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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Uncertainties in assessing the environmental impact of amine emissions from a CO_2 capture plant" *by* M. Karl et al.

Anonymous Referee #2

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The paper presents results from dispersion modelling of amine emission from a fictitious CCP. The work constitutes and important contribution to the on-going debate of CC HSE issues and should be published subject to minor corrections.

The title is perhaps too general - the authors actually only model the environmental impact of two amines MEA (CH2OHCH2NH2) and DEYA (Et2NH) emitted from a CCP at the West coast of Norway (Mongstad region). This region is characterized by meteorological conditions and air quality which both differ substantially from the "average industrialized world". This is in part compensated for in the abstract.

Page 8642, line 10: SO4 should be SO3.

Page 8653, line 5: Closer to Mongstad high NO2 concentrations led to a reduced production of OH radicals and hence less photochemical reactivity of the amine. This is not obvious to the Referee. Please explain.

The results from NO3 chemistry sensitivity studies imply that NO3 chemistry is important in the Mongstad region. With typical NO, NO2 and O3 mixing ratios of 0.2, 2 and 30 ppb, respectively, the NO3 radical mixing ratio (nighttime) should be around 107 cm-3. With k(amine+NO3) = 10-13 cm3 molecule-1 s-1, the amine removal rate will be around 10-6 s-1, which should be compared to the amine removal rate by OH radicals of around 10-5 s-1 (k(OH) = 10-11, OH = 106). At best, around 10% of the amine removal can therefore be caused by NO3 radicals in the Mongstad region. The Referee concludes that there must be something wrong in the code with respect to NO3 radical chemistry. Please justify and elaborate on the results from the KNO3M scenario. On page 8667, line 4 is stated: “consideration of amine oxidation by NO3 radicals increased maximum surface concentration of the sum of nitrosamines and nitramines by 150% in our simulations.” This cannot be correct. The results in Table 6 give max. surface air concentration sum 3.7 (BASE) and 5.6 (KNO3M). At best, this is a 50% increase. The danger of this table is that the numbers given are maximum numbers that do not necessarily relate to the same time of year. In other words, the authors are offering the reader to compare apples and bananas – pick whatever you like so to speak. It is suggested to present averages either for selected months of for the year modelled.

Concerning the input parameters to the fugasity model, the reference to the data cannot be found at the link given (Yiannoukas, S., Morale, G., Williams, R., and Johnson, A.: Deposition and soil transport modelling of components from postcombustion amine-based CO2 capture, Report for Gassnova SF. Det Norske Veritas Ltd, UK, Report No. PP011015, London, U.K, 2011. Available at: http://www.gassnova.no/gassnova2/frontend/files/CONTENT/Rapporter/Depositionandsoiltrans portmodelling_DNV.pdf). This may be, but the numbers given for the degradation time of nitrosamines and nitramines are highly questionable. The authors state on Page 8668, line 26 “More research on degradation rates of nitramines in soil and water is needed”, but the study does not include a sensitivity test of the nitrosamine and nitramine degradation rate in the dense compartments. This is surprising because the “worst case” scenario does not include a realistic degradation rate of nitramines in the aqueous phase (DT50 is actually around 1 year). In fact, the present study should actually conclude that the MAJOR uncertainty in the EIA is linked to the degradation of nitrosamines and nitramines in soil and water. It is not commendable to use fictional numbers from some unpublished report in a public domain publication without making proper reservations.

There is a misprint/inconsistency in Table 7. “DegrateMNA and DegrateNDMA” should be “DegRateMNA and DegRateNDMA” – by the way MNA and NDMA are not defined in the text or the Table header.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 8633, 2014.