POTENTIAL STUDIES OF RADIOACTIVE ELEMENTS IN SOILS AND SEDIMENTS, CHILE

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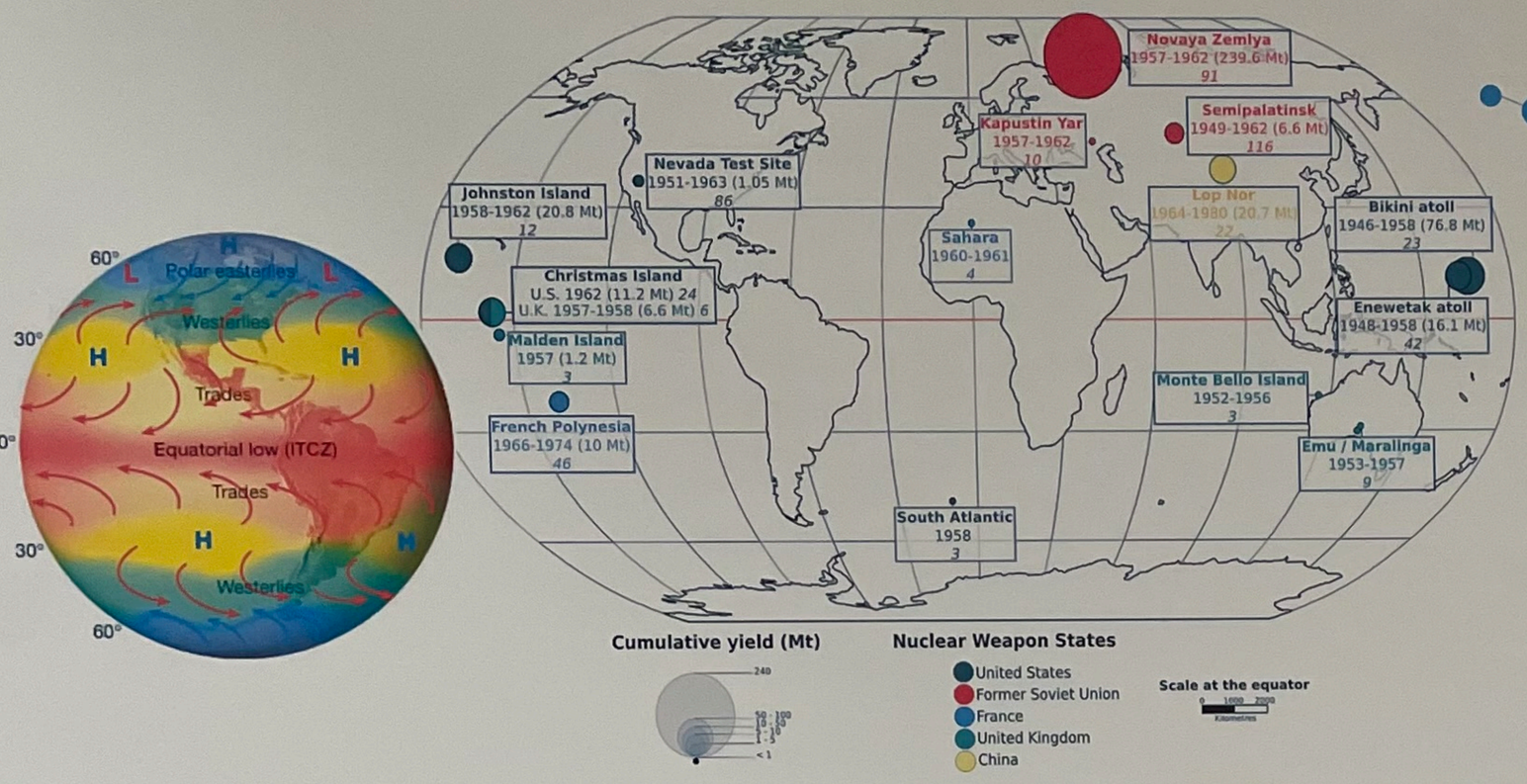


Fig. 1. Location, timing, number (in italics) and total yield of atmospheric nuclear tests conducted around the world (UNSCEAR, 2008). Two operational nuclear detonations (Hiroshima, Nagasaki), 39 safety trials, four tests in the Pacific Ocean, one in New Mexico (USA) and two tests in Aralsk (Former Soviet Union) with a cumulative yield of approximately 0.2 Mt (0.045 % of the total yield) are not shown for clarity.
Source: Chaboche et al., 2022.

INTRODUCTION

Atmospheric nuclear testing (1945-1980) has caused radioactive fallout around the world. The French Tests carried out in Polynesia (1966-1974) may influence the signature (concentrations) of South America, in addition to those carried out by the USA and the former USSR until 1963 in the northern hemisphere (Chaboche et al., 2022).

The importance of carrying out a baseline of ^{137}Cesio (^{137}Cs), ^{234}Thorio (^{234}Th), ^{232}Thorio (^{232}Th), ^{238}Uranio (^{238}U), ^{235}Uranio (^{235}U), ^{240}Plutonio (^{240}Pu) y ^{239}Plutonio (^{239}Pu), in the soils of the study area to be defined, says relation to the importance of establishing the natural concentrations (quantities) of these elements in the environment, which is known as the term Environmental Geochemical Background. If there were nuclear accidents in South America, the artificial radionuclide baselines from nuclear tests could help differentiate them from those deposits exclusive to nuclear accidents, such as the one that occurred in Fukushima in 2011.

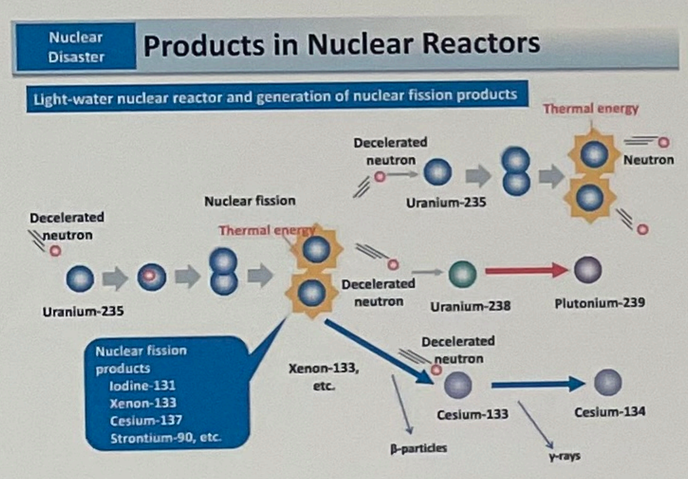
The importance of this information lies in having information that allows:

i) The detection and quantification of anthropogenic levels. Therefore, the identification of those responsible.

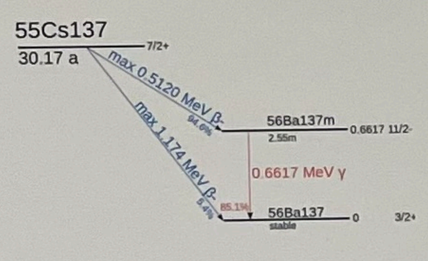
ii) Evaluation of the impact on the population of these levels, if any.

iii) Estimate the relationship between these atmospheric elements and that of the soil and vice versa.

iv) Propose mitigation and/or remediation techniques to local and national authorities



Source:Ministry of the Environment. Government of Japan (https://www.env.go.jp/en/chemi/rhm/basic-info/1st/02-02-03.html).



1. OBJECTIVE

1.1. GENERAL OBJECTIVE

Develop a baseline of radioactive elements (^{137}Cs, ^{234}Th, ^{232}Th, ^{238}U, ^{235}U, ^{240}Pu y ^{239}Pu) in soils in order to know the distribution in the study area of the concentrations of these radioactive elements.

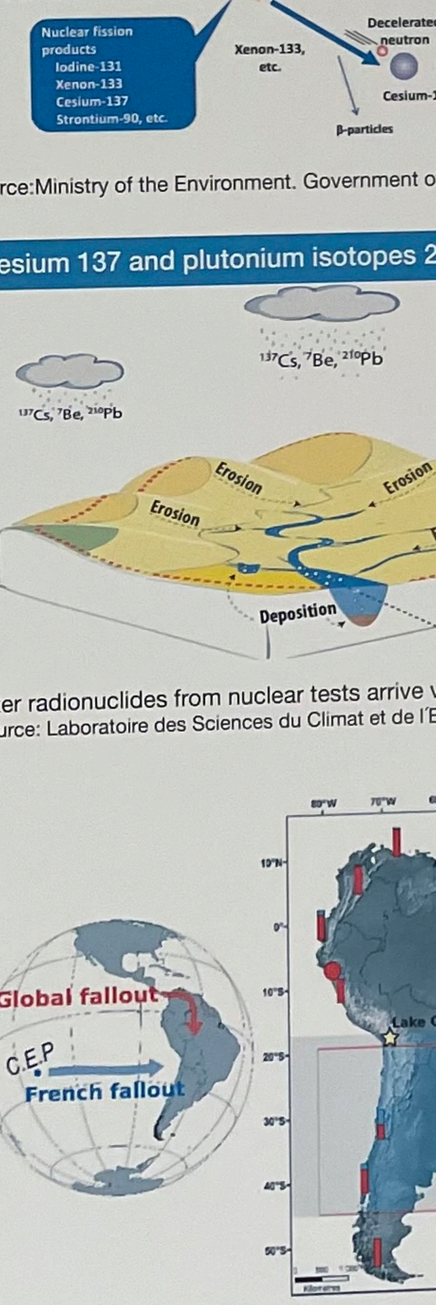
1.2. SPECIFIC OBJECTIVES

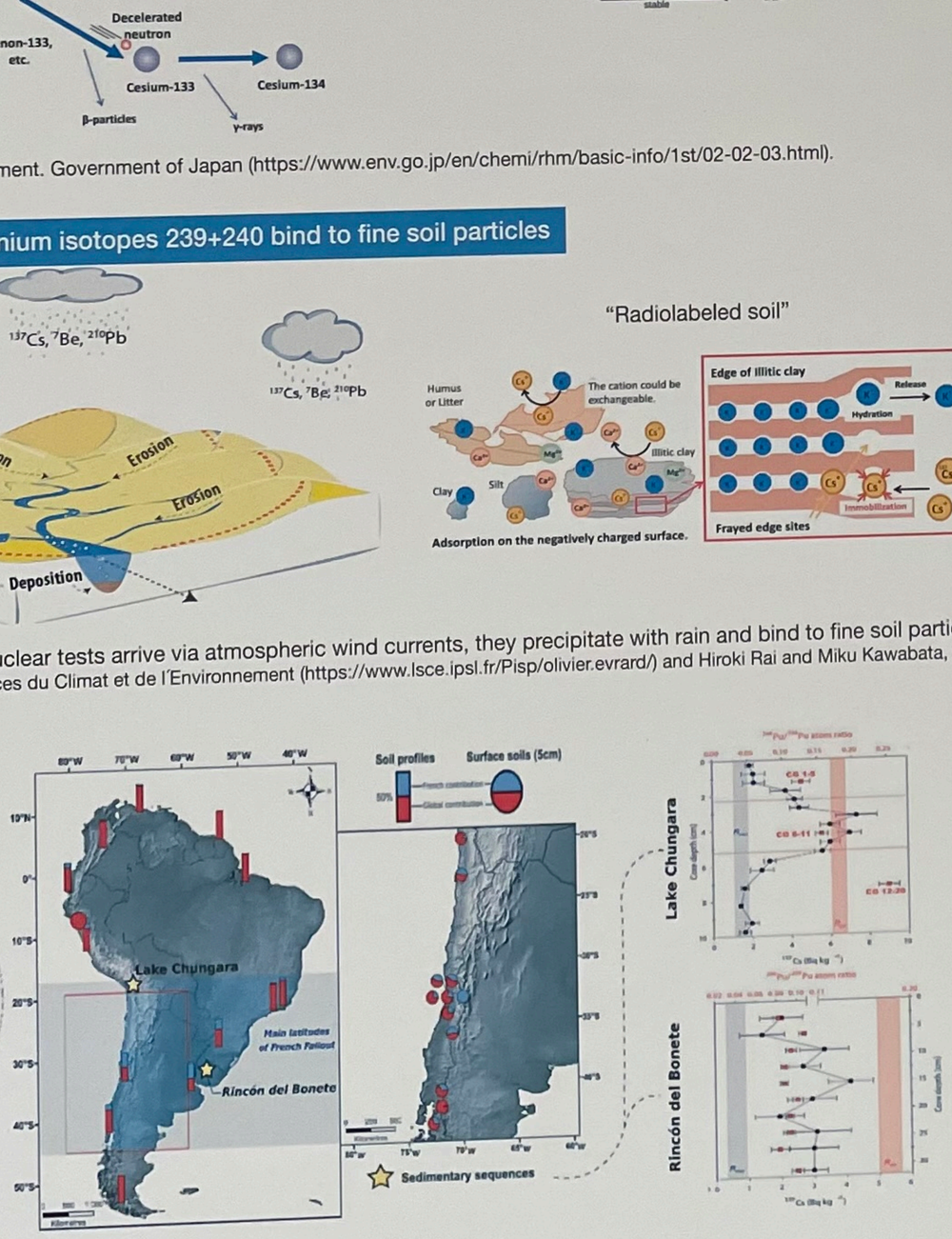
1.2.1 Determine the absence or presence of radioactive material from artificial origin in the soils of the study area.

1.2.2 Determine background levels of radioactive elements (^{137}Cs, ^{234}Th, ^{232}Th, ^{238}U, ^{235}U, ^{240}Pu y ^{239}Pu) in the area of interest.

1.2.3 Generate a distribution model of radioactive elements in the soils of the study area.

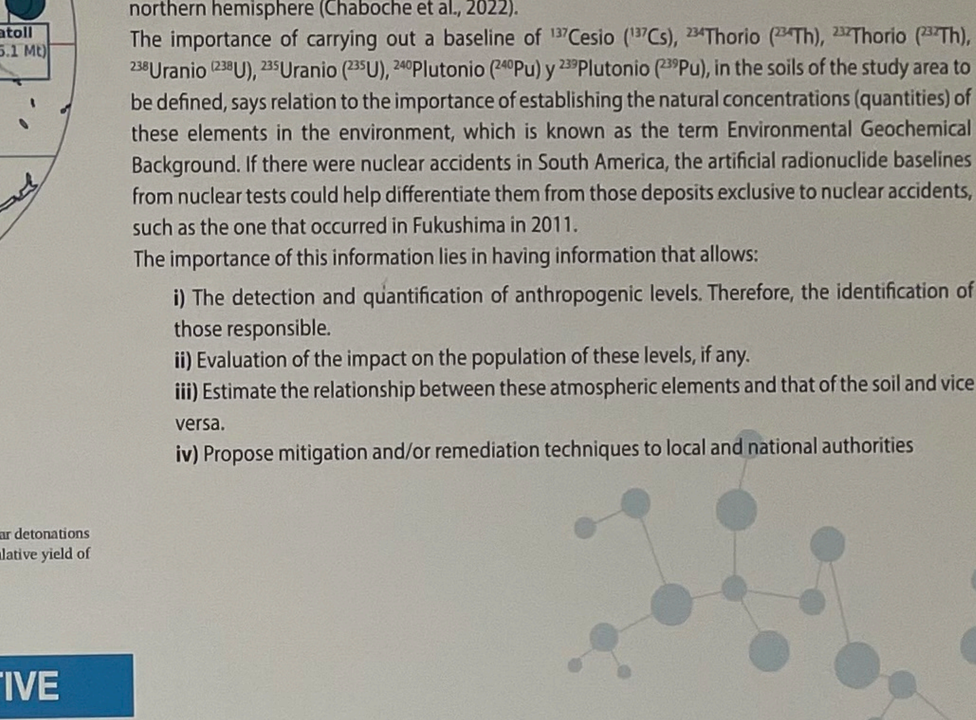
1.2.4 Analyze the origin of the radioactive material and its relationship with the atmospheric composition.





Source: Chaboche et al., 2022

After radionuclides from nuclear tests arrive via atmospheric wind currents, they precipitate with rain and bind to fine soil particles.
Source: Laboratoire des Sciences du Climat et de l'Environnement (https://www.lsce.ipsl.fr/Pisp/olivier.evrard/) and Hiroki Rai and Miku Kawabata, 2020.



2. METHODOLOGIES

2.1. FIELD WORK

To meet the objectives, a 15-day field work is proposed in order to collect approximately 150 samples of surface soil. The samples will be collected by applying an Eijkelkamp brand auger, in order to take samples of undisturbed soils, corresponding to superficial and deep samples. The use of plastic shovels is also contemplated in those places where the use of an auger is not possible.

Marcos Tassano, 2023

Gamma spectrometry, Marcos Tassano, 2023

2.2. ANALYTICAL WORK

Once the samples are acquired, they will be prepared to measure the radioactive elements (^{137}Cs, ^{234}Th, ^{232}Th, ^{238}U, ^{235}U, ^{240}Pu y ^{239}Pu). The analyzes will be carried out in the reactor of the Chilean Nuclear Energy Commission and in laboratories trained for the measurement of ^{240}Pu/^{239}Pu and the measurement of ^{137}Cs through gamma spectrometry.

2.3. DATA PROCESSING

Once the concentrations of the measured variables are obtained, the development of specific objectives 1, 2, 3 and 4 will proceed.