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Interactive comment on "Particle number concentrations over Europe in 2030: the role of emissions and new particle formation" *by* L. Ahlm et al.

Anonymous Referee #1

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This manuscript presents simulation results on particle concentrations over Europe projected to 2030 with emission reduction scenarios for PM2.5 and trace gases adopted from the IIASA report by Amann et al. (2012). The results of the paper are interesting, but there are a couple of shortcomings with the simulations that limits their usefulness. These shortcomings could be removed by additional simulations. I understand very well that the model is heavy, but I really hope that the authors could include at least some additional simulations in the final paper in order to address my concerns.

The biggest shortcoming of the paper is that meteorology for May 2008 has only been used. I understand that the authors aim to study specifically the role of emission re-

ductions. However, it is inevitable that meteorological conditions affect the particle number concentrations, both through new particle formation (which in general occurs in sunny conditions and has a clear seasonal variability) and growth (which is largely caused by oxidation products of BVOC species, whose emission in turn is temperature dependent), and through wet removal of both primary and secondary particles. Thus claiming (as the paper's title implicitly does) that the results are representative for the whole year 2030 is misleading. As the authors show in the paper, the total number concentration follows from an interplay between SO2 and PM emission reductions, for example reduced PM2.5 leads to reduced condensation sink, which in some locations can lead to enhanced nucleation despite decreased SO2 emissions. However, May in general represents high nucleation season all over Europe. The results could be quite different for low nucleation season. I therefore urge the authors to do simulations for November or December also. In order to limit the simulation time, just one emission reduction scenario (preferably the middle one) could be considered.

Secondly, the N100-concentrations are strongly influenced by the efficiency of new particle growth. Hamed et al (ACP, 2010) showed that SO2 emission reductions between the periods 1996-97 and 2003-06 lead to clearly diminished new particle formation, both event frequency and new particle formation rates, in Melpitz, Germany. However, the production of 100nm particles was not diminished. The cause for this was most probably more efficient growth during 2003-06 of both nucleated particles and sub-100nm primary particles. The more efficient growth may have been caused by the fact that the 2003-06 period was warmer than the 1996-97 period, with higher BVOC emissions and BSOA production. In view of this, I think it would be very useful if the authors could do a sensitivity simulation to see how much temperatures influence the N100-results. Here, probably just one 28-day simulation with somewhat increased temperatures for 2030 would be sufficient.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 8769, 2013.