IRSN
INSTITUT
DE RADIOPROTECTION
ET DE SÛRETÉ NUCLÉAIRE

Low-background environmental activities at IRSN

Surveillance
Radioecology
Dosimetry
and other things

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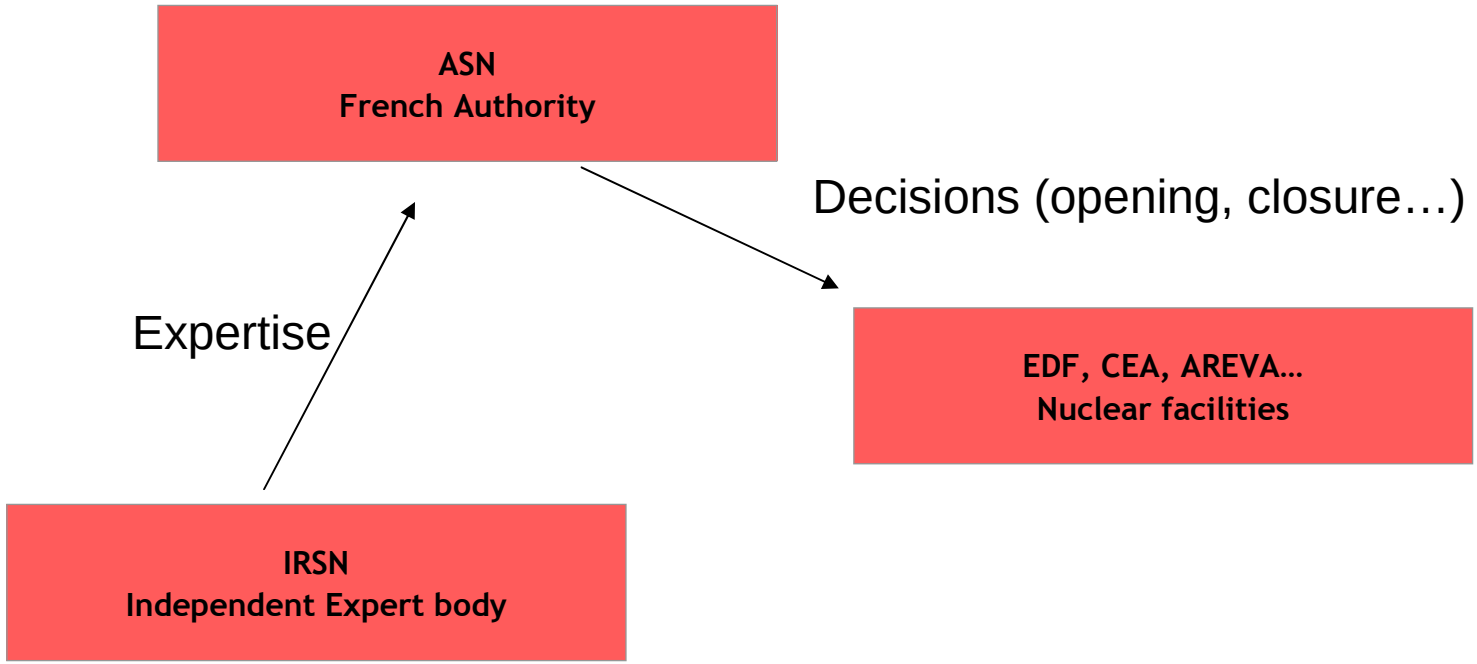
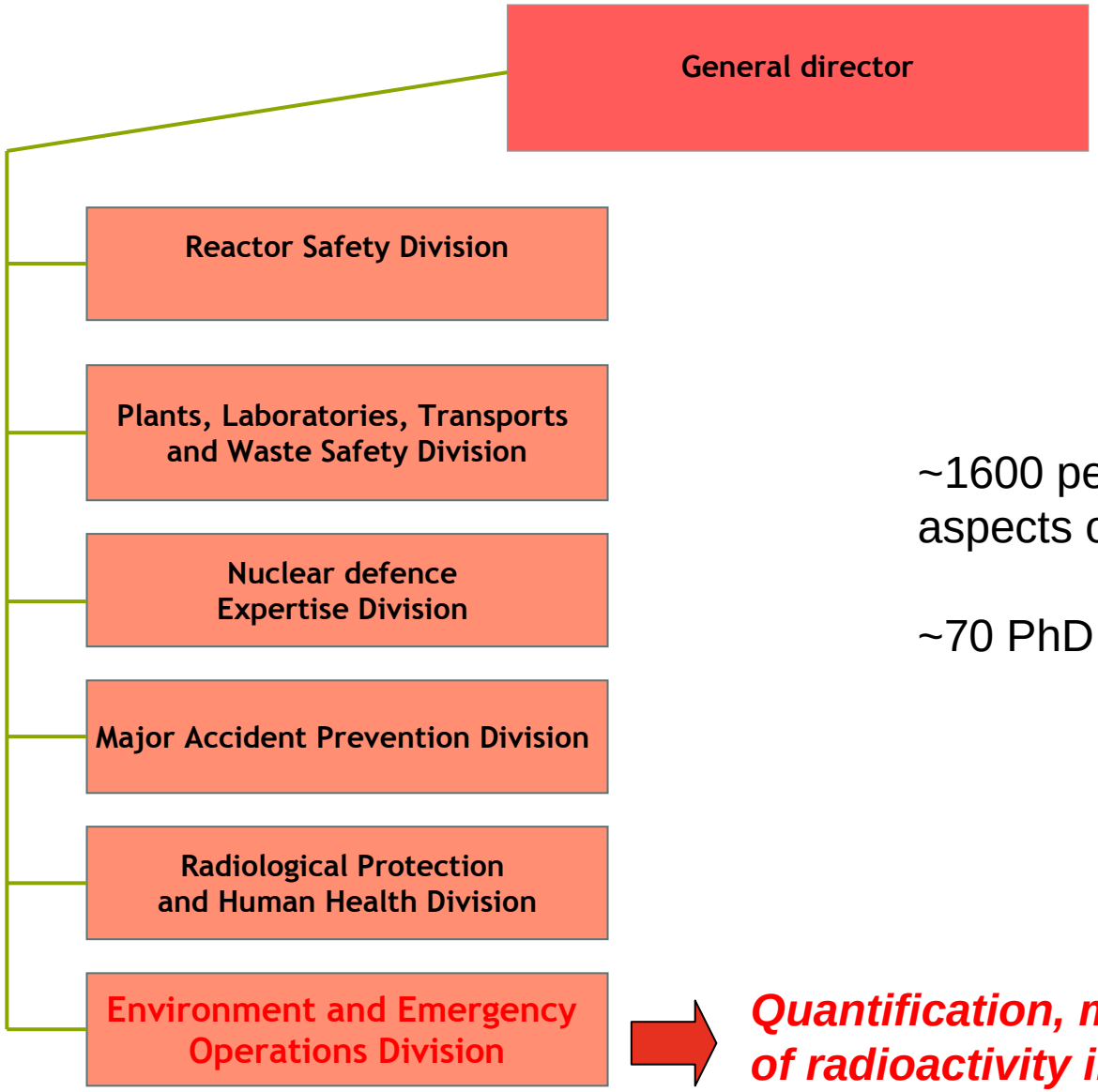
IRSN/DEI/STEME/LMRE

1. The IRSN
2. The need for low background measurements
3. Actual use of LSM measurements
   Some examples

French Nuclear Establishment



Institute for Radiological Protection and Nuclear Safety



~1600 persons involved in all the aspects of nuclear safety

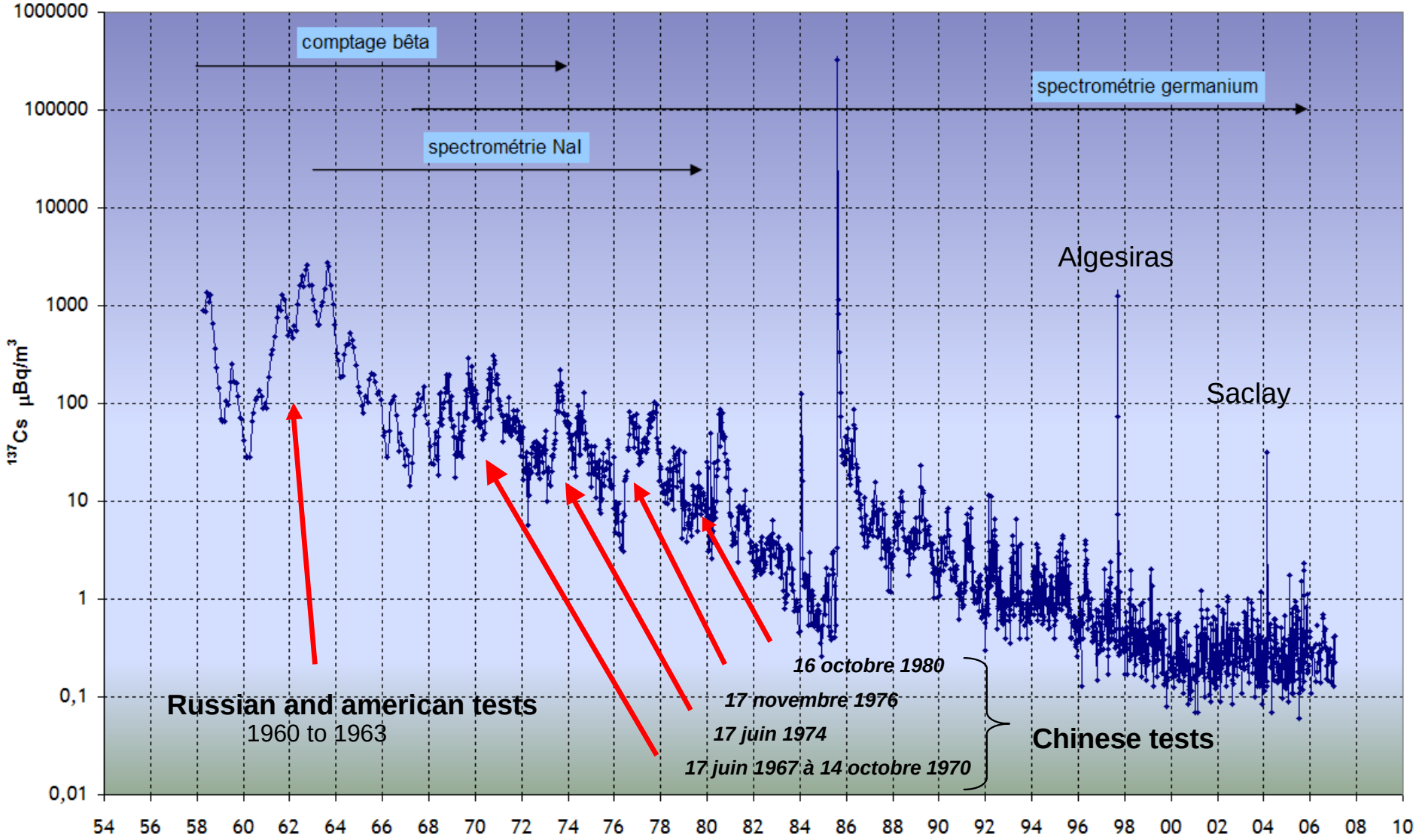
~70 PhD students

Quantification, monitoring and interpretation of radioactivity in the environment ;

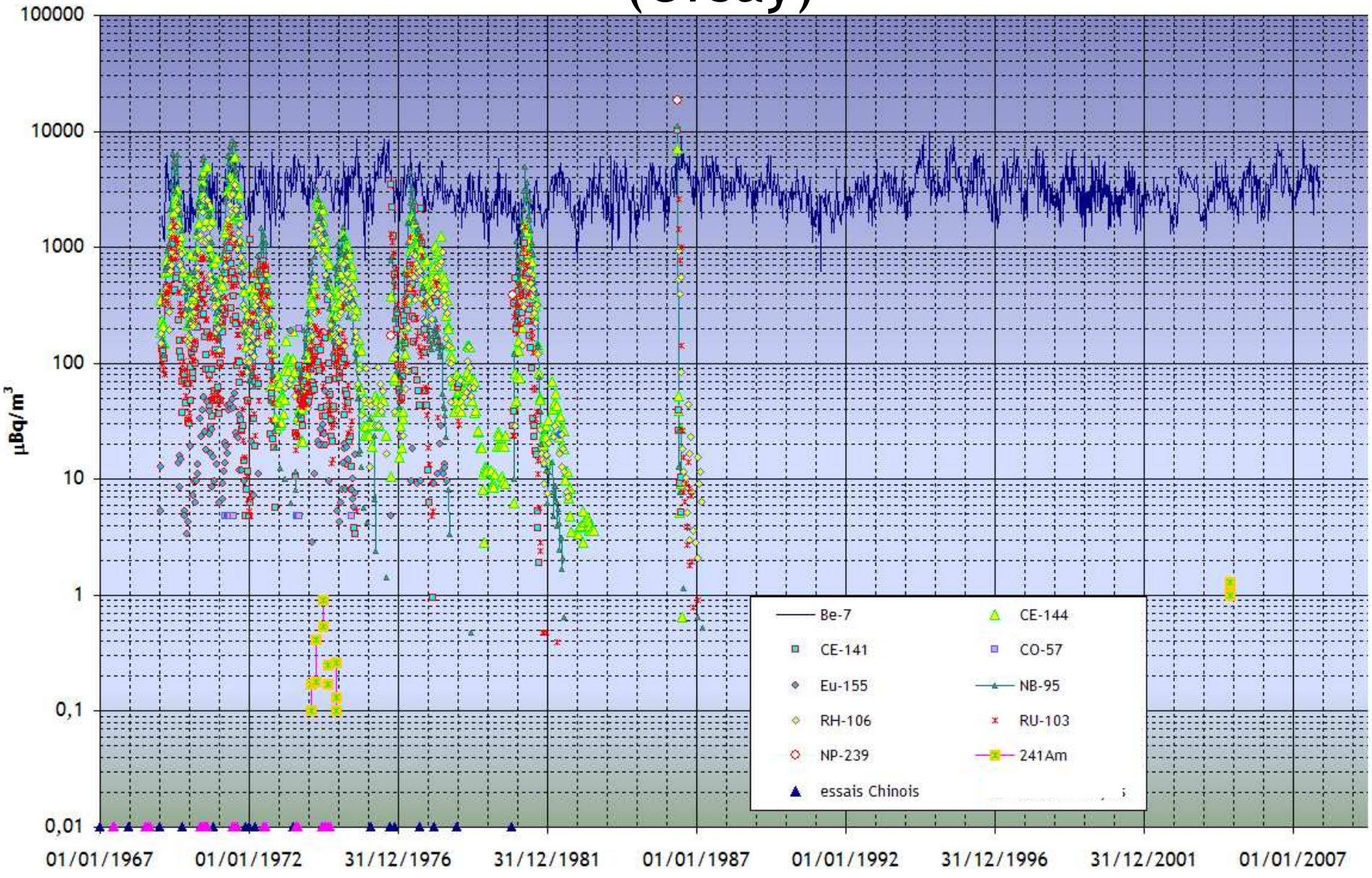
Environmental levels

…or the continuous need for improvement

^{137}Cs in the atmosphere

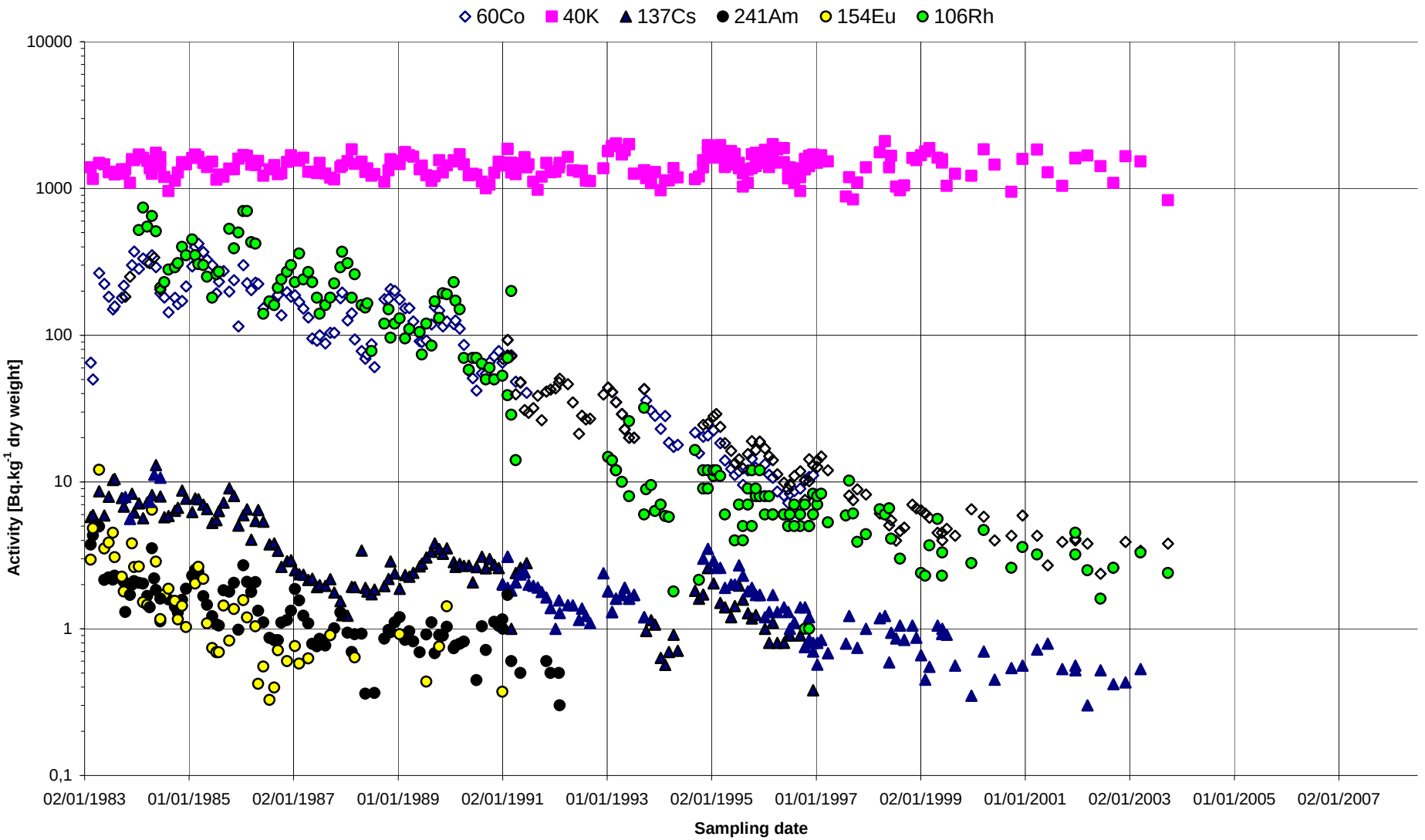


Other radionuclides in the atmosphere (Orsay)



Environmental levels

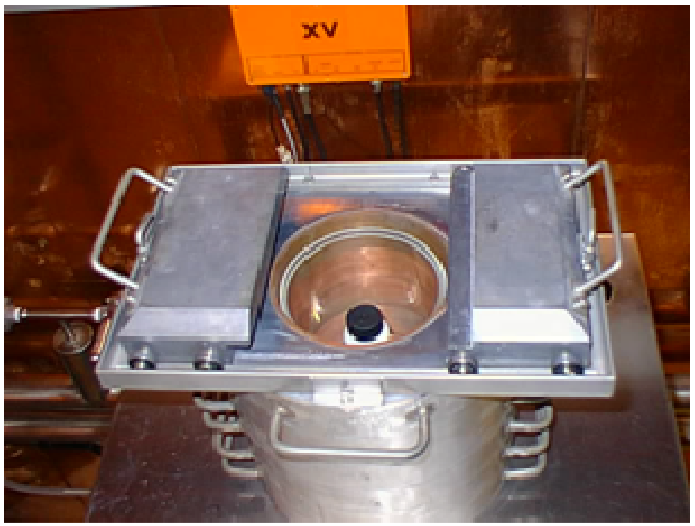
Fucus serratus -seaweed- English Channel



- Aims : Radioecological studies, understand and forecast the behaviour of released radionuclides in normal or incidental operation

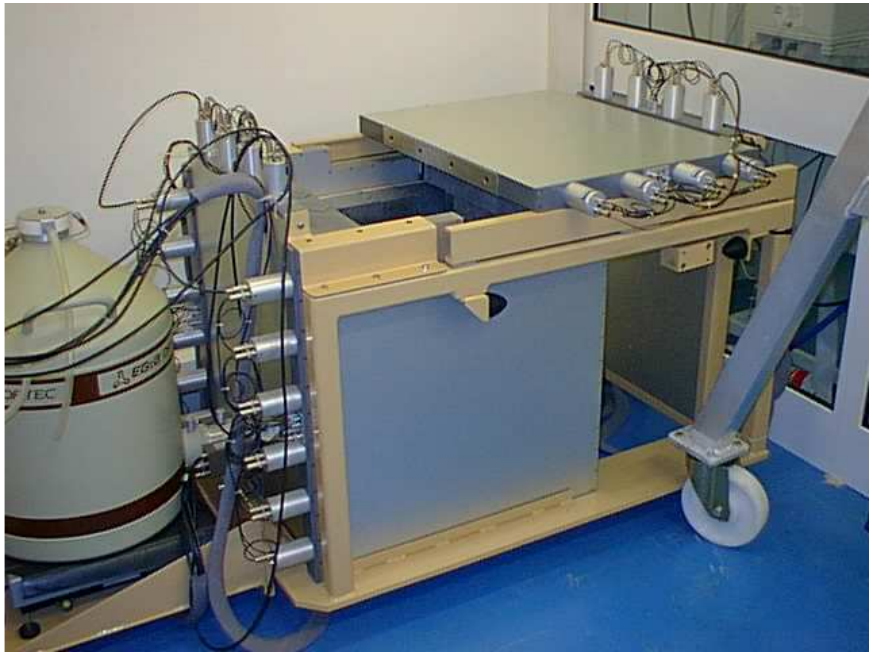
- Detection limits are not good enough to validate the models
- Need to continuously improve the measurement methods

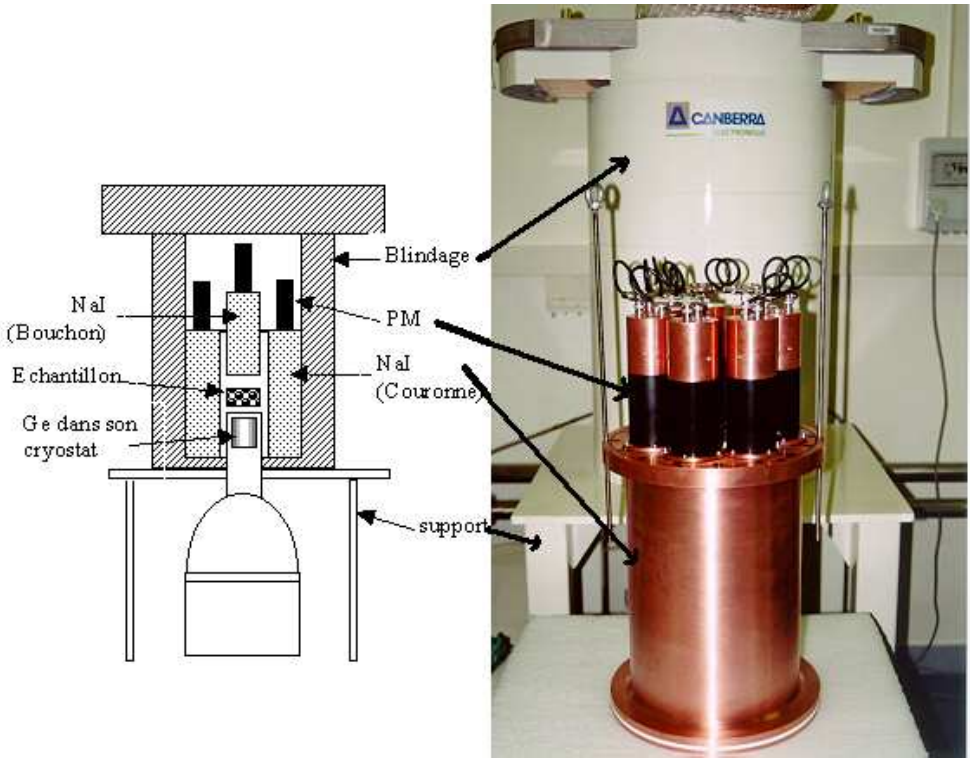
Standard detectors @ Orsay



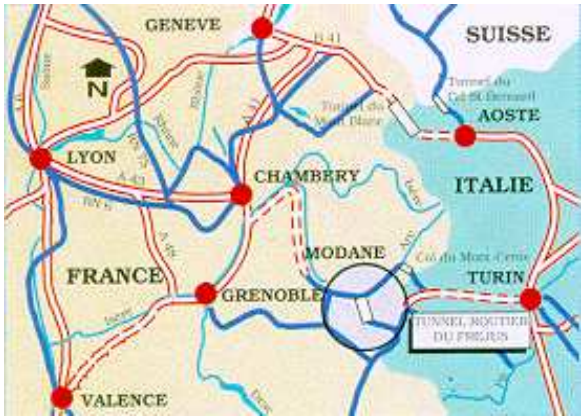
- Shielded room, 50% relative efficiency
- 3 m concrete overhead (~ 10mwe)

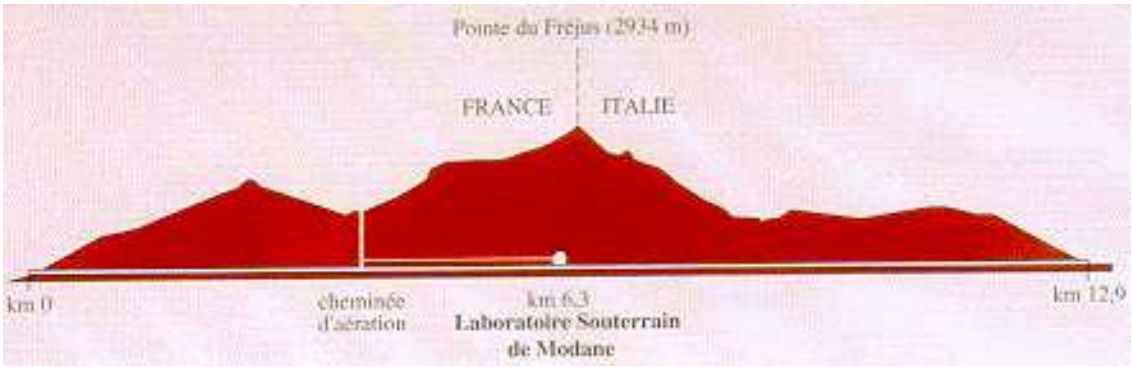
Special and low background detectors @ Orsay



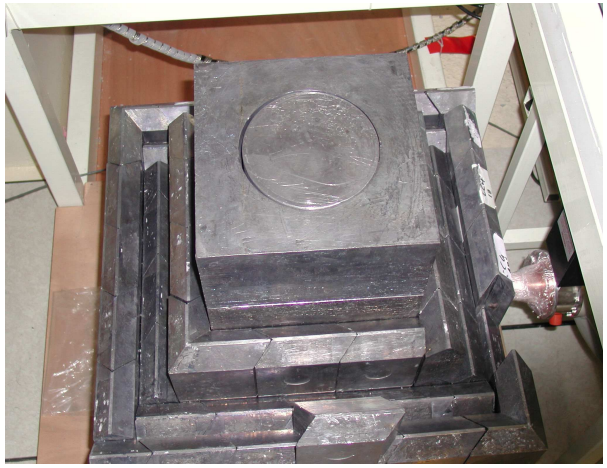


Ultra low background detectors @ LSM





Le laboratoire est situé à 1700 m sous la pointe du Fréjus au milieu du tunnel routier

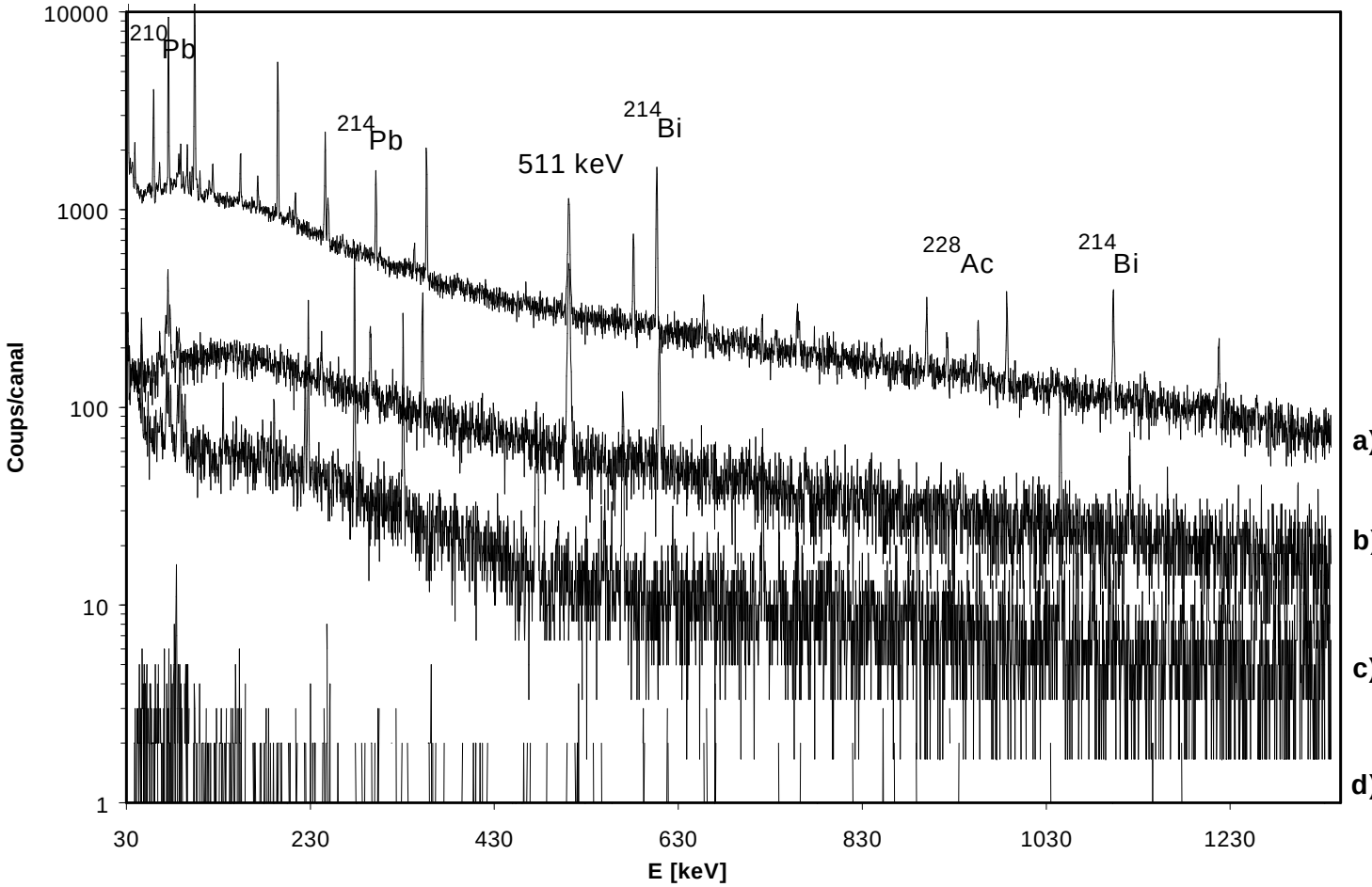


- 50% coaxial N-type

-Well type 860 cm^3

-Well type 450 cm^3

Detector Backgrounds



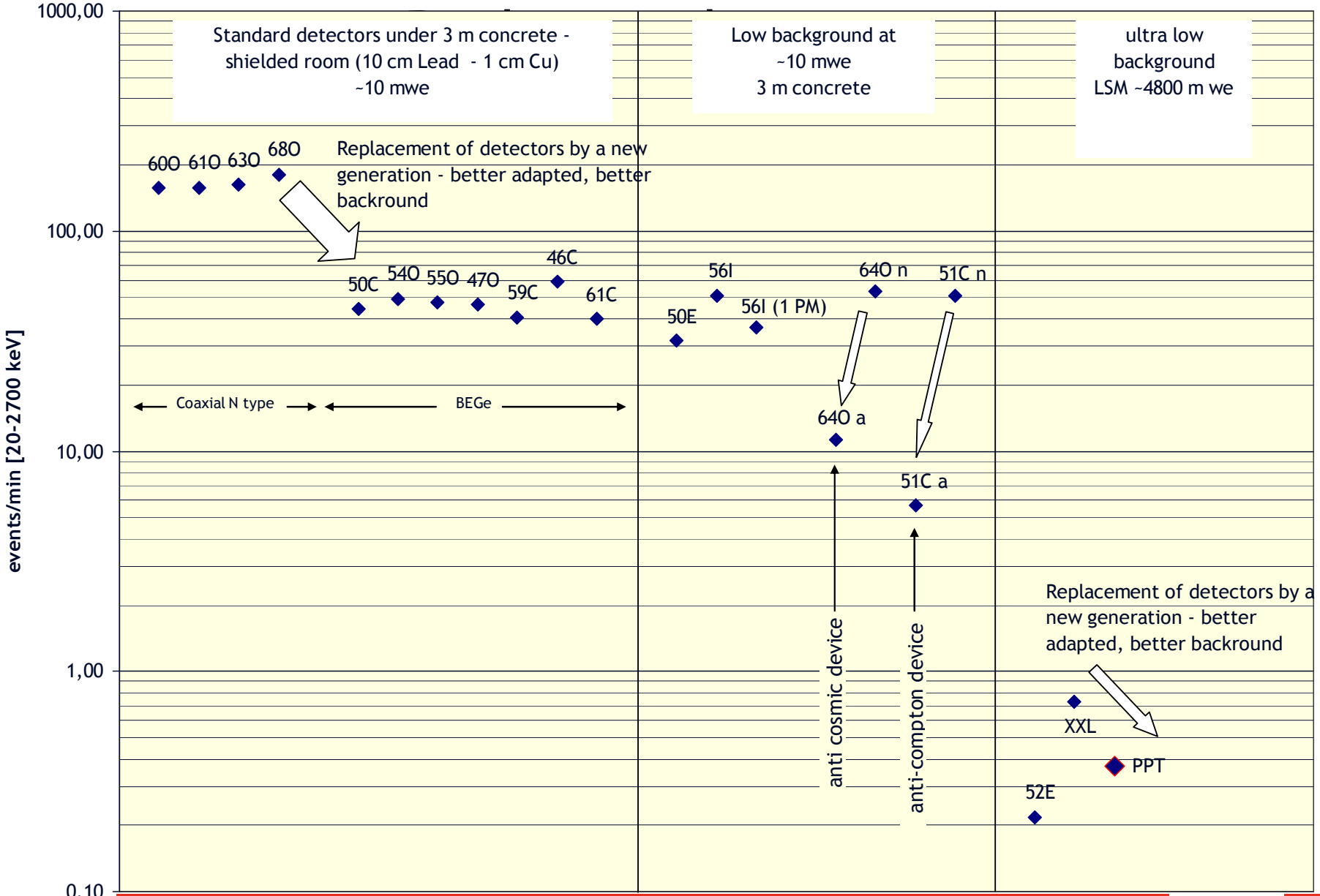
a) Standard

b) Low background

c) Low background + Anti-cosmic

d) Ultra low background

Detector backgrounds



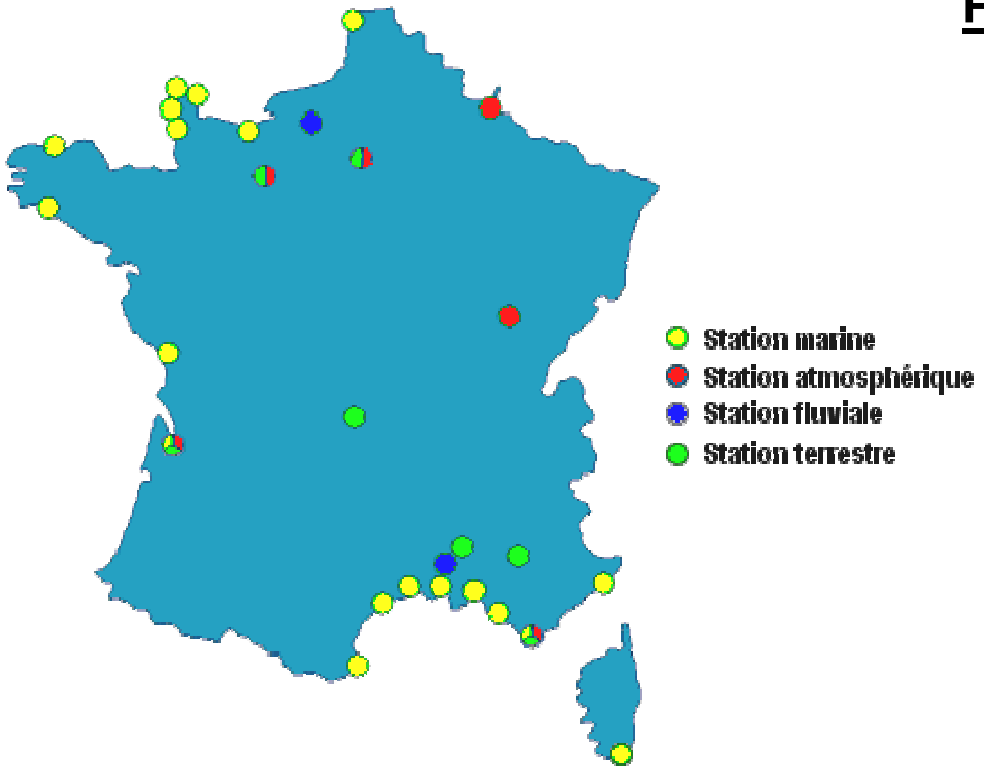
Understand and forecast…

- Regulatory surveillance
- Aerodynamics particle sizes
- Dosimetry impact
- Chronic doses

IRSN

Knowing the radioactive background

part of French regulatory surveillance



+ Papeete (Tahiti)
+ La Réunion

Far from nuclear facilities :

Air

- **Aerosol**
- **Rain**

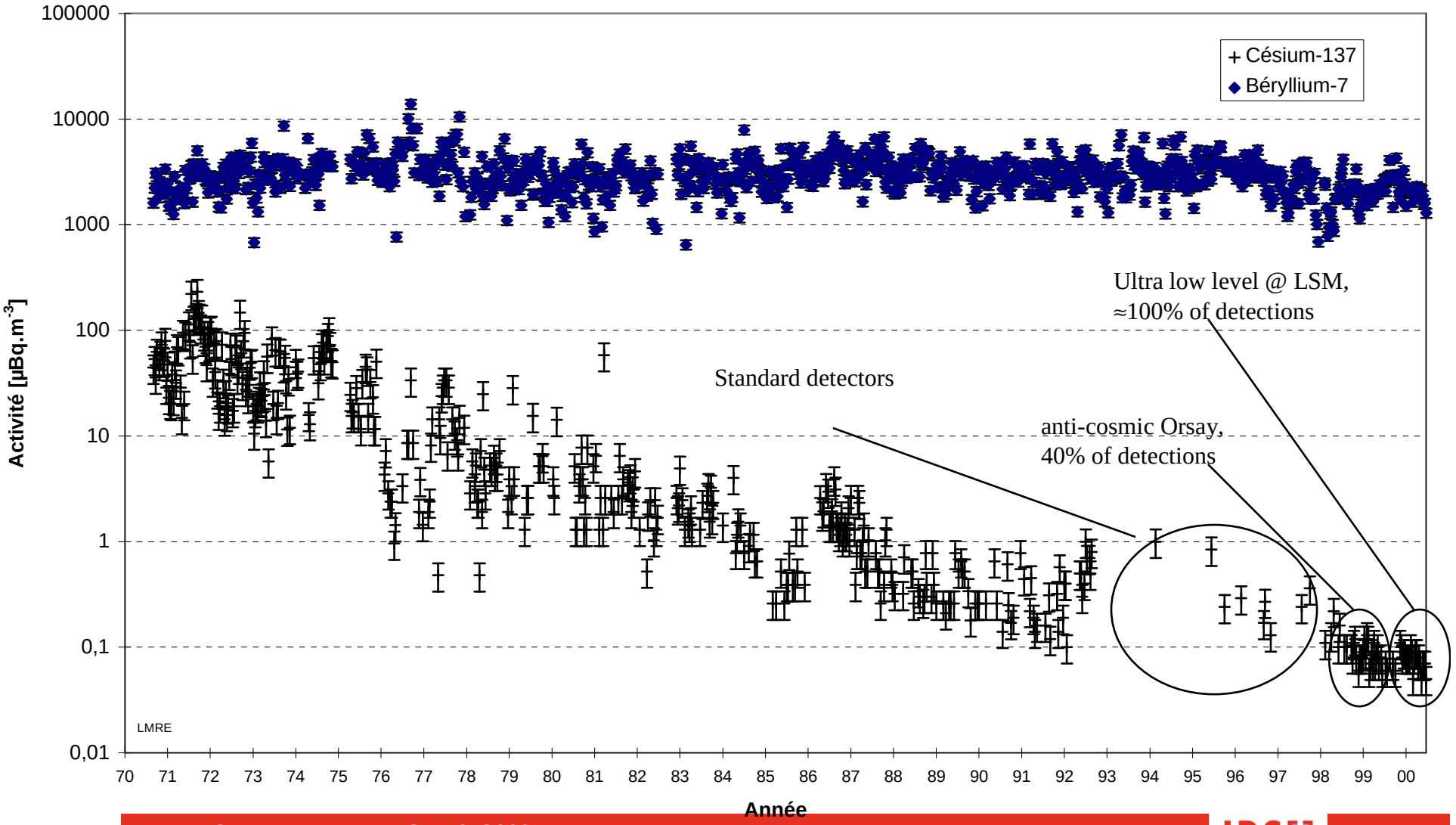
Ocean and Terrestrial compartment

- **Soil**
- **flora**
- **fauna**

Fluvial compartment

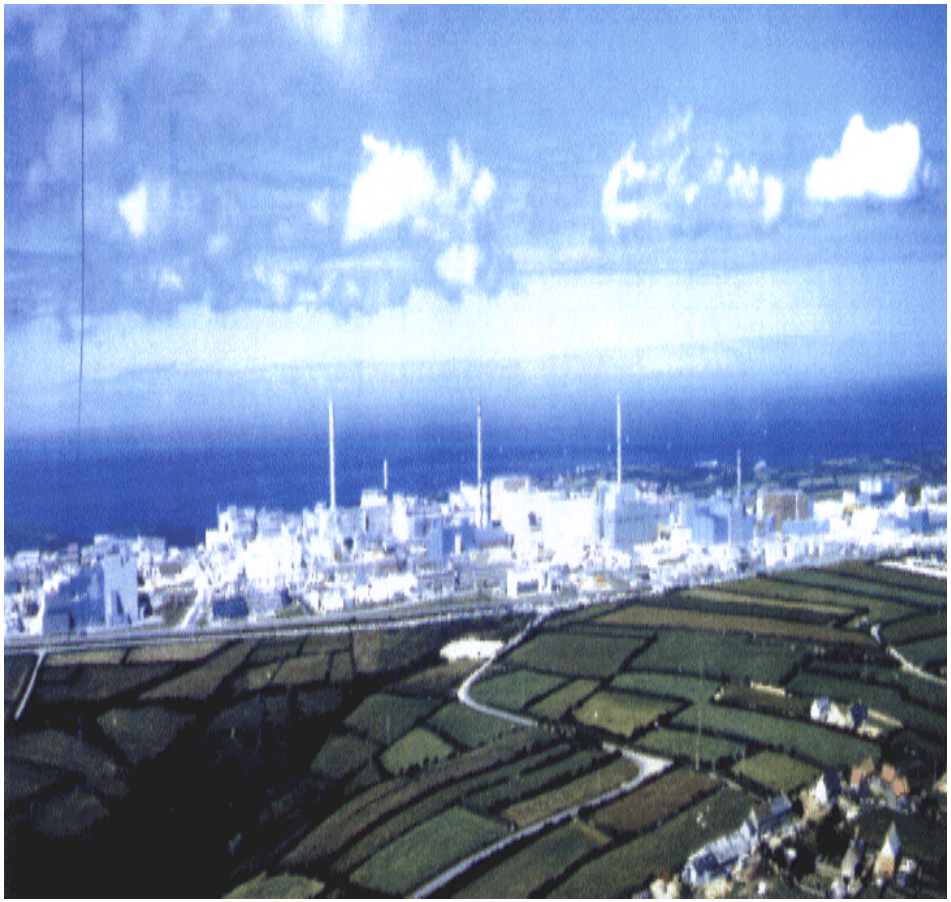
- **Water**

Atmospheric ^{137}Cs and ^{7}Be at Papeete



Understanding the sources of radioactivity

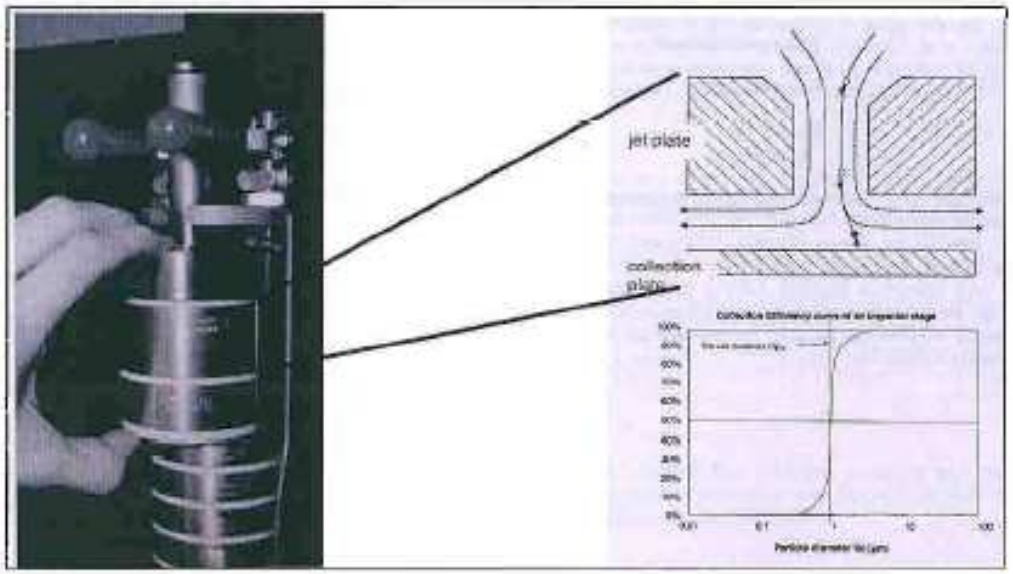
Aerosol aerodynamic sizes @ AREVA La Hague



Understand and forecast the behaviour of released radionuclides in normal or incidental operation

- Atmospheric discharges
- Aerosol Aerodynamic sizes

Aerodynamic sizes @ AREVA La Hague



13 Disks from 0.059 to >10.08 µm

Bq	^{129}I	^{125}Sb	^{106}Rh	^{137}Cs
Total	5	0.4	0.9	0.04

Environmental expertise

Camargue sand beaches

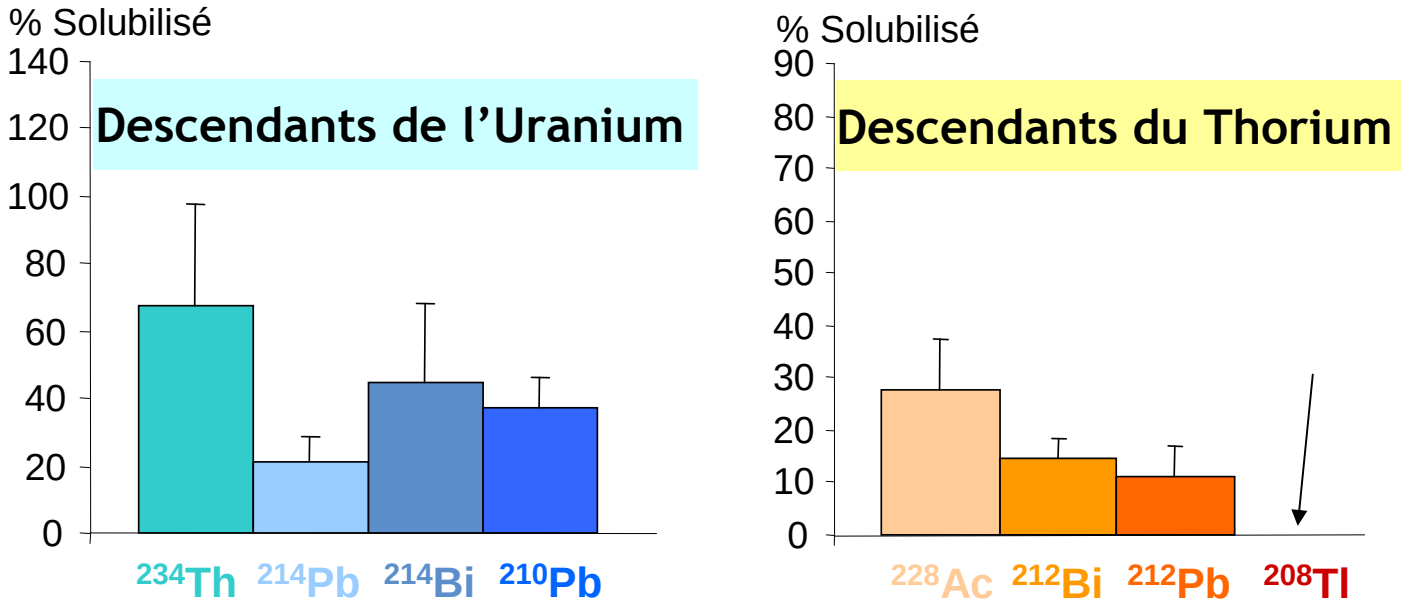
- Ambiant dose rates reaching a few µSv/h
- Natural origin (U and Th) up to 5000 Bq/kg at secular equilibrium
- Zyrcons
- Internal dosimetry questions :
  - i.e. inhalation

Camargue sand beaches

Solubility of the sand in a pulmonar fluid

Difficulty :

- extremely small samples/low radioactive
- measurements at LSM

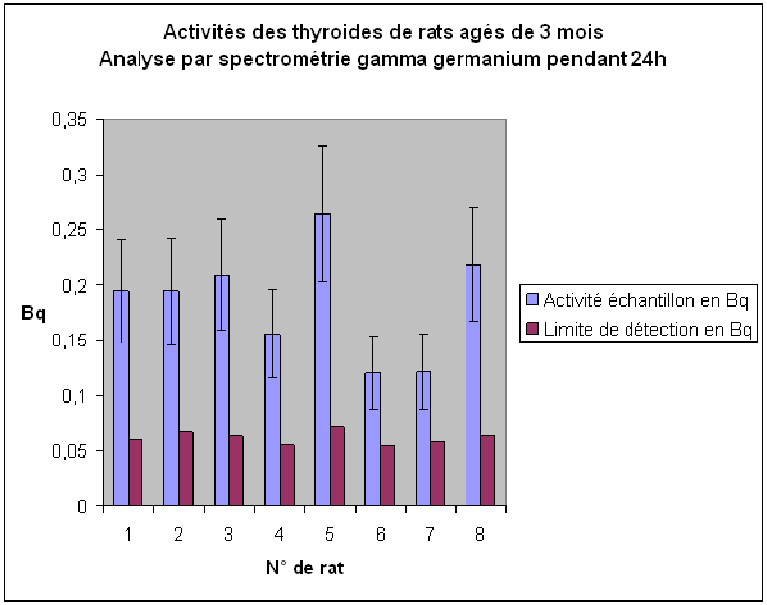


Children : 1 mSv reached with 40 kg of sand

Chronic doses

Evaluation of the ^{137}Cs distribution in rats after chronical consumption of contaminated water (6500 $Bq.l^{-1}$)

Measurement of ^{137}Cs in the thyroid of contaminated rats,
Need of LSM measuremenst



* Activités obtenues en utilisant un détecteur Ge ultra pur, coaxial, Φ = 58.8mm ; efficacité à 1.33 Mev = 42.1%

Not expected on the biokinetics models

Understanding transport phenomena

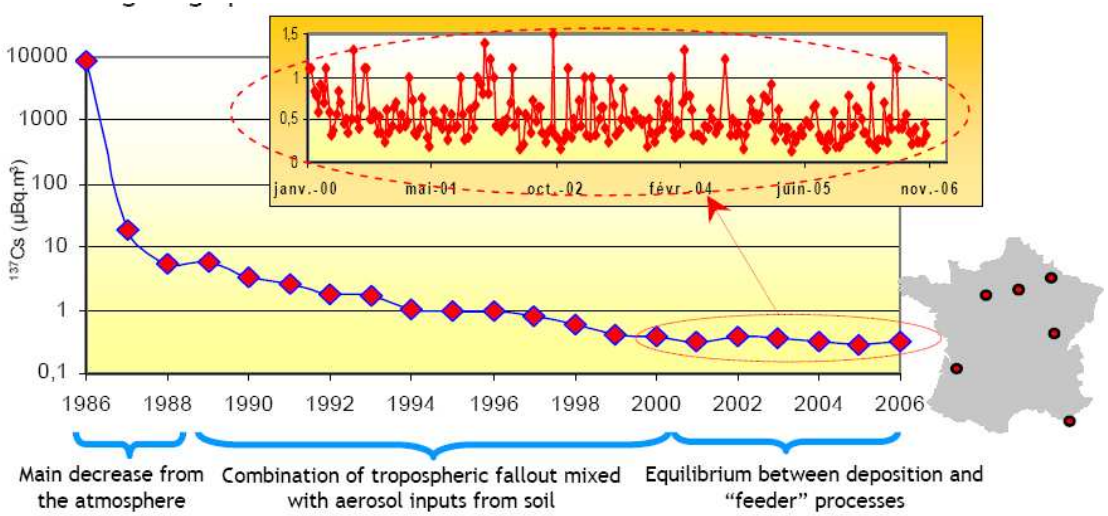


Figure 1 : Mean annual ^{137}Cs activity level in air and details on a 10-day sampling basis

Fig. 6: Trajectories of smoke plume and fire spots

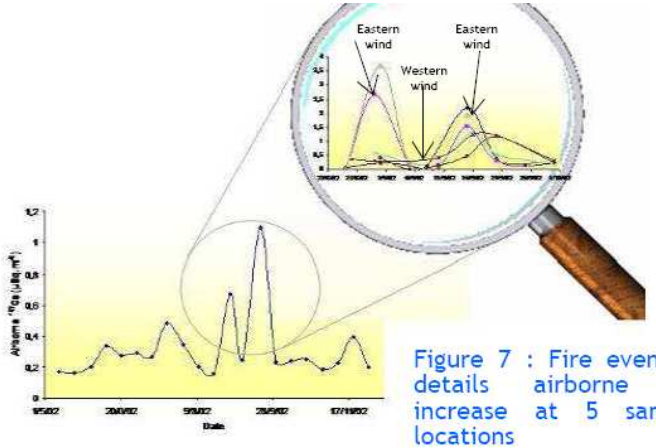


Figure 7 : Fire event and details airborne ^{137}Cs increase at 5 sampling locations

Conclusions

- **Globally, artificial radioactivity in the environment is decreasing**

  Hence, need of improving the detection limits for radioecology studies and Regulatory surveillance

- **The use of underground gamma spectrometry opens a window of oportunity in several fields :**

  Environment

  Biology

  Dosimetry

- **Our future studies :**
  - Measuring the radioactivty of clouds
  - Understanding the accumulation of radioactivity in the first few drops of rain
  - …