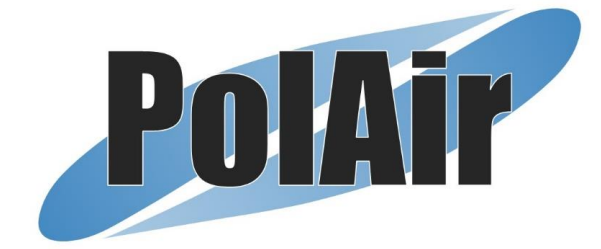


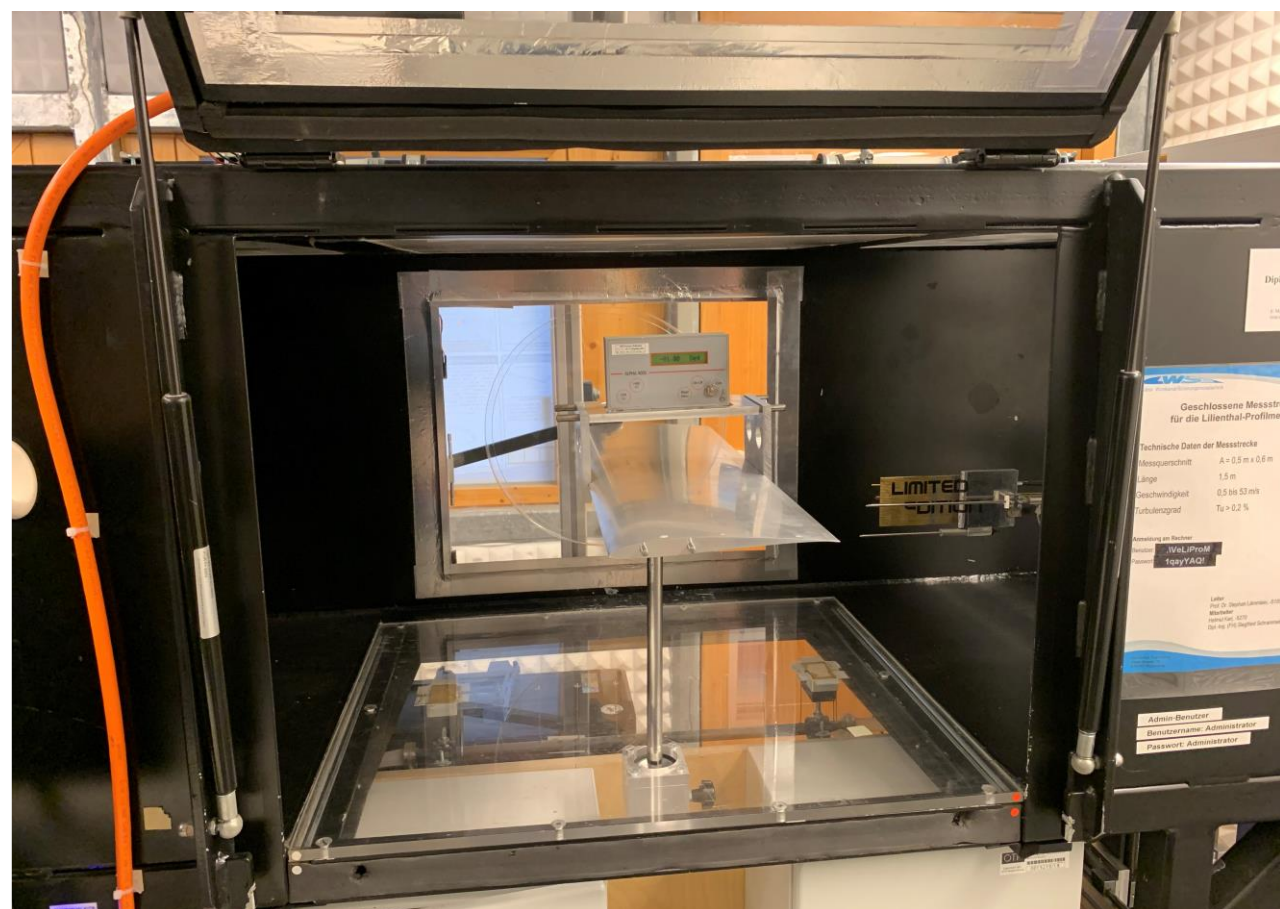
Automated measurement of dynamic type-2 polars



Wolfgang Ferstl, Maximilian Götz, Antonio Györög Chang, Simon Klinger, Johannes Kunder, Markus Michl, Alexander Steibl

Faculty of Mechanical Engineering, Galgenbergstr. 30, D-93053 Regensburg, Supervisor: Prof. Dr.-Ing. Stephan Lämmlein <https://hps.hs-regensburg.de/las39261/>

Workpackages

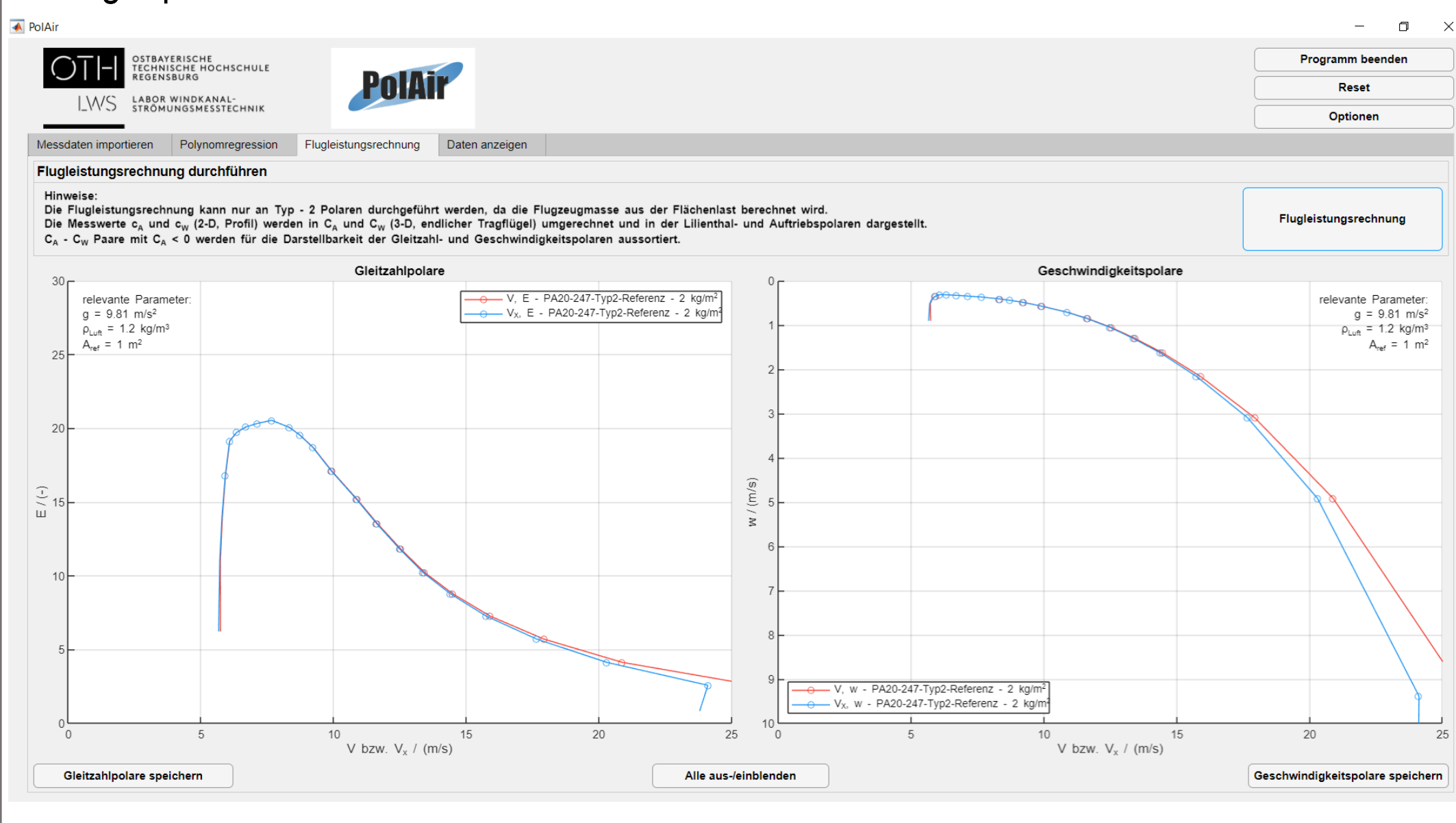


- WP1: Manufacturing of a new test wing based on the MF20-247 airfoil
- WP2: Implementation of a live measurement of a rear flap angle
- WP3: Aerodynamic measurements and update of the calibration matrix
- WP4: Modification of the Type-2 measurement in *LabVIEW*
- WP5: Conversion of the measured flight polars into flight performance data
- WP6: Revision of the standard wind tunnel corrections
- WP7: Introduction in *ProCap Compact* and execution of first measurements

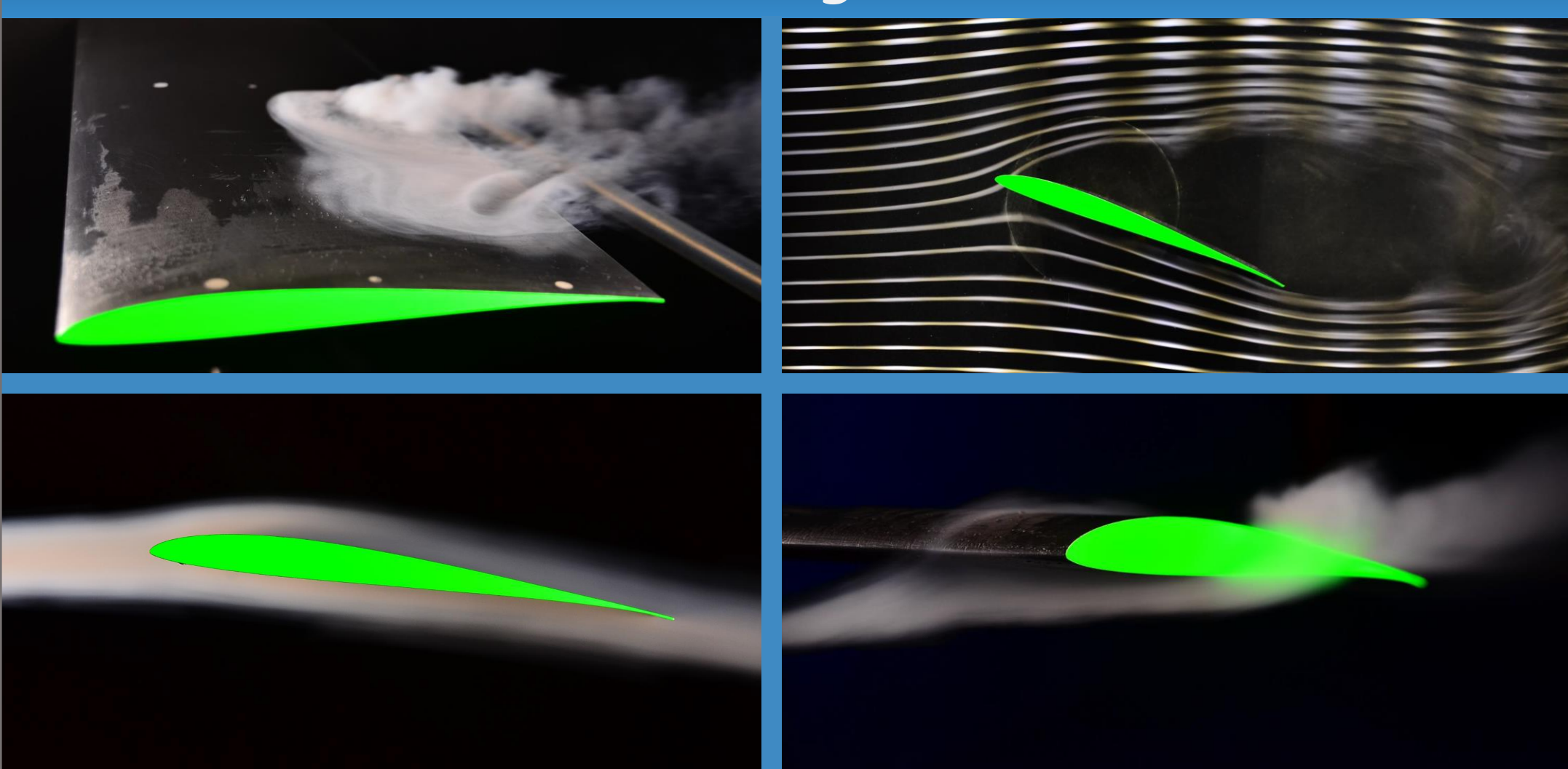
Calculation of flight performance data

For the automated calculation of flight performance parameters for the special case of non-powered flight, based on measurement data from the *POLAMAX* test rig, the software application *PolAir* was developed using *MATLAB App Designer*. The following functions are included:

- Direct data import of CSV and TDMS files
- Display as well as PDF export of the measured polars
- Approximation of polars by analytical approaches as well as implementation of the flight performance calculation.



Wind and smoke tunnel images



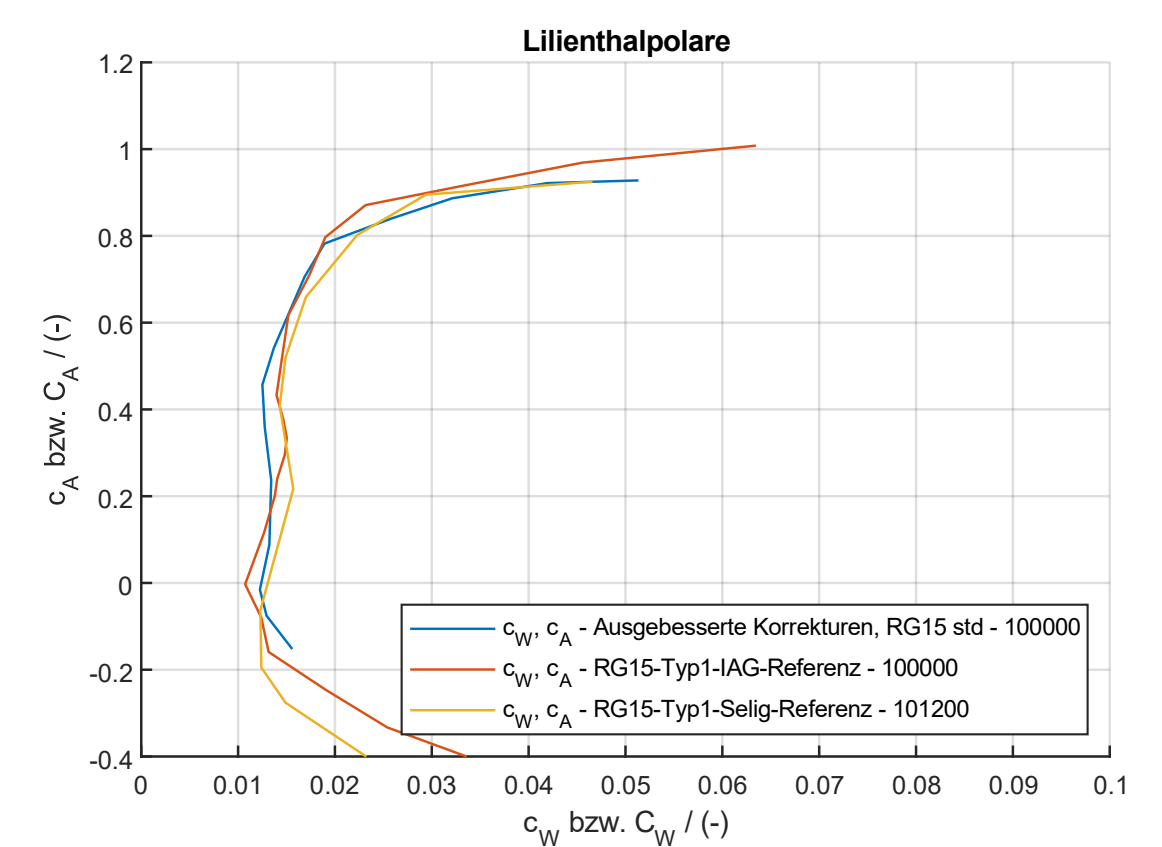
Modification of the measurement in LabVIEW

- The type-2 measurements could be modified by re-adjusting the angle of attack offsets and using practical parameters such as the angle of zero lift α_0 and the lift rise $c_{A\alpha}$, which can be determined by type-1 measurements
- The desired optimization of the PA20-247 measuring wing could be confirmed aerodynamically and improved in lift coefficient compared to the RG15 std
- The standard wind tunnel boundary corrections could be restored after a typing error in the corrections, undiscovered for years, was fixed

Type-1 and type-2 measurement results

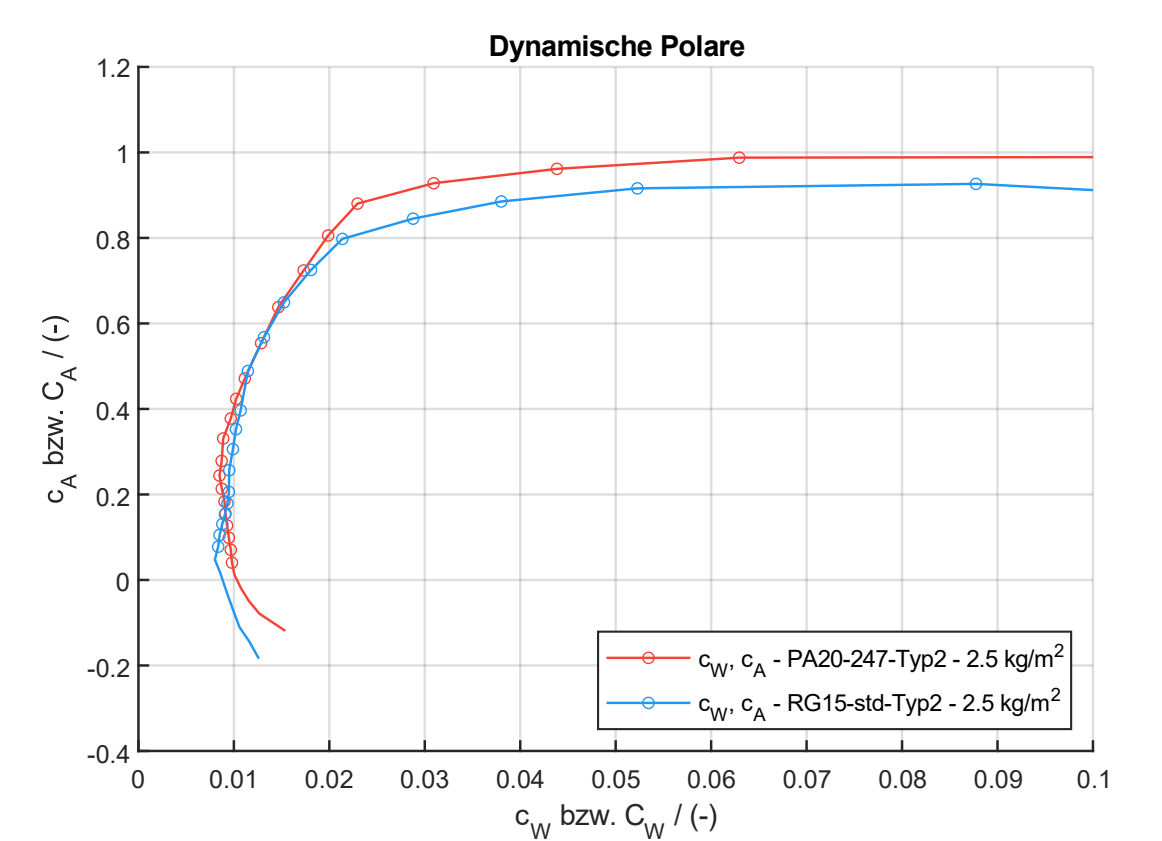
Comparison of the type-1 polars with new corrections

- RG15 std
- Reynoldsnumber = 100.000
- Comparison with wind tunnels of the IAG Stuttgart and the University of Illinois
- Measurements with new corrections are comparable to the reference measurements



Comparison of the type-2 polars of RG15 std and PA20-247

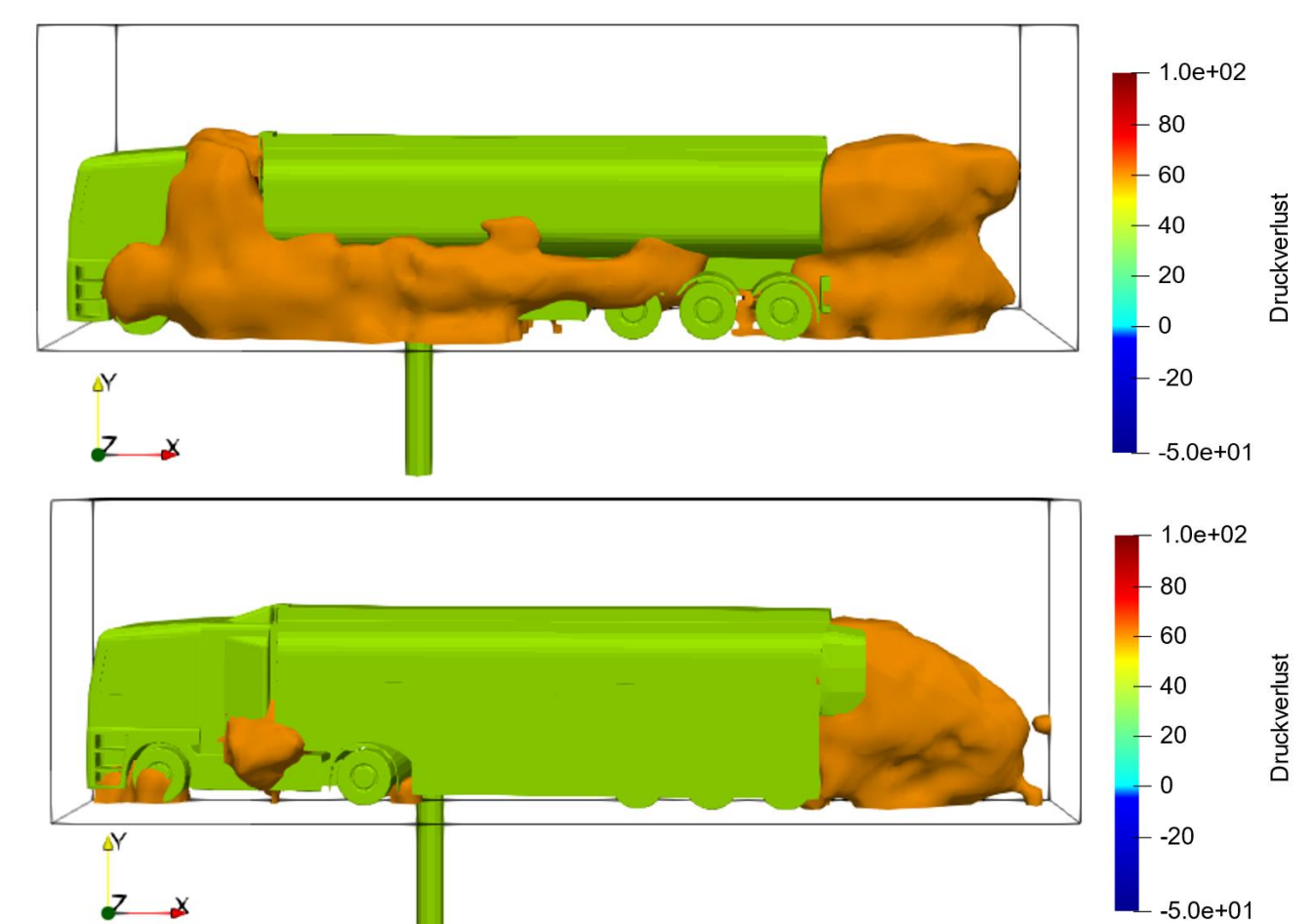
- Area load 2,5 kg/m²
- Improvement of the lift coefficient at high angles of attack of the PA20-247
- Lower drag coefficient of PA20-247 compared to RG15 std between $c_A = 0.2 - 0.4$



Flow visualization with ProCap Compact

Modifications of a tank truck

- Iso-surfaces of the (total) pressure loss are shown
- These are a direct indication of the drag
- Size and height of the pressure loss region provide information about the drag generation at the investigated geometries
- The higher the values of the pressure loss area, the higher drag is generated at these points



- The attached modifications show strong improvements in the area behind the cockpit compared to the reference model
- Further optimization possibilities in the rear area through modification of the side shields