

# DLR Design Challenge 2022

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## Welcome to the DLRK 2022 Session!



DLR Design Challenge 2022



**DLRK**  
DEUTSCHER LUFT-UND  
RAUMFAHRTKONGRESS

# DLR Design Challenge 2022 on Advanced Aerial Firefighting

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Institute of System Architectures in Aeronautics  
Hamburg



Knowledge for Tomorrow





# DLR Design Challenge 2022 Session

**16:20-16:45**      **General Overview and Task Description**

Tobias Dietl & Patrick Ratei  
German Aerospace Center (DLR)

**16:45-17:10**      **FireWasp**

Mucahit Fatih Evliyaoglu, Selim Karakus, Dominik Kau & Robin Mörsch  
RWTH Aachen University

**17:10-17:35**      **PEL-E-FAN-T**

Dominik Brunner, Hannes Jerzembek, Lennard Köhler, Paul Sanderbrand & Maximilian Wenk  
TU Dresden

**17:35-18:00**      **INFERNO**

Ahmet Günay Can, Hannes Kahlo, Benjamin Knoblauch, Nicolas Mandry, Prishit Modi & Johannes Ritter  
University of Stuttgart

**18:00**              **Open Discussion and Exchange**



# Agenda

## 1. DLR Design Challenge

- Background
- History
- Organization

## 2. DLR Design Challenge 2022

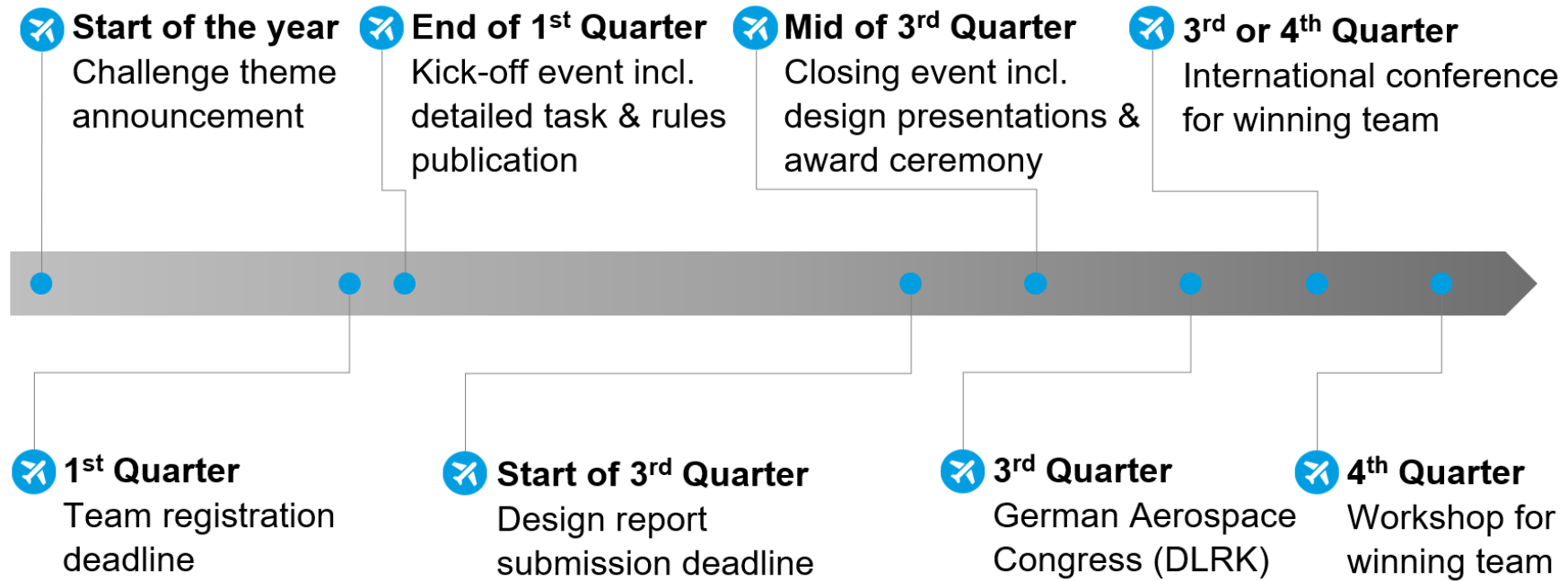
- Theme
- Task
- Field of Participants
- Design Concepts



# DLR Design Challenge – Background



# DLR Design Challenge – Organization



- Yearly student competition on aircraft design of future concepts
- Geared towards current focus areas in aeronautics research

- Design work is conducted during summer term
- Challenge is organized on a rotating basis between:



Institute of Aerodynamics and Flow Technology



Institute of System Architectures in Aeronautics





# DLR Design Challenge – Organization



- Team size between 2 and 6 students
- All participants have to be enrolled in a German university (Bachelor and/or Master)
- Teams are ranked based on technical design reports, presentations and pitch-videos
- Evaluation by DLR expert jury is chaired by DLR's Divisional Board Member for Aeronautics Dr. Markus Fischer
- Winning teams are invited to aeronautics conference



# DLR Design Challenge – History

**2017**  
Aircraft of the Future



Technical University of Munich



**2018**  
Ultra-efficient Commercial Transport



Technical University of Munich



**2019**  
Self-piloted Aircraft for Critical Rural/Suburban Needs



University of Stuttgart



**2022**  
Aerial Wildfire Fighting  
with Advanced Vehicle Concepts



University of Stuttgart



**2021**  
Hydrogen-based Medium-haul  
Aircraft of the Future



RWTH Aachen



**2020**  
Autonomous and Reliable Cargo  
Delivery in Urban Areas



RWTH Aachen

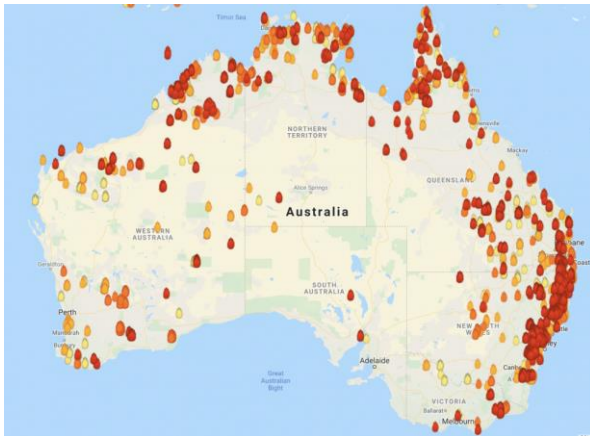




# DLR Design Challenge 2022 – Theme

## The Global Threat of Wildfires

- UN (2022) warns of a worldwide increase of wildfires by 50% until 2100, including regions not prone to wildfires today



Google Maps



Kent Porter/The Press Democrat/AP



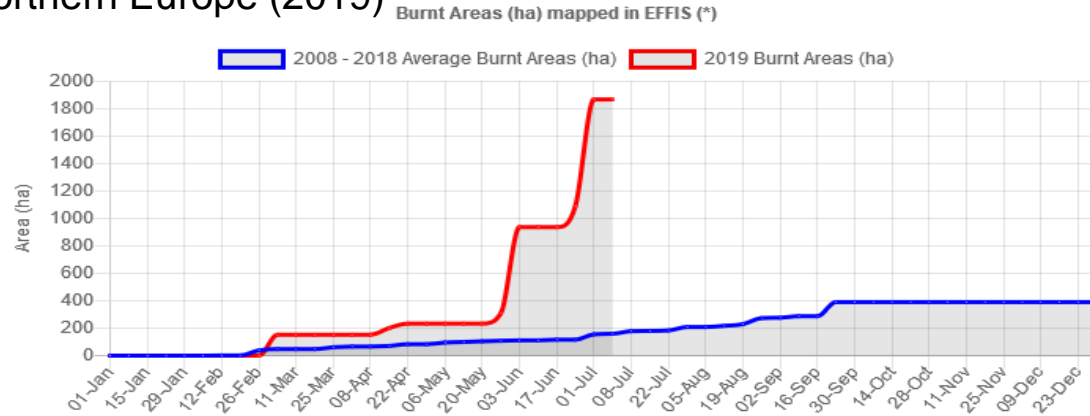
Matthew Abbott/The New York Times/laif

- Wildfires in Australia or California cost billions of dollars
- “True” costs:
  - Death of forest, humans and animals
  - Additional global warming: Copernicus (2021) reports global CO2 emissions of wildfires equal to 63% of the overall EU-wide CO2 emissions in 2021

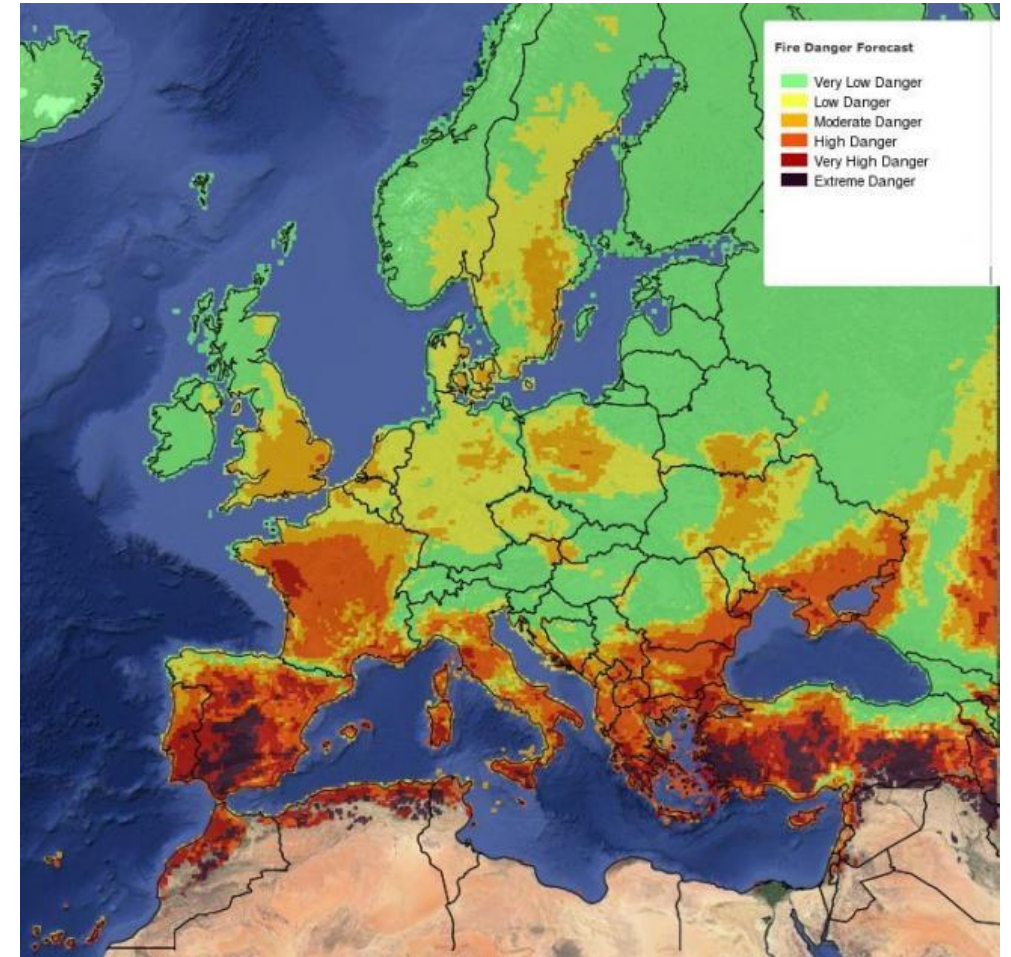
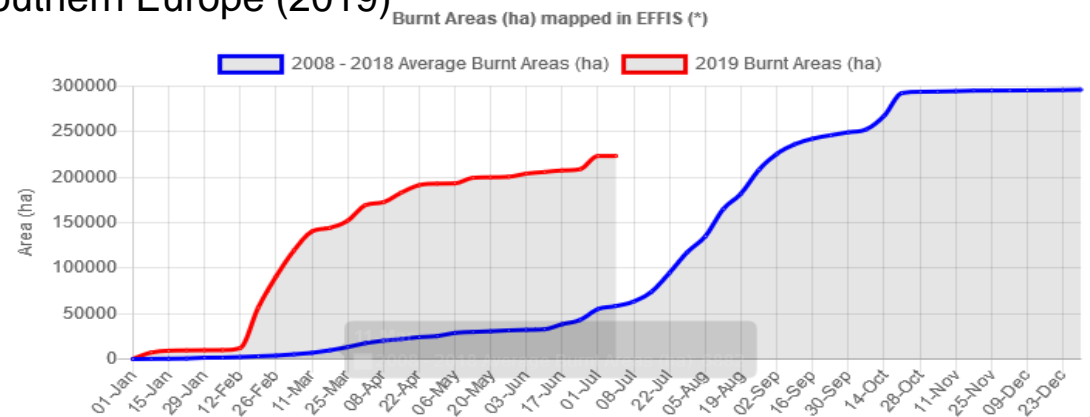


# DLR Design Challenge 2022 – Theme Wildfires in Europe

- Northern Europe (2019)



- Southern Europe (2019)

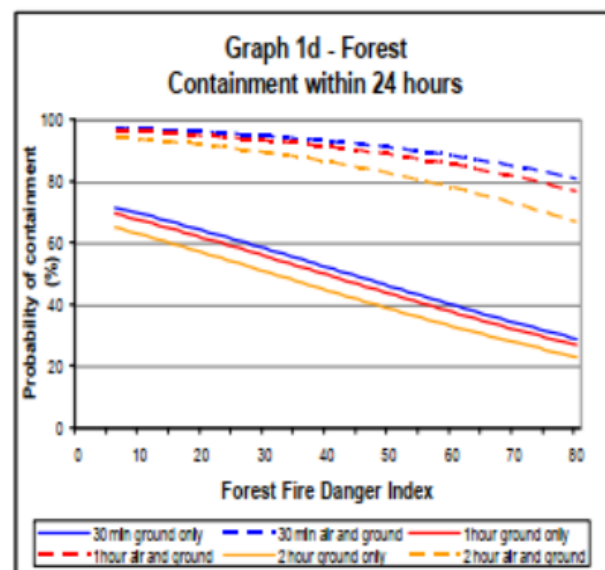
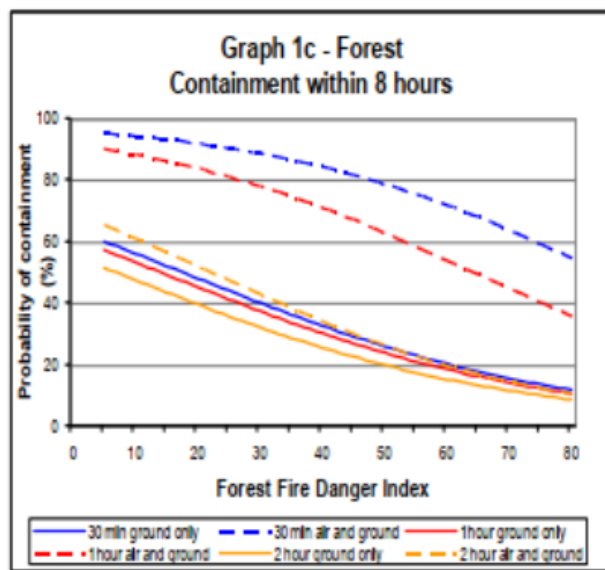




# DLR Design Challenge 2022 – Theme

## Aerial Firefighting Strengths and Weaknesses

- Aerial suppression increases effectiveness and safety of firefighters on the ground
  - Reduces fire-front intensity and slows down propagation
  - Spot fires can be put out quickly
- Risks and limitations of existing tactics and fleet
  - Low and slow flight during suppression runs coupled with high winds leads to high risk
  - Low visibility limits operations to circa 8 hours per day (often daytime only)





# DLR Design Challenge 2022 – Theme

## Design and Deployment of Advanced Air Vehicles

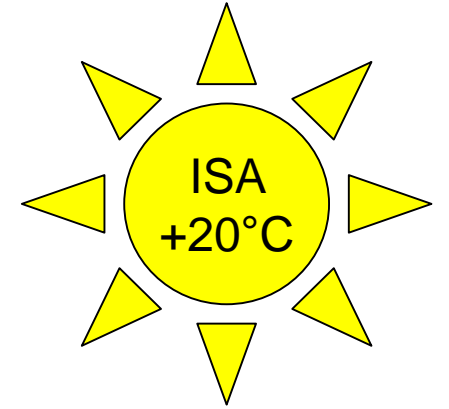
- Opportunity to develop advanced aerial firefighting vehicles
- Expand as well as enhance existing capabilities and optimize effectiveness
- Motivated by the developments in the field of Advanced Air Mobility (AAM)
  - Passenger and cargo transport in urban, suburban and rural areas
  - Short or Vertical Take-Off and Landing (S/VTOL) capabilities
  - Novel air vehicle architectures and technologies
  - Entry into service in 2025-2030



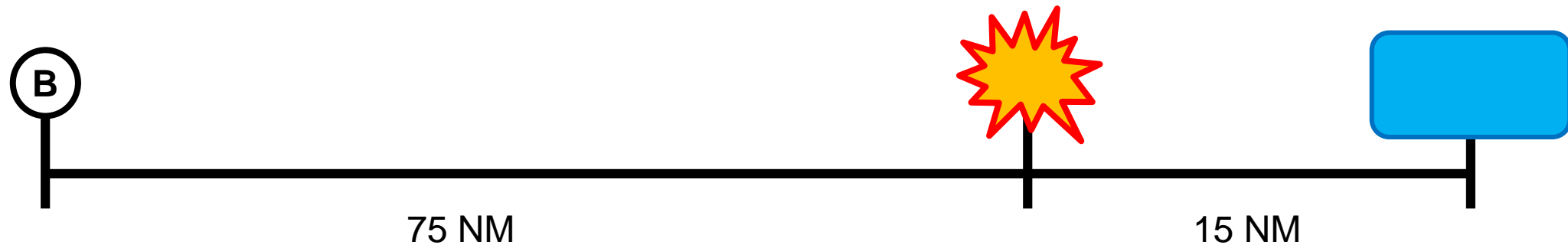
[Advanced Air Mobility Reality Index \(aamrealityindex.com\)](http://aamrealityindex.com)

# DLR Design Challenge 2022 – Task

## Design Mission



- Operating base on 1,000 ft (MSL)
- Fire location and water source are located on 2,000 ft (MSL)
- Battery charging or refueling requires return to operating base
- Water tank refill at the operating basis is optional and can be part of the concept of operations
- Service ceiling of 8,000 ft
- In addition to the given scenario teams need to consider a self-chosen inland and coastal scenario



# DLR Design Challenge 2022 – Task

## Air Vehicle

- Maximum Take-Off Mass: 5.670 kg
- V/STOL-Capabilities for utilization of small surface water sources (e.g. lake, river, etc.)
- Remote or single-pilot operations ability necessary
- Communality, modularity and retrofit to a passenger-/cargo variant have to be considered as well as application outside the wildfire season
- Entry into service in 2030



[https://upload.wikimedia.org/wikipedia/commons/0/01/Sikorsky\\_S-70A-27\\_Picking\\_Up\\_Water.jpg](https://upload.wikimedia.org/wikipedia/commons/0/01/Sikorsky_S-70A-27_Picking_Up_Water.jpg)





# DLR Design Challenge 2022 – Task

## Air Vehicle Fleet and Concept of Operations

Design of a set of air vehicles, capable of delivering 11,000 liters water in a single firefighting attack to a fire location. The number of aircraft and the payload of each vehicle is part of the design space.

- Objective: Maximize the amount of water delivered to the fire location within a 24-h timespan
- Design space: number of flights, speed, energy, fleet size
- Optional: Use of fire retardant



[https://upload.wikimedia.org/wikipedia/commons/7/73/1-DPCN\\_at\\_work\\_03\\_%284203528315%29.jpg](https://upload.wikimedia.org/wikipedia/commons/7/73/1-DPCN_at_work_03_%284203528315%29.jpg)

N. Cigal et al. (2022). Sensitivity Analysis for Aerial Wildfire Fighting Tactics with Heterogeneous Fleet via System of Systems Simulation Framework, Deutscher Luft- und Raumfahrtkongress 2022, Dresden.



# DLR Design Challenge 2022 – Task

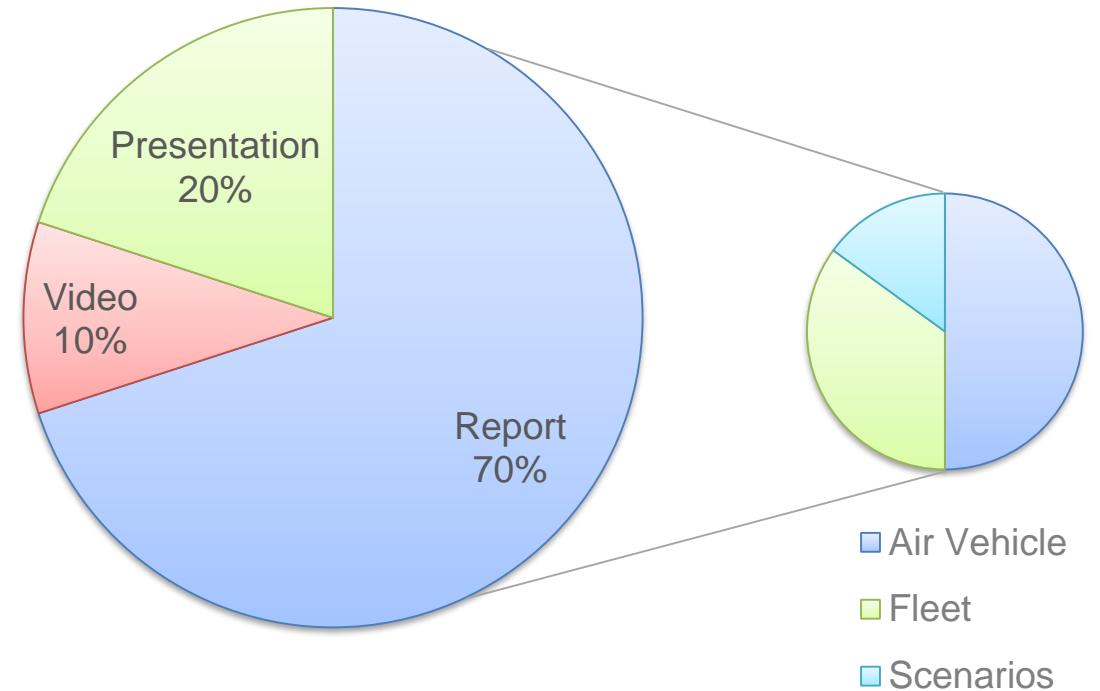
## Jury Evaluation and Incentives

### Jury

- Chair: Dr. Markus Fischer
- Members: Experts from DLR's aeronautics research

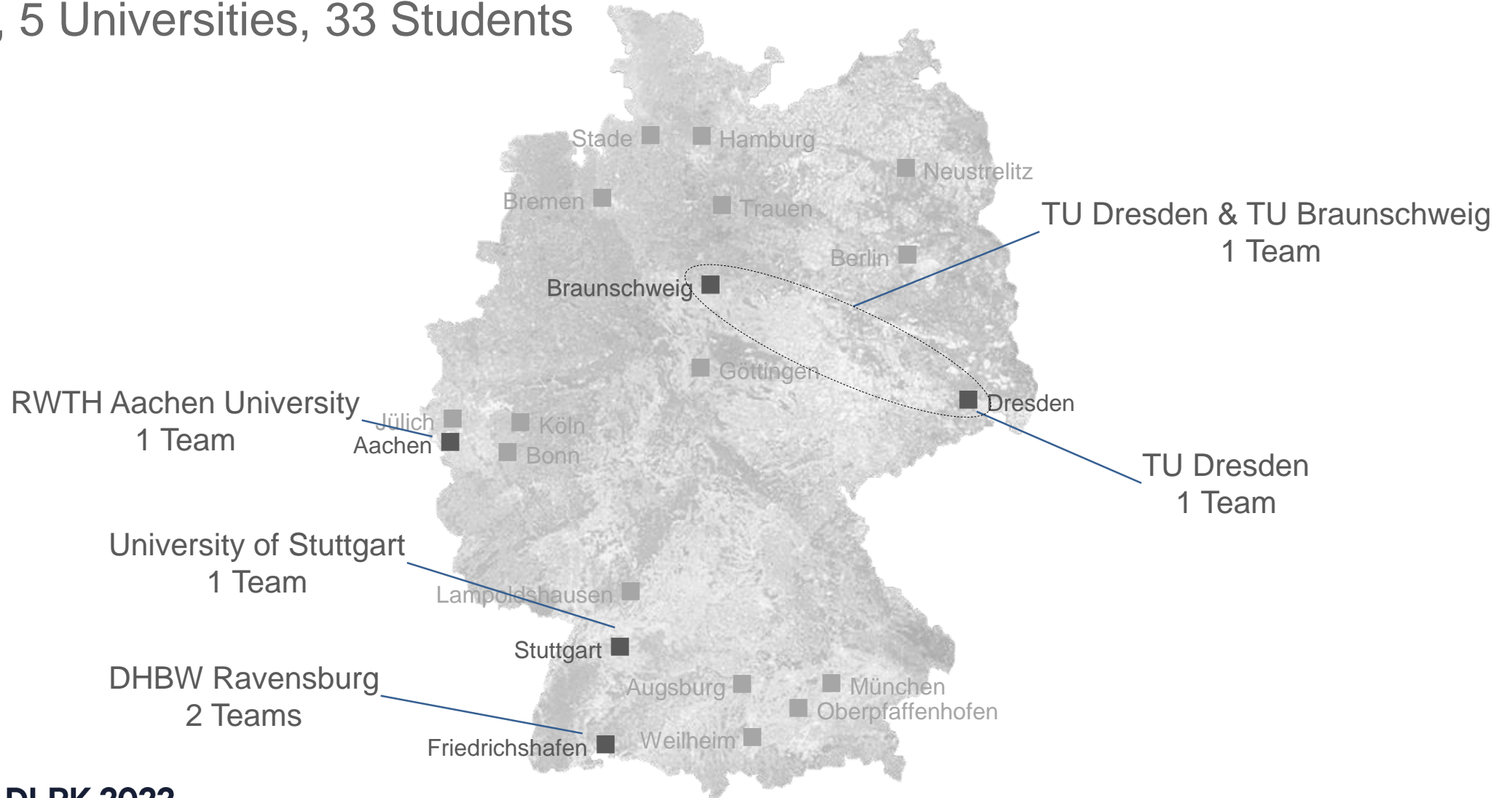
### Incentives

- All:
  - Invitation to kick-off and final event
  - Feedback on design concept
  - Certificate and design rendering print
- Top 3:
  - Invitation to DLRK 2022 incl. presentation
- Winning team:
  - Invitation to ICAS 2022 incl. Presentation
  - Invitation to DLR visit and workshop



# DLR Design Challenge 2022 – Field of Participants

## 6 Teams, 5 Universities, 33 Students





# DLR Design Challenge 2022 – Design Concepts



DHBW Ravensburg:  
Dipper & AEGIS



DHBW Ravensburg:  
FireF(l)ighter



3

RWTH Aachen:  
FireWasp



2

TU Dresden:  
PEL-E-FAN-T



TU Dresden & TU Braunschweig:  
GLAROS



1

University of Stuttgart:  
INFERNO



# Thank You and Enjoy the Design Presentations!

Tobias Dietl & Patrick Ratei

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German Aerospace Center (DLR)  
Institute of System Architectures in Aeronautics  
Hamburg



<http://s.dlr.de/DLR-Design-Challenge>



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