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International Centre for Theoretical Physics**



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Gamma Ray Spectrometry**

26 - 30 October 2009

**Role of ARPA-Friuli-Venezia Giulia and description of the in-situ gamma
spectrometry field exercise**

C. Giovani & M. Garavaglia

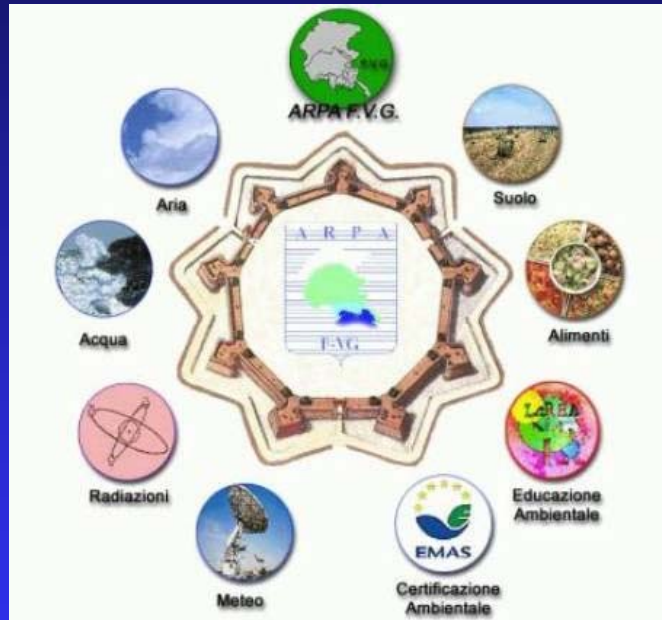
ARPA

Udine

Italy



Environmental Radioactivity Monitoring in Friuli Venezia Giulia: Role of ARPA



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Environmental Radioactivity Monitoring in Italy



<http://www.apat.gov.it/site/it-IT/APAT>



The National Network for the Surveillance of Environmental Radioactivity in Italy

After Chernobyl accident (1986.04.26) a national network for the surveillance of environmental radioactivity was born in Italy.

21 regional laboratories (19 regions and 2 autonomus provinces) compose the network that is coordinated by APAT.

After realization of regional structures the national network includes:

- **Local networks:** responsible for monitoring the immediate surroundings of the nuclear power plants and other significant facilities (potential) (*source related*);
- **Regional networks:** responsible for monitoring and controlling general radioactivity levels at regional level (*source related/person related*);
- **National network:** responsible for providing the general framework of the situation in Italy, for the purpose of assessing the population dose, regardless of the local situations (*person related*).





The National Network for the Surveillance of Environmental Radioactivity in Italy

National Network includes:

- *RESORAD network*: (Coordinated by ISPRA) network of sampling and measurements carried out by ARPA and other institutions
- *Alarm APAT networks*: GAMMA network (AIR gamma dose) and REMRAD network (Airborne particulate matter)
- *Interior Ministry network*: Fireman network





RESORAD network



RESORAD sampling and measurement table

Matrix	Sampling frequency	Radiometric measurement frequency	Principal radio nuclides
Airborne particulate matter	Daily	Monthly	Gross Beta, Cs-137
Fall out	Monthly	Monthly	Cs-137, Be-7, Sr-90
Drinking water*	Six-month	Six-month	Cs-137, Sr-90
Aquatic environmental matrix	six-month	six-month	Cs-137, Sr-90
Meat	Monthly	<u>Trimonthly</u>	Cs-137
Fish			Cs-137
Cereals and by-products	Seasonal	Seasonal	Cs-137, Sr-90
Pasta	<u>Trimonthly</u>	<u>Trimonthly</u>	Cs-137
Vegetables	Seasonal	Seasonal	Cs-137, Sr-90
Fruit	Seasonal	Seasonal	Cs-137
Milk	Weekly/ Monthly	Monthly	Cs-137, Sr-90

**Only a fraction of measurement provided for by the law are considered*



The National Network for the Surveillance of Environmental Radioactivity in Italy: the Agencies' System

➤ According to Art. 104 of the Legislative Decree 230/95, and subsequent amendments and integrations, the national network for the surveillance of environmental radioactivity is the instrument to estimate the exposure of the population due to diffuse sources.

➤ European Recommendation 2000/473/Euratom of June 8th, 2000 provides indications to member countries on the conducting of environmental radioactivity monitoring.

➤ Most of the data are collected by Regional Reference Centres for Environmental Radioactivity (CRR) of the Regional and Autonomous Provinces Agencies for Environmental Protection.

➤ At the end of 2002, the network for radioactivity surveillance was reorganized, also considering the lack of homogeneity on the geographical level.





SINANET

(National Environmental Information System)



















MCE: Main Component Element
ETC: European Topic Centre
NFP: National Focal Point

EEIS: European Environmental Information System
IPR: Main reference Institutions
PFR: Regional Focal Point

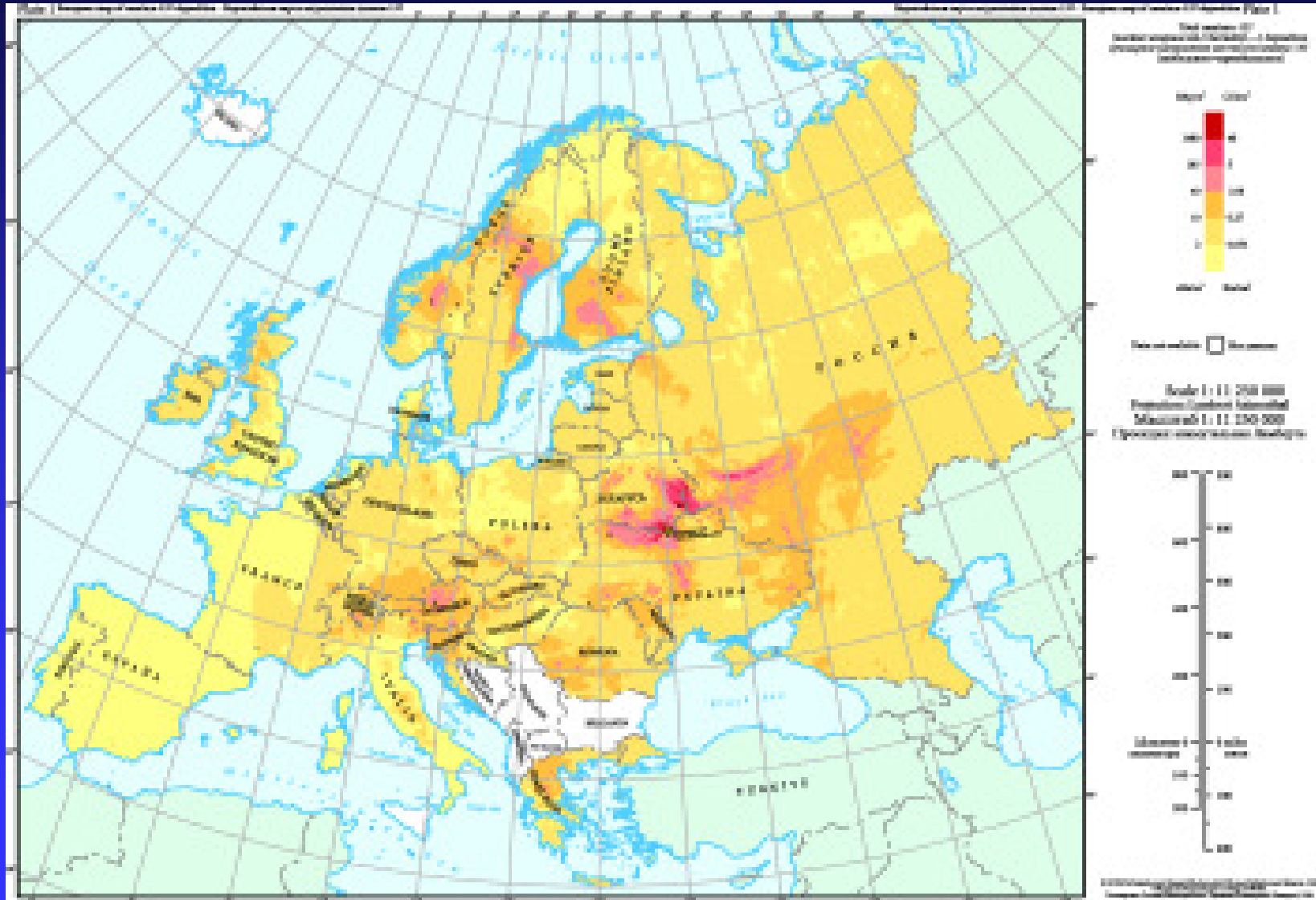


Products

Indicator	Theme	Policy issue	DPSIR 	Assessment
 Access to basic services [2001]	Transport	Ensure access to basic services by environment-friendly modes	D	
 Access to transport services [2001]	Transport	Provide access to quality transport services for all citizens and all modes	D	
 Accessibility to basic services and markets by transport mode [2003.10]	Transport	Ensure balanced accessibility of regions and markets by different modes of transport	D	
 Accidental and illegal discharges of oil by ships at sea [2001]	Transport	Eliminate pollution by persistent oils and prohibit illegal discharges.	P	
 Accidental and illegal discharges of oil by ships at sea [2002]	Transport	Eliminate pollution by persistent oils and prohibit illegal discharges.	P	
 Accidental by-catch: birds, mammals and turtles [2004.05]	Water	What is the impact of fisheries on habitats, benthos, mammals, birds, and turtles?	I	
 Accidental oil spills from marine shipping [2004.05]	Water	Are we reducing oil discharges from marine shipping?	P	
 Agri-environmental management contracts [2001]	Agriculture	What environmental protection measures are being taken by the sector?	R	

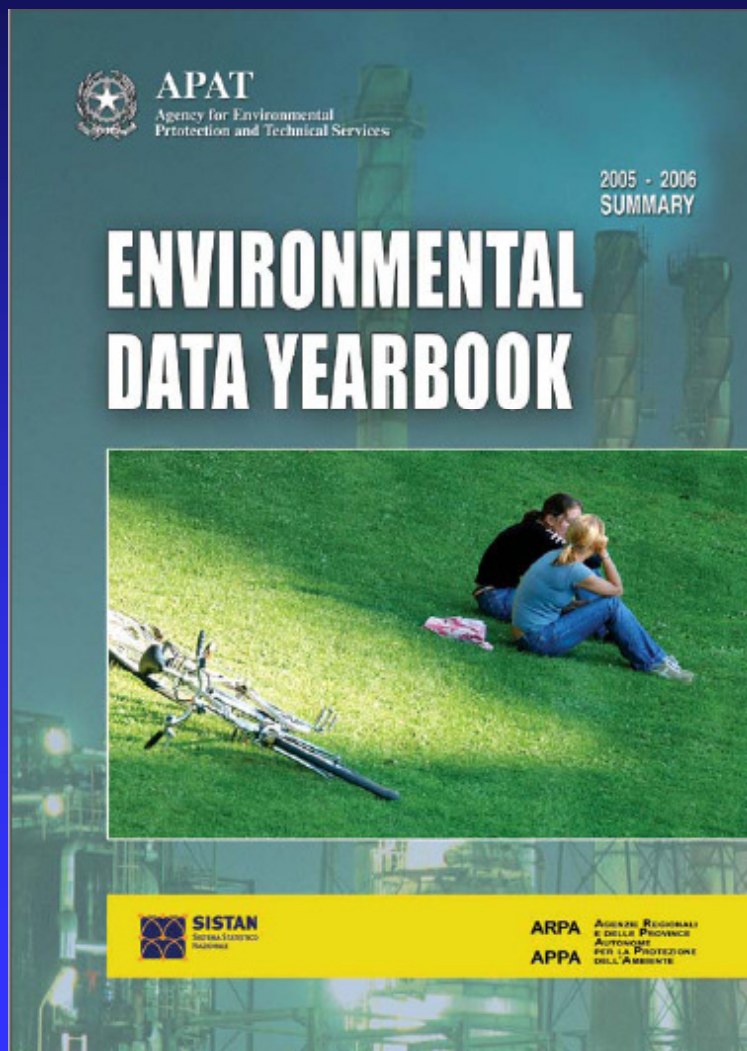


Maps and Graphs





Results of Environmental Radioactivity Monitoring in Italy

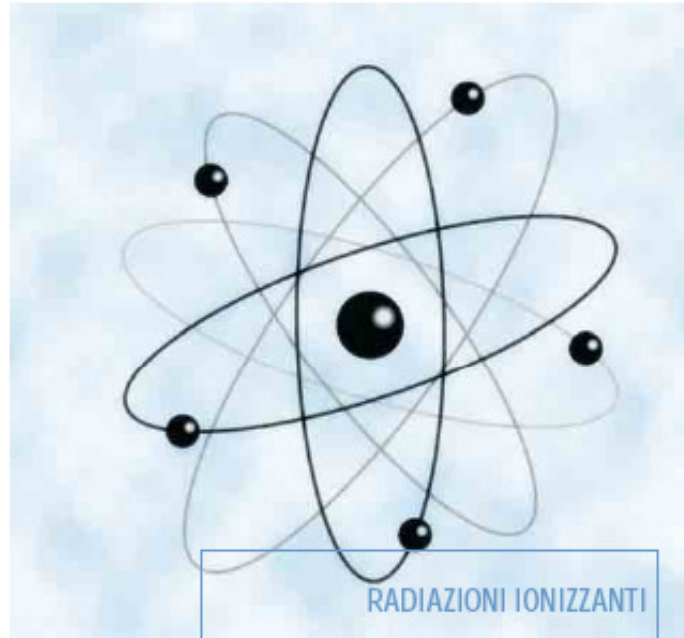


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Environmental Data Yearbook 2004: ionizing radiation



RADIAZIONI IONIZZANTI

CAPITOLO 15

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Annual Average Effective Dose per Person

ANNUAL AVERAGE EFFECTIVE DOSE PER PERSON INDICATOR - A06.009

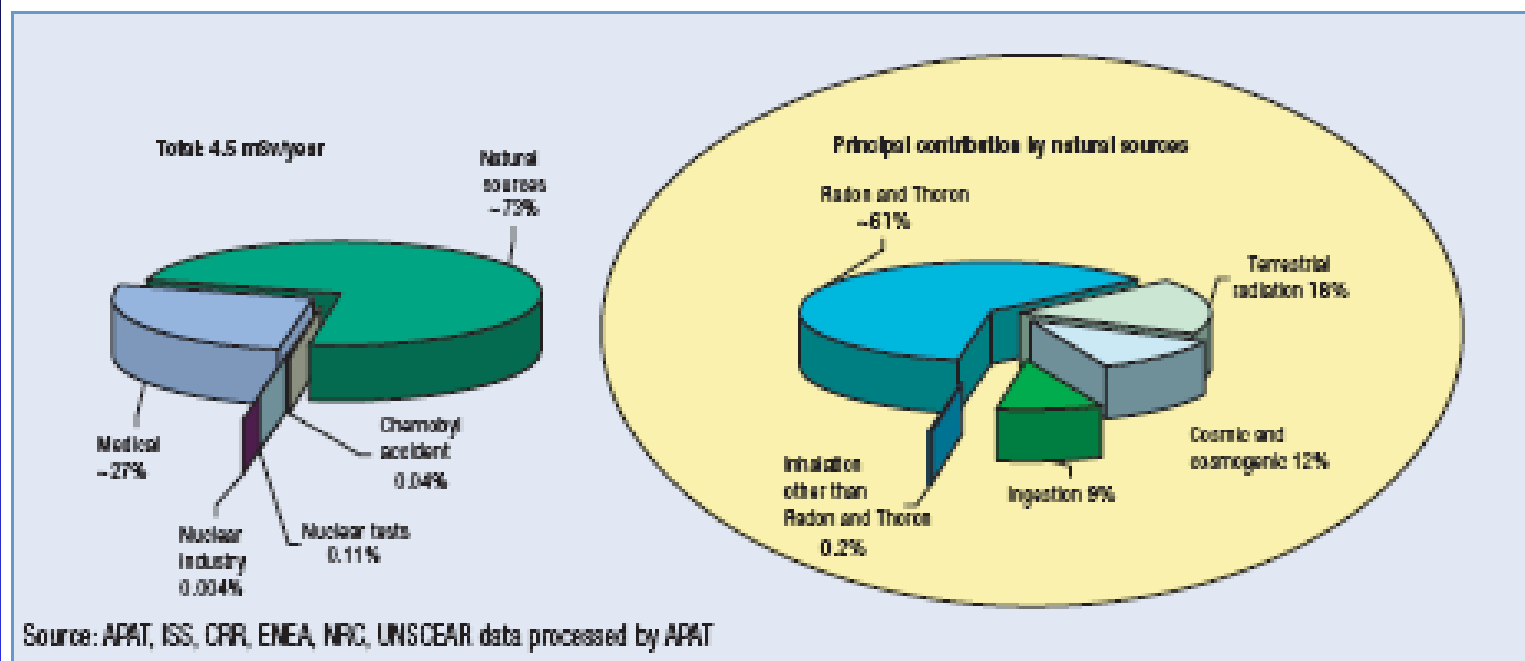


Figure 11.1: Distribution of contributions to the annual average effective dose per person

This indicator gives an approximate estimate of the impact of the principal sources of radiation on the Italian population. From figure 11.1, showing the estimated contributions to the effective dose, it emerges that 73% of the total is due to natural sources. The values shown refer to the averages for the entire population. Higher values, for individuals and groups of the population, may occur in relation to particular cases, for example, the presence of high concentrations of radon in dwellings or workplaces or exposure caused by natural materials in some particular work activities.



Indoor Radon Activity Concentration

Radon is a natural radioactive gas that rises from the soil and accumulates in enclosed environments. It accounts for about 45% of the total effective dose. Radon exposure is associated with an increased risk of developing lung cancer. Figure 11.2 shows the results of a survey, conducted on a statistically representative sample, for determining the mean concentration of radon inside homes (which are the environments where people spend most of their time) in all the Italian regions, while figure 11.3 highlights the regions where, until 2005, surveys were conducted and measures implemented, with a view to identifying high radon risk areas. European guidelines have fixed the indoor radon concentration thresholds - defined as action levels - above which it is recommended to implement measures to reduce the associated risk. These thresholds are 400 Bq/m³ for existing buildings and 200 Bq/m³ for new buildings (as a design parameter). It has been estimated that, in Italy, there are about 800,000 homes with radon concentrations in excess of 200 Bq/m³, and about 200,000 with concentrations above 400 Bq/m³.

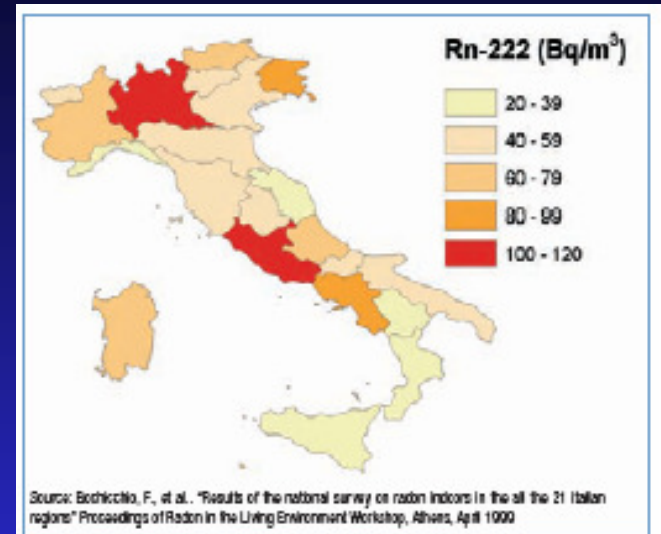


Figure 11.2: Theme map of the activity concentrations of Rn-222 inside homes, by region and autonomous province (the choice of intervals is given only by way of example) (1999-1997)

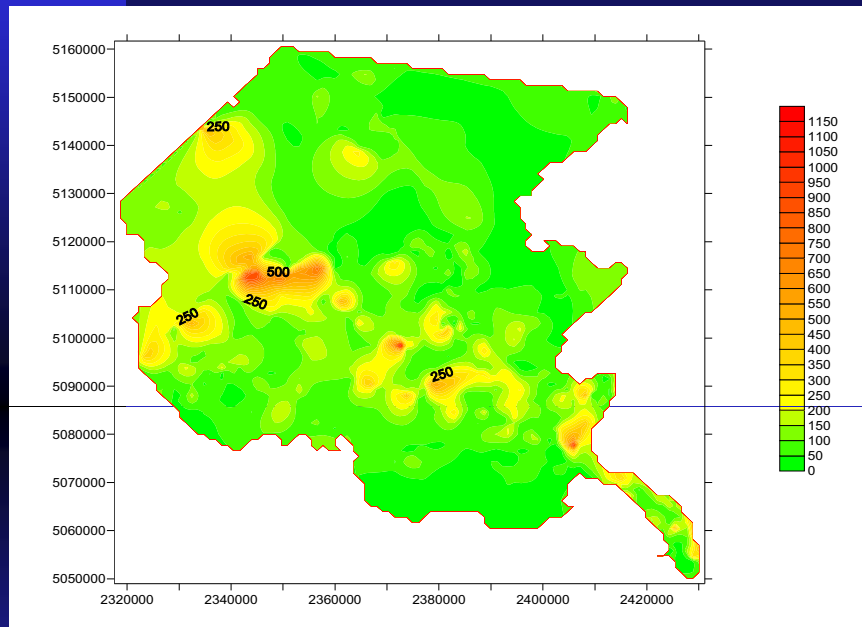


Figure 11.3: Regions where surveys have been conducted and measures implemented to identify radon risk areas (highlighted in green)

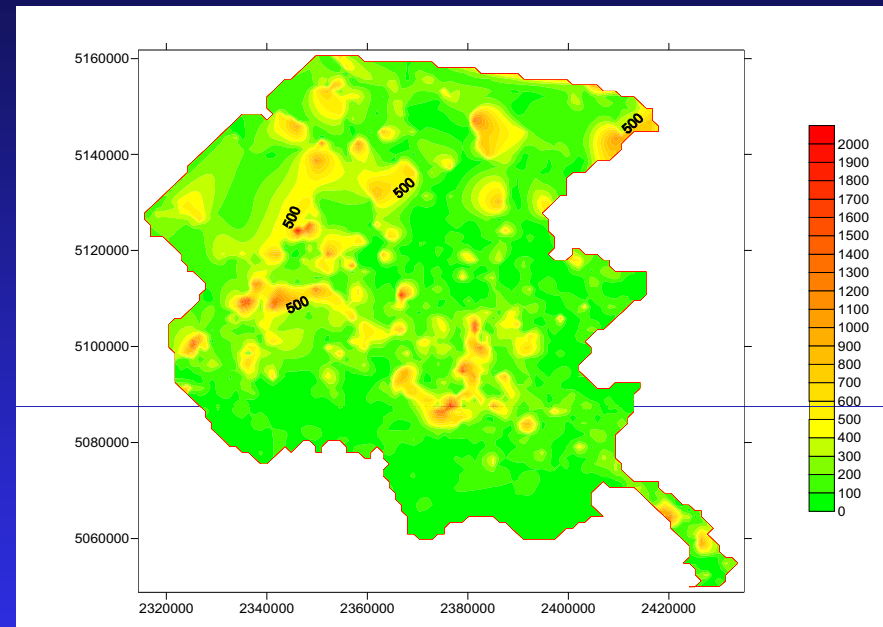


Indoor Radon Activity Concentration in FVG Region

Schools



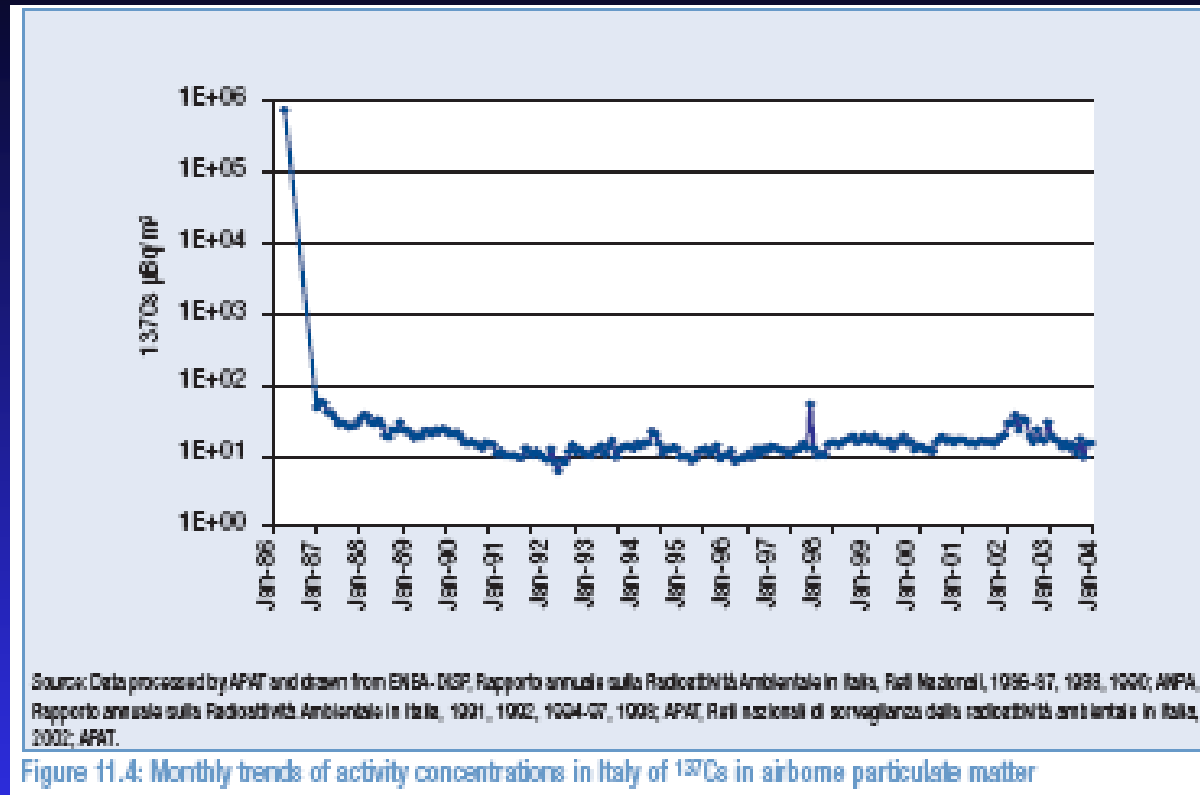
Homes



In order to make a detailed assessment of the geographical distribution of radon nationwide, and to rationalize resources for implementing appropriate remedial measures, it is necessary to map the country, i.e. to identify the areas with the largest likelihood of the presence of high concentrations of radon. With regard to the techniques for collecting and processing the relevant data, the most widespread method, applied internationally and for the surveys already conducted in several Italian regions (Veneto, Friuli Venezia Giulia, Toscana, Piemonte and the Autonomous Province of Bolzano), are indoor measurements, i.e. measurements made in closed environments, especially homes and schools. The surveys are typically conducted by dividing the area on a grid basis, also taking into account the geological composition of the area concerned.



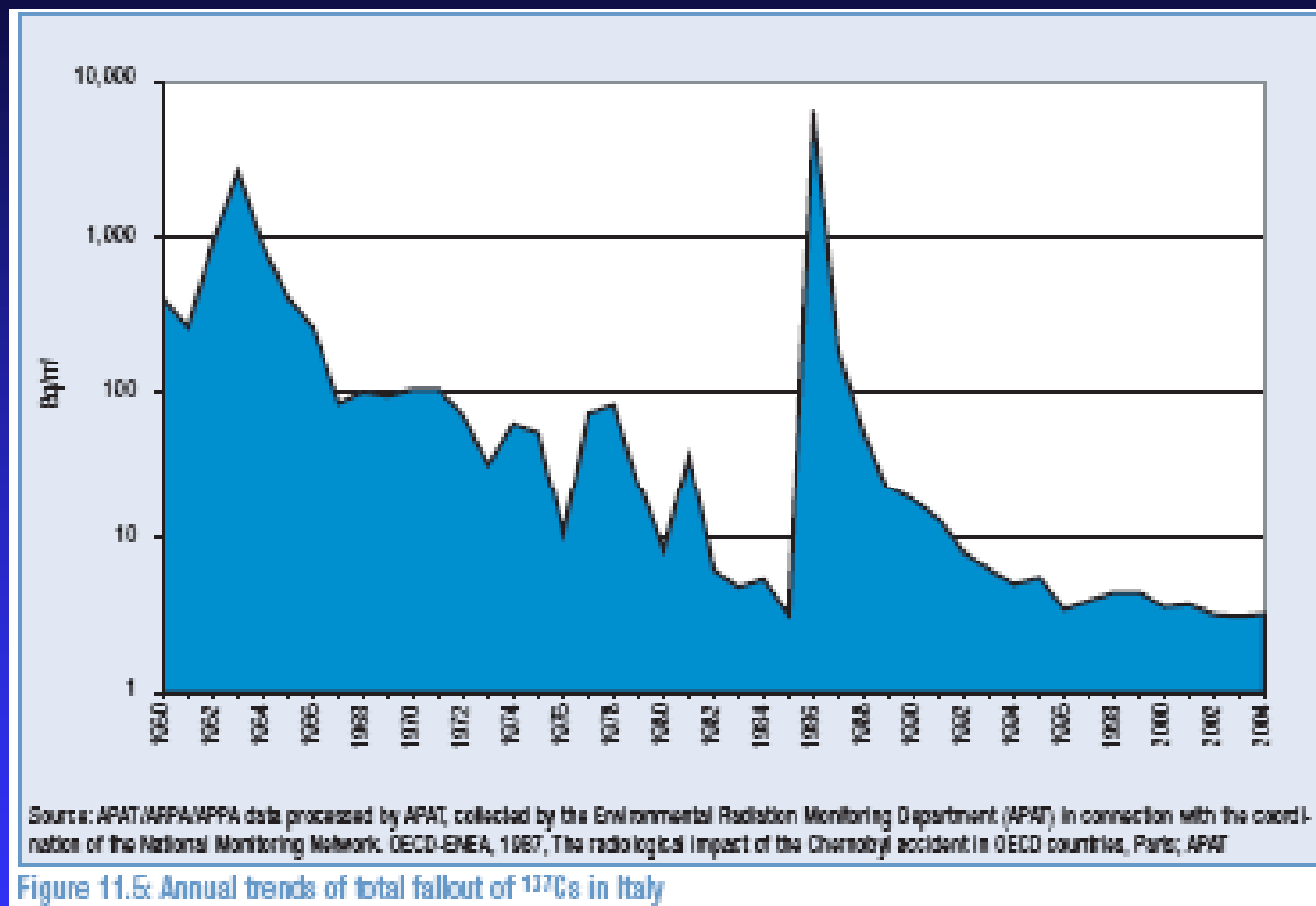
ARTIFICIAL RADIONUCLIDE ACTIVITY CONCENTRATIONS IN THE ENVIRONMENT AND FOODSTUFFS: AIRBORNE PARTICULATE MATTER



The assessment of the activity concentrations of artificial radionuclides in the environment and foodstuffs makes it possible to control environmental contamination by radionuclides from diffuse sources of radioactive materials such as, for example, nuclear fallout from tests or accidents to nuclear facilities. The principal benchmark parameters are: the presence of artificial radionuclides in samples of **atmospheric particulate matter** corresponding to known volumes of air, **wet and dry airborne fallout material** and (fresh and pasteurized) **cow's milk**. The first (figure 11.4) shows the trends in time (on a monthly basis) of the concentrations of ^{137}Cs in airborne particulate matter: the value for the first days of May 1986 refers to the arrival of the Chernobyl cloud in Italy, while the peak value for June 1998, higher in the North than elsewhere, is due to an accident that occurred in a Spanish foundry near Alceiras.



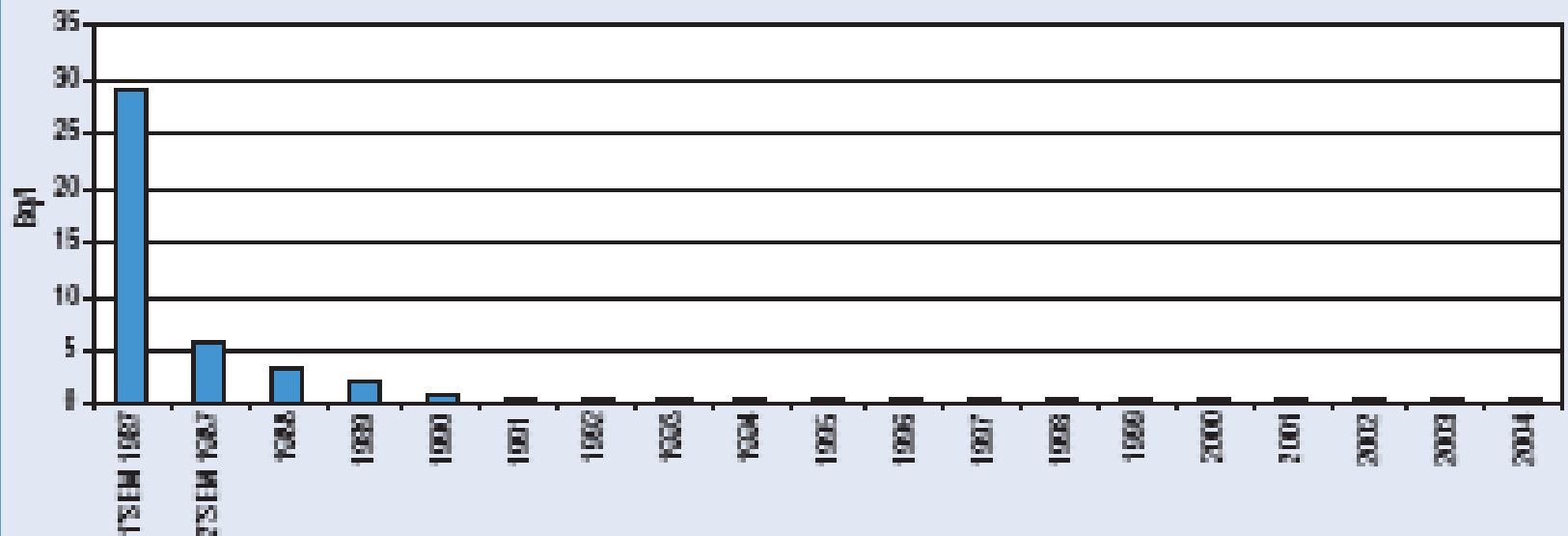
ARTIFICIAL RADIONUCLIDE ACTIVITY CONCENTRATIONS IN THE ENVIRONMENT AND FOODSTUFFS: WET AND DRY AIRBORNE FALLOUT



The second (figure 11.5) gives the trends of the total fallout of ^{137}Cs in Italy from 1961: the peaks correspond to the nuclear tests carried out in the 60s and to the Chernobyl incident



ARTIFICIAL RADIONUCLIDE ACTIVITY CONCENTRATIONS IN THE ENVIRONMENT AND FOODSTUFFS: COW'S MILK



Source: APAT/ARPA/APFA data processed by APAT/CTM-A&F, collected by the Environmental Radiation Monitoring Department (ARAT) in connection with the coordination of the National Monitoring Network.

Figure 11.6: Trends of mean national concentration of ^{137}Cs in cow's milk

The third (figure 11.6) shows the trends of the mean national concentration of ^{137}Cs in cow's milk from 1987.



1998 APAT report cow's milk

¹³⁷Cs in cow's
milk (Bq/l)

Regione	N° Misure	N° Misure < M.A.R.	Media	Min	Max
Abruzzo	4	3	0,1	0,1	0,3
Calabria	8	7	0,1	0,04	0,1
Campania	107	75	0,1	0,003	0,2
Emilia Romagna	89	74	0,1	0,02	0,4
Friuli Venezia Giulia	94	58	0,7	0,05	10,5
Lazio	9	5	0,3	0,1	0,7
Liguria	12	-	0,2	0,1	0,9
Lombardia	138	53	0,1	0,04	0,9
Marche	6	5	0,1	0,1	0,2
Molise	6	4	0,1	0,1	0,3
Piemonte	33	24	0,1	0,1	0,3
Puglia	25	22	0,1	0,1	0,2
Sardegna	8	8	0,1	0,02	0,2
Sicilia	11	11	0,1	0,1	0,1
Toscana	36	32	0,1	0,1	0,3
Trentino Alto Adige	153	36	0,3	0,04	1,5
Valle d'Aosta	24	6	0,2	0,1	0,4
Veneto	23	10	0,2	0,1	0,3

Arithmetic average calculated taking into account also values not detectable (assigned value = Minimum Detectable Activity)



Surveillance of Environmental Radioactivity in Friuli Venezia Giulia region

Monitoring of :

- Natural radioactivity
- Artificial radioactivity
 - ✓ in foodstuffs and drinkinkg water
 - ✓ in the environment



Surveillance of Environmental Radioactivity in Friuli Venezia Giulia region

Activities:

- Remedial action in case of finding of orphan sources or contamination event
- Consultancy and technical assistance to the institutions in case of radiological emergency or radiological problems
- Participation to radiological emergency planning
 - ✓ civil defence plan
 - ✓ nuclear emergency plan in case of stop of nuclear powered ship in the gulf of Trieste, etc.



Monitoring of Environmental Radioactivity in Friuli Venezia Giulia region

Foodstuffs and drinkable water:

- Sampling: Health Agency
- Gamma spectrometry measurement: ARPA FVG
- Samples of milk, meat, vegetables, fruit, forage, ecc.
 - ✓ Choice of foodstuffs: on the basis of the importance of the human and animal diets,
 - ✓ Choice of sampling site: mainly on the basis of consumption, but also on the basis of production



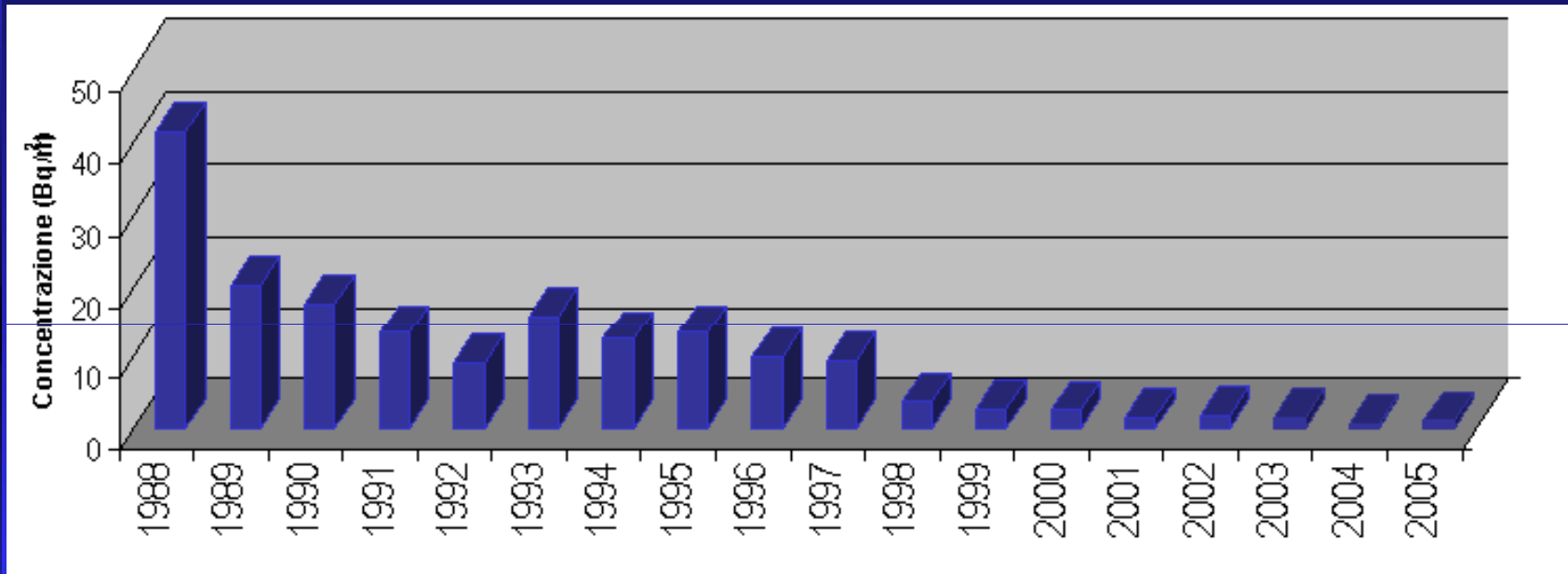
Monitoring of Environmental Radioactivity in Friuli Venezia Giulia region

Environmental matrixes:

- Airborne particulate matter:
 - ✓ Sampling: h24 ; measurements: all working days
- Fall out
 - Continuous sampling, monthly collection and gamma spectrometry measurement
- Soils: forest soils (coniferous and broadleaf forests) and undisturbed fields
- Indicators of environmental radioactivity:
 - ✓ Mosses; mushrooms, honey, sediments, algae, etc.



Monitoring results: Fallout

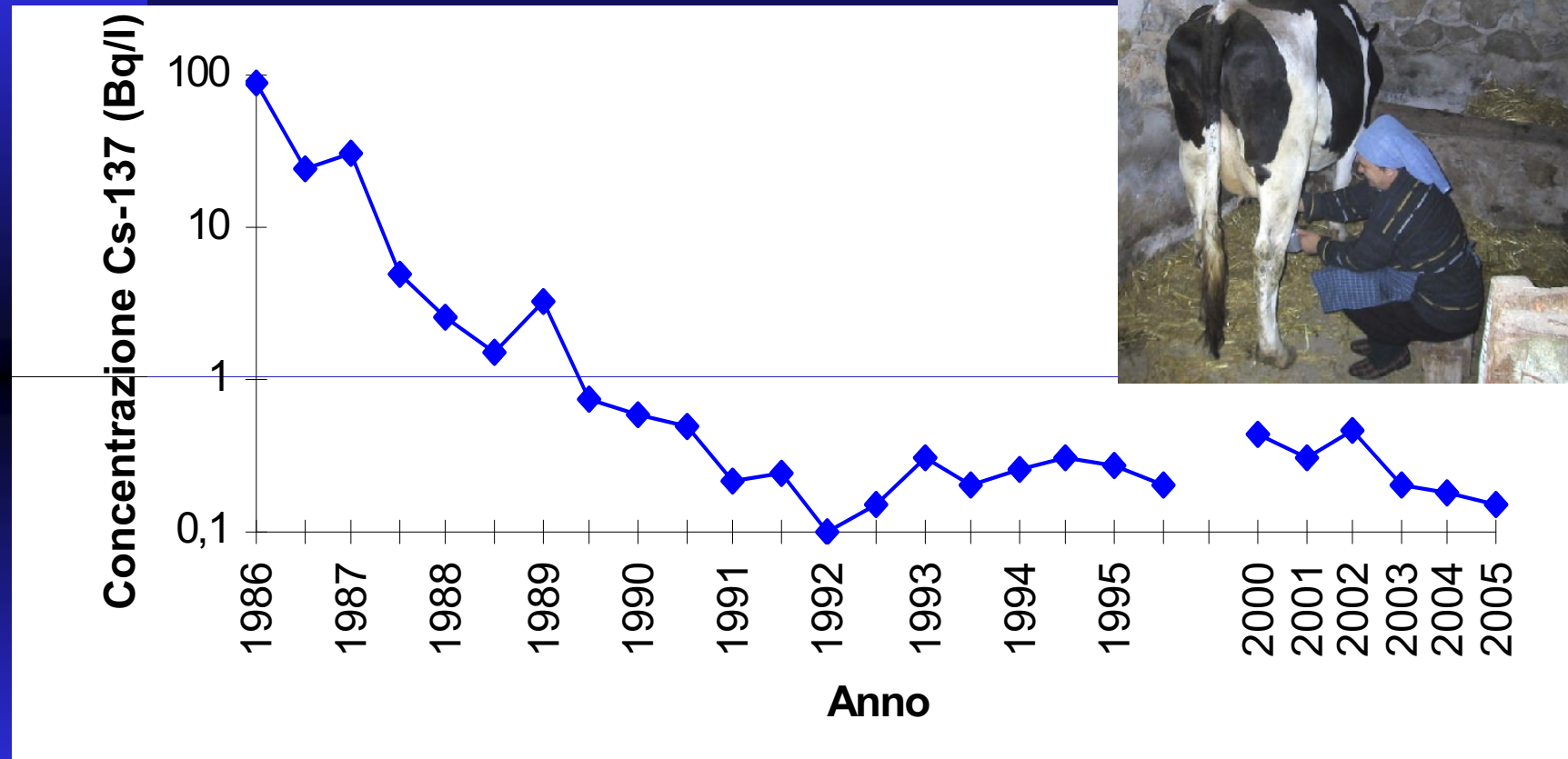


Cs-137 fall -out at Udine site: yearly average (Bq/m²), calculated on the basis of monthly samplings. Data are referred to sampling time.





Monitoring results: Cow's Milk

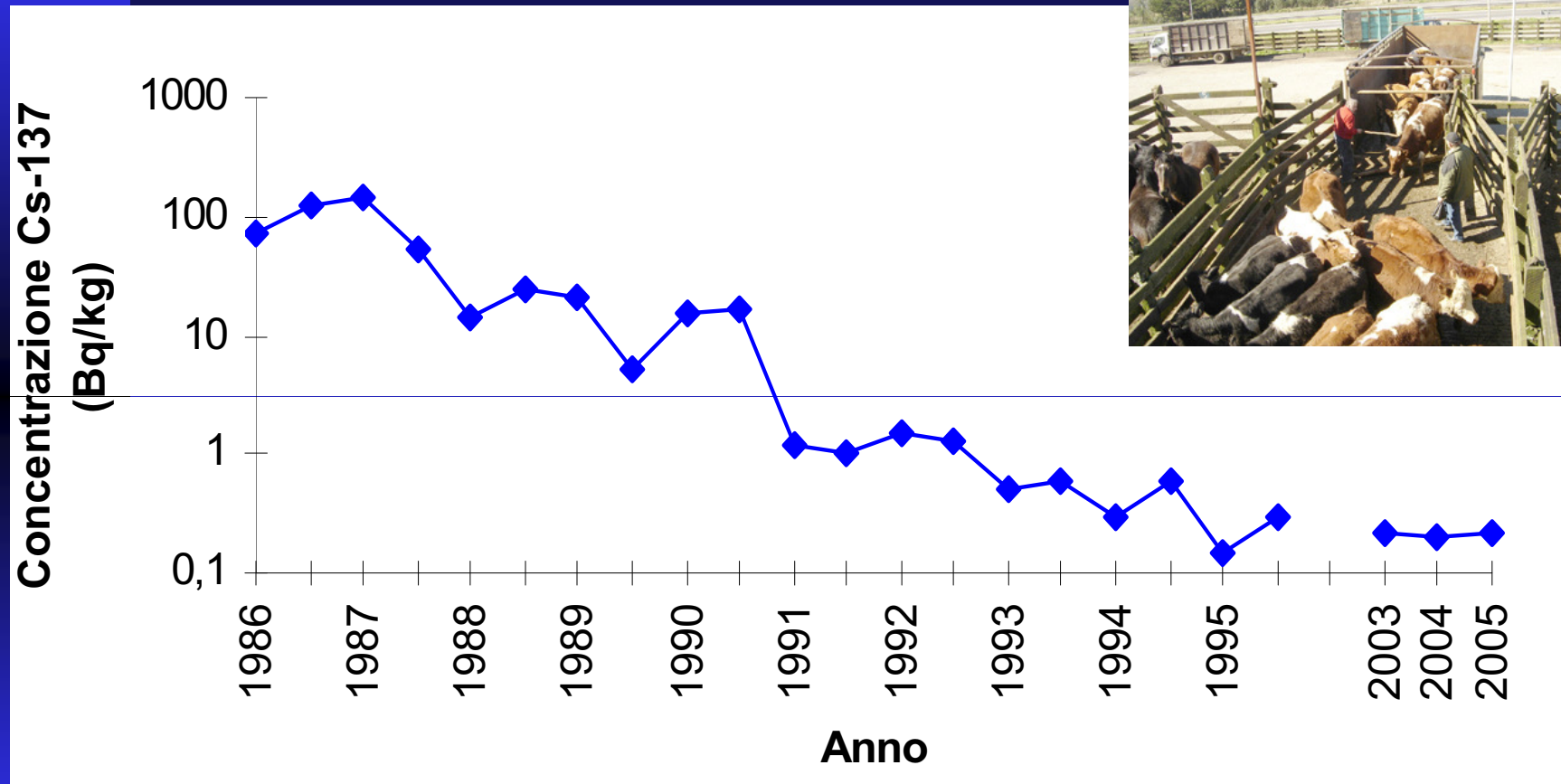


Cs-137 concentration in cow's milk from Udine Province (until 1995) and from all Friuli Venezia Giulia region (2000-2005) (Mainly local production)





Monitoring results: Beaf and pork meat

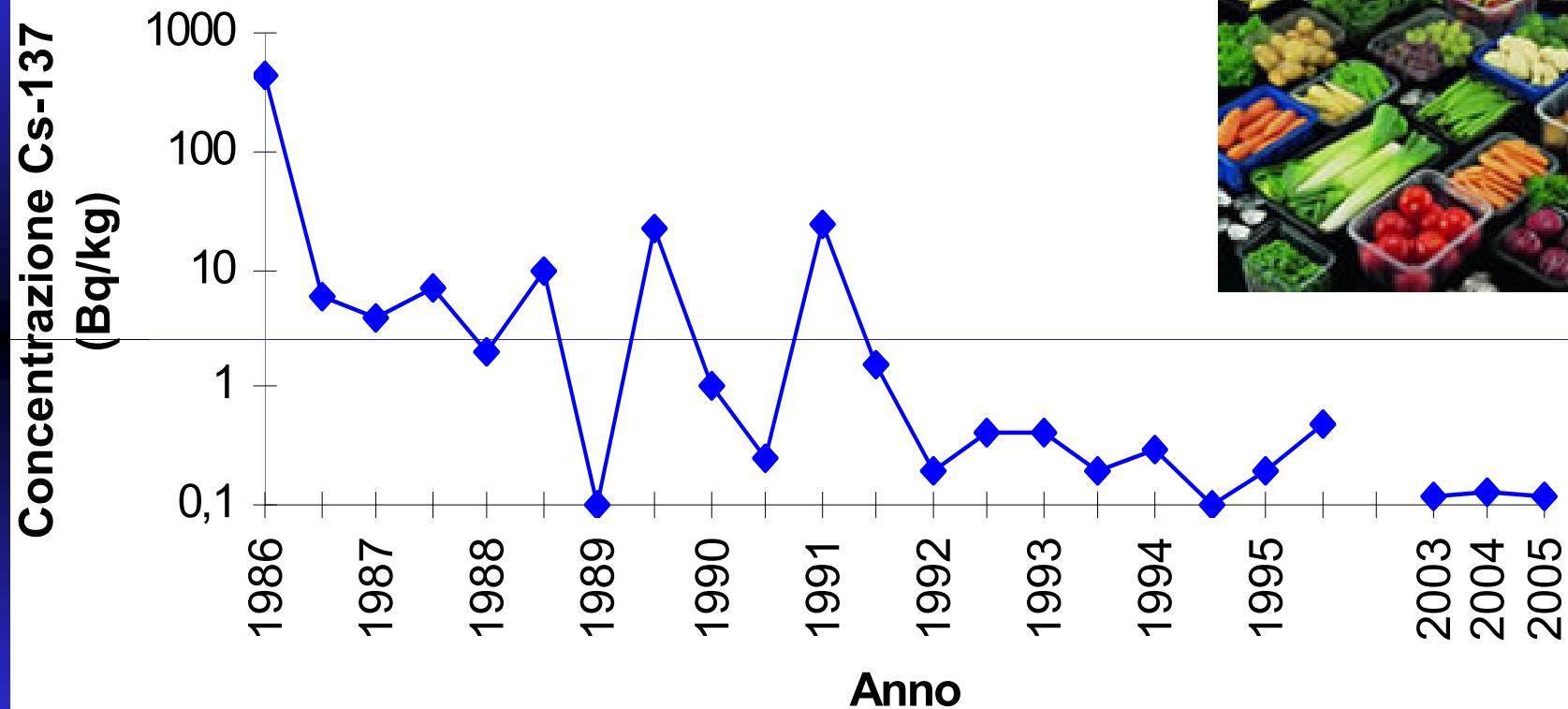


Cs-137 concentration in pork meat and beaf from Udine Province (until 1995) and from all Friuli Venezia Giulia region (2000-2005) (consumption)





Monitoring results: Vegetables



Cs-137 concentration in vegetables in Udine Province (until 1995) and from all Friuli Venezia Giulia region (2000-2005) (consumption)





Present day yearly average value

Parametro	Concentrazione di Cs -137 (Bq/kg)		
	2003	2004	2005
<i>Beaf</i>			
Valore max	2,13	0,54	2,96
Valore medio	0,26	0,20	0,30
<i>Pork meat</i>			
Valore max	0,67	0,60	0,248
Valore medio	0,18	0,20	0,139
<i>White meat</i>			
Valore max	0,41	0,27	0,22
Valore medio	0,14	0,14	0,12
<i>game</i>			
Valore max	---	67,9	27,14
Valore medio	---	3,94	3,02
<i>Fruit</i>			
Valore max	0,17	2,30	1,83
Valore medio	0,10	0,24	0,27
<i>vegetables</i>			
Valore max	0,30	0,22	0,247
Valore medio	0,12	0,13	0,119





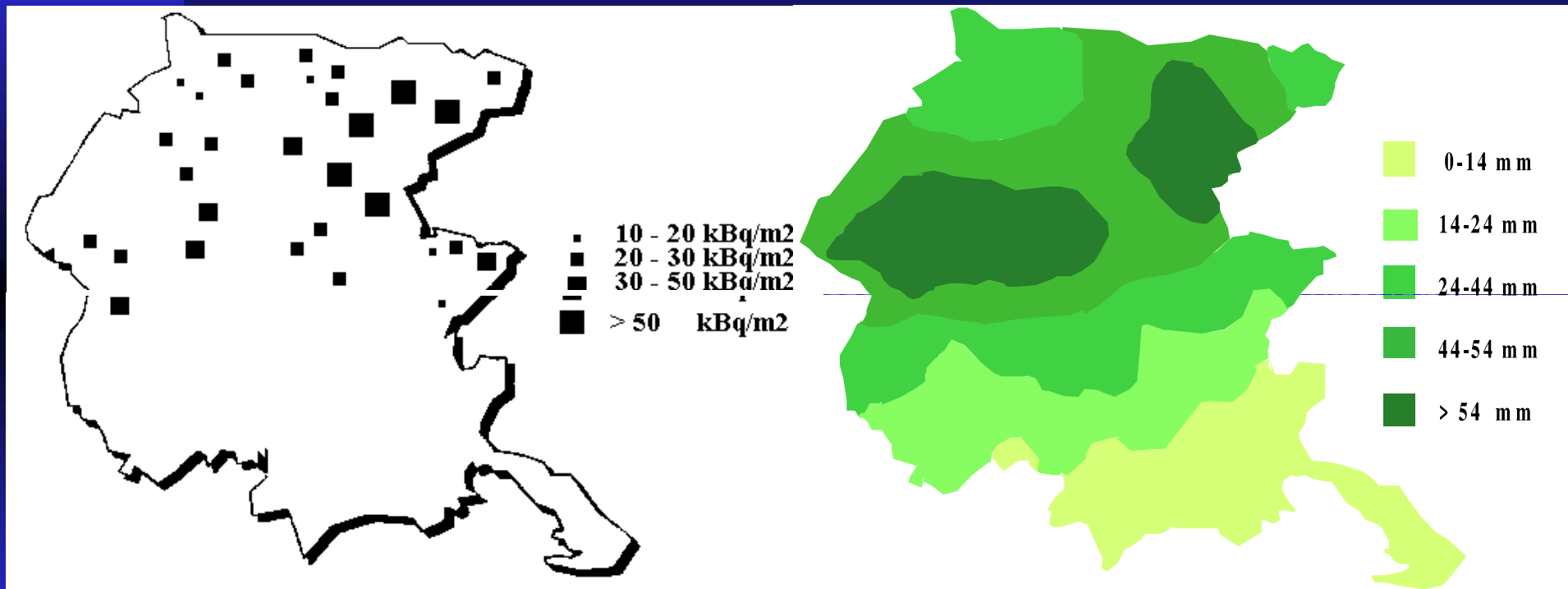
Present day Cs-137 concentration in edible mushrooms

Parametro	Concentrazione di Cs-137 (Bq/kg peso fresco)		
	2003	2004	2005
<i>Funghi porcini</i>			
Valore min	1,55	0,27	0,11
Valore max	15,7	9,61	13,2
Valore medio	7,58	4,23	6,31
<i>Funghi eduli</i>			
Valore min	0,11	0,08	0,04
Valore max	15,7	259	13,2
Valore medio	4,22	20,3	4,02





Soils: main results



Undisturbed fields 1992

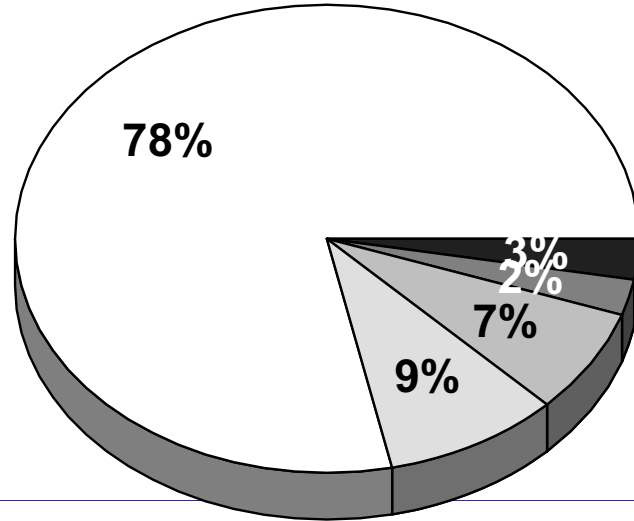
Rain during the first ten days of may 1986



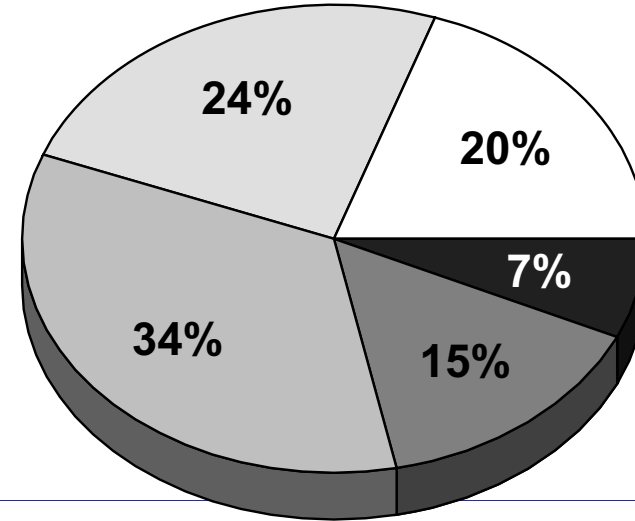


Soils: main results

Val D'Ajer (1340 m s.l.m.)

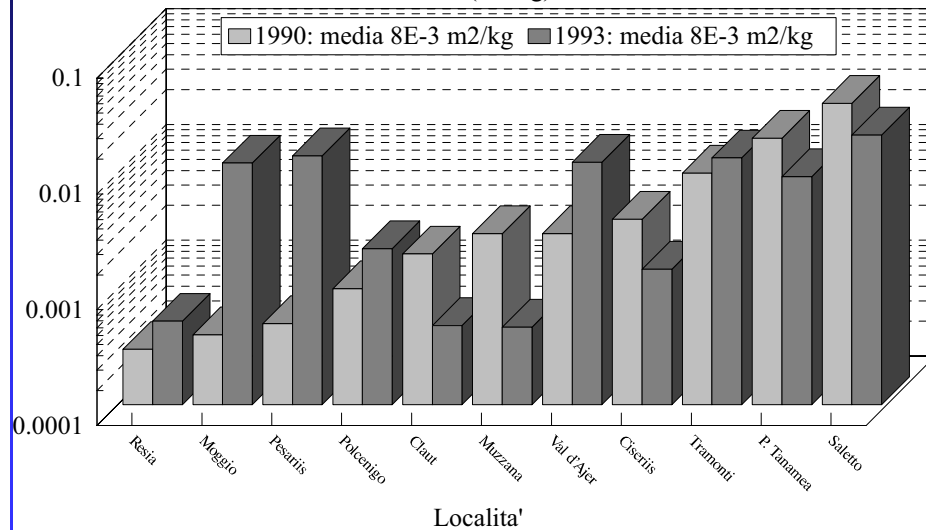


Muzzana (2 ms.l.m.)

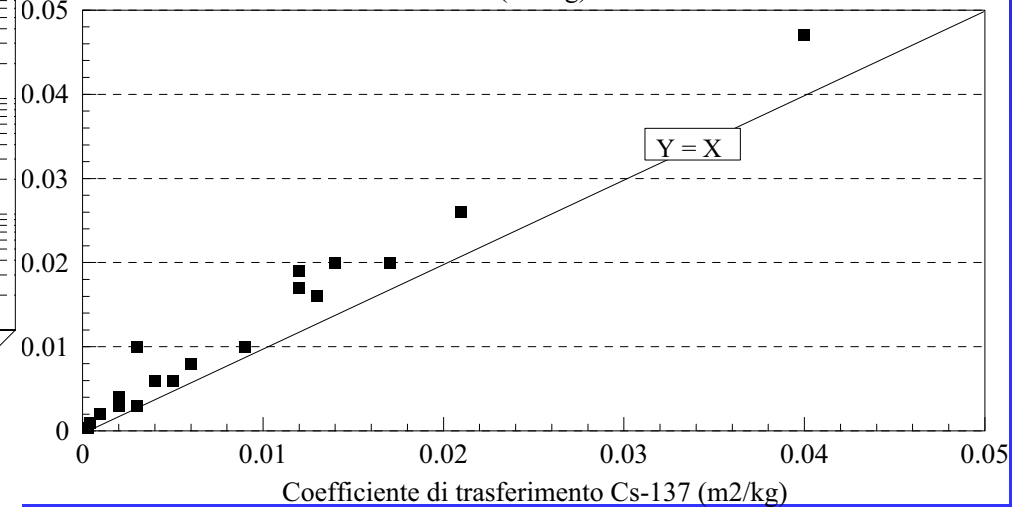


0-3 cm
 3-5 cm
 5-10 cm
 10-15 cm
 15-30 cm

Coefficienti di trasferimento (m²/kg)



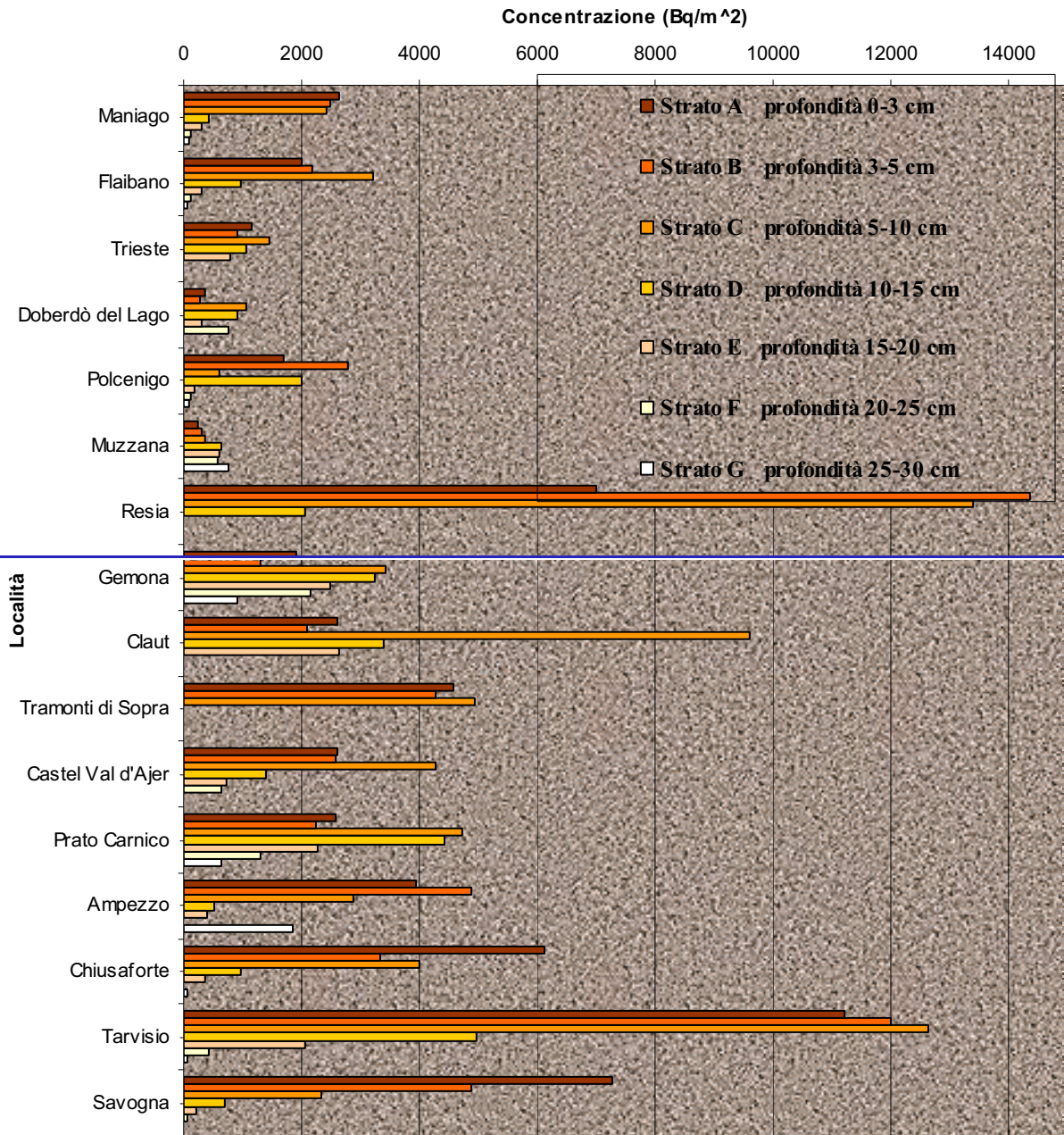
Coefficiente di trasferimento Cs-134 (m²/kg)





Cs-137 in terreni di prati stabili (2004)

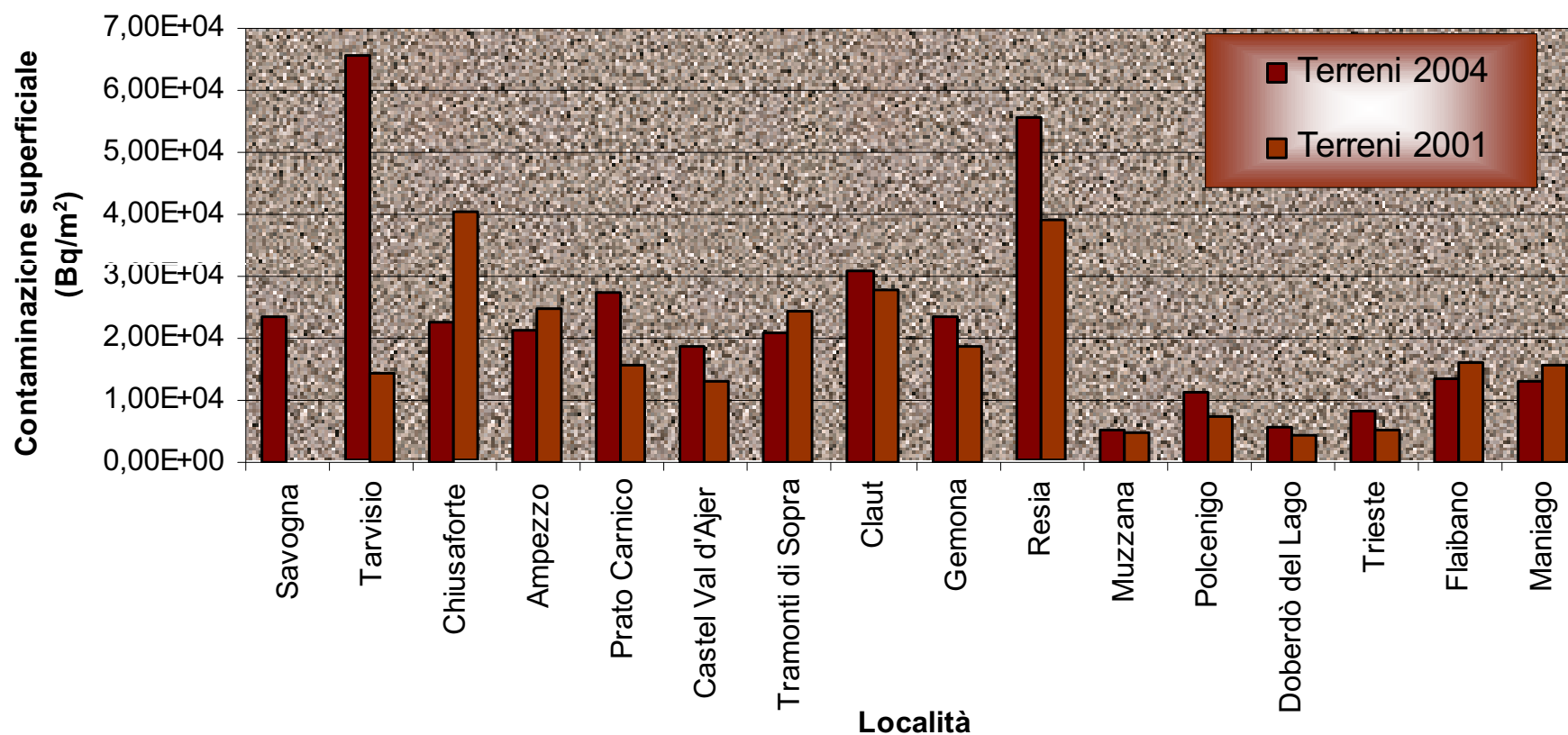
Andamento in funzione della profondità





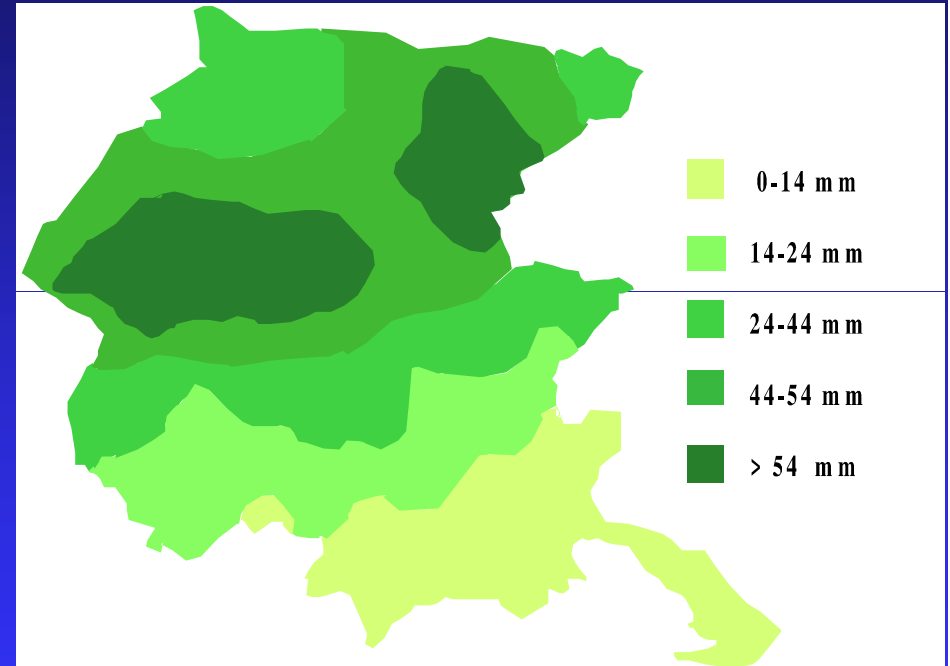
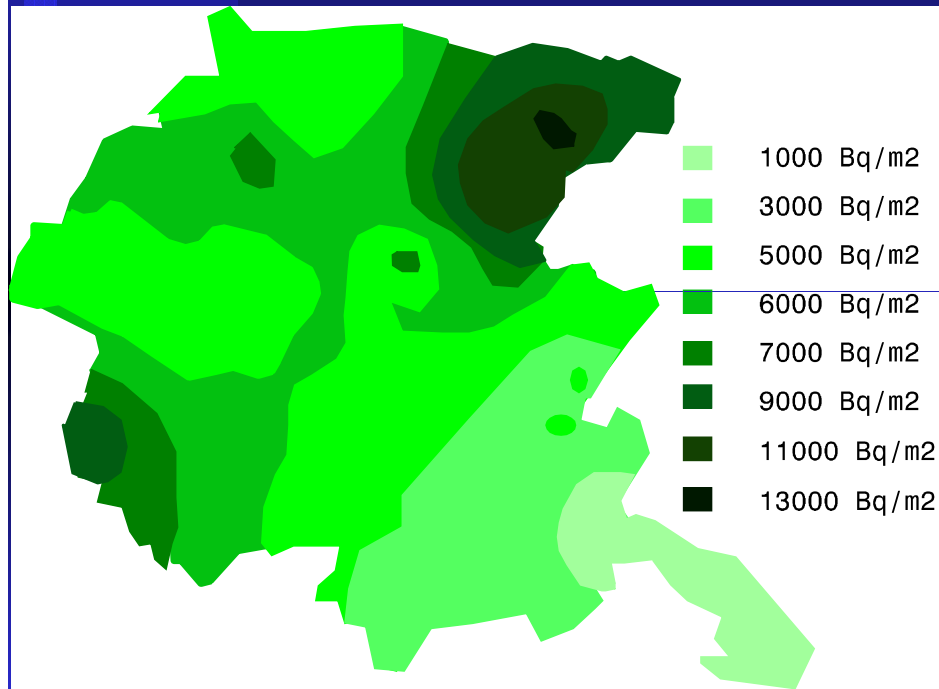
Soils: main results

Contaminazione superficiale di Cs-137
in 16 terreni di prato stabile in FVG





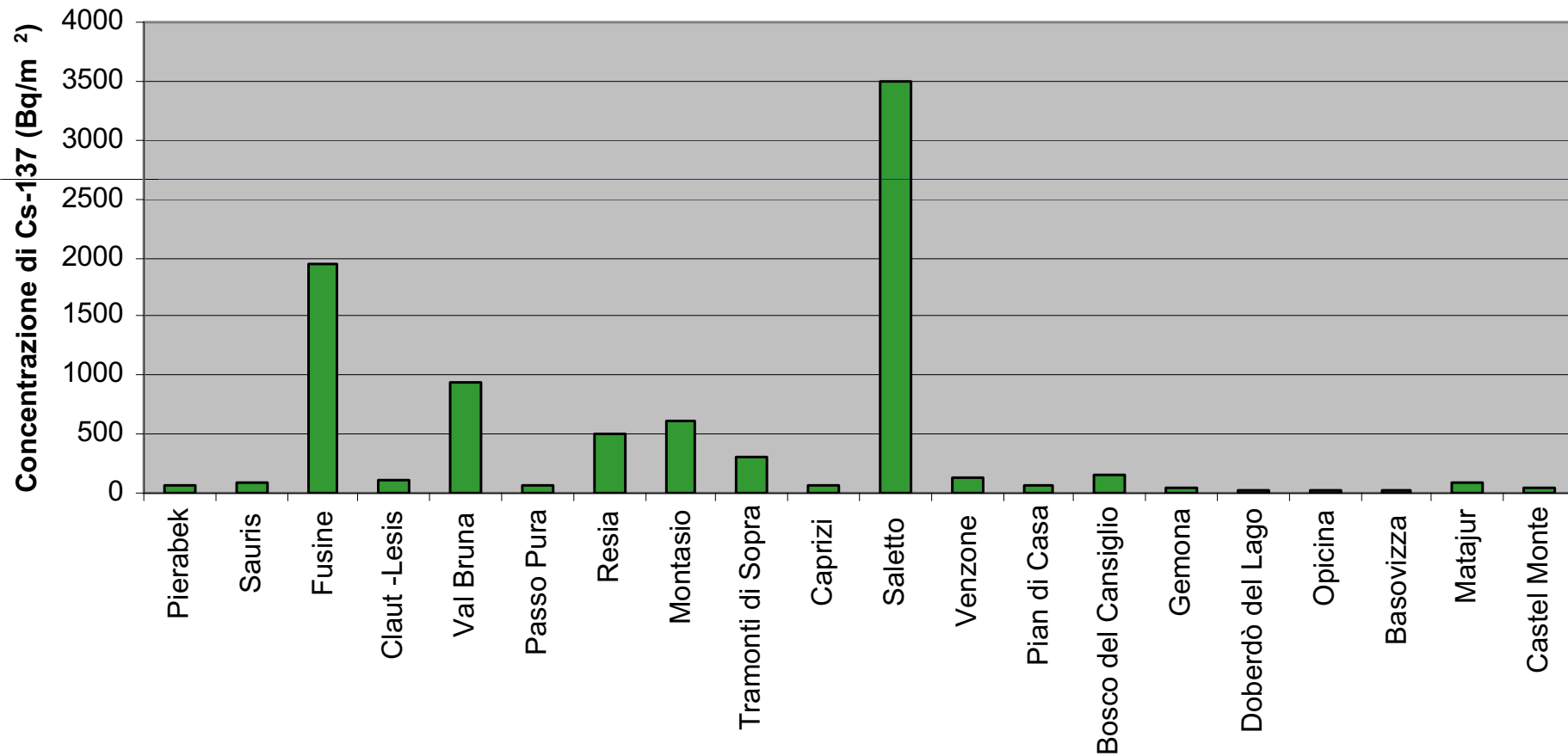
Mosses: deposition indicators





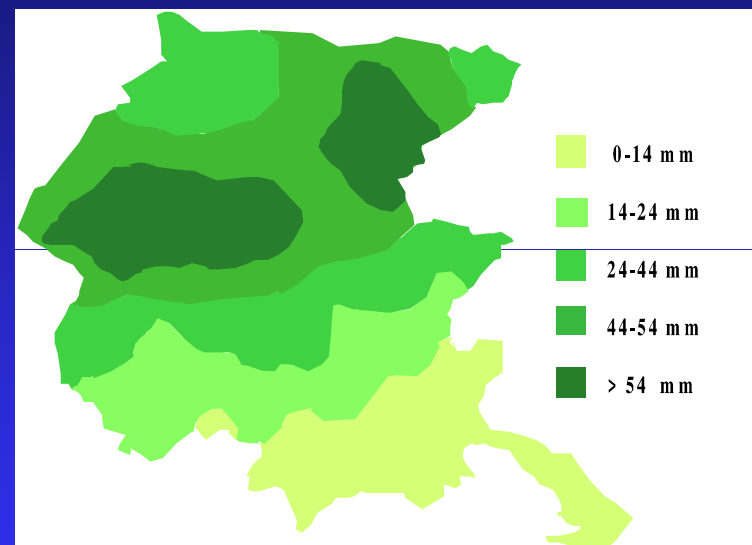
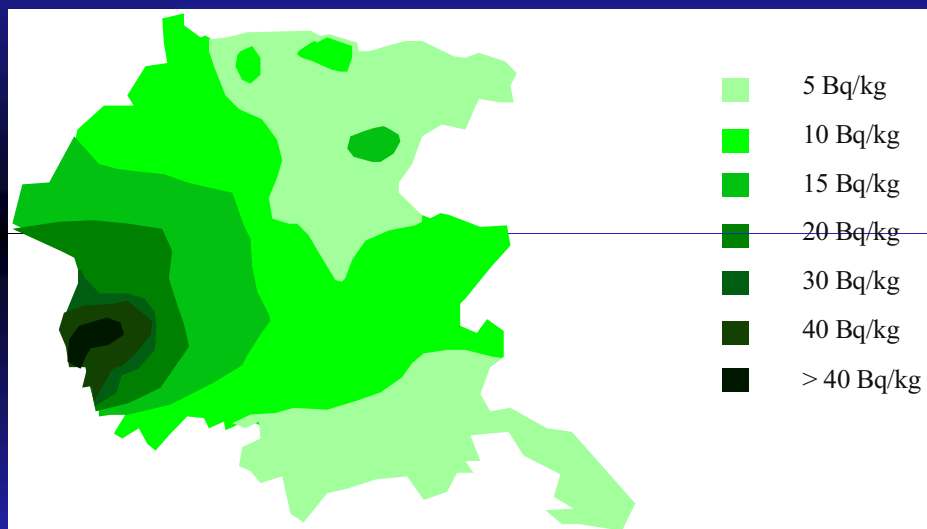
Mosses: present day situation

Concentrazione di Cs-137 nei Muschi
Campionamento 2005





Honey: deposition and transfer indicator





Honey and mosses: national maps

honey

mosses

Distribuzione della concentrazione di Cs¹³⁷ nei mieli italiani (smelatura '96)

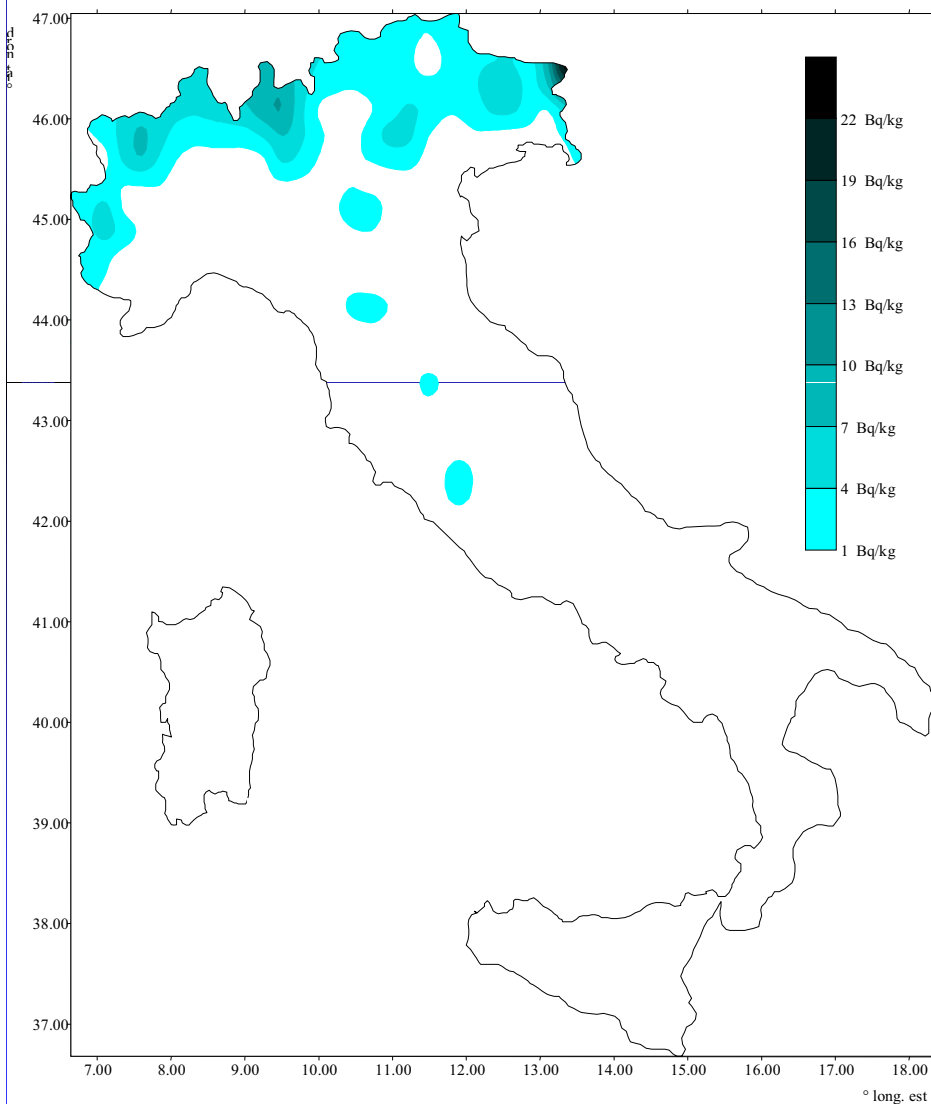
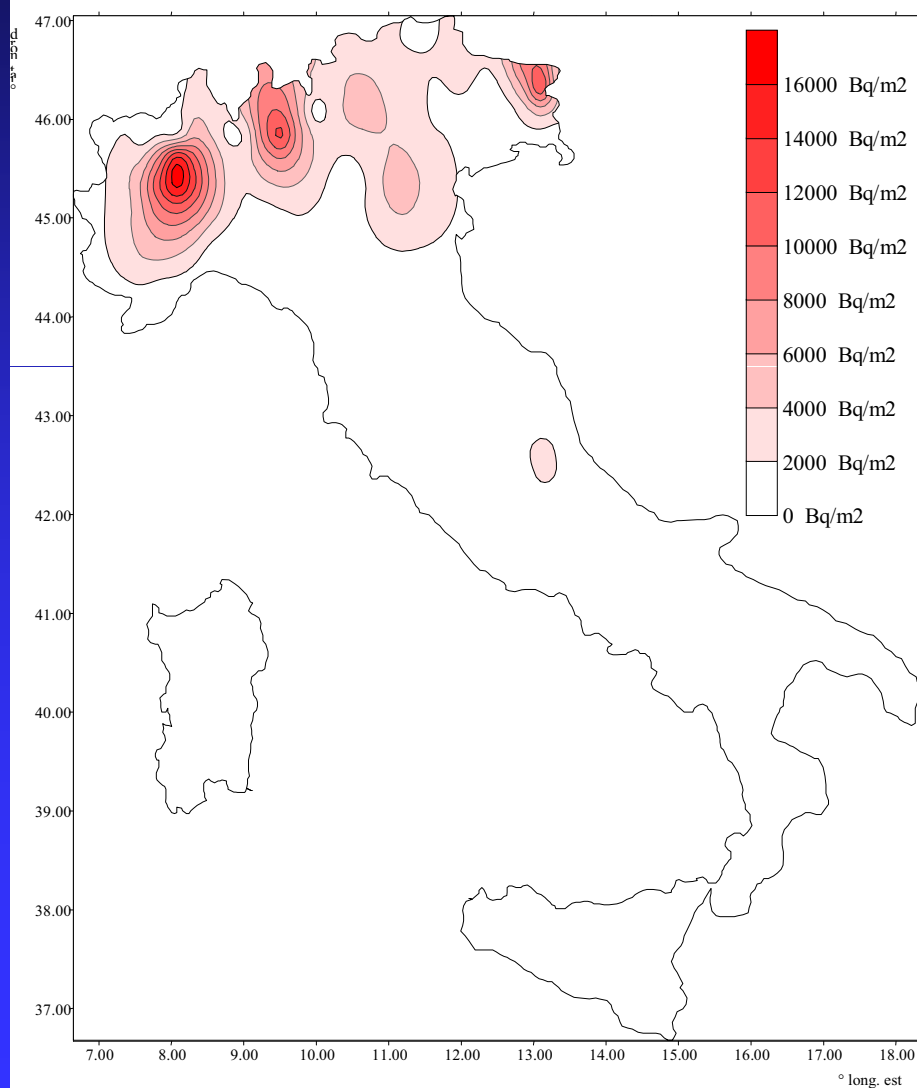


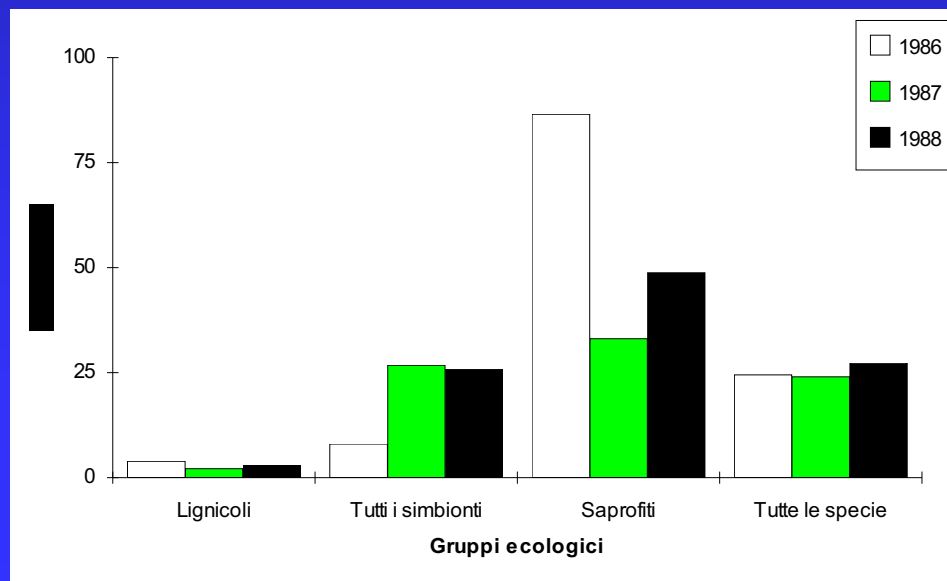
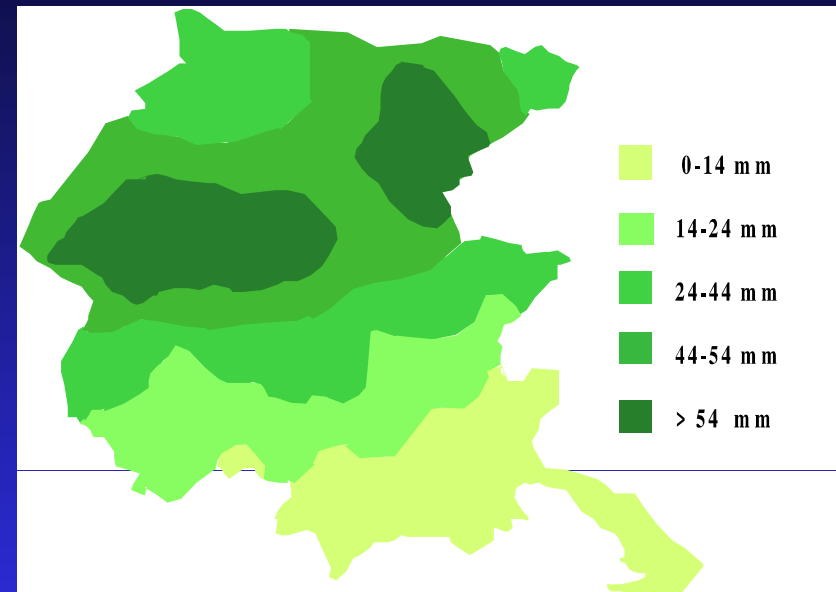
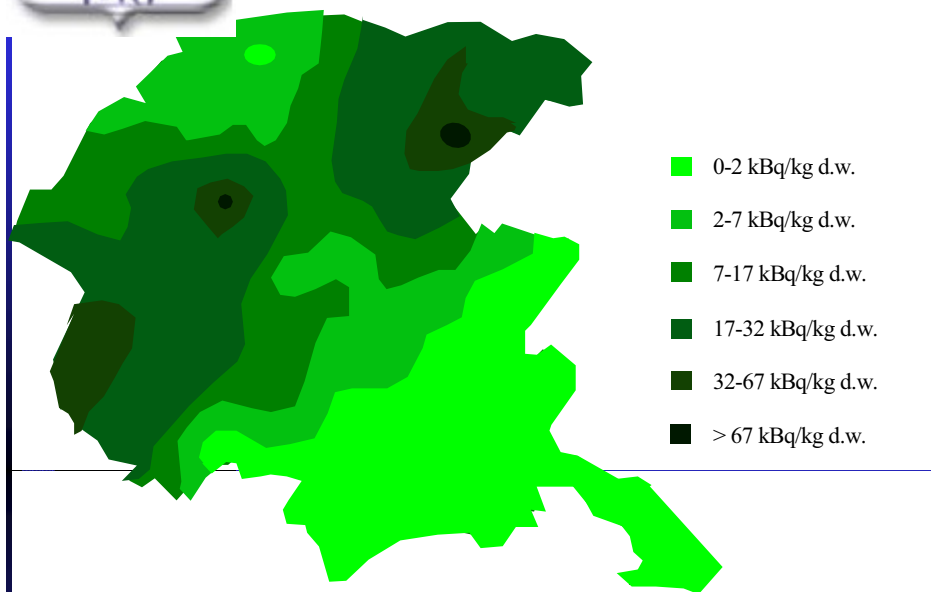
FIG. 3

Distribuzione della concentrazione di Cs¹³⁷ (Bq/m²) nei muschi della campagna nazionale



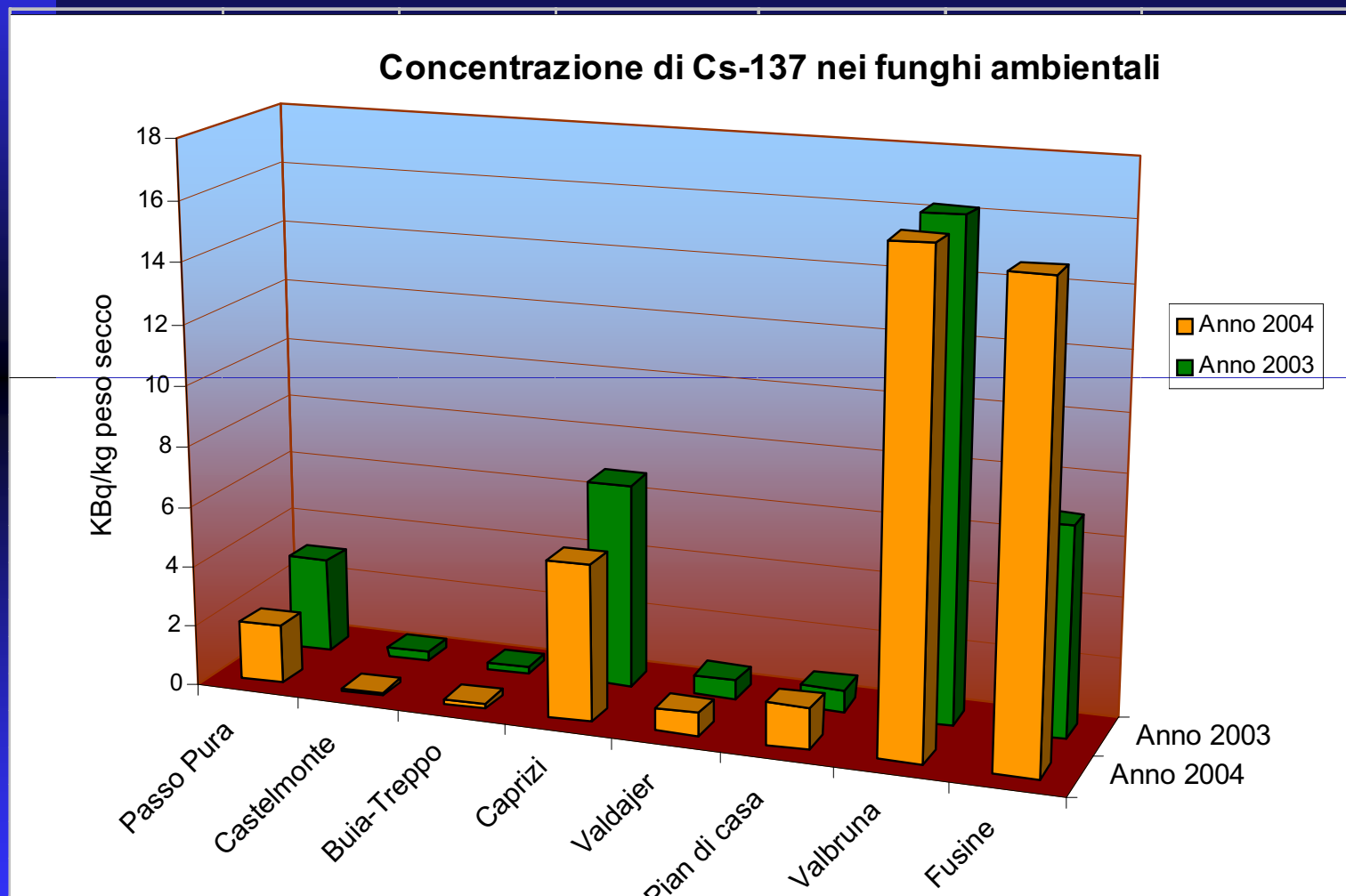


Wild mushrooms



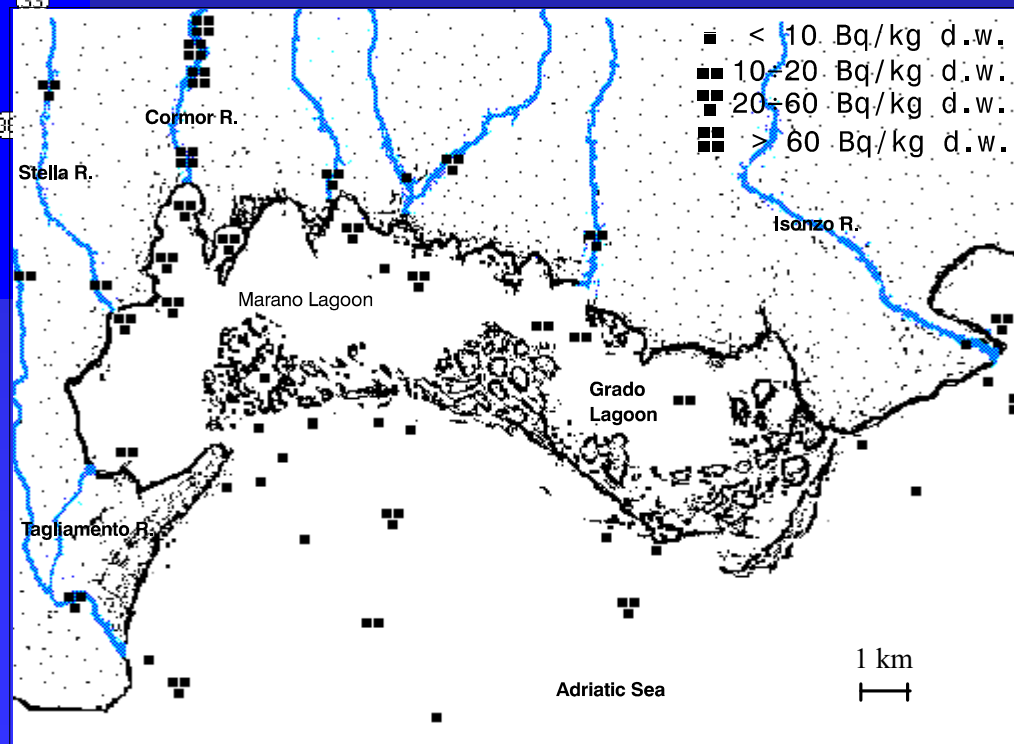
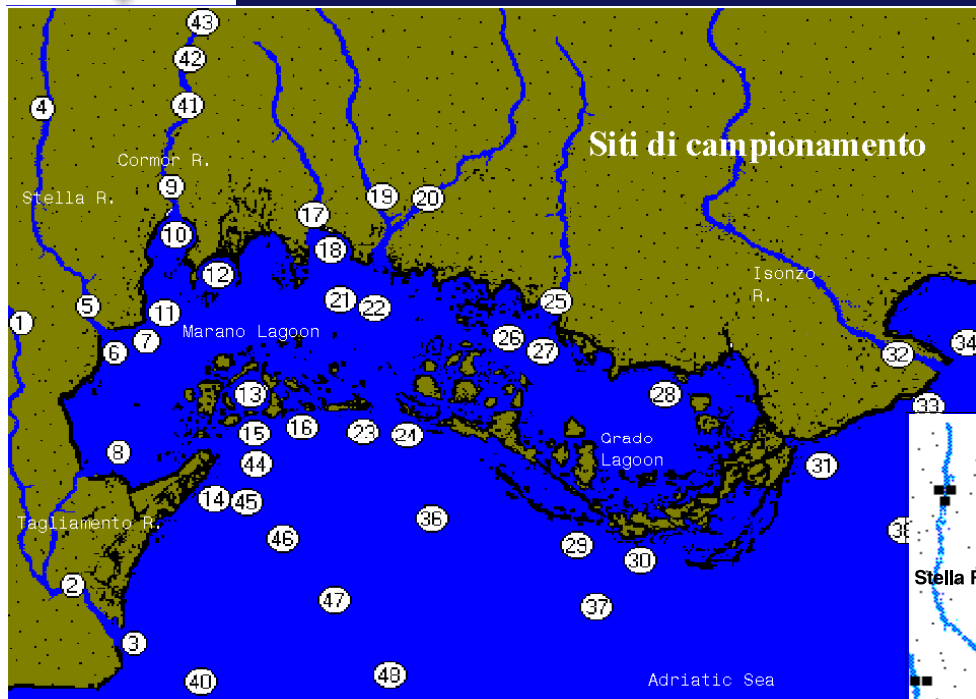


Wild mushrooms: present day situation





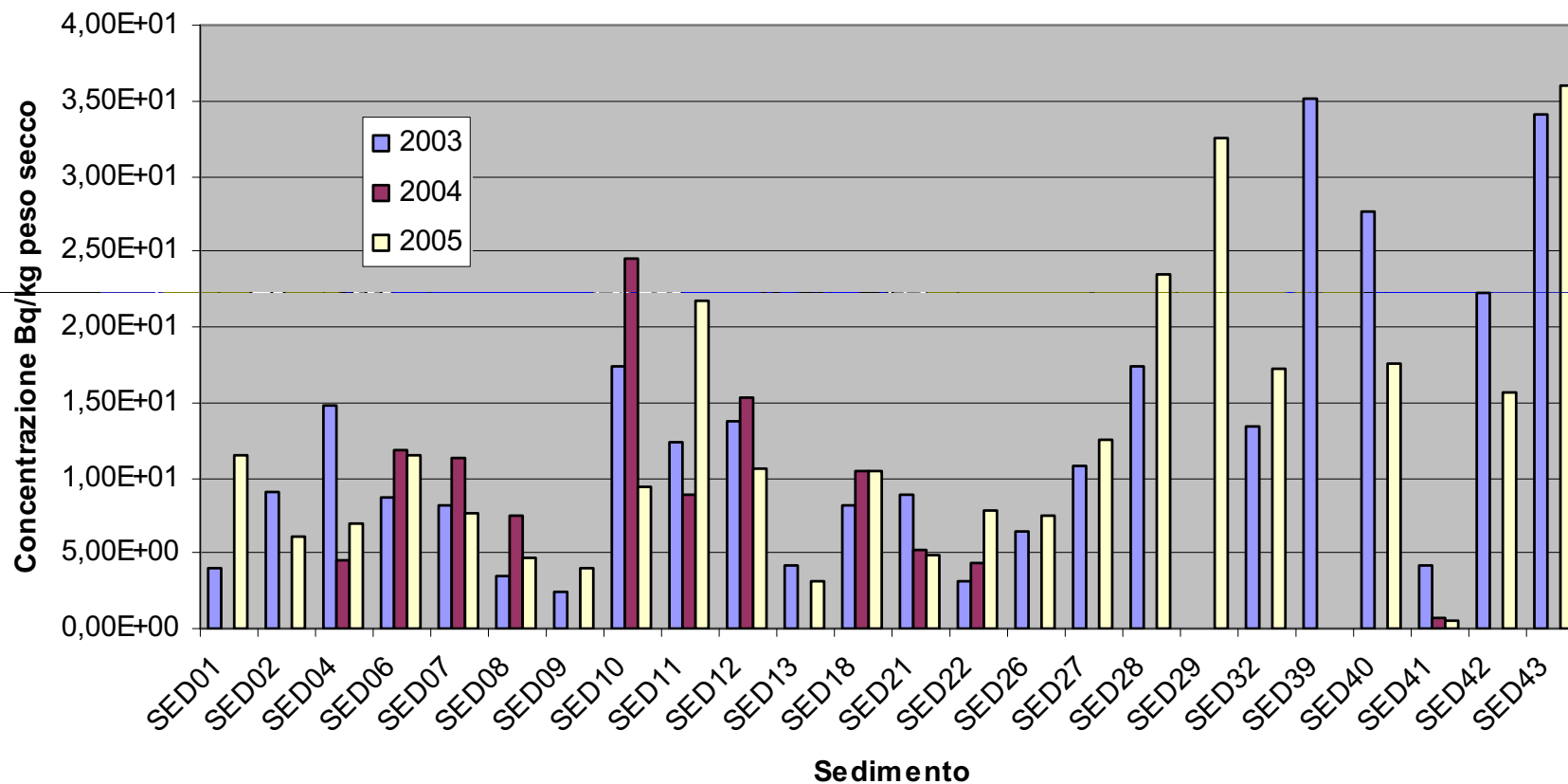
Algae and surface sediments





Surface sediments: present day situation

Cs-137 nei sedimenti analizzati





Surface sediments: present day situation

Cs-137 nei sedimenti della laguna di Grado e Marano

Anno di Campionamento	Concentrazione Media Bq/kg (peso secco)	Deviazione standard Bq/kg (peso secco)
1994	20.90	15.31
1995	23.29	14.61
2003	13.84	7.03
2004	14.34	9.82
2005	13.54	8.28





Field gamma spectrometry





Looking for orphan sources in wagons and trucks





Looking for orphan sources in wagons and trucks





Looking for orphan sources in wagons and trucks





Looking for orphan sources in wagons and trucks





Radioactive Lighting Conductors

Electroadvies
VeBo bvba

Project: 03071118 Combinateur 6
Radioactieve bliksemafleider met 6 bronnen Radium 226

Edinacchick - Aches - Bliksemafleider

ACCEPTATIE- EN OPHALINGSAAVRAAG VOOR NIEUWGECONSTRUEERD RADIOACTIEF AFVAL

1. Nummer BI: **617623**
Datum: **30/07/2003**
Aansluiting: **30/07/2003**

2. Naam: **Philippe Bernards Constructies**
Adres: **Sprengel 11, 1000 Brussel, België**
Telefoon: **02 261 41 11** Fax: **02 261 41 11**
Branche: **15**

3. Naam van de persoon of de firma die de aanvraag doet: **VeBo**
Ophalingsaansluiting: **30/07/2003**

4. Algemeen identificatie
No. Afvalsoort: **K12**
Materiaal: **AD**
Proceduur: **OE**
Ophalingsaansluiting: **OE**

5. Kenmerkende gegevens
Aantal bronnen: **6**
Aantal bronnen: **6**
Aantal bronnen: **6**
Aantal bronnen: **6**

6. Radioactieve bestemming
Type afval: **ME**
Type afval: **ME**
Type afval: **ME**
Type afval: **ME**

7. Specifieke bestemming
Type afval: **ME**
Type afval: **ME**
Type afval: **ME**
Type afval: **ME**

8. Opmerkingen

Combinateur.
6 Bronnen : Radium 226 (Ra- 226).
Geraamde activiteit : 74 MBq
Constructeurs : L'Algrete.

foto EVER

foto EVER

foto EVER

Hannekenstraat 45 3130 Betekom HRL 108880 BTW 477 513 776 Tel + (0)16 47 10 44 Fax + (0) 16 53 32 77
e-mail: info@vebo-electroadvies.be Website : www.vebo-electroadvies.be
Manipulatie radioactieve bliksemafleiders - Vervoervergunning F.A.N.C. R157A/428.02.382 Tijdelijke stockering F.A.N.C. 978/B-862A
Transport ADR colli = tank - ADR Klasse 7 colli = tank attest n° 111 196





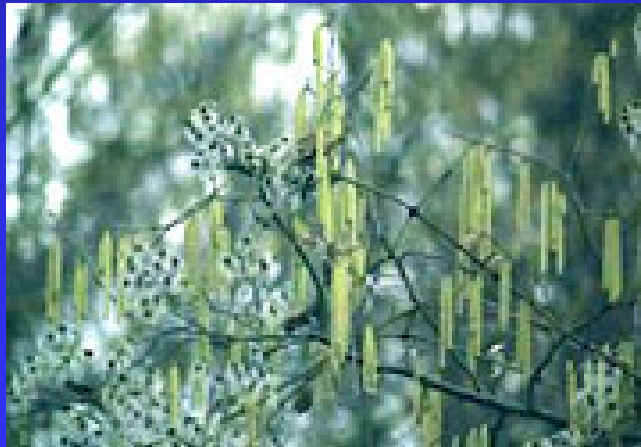
Description of in-situ gamma spectrometry field exercise



Muzzana del Turgnano - Bosco Baredi



Description of in-situ gamma spectrometry field exercise



Muzzana del Turgnano - Bosco Baredi



Description of in-situ gamma spectrometry field exercise





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Description of in-situ gamma spectrometry field exercise





Description of in-situ gamma spectrometry field exercise

	NOTTE	MATTINA	POMERIGGIO	SERA
Mercoledì 28 OTTOBRE				
	Nubi sparse	Coperto	Poco nuvoloso	Poco nuvoloso
Temperatura	11 °C	15 °C	17 °C	11 °C
Umidità	88 %	64 %	58 %	89 %
Precipitazioni	assenti	assenti	assenti	assenti
Vento	ENE 9 km/h debole	ENE 10 km/h debole	NE 6 km/h debole	N 7 km/h debole
Temp. percepita	11 °C	16 °C	17 °C	12 °C
Zero termico	3700 m	3730 m	3730 m	3590 m

Nuvolosità innocua. I venti saranno prevalentemente deboli e soffieranno da NE con intensità di 6 km/h. Possibili raffiche fino a 13 km/h. Temperatura minima di 11 °C e massima di 17 °C. Quota 0°C a 3700 metri.

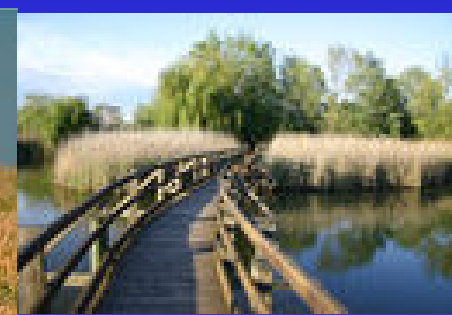


Marano Lagunare



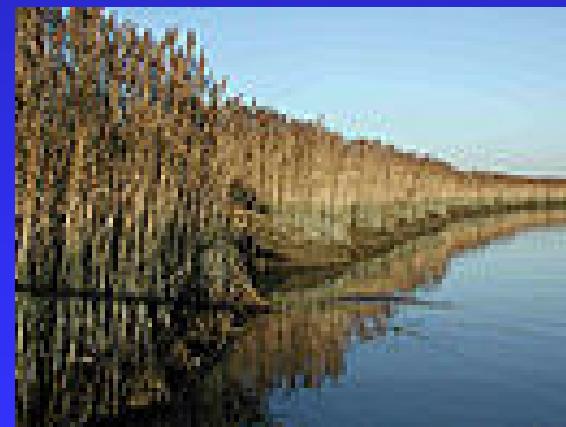
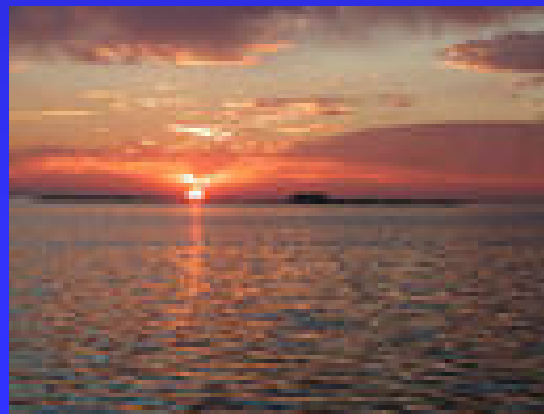
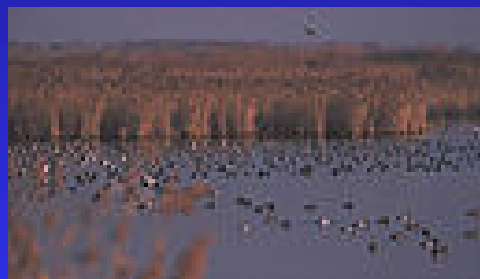
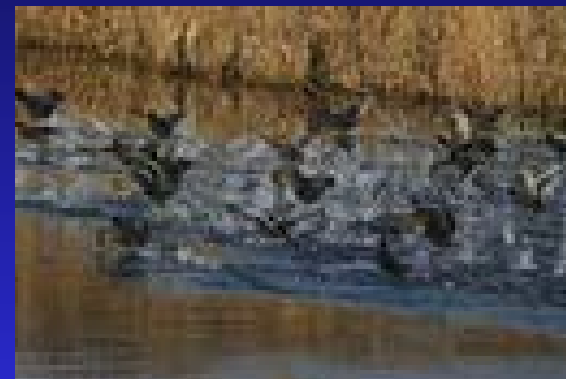
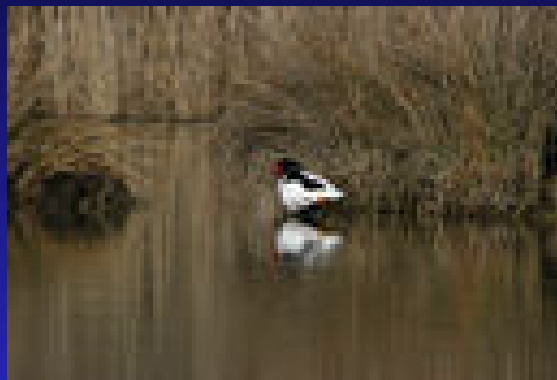


Faunal Region of Canal Novo Marano Lagunare





Faunal Region of Canal Novo Marano Lagunare





Thank you
for
attention, patience and understanding