Operational Science

NASEM Committee

Assessing Radiation Exposure, Health Outcomes, and Mitigation Strategies for Flight Crew Members

PCAIRE
crew radiation monitoring

Introduction

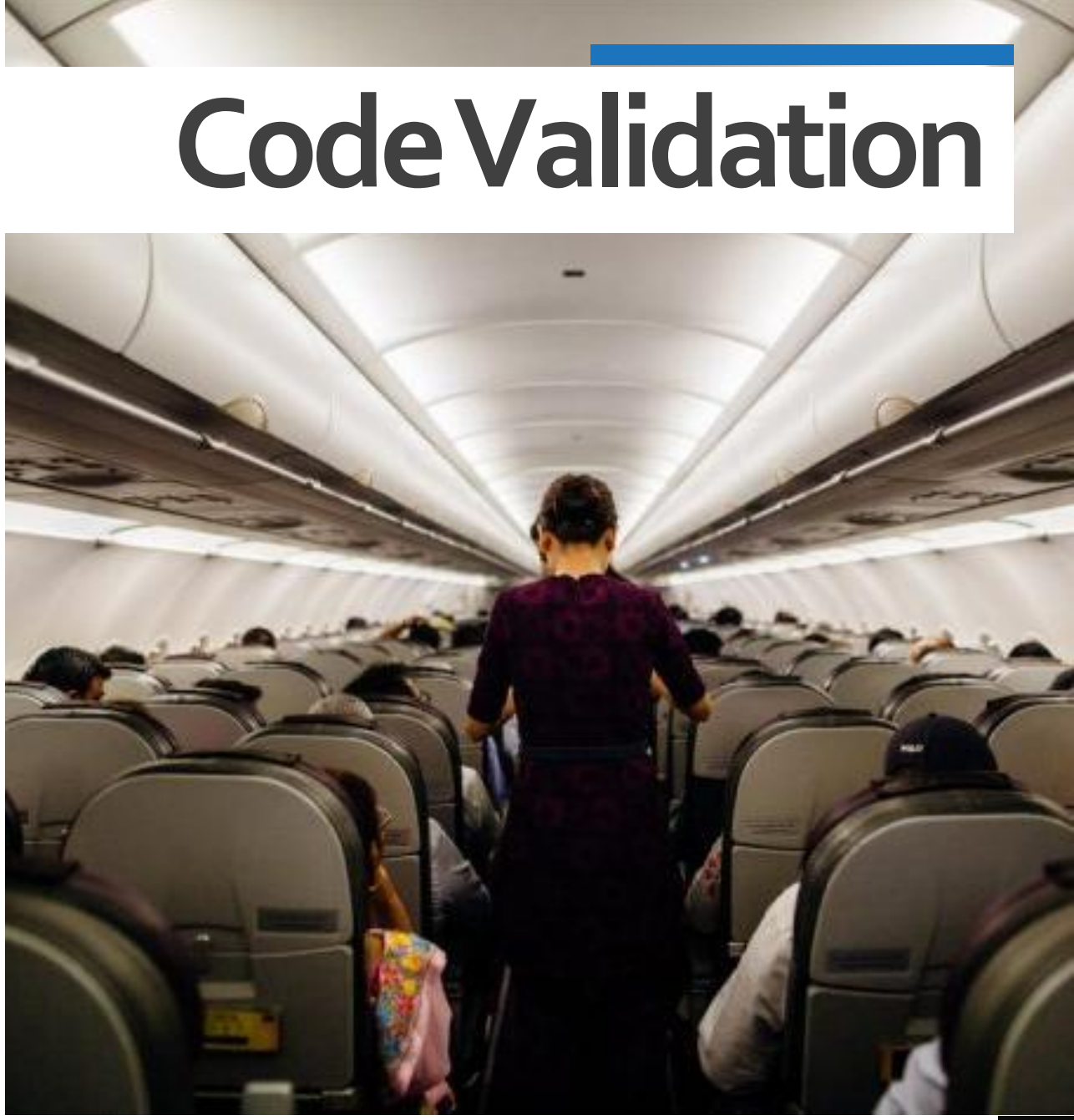
- Mike McCall MSc, MEng, CEO PCAire
  - Developer of PCAire code
- PCAire has estimated aircrew doses for over 20 years
  - >500 million aircrew flights estimated
  - 100+ airline clients
  - Certified in Europe
  - ISO data quality processes
  - Developed fully as a commercial tool
    - Not a research or test platform

PCAire Development

- Developed based on data collected using primarily TEPC on Air Canada and Canadian Airforce transport planes
- Algorithms developed based on
  - Solar modulation, Cut off rigidity
  - Positional dose rates
  - Empirically based, largest flight database in the world (TEPC)
  - H*10 and Luin and Fluka E dose included
  - ICRP 104 factors included

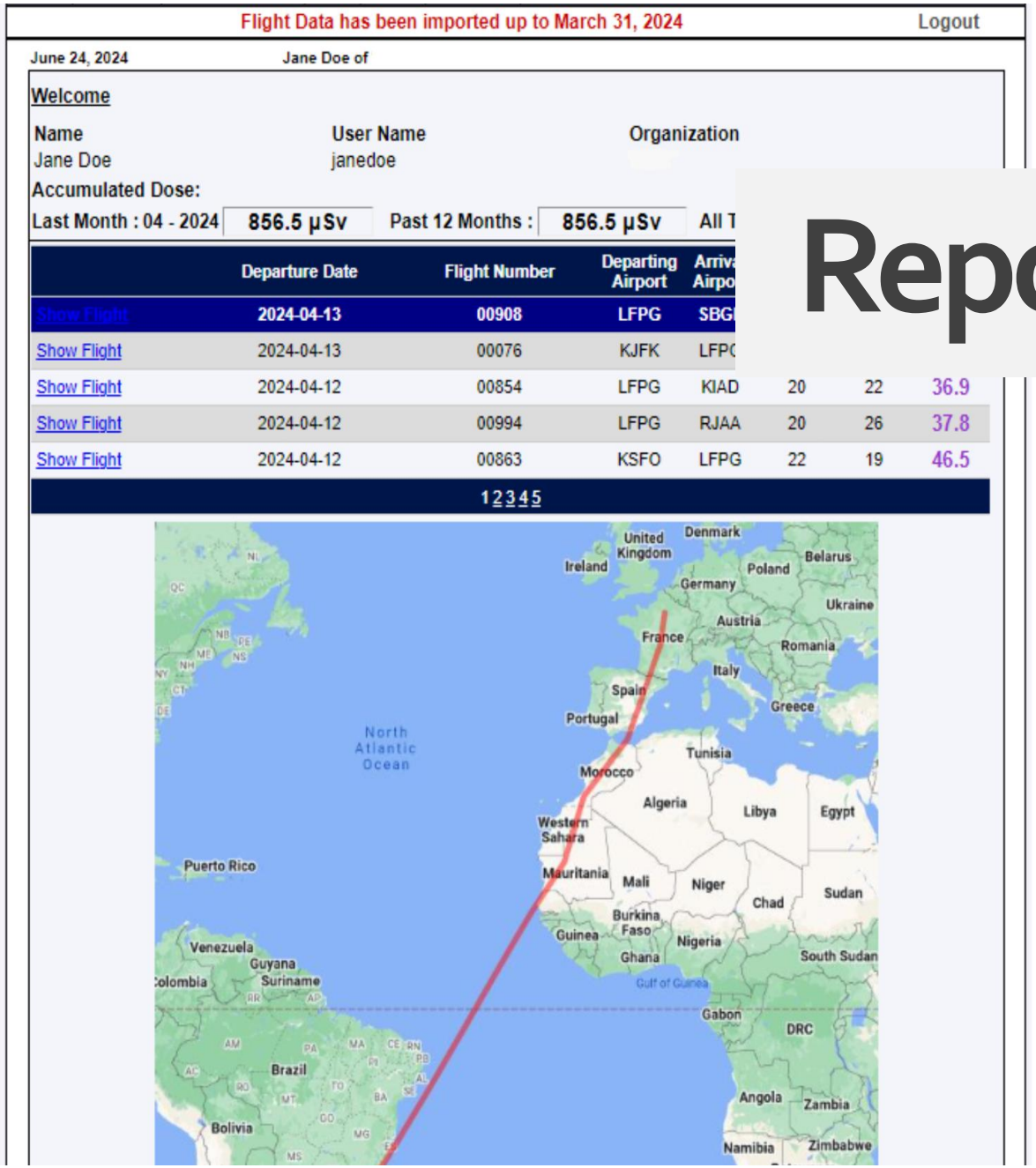
Code Validation

- Models verified every 6 months using original measured validations and from European partner TEPC measurements
  - Variance YoY is minimal
  - Have been included in 3 EURADOS comparison/validations studies showing continual accuracy
- PCAire Uncertainty
  - Uncertainty study undertaken after development, 15-25%
- Largest errors in many code's estimation are based on manual (human) input errors, minimal validation and coarse flight route models
- Uncertainty in result production is based on;
  - Airline data handling and export processes
  - Flight route precision (actual route flown vs planned, City pairs etc.)
  - Data handling, human errors production of .csv files etc.



Data Management and Integration

- Data import/Export
  - PCAire uses an automated import/export solution
    - Data sent or retrieved from airlines/clients via API, FTP and other transfer protocols
    - Data validated and verified based on format and technical requirements, before and during runs (e.g., flight path verifications)
    - Includes full flight path, alt, lat/lon (Waypoints), asc/desc time
    - Cumulative minute by minute dose rate based on 3D position
    - Crew ID for flight dose association
- Data security
  - Secure server data center, security software and patches, penetration test from outside firm annually
  - No crew protected data is collected by PCAire
- Crew tracking
  - Effective crew National Authority data storage is required for career long data management



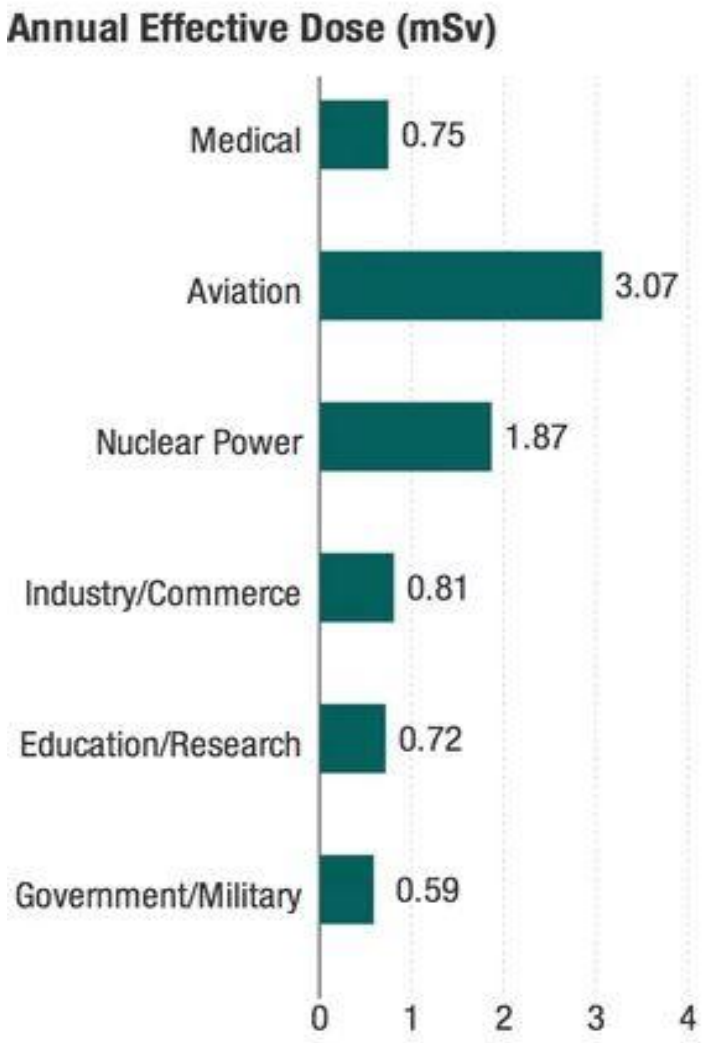
Reporting and Useability

- Reports
  - Client customized dose and history reports
  - Individual crew portal for personal history review
  - Reporting to National dose authorities (Europe)
- Reports provided 30 days after each month's calculations (heliocentric potential value requirement)
- Alerts and preplanning estimates are provided as requested by clients
- Secure SSO (Single Sign-on) portal for all individuals to view all historical individual data

Operational Considerations

- SPE event can be added to affected flights/crew with data supplied by FAA
- To note, even major SPEs over the last 50-100 years have a small contribution to a crew's annual dose (i.e., 100-200% for a flight)
  - Average annual exposure is ≈ 300 mrem, addition from a significant SPE of 10 mrem is within variance
  - Exception, possibly pregnant crew
  - A very significant event could possibly add 50-75 mrem – very, very rare
- Controls/interventions of pilot/crew schedules due to intervention levels exceedance is not supported by data
  - IL is 600 mrem, yearly limit is 2,000 mrem (averaged)
- PCAire retains 97% clients with losses due primarily to airline bankruptcy
- PCAire provides full support help desk
  - Used frequently by pregnant crew for planning

Occupational profiles



Data from the National Council on Radiation Protection and Measurements show the average annual effective dose for workers in various fields. Aviation doses are estimated based on flight routes and altitudes.

National Council on Radiation Protection and Measurements. Ionizing radiation exposure of the population of the United States. Bethesda, MD: NCRP; Report No. 160; 2009.

- PCAire can provide historical data for analysis
  - Data from 2003 – 2025
- Notes
  - Pilot are not specifically the highest exposure by group
  - Many Flight attendants in Europe and India etc., fly more block hours than pilots
- Highest doses are based on
  - Block hours, latitude and altitudes
  - Many newer jets fly frequently from FL 450-530
  - Commercial jets fly FL 350-380
  - Newer jets fly longer haul flights (at higher altitudes)
- Data is sent to PCAire primarily with crew ID only
  - Not simple to differentiate pilot and flight attendants
- Open to discussion on what data and analysis would be most useful for study

Thank You

Questions?

mccall@pcaire.com

www.pcaire.com

PCAIRE
crew radiation monitoring