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# Comment on acp-2021-262

Pavla Dagsson Waldhauserova (Referee)

Referee comment on "Measurement report: The chemical composition of and temporal variability in aerosol particles at Tuktoyaktuk, Canada, during the Year of Polar Prediction Second Special Observing Period" by John MacInnis et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-262-RC1, 2021

This study presents valuable atmospheric measurements from the remote areas of the Northern Territories in Canada. Tuktoyaktuk is a hamlet representing both continental and Arctic Ocean maritime climate conditions in summer, and thus important location to obtain information on atmospheric composition. The authors provide detailed analysis on the chemical composition of fine (PM2.5) and coarse (PM10-2.5) aerosol filter samples as well as PM mass concentrations from optical particle counter. Although they faced difficulties with the quantitative assessment of ions in metals in aerosol particle filter samples due to their low chemical mass, characteristic for such remote area in the Arctic, the report is important and valuable for further research of such areas. Available scientific literature was used to relate the results with similar Arctic locations. There is no clear conclusion what were the exact sources of captured aerosol particles, but the discussion explained in full extent the possible scenarios from where these aerosols could have originated.

The paper is clearly written and the figures represent well the analyses. I would recommend publication of this work after some minor revisions. Particularly, authors could add more information into the introduction, explain the methods/results on aerosol filter masses analysis in greater detail, focus possible local natural sources of aerosol – high latitude dust sources, biomass burning and marine aerosol, and correct the references not cited in the text.

Specific comments:

L31-32, , L39-42 – consider to include the study of Boy et al. (2019) describing the role of aerosols in changing climate in the Arctic here.

Boy, M., Thomson, E. S., Acosta Navarro, J.-C., Arnalds, O., Batchvarova, E., Bäck, J., Berninger, F., Bilde, M., Brasseur, Z., Dagsson-Waldhauserova, P., Castarède, D., Dalirian, M., de Leeuw, G., Dragosics, M., Duplissy, E.-M., Duplissy, J., Ekman, A. M. L., Fang, K., Gallet, J.-C., Glasius, M., Gryning, S.-E., Grythe, H., Hansson, H.-C., Hansson, M., Isaksson, E., Iversen, T., Jonsdottir, I., Kasurinen, V., Kirkevåg, A., Korhola, A., Krejci, R., Kristjansson, J. E., Lappalainen, H. K., Lauri, A., Leppäranta, M., Lihavainen, H., Makkonen, R., Massling, A., Meinander, O., Nilsson, E. D., Olafsson, H., Pettersson, J. B. C., Prisle, N. L., Riipinen, I., Roldin, P., Ruppel, M., Salter, M., Sand, M., Seland, Ø., Seppä, H., Skov, H., Soares, J., Stohl, A., Ström, J., Svensson, J., Swietlicki, E., Tabakova, K., Thorsteinsson, T., Virkkula, A., Weyhenmeyer, G. A., Wu, Y., Zieger, P., and Kulmala, M., 2019. Interactions between the atmosphere, cryosphere, and ecosystems at northern high latitudes, Atmos. Chem. Phys., 19, 2015-2061.

L37-38 – high latitude dust sources in the Arctic are active also in the winter. Please see examples here:

Mackay, J. R., & Burn, C. R. (2005). A long-termfield study (1951–2003) of ventifacts formed by kata-batic winds at Paulatuk, western Arctic coast, Canada. Canadian Journal of Earth Sciences,42(9), 1615–1635.

Bullard J.E., Baddock, M., Bradwell, T., Crusius, J., Darlington, E., Gaiero, D., Gassó, S., Gisladottir, G., Hodgkins, R., McCulloch, R., McKenna Neuman, Ch., Mockford, T., Stewart, H., Thorsteinsson, Th., 2016. High Latitude Dust in the Earth System. Reviews of Geophysics: DOI: 10.1002/2016RG000518.

Dagsson-Waldhauserova, P., Arnalds, O., Olafsson, H., 2014. Long-term variability of dust events in Iceland. Atmospheric Chemistry and Physics 14, 13411-13422. DOI:10.5194/acp-14-13411-2014.

Dagsson-Waldhauserova, P., Renard, J.-B., Olafsson, H., Vignelles, D., Berthet, G., Verdier, N., Duverger, V., 2019. Vertical distribution of aerosols in dust storms during the Arctic winter. Scientific Reports 6, 1-11.

L66-67– Important aerosol-cloud climate feedback in the Arctic has been described by Murray et al. (2021) and Sanchez-Marroquin et al. (2020).

Murray, B. J., Carslaw, K. S., and Field, P. R.: Opinion: Cloud-phase climate feedback and the importance of ice-nucleating particles, Atmos. Chem. Phys., 21, 665–679, https://doi.org/10.5194/acp-21-665-2021, 2021.

Sanchez-Marroquin, A., Arnalds, O, Baustian-Dorsi, K., Browse, J., Dagsson-Waldhauserova, P., Harrison, A.D., Maters, E.C., Pringle, K.J., Vergara-Temprado, J., Burke, I.T., McQuaid, J.B., Carslaw, K.S., Murray, B.J., 2020. Iceland is an episodic source of atmospheric ice-nucleating particles relevant for mixed-phase clouds. Science Advances 6, eaba8137, 1-9.

L165-167 – Could you please explain better why the **PM2.5** mean and maximum mass range from the filters **are higher than** for **PM10**? Are there other studies facing the same results? Consider to use also median.

L208-217 – These elements are abundant in dust from the high latitude dust sources. Consider to add discussion also on that here. Are you aware of some active dust sources in your region? MacKenzie River, lakes, beaches? For example peninsula north of Paulatuk is an active source in July (as on the SDS map, but also in winter as published). You can find the Sand Dust Storm activity index at this website: https://maps.unccd.int/sds/ (choose July). Chemical composition of different HLD sources can be found here:

Crocchianti, S., Moroni, B., Dagsson-Waldhauserová, P., Becagli, S., Severi, M., Traversi, R., Cappelletti, D., 2021. Potential Source Contribution Function Analysis of High Latitude Dust Sources over the Arctic: Preliminary Results and Prospects. Atmosphere 12, 347-362.

Mackay, J. R., & Burn, C. R. (2005). A long-termfield study (1951–2003) of ventifacts formed by kata-batic winds at Paulatuk, western Arctic coast, Canada. Canadian Journal of Earth Sciences,42(9), 1615–1635.

L235-240 – Biomass burning could be an explanation of your results here including high fluoride abundance. Consider to investigate if there was biomass burning event before or during your study period.

L477-479 – Jacobi et al. (2019) is not referred in the text

L538-539 – Thakur and Thamban (2019) is not referred in the text

L555-557 – Willis et al. (2019) is not referred in the text