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Institut für Medizinische Biometrie, Epidemiologie und Informatik (IMBEI)

Comparing Different EXPOsure Models in a Case-Control Study on the Association between Childhood Cancer and Air POllution (EXPO-SACCO)

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Introduction

- Air pollution is a major global health risk. Evidence on $PM_{2.5}$ and childhood cancer: suggestive but not conclusive.
- Epidemiological studies face several challenges, with accurate exposure assessment being critical, as even small errors can substantially bias health effect estimates.
- **Aim of the study**: Evaluate whether the ACAG and EXPANSE models are interchangeable for epidemiological research.

Methodology

- Randomly selected 10,000 locations across Germany and associated monthly $PM_{2.5}$ concentrations (2006–2019) from two exposure models:

I. The ACAG: global (~1 km) II. The EXPANSE: European (25 m).

- Measurements of agreement: Pearson correlation (temporal consistency), Mean Bias Error (systematic differences) and Root Mean Square Error absolute error).
- Analyses stratified according to urban–rural context.

Results

- ACAG and EXPANSE capture similar regional gradients, with higher $PM_{2.5}$ in western and southern Germany and an overall decline over time **(Figure 1)**
- Both models show higher $PM_{2.5}$ in urban than rural sites; EXPANSE detects sharper contrasts than ACAG due to its finer resolution **(Figure 2)**.
- Bias was generally low (0–2 µg/m³), but with local hotspots up to +6 µg/m³ and small negative deviations in North-Western Germany (**Figure 3**).
- Correlations remained strong. Small positive bias (ACAG slightly higher). Errors (RMSE ~2 µg/m³) decreased over time (**Figure 4).**

Figure 1. Concentration of PM2.5 according to the models ACAG and EXPANSE in 2006 and 2019

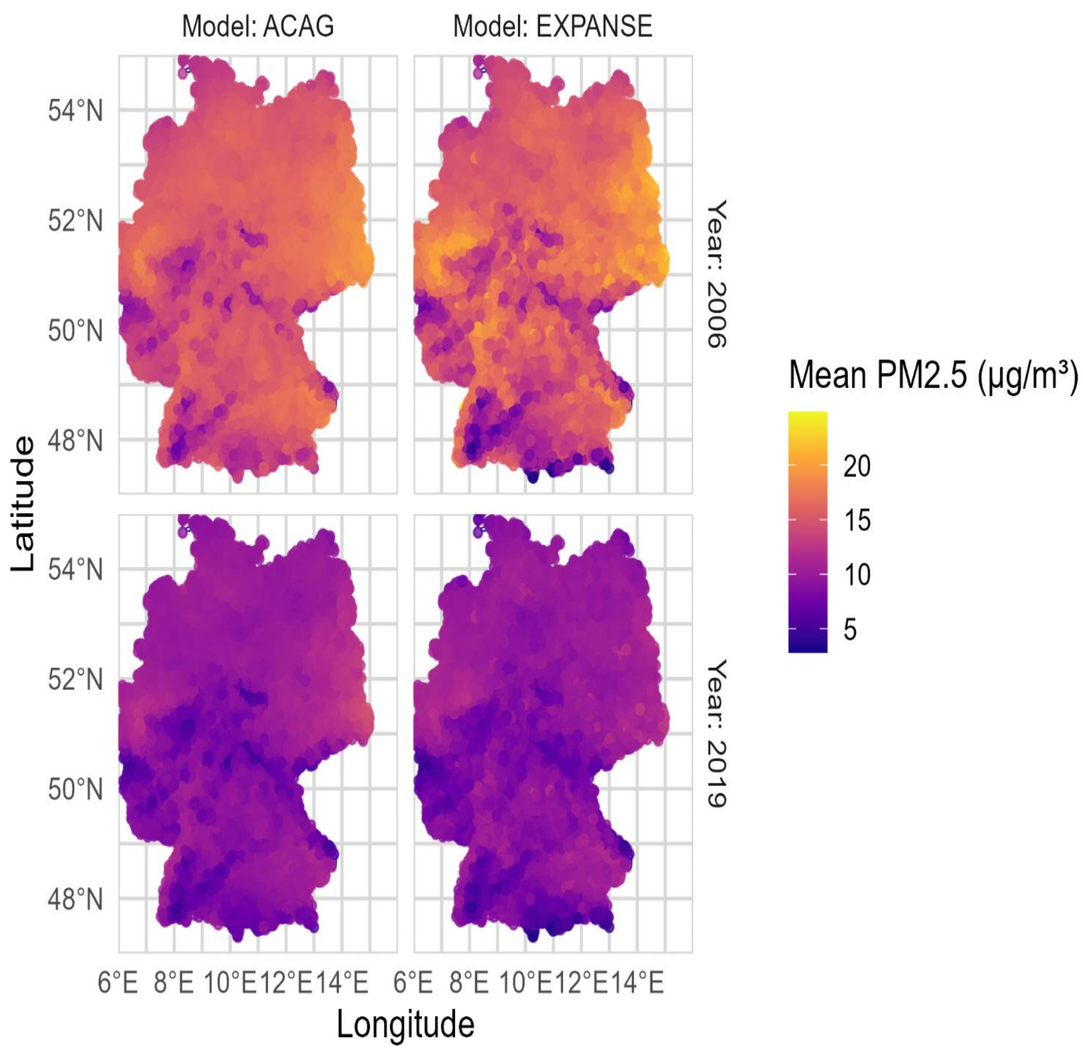


Figure2. Sampled locations by rural/urban context

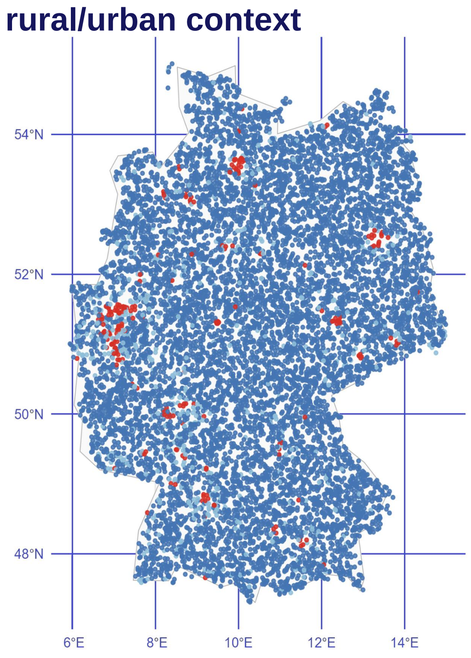


Figure 3. Spatial distribution of Mean Bias Error across Germany

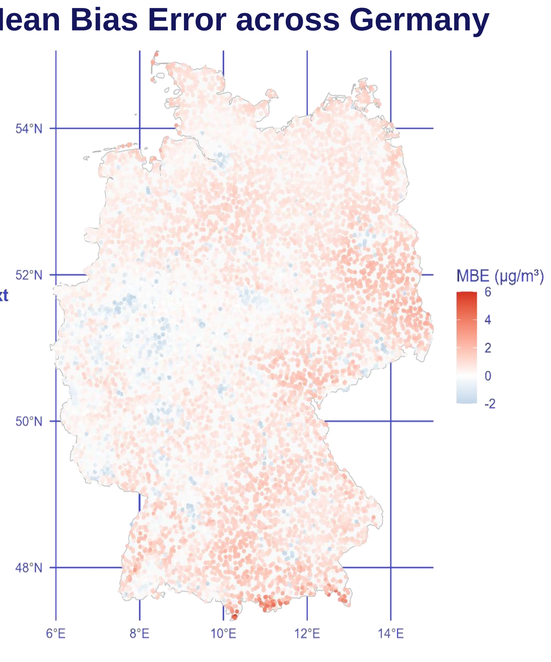
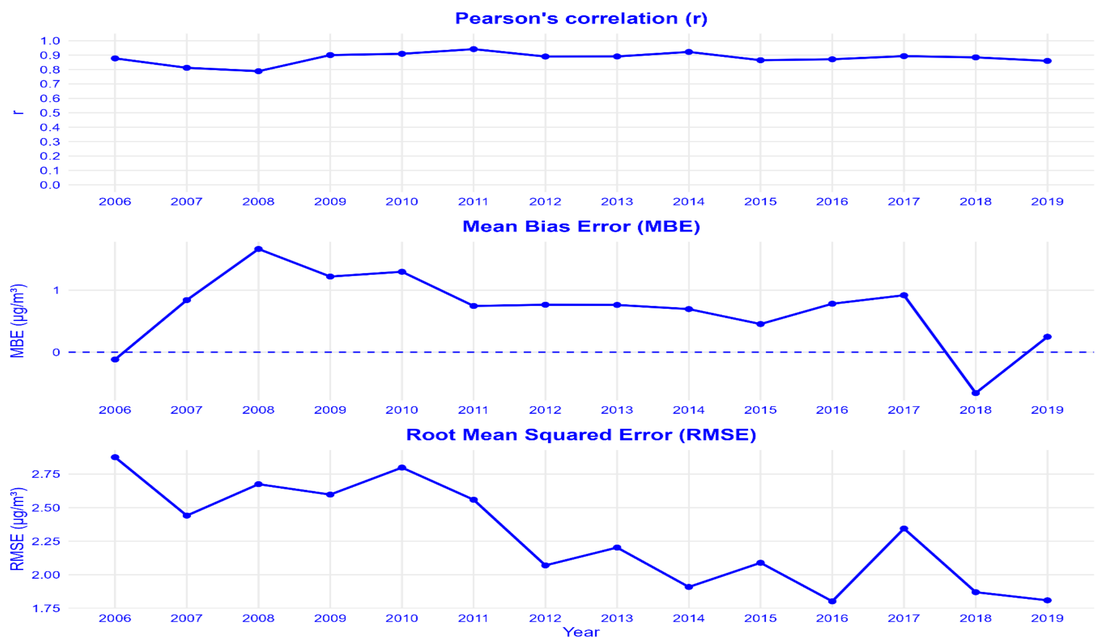


Figure 4. Annually agreement between ACAG and EXPANSE



Conclusion

- ACAG and EXPANSE strongly agree
- Small, stable bias (ACAG slightly higher).
- Both models capture similar spatial and temporal trends.
- ACAG best for long-term/global; EXPANSE for fine-scale urban.
- Either model can be applied in epidemiology.
- Bias adjustment is needed to improve absolute estimates.

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