FAKULTÄT TECHNIK UND INFORMATIK
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Possibilities and Limitations Using Flightradar24, ADS-B and Mode S Data for Aircraft Performance Analysis – an Overview

Investigating Initial Cruise Altitude and Step Climbs from the ground.

Automatic dependent surveillance broadcast, short ADS-B, is used for surveillance purposes by air traffic control. Besides that, it is used by flight tracking services and gains popularity among private users. In this project, two different sources of flight data are discussed: 1.) Data provided by the flight tracking service Flightradar24: Different cases of possible aircraft performance or flight analysis are presented. It is evaluated whether Flightradar24 data is suitable for this analysis. To demonstrate the value of Flightradar24 data, a study of initial cruise altitude and step climbs with 440 data sets of different aircraft types is conducted and the first findings are derived. 2.) A homebuilt receiver for ADS-B and other Mode-S data is used. The technology behind ADS-B is presented and a decoding script for ADS-B and Comm-B messages, based on the open source python library pyModeS, is developed. The potential of this data source is shown by analyzing flight data from an aircraft using the homebuilt set-up. The different sources are compared, and the results show that the data sources differ significantly in terms of the number of parameters, data rate, and coverage: 1.) offers more coverage, but 2.) offers more parameters.

POSSIBLE AIRCRAFT OBSERVATIONS AND METHODS OF ANALYSIS

- Aborted Take-Off
- Altitude and Speed during Holdings
- Taxi Time
- Altitude and Speed during Cruise Flight
- Initial Cruise Altitude
- Step Climbs

INITIAL CRUISE ALTITUDE

- An Initial Cruise Altitude is typically around 35000 ft.
- Initial Cruise Altitude is decreasing with flight distance (due to more fuel on board and a heavier aircraft).

STEP CLIMBS

- The number of steps increases with flight distance.
- Short-medium range aircraft (narrow body) show no step climb or only one step climb during the flight.

More interesting are long range (wide body) aircraft:

- They show up to 5 step climbs during the flight.
- There is typically a 2000 ft increase in altitude for every step climb (a few steps where 1000 ft or 4000 ft).
- There are approx. 0.35 and 0.45 step climbs per 1000 km, the highest number recorded was 1.6 steps per 1000 km.
- Depending on cruise speed, there is usually a step climb every 100 min to 150 min.
- The vertical speed during the step climbs is typicaly around 500 ft/min, but varied between 200 ft/min and 1000 ft/min.

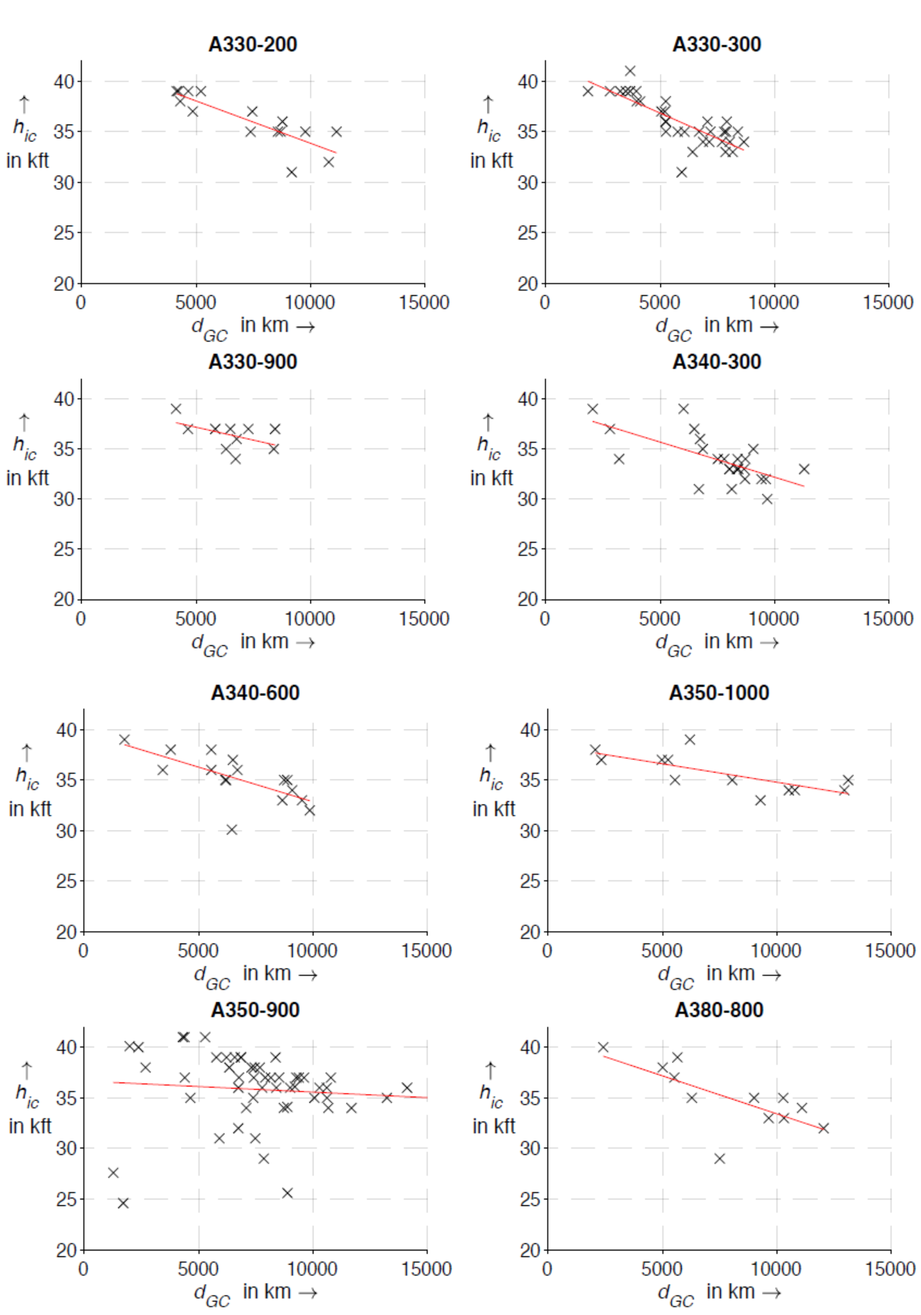

Figure 1: **Initial cruise altitude versus great circle distance of selected Airbus wide-body aircraft.**
dGC **Great circle distance between origin and destination airport**
hic **Initial cruise altitude**

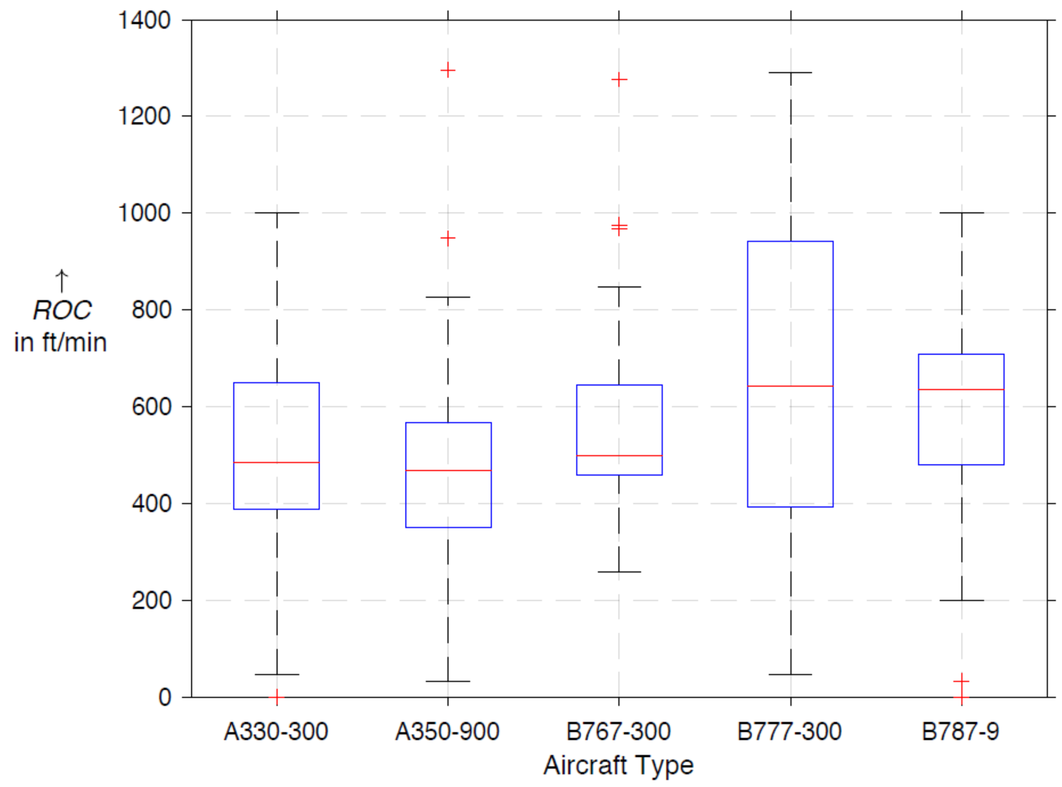

Figure 2: **Rate of Climb (ROC) during step climbs. The horizontal red line shows the median while the blue box indicates the first and third quartile. Black whiskers are used to show the range of values that are not considered outliers. The red pluses mark outliers, i. e. their value is lower or greater than 2.7 σ of the sample data.**

All details in the Bachelor Project of Jansen (2020):

https://nbn-resolving.org/urn:nbn:de:gbv:18302-aero2020-03-25.02

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