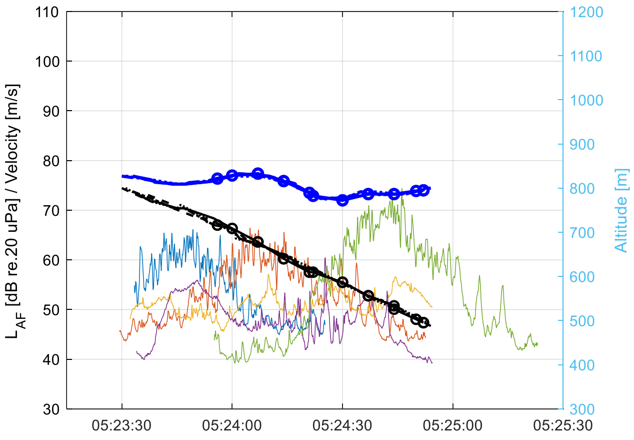

Figure 3: First pass-by noise of the Boeing 737at 05:23 flying over the measurement area. The blur thin right-most line shows the L_{AF} measured at the FAP-station. The red line is the Center-station and the green line is the West-station. Blue thick-dotted line shows the airplanes velocity in m/s while the black thick-dotted line shows the altitude in meters.

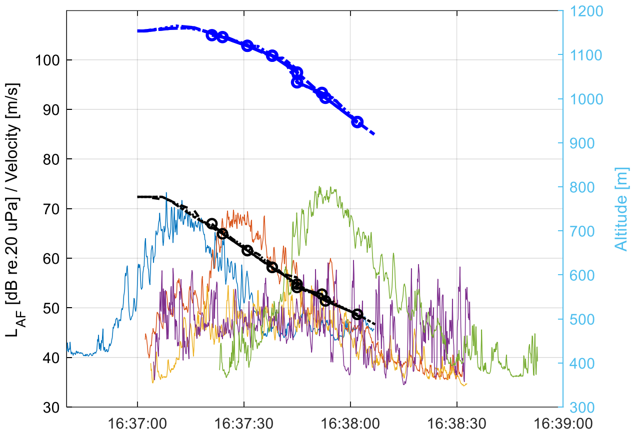

Figure 4: Second pass-by noise of the Boeing 737 at 16:37 flying over the measurement area. The blur thin right-most line shows the L_{AF} measured at the FAP-station. The red line is the Center-station and the green line is the West-station. Blue thick-dotted line shows the airplanes velocity in m/s while the black thick-dotted line shows the altitude in meters.

Figure 7 and 8 show a similar result for one Boeing 737, though not as drastic as for the A320. These two pass-by's occurred at 05:23 and 16:37. The wind this day was 5 m/s in the morning with direction 250 degrees and 3 m/s in the evening with direction 240 degrees. For these two pass-by measurements the noise level difference is about 5 dB. The velocity difference is also less but the acceleration for the low and high noise level pass-by's is similar to previous results. Note that West noise contour (the right-most curve) in fig.7-8, is higher than the other contours, showing the effect of noise-power distance.

3.3 Airbus A321

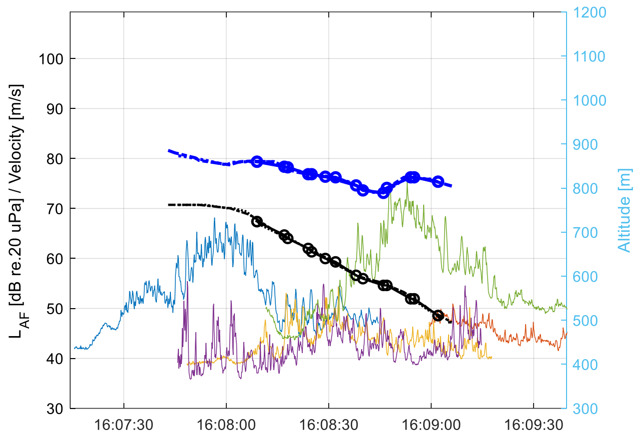

Figure 5: First pass-by noise of the Airbus A321 at 16:07 flying over the measurement area. The blur thin right-most line shows the L_{AF} measured at the FAP-station. The green line is the West-station and blue thick-dotted line shows the airplanes velocity in m/s while the black thick-dotted line shows the altitude in meters.

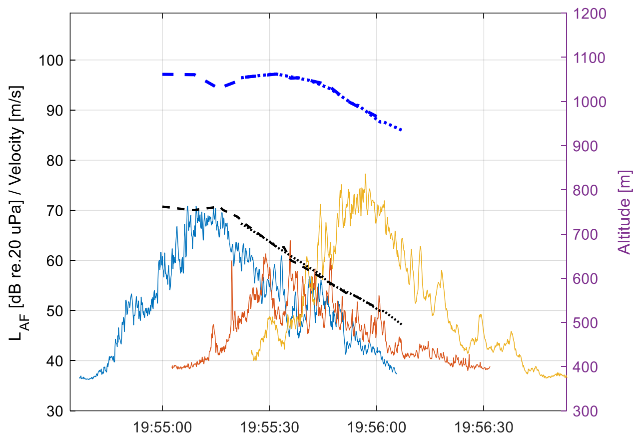

Figure 6: Second pass-by noise of the Airbus A321 at 19:55 flying over the measurement area. The blur thin right-most line shows the L_{AF} measured at the FAP-station. The yellow line is the West-station and blue thick-dotted line shows the airplanes velocity in m/s while the black thick-dotted line shows the altitude in meters.

Figure 9 and 10 show a pair of additional measurements, this time for one Airbus A321 passing over the measurement area at 16:08 and 19:55. The wind condition for the earlier flight was 4 m/s with direction 300 degrees and 3 m/s for the later flight with direction 310 degrees. During this day the Center station was out of order leaving measurements only for the FAP and West station. Comparing the two measurements in fig. 9-10 we can see that it is about a 5 dB noise level difference between the flights and that it is the later flight that generates the highest noise level. The difference is mostly pronounced in the noise contour of the FAP station. A reason for the higher noise level at the West station could be that the landing gear or flaps are deployed. ADB-S data does not give any parameters for flaps or landing gear deployment. However, an indication of alternations in flight configuration could perhaps be seen in the flights velocity as sudden changes. Maybe this is what is seen in fig. 9 at 16:08:45? However, to verify such a statement ADB-S data would have to be run against FDR-data or other records of flight parameters, such as visual observations.

3.4 Further work

The above snap-shots in fig. 5-10 are taken from a batch of measurements containing about 100 passages of the A320, c. 40 of the Boeing 737 and 20 for the A321. No statistical calculations have been performed on the material and the estimates are to be considered as rough. The continued measurement analysis will contain a statistical analysis that also include a greater number of aircraft pass-by's. It is thus necessary to consider the above result only as preliminary observations. To minimize the number of error sources the comparison of pass-by noise levels have been restricted to flights of the same individual aircraft and to flights that occurred in close proximity. There are however, a number of parameters that can have changed during the time of the two passby's. One factor for instance, is the passenger load which greatly would influence the thrust-settings and directly alter the strength of the noise source. None the less, the large differences in generated noise levels does raise some questions. Is it the airframe or engine that dominates the noise? How does the duration of the pass-by influence the noise perception, is it better to have a slow and quiet pass-by than a fast and loud? These are questions that have to be answered in the continued work of this project in investigating the possibilities of optimizing flight procedures for a quieter approach

Conclusion

A system of acoustic measurement stations has been built and deployed in the field east of runway 26R at Arlanda airport to investigate how different aircraft operational procedures impact the noise distribution on ground. Together with measurements of the single aircraft pass-by noise at ground level ADB-S data of the flights trajectory have been recorded for a prolonged period of time. This paper presents measurements that compare the noise level on ground generated by the same individual aircraft at different occasions during the same day, for similar flight trajectories and meteorological conditions. The differences in generated noise levels was found to be as large as 10 dB. A reduced velocity for the less noisy flight, indicate that this is the main factor that govern noise generation. Velocity differences were as large as 90 knots. Although, the result of this paper is only preliminary and a first step in the analysis of the noise situation, the large discrepancies in noise emission shows possibilities to optimize for a quieter approach procedure.

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