

(\*) BGC – Biogeochemical cycle



#### Research questions

Is Cs-137 distribution in a steady-state?

In which extent Cs-137 is correlated with its chemical analogues (Cs-133 & K)?

What about long-term Cs-137 bioavailability?

Which factors influence the variability of Cs-137 behaviour between sites & species?

#### Objectives

Analysis & comparison of observed variations between measured Cs-137, Cs-133 & K concentrations & stocks in forest stands

Apply BGC cycling model to quantify Cs-137, Cs-133 & K fluxes & identify key processes within each stand

Monitoring & sampling forest compartments in France



Context/Issues/Objectives

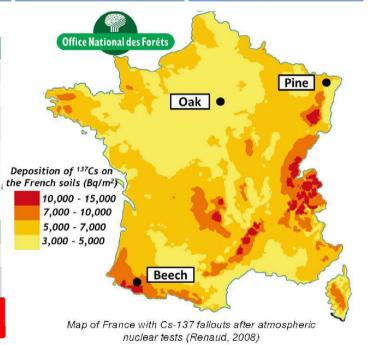
Materials & Methods

#### Resu

Conclusions

## Sites for monitoring & sampling

Sites characteristics			
Main specie	Beech	Oak	Pine
Basal area (%)	87	59	60
Average age (years)	90	132	55
Average DBH (cm)	37	56	41
Secondary specie	***	Beech	Beech
Basal area (%)		31	38
Soil type	Cambisol	Podzol	Podzol
Clay/silt/sand (%)	<b>40 /</b> 53 / 7	4/6/90	4/13/83
Stock of Cs-137 in soil (Bq/m²)	2800±110	1600±148	3300±208
Global fallouts contribution (%)	80	84	45





2 trees of secondary species

Pine site

2 beech

<mark>2021</mark>

Sampling, treatment, analysis







## **Drying & ashing**



Low Cs-137 level

Gamma-spectrometry for Cs-137 ICP-MS for Cs-133 & K

Extraction of available Cs-137 from soil with ammonium acetate

Biometrics => allocation factors => stand biomass estimation with allometric equations

LEAVES

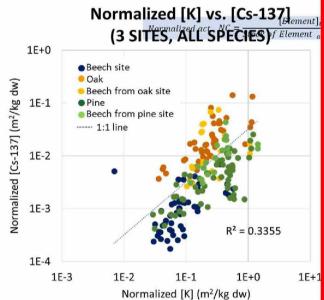
BRANCHES

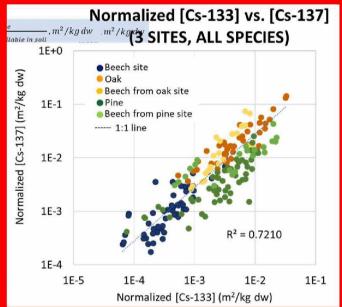
STEM

NEEDLES



## Correlation between Cs-133 & Cs-137 for all sites & species

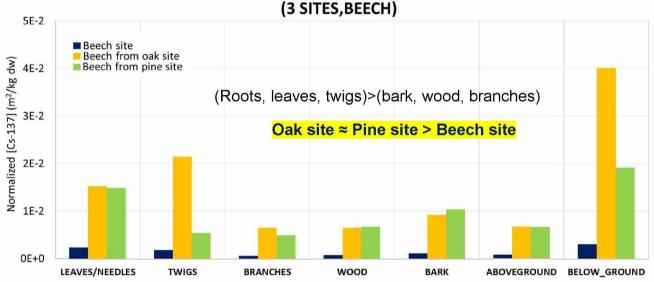






Common pattern for beech trees between sites

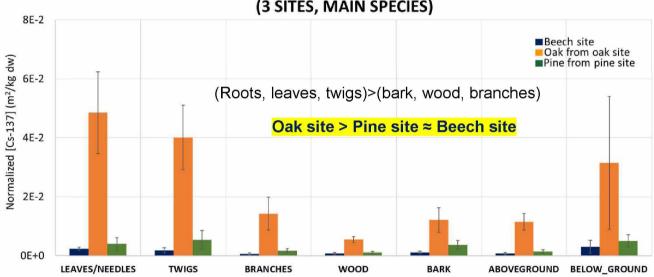
# Normalized [Cs-137] (m<sup>2</sup>/kg dw) per compartment (3 SITES,BEECH)





Common pattern between species

# Normalized [Cs-137] (m<sup>2</sup>/kg dw) per compartment (3 SITES, MAIN SPECIES)





The first results do not allow to identify all factors that are influencing observed variabilities

 $\frac{\begin{bmatrix}^{137}Cs\end{bmatrix}_{tree}}{Stock^{137}Cs_{available}}$ 

 $X = \frac{[K]_{tree}}{Stock \, K_{available}}$ 

 $\propto$ 

 $\frac{{{{\begin{bmatrix} {^{133}}Cs} \end{bmatrix}}_{tree}}}{{Stock}^{133}Cs_{available}}$ 

Cs-133 is the best proxy to address Cs-137 behaviour



Prospects

Estimate long-term BGC cycle processes (i.e. root uptake, internal translocation)

Obtained results will be used to parameterize process-based TREE4\* model to predict Cs-137 behaviour

(\*) TREE4 - Transfer of Radionuclides and External Exposure in FORest Systems, developed in IRSN

See presentation of Marc-André GONZE (05/09/22)





**IRSN**