Using AERMOD and ArcGIS to Model Ammonia Emissions from Irish Broiler Houses

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INTRODUCTION

Broiler and layer production in Ireland combined account for approximately 2% of Ireland's national ammonia emissions (EEA, 2015). Poultry production in Ireland is predominantly in the form of intensive agriculture. Broiler production involves raising chickens in large houses for 35 - 40 days, after which they and the manure that has built up are removed from the house. Layer birds are housed continuously throughout the year and manure is removed via conveyor belts. As the farms are located in discrete locations, any atmospheric ammonia produced by poultry manure during production is considered a point source of atmospheric ammonia. As a point source, the concentration around these houses is more likely to exceed limits designed to protect sensitive habitats and species at a local level, compared to diffuse sources such as cattle housing or land spreading of manure.

MATERIALS AND METHODS

Ammonia emission factors are used by the Irish Environmental Protection Agency (EPA) to determine ammonia emissions within their national inventory and are subsequently reported to the European Commission under the National Emission Ceiling Directive (2001/81/EC). Additionally, the EPA use this data in order to model emissions from intensive agriculture units and determine their impact on sensitive ecosystems. The Irish EPA ammonia emission factor for broilers of 0.22 g/bird/day (EPA, 2016) was used in the first part of this study. An ammonia emission factor for layers was used from existing Irish research (Hayes et al., 2006), as EPA guidance does not provide one. The dispersion models were run in AERMOD for each individual farm, which were subsequently input into ArcGIS to assess the cumulative impact of all intensive poultry production in Ireland.

RESULTS AND DISCUSSION

The final result of this work is a map of annual ammonia concentrations from intensive poultry production in Ireland. This map can be used to identify areas which exceed the critical level for atmospheric ammonia concentration (1 $\mu g/m^3$ – 3 $\mu g/m^3$) based on existing Irish emission factors. This can be used to identify areas which are likely to exceed these critical levels from poultry production alone, and form a basis for a cumulative assessment from other sources of atmospheric ammonia (such as pig and cattle production). Figure 1 shows the dispersion model output for one broiler farm in Ireland. Using this output in ArcGIS allows for multiple models to overlay each other and create a national emission map for poultry production. As this map is produced using an emission factor of 0.22 g/bird/day of ammonia, any change in the figure or could alter how ammonia is perceived to disperse from these farms. In the UK, the SCAIL project equivalent factor is 0.13 g/bird/day for broiler production (Hill et al. 2014). Using this figure could potentially reduce the number of habitats which appear to have exceeded their critical level. Hence it is important to use the most accurate figures when running models.

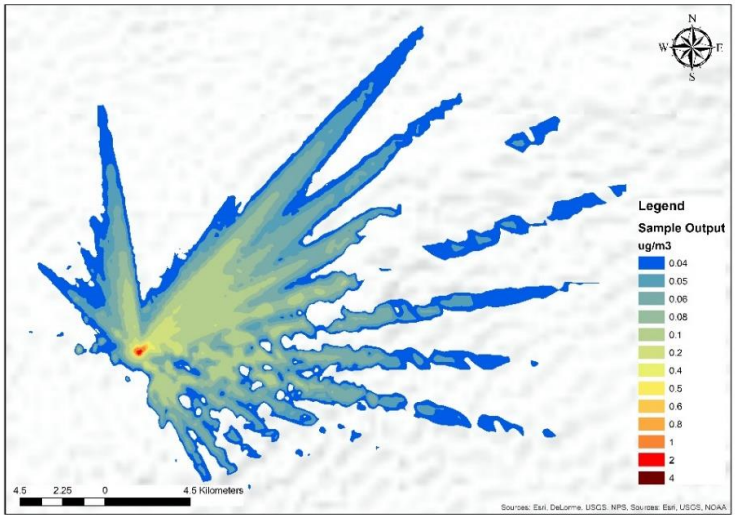

Figure 1: AERMOD model scenario for ammonia from a broiler farm presented in ArcGIS using EPA emission factor (EPA, 2016) and average ventilation rate from SCAIL (Hill et al. 2014).

CONCLUSION

The identification of areas which currently exceed the critical level of sensitive habitats and species is important as the development of new poultry houses planned under Food Wise 2025 need to be appropriately located so as to not exacerbate existing impacts. When considering the long term conservation of Natura 2000 sites using only critical levels as an indicator of impact is not sufficient. Critical loads of sensitive habitats need to be identified and mapped; this allows for impacts to be considered on a scale greater than 30 years (Sutton, 2009). Comparing emission factors used by the UK and Ireland is also important, as the production process and climate are broadly similar. Updated emission factors for Ireland are currently being monitored as part of the AmmoniaN2K project (http://ssu.ie/research/ammonian2k/) in University College Dublin; when developed this factor will also be modelled and compared with both EPA and SCAIL factors.

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