entox

Emerging POPs in Australians – models and measurements

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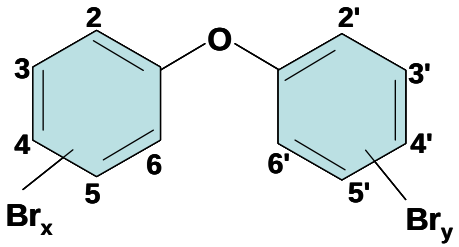
Entox is a joint venture between The University of Queensland and Queensland Health

Emerging chemical pollutants

- Examples of emerging chemical pollutants
- Our first studies….
- Outline a simple model that we developed to understand the body burden data and discuss input parameters
- Prediction versus measurement
- Where are the potential errors of the model

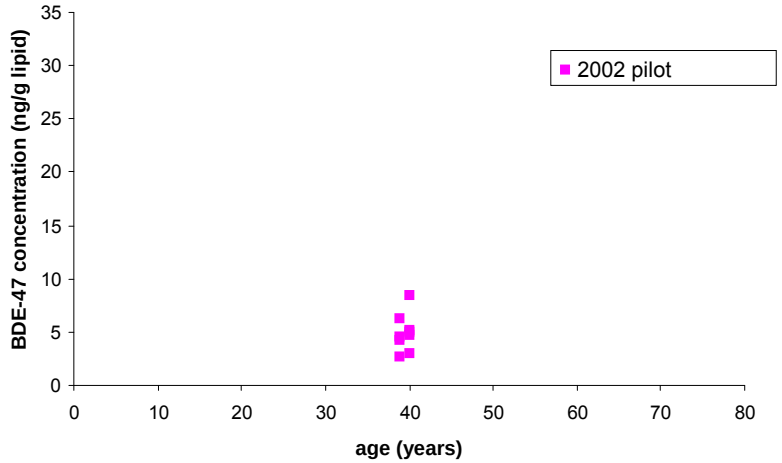
→ Do we understand exposure???



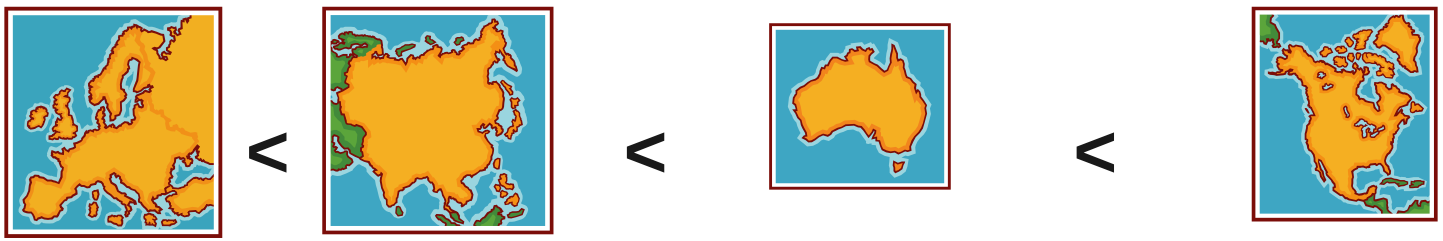
Polybrominated diphenylethers (PBDEs)

- Delay fire (reduce flameability)
- PERSISTENT
- BIOACCUMULATIVE
- TOXIC
- FOUND DISTANT TO SOURCES (Long range transport)

➔ Added to POPs/Stockholm Treaty at COP4 in May 09



First Australian data in human milk 7 – 19 ng/g lipid



Europe < **Asia** < **Australia** < **Nth America**

Aims

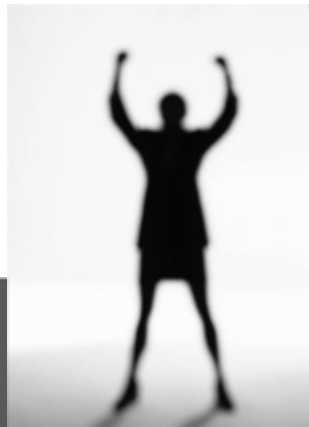
- PBDE body burden in Australia
- age, gender, region
- Assess whether exposure explains body burden
  - model

Methodology

Human blood

- De-identified human blood serum
- Stratification based on postcode, age and gender
- Surplus pathology samples ➔ pooled
- 2002/03, 2004/05 and 2006/07

➔ Later studies with focus on young children and infants

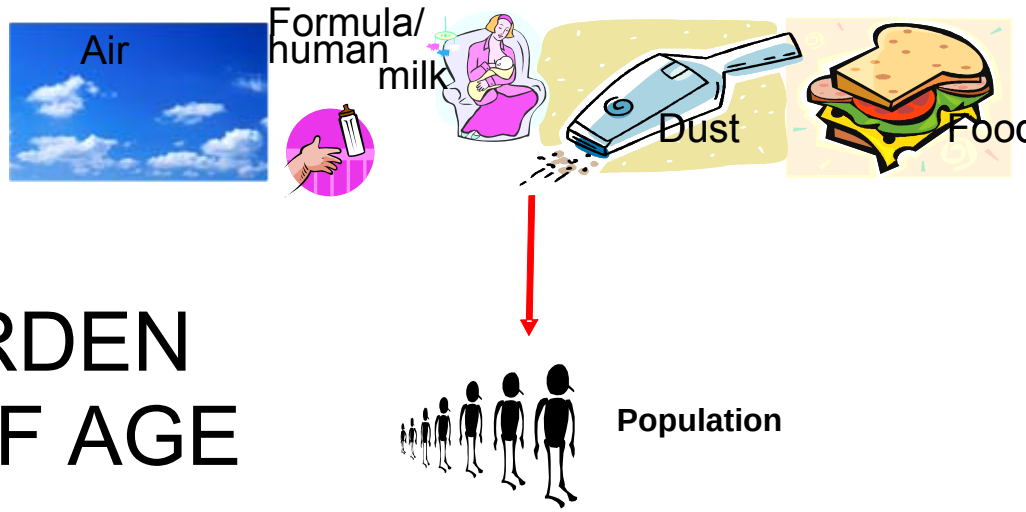


Sources and exposure pathways

- Air
- Dust
- Surface wipes
- Sediment
- Food (FSANZ)

Toms LML, Bartkow M, Symons R, Paepke O, Mueller JF. PBDEs in indoor environments (indoor and outdoor air, dust and surface wipes) collected in SE QLD, Australia. Chemosphere 2009;76:173-178
Toms LML, Mortimer M, Symons RK, Paepke O, Mueller JF. Polybrominated diphenyl ethers (PBDEs) in sediment by salinity and land-use type from Australia. Environ Int 2008;34(1):58-66.

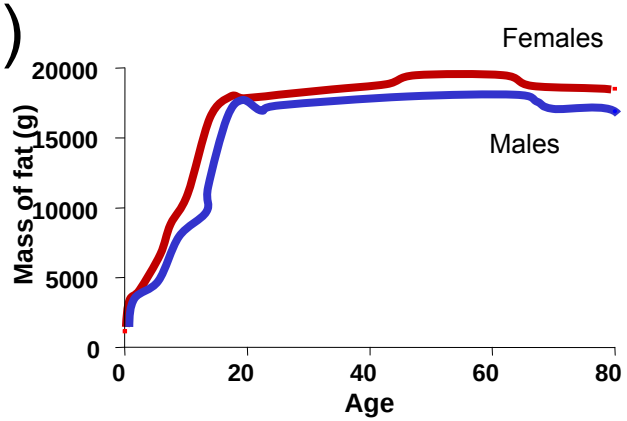
Model



OUTPUT BODY BURDEN AS A FUNCTION OF AGE

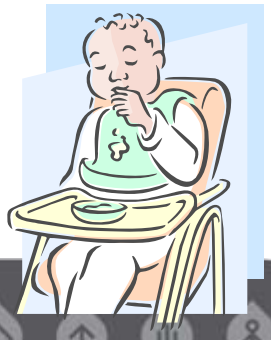
INPUT: Intake data including concentration in air, dust and human milk obtained concurrently from Australia plus food data (FSANZ 2007)

- Clearance data (Geyer et al. 2004)
- Body weight and lipid content age and gender specific



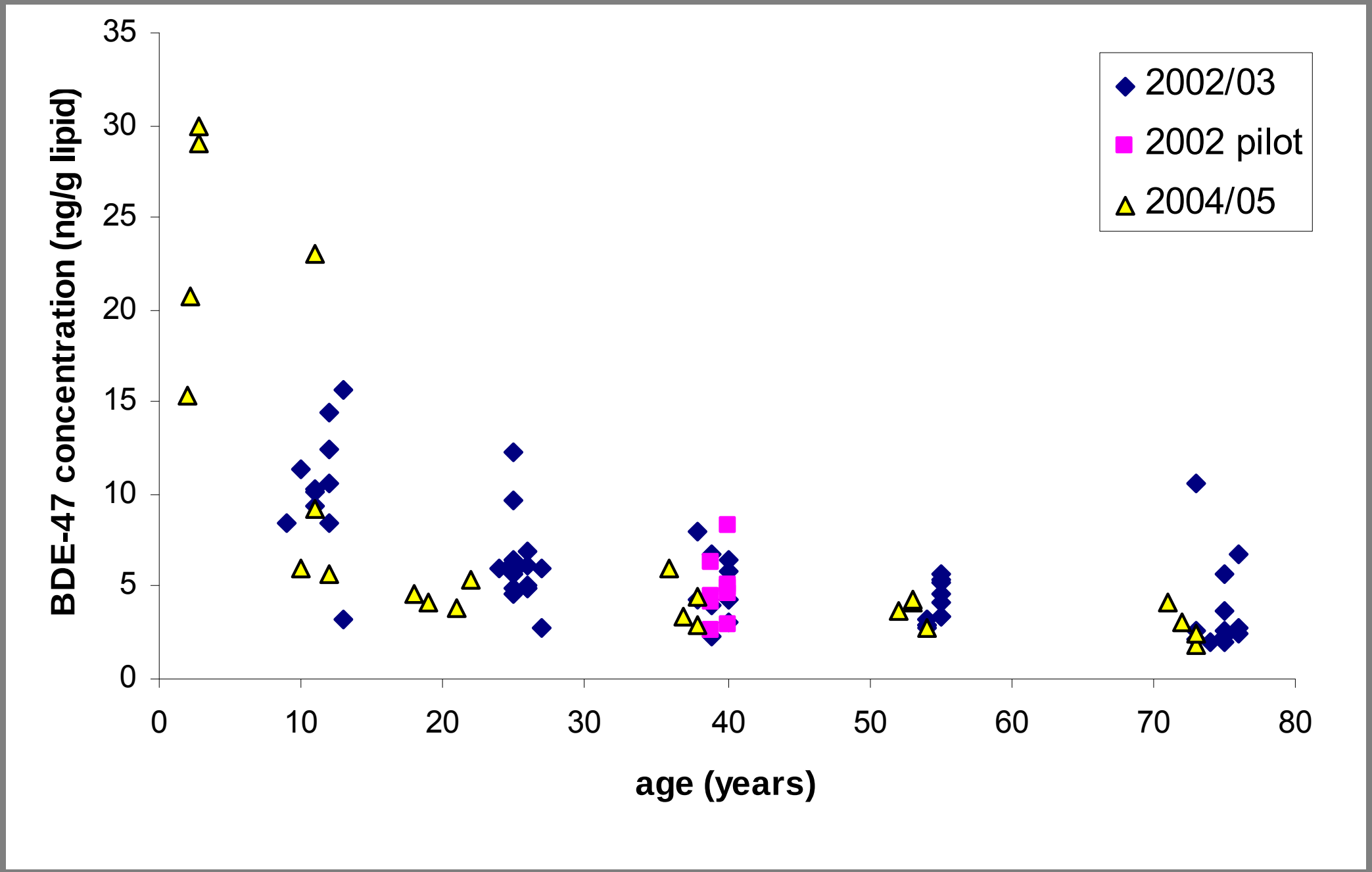
Assumptions

- PBDEs stored in lipids
- Maternal = newborn concentrations
- PBDEs in air and milk absorbed 100%
- Resorption rate of 0.94 for BDE-47 (food and air)
- 0-12 mths formula or breast milk (>6 mths + food)
- Current exposure

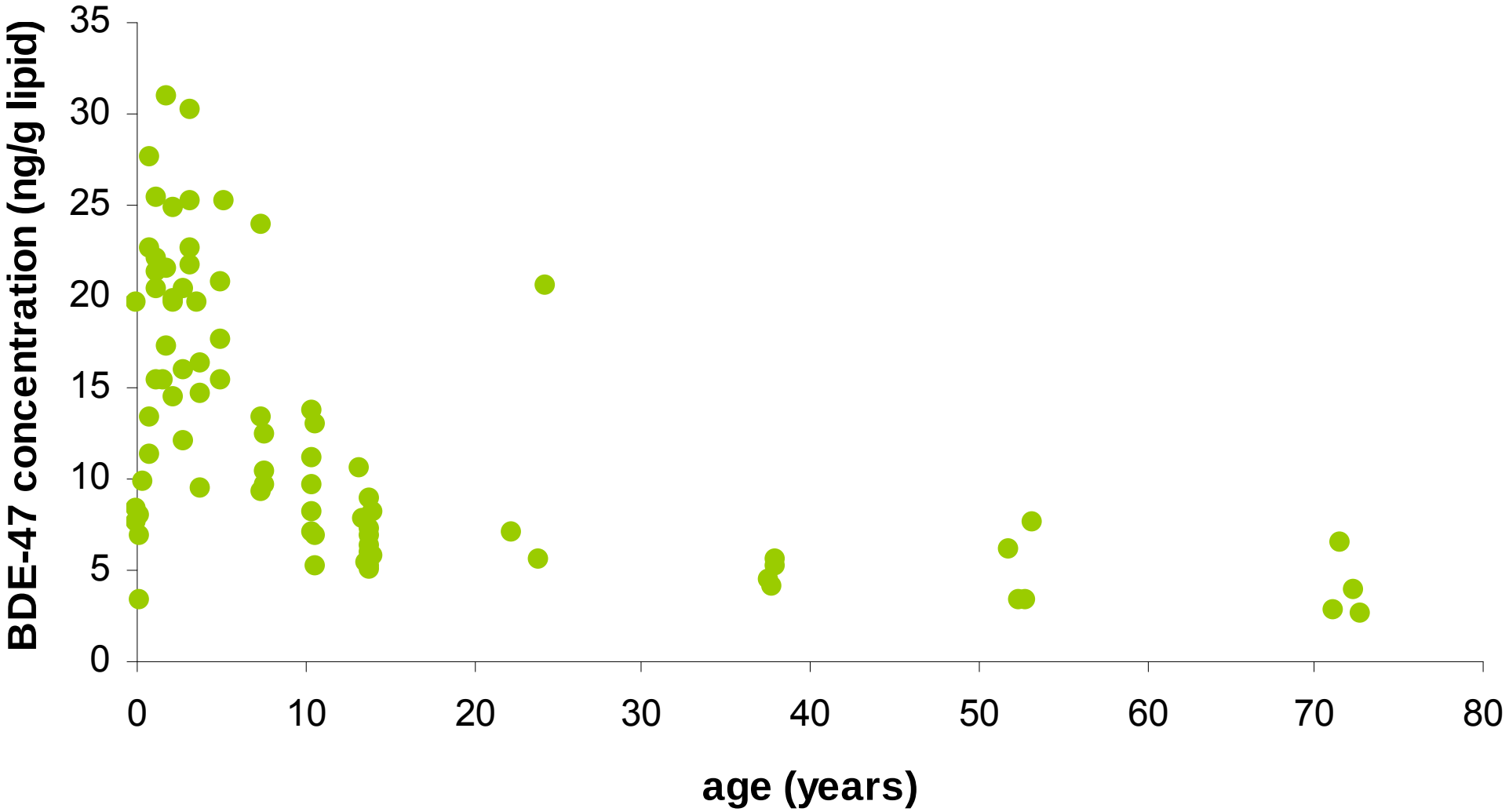


Present experimental results – chronologically

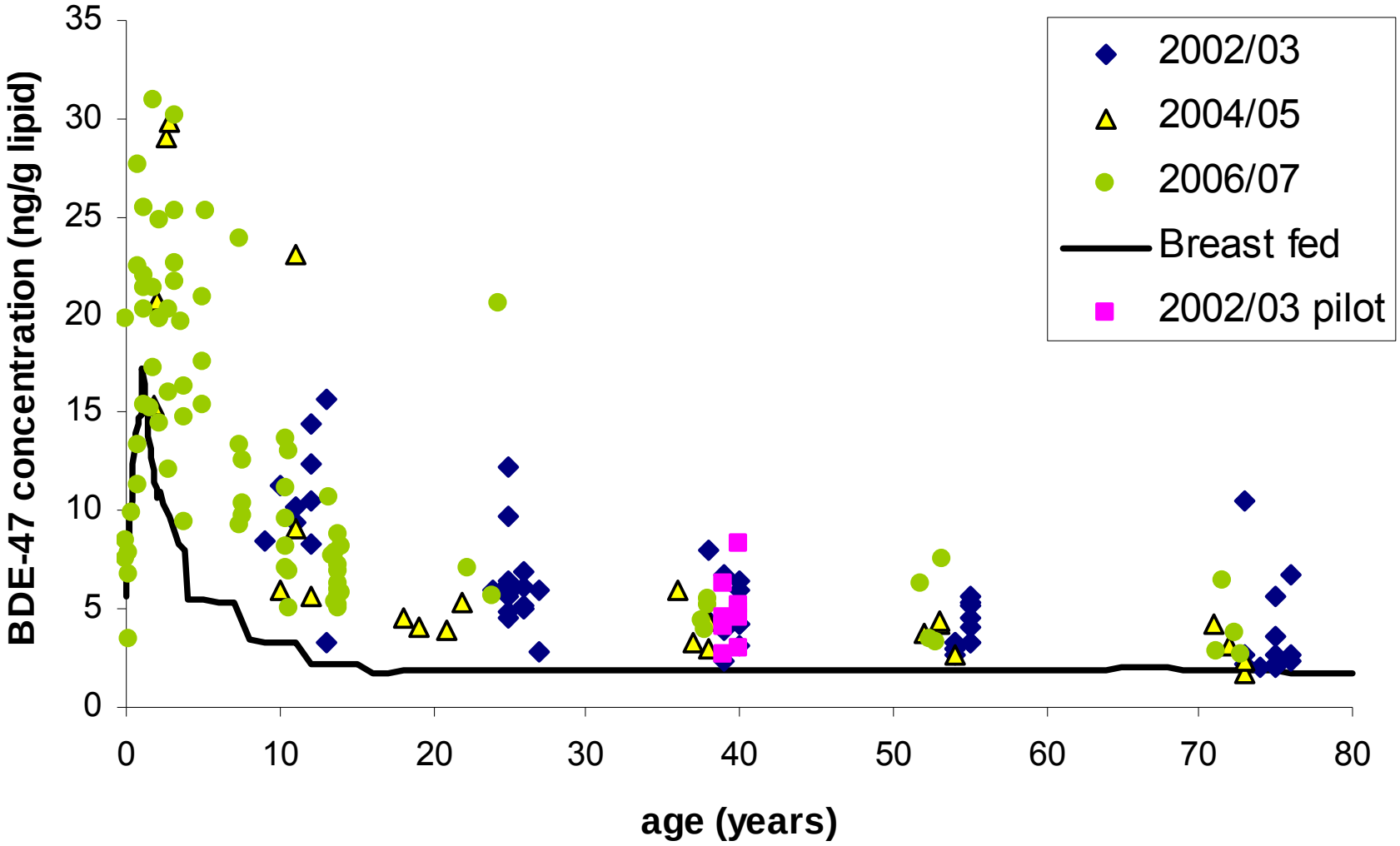
then compare with model results


BDE-47 concentration (ng/g lipid)
35
30
25
20
15
10
5
0
0
10
20
30
40
50
60
70
80
age (years)
2002/03
2002 pilot
2004/05

Results 2006/07



Measured vs. predicted



Some conclusions for PBDEs

Model predicts the trend

Model UNDERESTIMATES substantially

→ Body burden data has the least uncertainty….

→ Is the intake underestimated??? (role of dust???)

→ Is the clearance rate overestimated???

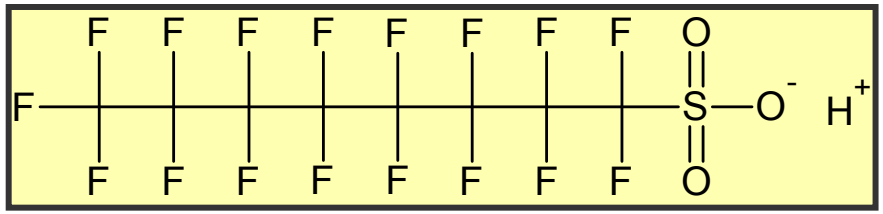
→ PEAK not when breast feeding finishs → dust important?

Perfluorinated compounds (PFCs)

- Surfactants & used in fluoropolymer manufacture (teflon, goretex etc)

- very widely used… plenty of exposure

- extremely persistent



Perfluorooctane sulfonate (PFOS)

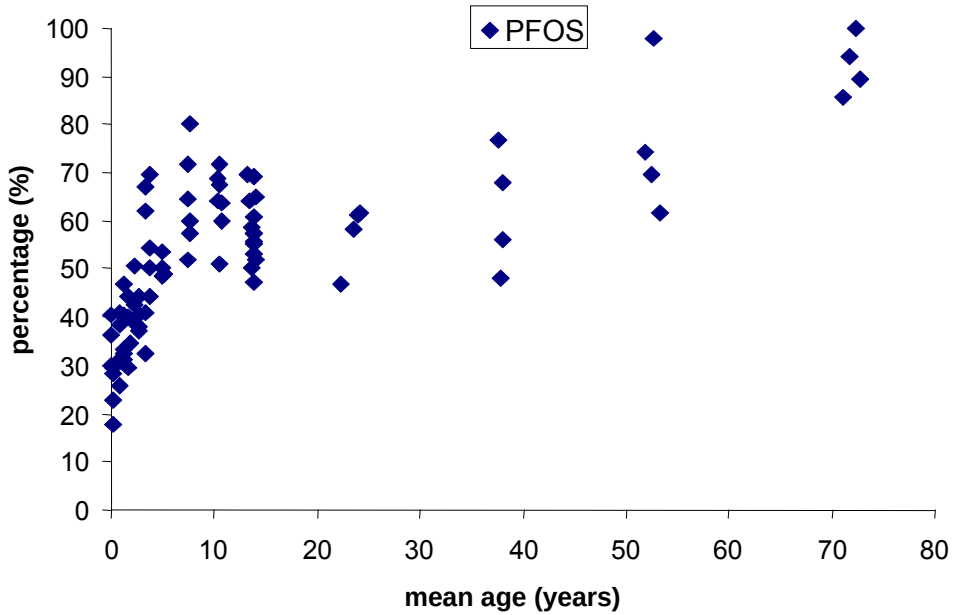
- some adverse effects from animal studies (hepatotox, cancer in animals and reproductive effects

- PFCs also found distant from source

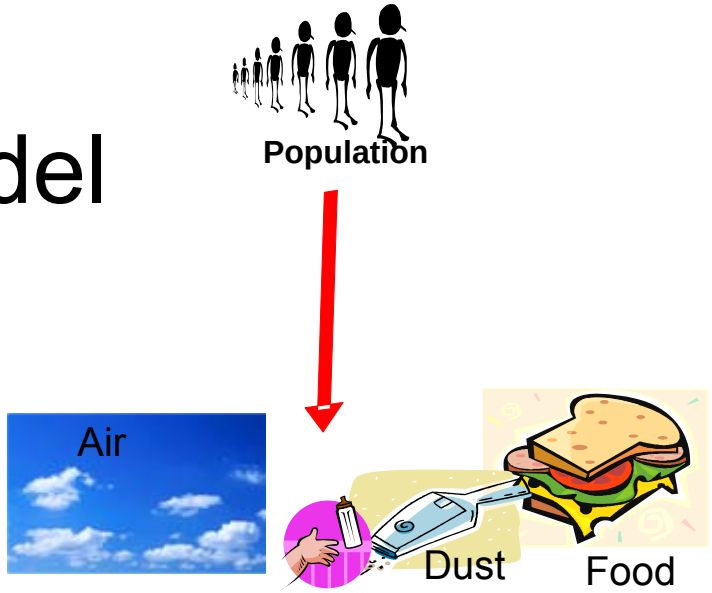
➔ Added to POPs/Stockholm Treaty at COP4 in May 09

"Let's hope they're friendly."

We have analysed these blood samples for PFCs and other pollutants of interest



Reverse application of Model

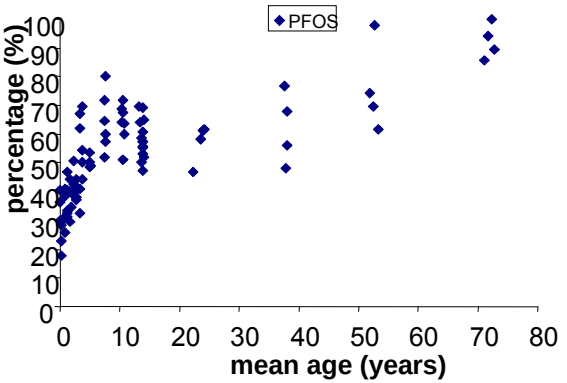


OUTPUT INTAKE

INPUT: Body burden data

- Clearance data
- Volume of distribution

➔ calculated from exposed populations



Results: average estimated intakes (range)

From both male and female pools, >12 years

PFOA: 0.9 ng/kg b.w/day (0.6 – 1.2) in 2002/03

0.7 ng/kg b.w/day (0.6 – 0.9) in 2006/07

PFOS: 2.7 ng/kg b.w/day (1.6 – 3.8) in 2002/03

2.4 ng/kg b.w/day (1.7 – 3.6) in 2006/07

Compare with international data:

Dietary intakes (Germany) 2.9 (PFOA), 1.4 (PFOS) *{Fromme et al.}*

Dietary Intakes (Canada) 0.1-0.4 (PFOA), 0.1-2 (PFOS) *{Ostertag et al.}*

Modeled etimates europe & US 2.5 – 9.8 (PFOA), 12 – 54.6 (PFOS) *{Trudel et al.}*

Some conclusions for PFCs

Age trends of PFCs are very unusual (for PFOS highest concentration at about 10 and > 50)

Backwards model predicts intakes that are comparable to intake data from a few countries

Many uncertainties (ie. Can we assume steady state; Volume of distribution)

Summay

Combination of PK modelling and experimental work provides tools for exposure evaluation

→ We can try to find out where we are wrong…
(and how wrong we are)

Thank you!

Thanx to mothers donated breastmilk

Volunteers (dust & indoor air collection)

Queensland Health, DEHWA, DERM, DECC, US-CDC, ERGO, Health Canada (Jake Ryan); ERGO (Olaf Paepke), NMI and many other organisations and individuals who assisted.

Publications associated with this work

Harden F, Toms L, Paepke O, Ryan J, Mueller JF. Evaluation of age, gender and regional concentration differences for dioxin-like chemicals in the Australian population **Chemosphere** *2007; 67, S318-S324*

Harden F, Toms L, Symons R, Fuerst P, Mueller JF. Evaluation of dioxin-like chemicals in pooled breast milk samples collected in Australia. **Chemosphere** *2007; 67, S325-S333*

Kärrman A, Mueller JF, van Bavel B, Harden F, Toms L, Lindström G. Levels of 12 Perfluorinated Chemicals in Australian Serum in Relation to Age, Gender and Region ***Environmental Science and Technology*** *2006, 40, 3742-3748.*

Mueller J.F.**,** Harden, F., Toms, L.-M., Symons, R., Persistent organochlorine pesticides in human milk samples from Australia. **Chemosphere** 2008, 70, 712-720.

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Toms LML, Hearn L, Kennedy K, Harden F, Bartkow M, Temme C, Mueller JF**.** Concentrations of polybrominated diphenyl ethers (PBDEs) in matched samples of human milk, dust and indoor air. Environment International (accepted 5/2/09)

Toms LML, Calafat AM, Kato K, Thompson J, Harden F, Hobson P, Sjodin A, Mueller JF. Polyfluoroalkyl chemicals in pooled blood serum from infants, children and adults in Australia. Environmental Science and Technology (accepted 25/3/09)

Toms LML, Bartkow M, Symons R, Paepke O, Mueller JF. Assessment of polybrominated diphenyl ethers (PBDEs) in samples collected from indoor environments in South East Queensland, Australia. Chemosphere (accepted 26/3/09)

Toms LML, Sjödin A, Harden F, Hobson P, Jones R, Edenfield E, Mueller, JF. 2009 – in press. Concentrations of polybrominated diphenyl ethers (PBDEs) in pooled human serum are higher in children (aged 2-5 years) than in infants and adults. Environmental Health Perspectives.