Ph.D. Dissertation Assesment

Author of the Dissertation: Cecilia Leoni, M.Sc.

Dissertation title: „Atmospheric aerosol: physical chemical characterization and source apportionment.“

Author of the assesment report: Vladimír Ždímal

The thesis dealt with the characterization of atmospheric aerosol, especially of its particle size distribution, and chemical composition. The work fits well into the current trend in aerosol research where attempts are made to measure a wider range of aerosol particle properties, even at a higher temporal resolution, and interpret the data along with the knowledge of meteorological parameters and concentrations of gaseous pollutants. At the same time, a successful attempt was made to measure some aerosol properties even on the vertical profile at the bottom of the planetary boundary layer.

Doctoral work is conceived as a commentary on a set of 4 published papers. Three of these four papers are published in journals with impact factor, the fourth paper is a peer-reviewed full text of the presentation at an international conference, published in the conference periodical. In two of the four papers, the applicant is listed as the first author, and in the other two she is listed as the second author. The materials submitted to the defense by the doctoral student contain also a necessary information on her contribution to individual articles. I noticed that the Ph.D. dissertation states that manuscript number 4 was only submitted to the journal, but according to my information it was already accepted for publication. The commentary on the articles has a total of less than 60 pages, followed by the published articles. These articles have already gone through a thorough peer-review process in the journals, so my further comments are focused on the introductory part.

All of the papers are connected by both experimental approaches to measuring particle size distribution at higher time resolution, as well as by source apportionment of aerosol particles that combines detailed chemical composition data at a lower resolution with particle size distribution data measured at a substantially higher time resolution.

If I were to emphasize the results of the work that I was most interested in, I would probably mention the combination of measurements of particle size distribution and chemical composition at different time resolutions, and then the subsequent source apportionment studies. Measurement of vertical particle concentration profiles by the airship is also original. It is of considerable practical importance to carry out the source apportionment study in the vicinity of a large industrial agglomeration, especially when it is a heavily polluted region on a European scale. If it is needed to decide on measures to effectively reduce air pollution in such a region, it is necessary to determine the shares of individual sources under different meteorological conditions beforehand.

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Commentary as well as articles are written in English. Even though I am not an English native speaker, I noticed a number of grammatically incorrect clauses and some less comprehensible parts of the text. In the future, I recommend the author to give more attention to language proofs before publishing the final work. However, this slight criticism does not significantly reduce the overall good quality of the dissertation.

Finally, I note that I have read the dissertation thesis as a whole, I believe that it meets all the conditions for this type of dissertation and, therefore, I recommend it for the oral defense.

However, I would like to ask the student several questions:

Page 20, 1.2. text about particle number concentration:
Can you comment on the measured atmospheric particle number concentrations in connection with the residence time these particles spent in the atmosphere since they were emitted by the source or since they were formed in situ by a photochemical reaction? How do these concentrations relate to the height of the planetary boundary layer or its changes?

On page 28, you claim that in the differential mobility analyzer DMA the positively charged particles move across the sheath air stream to the negatively charged central rod. Why could not the particles have a negative charge and the central rod charge positive? Would there be any difference between these situations physically?

On page 29, you say that in most CPC-type condensation particle counters, supersaturation is achieved by heat transfer between the hot air stream and the cold wall of the condenser. Does that mean that mass transfer does not play a role here? Does that mean that the transfer of momentum does not play any role here? Please explain.

On page 31, you say that when organic carbon is measured, the OC carbon will be quantitatively converted to carbon dioxide and eventually reduced to methane. Would not it be possible to determine carbon dioxide and save the conversion step to methane?

On page 38, you mention that the smallest size mode is formed by binary nucleation of sulfuric acid with water or ternary nucleation sulfuric acid - ammonia - water. Have you heard about the latest developments in the field, according to which amines are also involved in this process? Can their involvement influence the nucleation kinetics, and if yes, how?

On page 42, you are writing about the overlap of the size distributions determined by the scanning mobility particle sizer SMPS and those determined by the aerodynamic particle sizer APS. Is it possible to link these size spectra automatically, or should the data be somewhat converted beforehand? If yes, why?
In the middle of page 43 (G-plots), you write that it is assumed that the determined factors are mutually uncorrelated. Is it true? And, if they were correlated, what does it mean for interpretation of the results?

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On page 49, you mention that particles between 20 and 40 nm in diameter have twice as high deposition efficiency in the lung alveoli in comparison with other ultra-fine particles. Given the strongly nonlinear size dependence of particle deposition efficiency, please explain the published claim.

Minor comments to the text:

Page 5, par. 2, line 4: correctly should be „Czech Ministry of Education, Sports and Youth“.
Pg. 7, par. 2, line 2: correctly should be „...industry being dominant source, NOT sources;
line 8: the words „at the“ are repeated 2x.
Pg. 18, chapter 1.1.1, par. 1, line 1: the word „it“ is redundant.
Pg. 19, one line before the last: „...formation in the 10-100 size range...“, units are missing.
Pg. 21, chapter 1.3, line 2: instead of „rarely“ should better be „never“;
fourth line from bellow: in the reference Schwartz et al. is „t“ redundant, correct spelling of the authors name is „Schwarz“ et al., similarly at other places of the text.
Pg. 22, par. 2, line 4: in the phrase ..“impacted vehicular sources“ should be inserted „by“.
One line before the last in the same paragraph: I suggest that there should be rather „via condensation“, instead of „via coagulation“.
Pg. 34, chapter 2.4., par. 1, line 1: the word „few“ would better be replaced by „still more“.
Pg. 48, chapter 4.1., par. 1, line 4: in the phrase „...highly time-and-space airborne ...„ is missing the word „resolved“. Similarly at other occurences.
Pg. 49, one before the last paragraph, line 5 from bellow: missing „n“ in „nanoparticles“;
line 4 from bellow: in the phrase „No other studies on the were found „ is a word missing and the phrase is not well understandable.
Pg. 52, line 2: either the word „which“ is redundant or „are“ is missing.
Pg. 53, line 3 from bellow: the verb „monitor“ is not well selected in given context.
Pg. 54, chapter 4.3, par. 2, line 3: the verb „resolved“ is missing after „highly time and space...“
Pg. 55, par. 2, line 5: the word „it“ following „conditions“ is redundant.

Prague, February 20, 2018

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