ICAO Symposium on Non-CO_2 Aviation Emissions

16 — 18 September 2024

Montréal, Canada

Raimund Zopp

Director Innovation

FlightKeys

Speaker

Session 3: Mitigating Non-CO_2 Aviation Emissions – What is possible

Part II - Innovative Operations

ICAO

OPERATIONAL CONTRAIL MANAGEMENT

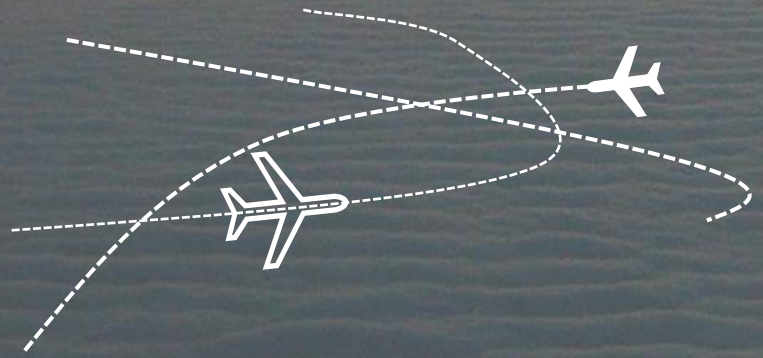
Fast Track to Sustainable Aviation

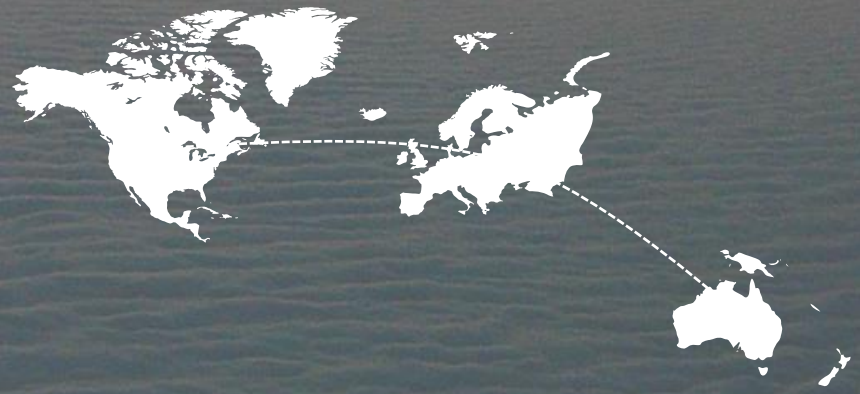
Raimund Zopp – Director Innovation

FL/GHTKEYS
SKYKEYS SPACEKEYS

FL/GHTKEYS
SKYKEYS SPACEKEYS

Who is FL/GHTKEYS





FL/GHTKEYS 5D

SPACEKEYS RAIM PRO

Loretta

3 steps to contrail avoidance NOW

FL/GHTKEYS
SKYKEYS SPACEKEYS

01

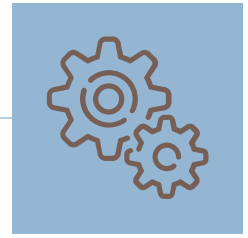
Intelligent flight operations

Through the use of contrail forecast and verification methods, applied both pre-tactically and tactically.

02

Sustainable Aviation Fuel (SAF)

SAF blends could reduce the size and concentration of ice particles. In 2019, only 0.1% of all aviation fuel was SAF, a number that is only forecast to reach only 2% by 2030.

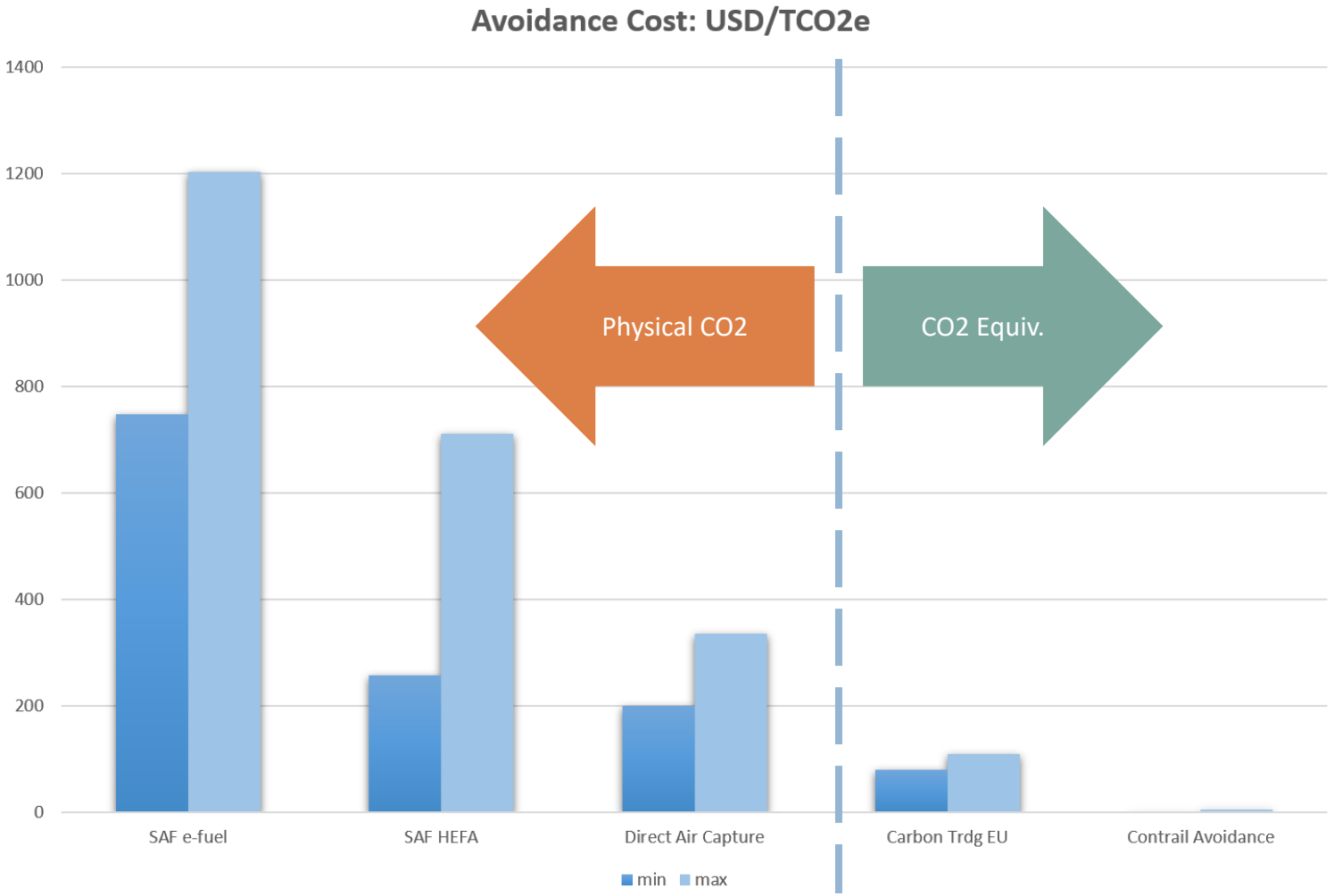


03

New engine technology

New engine technology could reduce contrail warming impacts by 70%. However, full adoption will take decades.

Cost effectiveness of contrail avoidance



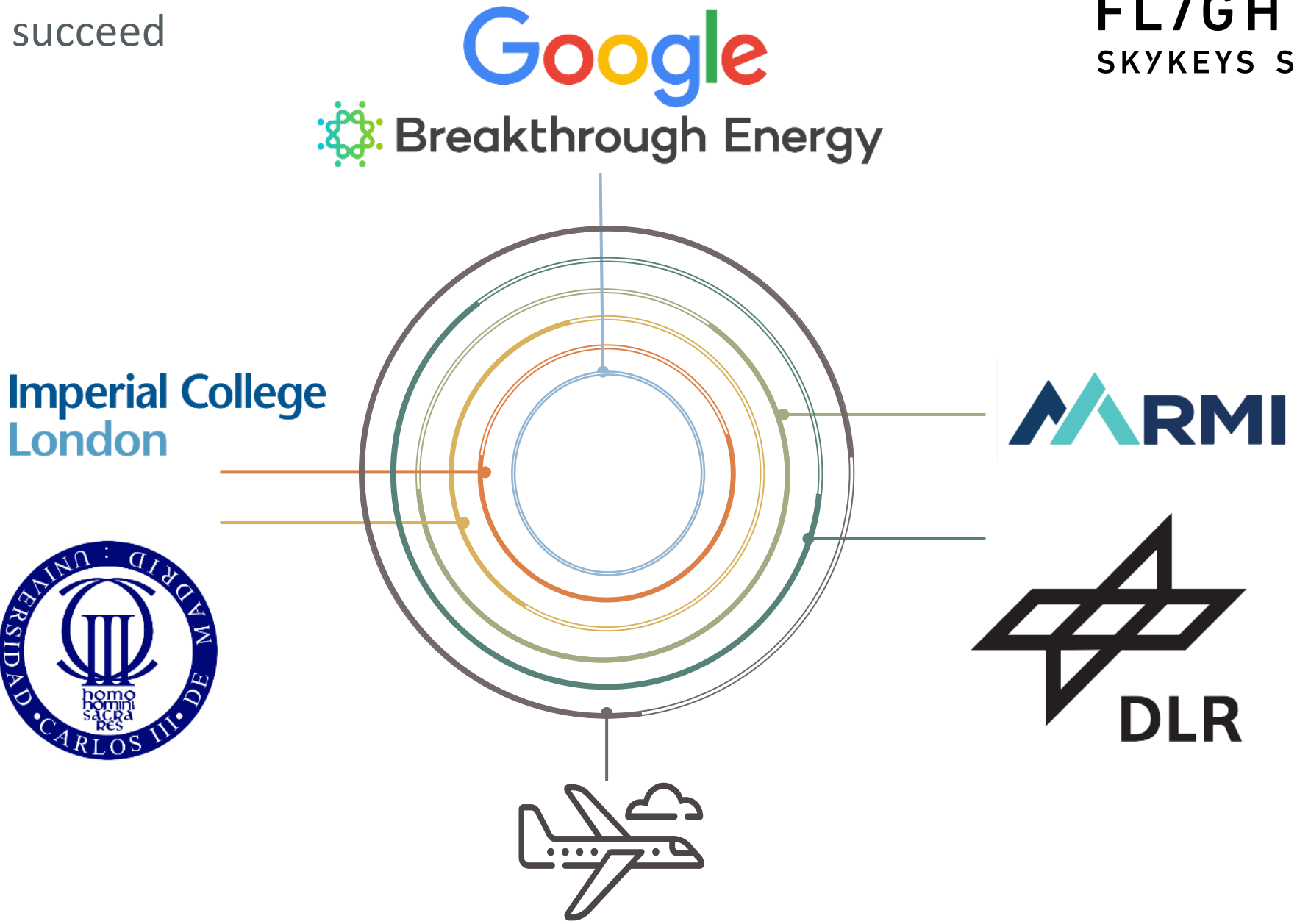
Contrail avoidance flight planning is by far the most cost effective and immediate measure to reduce aviation's climate impact.

Typical cost will be less than
1 USD per ton of CO_2e on average!

By applying minimal changes to a small number of flights,
aviation's global climate impact could be halved within the next 5 years.

Cooperating to succeed

FL/GHTKEYS
SKYKEYS SPACEKEYS



FLIGHTKEYS solution

FL/GHTKEYS
SKYKEYS SPACEKEYS

Introduction of contrail areas using GRIB data, as a separate weather layer.

Load contrail weather data

01

FL/GHTKEYS 5D

02

First round of contrail analysis

All flights can be analysed to see which ones will generate the most warming.

Using a cost-based approach. We set up a price per ton of CO_2e for the optimization.

Pre-tactical avoidance

03

Loretta

04

Tactical avoidance

Performed by pilots in flight using our EFB tool, Loretta.

In coordination with Beakthrough Energy and Google, to improve the prediction models.

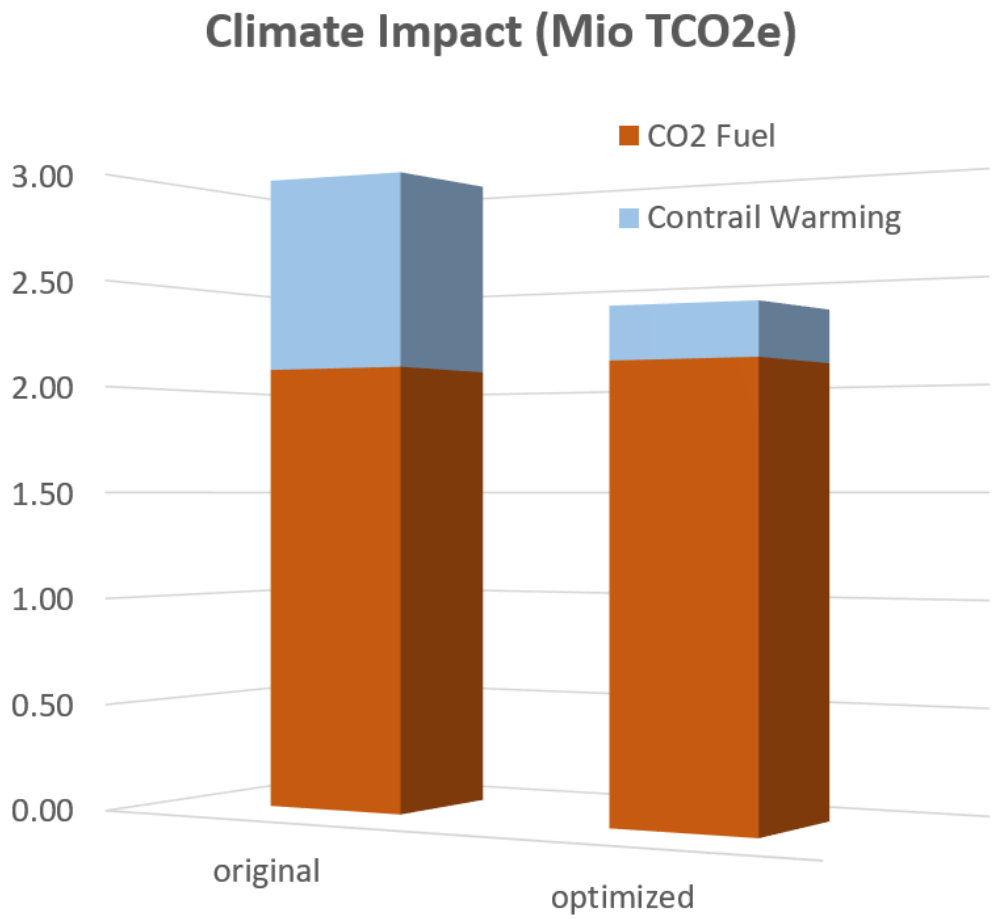
Validation and verification

05

Large-scale simulation results

FL/GHTKEYS
SKYKEYS SPACEKEYS

- Large-scale simulations were carried out over the last 2 years - we published very promising results just recently*
- 85000 domestic & international flights simulated for American Airlines
- 2 weeks in June 2023, 2 weeks in January 2024
- Predicted contrail energy forcing reduced by 73%, overall fuel increase 0.11%, cost increase 0.08%
- Total climate impact (including CO2) reduced by 22%
- Specific cost: 1.2 USD/TCO2e



CO2e based on 20y time horizon

*Feasibility of contrail avoidance in a commercial flight planning system: an operational analysis – IOPscience (Frias et al., 2024)

Large-scale simulation results

FLIGHTKEYS
SKYKEYS SPACEKEYS

- Large-scale simulations were carried out over the last 2 years*

84,839 flights
simulated. Summer 2023 and winter 2024.

10,911 flights
Were successfully rerouted. 709 could not find a solution

Polygon based approach

American Airlines

*Feasibility of contrail avoidance in a commercial flight planning system: an operational analysis – IOPscience (Frias et al., 2024)

10,697 flights
simulated. Summer 2024

1,087 flights
Formed contrails. Re-routings selected based on cost settings. More flexible approach.

Cost based approach
Different cost prices were considered for re-routing, leading to different optimization scenarios.

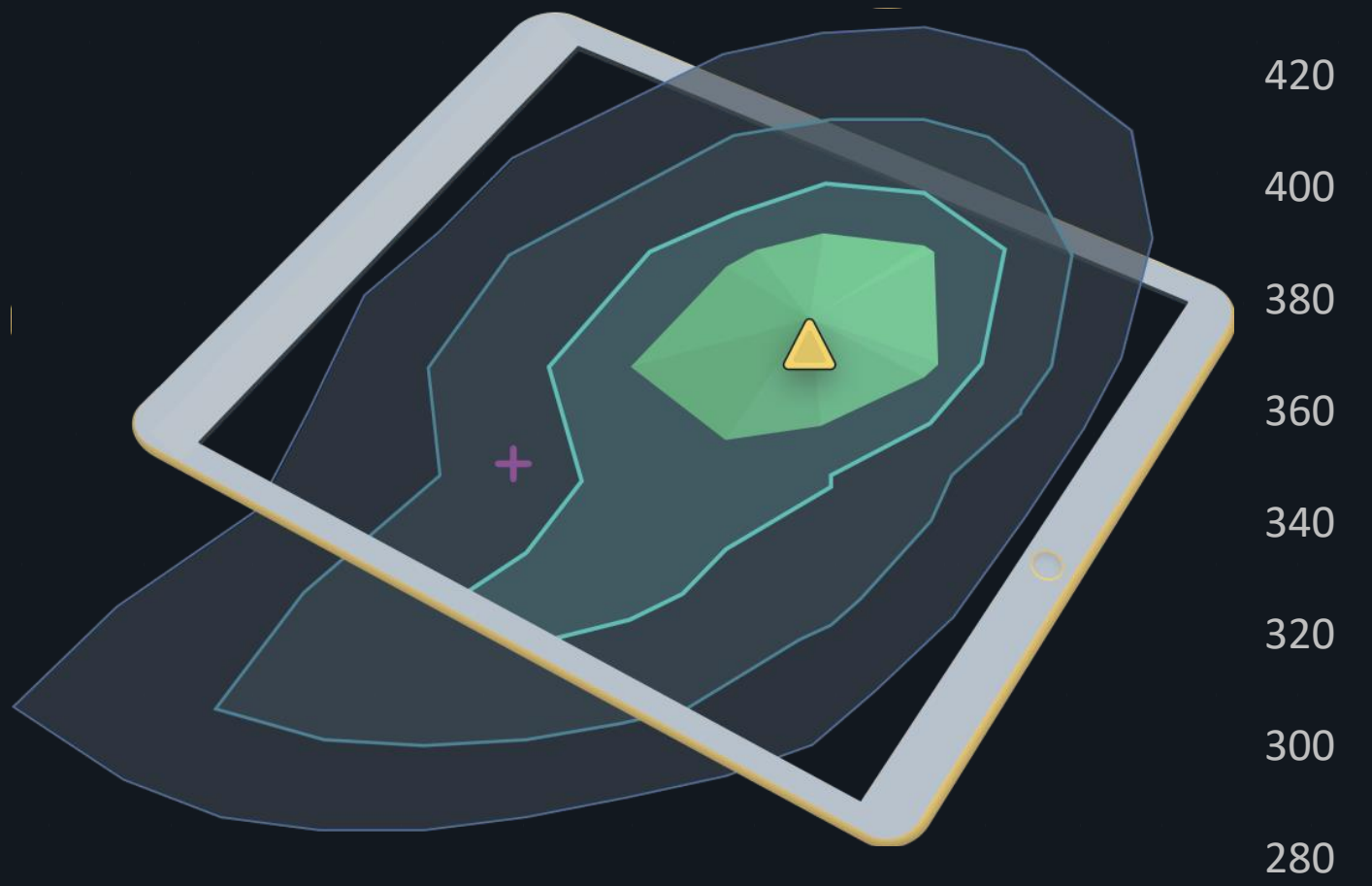
AIRFRANCE

Closing the loop with

Loretta

Our visual flightdeck assistant

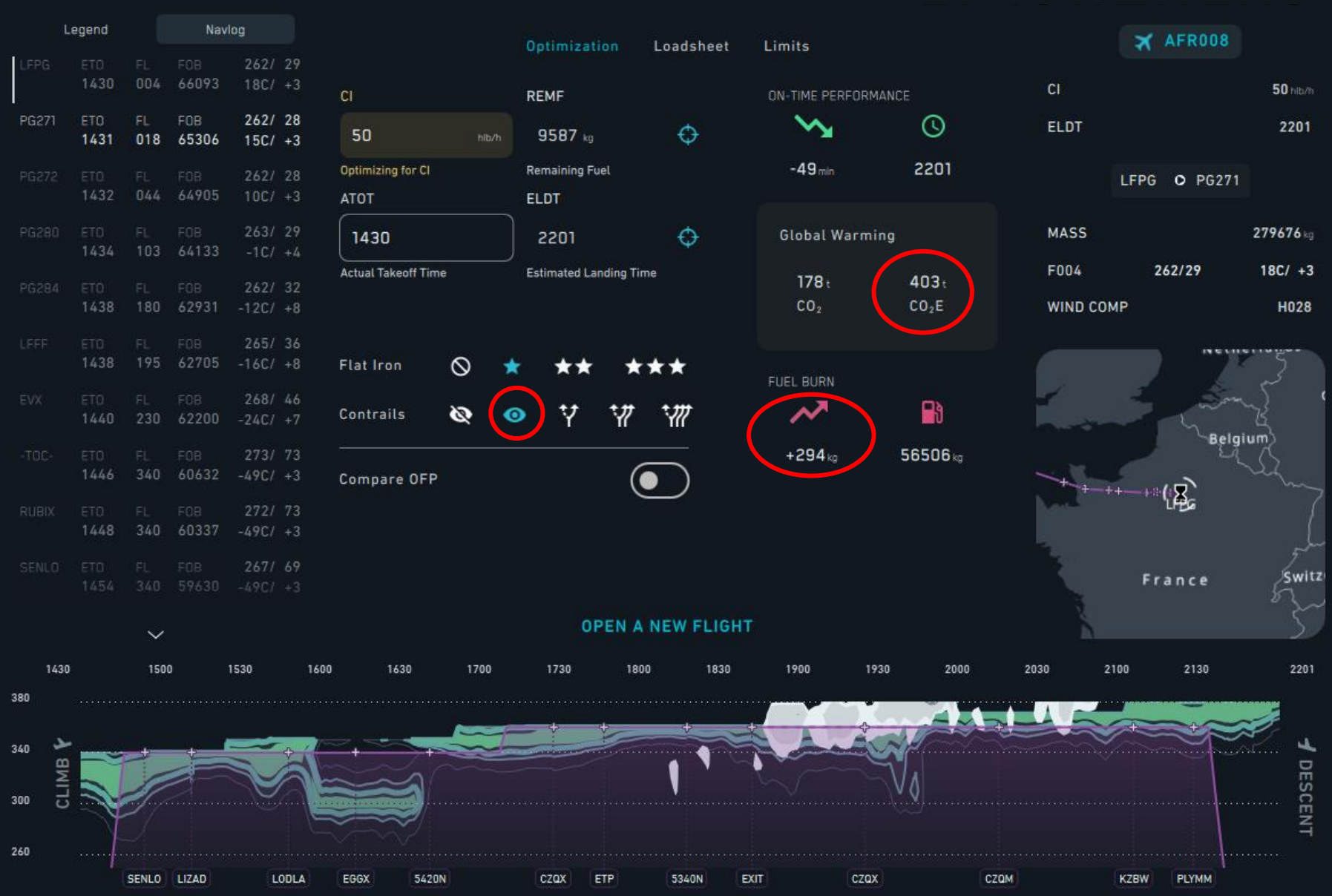
- Hi-Res gridded contrail forecast data
- Lateral and vertical trajectory visualisation
- Available cost-based contrail avoidance
- Instant updates
- Works online and offline
- Results of time, fuel, cost and climate (CO2e)



FL/GHTKEYS
SKYKEYS SPACEKEYS

Contrail visualisation in

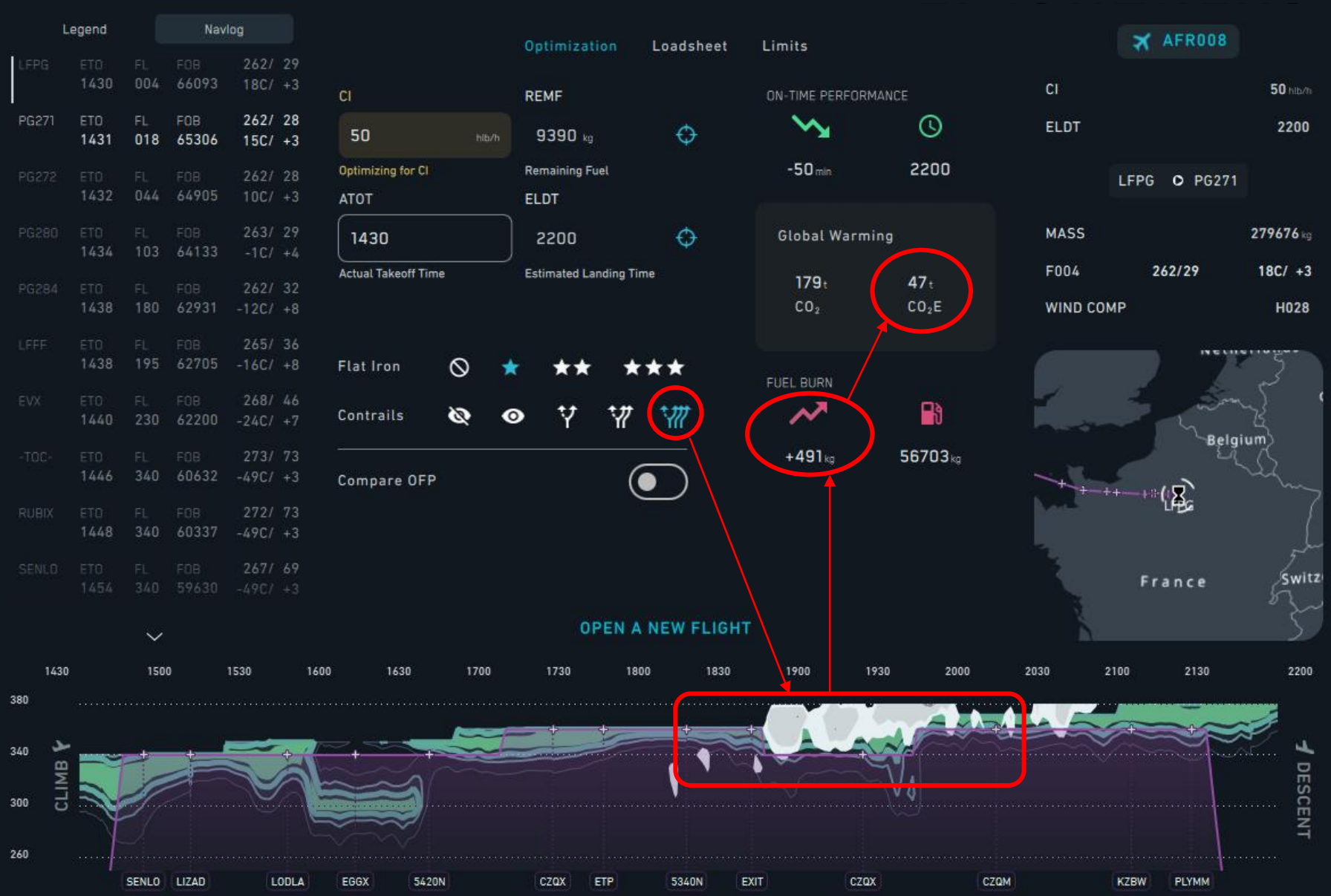
Loretta



Contrail avoidance in Loretta

356 tons CO2e saved
at the cost of only 197kg fuel!

That’s a CO2 saving ratio
of over 1/500!

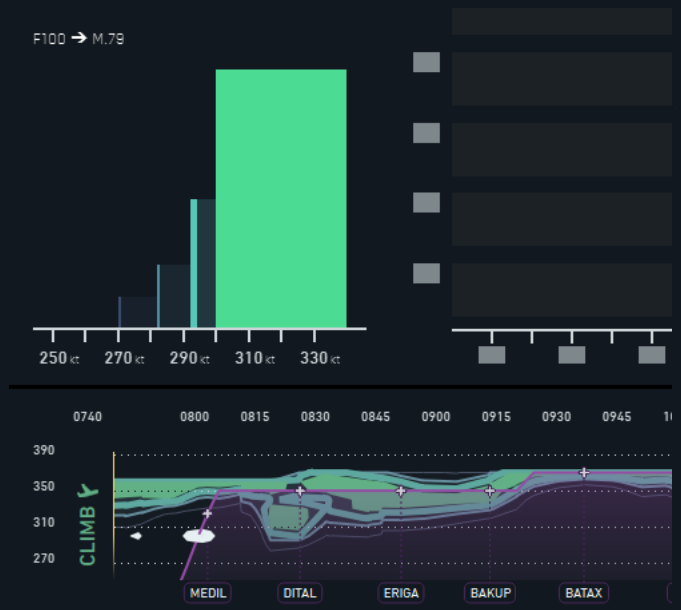


Effect of changing contrail cost

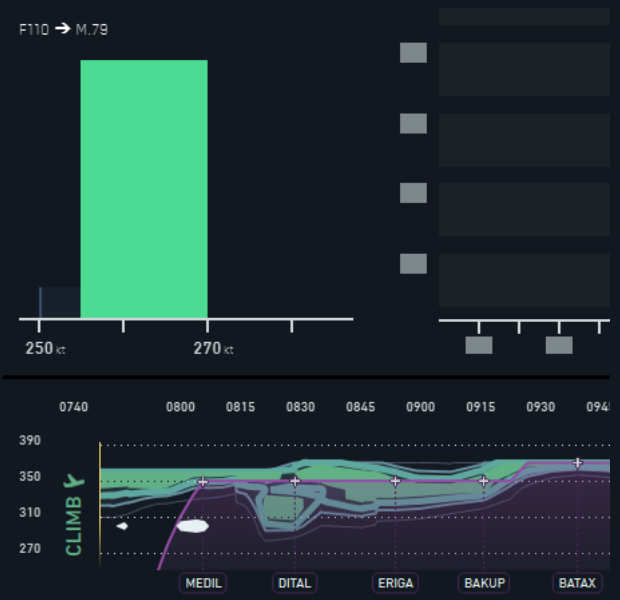
FL/GHTKEYS
SKYKEYS SPACEKEYS

Contrail avoidance in Loretta

Automatic climb profile adaptation



Cost-optimized climb speed of 320kts
resulting in shallow climb profile,
passing through contrail zone



Contrail-adjusted climb speed of 260kts
steeper climb profile,
40kgs more fuel, 1min longer flight time
avoiding contrail zone

Contrails:
No time to waste
No reason to wait

FL/GHTKEYS
SKYKEYS SPACEKEYS