Zał. 2a Autoreferat (English version) / Summary of professional accomplishments

1. First name and surname: Iwona Sylwia Stachlewska

2. Diplomas, degrees with the name, place and year of awarding and the title of the doctoral dissertation.

- **Dr. rer. nat. in Atmospheric Physics, 14 march 2006, Potsdam, Niemcy**
  Institut für Physik und Astronomie, Mathematisch-Naturwissenschaftliche Fakultät, Universität Potsdam, Niemcy

  Dissertation title: *Investigation of tropospheric arctic aerosol and mixed-phase clouds using airborne lidar technique*

- Ph.D. in Physics, 2008 (nostrification), Uniwersytet Warszawski, Wydział Fizyki
- PG Dipl. in R&D Project Management, 2014, Wyższa Szkoła Bankowa w Poznaniu
- M.Sc. in Environmental Physics, 1998, Uniwersytet Warszawski, Wydział Fizyki

3. Information on past employment in scientific instututions/entities:

- **Since March 2008 :** *various positions; currently Adiunkt (Assistant Professor),* Institute of Geophysics, Faculty of Physics, University of Warsaw, Poland.
- **April 2006 to May 2007:** *R&D researcher*, LEOSPHERE Lidar Environmental Observations, Ecole Polytechnique Incubator, Palaiseau, France.
- **October 2003 to February 2006:** *PhD student*, Institut für Physik und Astronomie, Mathematisch-Naturwissenschaftliche Fakultät, Universität Potsdam, Germany
- **February 2003 to March 2006:** *Researcher*, Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung (AWI), Potsdam, Germany.
- **October 2001 to January 2003:** *Research Associate*, Meteorologisches Institut, Fakultät für Physik, Ludwig-Maximilians-Universität München, Munich, Germany.
- **October 1999 to September 2001:** *Research Assistant*, Marine Remote Sensing Unit, Department of Oceanography, University of Cape Town, RSA.

4. Indication of achievement resulting from art. 16 sec. 2 of the Act of 14 March 2003 on academic degrees and academic title, and degrees and title in the field of art (Journal of Laws No. 65, item 595 with changes):

a) Title of the scientific achievement:

Influence of anthropogenic pollution and biomass burning on aerosol properties at a far distance from the emission source based on complex lidar mesurements.

b) (authors, titles, publication dates, name of publisheres):

B1: **Stachlewska I.S.**, Samson M., Zawadzka O., Harenda K., Janicka L., Poczta P., Szczepanik D., Heese B., Wang D., Borek K., Tetoni E., Proestakis E., Siomos N., Nemuc A., Chojnicki B.H., Markowicz K.M., Pietruczuk A., Szkop A., Althausen D., Stebel K., Schuettemeyer D., Zehner C., Modification of Local Urban Aerosol Properties by Long-Range Transport of Biomass Burning Aerosol, REMOTE SENSING Vol.10 Issue: 3 Article No.412, 2018, IF: 3.244

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B2: **Stachlewska I.S.**, Zawadzka O., Engelmann R., Effect of Heat Wave Conditions on Aerosol Optical Properties Derived from Satellite and Ground-Based Remote Sensing over Poland, REMOTE SENSING Vol.9 Issue 11 Article No.1199, 2017, IF: 3.244

B3: Janicka L., **Stachlewska I.S.**, Veselovskii I., Baars H, Temporal variations in optical and microphysical properties of mineral dust and biomass burning aerosol derived from daytime Raman lidar observations over Warsaw, Poland, ATMOSPHERIC ENVIRONMENT Vol.169, 162-174, 2017, IF: 3.629

B4: Ortiz-Amezcua P., Guerrero-Rascado J.L., Granados-Munoz J.M., Benavent-Oltra J.A., Böckmann Ch., Samaras S., **Stachlewska I.S.**, Janicka L., Baars H., Bohlmann S., Alados-Arboledas L., Microphysical characterization of long-range transported biomass burning particles from North America at three EARLINET stations, ATMOSPHERIC CHEMISTRY AND PHYSICS Vol.17 Issue 9, 5931-5946, 2017, IF: 5.318

B5: **Stachlewska I.S.**, Costa-Suros M., Althausen D., Raman lidar water vapor profiling over Warsaw, Poland, ATMOSPHERIC RESEARCH Vol. 194, 258-267, 2017, IF: 3.778

B6: Engelmann R., Kanitz T., Baars H., Heese B., Althausen D., Skupin A., Wandinger U., Komppula M., **Stachlewska I.S.**, Amiridis V., Marinou E., Mattis I., Holger Linné H., Ansmann A.,The automated multiwavelength Raman polarization and water-vapor lidar Polly(XT): the neXT generation, ATMOSPHERIC MEASUREMENT TECHNIQUES Vol.9 Issue 4, 1767-1784, 2016, IF: 3.089

B7: Sokół P., **Stachlewska, I.S.**, Ungureanu I., Stefan S., Evaluation of the boundary layer morning transition using the CL-31 ceilometer signals, ACTA GEOPHYSICA Vol. 62 Issue: 2, 367-380, 2014, IF:1.068

B8: **Stachlewska I.S.**, Piadlowski M., Migacz Sz., Szkop A., Zielinska A., Swaczyna P., Ceilometer Observations of the Boundary Layer over Warsaw, Poland, ACTA GEOPHYSICA Vol. 60 Issue: 5, 1386-1412, 2012, IF:0.910

c) Discussion of the scientific goal of the above mentioned articles and the results achieved, together with the indication on their potential use

Quasi-stationary high-pressure systems are one of the finest weather phenomena for supporting long-range transport of air masses in free troposphere, whereby the air masses can contain different aerosol types, including biomass burning particles (B4 Ortiz et al. 2017) or mineral dust particles (B3 Janicka et al. 2017). Indeed, strong anticyclons not only supress the air towards the ground causing drying of the atmosphere (B5 Stachlewska et al 2017b) but can also inject the long-range transported particles into the boundary layer (B1 Stachlewska et al. 2018, Stachlewska et al. 2017a).

It is expected that such injection of either anthropogenic pollution or biomass burning must influence the aerosol properties within boundary layer. This seems especially relevant for an urban environment, for which intrusions of additional particles into usually already polluted atmosphere may have significant influence on humans. Thus, a hypothesis was posed, that dependently on the type of particles injected into the urban boundary layer, there shall be a sort of correlation of the aerosol properties derived within the boundary layer with the surface particulate matter measurements, as in opposition to reported lack of any correlations on a long-term temporal scale (monthly, seasonaly).

A comprehensive set of observations was used. Important and unique instruments, the PollyXT lidar and the NARLa lidar, both developed in a scientific collaboration of University of Warsaw and Institute for Tropospheric Research (B6 Engelmann et al. 2016) were operated from the Remote Sensing Laboratory (RS-Lab) in Warsaw, Poland.

Quasi-continuous lidar measurements were evaluated to obtain the boundary layer top by applying the classical gradient method averaged signals (B8 Stachlewska et al. 2012, B7 Sokół et al. 2014).

Moreover, sets of extensive and intensive aerosol properties were calculated by using especially designed approaches (Stachlewska et al 2017b, Janicka et al. 2017), in the same manner for all data files, to assure the inter-comparability of all of the obtained results.

Lidar signals were evaluated at day and night-time using the Raman approach to obtain particle extinction coefficients at 355nm and 532nm, which were then used for the derivation of the Angstrom exponent at these two wavelengths (B1 Stachlewska et al. 2018a).

Finally, the lidar extinction profiles were also used for the retrieval of aerosol optical depth within the boundary layer (B2 Stachlewska et al. 2017a).

Additionally, the columnar aerosol optical depth at 550nm and at 635nm was derived from the satellite MODIS and SEVIRI sensors (B2 Stachlewska et al. 2017a).

The obtained lidar-derived and satellite-derived aerosol properties were compared with the surface measurements of the particulate matter of a size of less than 10μm and 2.5μm, whereby data for the Warsaw-Ursynów site were used (available via the WIOŚ Data Portal). For the data interpretation (not shown for brevity) following information was used: the NOAA HYSPLIT backward-trajectory calculations, the radiosounding at the WMO site in Legionowo, the NAAPS model surface sulphates, smoke and dust prediction, the CAMS and the GEM-AQ models output, the NASA LANCE fire maps, and the synoptic charts of the IMGW-PIB.

The boundary layer top (BLT) and aerosol optical properties derived within boundary layer from ground-based lidar (the daytime AOD_{LIDAR} at 532nm and the extinction related AE(355/532)) were compared to columnar aerosol optical depth at a satellite pixel for Warsaw (AOD_{SEVIRI} at 635nm, AOD_{MODIS} at 550nm) and surface particulate matter PM_{10} and $PM_{2.5}$ measured at Warsaw-Ursynow WIOS site with corresponding fine-to-coarse particle size ratio $FCR = PM_{2.5}/(PM_{10} - PM_{2.5})$.

As to confirm the stated above hypothesis, following two periods of interest were chosen:

- The case #1, depicted in Figure 1, regarding an inflow of long-range transported biomass burning particles into the urban boundary layer that occurred on 23-28 August 2016.
- The case #2, depicted in Figure 2, representing a persistent inflow of long-range transported anthropogenic pollution into the urban boundary layer on 8-13 September 2016.

In both cases, a few days of data in vicinity of the exact periods of interest were evaluated additionally, as to provide a background information and conclude on validness of results.

By comparison of Figures 1 & 2, the boundary layer top seems in the range of expected values for summer month of August but it is unexpectedly high for autumn month of September. Indeed, the mean daytime boundary layer height was reported at 1.67±0.24 km for August and 1.24±0.16 km for September (Stachlewska et al. 2012).

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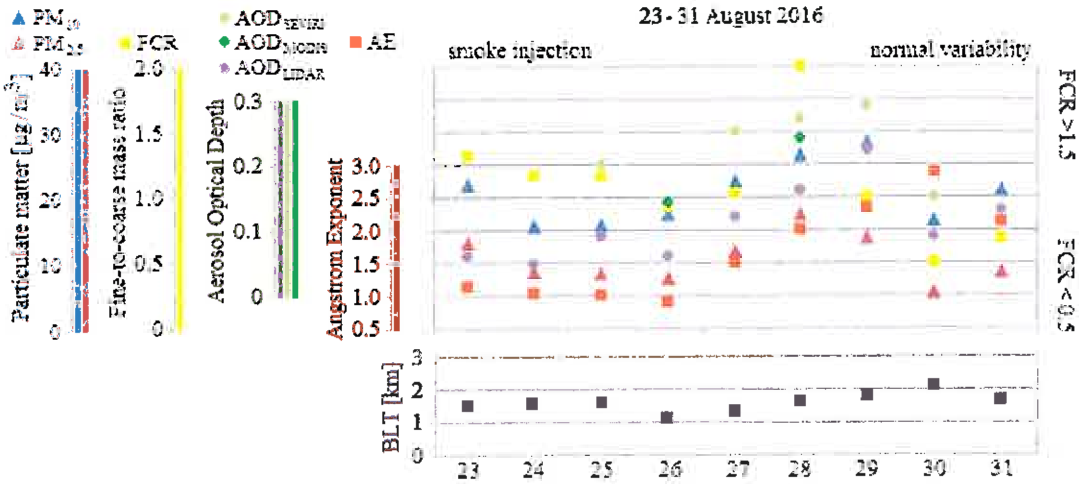

Figure 1. The case #1 of a persistent inflow of long-range transported biomass burning particles into the urban boundary layer on 23-28 August 2016 in Warsaw.

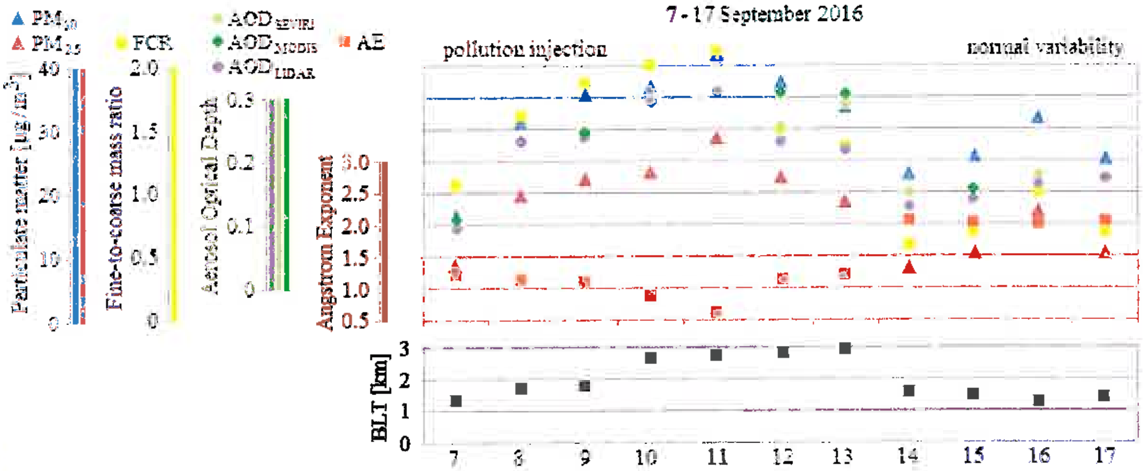

Figure 2. The case #2 of an inflow of long-range transported anthropogenic pollution into the urban boundary layer on 8-13 September 2016 in Warsaw.

In general, for increasing (decreasing) BLT there was an increase (a decrease) of both PM and $\mathrm{AOD}_{\mathrm{LIDAR}}$ calculated within boundary layer. However, in the case #1 (biomass burning) additionally the AE(355/532) being in the range of 0.8-2, was positively correlated with the surface $\mathrm{PM}_{2.5}$ and the FCR. In contrary, in the case #2 (pollution), the AE(355/532) being in the range of 0.6-1.3, was negatively correlated with $\mathrm{PM}_{2.5}$ and FCR. Thus, in the latter case, increase of fine-mode particles concentration was observed with increase of the particle size.

For comparison, on 29-31 August 2016 and 15-17 September 2016, a normal variability of the aerosol properties within the boundary layer is depicted. For these days, in general there seem to be a slight negative correlation of PM and AE and there are no clear correlations of the derived BLT with both columnar AODs.

It is likely that an increase of surface temperature was weakened by, among other factors, the likely absorbing, moderately-fresh and fresh biomass burning particles that were injected and accumulated below the boundary later top, whereas the surface temperature increase was unhindered by injection of the pollution. Therefore, the injection of biomass burning into the boundary layer in the case #1, acted in a way of diminishing the urban boundary layer development, whereas the injection of additional pollution into the boundary layer in the case #2, acted in a way of enhancing the boundary layer development.

The results indicate that an intrusion of long-range transported aerosol into the urban boundary layer can result in a distinct change of the boundary layer aerosol properties. Consequently, it can enhance or impair the development of the boundary layer. This not only utilizes unique capabilities of continuous Raman lidar detection of aerosol properties but also its capability to complement the surface in-situ and the satellite observations.

5. Discussion of remaining scientific research achievements (*selected contributions*)

- *Publications on the studies of aerosols occurring in Central Europe*

Work A2 of Baars et al. 2016, (different aerosol types) related to the review and status of Polly and PollyXT lidar measurements, carried out within the PollyNET observational network. In particular, the methods of data evaluation are discussed in the context of their automation. Typical optical properties profiles for several locations around the world were obtained. In Warsaw, during the summer, the occurrence of an unexpected aerosol layer located directly above the boundary layer was evident.

Work A4 of Markowicz et al. 2016, (aerosol of biomass combustion) presented the analysis of the optical properties of the aerosol originating from the wild-forest fires in the area of North America in July 2013, being transported over a long-distance to Central Europe. The data were discussed in the context of the radiative forcing due to such absorbing aerosol type.

Work A5 of Chilinski et al. 2016, (mineral dust) concerned the use of the lidar measurements to validate the vertical structures of the model output for the simulation of the mineral dust originating from an episode of the influx of Saharan dust particles to Central Europe.

Work A7 of Nemuc et al. 2014, (advected volcanic ash) discussed the determination of the optical properties of the long-range advected volcanic ash detected over Romania and Poland a few days after the Eyjafjallajokull volcanic explosion. In particular, the differences in optical properties (mainly in Angstrom exponent) over Warsaw and Bucharest, The study indicated an existence of less-modified aerosol at the latter location.

Work A8 of Markowicz et al. 2012, (advected volcanic ash) concerned active and passive remote measurements and their interpretation in the context of radiative effects for the case of an episode of the Eyjafjallajokull volcano errruption and a volcanic ash long-range transport to Poland in 2010.

- *Publications on aerosols and clouds in the Arctic*

Work A1 of Markowicz et al. 2017, dealt with development of a new methodology for aerosol single scattering albedo retrieval. The approach utilized a combination of remote measurements made with the KARL Raman lidar and the NARLa near-range lidar receiver with the in-situ measurements made onboard tethered balloon equipped with miniaturized aethalometer and particle counter. The method was applied to the iAREA 2015-2016 campaigns in the Arctic.

Work A3 of Ritter et al. 2016, concerned the determination of the optical and microphysical properties characteristic for Arctic aerosols based on the KARL Raman lidar observations and the in-situ measurements both made as a part of the iAREA 2014 campaign.

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Work A6 of Lisok et al. 2016, dealt with the physico-chemical analysis of properties of the spring-time Arctic aerosol measured during the iAREA 2014 campaign in Ny-Alesund.

Work A9 of Stachlewska et al. 2010 (*continuation of research in connection with a doctorate*), related to the description of the two configurations of the AMALi airborne lidar, including improvements made in order to optimize it for reliable work in difficult Arctic conditions. In the paper, a new method of auto-calibrating of the airborne lidar signals was proposed.

Work A10 of Doernbrack et al. 2010 (*continuation of research in connection with a doctorate*), concerned the use of the AMALi airborne lidar and the stationary KARL lidar measurements to model a mesoscale air flow over Svalbard during an episode of intense eastern winds.

Work A11 of Stachlewska & Ritter 2010 (*work in connection with the doctorate*), discussed an innovative method of determining extinction profiles from the so-called two-stream measurements derived from a combination of signals measured with the nadir-aiming AMALi lidar installed onboard the aircraft and with the zenith-aiming KARL stationary lidar sensing the atmosphere from the ground.

Work A12 of Gayet et al. 2007 (*work in connection with the doctorate*), presented the determination of the microphysical and optical properties of aerosol and cloud particles based on a combination of the airborne in-situ measurements and the airborne AMALi lidar sounding during an interesting case of a drizzle and ice crystal fall.

21/05/2018

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