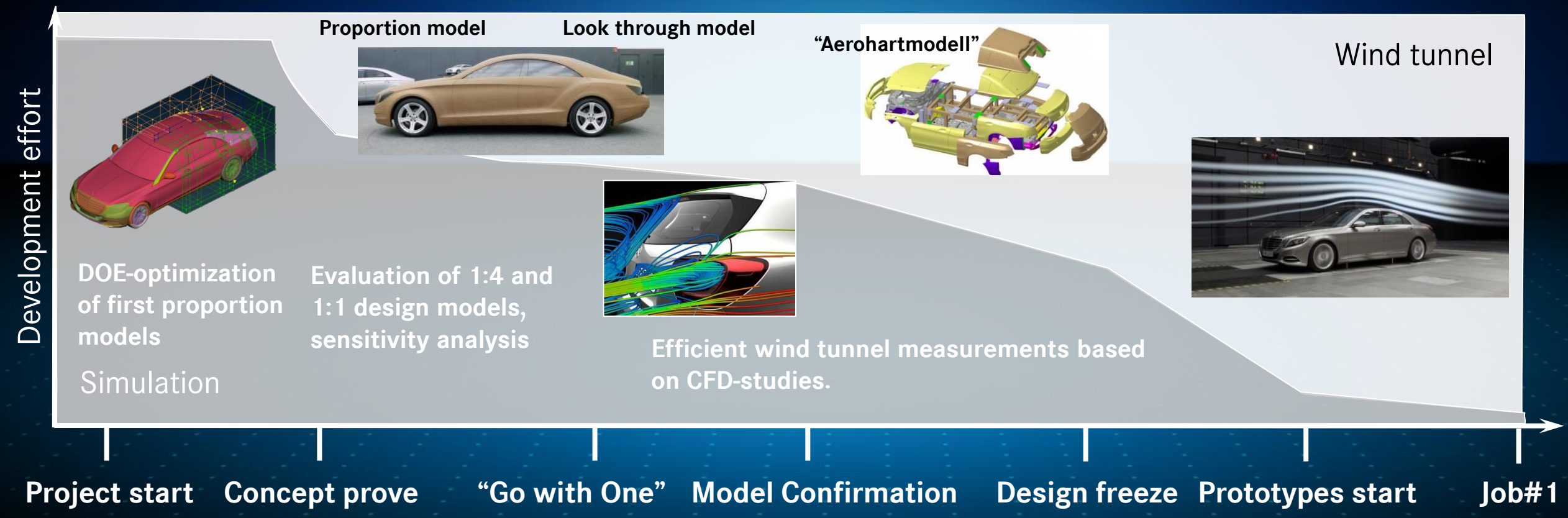
CAE-AutoWorkflow: A Framework Based on optiSLang for the Automated Build-up of Simulation Workflows Using the Example of Passenger Car Aerodynamics

Anke Jäger, Erich Jehle-Graf, Alexander Wäschle, Daimler AG

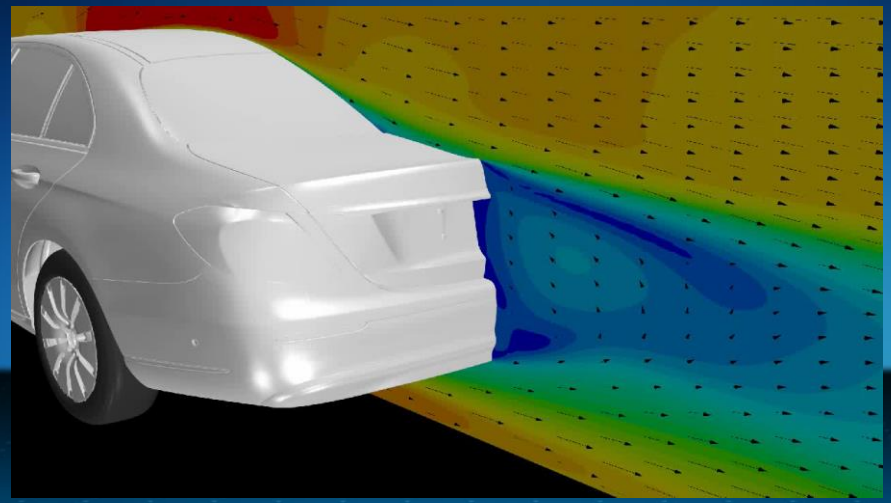
Mercedes-Benz
The best or nothing.

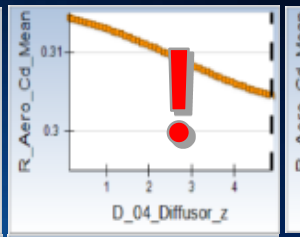
Content

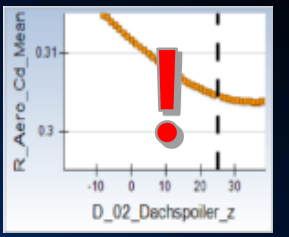
Close Link Between CFD and Wind Tunnel Ensures High Speed and Quality in Aero Development

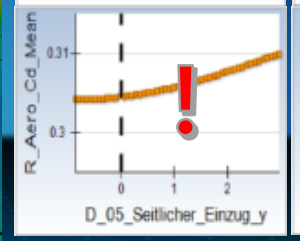


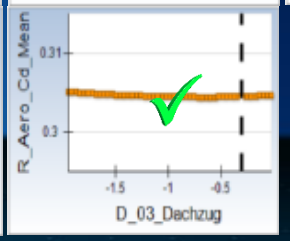
DOE-based Optimization in the Early Design Phases Deliver Precise Sensitivity Analyses











- Fully automated process with parametrized car geometry (ANSA-Morphing)
- over 200 fully resolved simulations per DOE
- Very helpful in discussions with styling und car projects

❗ = high impact on aero

✓ = low impact on aero
→ high degree of freedom for styling

→ Key technology for a digital driven early aerodynamic development!

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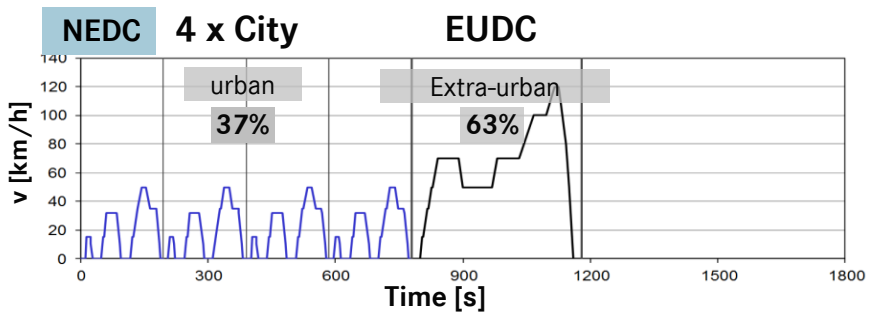
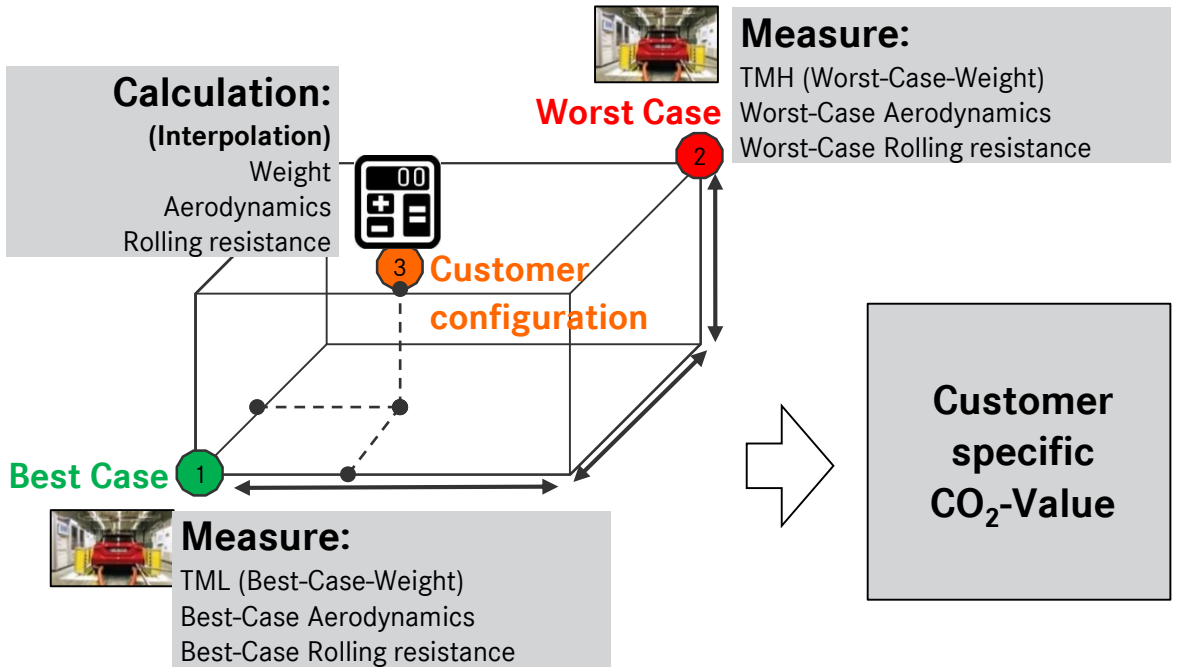
WLTP Increases the Weight of Aerodynamics Dramatically
The Drag of Each Individual Car is Base of CO_2-Certification





Driving Profile facts

- Double distance, +10min, +13km/h higher Ø-Speed, less Stopps
- A more „real driving profile“, increased dynamic driving (= no constant driving at constant speed)
- Higher weighting of extra urban driving

The Spread in Drag is Huge – the WLTP Takes This Into Account

CLA 180 BlueEFFICIENCY Edition

15“ steel wheels
sports trim (-15 mm)
underbody parts

c_D = 0.22
117 g/km

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The Spread in Drag is Huge – the WLTP Takes This Into Account

CLA 180

16“ alloy wheels cooling demand

$c_D = 0.23$

+ 1,5 g/km

The Spread in Drag is Huge – the WLTP Takes This Into Account

CLA 200

16“ light alloy wheel
cooling demand

c_D = 0.25
+ 4,5 g/km

The Spread in Drag is Huge – the WLTP Takes This Into Account

CLA 250 Sport

18“ alloy wheels exterior design

c_D = 0.29
+ 9 g/km

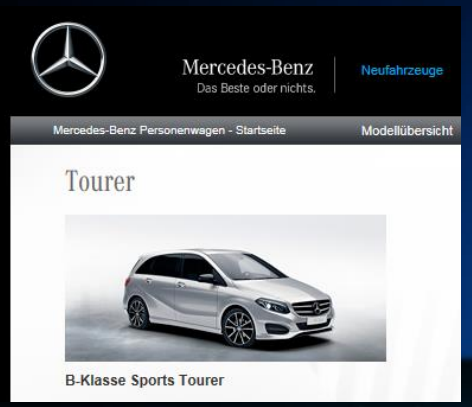
The Spread in Drag is Huge – the WLTP Takes This Into Account

CLA 45 AMG 4MATIC

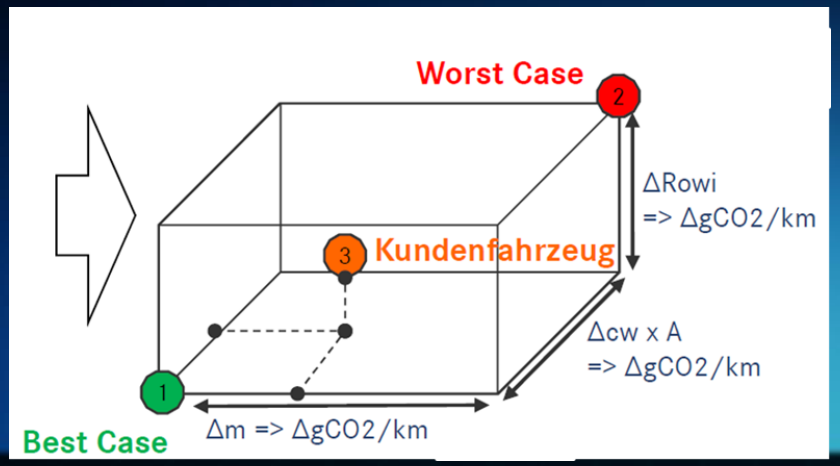
Expressive exterior design
high cooling demand
19“ alloy wheels
4MATIC

c_D = 0.33
+15 g/km

Without a Highly Automated CFD-Process WLTP Could not be Handled



~ 40.000 c_D-relevant combinations



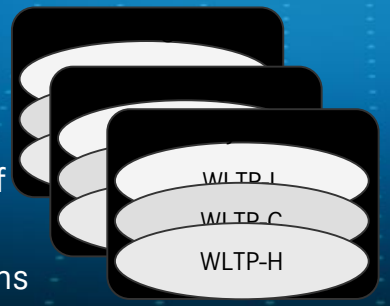
Customer CO_2 Value

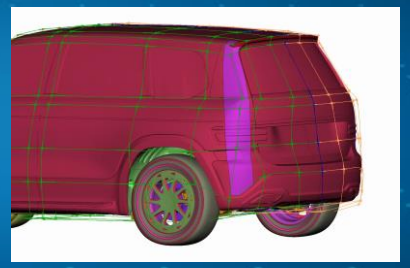
Requested accuracy (by law):
± 2 % oder c_D 0,005

Growth of effort in aerodynamic development with WLTP: ~ Factor 5

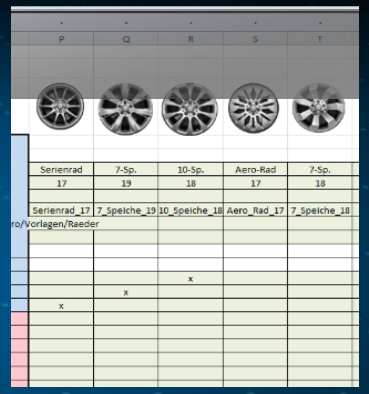
Step 1: Optimization of Aero-best-type

Step 2:
Evaluation of the relevant configurations





Step 3:
Optimization of the relevant configurations (digital + tests)



Step 4:
Reporting of c_D-deltas of all available car configurations (measurements only)

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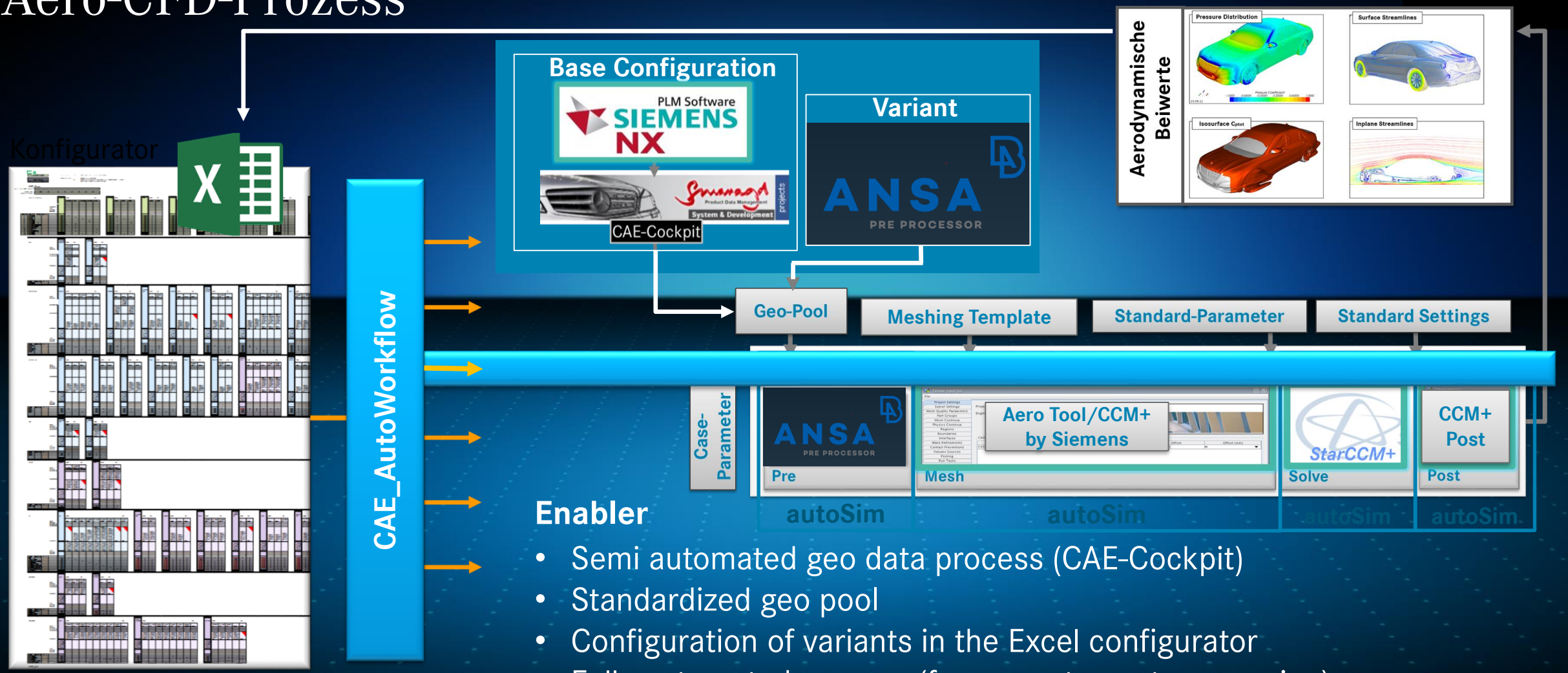
Variants- und Load-Case-Steering of the Fully Automated Aero-CFD-Prozess



Enabler

- Semi automated geo data process (CAE-Cockpit)
- Standardized geo pool
- Configuration of variants in the Excel configurator
- Fully automated process (from pre- to post-processing)
- Automated result documentation in the Excel configurator

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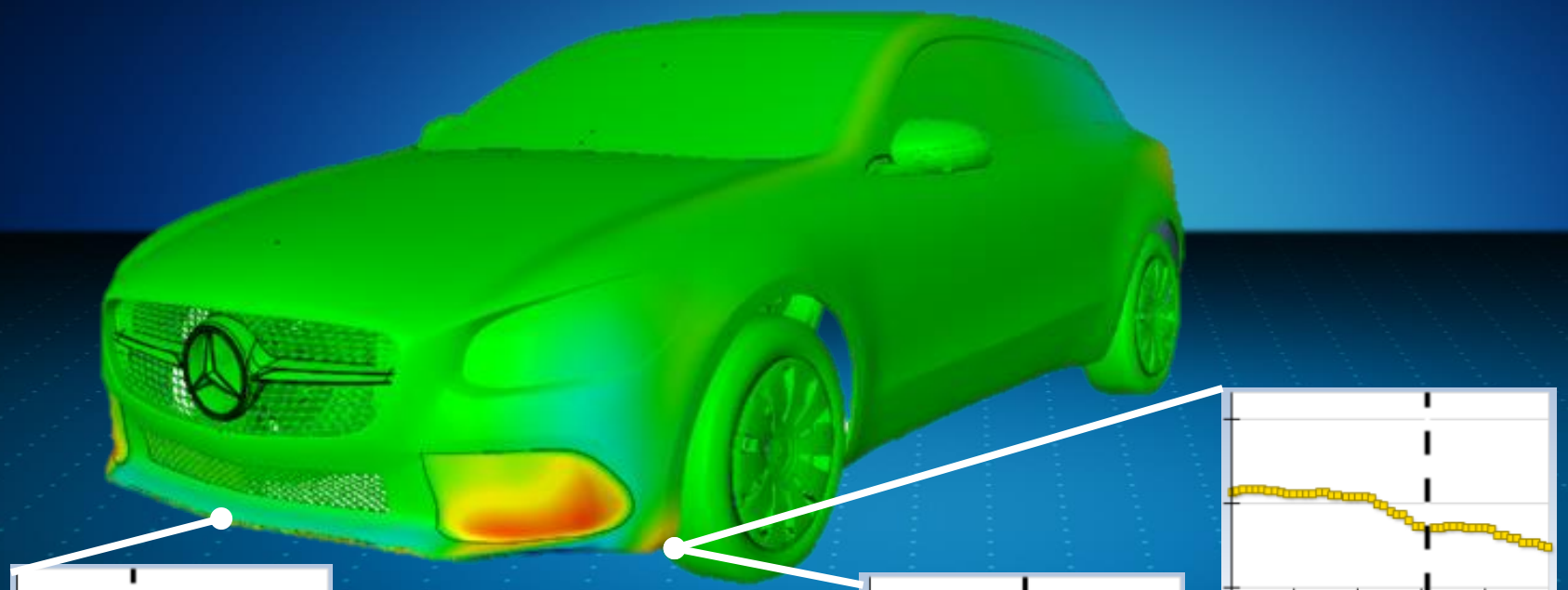
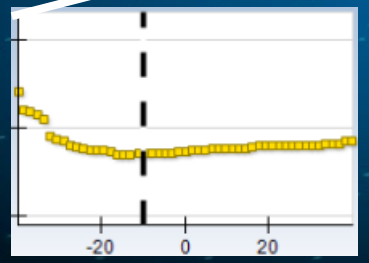
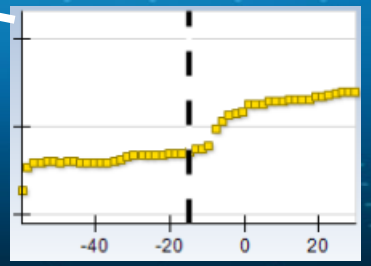
Aerodynamic Potentials in Early Development Stage A-Class





Buglippe mitte (z)

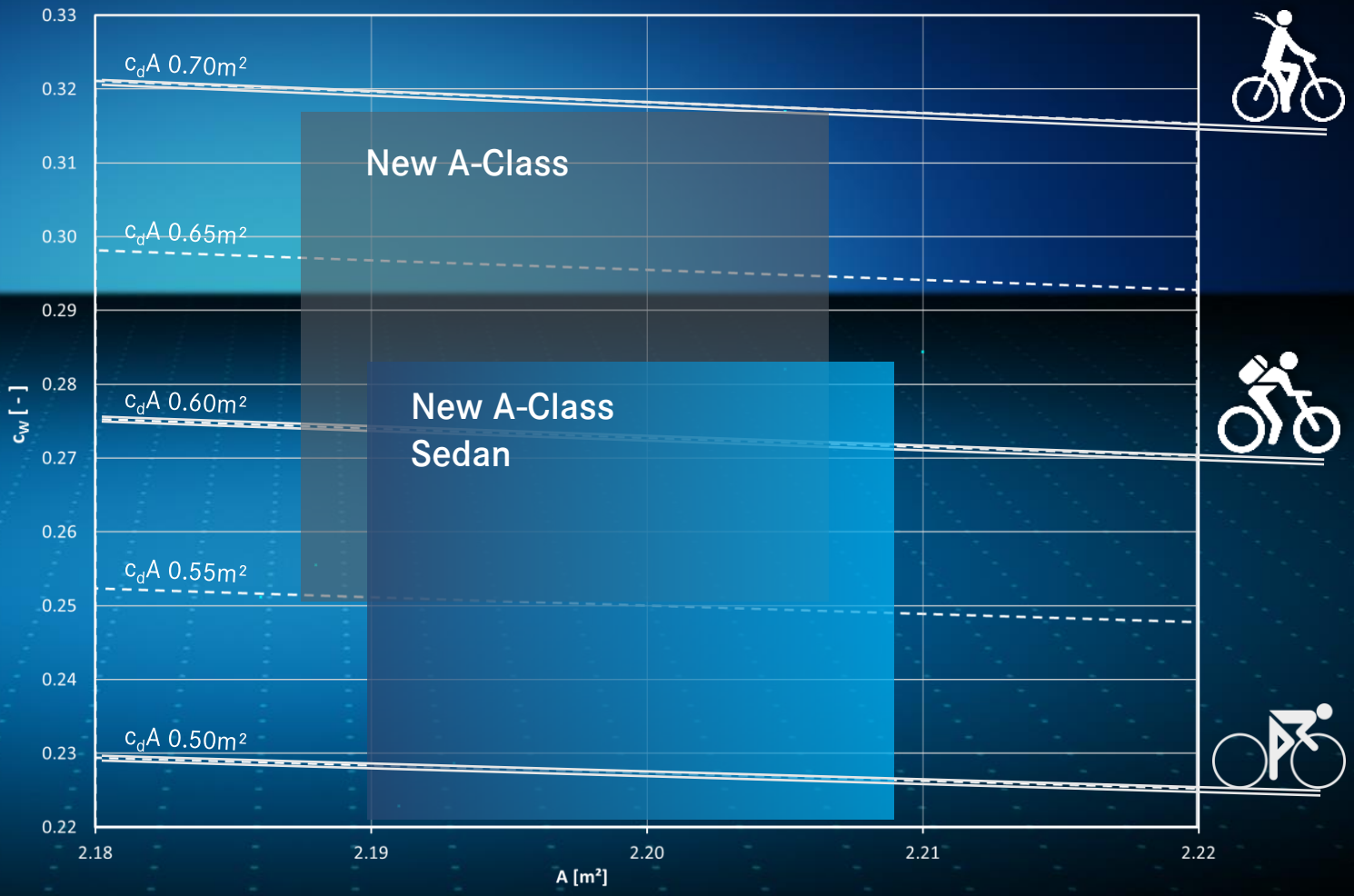


Radabdeckung (z)

Radabdeckung (y)

Aerodynamic of the new A-Class: c_D-Record defended: c_D = 0,22
Record of Aerodynamic Drag for Series Cars: c_D*A = 0,49m²

- The A-Class Sedan reaches an excellent c_D-value of c_D=0,22.
- Compared to the A-Class the c_D-value could be reduced by up to -0,030. This corresponds to a fuel efficiency improvement of:
  - 0,15 l/100 km in WLTP
  - 0,24 l/100 km on BAB
- Based on a reduced frontal area of A = 2,19m² compared to the CLA the new A-Class sedan reaches a new aerodynamic drag record for series cars of 0,49m².



Actual Highlight: New Drag World Champion A-Class Sedan

$c_D * A = 0.49$ (comparable to a typical race cyclist!)