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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Technical Note: In-situ quantification of aerosol sources and sinks over regional geographical scales" *by* G. Buzorius

G. Buzorius

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I would like to thank all referees for their time and effort reviewing the manuscript. All comments were addressed and changes were implemented where applicable. Due to number of minor changes in the text and some chapter-order reorganization as suggested by referees it would be more convenient for the reader to receive the updated manuscript text with the implemented changes. Detailed answers to the comments are below.

Anonymous Referee #1

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General comments

In the manuscript, airborne eddy covariance measurements of aerosol particle fluxes

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Discussion Paper

made in marine and continental environments are presented. Paper is also a technical note concerning the improvements is the spatial scale of the airborne EC measurements. These kinds of measurements are rare, and provide a possibility to measure fluxes in larger scales and in changing environments contrary to traditional flux towers. The data in interesting but there are, however, corrections which should be applied on the manuscript in order to publish it in ACP. First of all, the language is partly poor and some of the sentences are hard to follow. I found this problematic especially in Introduction part (Page 1303, Lines 1-25) which should be written again. Authors should also give special attention to past/present forms. **Language was checked by native English speaker. Some parts were rephrased**.

Text in Section 4.4 (Polluted Environment) is partly incoherent with same sentences repeated and thus the text could be condensed. E.g. the upward heat fluxes caused by sun radiation are mentioned in both Page 1315 lines 19-20 and in Page 1316 lines 24-25. In page 1315, line 21, dry deposition is pointed out to be a reason on downward fluxes. This is again repeated in page 1316 lines 23-24. The dry deposition and its references were also repeated in Page 1313 line 5, Page 1314 line2. The text in pages 1316(last line)-1317(lines 1-3) should be mentioned in the same place where the author comments on the possible sinks and sources (Page 1315, Lines 19-27). Unsystematically, traffic is mentioned as only urban source there. Also the information concerning the re-suspension is irrelevant because the author tells that the sources are impossible to identify. **Text was reorganized as suggested. Page 1315 lines 19-25 were removed to avoid the repetition. Corresponding references added to page 1316. Note that references on page 1513 and 1514 are about dry deposition to water. Those are different models than for dry deposition on land refereed**

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section 4.4.

Concerning the overall presentation, I would suggest that in results the clean marine environment should be before the plume ones. Then there would be a systematic change from clean marine environment to more polluted environments. **Section was moved as suggested.**

Below more specific comments concerning the manuscript are presented.

Specific comments

The abstract should be written more compactly. Lines 8-10 and 13-15 duplicate each other. Is the information "highway segments, city blocks" relevant since they are not studied in the paper? Could the text in lines 15-18 be condensed to e.g. "The improved spatial resolution airborne flux measurements were conducted from clean and partly polluted marine environments to heavily polluted continental environment with low mixed boundary heights"13**-15 lines removed, 8-10 lines expended, suggestions included.**

Page 1303, lines 14-16: Reference needed. **Reference added. Fountakis et al. (JGR, VOL. 112, D10S30, doi:10.1029/2006JD007272, 2007 and references therein).**

Page 1303: lines 23-25: The sentence "Sources than can be quantified with the EC include" seems rather strange. In theory you should be able to distinct all kind of sources with EC if you just know the footprint functions. Or is the purpose of the sentence to say that sea spray and dust have been well quantified with EC measurements.**When several sources are present within the same footprint they can not be distin-**

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guished with the presented EC method. The purpose of the sentence is bring-up aerosol sources in relation to EC method to reader's attention since later in the manuscript they are discussed in more detail.

Page 1306, line 12: The abbreviation CPC should be mentioned when Condensation

Particle Counter is mentioned for the first time in Experimental setup section. **Corrected as suggested.**

Page 1306, line 18: "The Webb correction will be presented..." could be removed **Since Web correction was left out from the previous paper it is good to mention here.**

Page 1306, line 21: Why only sea surface in "The sea surface fetch contributing to the

flux is defined as a footprint". Also reference on the footprints would be nice. **Corrected to "planetary surface area". References are already in the text within the same paragraph.**

The text in Section 3.3 (Page 1307, lines 18-25) is hard to follow, and it is misleading to

say "Moreover, this fluctuation is correlated with the vertical wind speed, and manifests

as an artificial particle flux as measured by EC",since if there is an upward particle flux,

WPL correction actually increases the flux. Assuming, of course, upward heat flux. **lines 18-25 were removed. The shorter version of the Webb correction explanation is sufficient.**

Page 1308, line 23: Should be explained from what SST is abbreviated. **Added "Sea Surface Temperature"**

Page 1309, line 4: I would add "since" in front of the "Heat flux is primary driven..." to

make the sentences more connected**. Added**

The long text concerning coagulation on Page 1310, lines 3-9 is unnecessary. If the

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author wants to mention coagulation is should be made somewhere in introduction part but not in results. **I would agree that this text is not necessary. However, very often reviewers ask about coagulation effect on flux results. That indicates that readers of aerosol flux papers are concerned about coagulation. To address those concerns these sentences were added.**

Page 1310, lines 19-20: I would remove "This plume was encountered on the 12 August 2006 flight" and add the information on the same page line 17 "...from a ship on 12 August 2006” to get the text more fluent. **Corrected as suggested.**

Page 1311, lines 16-18: "The increase causes a reduction in value of c'=c-c_mean..." is incorrect. Increase in average concentration does not affect the fluctuating part unless c is constant, which is not the case when compared with urban and clean areas. **This statement was not written in the way it should have been. A different idea was meant in here. Referee is correct, and the statement was removed. The idea of aerosol EC applications in polluted environment was adopted from Dorsey et al. (2002). Some critics have stated that in polluted environment aerosol concentration time series do not satisfy stationarity requirements. However, as it was noted by authors of Edinburgh study (I confirmed the statement from independent datasets), the relative variability in urban aerosol concentration often is comparable to that in the remote environment. It is not unreasonable to view urban aerosol as a mix of long-range-transported remote environment aerosol with multiple pollution plumes from urban sources. Each individual aerosol plume can increase aerosol concentration several-fold from the levels observed in clean environment, and presents an extreme case of non-stationarity problem. However, when more plumes are added to the footprint, soon a saturation point is reached, where the high enough spatial density of plumes does not al-**

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low the total aerosol concentration to drop back to levels observed before the long-range transported aerosol entered the urban area. This leads to reduction in std(c)/mean(c) term– the term frequently used for quantification of the non-stationarity problem compared to the single plume case. It affects c'=c-mean(c)" as well.

Vertical soundings were mentioned in the text (e.g. page 1312 line 1) but who made

them, where were they made and at what time. **Soundings were performed during the flights in numerous locations. To explain that text was added to 2.0 chapter on page 1305 line 25: "During each flight 8 to 20 vertical profiles were sampled by ascending/descending in spiral or straight heading from 33 m to 200 to 600 m elevation within the study area.** "

The point of the text concerning the CCN at the end of Section "Multiple plumes" is

unclear, since the manuscript does not present any data where they would try to determine

CCN flux from the total concentration and fluxes. **It is a suggestion for future applications. The method provides particle flux in vertical direction at certain elevation in atmosphere. The flux data combined with measured onboard aerosol size distribution, chemical composition data allows indirect estimation of CCN flux.**

Page 1316, lines 2-3: "The aerosol number concentration was sampled at 10 Hz" was

already mentioned in methods part where it belongs. **Corrected as suggested**

The sentences "Using the wind direction data ..." on page 1317, lines 4-7 are unclear. **Wind direction was used to determine from where air mass came to the sampling point. If at upwind direction there was a town (at distances less than several kilometers), it was assumed that the sampling occurred in the plume from the urban area. Text in the manuscript was not changed here.**

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Page 1317, lines 15-16: Other contributors to the aerosol particle concentrations are also other sources than traffic and long-range transport. **The comment is not applicable since the sentence it referees to, was removed.**

Traffic as main source for particles in urban areas is commonly know, but how could you distinguish that from your data (Page 1318, lines 22-23 "...traffic being one of the main particle sources"), since previously it was mentioned that the sources are impossible to distinguish (Page 1315, lines 1-3). **Two points: (1) those towns are small residential towns specializing in agricultural businesses that are primarily located of city limits. (2) other studies (refereed in MS) conducted in urban areas proved that aerosol flux is highly correlated with traffic intensity. With no industrial emissions, the traffic becomes one of the main sources. Nevertheless, emissions from burning (for heating or energy generating purposes) processes are possible.**

Figure 1 and 4: What was the measurement day **Figure 1 was August 8, 2006 (it is written on page 1308 line 20). Figure 4 the same day (it is written on page 1311 line 20).**

Technical comments:

In many parts of the text, units are presented as X/Y, while they should be X Y-1. **corrected by searching text for symbol "/" and changed as suggested and appropriate.**

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 1301, 2009.

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