Long-Range Transport of Various BFRs: non-PBDEs in Comparison to PBDEs

Martin Scheringer,
Sebastian Strempel, Carla Ng, Konrad Hungerbühler

ETH Zürich, Zürich, Switzerland

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General Main Points

- Many non-PBDE BFRs have properties similar to those of PBDEs
  - intended: effective as flame retardants
    – how effective?
    – unwanted effects (smoke)?
  - unintended: POPs and PBT properties
- Based on screening exercises using estimated physicochemical properties and degradation half-lives
- Key question:

What level of detail do we need to reach in our research into non-PBDE BFRs before they can be regulated / banned?

San Antonio Statement on Brominated and Chlorinated FR

Editorial

San Antonio Statement on Brominated and Chlorinated Flame Retardants

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Joseph DiGangi,[1] Arlene Blum,[2,3] Åke Bergman,[4] Cynthia A. de Wit,[5] Donald Lucas,[6] David Mortimer,[7] Arnold Schecter,[8] Martin Scheringer,[9] Susan D. Shaw,[10] and Thomas F. Webster[11]

[1]International POPs Elimination Network, Berkeley, California, USA; [2]Department of Chemistry, University of California, Berkeley, California, USA; [3]Green Science Policy Institute, Berkeley, California, USA; [4]Department of Materials and Environmental Chemistry, and [5]Department of Applied Environmental Science, Stockholm University, Stockholm, Sweden; [6]Lawrence Berkeley National Laboratory, Berkeley, California, USA ; [7]Food Standards Agency, London, United Kingdom; [8]University of Texas School of Public Health, Dallas, Texas, USA; [9]Institute for Chemical and Bioengineering, ETH Zürich, Zürich, Switzerland; [10]Marine Environmental Research Institute, Center for Marine Studies, Blue Hill, Maine, USA; [11]Department of Environmental Health, Boston University School of Public Health, Boston, Massachusetts, USA

The statement is signed by the individual scientists and other professionals listed separately below. Please note that the views expressed are those of the authors and signatories; institutional affiliations are provided for identification purposes only. Abbreviations and an Annotated Statement are available as Supplemental Material (doi:10.1289/ehp.1003089).

We, scientists from a variety of disciplines, declare the following:

1. Parties to the Stockholm Convention have taken action on three brominated flame retardants that have been listed in the treaty

Therefore, these data support the following:

11. Brominated and chlorinated flame retardants as classes of substances are a concern for persistence, bioaccumulation, long-range transport, and toxicity.
12. There is a need to improve the availability of and access to information on brominated and chlorinated flame retardants and other chemicals in products in the supply chain and throughout each product's life cycle.
13. Consumers can play a role in the adoption of alternatives to

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part 1

PBT Screening Exercise (I)

- How many chemicals exceed P, B, and T thresholds of REACH?
- ≈ 3% PBT chemicals among 100,000 chemicals on the market

S. Strempel, M. Scheringer, C. Ng, K. Hungerbühler, in preparation

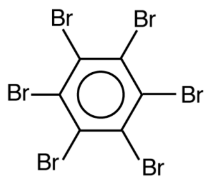
PBT Screening Exercise (II)

- Properties estimated with EpiSuite:
  - half-life of aerobic biodegradation (BIOWIN3)
  - BCF (BCFBAF)
  - LC_{50}, EC_{50}, NOEC for aquatic species (ECOSAR)
- Four hazard classes:
  - all three REACH thresholds exceeded: PBT
  - two thresholds exceeded: nonPBT2
  - one threshold: nonPBT1
  - no threshold exceeded: nonPBT0
- Calculate a **PBT score**

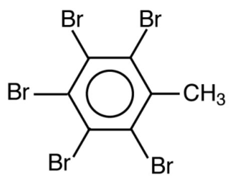
part 1

Results for non-BDE BFRs and DP

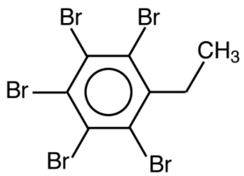
- HBB



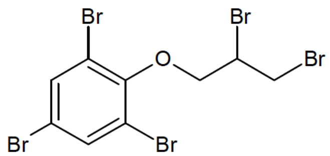
- PBT



- PBEB

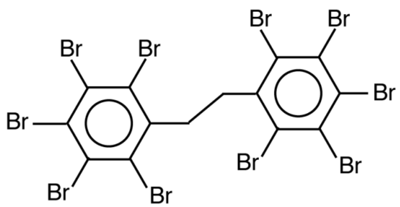


- DPTE

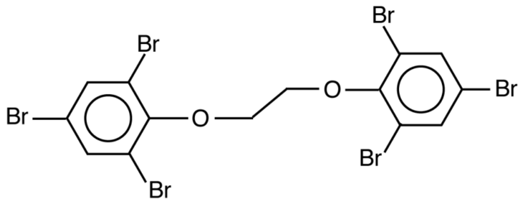


all four: PBT

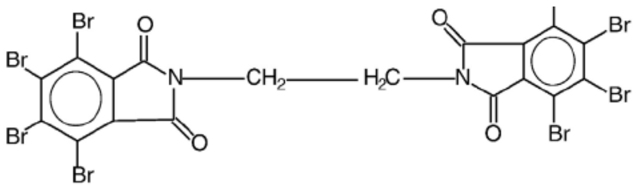
- DBDPE



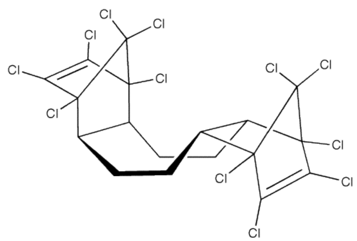
- BTBPE



- EBTPI



- DP

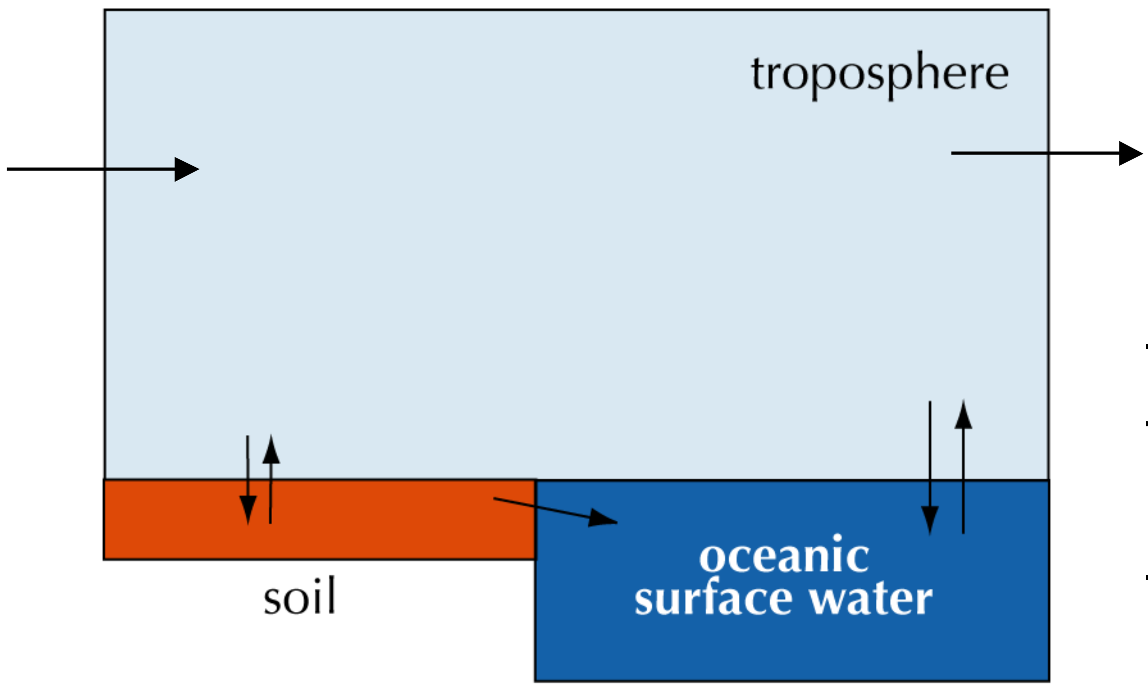


all four: P and T;
B not clear

part 2

Pov and LRTP Screening Exercise

- Calculate overall persistence (Pov) and long-range transport potential (LRTP) with the OECD Tool



interplay of
– **phase exchange**
– **degradation** in each medium, and
– **transport** in air and water

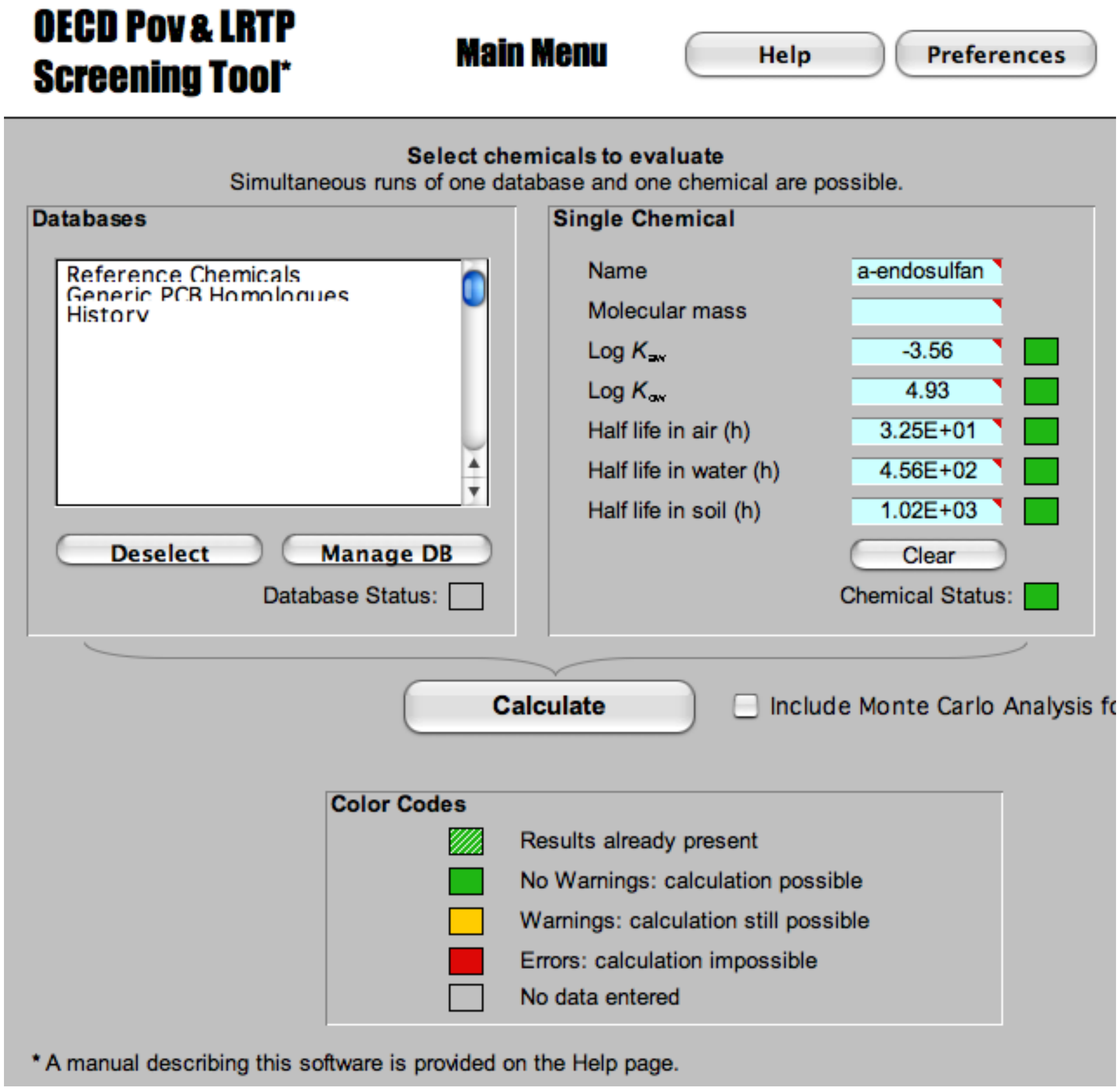
part 2

The OECD P_{ov} and LRTP Tool

- Multi-compartment model for the assessment of overall persistence and long-range transport potential
- Developed by ETH Zurich with a mandate by OECD
- Endorsed by a larger group of model developers
- Available from OECD website: http://tinyurl.com/66q47j
- Now a standard tool for Pov and LRTP assessments
- Described in a journal paper by Wegmann et al., *Environmental Modeling & Software* **24** (2009), 228–237.

The Tool: User Interface and Input Data

- Left: databases
- Right: single chemical
- Color code: quality of input data
- Chemical property data required:
  - $\log_{10} K_{aw}$
  - $\log_{10} K_{ow}$
  - degradation half-lives
    air
    water
    soil

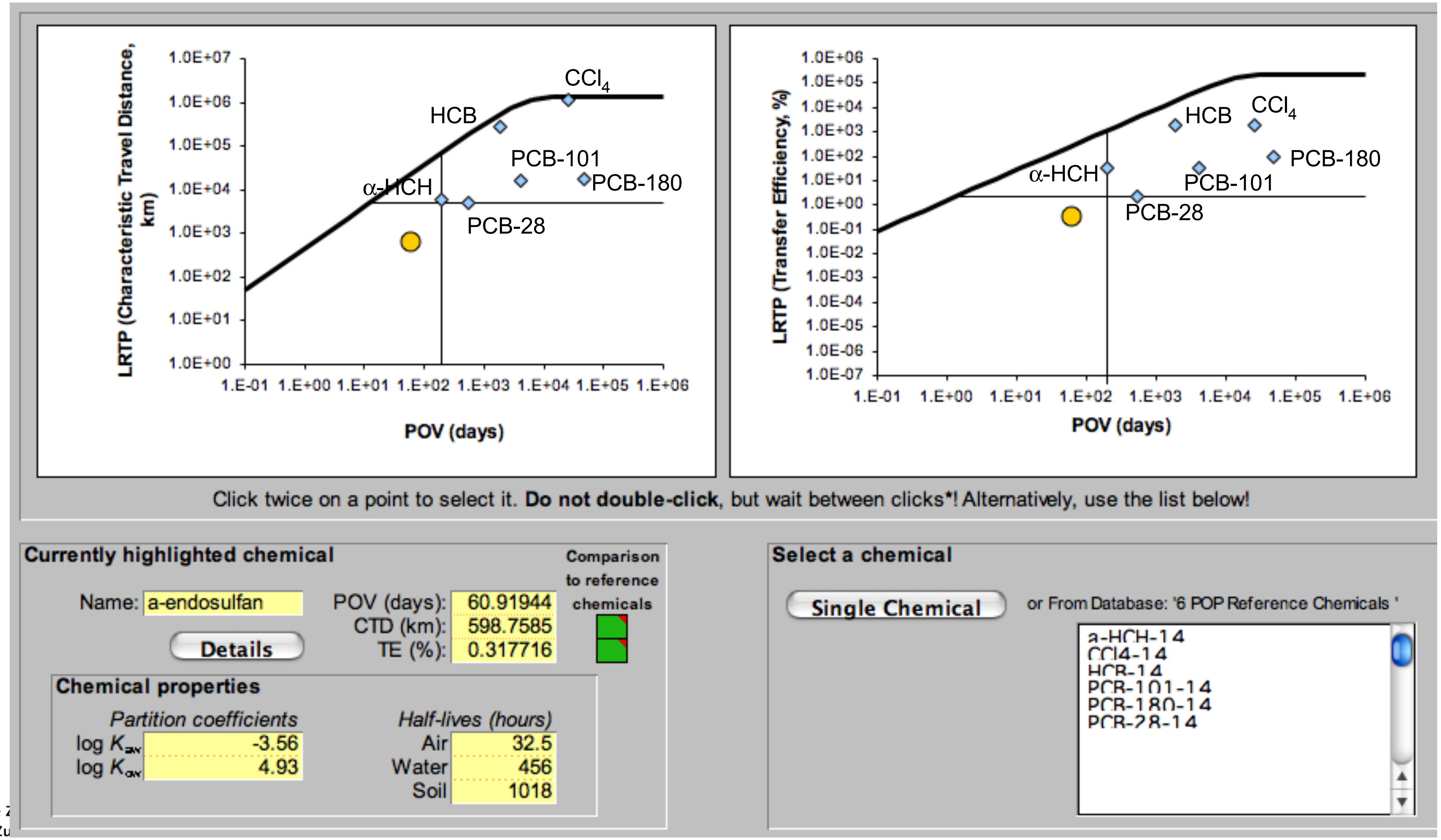


part 2

The Tool: Presentation of Results

- Left graph: Characteristic Travel Distance vs. P_{ov}
- Right graph: Transfer Efficiency vs. P_{ov}

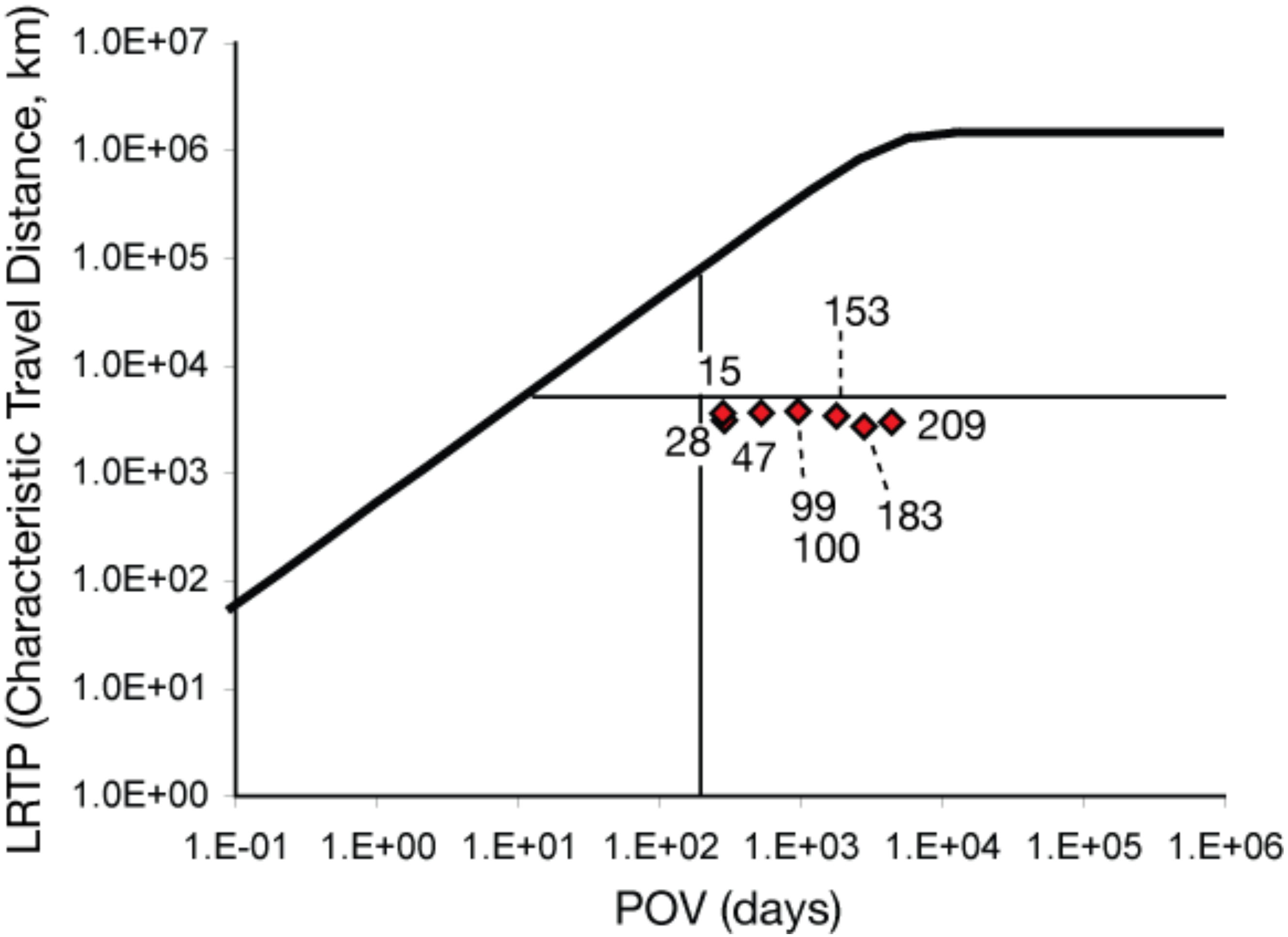
with lines for comparison with POP reference chemicals



part 2

The Tool: Results for PBDEs

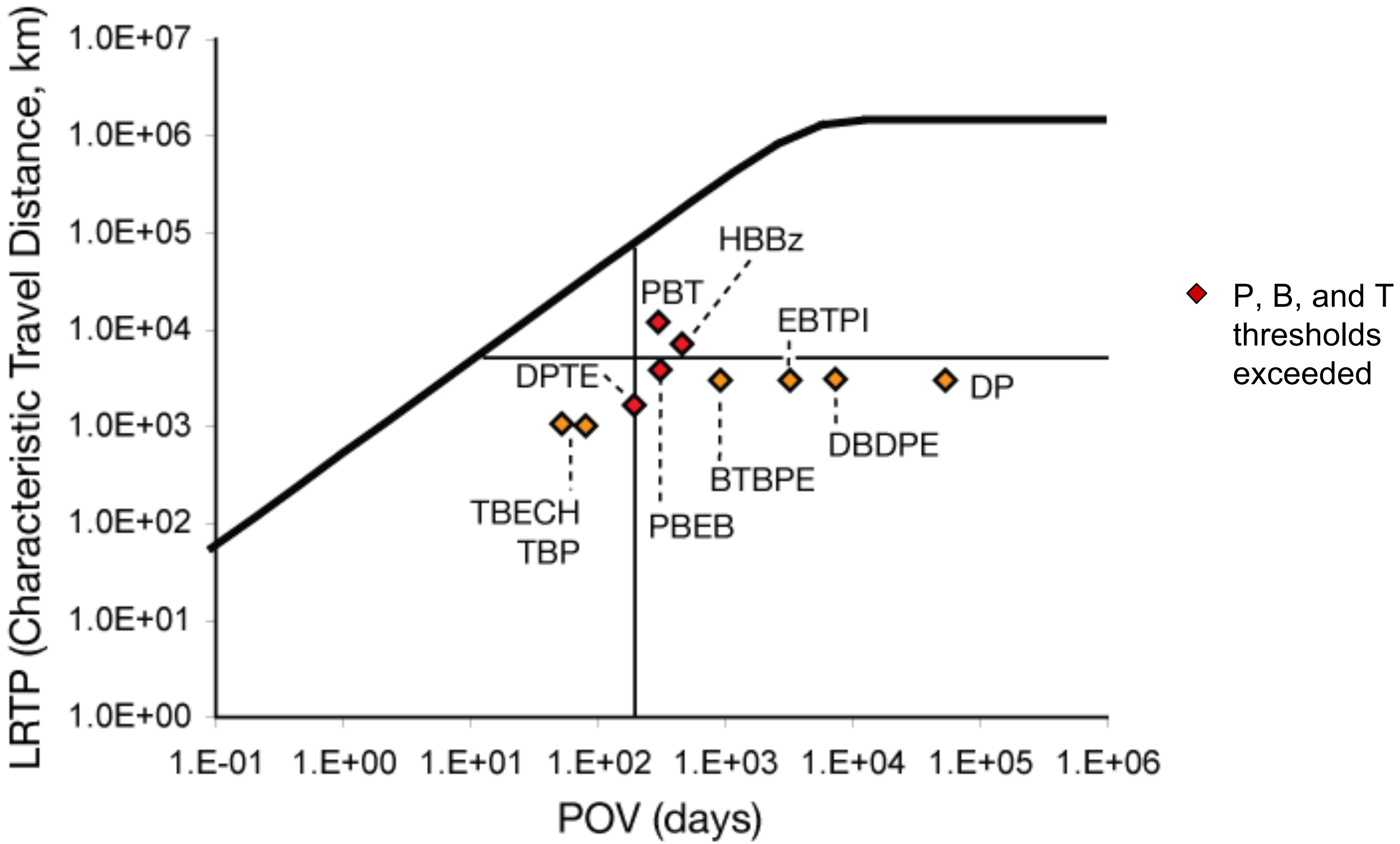
- Similar CTDs; Pov varies because of $t_{1/2}$ in soil.



part 2

The Tool: Results for non-BDE BFRs

- TBECH and TBP lower; others like PBDEs



ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

part 2

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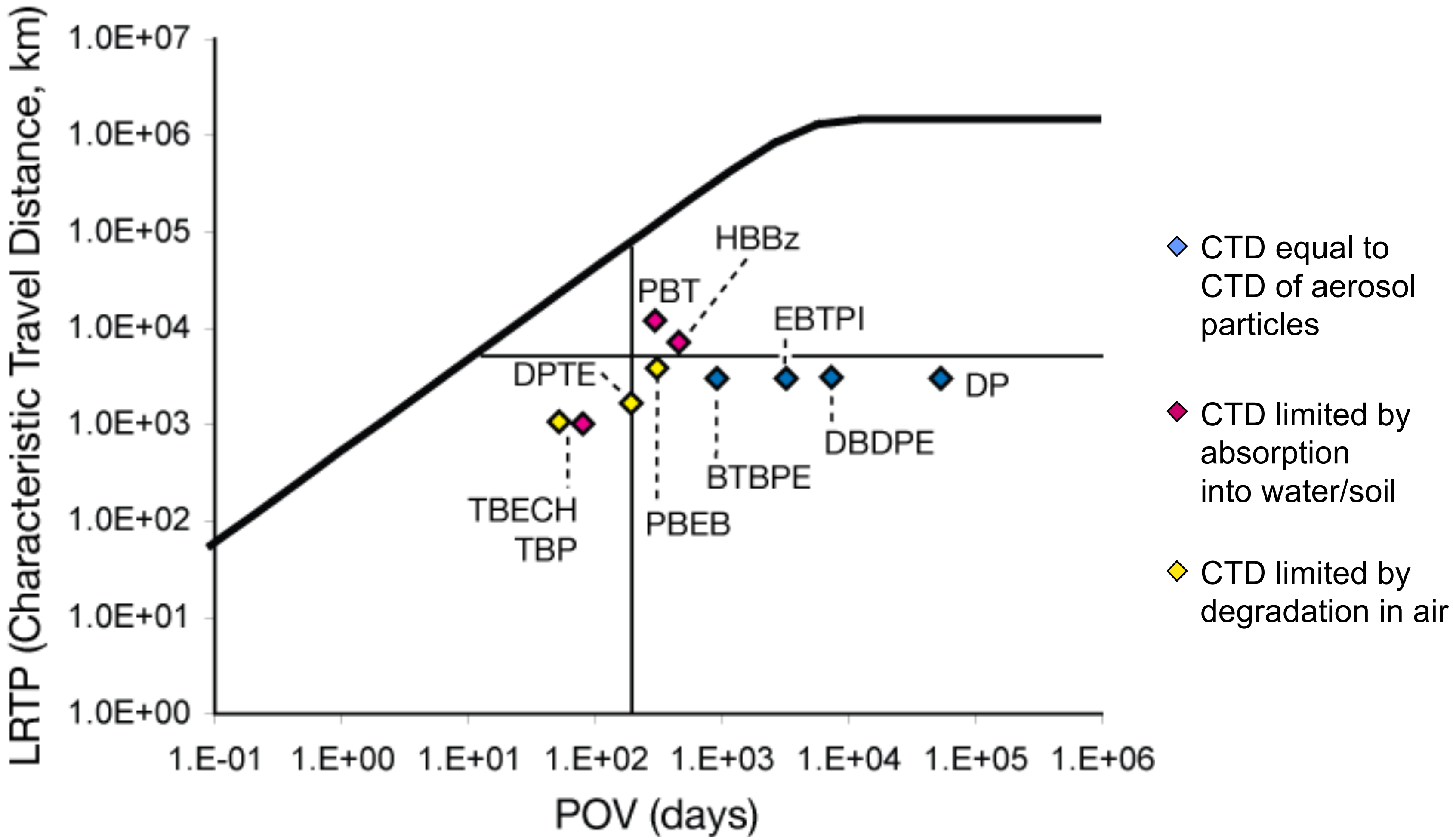
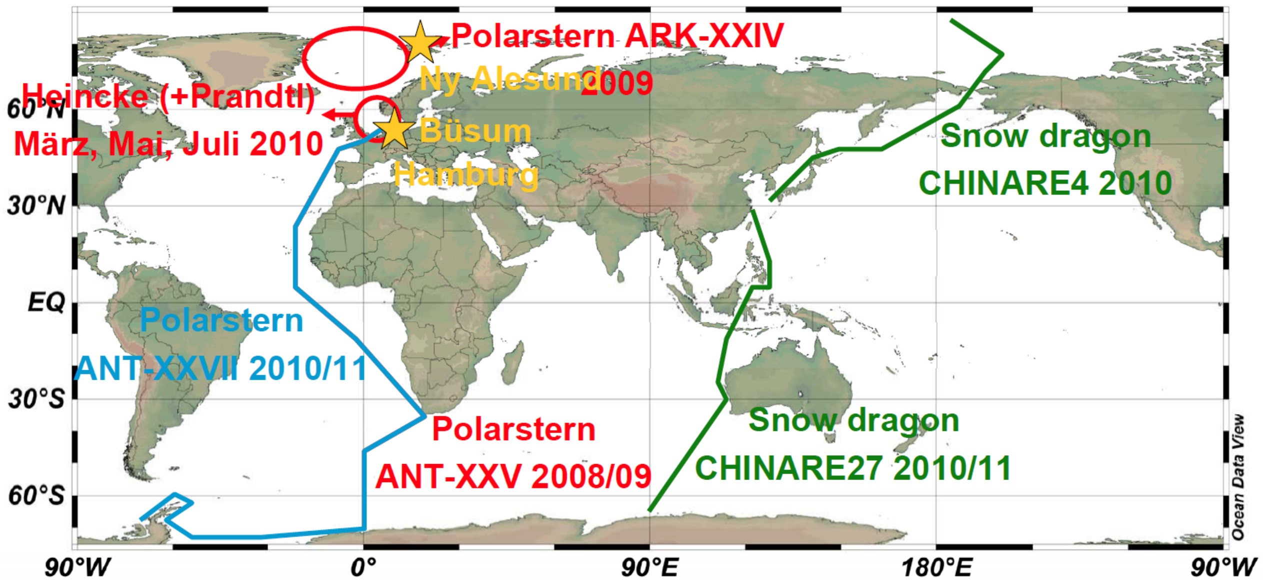


part 3

Recent Field Data on Emerging FRs

- Measurements in air and water by Axel Möller et al., Helmholtz Research Center Geesthacht, Germany:
  - HBB, DPTE, DP present in **all samples from Arctic to Antarctic**
  - other non-PBDEs present in some samples: PBT, TBPH, BTBPE, TBB, ...
  - concentrations similar to or higher than for PBDEs



from slides
by A. Möller, 2011,
axel.moeller@hzg.de

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A. Möller et al., Environ. Sci. Technol. 45 (2011), in press; A. Möller et al., Atmos. Environ. (2011), in press;
Z. Xie et al. Environ. Sci. Technol. 45 (2011), 1820–1826

Are We On the Wrong Track?

- M. Zennegg, “Novel” Brominated Flame Retardants in New Products of the Swiss Market[1]

- 2023 new products controlled by XRF (market survey 2008/09)
- 26% (*n* = 529) with bromine above 500 ppm
- 254 analyzed with GC/MS, LC/MS or GC/ECD for target compounds: PBDEs, HBCD, TBBPA, PBB
- 58 (23%) contained target compounds
- **196 (77%) contained bromine in unknown compounds**

Swiss Federal Laboratories for Materials Testing and Research (Empa),
Laboratory for Analytical Chemistry, Dübendorf, Switzerland,
markus.zennegg@empa.ch

1 talk given at ICCE 2011, Zürich, 13 September 2011

General Main Points

- Many non-PBDE BFRs have properties similar to those of PBDEs
  - intended: effective as flame retardants
    – how effective?
    – unwanted effects (smoke)?
  - unintended: POPs and PBT properties
- Based on screening exercise using estimated physicochemical properties and degradation half-lives
- Key question:

  What level of detail do we need to reach in our research into non-PBDE BFRs before they can be regulated / banned?

- Current scheme of substitution needs to be changed