Effect of ammonia and sulphuric acid to New Particle Formation in Po Valley, Italy

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An intensive atmospheric measurement campaign was conducted at the polluted rural site, San Pietro Capofiume (SPC) station in the Po Valley, Italy from June 9th to July 10th 2012 (the joint Supersito and PEGASOS project). One of the main purposes of this campaign was to characterize the new particle formation (NPF) events and the chemistry of particles during the growth phase. Measurements included aerosol size distributions down to 3 nm, properties and composition of freshly nucleated particles, concentrations of gases and several meteorological parameters. Formation and subsequent growth of particles at this site were often dominated by sulphuric acid. In this research, we have estimated the growth rate due to sulphuric acid (GR_{H2SO4}) from H2SO4 concetration calculated with proxy (Mikkonen et al., 2011). We have also studied an effect of ammonia on NPF.

Our results show that NPF was observed during 28 out of 32 campaign days. If we compare the ammonia concentration with growth rate (GR, Fig. 1), it seems that the overall effect is negligible on particle growth. However, the effect to GR_{H2SO4} is significant, which indicates that with high ammonia concentration, ammonium sulphates explain most of the growth of the particles. Decreasing effect for $GR_{remainder}$ (growth by other compounds than H_2SO_4) indicates that at low ammonia concentration the growth is mainly caused by organics.

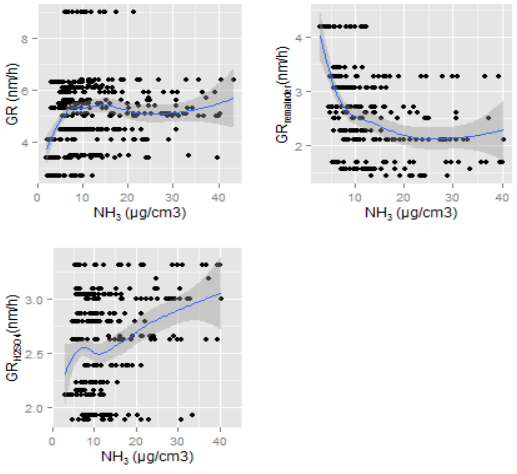

Figure 1. The effect of ammonia into growth rate. Blue line represents the statistical smoother with 95% CL.

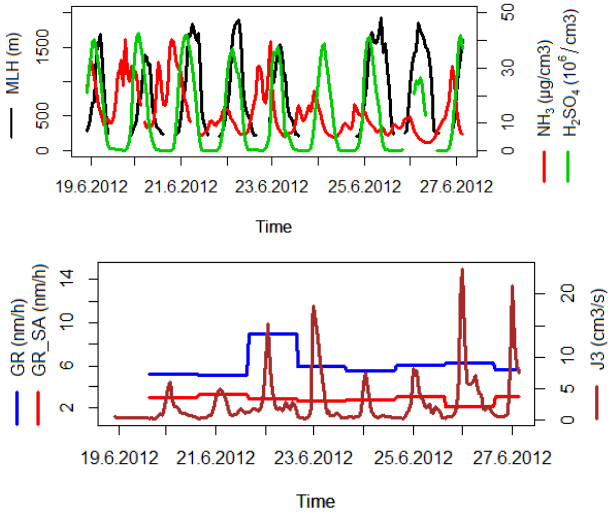

Figure 2. Upper: Mixed layer height (MLH), [NH_3] and [H_2SO_4]. Lower: GR, GR_{H2SO4} and J_3

Figure 2 indicates that particle formation (J_3) and subsequent growth rates seem not to be affected by [NH_3]. The highest growth rate of the period is even reached on a day with [NH_3] lower than the daytime average. Mixed layer height in turn seems to predict fairly well the highest daily J_3 and GR, as dilution the polluted air in SPC favours NPF. At SPC, the formation of stable sulphuric acid-ammonia clusters is saturated with respect to ammonia: This makes J_3 roughly proportional to [H_2SO_4]. However, no conclusions on the actual mechanism of NPF can be drawn from this dependence (see Kupiainen-Määttä et al., 2014).

During the S-PEGASOS campaign, growth rates varied between 2.7 to 8 nm h^{-1} with an average value of 5.3 nm h^{-1}. These values are comparable to our earlier analysis (Hamed et al., 2007). GR_{H2SO4} varies only little between the NPF days. Thus, variation of total GR comes from the other compounds affecting to particle growth, most probably from amines and other organics.

Hamed et al. (2007) *Atmos. Chem. Phys.* **7**, 355–376.
Kupiainen-Määttä et al. (2014) *J.Aerosol Sci*. **77**, 127–144.
Mikkonen et al (2010) *Atmos.Chem.Phys.* **11,** 11319–11334