Evaluating a Forecast System for Long-range Atmospheric Transport Episodes of POPs

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Introduction

Background air measurements of persistent organic pollutants (POPs) at many sites occurs only at fixed intervals (e.g. one day per week) without any a priori consideration of air mass transport (i.e., whether the air is likely to be polluted or not).

The intermittent sampling approach may miss key long-range atmospheric transport (LRAT) episodes, which are often associated with the highest POP concentrations [1].

Objectives

I. To develop a forecast system using the FLEXPART model to predict long-range atmospheric transport episodes of POPs using PCB-28 as a model compound,
II. To evaluate the capability of the forecast system to capture specific LRAT episodes at a background site in southern Norway (Birkenes) through targeted sampling (i.e. when LRAT episodes are predicted),
III. To assess whether predicted LRAT episodes for PCB-28 coincide with elevated concentrations of additional PCBs, and
IV. To identify source regions of PCBs during individual episodes.

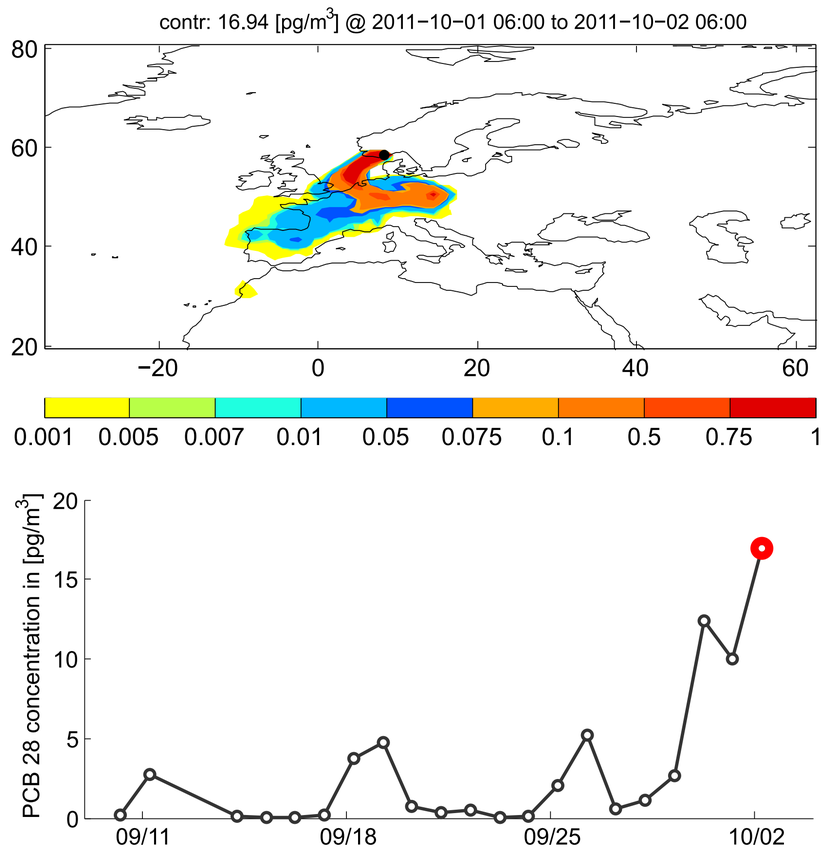

Figure 1: Forecasts of predicted concentrations of PCB-28 at Birkenes were made one day ahead using FLEXPART. Example shows predictions for October 1st, 2011.

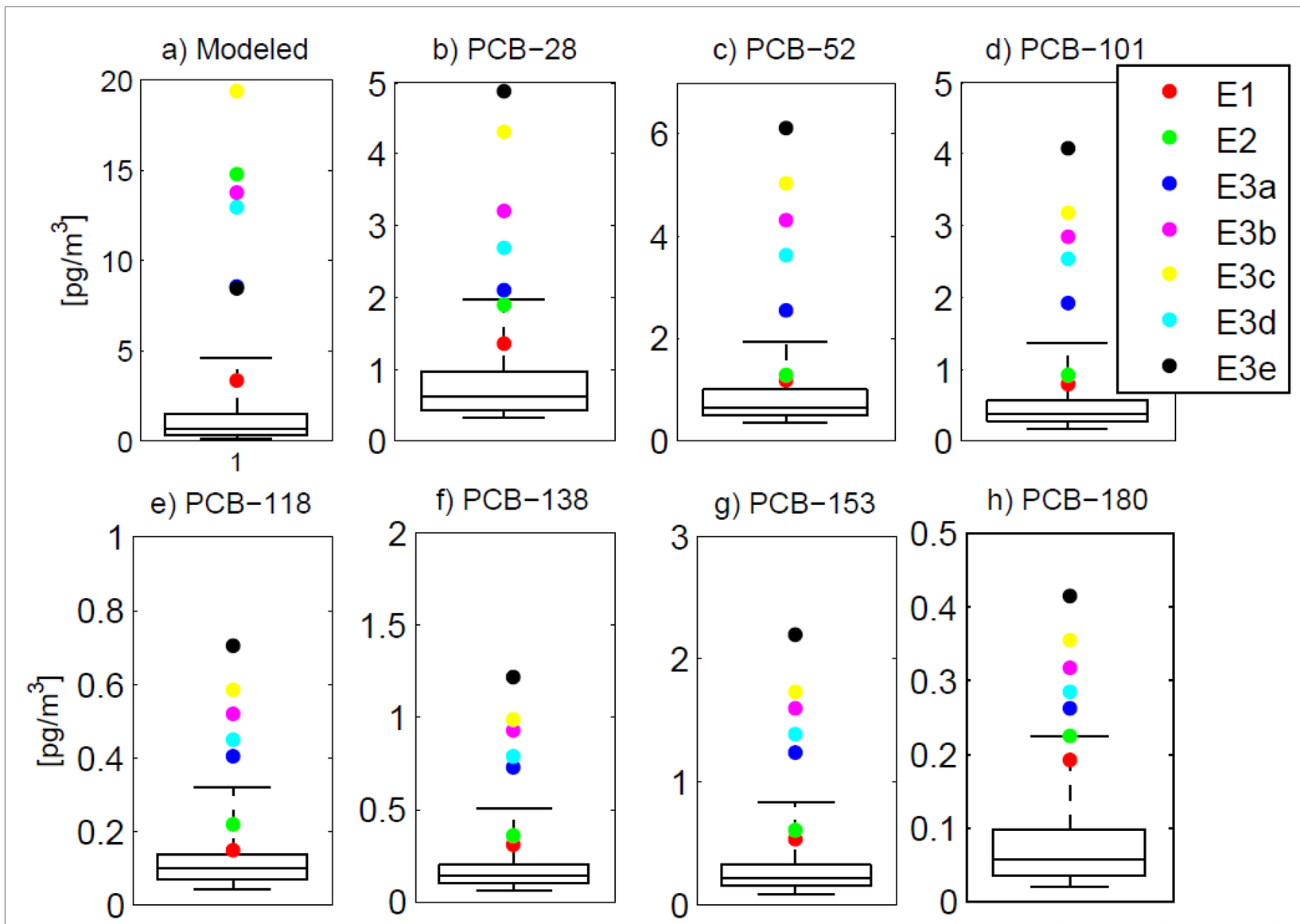

Figure 2: Modeled PCB-28 (a) and measured PCB concentrations (b-h) in units of pg/m³, for both the annual sampling program and the targeted samples. The box and whisker plots show the annual results (2011) for Birkenes, based on weekly samples (N=52). The line shows the median, while the box and whiskers delineates the 25 and 75 percentiles and the 5 and 95 percentiles, respectively. Targeted samples (N=7) are represented by colored dots (see Table 1).

Methods

Sampling was carried out at the Birkenes observatory in 2011, a background station located in southern Norway (N 58°23, E 08°15). Regular monitoring samples were collected over 24 h once per week (N=52). Targeted LRAT samples were collected over 12 to 25 hours.

The atmospheric transport of PCB-28 was simulated by use of the Lagrangian particle dispersion model FLEXPART [2-3] which can be operated in forward mode (for forecasting) and backward mode (for retrospective evaluation of LRAT episodes). PCB-28 was chosen as our model compound, following an earlier study for Birkenes [4].

Table 1: Sampling times for targeted samples collected during predicted episodes in 2011.

Episode	Start date	Start time	End date	End time
E1	06.01	11:50	07.01	23:49
E2	24.02	17:29	25.02	05:49
E3a	29.09	08:05	29.09	21:10
E3b	29.09	21:15	30.09	15:30
E3c	30:09	15:30	01.10	05:35
E3d	01.10	05:38	02.10	07:04
E3e	02.10	07:08	02.10	18:49

Results and Discussion

- Forecasts were made on day ahead to decide whether targeted samples should be collected during suspected LRAT events (Figure 1)
- Three predicted LRAT episodes (E) in 2011, which occurred in January (E1), February (E2) and late September/early October (E3a,b,c,d,e), were analyzed (Table 1).
- Measured concentrations of PCBs in all targeted samples (N=7) were above the 75th percentile of the concentrations obtained from the regular monitoring program (N=52) and included the highest measured values of all samples (Figure 2).
- A retrospective evaluation of the episodes with highest measured concentrations of PCB-28 in 2011 provides information on source regions (Figure 3).

Conclusions

- This study most likely represent the first attempt to both (i) use model predictions driven by a priori information on emissions of POPs to trigger air sampling as well as (ii) retrospectively evaluate the source regions for measurements collected during predicted episodes.
- Observations targeted at strong pollution episodes (as in this study) or on transport from specific source regions with highly uncertain emissions (as could be done in a very similar forecasting framework) could significantly enhance our understanding of POP sources.
- For details, see Halse et al. [5]

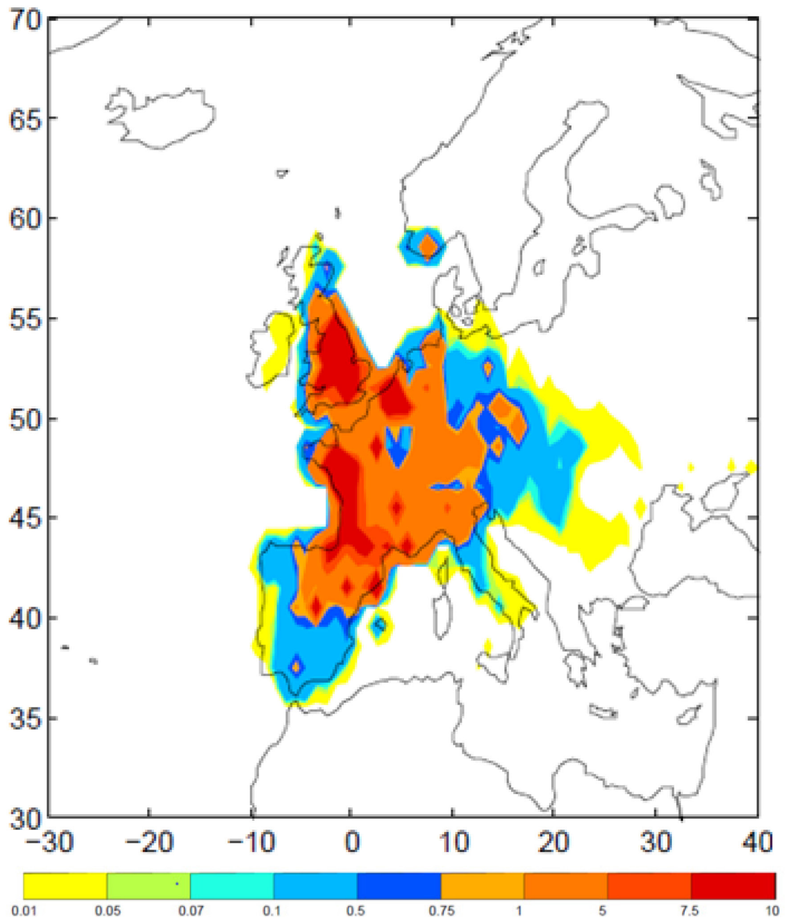

Figure 3: Map of EC (emission contributions, 1E-12 [pg/m3]) for PCB-28 for the episode with highest measured concentrations at Birkenes during 2011 (E3e).

Acknowledgements

This study received financial support from the Research Council of Norway and the Norwegian Climate and Pollution Agency.

References

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PP 08 2013 KBr