Assessment of Air Quality Measures

Deliverable B8.1

Using the ATMOSYS system to support local air quality measures and plans

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1 Introduction

The LIFE Emerald project is delivering an air quality modelling system that is primarily designed to provide daily air quality forecasts, hourly air quality maps and high-resolution historic annual air pollutant assessment maps for Ireland. A secondary objective of the project is to assess and demonstrate how these services could be used to support Irish policymakers in assessing the impact of Climate Action Plans, Clean Air strategies and any other relevant policies on air quality.

In Action B.4 the focus was on assessing how the air quality modelling system could be used to support national level strategies. Policies that effect the whole territory of Ireland, such as modelling the national level emissions reductions put forward in the Climate Action Plans (CAPs) and the recent national Solid Fuel Regulations.

Within Action B.8 the primary aim was to demonstrate how the system can be used to support Ireland's local authorities to prepare air quality plans and assess local measures aimed at reducing air pollution levels in their local jurisdictions. As air quality levels across Ireland have been generally good over the past years, air quality plans, as mandated in the Ambient Air Quality Directive (AAQD), have hardly been necessary. In 2019, an exceedance of the EU limit value for nitrogen dioxide was measured at a single station in the Dublin region. At that time, as LIFE Emerald had not yet commenced the EPA commissioned external air quality modelling expertise to support the resulting air quality plan [1]. Going forward, the aim is that the LIFE Emerald high resolution assessment product can be used to support the preparation of future plans. The preparation of that plan highlighted the lack of a guidance document to support the local authorities in preparing that plan.

As well as supporting air quality plans, the modelling system can also be used to assess the co-benefit of local measures targeting specific sectors and/or the climate and ensure that air quality remains good. Many of the actions that are listed in Ireland's CAPs can be broken down into local actions that have co-benefits on climate and air quality. For example, measures to reduce local traffic emissions and congestion, or actions aimed at increasing the use of renewable energy sources.

To conclude, LIFE Emerald was not required to directly support any local air quality plans during the project lifetime. Instead, the products were demonstrated to the local authorities and the National Transport Authority (NTA), to show how they can be used to identify local hotspots (possible exceedances) and to support source apportionment and preparation of measures to reduce the underlying emission sources. An overview of the key demonstrations and meetings with stakeholders are presented in Chapter 2.

A key part of this demonstration process was the selection of a concrete real-life use case to demonstrate how the LIFE Emerald modelling can support a local policy decision. As part of the recent (2023) National Demand Management Strategy, studies are being carried out to assess optimal traffic congestion reduction measures for Dublin. Together with the EPA, NTA and DECC, it was decided to model the impact of the proposed 2030 'Low Emission Zone' package for Dublin. The results of that modelling exercise are provided in Chapter 3.

Finally, as the Irish authorities do not have their own guidance document on how to prepare an air quality plan, in Chapter 4 we provide a status of the information that is being prepared by FAIRMODE in this regard.

[1] The 2019 nitrogen dioxide exceedance measurement in the Dublin region necessitated the preparation of the Dublin Region Air Quality Plan 2021. The Dublin region is governed by the four Dublin Local Authorities – Dublin City Council, Dún Laoghaire-Rathdown CountyCouncil, Fingal County Council and South Dublin County Council.

2 Demonstration of the LIFE Emerald Products to national & local stakeholders

In Ireland, current legislation (S.I. No. 180/2011 - Air Quality Standards Regulations 2011) requires local authorities to write air quality plans, with review from the Department of Environment, Climate and Communications. The EPA's responsibility is to ensure a plan is carried out if required.

Over the course of the project several demonstrations and workshops (both national and international) have taken place to show how the LIFE Emerald ATMOSYS system can support local air quality measures and plans. The first demonstrations took place in 2022 – 2023 and focussed on educating the EPA and DECC, thereafter the NTA, on how the modelling components could be used to support the assessment of plans and measures, and what types of measures could be supported. Some of the key fundamental take-home messages here were:

- Importance of obtaining an understanding of and informing those responsible for plans and policies.
- National versus local measures. Understanding the differences and the requirements.
- The current lack of capacity and skills at local level for uptake of modelling to support plans.
- For national level plans as discussed in Action B4, aside from the Solid Fuel Regulation most of the air quality measures are absorbed in the Climate Action Plans, which link to the National Air Pollution Control Programme (NAPCP) .
- Traffic measures: the availability of traffic fleet and network data, for the baseline and future years e.g., fleet evolution, modal change shifts…. In some cases, traffic modelling will be required.
- The NTA are interested in incorporating the LIFE Emerald model in the assessment of transport measures and look to the concrete use case test to investigate how best to streamline this into their modelling workflow.

These discussions resulted in the selection of policy use cases that were modelled to demonstrate the potential of LIFE Emerald to support future national (Action B4) and local plans and policies related to air quality. Further engagement with stakeholders will be sought to maximise benefit of integrating LIFE Emerald outputs into policy and plans, as described in the LIFE Emerald After LIFE plan.

3 National Demand Management Measure for Dublin – Modelling Use Case

3.1 General overview

As part of the recent (2023) National Demand Management Strategy, studies are being carried out by Department of Transport to assess optimal traffic congestion reduction measures for Dublin. In a pilot study, we show how the ATMO-Street model chain can be used to study the impact of these types of local-scale plans on air pollution. For this case study, we used the emissions data composed within the GDA Demand Management Scheme project by Systra. Traffic emissions data for the East Regional Model (ERM) in 2030, under two scenarios, low growth (ADH) and high growth (ADI) was provided. Based on this data the impact on NO_2 concentrations was modelled. It is important to stress that this is a feasibility study, where the lessons learned concerning how and where the data can be used are more important than the actual results.

3.2 Methodology

The emissions data were provided for the East Regional Model and are based on the traffic network supplied by the National Transport Authority (NTA). Due to the similarities between the network used for the annual ATMO-Street mapping within the B3 Action and the network provided for the GDA Demand Management Scheme project, only minor modifications to the processing scripts were required to couple the supplied emissions to the ATMO-Street modeling tools. However, since only NO_x emissions were provided, we could only use the model chain for NO_2, and not for particulate matter or other pollutants. Additionally, some input parameters were not supplied. For these, the following default values have been used:

- NO/NOx: default value of 0.7 (based on estimates for Flanders)
- Number of cars for each road: 200 per hour (based on average over urban roads in ERM for 2021)
- Number of heavy-duty vehicles fore each road: 15 per hour (based on average over urban roads in ERM for 2021)
- Vehicle speed for each road: 50 km/h
- Temporal profiles: copied from the data used in the annual maps composed in B3

We shortly discuss the impact of these assumptions in the section on the results.

Apart from the traffic emissions, the following input parameters have been considered:

- Background concentrations for 2030, based on the WEM (with existing measures) scenario. As we only focus on the difference maps, these background concentrations are only relevant to determine the chemical equilibrium between NO_x and O_3, as the same background is used for both scenarios.
- Meteorological data (wind speed and direction) for 2021
- No other emissions are considered.

3.3 Results

Figure 1 shows the concentration difference for annual mean NO_2 concentrations between the ADH and the ADI scenarios (with green colors indicating locations where the ADI scenario provides lower concentrations). As the emissions are lower for the ADI scenario, the concentrations are correspondingly lower (yielding negative concentration changes). The results indicate that for a large part of the domain, the differences are rather limited, being smaller than 0.2 µg/m³. In Dublin city centre and in a wide band around the Ring Road, the concentrations increase moderately (between 0.2 and 0.6 µg/m³). Larger differences are observed only very close to the main roads and in some busy street canyons. At almost all locations, the concentration difference is smaller than 2 µg/m³.

As mentioned before, because this is a demonstration case these results should be interpreted with great care, as the uncertainty is large. One should especially consider the following constraints:

- We only consider the concentration differences and do not provide any absolute concentration maps that could be used for compliance checking. The reason is that we do not have detailed information on the assumptions that were made when computing the emissions. Therefore, we do not know whether these align with the assumptions made when devising the background concentrations (which were developed in Action B4 based on the WEM scenario). If more details concerning the compatibility between the regional scenarios and the national WEM scenario are provided, compliance checking of the absolute concentrations can be performed.
- Only the effects in Dublin are included, and thus background effects are not considered. Given the decline in emissions for all roads in the ERM, we expect the emissions outside the ERM to decrease as well (e.g. by less-polluting cars from within the ERM driving in other regions), and

consequently the background concentrations will also decrease. These effects could be taken into account if more details on the scenarios are provided and if Sherpa or Chemical Transport modelling is conducted to quantify the impact on the background concentrations.

- The traffic-induced turbulence is not accurately accounted for, as we use default vehicle counts and speeds (which are the same in both scenarios). This limitation will make a difference in the street canyons, but it is impossible to quantify the impact, as it is influenced by factors such as differences in speed, vehicle counts, local building configurations, etc.
- There are some minor inaccuracies in the emissions, which also impact the difference maps (mainly locations in the street canyon where the difference is greater than 2 µg/m³). The reason of the inaccuracies is unknown, but they are probably related to the coupling of the NTA network to the initial emission dataset.

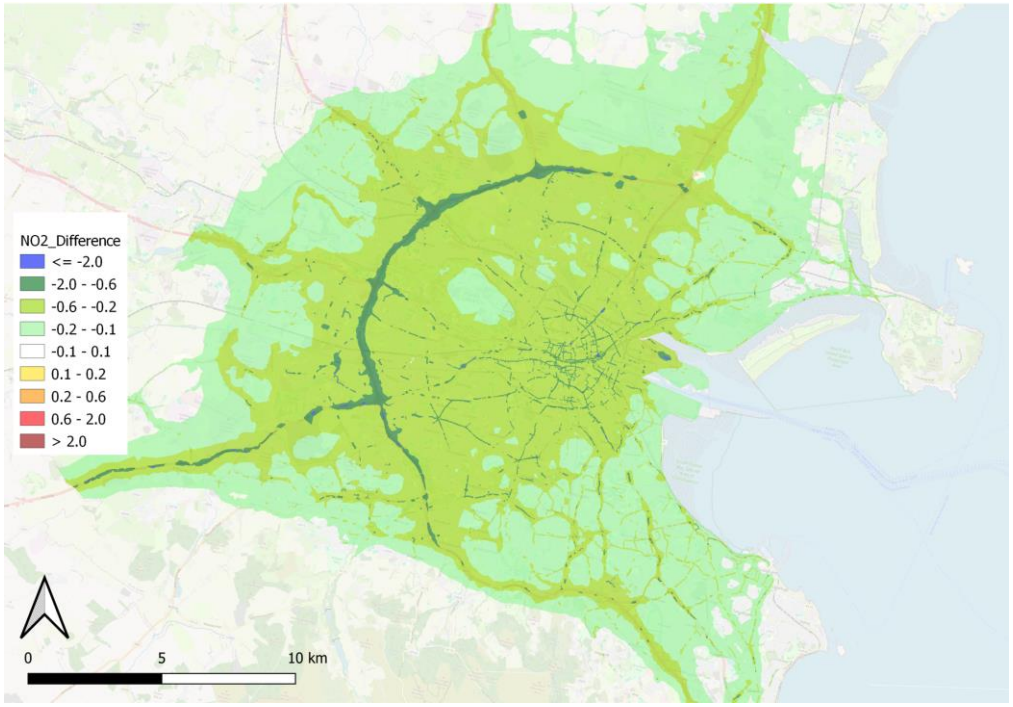

FIGURE 1: CONCENTRATION DIFFERENCE FOR ANNUAL MEAN NO_2-CONCENTRATIONS (IN µG/M³) BETWEEN THE ADH (LOW GROWTH) AND ADI (HIGH GROWTH) SCENARIO. GREEN COLORS INDICATE THE LOCATIONS WHERE THE CONCENTRATIONS ARE LOWER FOR THE ADI THAN FOR THE ADH SCENARIO.

3.4 Lessons learned

The methodology demonstrates that, in general, as long as the data format of the NTA's network is being used, it should be relatively easy to couple city-scale emissions projections from similar studies to the ATMO-Street model chain, although some gap filling may be required.

The pilot study, however, also indicated some shortcomings that should be addressed to improve the results:

- A better understanding of the underlying assumptions of the scenarios is required, especially if compliance checking is needed. This is also necessary for making a better estimate of the effect on the background concentration.

- Some parameters are missing from the datasets that have been delivered. Most of them are not crucial, but some have an important influence on the concentrations in street canyons (such as vehicle speeds and traffic volumes for each road).
- The correct geographical representation of the roads is required in air quality modeling.

4 FAIRMODE - Best Practices for Local and Regional Air Quality Management

FAIRMODE is the Forum for Air Quality Modelling created for exchanging experience and results from air quality modelling in the context of the Air Quality Directives (AQD) and for promoting the use of modelling for air quality assessment and management. Among the different activities, one is devoted to Air Quality Planning, called Working Group 5 (WG5).

In 2022 WG5 (previously known as Cross Cutting Activity 5) published a first version of its 'Handbook' "Best practices for local and regional air quality management". The aim of the report is to share best practices, based on actual measures and lessons learnt from existing air quality plans across Europe, that can inspire others in their preparing plans. The information is intended to support the use of modelling for the development of air quality plans, as requested in the Air Quality Directive. The publication is available here https://dx.doi.org/10.2760/993882.

The examples show how different pollutants should be tackled differently, the importance of integration among different sectoral plans (on emissions, greenhouse gases mitigation) and also how other dimensions of the problem (i.e., social aspects) should be considered when building air quality plans.

This year, WG5 is drawing up a guidance document for the preparation of air quality plans, which will be harmonised across the EU. This guidance document considers the new AAQD recast and is expected to be issued by FAIRMODE early 2025.

These guidance documents together with the EMERALD modelling tools will be used to underpin future air quality plans and measures in Ireland.

At the EMERALD final event, Dr Stijn Janssen presented an overview of FAIRMODE's activities regarding air quality modelling and supporting the proposed new air quality directive recast.