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WORKING FOR A HEALTHIER FUTURE

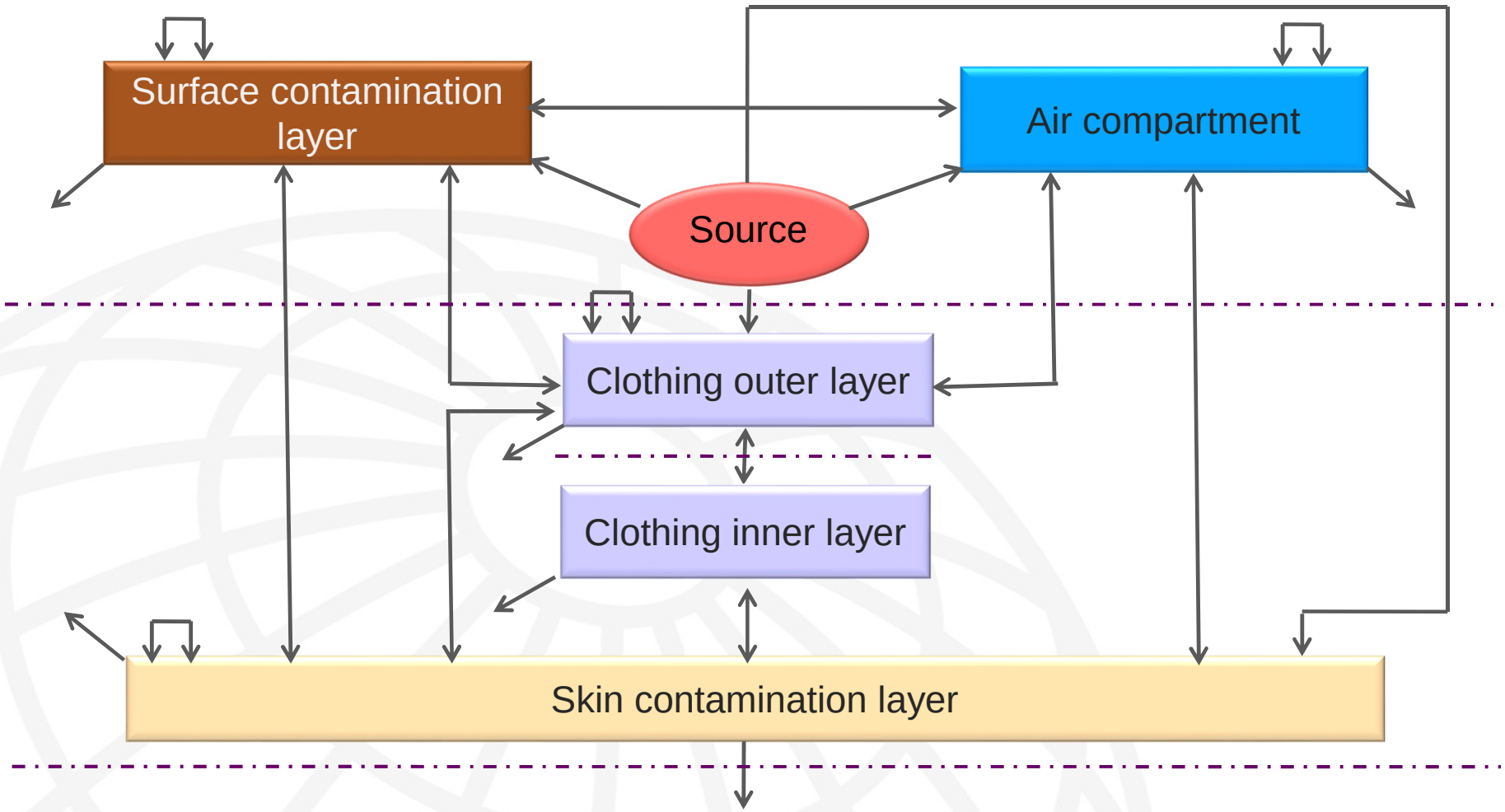
# Current activities on model development and validation

John Cherrie

# Summary…

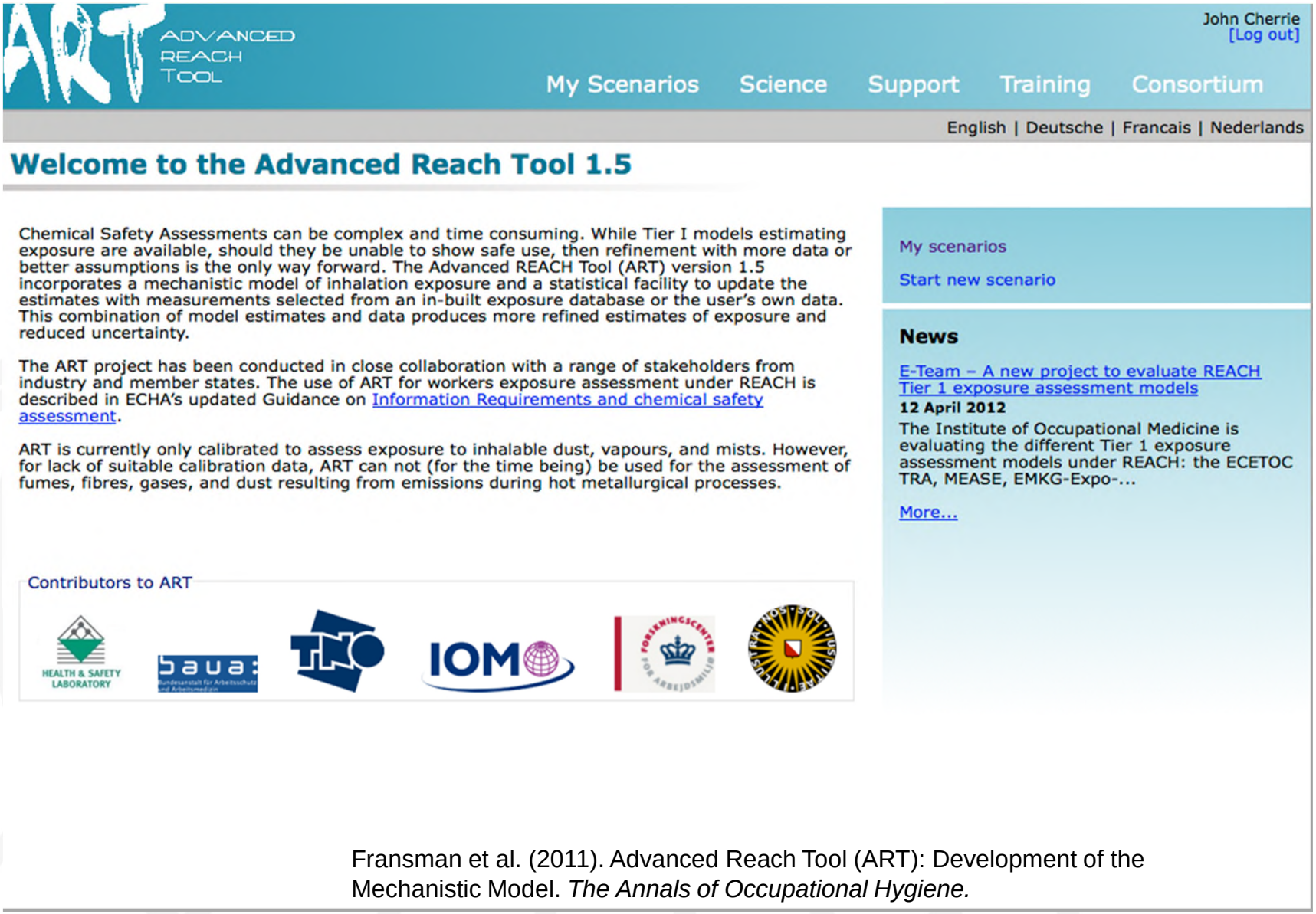
- Developments:
  - ART, dART and other higher tier tools
  - Tools for specific scenarios
  - Nanomaterials
  - Inadvertent ingestion
- Validation efforts
- What can modelling tools achieve?

# Conceptualisation of the problem



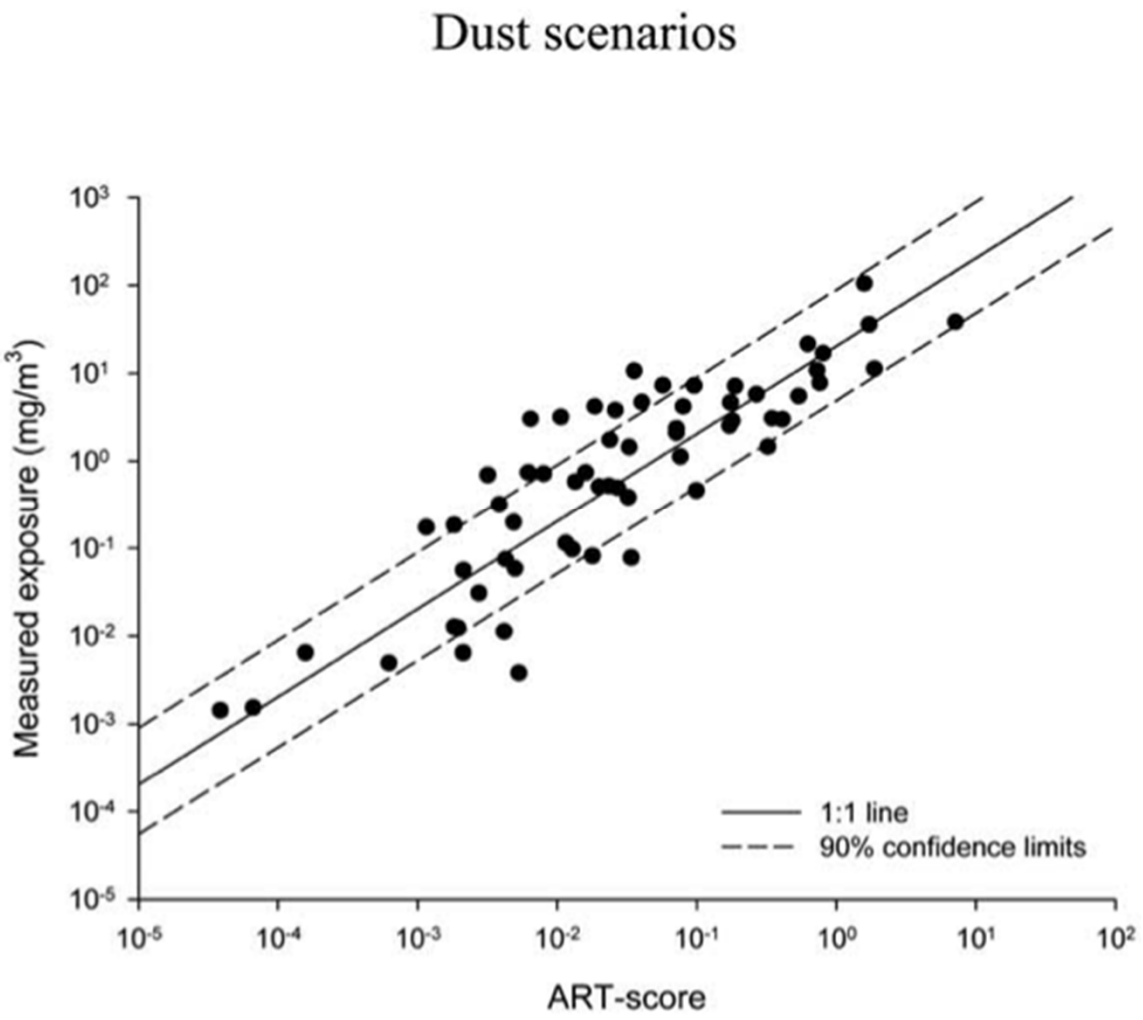

Schneider et al. (1999). Conceptual model for assessment of dermal exposure. *Occupational and Environmental Medicine, 56(11), 765–773.*

# ART…




Fransman et al. (2011). Advanced Reach Tool (ART): Development of the Mechanistic Model. *The Annals of Occupational Hygiene.*

# ART calibration…



# DREAM...

GuLF STUDY
A health study for oil spill clean-up workers and volunteers

- Tool has been updated for an epidemiological study of oil spill clean-up workers (GuLF DREAM)
- DREAM based on exposure by immersion, surface transfer and deposition from air
- We retained the structure of the DREAM model but updated parameters from a review
  - Viscosity more important for immersion
  - Evaporation potentially more important
  - Reduced impact of gloves and clothing for protection

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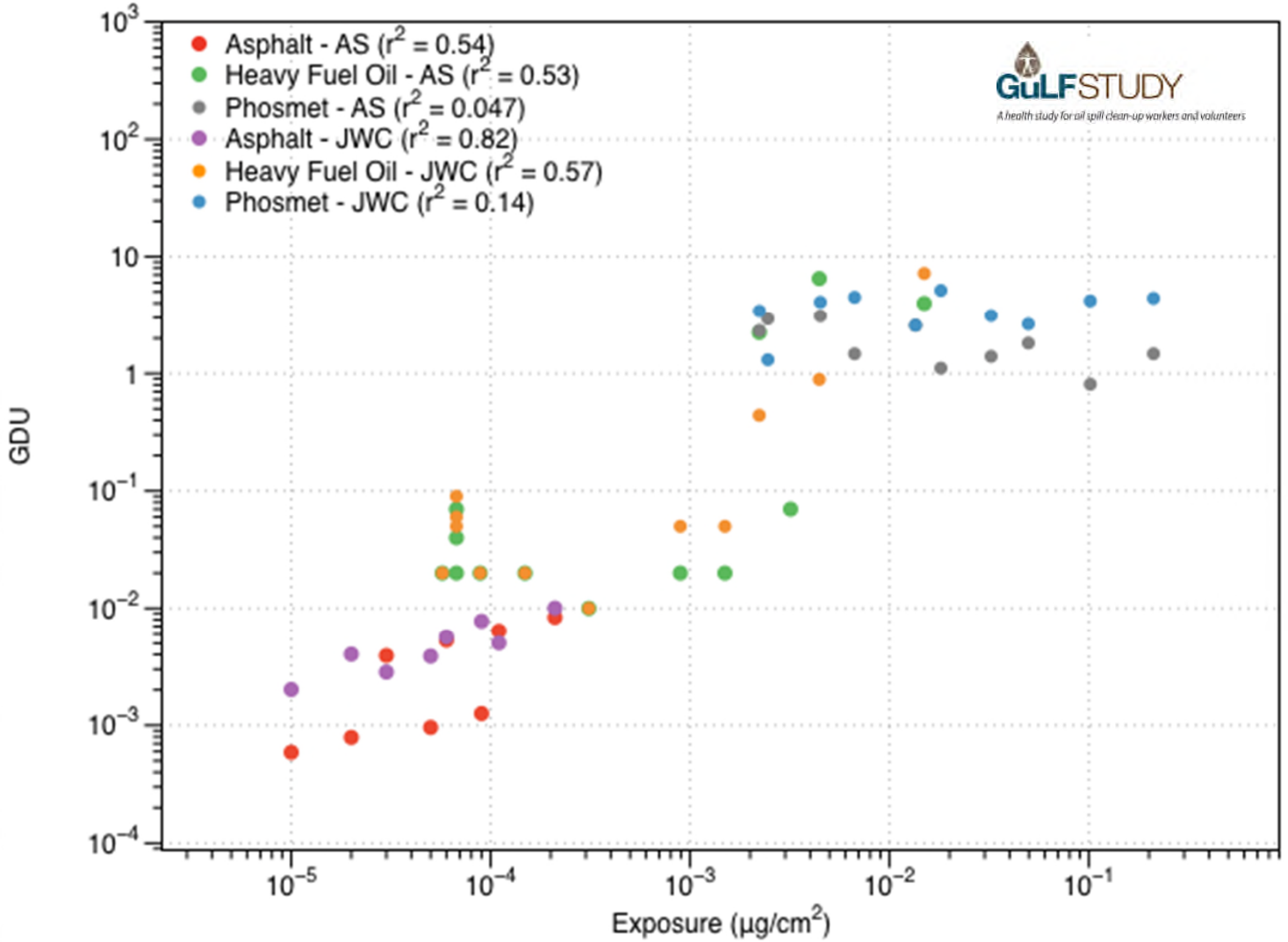
NIH...Turning Discovery Into Health

NIEHS National Institute of Environmental Health Sciences

# Wipes, washes and inside gloves

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NIH...Turning Discovery Into Health

NIEHS
National Institute of Environmental Health Sciences

# Outline of dART

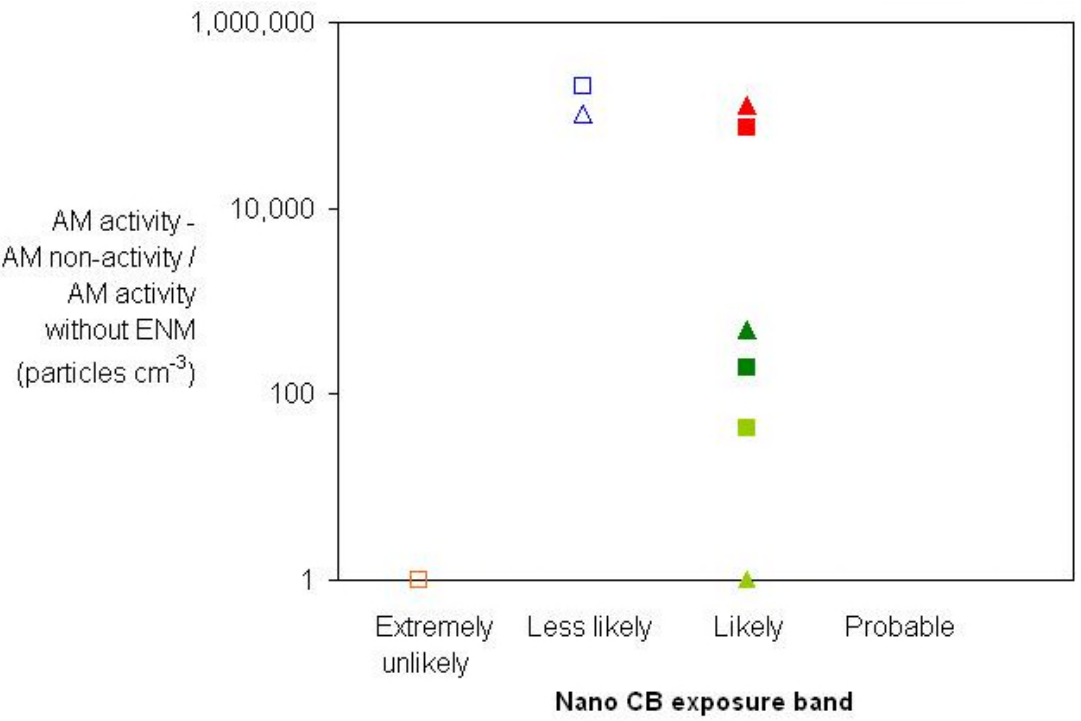
- Model based on…
  - Conceptual model of Schneider – three exposure routes
  - Algorithms similar to DREAM, although dART task-based
  - Determinants similar to DREAM
- ART model used to estimate the deposition route and surface contamination for the surface contact
- Like ART – we distinguish between near-field (NF) and far-field (FF) for all routes

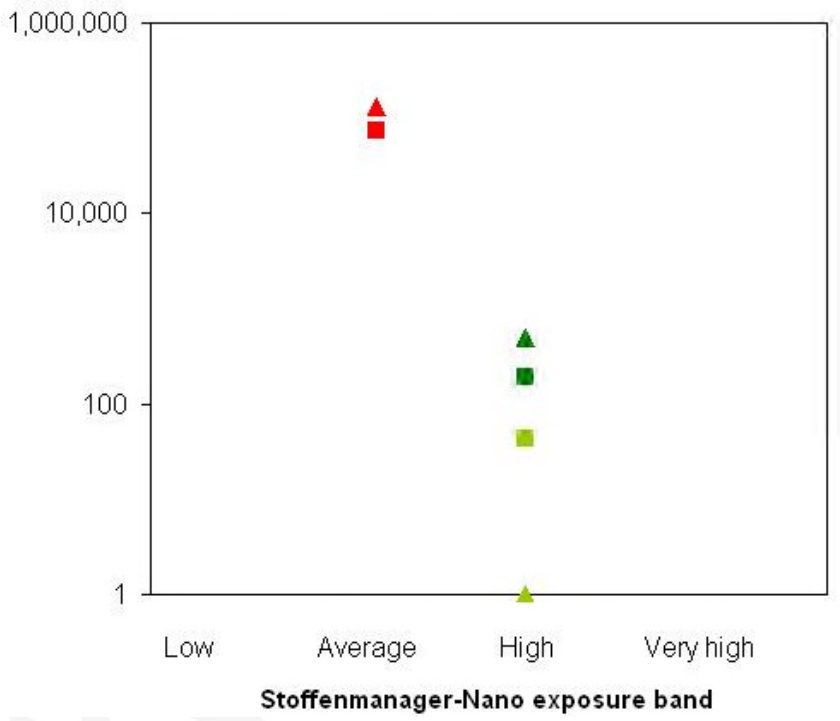
# Nanomaterials…

- Schneider et al conceptual model for engineered nanoparticles
- Control banding tools
  - Stoffenmanager Nano
  - NanoSafer
- Higher tier tool based on a dynamic source receptor model, incorporating coagulation

Schneider et al. (2011). Conceptual model for assessment of inhalation exposure to manufactured nanoparticles. *Journal of Exposure Science and Environmental Epidemiology, 1–14.*

# Exposure band vs. measurements




**Scenarios :**

- Weighing of powder
- Mixing of powder based formulation with polymer
- Extrusion of masterbatch
- Milling of the end product

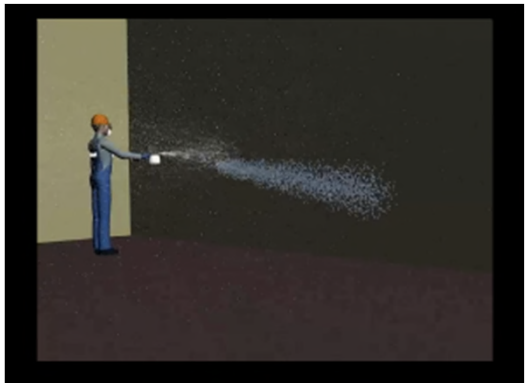
**Particle size (FMPS):**

△ 5-100 nm

□ 100-30

# Tools for specific scenarios…

- For example, SprayExpo tool
  - spray application of a non-volatile substance in a volatile solvent
  - Inhalation and dermal exposure
  - For indoor spaces
  - Developed by Fraunhofer Institute for Toxicology and Experimental Medicine for BAuA
  - Partly validated





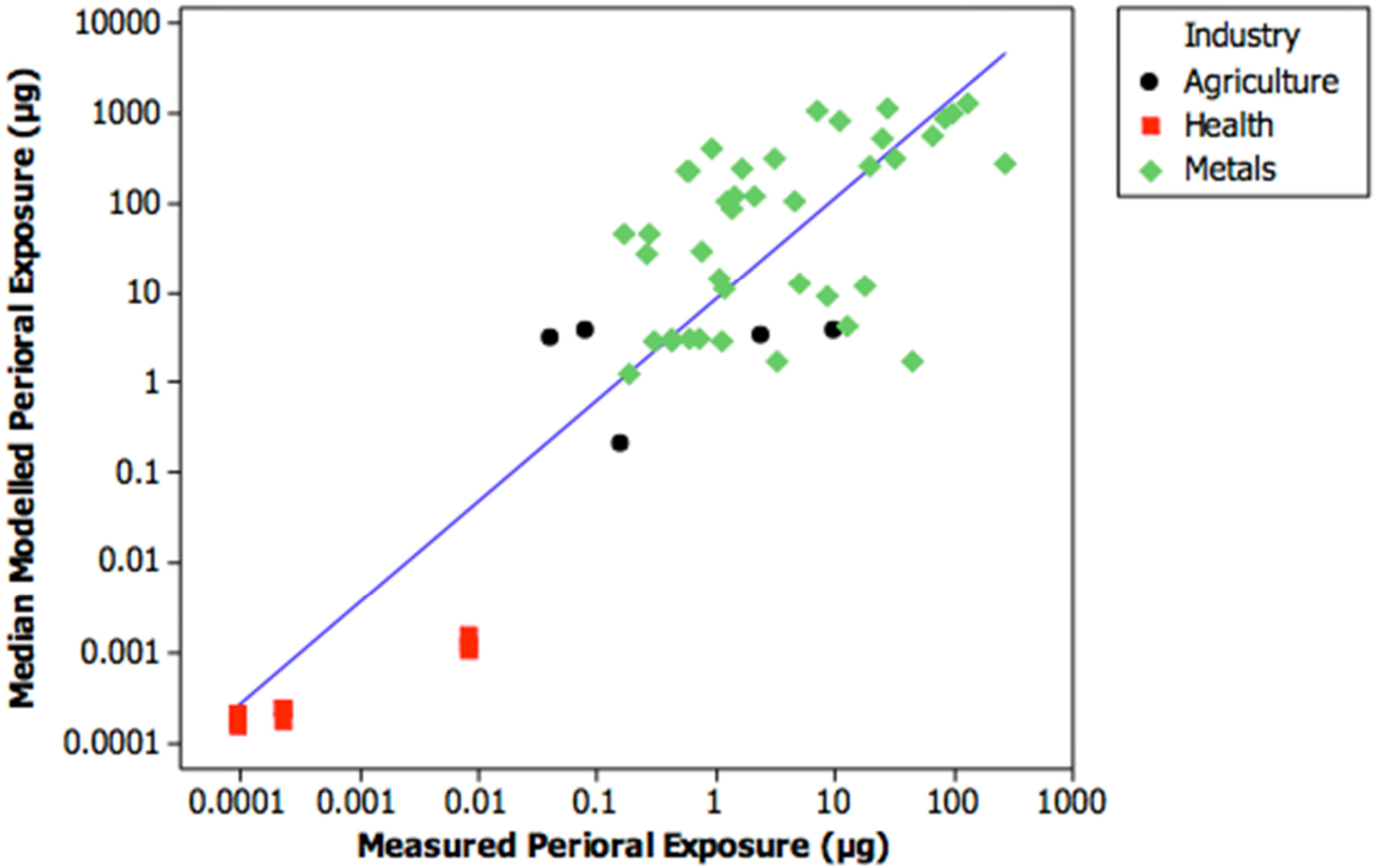
http://www.baua.de/en/Topics-from-A-to-Z/Hazardous-Substances/SprayExpo.htm

# Inadvertent ingestion…

- Occupational ingestion exposure from hand-to-mouth and other transfer processes can be important
- iEAT model developed into a screening tool
  - Supported by a database of transfer efficiencies
- Inadvertent ingestion exposure closely related to dermal exposure

Gorman Ng, et al. (2012). The relationship between inadvertent ingestion and dermal exposure pathways: a new integrated conceptual model and a database of dermal and oral transfer efficiencies. *The Annals of Occupational Hygiene, 56(9), 1000–1012.*

# Calibration…




Gorman Ng (2013) Development of a predictive tool for estimating occupational inadvertent ingestion exposure. A thesis presented for the degree of Doctor of Philosophy. Aberdeen: University of Aberdeen.

# Validation efforts…

- Designed to establish model and tool credibility
  - Accuracy and precision
  - Applicability domain
- No "gold standard" for validation
  - Check coding correct (verification)
  - Evaluate conceptual basis
  - Compare with other models
  - Compare with data
- Important that measurements made in "sympathy" with models and their inputs

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# Model tools should be…

- Minimum requirements:
  - Provide an estimate of exposure that is biologically-relevant
  - Estimate an upper percentile of the target population exposure distribution
  - Be user-friendly
  - Be validated
- Ideally:
  - Estimate the whole exposure distribution, within and between workers and workplaces
  - Provide estimates correlated with exposure
  - Facilitate integration of measurements and model estimates

# Measurements and Models…

”Essentially, all models are wrong, but some are useful”

However, it is equally true that all measurements are “wrong”


George E. P. Box

Two key things to remember:

- Treat models like measurement instruments
- Try to maximise the utility of the information you have, i.e. combine model and measurement data

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