

IRSN

INSTITUT
DE RADIOPROTECTION
ET DE SÛRETÉ NUCLÉAIRE

Faire avancer la sûreté nucléaire



A citizen science project for cosmic radiation monitoring in airplane



MUSÉUM
NATIONAL D'HISTOIRE NATURELLE



Darley G, Berthelot N,
Bottollier JF, Briand G,
Fuller N, Klein L, Lejeune
V, Steinhauser A and
Trompier F

Context



Legal obligation to monitor occupational exposure for aircrew: both for GCR and **in case of SEP events**

Monitoring of exposure doses in most European countries is performed by calculations



Article 42, directive 96/29/EURATOM may 13th, 1996

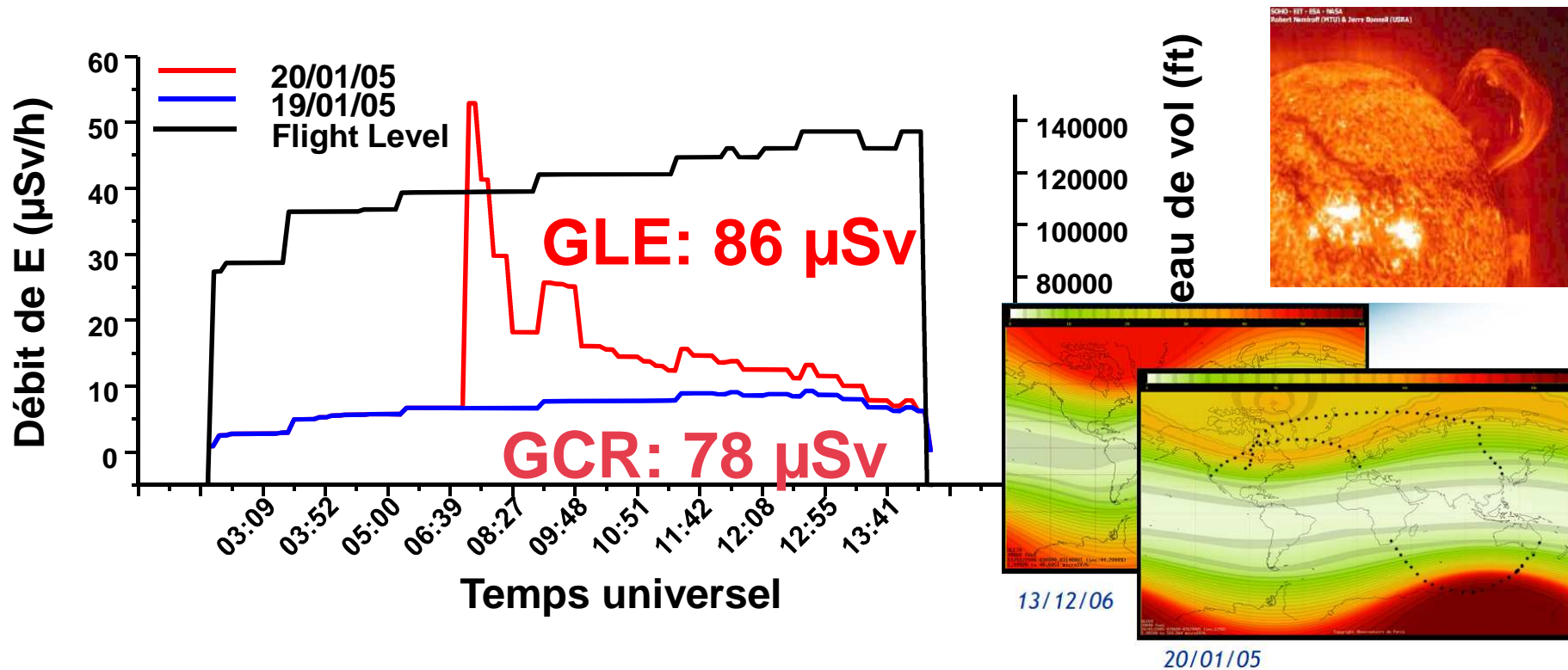
Arrangements for undertakings operating aircraft to take account of exposure to who are liable to be subject to exposure to **more than 1 mSv per year**. The undertakings measures, in particular:

- *to assess the exposure of the crew concerned,*
- *to take into account the assessed exposure when organizing working schedules with a view to reducing the doses of highly exposed aircrew,*
- *to inform the workers concerned of the health risks their work involves,*
- *to apply Article 10 to female air crew. » (Article 10: the dose to the foetus should not be higher than 1 mSv during pregnancy)*

Motivations of the project



Improvement of aircrew dosimetry (in case of GLE)



Large discrepancies between models for GLE, no references!

Very few data measurements available during GLE: not sufficient for validation

Monitoring with airlines

- GLE are rare and sporadic events: permanent monitoring is required
- One large monitoring experiments in cooperation with Air France since 2013
- About 35 airplanes supplied with electronic dosimeters on long-haul airplanes
- Limited flight routes (no polar route) with AF
- Depend on airlines motivation



EPDN2
gamma and neutron
dose, data stored every
for every dose
increment, scanning
rate 1 min



LIULIN
energy deposited
spectra in Si and
D(Si) rate

HaWK TEPC
“Gamma” dose is
calibrated vs low
LET component
from TEPC and
“Neutron” dose vs
high LET

Project genesis and aims

- Needs for more inflight measurements during a GLE to verify model
- Limited possibilities of monitoring with airlines
- Numerous citizen meas. But not reported and finally lost
- Others phenomena to be studied in the atmosphere (cf TGF...)
- Necessity to extend the actual network of in flight meas.: why not using data from citizen?



Mains problems with public meas

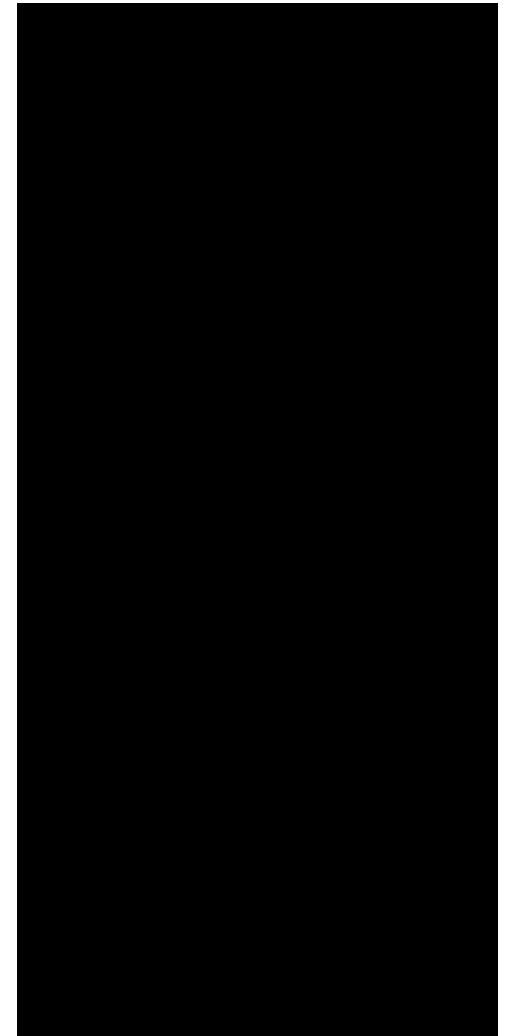
- Variety of devices types and model (GM, photodiode,..), not ideal for CR meas. but better than nothing
- Needs for characterization to CR (in flight)
- Data collection from different devices
- Sharing the data collected with scientiific communauty

Project's aims

- **To collect** and organize the measured data to make them available to the scientific community
- **To consolidate** and structure the data collected in an open data frame
- **To develop** educational visualization tools for the general public and more technical tools for experts
- **To develop** our analysis tools to enhance the value of the data collected

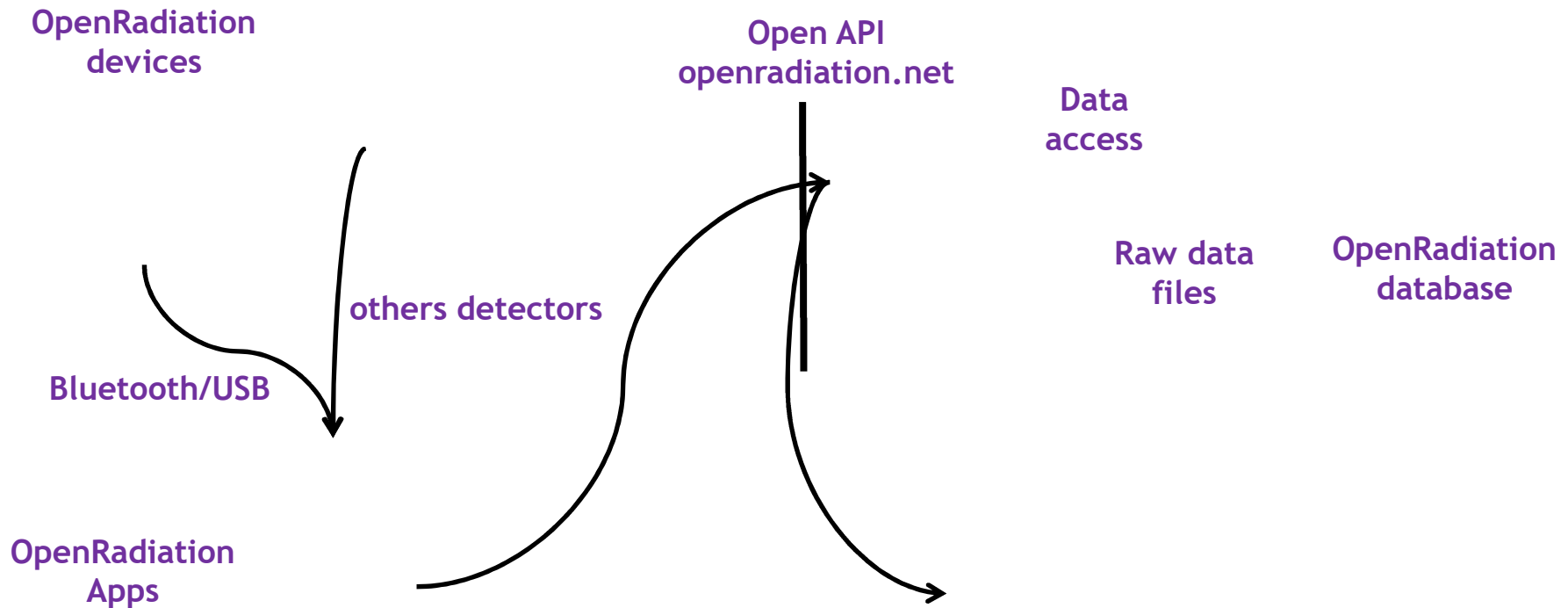
Citizen motivation

- Participate in citizen science project on the theme "Chase away solar flares"
- Take ownership of the measurement of radioactivity, dose concepts and in particular in-flight dose levels



Functionalities of the project

➤ Use of structure of an already existing project (openradiation)



www.openradiation.org

A free mobile app to collect data

➤ OpenRadiation mobile application

- Connected devices (BT or USB) to collect and share data (Safecast, Rium GM, Atomtage, pocketgeiger, openradiation kit, Polimaster)

- Possibility to connect more types in future and detectors from others projects

- Calibration factors in the apps for each detector used with openradiation app

- Two meas. modes: ground and in flight
 - Specific calibration to CR
 - Possibility to provide information as Flight number, seat, meteo (thunderstroms or not)..

Modification of the openradiation app

➤ In Flight measurements mode is now supplied

Flight number

A red outlined rectangular box, likely representing a UI element or a placeholder for data.A red outlined rectangular box, likely representing a UI element or a placeholder for data.



A dedicated webpage for the project

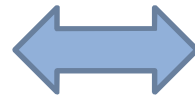
➤ **Comunication with public and scientific communauty**

www.cosmic-on-air.com

Calibration of devices

➤ Device calibration versus:

- in flight measurement with TEPC (tissue equivalent proportional counter)
- dose calculation



TEPC reference dosimeter

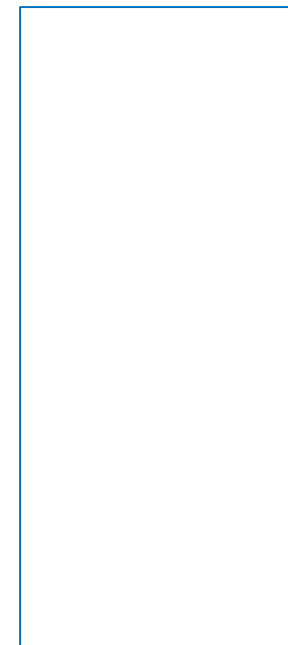
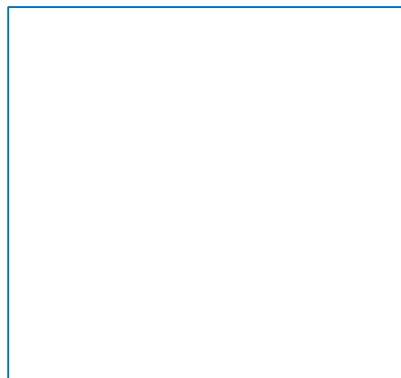
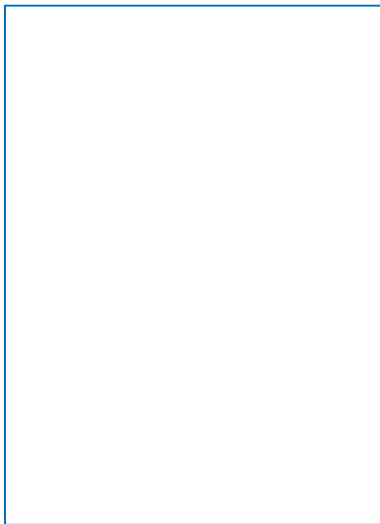
Meas with Atomtag system



Measurements comparison

How to participate

- Get a device (various devices compatibles)
- Create an account on the openradiation website
- Take a plane and make your CO₂ emission useful



How to join the project

- Propose a new measurements device
- To insure project promotion in your own country

Conclusions

- New citizen science project (opendata)
- Project complementary to airline monitoring for GLE model improvement
- Education of Public on Radiation Risk and GCR