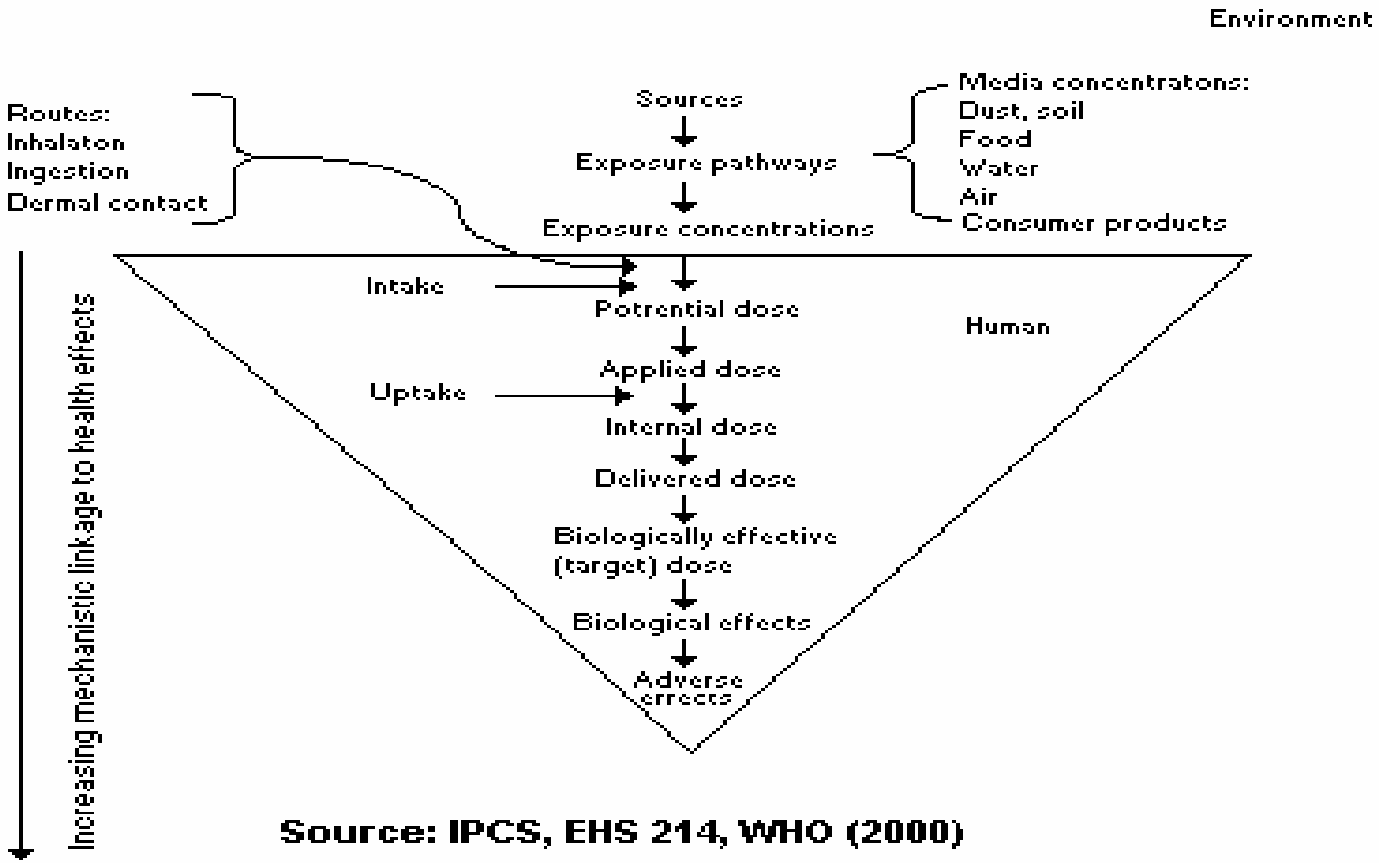
THE REALTIONSHIP BETWEEN INDOOR, OUTDOOR AND PERSONAL AIR (RIOPA) STUDY

Exposure Assessment in the Environmental Health Paradigm



Source: IPCS, EHS 214, WHO (2000)

Major Studies in Environmental Exposure Assessment

Carbon Monoxide Exposure Studies (EPA, 1982-1983)

Participants:

Representative samples selected by a stratified random sampling design from the nonsmoking adult populations each of Washington DC and Denver, CO., with over-sampling for certain groups.

Measurements:

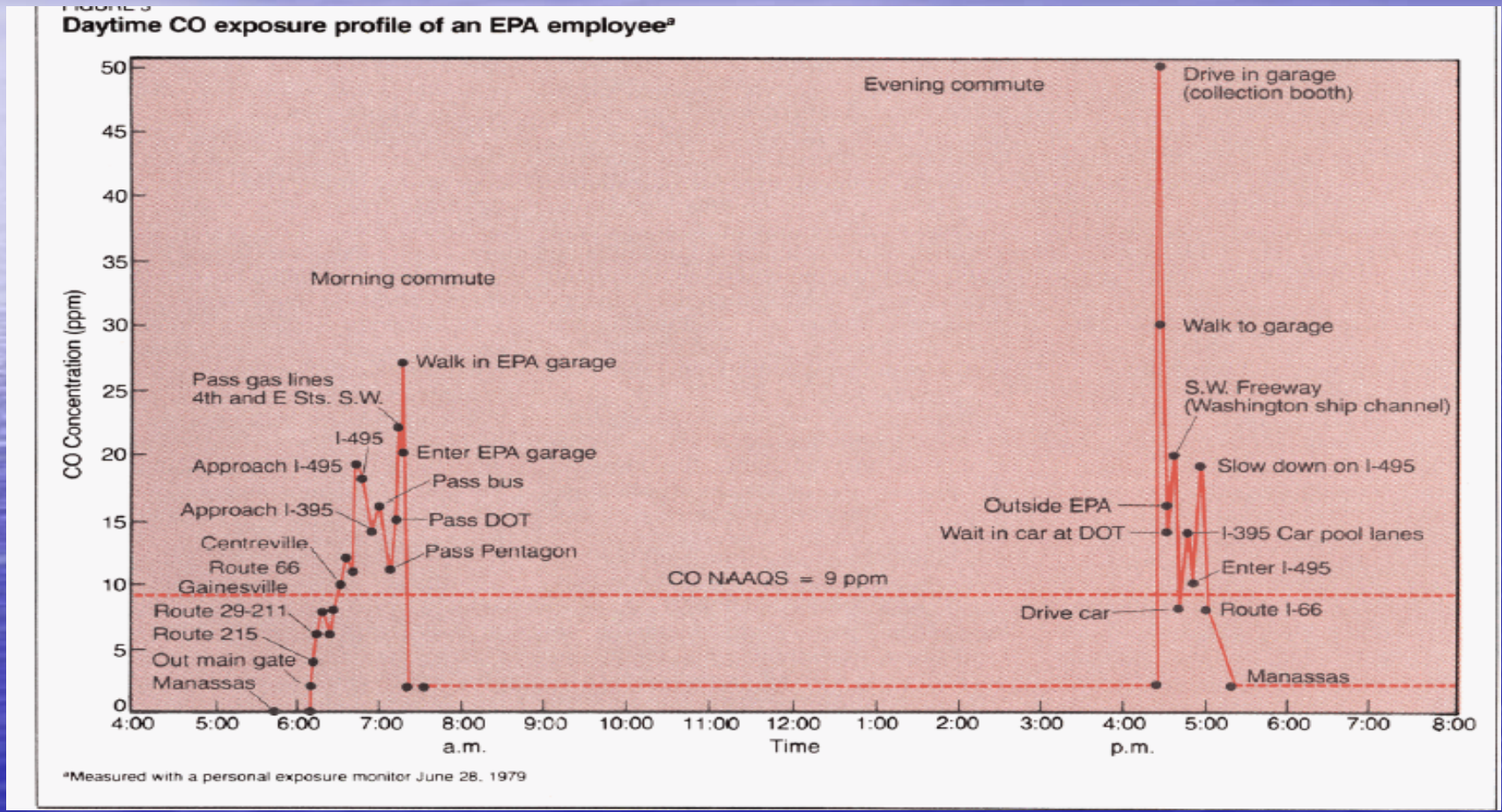
CO concentrations measured with a personal exposure continuous monitor carried by participants.

Daily activity logs

Data logging device to mark change of activities

Personal habits and household characteristics/activities questionnaires

Major Studies in Environmental Exposure Assessment



Major Studies in Environmental Exposure Assessment

NATIONAL HUMAN EXPOSURE ASSESSMENT SURVEY (NHEXAS) EPA/contractors 1996-2000

Objectives: evaluate comprehensive human exposure on a community and regional scale

Methodology:

Phase 1: design, field evaluation, and demonstration projects

Phase 2: human exposure field studies

Phase 3: special studies (long term exposures, highly exposed

Phase I (completed)

Participants:

-representative sample selected by stratified random sampling with over-sampling for some groups in Region V and Arizona; special study in Maryland

Measurements:

-Target contaminants: PM, biologic agents, VOCs, pesticides in air, water, soil , settled dust, and food

- Sampling in all relevant environments (indoor/outdoor)
- Residential) ventilation rates, I/O temperature
- Urine and blood biomarkers
- Activity logs, personal and household characteristics and activities (very extensive)

Major Studies in Environmental Exposure Assessment

Total Exposure Assessment Methodology Studies (TEAM)
EPA 1980-1984

Objectives: to determine the distribution of exposures and determinants of exposure for the population

Methodology:

Participants:

-representative sample of the population selected by stratified random sampling with over-sampling for some groups

Measurements:

-Target contaminants: central site, indoor/outdoor residential, and personal monitoring (occasionally other environments)
-Residential ventilation rates, I/O temperature
-Biomonitoring
-Some multimedia sampling included.
-Activity logs, personal and household activities

Major Studies in Environmental Exposure Assessment

Particle Total Exposure Assessment Methodology Study (PTEAM)
EPA 1983 – Particulate Matter

Objectives: to determine the distribution of exposures and determinants of exposure to PM10 and PM2.5 in riverside Ca.

Methodology:

Participants:

-representative sample of the Riverside population selected by stratified random sampling with over-sampling for some groups

Measurements:

-Target contaminants: central site, indoor/outdoor residential, and personal monitoring (PM10) and indoor/outdoor (PM2.5) (occasionally other environments)

- Residential ventilation rates, I/O temperature
- Activity logs, personal and household characteristics and activities
- PM was analyzed for elemental composition

THE REALTIONSHIP BETWEEN INDOOR, OUTDOOR AND PERSONAL AIR (RIOPA) STUDY

HYPOTHESES

Residences immediately adjacent to outdoor point and area sources have a measurable and significant proportion of the personal exposures and indoor air concentrations contributed by those sources.

Residential air exchange rate is a major determinant of the influence of outdoor air on indoor and personal air, & when combined with outdoor air concentrations can be used to predict exposures to a large segment of the study area.

STUDY DESIGN

Sample: 100 non-smoking homes in each of three urban centers: Elizabeth, NJ; Houston, TX; Los Angeles, CA, near and away from sources

Target pollutants: VOCs, PAHs, PM2.5, Aldehydes

Measurements: Personal (adult and children), Indoor & Outdoor Air Samples Using 48-hour Integrated Samples and in Vehicles during Driving (aldehydes only)

Breath Samples for VOCs

CITY SELECTION CRITERIA

- NJ - mixture of point, area (mobile) and commercial within residences
- TX - predominantly industrial (point)
- CA -predominantly area (mobile)
- Differences in meteorology and housing characteristics across the three cities: Elizabeth, Houston, and Los Angeles

SAMPLING & ANALYSIS PROTOCOLS

- **VOCs** - Passive badges solvent extracted, with GC/MS analysis
- **Aldehydes** - Active & passive sampling with DNPH or DNSH cartridges and HPLC/UV/FLUOR
- **Particulate Matter** (PM2.5) - Active filters Mass (weighing), Metals (XRF & ICP/MS), PAHs (extraction GC/MS)
- **Air Exchange** by PFT with GC
- **Temperature and Humidity** (continuous – HOBO)

SAMPLING & ANALYSIS PROTOCOLS - VOCs

- **Passive badges** (3M 3500)
  CS_2 / acetone solvent extracted
  GC/MS analysis
- **Target Compounds**: Benzene, Ethyl benzene, Toluene, Xylenes, Styrene, 1,3-Butadiene, MTBE, Chloroform, Carbon Tetrachloride, Tetrachloroethylene, Methylene Chloride, 1,4-Dichlorobenzene, d-Limonene, α/β-Pinenes

Monitoring Concentrations in Breathing Zone and Indoor Air

Receptor: Human breathing zone

Receptor:Indoor microenvironmental monitor

RIOPA TEXAS – Personal time-location patterns (% time)

Mean

	ADULTS	CHILDREN
HOME	81.80	65.71
SCHOOL	1.83	18.46
INDOOR OTHER	5.04	3.49
OUTDOOR-NEIGHBORHOOD	3.11	3.93
OUTDOOR AWAY	.77	.32
CAR-WINDOWS OPENED	1.10	.95
CAR-WINDOWS CLOSED	2.96	1.60
TOTAL INDOORS	91.73	92.76
TOTAL OUTDOORS	3.99	4.52
TOTAL IN CAR	4.28	2.72

RIOPA AIR EXHANGE RATES (1/hr)

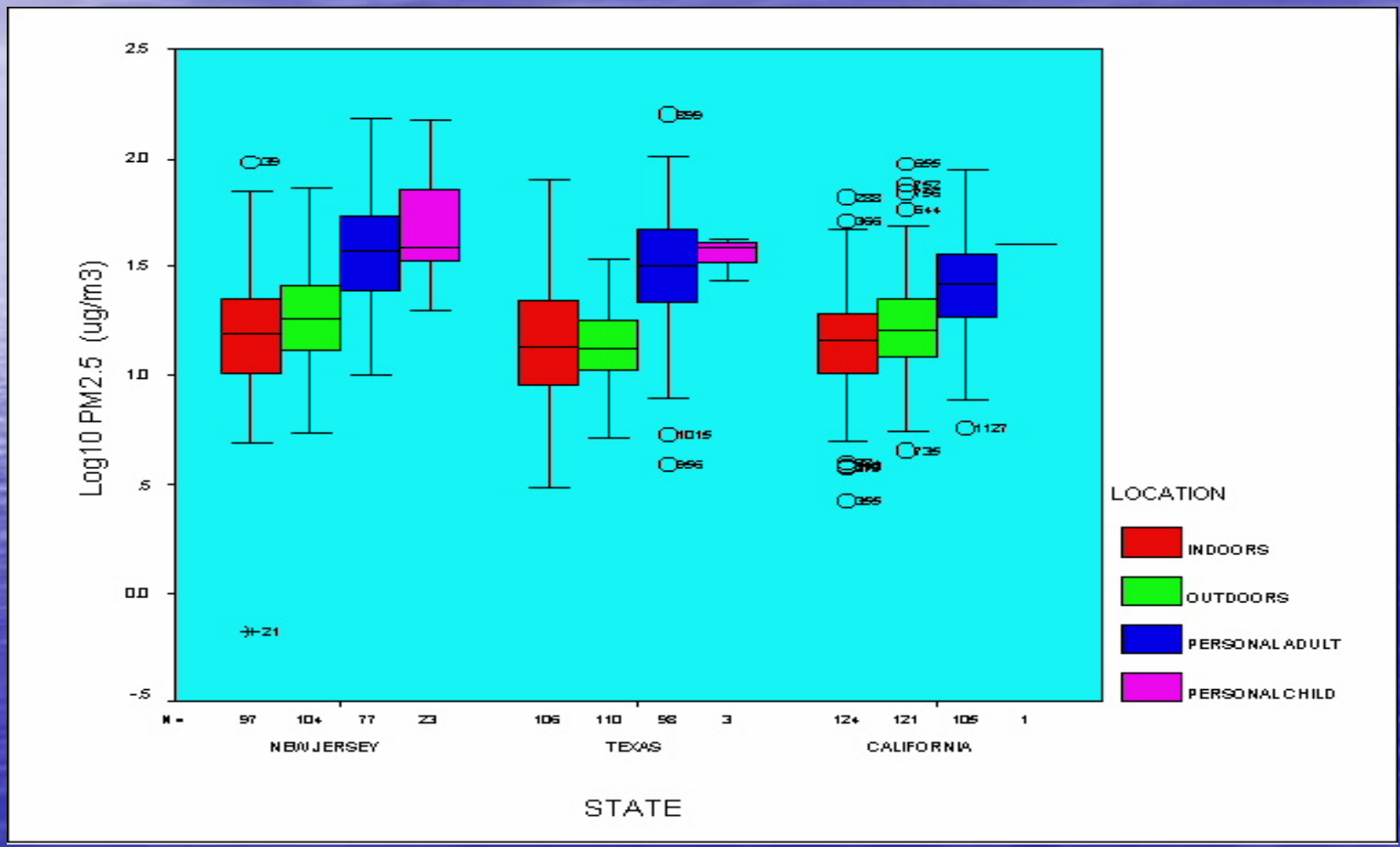
AIR EXCHANGE RATE (1/hr)

	Mean	Median	STD	G. Mean	N
NJ	1.4269	.8800	1.4212	1.0019	177
TX	1.4065	.4800	6.4256	.5387	217
CA	1.3728	.8700	2.0800	.8977	211
Total	1.4007	.7200	4.1059	.7719	605

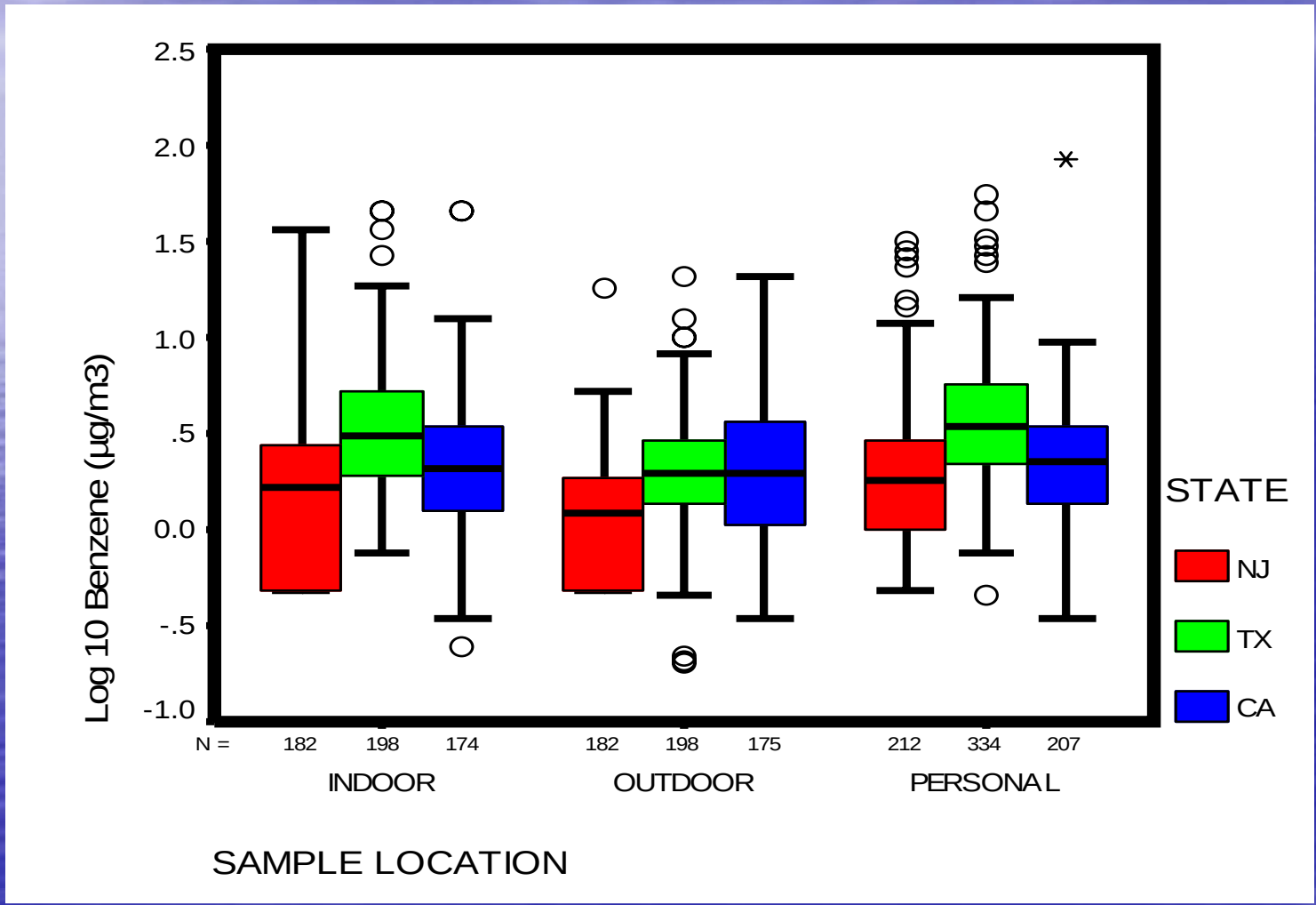
RIOPA – PM2.5 INDOOR/OUTDOOR RELATIONSHIPS (by AER)

	AIR EXHANGE RATE	REGRESSION COEFF	P-VALUE (r.c.)	INTERCEPT	P-VALUE (INT.)	R** 2	N
	0.0 - 0.5	.18	.14	10.50	.04	.03	69
	0.5 - 1.0	.54	.00	7.82	.00	.28	98
	1.0 - 2.0	.55	.00	10.48	.00	.30	62
	2.0 - 4.0	.46	.09	6.81	.12	.21	30
	4.0 - 8.0	.66	.01	5.32	.22	.43	14
	>1.00	.51	.00	9.96	.00	.25	106
	0.00-8.00	.43	.00	8.77	.00	.51	253

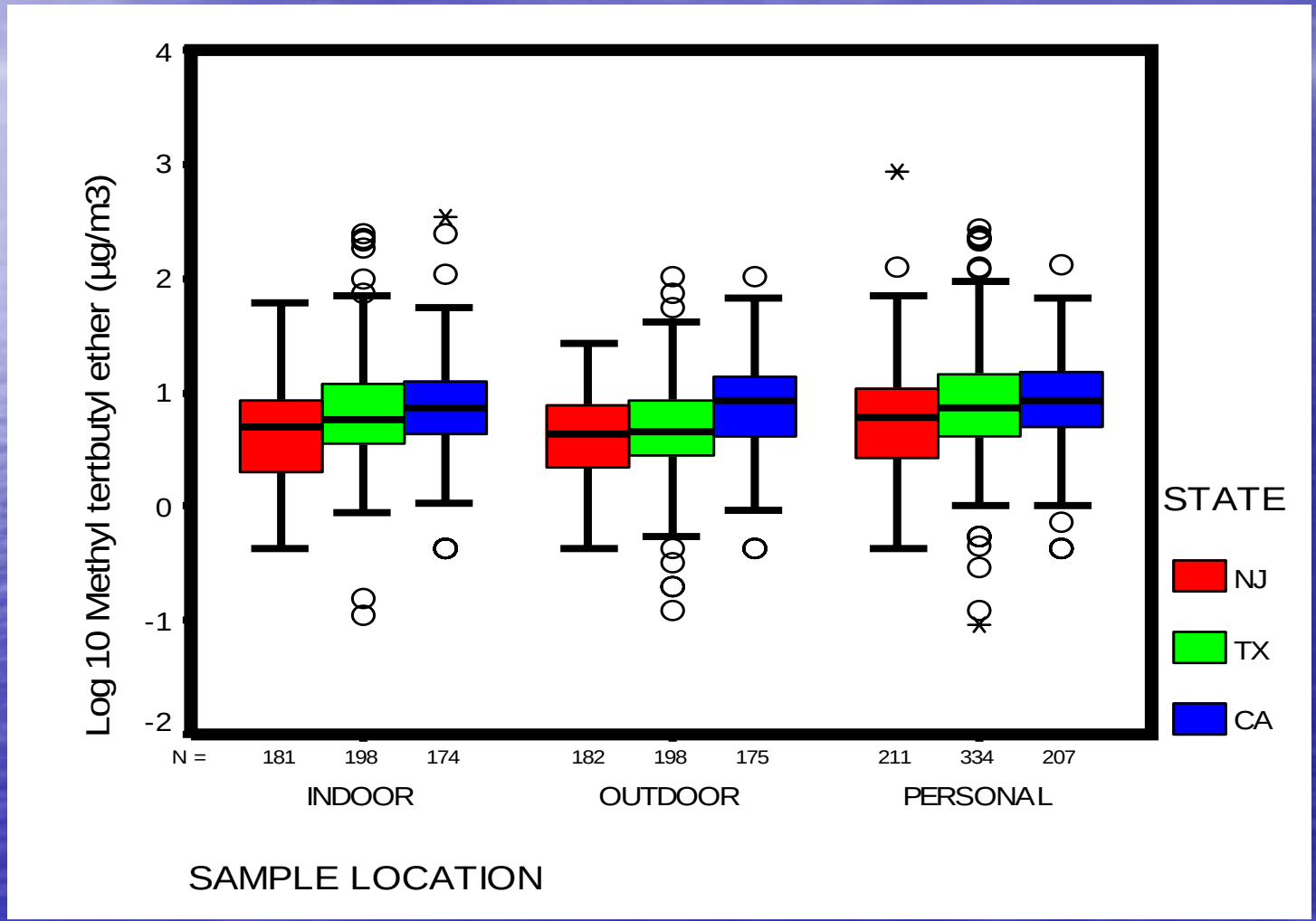
RIOPA – PM 2.5
INDOOR, OUTDOOR AND PERSONAL AIR CONCENTRATIONS



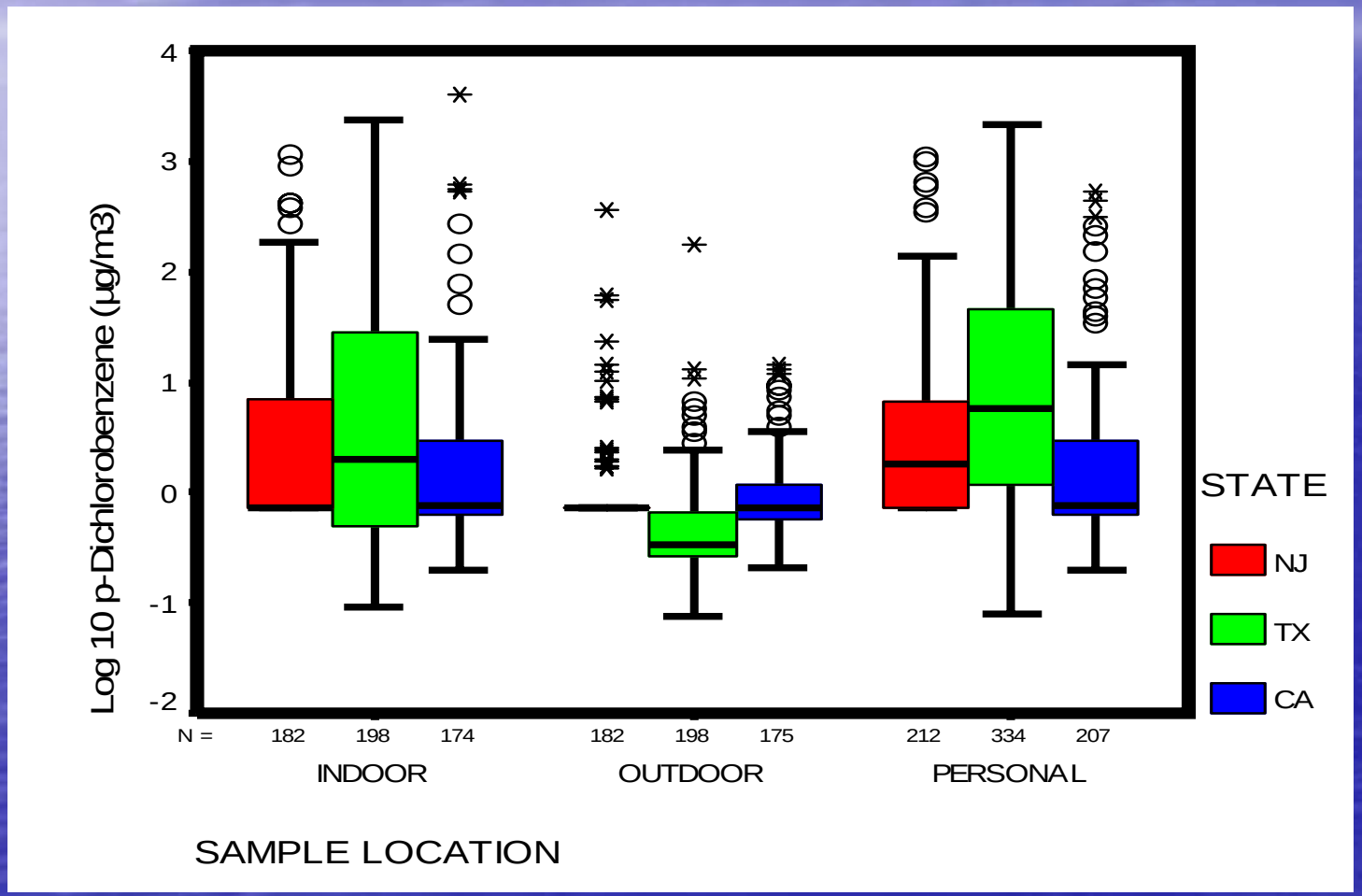
BENZENE DISTRIBUTIONS



MTBE DISTRIBUTIONS



p-DICHLOROBENZENE DISTRIBUTIONS



Are outdoor concentrations of air pollutants a good metric for exposure and health risk?

- It depends on the pollutant and the health effect:
  - PM: is mass the health relevant metric? Is PM of outdoor origin more potent than PM of indoor origin? For which effects is outdoor PM a good indicator of the health-relevant exposure metric?
  - Ozone: Since exposures are much lower than outdoor levels, is ozone acting in part as a surrogate for other oxidants of both indoor and outdoor origin?
  - VOCs: with some exceptions outdoor concentrations are not a good indicator of the health relevant exposure metric.