Stochastic fate analysis of engineered nanoparticles during release processes, e.g. in an incineration plant

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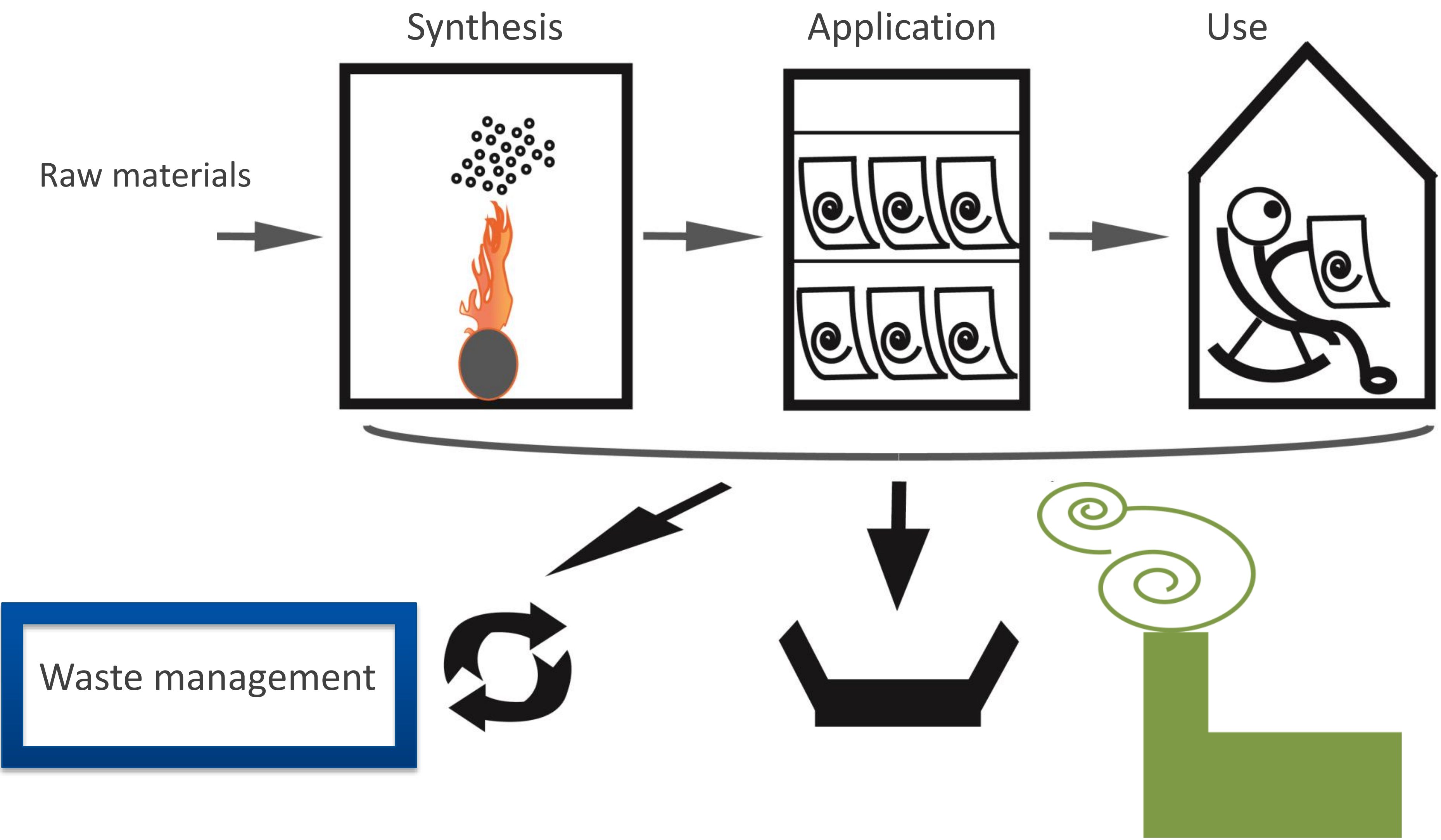
Hotspots of nanoparticle emissions



Nanowaste

Products containing engineered nanoparticles at the end of the use phase

LETTERS
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nature nanotechnology

Persistence of engineered nanoparticles in a municipal solid-waste incineration plant

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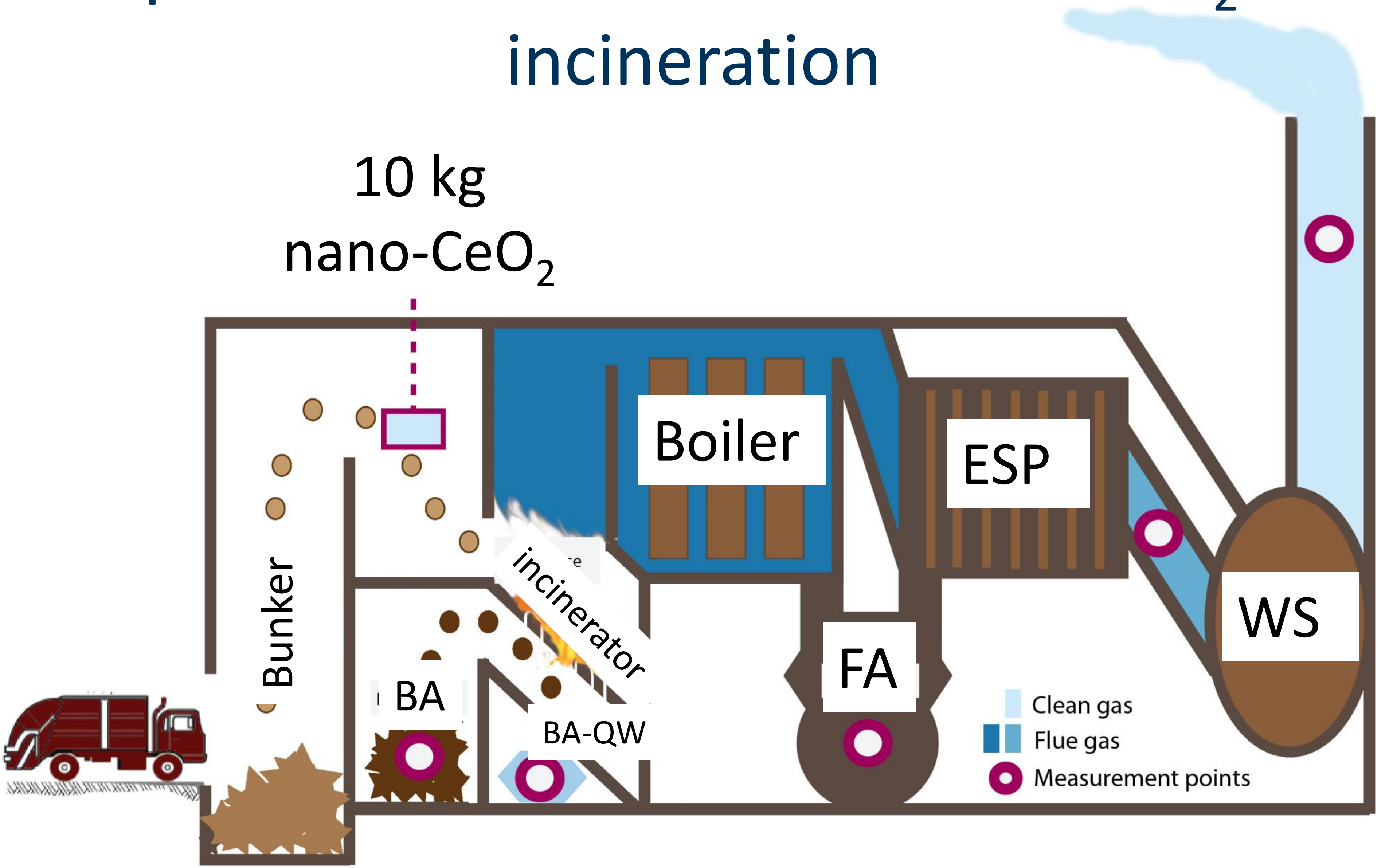
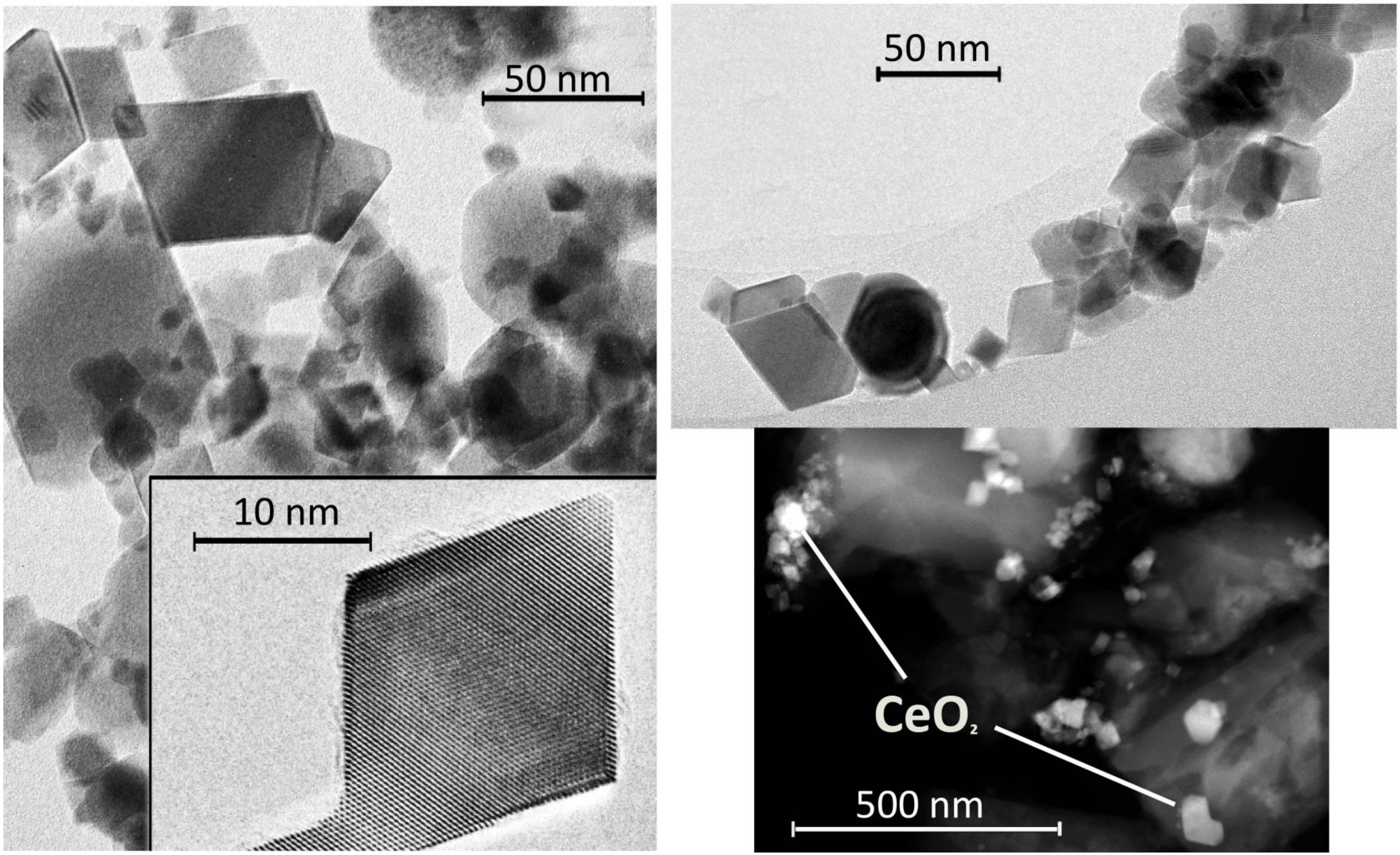
Experiment on the fate of nano-CeO_2 in incineration

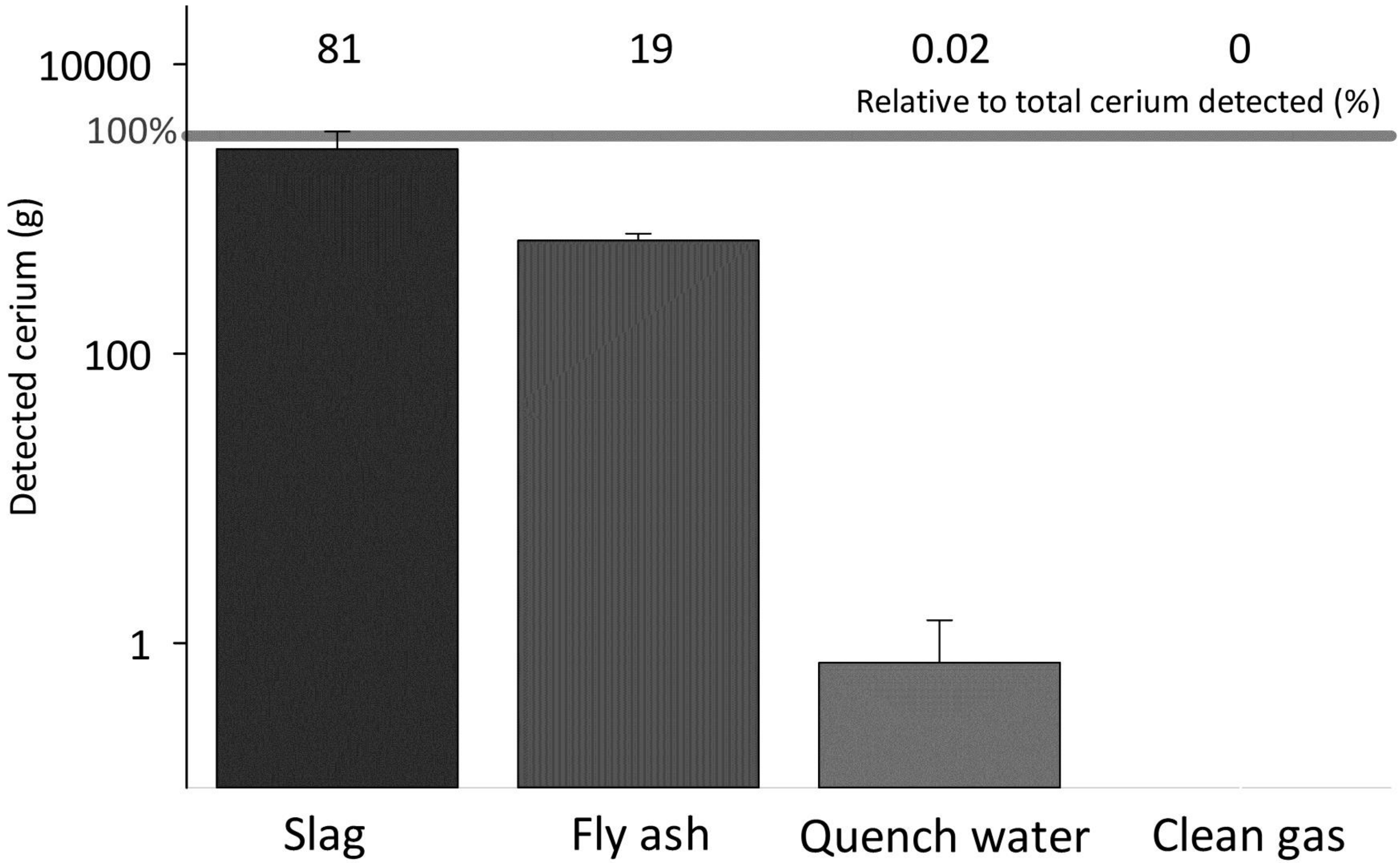


No alteration of nano-CeO_2



Walser et al. Nature Nanotechnology, **7**, 520–524 (2012)

High removal rate of nano-CeO_2



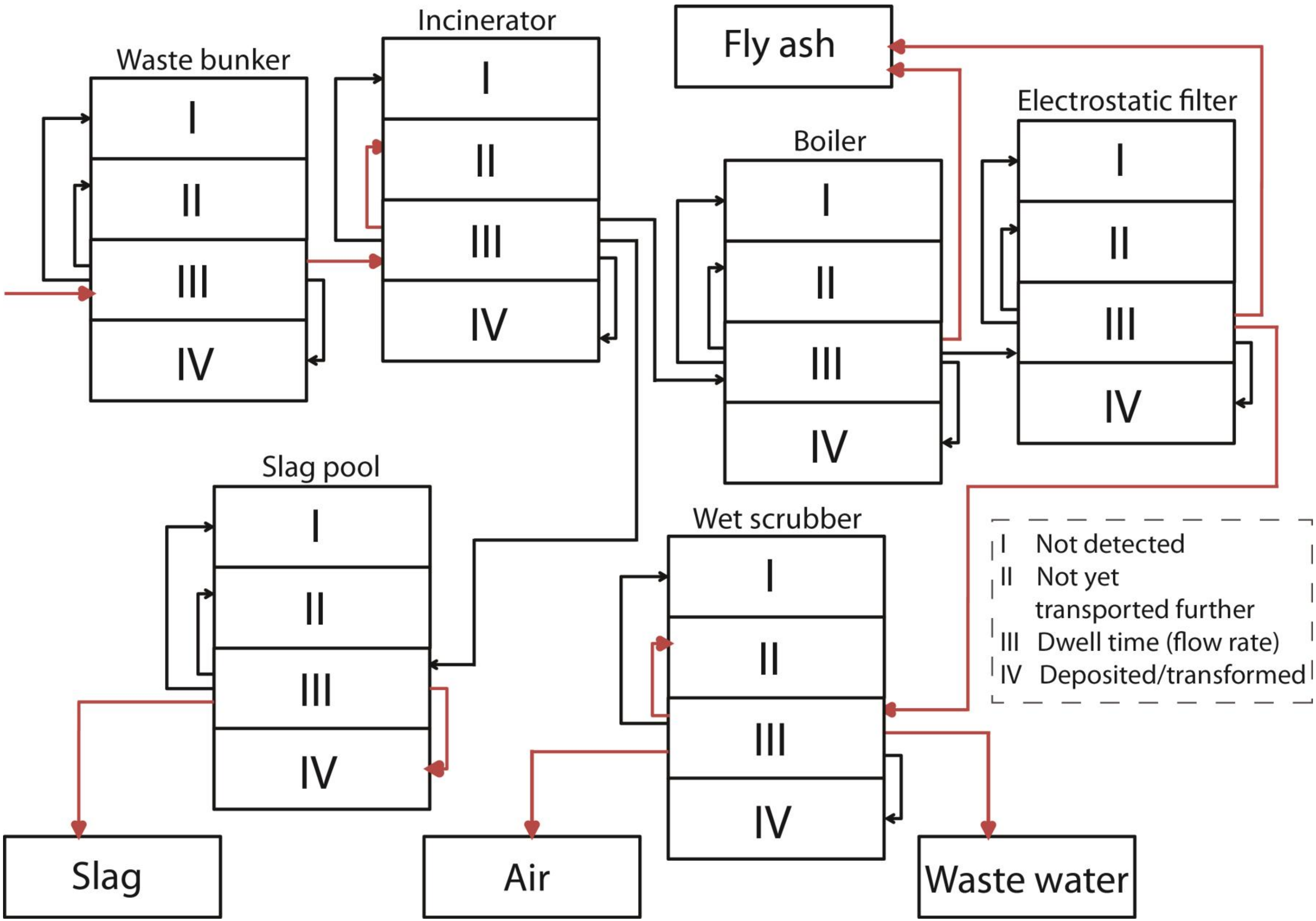
Walser et al. Nature Nanotechnology, **7**, 520–524 (2012)

Aim of the study

- Structure of a dynamic stochastic flow model
- Associated uncertainties with their propagation
- Evidence for consistency of measurement results
- Benefits for future experiments

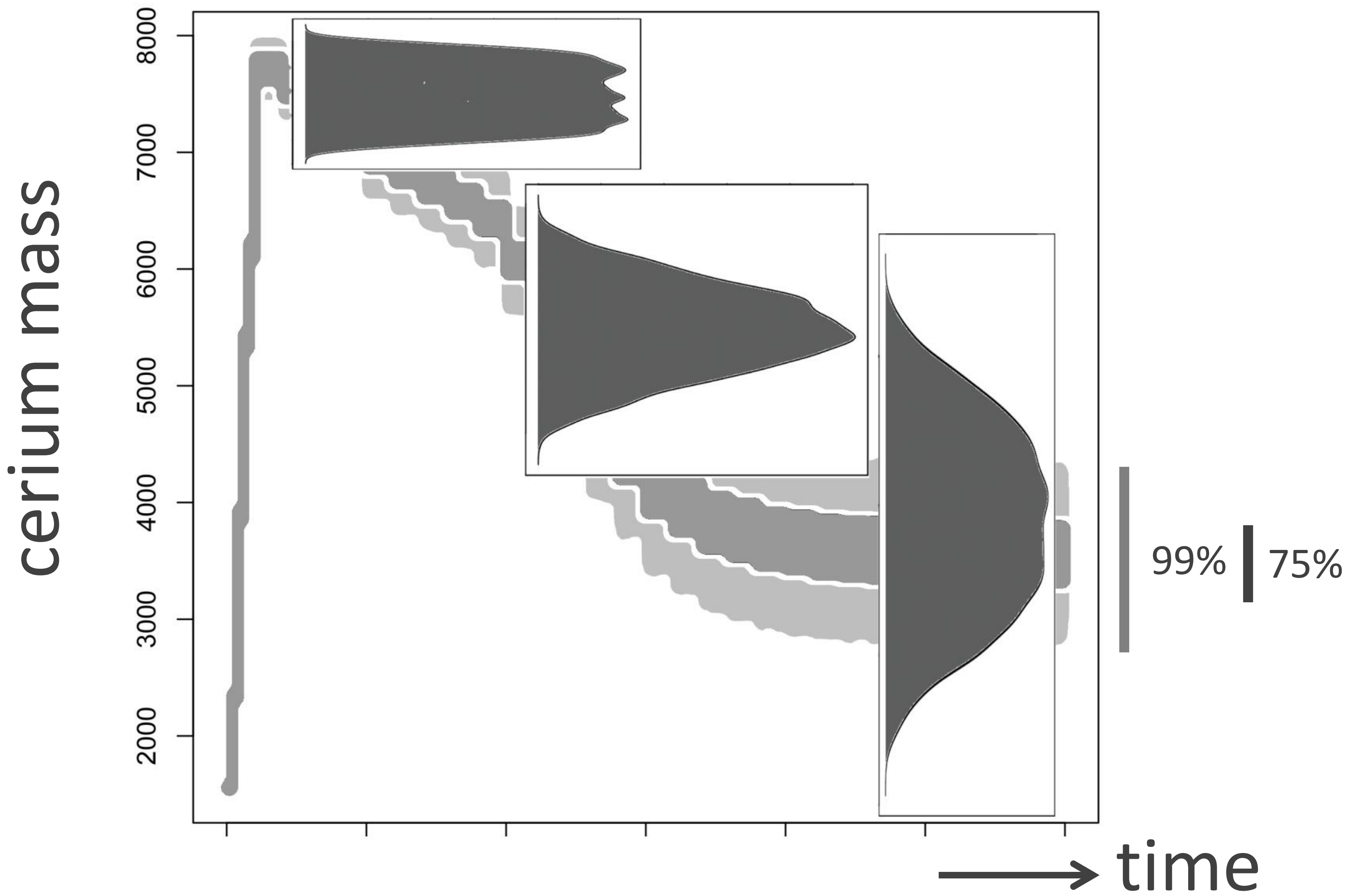
Walser, T., Gottschalk, F., 2014. Stochastic fate analysis of engineered nanoparticles in incineration plants. Journal of Cleaner Production. 80, 241-251.

Model



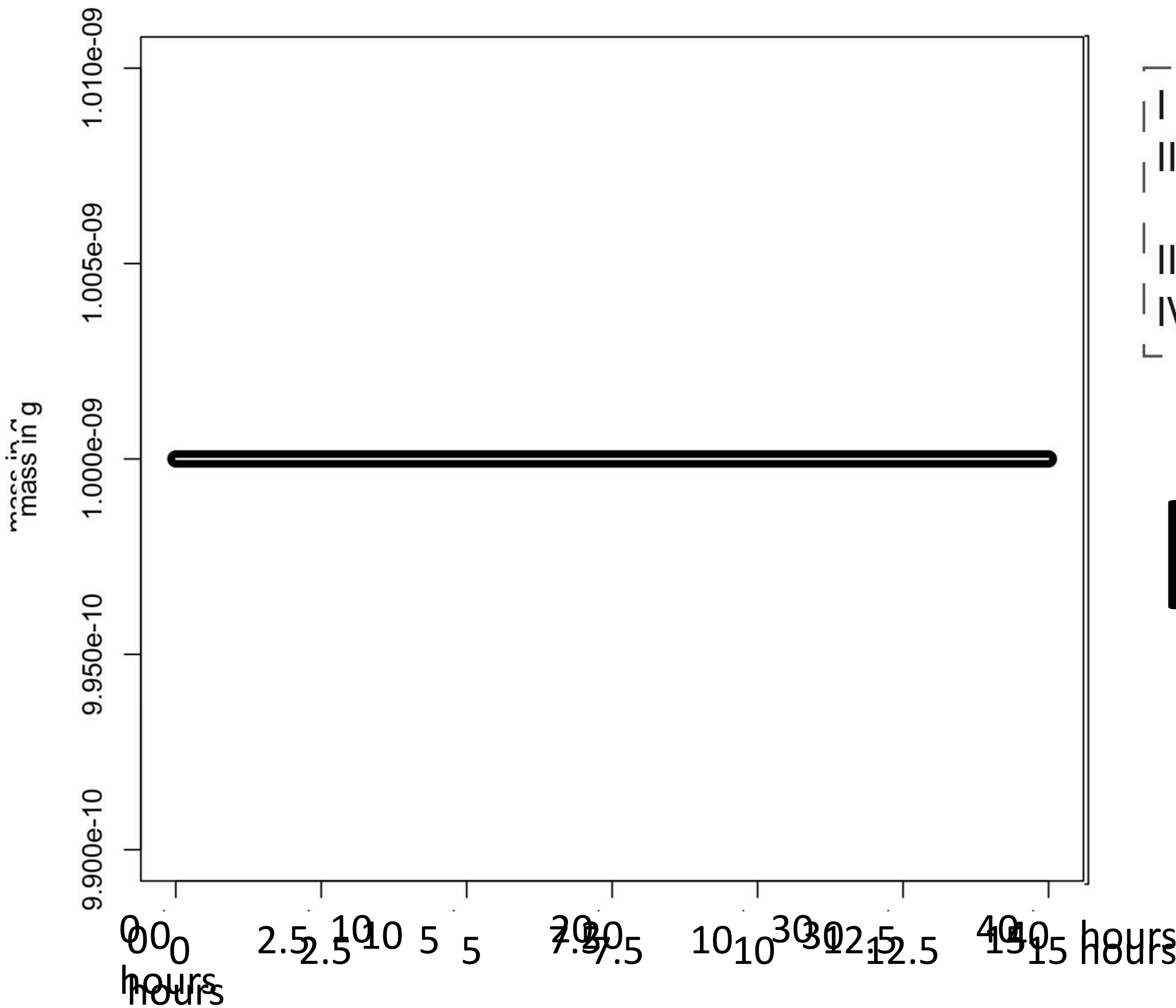
Walser & Gottschalk (2014)

Output interpretation



Walser & Gottschalk (2014)

Input data and uncertainty ranges

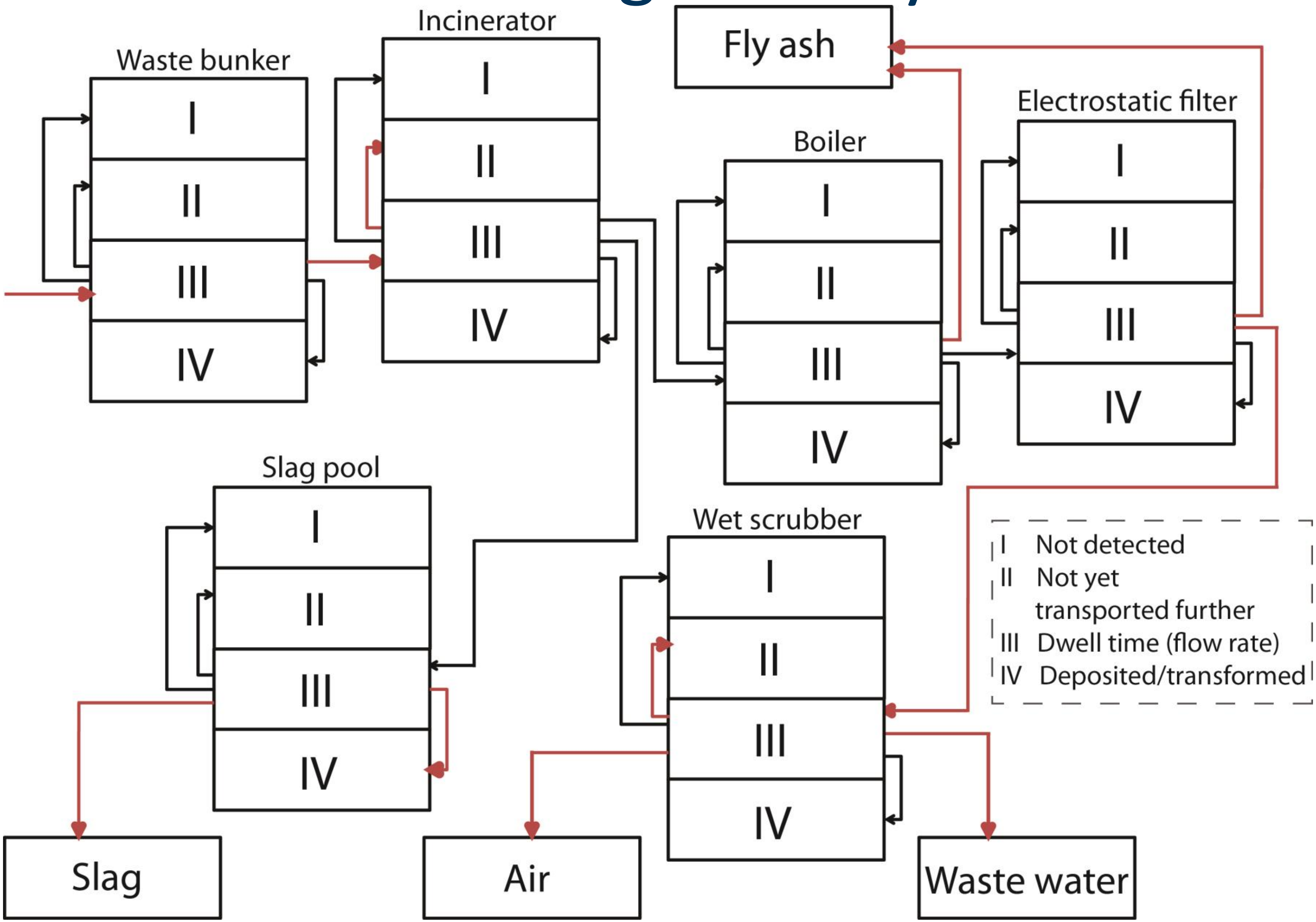


I Not detected
II Not yet transported further
III Dwell time (flow rate)
IV Deposited/transformed

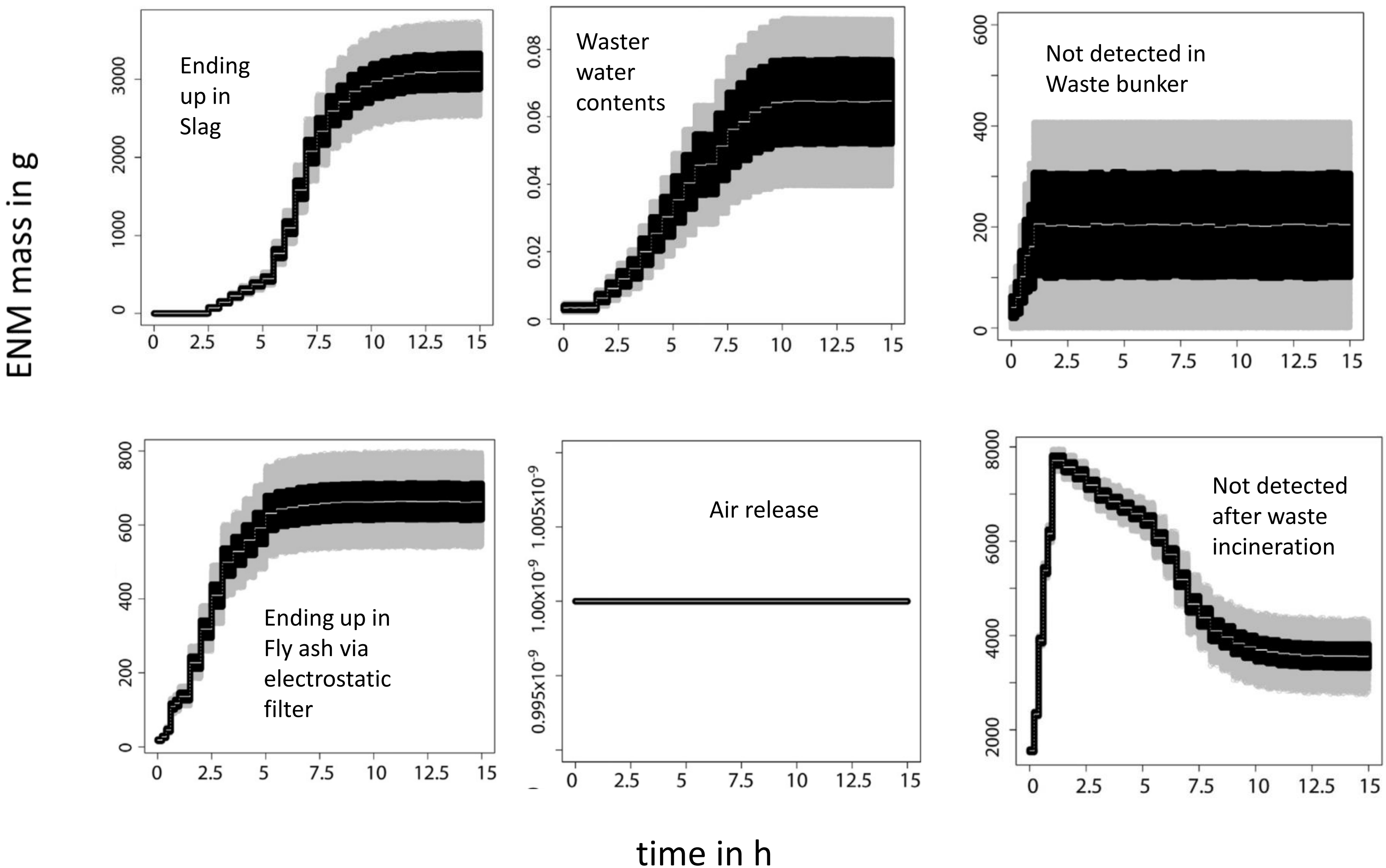
I II III IV

Walser & Gottschalk (2014)

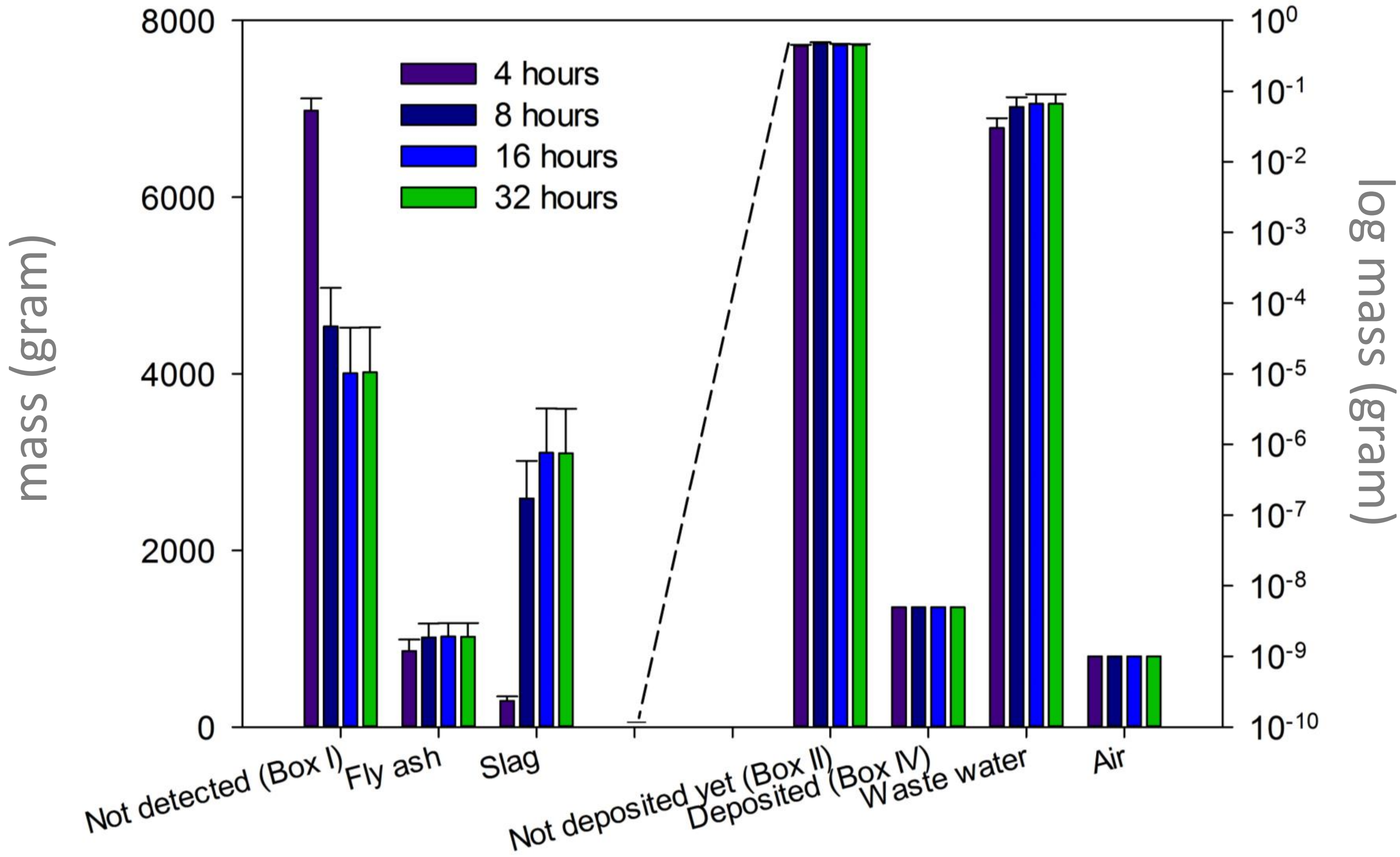
Model geometry



Some results



Overall recovery



Walser & Gottschalk (2014)

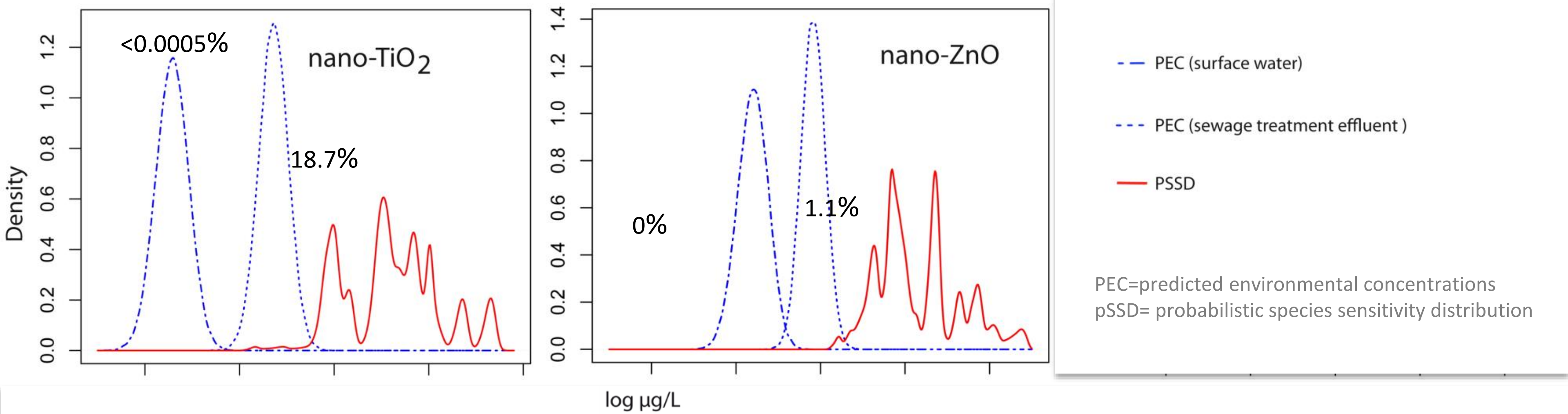
Conclusion

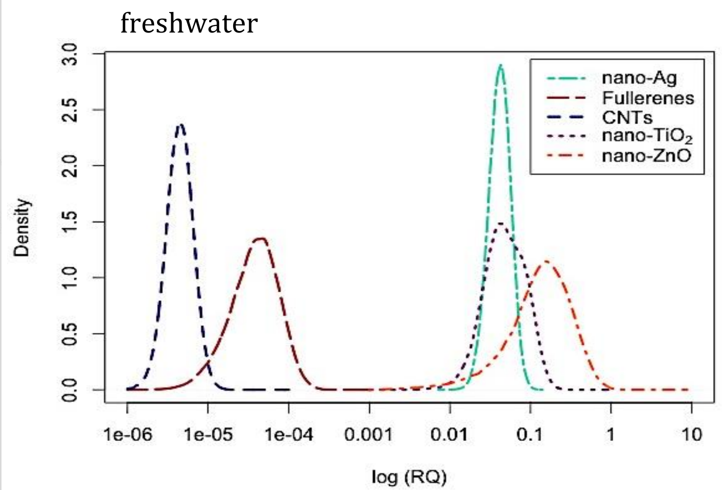
- Dynamic probabilistic flow model, based on real, time dependent measurements
- Model adds an additional flow in comparison to the measurements
- Consistency of measurement results
- Underlying mass flows are decisive for uncertainty range
- The model can be easily adapted to various types and conditions of MSWI plants

Outlook

- non-rhythmic material transfer, e.g. pulse releases
- inclusion of reactivity and bonding, and other chemical processes
- Added new engineered nanoparticles

… this helps improving fully probabilistic risk evaluation for engineered nanomaterial (ENM)





RQ=PEC/PNEC

RQ=risk quotient
PEC=predicted environmental concentrations
PNEC=predicted no effect concentrations

Gottschalk F, & Nowack B. (2013). Engineered nanomaterials (ENM) in waters and soils: a risk quantification based on probabilistic exposure and effect modelin. *Environ. Toxicol. Chem.*

Coll, C., Notter, D., Gottschalk, F., Sun, T.Y., Som, C., Nowack, B., submitted. Probabilistic environmental risk assessment of five nanomaterials (nano-TiO2, nano-Ag, nano-ZnO, CNT, and Fullerenes).

Thank you for your attention!

https://www.etss.ch/

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