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Space Weather and Cosmic Rays

Solar radiation impacts on aviation avionics and flight crews



The Team and its Tasks

- **University of Oulu:** Analysis of solar activity and cosmic ray driven enhancements in radiation levels at flight altitudes.
- **ONERA:** Studies of radiation impacts on electronics used in airplanes.
- **Finnish Meteorological Institute:**
 - Impact of strong geomagnetic storms on power transmission to airports.
 - Space weather storm scenario as training material for table top exercises

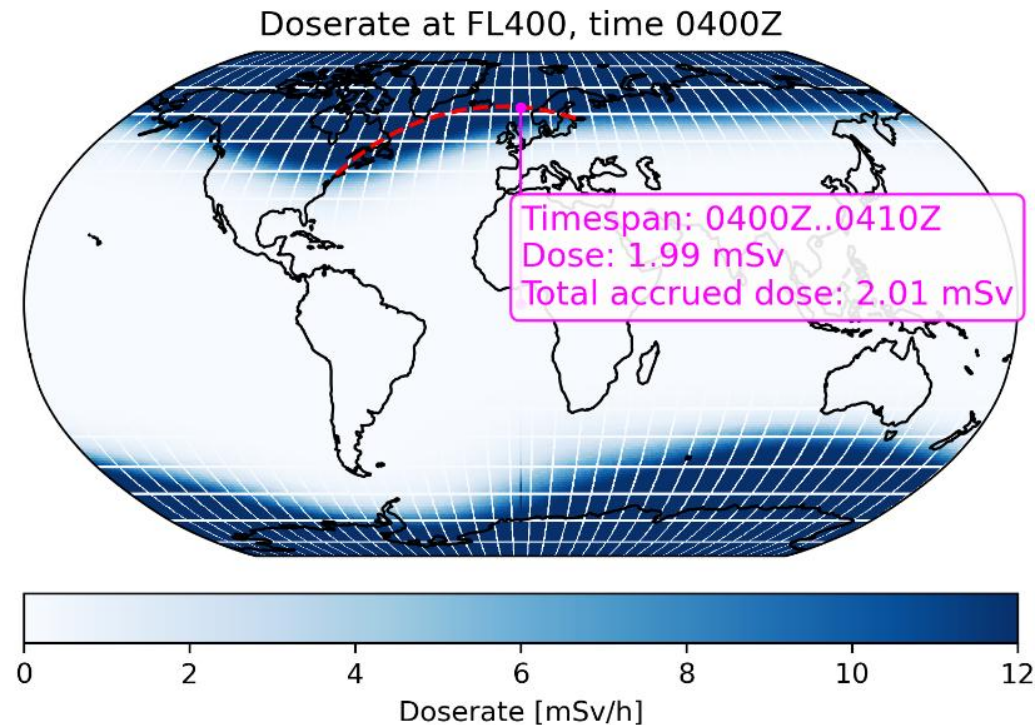


ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
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Main findings: Radiation at flight altitudes

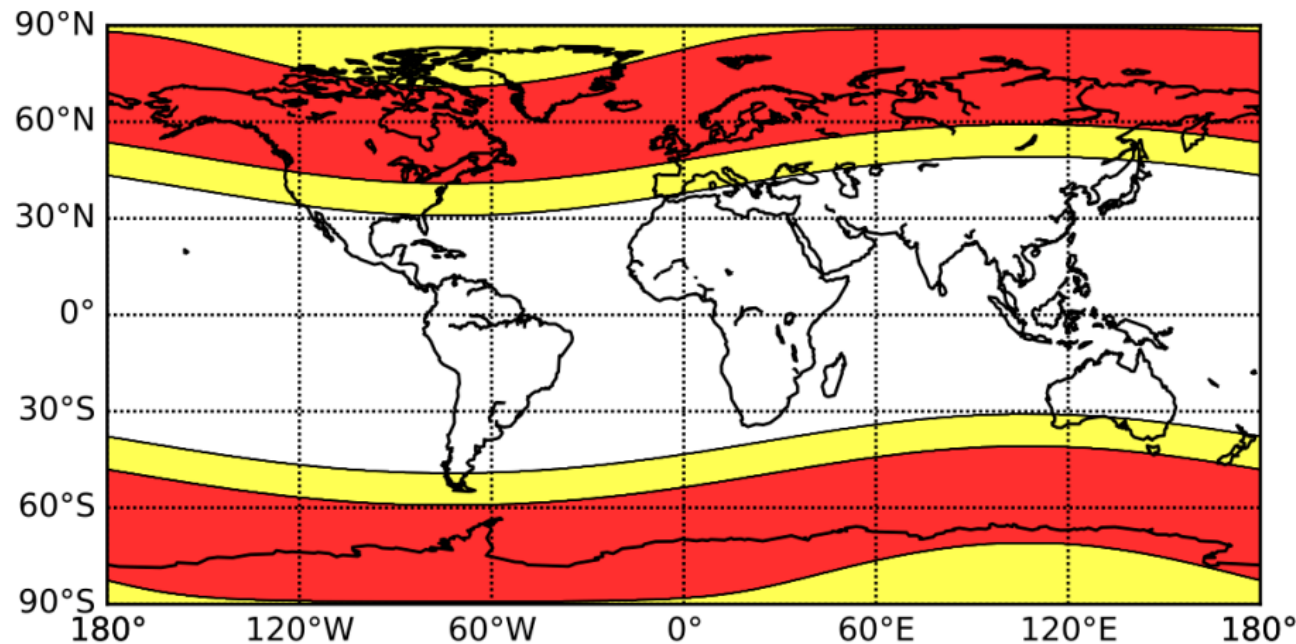
- A non-negligible risk of **aircrew and passengers** to be exposed during high-latitude long-haul flights **by enhanced radiation doses**.
- Standby warnings can be given with 1-week lead time & Operational warnings with 1-hour lead time



*Physics-based radiation
model output combined
with flight route
information*

Main findings: Power availability at airports

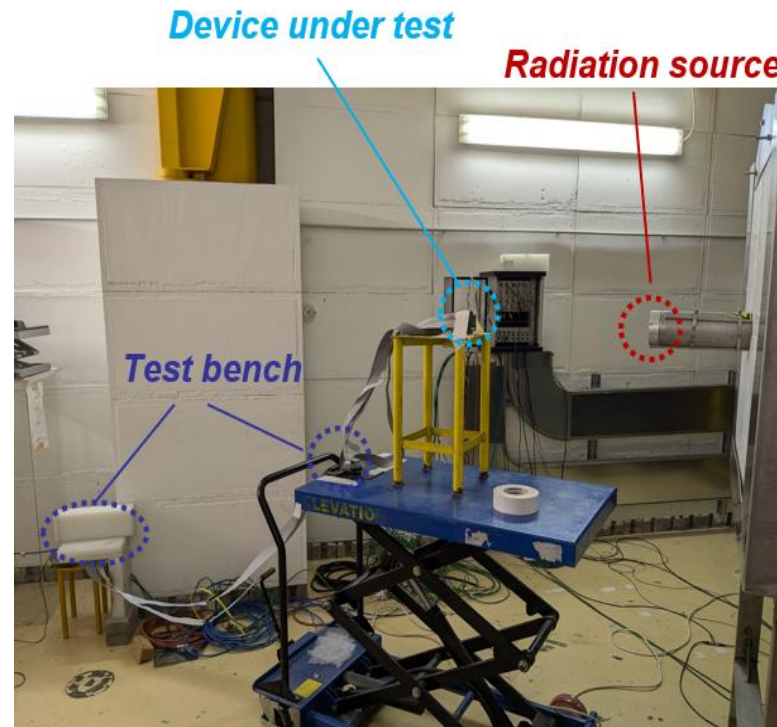
- There is a non-negligible risk of several **mid-latitude airports suffering from occasional simultaneous breaks of 5-60 minutes in the electric power transmission.**
- Standby warnings can be given with ≤ 1 -day lead time & Operational warnings with ≤ 1 -hour lead time



Latitude bands of exceptionally high geo-electric field posing a risk for power transmission.

Main findings: Usage of Commercial off-the-shelf solutions

- Our preliminary **tests on Static Random-Access memory cells' sustainability against enhanced radiation show promising results.**
- Additional research with more dynamics in the driving processes of soft error rates is recommended.



*Laboratory setup
by ONERA*

Some recommendations

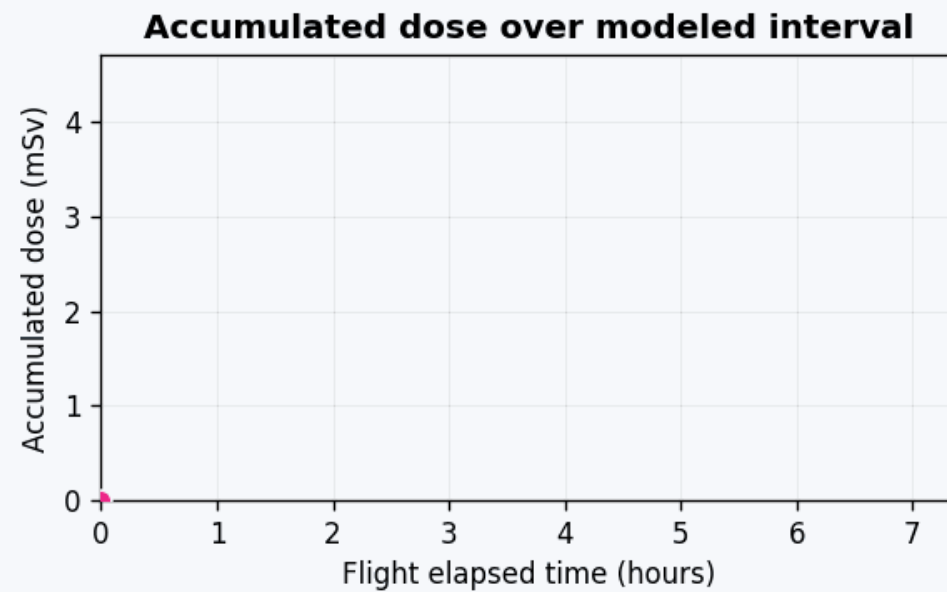
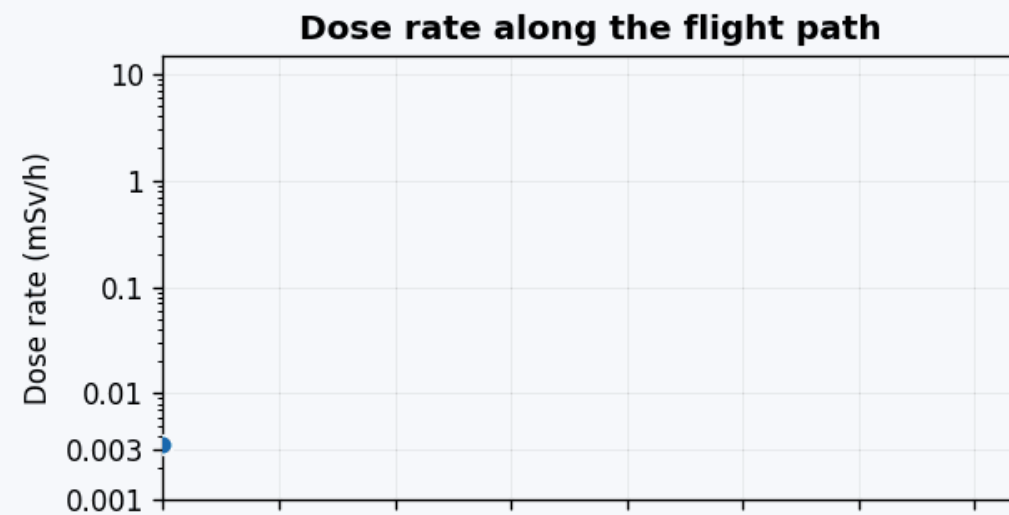
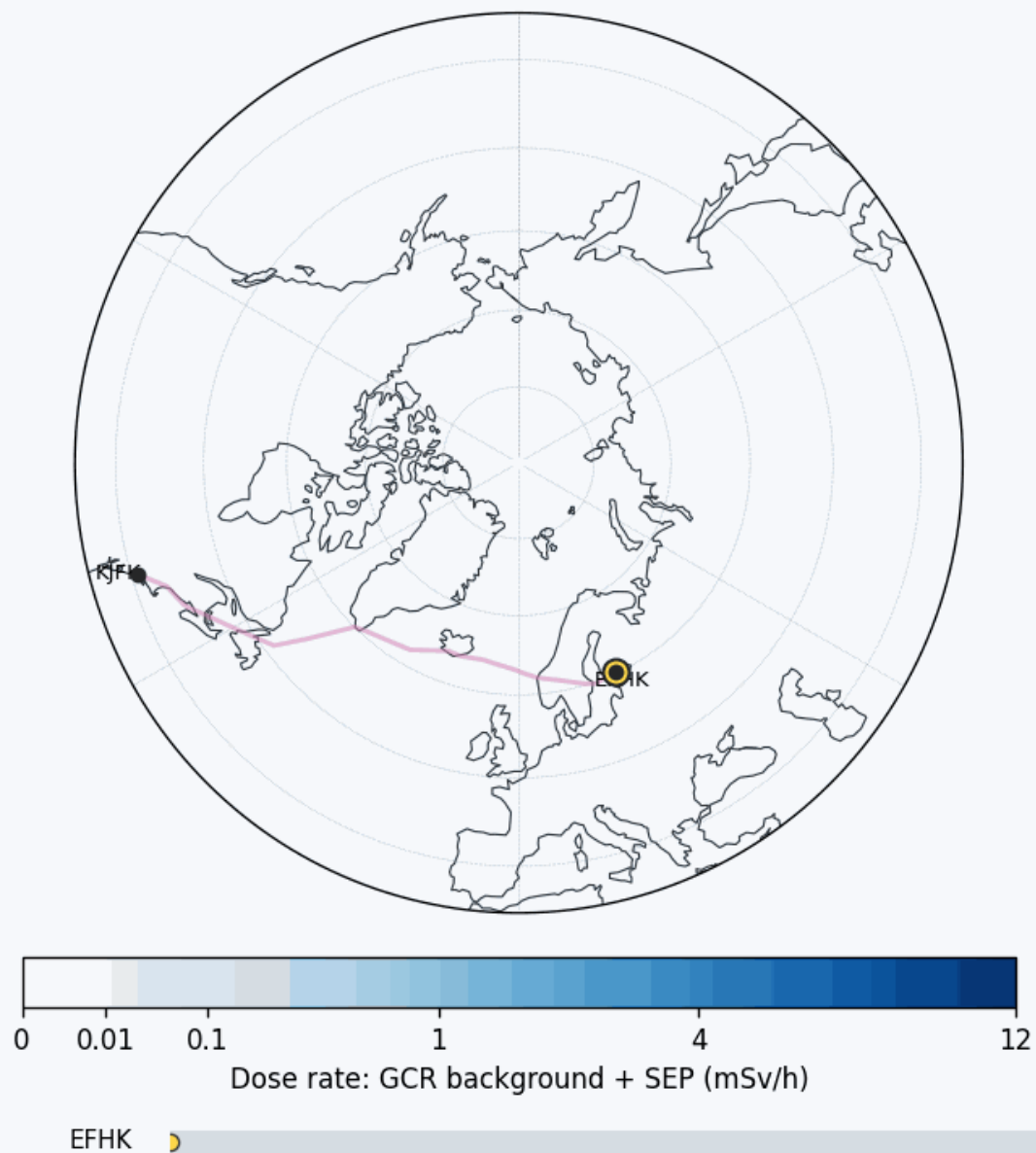
- Very extreme but rare space weather events are likely to cause overreactions both among the air traffic professionals and among the general public → More systematic public communication and education and training among professionals is recommended.
- Manufacturers of the technologies behind services like GNSS, SATCOM, VHF data links, and embedded applications in avionics would be a very welcome addition to the team composing the next generation ICAO space weather manuals.
- Special attention should be paid to the development of modeling tools and environment specifications to support the robustification of embedded avionics against radiation risks. Field Programmable Gate Arrays (FPGAs) are an important target for modelling efforts.

The worst case scenario



An exceptionally strong solar storm occurring during a flight at high-latitudes

Extreme SEP event · Helsinki-New York
01:37 UT · FL400 · flight elapsed 0.0 h





Consortium

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DEUTSCHES ZENTRUM FÜR LUFT - UND RAUMFAHRT EV (DLR)
OFFICE NATIONAL D'ETUDES ET DE RECHERCHES AEROSPATIALES (ONERA)
CENTRO ITALIANO RICERCA AEROSPAZIALI (CIRA)
ROTTERDAM AIRPORT BV (RABV)
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ECOLE NATIONALE SUPERIEURE DES OFFICIERS DE SAPEURS-POMPIERS (ENSOSP)

PIPISTREL VERTICAL SOLUTIONS DOO PODJETJE ZA NAPREDNE LETALSKE RESITVE (PVS)
FERRONATS AIR TRAFFIC SERVICES SA (FATS)
STICHTING BEHEER JAA TRAINING ORGANISATION (JAA)
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EUROPEAN UNION AVIATION SAFETY AGENCY (EASA)
FACHHOCHSCHULE NORDWESTSCHWEIZ (FHNW)
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*ALBATROS has received funding from the European Union's Horizon Europe research and innovation programme, under Grant Agreement No 101077071.
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