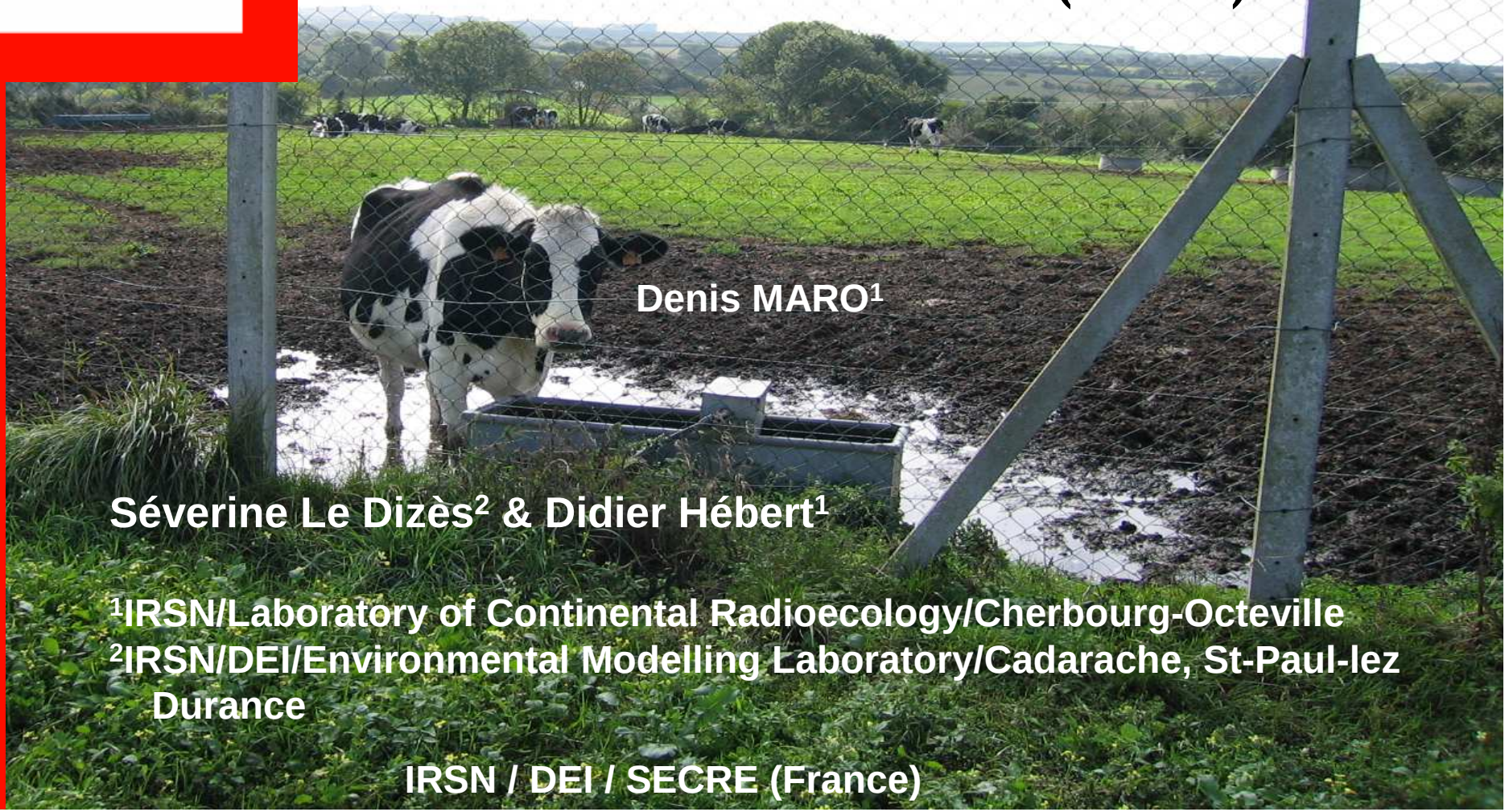
TRANSFER STUDY OF ^{14}C and ^{3}H BETWEEN AIR, GRASS AND COWS : VALIDATION OF TOCATTA MODEL (VATO)



Denis MARO[1]

Séverine Le Dizès[2] & Didier Hébert[1]

[1]IRSN/Laboratory of Continental Radioecology/Cherbourg-Octeville
[2]IRSN/DEI/Environmental Modelling Laboratory/Cadarache, St-Paul-lez Durance

IRSN / DEI / SECRE (France)

Context

❖ Uncertainties in transfer models of ^{14}C and ^{3}H in rural environment in case of accidental release due to a lack of global experimental data

❖ In general transfer models are based on constant isotopic ratio and this concept is not very appropriate with accidental releases

Necessary to acquire well-documented new data of concentrations of ^{14}C and ^{3}H in different compartments of the rural environment

Objectives

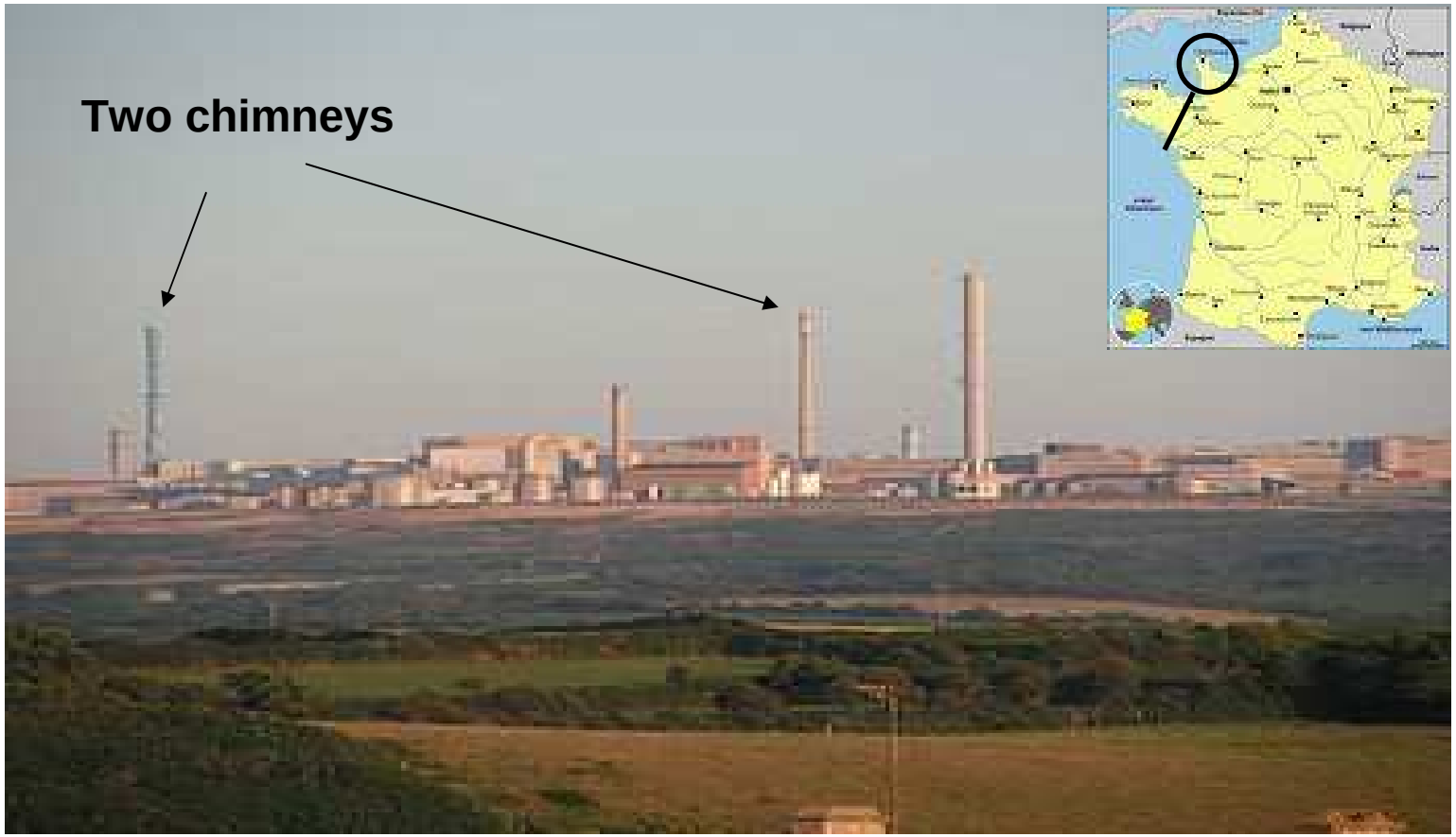
❖ Estimate fluxes of **^{14}C** and **^{3}H** in a grassland ecosystem (*Raygrass***)**, in relation with :

- ^{14}C and ^{3}H concentrations in air,
- Climate conditions,
- Land use (grazing, silage maize and hay).

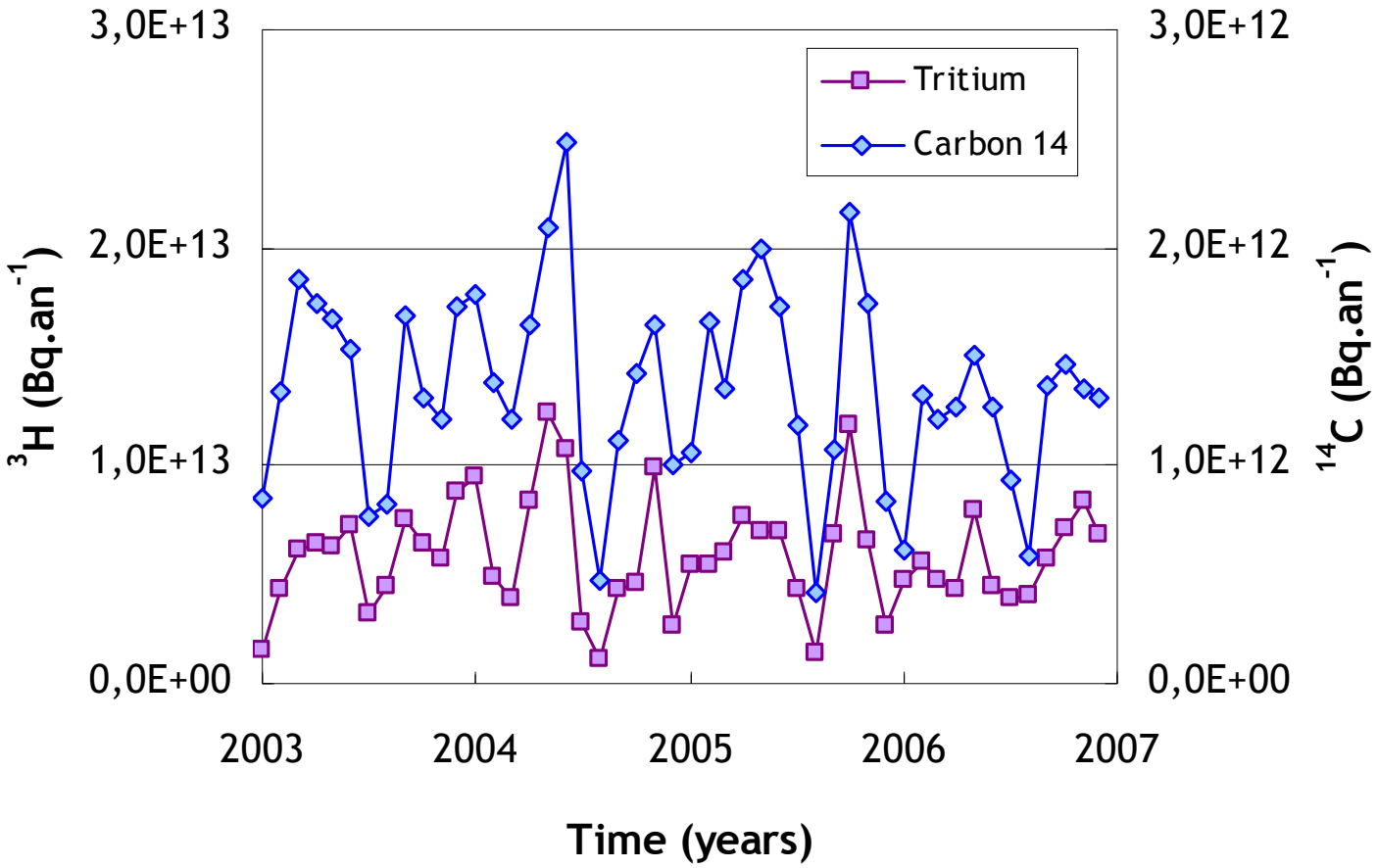
❖ Study transfers of ^{14}C and ^{3}H to cows and milk in function of the alimentary diet.

In order to improve the TOCATTA model or another model

❖ Originality : Using the atmospheric release of radionuclides of AREVA NC La Hague reprocessing plant to quantify the transfers of ^{14}C and ^{3}H in rural environment

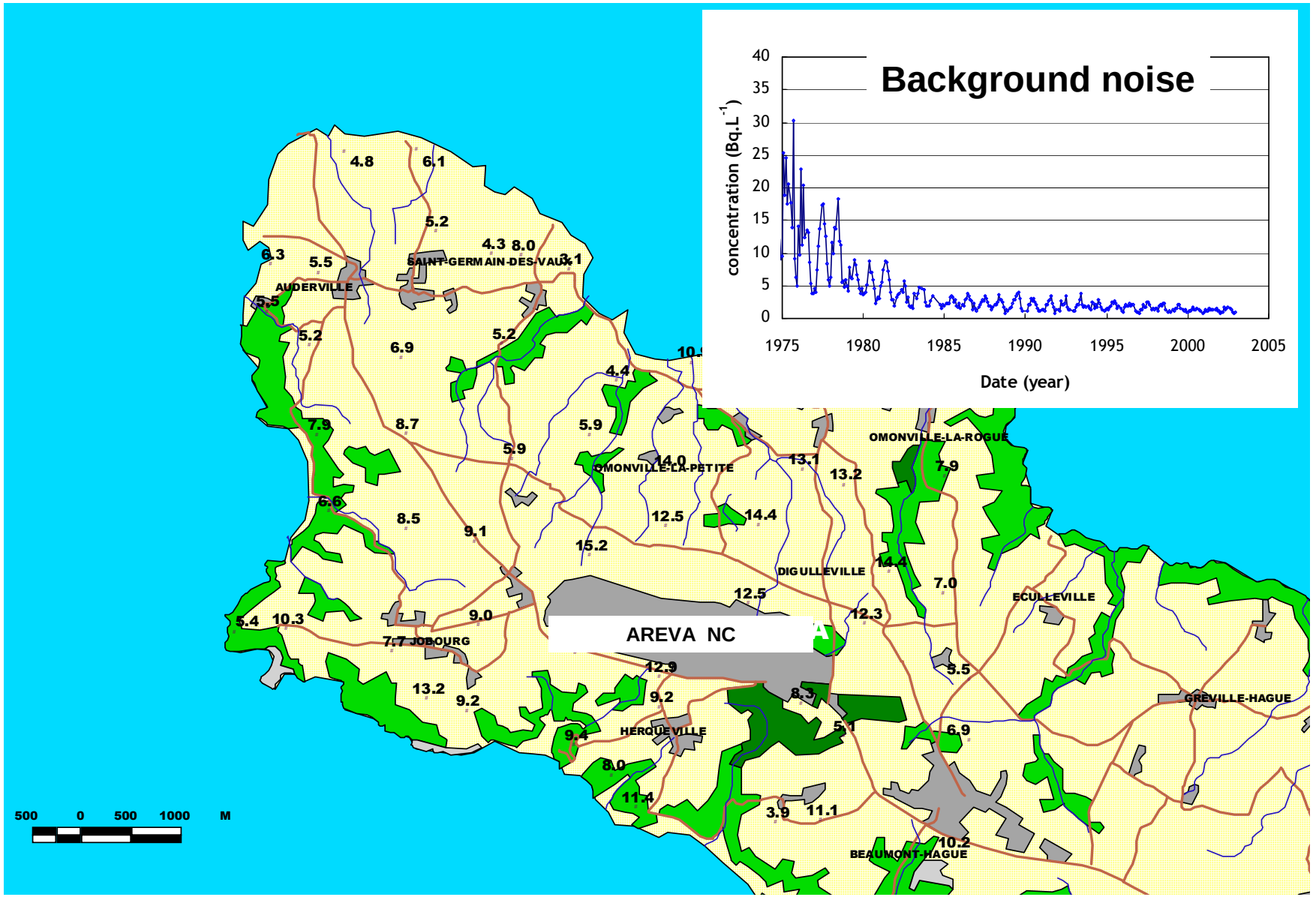


^{14}C and ^{3}H atmospheric releases

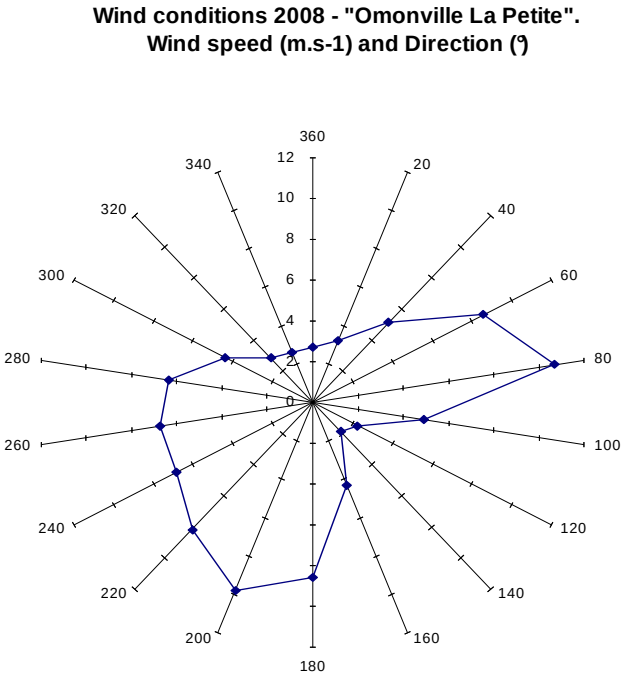


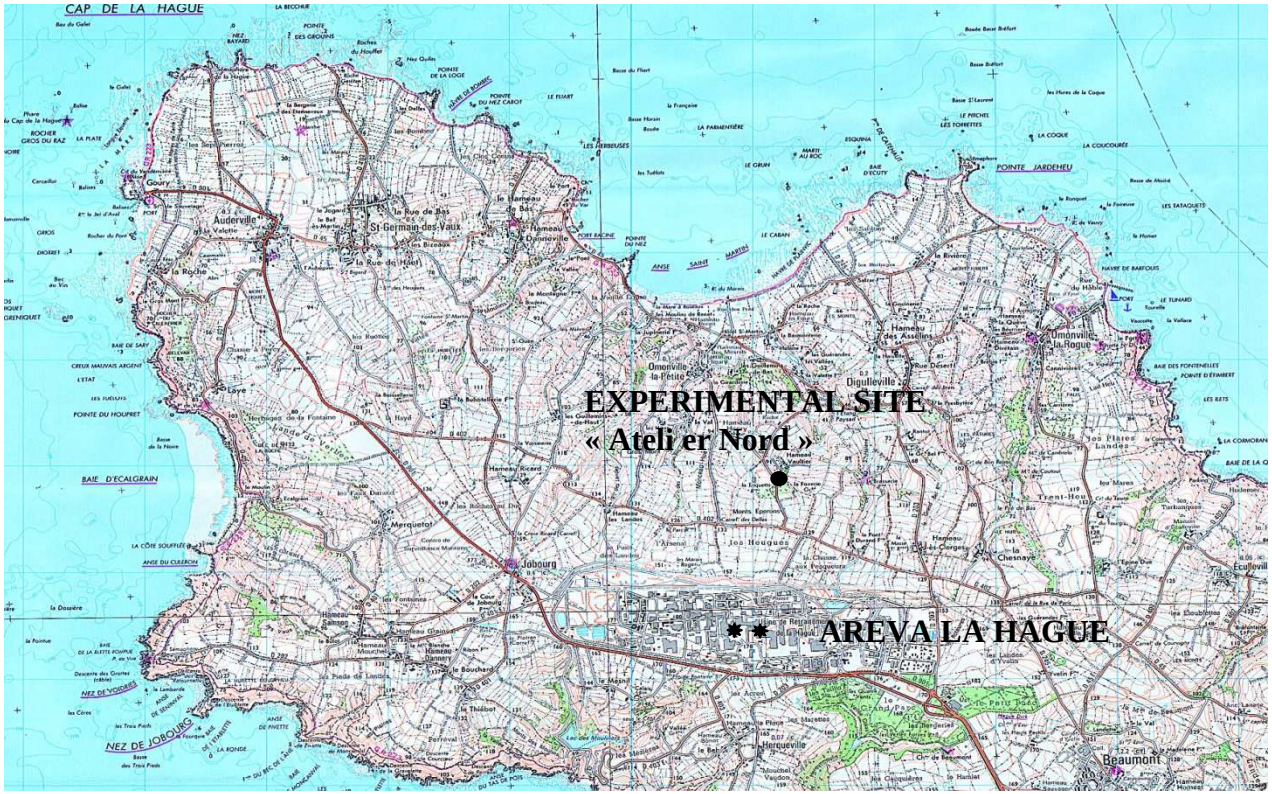
Lead to greater concentration than the background level in the environment

Example of OBT concentration measured in furze



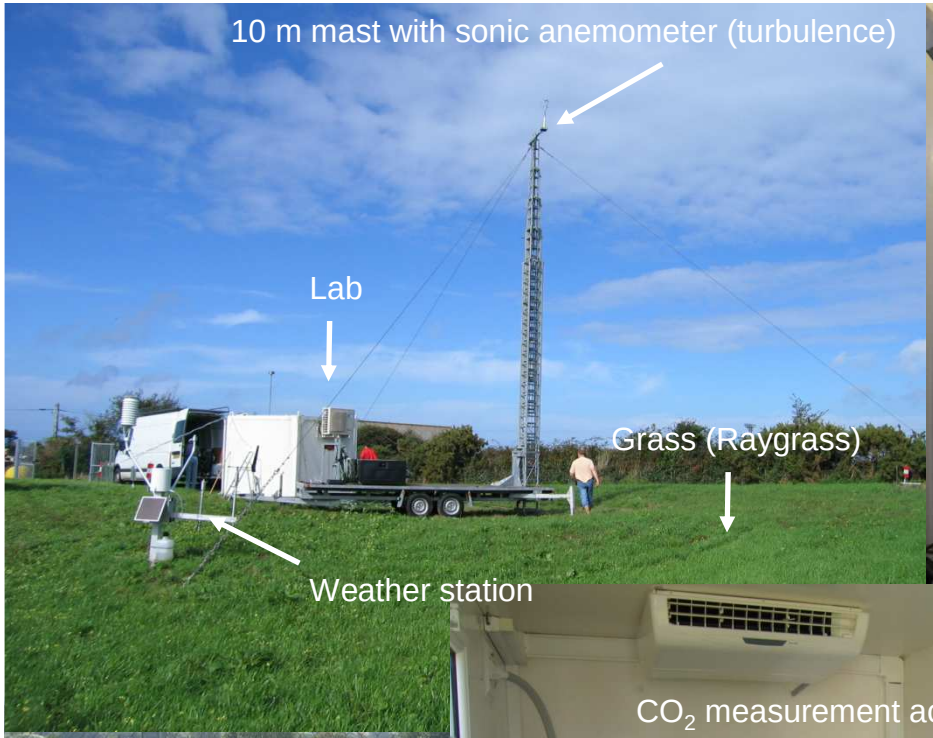
Site location

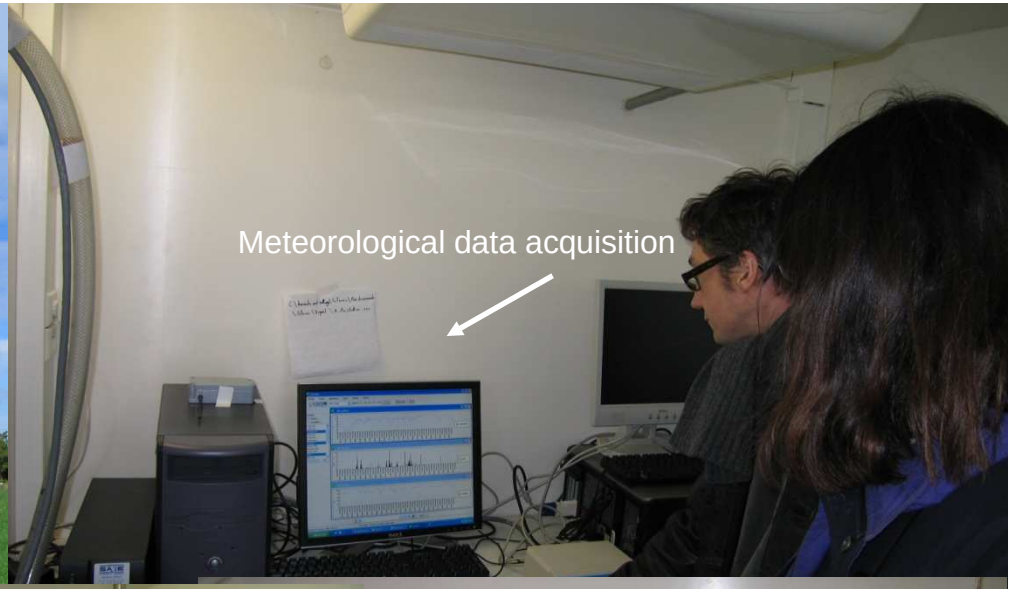


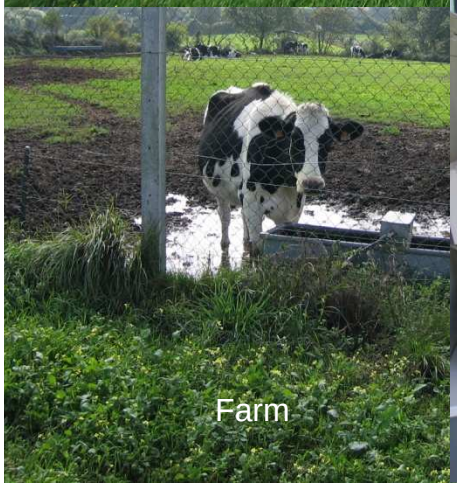


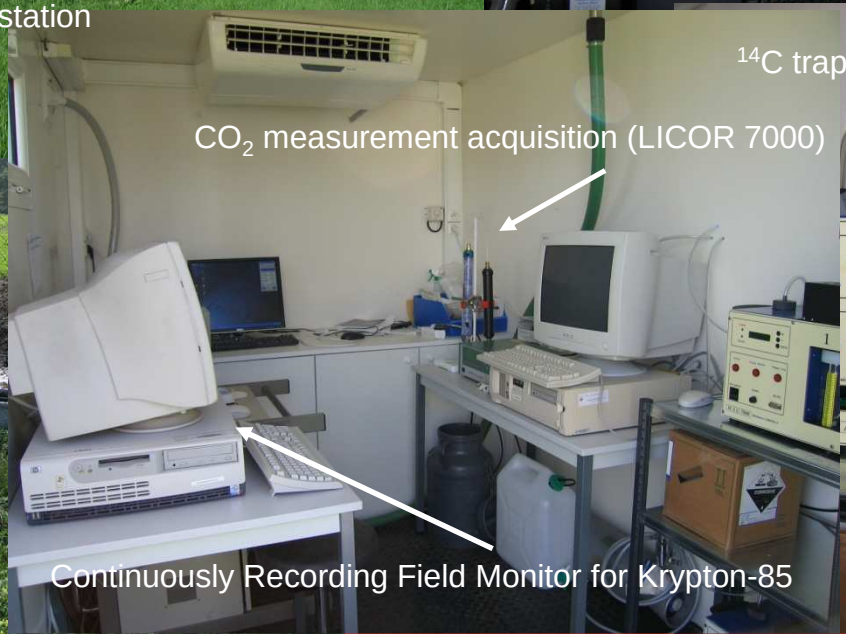
« Atelier Nord » : a well located experimental site, considering the most frequent wind direction

Experimental design (sampling periodicity 1 month)

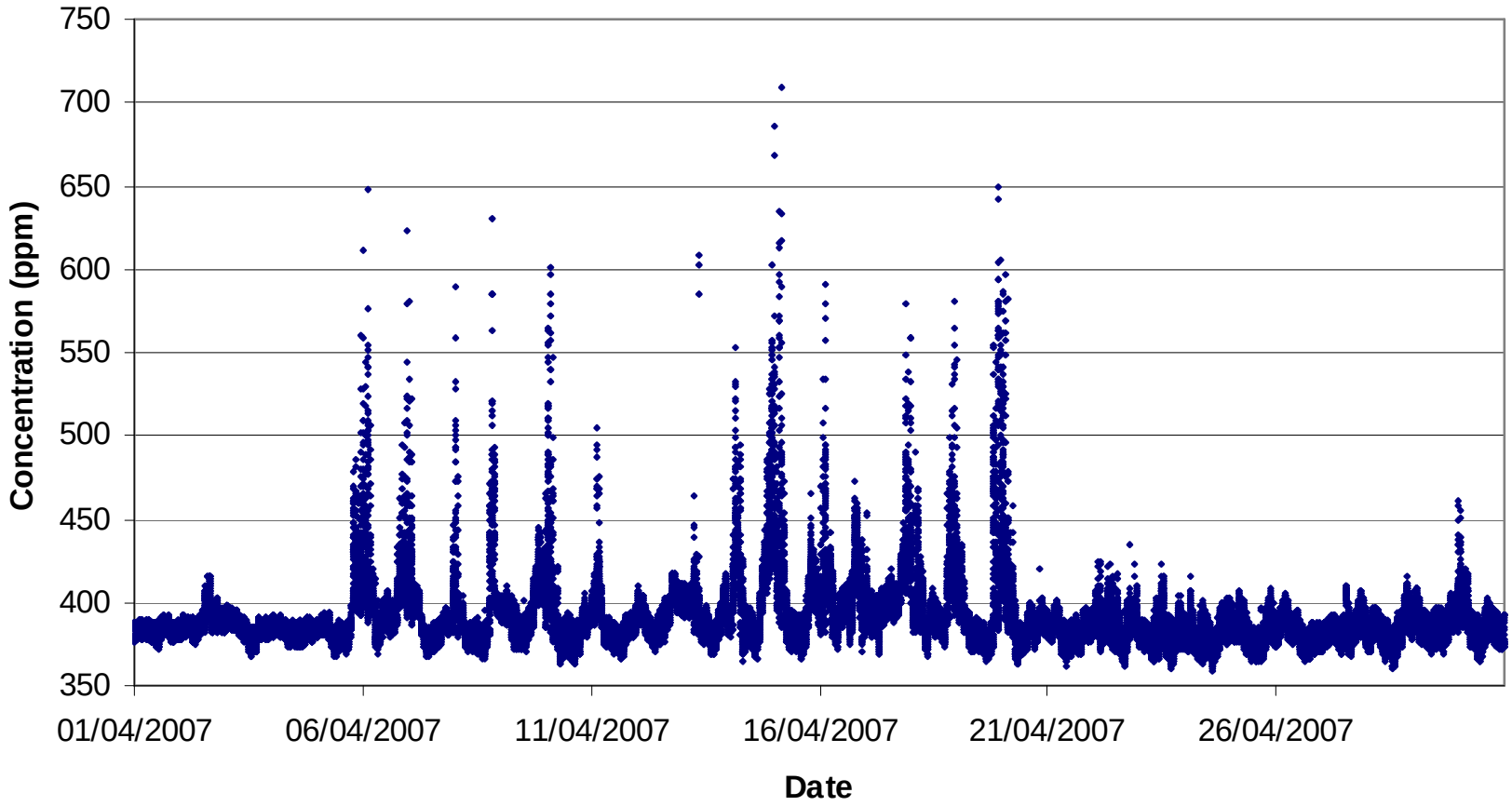




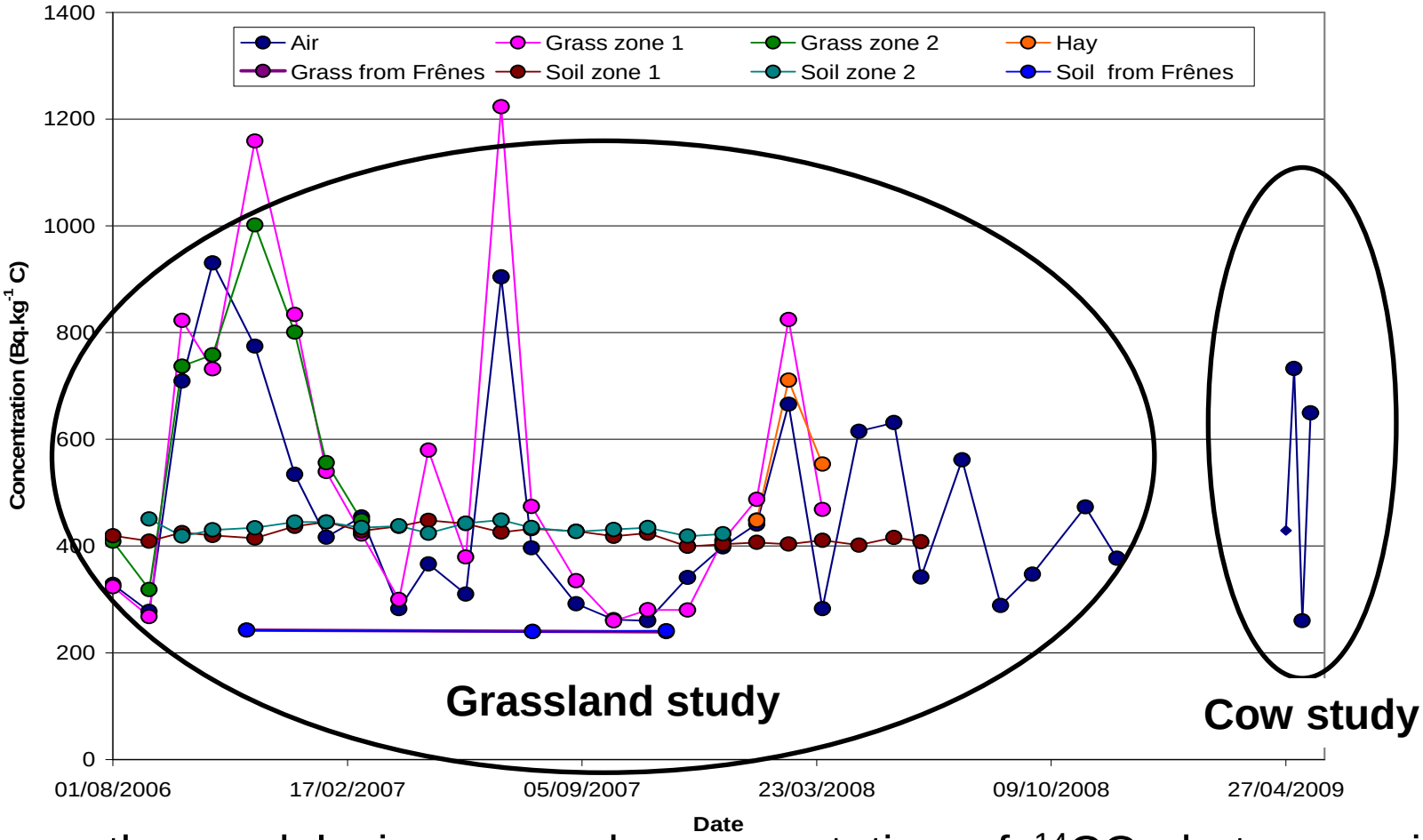




Example of CO_2 atmospheric concentrations



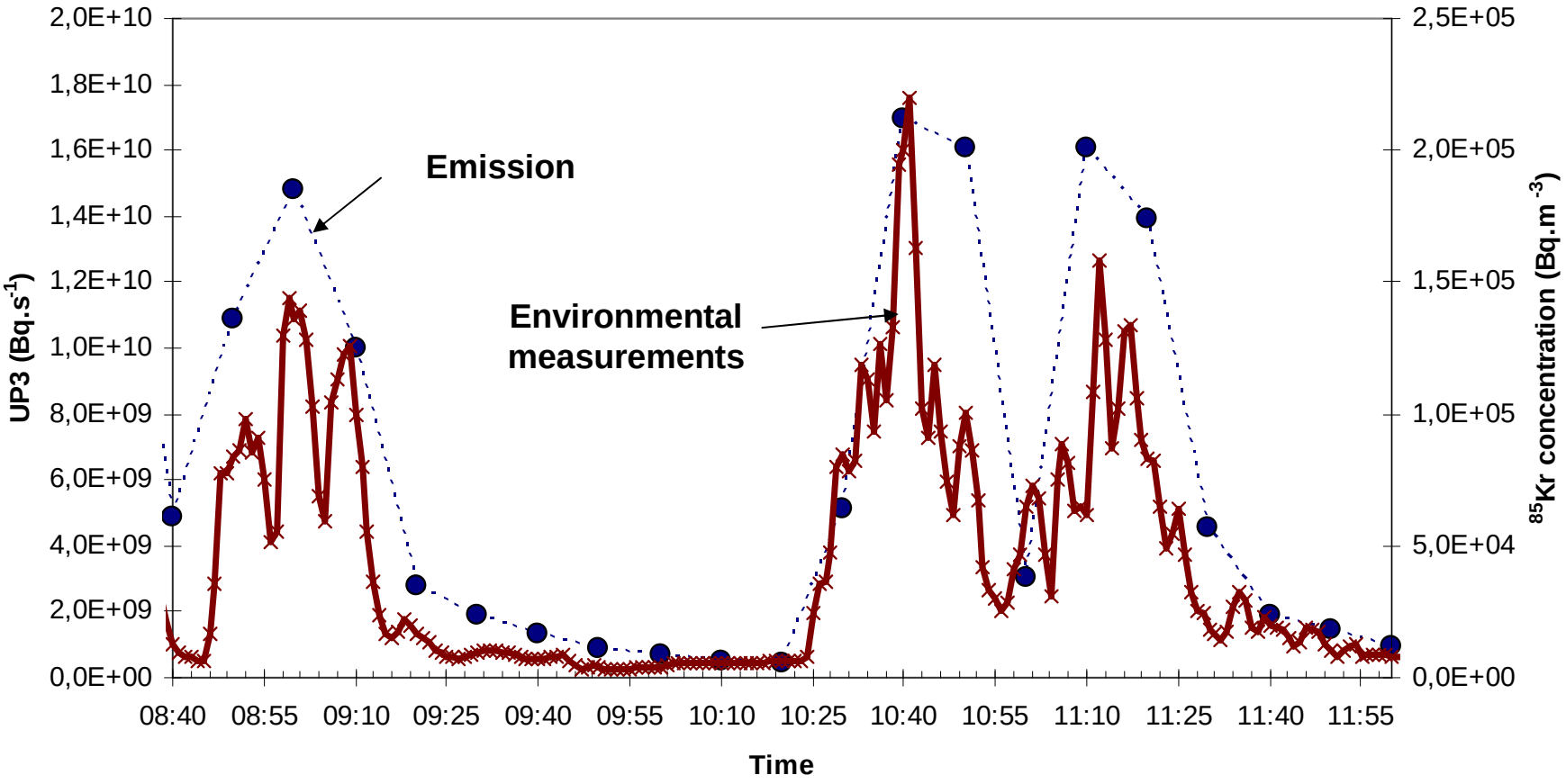
Example of ^{14}C concentrations



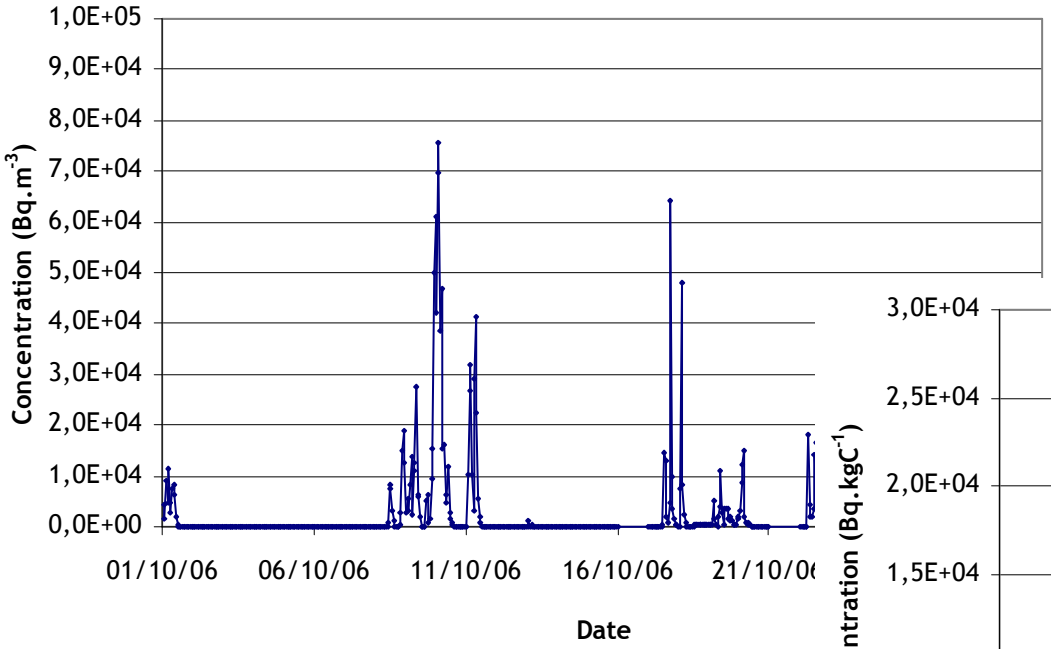
Does the model give a good representation of $^{14}CO_2$ between air and grass? No, as it uses constant isotopic ratio (no photosynthetic process)

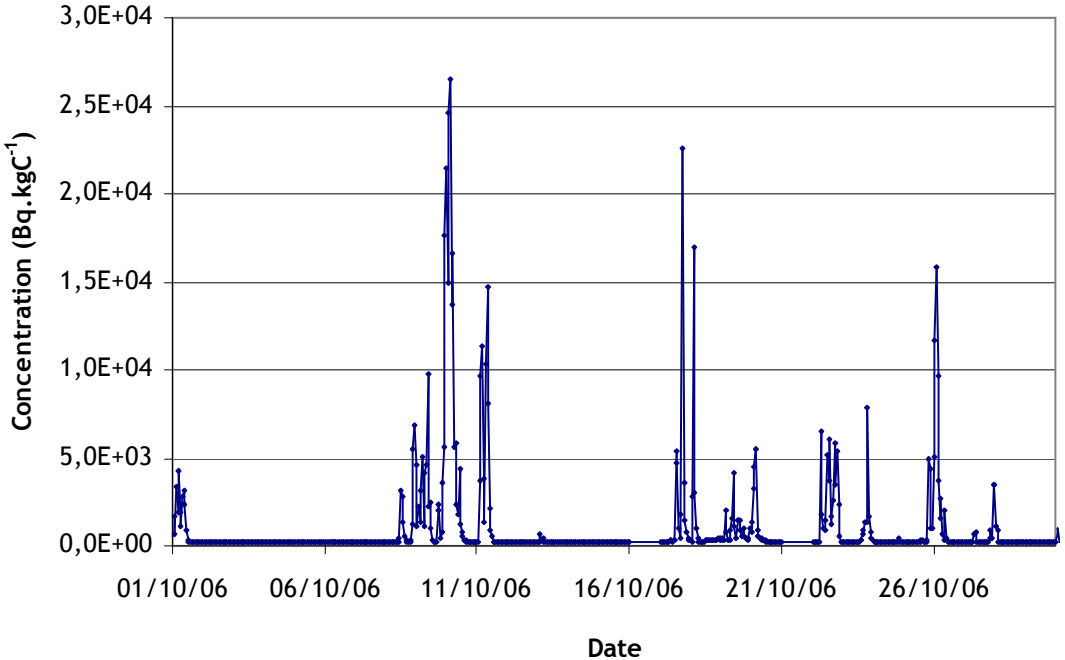
To get a better model-measures comparison : need to rebuild ^{14}C atmospheric concentrations on an hourly basis and use a dynamic model

Krypton 85 : a plume tracer measured with short periodicity (1 minute) compared with ^{14}C (1 month)



Krypton 85 : a good indicator of ^{14}C atmospheric dispersion over a short periodicity





Need to rebuild hourly ^{14}C atmospheric concentration with hourly ^{85}Kr concentration and monthly ^{14}C concentration

To obtain more precise ^{14}C atmospheric concentrations for calculations

Conclusion

- The results analysis needs dynamic modelling of ^{14}C and ^{3}H in plants, it's necessary to take into account the modelling of photosynthesis
- Concerning ^{3}H modelling in case of accidental release, it is also necessary to consider water transfer processes with a dynamic approach based on a short time step

- Ongoing discussions with INRA (Clermont-Ferrand) to use the PASIM* model
- PASIM* is a biogeochemical grassland ecosystem model that simulates fluxes of C, N, water and energy at the soil-plant atmosphere interface with hourly step time

*Riédo et a., 1998. A Pasture Simulation Model for dry matter production, and fluxed of carbon, nitrogen, water and energy. Ecol. Model. 105, 141-183.

Agenda

Carbon 14

2007-2009 : Transfers between air, grass and soil

2009-2010 : Transfers to cow

2009-2010 : Model-measures comparisons

2010/2011 : Publication

Tritium

2010 : Measurement (speciation of ^{3}H releases in air)

2010-2011 : Transfers between air, rain water, grass and soil… dry and wet deposition

2012 : Transfers to cow

2011-2012 : Model-measures comparison

2012 : Publication


Thank You