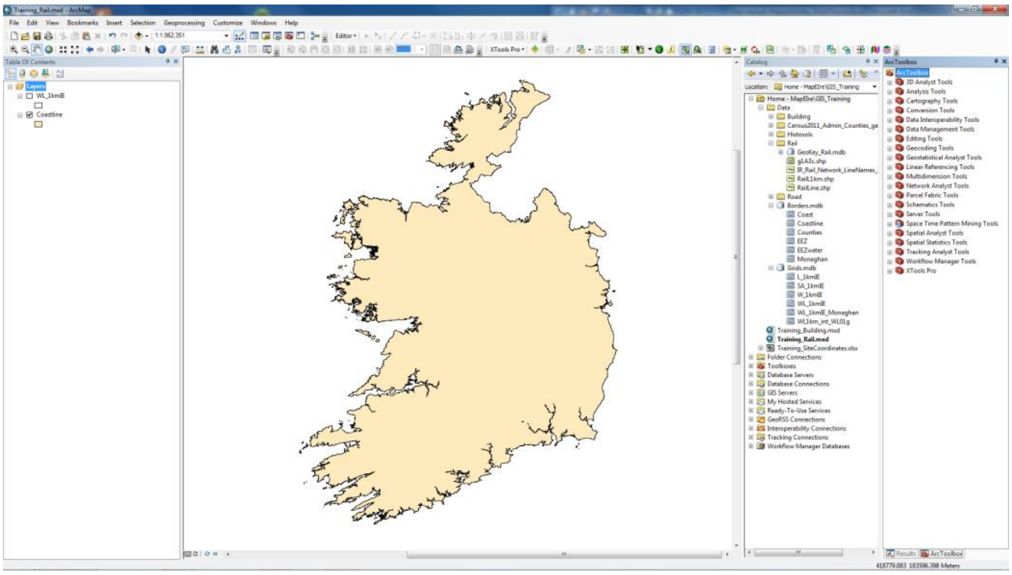
ShrRpop, natural breaks
Adjusted ranges



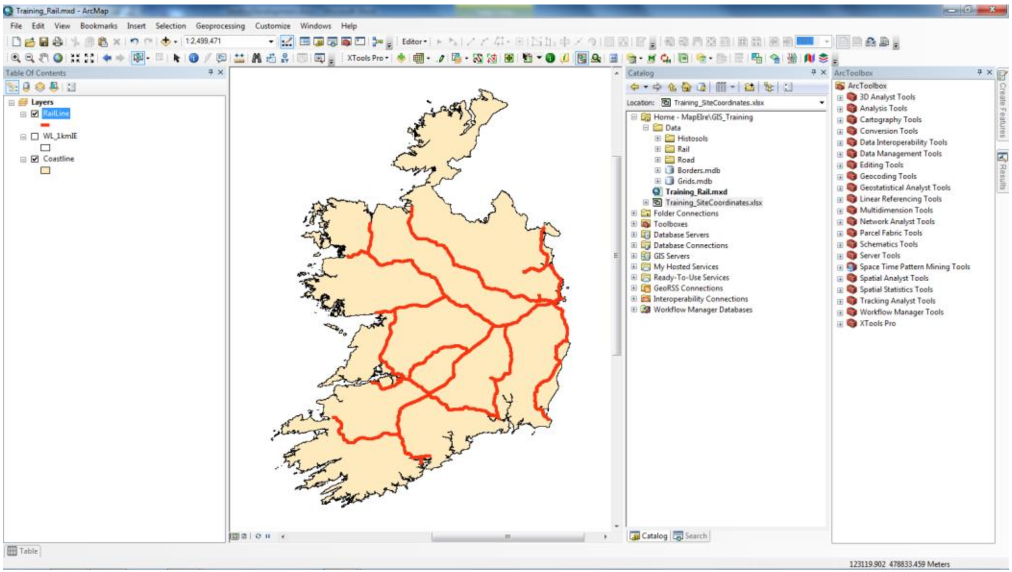
ShrRpop, geometrical intervals
Adjusted ranges

Annex 9 – Preparing a GeoKey for a line source

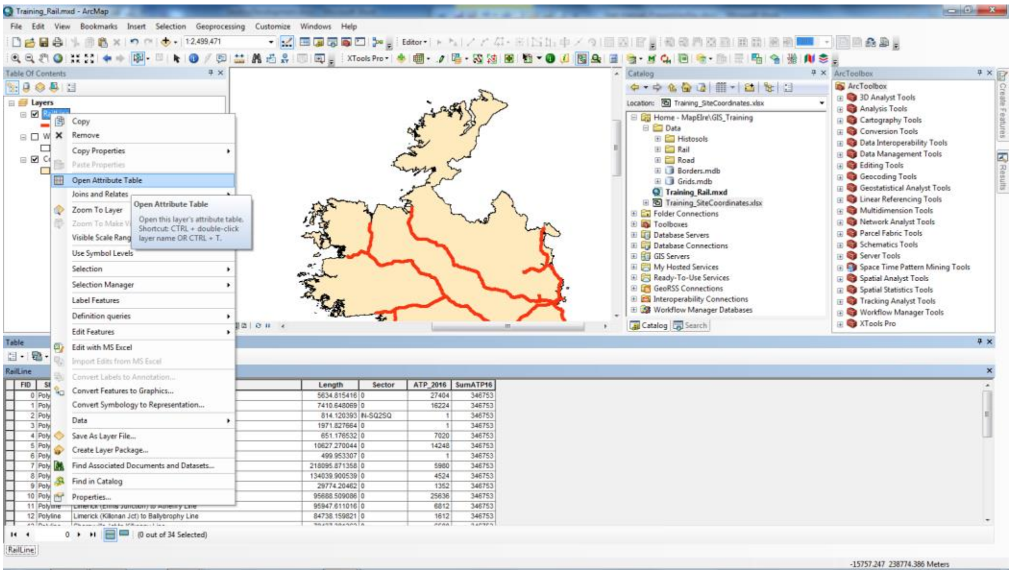
- Open ArcMAP and create a new mxd file (…\\MapEIre\GIS_Training\Training_Rail.mxd)
- Add the coastline (…\\MapEIre\GIS_Training\Data\Borders.mdb\Coastline) and the 1 km grid (…\\MapEIre\GIS_Training\Data\Grids.mdb\WL_1kmIE) using the Add data button or Drag-and-drop from ArcCatalog



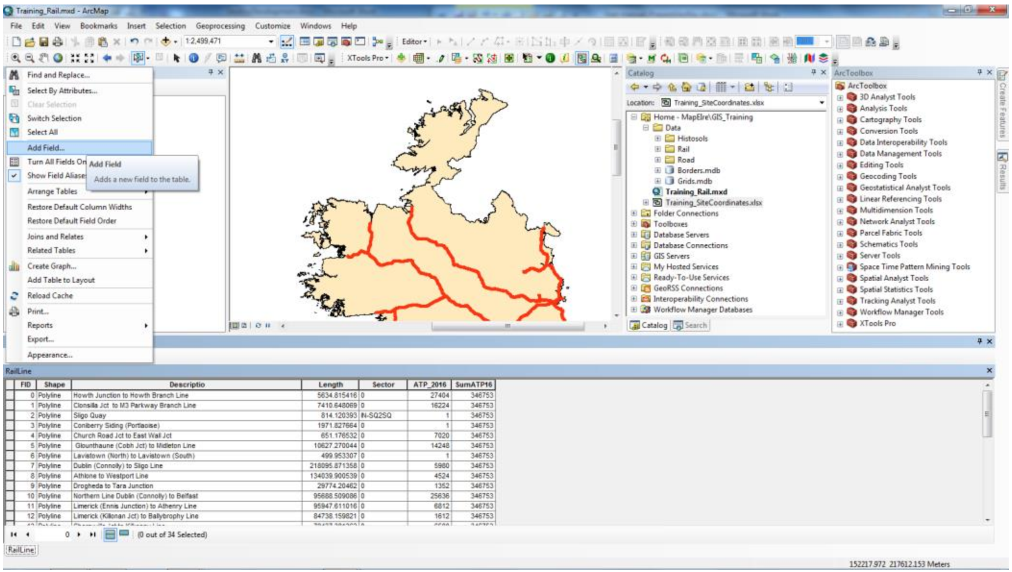
- Add the shapefile RailLine (\\MapEIre\GIS_Training\Data\Rail\RailLine.shp)

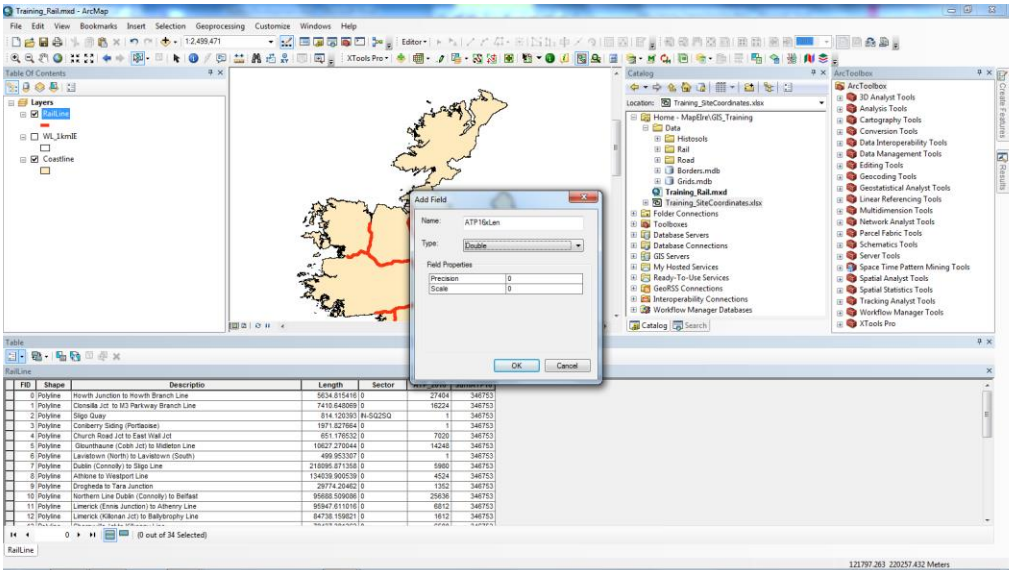


- Open the attribute table for RailLine (right click layer in table of content, TOC). The attribute table holds the parameters for each line; name, annual train passages in 2016 (“ATP_2016”), and sum of annual train passages in 2016 (“sumATP16”)

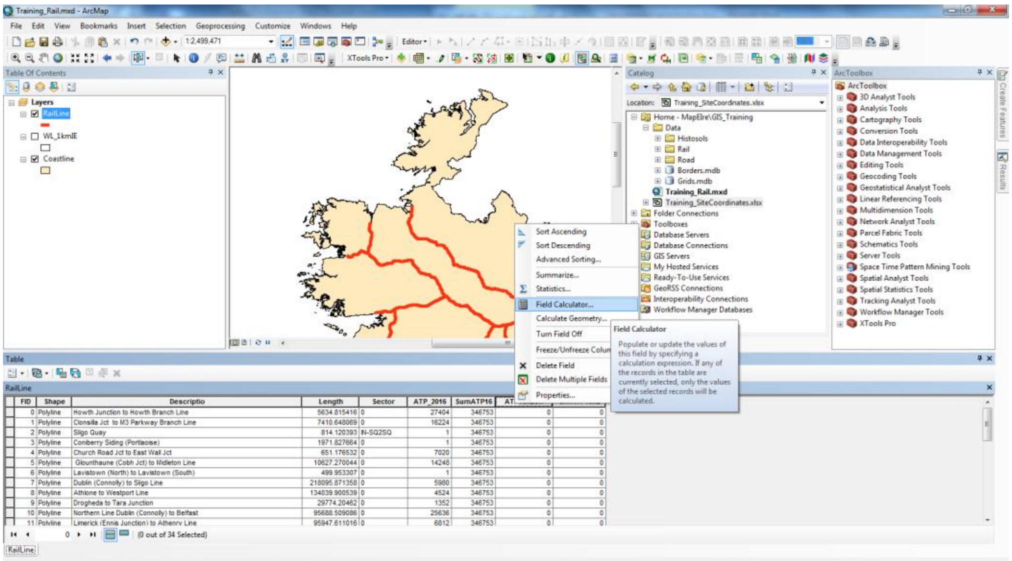


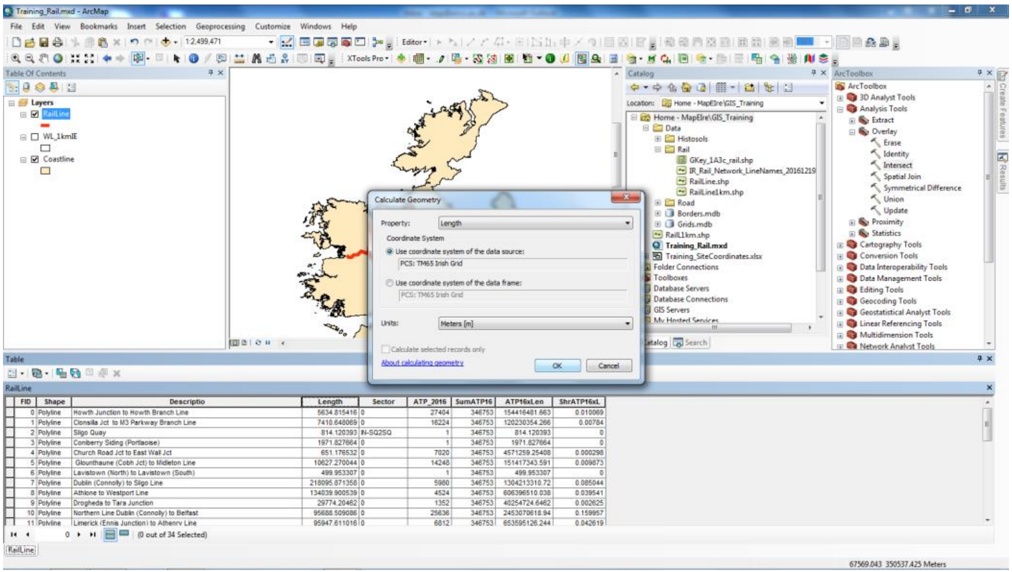
- Use Add field from the attribute table menu to add 3 new fields for calculation. Name the fields “Length”, “ATP16xLen” and “ShrATP16xL”, and set the Type to Double



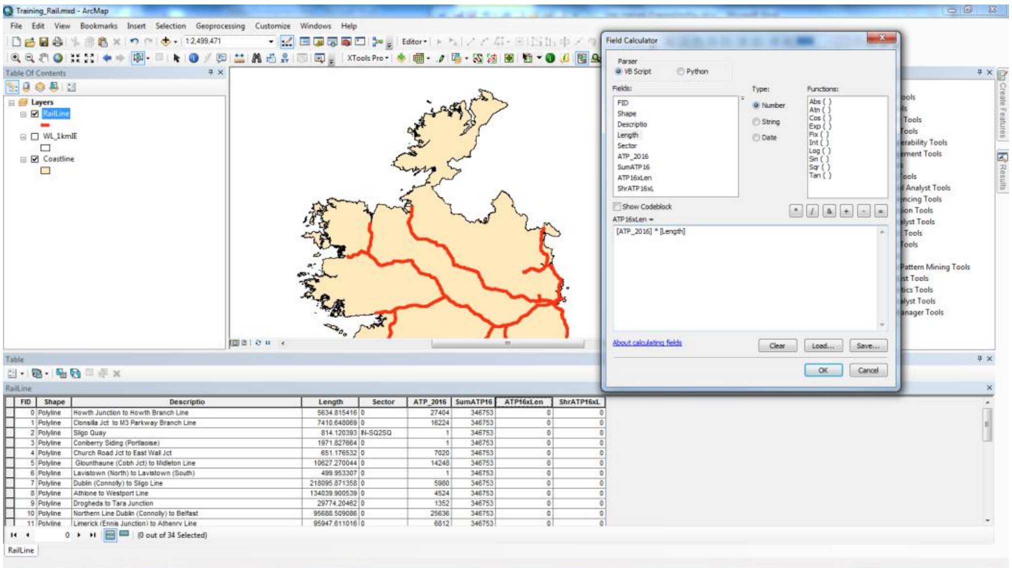


- Open the Calculate geometry tool by right click on the column name “Length” and calculate the length of each rail line. Make sure the calculation use the TM65 projection

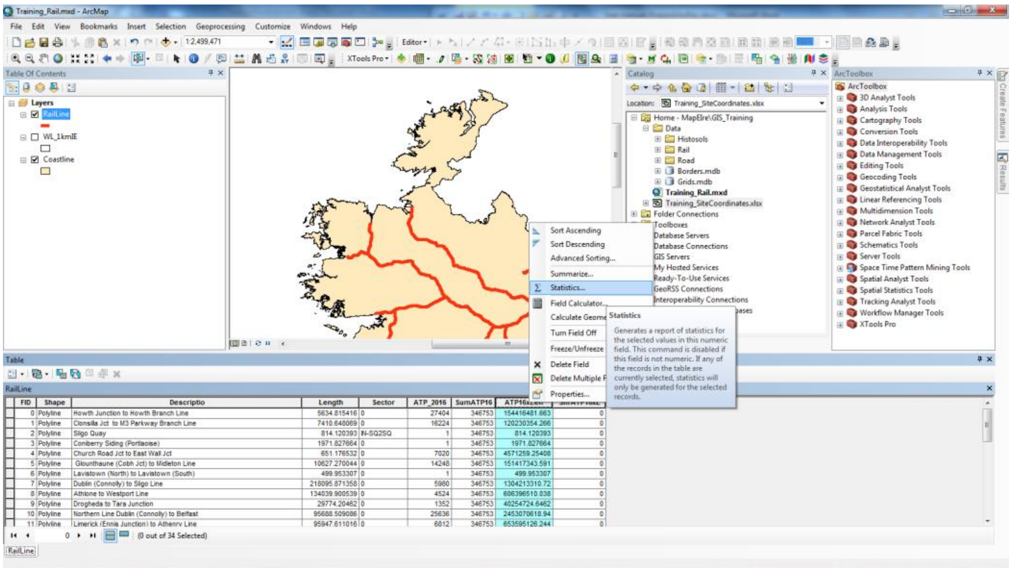


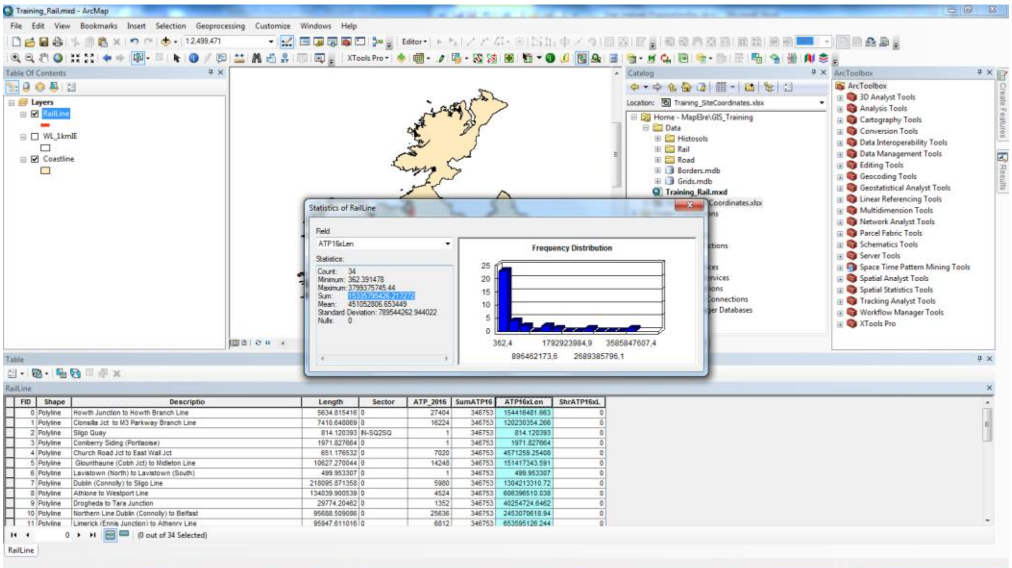


- Open the Calculate field tool by right click on the column name “ATP16xLen” and calculate values as [ATP16xLen] = [ATP_2016] * [Length]

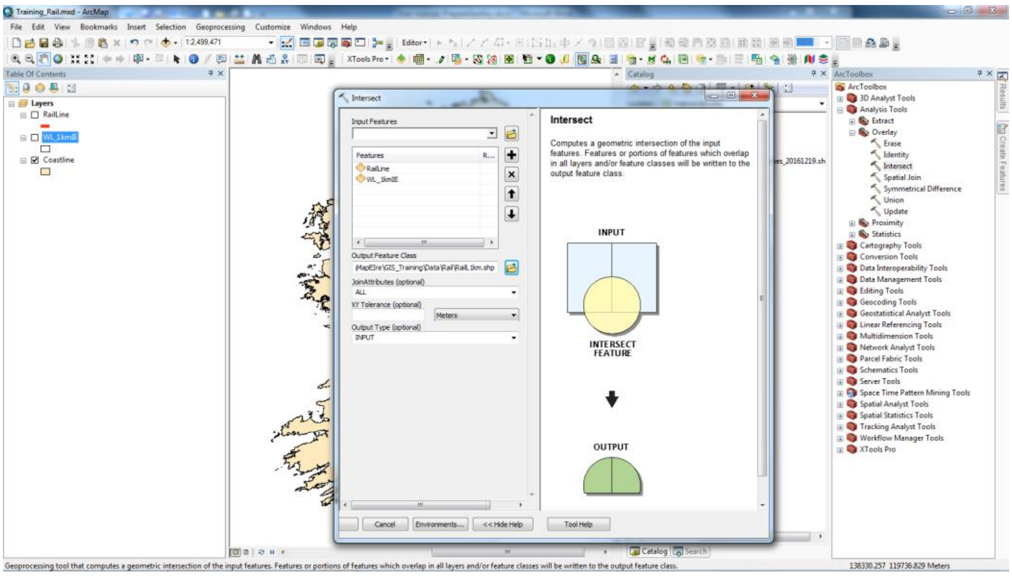


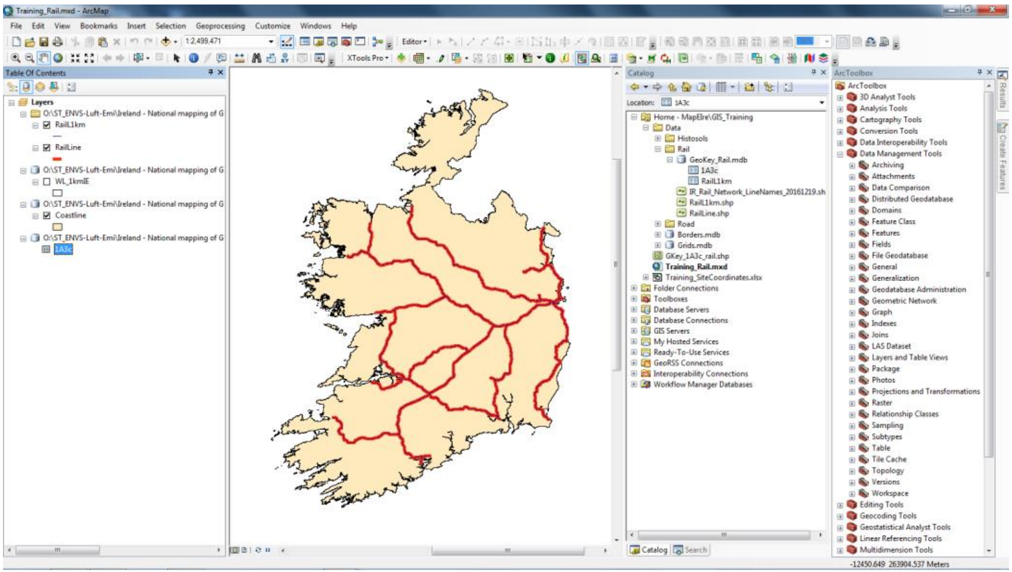
- Right click on the column name “ATP16xLen” and use the Statistics tool to calculate the sum for the column. Copy the sum for calculation of shares (Sum=15335795426.217272)



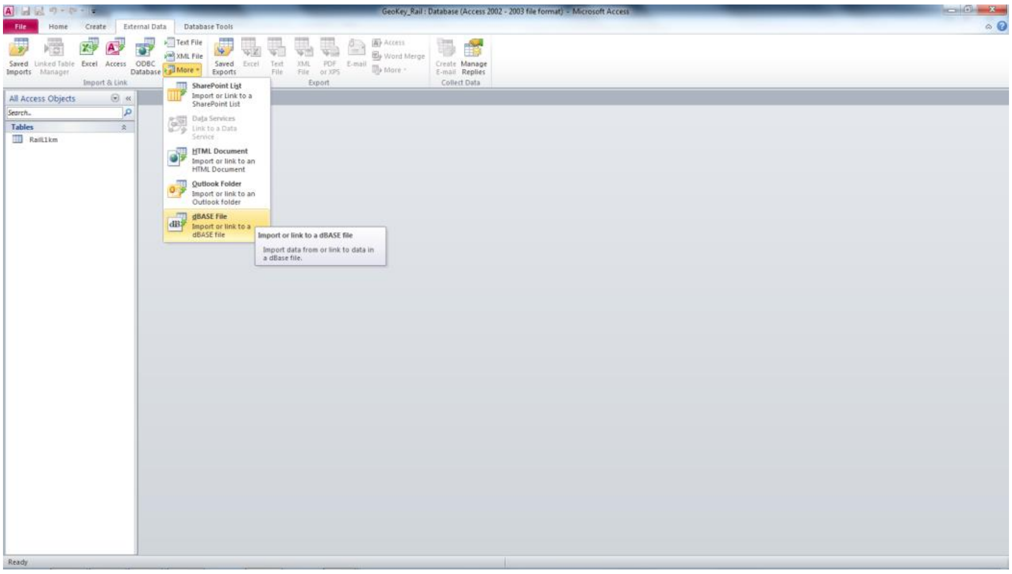


- Use Calculate field and calculate values as ([ShrATP16xL]=[ATP16xLen]/15335795426.217272), where 15335795426.217272 is the sum of ATP16xLen
- Use Statistics to verify that the sum of shares ("ShrATP16xL") is 1
- Use the Intersect tool in ArcToolbox (ArcToolbox\AnalysisTools\Overlay\Intersect) to intersect "RailLine" and "WL_1kmIE". Save the new layer as RailL1km and add it to the map

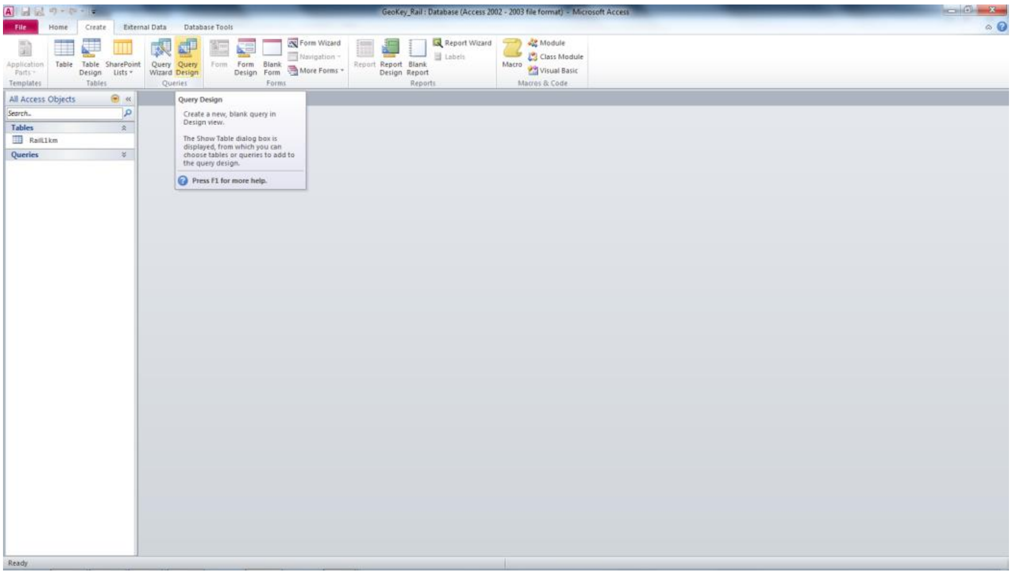




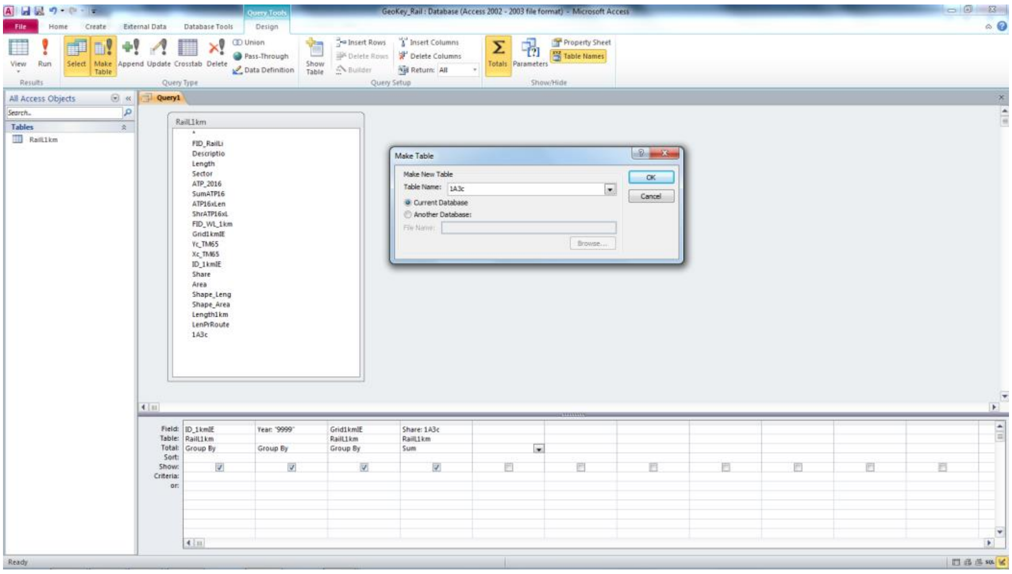
- Open the attribute table for “RailLine1km”
- Add a new field “Length1km” as double, and use Calculate geometry to calculate the length of the intersected line segments
- Add a new field “LenPrRoute” as double, and calculate values as ([LenPrRoute]=[Length1km]/[Length]) using Field calculator
- Add a new field “g1A3c” as double, and calculate values as ([g1A3c]=[ShrATP16xL]*[LenPrRoute]) using Field calculator. Use Statistics to verify that the sum of “g1A3c“ is 1
- Close ArcMAP
- Create a new access database (make sure to use the 2002-2003 format – *.mdb) and save as GeoKey_rail.mdb
- Import the attribute data from RailL1km using the Import DBF file tool in Access



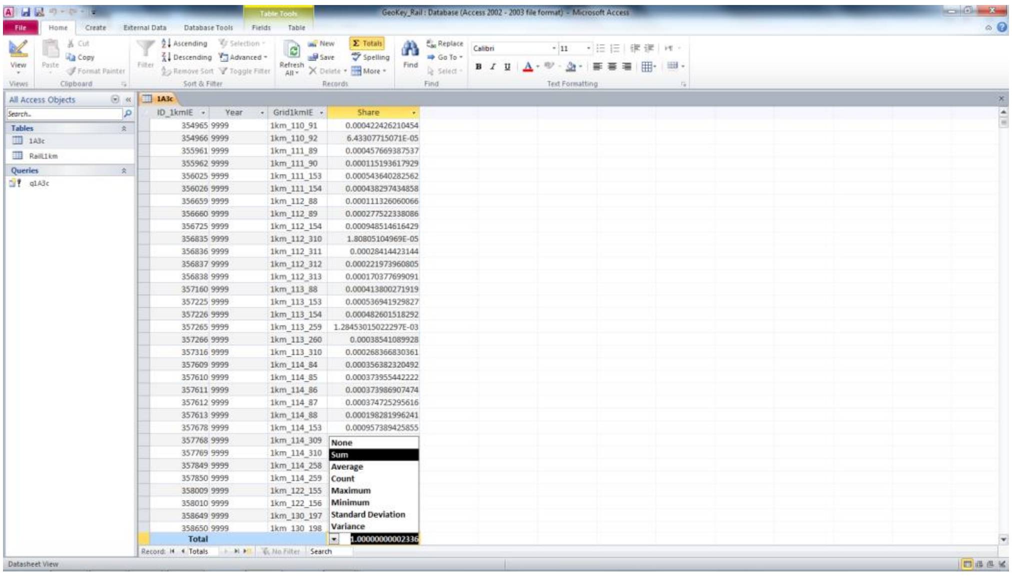
- Create a new query (“q1A3c”) and drag the table “RailL1km” to the query. Drag the fields “ID_1kmIE” and “Grid1kmID” to the selected fields. Add “Year” and “Share” in two new fields using the statements Year:"9999" and Share:g1A3c



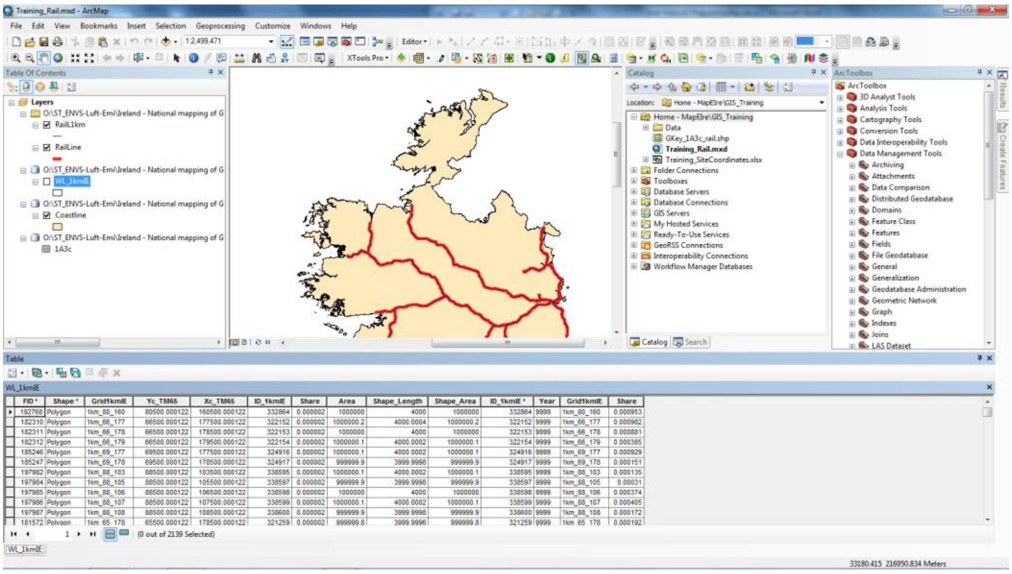
- Use the ∑ tool to Group by ID_1kmIE, Grid1kmID and Year, and to summarize g1A3c in the field Share
- Change the query to a Make table query, naming the output table 1A3c
- Save and run the query to create the table “1A3c”



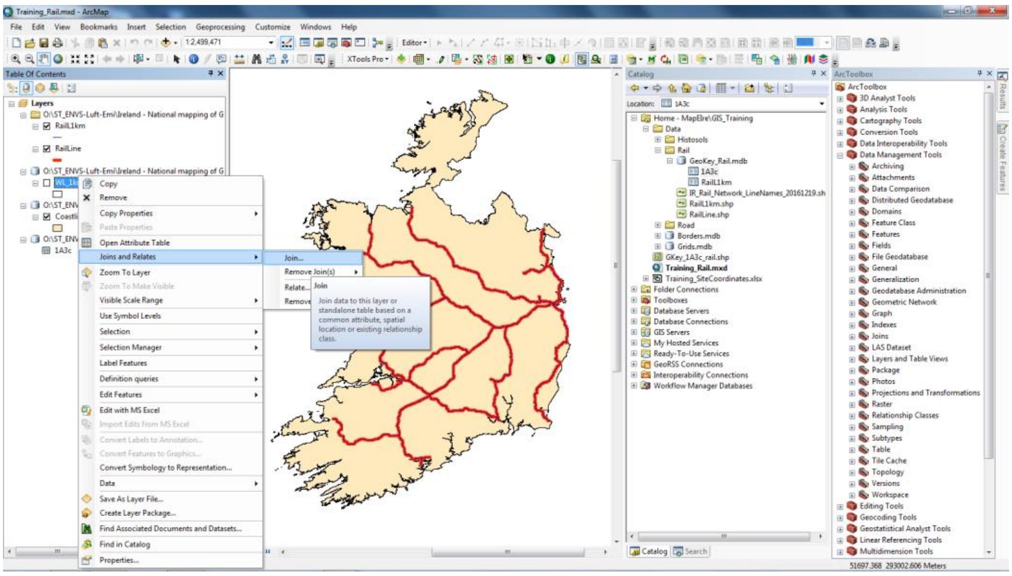
- Open the GeoKey table “1A3c” and use the ∑Totals tool to verify that the shares sum to 1 (a minor difference may occur when data moves between different programs)

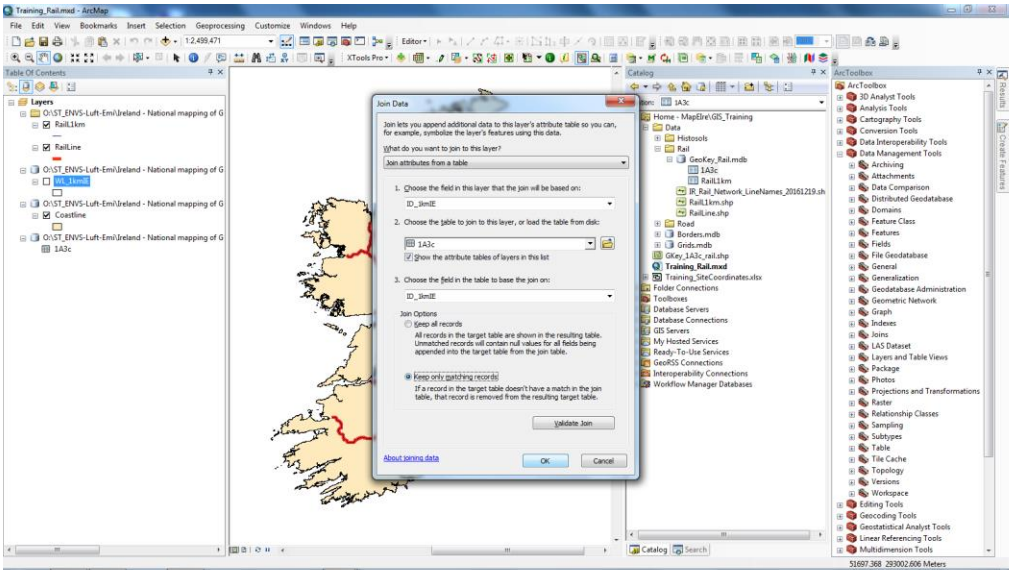


- Close Access
- Open Training_rail.mxd inArcMap
- Import the table “1A3c” or use drag-and-drop from ArcToolbox

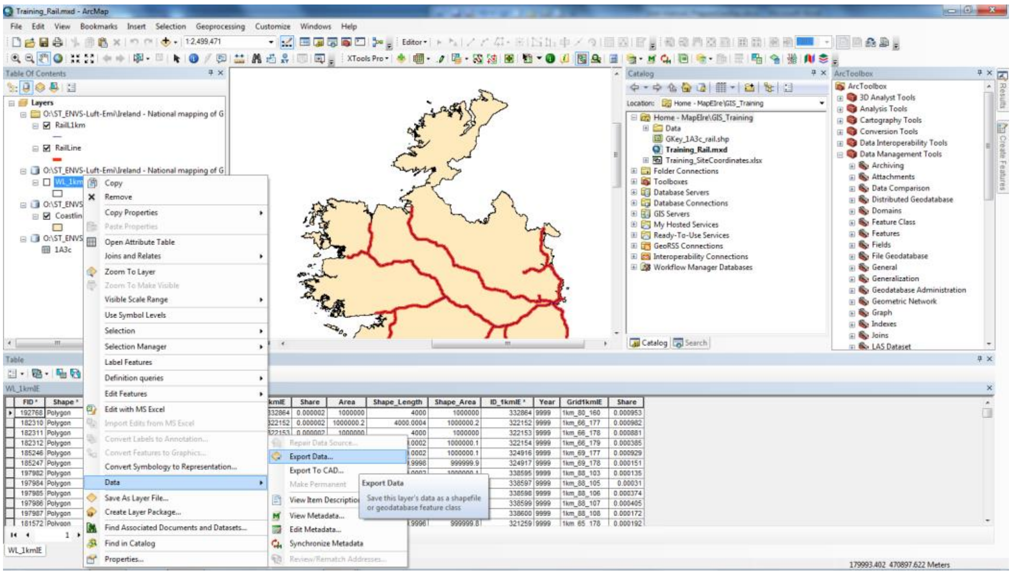


- Join the table “1A3c” to the layer “WL_1kmIE” using “ID_1kmIE” as join field (right click WL_1kmI in the TOC, select Joins and Relates, Join). Keep only matching records and allow the program to create index

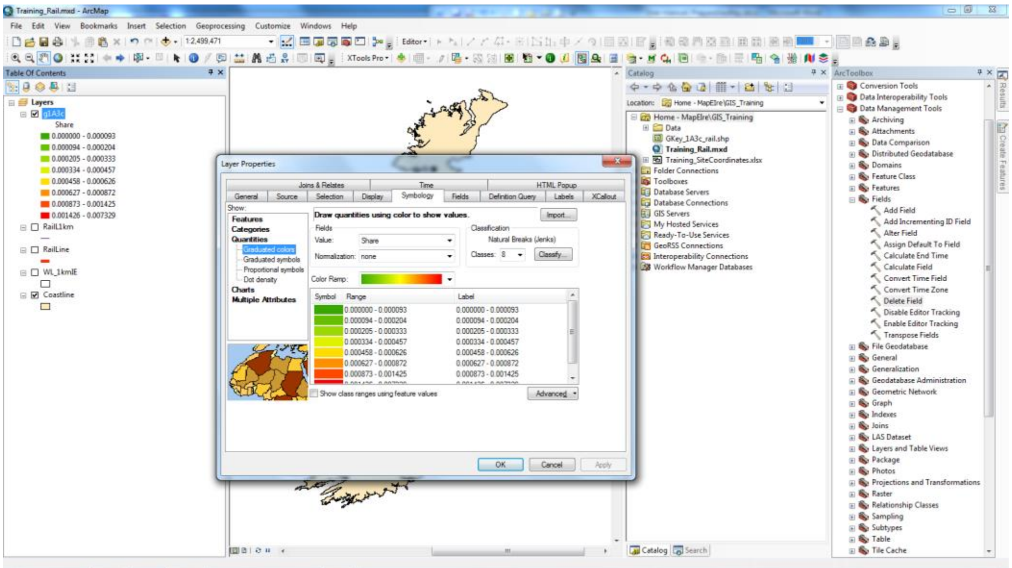


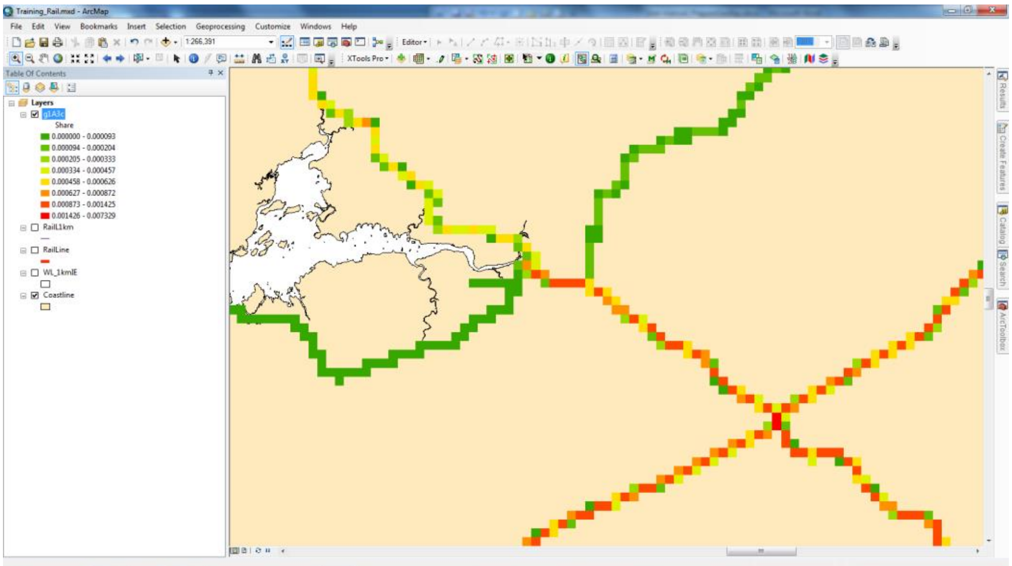


- Export the joined layer to a shape file or a geodatabase as “g1A3c” (right click WL_1kmI in the TOC, select Data, Export data), and add the new layer to the map



- Use Layer properties to change the symbology for “g1A3c”. Set Share as Value field, and change Show to Quantities/Graduated colours. Select an appropriate number of classes, colour ramp, symbols and labels. E.g. use the classify tab to change classification method, exclusions and sample size


Training_Rail.mxd - ArcMap
Table Of Contents
Layers
g1A3c
Share
0.000000 - 0.000093
0.000094 - 0.000204
0.000205 - 0.000333
0.000334 - 0.000457
0.000458 - 0.000626
0.000627 - 0.000872
0.000873 - 0.001425
0.001426 - 0.007329
Rail1km
RailLine
WL_1kmIE
Coastline
Layer Properties
Draw quantities using color to show values.
Catalog
ArcToolbox


Training_Rail.mxd - ArcMap
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0.000458 - 0.000626
0.000627 - 0.000872
0.000873 - 0.001425
0.001426 - 0.007329
Rail1km
RailLine
WL_1kmIE
Coastline

Annex 10 – Working with coordinates and projections

Part 1: Coordinate transformation using Franson CoordTrans

Find and transform geographical coordinates. Use EPA, Monaghan as an example

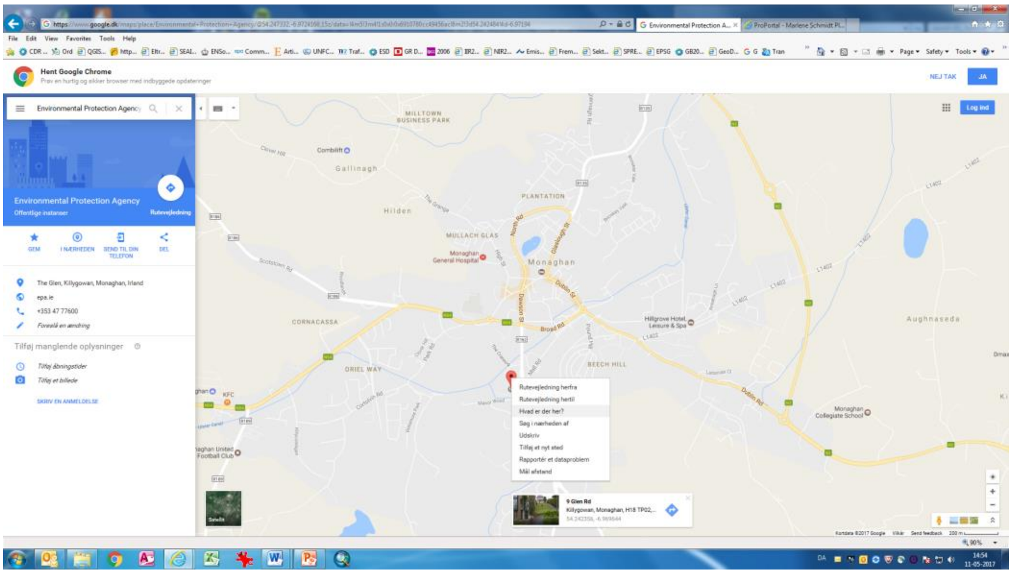
- Open Google Earth and search for EPA, Monaghan. Read the coordinates in the bottom line

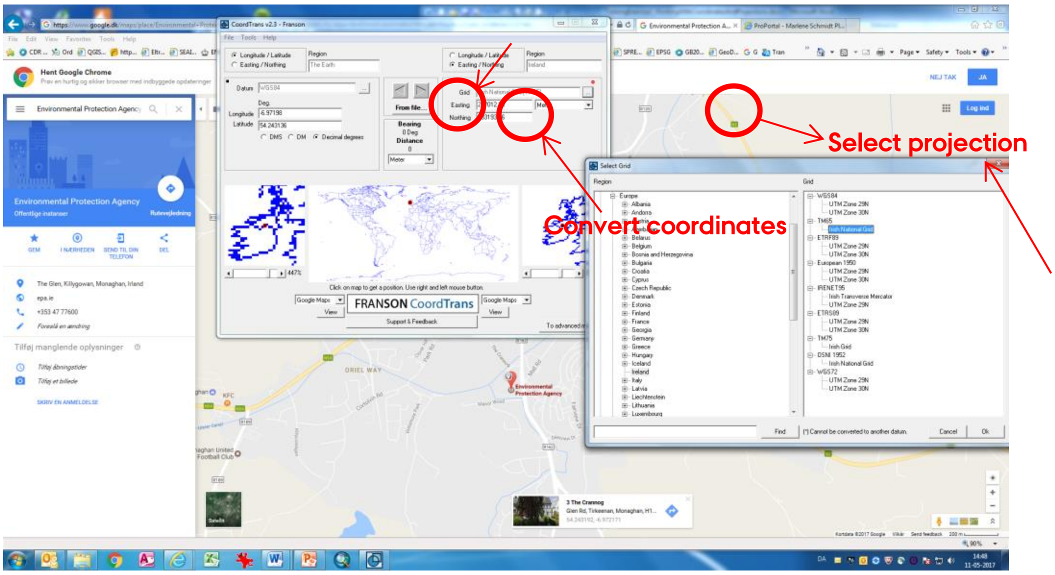
Hint: If coordinates don't show, right click the point of interest, select "What's here", and read the coordinates in the pop-up window. The format of the coordinates is decimal degrees and the datum is WGS84.

- Open the coordinate transformation program Franson CoordTrans (http://coordtrans.com/coordtrans/)

Hint: A 7 day free trial version of the program can be downloaded for free. A licence must be purchased to get unrestricted use of the program, including the feature to convert numerous coordinates in a file at one run

- Type in the first set of coordinates in the left side of the window. Make sure to select the right input type (Longitude/Latitude or Easting/Northing) and the right datum. Use the button right to the datum field to browse the datum.
- Change the settings for the output coordinates in the right side of the window. Select the output type (Longitude/Latitude) and set the output projection in the right side of the window (TM65 Irish National Grid). Use the button right to the grid field to change the selected grid.
- Click the arrow pointing to the right to convert the data in the left side of the window to the projection set in the right side of the window. Verify the location in the maps in Franson CoordTrans.





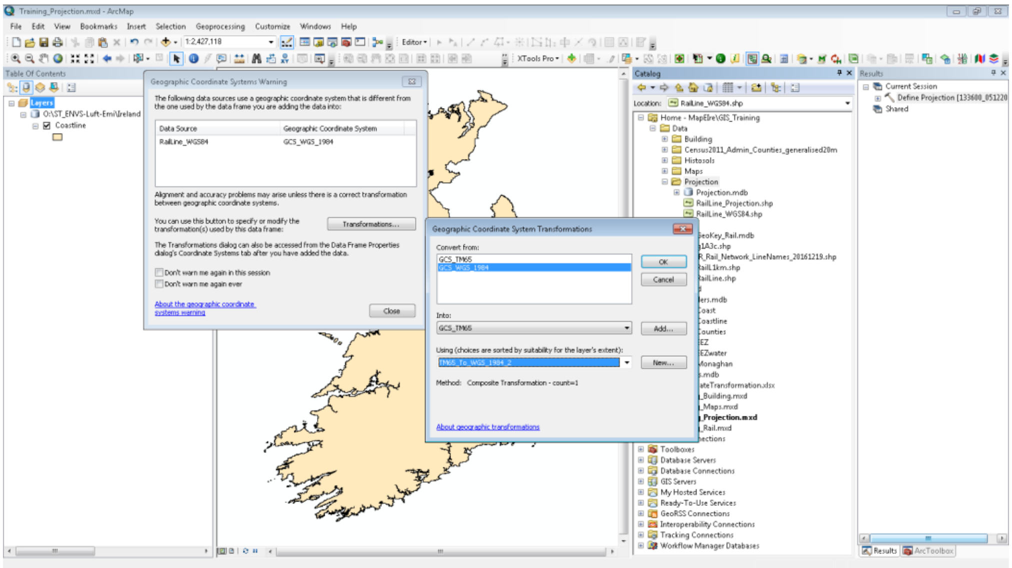
	A	B	C	D	E
1	Site	Long_WGS84	Lat_WGS84	Easting_TM65	Northing_TM65
2	EPA, Monaghan, Ireland	-6.97198	54.243136	267012.08	333193.46
3					
4					
5					

Part 2: Working with projection – Project

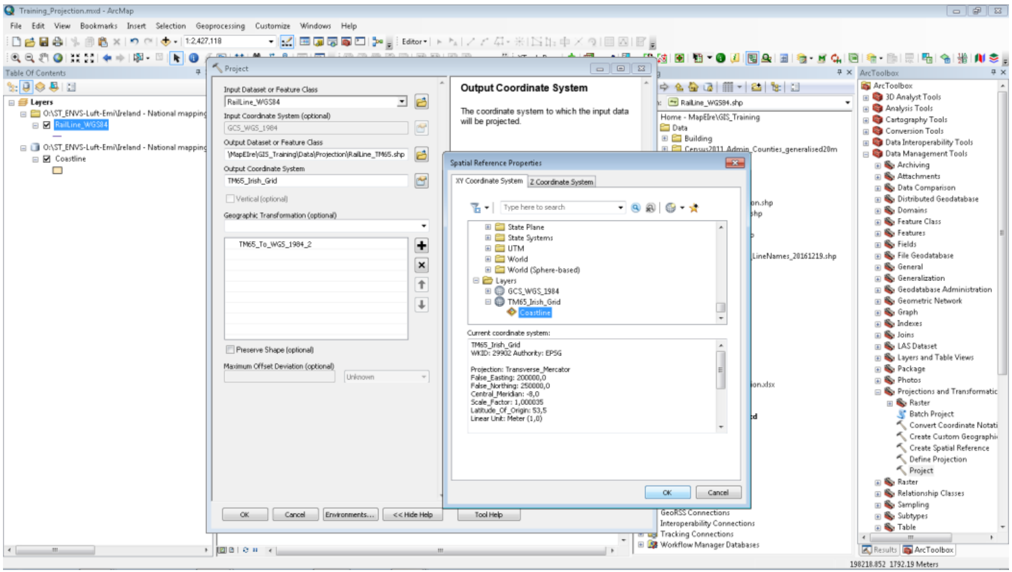
The railway network has another projection than TM65, which is used in the MapEIre model. The projection is WGS84. To be able to calculate geometries (length, area and coordinates) correct for use in the model, the file must be reprojected.

- Open \\MapEIre\GIS_Training\Training_Projection.mxd
- Add \\MapEIre\GIS_Training\Data\Borders.mdb\Coastline
- Add \\MapEIre\GIS_Training\Data\Projection\RailLine_WGS84.shp

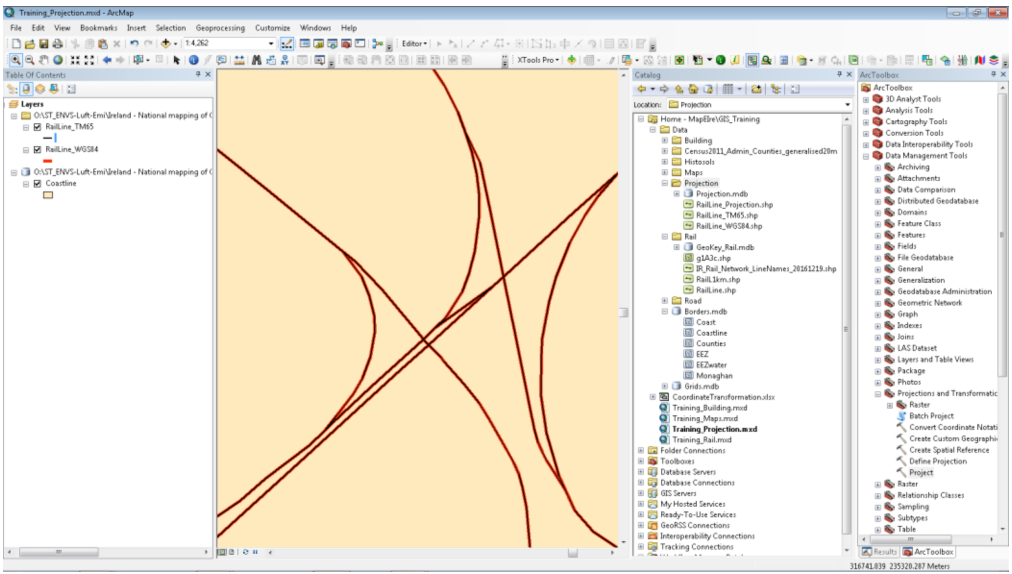
Hint: A warning appears when the geographical coordinate system for the added layer and the data frame is different. Select a built in transformation to let ArcMAP make an on-the fly reprojection to draw the added layer correct on the map. Note that the projection is not changed in the file.



- Change the spatial reference of RailLine_WGS84 to TM65 using the Project tool (ArcToolbox\DataManagementTools\ProjectionsAndTransformations\Project). Save as \\MapEIre\GIS_Training\Data\Projection\RailLine_TM65.shp



- Zoom in on the map to verify that the two layers overlap

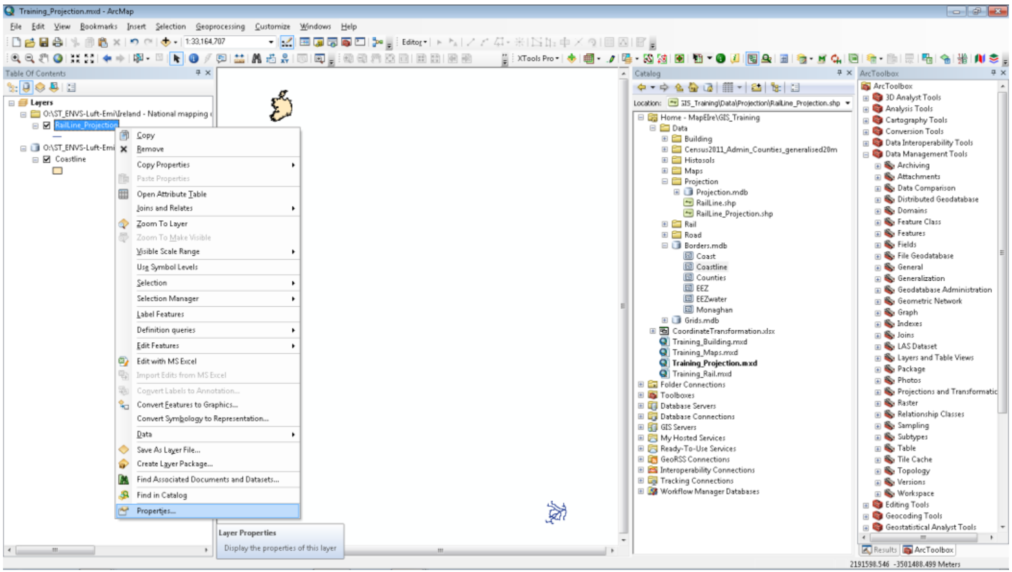


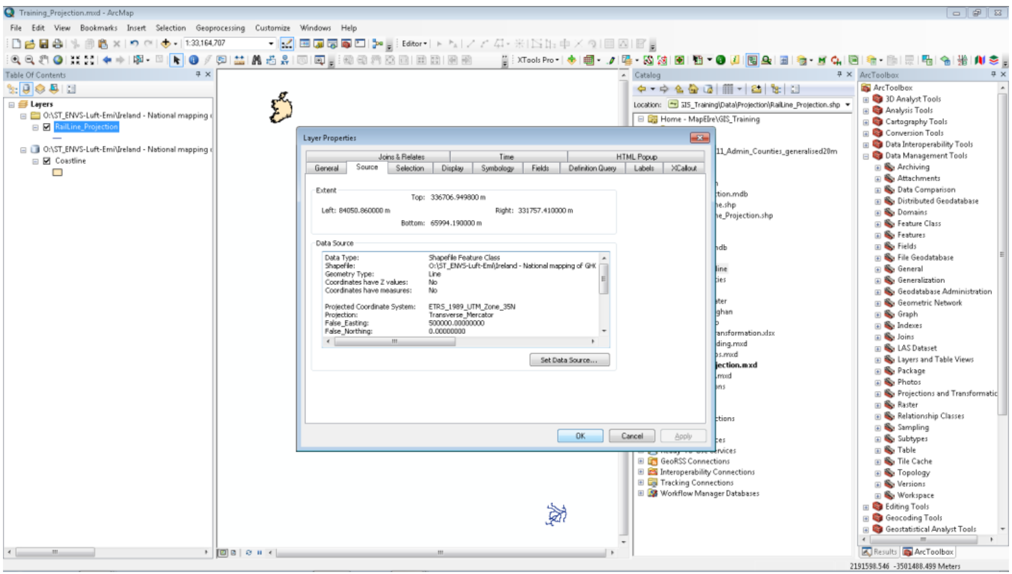
Part 3: Working with projection – Define projection

- Open …\\MapEIre\GIS_Training\Training_Projection.mxd
- Add …\\MapEIre\GIS_Training\Data\Borders.mdb\Coastline
- Add …\\MapEIre\GIS_Training\Data\Projection\RailLine_Projection.shp

Hint: Zoom to full extend if the data does not appear in the view

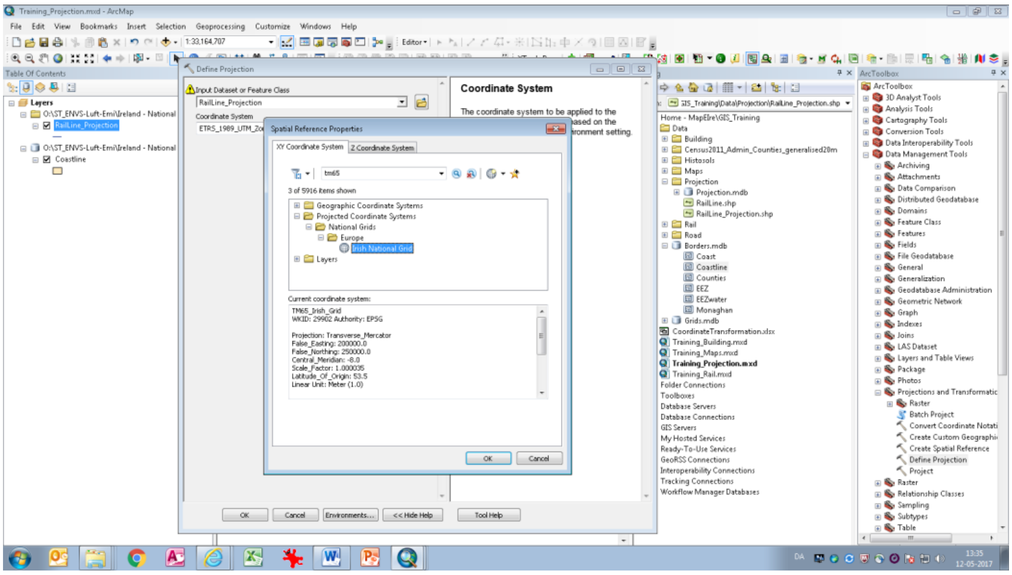
- Check the spatial reference of RailLine_Projection in Layer properties (right click the layer in table of content, TOC)





The railway network is not located in Ireland on the map, and the projection is ETRS_1989_UTM_Zone_35N. The correct UTM zone for Ireland is 29N. Assume that the data set is correct, but have been assigned a wrong projection (this should always be verified by the data provider), and correct the projection to TM65 using the define projection tool.

- Correct the projection of RailLine_Projection using Define projection (ArcToolbox\DataManagementTools\ProjectionsAndTransformations\Project\DefineProjection)



Verify on the map that the railway network is located correct on the map

Annex 11- Importing a set of CRF variables

This procedure is useful if a lot off new CRF Variables has to be imported. You can mark all CRF Variables you need with a colour in CRF Reporting tables, run a macro and import the result to CRF_Importer

- Open the macro sheet CRF_macro.xlsm and copy the brown coloured cell in sheet 5
- Open the CRF Report and mark all cells you need in the CRF Report sheets with that colour. Paste the copied cell using the paste format function
- Select the Panel Developer, Select Macros, and Run Traverse_MarkedCells
- Open the output file cel_marked.csv from the same folder as the excel files, using a text editor.
- Change the output file in order to be able to import it properly to Access running the following find and replace (see example in the box below);
    - Replace **:** with **;**
    - Replace **“** with nothing
    - Replace **][** with ;
    - Replace **[** with nothing
    - Replace **]** with nothing
- Save the file

Example of changing of csv file before import to Access

Before changing:

“Table1s1; [Public Electricity and Heat Production][Fossil fuels][Emissions][CO2][kt][no source][no method][no target][no option][no type] : 7A13F901-DB8D-4175-B68B-A7A6214B92AC; B10"

After changing:

Table1s1; Public Electricity and Heat Production;Fossil fuels;Emissions;CO2;kt;no source;no method;no target;no option;no type ; 7A13F901-DB8D-4175-B68B-A7A6214B92AC; B10

- Open the Access file *CRF_Importer*
- Select External data, Select Text file, browse to documents and import *cells_marked.csv*
- Run the query *qCRF_Variable_Append_CellsMarked* to import only the rows with values, and not any notation keys like NO or IE
- Open the table CRF_Variables and update the SectorID field.