IRSN
INSTITUT
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Faire avancer la sûreté nucléaire

Post-Fukushima environmental research program within the framework of the franco-japanese collaboration

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February 19th, 2015

Why to perform research on environmental aspects following Fukushima accident?

- Large parts of the environment have been contaminated by radioactive releases following FDNPP accident.

- It is important to be able to monitor, on the long term, the evolution of the contamination in the different compartments.

- All the knowledge acquired will allow to improve our capacity to predict the evolution of the contamination in case of a nuclear accident, especially in compartments of the environment that have been less studied than, for example, agricultural products namely sea and forests.

Context of the AMORAD research program

- Following FDNPP accident, french government has launched a call for proposal for research activities on the consequences of the accident

- The AMORAD research program, that aims at improving the capacity of prediction of the radionuclides dispersion in the biosphère, was consequently launched in 2014.

- Large parts of the AMORAD program are dedicated to research topics that focus on the environmental consequences of radionuclides dispersion in Fukushima area.

- Research consortium involve both french and japanese research teams (University of Tsukuba, University of Fukushima)

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INVESTISSEMENTS D'AVENIR

Main objectives of AMORAD research program

Main objectives of AMORAD are connected to some specificities of Fukushima accident :

- Large releases in Pacific ocean
- Due to weather conditions (extreme events), erosion processes are a major issue for the transfer of contamination from land to sea
- Contamination of large area covered by forests

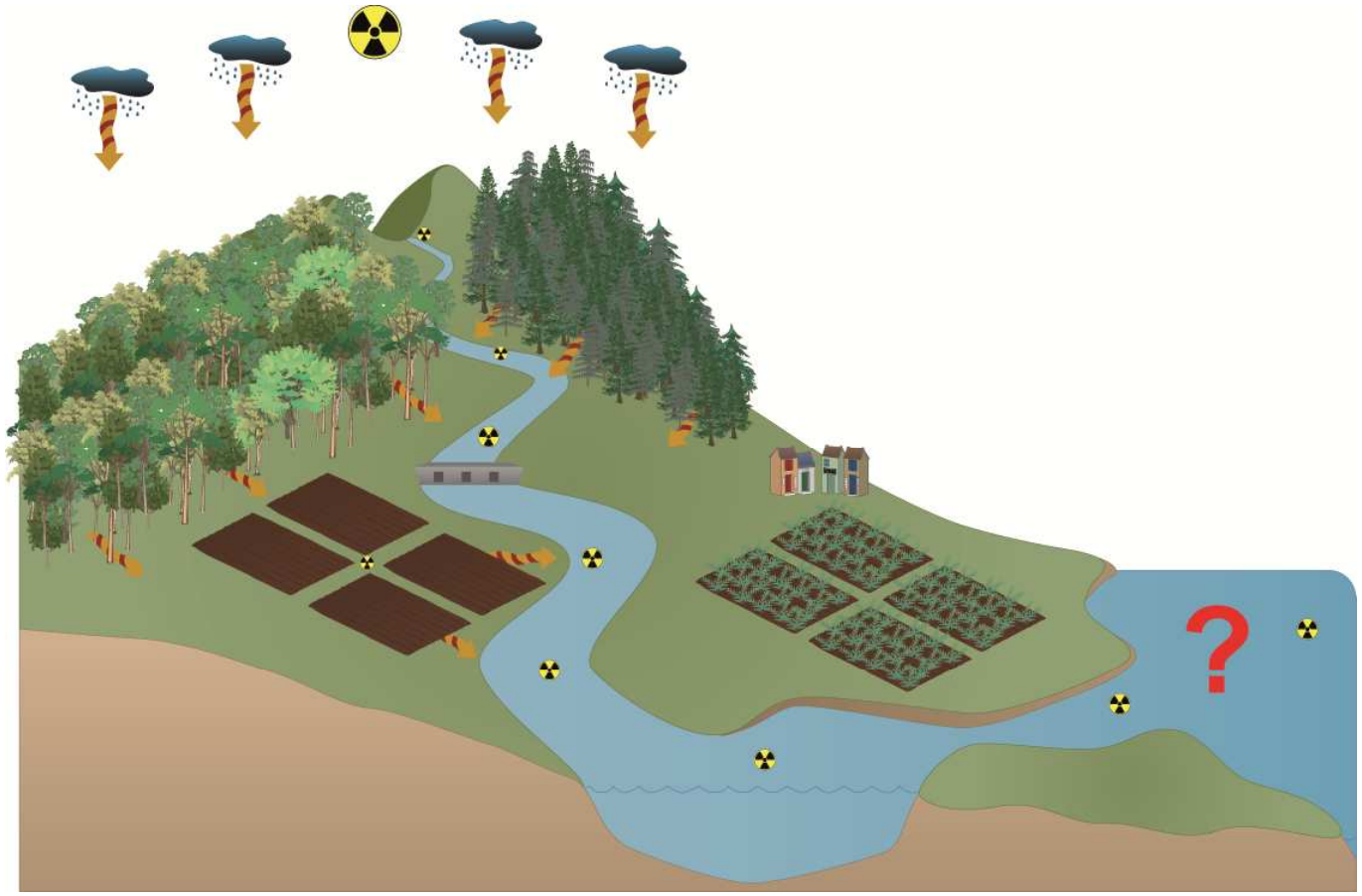
■to estimate fluxes of radionuclides to the sea from Fukushima area

■ to improve existing models of radionuclides wash-off

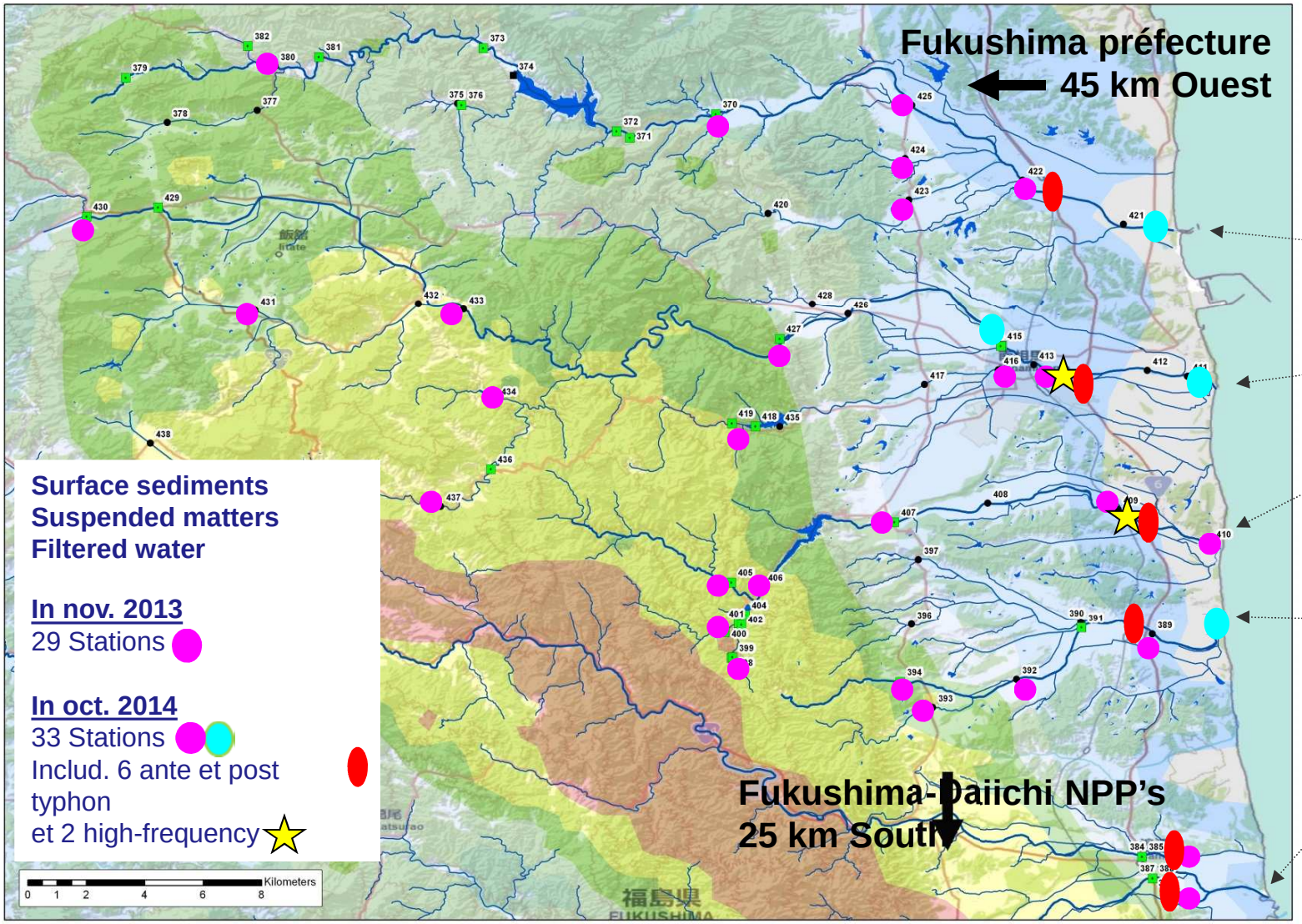
■ to caracterize the biogeochemical cycle of cesium in forests

■To improve existing models of radionuclides transfer in forests.

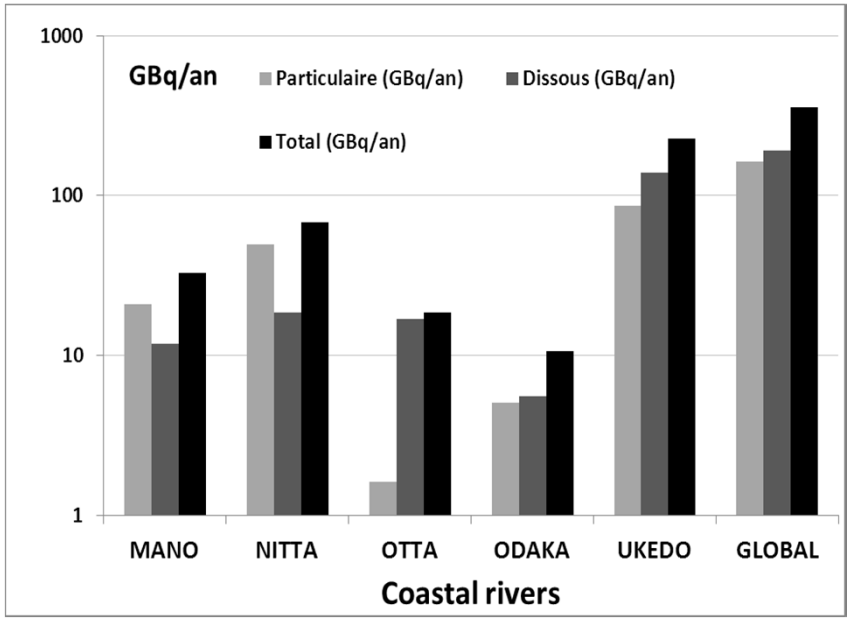
Preliminary results on the estimation of fluxes of radionuclides to the sea from Fukushima area



Monitoring campaigns for erosion process studies



Flux of CS-137 to sea : preliminaty results



Estimation of dissolved and particular fluxes in Cs-137

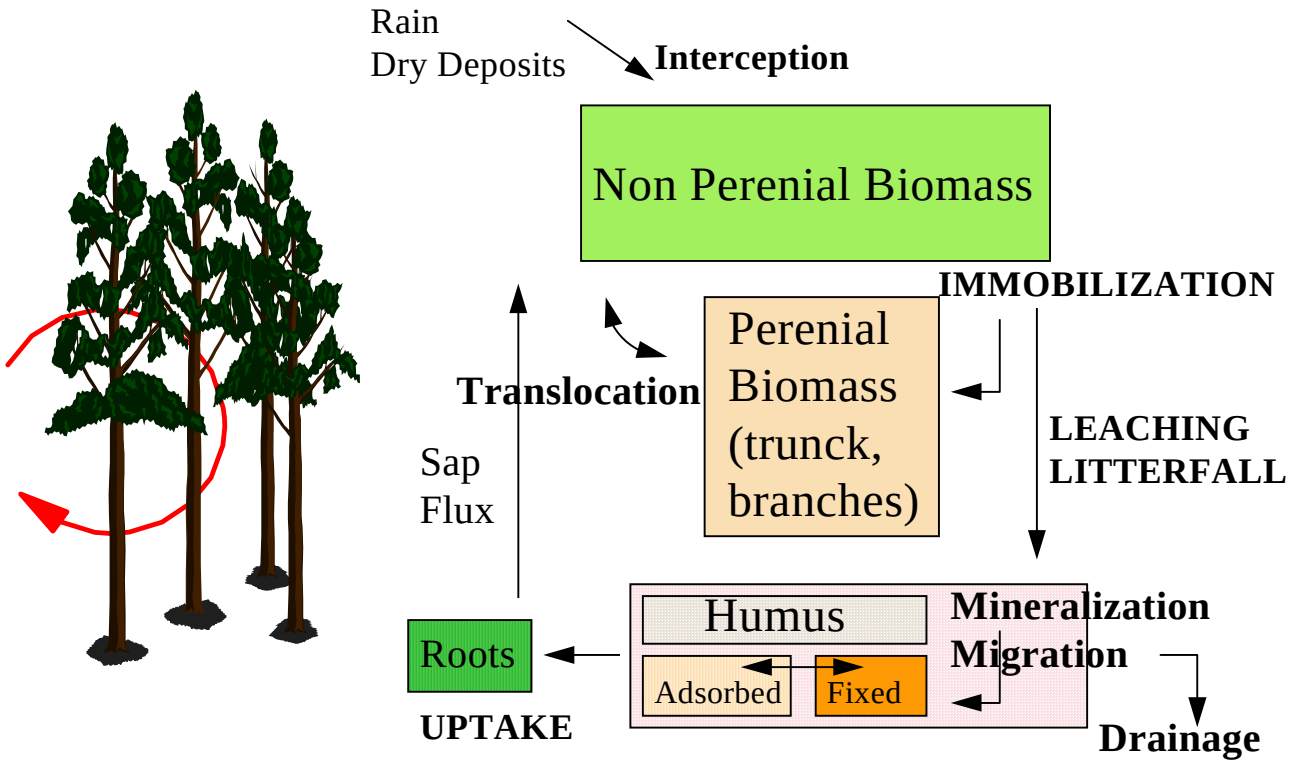
Solid Flux : 190 ± 37 GBq/year
Dissolved Flux : 166 ± 33 GBq/year

Global 356 ± 73 GBq/year
excluding typhoons

This represents approximately 0,03% of the total stock (1887 TBq)

About 70 to 90% of the flux comes from extreme events (typhoons)

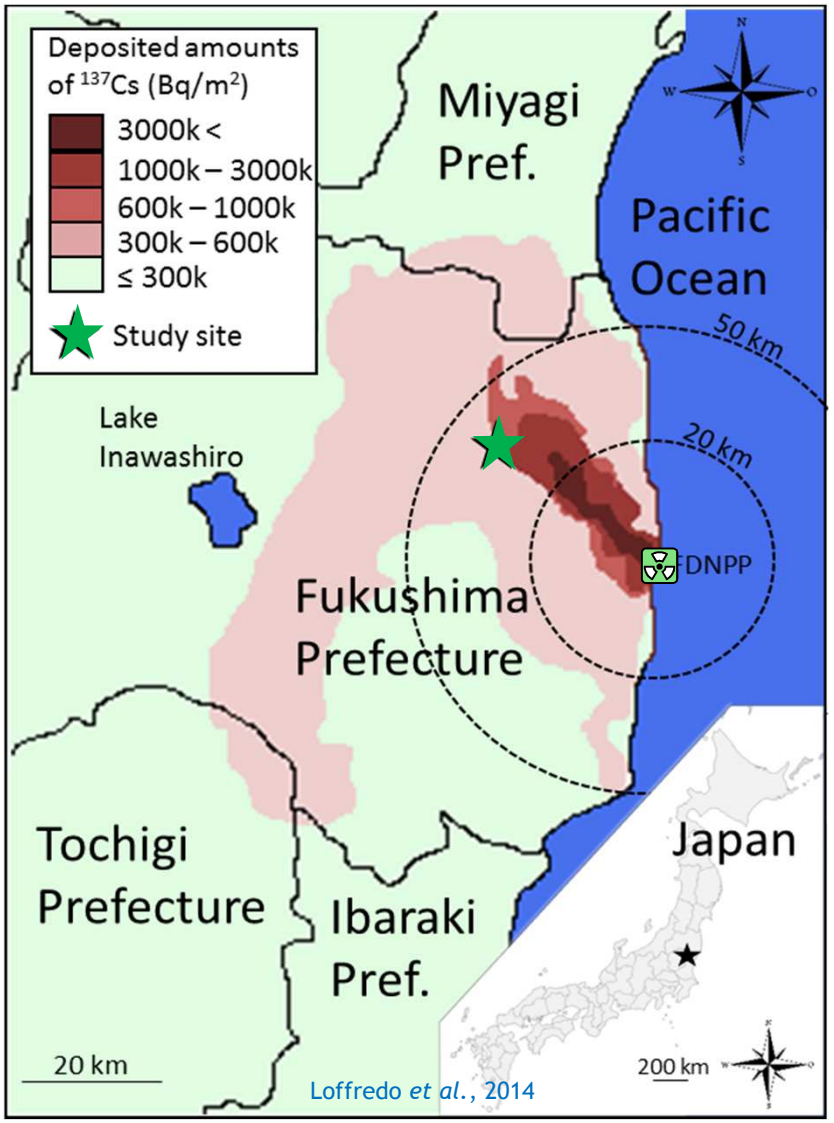
Preliminary results on the Cs cycling in forests



Cs transfer in forest studies

- **Forests cover 75% contaminated area (1343 km^2)**
- **Mainly evergreen conifer species settlements with high interception efficiency (Sugi, Hinoki)**
- **Huge amount of contaminated biomass and potential wastes**

  20.7^c Mt / 32.7^c Mm^3
- **Forests are a possible reservoir for further RNs transfer (e.g. runoff)**
- **^{137}Cs half-life period ~ 30 y ▸ long term risks**



Experimental site : cedar forest

GPS coord. +37° 35' 6,42'' /+140° 41' 27,55''
Alt. 550 m a.s.l.

Yamakiya district forest stand survey plot

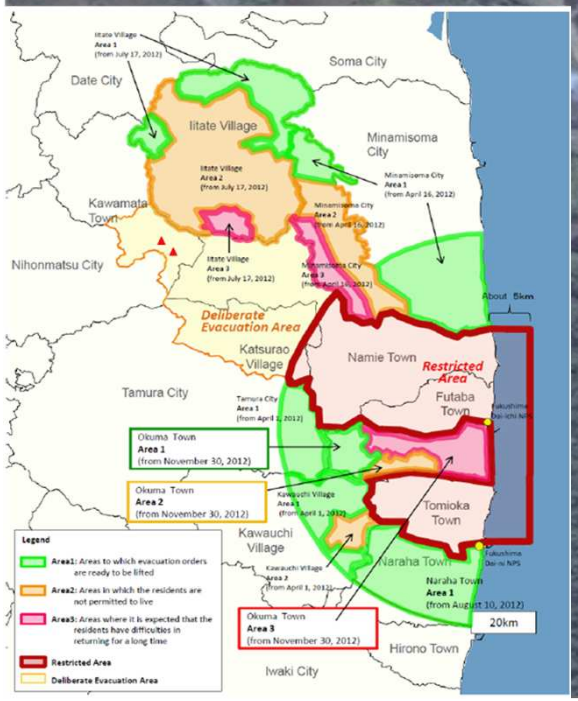
MC plot

RICO Factory

YC plot

~20 m

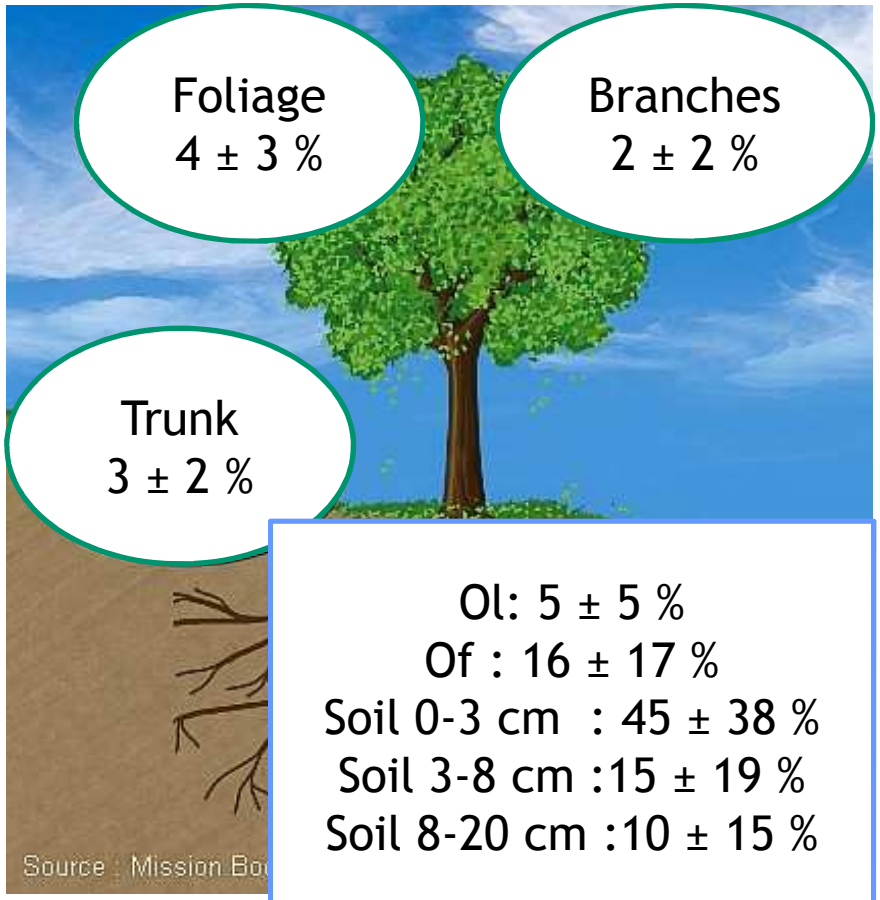
N



Tree sampling in the japanese cedars plots

^{137}Cs budget in an old cedar stand after 3 vegetative periods

Organs	Caesium 137 content (Bq/kg dw)		
	N	Cs-137	sigma
1y. old foliage	9	4207	1238
Foliage > 1y.	9	7880	2724
Dead foliage	3	20218	9071
Leaving branches	6	4185	1703
Dead branches	3	5071	1220
External bark	3	4638	1411
Internal bark	2	2108	115
Sapwood	7	435	130
Heartwood	5	817	223
Litter	7	37500	6000
Of	7	83500	21000
Soil 1-3 cm	7	34400	12900
Soil 3- 8 cm	7	4200	2900
Soil 8-20 cm	7	979	623



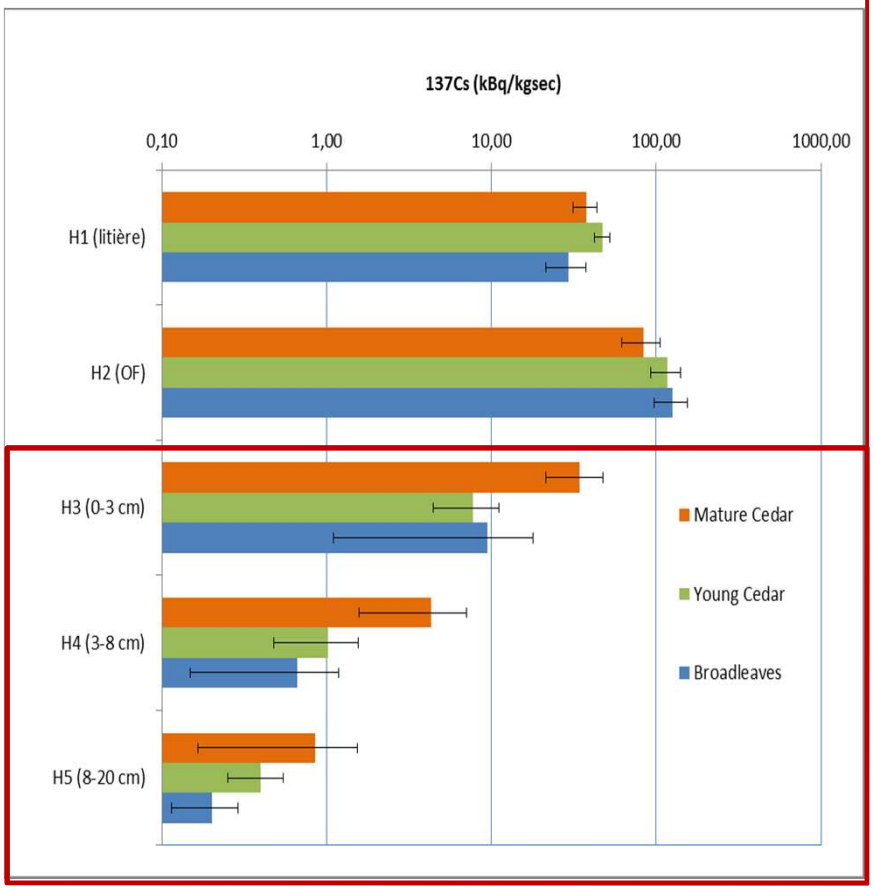
10% of contamination in aboveground biomass (50 kBq/m²)

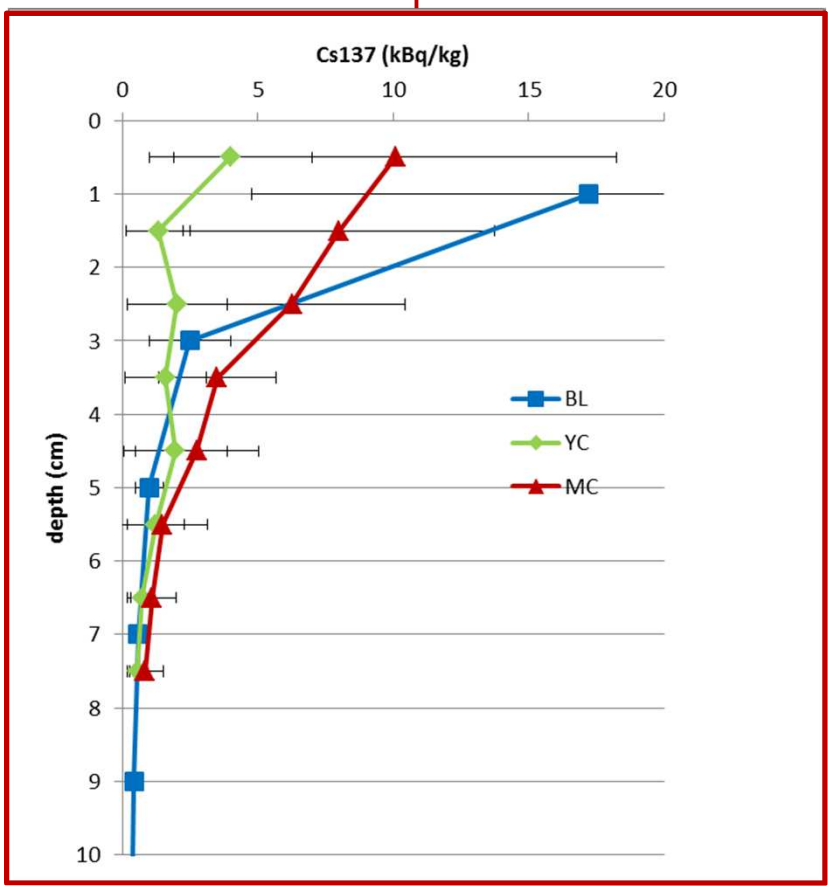
90 % of contamination in soil (450 kBq/m²)

Total deposits 450 kBq/m²

(Loffredo et al., STOTEN, 2014)

Vertical profile of Cs content





CONCLUSIONS

- Large parts of the environment have been contaminated by radioactive releases from Fukushima accident.

- In order to be able to predict the evolution of the contamination in all the compartments of the environment on the long term, it is necessary to perform research in order to understand and derive parameters that governs transfer of radionuclides in the environment.

- Such research programs are also useful to improve predicting models used in emergency and post-accidental situations.

- The AMORAD research program that gathers research groups from both France and Japan focuses on compartments (forests, sea) where knowledge about radionuclides transfer is less developped than for example agricultural products. Most of the actions performed in this program are long term studies that focuses on the evolution of contamination in sediments, watershed, sea or forests.