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Interactive Comment

Interactive comment on "Observing wind, aerosol particles, cloud and precipitation: Finland's new ground-based remote-sensing network" *by* A. Hirsikko et al.

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Authors: We thank reviewer 2 for the comments and suggestions for improving our manuscript. We reply below to each question and comment.

Reviewer: The paper from Hirsikko et al., describes the new Finland's ground-based remote- sensing network. The introduction and network and instruments description are well written and balanced. The section 4 instead has some deficiencies. It focuses on Doppler lidar without making use of the other instruments (Polly could be used for comparison and assessment for example) even without a previous discussion about motivation of it.

Authors: Halo Photonics Doppler lidars are key instruments of the network with one present at each site, plus one additional instrument for campaigns. This was stated clearly in the abstract (AMTD version, page 7253, lines 5-7): *"The main goal of the network is to monitor air pollution and boundary layer properties in near real time, with a Doppler lidar and ceilometer at each site."*

These instruments are relatively new in the field. Research groups and initiatives such as COST Actions have begun comparing the performance of Doppler lidar wind observations and subsequent retrievals. However, only a few studies have been made publicly available. In addition, we have the first Streamline Pro model lidars in an operational observation network. Therefore, we think that some investigation of the performance of six Doppler lidars is relevant and justified. We propose the following revisions to smooth the contrast between Sect. 4 and the rest of the manuscript:

Last paragraph of introduction (AMTD version, page 7257, lines 14-19) is revised: *"In this paper, we introduce Finland's ground-based remote-sensing network (Sect. 2), the instrumentation deployed, discuss the measurement strategies at each location and present selected case studies of research potential (Sect. 3). The Halo Photonics Doppler lidars are key instruments in the network. To our knowledge this is the world's first meteorological Doppler lidar network. Therefore, we also focus on the performance of Doppler lidars in challenging environments, by displaying results from two Doppler lidar inter-comparison campaigns performed in Helsinki, discussing the operational reliability (Sect. 4.1-4.2) and presenting case studies (Sect. 4.3). In addition, we discuss the research potential for a network of remote and in-situ sensors (Sect. 3 and 4.3)."*

Sect. 3.2: In connection to Fig. 2 we have included a qualitative discussion of observations of operational Doppler lidar. The proposed text to be included at the end of paragraph (AMTD version, page 7267, line 7): *"Indeed, Doppler lidar aerosol attenu-*

ated backscatter profiles were available up to 400-500 m during 06:00-10:00 UTC on this day, whereas the air was too clean for sufficient data quality during the rest of the day. A combination of water vapour and aerosol particle microphysical retrievals from PollyXT, together with mixing layer evolution and winds from a Doppler lidar enables a more comprehensive and detailed investigation of the aerosol and boundary layer than from either instrument alone."

We added text on AMTD manuscript page 7269, line 14: *"Cloud radar observations alone provide a useful basis for cloud research (e.g. Tonttila et al., 2011), however, the sensitivity of cloud radar to low-level liquid clouds can be limited. Cloud radar is a key instrument in multi-sensor synergetic-retrievals and analysis of clouds. As an example, Cloudnet (A network of stations for the continuous evaluation of cloud and aerosol profiles in operational NWP models) developed a scheme to quantitatively analyse cloud types, microphysical properties of ice clouds and drizzle flux, and cloud fraction, by combining data from microwave radiometer, ceilometer, cloud radar with radiosonde or model profiles of temperature and humidity (Illingworth et al., 2007). This scheme will be implemented at Sodankylä within the ACTRIS framework. In addition, the inclusion of Doppler lidar observations allows the investigation of cloud base and below cloud dynamics, and identifying whether clouds are coupled to or de-coupled from the surface (Hogan et al., 2009; Harvey et al., 2013). When clouds are coupled with the surface the inclusion of in-situ observations in the analysis is justified."*

Sect. 4, the first two sentences were added: *"The strategy behind Finland's new remote sensing network is to co-locate an additional advanced instrument, such as a Raman lidar, cloud radar, or weather radar, with each Doppler lidar, where possible. Therefore, in this section we concentrate on evaluating the performance of the Doppler lidar and applicability via case studies."*

We agree that comparison with PollyXT lidar observations is important. An intercomparison campaign is ongoing and results are planned to be published in the near future. We mention this in the revised manuscript.

Reviewer: Discussion about the observed differences (section 4.2.1) is only qualitative and cannot support the statement "we are able to consider them in data analysis and subsequent conclusions" reported in the final section.

Authors: Section 4 has been modified to provide a more quantitative determination of the instrument inter-comparison and performance. The statements in the final section have been modified where appropriate to reflect the revisions made in the Sect. 4.

Reviewer: Too strong conclusion id reported for section 4.3.2 "This example has demonstrated the capability of Doppler lidar network for air-quality monitoring purposes". Layers identification and origin identification through backtrajectories is an important piece of information but fur sure not sufficient for air-quality purposes.

Authors: We agree with this comment and have toned down the revised sentence: *"This example has demonstrated that by combining observations of the Doppler lidar network and in-situ sensors we get more comprehensive information on boundary layer aerosol and air quality. However, air mass back trajectories provide important ancillary information."*

Reviewer: Page 7253, line12: check the EARLINET acronym

Authors: We have written now: EARLINET (the European Aerosol Research Lidar Network).

Reviewer: Page 7265, line 4: typo error uncalibrated Page 7275, line 16: typo error three

Authors: typos are corrected

Reviewer: Page 7266, description of fig2. The apparent increasing of the ABL top height during the night is typical in Finland? Which is the reason of this behavior?

Authors: The 'ABL' signature, or apparent growth, in this case was due to the advection of a warmer, moister layer over the site, as a result of the passage of a decaying front.

Reviewer: Table 5: not easily readable. I suggest adding some columns and splitting the wind speed and direction results

Authors: We have revised the table to improve its readability. Additional changes were also made based on reviewer 1 comments.

Reviewer: The English should also be checked throughout the paper

Authors: One of the native English speaking co-authors has rechecked the manuscript.

References

Harvey, N.J., Hogan, R.J., and Dacre, H.: A method to diagnose boundary-layer type using Doppler lidar, Q. J. R. Meteorol. Soc., in press, 2013.

Hogan, R.J., Grant, A.L.M., Illingworth, A.J., Pearson, G.N. and O'Connor, E.J.: Vertical velocity variance and skewness in clear and cloud-topped boundary layers as revealed by Doppler lidar, Q. J. Royal Met. Soc., 135, 635-643, 2009.

Illingworth, A.J., Hogan, R.J., O'Connor, E.J., Bouniol, D., Brooks, M.E., Delanoë, J., Donovan, D.P., Eastment, J.D., Gaussiat, N., Goddard, J.W.F., Haeffelin, M., Klein baltink, H., Krasnov, O.A., Pelon, J., Piriou, J.-M., Protat, A., Russchenberg, H.W.J., Seifert, A., Tompkins, A.M., van Zadelhoff, G.-J., Vinit, F., Willén, U., Wilson, D.R. and Wrench, C.L.: CLOUDNET: Continuous Evaluation of Cloud Profiles in Seven Operational Models Using Ground-Based Observations, Bulletin for American Meteorological Soc., 88, 883-898, doi: 10.1175/BAMS-88-6-883, 2007.

Tonttila, J., O'Connor, E.J., Niemelä, S., Räisänen, P., and Järvinen, H.: Cloud base vertical velocity statistics: a comparison between an atmospheric mesocale model and remote sensing observations, Atmos. Chem. Phys., 11, 9207-9218, 2011.

Interactive comment on Atmos. Meas. Tech. Discuss., 6, 7251, 2013.