Interactive comment on "Presenting SAPUSS: solving aerosol problem by using synergistic strategies at Barcelona, Spain" by M. Dall'Osto et al.

Reply in Italic

Anonymous Referee #1

General Comments:

The paper by Dall'Osto et al presents an introduction to the SAPUSS project. The paper discusses the aims/objectives of the project, and presents logistical and instrumentation issues, meteorological conditions, time series of certain measured quantities, and results from a model simulation. While a huge amount of data is presented in this paper, very limited analysis/interpretation is undertaken by the authors. The met overview is shallow, instrument inter-comparisons are incomplete, case studies are not fully investigated, overall conditions/concentrations are not put into context, and unsupported claims of findings are presented.

We acknowledge reviewer one for raising important comments and for the time spent reading this paper aiming at presenting SAPUSS. We value these comments highly, and we have modified this manuscript accordingly following all the suggested revisions. We also highlighted several aspect of this paper where we feel referee one might have not fully appreciated, including gaseous concentrations and PM_x values and temporal trends in a three dimensional urban scale.

One only has to read the abstract and conclusions to realise that there are no results of importance to report in this paper. The authors do acknowledge this fact early on, but state this study is so unique that it deserves an introductory paper. I strongly disagree, and while this paper is useful to the SAPUSS community, it is of little use to the wider scientific community due to the lack of scientific analysis/interpretation.

To our knowledge, SAPUSS is the first field study (and up to year 2012) where such a variety of instruments has been deployed in such a large spatial Mediterranean scale. Whilst CLEARFLOW took part in London and in the Po Valley in 2012, we still feel this is the most intensive field study carried out in the Mediterranean region so far. Moreover, there are at least two novel aspect of the SAPUSS field study:

1 As stated in Harrison et al. (2012):"Despite the relatively intensive monitoring activity, detailed three-dimensional studies of air pollution processes are notably lacking". The focus of most past urban air pollution experiments has been upon urban plume chemistry and the impact of urban emissions upon downwind regions. The use of research aircraft to provide rapid measurement capability in three spatial dimensions has provided important information. However, air traffic control requirements can provide a major limitation on the aircraft's deployment, whereas urban towers may provide a more suitable platform for the measurements of vertical profiles and fluxes

above the city. To our knowledge, SAPUSS is the first field study where <u>two</u> towers have been used as monitoring sites in a large Mediterranean city.
2. To our knowledge, this is also the first time (surely in Europe, and to our knowledge worldwide too) where two HR-ToF-AMS and two ATOFMS have been deployed simultaneously in a four weeks long intensive urban field study. Additionally, we have been used a total of 11 hi-vol samplers simultaneously in a large urban European Mediterranean city, as well as all the other aerosol instrumentations used (CPCs, SMPSs, etc.).

In summary, we believe the number of sites and the huge variety of instruments used are unique.Reviewer one disagrees this can be a paper of use to the wider community. We still believe the SAPUSS is a novel urban aerosol experiment. We have taken into account all the comments raised, shorten some introduction parts and expanded some other parts which could really only find space in an introduction overview paper. We address the concerns of reviewer one further in the next paragraph. In summary, we deleted a large fraction of the descriptive text and we focused the presentation of the project. This paper is essential to understand other papers of this special ACP issue. Additionally, we better summarized the PM section, the gaseous measurements sections and the modeling section.

The authors touch on many different topics, but in a manner so superficial it leaves the reader frustrated and un-informed. The comments below (which i have still included for the authors benefit) may be being addressed in detail by other manuscripts and therefore not within the scope of this article, but if so it begs the question: What is the overall message of this manuscript?

We agree with reviewer one that we touched too many different topics. We removed a number of paragraphs regarding different parameters measured and we expanded other sections as suggested.

As regard to the main question "What is the overall message of this manuscript?":

We believe we have at least three solid points in answer to it, and <u>altogether</u> they represent the reason why we wrote this introduction paper:

1. Presenting the project and its objectives, the six monitoring sites and the concept of monitoring in a three dimensional environment. We believe addressing all these points is important in a special issue. Such description cannot be fully presented (and/or repeated!) in every paper of the special issue.
2. Presenting the meteorological conditions, the different air mass scenarios and the main air quality parameters (including gaseous and PM_x concentrations). The monitoring sites are not only described but also compared, in order to avoid repeating information in other more specific papers of this special issue.
3. In order to make this overview presenting the SAPUSS project, we also report <u>unique</u> information which we <u>only</u> report in this paper, including time series and case studies of PM_x values in a urban three dimensional scale. We agree with reviewer one that to do so is very difficult. Merging two different manuscripts' concepts (an ad-hoc scientific paper

addressing specific scientific questions and an overview more general paper) is very difficult. There are several examples of scientific manuscripts, ranging from reviews (where nothing new is presented, but a review of existing studies is made) to specific manuscripts (at times cited very little). We have done our best to make this manuscript potentially citable not only by the papers within the special issue (which will be about a dozen, making this paper cited about four times more the average number of citations), but also by other manuscripts, especially in the context of air quality parameters in a three dimensional urban scale. It is imperative to remember measurements of such type are really lacking in the literature.

Therefore I recommend this paper is NOT taken forward to full publication. I do however look forward to the wealth of information which is sure to be generated from the more focused manuscripts found within the SAPUSS special issue. The information in this paper is not relied on heavily by the other papers in the special issue (based on a brief scan of the other papers), so its exclusion should have minimum impact.

This is an important point where the reviewer one is right. This is not a repetition of other data presented in other papers. At the current stage (May 2013) there are four papers already accepted on SAPUSS ACP, two in discussion in SAPUSS ACPD and four additional papers being submitted on the SAPUSS special issue, and at least other four will be presented in the coming two year. Surely we cannot add the meteorology and the presentation of the six monitoring sites in every paper – it would only leave to a boring repetition (and expensive one!) of the same concepts. By contrast, we present the monitoring sites and the projects as a whole in an introduction paper. We also report important atmospheric air pollution parameters (gaseous concentrations, PM_x values) only in this paper, without repeating them in any other paper. This adds at least two important pieces of information:

1. *The sites can be fully described and compared.*
2. *Important novel information are made available on a three dimensional urban scale.*

Specific Comments:

In the special issue introduction, it is stated that "Compared to other European regions, the metropolitan area of Barcelona sees relatively high particulate matter due to high anthropogenic emissions, a dry and warm Mediterranean climate and low dispersive conditions due to a unique topographical situation." Given the introductory nature of this paper, it would have been useful for the authors to demonstrate/introduce this, possibly by comparing air quality monitoring datasets between cities etc.

We added a description of the Mediterranean Area, also in the context of the air pollution context.

In general, the paper is poorly written (with the exception of the modelling section). Countless technical and general statements/descriptions are inaccurate (e.g. "..... some

atmospheric parameters of interest are derived indirectly by the changes in atmospheric radiation that result from the presence of the parameter" is highly suggestive of passive remote sensing, but LIDAR is used as a subsequent example;

Barcelona is stated as having the highest population density in Europe, despite it actually being Paris).

We modified the text

Poor grammar is widespread and sentence structure is frequently confusing.

We hope we now improved the grammar of the manuscript.

Figure clarity is very poor: axis labels/values are difficult to read; too much data is shown to be useful (e.g. 4 weeks of data at high time resolution on small figures such as Fig. 2a); inappropriate figure legend size/location (e.g. Figure 9). Figures 1a and b are repetitive and unclear. A plan view of topographical data would be more appropriate.

We modified Figure 2, we added information on Figure 9 and generally we improved most of the Figures. We removed some (and some tables too). We believe Figure 1a and 1b are not repetitive because it is important to see the six monitoring sites (Figure 1a) and a picture of the city with the two towers in order to have a full vision of the monitoring sites.

Sigma is not defined as standard deviation in Figure 4. Variability/uncertainty values in Tables 4-5 are not defined (standard deviation?).

We now clearly state at the beginning that uncertainty is given as sigma (±1 standard deviation). "for different sites gave minimum, maximum, average and one sigma standard deviation"

Values of measured parameters are quoted inline in the text and in various tables. It is not stated in the text what these represent (presumably standard deviation), and values of e.g. 8.8+-12μg m-3 (l2, p18766) are both non-physical and misleading, and should be quoted correctly. Discussing PDFs of parameters which exhibit such skewed distributions is more appropriate than simply means and standard deviations. Incorrect symbols are occasionally used (e.g. l20, p18764).

We checked several times the manuscripts, and we now hope we reduced the number of errors.

Generally speaking, gas phase concentrations are reported in μg/m-3 in this paper. They are later reported in ppb. While different communities do use different units (air quality, atmospheric chemistry etc), it would make sense to use only one set of units in the paper.

Also, the quoted conversion between ppb and µg/m-3 for ozone varies (albeit weakly) as a function of T and P, not a constant as implied in l5, p18770.

We clearly stated that the measurements are reported in µg/m-3 across all the manuscript but "It is important to remember that ozone values in Table 4, Figs. 10 and 11 are in µgm−3, whereas Fig. 11 b shows data in ppb (1 ppb=2.00 µgm−3) in order to stoichiometrilly compare OX and NOx". It is simple not possible to make an oxidant plot without using ppb. At the same time, we reported the average values.

Conversion factors for NO, NO2 etc have been omitted, and should have been presented to allow the reader to quickly convert. No discussion of the gas phase concentrations reported relative to e.g. exposure limits, other European urban/background sites etc, takes place.

We believe we extensively discussed the gaseous concentrations, also by considering diurnal profiles across different meteorological conditions. We added as requested information relative to exposure limits.

The overview of the large scale meteorological situation is poor. How was classification of the back trajectories performed? Was an automated clustering technique used, or was it a subjective decision? What was the variability of the (a) local (<24hours) and (b) more distant (>24hours) sections of the trajectory within each individual group? It would have been interesting to examine MSLP and 500hPa geo-potential heights to identify the features responsibly for the flow regimes (particularly for the interesting case of strong easterly flow from Europe).

We looked at both large scale and local meteorology. For the first time, we also used a number of different local meteorological stations in order to validate the different sites. We selected specific air mass scenarios, and when not sure we left some days of the field studies unclassified (23 days during SAPUSS presented the same air mass type within the 24 h of each day, whereas days with multiple air mass types within the same day were classified as "transition" (Table 3, Fig. 3).". We believe we classified the days correctly. We looked at air mass trajectories (both 5-days and less reliable 1-day ones) but most importantly we also used local meteorology to classify different periods of the field study, in order to avoid wrong classifications based only on air mass trajectories. This was done with international collaborators as well with the IDAEA-CSIC groups (Dr. X. Querol), which has more than ten years experience in classifying air mass scenarios in the study area.

Local flow phenomena are discussed in the introduction, but are rarely related to any trends observed in the data (occasionally discussion of the observed of the sea breeze is found). The presentation of the met data in Fig 4 shows standard deviations for RH, T etc for each site as a whole. To make this more useful the standard deviations should be reported for each trajectory group. Also, an estimate of precipitation would be useful due to its impact on the aerosol population.

We added standard deviations and precipitation values.

Detailed descriptions of the measurement sites and instrumentation are provided. However, important information is missing, such as inlet flow rates/residence times, humidity conditioning etc.

We thank the reviewer for appreciating the detailed description of the monitoring sites. According to the concerns, we substantially reduced the information about instrumentations.

A description/plot of the comparison of all the ToF-AMS instruments with each other and the off line filters would be useful in such an introduction paper, as would discussion of the collection efficiencies used for these instruments. Was this collection efficiency constant with time/instrument? Was the comparison between involatile (NH42SO4) and semi-volatile (e.g. NH4NO3) components for online and offline techniques favourable?

We will address such technical issues (already addressed in several papers including Middlebook et al., 2012) in future specific AMS-ATOFMS papers, in this special issue..

An average particle size distribution for the entire 1 month study is presented, and lognormal modes are fit to this distribution. Is this appropriate and are there really ever 3 modes <1μm at any one time?

Yes it is appropriate. At every of the four sites we find three modes, which are the three modes that describe the aerosol particle number population (nucleation, Aitken and accumulation). However, in order to reduce the length of the paper and to focus only on presenting the project and main air quality parameters, we reduced this section as other ad-hoc papers will be published in the future (two are already found in this issue). We merged the aerosol size distribution and particle number concentration section, and overall we sensibly reduced it.

No discussion of whether the conditions encountered during SAPUSS were typical for the time of year etc.

We added a section on the representation of the SAPUSS.

Virtually no analysis on the evolution of the aerosol composition and size distribution is presented. It is hard to criticise analysis when virtually none has not been conducted.

We reduced this section, and we only briefly commented the results in the context of comparing the sites.

Anonymous Referee #2

This paper contains an introduction to SAPUSS, a project that involved measurements at several sites in and around Barcelona, Spain. It is intended to provide a basis for a series of papers for a special issue in Atmospheric Chemistry and Physics on findings from the SAPUSS project. The authors present detailed information about the sites and instrumentation and also the key objectives of SAPUSS. Besides that, the paper includes a variety of short sections presenting first results and touching diverse topics such as air mass back trajectory analysis, local meteorology, levels of NH3 and other gaseous pollutants, aerosol characterization (number, size distribution, mass concentrations) and chemical transport modelling.

We thank reviewer two for reviewing this manuscript. We addressed main concerns and detailed answers are found below.

This variety of topics makes the paper on one hand lengthy and difficult to read, on the other hand the results remain shallow and incomplete and do not reach the required scientific standard. As an example, the activities on chemical transport modelling using CHIMERE are not sufficiently described by sections 3.3.2 and 4.6. Readers simply get not the required information about how the modelling system was set up and what exactly has been done, readers therefore cannot judge about the value of the presented results.

Following this suggestion, section 3.3.2 have been rewritten in order to provide more insights into the modeling configuration and modeling activities shown in section 4.6.

The authors state in section 4.6 that "the measurements for SAPUSS will contribute to a better characterization of this intra-daily variability and to check why the amplitude of the daily cycle is not well captured generally by these models". This is only a statement here that is not supported by the results provided in this manuscript. The questions raised by this statement could however be addressed in a separate focused paper.

We strongly appreciate the reviewer's suggestion. Encouraged by the aforementioned comment, a paper focusing on modeling the SAPUSS campaign is under preparation.

I therefore strongly suggest rewriting this paper in a way so that the text is confined to a short and concise introduction into SAPUSS and its key objectives. The results should be left for the focused papers within this special issue. This paper can be published in ACP (as an introduction to the special issue rather than a research paper) when revised accordingly.

Following these suggestions, we sensibly reduced the length of the description of the instrumentation used. We not only present a description of the projects and its objectives, a description of the monitoring sites, the meteorology encountered and relative air mass

scenarios, and an detailed analysis of the air quality parameters (gaseous and PM_x concentrations).

My suggestion basically is to skip the brief descriptions of results and also the sections on measurement technologies because the used measurement technologies should anyway be described appropriately in the focused papers and redundancy should be avoided.

We sensibly reduced some brief descriptions of the results (on-line aerosol techniques, aerosol size distributions, cielometers) and extend the analysis of other results (gaseous, PM_x). We overall reduced the length of the manuscript, and we hope it is now confined to a short and concise introduction into SAPUSS and its key objectives.