CASE STUDY OSLO/GARDERMOEN

Vertical flight efficiency during climb and descent

Performance Review Unit, EUROCONTROL

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1 Introduction

1.1 General

This document provides results on vertical flight efficiency for Oslo/Gardermoen as calculated by the Performance Review Unit of EUROCONTROL. More information on the methodology can be found on the **PRU website**.

First, the results for the top 30 airports in Europe during 2017 are presented, allowing a comparison between the results of Oslo/Gardermoen and the rest of the top airports. Afterwards, the results for Oslo/Gardermoen are presented up to the last available month.

1.2 Acronyms and terminology

Term	Definition
CCO	Continuous climb operations
CDO	Continuous descent operations
FIR	Flight Information region
PRU	Performance Review Unit

2 Vertical flight efficiency for the top 30 airports in Europe in 2017

Figure 1 and Figure 2 show respectively the average time flown level per flight and median CDO/CCO altitudes for the top 30 airports in Europe with a highlight of the values for Oslo/Gardermoen.

As shown in Figure 1, the average time flown level per flight for Oslo/Gardermoen is 1 minutes during descent (lower than the top 30 average value of 2.6 minutes) and 0.2 minutes during climb (lower than the top 30 average value of 0.5 minutes).

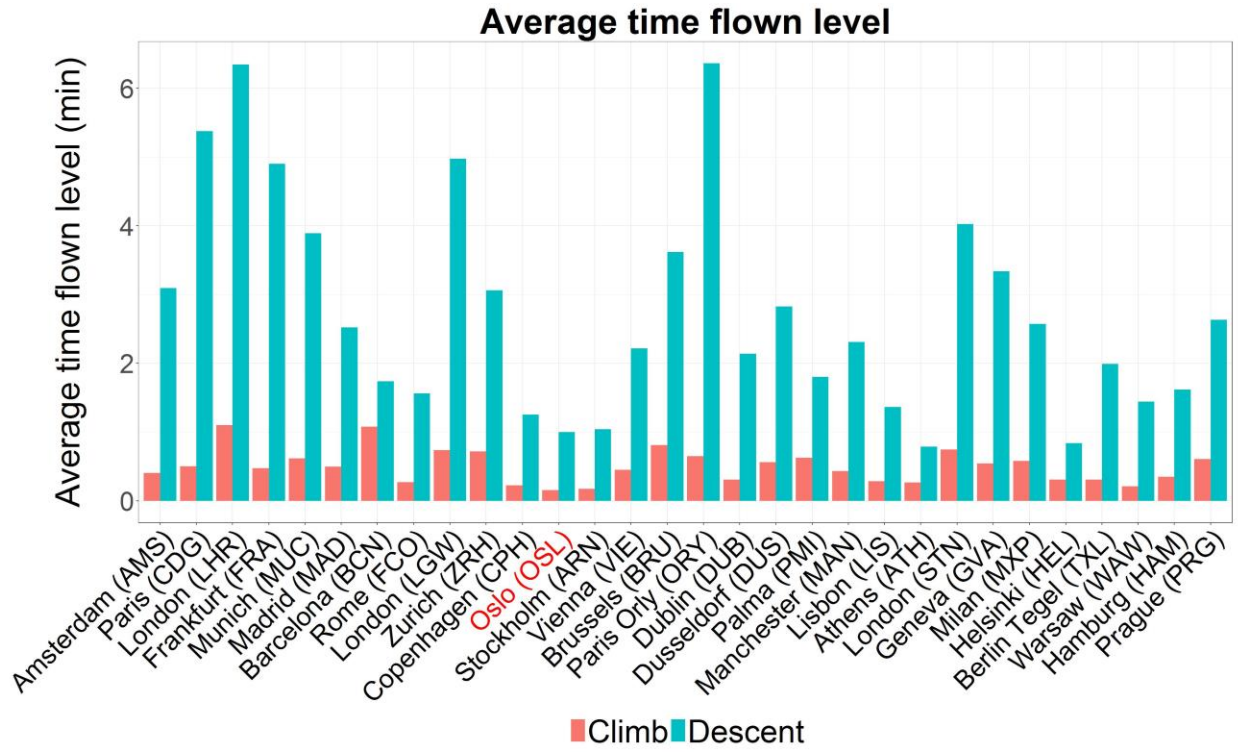

Figure 1 Average time flown level per flight for the top 30 airports in Europe

The median CDO altitude of Oslo/Gardermoen is 12000 feet while the median CCO altitude is 34000 feet (see Figure 2).

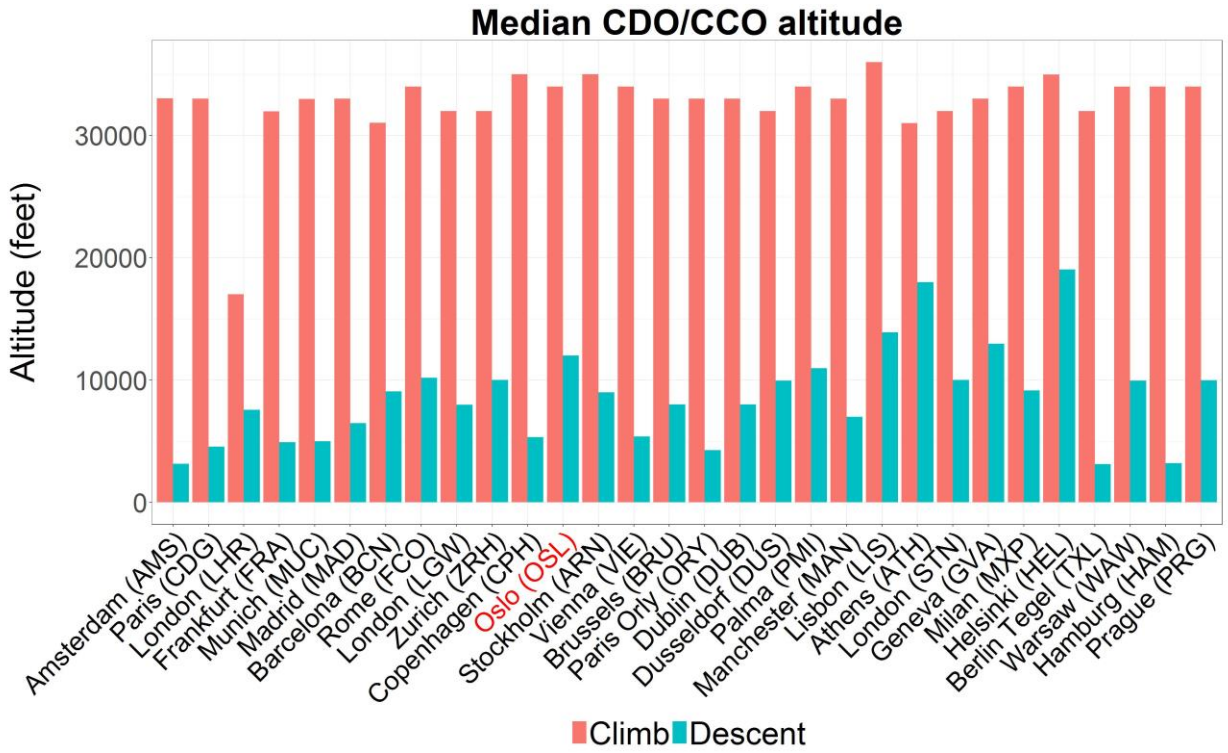

Figure 2 Median CDO/CCO altitudes for the top 30 airports in Europe

Figure 3 shows the median CDO and CCO altitudes with respect to the average time flown level per flight for the corresponding airports in 2017. Circles and triangles respectively indicate the climb and descent values while their colours give an idea about the number of movements on the individual airports. Low average level times and high median CDO/CCO altitudes indicate good vertical flight efficiency so the top left corner of Figure 3 contains the most efficienct airports while the lower right corner has the airports with the worst efficiency.

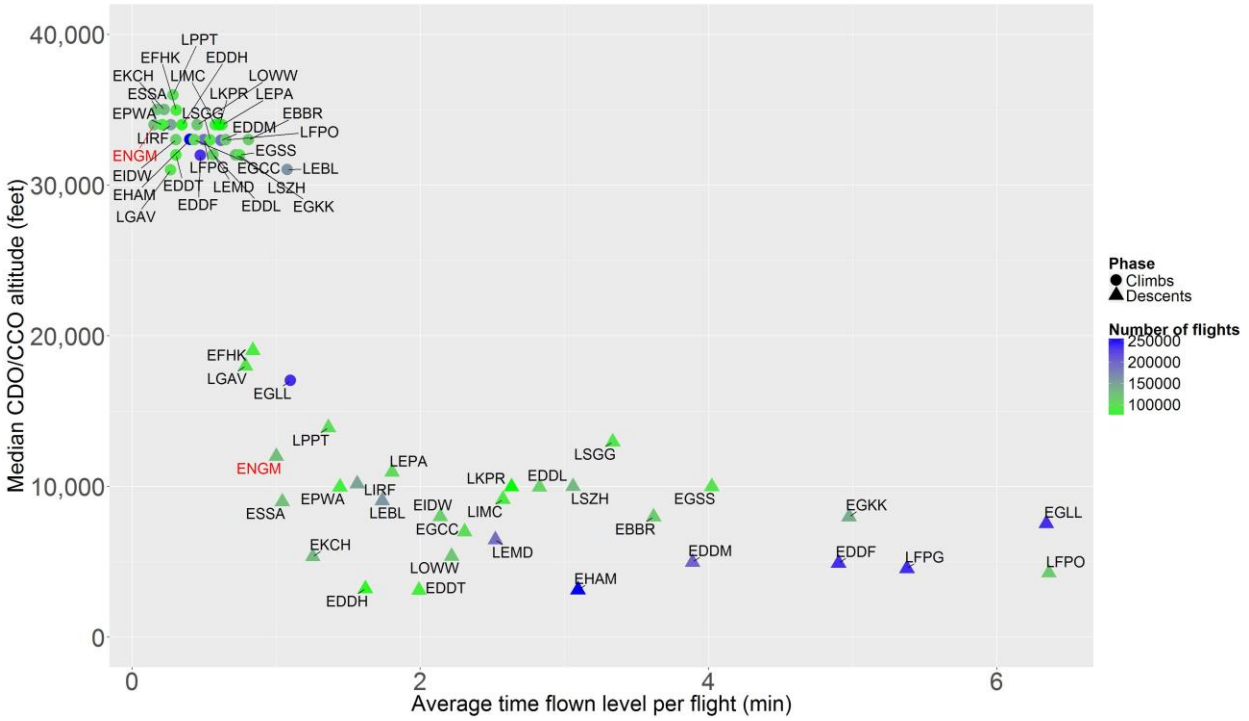

Figure 3 Average time flown level vs. Median CDO/CCO altitudes for the top 30 airports in Europe

Figure 4 presents the share of unimpeded flights. The percentage of CDO flights for Oslo/Gardermoen is 48.2% which is higher than the overall share for the top 30 airports (30.2%) while the share of CCO flights for Oslo/Gardermoen is 90.9% which is higher than the overall share for the top 30 airports (74.8%).

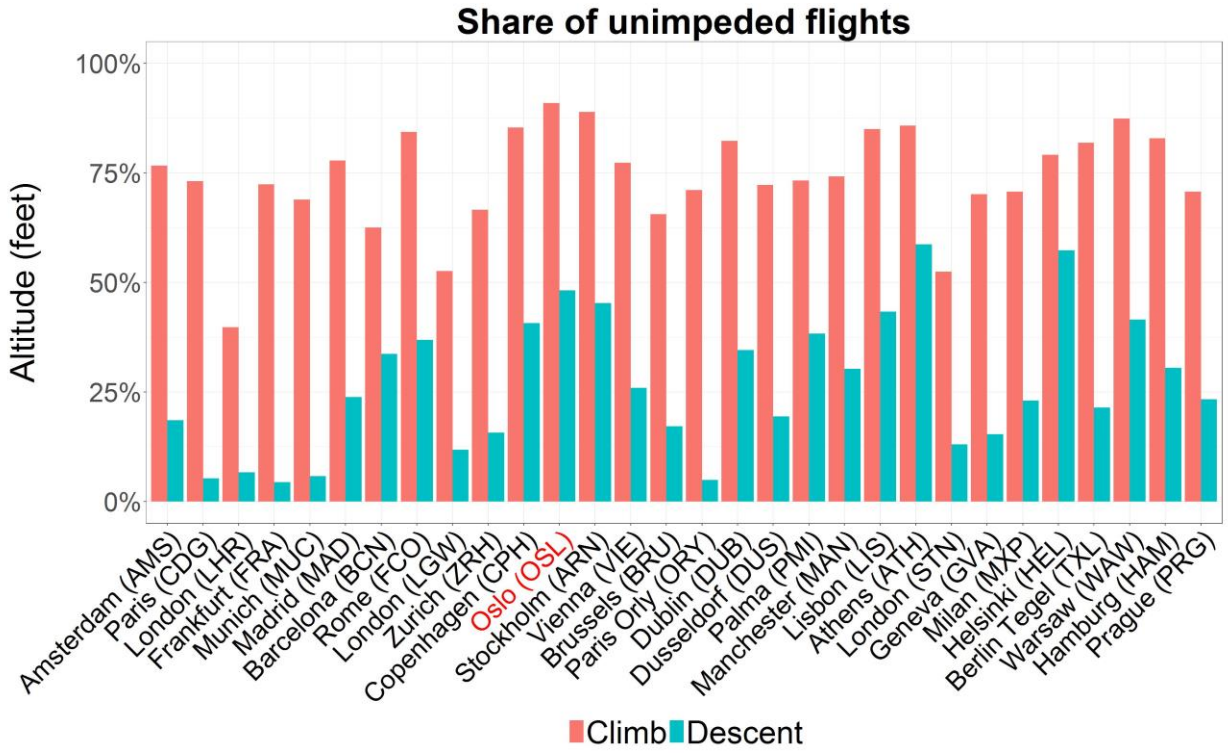

Figure 4 Share of unimpeded flights for the top 30 airports in Europe

Figure 5 and Figure 6 show the total time flown level by altitude bands during respectively descent and climb. The lowest altitude bands ([0,7500) feet for descents and [0,10500) feet for climbs) are chosen as such since at these altitudes not only fuel consumption but also noise has an environmental impact.

For Oslo/Gardermoen, most level flight is detected in level band [7500,15500) for the descent and [30500,Inf) for the climb.

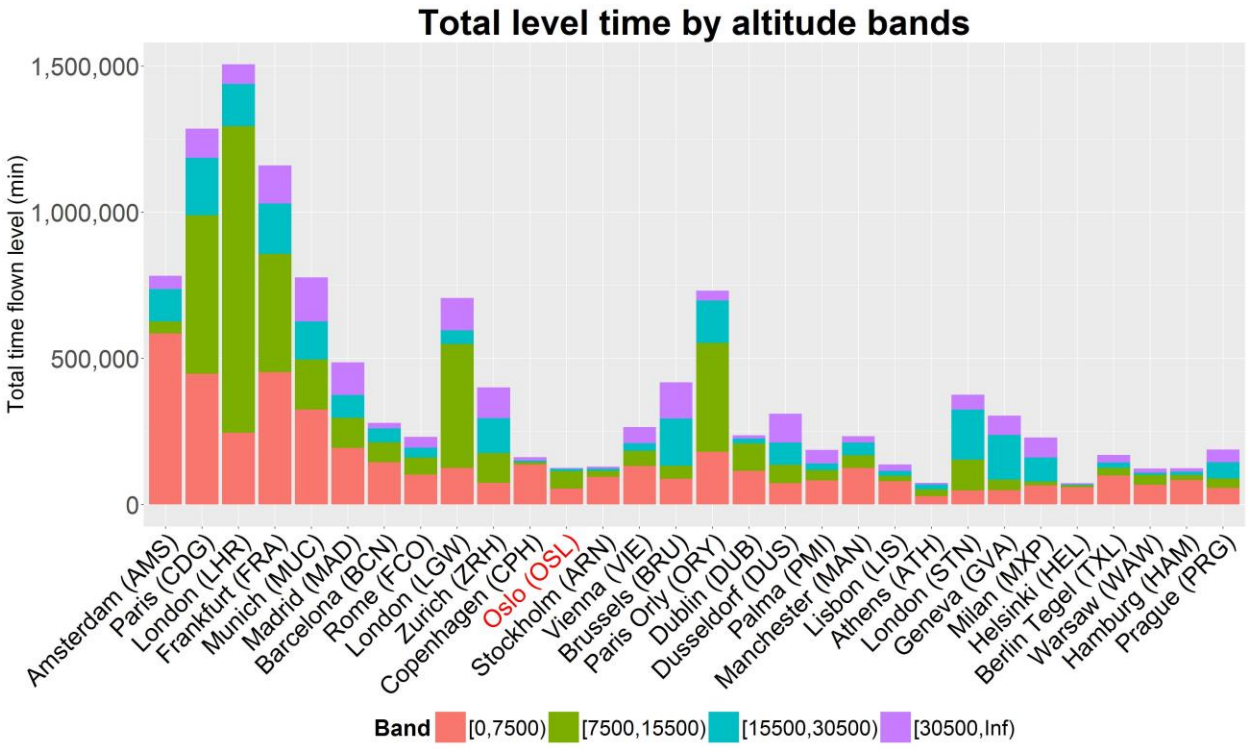

Figure 5 Total time by altitude band for the top 30 airports in Europe (Descent)

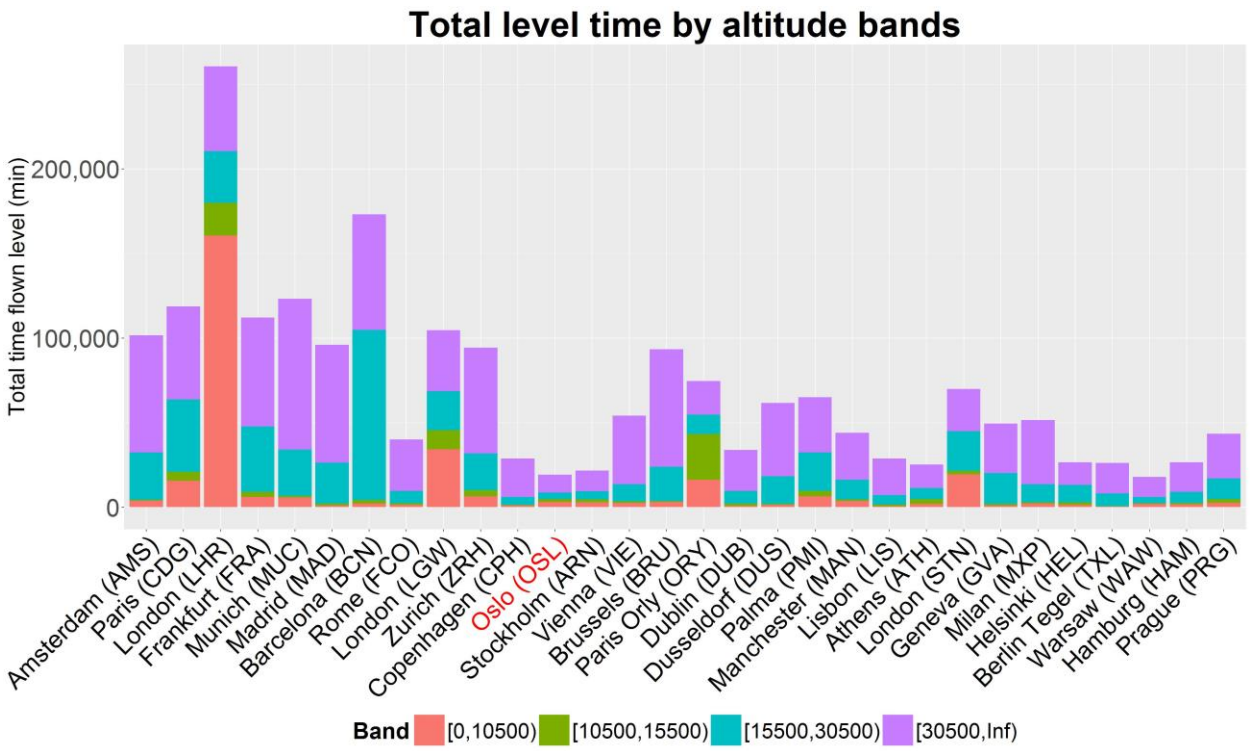

Figure 6 Total time by altitude band for the top 30 airports in Europe (Climb)

3 Situational description

Figure 7 shows the FIR boundaries and main airports in the wide vicinity of Oslo/Gardermoen.

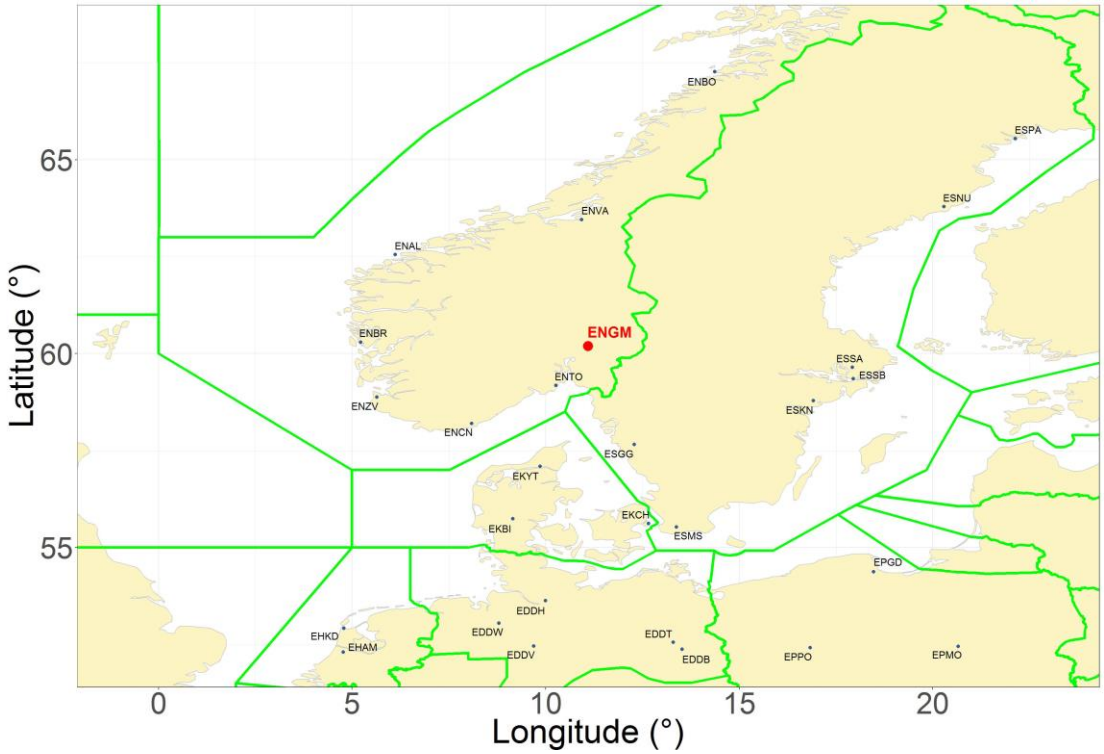

Figure 7 States and main airports around Oslo/Gardermoen

4 Results for Oslo/Gardermoen

4.1 Overall results

The evolutions of the average time flown level per flight, median CDO/CCO altitude and share of CDO/CCO flights are shown in respectively Figure 8, Figure 9 and Figure 10.

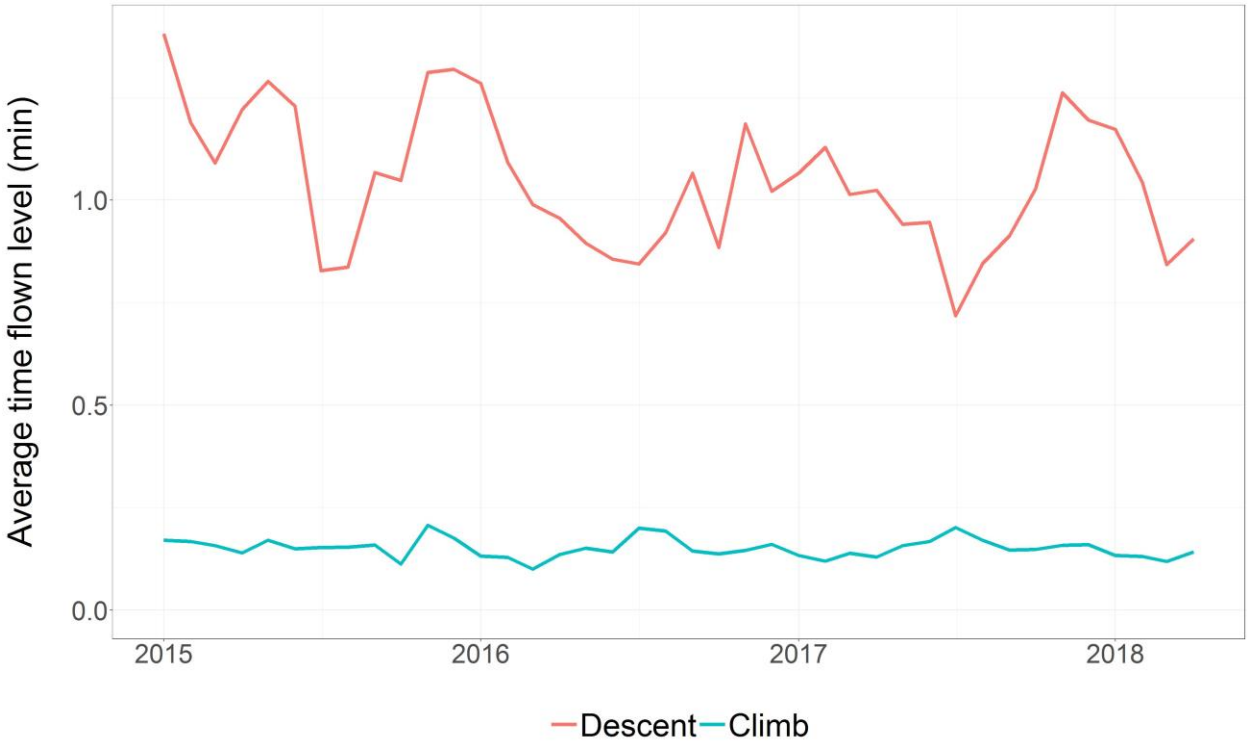

Figure 8 Average time flown level per flight

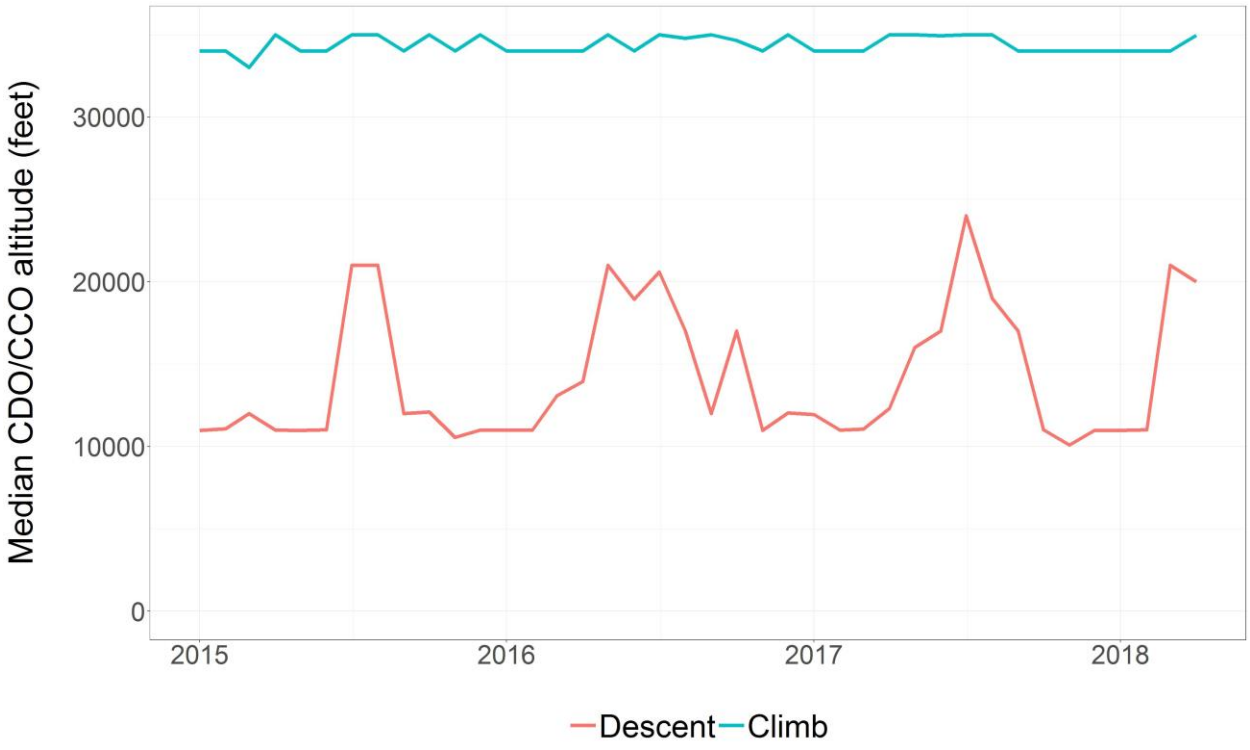

Figure 9 Median CDO/CCO altitude

Figure 10 Percentage of CDO/CCO flights

Figure 11 shows the level flight durations by altitude for Oslo/Gardermoen. Most level flight occurs at [8500,9500) feet during the descent and at [35500,36500) feet during the climb.

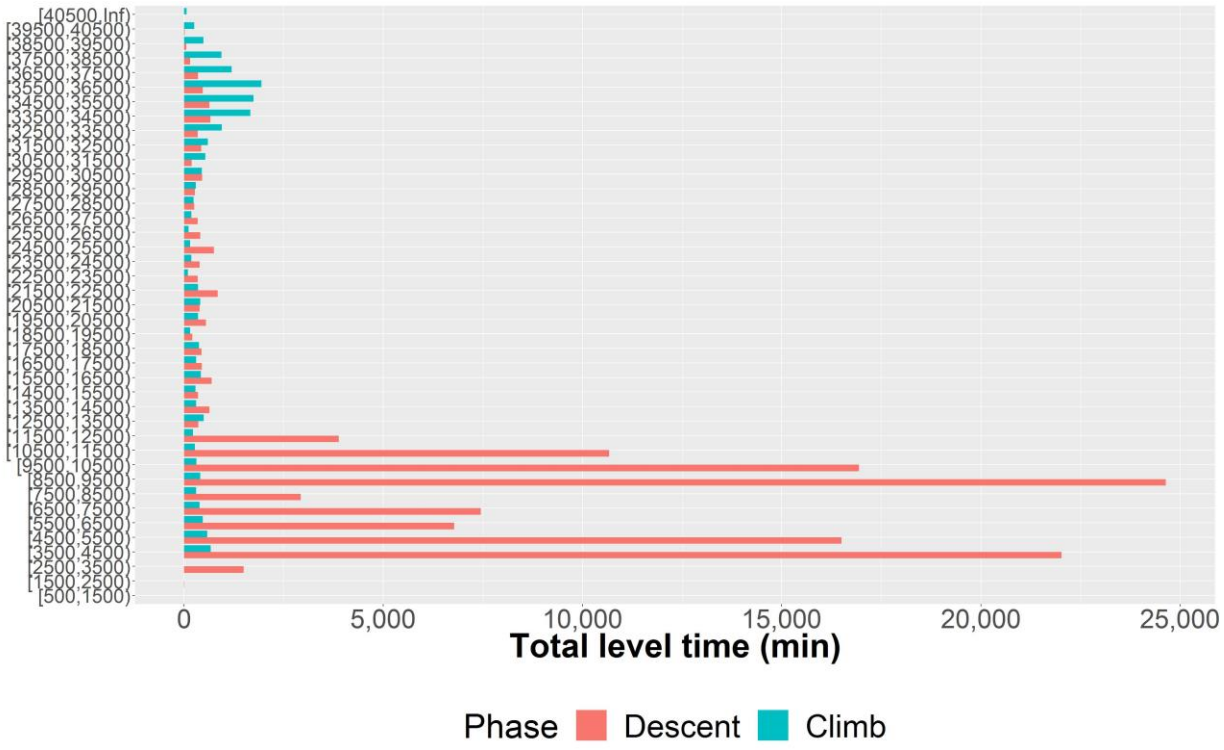

Figure 11 Total level time per altitude band

4.2 Results by runway-procedure combination

Figure 12 and Figure 13 show the significant points for respectively arrival and departure procedures into/from Oslo/Gardermoen.

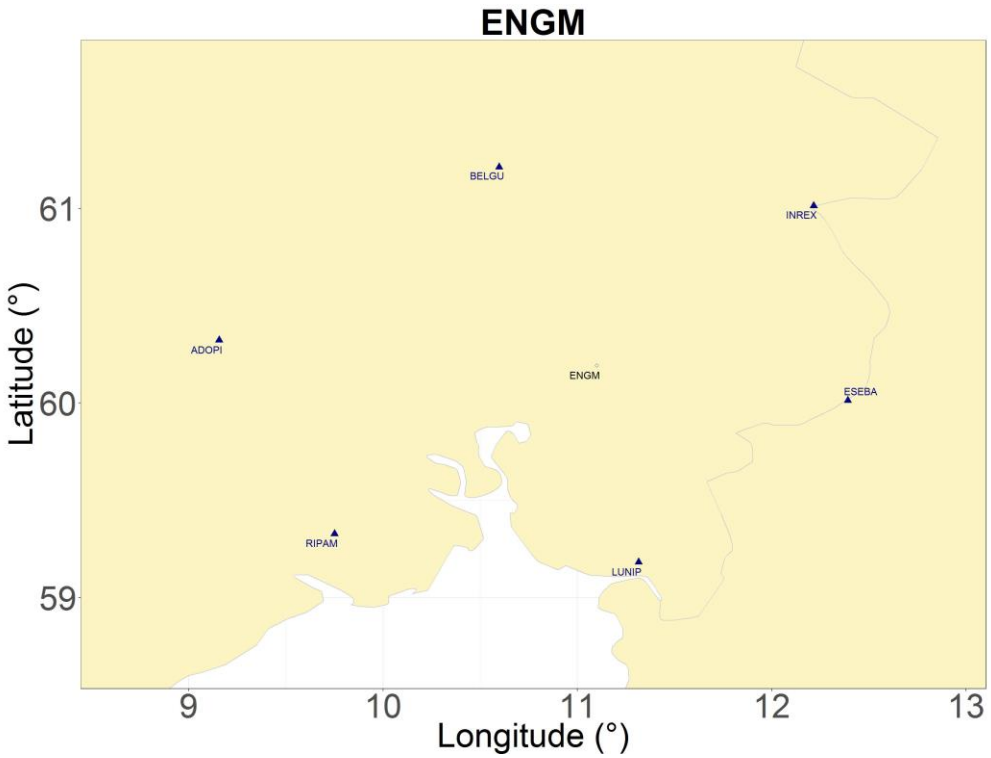

Figure 12 Significant points for arrivals

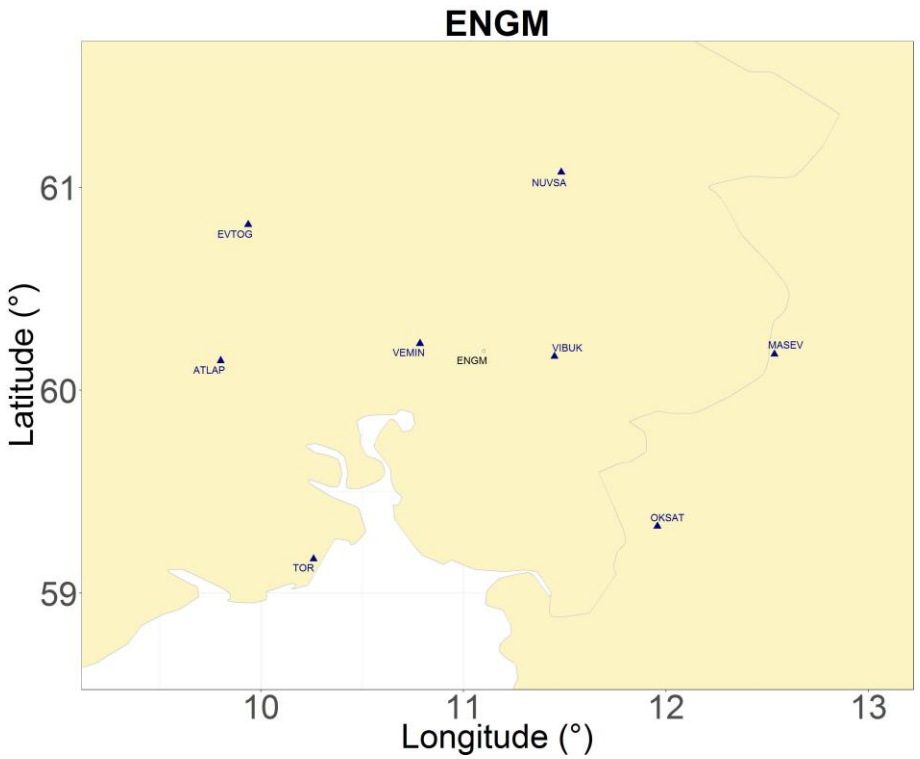

Figure 13 Significant points for departures

Figure 14 to Figure 17 present the number of movements, average time flown level per flight, median CDO altitude and share of CDO flights grouped by arrival procedure and runway used.

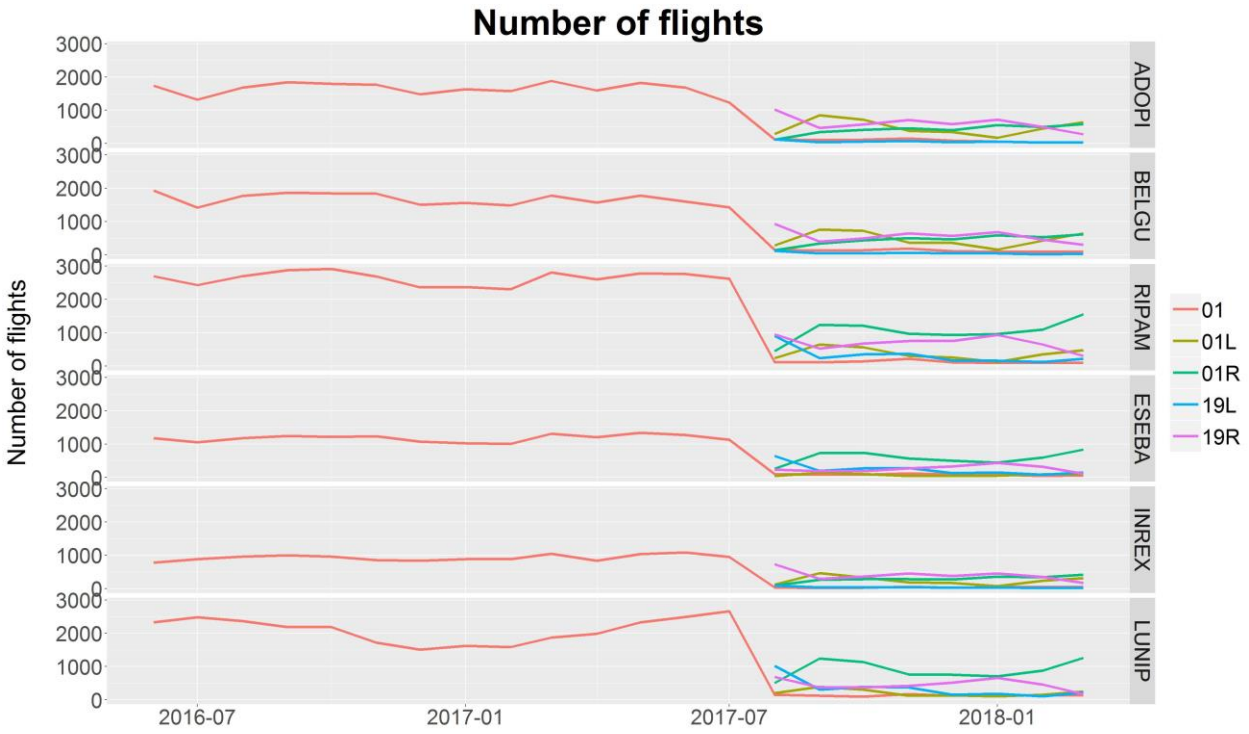

Figure 14 Number of movements per runway-procedure combination (descent)

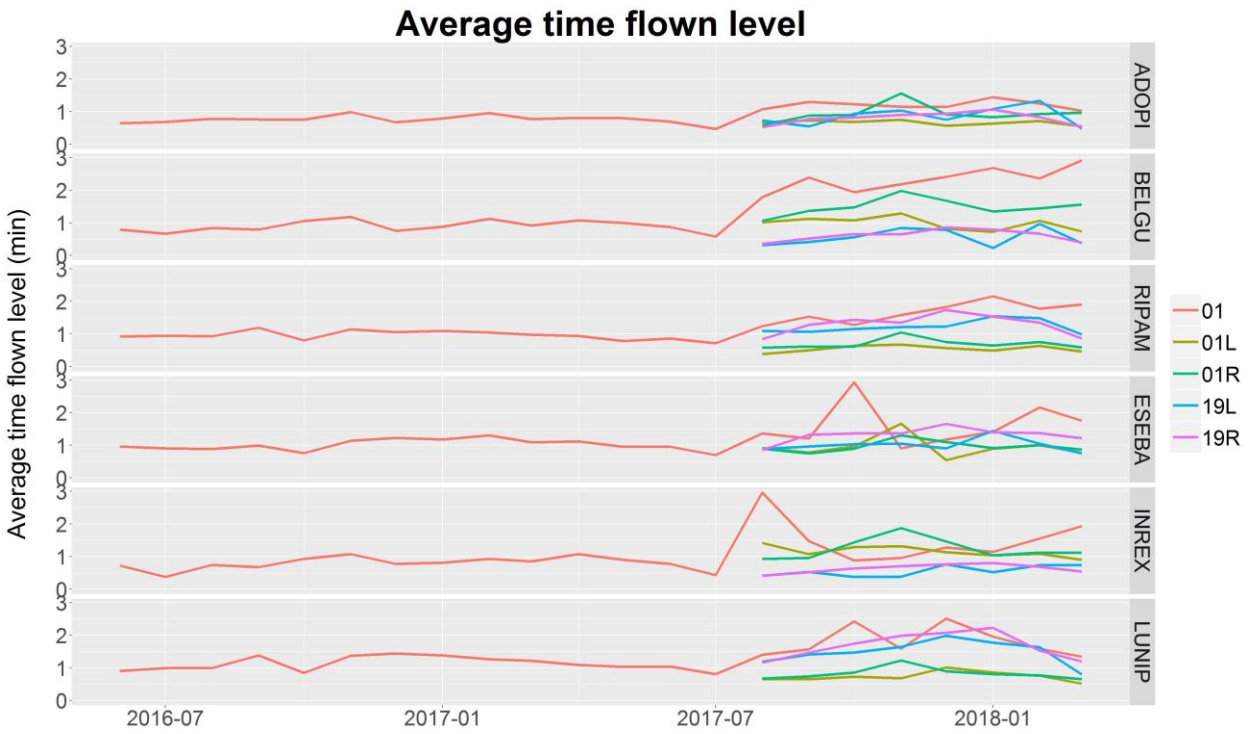

Figure 15 Average time flown level per runway-procedure combination (descent)

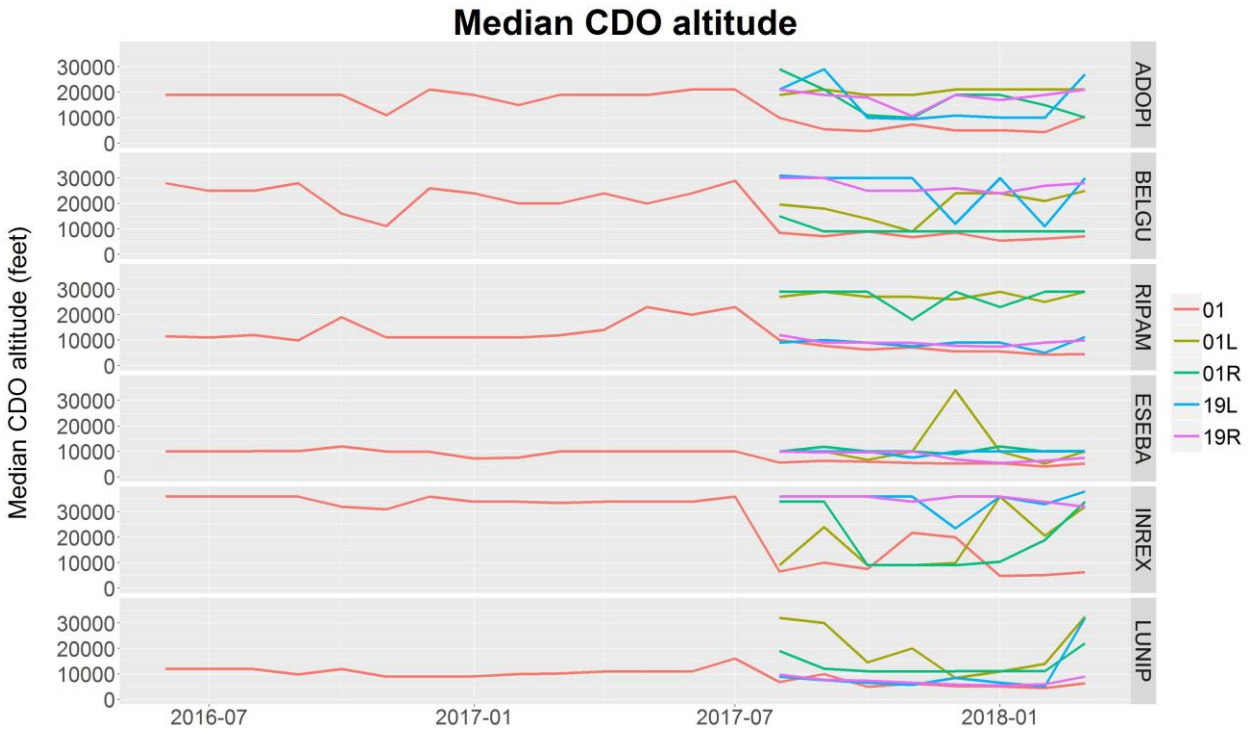

Figure 16 Median CDO altitude per runway-procedure combination

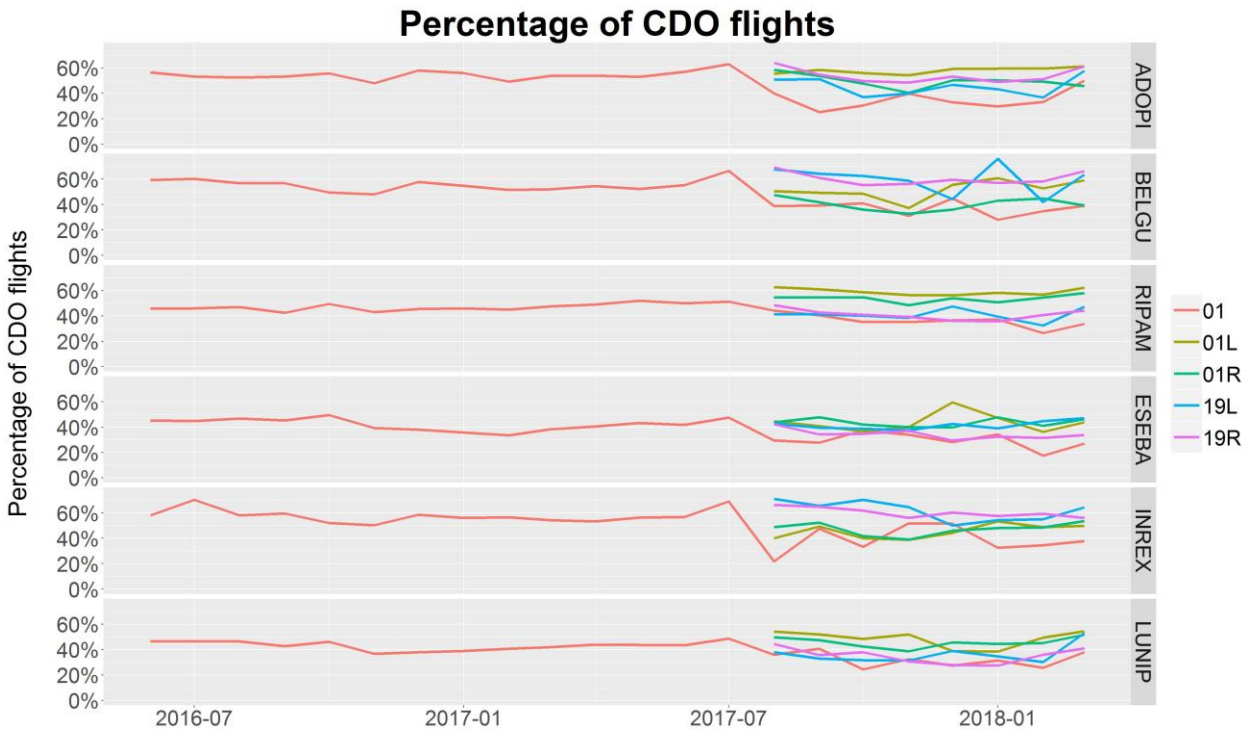

Figure 17 Share of CDO flights per runway-procedure combination

Figure 18 to Figure 21 present the number of movements, average time flown level per flight, median CCO altitude and share of CCO flights grouped by departure procedure and runway used.

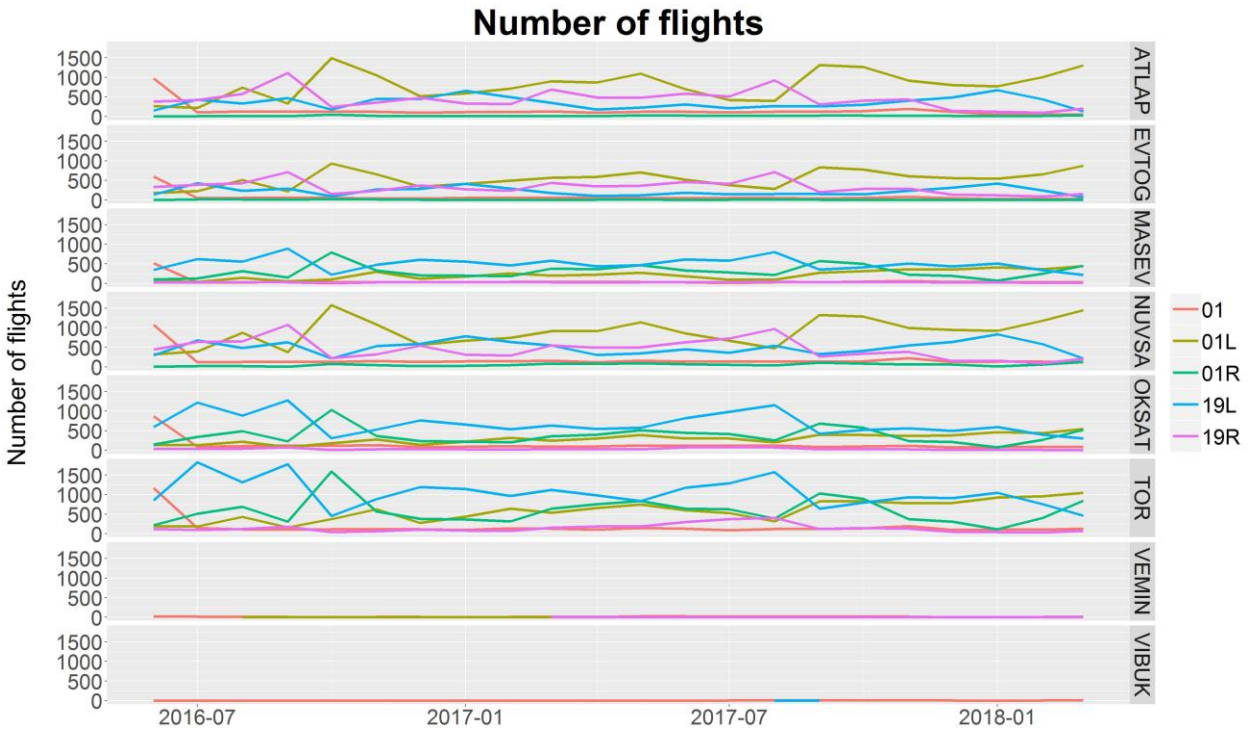

Figure 18 Number of movements per runway-procedure combination (climb)

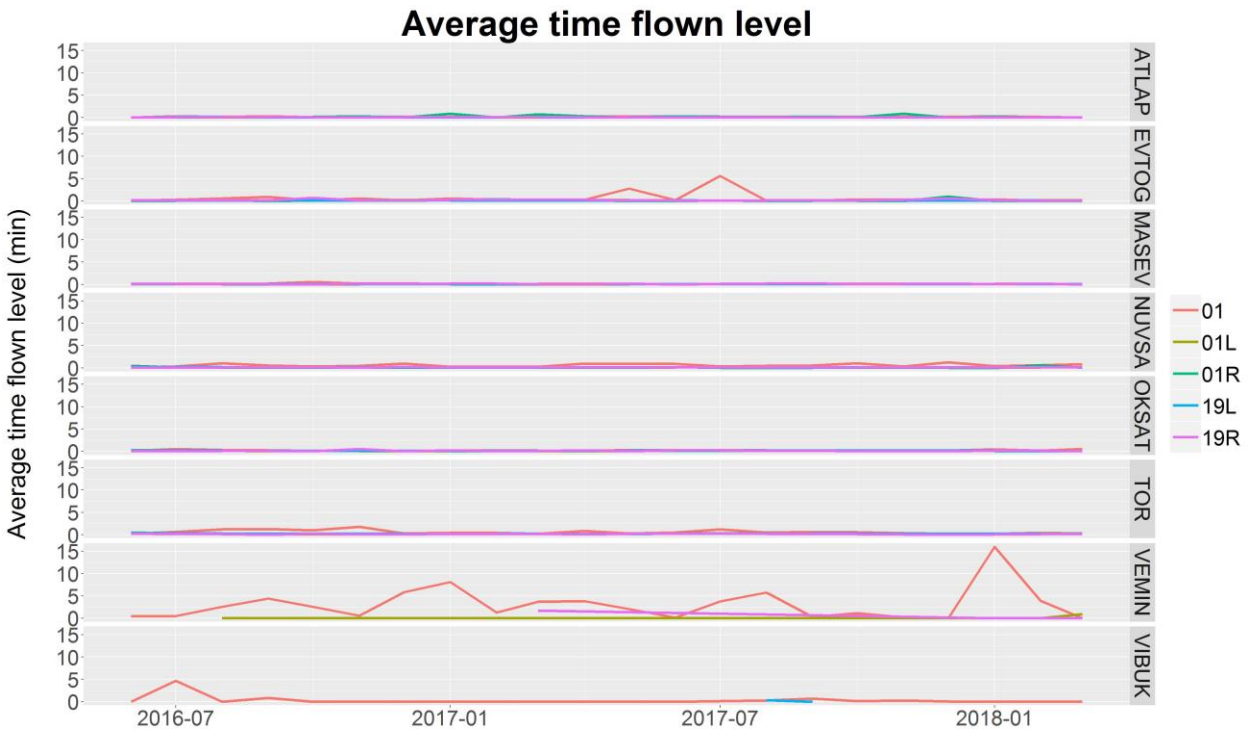

Figure 19 Average time flown level per runway-procedure combination (climb)

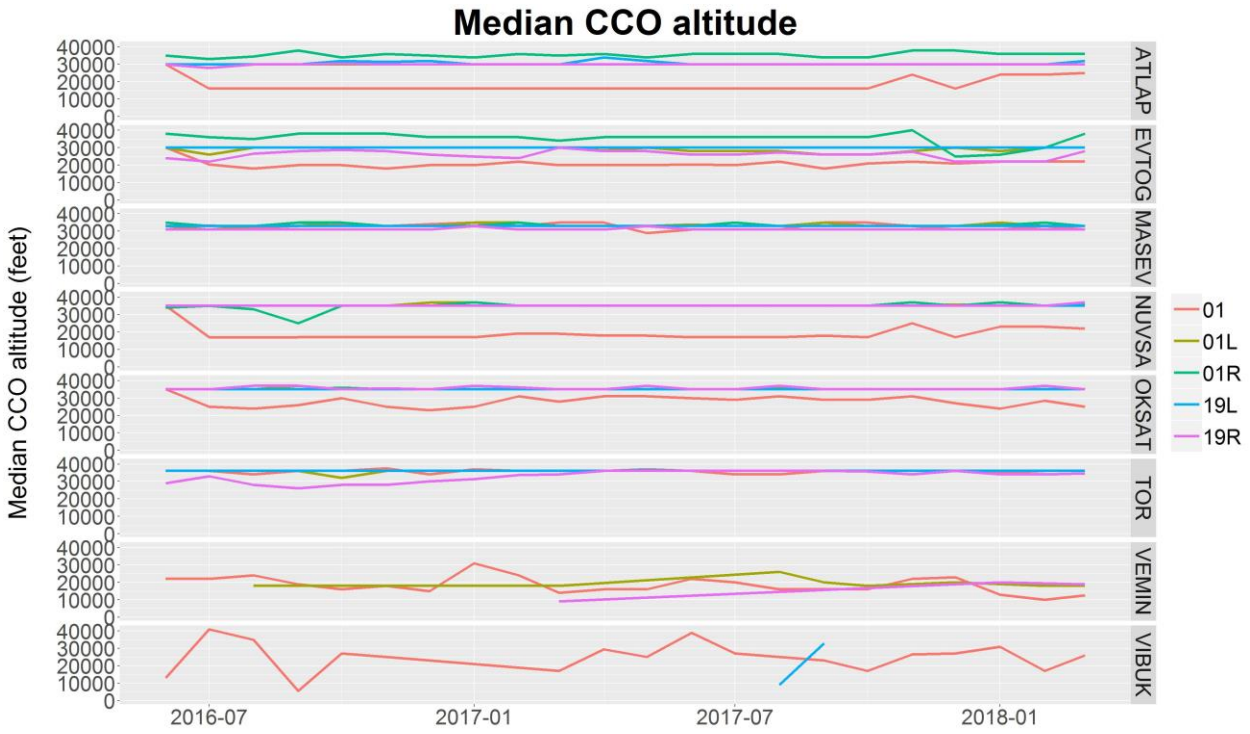

Figure 20 Median CCO altitude per runway-procedure combination

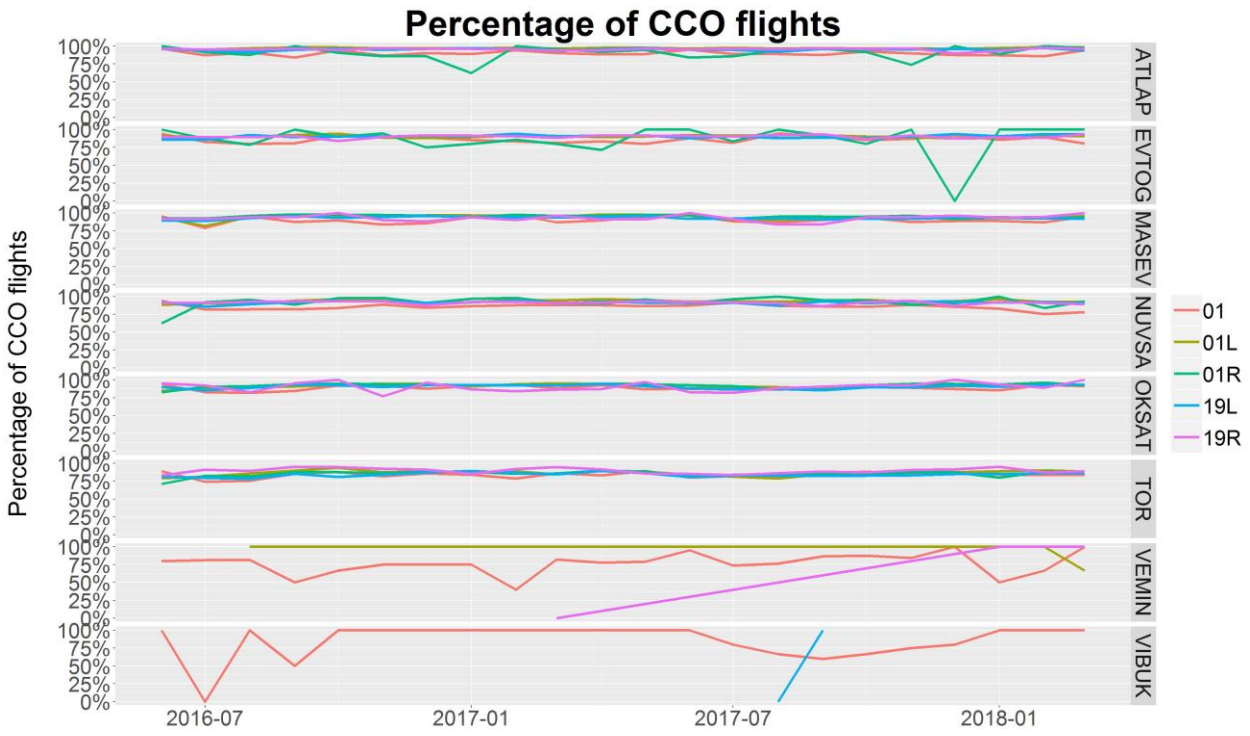

Figure 21 Share of CCO flights per runway-procedure combination

5 Level segment positions

The figures in this section present the trajectories to/from Oslo/Gardermoen in April 2018. The trajectories are shown in blue whereas the detected level segments are highlighted in red.

Figure 22 displays the lateral trajetories of arrivals into Oslo/Gardermoen while Figure 23 and Figure 24 show the vertical trajectories with regard to respectively time and track distance.

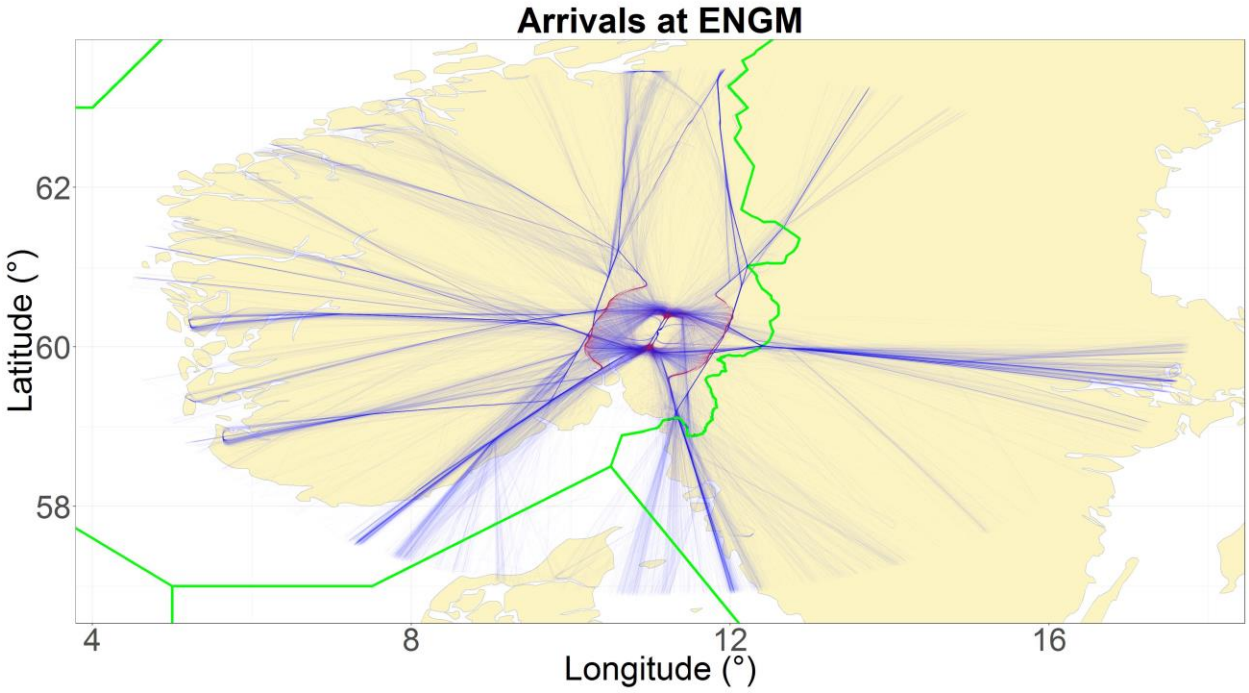

Figure 22 Lateral arrival trajectories

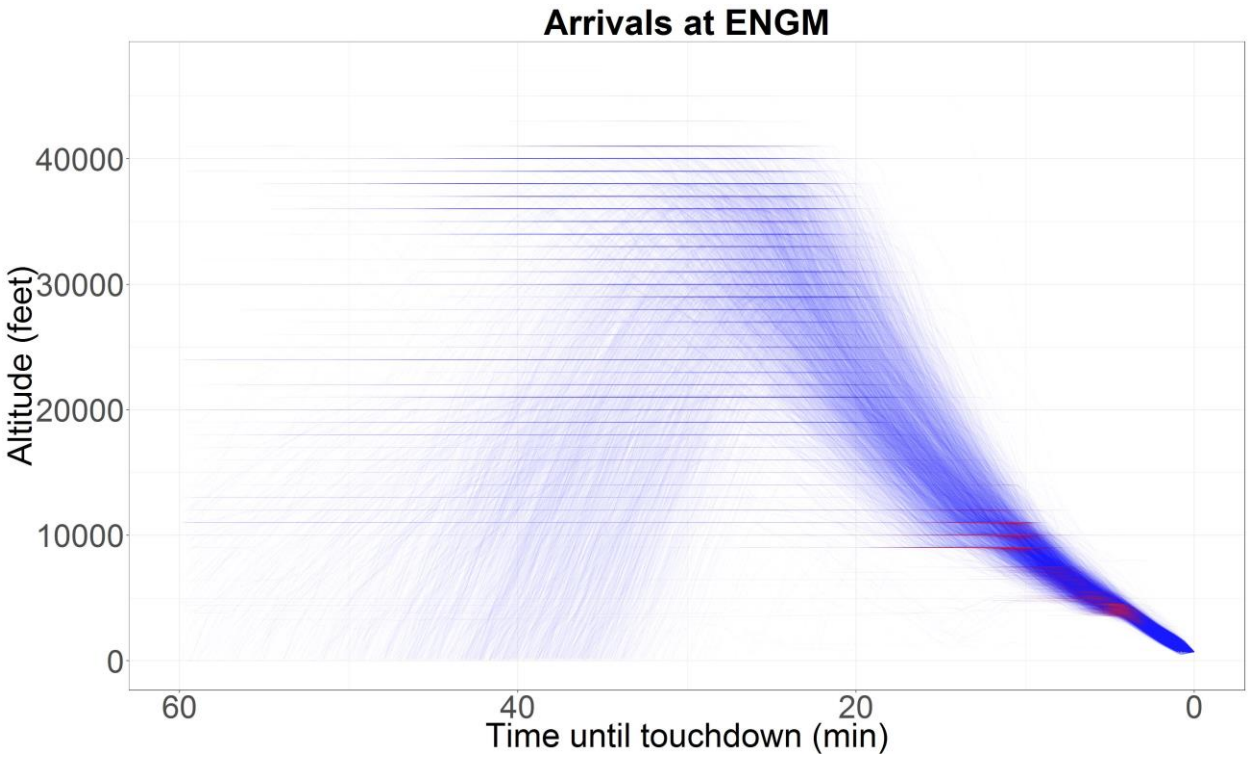

Figure 23 Vertical arrival trajectories with respect to time

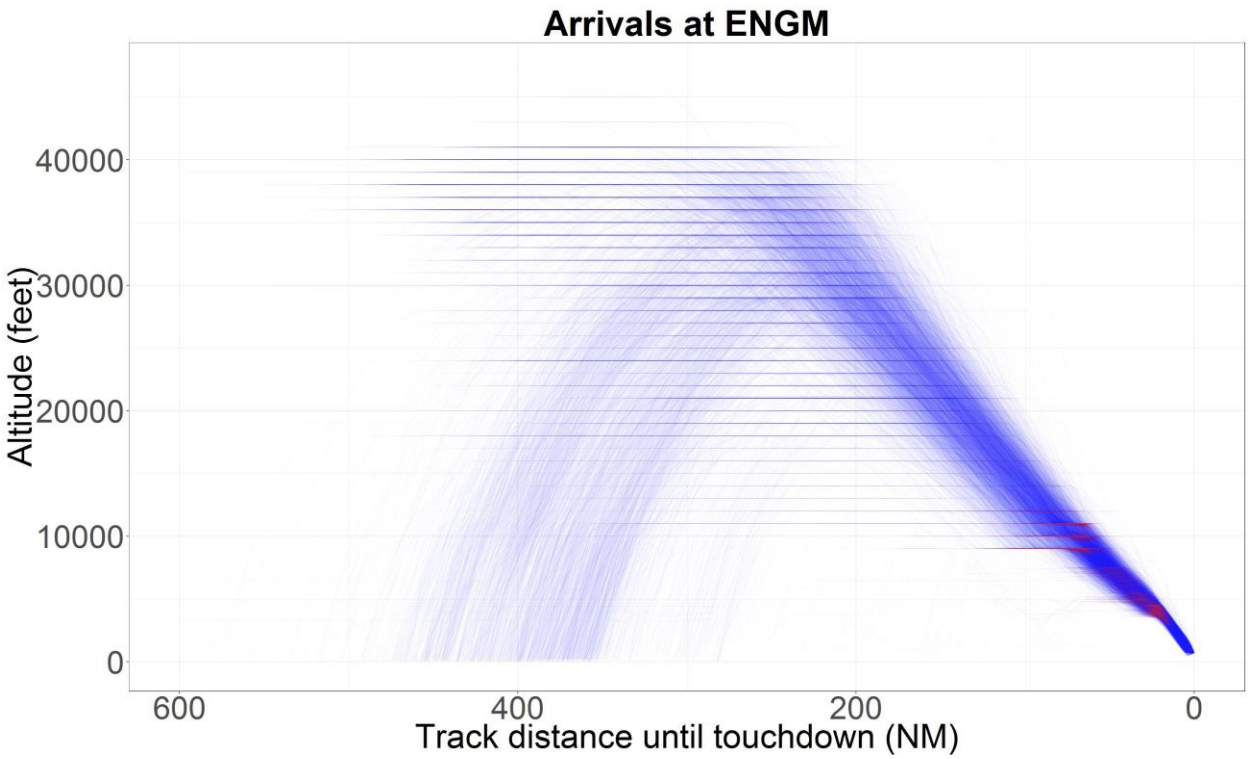

Figure 24 Vertical arrival trajectories with respect to track distance

Figure 25 displays the lateral trajetories of departures from Oslo/Gardermoen while Figure 26 and Figure 27 show the vertical trajectories with regard to respectively time and track distance.

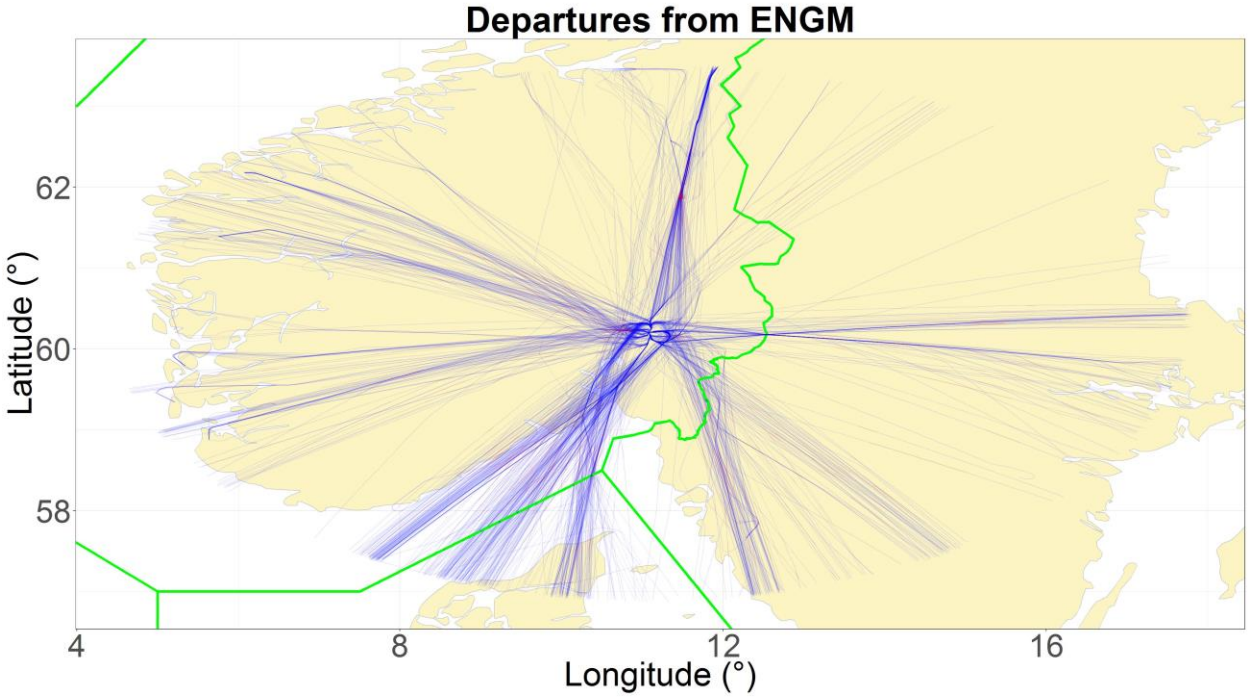

Figure 25 Lateral departure trajectories

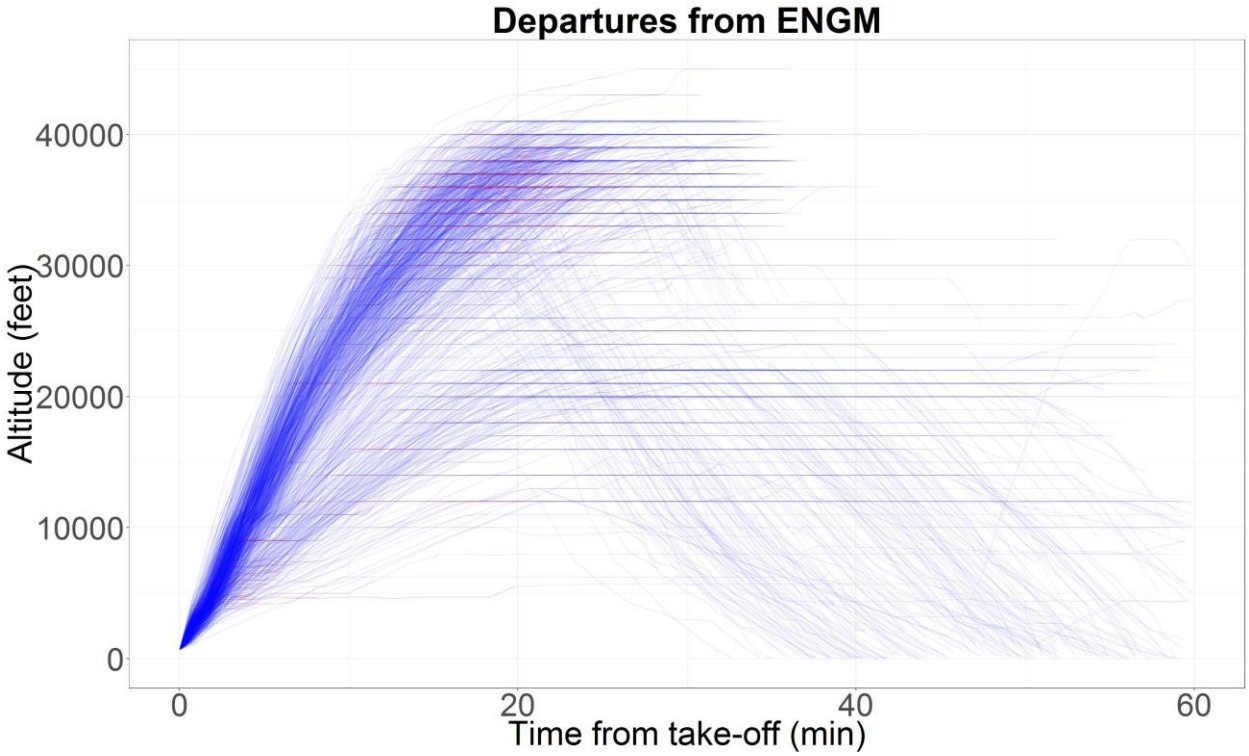

Figure 26 Vertical departure trajectories with respect to time

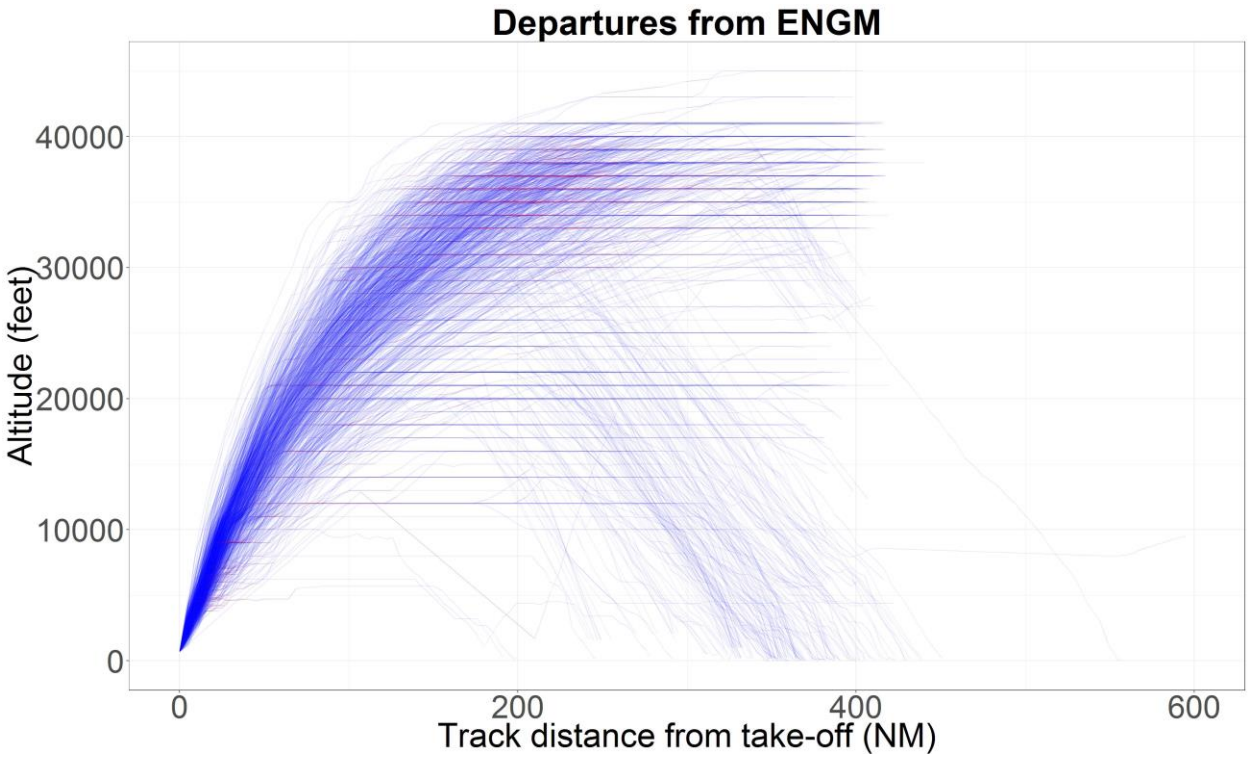

Figure 27 Vertical departure trajectories with respect to track distance

6 Conclusions