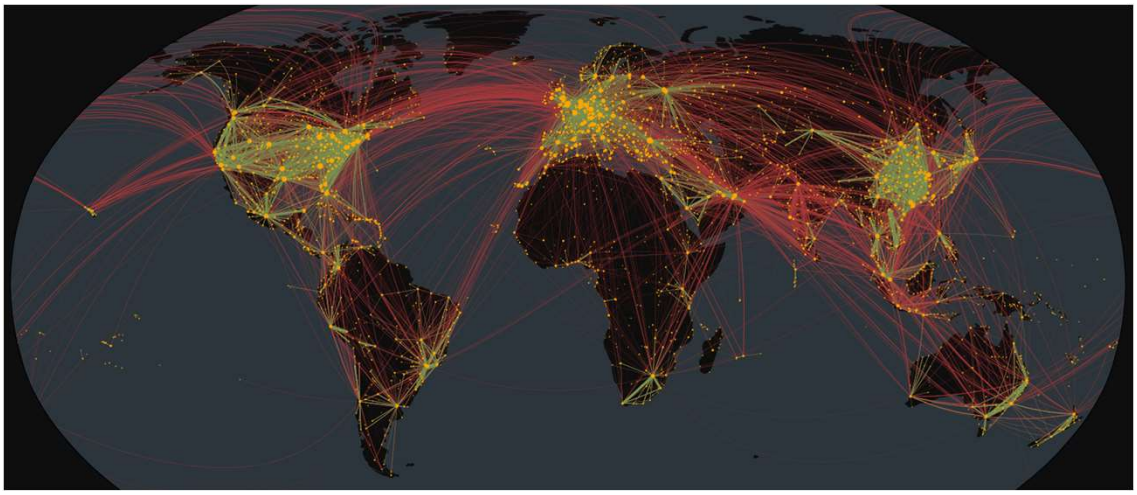
GeoDPA'24
23.-25. April 2024 in Oldenburg
International Conference on Geoinformation Data, Processing and Applications

GeoData in Air Transportation – Modeling Global Adoption of Hydrogen Aircraft

Martin Jung, Wolfgang Grimme, Katrin Oesingmann, Fabian Schwarz
German Aerospace Center (DLR) Institute of Air Transport
Contact: m.jung@dlr.de



The figure shows the potential global use of hydrogen-powered aircraft on routes up to 3700 km in 2050

Source: DLR simulations

Data sources

The global use of hydrogen-powered aircraft has been calculated and simulated in three steps using aviation-specific and geo-economic data:

1. Module: Air Traffic Forecast
- Air traffic forecast until 2050 for passenger numbers and aircraft movements on an airport-to-airport basis
- Based on regression analysis incorporating geo- and socio-economic factors such as GDP, population growth and distance

2. Module: Aircraft Retirement Cycles
- The module estimates the retirement of individual in-service aircraft in each five-year forecast period
- Based on logistic regression from the International Civil Aviation Organization (ICAO) aircraft model

3. Module: New (hydrogen) Aircraft entering in Service.
- An algorithm assigns the most suitable available aircraft to each route based on distance, passenger demand and remaining fleet
- Hydrogen aircraft technologies are based on DLR's EXACT project, which includes aircraft powered by fuel cells and direct hydrogen combustion

Data visualization

1. Step: Data compilation and preparation with PYTHON
- Data preparation using Pandas and GeoPandas in a Jupiter Notebook to map the forecast with geo data
- Creating map / image using Cartopy and Matplotlib

2. Step: Visualization of graphs with the Omniglobe®
- The visualisation on an Omniglobe works by combining different technologies to display geographical data on a spherical projection surface
- Upload/transfer graphs from Python to the Omniglobe® Software and create Animation from the year 2035 to 2050, with intervals of 5 years

Content and assumptions

- Simulation of the global use of hydrogen-powered aircraft for the years 2035, 2040, 2045 and 2050
- Leads to global CO_2 emissions savings of up to 23% by 2050
- Moderate air traffic growth of around 2.5% per year
- Different types of hydrogen-powered aircraft:
  - Regional aircraft: Fuel cell technology (turboprop), 40/70/100 seats, range up to 1850 km
  - Short and medium range aircraft: Direct hydrogen combustion (turbofan), 160/200/250 seats, range up to 3700 km

The Omniglobe® illustrates the gradual increase of hydrogen-powered aircraft from 2035 to 2050