Evaluating of the Benefits of Allowing Flight Level and Mach Number Adjustment for Efficiency for Flight Operations in Oceanic Airspace

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Satellite-based surveillance and communication technologies have been adopted for flight operations in oceanic airspace.
Space-based ADS-B surveillance

- ADS-B receivers on 66+ Low Earth Orbit Satellites to offer a global ADS-B flight surveillance coverage.

- Spaced-based ADS-B is expected to provide a better surveillance capability.

![Diagram of Space-based ADS-B surveillance](image)
Improvements in the Air Traffic Management

• Reducing separation standards.

• Allowing flight level and Mach number adjustment for fuel and time efficiency without reducing separation standards.
  • Fuel consumption rate is lower at higher flight levels
  • Higher Mach numbers will increase fuel consumption rate but will also reduce travel time.
Global Oceanic Model

A microscopic discrete time flight simulation model developed to evaluate the system-wide benefits of improvements in the air traffic management in the oceanic airspace.
Global Oceanic Model (Cont.)
Modeling flight level and Mach number adjustment

Feasible flight levels:
- Flight level A (Current Flight level)
- Flight level B
- Flight level C
- Flight level D

Feasible Mach numbers:
- Mach A: (Current Mach)
- Mach B

Alternatives:
- Flight level A, Mach A
- Flight level A, Mach B
- Flight level B, Mach A
- Flight level B, Mach B
- Flight level C, Mach A
- Flight level C, Mach B
- Flight level D, Mach A
- Flight level D, Mach B

Alternatives without increase in fuel consumption and travel time

The Alternative with the lowest fuel consumption
Modeling flight level and Mach number adjustment (Cont.)

- **Detect conflicts**
- **Resolve conflicts**
- **Evaluate Flight level or/and Mach number change for fuel efficiency**
- **Save fuel and time to change?**
  - **Yes**
  - **No**
    - **No action**

**Request**

- **Meteorological conditions (e.g., wind)**
- **Air traffic management rules (e.g., separation minima)**

**Decision**

- **Controllers’ instructions**
- **Flight plan**
- **Air traffic management rules (e.g., hemispherical rules)**
- **Meteorological conditions (e.g., wind)**
- **Aircraft performance, aircraft type, aircraft type weight, equipage, and takeoff weight**

**De-conflict measures**

- **Fuel consumption**
- **Travel time**
Benefits Evaluation

Screenshot from flightradar24 https://www.flightradar24.com/
Benefits Evaluation (Cont.)

Baseline: No flight level/Mach number adjustment for fuel efficiency

Scenario 1: FL only: Only flight level adjustment for fuel efficiency

Scenario 2: M only: Only Mach number adjustment for fuel efficiency

Scenario 3 FL + M: Flight level and Mach number adjustment for fuel efficiency

We compared the fuel consumption and travel time of the three scenarios with those in the baseline in 2020 and 2025.
Results

- The benefit estimates are for the oceanic airspace managed by ZNY.
Thank you very much!

Questions and Comments?