

# AMS deployment at Melpitz (Germany) during winter 2007

## Introduction

An Aerodyne High Resolution Time of Flight Aerosol Mass Spectrometer (HR-ToF-AMS) was deployed at Melpitz Supersite (Figure 1) during the last EMEP intensive winter campaign. This instrument was developed and manufactured by Aerodyne Research Inc. (Jayne et al., 2000) and allow to have in real time and at the same time the particle size distribution and their chemical composition with a time resolution of 5 min in our conditions. The AMS was directly connected to a PM2.5 inlet and sampling continuously from the 12<sup>th</sup> January to the 12<sup>th</sup> February 2007. In this poster, we present the variation in concentration and mass fraction of non-refractory organic, nitrate, sulfate, ammonium and chloride during the measurement times. Results were also compared to PM1 daily filters measurements and thermodenuder measurements. Moreover, the first organic mass spectra results are presented.

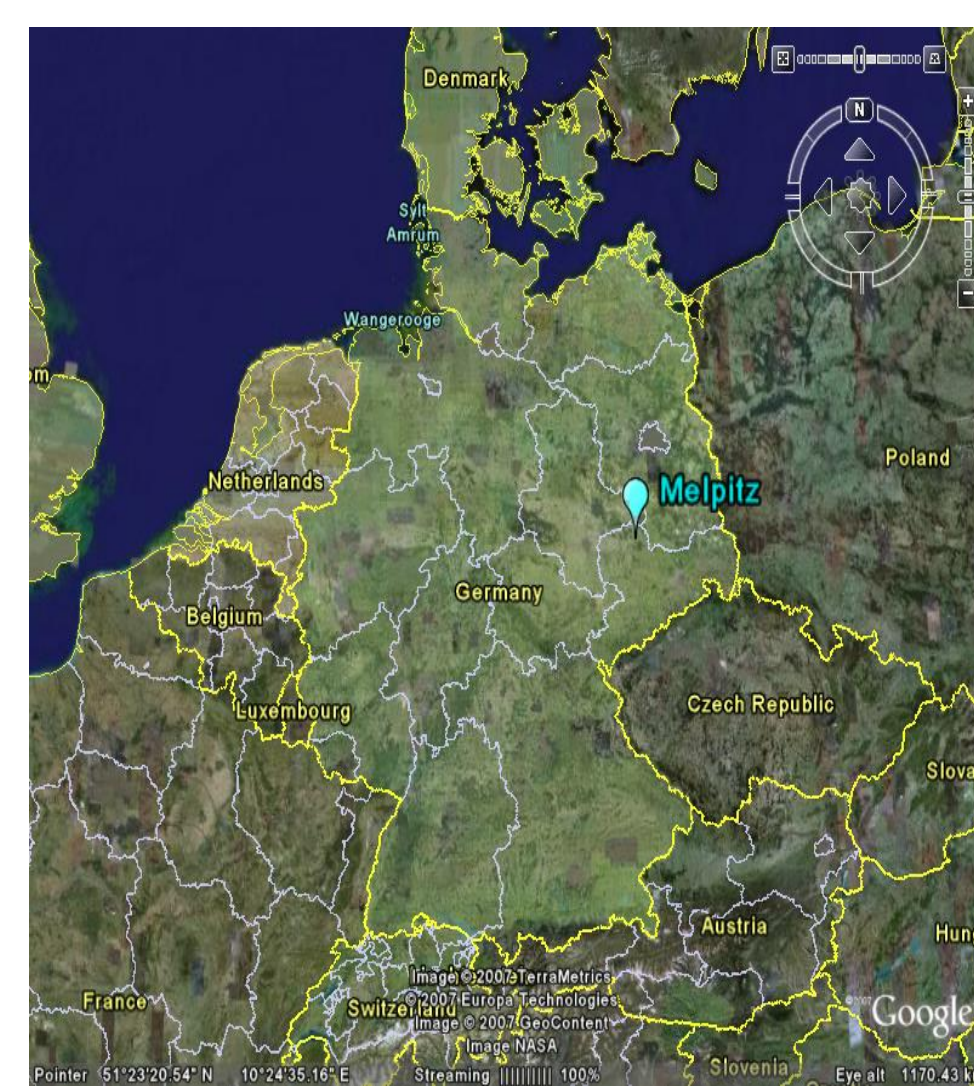


Figure 1: localisation of the Melpitz supersite (51°31N, 12°55E alt 83m)

## Time profiles and mass fraction

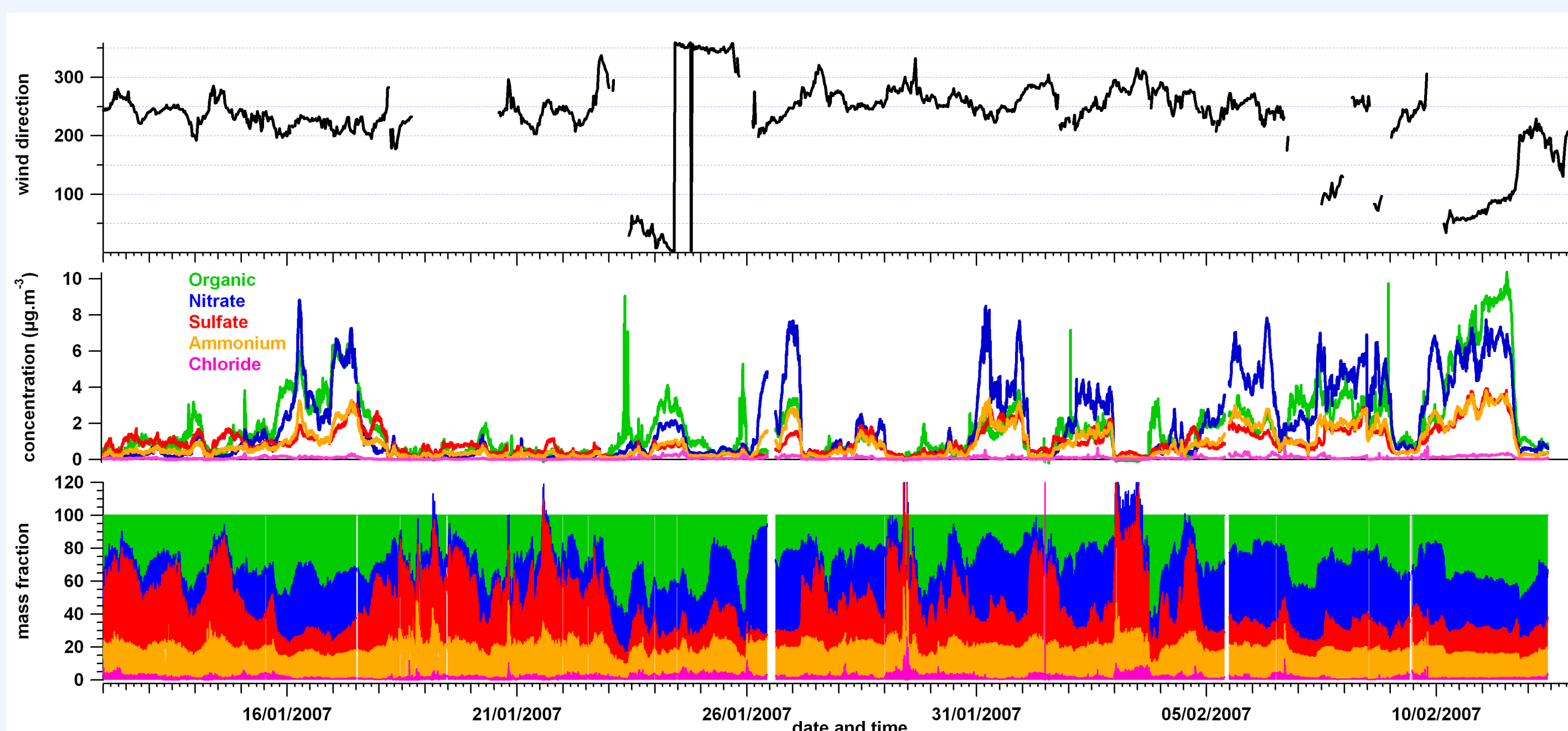


Figure 2: Wind direction, time profiles and particle mass fraction during winter 2007 campaign.

Figure 2 shows the wind direction, the mass concentration and the mass fraction of particles during the campaign. The wind direction looks relatively stable and comes mainly from the quarter NW-SSW. Two different situations were observed, in high particle concentration, organic and nitrate are the main components of the particle mass fraction. While in low particle concentration, sulfate represents the most important part of the particle mass fraction. The contribution of ammonium looks relatively stable during all the time and represent around 15-20% of the particle mass fraction.

## Comparison with a thermodenuder

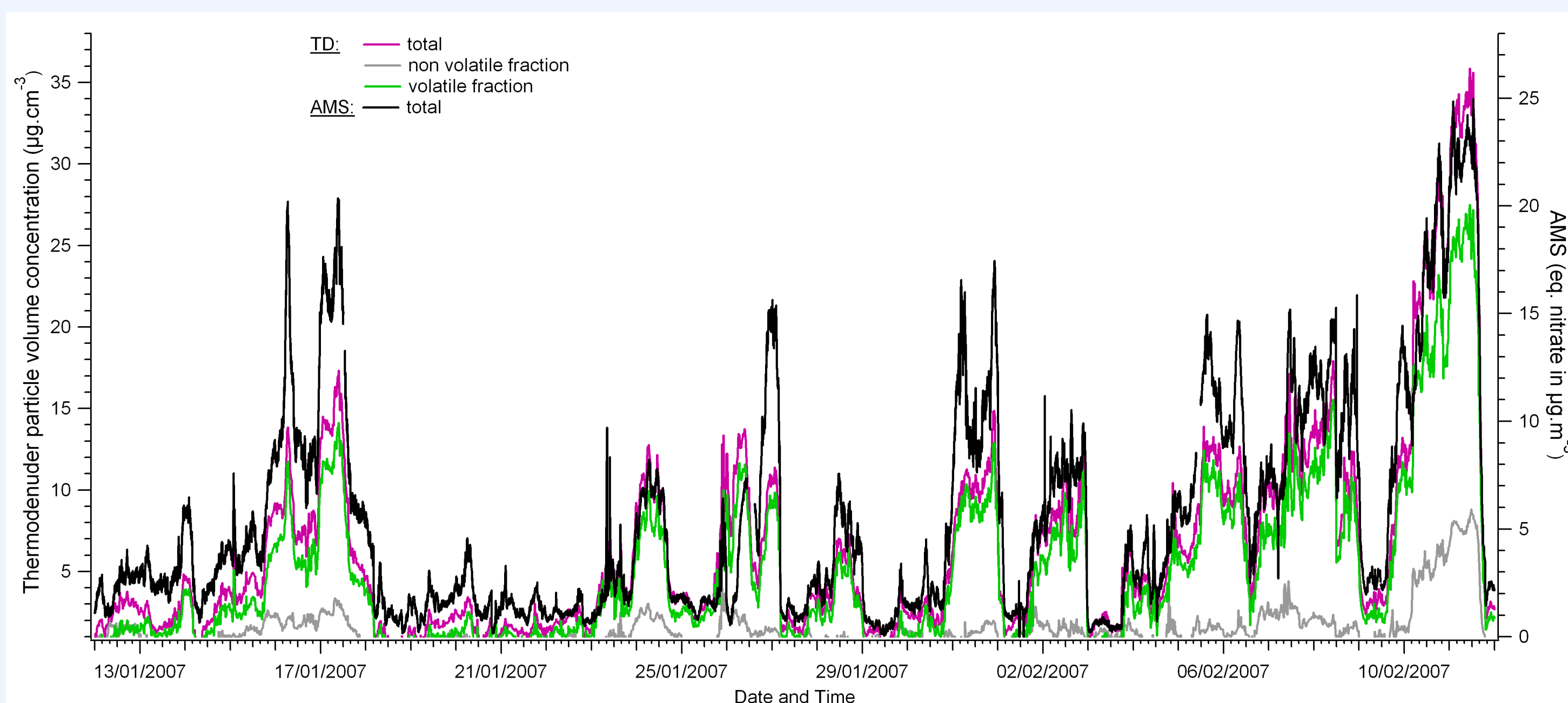


Figure 3: Comparison of the AMS and the thermodenuder (TD) results. The non-volatile fraction correspond to the particle components that are not evaporated after crossing the thermodenuder whereas volatile fraction is the evaporated one.

Thermodenuder measurements were also performed during the campaign. The comparison between the time series of the thermodenuder and the total AMS signal are presented in Figure 3. The volatile fraction and the total AMS signal show a very similar time trends for the most of the time during the campaign. However, the differences observed may correspond to high nitrate concentration events (see Figure 1).

## Summary

AMS deployment at Melpitz supersite during winter 2007 allows us to follow in real time and at the same time the particle size distribution and their chemical composition. Results have shown that the particle composition can be divided in two groups corresponding to two different kinds of particle concentrations. The first group corresponding to high particle concentration periods, in this case the main particle mass fractions are organic and nitrate whereas in more low particle concentration events, sulfate is the most important fragment. The mass fraction of ammonium appears to be relatively stable during all the time. The AMS results show a good correlation between daily PM1 measurement but also with thermodenuder measurements. Nevertheless, in high nitrate events a small gap is observed between the thermodenuder results.

Comparison between  $m/z44$  and  $m/z57$  show that the organic fraction of the particles are certainly mainly composed of oxygenated organic compounds that is characteristics from secondary organic aerosol. This could be explain by the location of the sampling site which is a rural site under urban influence but also by the wind which is more under oceanic influence during the main part of our measurements.

## Comparison with PM1

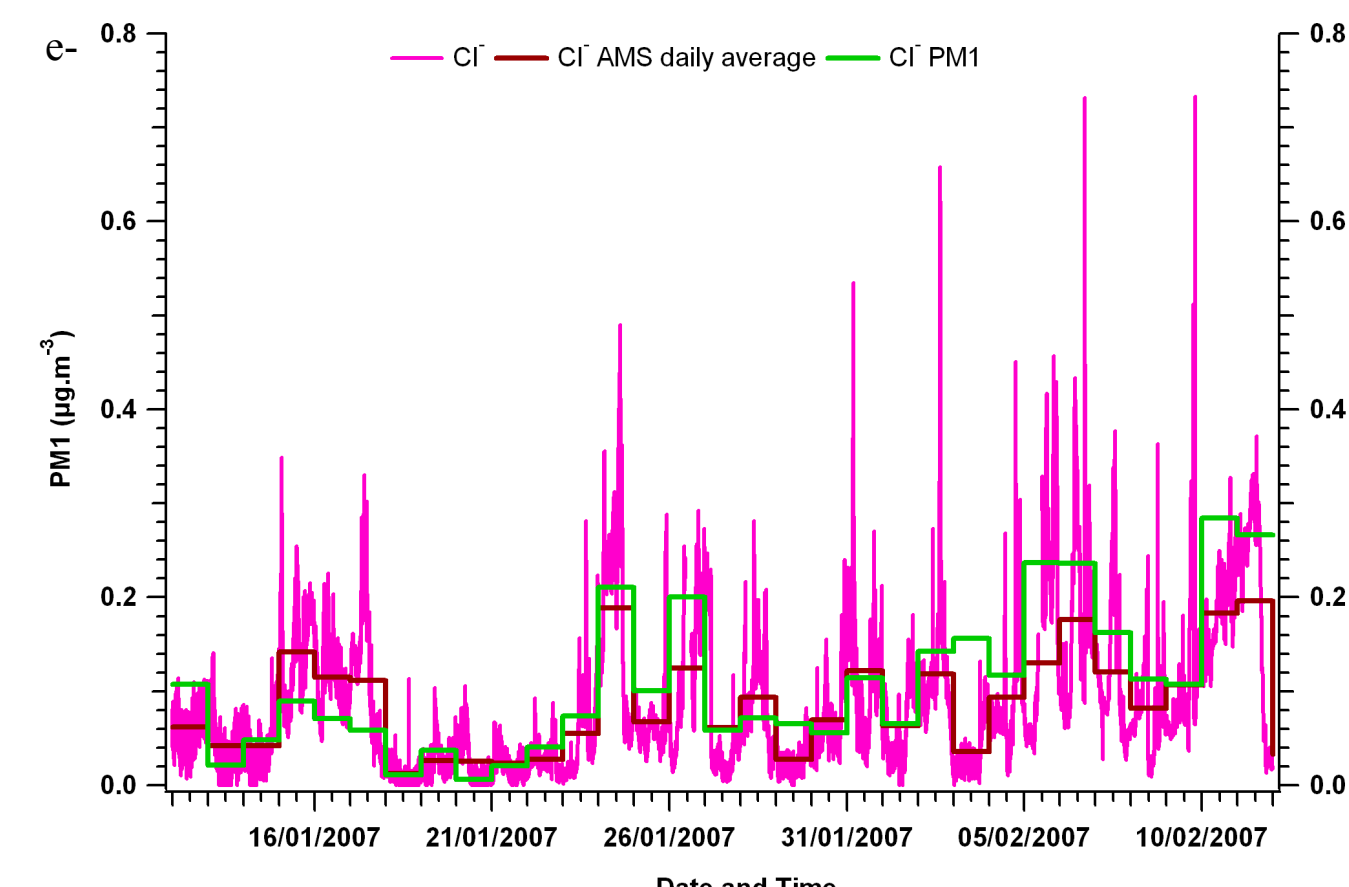
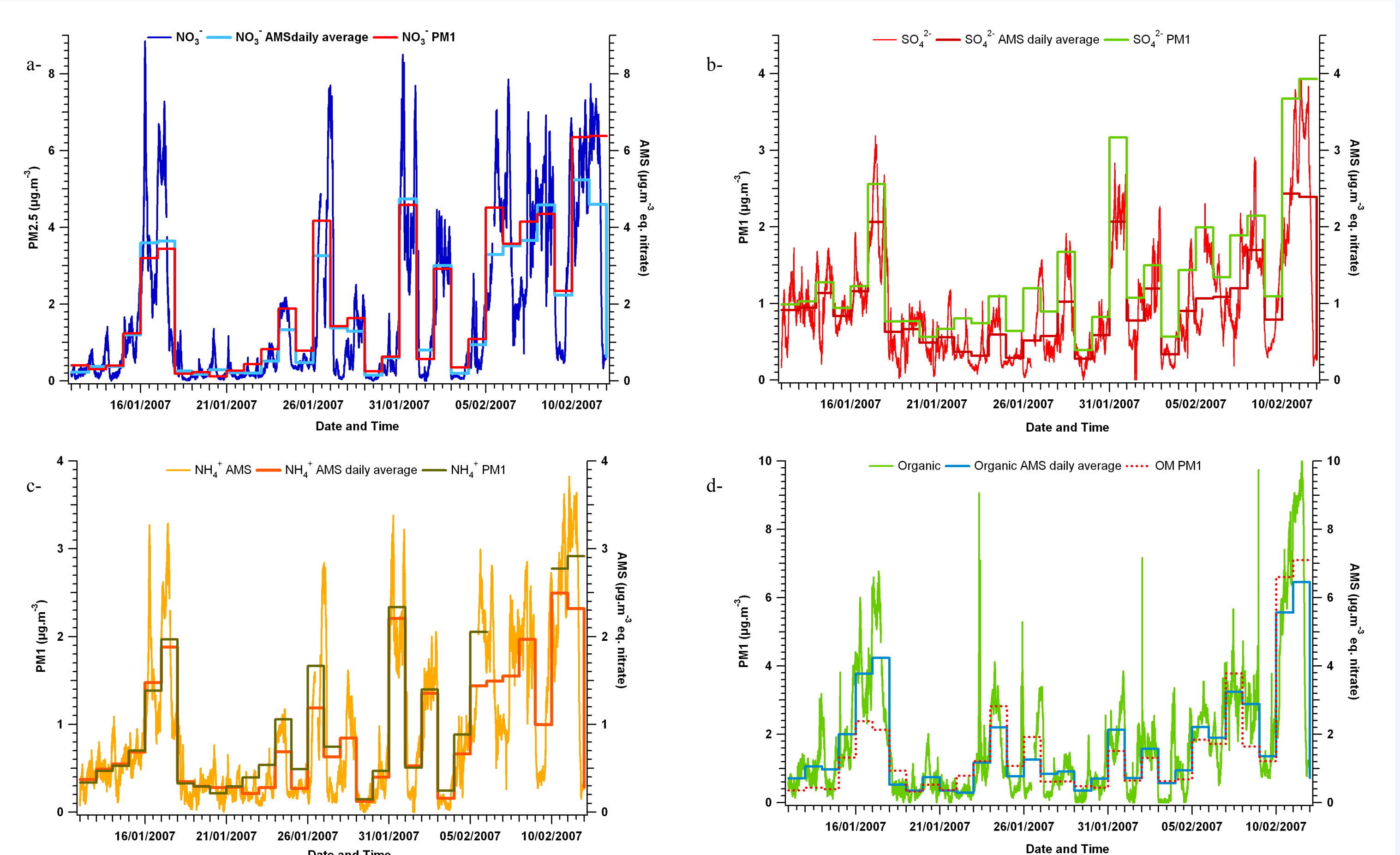
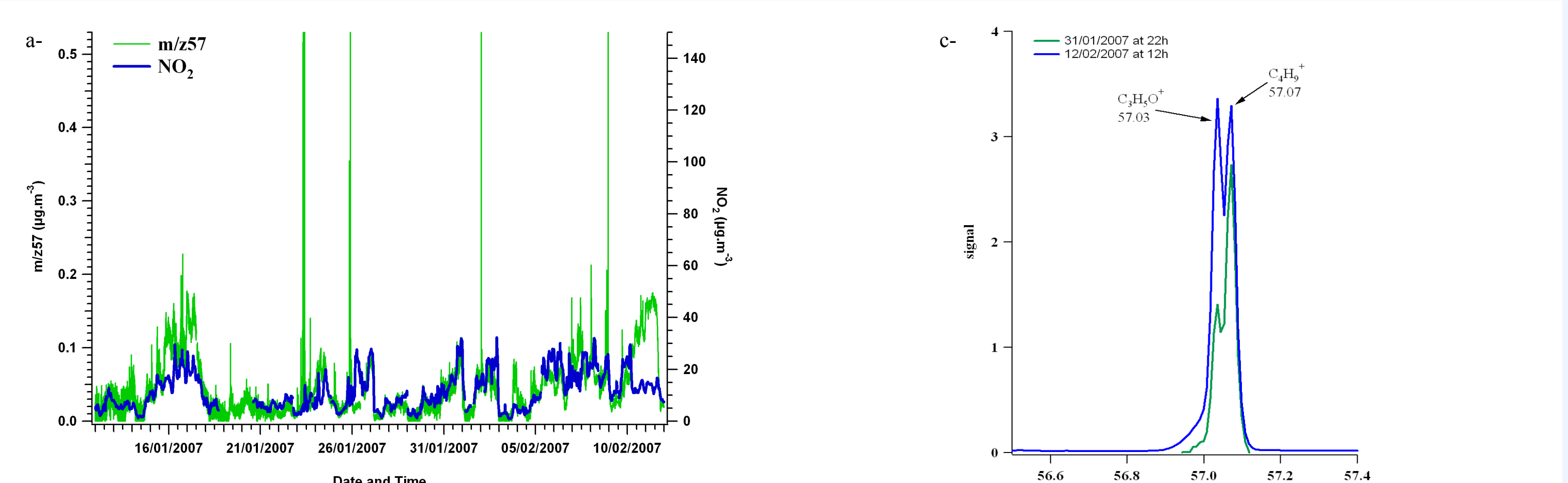


Figure 4: Comparison of the PM1 daily filter and AMS results during the campaign, a- nitrate, b- sulfate, c- ammonium, d- non refractory organics, e- chloride.

AMS is known to have a particle size detection close to PM1. Thus, our AMS results were compared to the daily PM1 filters measurements made in parallel to our measurements. To make comparison between the two methods, AMS data were daily averaged to have exactly the same time resolution than filters (Figure 4). Results show a strong correlation between the AMS and PM1 time series for  $\text{NO}_3^-$ ,  $\text{NH}_4^+$ ,  $\text{SO}_4^{2-}$ , non refractory organic compounds and chloride for most of the sampling time. However, chloride variations may be explain by the wind direction which come mainly from the NW-SSW (Figure 2) which corresponding to air masses with strongly influences by continental but also from oceanic sources and the sea-salt fraction of particles is known to can not be detected by AMS.

## Organic fraction composition



Organic fraction of the particle can be characterized by two fragments (Zhang et al., 2005): the fragment  $m/z57$  (mostly  $\text{C}_4\text{H}_9^+$ ) is considered like a marker from primary emission and has a similar profile than  $\text{NO}_2$  (Figure 5-a). However, at the last days of sampling an excess of  $m/z57$  is observed compare to  $\text{NO}_2$ . The HR-ToF-AMS have a high mass spectra resolution and Figure 5-c shows that  $m/z57$  is composed of 2 different fragments ( $m/z57.07$ ,  $\text{C}_4\text{H}_9^+$ ) and also an oxygenated fragment ( $m/z57.03$ ,  $\text{C}_3\text{H}_5\text{O}^+$ ). The second fragment is more specific to secondary organic aerosol and may explain this change. The fragment  $m/z44$  (mostly  $\text{CO}_2^+$ ) is more characteristic from oxygenated organic compounds and thus secondary organic aerosol (Figure 5-b).

Figure 5: scatter plot of  $m/z 57$  vs.  $\text{NO}_2$  (a) and  $m/z44$  vs.  $\text{SO}_4^{2-}$  (b). In (c) the fragment  $m/z57$  at two different dates.

## References

- Jayne J., Lear D. C., Zhang X., Davidovits P., Smith K. A. Kolb C.E. and Worsnop D. R., Aerosol Science and Technology, 33, 49 (2000)  
Schneider J., Weimer S., Drewnick F., Borrmann S., Helas G., Gwaze P., Schmid O., Andreae M. O., Kirchner U., International Journal of Mass Spectrometry, 258, 1-3, 37-49 (2006)  
Zhang Q., Alfarra M.R., Worsnop D., Allan J.D., Coe H., Canagaratna M.R., Jimenez J., Environmental Science and Technology, 39, 4938-4952, (2005)