Persistent Organic Pollutants in Soils of Veneto Region

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POPs

- **Dioxins** and **furans** (PCDD/PCDFs),
- **PolyChlorinated Biphenyls** (PCBs) and
- **Polycyclic Aromatic Hydrocarbons** (PAHs)

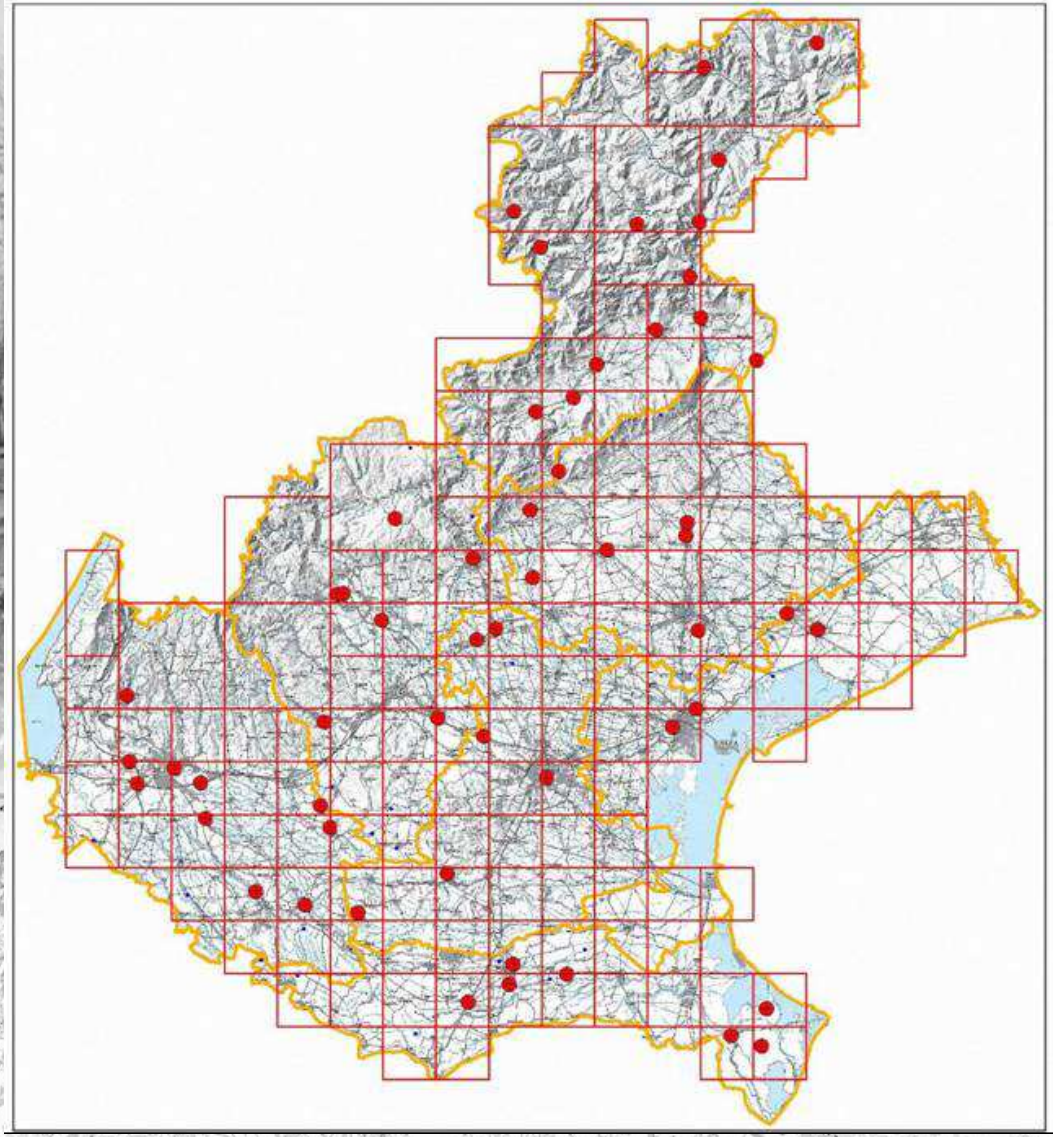
are organic pollutants that are:

- mostly of anthropogenic origin
- dangerous to human health and the environment
- characterized by high lipo-affinity, semi-volatility and resistance to degradation
- extremely persistent in the environment

The investigation

From 2011, in order to increase the knowledge and to defined reference values for these POPs in soils, the Environmental Protection Agency of Veneto region (ARPAV) started a soil monitoring programme allover regional area, not strictly linked to specific incidental events.
The aim is to understand the phenomenon of enrichment due to atmospheric fall out or diffuse contamination.

Methodology (1)



Several sources of environmental pressure (red points) have been selected:

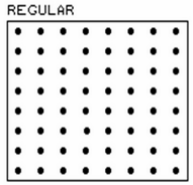
- waste disposal: incineration of municipal waste;
- combustion plants: for the production of energy and heat;
- high temperature processes: production of cement, asphalt and lime;
- melting and metals processing plants: primary and secondary metallurgy operations, iron ore sintering, steel production;
- urban areas

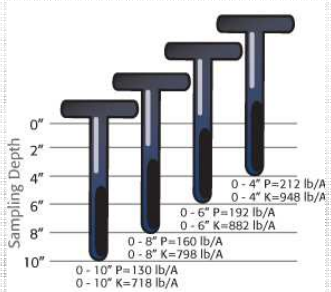
In the remaining areas of the region the sample grid has a density of about 1 sample per 100 km^2 (red grid)

Methodology (2)

Sampling strategy

Areal sampling with regular cells (10-16 subsamples, about 4000 m^2)



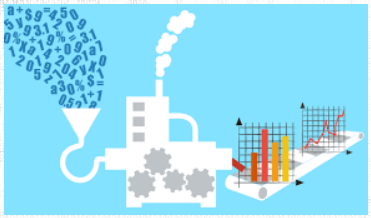


Sampling depth

Sampling depth is different depending on soil use (plowing or not): plowed horizon on agricultural soils and the first few centimeters of soil (generally 0-5 cm). In some areas, also deep samples have been collected.

Analysis

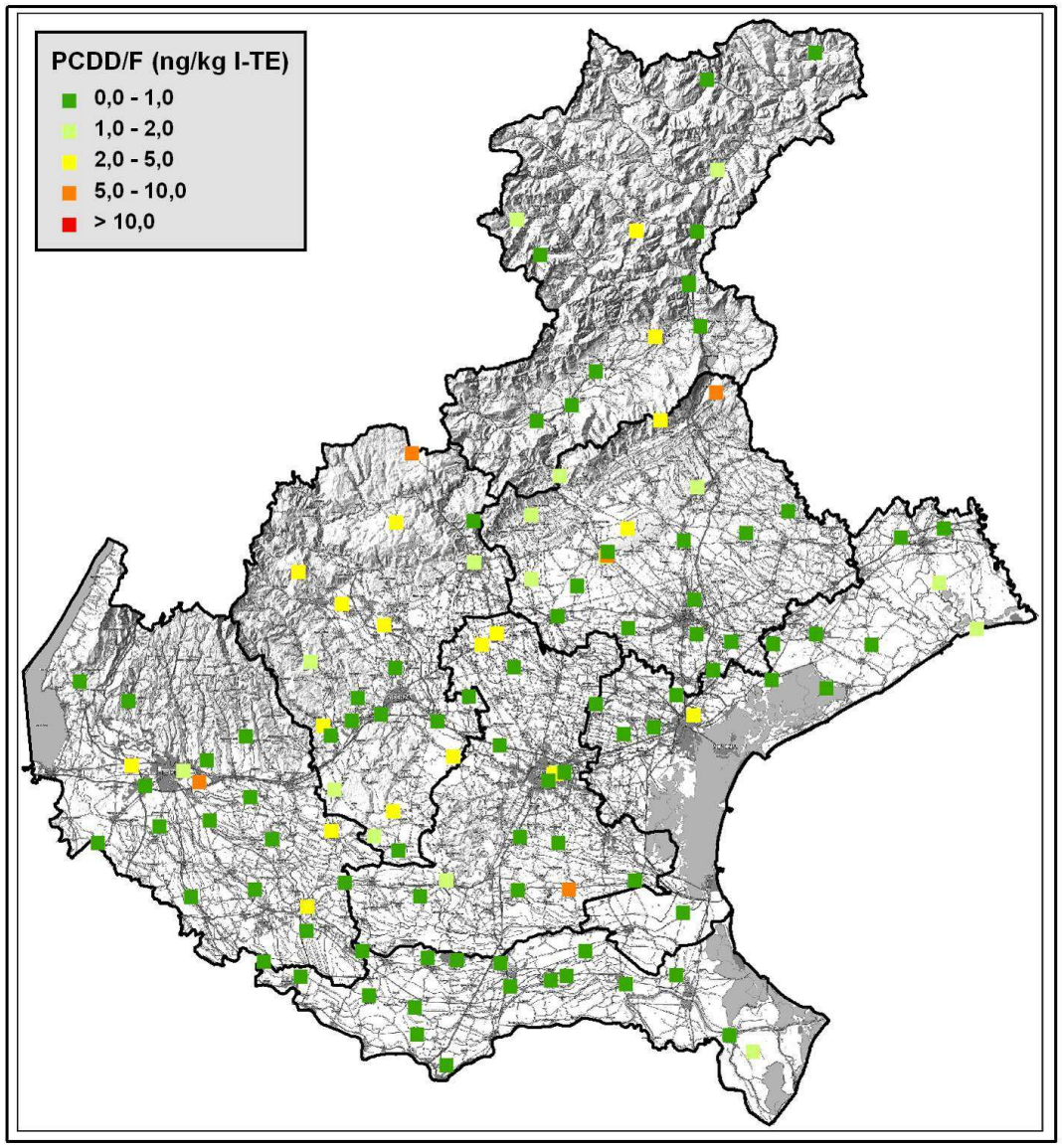
We also determined pH, texture, organic carbon, total limestone, cation exchange capacity and heavy metals, in order both to have useful elements to establish the soil natural origin and to better understand the behavior of organic compounds in soil.



Data processing

- Descriptive statistics (whole dataset and on homogeneous groups for land use/pressure source),
- various tests for normality and correlation;
- outliers analisys.

Results: PCDD/PCDF

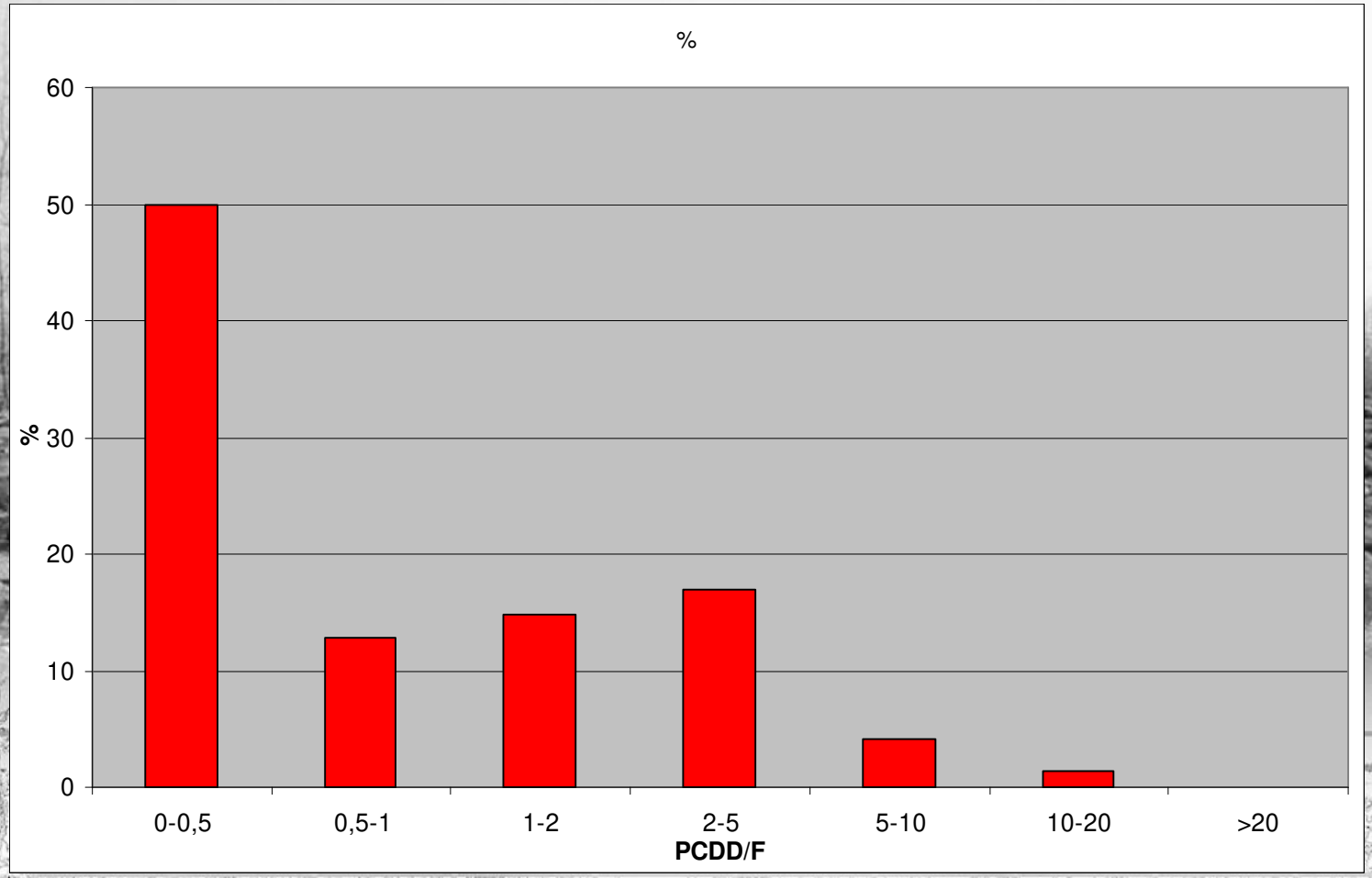


148 samples from 129 sites; 19 sites have samples even in the deep horizons.

About 50% of the samples have concentrations lower than 0.5 ng/kg I-TE, a value close to the detection limit.

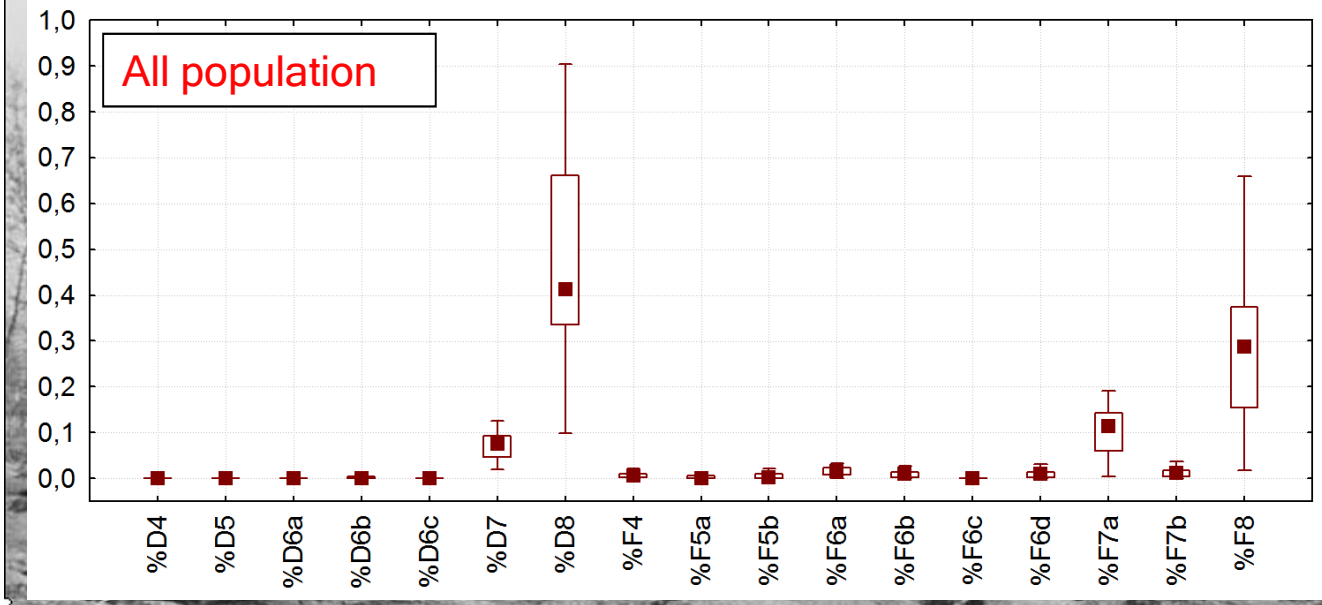
In the class of values above 5 ng/kg I-TE only few samples occur.

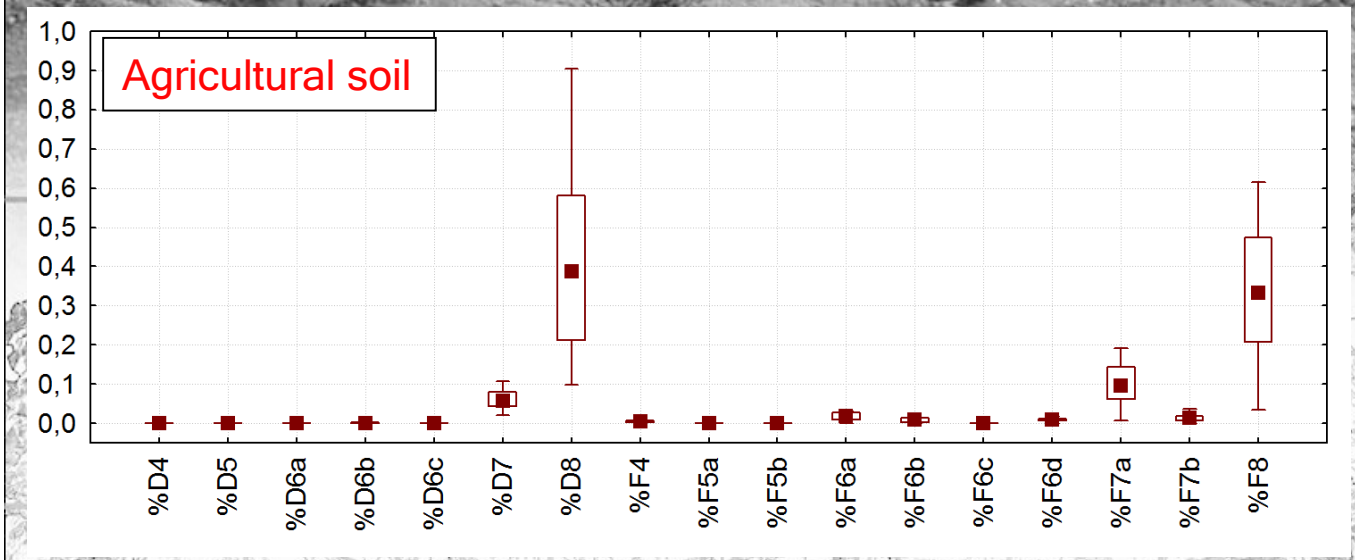
Results: PCDD/PCDF



Concentration frequency classes of dioxins and furans, expressed as equivalent toxicity (I-TE ng/kg).

Results: PCDD/PCDF - fingerprint





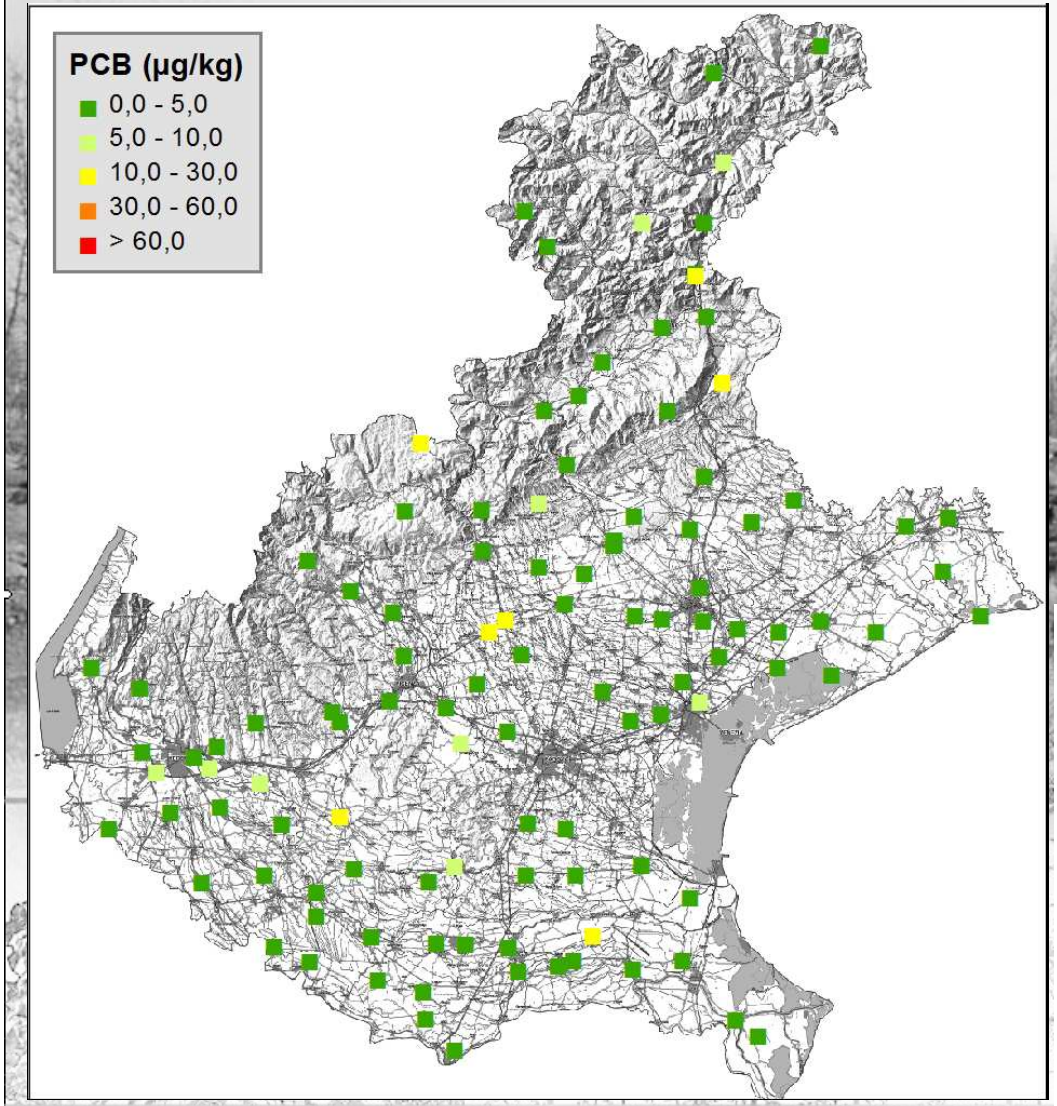
Box and whiskers plot of congeners distribution: % on total content in non-outliers interval (median, 25th and 75th percentile).

Results: PCDD/PCDF – Critical thresholds

Critical thresholds (ng/kg I-TE) - *i.e.value beyond which further investigation is needed:*

- Agricultural soils: 1.1
- Soils near foundries: 1.9
- Urban soil: 3.1
- Soils near waste incinerators: 3.8

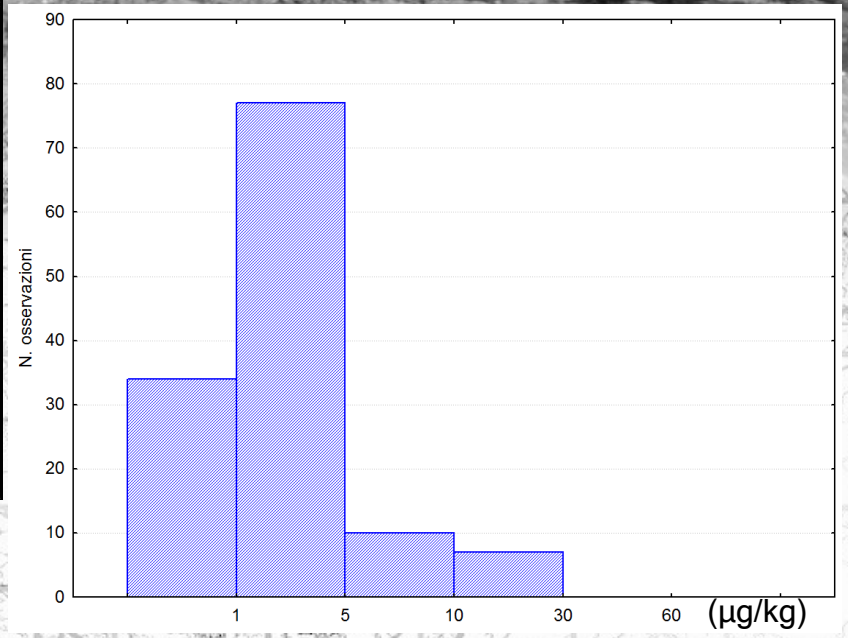
Results: PCB - PolyChlorinated Biphenyls



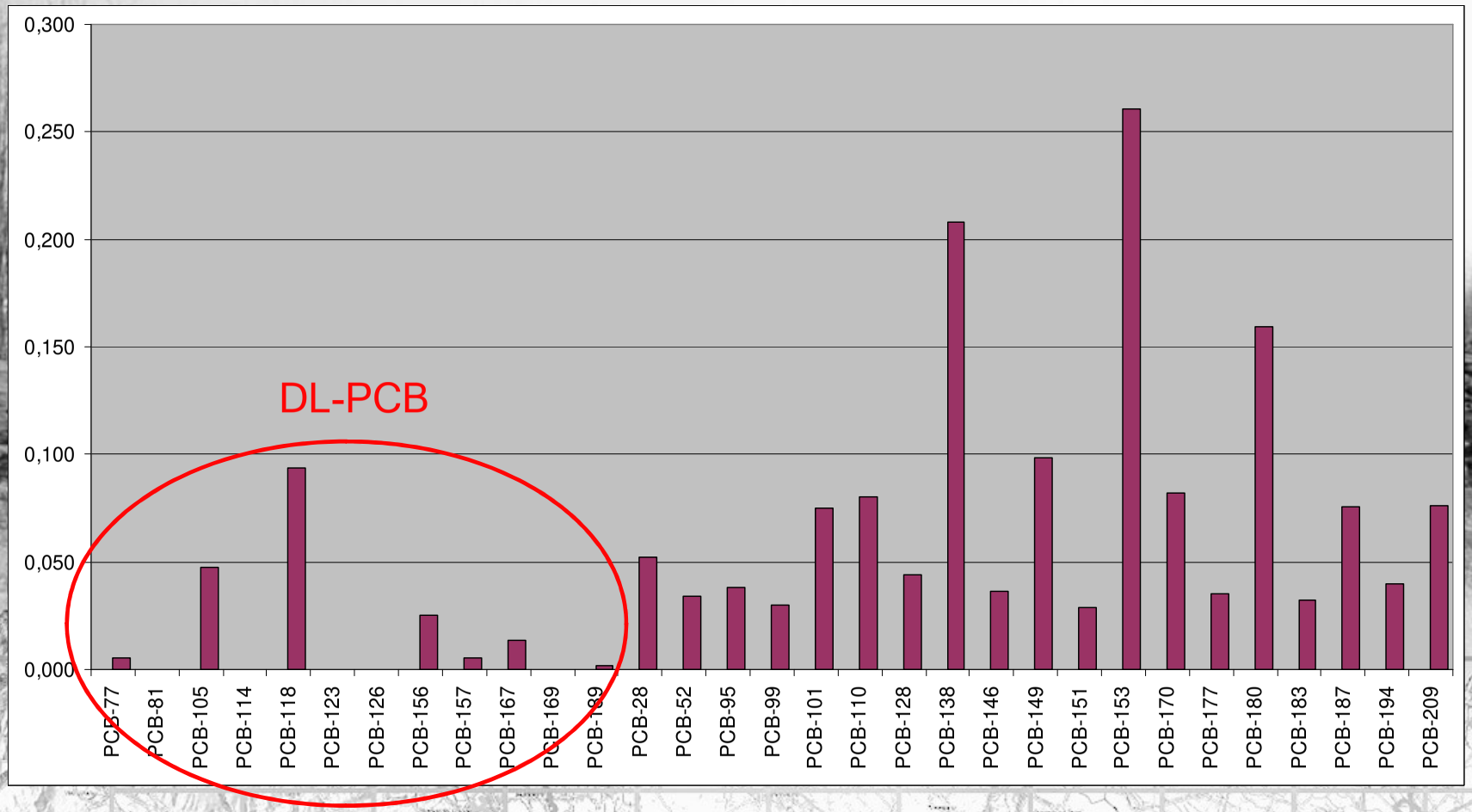
PCB in Veneto soils (µg/kg)

113 sites were sampled for a total of 128 analyzed samples, including 15 deep horizon.

Most data are lower than 5 µg/kg that means near the detection limit, all data are lower than 30 µg/kg *(Italian law limits for residential area is 60 µ g/kg)*



Results: PCBs

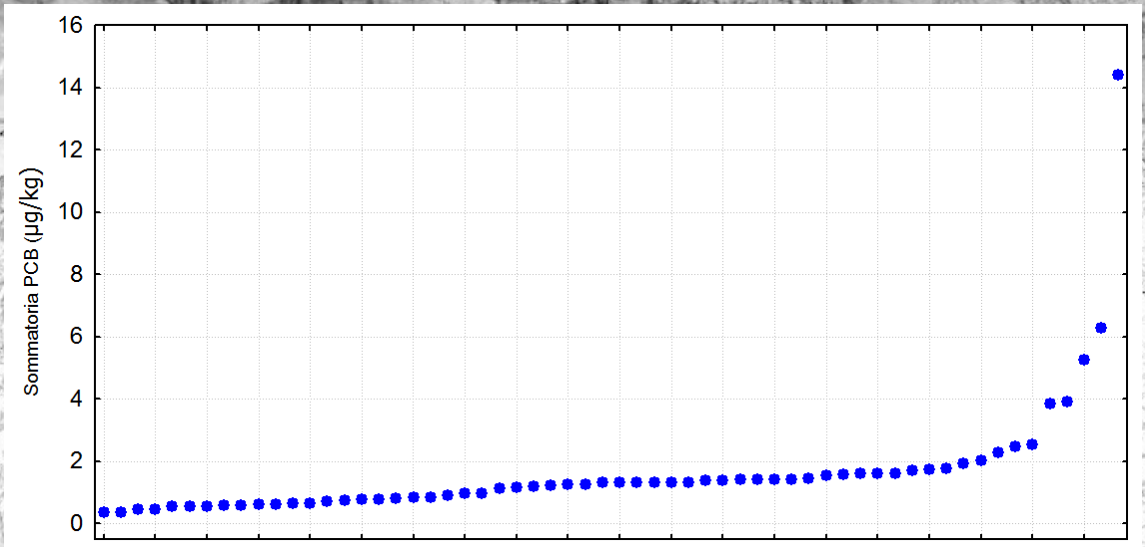


Median concentration of the different PCB congeners (in µg/kg)

Results: PCB - Critical thresholds

Critical thresholds (PCB expressed as sum - µg/kg) for different land uses:

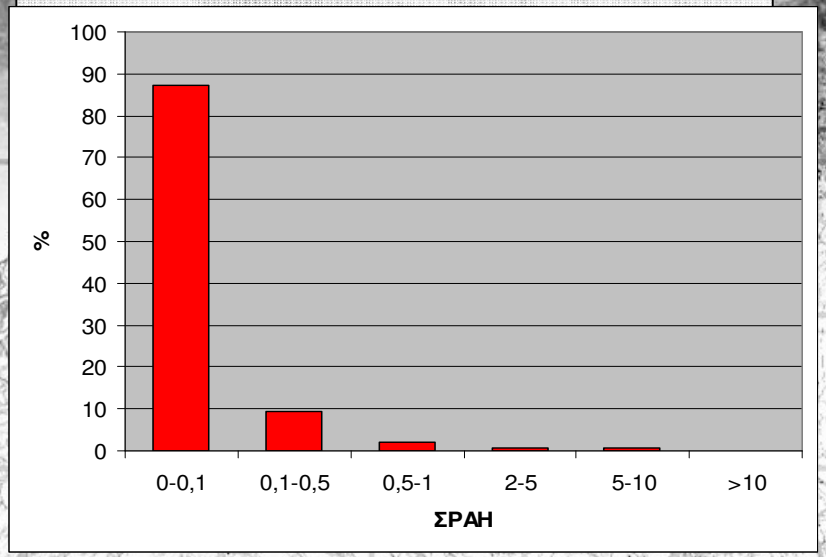
- Agricultural soils: 4.0
- Soils near foundries: 5.5
- Urban soil: 13.2
- Forest soils : 12.4

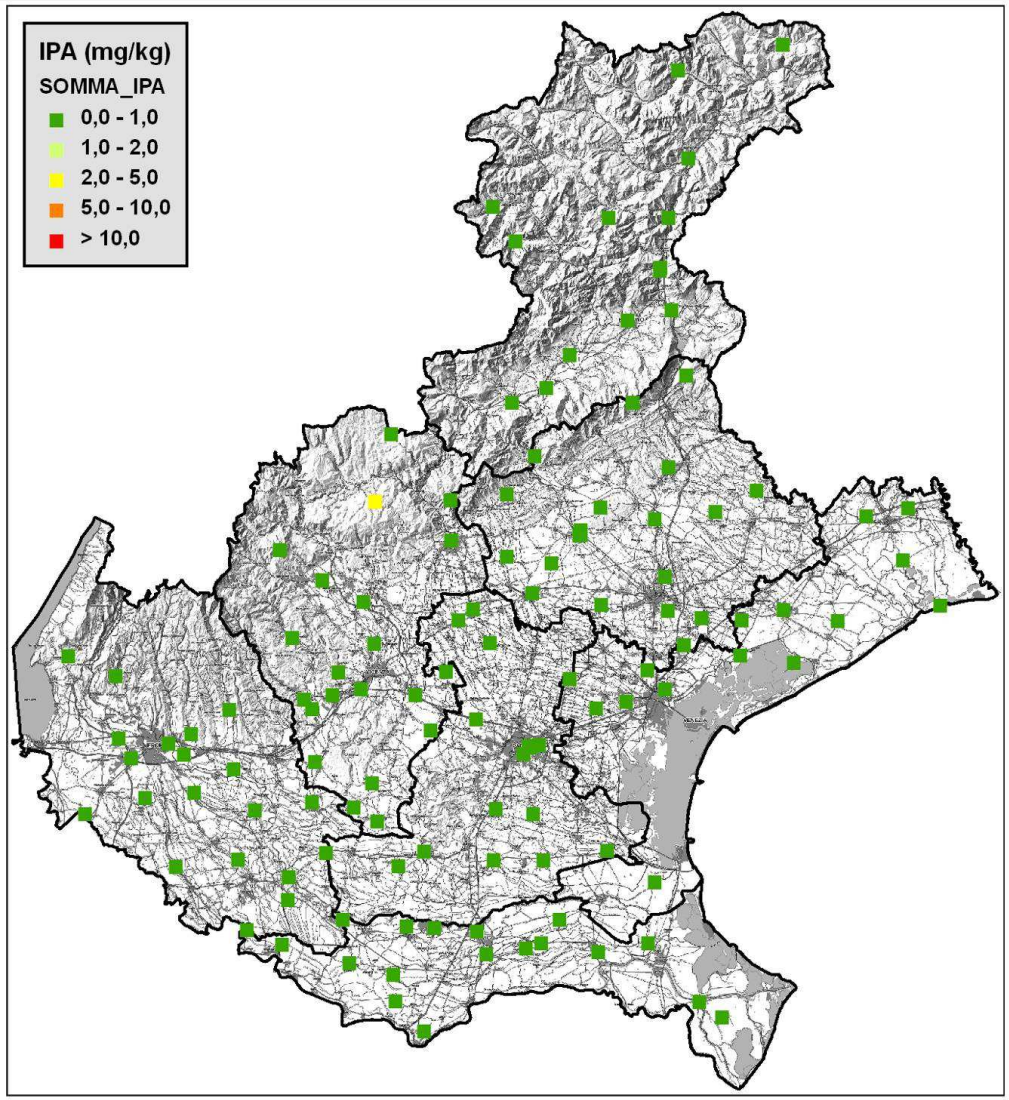


Cumulative frequency distribution of PCB in agricultural soil.

Results: PAH - Polycyclic Aromatic Hydrocarbons

- 131 sites were sampled and analyzed, 19 also in the deep horizons.
- No exceedance of italian law limit was observed *(sum of PAHs: 10 mg/kg)*.
- Only one third over the total showed a detectable concentration.
- 13 samples have concentrations greater than 0.1

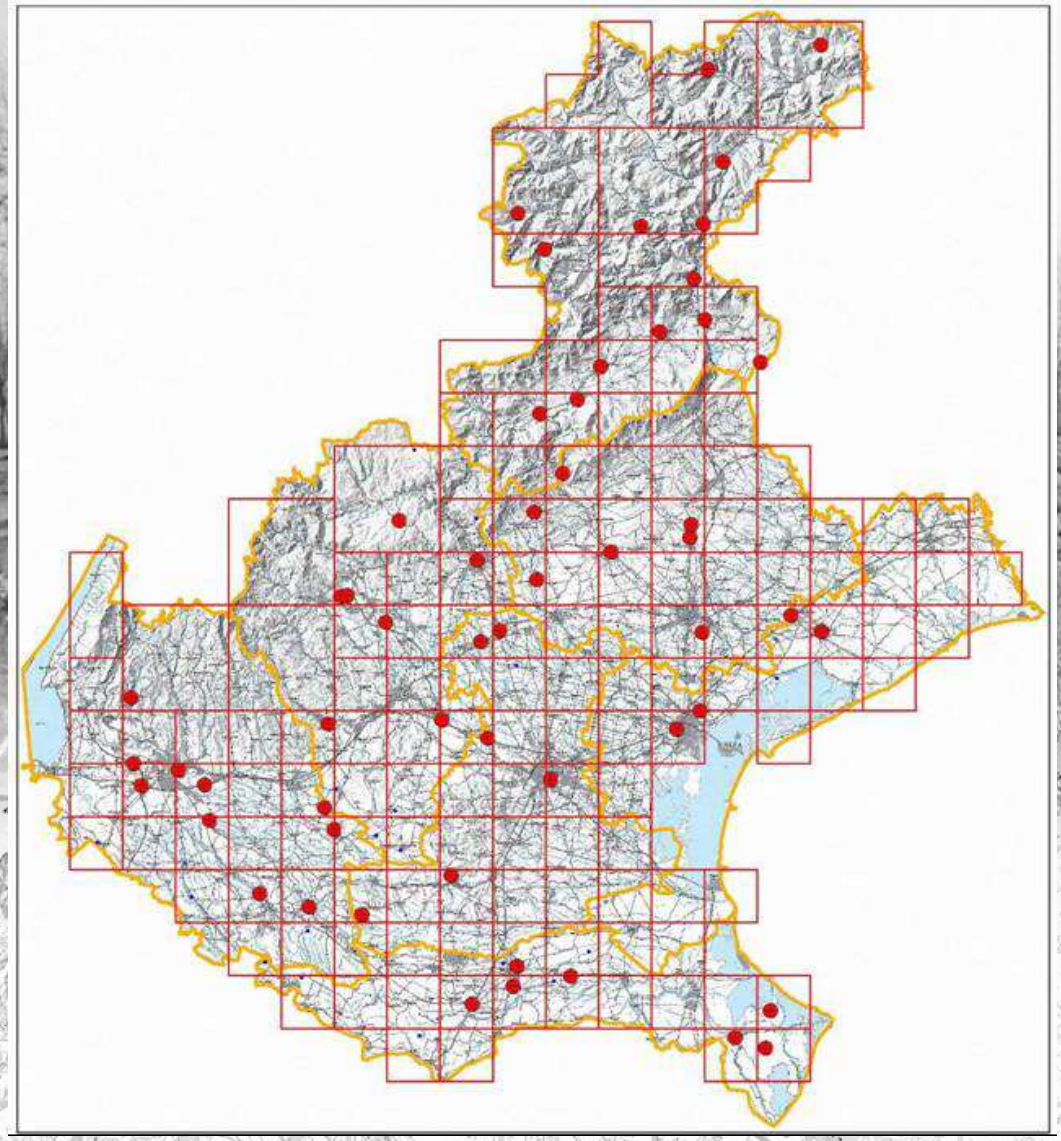




Conclusions

- Low concentration of POPs in soils of Veneto region if compared with italian regulatory limits.
- PCDD/PCDF: quite all samples range between 0.1 and 5 ng/kg I-TE;
- PCBs: between 1 and 30 µg/kg;
- PAHs: only one third of the total samples showed a detectable concentration always <10 mg/kg;
- Critical thresholds: effective tool in order to highlight specific POPs enrichments.

Future Developments



After 10 years from the beginning of the monitoring program some of the points already monitored in addition to others specifically chosen will be resampled in order to evaluate the trend over time of these pollutants.