Istituto Superiore di Sanità
Gruppo di Studio Nazionale
"Inquinamento Indoor"

IPA indoor a Roma: scuole, case, uffici, veicoli

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Workshop del GdS Nazionale

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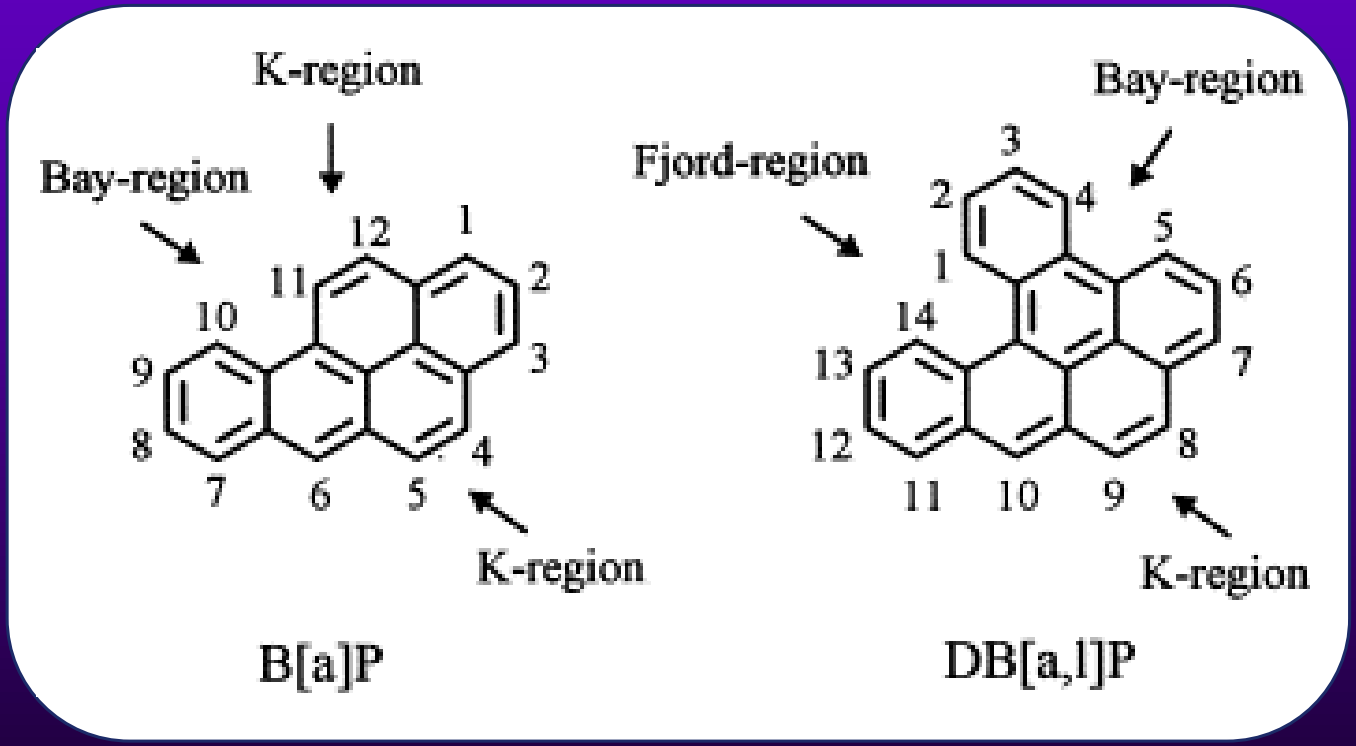
Idrocarburi policiclici aromatici

(IPA o PAHs)

- Generalmente presenti in aria a concentrazioni relativamente basse.

- Tuttavia assai e a lungo studiati, per le riconosciute proprietà cancerogene

Tossicità e stereochimica:
bay-, *key-* e *fjord-* regions nella molecola



I primi studi italiani dei componenti delle polveri sospese furono dell'Università La Sapienza – Roma e del CNR - IIA

anno 1969-70	Set	Nov	Gen	Mar
fluorantene	1.9	3.8	6.4	3.8
pirene	2.9	5.9	10.1	3.2
benz(a)antracene	0.6	5.1	13.1	1.4
crisene	1.4	12.5	36.5	3.2
benzo(b/k)fluorantene	3.0	13	21	4.8
benzo(e)pirene	0.9	6.2	8	2.1
benzo(a)pirene	0.7	5.8	6.3	1.3
anno 1970-71	**Set**	**Nov**	**Gen**	**Mar**
fluorantene	1.0	5.3	10.7	3.2
pirene	0.4	5.6	9.6	2.7
benz(a)antracene	0.6	3.4	7.5	0.1
crisene	1.4	7.9	18.2	0.4
benzo(b/k)fluorantene	1.4	10	8.7	4.0
benzo(e)pirene	0.4	1.8	1.1	0.6
benzo(a)pirene	0.1	1.2	0.8	0.6

ng/m^3

$\mu g/g$

Composto	µg/g
fenantrene	7.3
fluorantene	8.8
pirene	11.3
benzo(b/k)fluorantene	23.0
benzo(a/e)pirene	21.0

Benzo(a)pirene misurato presso la stazione di prelievo ISS (Viale Regina Elena, Roma) dal 1993 al 2004

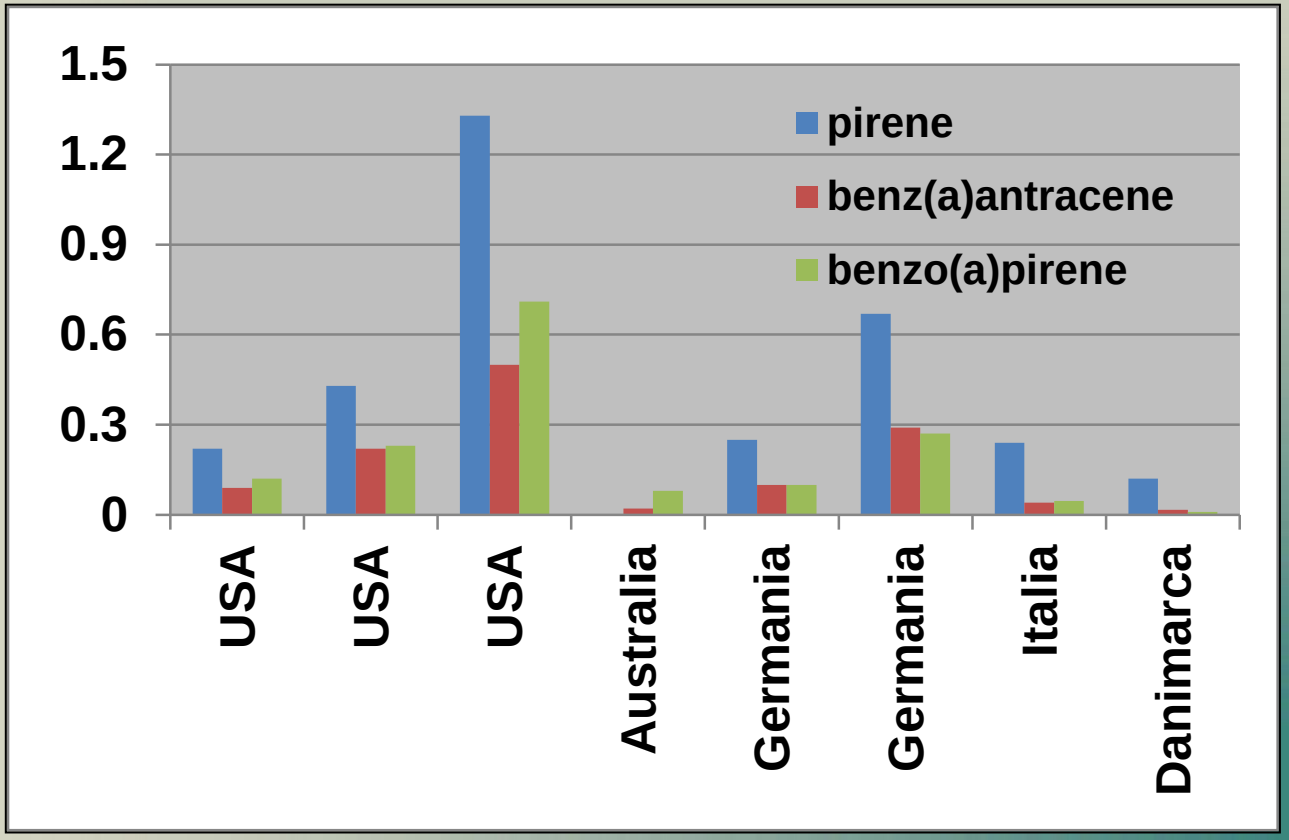
Periodo di prelievo	anno solare	BaPY ng m^{-3}
3/93 -2/94	1993	1.47
3/94 -2/95	1994	1.50
3/95 -2/96	1995	1.35
3/96 -2/97	1996	1.29
3/97 -2/98	1997	1.22
2/02 -1/03	2002	1.13
4/03 -2/04	2003	0.89 (*)

(*) manca una serie di dati invernali: si presume che il valore corretto è più alto.

uno sguardo alla provincia di Roma (2009) (ng/m^3)

Roma città	BaP		IPA	
	Inverno	Estate	Inverno	Estate
Via Belloni	0.68	0.10	13	2.2
Via Cipro	0.80	0.09	15.3	3.5
Corso Francia	0.95	0.05	18.1	2.1
Villa Ada		0.04		1.0
Malagrotta	0.67		8.4	
Roma Provincia				
Ciampino	2.0	0.10	40.5	2.4
Civitavecchia	0.23	0.03	6.4	1.1
Colleferro	2.1	0.34	41	5.9
Guidonia	0.94	0.05	17.3	2.1
Montelibretti		0.03		0.48

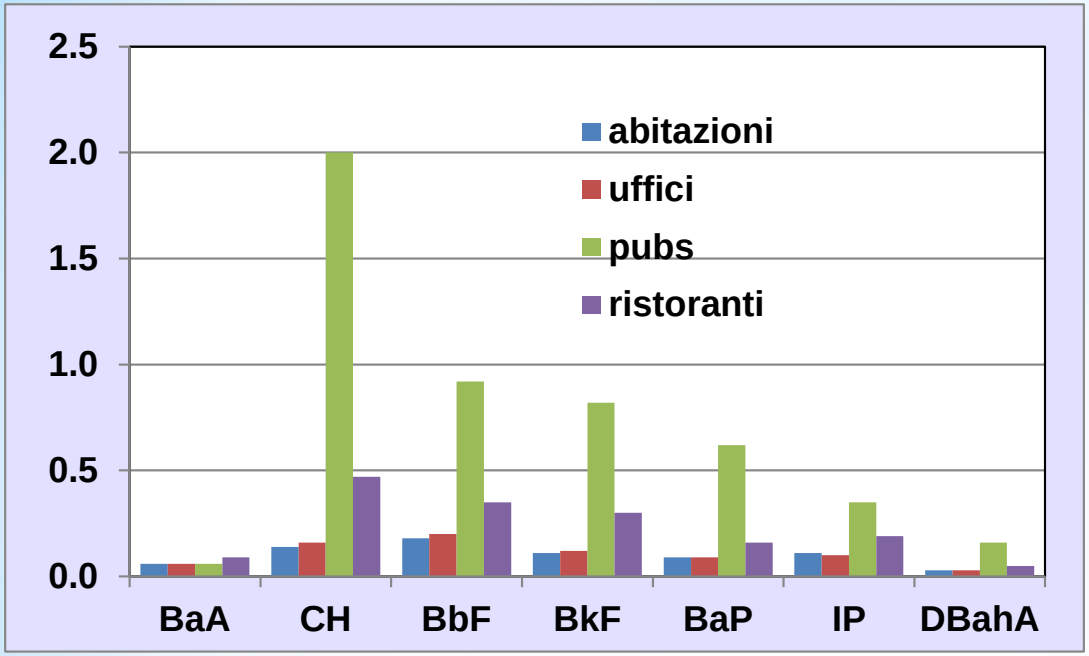
IPA nelle polveri delle abitazioni (µg/g)



IPA nelle polveri di deposizione in ambienti interni (µg/kg)

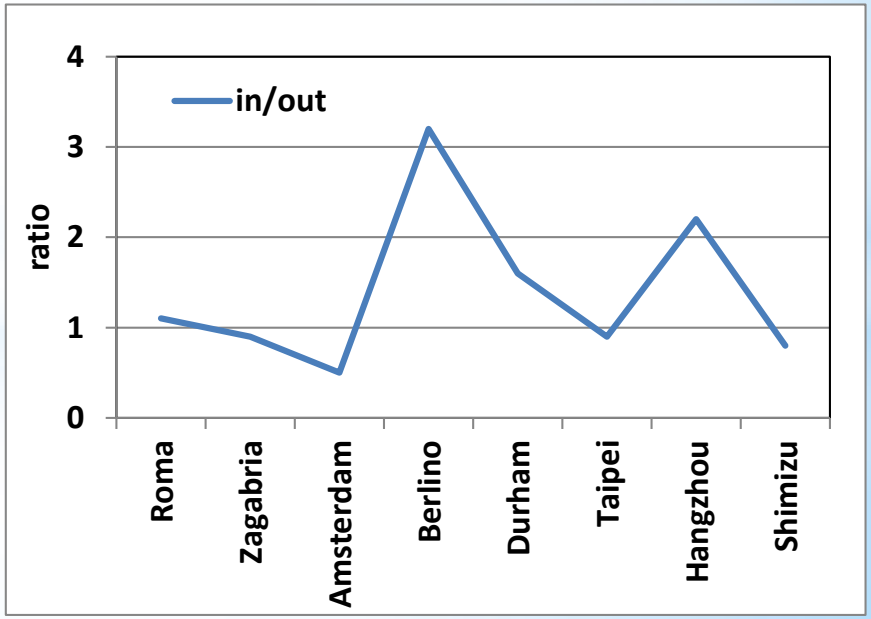
concentrazioni	**camere da letto**			**saloni/soggiorni**		
ng/g	media	min	max	media	min	max
BaA	121	0.8	712	50	5	162
CH	326	2.4	1391	274	47	715
BbF	232	0.0	1051	94	22	340
BkF	107	0.0	397	39	9	109
BaP	155	1.8	608	55	10	116
IP	98	6.0	363	46	5	119
DBahA	106	2.2	451	37	0.4	126
Totale IPA	7271	36	34453	2925	266	11615

concentrazioni	**cucine**			**ambienti di lavoro**		
ng/g	media	min	max	media	min	max
BaA	164	7	432	113	10	738
CH	944	21	3046	312	41	832
BbF	292	10	644	205	0.0	891
BkF	217	6	662	118	0.0	496
BaP	72	7	147	110	4	516
IP	158	0.2	317	148	18	487
DBahA	139	0.3	303	72	1.2	265
Totale IPA	8566	146	28566	2889	893	8083



IPA nelle polveri sospese di alcuni tipi di ambiente interno (ng/m^3)

Rapporto tra concentrazioni indoor e outdoor di IPA (BaP) in alcune città



Principali fonti di IPA e BaP in ambienti indoor

Impianti di riscaldamento

Cucina, preparazione di cibi

Penetrazione dall'esterno

Auto/motoveicoli (garages)

Candele, lumini

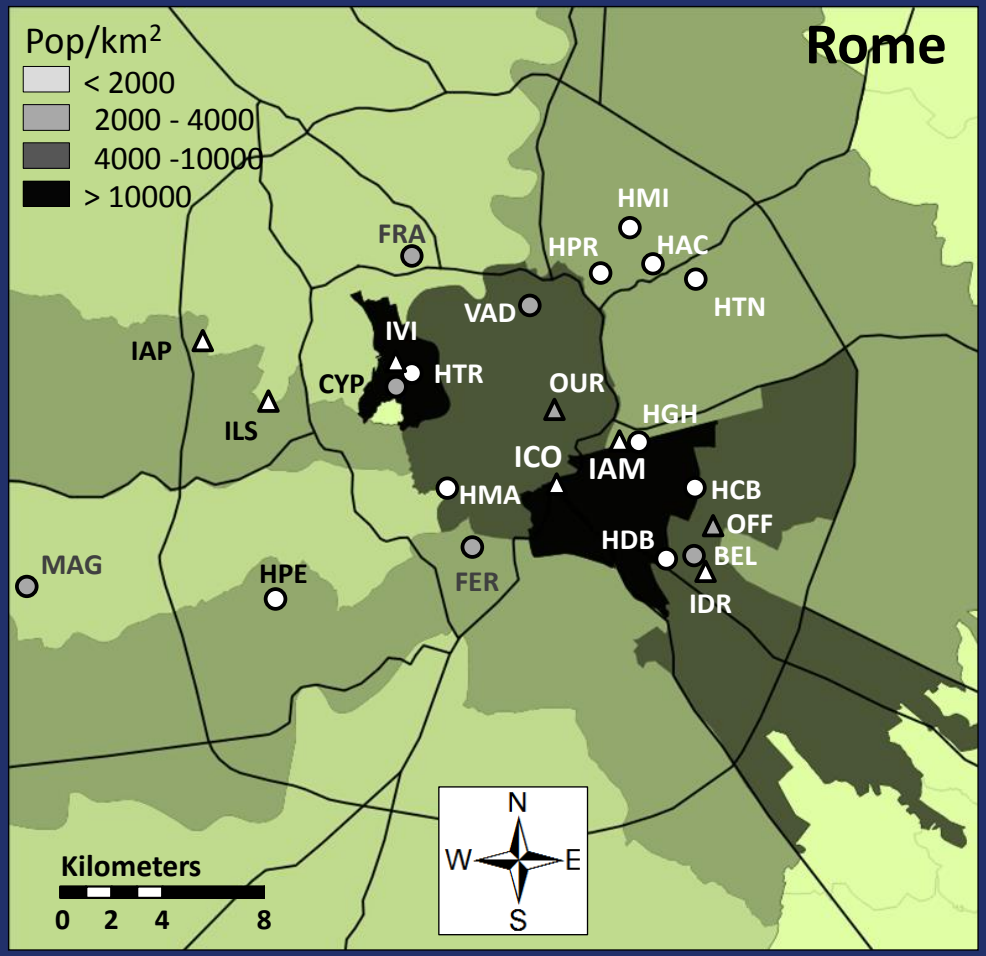
Processi e prodotti di lavoro

Risospensione polveri

Fumo di tabacco

Il Progetto *Life+EXPAH*

Population Exposure to PAH



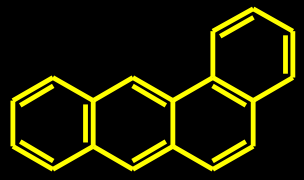
6 scuole

9 case

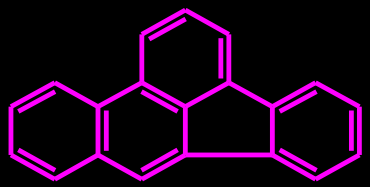
2 uffici

IPA monitorati nelle polveri sospese per il Progetto EXPAH

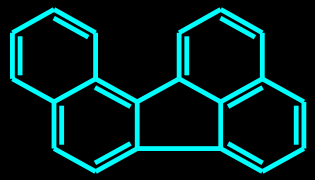
1. PAH cancerogeni



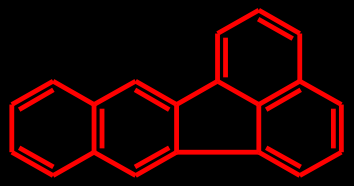
BaA



BbF

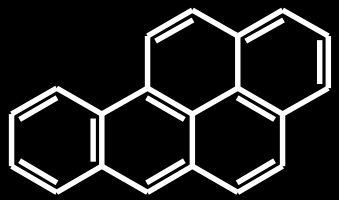


BjF

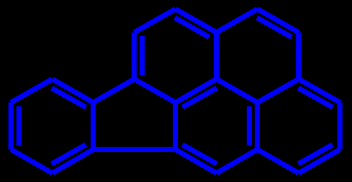


BkF

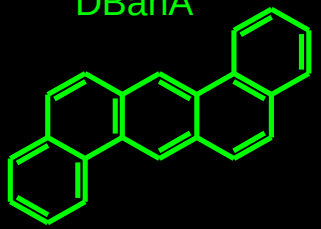
BaP



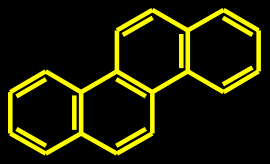
IP



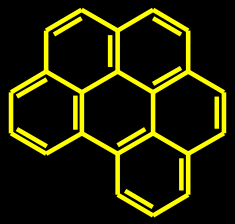
DBahA



2. PAH mutageni

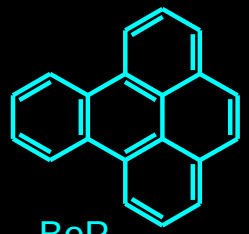


CH

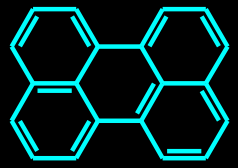


BPE

3. PAH addizionali



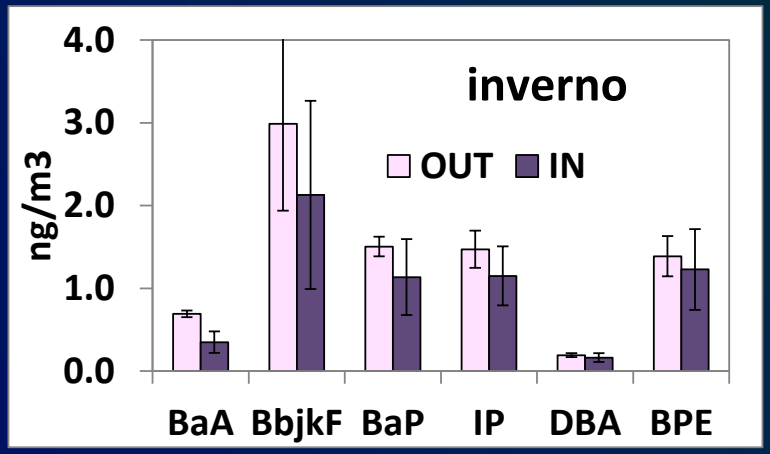
BeP

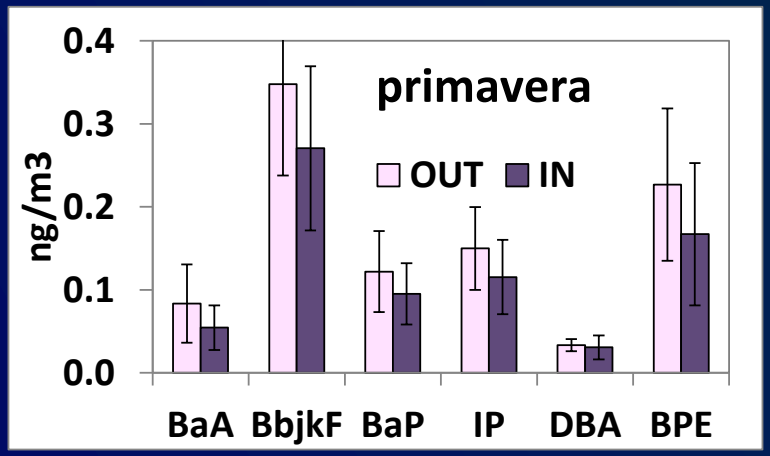


PE

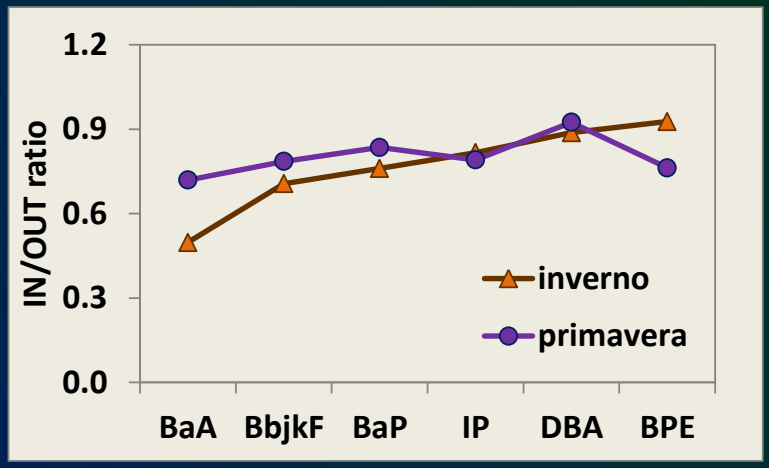
IPA nelle polveri sospese delle scuole

Concentrazioni (ng/m³)





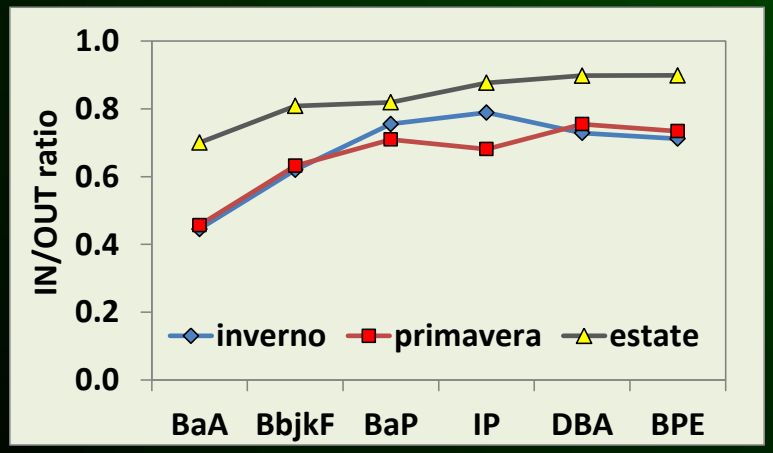
Rapporto indoor/outdoor

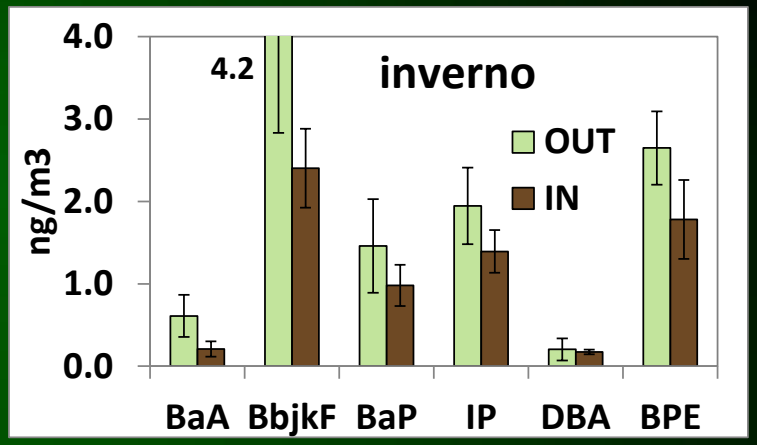


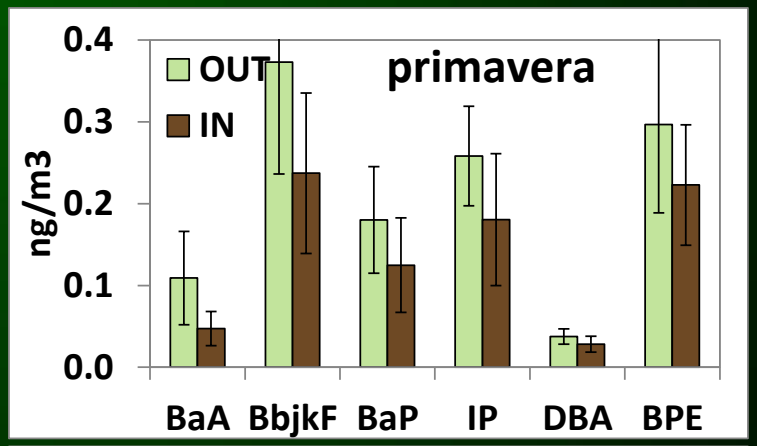
IPA nelle polveri sospese delle case

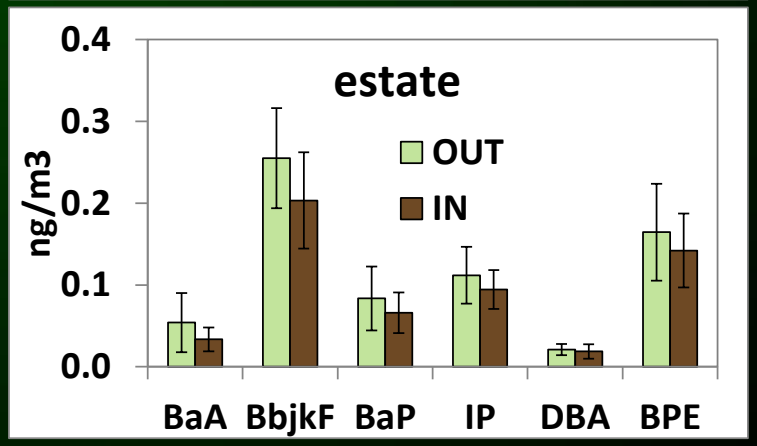
Concentrazioni (ng/m³)

Rapporto indoor/outdoor

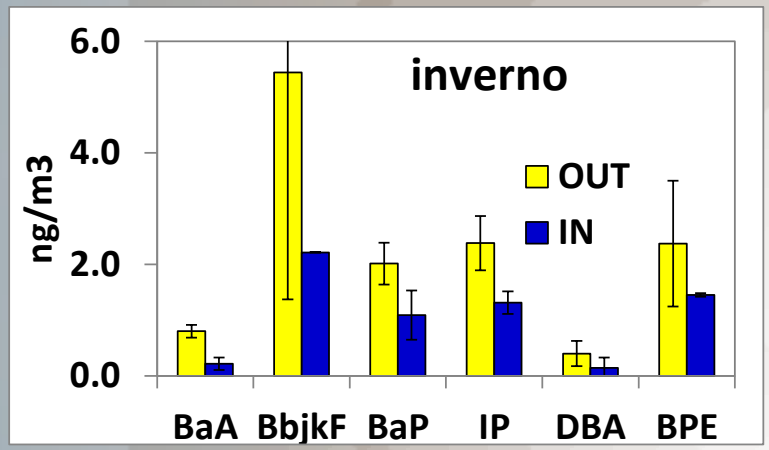




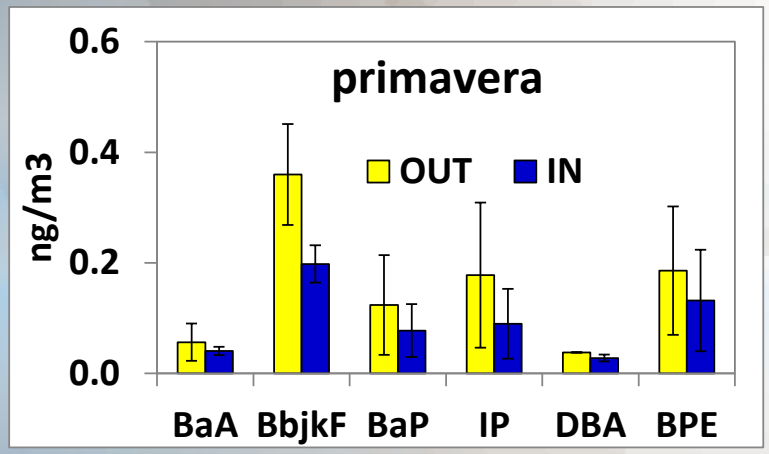




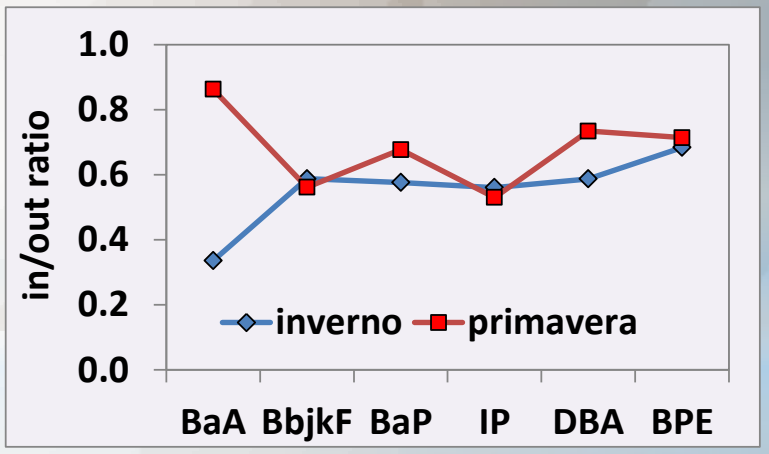
IPA nelle polveri sospese degli uffici



Concentrazioni (ng/m³)

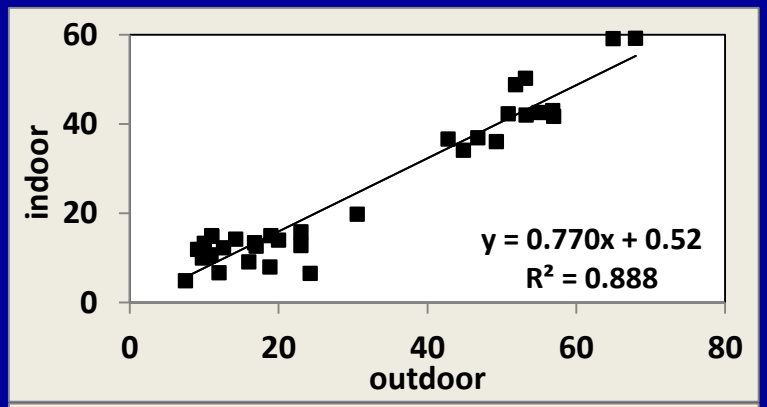


Rapporto indoor/outdoor



Correlazione indoor/outdoor per gli IPA atmosferici: scuole

Inverno (1)



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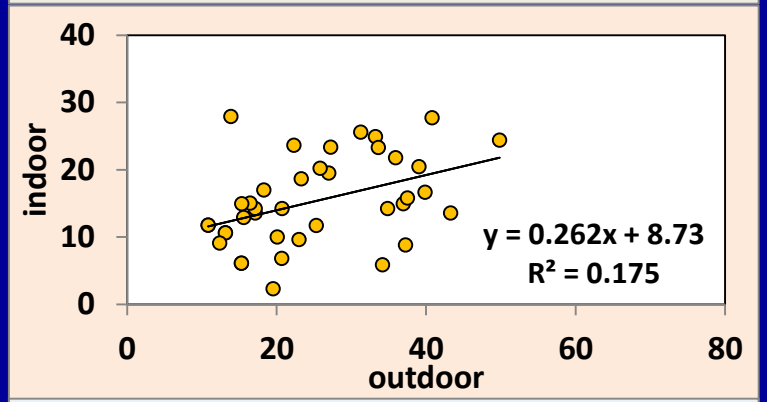
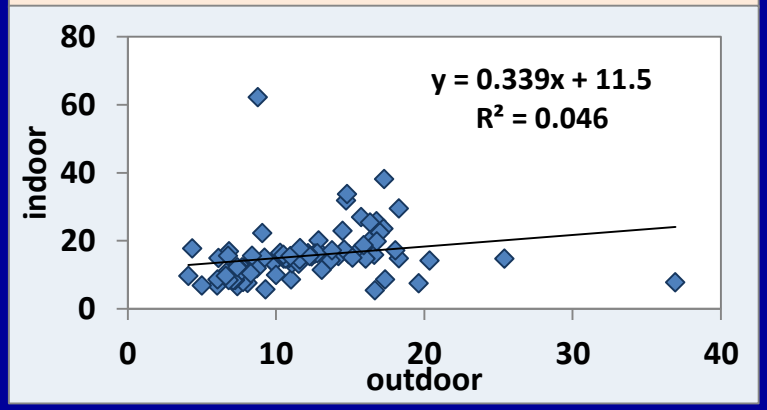
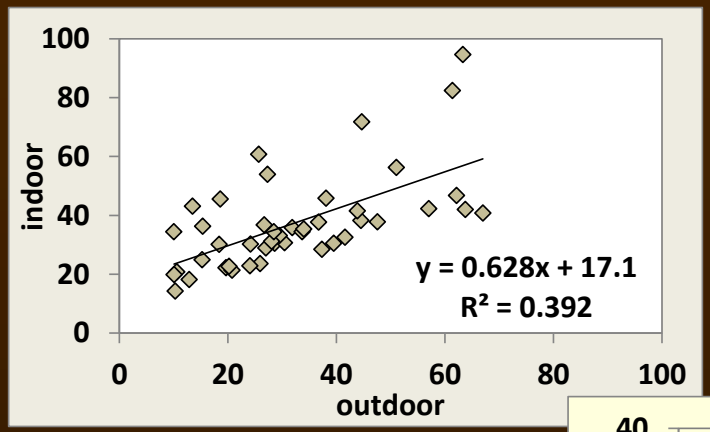


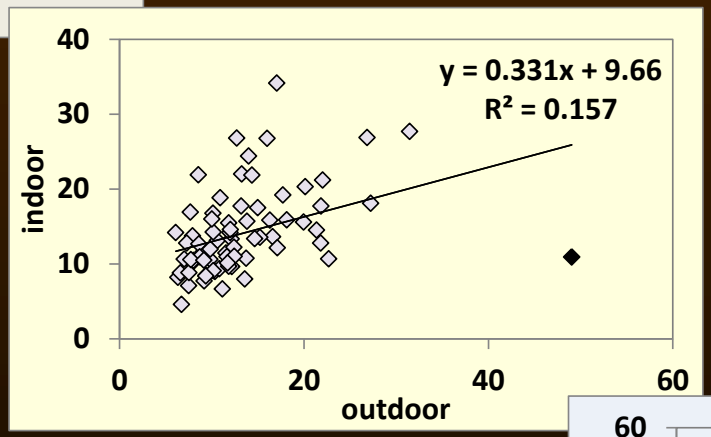
Primavera



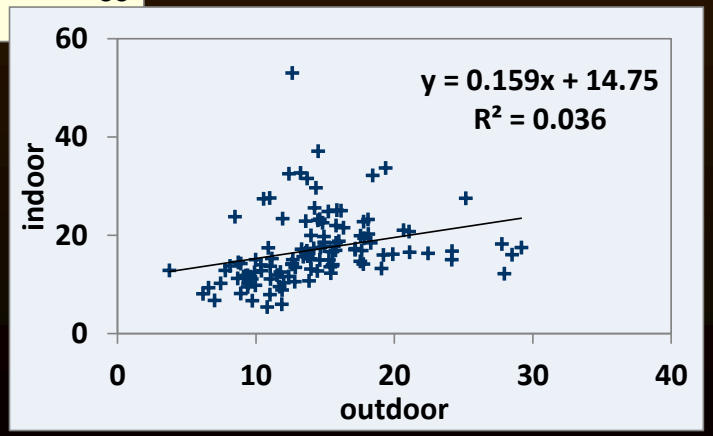
Correlazione indoor/outdoor per gli IPA atmosferici: case



Inverno



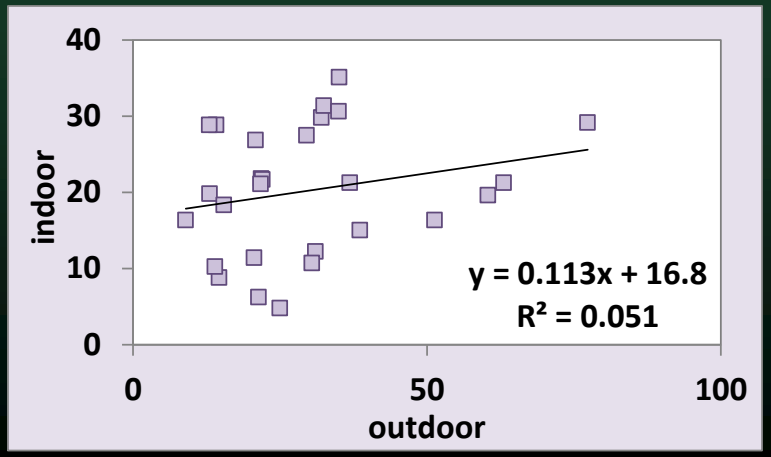
Primavera



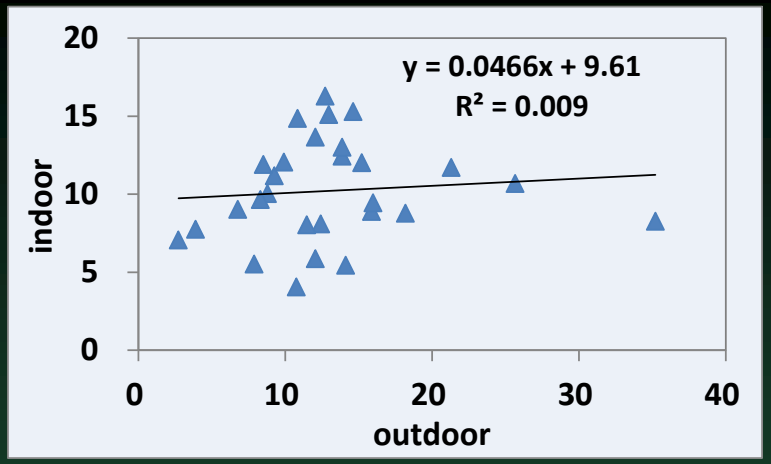
Estate

Correlazione indoor/outdoor per gli IPA atmosferici: uffici

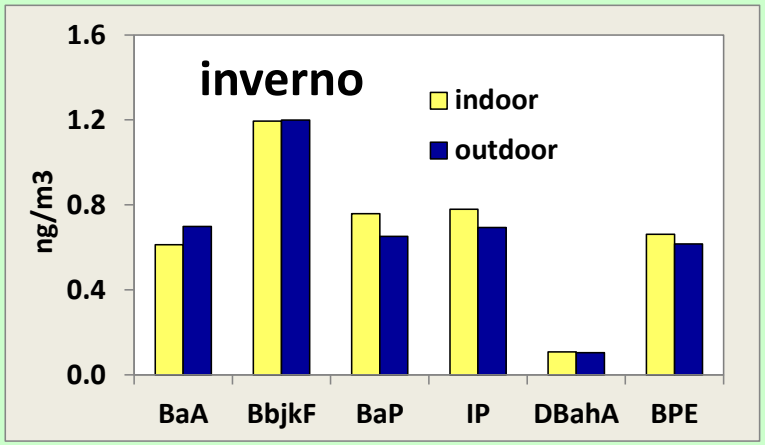
Inverno



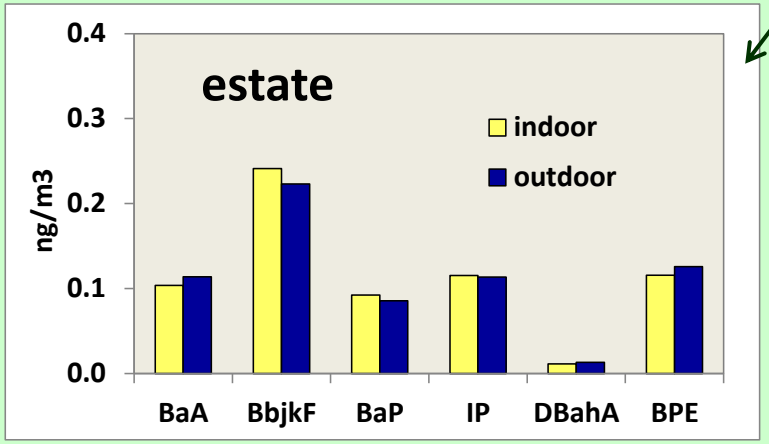
Primavera



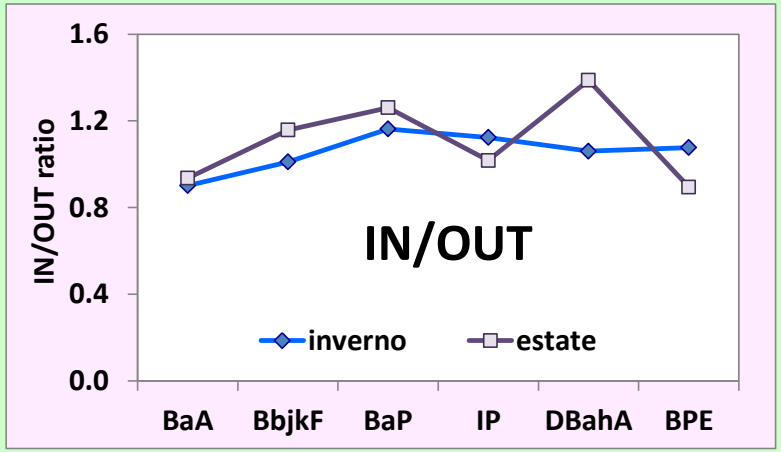
IPA nelle polveri sospese dei veicoli: bus



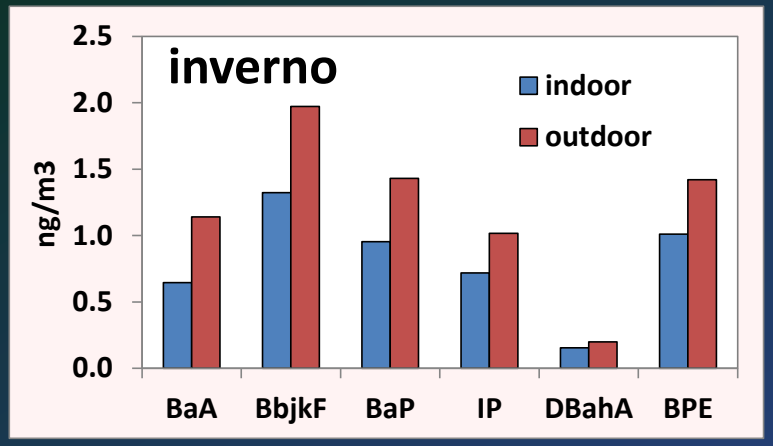
Concentrazioni (ng/m³)



Rapporto indoor/outdoor

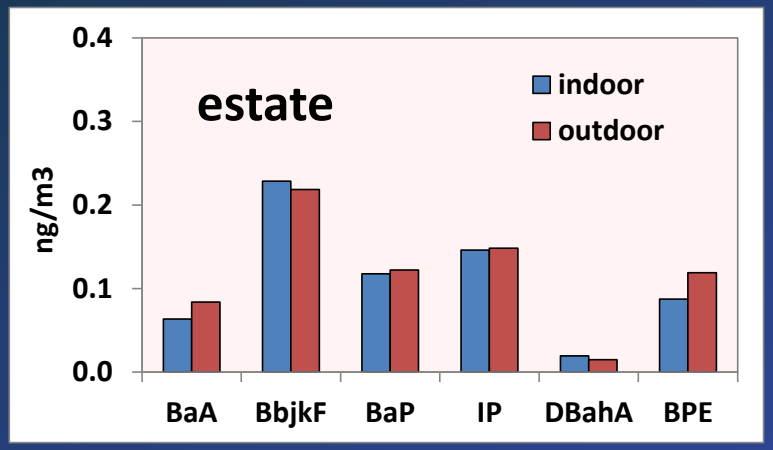


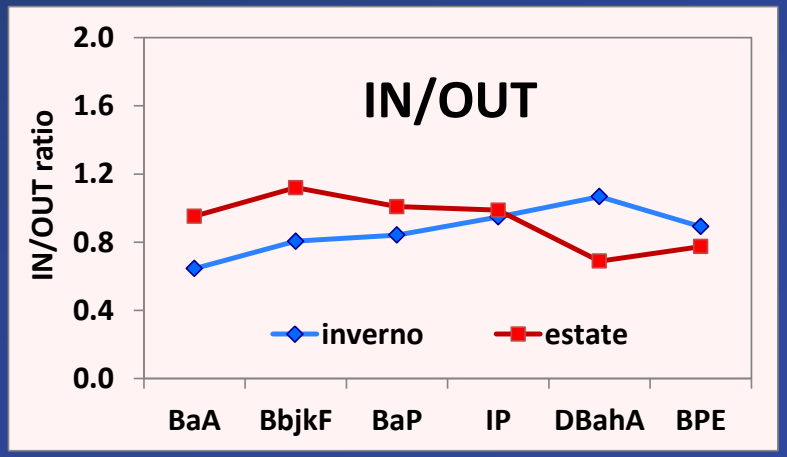
IPA nelle polveri sospese dei veicoli: autovetture



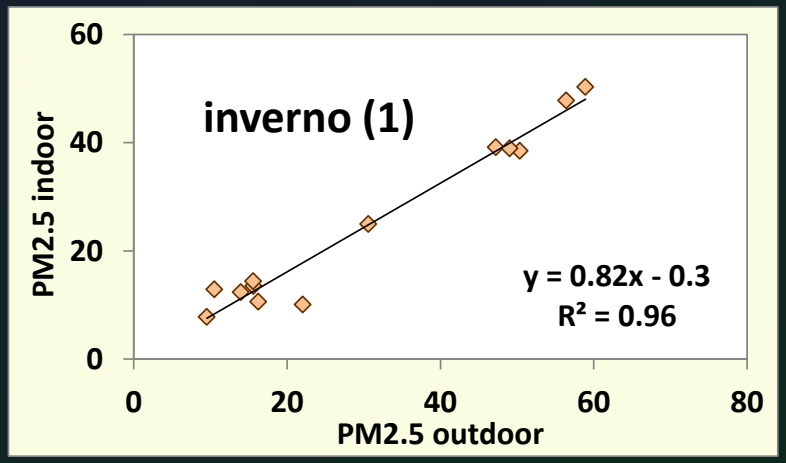
Concentrazioni (ng/m³)

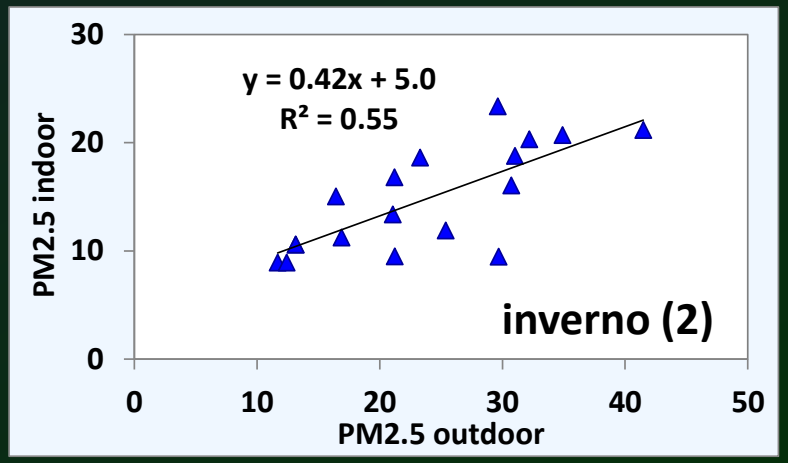
Rapporto indoor/outdoor

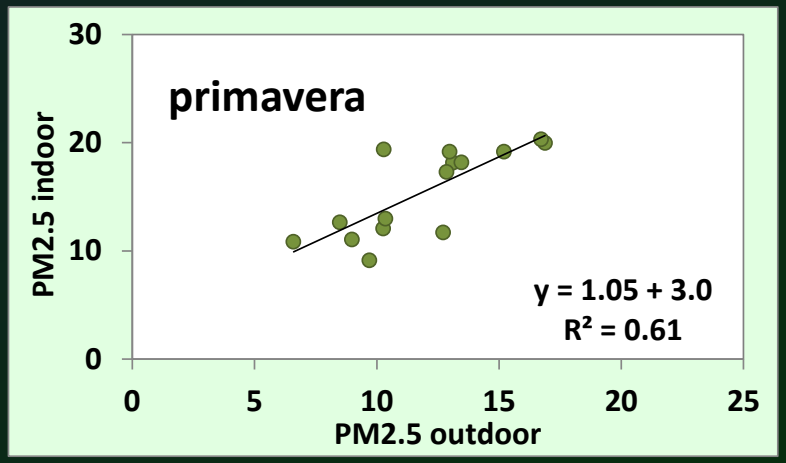




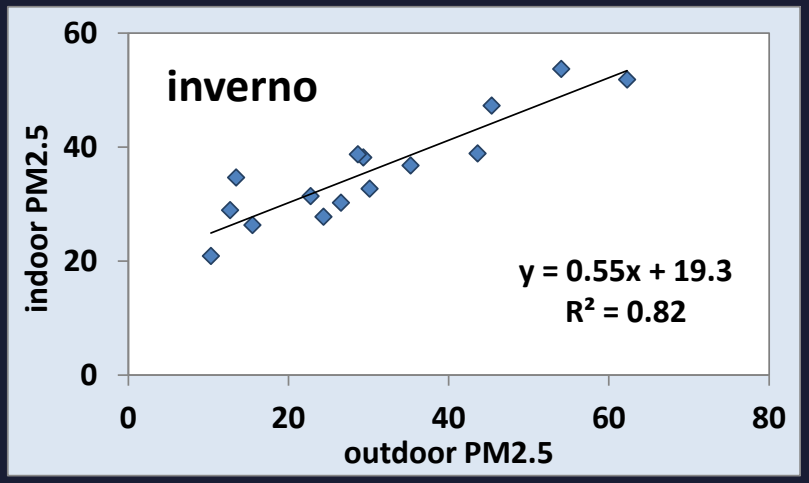
Correlazione indoor/outdoor per il $PM_{2.5}$: scuole

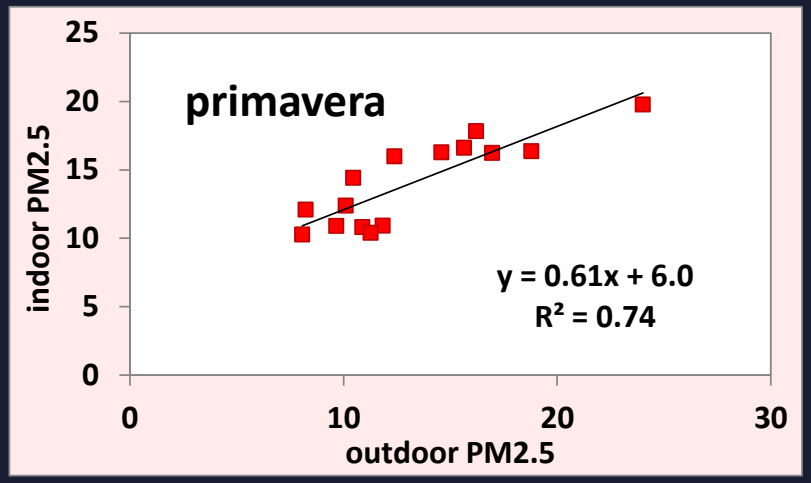


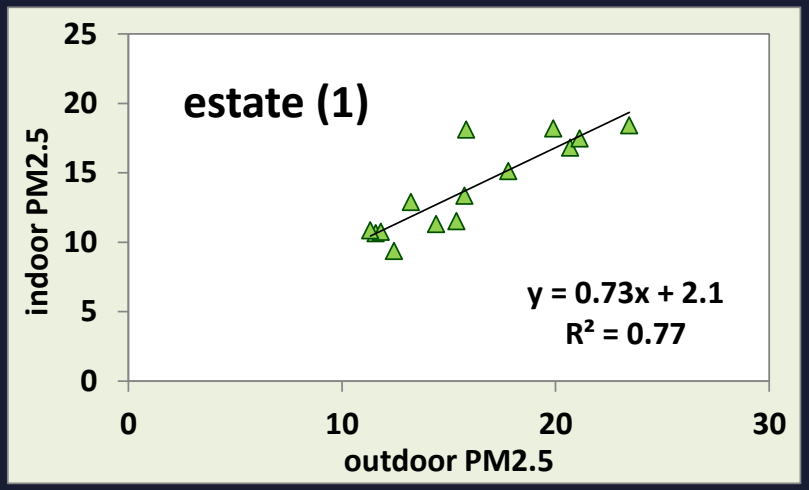


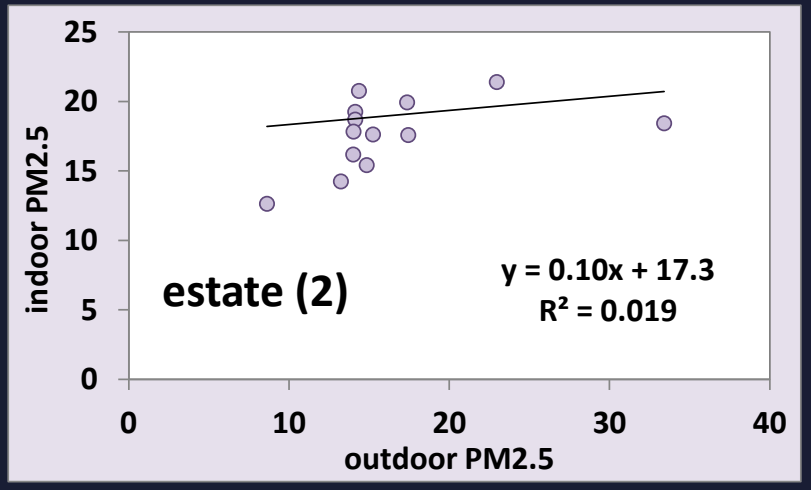


Correlazione indoor/outdoor per il $PM_{2.5}$: case

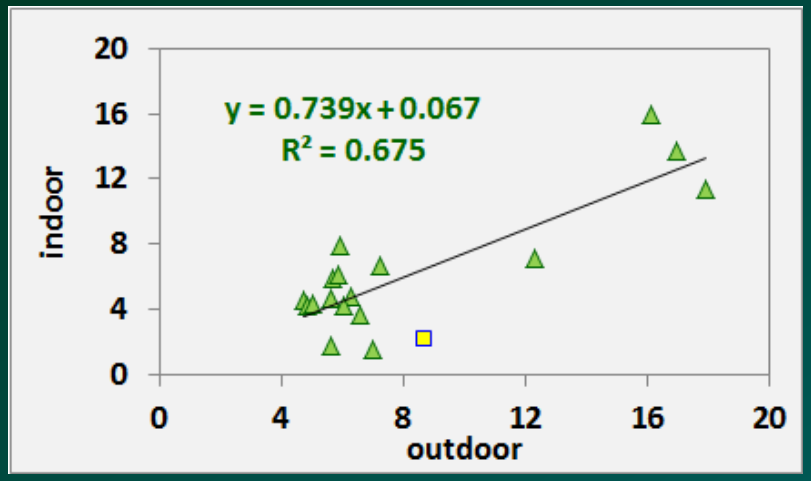


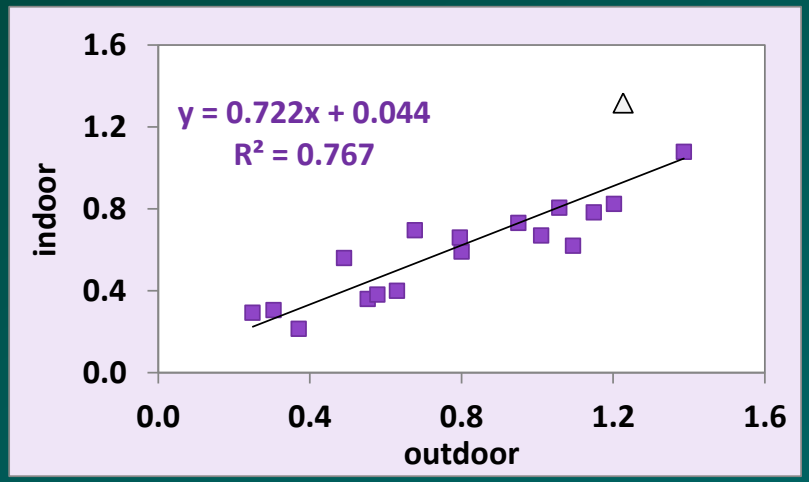






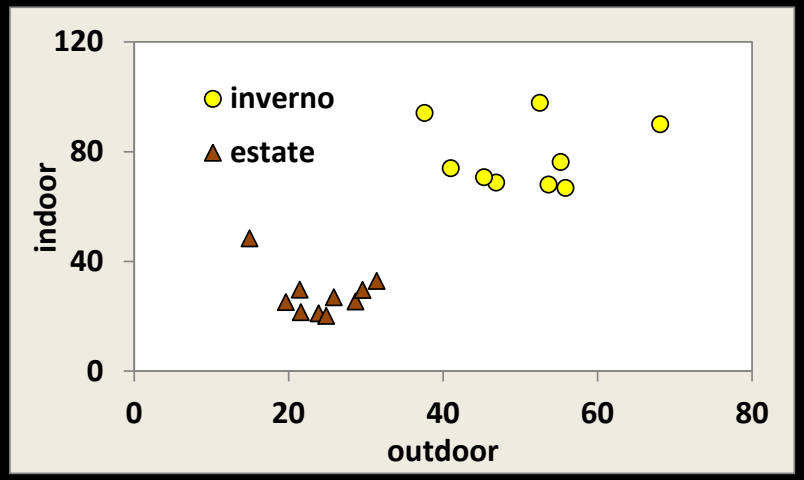
Correlazione indoor/outdoor per il $PM_{2.5}$: uffici



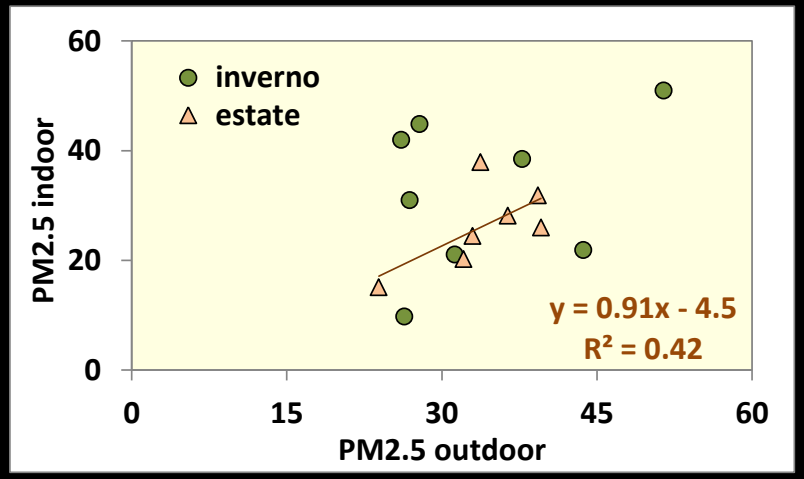


Correlazione indoor/outdoor per il $PM_{2.5}$: veicoli

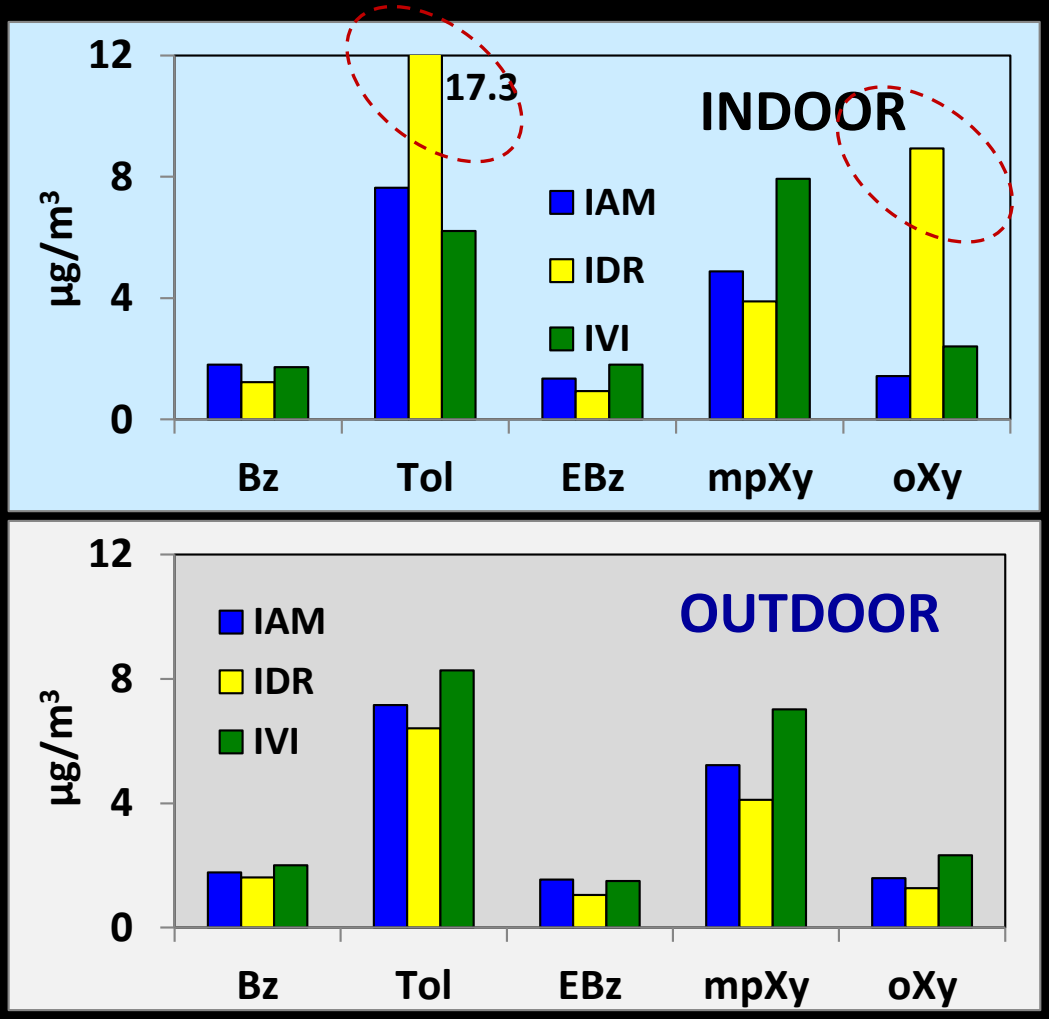
bus



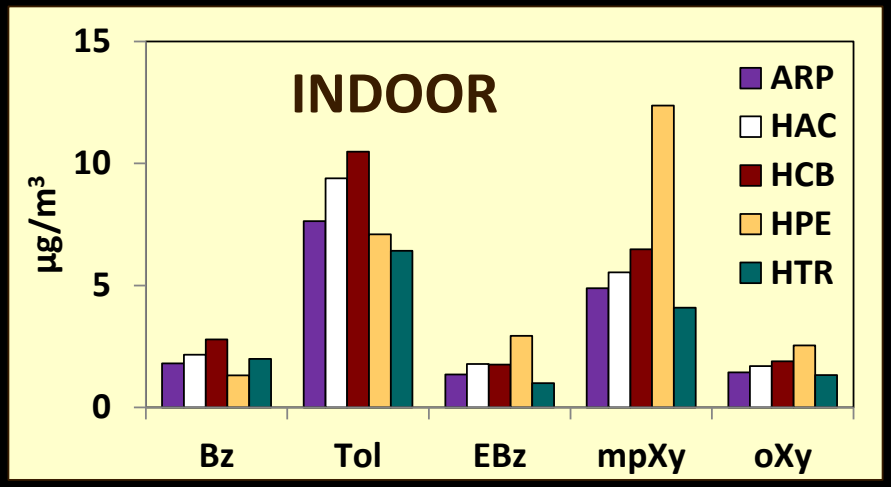
autovetture

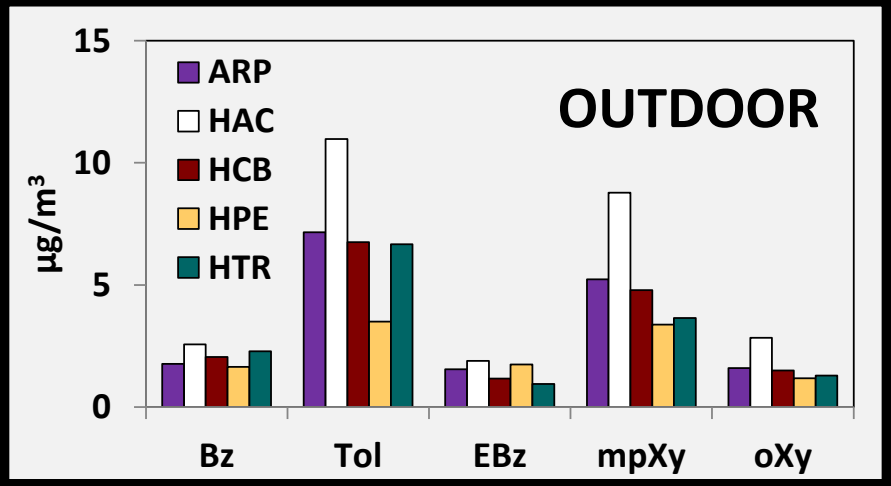


Idrocarburi benzenici (BTEX) a Roma d'inverno: scuole



Idrocarburi benzenici (BTEX) a Roma d'inverno: case e ufficio



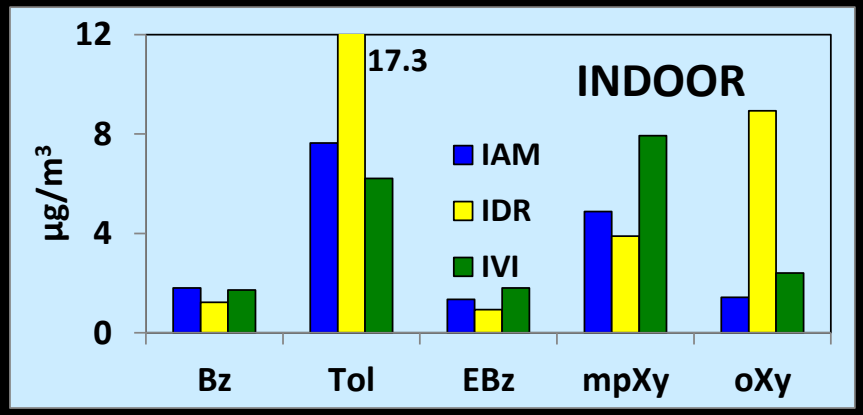


HAC: in/out < 1

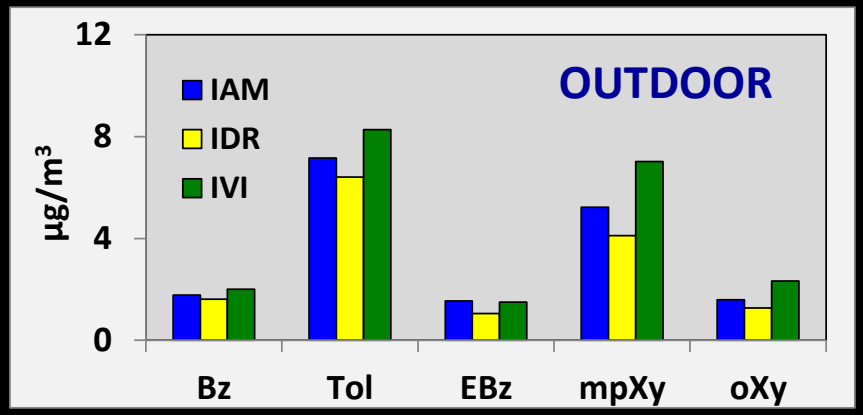
ARP, HTR: in/out ~ 1

HCB, HPE: in/out > 1

Idrocarburi benzenici (BTEX) a Roma d'inverno: scuole

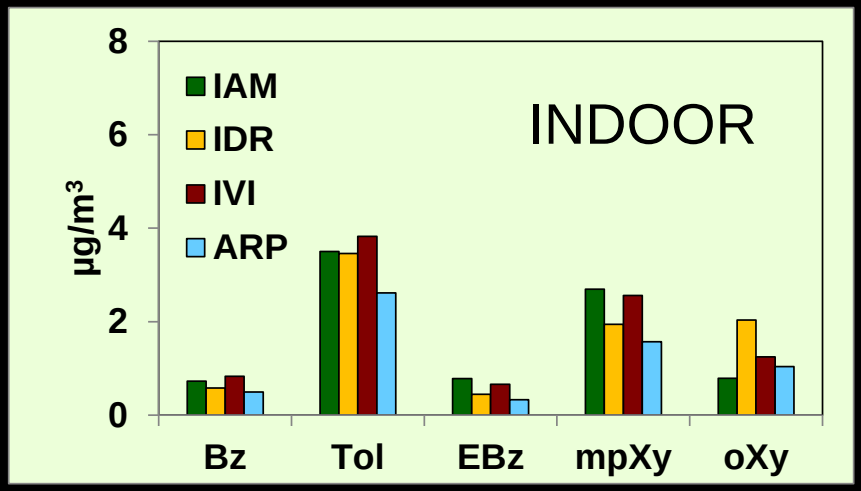


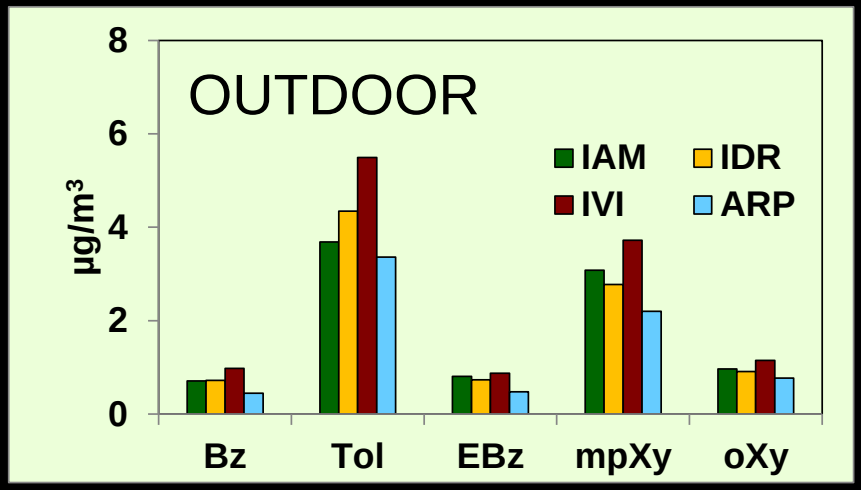
IDR: in/out > 1



IAM, IVI: in/out < 1

Idrocarburi benzenici (BTEX) a Roma in primavera: scuole e ufficio





IAM: *in/out ~ 1*

IAM, IDR, ARP: *in/out < 1*

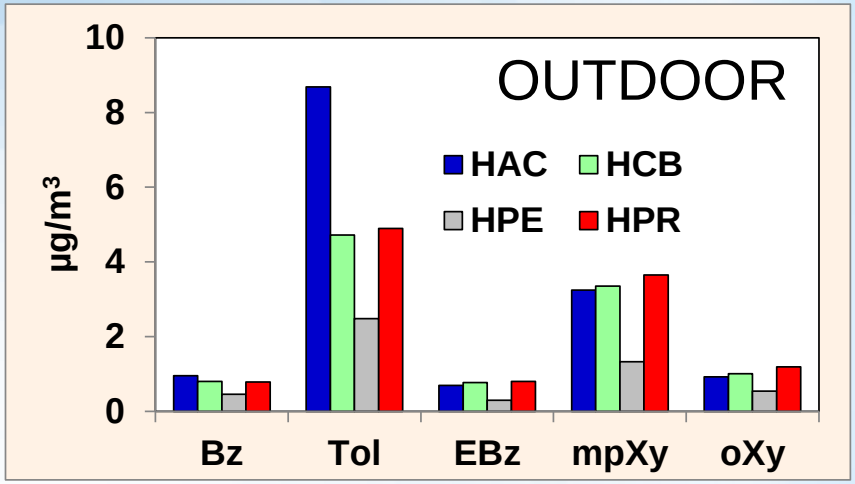
o-Xylene: *in/out > 1*

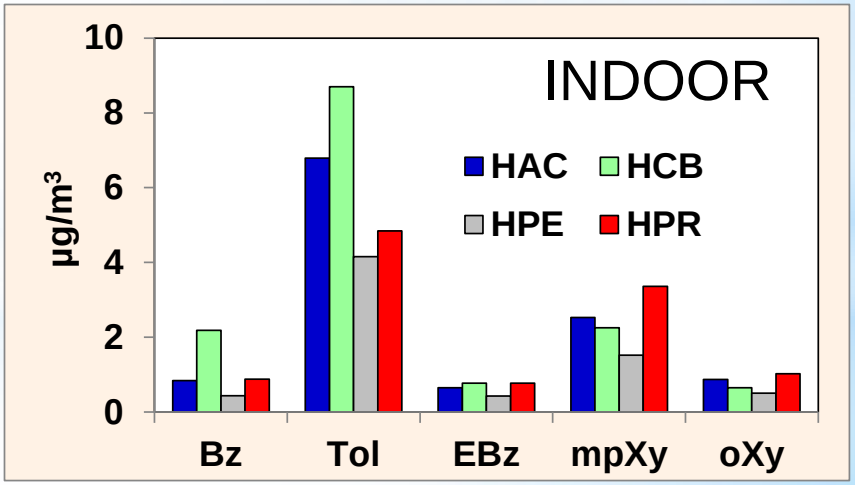
Idrocarburi benzenici (BTEX) a Roma in estate: case

HAC, HPR: *in/out ~ 1*

HCB: *Bz, Tol,* *in/out > 1;*
Xy, *in/out < 1*

HPE: *in/out > 1*





Conclusioni:

- Le polveri sospese respirabili ($PM_{2.5}$) degli ambienti interni (scuole, abitazioni e uffici) contengono quantità apprezzabili di IPA;
- I «coefficienti di penetrazione» degli IPA (rapporti di concentrazione $R_{IN/OUT}$) ricadono nell'intervallo 0.2÷1.5;
- I coefficienti $R_{IN/OUT}$ variano col sito, con la specie e con la stagione, in base alle sorgenti interne degli IPA;
- D'inverno il BaP può superare, anche in ambienti indoor, il *valore guida* di qualità dell'aria pari a 1.0 ng/m^3.
- Gli ambienti interni sono caratterizzati da valori d'inquinamento per $PM_{2.5}$ simili a quelli misurati parallelamente all'esterno; questi a loro volta sono diversi (anche per eccesso) da quelli registrati dalle reti di monitoraggio ambientale.

APPENDICE:

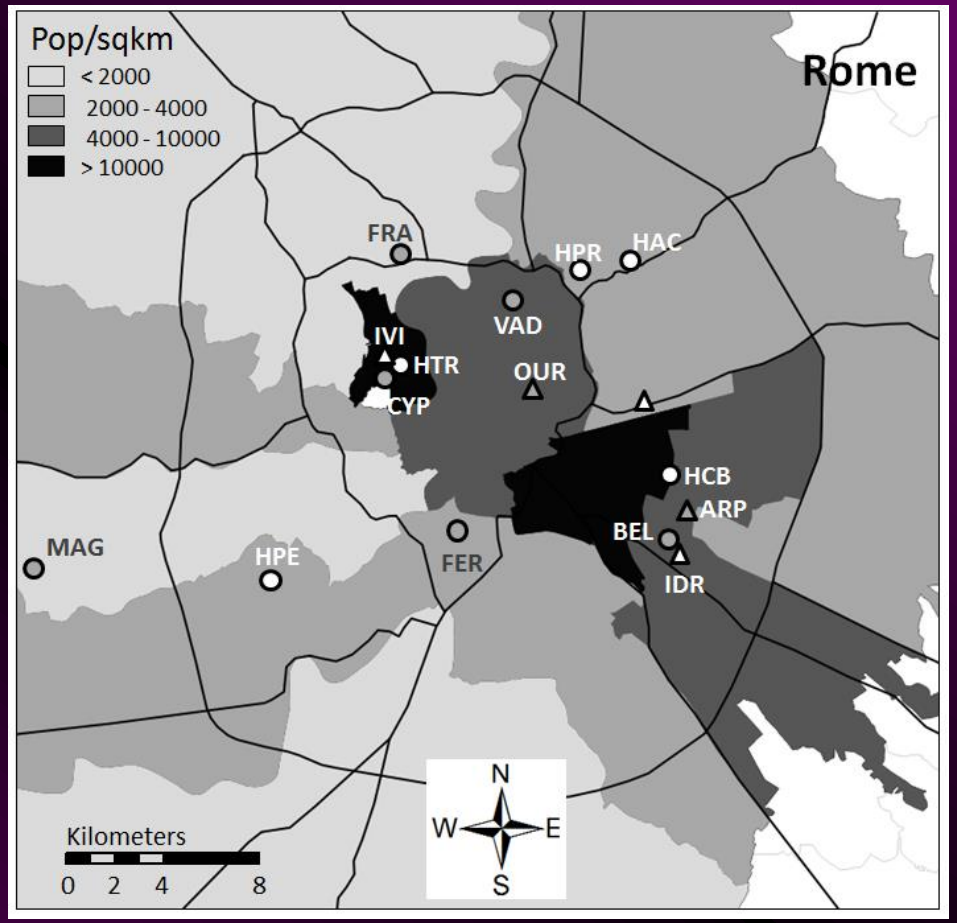
Un accenno alla presenza di

sostanze psicotrope

in aria indoor

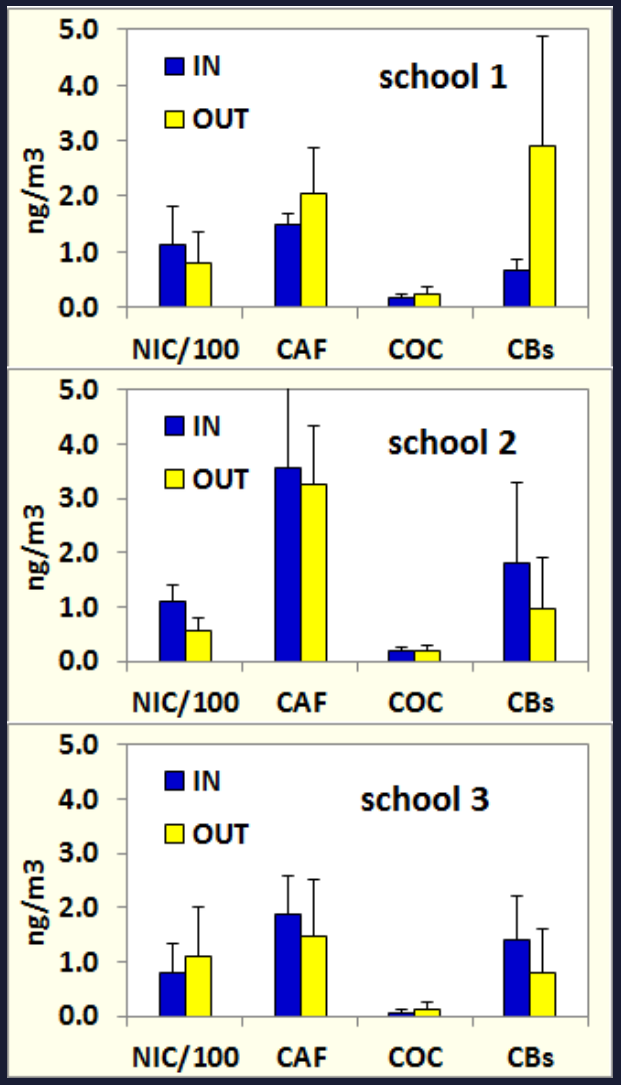
Concentrazioni di sostanze psicotrope a Roma

- Droghe lecite e illecite
- Campagne di misura stagionali
- 3 scuole, 4 appartamenti, 1 ufficio
- Misure parallele in aria indoor e outdoor
- Nessun consumatore di droga; fumatori solo in 1 appartamento
- Misure parallele alle stazioni ARPA di città e provincia

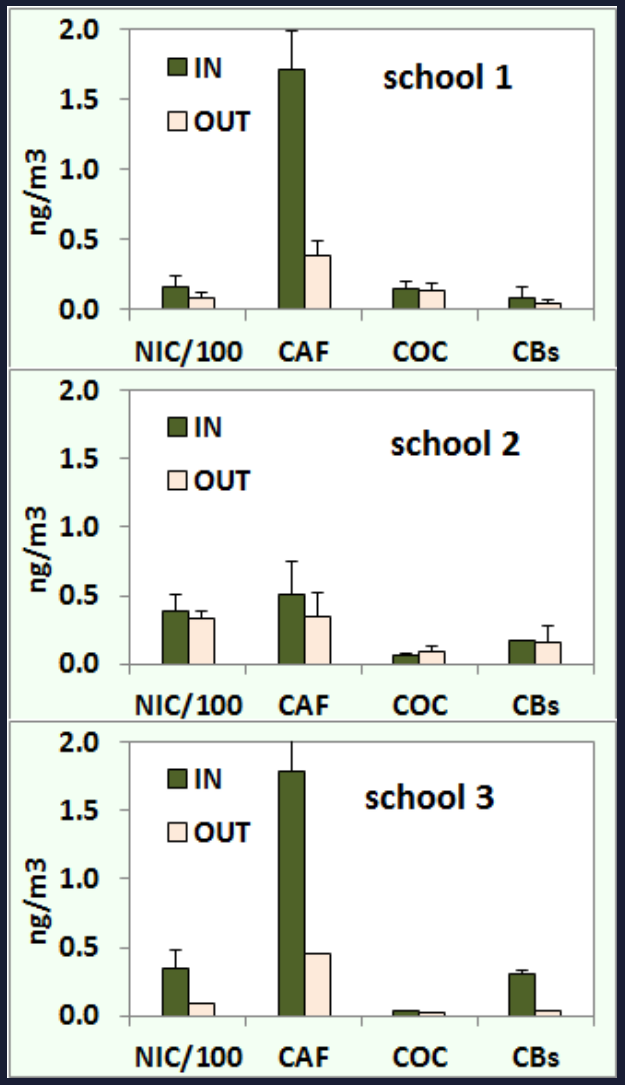


Concentrazioni di droghe nelle scuole

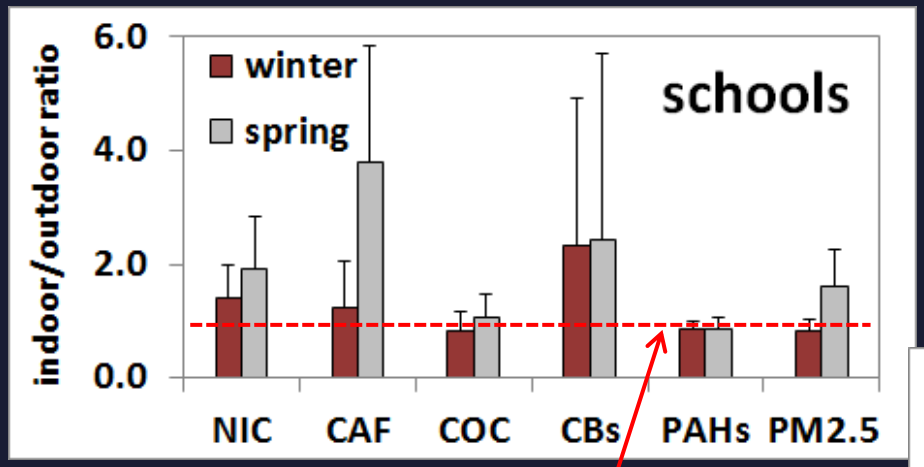
inverno

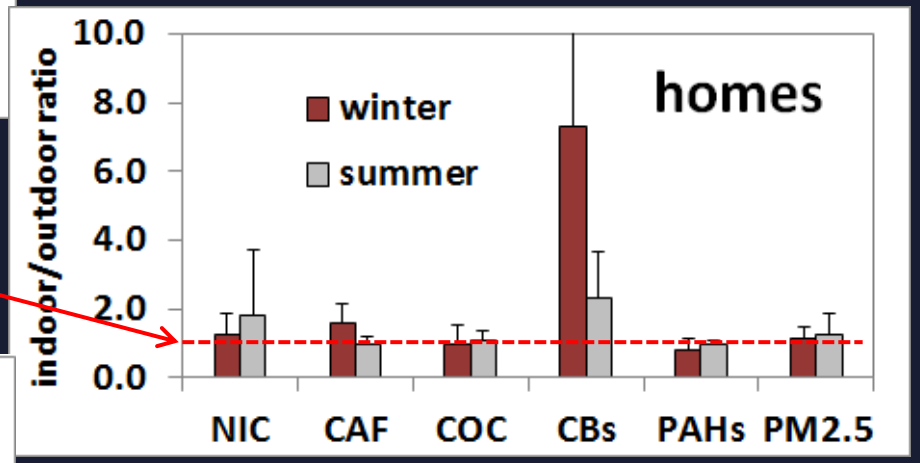


primavera

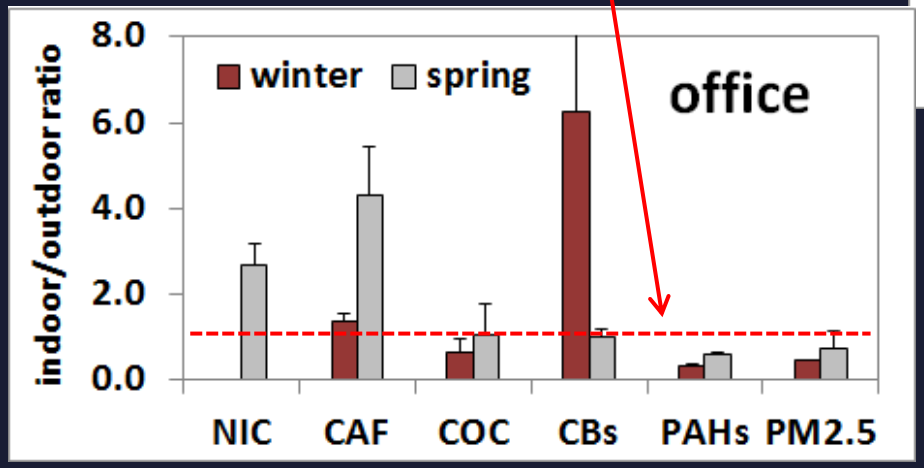


Rapporto di concentrazioni indoor/outdoor





$R_{i/o} = 1$



Concentrazioni tipiche di contaminanti in aria:

	outdoors	*indoors*
Formaldeide:	5000 ng m^{-3}	20000 ng m^{-3}
PM_{10}:	30000 ng m^{-3}	30000 ng m^{-3}
Ozono:	50000 ng m^{-3}	10000 ng m^{-3}
Benzo(a)pirene:	0.5 ng m^{-3}	0.5 ng m^{-3}
Diossine:	0.001 ng m^{-3}	0.001 ng m^{-3}
Cocaina:	0.1 ng m^{-3}	0.1 - 2 ng m^{-3}
Cannabinoidi:	0.2 ng m^{-3}	0.1 - 100 ng m^{-3}
Nicotina:	10 ng m^{-3}	20 – 10,000 ng m^{-3}
Caffeina:	2 ng m^{-3}	0.5 - 100 ng m^{-3}

Conclusioni :

Le droghe lecite e illecite sono state riscontrate in tutti gli ambienti esaminati

Sono stati registrati *hot spots* di cannabinoidi (80 ng/m^3) e cocaina (1.6 ng/m^3) indoor.

A differenza di molti comuni inquinanti le droghe sono più abbondanti in aria indoor.

Le concentrazioni di droghe sono più alte negli ambienti di vita rispetto alle stazioni ARPA.

L'esposizione alle droghe, e il conseguente impatto sanitario, sono tuttora sconosciuti.

Conclusioni:

È importante studiare gli IPA e le droghe indoor!

Grazie per l'attenzione

e buon lavoro!