Risk of Cancer Related to Exposure to Municipal Solid Waste Incinerators in France

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Introduction

An excess of risk of cancer in the populations living near municipal solid waste incinerators (MSWI) has been highlighted in some scientific publications [1, 2, 3] and caused a concern to the French population exposed to these facilities.

In addition, several occupational studies suggest that dioxin is a human carcinogen in workers [4], however no consistent pattern has emerged on its carcinogenicity in the general population

Objective

The objective of this study is to evaluate the excess of risk of cancer, in France, related to the past exposure to the atmospheric emissions of MSWI

Methods

▶▶ General design

Retrospective ecological study

- **Statistical unit: IRIS** (Îlots regroupés pour l'information statistique) Demographic unit defined by the French National Institute for Statistics and Economic Studies (Insee)
- **Study period:** 1990 -1999
- **Population:** adults of either sex above 14
- **Study area:** 4 French metropolitan administrative areas «départements» (Bas-Rhin, Haut-Rhin, Isère, Tarn) representing
    - 2,272 IRIS and, over the period study,
    - 25,000,000 person-years and 135,567 cases of cancer


Women SIR for all cancer department of Isere
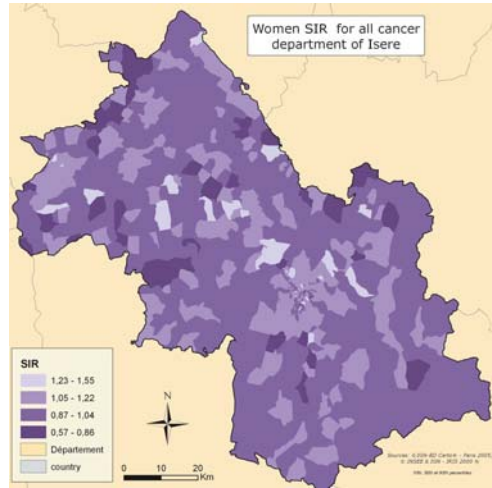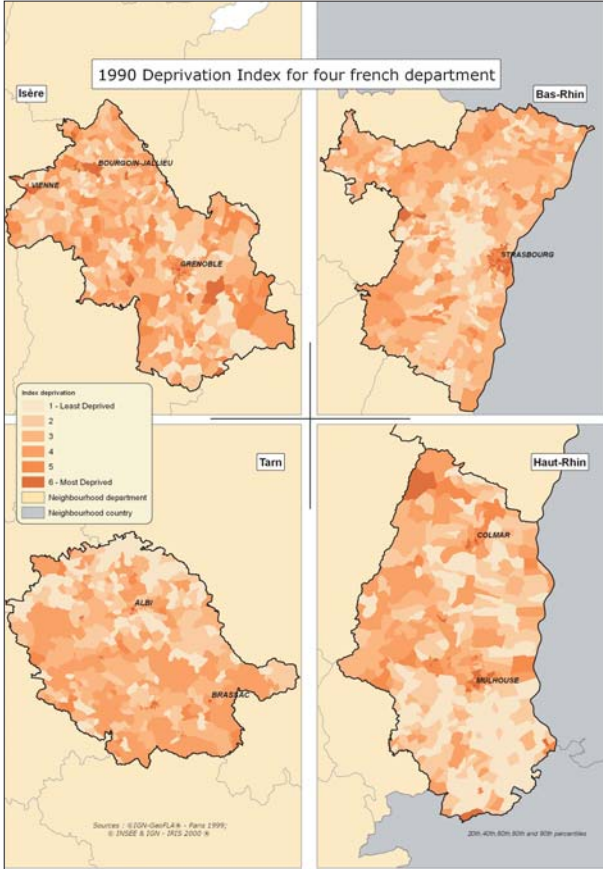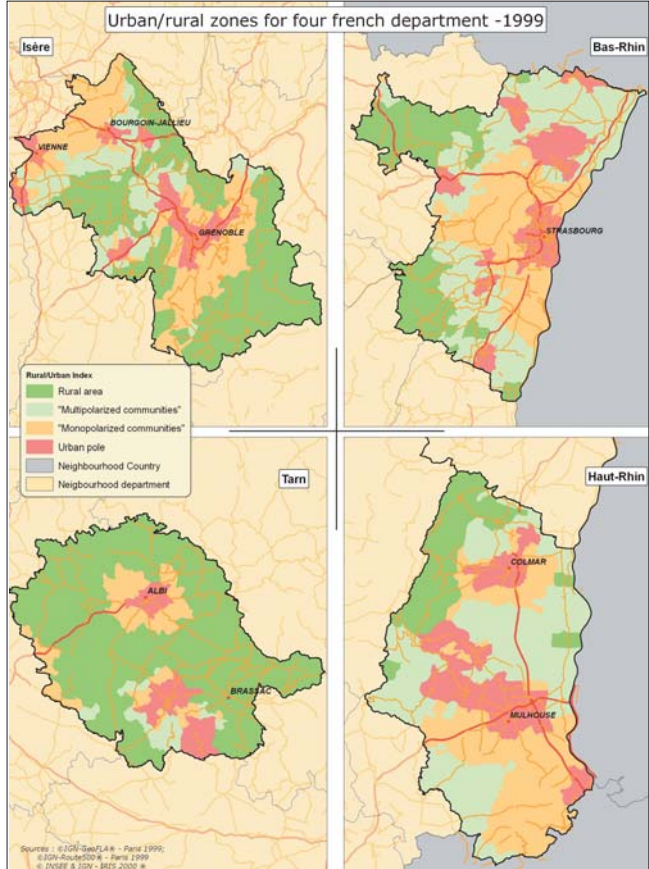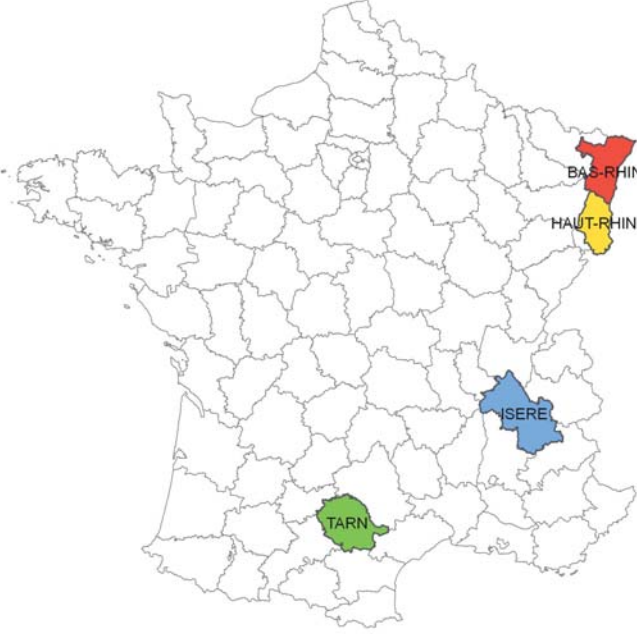
- **Cases:** the study addressed **cancers, whatever the type**, and **specific localizations** (lung, bladder, soft-tissue sarcoma, leukaemia and non-Hodgkin's lymphoma) according with ICD-0-2, ICD-0-3
- **Colleted data on cases:** birth date, gender, date of diagnosis, localization of cancer, home address the day of diagnosis. Data came from the population-based cancer registry of each département
- Address of each case was **geocoded** at the IRIS level, with 99% of success in the process

▶▶ Exposure to the risk factor and co-factors

Estimation of exposure to MSWI

- **16 municipal solid waste incinerators (MSWI)** have been running during the study period
- **Dioxin** (2,3,7,8 TCDD) was considered as a surrogate marker of emitted pollutants
- **Atmospheric dispersion was modeled** by a second generation Gaussian model (ADMS3)
- **Variable of exposure:** mean of annual cumulated deposition of dioxin (over the study period)
- **Duration of exposure:** from the start of incineration operations (earlier:1972) to the beginning of the latency period (5 years for leukaemia, 10 years for other localizations)
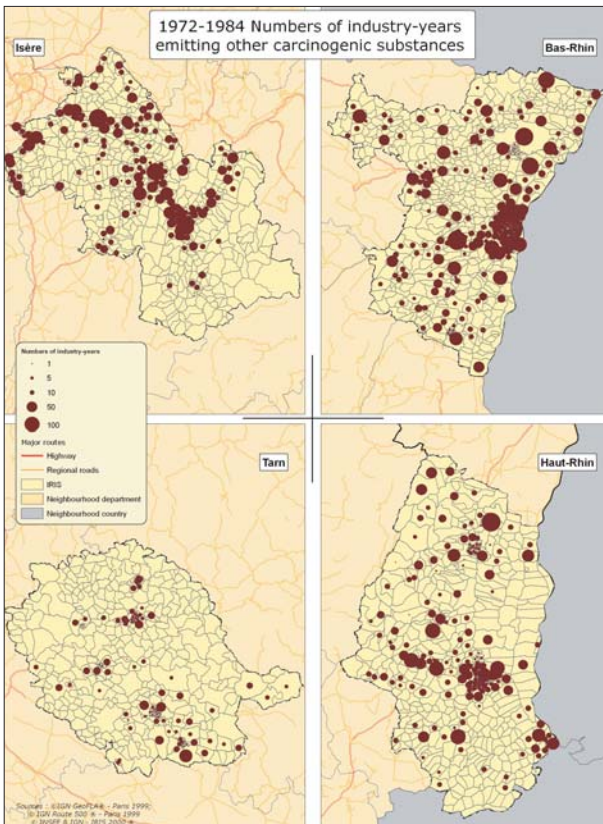

1972-1984 Modelling of the yearly soil deposition of dioxin at MSWI La Tronche (Isère)
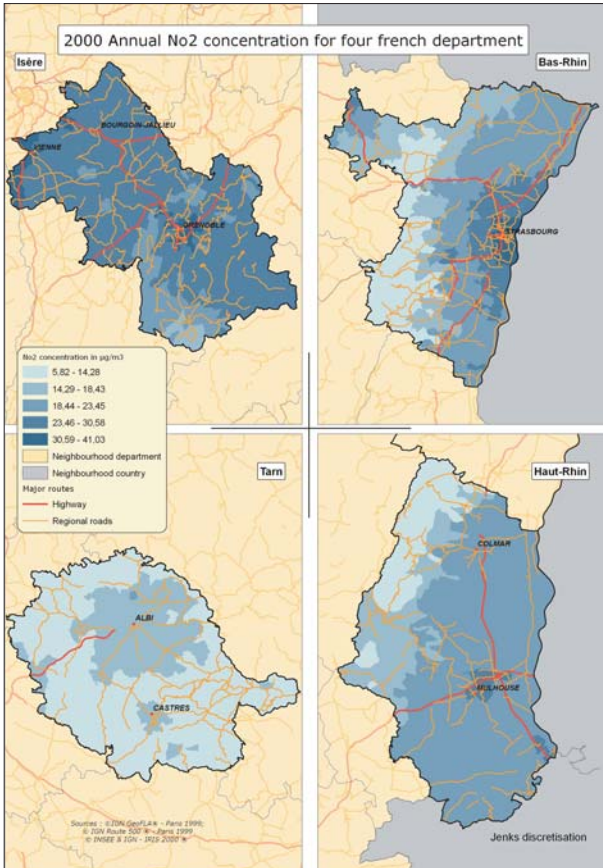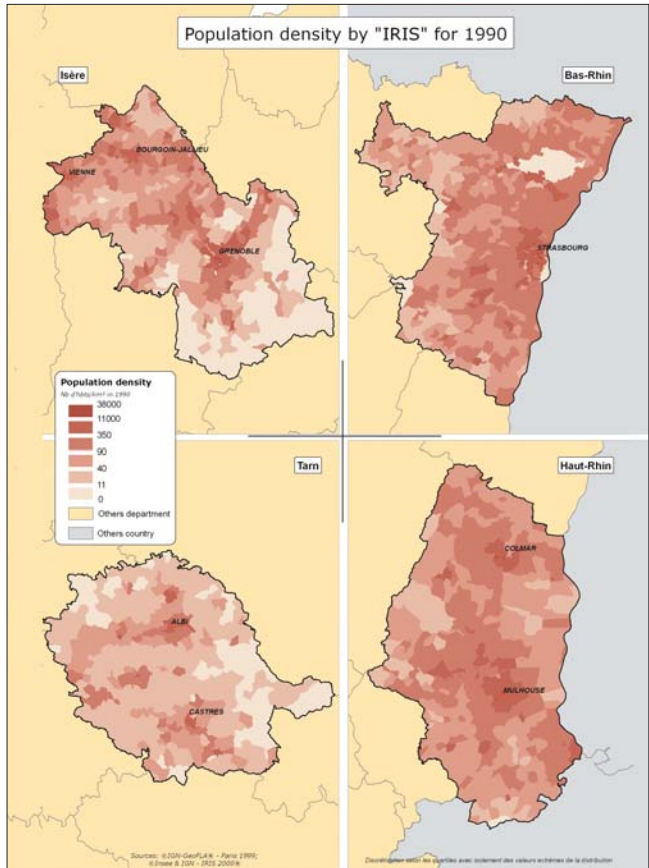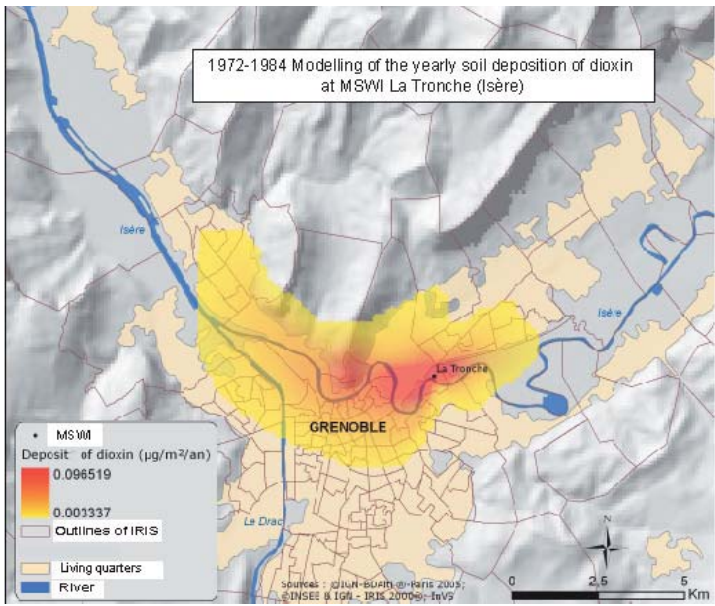
Confounding factors

- **Urban/ Rural status** (data from Insee, 1999)
- **Socio-economic deprivation** (index defined by a principal component analysis of Insee's data, 1990 census)
- **Population density** (data from Insee, 1990 census)
- **Air pollution from traffic:** NO2 air concentrations (WHO II project, 2000)
- **Pollution to other industries:** number of industry-years (data from Insee, 1972-1984 period)

Development of a **Geographic Information System** (GIS) to localize cases of cancer and define exposures at the IRIS level

▶▶ Statistical analysis

- **Poisson regression**
- **Generalized additive models** with a function of the coordinates of the centroid of the IRIS
- **Bayesian hierarchical analysis** accounting for over dispersion

Urban/rural zones for four french department -1999

1990 Deprivation Index for four french department

Population density by "IRIS" for 1990

2000 Annual No2 concentration for four french department

1972-1984 Numbers of industry-years emitting other carcinogenic substances

Preliminary results on 2 cancer localizations

- The table on the right presents the relative risks and their 95% confidence interval for an increase of the exposure index from the 5th to the 95th percentiles.
- We can observe a positive association for the 2 first localizations studied. In women, it is a positive significant association for all cancers while it is close to statistical significance for lung cancer.
- *Note that this work is still in progress !*

Localizations	N	RR	95% CI
All cancers for Women	59,284	1.052	(1.018- 1.087)
Lung cancer for Women	1,990	1.141	(0.998- 1.304)

Discussion

Strengths

- Large size of population sample
- High rate of success in geocoding home addresses
- Description of exposure to MSWI emission using a reliable dispersion model and a GIS
- Several confounding factors taken into account

Limits

- Well-known biases of ecological studies (i.e. individual smoking status, people migration)
- Use of recent data (for air pollution and rural/urban status) to describe exposure in the past
- Relative weakness of results for some cancer localizations regarding the small number of cases

In favor of a potential carcinogenic risk associated with residential exposure to carcinogens emitted by MSWI, these epidemiological elements need to be supported by further investigations.

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