Review of ACP-2013-158 by Pennington et al.

The manuscript describes measurements of the elemental particle composition of 20 nm sized particles during New Particle Formation events in Hyytiälä in spring. Several important statements on nanoparticle growth are derived from the measurements as nicely summarized in the abstract. The paper is well written and concise. It is clearly suitable for publication in ACP, but one major comment and some minor comments need to be considered:

Major comment:

The finding of the strong increase in sulfate mass fraction from 5 to 30% during the onset of the nucleation events is highly interesting but it also opens some questions:
- what time intervals were chosen for the NPF onset?
- which time intervals were used to calculate the H2SO4 averages of Table 1?
- how did the growth rate change over time during the NPF events (during onset and for the yellow bands when NPF particle sizes were ~20 nm)?
- the limits of Eq. (2) need to be discussed. For example, one can imagine a situation where sulfuric acid is condensing while other compounds are evaporating, leading to zero net growth (or even negative net growth) and then a too low (or unphysical negative) H2SO4 concentration is derived. Γ_m will typically be changing during the growth and the assumption of an average Γ_m is limited.
- which Γ_m was assumed for the NPF onset time interval?
- the increase of sulfate mass fraction from 5 to 30% for 20 nm particles growing by H2SO4/H2O condensation by 1 (or rather 2 nm) within approximately one hour is hard to reproduce for me for H2SO4 concentrations during NPF onset of <3 x 10^6 cm-3 (18 April), and <6 x 10^6 cm-3 (19 April) . Please explain the calculation in more detail. Nieminen et al., ACP, 2010, would yield lower growth rates for these concentrations.
- how can the *nucleation* be explained, if during the NPF onset highly oxidized organics are not present (if they were present then they would be condensing on the 20 nm particles and contribute considerably to the particle growth of the preexisting particles as well; also low O/C ratios are observed later for the condensing SOA), and sulfuric acid+ammonia alone are not sufficient to explain the observed nucleation rates (Kirkby et al., 2011)? What can be said about amine levels in Hyytiälä in early spring? Nucleation is not the main subject of this paper but consistency/inconsistency of the results in this respect should be discussed.

Minor comments:

p. 14122 l. 15-16: Did you find other (minor) elements? Which ones were found? How high was their mole fraction at maximum?

Were the 8 event days all the NPF events during the measurement period?

Fig 2: it would be interesting to see also how the mole fractions develop on non-event days. Is the sulfur mole fraction always increasing during the day?

Technical comments:

Fig 1c: the blue and the violet colors for N and O can hardly be distinguished in a print-out. Please change the color for one of these two elements. (For consistency the color should then be changed througout).

Figures 2 a)-c) should be depicted larger (especially wider) and with better time resolution.