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Interactive comment on "Physical aerosol properties and their relation to air mass origin at Monte Cimone (Italy) during the first MINATROC campaign" *by* R. Van Dingenen et al.

R. Van Dingenen et al.

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First of all we would like to thank both referees for their constructive comments to the manuscript. We have listed below our response, and have decided to integrate most of them into a revised version of the manuscript.

Comments are addressed in the order they have been listed by the referee.

Regarding the comment on vague and weak statements in the introduction and conclusion, we have now included values for the estimated hygroscopicity factor for WSOM in a new table, in the abstract, as well as in the conclusion.

In the revised manuscript, the introduction has been extended with a brief literature review on the use of hygroscopicity and volatility techniques.

We agree with the referee that an additional plot showing the agreement between T-DMA and SJAC data (which is indeed quite impressive) would enhance the significance of the presented material. So, in the revised version we have now included and discussed a figure showing the time series of the SJAC sub-μm ion mass, and the soluble mass estimated from the soluble fraction from TDMA measurements, DMA volume, assuming a density of 1.4 for the soluble fraction.

Regarding the comment on assigning chemically determined organic matter (OM) to the "non-soluble + volatile" fraction in table 6: the solubility of WSOM can be formally interpreted as resulting from a fraction ε with solubility equal to the model salt (ammonium sulfate) and a non-soluble fraction (ε-1), as given in Equation (2) in the paper. Hence, the contribution of WSOM to the semi-volatile/soluble class equals $\varepsilon \times f_{WSOM}$ and the fraction contributing to the semi-volatile/non-soluble class is (1-$g\varepsilon p \times f_{WSOM}$with f_{WSOM} the (chemical mass) fraction of WSOM in the sub-μm size range as given by Putaud et al. (2004a) in their table 4. The thus calculated contribution of WSOM to the soluble fraction varies between 1 and 15% for the different sectors, confirming that indeed ions are the major contributors to the observed hygroscopicity – as already appeared from the intercomparison between SJAC and T-DMA in the added figure. We have now included this discussion in the revised paper and have, more correctly, added the $\varepsilon \times f_{WSOM}$ fraction to the soluble class. We also included in the discussion the comment by the referee that in a first approximation, the contribution of OM to aerosol hygroscopicity may be neglected for ambient RH conditions.

Page 1086, line 14: We have now included also non-volatile organic carbon in the list of refractory compounds. Sea-salt has been excluded on the basis of chemical analysis.

Estimate of BC number fraction: we have added a phrase stating that the refractory number correlates very well with BC, and hence the refractory number in fact gives a

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good estimate (and upper limit) for the BC number concentration.

The size of the dataset used for the regression analyses is now being explicitly mentioned.

We took care of the symbol consistency.

Correlation is now expressed in terms of R^2 everywhere.

WSOM is now defined in the abstract

NWSOM is now used.

$\sigma_{g,min}$ is now properly defined

The 'closure' meant here is closure between soluble fraction obtained from T-DMA and soluble fraction obtained from chemical measurements. The latter requires a priori knowledge of all compounds, which is not the case. This is now better explained in the text.

'Ambient' conditions have been properly defined

EBC (equivalent black carbon) refers to the data delivered by the aethalometer. We use BC (black carbon) when referring to the compound in general. We have corrected text and figures such that aethalometer output is always labeled as EBC.

LH (less hygroscopic) and MH (more hygroscopic) have been defined.

The specification 'DMA priority' has been omitted. It referred to the overlapping part of the number size distribution where both OPC and DMA where measuring, and for which the DMA data where used.

"Ambient, dry" in Figure 7: explained.

The percentage of time of each sector occurring has now been added in table 2.

Re-condensation in the V-DMA could in principle occur, but it was proven in lab tests

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that this was not the case. This is now mentioned in the text.

We now mention that volume and number are obtained from integrated size distributions.

p. 1087, line 20: H_2SO_4 has been omitted. Ammonium salts may also contain ammonium nitrate.

Regarding the validation of the dust-rich accumulation mode: chemical size distribution data (Putaud et al., 2004a) indeed show the occurrence of 10 to 40 ng/m^3 Ca^{2+} in the 50 – 130 nm aerodynamic diameter size class during the dust episode, corresponding to a dust mass of 0.15 to 0.6μg/m^3. The soluble fraction derived from the hygroscopicity measurements is, within the uncertainty, consistent with the soluble fraction derived from the chemical measurements. The impactor size-class resolution however is too coarse to distinguish it as a separate accumulation mode, nor does it allow to obtain information on the number concentration and the mixing state of the particles.

Sonication is indeed used as extraction technique, and the suggested mechanism which was not known to us may offer a possible explanation for the discrepancy in the dust case. We have added this remark in the text.

Typing errors have been corrected.

References:

Putaud, J.-P., R. Van Dingenen, A. Dell'Acqua, F. Raes, E. Matta, S. Decesari, M. C. Facchini, and S. Fuzzi: Size-segregated aerosol mass closure and chemical composition in Monte Cimone (I) during MINATROC, Atmos. Chem. Phys. 4, 889-902, 2004a.

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