



WORKING FOR A HEALTHY FUTURE

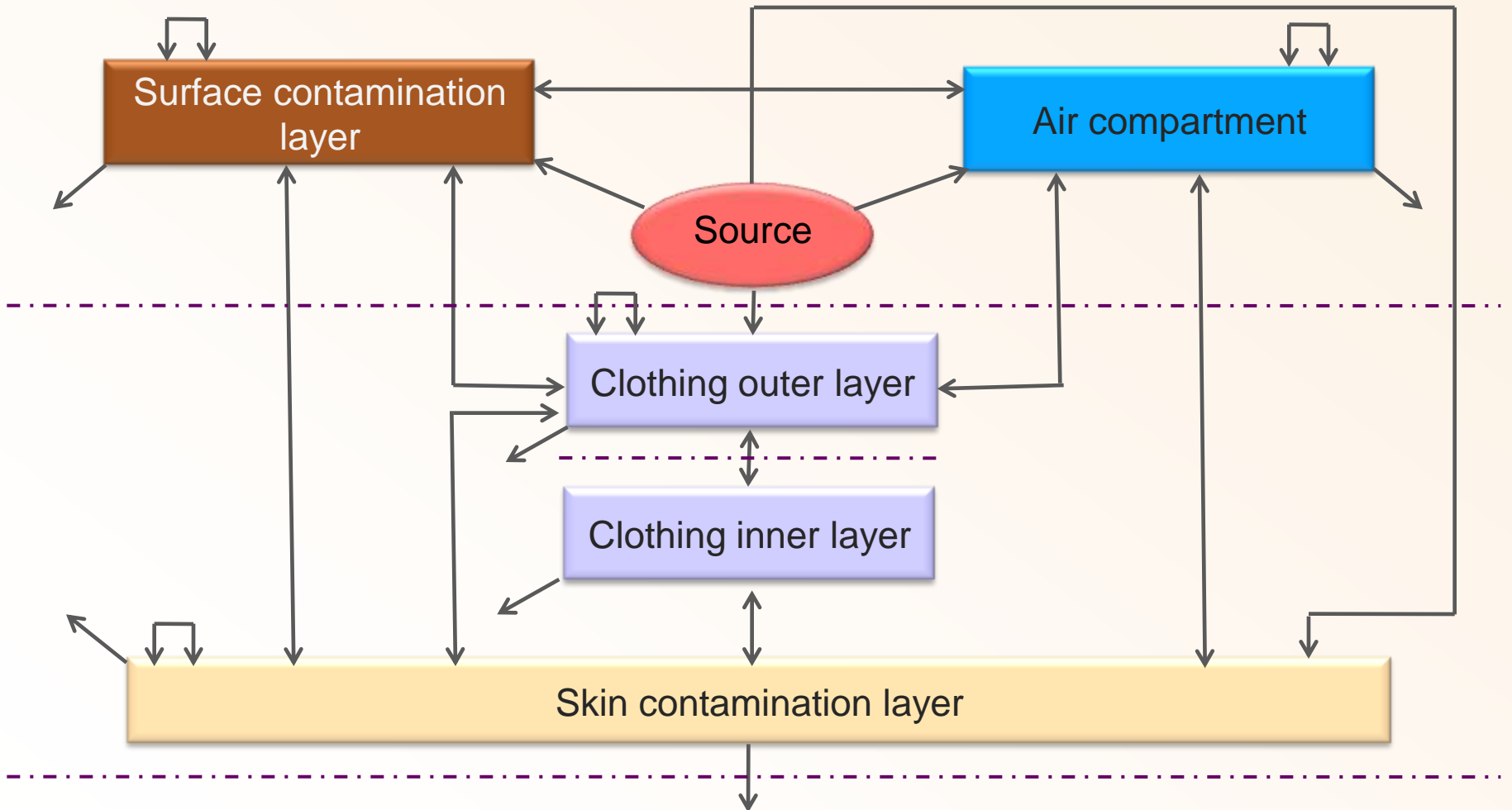
Modeling of dermal exposure

Martie van Tongeren

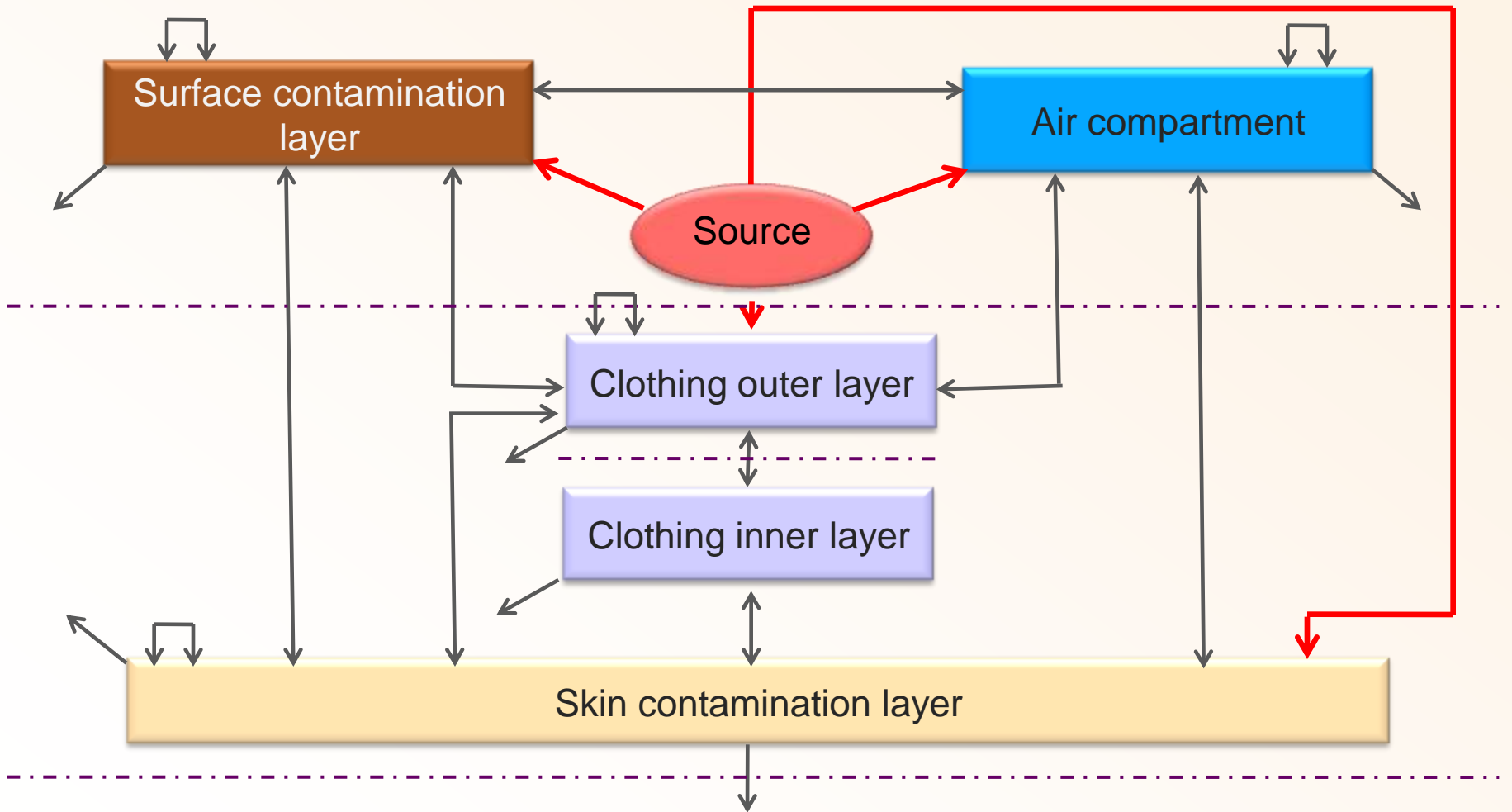
Overview

- Conceptual model for dermal exposure
- Existing models for dermal exposure assessment
- Dermal exposure to heavy fuel oil
- Comparison of measured and modelled results
- Conclusions

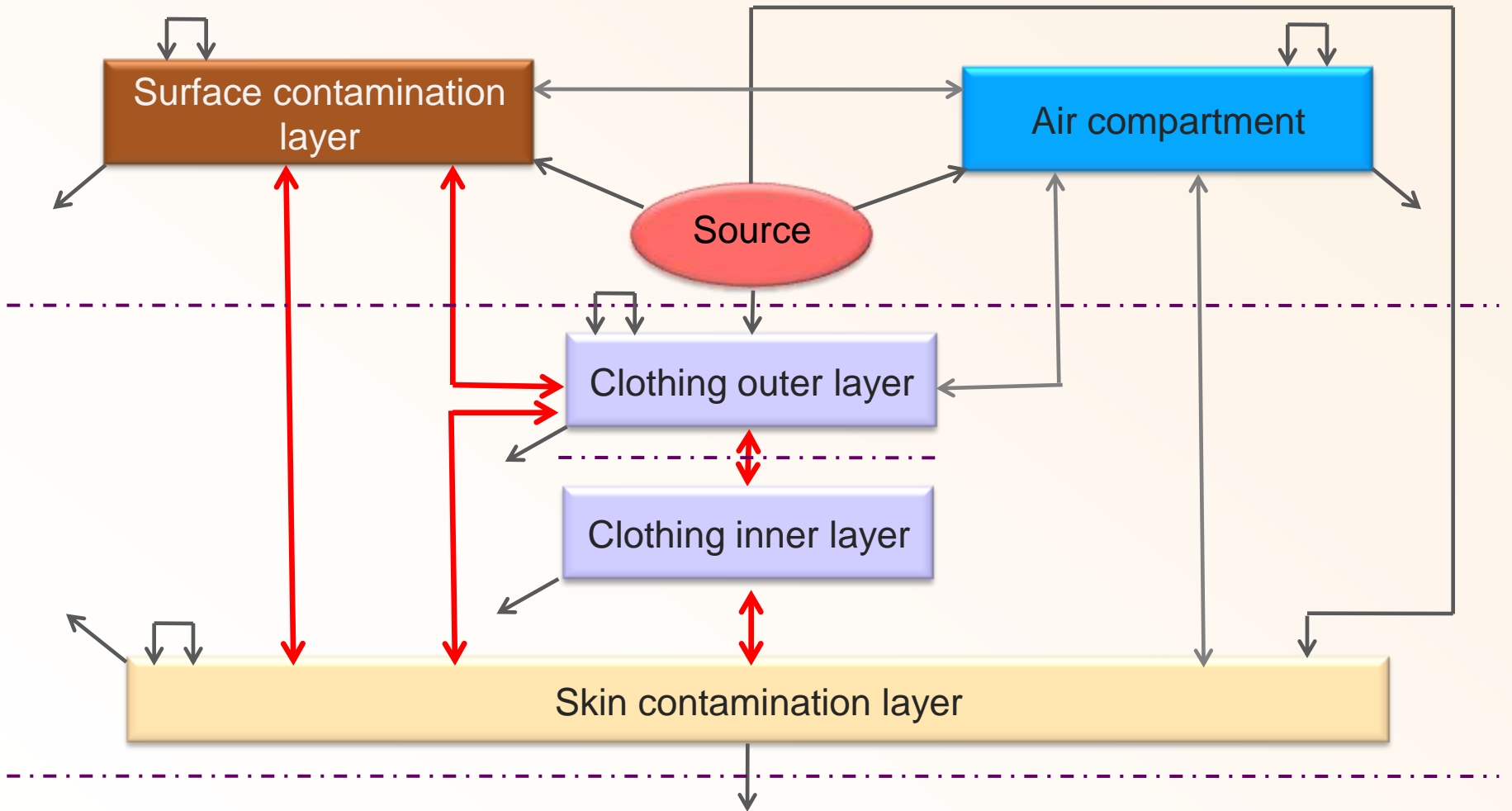
Schneider and colleagues...



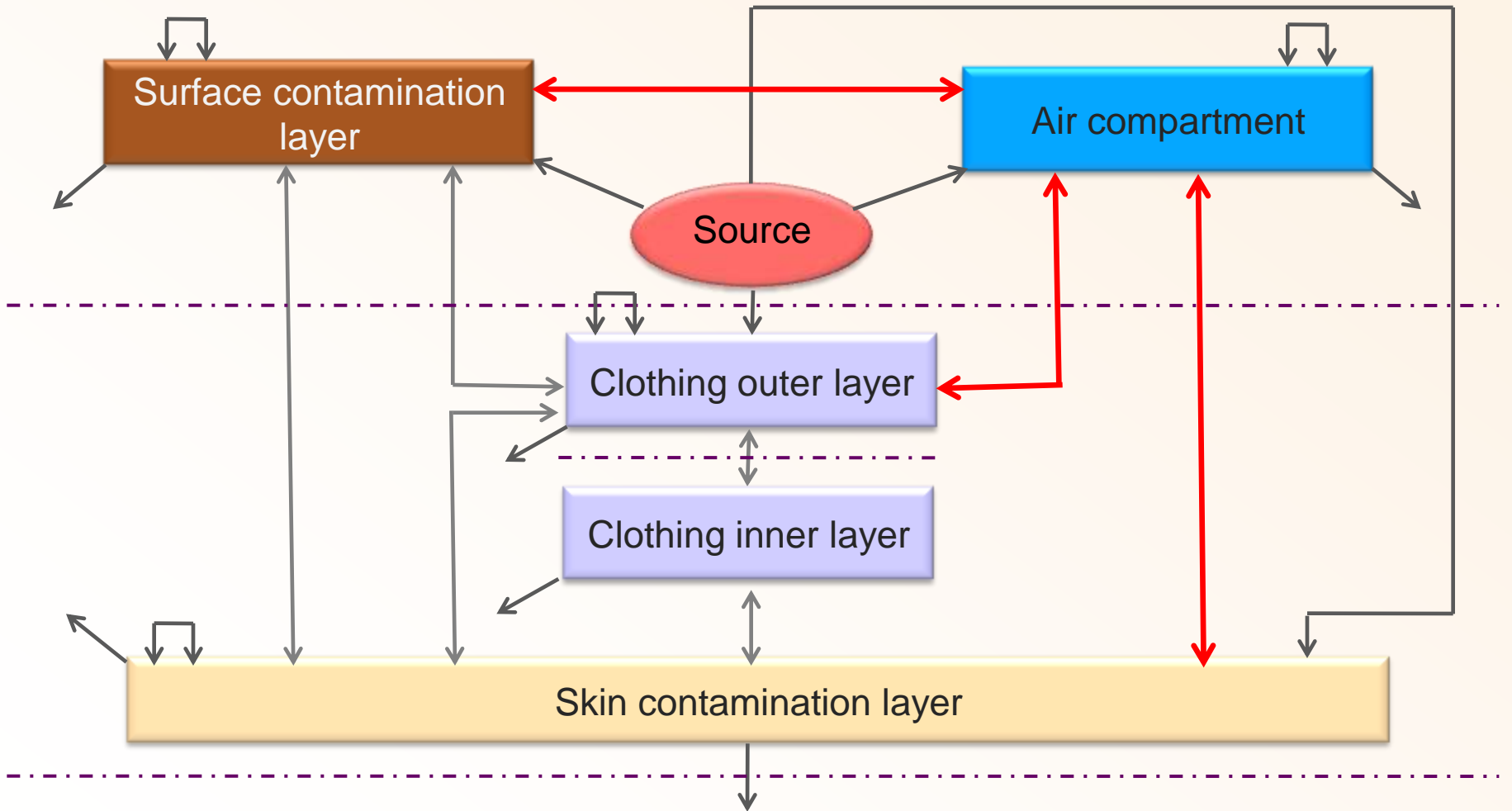
Emission



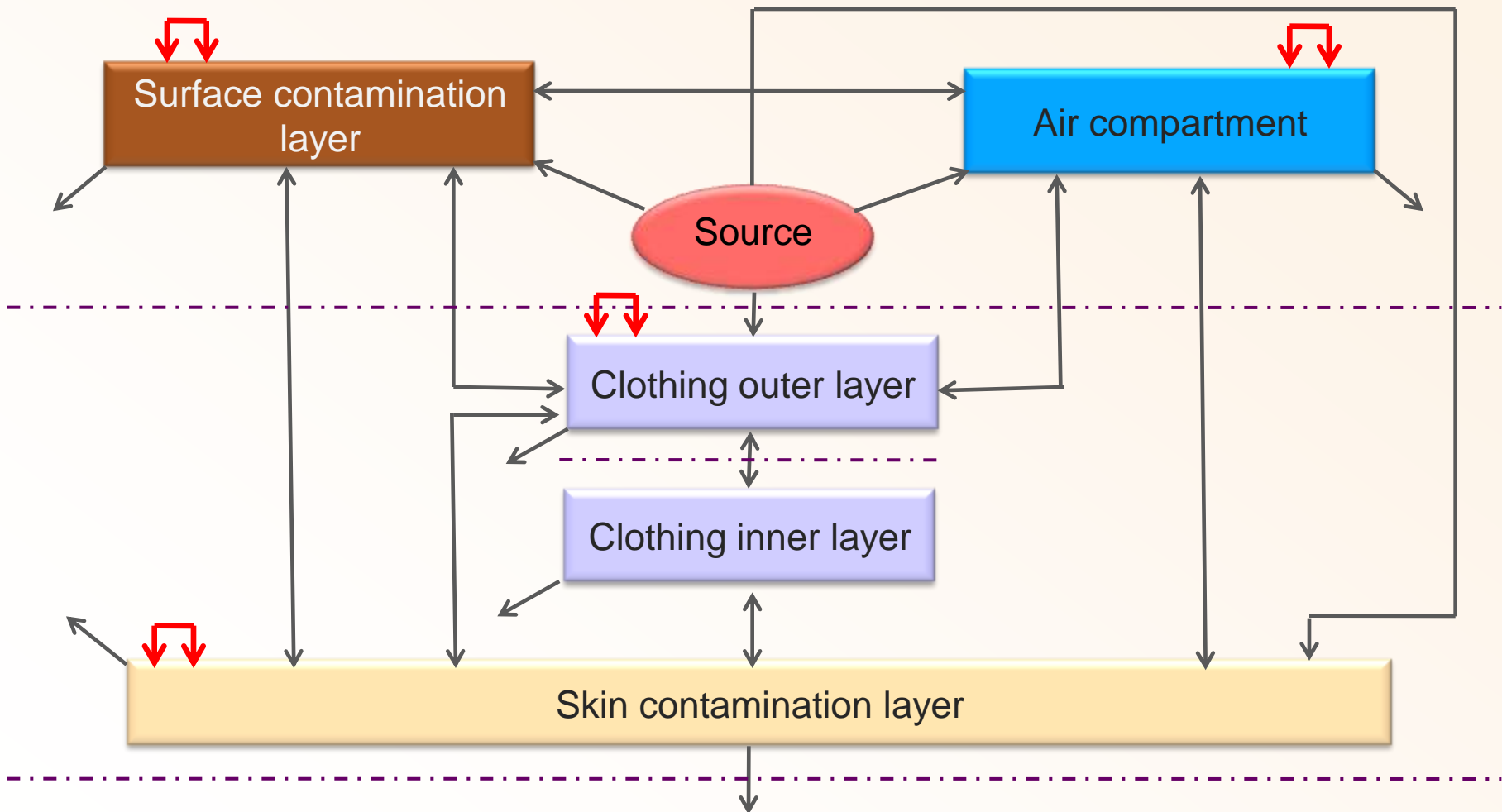
Transfer



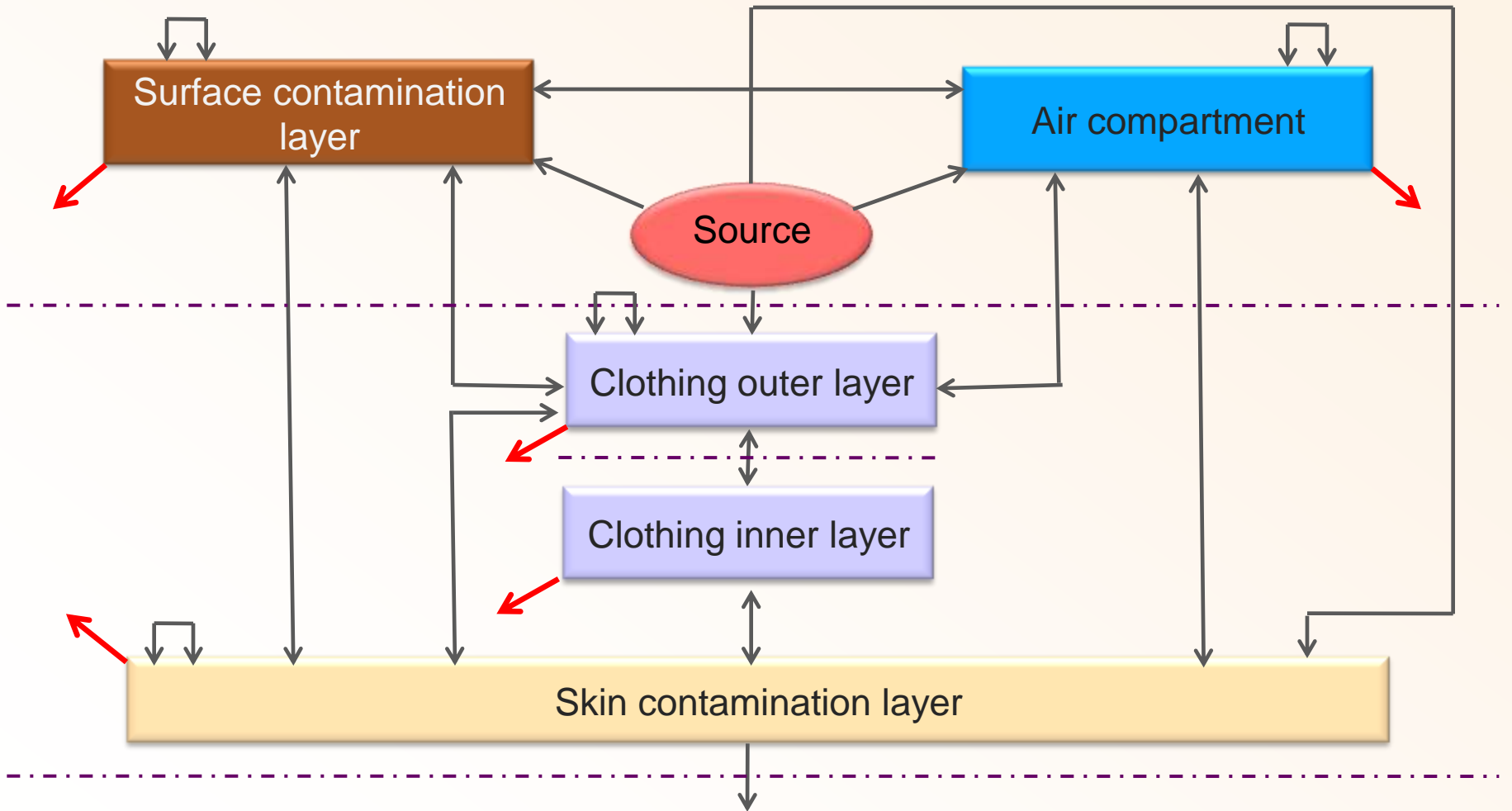
Deposition



Redistribution



Losses



Dermal exposure models

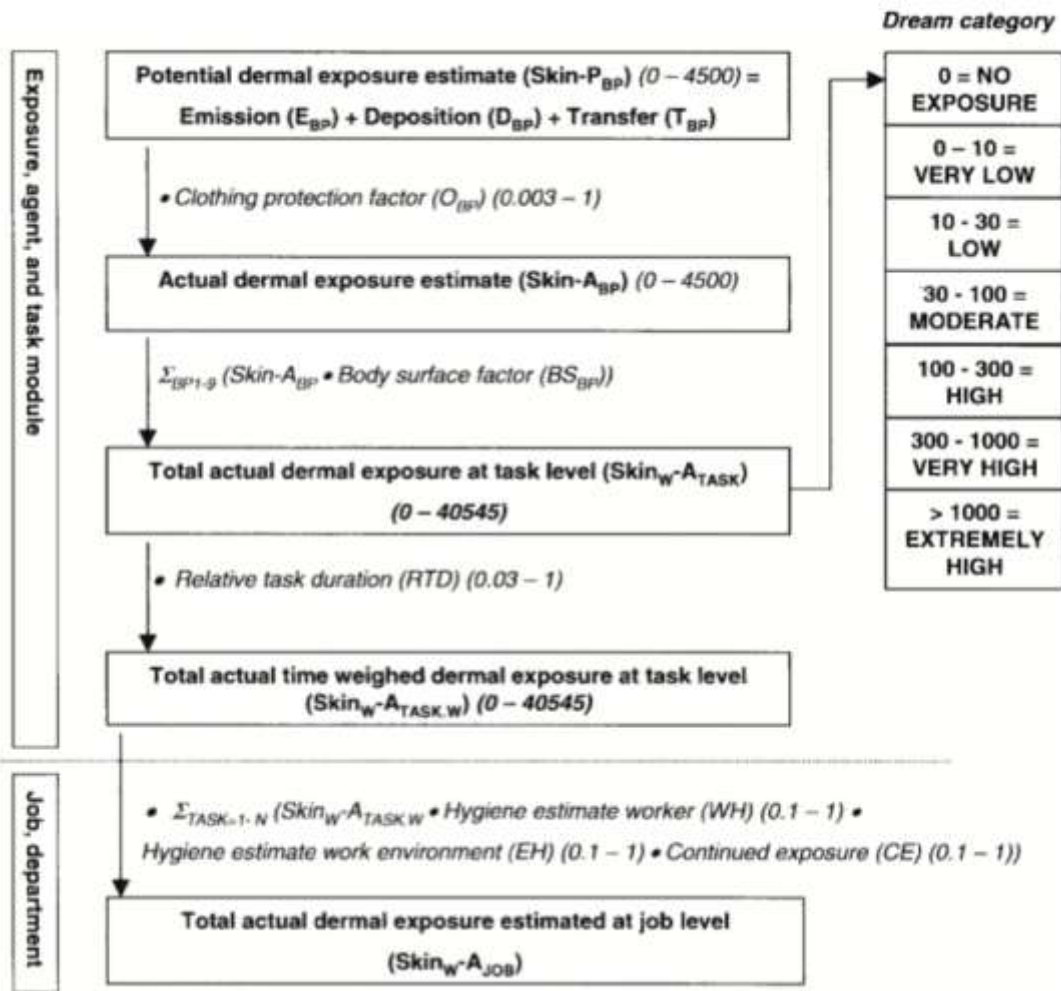
- DREAM
 - Semi-quantitative model based on the conceptual model
 - Observational
 - User needs to estimate the probability and intensity of exposure routes.
- ECETOC TRA
 - 1st tier model, based on EASE
- RiskofDerm
 - Individual (statistical) models for 6 Dermal Exposure Units estimating exposure rate (mg/min).
 - Not based on the conceptual model
 - Protective clothing not taken into account
- BEAT
 - Probabilistic task-based model
 - Based on analogy with existing exposure data
 - Mainly used for biocides
 - Not based on the conceptual model
- DERM and EUROPOEM
 - for pesticides

Data collection for DREAM

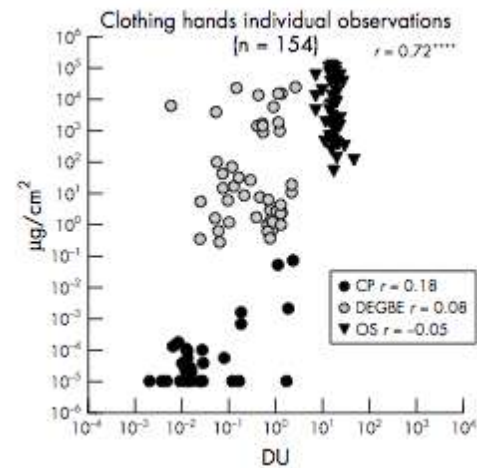
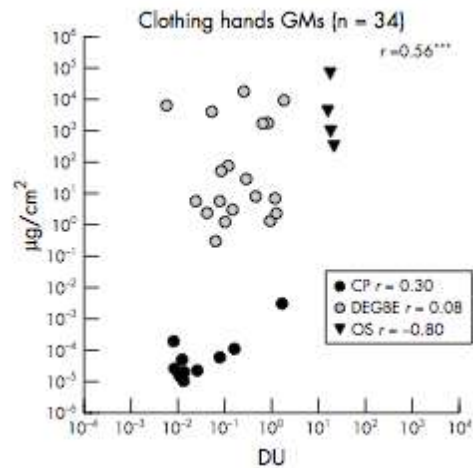
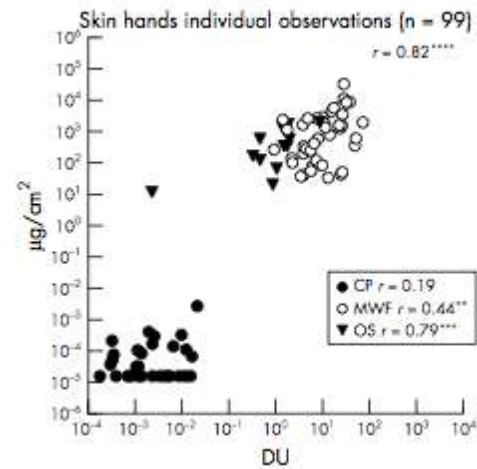
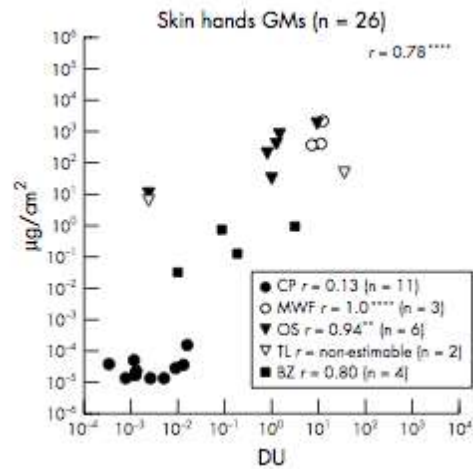
Table 1. Summarizing the information obtained in the inventory part

Module	Data obtained on	Processes in conceptual model of Schneider <i>et al.</i> (1999)
1. Company	General information about company and observer	
2. Department	Chemical or biological agents that occur in work environment Cleaning activities at department	Source present (no/yes), surface contaminant layer present (no/yes) Decontamination of surface contaminant layer
3. Agent	Physical characteristics of substance for which dermal exposure is assessed, such as concentration of active ingredient in substance, physical state, boiling temperature, viscosity, formulation (powder, granules), dustiness, stickiness	Source strength, emission, evaporation, decontamination
4. Job	Hygienic behaviour Number of people with this job title	Decontamination of skin
5. Task	Percentage of time that task is performed Number of people performing task	Event per unit of time
6. Exposure to a substance assessed for a certain task	Probability and intensity of dermal exposure routes (per body part) Use of clothing (per body part) (covered versus uncovered body parts, clothing material, repeated use of clothing) Contamination of work environment	Emission, deposition, transfer Clothing barrier, contamination of clothing, redistribution

DeRmal Exposure Assessment Method - DREAM



DREAM validations...



van Wendel de Joode et al (2005)

Heavy fuel oil (HFO)...

- Industrial fuel for power stations
- Heating large industrial sites
- Heating fuel in hospitals and distilleries in remote area (e.g. Scottish Highlands)
- Marine oil

- HFO contains polycyclic aromatic hydrocarbons

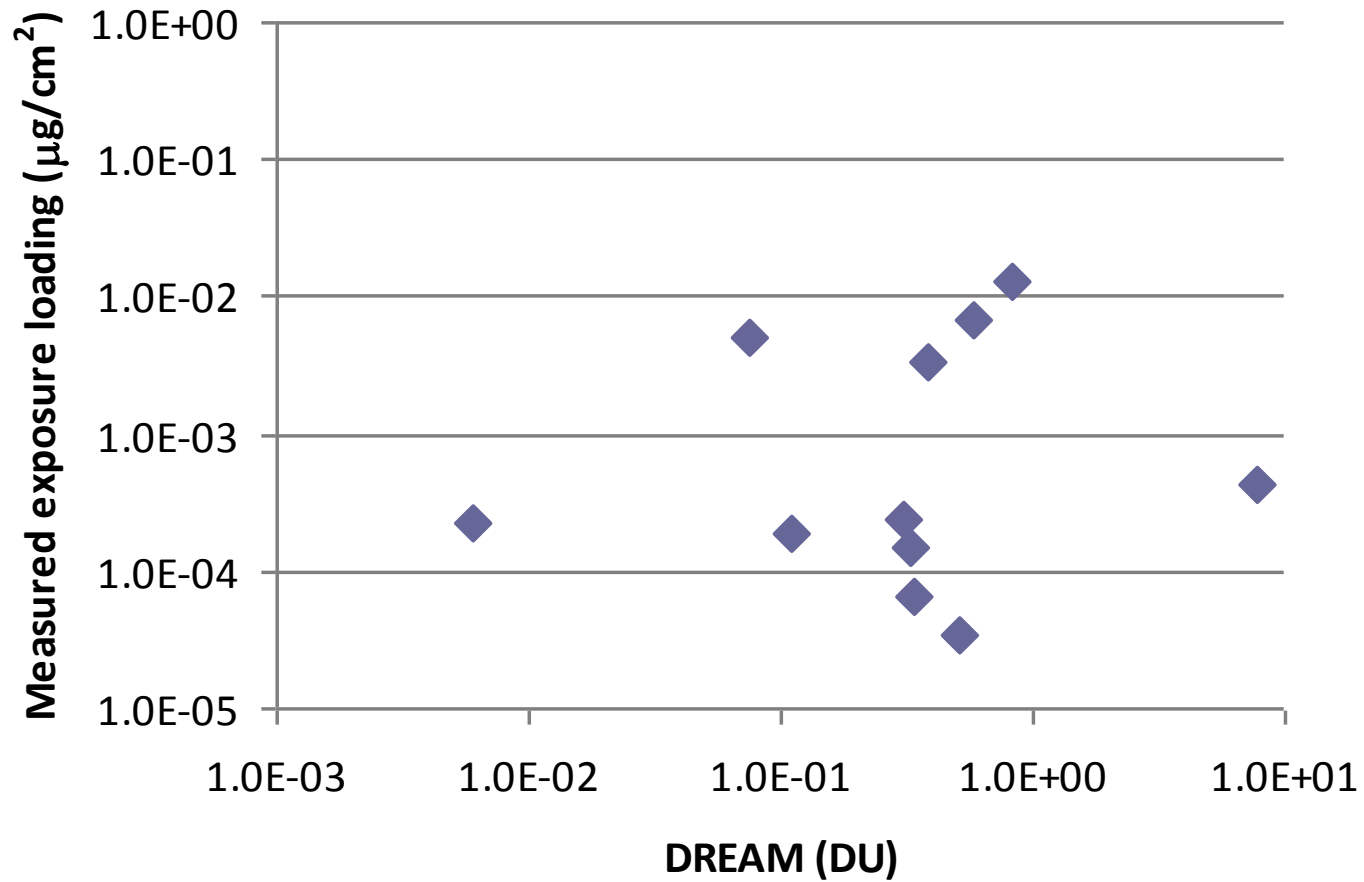
Aims of our study...

- To develop a validated method for measuring dermal HFO exposure
- To collect exposure data using the validated method
- To collect contextual exposure information and use these data to apply the DREAM model

Sites investigated...

- Production
 - 2 oil refineries
- Distribution
 - 2 fuel distribution terminals
 - including 1 associated with distribution by shipping
- Use
 - 2 Energy providers
 - 1 Power plant engine building and repair

Comparison HFO measurements with DREAM estimates



Discussion

- Dermal exposure models are available.
- Relatively crude, conservative and based on direct observations
- DREAM is currently the most promising, but may not sufficiently sensitive to discriminate between exposure scenarios for similar agents
- Generic dermal exposure models (eg Dermal-ART) are currently not available
- Brouwer et al (2009) carried out a feasibility study for development of dermal ART
 - In principle, it should be feasible to develop a dermal ART, based on modifying factors
 - However, lack of data to quantify the effects of these determinants.
- Hence, more dermal exposure studies are required
 - to help understand the determinants of the transfer processes and
 - to develop a comprehensive exposure database

Acknowledgments

- John Cherrie (IOM)
- Yvette Christopher (University of Utrecht)
- Jan Urbanus (Shell)
- Concawe for funding the HFO study